FISHERY RESEARCH

IDAHO STEELHEAD MONITORING AND EVALUATION STUDIES

ANNUAL PROGRESS REPORT

January 1, 2012—December 31, 2012

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IDFG Report Number 13-07
March 2013

IDAHO STEELHEAD MONITORING AND EVALUATION STUDIES

Project Progress Report

2012 Annual Report

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P.O. Box 3621
Portland, OR 97283-3621

Project Number 1990-055-00
Contract Number 55728

IDFG Report Number 13-07
March 2013

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ABBREVIATIONS AND ACRONYMS

CI	Confidence Interval
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FL	Fork Length
GPM	General Parr Monitoring
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
INPMEP	Idaho Natural Production Monitoring and Evaluation Project
ISMES	Idaho Steelhead Monitoring and Evaluation Studies
LGD	Lower Granite Dam
NOAA	National Oceanic and Atmospheric Administration
PIT	Passive Integrated Transponder
PTAGIS	PIT Tag Information System
SURPH	Survival Under Proportional Hazards
VSP	Viable Salmonid Population

ABSTRACT

The goal of Idaho Steelhead Monitoring and Evaluation Studies (ISMES) is to monitor and evaluate the status of wild steelhead populations in the Clearwater and Salmon river drainages. Abundance and life history data were collected in Fish Creek (Lochsa River tributary), Rapid River (Little Salmon River tributary), and Big Creek (Middle Fork Salmon River tributary) during 2012. In general, weirs were operated to estimate adult escapement; snorkel surveys were conducted to estimate parr density; screw traps were operated to estimate juvenile emigrant abundance and to tag fish for survival estimation. We collected scale samples for age determination and tissue samples for genetic analysis. The estimated escapement into Fish Creek was 152 fish. Escapement into Rapid River was 81 fish. Another project (2003-017-00) estimated that escapement into Big Creek was 398 fish. Adult productivity had a geomean of 1.38 recruits/spawner in Fish Creek (1992-2006 brood years) and 1.20 recruits/spawner in Rapid River (2003-2006 brood years). Snorkel surveys of the Fish Creek (21 sites) and Rapid River (20 sites) drainages were completed. The estimated juvenile emigration in 2012 was 30,451 steelhead from Fish Creek, 3,615 steelhead from Rapid River, and 28,804 steelhead from Big Creek. To estimate age composition, scale samples were aged from 663 adults and 3,473 juveniles collected at selected weirs and screw traps. The latter number includes 1,255 samples that were not analyzed for the 2011 report. Water temperature was recorded at 23 locations in the Clearwater and Salmon river drainages.

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INTRODUCTION

Populations of steelhead trout *Oncorhynchus mykiss* in the Snake River basin declined substantially following the construction of hydroelectric dams in the Snake and Columbia rivers. Raymond (1988) documented a decrease in survival of emigrating steelhead trout and Chinook salmon *O. tshawytscha* from the Snake River following the construction of dams on the lower Snake River during the late 1960s and early 1970s. Abundance rebounded slightly in the early 1980s, but then escapements over Lower Granite Dam into the Snake River basin declined again (Busby et al. 1996). In recent years, abundances in the Snake River basin have slightly increased. The increase has been dominated by hatchery fish, while the returns of naturally produced steelhead and Chinook salmon remain critically low, especially for stocks with later run timing (B-run populations; Busby et al. 1996). As a result, Snake River steelhead trout (hereafter steelhead) were classified as threatened under the Endangered Species Act (ESA) in 1997. Within the Snake River steelhead evolutionarily significant unit, there are six major population groups, of which three are located in Idaho (Clearwater River, Salmon River, and Hells Canyon; ICBTRT 2003). However, the Hells Canyon major population group is considered to be extirpated. A total of 17 demographically independent populations have been identified within Idaho (ICBTRT 2003).

Anadromous fish management programs in the Snake River basin include 1) large-scale hatchery programs intended to mitigate for the impacts of hydroelectric dam construction and operation in the basin; and 2) recovery planning and implementation efforts aimed at recovering ESA-listed wild salmon and steelhead stocks. The Idaho Department of Fish and Game's (IDFG) long-range goal of its anadromous fish program, consistent with basinwide mitigation and recovery programs, is to preserve Idaho's salmon and steelhead runs and recover them to provide benefit to all users (IDFG 2013). Management to achieve these goals requires an understanding of how salmonid populations function (McElhany et al. 2000) as well as regular monitoring for status assessments. However, specific data on Idaho steelhead populations are lacking, particularly estimates of key parameters such as population abundance, age composition, genetic diversity, recruits per spawner, and survival rates (ICBTRT 2003). The relevant parameters needed to assess the population viability of salmonid populations are abundance, productivity, spatial structure, and diversity (McElhany et al. 2000).

The goal of Idaho Steelhead Monitoring and Evaluation Studies (ISMES) is to provide information to guide restoration of wild steelhead populations in Idaho. Data are collected in selected spawning tributaries in the Clearwater and Salmon river basins to provide the population-specific demographic information needed for management. The aggregate escapement of Snake River steelhead is measured at Lower Granite Dam (LGD) in Washington State (excluding the Lower Snake population, which spawns primarily in the Tucannon River). Some of these fish are headed to Washington or Oregon, but the vast majority is destined for Idaho. Therefore, we also sample wild adult steelhead during the spring and fall at LGD. In Idaho, a portion of the escapement for some populations is measured at weirs, such as in Rapid River and in Fish Creek (Figure 1). The Fish Creek weir is the only weir in Idaho operated solely for wild B-run steelhead. Because of the collaborative nature of the work at LGD and the need for more timely reporting than the calendar-year cycle of this project, the full description of work at LGD will be contained in a separate report issued by all IDFG projects conducting operations at LGD (see Schrader et al. 2011 for an example using fall 2008 and spring 2009 data).

OBJECTIVES

1. Conduct intensive, high-precision (fish in, fish out) monitoring of steelhead in Fish Creek (Lochsa River population), Rapid River (Little Salmon River population), and Big Creek (Lower Middle Fork Salmon River population).

2. Support and coordinate intensive, high-precision (fish in, fish out) monitoring of wild steelhead at other locations in Idaho.

3. Conduct extensive monitoring in selected streams (snorkel surveys and temperature monitoring).

4. Monitor temporal and spatial genetic patterns of steelhead populations in Idaho.

5. Monitor status and trends of wild steelhead at Lower Granite Dam.

Report Topics

Evaluation of the status of steelhead populations in the Columbia River basin is conducted using the viable salmonid population (VSP) criteria (McElhany et al. 2000). This report is organized in the VSP framework with the following subsections: adult abundance and productivity, juvenile abundance and productivity, spatial structure, and diversity. The abundance and productivity subsections include age composition, sex ratio, hatchery fraction, as well as abundance estimates. Ideally, spatial structure would be assessed by redd locations, but steelhead redd counts in Idaho are not reliable because of snowmelt-related turbidity and changing flow conditions during the spring spawning period (Thurow 1985); therefore, we use parr distribution as a surrogate. The diversity subsection will include migration timing and genetic data. The final subsection will be water temperature monitoring, which is directed towards habitat rather than fish. Population designations are also important. Most fieldwork took place in Fish Creek, which is part of the Lochsa River population; in Rapid River, which is part of the Little Salmon River population; and in Big Creek, which is part of the Lower Middle Fork Salmon River population (Figure 1).

In this report, we have included extra material on juvenile Chinook salmon in an Appendix. Monitoring of Chinook salmon is not in the ISMES purview; however, juvenile Chinook salmon are captured incidental to operations of all ISMES screw traps. Large numbers of Chinook salmon parr are collected by the Big Creek trap. These data are important but are not routinely reported. In order to provide documentation, data collected on juvenile Chinook salmon at Big Creek since 2007 are presented in the Appendix.

METHODS

Adult Abundance and Productivity

Adult Abundance

We operated a temporary picket weir to estimate escapement in Fish Creek. Adult steelhead moving upstream entered a holding box that was checked several times daily. The trap tender removed the trapped fish with a net and placed them in a plastic livestock trough for processing. Gender was determined based on external sex characteristics, e.g., a developed kype for males. Fork length (FL) was measured to the nearest centimeter. Each fish was examined for marks and tags and scanned for the presence of a passive integrated transponder (PIT) tag or coded wire tag. Scales were collected and a small portion of the anal fin was removed for a genetics tissue sample. All fish were marked with a right opercular punch and released upstream of the weir, except hatchery fish, which were transported to the Lochsa River and released without processing. Using software developed by Steinhorst et al. (2004), we estimated escapement above the weir with Bailey's modification of the Lincoln-Peterson estimator. The 95% confidence intervals were computed with the bootstrap option (2,000 iterations). Program inputs were number of marked adults passed above the weir and the numbers of marked and unmarked kelts recovered at the weir as post-spawn fish moving downstream.

We assisted hatchery staff at the Rapid River Hatchery to operate a permanent weir to enumerate steelhead escapement in Rapid River. This weir is a velocity barrier with the trap located in the fish ladder. Steelhead were processed as in Fish Creek. Hatchery fish are not released above the trap. Because fish cannot pass the trap without passing through the ladder, adult steelhead escapement was the total number of adults trapped. This number is considered a complete census with no variance.

We sampled adult steelhead in Big Creek by angling. The lower 20 km of Big Creek was sampled, concentrating on holding pools. Migrants were targeted and spawning steelhead were avoided. Upon capture, fish were held in the water in a landing net for processing at the site of capture. Steelhead were processed as in Fish Creek. Wild fish were released at the site of capture. Hatchery fish were euthanized, the caudal fin was removed by severing the caudal peduncle to indicate the fish was processed, and the carcass was returned to the river.

Adult Age Composition

Age data are required to estimate population productivity. To collect this information, technicians processed scale samples in the IDFG Nampa Fisheries Research aging laboratory. Scales were examined for regeneration and 6-10 nonregenerated scales were cleaned and mounted between two glass microscope slides. Scales were examined on a computer video monitor using a Leica DM4000B microscope and a Leica DC500 or DFC425 digital camera. A technician chose the best 2-4 scales for aging the fish and saved them as digitized images. The entire scale was imaged using 12.5x magnification. The freshwater portion was imaged using 40x magnification. Two technicians independently viewed each image to assign age without reference to fish length. If there was no age consensus among the readers, a third reader viewed the image and all readers collectively examined the image to resolve their differences before a final age was assigned. If a consensus was not attained, the sample was excluded from analysis.

Freshwater annuli were defined by pinching or cutting-over of circuli within the freshwater zone in the center of the scale. The criterion for a saltwater annulus was the crowding of circuli after the rapid saltwater growth had begun. We used only visible annuli formed on the scales, excluding time spent overwintering in fresh water prior to spawning. A spawn check was identified as a ragged scar-like mark within the saltwater zone. We use the European system to designate ages: freshwater age is separated from saltwater age by a decimal. Total age at spawning is the sum of freshwater and saltwater ages, plus 1.

Adult Productivity

Adult-to-adult productivity can be calculated over time by combining adult abundances with age composition. We summarized the 2007-2012 age data for Rapid River as well as for Fish Creek back to the 1992 brood year (first year of weir operation), estimated the age composition of those runs, and compared each brood year to the number of spawning steelhead to generate estimates of adult-to-adult productivity. Samples that did not have a total age were excluded. Age composition for each return year was then determined from the remaining samples and applied to the escapement estimate to get total number of fish at age per calendar year. Age categories were combined into brood years (e.g., ages 2.2 and 3.1 in a particular year have the same total age and are from the same brood year) to get adult returns by total age. Repeat spawners were dropped from the analysis because they had been accounted for in a previous year. Brood years are summed across return years and divided by parental escapement to get productivity rate (adult progeny per spawner).

Juvenile Abundance and Productivity

Juvenile Abundance

Abundance of emigrating juvenile steelhead was estimated from data collected at rotary screw traps located near the mouths of Fish Creek, Rapid River, and Big Creek (Figure 1). The traps were checked daily and the number of steelhead captured and tagged was recorded. Individuals that were too small to be distinguished from small westslope cutthroat trout *O. clarkii lewisi* with confidence were recorded as trout fry. Each fish was scanned before tagging to verify that it had not been previously tagged. All steelhead ≥80 mm were PIT tagged, measured (FL, nearest mm) and weighed (nearest 0.1 g). The tag files were uploaded to the PTAGIS database (www.ptagis.org). After PIT-tagging, juvenile steelhead were released at least 300 m upstream of the screw trap. Recaptured fish were released downstream of the trap. When >50 steelhead were tagged in a day, only 50 fish were released upstream of the trap and the remainder were released downstream of the trap. When ≤50 steelhead were trapped in a day, all of the newly tagged fish were released upstream of the trap for estimation of trap efficiency. Flow conditions were recorded, either as flow at nearby stream gauges or as depth below the sill of the trap. In Big Creek, flow is indexed by the distance from the bottom of the nearby pack bridge to the water surface.

Data from each trap are summarized by season in this report. The seasonal bounds approximate the major periods of fish movement during spring and fall and are consistent with past ISMES reports. Spring was from trap installation until May 31. Summer was from June 1 to August 14. Fall was from August 15 until trap removal. Using software developed by Steinhorst et al. (2004), we estimated emigrant abundance by season with Bailey's modification of the Lincoln-Peterson estimator. The 95% confidence intervals (CIs) were computed with the bootstrap option (2,000 iterations).

Juvenile Age Composition

We estimated emigrant age composition using scale samples collected at screw traps operated in Idaho's anadromous production streams (Figure 1). Screw trap tenders from ISMES collected scale samples from juvenile steelhead caught in Fish Creek, Rapid River, and Big Creek. Scale samples were also collected at six screw traps operated by the Idaho Supplementation Studies (project 1989-098-00) for a total of nine locations (see Figure 1). We processed scale samples from the Potlatch River Steelhead Monitoring and Evaluation project, but those results are reported by that project (Bowersox et al., in preparation). Scales were collected and processed as described above for adults, except that laboratory technicians examined scales using 40x magnification.

Spatial Structure

Snorkel surveys were used to estimate distribution and density of steelhead parr. Methods were identical to those used by the Idaho Natural Production Monitoring and Evaluation Project (INPMEP, project 1991-073-00; Copeland et al. 2009), and fieldwork was planned in coordination with crews from that project. All crews attended a multiday training session in early June to learn fish identification and survey methods.

