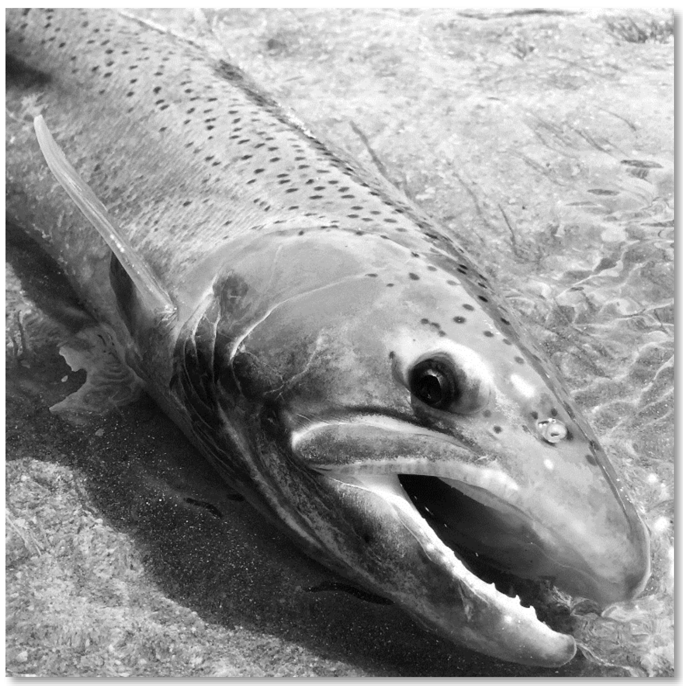
FISHERY RESEARCH

IDAHO ADULT STEELHEAD MONITORING

2023 ANNUAL REPORT



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2023 Annual Report

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ABBREVIATIONS AND ACRONYMS

BY	Brood Year
CI	Confidence Interval
DPS	Distinct Population Segment
ESA	Endangered Species Act
GSI	Genetic Stock Identification
ICBTRT	Interior Columbia Basin 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 2023, Idaho Department of Fish and Game personnel used weirs (temporary picket, floating board resistance, and hatchery traps) and select passive integrated transponder (PIT) tag arrays to monitor wild adult steelhead *Oncorhynchus mykiss* in Idaho. Three weirs and three PIT tag array sites were in the Clearwater River basin, and four weirs and seven PIT tag array sites were in the Salmon River basin. Some of these monitoring structures had small sample sizes, resulting in unreliable abundance and diversity inferences. Steelhead escapement ranged from six fish (95% CI 0-19) in Crooked River to 797 fish (95% CI 649–947) in the Lochsa River. Across all sites, 4.4% of return adults were 1-ocean, 82.5% were 2-ocean, 6.1% were 3-ocean, and 0.6% were repeat spawners. Of the fish sampled, sex ratios varied from 57.9% females in the Upper Salmon River to 100.0% females in the lower Lemhi River and Crooked River (n < 10). Adult-to-adult productivity estimates for brood year (BY) 2016 are now complete with fish that returned in 2023. Productivity estimates for BY 2016 (n = 10 locations) varied from 0.13 recruits per spawner in Big Bear Creek (likely biased low) to 1.49 recruits per spawner in the upper Salmon River. Except for the Upper Salmon River, steelhead were below replacement at all monitored locations for BY 2016 (Big Bear Creek, East Fork Potlatch River, Fish Creek, Rapid River, Big Creek, Lemhi River, North Fork Salmon River, Pahsimeroi River, and East Fork Salmon River). Productivity increased slightly from BY 2015 to BY 2016 at East Fork Potlatch River, Fish Creek, Rapid River, Big Creek, and the Pahsimeroi River and decreased at all other locations. Productivity has been below replacement for the last five to nine BYs for all locations, except for BY 2016 in the Upper Salmon River (1.49 recruits per spawner). The productivity data series at Big Creek and the Lemhi River are the two shortest data series considered in this report, and additional years may reveal density-dependent mechanisms. The smolt-to-adult return (SAR) rates for fish from Big Bear Creek (MY 2020), Fish Creek (MY 2019), Big Creek (MY 2019), and the Lemhi River (MY 2020) were 1.7%, 0.69%, 1.2%, and 1.5%, respectively. All SAR's 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 2015, total steelhead abundance estimates have been far below objectives outlined in the draft recovery plan (Ford 2022). 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 (ICBTRT 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 (ICBTRT 2007). Nonetheless, there are 17 demographically independent and extant steelhead populations identified within the Clearwater River and Salmon River MPGs (ICBTRT 2007; 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 basin wide 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 Goal for naturally produced 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 naturally produced steelhead from 2008–2017 was 30,452 (IDFG 2019). By first understanding the processes that govern salmonid population viability through trend monitoring and status assessments, we can then work toward achieving 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 for spawn year 2023, will be reported by Beeken et al. (in review). The four objectives of this report are:

Objective 1: Summarize IDFG's intensive, high-precision monitoring of wild adult steelhead in selected locations within the Clearwater River and Salmon River MPGs (Table 2).

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

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

Objective 4: Estimate steelhead population demographic and diversity metrics including sex ratio, length and age composition, and run timing at selected 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 during their spawning migrations. 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 River, Pahsimeroi River, East Fork Salmon River, Crooked River, and the upper Salmon River. Temporary and permanent weirs were used to monitor adult steelhead that moved upstream for spawning. 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.

Naturally produced 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; Jenkins et al. 2018). All repeat spawners were released above weirs to naturally spawn and were incorporated as spawners in productivity analyses for every year that they returned to spawn. They were assumed to have the same probability of producing the same number of progeny with each spawning event as all other adult returners. 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 hatchery 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 2023, 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. The Fish Creek weir was installed and began operating on March 12 and operated until it was breached on May 1. The weir was repaired on May 11 and operated partially for 19 days until it was repaired on May 30 and operated fully through the remaining adult steelhead migration period. The East Fork Potlatch River weir was installed and began operating on March 13th, 2023. The weir was either partially operable or inoperable for 24 days during high flow period and was fully operable through the remaining adult steelhead migration period.

At temporary weirs, adult steelhead moving upstream entered a holding box that was checked at least once daily. Trapped fish were removed with a net and placed in a large holding container 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 were sampled from each unique fish to determine freshwater, saltwater, and total ages. A small portion of fin tissue (for genetic analysis) was sampled from each unique fish at Fish Creek and East Fork Potlatch River. 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 were estimated using a Lincoln-Peterson estimator with a Bailey's modification:

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

where $\widehat{N}$ was estimated adult abundance; c was the total number of marked and unmarked kelts captured; m was the number of unique adults marked and passed upstream; and r was the number of marked adults recaptured as kelts. The estimate was computed with R statistical software (http://ifwisshiny.idfg.state.id.us:3838/JLM/IDFGStatApps/; R Development Core Team, 2023) 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). If the number of unique adults captured, or kelts recaptured were too low to provide a reliable escapement estimate, the number of unique, wild adults passed upstream of the weir was used as a minimum abundance estimate.

Permanent Weirs—During 2023, 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 described above.

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, except for 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 (Krassel Creek).

To estimate escapement at each array site, wild adult steelhead were systematically PIT tagged at LGR throughout the migration period (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 PIT tag arrays throughout the Snake River basin stream network using the Lower Granite Dam Adult Branch Occupancy Model (DABOM; Waterhouse et al. 2020). The DABOM model estimated movement probabilities and site-specific detection probabilities of fish traveling throughout the 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.

We reported abundance estimates of SY 2023 adult steelhead from the DABOM analysis (Stright et al. 2024; Mike Ackerman and Ryan Kinzer, Nez Perce Tribe, Department of Fisheries Resources Management – Research Division, personal communication) for PIT tag array sites that operated in the Lochsa River, Crooked River, Big Bear Creek, South Fork Salmon River, Big Creek, Marsh Creek, North Fork Salmon River, lower Lemhi River, upper Lemhi River, and Hayden Creek. An estimate of adult steelhead escapement to the Big Bear Creek PIT tag array was not feasible due to unreliable operation throughout the spawning season including zero detections during SY 2023.

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, North Fork Salmon River, and the upper Salmon River. Productivity results were reported for the most recently completed brood year (BY 2015), with preliminary information for BY 2016. The entire range of adult productivity estimates for each location are presented in Appendices C and D. Comparisons across populations were limited to BYs 2003–2016, 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 were lacking. Productivity analyses were not conducted at the upper Lemhi and Hayden Creek PIT tag array sites due to concerns discerning which tributary in which a fish actually spawns, due to the close proximity of the arrays to each other and the spawning grounds. Additionally, the lower Lemhi River array site provides coverage for analyzing adult-to-adult productivity at the Lemhi River TRT population level.

Productivity was calculated by multiplying adult abundances with age composition determined from scale samples. Interpreting patterns in steelhead scales provides an accurate and unbiased method for producing age compositions when scales are collected in a statistically representative design (Reinhardt et al. 2022). 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. We consider BY 2016 mostly complete because few age-7 adult spawners have been observed. 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—Adult trapping data was extracted from the Fish Inventory System (FINS) hatchery database (https://www.finsnet.org/). 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. 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. Hatchery strays were excluded from productivity analysis at all temporary and permanent weirs because they were not passed upstream for natural spawning except at the East Fork Salmon River. 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, North Fork Salmon River, and the Lemhi River PIT tag array sites. The PIT tag array estimates at the South Fork Salmon River (Krassel Creek), Crooked River, and Marsh Creek 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 in 2026, the South Fork Salmon River and Marsh Creek populations in 2028. Methods for annual abundance estimates for these locations are outlined in the Sampling and Abundance section. On occasion, hatchery strays with PIT tags migrate upstream of PIT tag arrays but are generally too low in numbers to be statistically expanded and it is unknown if fish stay and spawn. Therefore, hatchery strays are not included in productivity analysis for sites with PIT tag arrays. 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 metric 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 (Nemeth and Kiefer 1999). 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. Using Bonneville Dam as the adult detection location, as opposed to LGR, helped ensure that enough adults were detected to generate reliable estimates for groups with low returns. Other weir and PIT tag array sites lacked 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 based on 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 each 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 was 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

Temporary and Permanent Weirs—We determined the 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 from which to remove scales was the second and third rows of scales above the lateral line and between the posterior fin ray of the dorsal fin and the anterior fin ray of the anal fin (Wright et al. 2015). At least ten scales per fish were collected from this target area. Scales were sent to the IDFG Nampa Research Anadromous Ageing Laboratory for processing 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, Crooked River, Lochsa River, South Fork Salmon River (Krassel Creek), Big Creek, Marsh Creek, North Fork Salmon River, lower Lemhi River, upper Lemhi River, and Hayden Creek); therefore, diversity information was collected from samples of wild adult steelhead sampled at LGR with known tributary destinations. Steelhead are systematically sampled by operation of a computerized trap gate, following a species-specific sample rate goal (Baum et al. 2023). 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 July 1, 2022 and June 30, 2023, which were subsequently detected at these PIT tag array sites during 2023. We also queried adult steelhead sampled at LGR, which had been previously PIT tagged as juveniles upstream of PIT tag arrays through rotary screw 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. 2022) 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, 2022 and June 30, 2023 at Bonneville, McNary, and Lower Granite dams. Detections of kelts moving downstream were excluded. The first, last, and median timing of detections for 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 examined at sites with sufficient 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. 2022). During this report period, tissue samples were taken and archived for future analyses.

RESULTS

Adult steelhead information was collected from 10 instream PIT tag arrays, two temporary weirs, and five permanent hatchery weirs during the 2023 adult steelhead migration season (Table 2; Figure 1). All instream PIT tag arrays were fully operational during the migration period, except for the Big Bear Creek array (BBA) that experienced outages in late March and early April, missing the end of migration. In addition, the antenna nodes for the BBA were compromised resulting in inconsistent detection efficiency during the migration period. All Salmon River basin hatchery weirs were fully operational during the migration period, whereas all Clearwater basin hatchery weirs experienced partially or fully inoperable periods of 24-30 days during high flow events (Table 2).

<u>Abundance</u>

Wild adult steelhead were detected at all monitoring locations except the Big Bear Creek array and the Crooked River weir, both of which were inoperable at some point during the steelhead migration period (Table 2, 3). Minimum abundance ranged from 12 fish (Rapid River) to 19 fish (Upper Salmon River) at permanent hatchery weirs and was seven fish at the temporary East Fork Potlatch weir, where no kelts were captured (Table 3). At instream PIT arrays, adult steelhead abundances estimated from the DABOM ranged from six fish in Crooked River (95% CI 0-19) to 797 fish in the Lochsa River (95% CI 649-947; Table 3).

Adult steelhead abundance estimates in the Clearwater River basin ranged from six fish in Crooked River (95% CI 0-19; Table 3) to 797 fish in the Lochsa river (95% CI 649-947; Table 3). The Big Bear Creek array was compromised for most of the migration period and abundance estimates were considered invalid for 2023. Compared to 2022 estimates, abundances decreased in Crooked River, remained stable or slightly increased in the East Fork Potlatch and Fish Creek, and increased in the Lochsa River (Figure 2). Long term abundance trends continue to steadily decline in the Clearwater basin (Figure 2; Appendix A).

Abundance estimates in the Salmon River basin ranged from six fish in the upper Lemhi River (95% CI 1-17; Table 3) to 218 fish in the South Fork Salmon River (95% CI 152-292; Table 3). Compared to 2022 estimates, abundances declined in all locations except Big Creek, Marsh Creek, North Fork Salmon River, and the South Fork Salmon River (Figure 3). Long term abundance trends continue to steadily decline in the Salmon River basin (Figure 3; Appendix B).

Adult to Adult Productivity

Brood year 2016 (BY 2016) was the most recently completed adult-to-adult productivity estimate for wild adult steelhead, with returning progeny ranging from eight fish at Rapid River to 117 fish at Big Creek (Table 4). Brood year 2016 productivity estimates ranged from 0.13 adult recruits per spawner in Big Bear Creek to 1.5 recruits per spawner in the Upper Salmon River (Table 4). Except for the Upper Salmon River, all productivity estimates for BY 2016 fell well below the 1.0 replacement threshold, while preliminary results for BY 2017 show a positive trend for some locations (Figure 4). On average, across all years and locations, adult steelhead spawned mostly as age 5 (45%) and age 4 (31%) and to a lesser extent, age 6 (19.6%) and age 3 (2.8%; Table 4).