Site selection was based on a generalized random-tessellation stratification design, i.e., a spatially-balanced probabilistic selection from all potential sites (Stevens and Olsen 2004, Stevens et al. 2007). A list of all potential sites in the Clearwater and Salmon basins was obtained from the Columbia River basin master sample (Stevens et al. 2007) constructed by personnel in the Environmental Protection Agency (EPA) office in Corvallis, Oregon. These sites were plotted on a 1:100,000 stream layer and their order randomized by EPA. The basins of interest in 2012 (for this report) were Fish Creek and Rapid River. We used the anadromous stream data layer from StreamNet (www.streamnet.org) to determine which sites in each watershed were within the anadromous production zone. The potential sites that fell within a 100 m buffer of an anadromous stream were retained. The minimum number of sites was 20 for Fish Creek and 20 for Rapid River. A list of approximately twice the desired number of sites was drawn for both watersheds. The snorkel crew also surveyed selected historic trend sites.

The site list was narrowed down to a logistically feasible plan before snorkel crews began field operations. For watersheds surveyed annually, the specific field plan was developed in previous years. Where possible, new sites were inspected, documented, and photographed before the field crew arrived. Each potential site had a design number that was used as the unique site identifier for data entry forms and the IDFG Standard Stream Survey database. Site priority started with the lowest design number (high priority) and proceeded to the highest number (low priority). High priority sites were included or rejected before lower-priority sites could be considered in survey plans. Criteria for rejection were: 1) the site could not be safely surveyed or site boundaries adjusted to make it safe (see next paragraph); 2) the location was above barriers to spring movement of adult steelhead; 3) the site was dry at the time of survey (recorded as 0 abundance); 4) a private landowner denied access to the site; or 5) the site was too wide or complex to be surveyed efficiently by the full crew. Survey dates were arranged as logistics dictated and did not always follow the priority order. Sites that have been historically sampled in the past for General Parr Monitoring (GPM) were repeated as time and logistics allowed. The purpose of surveying the GPM sites was to provide a link between the new site selection protocol and previous statewide monitoring. All GPM survey data will be reported by INPMEP (Kennedy et al., in preparation).

Field surveys were done according to standard protocol. Site locations and lengths were adjusted by the crew leader based on stream conditions. The desired average site length was 100 m. Actual site bounds were adjusted to fit within hydraulic controls. If necessary, a site was moved up to 500 m from the designated point, but no further than necessary. The percentage of each habitat type (pool, pocket water, riffle, or run) within the site was visually estimated and recorded. One to five snorkelers counted fish in each site, depending on the stream size and visibility. All salmonids observed were counted and individual size was estimated to the nearest 25-mm group while moving slowly upstream. Steelhead and cutthroat trout <50 mm in length are very difficult to distinguish with underwater observation and so were enumerated as simply trout fry. Chinook salmon parr were assigned an age based on length. Non-salmonid species observed were noted as present. After the crew snorkeled each site, they measured site length and up to ten wetted widths to calculate surface area. Data were entered into the IDFG Standard Stream Survey database (https://fishandgame.idaho.gov/ifwis/portal/page/stream-survey).

Diversity

Adult Migration Timing

We estimated the timing of adult steelhead returning to Fish Creek and Rapid River through the hydrosystem. The PTAGIS database (www.ptagis.org) was queried to obtain detection dates of fish PIT tagged as juveniles in Fish Creek or Rapid River and returning to spawn as adults. The query was for detections between July 1, 2011 and June 30, 2012 at Bonneville, McNary, Ice Harbor, and Lower Granite dams. We calculated the proportion detected at Bonneville Dam that was also detected at upstream dams and at the Fish Creek and Rapid River traps, i.e., the conversion rate.

Smolt Migration Timing

We ascertained smolt detection rates and emigration timing during the 2012 emigration using PIT-tagged fish detections downstream of the three ISMES traps. The PTAGIS database (www.ptagis.org) was queried to obtain detection date and location, tagging date and location, and the length and weight at tagging of wild steelhead smolts tagged by ISMES. Potential interrogation sites were Lower Granite, Little Goose, Lower Monumental, McNary, John Day, and Bonneville dams and the estuary-towed array. Passage date at LGD was calculated for three percentiles (10%, 50%, and 90%) for each trap location.

Genetic Diversity

Since 2000, ISMES has collected tissue samples for genetic analysis from populations that span the range of geographic, temporal, and phenotypic variability observed in the Salmon and Clearwater basins (Nielsen et al. 2009). Data from past collections by ISMES are currently in use by Project 2010-026-00 to conduct genetic stock identification at LGD and to monitor genetic diversity of natural origin steelhead in the Snake River basin. The genetic diversity and structure of populations surveyed by ISMES will be evaluated with other Snake River steelhead populations in the annual report by Project 2010-026-00 (e.g., Ackerman and Campbell 2012). During this report period, activity in this category was confined to collection of tissue samples, which were archived pending future analysis.

Water Temperature Monitoring

Water temperatures were monitored in tributaries throughout the Clearwater and Salmon river drainages with temperature recorders set to record every 15 min to obtain yearly temperature profiles from streams with wild steelhead populations. The streams span a range of the elevations, geomorphic features, and vegetative cover found in Idaho’s steelhead streams. The daily mean, maximum, and minimum water temperatures were calculated for each stream. These data are stored in a database located at the IDFG Nampa Fisheries Research office.

RESULTS

Adult Abundance and Productivity

Adult Abundance

Fish Creek—Operation of the Fish Creek weir began March 14 and the first adult fish was captured on March 25, 2012 (Table 1). High flows from snowmelt began in mid-April and peaked in late April (Figure 2). On April 23, two tripods collapsed and the weir was breached on April 24. On April 25, four more tripods collapsed and the weir began collecting heavy debris. On April 29, pickets were pulled from the upstream trap box due to the inability to safely and effectively remove trapped adult steelhead from the trap box. With receding flows, tenders were able to clear debris and patch the weir on May 9. During this time fish may have been able to pass over or under certain sections of the weir or through the upstream trap box. In total, the weir was partially operable for six days and completely inoperable for an additional ten days. The first adult fish was captured on March 25 and the last on June 14. The first kelt was captured on May 27 and the last on July 7.

Trap tenders passed 107 prespawn adults upstream and 29 unmarked kelts downstream, for a total of 136 unique individuals handled (Table 2). No hatchery fish were collected at the weir. In addition, there were two dead kelts recovered from the weir that were unable to be identified as marked or unmarked, so they were excluded from further analysis. One of the dead kelts was discovered on April 20 and may have been killed by the otters that were frequenting the weir area from late March to mid-May. The escapement estimate was based on 68 marked and 29 unmarked kelts returning to the weir. From this information, we estimated that the 2012 escapement above the weir was 152 fish (95% CI 126—183 fish).

Sex ratio was biased towards females. Females comprised 81% of the anadromous spawners and 91% of the kelts collected (Table 2). The mean FL of all females, including kelts, was 76 cm and ranged from 63 cm to 88 cm. The mean FL of all males, including kelts, was 78 cm and ranged from 64 cm to 88 cm.

The spawning run extended from March until June. The first female prespawn migrant was trapped on March 27 and the first male on March 25 (Table 1). The midpoint for females sampled was May 19 and the midpoint for males sampled was May 9. The midpoint for both sexes combined was May 19. Accurate statistics on run timing cannot be computed because of the gap in weir service during the middle of the run.

Rapid River—Operation of the Rapid River weir began March 19 and the first adult fish was captured March 28, 2012 (Table 1). The last prespawn adult moving upstream was captured on July 12. It is not possible to capture kelts at the Rapid River weir because it is not a barrier to downstream passage.

Trap tenders passed 81 wild prespawn adults upstream (Table 2). There was one wild prespawn adult female mortality found in the weir trap on May 8. An additional two hatchery fish were also collected at the weir but were not passed. The number of trapped wild fish is considered a population census without error.

Sex ratio was biased towards females. Females comprised 71% of the wild fish (Table 2). The mean FL of females was 68 cm and ranged from 56 cm to 79 cm. The mean FL of males was 67 cm and ranged from 57 cm to 82 cm.

The spawning run extended from March until July. The first female and male prespawn migrants were trapped on March 28 (Table 1). The midpoint for both sexes was April 23.

Big Creek—Angling began March 19 and the first wild adult steelhead was captured March 24, 2012 (Table 1). High turbidity and early spring runoff limited sampling success and duration. Angling continued until April 17, when flows and turbidity increased.

There were three wild steelhead captured (Table 2). Two females were 66 cm and 68 cm FL and one male was 64 cm FL. No hatchery fish were collected. Given the limited effort, run timing statistics were not calculated.

Adult Age Composition

Fish Creek—Of the 136 unique steelhead adults collected at the weir, 134 were aged (Table 3). The majority (91%) spent two years in the ocean, although 7% spent one year and 2% spent three years. There were 116 fish that had both freshwater and ocean ages assigned; the majority (56%) smolted after three years in freshwater, although some smolted after two years (42%). A few individuals had smolted at one year. Total ages ranged from four to seven years at spawning. There were seven different age classes identified.

During 2012, old samples were re-examined in order to assign total ages to fish collected 1995-2006. These were combined with samples collected and aged 2007-2011 to generate a complete age structure for Fish Creek steelhead since the beginning of IDFG work there. A total of 1,409 samples were examined and added to the ages for the 2007-2011 samples; 1,991 fish were assigned an ocean age and 1,603 assigned a total age (Table 4). There were three fish that had a spawn check indicative of a repeat spawner; one of these was not assigned a total age and was omitted from further consideration (this fish had skipped two years between spawns). The age structure was dominated by 2-ocean fish (annual mean = 78%, range 41%-94%, omitting repeat spawners). Of the fish assigned a total age (including repeat spawners), age at spawn range from three years to seven years. On average, almost half spawned at six years of age (47%). Both repeat spawners were seven years of age at second spawn; one had skipped a year between spawns (1996 and 1998), while the other spawned in consecutive years (2002 and 2003). Most fish smolted after three years (59%) or two years (36%) in freshwater, although some smolted after one year (2%) or four years (3%). There were 12 different age classes identified but three of them composed most of the spawning population: 3.2 (average 45%), 2.2 (average 30%), and 3.1 (average 14%).

Rapid River—Of the 81 adult steelhead collected at the Rapid River weir, all were aged (Table 3). A repeat spawner was identified; this fish was PIT tagged as an adult at Lower Granite Dam on August 26, 2009, captured at the Rapid River weir on April 14, 2010, detected as a kelt at Bonneville Dam on May 25, 2010, recaptured at Lower Granite Dam as a repeat migrant on September 7, 2011, and collected again at the Rapid River weir on March 28, 2012. Not counting the repeat spawner, most fish (60%) spent two years in the ocean, 36% spent one year, and three fish spent three years. There were 55 fish that had both freshwater and ocean ages assigned, including the repeat spawner. Most fish smolted after two years (55%) or three years (38%) in freshwater, although some smolted after four years (4%). Total ages ranged from four to seven years at spawning. There were eight different age classes identified.

Big Creek—Scales were collected and aged from the three fish collected in Big Creek (Table 3). Two fish spent one year in the ocean and one spent two years. The former two specimens were assigned total ages; one had smolted after three years and the other after four years. Total age at spawn was five years and six years.

Other Locations—We received scale samples from wild adults collected at the Crooked River weir (n = 41), the East Fork Salmon River weir (n = 80), the Sawtooth Hatchery weir (n = 61), and the Pahsimeroi Hatchery weir (n = 284; Table 3). Ages were assigned to 39 fish from Crooked River; the majority spent two years in the ocean (56%) but 33% had spent three years and 10% had spent one year. There were 28 fish assigned both freshwater and saltwater ages. Most (82%) had smolted after two years but 14% smolted after three years and one fish had smolted after one year. Six age classes were identified.

Ages were assigned to 79 fish from the East Fork Salmon River; the majority (82%) spent two years in the ocean but some spent one year (16%) or three years (1%). There were 61 fish assigned both freshwater and ocean ages. Most (79%) smolted after two years, 18% after three years and two fish smolted after one year. Six age classes were identified and total ages ranged from four to six years.

Ages were assigned to 60 fish from the Sawtooth weir; most (75%) spent two years in the ocean, although there were some that spent one year (25%). There were 43 fish assigned both freshwater and ocean ages. Most fish had smolted after two years (88%) but a few had smolted at either one or three years. Total ages ranged from four to six years. There were five different age classes identified.

From the Pahsimeroi River sample, 267 fish were assigned ages. One fish was identified as a repeat spawner. Not counting the repeat spawner, the majority (76%) spent one year in the ocean, the remainder spent two years. There were 194 fish assigned both freshwater and ocean ages, including the repeat spawner. Most (73%) had smolted after two years but 25% smolted after only one year in freshwater. There were three individuals that had smolted at three years. Six age categories were identified.

Adult Productivity

Adult productivity estimates were made for Fish Creek since brood year 1992 but the series in Rapid River is much shorter (Table 5). Steelhead from both locations spawned at total ages of 3 to 7 years. It is possible that steelhead in Idaho may spawn at 8 years but very rarely. Therefore, in Rapid River, abundances should be complete for the 2004 and 2005 brood years. The portions are missing from the 2001-2003 brood years and returns are still possible for the 2006-2008 brood years. Nonetheless, estimates for the 2003 and 2006 brood years include the ages at which most fish spawn and will not likely change much.

Within a brood year, most steelhead in Fish Creek spawned at age 6 but most steelhead in Rapid River spawned at age 5 (Table 5). In Fish Creek, number of adult recruits per brood year ranged from 40 steelhead to 363 steelhead and adult productivity ranged from 0.34 recruits/spawner to 10.39 recruits/spawner (brood years 1992-2006). In Rapid River, number of adult recruits per brood year ranged from 73 steelhead to 145 steelhead and productivity ranged from 0.84 recruits/spawner to 1.70 recruits/spawner (brood years 2003-2006).

Juvenile Abundance and Productivity

Juvenile Abundance

Fish Creek—The Fish Creek screw trap operated from March 14 to November 9, 2012 and trap service was impacted by flow conditions (Figure 2). The trap cone was pulled from April 21 to May 4, which was the peak of snowmelt. The trap became filled with debris after a rainstorm on May 22, which also caused the main cable to slip. Repairs were made and the trap was fished again starting the morning of May 24. Lastly, the cone was pulled October 29 when another heavy rainstorm again filled the trap with debris. Trapping resumed on October 31 until the end of the season.

We trapped 44 juvenile steelhead during the spring, 1,220 during the summer, and 6,973 during the fall (Figure 2). These numbers include 318 fish <80 mm FL, which are not included in the population estimate below. Daily catches were mostly <10 steelhead through the spring and the early summer. Catches began to increase during July, peaked on July 17, and declined through the remainder of the summer. There were several small peaks in the fall catch during August and September. Then a very large peak in catch occurred in mid-October after the first large rain event, after which catches declined. Average daily catch was 80 steelhead during the fall but this was greatly influenced by five days when catches exceeded 400 fish. Not enough tagged fish were recaptured during the spring so we combined spring and summer for abundance estimation. Seasonal trap efficiencies were 23% and 34% for the spring/summer and fall, respectively. We estimated 30,451 juvenile steelhead ≥80 mm FL (95% CI 28,912–32,003 fish) emigrated from Fish Creek during the trapping period.

The length distribution of fish collected during the spring was different from that of fish collected during the summer or fall (Figure 3). The spring distribution had three peaks, one at less than 80 mm, another at 100 mm, and another at 150 mm. The summer distribution was broad with a peak at 90 mm FL and a possible second peak at 130 mm FL. The fall length distribution was similar to the summer distribution but skewed left slightly and with more definite modes at 100 mm FL and 140 mm FL.

Rapid River—The Rapid River trap was installed on March 18, 2012 but not operated until April 29 because of the release of Chinook smolts from the Rapid River hatchery (Figure 4). The period of the hatchery release was more protracted in 2012 than in previous years. The trap was monitored every two hours until the hatchery ponds were completely lowered and pumped out. Full operation began May 1. The trap was pulled because of high flows from May 16 to May 18, and from June 5 to June 9. Thereafter, trapping continued until November 8, 2012.

We trapped 40 juvenile steelhead during the spring, seven fish during the summer, and 144 fish during the fall (Figure 4). These numbers include three fish <80 mm FL, which are not included in the population estimate below. The spring average daily catch was >2 fish. Few juveniles were trapped after the second peak in flows. A few fish were collected during early summer but none after June 22. The fall catch had a peak during early October, which coincided with the first cool weather and rain of the season. We combined the spring and summer periods to estimate abundance. Seasonal trap efficiencies were 7% and 4% for the spring/summer and fall, respectively. We estimated 3,615 juvenile steelhead ≥80 mm FL (95% CI 1,864–6,629 fish) emigrated from Rapid River during the trapping period.

The length distribution of fish collected in Rapid River was different in each season (Figure 5). In the spring, there was a strong mode at 180 mm. Too few fish were collected to describe length frequency during the summer. The length distribution of fall fish was broad with peaks at 160 mm and at 180 mm.

Big Creek—The Big Creek trap operated from March 19 to November 9, 2012. Due to spring ice, snowmelt, and summer rain events with associated high turbidity, the trap was pulled for a total of 74 days throughout the season (Figure 6). In all, the trap was run for 162 days during 2012. There were no mammalian predators observed at the trap this year. A combination of shrubbery and an overturned laundry basket was used for cover for smaller fish in the trap box to minimize predation in the trap box. Bull trout *Salvelinus confluentus* captured were released several hundred meters upstream or downstream from the trap to minimize the likelihood of recapture. A small differential caudal clip was applied to a subsample of bull trout to monitor incidents of recapture specific to release location. Of 210 bull trout marked, we documented only seven recaptures, four of which were from the upstream release site.

We trapped 112 juvenile steelhead during the spring, 300 fish during the summer, and 1,273 fish during the fall (Figure 6). These numbers include 284 fish <80 mm FL, which are not included in the population estimate below. The maximum daily catch in the spring was 26 fish and averaged 4.3 fish for the days that the trap was operated. The trap was not operated during high flows (April 22-June 14). Once the trap was operational again, catch fluctuated at low levels for most of the summer (mean daily catch = 5.1 steelhead). Summer catch peaked at 23 fish on August 11. There were several peaks in the fall steelhead catch with a large peak of 134 fish on October 17. Only one tagged steelhead was recaptured during the spring, so we combined spring and summer periods to estimate abundance. Seasonal trap efficiencies were 2% and 6% for the spring/summer and fall, respectively. We estimated 28,804 juvenile steelhead ≥80 mm FL (95% CI 21,141–41,524 fish) emigrated from Big Creek during the trapping period.

The length frequency distribution of the steelhead in Big Creek had a peak <80 mm FL in each season (Figure 7). During the spring, the distribution of larger steelhead (>130 mm FL) was broad with a mode at 150 mm. Similarly, the larger mode during the summer was also broad but was at 170 mm. However, the fall length distribution for fish >120 mm was strongly normal with a mode at 160 mm.

Juvenile Age Composition

A total of 2,317 scale samples were taken from juvenile steelhead at nine screw trap locations in 2012. Samples from locations with many fish collected were subsampled systematically. Targets for subsampling were 200 per season. A total of 2,218 samples had an age assigned. We present number of fish aged and length at age by season.

There were 804 fish aged from samples during the spring 2012 period (Table 6). Ages ranged from one to five years. The largest fish at age 2 were from the Pahsimeroi River, as were the largest fish at age 1. The smallest fish at age 2 were from Fish Creek and Marsh Creek. The oldest average age was from Rapid River (3.27 years). The locations with the youngest average ages were Pahsimeroi River and Sawtooth (1.46 and 1.51 years, respectively).

There were 410 fish aged from samples during the summer 2012 period (Table 7). Fish movement is reduced during the summer and ceases in some locations. In other locations, traps are pulled during snowmelt and may not be re-installed until mid-summer. Ages ranged from young-of-year to six years. The largest fish at age 1 were from the Pahsimeroi River. The smallest fish at age 1 were from Marsh Creek. In general, age compositions of summer-caught fish were approximately half a year younger than those in the spring.

There were 1,004 fish aged from samples during the fall 2012 period (Table 8). Ages ranged from young-of-year to four years. Young-of-year fish were collected in eight locations but were common only at Pahsimeroi River and Sawtooth. Average length at age 1 was largest at Pahsimeroi River. Smallest length at age 1 was from Fish Creek. Average ages were similar among most locations (range 1.80-2.19 years) except at Pahsimeroi River and Sawtooth (0.40 and 0.58 years, respectively).

In addition, samples from six locations dropped from the processing schedule in 2011 (Copeland et al. 2012) were processed during 2012 (American River, Colt Killed Creek, Crooked Fork, Crooked River, Marsh Creek, Red River; n = 1,255). There were 427 fish aged from samples taken during the spring 2011 period (Table 9). Ages ranged from one to five years at these locations. The largest fish at age 3 were from Colt Killed Creek and the smallest at age 3 were from Marsh Creek. Similarly, average age was oldest in Colt Killed Creek (3.48 years) and youngest in Marsh Creek (2.37 years).

There were 371 fish aged from samples taken during the summer 2011 period (Table 10). Ages ranged from one to four years. The largest fish at age 2 were from Crooked River and the smallest at age 2 were from American River. Average age was oldest in Colt Killed Creek (1.69 years) and youngest in Crooked River (1.10 years).

There were 506 fish aged from samples taken during the fall 2011 period (Table 11). Ages ranged from young-of-year to four years. The single young-of-year was collected in Crooked River. The largest fish at age 1 were from Crooked River and the smallest at age 1 were from Colt Killed Creek. Average age was oldest in Colt Killed Creek (2.25 years) and youngest in Crooked River (1.06 years).

Spatial Structure

Fish Creek Drainage

The Fish Creek drainage was surveyed July 18 to July 25, 2012. A total of 21 sites were surveyed (Table 12). In 2012, three sites were surveyed that had not been visited during 2011 due to difficult access and time constraints. Six salmonid taxa were observed within the Fish Creek drainage (Table 12): steelhead parr, trout fry, Chinook salmon *Oncorhynchus tshawytscha*, bull trout, westslope cutthroat trout, and mountain whitefish *Prosopium williamsoni*. Trout fry were observed in more than half of the sites surveyed. Cutthroat trout were observed in all sites surveyed and their densities were highest in the upper portion of the drainage. Chinook salmon, bull trout, and mountain whitefish were the least abundant and only observed in one site each. Steelhead parr were the most abundant taxa observed in all but three of the sites surveyed. Where observed, steelhead densities ranged from 2.11/100 m^2 to 14.13/100 m^2; in general, increasing at lower elevation sites. Occupancy rate of the Fish Creek drainage by juvenile steelhead is 86%.

There were errors in fish identification at two sites this year. New members on the snorkel crew misidentified juvenile steelhead in the 75 mm – 175 mm range as cutthroat trout. The errors were discovered within a day and the crew trained on the proper distinction.

However, there was no time to re-do the sites and complete the full survey. We conducted an analysis of species composition at these sites for the past three years and compared them to the 2012 densities. The total percentage of cutthroat parr observed were 3-6 times higher in 2012 than the past three year average. But after adjusting densities at these sites to reflect the 2009-2011 species composition, the average densities in the watershed for juvenile steelhead increased only 0.41/100 m^2 and those for cutthroat trout were 0.30/100m^2 lower. We concluded the misidentifications did not seriously compromise the integrity of the survey and do not report the adjusted densities in Table 12.

Rapid River Drainage

The Rapid River drainage was surveyed during August 1–8, 2012. A total of 20 sites were surveyed (Table 13). Six of these were new sites. In 2011, the lowest site in the system was not surveyed because the landowner denied access, so we selected a replacement site in 2012. A review of the site descriptions revealed that four other sites were actually in small tributaries not considered to be anadromous streams (at the mouth). These sites were also replaced.

Five salmonid taxa were observed: steelhead parr, trout fry, Chinook salmon parr (both hatchery and natural), bull trout, and westslope cutthroat trout (Table 13). Bull trout were the only species present in the upper third of the drainage (above Lake Fork). Bull trout were observed in all but three sites surveyed with a mean density of 1.48/100 m^2. Steelhead parr were most abundant with a mean density of 2.27/100 m^2. They were observed in all but the upper seven sites. In past surveys, there was a section of the Rapid River trail downstream of the upper sites (that lacked steelhead parr), which had not been checked for potential barriers (between sites 155730 and 196690). It was suspected there might be a velocity barrier for steelhead at high water when they were moving up to spawn because steelhead parr had not been observed upstream of this section. In 2012, the personnel surveying the upper sites hiked out downstream and did not identify any potential barriers within the survey area. Occupancy rate of the Rapid River drainage by juvenile steelhead is 65%.

Other Drainages

Project personnel participated in surveys in two other drainages during the 2012 season. The ISMES crew joined with the INPMEP snorkel crews in a training session and sampling trip in the Potlatch River drainage (June 6-10, 2012). Due to heavy rains, no sites were snorkeled during this trip. During June 19-22, the ISMES crew returned to the Potlatch drainage and surveyed 22 sites. The ISMES crew joined the INPMEP snorkel crew based in Lewiston on three occasions (June 23-26, July 5-12, and August 15-22, 2012) to survey sites within the South Fork Clearwater drainage. High water caused the repeat visits. The ISMES crew surveyed 79 sites and collected tissue samples for genetic analysis. Seven of these surveys were re-visits to conduct mark-resight studies. The results of the Potlatch and South Fork Clearwater surveys will be reported in the INPMEP 2012 annual report (Kennedy et al., in preparation).

Diversity

Adult Migration Timing

Fish Creek—There were 49 individual adult steelhead detected in the hydrosystem during the 2011-2012 spawning run that were PIT tagged in Fish Creek as juveniles. Median date of passage over Bonneville Dam was September 8, but fish passed from July 27 through November 6. All but one were first detected at Bonneville Dam. The conversion rate from Bonneville Dam to McNary Dam was 76%; from Bonneville Dam to Ice Harbor Dam was 71%; and from Bonneville Dam to Lower Granite Dam was 63%. Given that detection rate of adult salmonids is very high at main-stem dams, these numbers approximate survival in the hydrosystem. There were 25 fish that passed Lower Granite Dam during the fall and six during the spring. Median dates of passage for fall and spring migrants were October 4 and April 17, respectively.

One of the fish detected in the hydrosystem had an interesting detection history (3D9.1BF231FC07). It was originally tagged in Fish Creek during the fall of 2008 and detected emigrating past Lower Granite Dam as a smolt the following spring. It was first detected as an adult at Bonneville Dam ascending the Washington shore adult ladder on July 27, 2011. It was next detected ascending the Bradford Island ladder at Bonneville Dam on April 20, 2012. It ascended McNary Dam on May 1, 2012 and then again on May 10, 2012. It was last detected re-ascending the Bradford Island ladder at Bonneville Dam on May 18, 2012 and never made it to Lower Granite Dam. This example is a good illustration of the variety in steelhead travel histories in the hydrosystem.

There were 18 fish that were detected at the weir in Fish Creek plus three tagged kelts that were not detected going upstream but recovered later. Based on these fish, conversion rate from Lower Granite Dam was 68%; total conversion rate from Bonneville Dam to Fish Creek was 43%. These rates may be biased slightly low because of the period when the Fish Creek weir was breached.

We also collected 12 PIT-tagged steelhead in Fish Creek that had been tagged as adults at Lower Granite Dam. There were five PIT-tagged kelts that were recovered, of which two were detected at the weir as upstream spawners. Based on the latter two kelts, median time above the weir was 26 days but the range was from 18 to 34 days.

Rapid River—There were eight adult steelhead detected in the hydrosystem during the 2011-2012 spawning run that were PIT tagged in Rapid River as juveniles. Five were subsequently detected upstream. Only two were passed upstream at the Rapid River weir. Median date of passage over Bonneville Dam was August 20, but fish passed from August 7 to September 3. The conversion rate from Bonneville Dam to McNary Dam (n = 5) was 63%, from Bonneville Dam to Ice Harbor Dam (n = 5) was 63%, and from Bonneville Dam to Lower Granite Dam (n = 4) was 50%. Three fish passed Lower Granite Dam during the fall; median date of passage at Lower Granite Dam was September 7. The spring migrant passed Lower Granite Dam on April 27. Conversion rate from Lower Granite Dam to Rapid River was 50% (n = 2); similarly, total conversion rate from Bonneville Dam to Rapid River was 25%.

Additionally, there were another 11 fish passed at the weir that had been tagged elsewhere. Of the latter 11 fish, eight were tagged at Lower Granite Dam as adults and three as juveniles. One of the fish tagged as an adult was recorded as a hatchery origin fish at tagging but was passed at the weir due to an oversight by the weir tenders.