In the Clearwater River basin, returning BY 2016 progeny ranged from 24 fish in the East Fork Potlatch River to 77 fish in Fish Creek (Table 4). Adult to adult productivity ranged from 0.13 to 0.32 adult recruits per spawner for BY 2016, which is less than half of the respective 10-year mean. Productivity estimates remain below the 1.0 replacement threshold, as they have for at least seven out of the last 10 years (Table 4; Figure 4; Appendix C), but preliminary results for BY 2017 indicate replacement (>1.0) in Big Creek. On average, across all years and Clearwater River locations, adult steelhead spawned mostly as age-5 (47.6%) and age-4 (29.6%) and to a lesser extent, age-6 (19.6%), age-3 (2.3%) and age-7 (0.7%; Table 4).

In the Salmon River Basin, returning BY 2016 progeny ranged from eight fish in Rapid River to 117 fish in Big Creek (Table 4). The Upper Salmon River was the only location with a BY 2016 productivity estimate above its 10-year mean and above the 1.0 replacement threshold (1.50 recruits per spawner). Productivity estimates in all other locations ranged from 0.15 to 0.33 for BY 2016, falling below respective 10-year mean and well below the 1.0 replacement threshold, as they have for at least six out of the last 10 years (Table 4; Figure 4; Appendix D). However, preliminary data for BY 2017 indicates replacement (> 1.0) for Pahsimeroi River, Upper Salmon River, and Rapid River. On average, across all years and Salmon River locations, adult steelhead spawned mostly as age-5 (43.9%) and age-4 (31.6%) and to a lesser extent, age-6 (19.5%), age-3 (3.0%), and age-7 (1.3%; Table 4).

Smolt-to-Adult Return Rates

Smolt-to-adult return (SAR) rates were completed for migration year (MY) 2019 in Fish Creek and Big Creek and MY 2020 in Big Bear Creek and the Lemhi River. Estimates ranged from 0.69% in Fish Creek to 1.7% in Big Bear Creek, all falling below the lower range (2.0%) of the NPCC objective threshold (NPCC 2020; Figure 7). Estimates increased compared to previous years in all areas except for Fish Creek, but long-term trends remain low for all locations (Figure 7). For most recently completed MYs, emigrating smolt detections ranged from 294 to 1,167 fish and returning adult detections ranged from five to nine fish (Appendix E). The proportion of adults not detected as out-migrating smolts for the most recently completed MY were 0.33 in Big Bear Creek, 0.55 in Big Creek, 0.33 in the Lemhi River, and 0.46 in Fish Creek (Appendix E).

Diversity

Age, Sex, and Size Composition

Age data was collected from 343 wild adult steelhead representing SY 2023, resulting in 260 samples with complete ages, 73 with unknown freshwater ages, and 10 samples that could not be aged (Table 5). Returning fish represented 11 different life histories (freshwater-saltwater age combinations) with total ages that ranged between four and eight years.

In the Clearwater River Basin, age data was collected from 172 adult steelhead, representing eight life history strategies and total ages between four and eight years (Table 5). One adult smolted after one year in freshwater, 36 smolted after two years, 85 smolted after three years, and five smolted after four years. Of fish assigned ocean ages, one fish was a 1-ocean adult (0.06%), 151 fish were 2-ocean adults (91.0%), and 14 were 3-ocean adults (8.4%; Figure 8). Females represented 77.5% of returning adults and had greater mean fork lengths (77.9 cm) compared to males (67.2 cm; Table 6). The Lochsa River population represented most of the Clearwater River basin diversity with 146 sampled adults.

In the Salmon River Basin, age data was collected from 171 adult steelhead representing nine life history strategies with total ages between four and six years (Table 5). One adult smolted after one year in freshwater, 68 smolted after two years, 61 smolted after three years, and one smolted after four years. Of fish assigned ocean ages, 15 were 1-ocean adults (9.2%), 141 were 2-ocean adults (86.5%), and seven were 3-ocean adults (4.3%; Figure 9). Females represented 74.4 % of returning adults and had shorter mean fork lengths (71.3 cm) compared to males (73.2 cm; Table 6).

Adult Migration Timing and Conversion Rates

Migration timing estimates were developed from 116 unique adult steelhead during the SY 2023 migration. Of the 116 fish detected at Bonneville Dam, 93 (80% conversion from Bonneville) were detected at McNary Dam, 87 (75%) were detected at Lower Granite Dam, and 48 (41%) were detected at their respective weirs or arrays (Table 7). The median date of passage at Bonneville Dam for all fish was August 15, 2022, September 27, 2022, at Lower Granite Dam, and April 25, 2023, at respective arrays/weirs (Table 7; Figure 10, 11). Historic migration timing detections and conversion rates are provided in appendices F and G.

Migration timing estimates for locations in the Clearwater River basin were developed from 78 unique adult steelhead during the SY 2023 migration. Of the 78 fish detected at Bonneville Dam, 61 (78%) were detected at McNary Dam, 57 (73%) were detected at Lower Granite Dam, and 27 (35%) were detected at their respective weir or array (Table 7). The median date of passage for all pre-spawn fish was September 7, 2022 at Bonneville Dam, October 8, 2022 at Lower Granite Dam, and April 22, 2023 at respective arrays/weirs (Table 7, Figure 10, 11). With the exception of one fish detected in late April, 2023 (Lochsa/Fish Creek), all fish were detected at Lower Granite Dam in the fall (on or after August 18th) of 2022. This data corroborates past years' data, showing that migration timing in the Lochsa occurs later than other populations (i.e. Potlatch River basin).

Migration timing estimates for locations in the Salmon River basin were developed from 38 unique adult steelhead during the SY 2023 migration. Of the 38 fish detected at Bonneville Dam, 32 (84%) were detected at McNary Dam, 30 (79%) were detected at Lower Granite Dam, and 21 (55%) were detected at their respective weir or array (Table 7, Figure 10, 11). The median date of passage for all pre-spawn fish was August 8, 2022 at Bonneville Dam, September 22, 2022 at Lower Granite Dam, and April 29, 2023 at respective arrays/weirs (Table 7). With the exception of one fish detected in mid-April, 2023 (SF Salmon), all fish were detected at Lower Granite Dam in the fall of 2022.

Genetic Sampling

During 2023, we collected genetic samples from wild adult steelhead captured during other projects. One hundred and fifty-seven genetic samples were collected across six IDFG research and hatchery weir locations. All samples were archived for later analysis (Appendix H).

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. 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. One example is the analysis of incidental catch-and-release fisheries using data from Fish Creek (McCormick et al. 2021).

<u>Adult Abundance and Productivity</u>

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 (Ford 2022). 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 to evaluate these populations at the proper scale to assess recovery objectives (Copeland et al. 2017).

Adult steelhead abundances continue to remain depressed in the Clearwater River and Salmon River MPGs. With respect to more recent estimates, most individual populations experienced a decrease in abundance in 2017 and remain relatively low (Big Bear Creek, East Fork Potlatch River, Fish Creek, East Fork Salmon River, Hayden Creek, Lower Lemhi River, Marsh Creek, Pahsimeroi River, South Fork Salmon River, Upper Lemhi River, and the Upper Salmon River). This initial drop in adult abundance coincided with drought conditions and warm water temperatures for SY 2017's juvenile life stages, as well as abnormally warm ocean temperatures during respective saltwater life stages (Camacho et al. 2018). Drought conditions were less severe from 2016 to 2021 (data from National Integrated Drought Information System, drought.gov), but inconsistent ocean condition indicators continued to provide "average" conditions for juvenile salmonids (NWFSC 2023), suggesting that ocean conditions may be a larger contributor to lower abundances in recent SY's. Ocean condition indicators are available through the Northwest Fisheries Science Center (NWFSC 2023; Peterson et al. 2020), and some of the poorest "stoplight" rankings are broadly congruent with the recent trend of poor adult-to-adult and smolt-to-adult rates. However, these indicators were established to understand factors affecting Coho and Chinook Salmon. Few studies have looked at how these rankings relate to steelhead populations with diverse life history strategies and overlapping cohorts.

The Lochsa River population is an exception, where abundance increased 3-fold in SY 2021 and continues to trend upward (Figure 2). The Lochsa River is the only major Clearwater subbasin in this report, classified at the HUC-8 (subbasin) level, whereas all other Clearwater populations are classified at the HUC-10 (watershed) level or smaller. Therefore, higher abundance relative to other Clearwater Basin monitoring locations is expected. Additionally, current methods weren't implemented for the Lochsa River population until 2018 and interpretations regarding relative abundance trends within the basin should be made cautiously.

Natural repeat spawners and reconditioned kelts make up a small percentage (<5%) of annual adult returns to wild steelhead spawning areas. Contributions from repeat spawners diversify steelhead life history and can buffer anthropogenic effects (Moore et al. 2014; Copeland et al. 2019). Although the overall effect of reconditioned kelts on natural productivity is largely unknown, long-term reconditioned kelts were found to have a much higher return rate to spawning tributaries than in-river migration control groups (Trammell et al. 2016) and have shown reproductive success in the Yakima River basin (Hatch et al. 2021). Four reconditioned kelts were observed in monitored tributary systems in 2022; two were detected at the Upper Salmon River weir; one was detected on the Lower Lemhi River arrays, and one was detected at the East Fork Potlatch River weir.

Occurrences of hatchery strays above PIT tag array sites are also relatively low based on PIT tag detections. This is partially due to the reduced tag rate of hatchery-origin steelhead within the Snake River basin relative to wild-origin steelhead. Stray detections can be higher than returning wild fish in any given year, but it is unknown if fish stay and spawn in those tributaries. Therefore, total contributions to the steelhead population are currently unknown. Current productivity analyses have not incorporated hatchery-origin steelhead, and future iterations of this report would benefit from examining the influence of hatchery spawners on the productivity of wild steelhead populations where they cannot be regulated (i.e., PIT tag array sites). Monitoring trends in abundance of hatchery-origin strays in areas managed for wild steelhead populations is 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 have failed to consistently meet replacement (1:1) in the last two decades based on adult-to-adult productivity. All populations reported here were below replacement for the last 6-10 BYs, except for the Upper Salmon BY 2016 (Figure 4). Mean productivity for BY 2016 across all populations monitored was 0.37 (range = 0.13–1.49), well below replacement but slightly higher than productivity for BY 2015 (0.23; Appendix C, D). Fish Creek (Clearwater River MPG) contains the longest productivity time series (25 complete BYs) and highlights variability in steelhead productivity, varying from 0.3 to 10.3 recruits per spawner with nine years (36.0%) meeting replacement. Fluctuations in productivity are expected in wild populations and were 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. To increase our understanding of the status of Idaho steelhead populations, we will expand our population productivity baseline data sets to include the Lochsa River population in 2026, and Marsh Creek and South Fork Salmon River populations in 2028.

In Idaho, density dependence in juvenile steelhead production has been observed in populations in Fish Creek (Dobos et al. 2020a*;* Dobos et al. 2020b) and the Potlatch River (Knoth et al. 2021), and in spring/summer Chinook Salmon production throughout the state (Walters et al. 2013). Our adult-to-adult productivity dataset is limited and is characterized by survival and movement at multiple life stages, but density-dependent patterns are starting to emerge in some study locations (Figure 5, 6). While it is likely that density dependence mechanisms are occurring during juvenile life stages, it is important to recognize them as one of many limiting factors in adult recruitment. Habitat restoration efforts can increase juvenile rearing capacity in systems where density dependence has been observed. Improving freshwater rearing habitat is one of the actions being taken to reduce density-dependent effects on salmonid populations (Copeland et al. 2021). Efforts by IDFG focus on evaluating fish population response to habitat restoration in four monitored watersheds: the Potlatch River, North Fork Salmon River, Lemhi River, and Pahsimeroi River (IDFG 2019; Uthe et al. 2017; Meyer et al. *in review*). Restoration and monitoring programs have been underway in these watersheds for more than a decade and have provided increased habitat quality and quantity for spawning and rearing. Restoration efforts have elicited positive, local response in salmonid abundance and distribution, but continuous monitoring is required to determine any sustained positive response in juvenile steelhead production (Meyer et al. *in review*). 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 in all four monitored populations have been consistently below the range of SARs for the NPCC objective (mean = 4.0 %; range = 2.0–6.0 %) since a concordant decline during MY 2015 (Figure 7; Appendix E). The only exception is Big Bear Creek BY 2018 (4.0%; Appendix E). This trend closely mirrors the poor BY replacement observed in recent years among monitored populations (Figure 4), further highlighting the influence of ocean conditions on Idaho steelhead

(Petrosky and Schaller 2010). In 2019, standard methods were expanded to areas with sufficient data, and SARs (to Bonneville Dam) for Big Bear Creek, Big Creek, Fish Creek, and the Lemhi River were reported (Dobos et al. 2020b). Changing the adult detection location from LGR to Bonneville Dam allowed for a metric focused more on ocean survival and free of influence from downstream harvest management actions. Using Bonneville as the adult detection location also helped ensure that enough adults were detected to generate reliable estimates for groups with low returns.

Our population-level SARs complement the large-scale analyses being reported at the MPG-level for the Comparative Survival Study (McCann et al. 2018) and can guide management by examining population-specific performance within MPGs. However, low or no returns of PIT-tagged adults limits the expansion of calculating SARs in the other monitored populations included in this report. We recommend considering combining watersheds (e.g., all juvenile marking sites in the upper Salmon River basin) for systems that have too few PIT-tagged returning adults to calculate SARs.

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). In spawn year 2023, 4.4% of adult steelhead were 1-ocean, 82.5% were 2-ocean, 6.1 % were 3-ocean, and 0.6 % were repeat spawners. Dramatic shifts in age composition have been common in recent years. Spawn year 2017 was dominated by 2-ocean fish (89.7%), which shifted dramatically to predominantly 1-ocean adults in SY 2018 (73.5%), while SYs 2019 and 2020 were comprised of 59.0% and 46.2% 2-ocean fish, respectively. Spawn year 2021 was dominated by 2-ocean adults, with 92.7% of ocean-aged steelhead spending two years in the saltwater. Spawn year 2022 was more balanced across 1-ocean and 2-ocean fish, and likely shows there haven't been improvements in cohort strength. The observed shifts in age composition likely reflect fluctuations in ocean productivity, which can heavily influence year class strength. The two-year life cycle of pink salmon (*Oncorhynchus gorbuscha*) is one such fluctuation that may be affecting steelhead productivity and diversity. Interspecific competition between pink salmon and other Pacific salmonids can introduce density-dependent mechanisms related to prey availability (Kendall et al. 2020, Ruggarone et al. 2023, Vosbigian et al. 2024), creating an every-other-year shift in productivity when pink salmon outmigrants are abundant.