Big Creek—There were 23 adult steelhead detected in the hydrosystem during the 2011-2012 spawning run that were PIT tagged at the Big Creek trap as juveniles. Median date of passage over Bonneville Dam was August 30, but fish passed from July 23 through September 26. All fish subsequently detected in the hydrosystem were first detected at Bonneville Dam. The conversion rate from Bonneville Dam to McNary Dam (n = 18) was 78%, from Bonneville Dam to Ice Harbor Dam (n = 18) was 78%, and Bonneville Dam to Lower Granite Dam (n = 17) was 74%. All steelhead passed Lower Granite Dam during the fall. Median date of passage was September 19. Seven of these fish were detected at the antenna array at Taylor Ranch in Big Creek. This number is biased low because the detection efficiency of the Taylor Ranch antennae is less than 100% (55% in 2012; Jody White, QCI, personal communication). Adjusting for efficiency gives an estimated total conversion rate from Bonneville Dam to Big Creek of 57%. Median date of detection at Taylor Ranch was April 17 with a range of April 4 to May 14.

One of the fish detected in Big Creek was a repeat spawner. It was tagged as a juvenile on August 8, 2007. It returned in 2009, crossing Lower Granite Dam on September 23, but it was never detected at the Taylor Ranch antenna array. It was detected as a kelt at Bonneville Dam on June 18, 2010. It returned upstream past Bonneville Dam on September 5, 2011 and finally crossed the Taylor Ranch array on April 20, 2012.

Smolt Migration Timing

During spring 2012, there were 5,554 unique detections in the hydrosystem of steelhead smolts tagged in ISMES study streams from 2009 to 2012 (Table 14). Most of the detections (84%) were from fish tagged in Fish Creek; most were tagged in fall 2011 and reared for the winter downstream of the trap. In contrast, detections of smolts from Rapid River were fairly evenly split into fish tagged in 2011 and 2012. Most detections of fish from Big Creek were from fish tagged during 2011.

The period of smolt emigration was most protracted from Rapid River (Table 15). The 10^{th} percentile arrival dates were different among all locations: April 15, April 11, and April 7 for Fish Creek, Big Creek, and Rapid River, respectively. Median dates were the same for Fish Creek and Big Creek, a week earlier than the Rapid River median. The 90^{th} percentile arrival dates were different among all locations: May 10, April 30, and May 18 for Fish Creek, Big Creek, and Rapid River, respectively. Nearly half of the smolts from Rapid River started the spring emigration upstream of the Rapid River trap and were tagged during spring 2012, whereas most smolts from Fish Creek and Big Creek were tagged in fall 2011 and spent the winter downstream of those traps.

Genetic Diversity

During 2012, we collected genetic samples from wild adult steelhead captured in the course of other project activities. In Fish Creek, there were 107 genetic samples taken from adults passed over the weir and from all unmarked kelts. In Rapid River, tissue samples were collected from all adults passed over the weir and a resident fish collected in the screw trap. In Big Creek, samples were collected from all three fish. All samples were archived for later analysis.

Water Temperature Monitoring

Water temperatures were recorded at 23 locations in the Clearwater River and Salmon River drainages (Table 16). Three recorders were either lost or damaged during 2012 and one was found out of water. One recorder in the Selway River drainage was lost during high water and was replaced. Two recorders in the Salmon River drainage were not functioning due to battery failures. Note the change of location of the Red River unit in Table 15; the location had actually been changed to the current location in 2008 but this had been omitted from previous reports. In addition to water temperature, we recorded air temperature at Fish Creek. Data were downloaded and stored at the Nampa Fisheries Research office.

In 2012, all U10 temperature recorders were replaced with TidBit v2 water temperature data loggers with the exception of one. Fire activity and road closures prevented access to the recorder in the Middle Fork Salmon River drainage. This U10 recorder will be replaced in 2013. TidBits are fully waterproof and have an internal battery with a five-year life span. Recording intervals were changed to 30 minutes to increase battery life.

DISCUSSION

Evaluation of the status of steelhead populations in the Columbia basin is conducted using the viable salmonid population (VSP) criteria. As in the previous sections, the discussion is organized in the VSP framework with the following subsections: adult abundance and productivity, juvenile abundance and productivity, spatial structure, and diversity. The work at Lower Granite Dam will not be reviewed here, but will be contained in a separate report issued by all IDFG projects conducting operations at Lower Granite Dam.

Adult Abundance and Productivity

Abundance and productivity data are of primary importance in ESA assessments of Idaho's steelhead populations. The current assessments by the ICBTRT (2007) use generic A- and B-run population models founded on aggregate data collected at Lower Granite Dam. Key inputs to these analyses were assumed length and age structures. All of Idaho's populations are considered to have a high risk of extinction within 100 years (probability >25%) based on the modeled abundances and productivities. Because the mandate for viability assessments is on the population level, development of more specific data is a key data need.

Adult sampling by ISMES has been conducted annually in Fish Creek and Rapid River for several years. The effort in Big Creek was reduced compared to the directed efforts expended in 2010 and 2011 (see Copeland et al. 2011, 2012). Comparison of 2012 data with those from the past three years (Table 17) suggests that adult abundance has decreased at Rapid River and Fish Creek. Starting with the 2010 spawn year, PIT-tag detections at the PIT antenna array at Taylor Ranch were used to estimate adult abundance in Big Creek. The estimated spawning run into Big Creek in 2012 was 398 steelhead (95% CI 298 – 521 fish). The recent peak abundance was during 2010 at Rapid River and a year later (2011) for Fish Creek. The majority of the wild steelhead return in 2009-2010 was composed of 1-ocean fish (Schrader et al. 2012), whereas the 2010-2011 run was composed of a large proportion of 2-ocean fish (Schrader et al., in preparation), which would favor B-run populations like Fish Creek over A-run populations such as Rapid River. These two runs were the largest in the last five years and abundance has apparently declined since then. Overall abundance of all wild steelhead remains below recovery goals.

This report contains the first adult productivity estimates based on scale ages for steelhead in Idaho. The record at Fish Creek is much longer and shows how variable productivity rates can be. For this discussion, we focus on the 1992-2006 brood years. For an even sex ratio, replacement occurs when recruits/spawner = 2.00; however, the average sex composition at Fish Creek is 65% female, therefore replacement is approximately 1.54 recruits/spawner. Of the 15 brood years under consideration, eight did not replace themselves, with a geomean recruits/spawner ratio of 0.46 for those brood years. But when a generation did replace itself, the recruits/spawner ratio could be quite high (up to 10.39 for the 1997 brood year) with a geomean of 3.54 recruits/spawner. We speculate that the life history of Fish Creek steelhead (older, larger spawners that are mostly females) is a bet-hedging strategy (Wilbur and Rudolf 2006) that allows rapid population growth when conditions are right. However, productivity is low when spawner abundance is high (Figure 8), evidence of density-dependent forces acting on population production in the last two decades. Density dependence in smolt production has been observed in Potlatch River steelhead (Bowersox et al. 2011) and in spring/summer Chinook salmon in Idaho (Walters et al., in press).

Juvenile Abundance and Productivity

Juvenile abundances fluctuated widely at ISMES screw traps during 2007-2012 (Table 18). ISMES operates three screw traps: at Fish Creek, Big Creek, and Rapid River (Figure 1). Big Creek is the largest of the three streams in which we operate screw traps for this project, thus the relatively low trapping efficiencies at that trap. The low efficiencies at the Rapid River trap in the fall are puzzling because efficiencies usually increase during the summer and fall as flows decrease. The problem is aggravated by the relatively small number of fish captured and tagged. During 2007-2009, fall trap efficiency was 9%-13% but that has decreased to 3%-5% in the last three years. The decrease may be related to bull trout predation on marked fish or a change in fish behavior but we are not sure why there has been a change in the last three years.

Another objective was to estimate smolt survival from selected tributaries to Lower Granite Dam, through the hydrosystem, and to adult return. The major confounding issue is that many steelhead do not migrate to the ocean during the anticipated year but frequently delay one or more years. The commonly used model for estimating survival in the Columbia River hydrosystem (SURPH, Lady et al. 2001) assumes that lack of movement equals mortality and that detection probability is equal among individuals. This model may yield biased estimates when used on groups with a flexible life history with respect to migration timing. An alternative has been suggested by Lowther and Skalski (1998) for fall Chinook salmon in the Snake River but it has not been adapted for use by non-statisticians. In November 2010, we consulted with the Columbia Basin Research group from University of Washington, who built the SURPH software. They are implementing the Lowther and Skalski (1998) model in a custom software interface. A beta version is anticipated to be ready in early 2013.

Spatial Structure

Population spatial structure in the VSP arena ideally is based on distribution of spawning adults. Observations of spawning steelhead in Idaho are not reliable because of snowmelt-related turbidity and changing flow conditions during the spring spawning period (Thurow 1985); therefore, we use parr distribution as a surrogate. This assumes that parr do not move long distances from where they emerged until the time of the survey.

The major metric for evaluation of spatial structure is occupancy rate in terms of arrangement and continuity of distribution and the variety of habitats occupied. For the latter, terrestrial ecoregion is used as a large-scale indicator of major habitat type (ICBTRT 2007; see McGrath et al. 2002 for ecoregion definitions). We found that occupancy rates were high in the watersheds we surveyed (65%-86%) but note that sampling was confined to streams defined as anadromous production waters. Although these watersheds do not encompass an entire population as defined by the ICBTRT (2003), they are useful indicators of population status. Fish Creek is one of seven major spawning aggregates in the Lochsa population, but it contains the majority of the Clearwater Mountains and Breaks ecoregion in the population. The Rapid River watershed contains approximately half of the only major spawning aggregate in the Little Salmon population. For each population, the ICBTRT (2007) rated spatial risks as low or very low. Those ratings agree with our results.

Diversity

ISMES has contributed a major portion of the current genetic baseline for Snake River steelhead and has added collections from Fish Creek, Rapid River, and Big Creek during 2012. Emphasis has shifted towards application of these data as a baseline to inform genetic stock identification (GSI) analyses. The GSI work became a separate project in 2010 (project 2010-026-00), but ISMES will continue to collect samples to support genetic baseline maintenance and GSI. Uses of the genetic baseline are reported by Schrader et al. (2011, 2012).

Water Temperature Monitoring

Part of the extensive monitoring objective was to monitor water temperatures in selected tributaries of the Clearwater and Salmon drainages. ISMES temperature monitoring takes place year-round, whereas many other projects only monitor during the growing season. During 2011, we gathered the entire record of temperature records collected by ISMES into an Access database. These data have been shared with researchers in the US Forest Service and are available on-line (http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html).

Other Project Activities

Project personnel have engaged in other activities beyond collection of the data reported above. The project leader was a co-author on three manuscripts published by peer-reviewed journals during the year (Byrne and Copeland 2012; Campbell et al. 2012; Johnson et al. 2012). Another two papers were accepted for publication with revisions during 2012 and will be published during 2013 (Kohler et al., in press; Walters et al., in press).

Project personnel have also made several professional presentations during 2012. There was a presentation on wild salmon and steelhead monitoring to the Anadromous Fisheries Section within the Idaho Department of Fish and Game, as well as presentations at the Pacific Coast Steelhead Management Meeting and to the NOAA Fisheries Adaptive Management Implementation Plan Life-cycle Modeling work group. Two presentations were made at the University of Idaho to the Fish Ecology class and the Palouse Student Subunit of the Idaho Chapter of the American Fisheries Society.

In 2012, we collaborated with the Army Corps of Engineers and Pacific Northwest National Laboratory to study survival and migration of steelhead kelts. We provided access to live steelhead kelts at the Fish Creek weir. The objective was to place acoustic tags in kelts in fair or good condition. A total of 52 kelts were tagged. Of these fish, 36 were detected at receivers at LGD or downstream (Colotelo et al. 2012). Survival rate of Fish Creek kelts declined below Little Goose Dam to <0.4 but a few made it to the Columbia River below Bonneville Dam. This research is being continued in 2013.

The scope of ISMES activities has increased the last few years and further increases took place during 2010. The first increase was in May 2008, a result of the Memorandum of Agreement between Bonneville Power Administration and the State of Idaho for a period of 10 years (one of the Fish Accord projects). In the Idaho Fish Accord, the need was identified for additional monitoring work of Snake River steelhead, particularly B-run populations. Consequently, ISMES was amended to collect scale and genetic samples from wild steelhead at Lower Granite Dam as a VSP assessment at the largest scale. Another increase came in 2010 as part of the regional 'fast-track' proposal solicitation. The largest increase was an expansion of the work at Lower Granite Dam to include sampling of smolts, essentially using Lower Granite Dam to do 'fish in, fish out' monitoring at the largest scale.

The profile of steelhead has risen in the Snake River basin and proposals by various entities are being funded that include work on steelhead; ISMES is collaborating with many of these. Work with the Potlatch River Steelhead Monitoring and Evaluation project and Army Corps of Engineers kelt project are described above. To support their population models, the Integrated Status and Effectiveness Monitoring Project (ISEMP) is PIT tagging adult steelhead at Lower Granite Dam; ISMES personnel work with ISEMP and NOAA Fisheries staff (project 2005-020-00) to collect samples from these fish. Reconstruction of steelhead runs into the Snake River was identified as a key part of the Anadromous Salmonid Monitoring Strategy developed for the Columbia River basin by the management agencies in 2009. The run reconstruction objective was developed into a proposal by the Nez Perce Tribe and Idaho Department of Fish and Game and approved for funding by Bonneville Power Administration in 2011. In 2012, an inter-agency workgroup was convened under the aegis of ISMES. We conducted a run reconstruction of the 2010-2011 steelhead spawning run to the Snake River basin and the report was finalized as this report was being finished (Copeland et al 2013).

SUMMARY

In conclusion, ISMES has been the primary monitoring and evaluation project collecting data on wild steelhead in Idaho. During 2012, ISMES continued to generate data relevant to the viable salmonid population criteria: abundance, productivity, spatial structure, and diversity. A large archive of adult and juvenile age data has been developed. We have begun to estimate adult-to-adult productivities for steelhead in Idaho using specific age data. The development of Big Creek as an intensively monitored watershed continues. Other recent expansions to ISMES include data collection at Lower Granite Dam and a number of collaborations with other projects focusing on steelhead. ISMES fulfills the objective of more monitoring of Idaho's steelhead populations by the work it does and by coordination with cooperating projects. Work at Lower Granite Dam covers all steelhead populations upstream. We have developed relationships with projects running weirs for steelhead to provide age composition data. Similarly we are coordinating the collection of scale samples and PIT tagging of juvenile steelhead throughout Idaho. This project is vital to the assessment of the status of steelhead populations pursuant to the Endangered Species Act and the Federal Columbia River Power System 2008 Biological Opinion.

ACKNOWLEDGEMENTS

Fieldwork was conducted by Chrystal Allen, Dustin Allen, Joseph Blackburn, Chance Broderius, Joseph Buchanan, Casey Clark, Micah Davison, Kendra Graber, Laurie Janssen, Ryan Johnson, Dustin Miller, Bryce Oldemeyer, Colton Pickett, and Kevin Poole. Scales were aged by Leslie Ferguson, Kala Hernandez, Cliff Hohman, Tyler Johnson, and Kristin Wright. Cheryl Zink helped format and edit the document. The final report was improved after reviews by Lance Hebdon and Bill Schrader.

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Table 1. Capture date percentiles of adult steelhead in Fish Creek (Lochsa River population), Rapid River (Little Salmon River population), and Big Creek (Lower Middle Fork Salmon River population) during 2011. N = number of fish. Two unidentified carcasses were excluded from Fish Creek kelt total.

Life stage	Sex	N	Date percentile attained						
			First	10%	25%	50%	75%	90%	Last
Fish Creek									
Spawner	Female	87	3/27	4/9	4/21	5/14	4/21	5/30	6/14
Spawner	Male	20	3/25	3/27	4/10	5/9	5/15	5/25	5/30
Spawner	All	107	3/25	4/10	4/18	5/13	5/19	5/29	6/14
Kelt	Female	88	5/27	6/1	6/6	6/12	6/19	6/25	7/8
Kelt	Male	9	5/28	5/28	6/1	6/13	6/18	6/18	6/18
Kelt	All	97	5/27	6/1	6/5	6/12	6/18	6/24	7/8
Rapid River									
Spawner	Female	57	3/28	3/28	4/17	4/23	5/11	5/16	5/30
Spawner	Male	24	3/28	3/29	4/18	4/23	5/13	5/15	7/12
Spawner	All	81	3/28	3/29	4/17	4/23	5/11	5/15	7/12
Big Creek									
Spawner	Female	2	3/24	3/24	3/24	4/22	4/25	4/29	4/7
Spawner	Male	1	4/7	4/7	4/7	4/7	4/7	4/7	4/7
Spawner	All	3	3/24	3/24	3/24	4/7	4/7	4/7	4/7

Table 2. The number and mean fork length, by sex, of wild adult steelhead captured in Fish Creek (Lochsa River population), Rapid River (Little Salmon River population), and Big Creek (Lower Middle Fork Salmon River population) during 2012.

Sex	Adult spawners trapped	Unmarked kelts recovered	Marked kelts recovered	Fork length (cm)		
				Mean	Minimum	Maximum
Fish Creek						
Female	87	26	62	76	63	88
Male	20	3	6	78	64	88
All	107	29	68	77	63	88
Rapid River						
Female	57	0	0	68	56	79
Male	24	0	0	67	57	82
All	81	0	0	68	56	82
Big Creek						
Female	2	0	0	66	63	68
Male	1	0	0	64	64	64
All	3	0	0	65	63	68

Table 3. Number of fish by age of adult steelhead sampled at weirs during spring 2012. Age values before the period denote freshwater ages and values after denote saltwater ages. X means a freshwater age was not assigned.

Location	Population	N	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	2.1S1	3.2S1	x.1	x.2	x.3
Fish Creek	Lochsa	134	--	2	--	3	45	1	4	59	2	--	--	--	--	2	16	--
Crooked River	SF Clearwater	39	--	--	1	2	13	8	1	3	--	--	--	--	--	1	6	4
Rapid River	Little Salmon	81	--	--	--	12	16	2	8	12	--	1	3	--	1	8	17	1
Big Creek	Lower MF Salmon	3	--	--	--	--	--	--	1	--	--	1	--	--	--	--	1	--
Pahsimeroi	Pahsimeroi	267	36	16	--	121	28	--	3	--	--	--	--	1	--	43	19	--
EF Salmon	East Fork Salmon	79	--	2	--	5	42	1	7	4	--	--	--	--	--	1	17	--
Sawtooth	Upper Salmon	60	--	3	--	10	28	--	1	1	--	--	--	--	--	4	13	--

Table 4. Number of fish by age of adult steelhead sampled at Fish Creek during 1995-2011. Age values before the period denote freshwater ages and values after denote saltwater ages. X means a freshwater age was not assigned.

Year	N	1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	3.2S1	3.2S	x.1	x.2	x.3
1995	32	--	--	--	5	--	--	7	1	--	1	--	--	1	17	--
1996	32	--	--	--	3	--	7	10	--	1	2	--	--	3	5	1
1997	22	--	--	1	5	1	1	8	--	--	--	--	--	1	5	--
1998	103	--	--	4	31	1	10	36	--	1	2	1	--	5	12	--
1999	72	--	--	1	16	--	1	40	--	--	2	--	--	--	12	--
2000	33	--	1	--	9	--	7	10	--	--	--	--	--	2	3	1
2001	113	--	--	3	20	--	17	52	--	1	3	--	--	2	15	--
2002	204	--	--	31	27	--	63	51	--	6	2	--	--	13	10	1
2003	333	--	1	5	95	1	22	118	--	--	--	--	1	10	80	--
2004	192	--	--	9	78	1	23	58	--	--	--	--	--	6	17	--
2005	123	--	1	3	33	1	3	52	--	--	--	--	--	1	29	--
2006	95	--	--	1	23	--	6	35	--	--	1	--	--	6	23	--
2007	82	3	17	9	34	1	3	2	--	--	--	--	--	1	12	--
2008	17	--	--	3	3	1	3	2	--	--	--	--	--	3	2	--
2009	124	--	--	--	8	1	11	81	1	2	2	--	--	2	15	1
2010	200	--	--	13	23	--	51	72	--	8	3	--	--	6	24	--
2011	216	1	1	1	68	1	--	94	3	--	4	--	--	1	41	1

Table 5. Age composition of adult recruits by brood year, number of parent spawners, and adult-to-adult productivity estimates (recruits/spawner) of steelhead returning to Fish Creek and Rapid River. Accounting is incomplete for brood years with dashes in any age column.

Brood year	Number of adult recruits by age (years)					Sum	Parents	Productivity
	3	4	5	6	7			
Fish Creek								
1992	0	0	10	35	3	48	105	0.46
1993	0	2	38	51	0	91	267	0.34
1994	0	4	22	12	2	40	70	0.57
1995	0	1	20	41	3	65	70	0.93
1996	0	1	29	77	0	107	39	2.74
1997	0	2	121	168	0	291	28	10.39
1998	0	42	165	72	0	279	80	3.49
1999	0	8	123	69	2	202	77	2.62
2000	0	11	47	63	0	121	33	3.67
2001	0	5	52	4	0	61	75	0.81
2002	0	2	43	34	6	84	242	0.35
2003	0	30	67	173	4	274	343	0.80
2004	4	34	39	96	20	193	206	0.94
2005	0	0	89	271	3	363	121	3.00
2006	0	16	194	78	--	288	119	2.42
2007	0	6	64	--	--	70	81	0.86
2008	3	7	--	--	--	10	134	0.08
Rapid River								
2001	--	--	--	2	4	6	31	0.19
2002	--	--	10	20	2	32	106	0.30
2003	--	16	38	18	0	73	87	0.84
2004	3	26	67	22	1	119	120	0.99
2005	0	21	72	40	5	138	81	1.70
2006	0	53	70	22	--	145	99	1.47
2007	4	21	36	--	--	61	32	1.91
2008	1	18	--	--	--	19	88	0.22

Table 6. Mean fork length (mm) at age of juvenile steelhead captured at screw traps in locations within the Clearwater and Salmon drainages during spring 2012 (March 1–May 31). Number of fish aged is in parentheses.

		Fork Length				
Location	**Population**	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**
Clearwater MPG						
American River	SF Clearwater	84 (1)	157 (87)	182 (3)	--	--
Crooked River	SF Clearwater	121 (2)	150 (350)	170 (29)	207 (7)	--
Fish Creek	Lochsa	80 (1)	108 (17)	151 (9)	--	--
Red River	SF Clearwater	110 (1)	154 (34)	157 (9)	160 (4)	203 (1)
Salmon MPG						
Big Creek	Lower MF Salmon	86 (1)	121 (6)	177 (5)	205 (2)	--
Marsh Creek	Upper MF Salmon	91 (5)	112 (48)	148 (18)	177 (5)	--
Pahsimeroi River	Pahsimeroi	130 (25)	165 (21)	--	--	--
Rapid River	Little Salmon	102 (2)	150 (2)	186 (14)	188 (15)	--
Salmon at Sawtooth	Upper Salmon	89 (39)	153 (41)	--	--	--

Table 7. Mean fork length (mm) at age of juvenile steelhead captured at screw traps in locations within the Clearwater and Salmon drainages during summer 2012 (June 1–August 14). Number of fish aged is in parentheses.

		Fork Length						
Location	**Population**	**Age 0**	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**
Clearwater MPG								
American River	SF Clearwater	--	92 (15)	145 (22)	--	--	--	--
Crooked River	SF Clearwater	--	101 (8)	152 (45)	192 (5)	176 (1)	--	233 (1)
Fish Creek	Lochsa	--	94 (36)	123 (69)	191 (3)	--	--	--
Red River	SF Clearwater	--	119 (5)	156 (11)	141 (2)	--	--	--
Salmon MPG								
Big Creek	Lower MF Salmon	--	99 (23)	153 (40)	190 (8)	--	--	--
Marsh Creek	Upper MF Salmon	--	90 (20)	113 (38)	152 (8)	158 (1)	--	--
Pahsimeroi River	Pahsimeroi	82 (1)	150 (24)	166 (2)	--	--	--	--
Rapid River	Little Salmon	--	103 (3)	158 (2)	--	200 (1)	--	--
Salmon at Sawtooth	Upper Salmon	55 (1)	141 (14)	203 (1)	--	--	--	--

Table 8. Mean fork length (mm) at age of juvenile steelhead captured at screw traps in locations within the Clearwater and Salmon drainages during fall 2012 (August 15–November 31). Number of fish aged is in parentheses.

		Fork length				
Location	**Population**	**Age 0**	**Age 1**	**Age 2**	**Age 3**	**Age 4**
Clearwater MPG						
American River	SF Clearwater	--	120 (1)	171 (28)	183 (2)	--
Crooked River	SF Clearwater	86 (1)	130 (9)	171 (56)	176 (2)	--
Fish Creek	Lochsa	88 (1)	111 (73)	148 (169)	170 (21)	--
Red River	SF Clearwater	66 (1)	128 (1)	152 (3)	184 (1)	250 (1)
Salmon MPG						
Big Creek	Lower MF Salmon	88 (1)	121 (15)	169 (173)	193 (62)	235 (1)
Marsh Creek	Upper MF Salmon	113 (1)	127 (20)	144 (31)	167 (10)	--
Pahsimeroi River	Pahsimeroi	109 (39)	174 (61)	202 (2)	--	--
Rapid River	Little Salmon	85 (1)	159 (29)	174 (73)	188 (26)	203 (1)
Salmon at Sawtooth	Upper Salmon	86 (51)	152 (37)	--	--	--

Table 9. Mean fork length (mm) at age of juvenile steelhead captured at screw traps in locations within the Clearwater and Salmon drainages during spring 2011 (March 1–May 31). Number of fish aged is in parentheses.

		Fork length				
Location	**Population**	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**
Clearwater MPG						
Colt Killed Creek	Lochsa	82	169	185	192	208
		(4)	(6)	(33)	(57)	(3)
Crooked Fork Creek	Lochsa	87	152	182	188	195
		(10)	(14)	(31)	(47)	(1)
American River	SF Clearwater	75	125	182	190	--
		(5)	(2)	(9)	(3)	
Crooked River	SF Clearwater	77	161	172	184	169
		(25)	(6)	(58)	(26)	(1)
Red River	SF Clearwater	95	106	171	177	--
		(2)	(1)	(13)	(7)	
Salmon MPG						
Marsh Creek	Upper MF Salmon	90	117	158	190	--
		(2)	(41)	(15)	(5)	

Table 10. Mean fork length (mm) at age of juvenile steelhead captured at screw traps in locations within the Clearwater and Salmon drainages during summer 2011 (June 1–August 14). Number of fish aged is in parentheses.

Location	Population	Fork length Age 1	Fork length Age 2	Fork length Age 3	Fork length Age 4
Clearwater MPG					
Colt Killed Creek	Lochsa	92 (9)	116 (20)	--	--
Crooked Fork Creek	Lochsa	93 (49)	125 (51)	184 (3)	251 (1)
American River	SF Clearwater	101 (51)	118 (4)	215 (3)	--
Crooked River	SF Clearwater	98 (93)	173 (7)	--	180 (1)
Red River	SF Clearwater	110 (15)	128 (4)	206 (1)	--
Salmon MPG					
Marsh Creek	Upper MF Salmon	92 (19)	132 (33)	156 (7)	--

Table 11. Mean fork length (mm) at age of juvenile steelhead captured at screw traps in locations within the Clearwater and Salmon drainages during fall 2011 (August 15–November 31). Number of fish aged is in parentheses.

		Fork length				
Location	**Population**	**Age 0**	**Age 1**	**Age 2**	**Age 3**	**Age 4**
Clearwater MPG						
Colt Killed Creek	Lochsa	--	96 (9)	154 (59)	182 (32)	195 (1)
Crooked Fork Creek	Lochsa	--	103 (45)	151 (124)	177 (30)	197 (4)
American River	SF Clearwater	--	115 (54)	135 (7)	262 (1)	247 (1)
Crooked River	SF Clearwater	57 (1)	142 (16)	--	170 (1)	--
Red River	SF Clearwater	--	132 (19)	140 (7)	174 (3)	218 (1)
Salmon MPG						
Marsh Creek	Upper MF Salmon	--	127 (18)	154 (54)	169 (19)	--

Table 12. Densities (fish/100 m^2) of salmonids observed at basinwide sites snorkeled in the Fish Creek drainage (Lochsa River steelhead population) during 2012. Trout fry includes all trout <50 mm. Sites are arranged by elevation (high to low).