Additionally, 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. Drought conditions may also explain the differences in year class strength across SY 2021 and SY 2022, leading to another dramatic shift to age-2 adults for SY 2023. 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 individual steelhead populations within MPGs has been reflected in their freshwater and saltwater ages. The Lochsa River, South Fork Salmon River, and Big Creek generally return a higher portion of fish that had spent extended time in both freshwater and saltwater. Returning adults for SY 2022 from these populations were mostly comprised of freshwater age-3 fish (48.9%) compared to a mean of 30.2% of age-3 adults for all other populations in this study. Generally, these three populations also return with higher portions of older ocean ages relative to other populations with a mean of 54.5% 2-ocean adults, compared to a mean of 24.8% for all other populations for SY 2022). Interestingly, adult returns for SY 2023 across all populations were similar with 2-ocean adults comprising 84.6% of the Lochsa River, South Fork Salmon River, and Big Creek returns compared to 87.9% 2-ocean fish for all other populations. Older freshwater ages in the Lochsa River, South Fork Salmon River, and Big Creek areas, but similar ocean ages across all monitoring locations, suggest differences in environmental conditions and potential genetic drivers. We recommend that future iterations of this report examine if the age and sex diversity findings that are annually reported here align with IDFG's efforts at LGR to monitor steelhead viability at the tributary level (Baum et al. 2022).

Diversity of steelhead populations was also observed 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" type 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

Abundance estimates derived from PIT tag array observations provide a valuable tool for fishery managers. However, potential limitations should be considered prior to including additional array sites in this report. For example, previous to SY 2020, it was sometimes difficult to update model files (i.e., the model files used by the program JAGS [Depaoli et al. 2016]) to reflect PIT tag detection sites which may have been added to or removed from the landscape; however, in 2020, functions within the DABOM R package (https://github.com/KevinSee/DABOM) were improved to ease the process of writing the JAGS files (including setting input parameters, etc.) (See et al. 2021). This eased model maintenance; moreover, the model can now be operated using a list of all PIT tag detection locations throughout the Snake River basin, past and present, and an option is now included to "turn off" any sites that no longer exist or where no detections occur in a given year. Soon after, partially in response to the installation of the ogee antenna on the LGR spillway, configuration files used to process detections were also updated to leverage adults detected going over the spillway and/or at sites downstream of LGR (e.g., mainstem dams, in Columbia River tributaries) and that were not observed migrating upstream through the LGR adult ladder again. Incorporating these observations further helps to improve the accuracy and precision of movement and detection probabilities throughout the Snake River basin. However, since its inception, the formulation within the DABOM model has not changed. Finally, in 2024, a retrospective effort was completed for SY 2010 through 2023 to ensure all years to-date are analyzed using the most up-to-date list of PIT tag detection sites across the landscape (past and present) and to leverage detections at sites downstream of LGR (Mike Ackerman, Nez Perce Tribe, personal communication); all years to date have now been analyzed in a consistent manner.

Another potential issue with using PIT tag arrays to monitor escapement is the limitation of the number of PIT-tagged adult steelhead with associated sex and age information for diversity and productivity analyses. The number of adults handled and tagged at LGR is annually decided through a cooperative process among multiple agencies, and current guidance is a maximum sample rate of 20% of all adults. In low return years, or in small populations, sample sizes available might not provide accurate sex and age proportions for demographic inference at all sites. Ideally, sample sizes should be sufficient to estimate binomial (e.g., sex) or multinomial (e.g., age) proportions being estimated, and depends on the number of "bins" in question. This can be especially problematic for small spawning aggregates or locations with few adults detected. However, multiple potential solutions exist including: 1) increasing the number of adults PIT-tagged and handled at LGR, 2) aggregate sex and age data for across multiple locations within a population and/or use detections from sites upstream that may not have been detected at a given location, and/or 3) employ methods to estimate sex and age proportions which leverage information from additional years within a location or from adjacent, similar populations in the same year. These issues are not necessarily unique to PIT tag arrays and can be commonplace in monitoring of depleted spawning aggregates or populations.

Infrastructure deficiencies at certain sites, compounded by low numbers of returning adult steelhead over the past five years, continue to hamper our ability to accurately estimate spawners and generate adult-to-adult and adult-to-juvenile productivity analyses. For example, the weir structures at Crooked River and Fish Creek are ineffective during high spring flows when adult steelhead are migrating, and Crooked River has not had enough individuals trapped to consistently estimate an expanded abundance of spawners in recent years. Additionally, Crooked River weir is not designed to capture kelts, thus we cannot generate estimates using mark recapture methodology. Therefore, a PIT tag array site was installed on Crooked River in the fall of 2021. The PIT tag array effectively captured enough adult steelhead to generate an abundance estimate for SY 2022. 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 physically maintaining a dual span array. We are examining alternative methods using an integrated state-space model incorporating data from Lower Granite Dam and PIT-tag data in Big Bear Creek to better estimate adult steelhead abundance in years where expanded estimates could not be generated.

RECOMMENDATIONS

1. 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 River, the South Fork Salmon River, and Marsh Creek.

2. 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.

3. 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.

4. Develop an alternative model to estimate adult abundance at Big Bear Creek during years in which traditional mark-recapture techniques are not feasible. Implement in other locations as necessary to achieve abundance estimates when returning fish are limited.

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TABLES

Table 1. Major population groups and independent populations within the Snake River steelhead distinct population segment (DPS; ICBTRT 2007; 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. IDFG's intensive, high-precision adult steelhead monitoring locations within the Clearwater River and Salmon River MPGs, and dates of operation during the 2023 adult steelhead migration period.

Population	Site location	2023 dates of operation
Clearwater River MPG		
Lower Clearwater River	Big Bear Creek (Array)	1/1/23 – "migration period" [a] Outage: 3/24/23 - 4/03/23
Lower Clearwater River	East Fork Potlatch River (Weir)	3/13/2023 – "migration period" Partial/Inoperable: 24 days
South Fork Clearwater River	Crooked River (Weir)	4/6/2023 – "migration period" Partial/Inoperable: 28 days
South Fork Clearwater River	Crooked River (Array)	Fully operable for entirety of migration period
Lochsa River	Lochsa River (Array)	Fully operable for entirety of migration period
Lochsa River	Fish Creek (Weir)	3/12/23 – "migration period" Partial/Inoperable: 30 days
Salmon River MPG		
Little Salmon River	Rapid River Hatchery (Weir)	3/12/23 – 9/12/23 Partial/Inoperable: 0 days
South Fork Salmon River	Krassel Creek (Array)	Fully operable for entirety of migration period
Lower Middle Fork Salmon River	Big Creek at Taylor Ranch (Array)	Fully operable for entirety of migration period
Upper Middle Fork Salmon River	Marsh Creek (Array)	Fully operable for entirety of migration period
North Fork Salmon River	North Fork Salmon River (Array)	Fully operable for entirety of migration period
Lemhi River	Lower Lemhi River (Array)	Fully operable for entirety of migration period
Lemhi River	Hayden Creek (Array)	Fully operable for entirety of migration period
Lemhi River	Upper Lemhi River (Array)	Fully operable for entirety of migration period
Pahsimeroi River	Pahsimeroi River Hatchery (Weir)	2/24/23 - 5/08/23 Partial/Inoperable: 0 days
East Fork Salmon River	East Fork Salmon River (Weir)	4/12/23 - 5/22/23 Partial/Inoperable: 0 days
Upper Salmon River	Sawtooth Hatchery (Weir)	3/20/23 - 5/9/23 Partial/Inoperable: 0 days

[a] Indicates the array(s) operated intermittently/unreliably throughout the migration period and was therefore unable to provide a valid abundance estimate.

Table 3. Number of spawn year (SY) 2023 wild adult steelhead (prespawn and kelts) and respective abundance estimates for fish captured at weirs (M-R estimate) or sampled at Lower Granite Dam and subsequently detected at PIT tag arrays (DABOM estimate). An asterisk indicates a minimum abundance estimate. A dash indicates a location with insufficient data for reliable abundance estimate. NA = not applicable.

Location	Pre-spawn fish captured	Kelts		SY 2023 abundance est (95% CI)
		Unmarked	Marked	
Clearwater River MPG				
Big Bear Creek Array	0	NA	NA	-
EF Potlatch Weir	7	0	0	7*
Crooked River Weir	0	0	0	-
Crooked River Array	1	NA	NA	6 (0 - 19)
Lochsa River Array	182	NA	NA	797 (649 - 947)
Fish Creek Weir	19	15	5	67 (40 - 133)
Salmon River MPG				
Rapid River Weir	12	NA	NA	12*
SF Salmon Array	45	NA	NA	218 (152 - 292)
Big Creek Array	48	NA	NA	201 (136 - 268)
Marsh Creek Array	7	NA	NA	35 (14 - 66)
NF Salmon Array	19	NA	NA	54 (25 - 90)
Lower Lemhi Array	12	NA	NA	39 (16 - 69)
Hayden Creek Array	4	NA	NA	14 (3 - 30)
Upper Lemhi Array	1	NA	NA	6 (1-17)
Pahsimeroi River Weir	13	NA	NA	13*
EF Salmon River Weir	17	NA	NA	17*
Upper Salmon River Weir	19	NA	NA	19*

Table 4. Brood year (BY) 2016 returning progeny for Clearwater River and Salmon River MPGs with respective adult-to-adult productivity estimates, mean 10-year productivity (SYs 2013−2023), and number of years productivity was below 1.0. Also includes mean spawner age proportions (SYs 2013−2023) at each location. An asterisk indicates sites with less than 10 years of complete BY data. A dash indicates insufficient data for adult-to-adult productivity estimates.

Location	Returning progeny	Productivity			Mean proportion				
		BY 2016	Mean	# Yrs < 1.0	Age 3	Age 4	Age 5	Age 6	Age 7
Clearwater River MPG									
Big Bear Creek Array	34	0.13	1.16	7	0.07	0.51	0.39	0.09	0.00
EF Potlatch Weir*	24	0.27	0.76	7	0.03	0.38	0.49	0.10	0.00
Crooked River Weir	-	-	-	-	-	-	-	-	-
Crooked River Array	-	-	-	-	-	-	-	-	-
Lochsa River Array	-	-	-	-	-	-	-	-	-
Fish Creek Weir	77	0.32	0.69	8	0.00	0.08	0.51	0.40	0.01
Salmon River MPG									
Rapid River Weir	8	0.30	0.51	9	0.00	0.27	0.51	0.21	0.00
Krassel Creek Array	-	-	-	-	-	-	-	-	-
Big Creek Array*	117	0.33	0.34	7	0.00	0.10	0.51	0.37	0.03
Marsh Creek Array	-	-	-	-	-	-	-	-	-
NF Salmon Array*	23	0.15	-	-	0.00	0.20	0.37	0.43	0.00
Lower Lemhi Array*	92	0.26	0.49	7	0.07	0.44	0.42	0.07	0.00
Pahsimeroi River Weir	29	0.32	2.47	6	0.13	0.59	0.25	0.02	0.00
EF Salmon River Weir	59	0.15	0.38	9	0.01	0.25	0.57	0.16	0.00
Upper Salmon River Weir	115	1.49	1.13	7	0.02	0.31	0.57	0.08	0.01

Table 5. Final scale age frequencies of wild adult steelhead captured at weirs or sampled at Lower Granite Dam (LGR) that were subsequently detected at PIT tag arrays, for spawn year 2023. Dashes represent final ages with no representation. Freshwater age that could not be determined is signified by x, total age that could not be determined is signified by NA, and natural repeat spawners are signified by R.

Location	Adult steelhead age (freshwater.saltwater)																
	1.1	**1.2**	**2.1**	**2.2**	**2.3**	**3.1**	**3.2**	**3.3**	**4.1**	**4.2**	**4.3**	**R**	**x.1**	**x.2**	**x.3**	**NA**	**Total**
Clearwater River MPG																	
Big Bear Creek	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
East Fork Potlatch River	-	-	-	3	-	-	2	-	-	-	-	-	-	1	-	-	6
Crooked River (Weir)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Crooked River (Array)	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Lochsa River	-	1	-	27	3	-	68	6	1	3	1	-	-	29	3	4	146
Fish Creek	-	-	-	2	1	-	8	-	-	-	-	-	-	7	-	1	19
Salmon River MPG																	
Rapid River	-	-	-	4	1	1	3	-	-	-	-	-	-	1	1	1	12
South Fork Salmon River	-	-	1	9	3	1	14	-	-	-	-	1	-	11	-	1	41
Big Creek	-	-	1	12	-	7	14	1	-	-	-	-	-	4	-	1	40
Marsh Creek	-	-	-	2	-	-	4	-	-	-	-	1	-	-	-	-	7
North Fork Salmon River	-	-	-	-	-	-	8	-	1	-	-	-	-	3	-	1	13
Lower Lemhi River	-	-	-	2	-	1	1	-	-	-	-	-	-	1	-	-	5
Hayden Creek	-	-	-	3	-	-	1	-	-	-	-	-	-	1	-	-	5
Upper Lemhi River	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Pahsimeroi River	-	1	-	4	-	-	1	-	-	-	-	-	-	6	1	-	13
East Fork Salmon River	-	-	1	11	-	-	1	-	-	-	-	-	-	2	-	1	16
Upper Salmon River	-	-	1	13	-	-	3	-	-	-	-	-	-	2	-	-	19
Total	**0**	**2**	**4**	**92**	**8**	**10**	**127**	**7**	**2**	**3**	**1**	**2**	**0**	**68**	**5**	**10**	**343**

Table 6. Sex, length, and total age proportions for all IDFG sampling locations. Age proportions exclude fish with incomplete age information (missing freshwater age or bad sample) and repeat spawners are denoted by R.