		Density							
Stream	**Site**	**Trout Fry**	**Steelhead**	**Chinook Salmon**	**Cutthroat Trout**	**Bull Trout**	**Whitefish**	**Visibility (m)**	**Temp (C)**
Hungery Creek	24610	0.76	4.56	0.00	2.53	0.00	0.00	2.0	14.0
Hungery Creek	33698	0.00	4.07	0.00	0.90	0.00	0.00	4.0	15.5
Hungery Creek	164770	2.19	0.00	0.00	15.03	0.00	0.00	2.1	14.0
Fish Creek	69666	0.00	0.00	0.00	5.05	0.00	0.00	1.9	13.0
Fish Creek	57378	0.79	0.00	0.00	8.44	0.00	0.00	2.1	13.0
Hungery Creek	17314	0.00	8.09	0.00	2.98	0.00	0.00	2.3	14.5
Hungery Creek	213922	0.00	7.12	0.00	3.98	0.00	0.00	2.7	17.0
Fish Creek	194498	2.27	8.62	0.00	1.21	0.00	0.00	2.7	16.0
Hungery Creek	97698	0.72	6.50	0.00	2.68	0.00	0.00	2.8	14.5
Fish Creek	96194	0.00	11.52	0.00	2.22	0.00	0.00	3.5	10.5
Fish Creek	167874	0.00	2.48	0.00	1.73	0.00	0.00	3.4	14.0
Fish Creek	151490	0.12	2.11	0.00	1.99	0.00	0.00	3.3	12.0
Fish Creek	102338	0.00	5.66	0.00	1.50	0.00	0.00	2.9	16.0
Fish Creek	20418	0.10	7.00	0.00	4.70	0.00	0.00	4.0	14.0
Willow Creek	221890	0.00	3.39	0.00	5.64	0.00	0.00	2.3	15.0
Hungery Creek	58050	1.23	14.13	0.00	2.21	0.12	0.00	2.3	20.0
Willow Creek	156354	4.4	5.38	0.00	2.69	0.00	0.00	4.4	16.5
Fish Creek	172738	2.95	3.73	0.00	5.00	0.00	0.00	2.3	18.0
Fish Creek	74434	4.28	12.06	0.00	3.00	0.00	0.00	2.5	15.0
Fish Creek	41666	4.20	10.45	0.00	1.40	0.06	0.00	2.9	16.0
Fish Creek	12994	2.21	3.26	1.99	3.42	0.00	0.33	2.2	21.0
Mean		**1.25**	**5.72**	**0.09**	**3.73**	**0.01**	**0.02**		
SD		**1.53**	**3.94**	**0.42**	**3.08**	**0.03**	**0.07**		

Table 13. Densities (fish/100 m^2) of salmonids observed at basinwide sites snorkeled in the Rapid River drainage (Little Salmon River steelhead population) during 2012. Trout fry includes all trout <50 mm. Sites are arranged by elevation (high to low).

		Density							
Stream	**Site**	**Trout Fry**	**Steelhead**	**Chinook Salmon**	**Hatchery Chinook**	**Cutthroat Trout**	**Bull Trout**	**Visibility (m)**	**Temp (C)**
Rapid River	135250	0.00	0.00	0.00	0.00	0.00	6.63	2.3	9.5
Rapid River	24658	0.00	0.00	0.00	0.00	0.00	2.35	2.7	6.0
Rapid River	200786	0.00	0.00	0.00	0.00	0.00	3.31	2.5	8.0
Rapid River	237650	0.00	0.00	0.00	0.00	0.00	1.92	2.5	9.0
Rapid River	90194	0.00	0.00	0.00	0.00	0.00	4.27	2.6	11.0
Rapid River	155730	0.00	0.00	0.00	0.00	0.00	4.21	2.4	11.5
Rapid River	196690	0.00	0.00	0.00	0.00	0.00	1.47	2.7	8.0
Rapid River	323474	0.00	0.82	0.00	0.00	0.00	1.55	2.5	10.0
Rapid River	192402	0.00	0.57	0.00	0.00	0.00	1.38	2.8	12.5
Rapid River	126866	0.00	0.77	0.00	0.00	0.00	0.51	2.3	12.5
Rapid River	17298	0.39	3.26	0.00	0.00	0.00	0.89	1.6	11.0
Rapid River	15762	0.22	5.43	0.00	0.00	0.00	0.00	2.2	8.5
Rapid River	294290	0.00	5.56	0.00	0.00	0.21	0.10	2.7	10.0
WF Rapid River	163218	0.00	3.90	0.00	0.00	0.00	0.00	2.3	12.5
Rapid River	324498	0.58	3.67	0.00	0.08	0.00	0.08	3.0	10.0
Rapid River	193426	0.22	2.74	0.00	0.29	0.00	0.14	2.9	10.0
Rapid River	390034	1.10	5.71	0.00	0.30	0.20	0.40	1.8	12.5
Rapid River	62354	4.16	3.90	0.00	0.00	0.00	0.08	3.0	12.0
Rapid River	19346	7.95	6.76	0.72	0.00	0.00	0.00	2.2	13.0
Rapid River	215954	6.24	2.25	3.02	0.00	0.00	0.39	2.2	13.0
Mean		**1.04**	**2.27**	**0.19**	**0.03**	**0.02**	**1.48**		
SD		**2.23**	**2.29**	**0.67**	**0.09**	**0.06**	**1.79**		

Table 14. Number of PIT-tagged steelhead smolts that were detected in the hydrosystem during 2012 by population and year tagged. See Methods for a list of interrogation sites.

		Number detected by year tagged				
Stream	Population	2009	2010	2011	2012	Total
Fish Creek	Lochsa	1	564	4,071	8	4,644
Rapid River	Little Salmon	0	0	27	25	52
Big Creek	Lower MF Salmon	4	77	763	15	859

Table 15. Percentile dates of arrival at Lower Granite Dam for PIT-tagged steelhead smolts detected in spring 2012.

		Percentile		
Stream	Population	10%	50%	90%
Fish Creek	Lochsa	April 15	April 24	May 10
Rapid River	Little Salmon	April 7	May 1	May 18
Big Creek	Lower MF Salmon	April 11	April 24	April 30

Table 16. Streams sampled for water temperatures in 2012. Measurements were taken within 1 km of the mouth of each stream unless otherwise noted.

Salmon River drainage
Big Creek (tributary of Middle Fork Salmon River) at Taylor Ranch
Marsh Creek, 100 m downstream of screw trap site
Pahsimeroi River at weir
Rapid River (tributary of Middle Fork Salmon River), upstream of bridge
Rapid River at Rapid River Fish Hatchery
Redfish Lake Creek at weir
Salmon River at Sawtooth Fish Hatchery
Valley Creek, 200 m upstream of Meadow Creek
Clearwater River drainage
Boulder Creek
Brushy Fork Creek
Crooked Fork Creek, 50 m upstream of Brushy Fork Creek
Fish Creek #1 at screw trap site
Fish Creek #2, 50 m downstream of screw trap site (backup)
Fish Creek #3, 2 km upstream of Hungery Creek
Gedney Creek, 2 km upstream of mouth
Hungery Creek
Indian Creek (tributary of Selway River)
Little Clearwater River (tributary of Selway River)
Red River, 100 m downstream of SF Red River
Selway River, at Magruder Cabin
Selway River, near Cache Creek (7.6 km downstream of Selway Falls)
White Cap Creek (tributary of Selway River), downstream of Paradise Cabin
Willow Creek (tributary of Fish Creek)

Table 17. Abundance of wild adult steelhead in Fish Creek (Lochsa River population) and Rapid River (Little Salmon River population), 2007-2012. Confidence intervals are given in parentheses for Fish Creek only; Rapid River abundance is a census.

	Spawn year					
Location	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Fish Creek	81 (79-96)	134 (84-184)	218 (152-312)	205 (164-255)	494 (355-689)	152 (126-183)
Rapid River	32	88	108	150	133	81

Table 18. Juvenile steelhead abundance at traps operated by ISMES, 2007-2012. Confidence intervals (95%) are in parentheses.

Location	**Population**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Big Creek	Lower MF Salmon	21,346 (18,253-25,630)	47,767 (37,244-62,717)	21,918 (18,424-26,334)	28,769 (24,941-33,489)	34,891 (29,443-42,543)	28,804 (21,141-41,524)
Fish Creek	Lochsa	24,127 (22,008-24,492)	15,946 (14,697-17,313)	15,278 (14,352-16,048)	30,282 (28,690-31,881)	48,478 (46,360-50,843)	30,451 (28,912-32,003)
Rapid River	Little Salmon	5,632 (4,108-7,091)	5,165 (3,912-6,082)	3,877 (2,844-5,316)	3,099 (2,093-4,661)	3,476 (2,167-4,019)	3,615 (1,864-6,629)

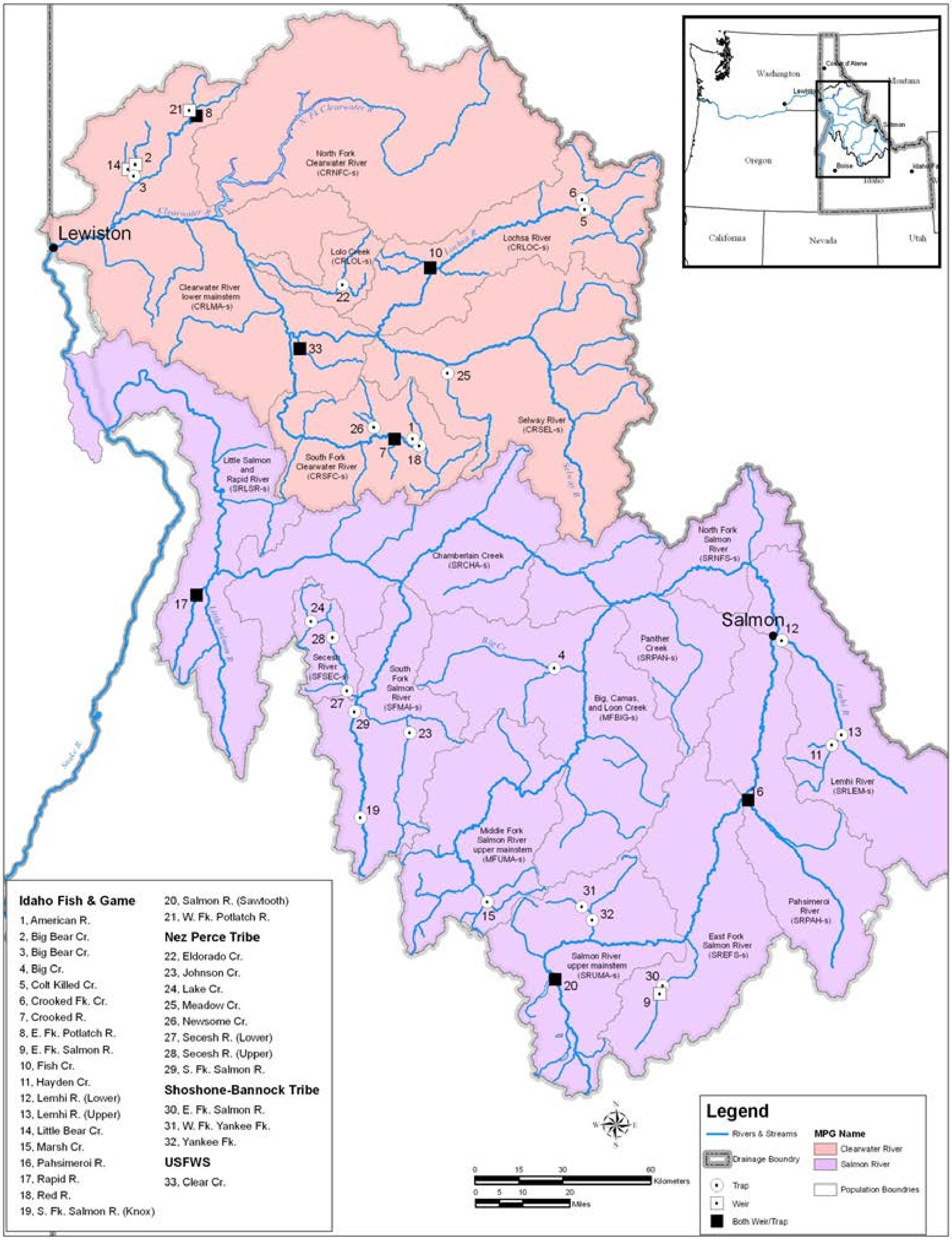

Figure 1. Locations of weirs and screw traps sampling steelhead in Idaho. The Clearwater Major Population Group is in pink; the Salmon in purple. Population boundaries are shown as light gray lines.

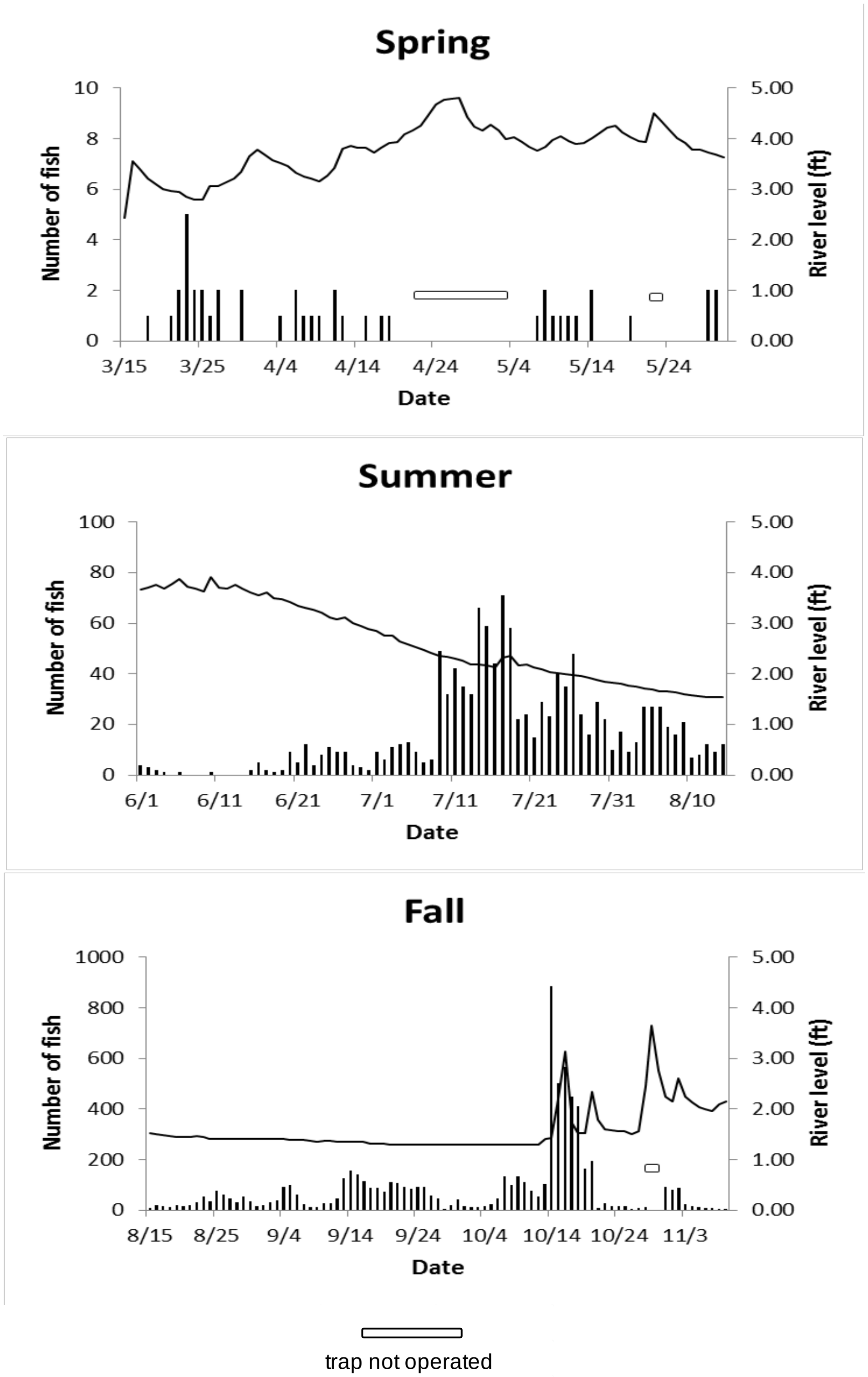

Figure 2. Daily number of steelhead juveniles (bars) captured in the Fish Creek screw trap and river level (line; ft) during 2012. Spring (n = 44) is top panel; summer (n = 1,220) is middle panel; and fall (n = 6,973) is bottom panel. Note difference in the left-axis scale in each panel.

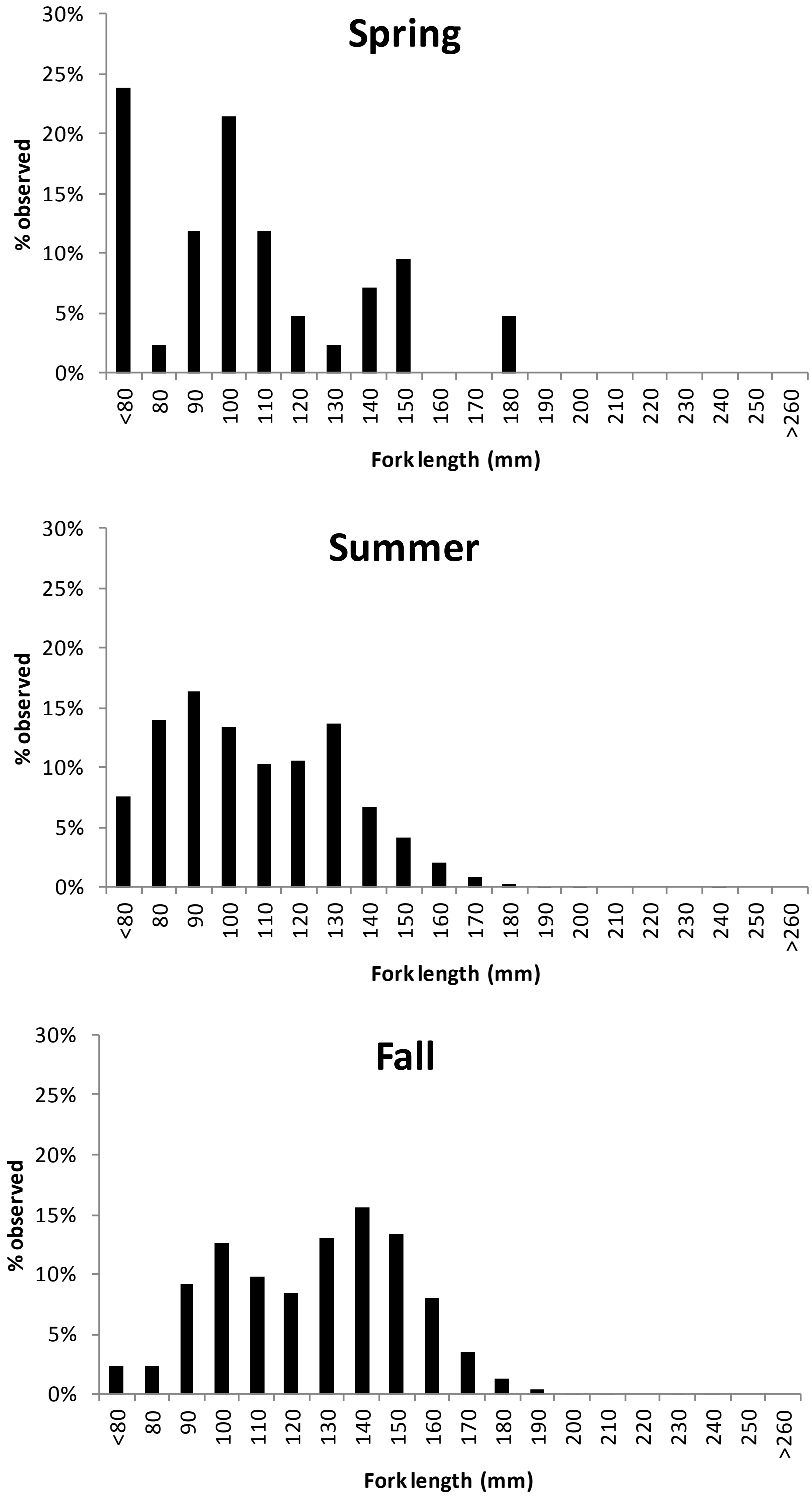

Figure 3. Relative length frequency of steelhead juveniles captured in the Fish Creek screw trap during 2012. Spring (n = 42) is top panel; summer (n = 1,216) is middle panel; and fall (n = 6,598) is bottom panel. Note that some fish were released without being measured.

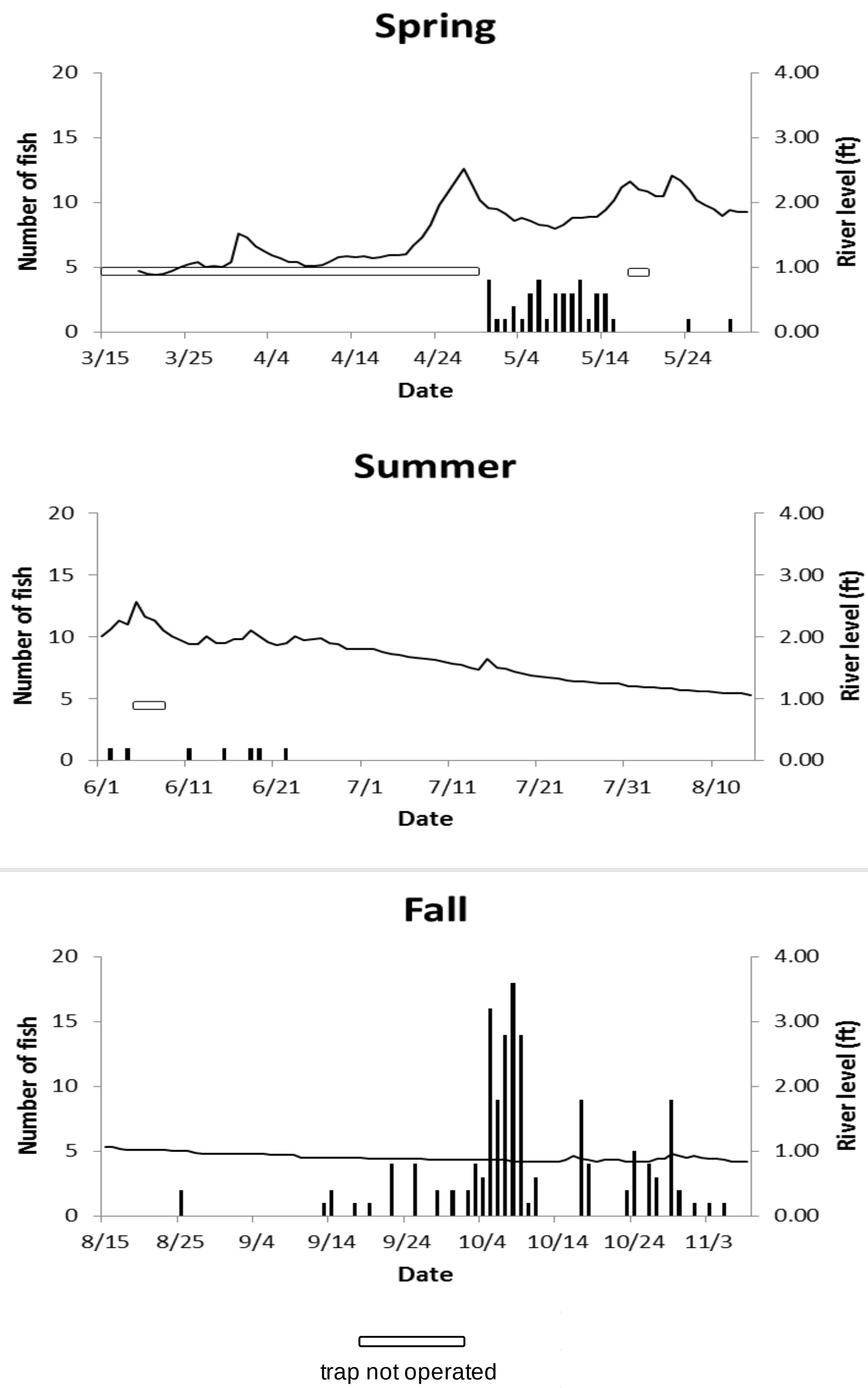

Figure 4. Daily number of steelhead juveniles (bars) captured in the Rapid River screw trap and river level (line; ft) during 2012. Spring (n = 40) is top panel; summer (n = 7) is middle panel; and fall (n = 144) is bottom panel.

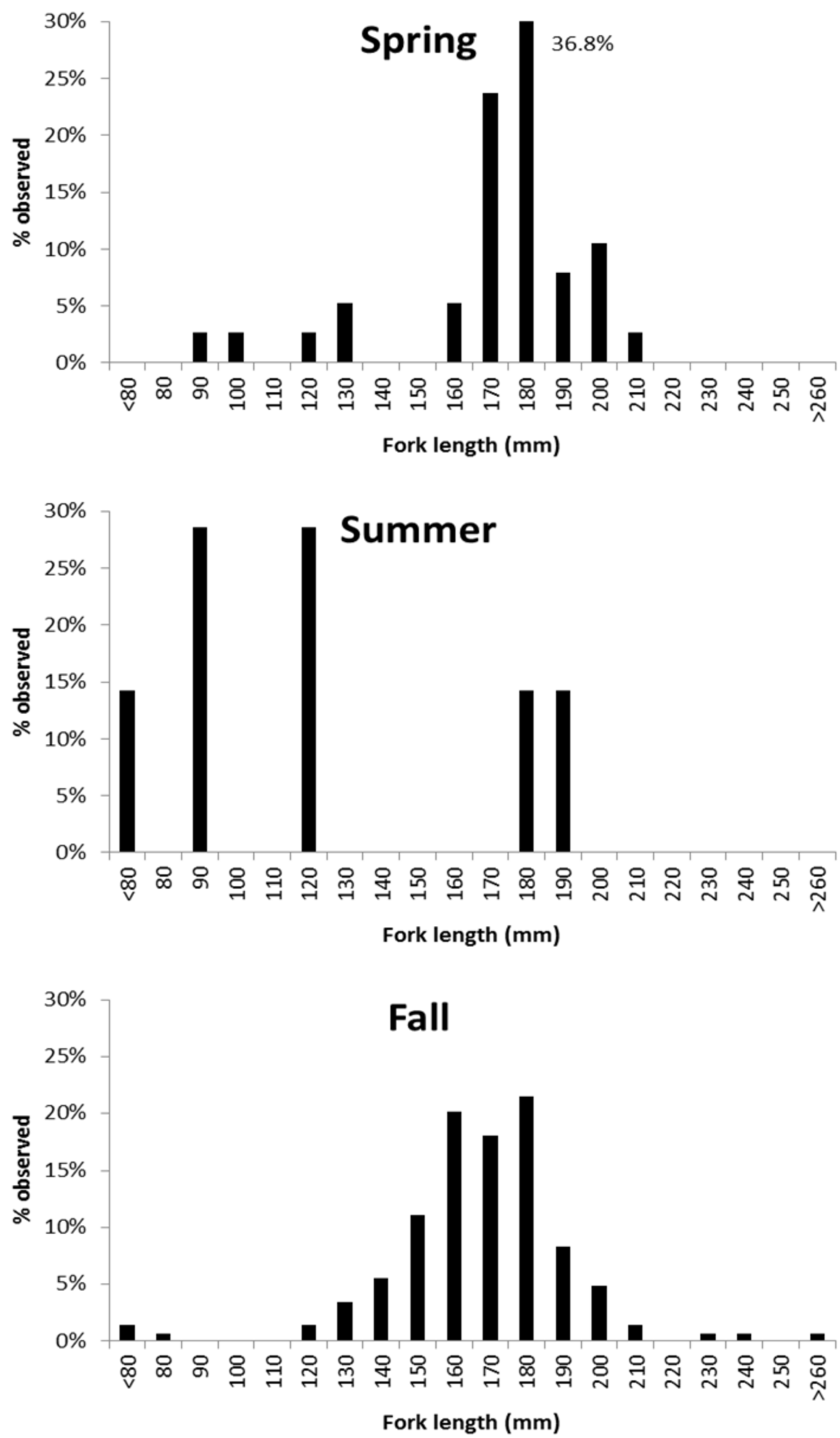

Figure 5. Relative length frequency of steelhead juveniles captured in the Rapid River screw trap during 2012. Spring (n = 38) is top panel; summer (n = 7) is middle panel; and fall (n = 144) is bottom panel. Note that some fish were released without being measured.