Location	Sex	Unique adults trapped or detected	Fork length (cm)			Proportions by total age					
			Min	Mean	Max	4	5	6	7	8	R
Clearwater River MPG											
Big Bear Creek	Female	0	-	-	-						
	Male	0	-	-	-						
	All	0	-	-	-	-	-	-	-	-	-
East Fork Potlatch River	Female	6	67.0	72.4	77.0						
	Male	1	34.0	34.0	34.0						
	All	7	34.0	66.9	77.0	-	0.50	0.33	-	-	-
Crooked River	Female	1	80.0	80.0	80.0						
	Male	0	-	-	-						
	All	1	80.0	80.0	80.0	-	-	1.00	-	-	-
Lochsa River	Female	113	65.0	79.7	88.0						
	Male	33	76.0	85.0	92.0						
	All	146	65.0	80.8	92.0	0.01	0.18	0.49	0.06	0.01	-
Fish Creek	Female	14	65.0	79.6	87.0						
	Male	5	77.5	82.6	88.7						
	All	19	65.0	80.4	88.7	-	0.11	0.47	-	-	-
Salmon River MPG											
Rapid River	Female	7	58.0	71.7	81.0						
	Male	5	65.0	73.2	77.0						
	All	12	58.0	72.3	81.0	-	0.42	0.33		-	-
South Fork Salmon River	Female	31	68.0	78.3	85.0						
	Male	10	58.0	81.2	89.0						
	All	41	58.0	79.0	89.0	0.02	0.24	0.41	-	-	-
Big Creek	Female	32	59.0	74.3	83.0						
	Male	8	54.0	64.3	83.0						
	All	40	54.0	72.3	83.0	0.03	0.48	0.35	0.25	-	-
Marsh Creek	Female	5	69.0	72.6	77.0						
	Male	2	81.0	83.5	86.0						
	All	7	69.0	75.7	86.0	-	0.29	0.57	-	-	0.14
North Fork Salmon River	Female	10	69.0	71.5	77.0						
	Male	3	55.0	67.7	76.0						
	All	13	55.0	70.6	77.0	-	-	0.69	-	-	-
Lower Lemhi River	Female	5	57.0	65.8	71.0						
	Male	0	-	-	-						
	All	5	57.0	65.8	71.0	-	0.60	0.20	-	-	-

Table 6. continued

Location	Sex	Unique adults trapped or detected	Fork length (cm)			Proportions by total age					
			Min	Mean	Max	4	5	6	7	8	R
Hayden Creek	Female	4	63.0	68.5	71.0						
	Male	1	75.0	75.0	75.0						
	All	5	63.0	69.8	75.0	-	0.60	0.20	-	-	-
Upper Lemhi River	Female	0	-	-	-						
	Male	0	-	-	-						
	All	0	-	-	-	-	-	-	-	-	-
Pahsimeroi River	Female	9	62.0	67.9	72.0						
	Male	4	67.0	72.3	82.0						
	All	13	62.0	69.2	82.0	0.08	0.31	0.08	0.17	-	-
East Fork Salmon River	Female	14	75.4	75.4	75.4						
	Male	3	-	-	-						
	All	17	75.4	75.4	75.4	0.06	0.69	0.06	-	-	-
Upper Salmon River	Female	11	63.0	67.4	72.0						
	Male	8	56.0	68.5	78.0						
	All	19	56.0	67.8	78.0	0.05	0.68	0.16	-	-	-

Table 7. Spawn Year 2023 wild adult steelhead counts and respective run timing at Bonneville Dam, Lower Granite Dam, and home array or weir. Locations with no detections of adult fish (previously PIT tagged as juveniles at the respective array/weir) are indicated with dashes.

Location	Bonneville Dam				Lower Granite Dam				Array/weir			
	n	Min	Median	Max	*n*	Min	Median	Max	*n*	Min	Median	Max
Clearwater River MPG												
Big Bear Creek	3	9/11/22	9/17/22	11/3/22	2	9/22/22	9/28/22	10/4/22		_	_	_
EF Potlatch (Weir)	1	8/30/22	8/30/22	8/30/22	_	_	_	_		_	_	_
Crooked River Weir	–	–	–	–	–	–	–	–		–	–	–
Crooked River Array	–	–	–	–	–	–	–	–		–	–	–
Lochsa River (Array)	43	8/4/22	9/8/22	4/20/23	33	9/22/22	10/8/22	4/28/23	27	3/28/23	4/21/23	5/19/23
Fish Creek Weir	37	8/4/22	9/6/22	4/20/23	28	9/22/22	10/9/22	4/28/23	6	4/17/23	4/23/23	5/24/23
Salmon River MPG												
Rapid River Weir	1	8/3/22	8/3/22	8/3/22	1	9/11/22	9/11/22	9/11/22		_	_	_
SF Salmon Array	6	8/15/22	8/19/22	9/26/22	4	9/22/22	9/30/22	4/11/23	4	4/15/23	5/1/23	5/16/23
Big Creek Array	11	7/28/22	8/15/22	9/18/22	9	9/4/22	9/19/22	10/17/22	6	4/23/23	4/28/23	5/11/23
Marsh Creek Array	–	–	–	–		–	–	–		–	–	–
NF Salmon Array	8	7/4/22	7/25/22	8/3/22	5	7/19/22	9/22/22	11/20/22	5	4/29/23	6/5/23	6/10/23
Lower Lemhi Array	10	7/8/22	8/7/22	9/9/22	9	8/4/22	9/27/22	10/27/22	6	4/9/23	4/22/23	4/29/23
Pahsimeroi River Weir	1	7/26/22	7/26/22	7/26/22	1	9/30/22	9/30/22	9/30/22		_	_	_
EF Salmon River Weir	–	–	–	–		–	–	–		–	–	–
Upper Salmon River Weir	1	7/21/22	7/21/22	7/21/22	1	9/22/22	9/22/22	9/22/22		_	_	_

FIGURES

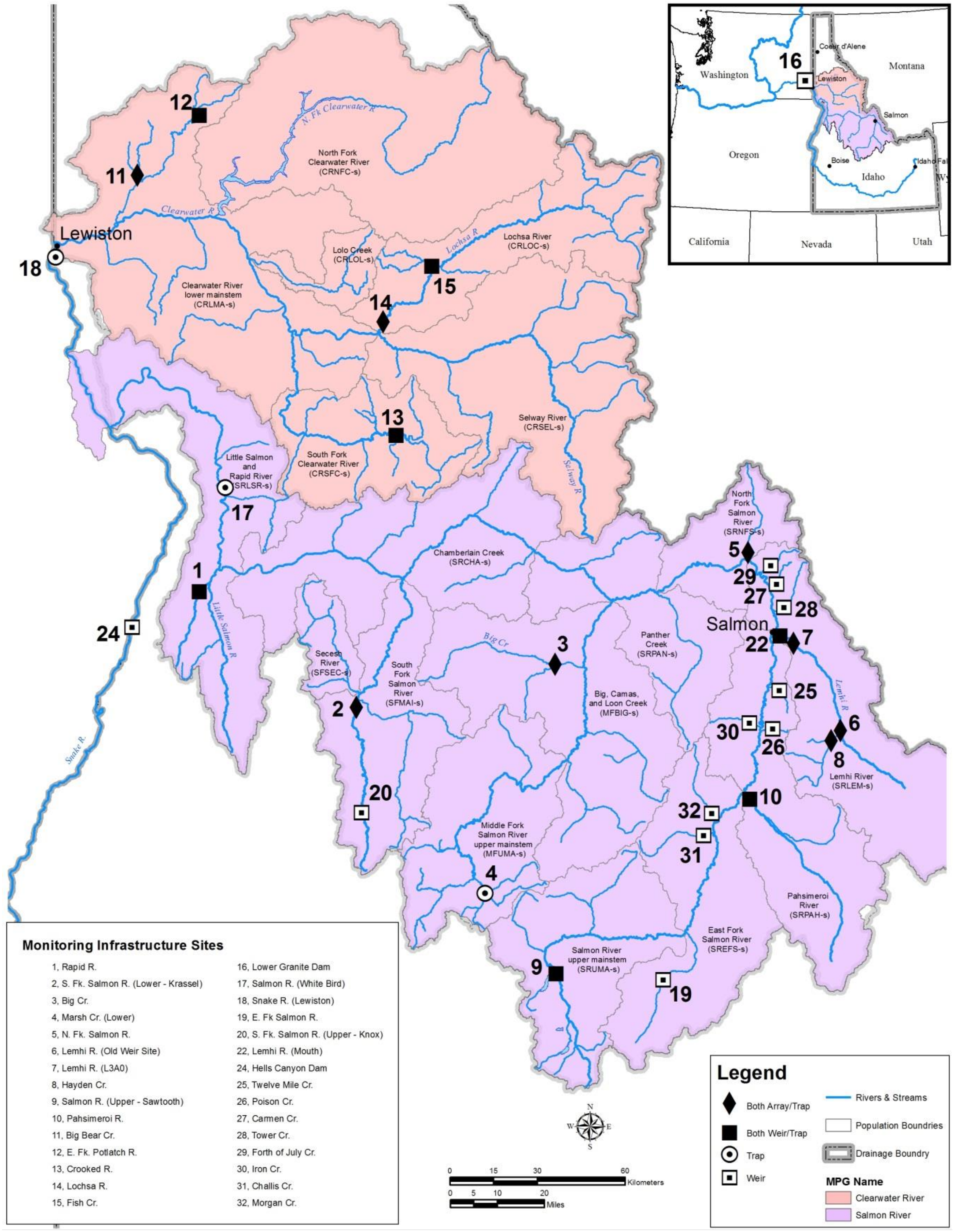

Figure 1. Locations of wild steelhead monitoring infrastructure operated by IDFG in Idaho. The Clearwater River Major Population Group is pink; the Salmon River Major Population Group is purple. Population boundaries are shown as light gray lines.

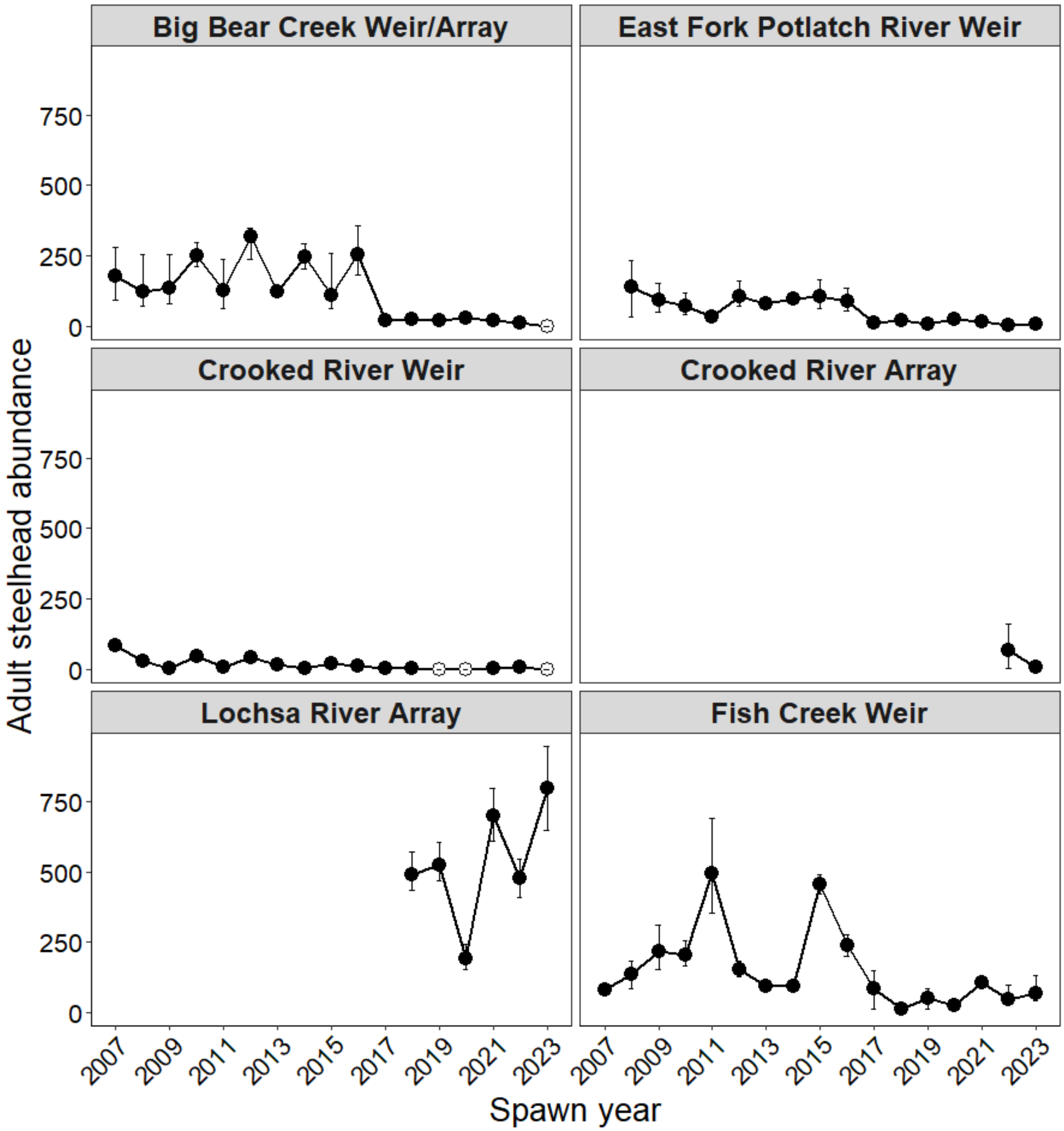

Figure 2. Abundance trends of wild adult steelhead at weirs or PIT tag arrays in the Clearwater River basin, spawn years 2007–2023. Confidence intervals are at 95%. Points without confidence intervals are unique adults trapped or detected. Hollow points indicate an abundance of zero.

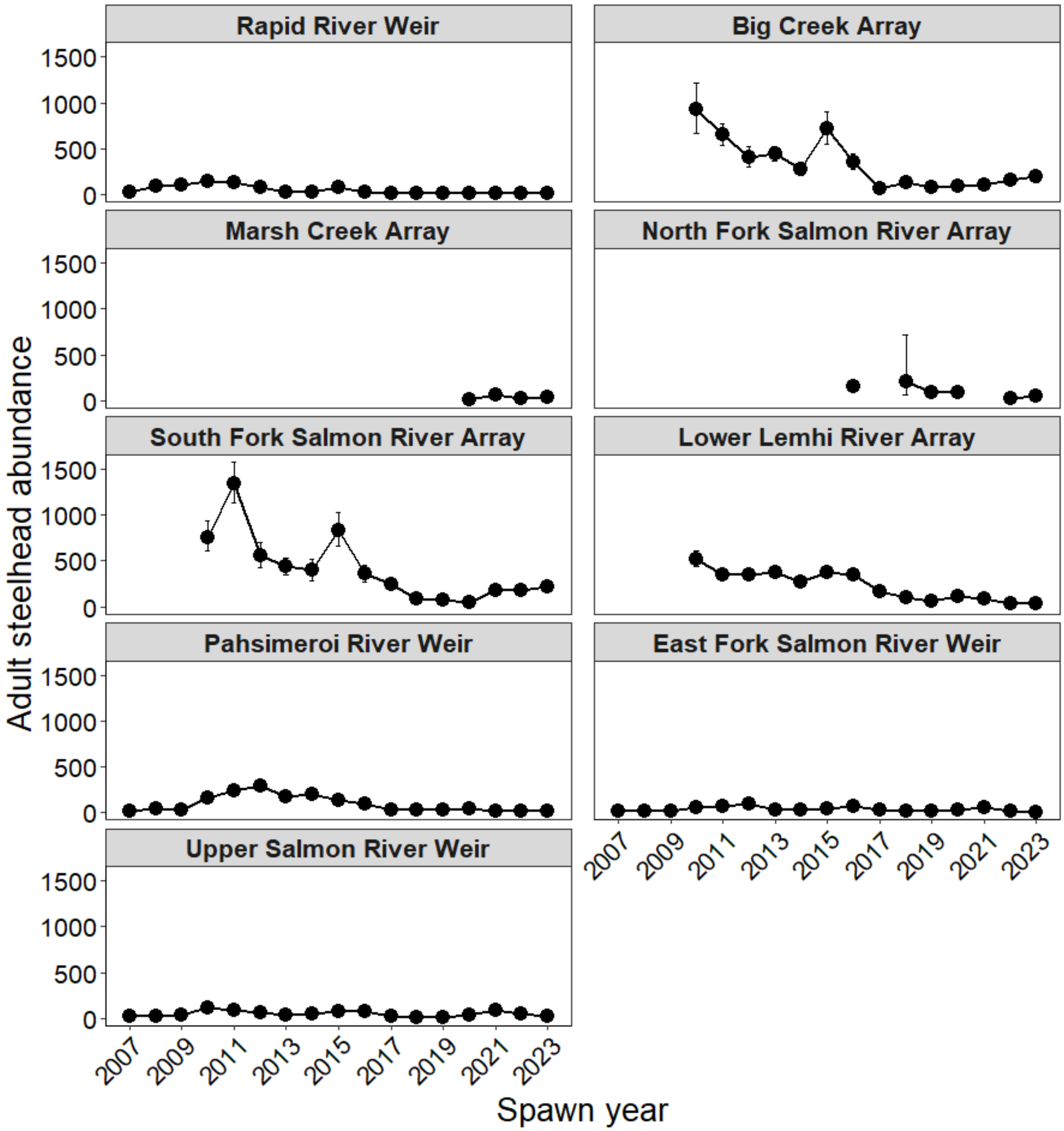

Figure 3. Abundance trends of wild adult steelhead at weirs or PIT tag arrays in the Salmon River basin, spawn years 2007–2023. Confidence intervals are at 95%. Points without confidence intervals are unique adults trapped or detected.

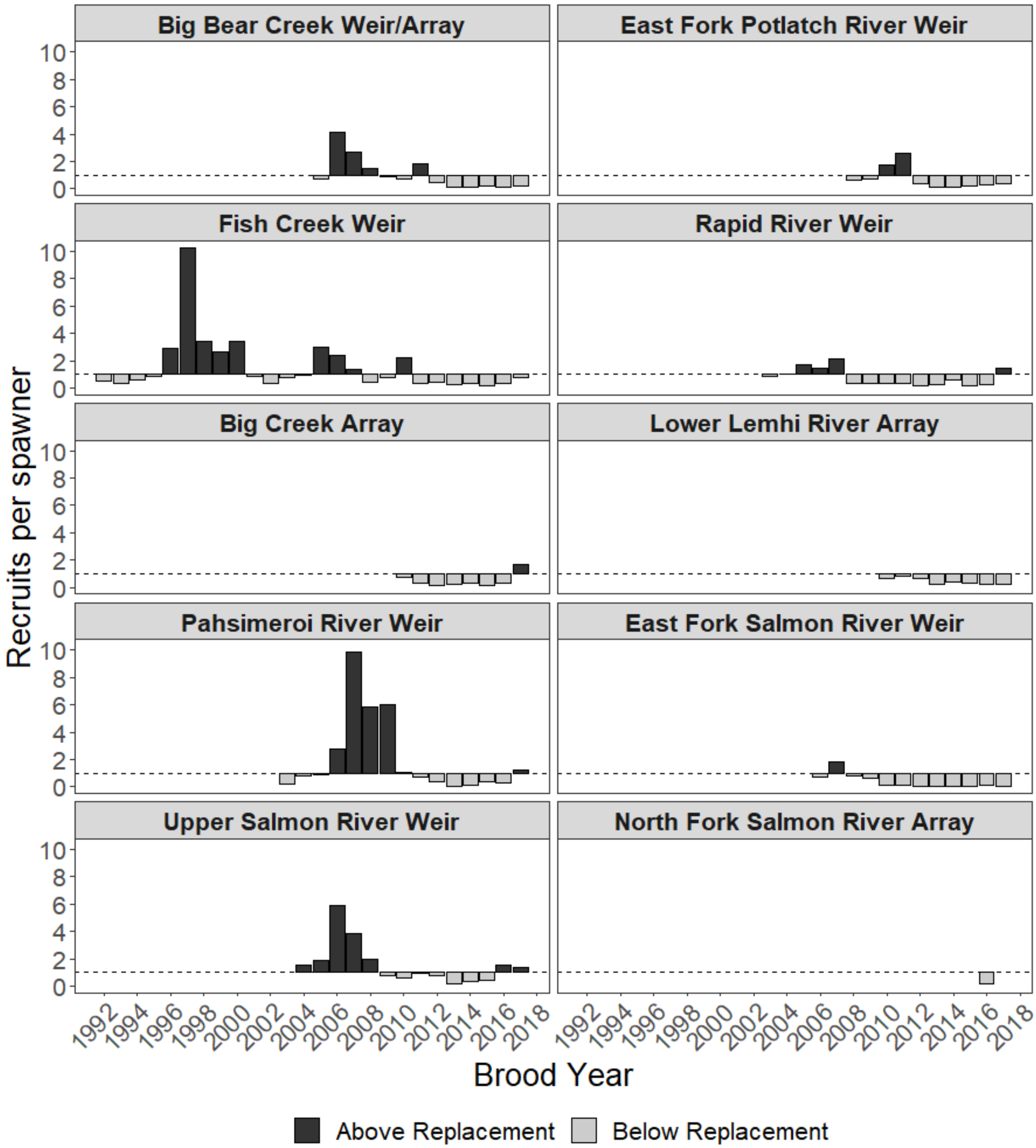

Figure 4. Productivity (wild adult recruits per spawner) of steelhead at select Idaho weirs or PIT tag arrays, for completed brood years 1992–2016, and preliminary brood year 2017. Select brood years were omitted due to incomplete data. Dashed line represents 1:1 replacement.

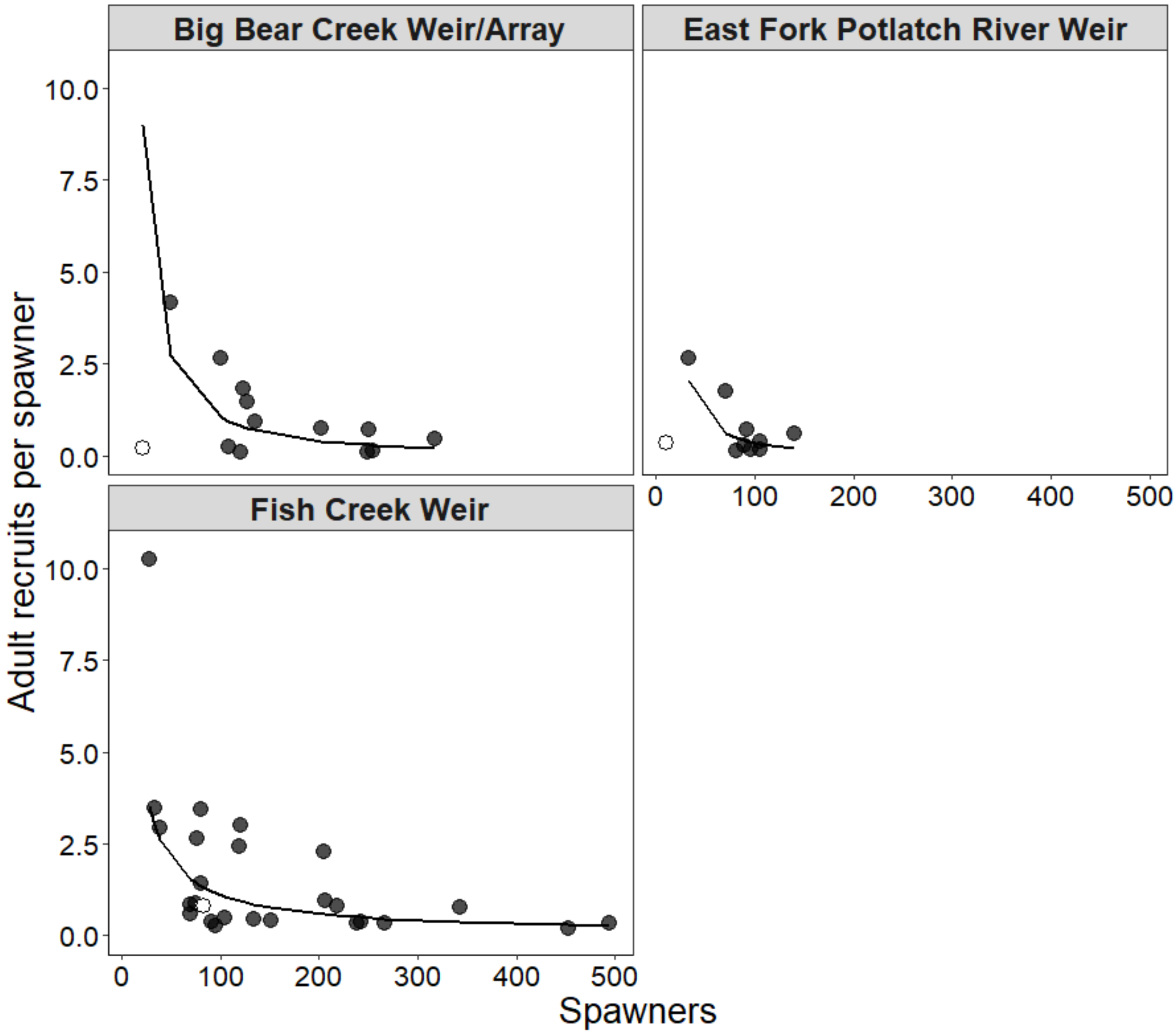

Figure 5. Relationship of steelhead productivity (wild adult recruits per spawner) to spawner abundance at select weirs or PIT tag arrays in the Clearwater River basin, brood years 1992–2017. All completed brood years (2016 and prior) are represented by filled points, and preliminary data for BY 2017 are represented by open points. Trend lines for each data set were fit with a power function and do not include BY 2017.

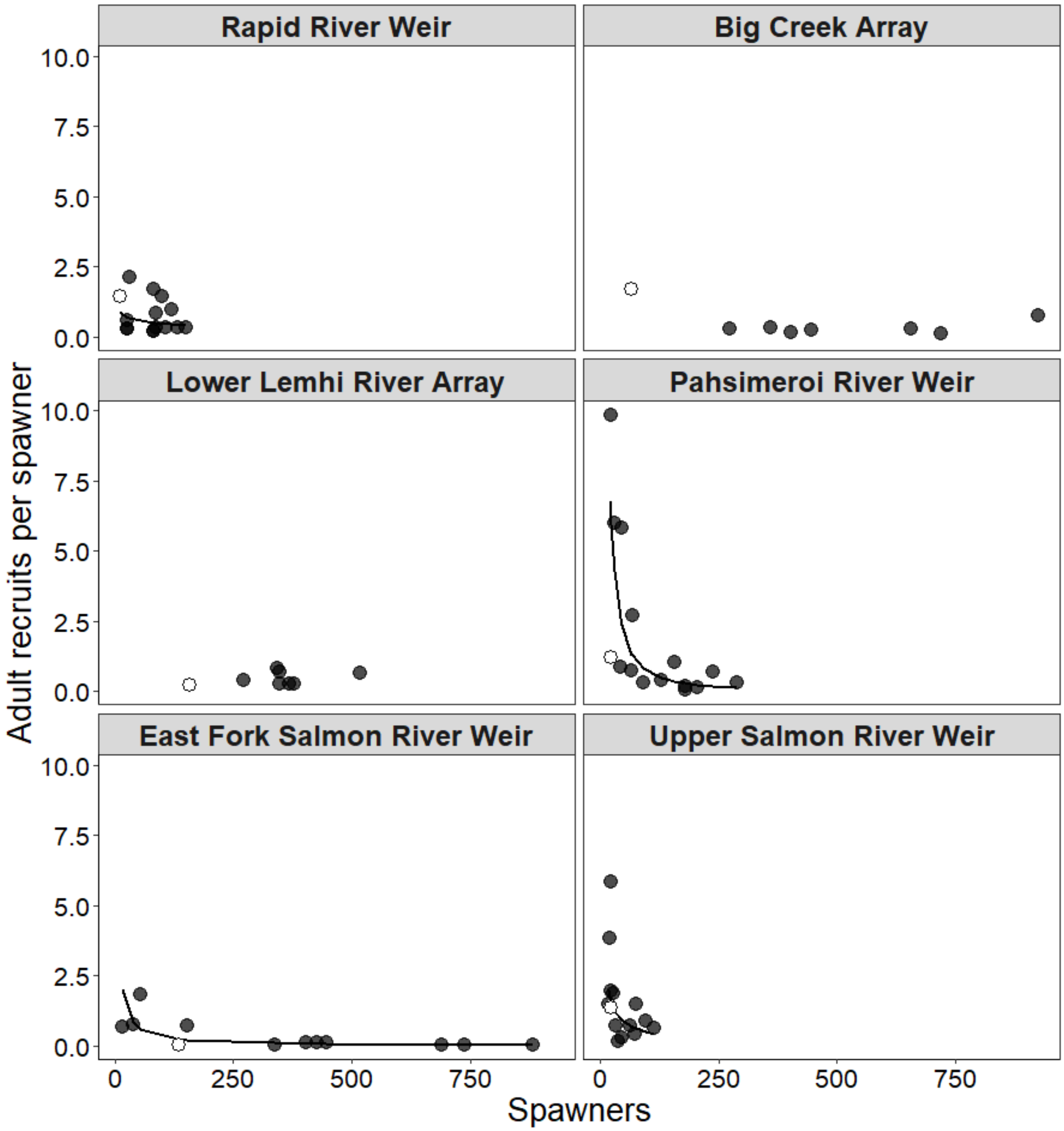

Figure 6. Relationship of steelhead productivity (wild adult recruits per spawner) to spawner abundance at select weirs or PIT tag arrays in the Salmon River basin, brood years 1992–2017. All completed brood years (2016 and prior) are represented by filled points, and preliminary data for BY 2017 are represented by open points. Trend lines for each data set were fit with a power function where applicable and do not include BY 2017.

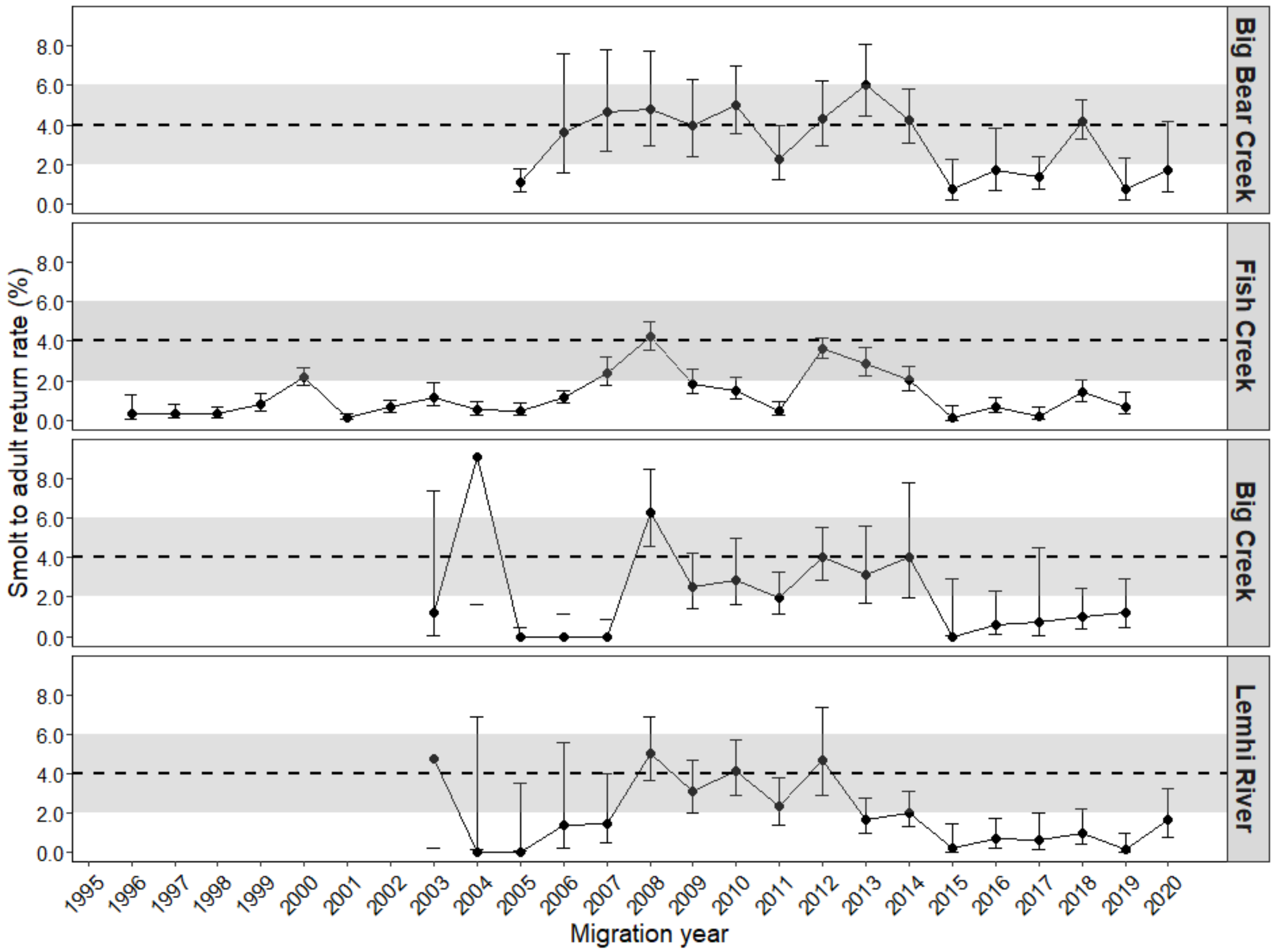

Figure 7. Wild steelhead smolt-to-adult return rate (SAR, %) from select Idaho weirs or PIT tag arrays to Bonneville Dam, migratory years 1996–2020. Confidence intervals are at 95%. Select confidence intervals were omitted due to small number of smolts used for analyses and extreme interval values. Median SAR objective dashed lines) with upper and lower range (shaded areas) goals were established by the Northwest Power and Conservation Council (NPCC 2020).

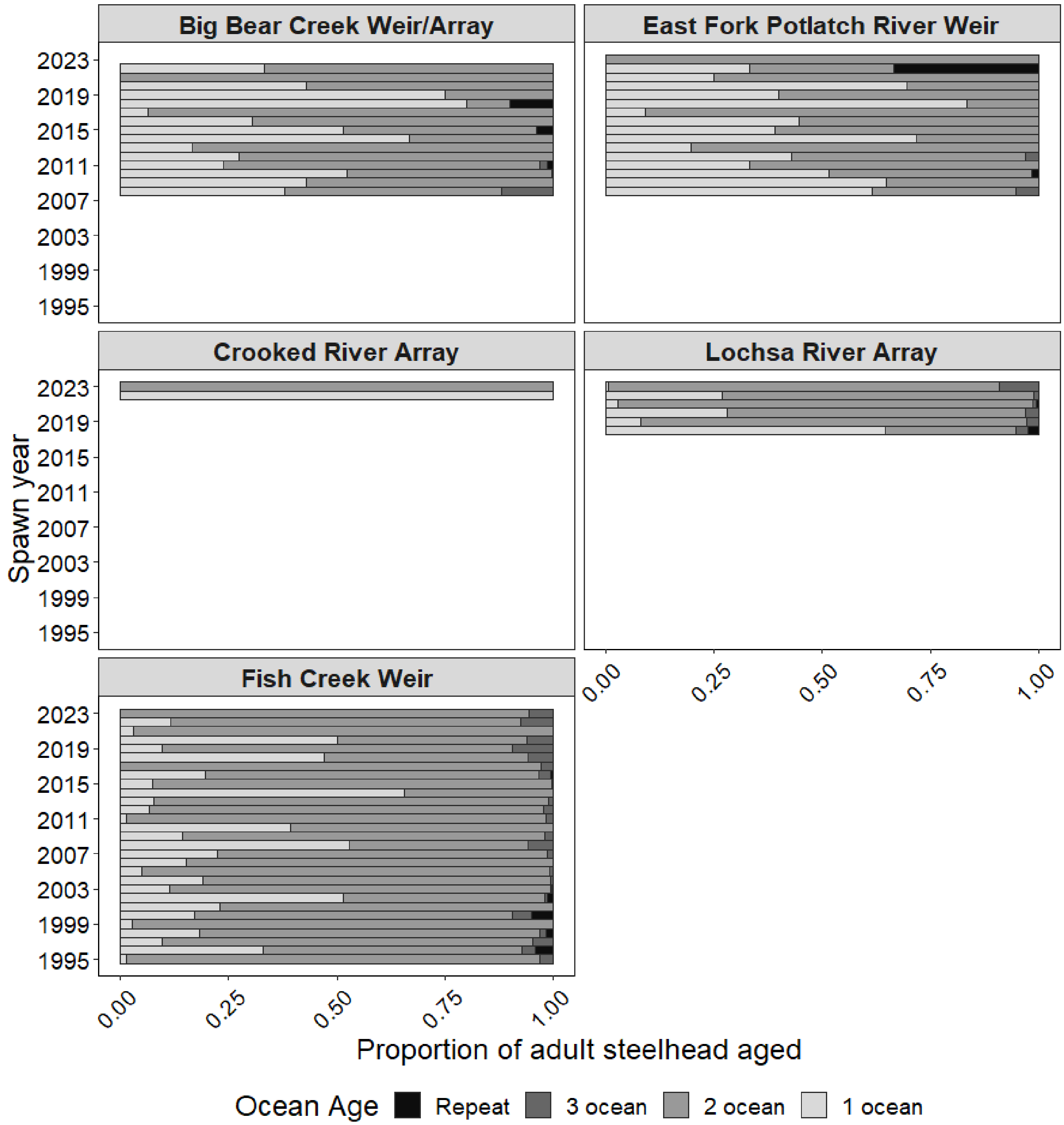

Figure 8. Ocean age composition of wild adult steelhead at select Idaho weirs or PIT tag arrays in the Clearwater River basin, spawn years 1995–2023. Select spawn years were omitted due to incomplete data.

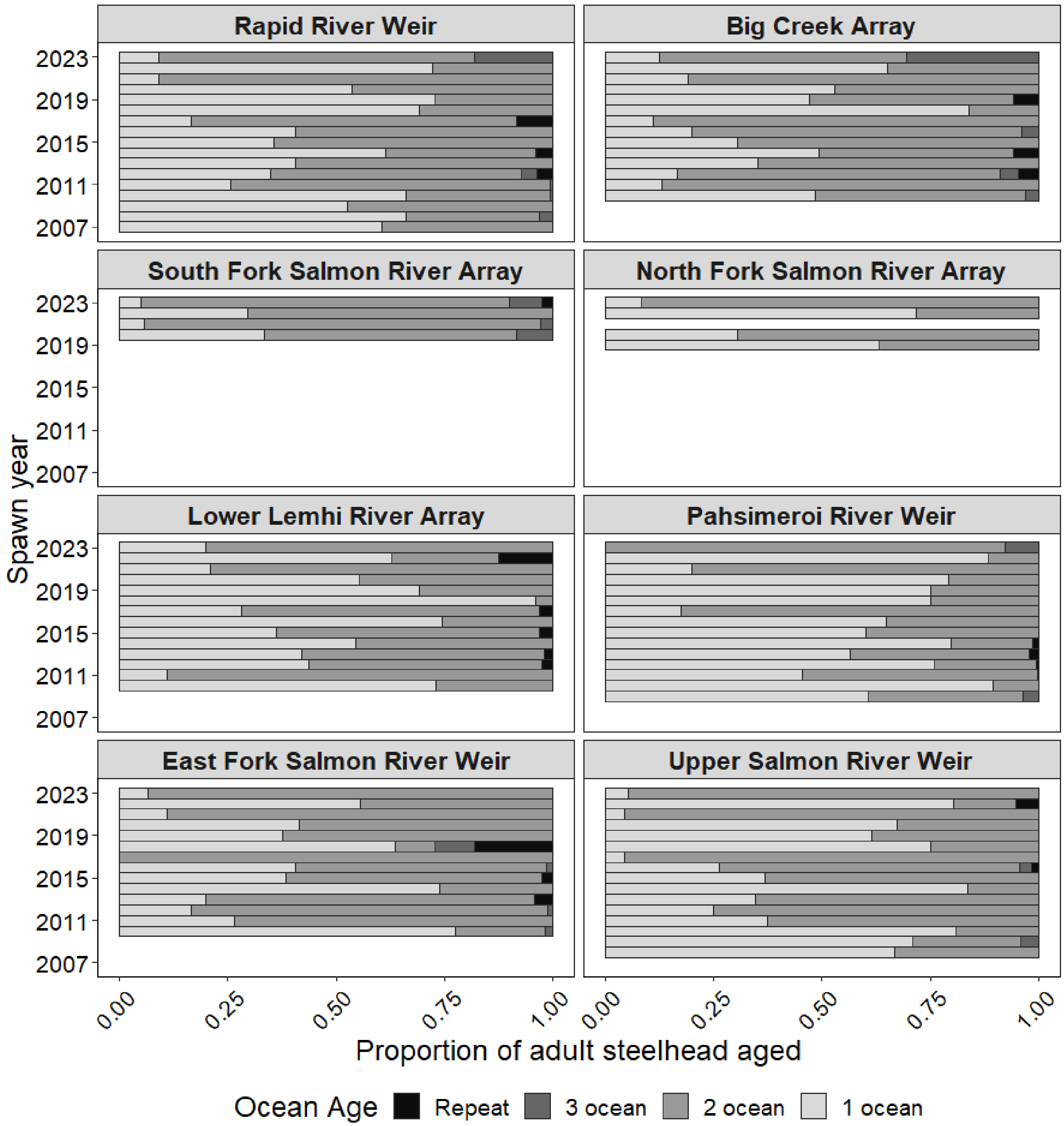

Figure 9. Ocean age composition of wild adult steelhead at select Idaho weirs or PIT tag arrays in the Salmon River basin, spawn years 2007–2023. Select spawn years were omitted due to incomplete data.

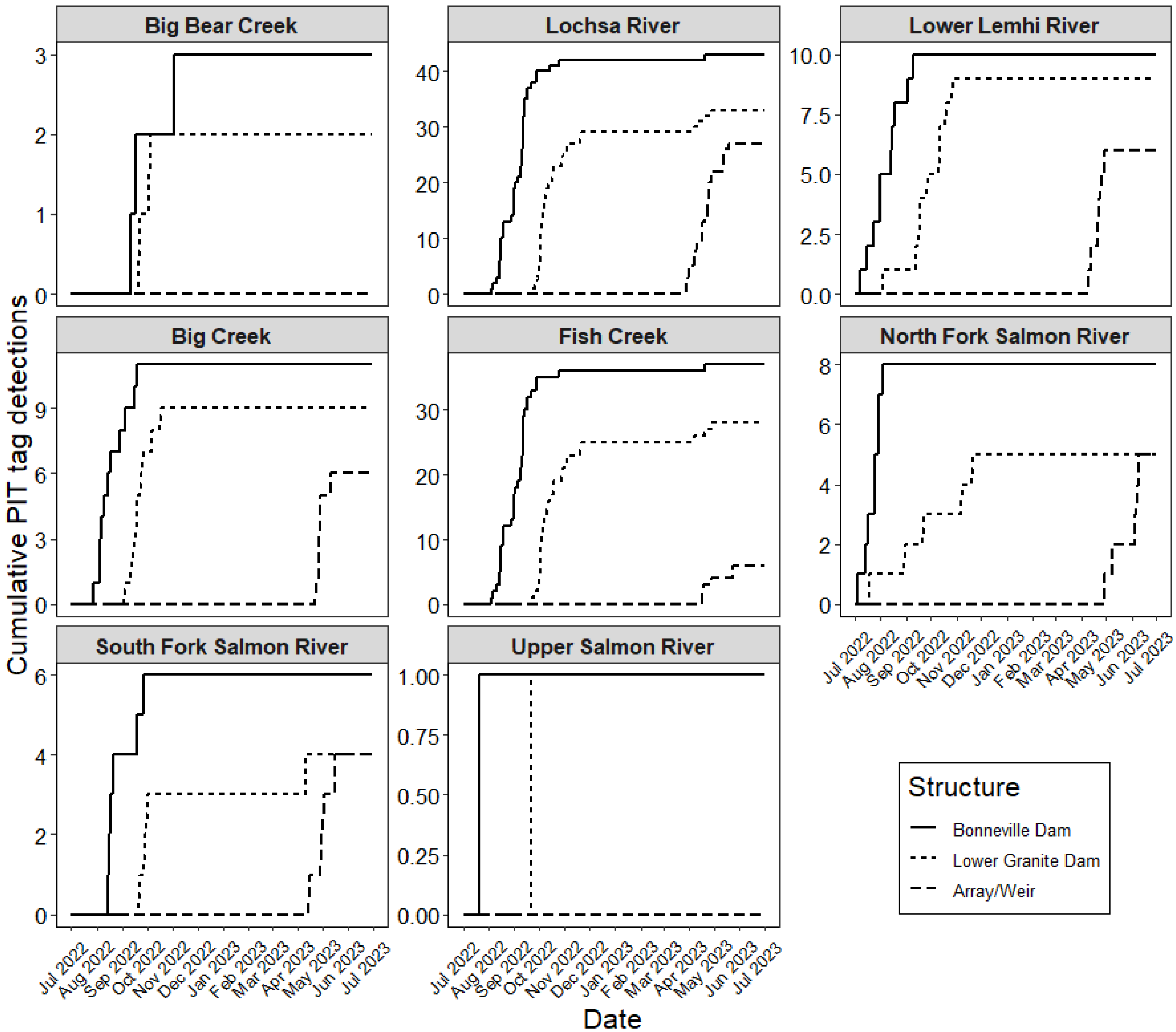

Figure 10. Cumulative wild steelhead run-timing curves at Bonneville Dam, Lower Granite Dam, and select Idaho PIT tag arrays and weirs, spawn year 2023. Steelhead were PIT-tagged as juveniles is in their natal tributaries.

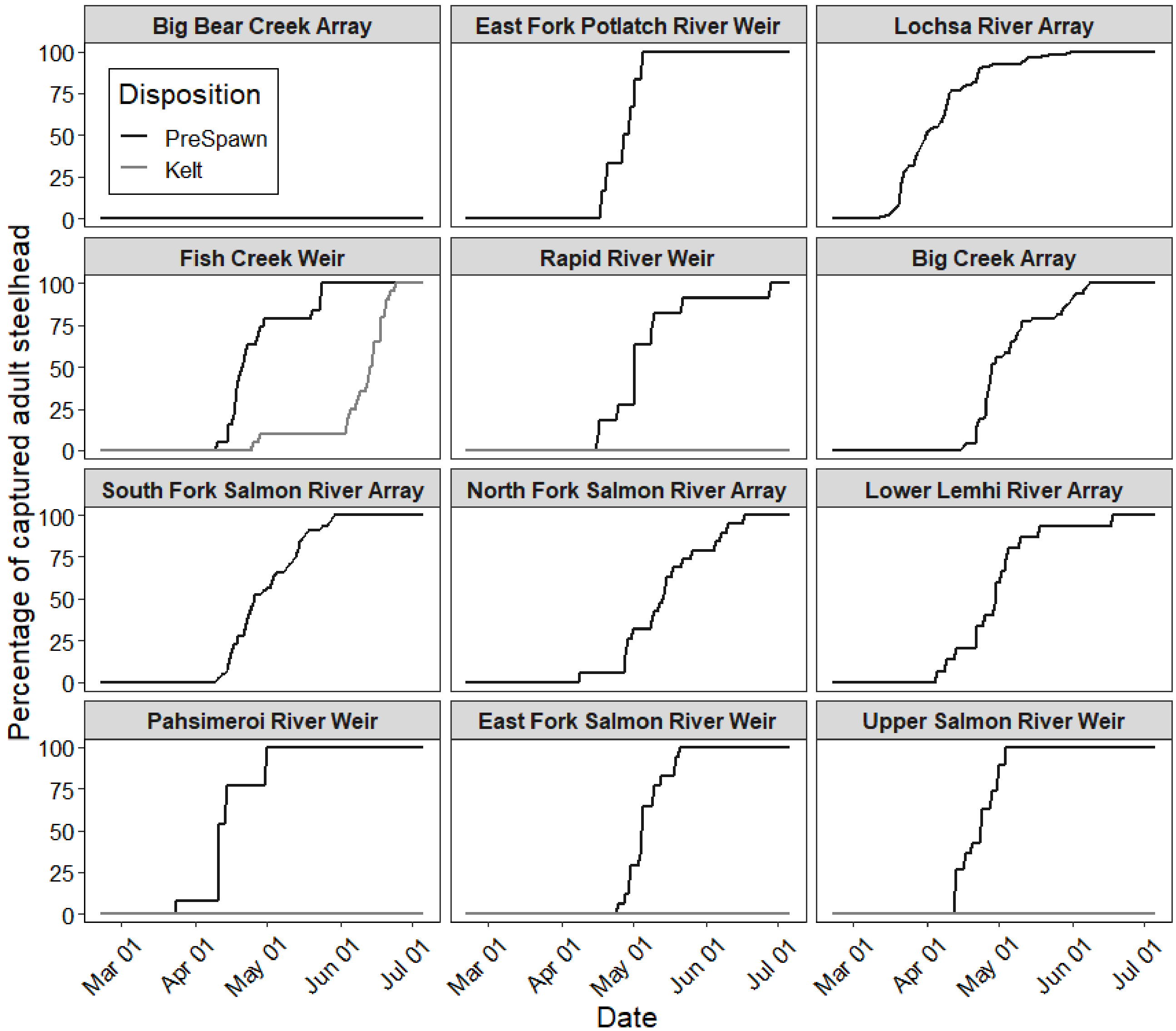

Figure 11. Cumulative wild prespawn (black line) and kelt steelhead (gray line) run-timing curves at select Idaho weirs and PIT tag arrays, spawn year 2023. Kelt data were mostly unavailable.

APPENDICES

Appendix A. Wild adult steelhead abundance estimate time series for Clearwater River weirs and 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]	16	4	35
		2019[b]	13	2	33
		2020[b]	30	11	55
		2021[b]	17	3	36
		2022	NA	NA	NA
		2023	NA	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
		2021[c]	17	17	17
		2022	2	NA	NA
		2023	7	NA	NA
Crooked River	Weir	2007[e]	84	NA	NA
		2008[e]	27	NA	NA
		2009[e]	4	NA	NA
		2010[e]	46	NA	NA
		2011[e]	5	NA	NA
		2012[e]	41	NA	NA
		2013[e]	15	NA	NA
		2014[e]	2	NA	NA
		2015	22	NA	NA
		2016	10	NA	NA
		2017	1	NA	NA
		2018	1	NA	NA

Appendix A continued.

Population	Structure	Spawn year	Abundance	LCI	UCI
Crooked River (continued)	Weir	2019	0	NA	NA
		2020	0	NA	NA
		2021	1	NA	NA
		2022	5	NA	NA
		2023	6	0	19
Lochsa River	Array	2017	1187	750	2061
		2018	490	433	572
		2019	526	469	615
		2020	189	152	243
		2021	699	611	798
		2022	933	800	1080
		2023	797	649	947
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
		2021	104	94	119
		2022[f]	48	35	79
		2023	67	40	133

[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.

Appendix A. continued

[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.

[e] Numbers of natural fish returning to hatchery weirs were obtained via Chuck Warren (IDFG steelhead hatchery evaluation biologist, personal communication) for years prior to 2015.

[f] Methods for estimating escapement at Fish Creek used a logistic regression model due to the weir being breached.

Appendix B. Wild adult steelhead abundance estimate time series for Salmon River weirs and 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[e]	32	NA	NA
		2008[e]	88	NA	NA
		2009[e]	108	NA	NA
		2010[e]	150	NA	NA
		2011[e]	133	NA	NA
		2012[e]	81	NA	NA
		2013[e]	27	NA	NA
		2014[e]	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
		2021	11	NA	NA
		2022	18	NA	NA
		2023	12	NA	NA
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	52	28	74
		2021	184	132	249
		2022	175	129	218
		2023	218	152	292
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
		2021	114	88	143
		2022	160	128	194
		2023	201	136	268
Marsh Creek	Array	2020	17	11	44
		2021	63	46	81

Appendix B. continued

Population	Structure	Spawn year	Abundance	LCI	UCI
Marsh Creek (continued)	Array	2022	26	17	35
		2023	35	14	66
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
		2021[d]	NA	NA	NA
		2022	29	20	39
		2023	54	25	90
Lower Lemhi River[a]	Array	2010	518	435	613
		2011	342	287	406
		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
		2021	92	71	116
		2022	38	28	50
		2023	39	16	69
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
		2021	10	1	21
		2022	0	0	0
		2023	0	NA	NA
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
		2021	29	12	50

Appendix B. continued

Population	Structure	Spawn year	Abundance	LCI	UCI
Hayden Creek (continued)	Array	2022	8	2	19

		2023	14	3	30
Pahsimeroi River	Weir	2007[e]	22	NA	NA
		2008[e]	45	NA	NA
		2009[e]	30	NA	NA
		2010[e]	157	NA	NA
		2011[e]	239	NA	NA
		2012[e]	288	NA	NA
		2013[e]	179	NA	NA
		2014[e]	205	NA	NA
		2015	130	NA	NA
		2016	92	NA	NA
		2017	24	NA	NA
		2018	30	NA	NA
		2019	35	NA	NA
		2020	41	NA	NA
		2021	20	NA	NA
		2022	18	NA	NA
		2023	13	NA	NA
East Fork Salmon River[c]	Weir	2007[e]	16	NA	NA
		2008[e]	11	NA	NA
		2009[e]	17	NA	NA
		2010[e]	61	NA	NA
		2011[e]	72	NA	NA
		2012[e]	92	NA	NA
		2013[e]	33	NA	NA
		2014[e]	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
		2021	56	NA	NA
		2022	13	NA	NA
		2023	17	NA	NA
Upper Salmon River	Weir	2007[e]	21	NA	NA
		2008[e]	23	NA	NA
		2009[e]	34	NA	NA
		2010[e]	115	NA	NA
		2011[e]	96	NA	NA
		2012[e]	63	NA	NA
		2013[e]	39	NA	NA
		2014[e]	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
		2021	87	NA	NA

Appendix B. continued

Population	**Structure**	**Spawn year**	**Abundance**	**LCI**	**UCI**
Upper Salmon River (continued)	Weir				

	2022	55	NA	NA
	2023	19	NA	NA

[a] Abundance estimates analyzed with the latest version of the DABOM model (Simmons et al. 2022). 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.

[d] Indicates the weir/array was compromised and did not operate during the migration period; therefore, an estimated abundance was not developed.

[e] Numbers of natural fish returning to hatchery weirs were obtained via Chuck Warren (IDFG steelhead hatchery evaluation biologist, personal communication) for years prior to 2015.

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. Dashes indicate incomplete age-specific accounting for respective brood years. Grey, hatched cells indicate years where adult abundance represented a minimum estimate.

Population	Brood year	Number of adult recruits					Total	Parents	Productivity
		Age-3	Age-4	Age-5	Age-6	Age-7			
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	0	25	249	0.10
	2015	0	14	11	0	0	25	109	0.23
	2016	0	14	20	0	0	34	254	0.13
	2017	4	0	0	0	--	4	21	0.19
	2018	0	0	0	--	--	0	23	0.00
	2019	0	0	--	--	--	0	19	0.00
	2020	0	--	--	--	--	0	0	0.00
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	0	15	96	0.16
	2015	0	1	11	6	0	18	105	0.17
	2016	0	13	11	0	--	24	89	0.27
	2017	0	0	0	--	--	0	11	0.00
	2018	0	0	--	--	--	0	18	0.00
	2019	0	0	--	--	--	0	6	0.00
	2020	0	--	--	--	--	0	25	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

Appendix C. continued

Population	Brood year	Number of adult recruits					Total	Parents	Productivity
		Age-3	Age-4	Age-5	Age-6	Age-7			
Fish Creek	1998	0	38	166	72	0	276	80	3.45
	1999	0	9	124	71	0	204	77	2.65
	2000	0	10	46	58	0	114	33	3.45
	2001	0	4	59	4	0	67	75	0.89
	2002	0	2	45	34	8	89	242	0.37
	2003	0	29	67	170	2	268	343	0.78
	2004	3	33	40	98	20	194	206	0.94
	2005	0	0	89	271	2	362	121	2.99
	2006	0	16	194	79	0	289	119	2.43
	2007	0	6	64	44	0	114	81	1.41
	2008	3	7	40	7	1	58	134	0.43
	2009	0	11	40	121	5	177	218	0.81
	2010	0	39	307	116	3	465	205	2.27
	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	28	95	0.27
	2014	0	3	29	4	0	36	91	0.40
	2015	0	3	14	66	0	83	452	0.18
	2016	0	4	38	35	0	77	239	0.32
	2017	0	0	11	55	--	66	83	0.00
	2018	0	2	12	--	--	14	13	0.00
	2019	0	0	--	--	--	0	51	0.00
	2020	0	--	--	--	--	0	24	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. Dashes indicate incomplete age-specific accounting for respective brood years.

Population	Brood year	Number of adult recruits					Total	Parents	Productivity
		Age-3	Age-4	Age-5	Age-6	Age-7			
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	0	16	26	0.62
	2015	0	0	9	8	0	17	82	0.21
	2016	0	3	3	2	0	8	27	0.30
	2017	0	0	8	8	--	16	11	0.00
	2018	0	8	4	--	--	12	14	0.00
	2019	0	0	--	--	--	0	10	0.00
	2020	0	--	--	--	--	0	13	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	0	86	275	0.31
	2015	0	5	57	42	6	110	721	0.15
	2016	0	0	73	43	1	117	360	0.32
	2017	0	0	99	16	--	115	67	0.00
	2018	0	12	22	--	--	34	138	0.00
	2019	0	1	--	--	--	1	80	0.00
	2020	0	--	--	--	--	0	96	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	0	110	272	0.40
	2015	0	36	61	12	0	109	379	0.29

Appendix D. Continued.

Stream	Brood year	Number of adult recruits Age-3	Age-4	Age-5	Age-6	Age-7	Total	Parents	Productivity
Lower Lemhi River	2016	0	31	55	6	0	92	348	0.26
	2017	0	25	11	10	--	46	158	0.23
	2018	0	16	29	--	--	45	102	0.16
	2019	0	0	--	--	--	0	62	0.00
	2020	0	--	--	--	--	0	109	0.00
North Fork Salmon River	2016	0	15	0	8	0	23	157	0.15
	2017	0	0	17	13	--	30	--	--
	2018	0	4	0	--	--	4	209	0.02
	2019	0	0	--	--	--	0	91	0.00
	2020	0	--	--	--	--	0	93	0.00
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	0	30	205	0.15
	2015	0	30	16	4	0	50	130	0.39
	2016	0	25	4	0	0	29	92	0.32
	2017	0	12	15	2	--	29	24	1.13
	2018	0	3	9	--	--	12	30	0.10
	2019	0	2	--	--	--	2	35	0.00
	2020	0	--	--	--	--	0	41	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	0	13	339	0.04

Appendix D. continued

Stream	Brood year	Number of adult recruits					Total	Parents	Productivity
		Age-3	Age-4	Age-5	Age-6	Age-7			
East Fork Salmon River (continued)	2015	0	4	12	10	0	26	884	0.03
	2016	0	10	44	5	0	59	405	0.15
	2017	0	2	3	1	--	6	135	0.04
	2018	0	5	14	--	--	19	42	0.12
	2019	0	1	--	--	--	1	33	0.00
	2020	0	--	--	--	--	0	25	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
	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	0	14	46	0.30
	2015	0	7	20	5	4	36	73	0.37
	2016	0	24	80	11	0	115	77	1.49
	2017	0	2	25	3	--	30	22	1.23
	2018	0	15	14	--	--	19	17	0.88
	2019	0	1	--	--	--	1	12	0.00
	2020	0	--	--	--	--	0	44	0.00

Appendix E. Smolt to adult rates and respective ocean age proportions by migration year (MY) for select populations of Snake River wild adult steelhead. The proportion of adults not detected as smolts for that returning spawn year are provided to show proportion of fish not included in SAR estimates. Shaded cells represent incomplete adult return data for respective MYs. Dashes represent missing data.

Population	MY	Smolts	Adults	P(no smolt detection)	SAR	lower CI	upper CI	P(1-ocean)	P(2-ocean)	P(3-ocean)
Big Bear Creek	2005	1490	16	_	0.01	0.01	0.02	0.31	0.69	0.00
	2006	194	7	_	0.04	0.02	0.08	0.86	0.14	0.00
	2007	303	14	0.00	0.05	0.03	0.08	0.36	0.64	0.00
	2008	354	17	0.00	0.05	0.03	0.08	0.41	0.59	0.00
	2009	457	18	0.14	0.04	0.02	0.06	0.22	0.78	0.00
	2010	680	34	0.16	0.05	0.04	0.07	0.41	0.59	0.00
	2011	575	13	0.26	0.02	0.01	0.04	0.38	0.62	0.00
	2012	669	29	0.15	0.04	0.03	0.06	0.41	0.59	0.00
	2013	716	43	0.29	0.06	0.04	0.08	0.30	0.70	0.00
	2014	923	39	0.05	0.04	0.03	0.06	0.59	0.41	0.00
	2015	417	3	0.30	0.01	0.00	0.02	0.33	0.67	0.00
	2016	358	6	0.11	0.02	0.01	0.04	0.67	0.33	0.00
	2017	901	12	0.36	0.01	0.01	0.02	0.33	0.67	0.00
	2018	1727	72	0.25	0.04	0.03	0.05	0.21	0.79	0.00
	2019	411	3	0.25	0.01	0.00	0.02	0.33	0.67	0.00
	2020	294	5	0.12	0.02	0.01	0.04	0.20	0.80	0.00
	2021	165		0.06						
	2022	234		0.40						
	2023	147		0.33						
Big Creek	2003	84	1	_	0.01	0.00	0.07	0.00	1.00	0.00
	2004	22	2	_	0.09	0.02	0.31	0.00	1.00	0.00
	2005	21	0	_	0.00	0.00	0.19	NA	NA	NA
	2006	8	0	0	0.00	0.01	0.41	NA	NA	NA
	2007	11	0	0	0.00	0.01	0.32	NA	NA	NA
	2008	639	40	_	0.06	0.05	0.09	0.70	0.28	0.03
	2009	564	14	_	0.02	0.01	0.04	0.36	0.64	0.00
	2010	455	13	0.33	0.03	0.02	0.05	0.54	0.46	0.00
	2011	818	16	0.15	0.02	0.01	0.03	0.50	0.50	0.00
	2012	951	38	0.26	0.04	0.03	0.05	0.63	0.37	0.00
	2013	383	12	0.30	0.03	0.02	0.06	0.58	0.42	0.00
	2014	224	9	0.20	0.04	0.02	0.08	1.00	0.00	0.00
	2015	161	0	0.28	0.00	0.00	0.03	NA	NA	NA
	2016	345	2	0.18	0.01	0.00	0.02	1.00	0.00	0.00
	2017	141	1	_	0.01	0.00	0.04	1.00	0.00	0.00
	2018	501	5	0.33	0.01	0.00	0.02	0.40	0.60	0.00

Appendix E. continued

Population	MY	Smolts	Adults	P(no smolt detection)	SAR	lower CI	upper CI	P(1-ocean)	P(2-ocean)	P(3-ocean)
Big Creek	2019	418	5	0.00	0.01	0.00	0.03	0.60	0.40	0.00
	2020	183	5	0.00	0.027	0.010	0.066	0.40	0.00	0.60
	2021	389	0	0.25	0.00	0.00	0.01	NA	NA	NA
	2022	72	2	0.43	0.03	0.00	0.11	1.00	0.00	0.00
	2023	231		0.55						
Lemhi River	2003	21	1	_	0.05	0.00	0.26	0.00	1.00	0.00
	2004	66	0	_	0.00	0.00	0.07	NA	NA	NA
	2005	132	0	_	0.00	0.00	0.04	NA	NA	NA
	2006	141	2	0.00	0.01	0.00	0.06	1.00	0.00	0.00
	2007	269	4	_	0.01	0.00	0.04	0.50	0.50	0.00
	2008	755	38	0.00	0.05	0.04	0.07	0.63	0.37	0.00
	2009	747	23	0.50	0.03	0.02	0.05	0.22	0.78	0.00
	2010	850	35	0.37	0.04	0.03	0.06	0.63	0.37	0.00
	2011	730	17	0.24	0.02	0.01	0.04	0.47	0.53	0.00
	2012	406	19	0.18	0.05	0.03	0.07	0.53	0.47	0.00
	2013	1011	17	0.16	0.02	0.01	0.03	0.53	0.47	0.00
	2014	1077	22	0.34	0.02	0.01	0.03	0.55	0.45	0.00
	2015	445	1	0.31	0.00	0.00	0.01	0.00	1.00	0.00
	2016	697	5	0.31	0.01	0.00	0.02	0.60	0.40	0.00
	2017	477	3	0.23	0.01	0.00	0.02	0.00	1.00	0.00
	2018	686	7	0.20	0.01	0.00	0.02	1.00	0.00	0.00
	2019	637	1	0.00	0.00	0.00	0.01	0.00	1.00	0.00
	2020	540	8	0.23	0.02	0.01	0.03	0.13	0.88	0.00
	2021	735	5	_	0.01	0.00	0.02	1.00		
	2022	485		0.63						
	2023	278		0.33						
Fish Creek	1996	629	2	_	0.00	0.00	0.01	0.50	0.50	0.00
	1997	1779	6	_	0.00	0.00	0.01	0.17	0.83	0.00
	1998	2024	6	0.00	0.00	0.00	0.01	0.17	0.83	0.00
	1999	1838	15	0.25	0.01	0.00	0.01	0.20	0.80	0.00
	2000	4247	91	0.14	0.02	0.02	0.03	0.34	0.66	0.00
	2001	3849	5	0.00	0.00	0.00	0.00	0.20	0.80	0.00
	2002	3137	20	0.09	0.01	0.00	0.01	0.55	0.45	0.00
	2003	1535	18	0.05	0.01	0.01	0.02	0.00	1.00	0.00
	2004	2504	13	0.06	0.01	0.00	0.01	0.31	0.69	0.00
	2005	2332	11	0.18	0.00	0.00	0.01	0.18	0.82	0.00
	2006	4135	47	0.04	0.01	0.01	0.02	0.19	0.81	0.00

Appendix E. continued

Population	MY	Smolts	Adults	P(no smolt detection)	SAR	lower CI	upper CI	P(1-ocean)	P(2-ocean)	P(3-ocean)
Fish Creek	2007	1908	45	0.00	0.02	0.02	0.03	0.27	0.73	0.00
	2008	3162	134	0.10	0.04	0.04	0.05	0.25	0.74	0.01
	2009	1884	35	0.00	0.02	0.01	0.03	0.00	1.00	0.00
	2010	1972	30	0.14	0.02	0.01	0.02	0.20	0.80	0.00
	2011	1895	9	0.12	0.00	0.00	0.01	0.22	0.78	0.00
	2012	4975	180	0.14	0.04	0.03	0.04	0.14	0.86	0.01
	2013	2200	63	0.19	0.03	0.02	0.04	0.25	0.75	0.00
	2014	2413	49	0.11	0.02	0.02	0.03	0.33	0.67	0.00
	2015	901	1	0.10	0.00	0.00	0.01	0.00	1.00	0.00
	2016	1957	13	0.09	0.01	0.00	0.01	0.62	0.38	0.00
	2017	1224	2	0.08	0.00	0.00	0.01	0.50	0.50	0.00
	2018	2135	31	0.18	0.01	0.01	0.02	0.13	0.84	0.03
	2019	1167	8	0.14	0.01	0.00	0.01	0.00	1.00	0.00
	2020	860	20	0.00	0.023	0.015	0.036	0.05	0.90	0.00
	2021	368	1	0.10	0.27	0.01	1.75	1.00		
	2022	552		0.23						
	2023	583		0.46						

Appendix F. Number of PIT-tagged adults from select 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%
	2021	64	53	50	82.8%	78.1%
	2022	5	3	3	60.0%	60.0%
	2023	3	2	2	70.0%	70.0%
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%

Appendix F. continued

Population	Spawn year	Bonneville Dam count	McNary Dam count	Lower Granite Dam count	Conversion to McNary Dam	Conversion to Lower Granite Dam
Fish Creek	2018	11	9	8	81.8%	72.7%
	2019	7	6	5	85.7%	71.4%
	2020	5	4	4	80.0%	80.0%
	2021	29	22	21	75.9%	72.4%
	2022	13	11	12	75.0%	87.5%
	2023	37	29	28	78.4%	75.7%

Appendix G. Number of PIT-tagged adults from select 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%
	2021	8	6	6	75.0%	75.0%
	2022	6	5	5	83.3%	83.3%
	2023	11	10	9	91.0%	82.0%
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	83.3%	83.3%
	2021	9	7	5	77.8%	55.6%
	2022	7	6	6	85.7%	85.7%
	2023	10	9	9	100.0%	90.0%

Appendix H. Number of genetic samples collected from wild adult steelhead captured at select IDFG weirs, 2010–2023.

Population	Location	Structure	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Clearwater River MPG																
Potlatch River																
	Big Bear Creek	Weir	51	18	38	0	0	0	0	0	0	0	0	0	0	0
	Little Bear Creek	Weir	212	46	180	0	0	0	0	0	0	0	0	0	0	0
	WF Potlatch River	Weir	50	0	0	0	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	17	0	0
SF Clearwater River																
	Crooked River	Weir	0	5	41	17	2	22	10	1	1	0	0	1	0	0
Lochsa River																
	Fish Creek	Weir	200	224	135	91	90	450	204	53	11	22	20	96	26	19
Salmon River MPG																
Snake River																
	Hells Canyon Dam	Adult Ladder	0	164	114	161	150	186	38	21	14	52	39	50	27	12
Little Salmon River																
	Rapid River	Weir	149	133	82	27	26	82	27	12	14	10	13	11	18	12
SF Salmon River																
SF Salmon River		Weir	12	0	0	5	0	2	0	0	0	0	0	0	NR	0
Pahsimeroi River																
	Pahsimeroi River	Weir	157	239	285	177	205	130	94	24	31	35	41	20	18	13
EF Salmon River																
	EF Salmon River	Weir	425	442	721	690	339	885	410	132	7	5	29	56	34	17
Upper Salmon River																
	Fourth of July Creek	Weir	0	0	0	0	27	0	10	5	2	4	0	0	0	0
	Tower Creek	Weir	0	0	0	0	29	0	18	19	5	0	0	0	0	0
	Carmen Creek	Weir	0	0	0	0	79	0	16	3	2	1	0	0	0	0
	Iron Creek	Weir	6	0	0	0	0	7	5	1	1	0	1	2	0	0
	Salmon River	Weir	114	96	82	39	46	74	77	22	17	14	44	86	56	19
	Total		1,447	1,400	1,751	1,289	1,080	1,976	1,060	302	123	143	210	339	179	92

Appendix I. Archived monitoring structure (i.e. PIT tag array or weir), and associated abundance analyses for selected Idaho adult steelhead monitoring locations.

Structure	Analysis	Monitoring Locations
Weir	Lincoln-Peterson estimator, with Bailey's modification	Big Bear Creek (2005 – 2012) EF Potlatch River (2008 – 2021) Fish Creek (1998 – 2021, 2023)
	Minimum count of fish passed above weir structure	Crooked River (2007 – 2023)* Rapid River (2007 – 2023)* Pahsimeroi River (2007 – 2023)* EF Salmon River (2007 – 2023)* Upper Salmon River (2007 – 2023)* EF Potlatch River (2022, 2023)
	Cumulative curve estimation Linear mixed regression model	Fish Creek (1992 – 1997) Fish Creek (2022)
PIT Array	DABOM (Waterhouse et al. 2020)	Lochsa River (2020 – 2023) SF Salmon River (2020 – 2023) Big Creek (2010 – 2023) Marsh Creek (2023) NF Salmon River (2016 – 2023) Lower Lemhi River (2010 – 2023) Upper Lemhi River (2010 – 2023) Hayden Creek (2010 – 2023) Crooked River (2022, 2023)
	DABOM minimum	SF Salmon River (2010 – 2019)
	Connolly et al. (2005); Lady et al. (2009)	Big Bear Creek (2013 – 2017) Lochsa River (2018 – 2019) Marsh Creek (2020)
	Connolly et al. (2005); Lady et al. (2009) minimum	Big Bear Creek (2018 – 2021)

* Numbers of natural fish returning to hatchery weirs were obtained via Chuck Warren (IDFG steelhead hatchery evaluation biologist, personal communication) for years prior to 2015.

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