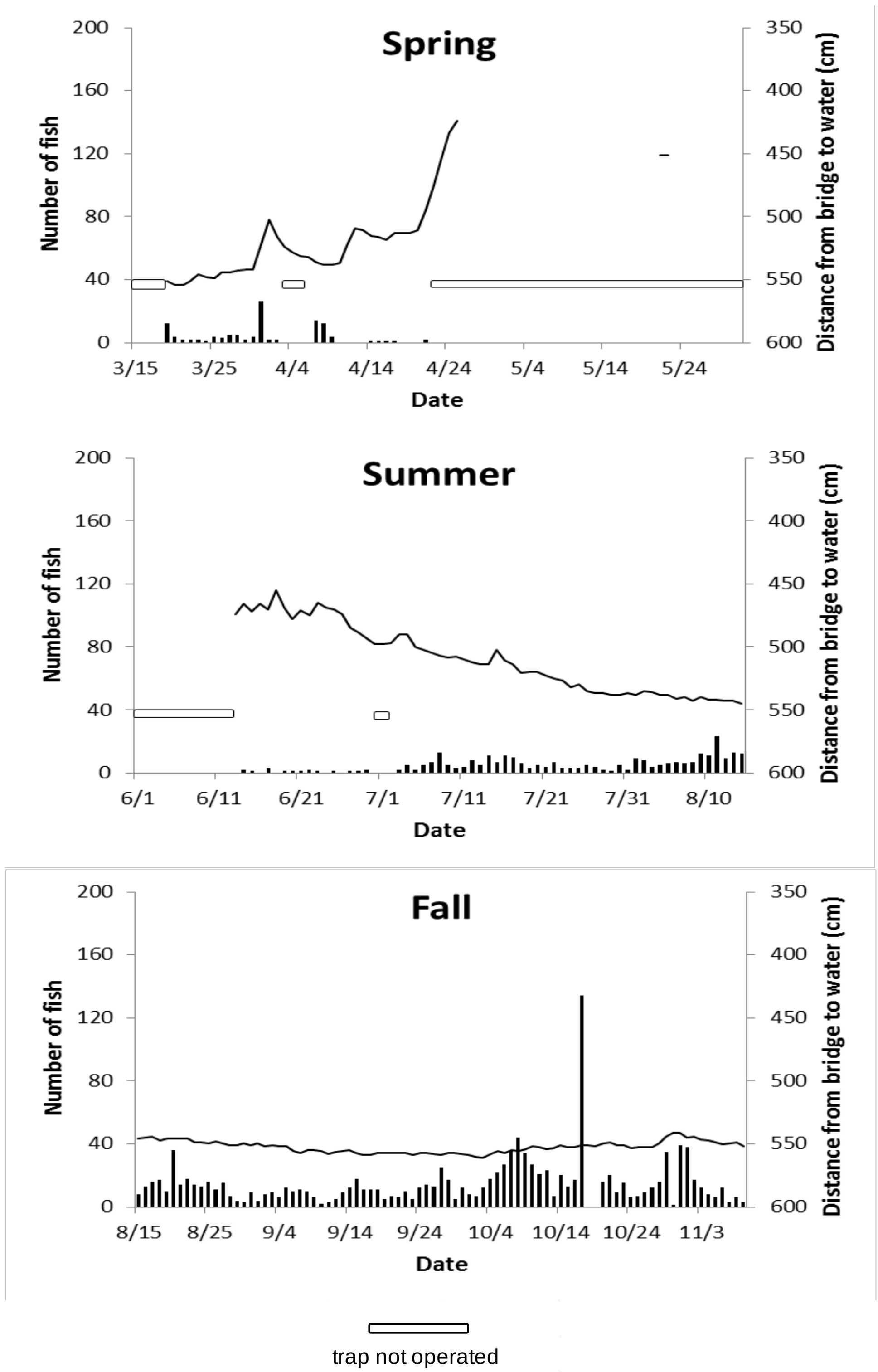

Figure 6. Daily number of steelhead juveniles (bars) captured in the Big Creek screw trap and distance from pack bridge to water surface (line; cm) during 2012. Spring (n = 112) is top panel; summer (n = 300) is middle panel; and fall (n = 1,273) is bottom panel.

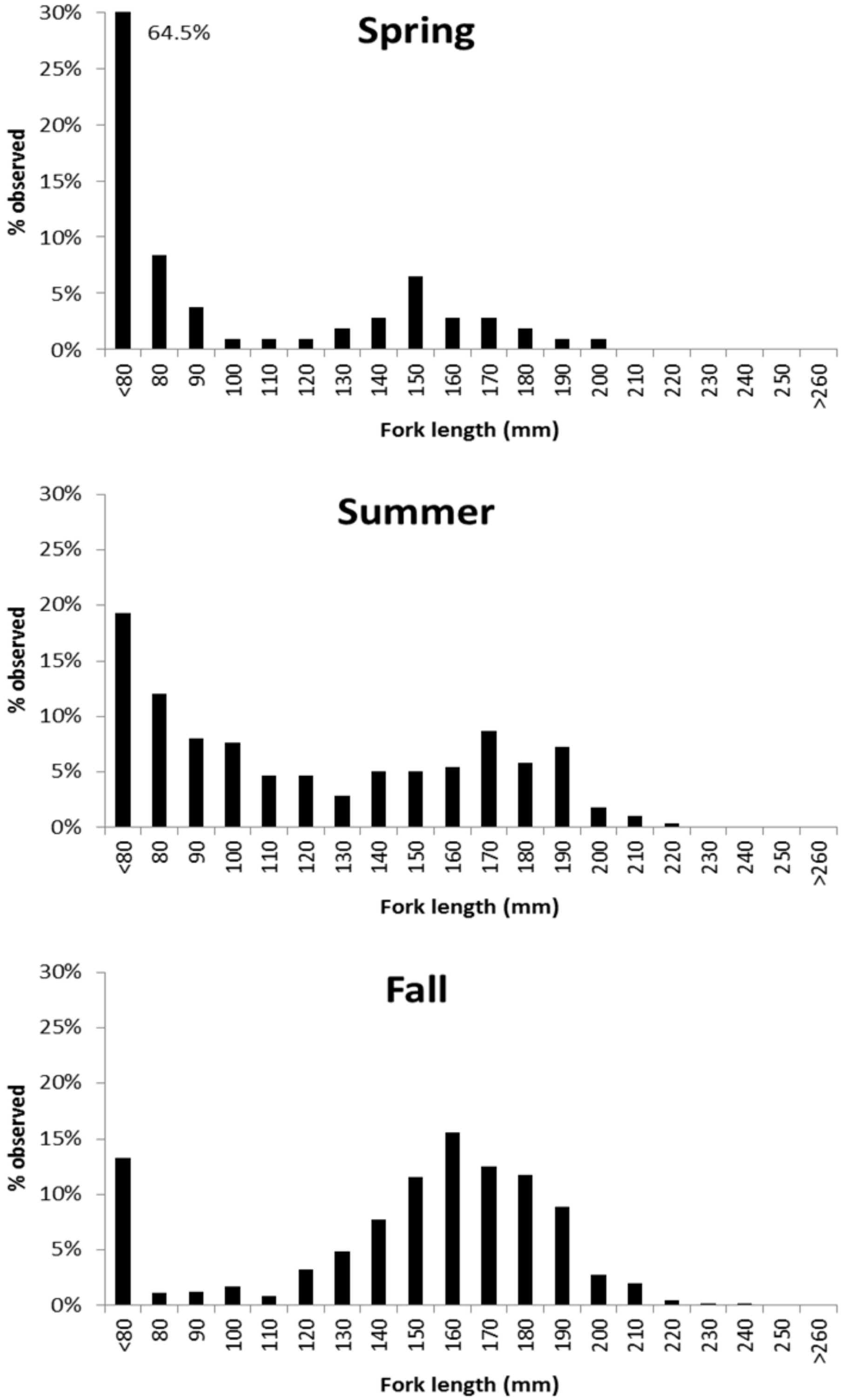

Figure 7. Relative length frequency of steelhead juveniles captured in the Big Creek screw trap during 2012. Spring (n = 107) is top panel; summer (n = 275) is middle panel; and fall (n = 1,218) is bottom panel. Note that some fish were released without being measured.

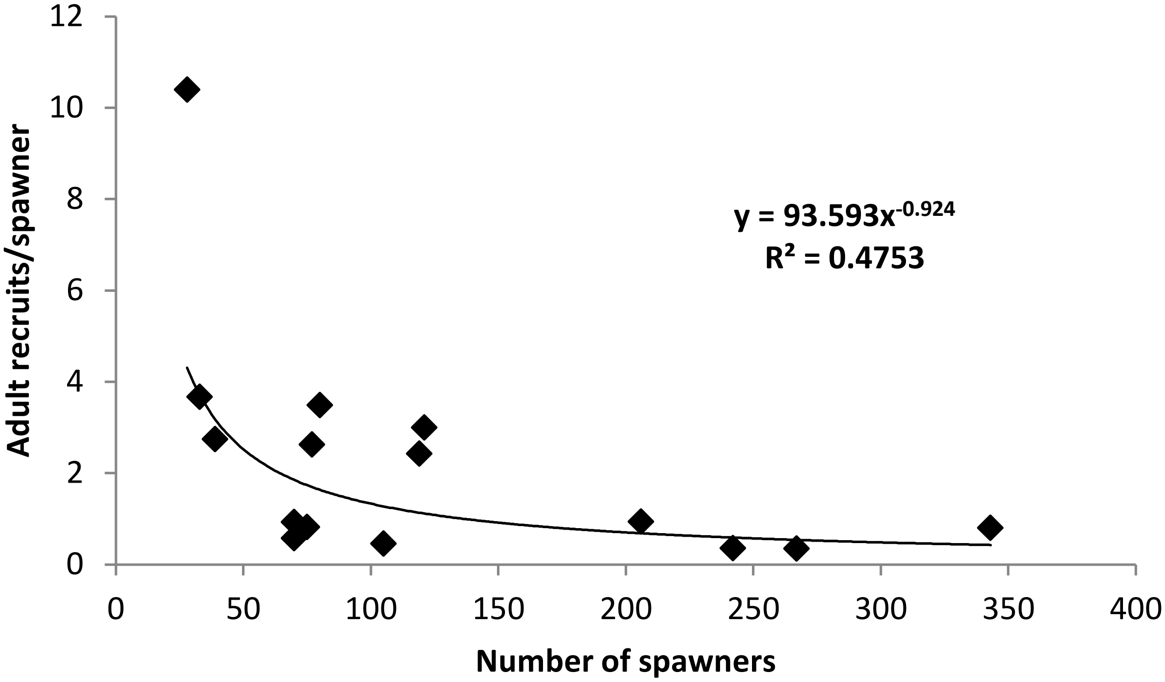

Figure 8. Relationship of adult productivity (recruits/spawner) to spawner abundance in Fish Creek steelhead (brood years 1992-2006).

APPENDIX A. JUVENILE EMIGRANT AND SMOLT SURVIVAL ESTIMATES FOR CHINOOK SALMON CAPTURED AND PIT TAGGED AT THE ISMES SCREW TRAP IN LOWER BIG CREEK, MIDDLE FORK SALMON RIVER.

INTRODUCTION

Juvenile Chinook salmon (hereafter Chinook) are captured incidental to operations of all ISMES screw traps. Data on Chinook salmon are not routinely analyzed or reported. The Big Creek Chinook salmon population is one of the intensively monitored populations and is critical to the recovery of the Middle Fork Salmon River spring/summer Chinook salmon major population group (NMFS 2011). This appendix reports on emigrant and smolt survival estimates generated from the Big Creek screw trap since its first deployment at Taylor Ranch in 2007.

METHODS

We handled juvenile Chinook salmon captured in the screw trap following the same protocols described for steelhead in this report. All fish were enumerated and examined for marks and tags. A sample of up to 50 fish ≥60 mm were PIT tagged daily and released upstream to measure trapping efficiency following methods described for steelhead in this report.

We followed guidelines established by Idaho Supplementation Studies to generate emigration and survival estimates by standardized life stages (Venditti et al. 2012). Newly emerged, young-of-the-year juveniles captured prior to July 1 (spring trapping season) were considered fry. Fry became “parr” as they entered their first summer and included age-0 fish collected between July 1 and August 31 (summer trapping season) as they migrated from natal streams. Presmolts were juvenile fish that were collected moving downstream between September 1 and trap removal at ice-up (fall trapping season).

We estimated the survival of PIT-tagged juveniles to Lower Granite Dam using PIT tag interrogations at dams on the Snake and Columbia rivers and the Survival Under Proportional Hazards (SURPH) model (Lady et al. 2010).

RESULTS

Table 1 provides estimates for emigrant Chinook salmon by life stage for each brood year sampled. We omitted small numbers (from one to 194) of subtaggable young-of-year Chinook salmon sampled prior to July 1 each year from our estimates. We also omitted yearling and precocial Chinook salmon from our estimates (from 5 to 133). Table 2 provides smolt survival estimates to Lower Granite Dam, by life stage at tagging for each brood year sampled.

DISCUSSION

Juvenile Chinook salmon are routinely the most abundant species captured by the screw trap in lower Big Creek, routinely exceeding numbers of juvenile steelhead by several fold (Table 3). We recommend continuation of monitoring Chinook salmon abundance in Big Creek and mainstem survival of smolts. This information is valuable for managers and should find an appropriate reporting venue.

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Venditti, D. A., J. Flinders, R. Kinzer, C. Bretz, M. Corsi, B. Barnett, K. A. Apperson, and A. Teton. 2012. Idaho supplementation studies, brood year 2009 synthesis report. Report to US Department of Energy, Bonneville Power Administration. Contract numbers 39993, 40184, 40511, 40843, 45292, 45601, 45728, 45805, 50460, 50465, 50511, 5190; Project 198909800. Idaho Department of Fish and Game Report 12-13, Boise.

Table 1. Emigration estimates by brood year and life stage of juvenile Chinook salmon from lower Big Creek, Middle Fork Salmon River, operated from May 2007 through 2012.

Brood year	Life Stage	Number trapped	Trapping efficiency	Emigrant estimate	Lower 95% CI	Upper 95% CI	Standard error
2005	Smolt	23	0.00	--	--	--	
	Total	23	Trap installed May 2007, therefore no BY 2005 estimates				
2006	Parr	379	0.18	2,066	1,600	2,672	260
	Presmolt	10,369	0.24	42,395	39,872	45,040	1,324
	Smolt	864	0.04	18,981	13,129	27,487	3,823
	Total	11,612	0.21	61,744	55,445	70,652	3,847
2007	Parr	857	0.07	11,912	8,854	16,068	1,852
	Presmolt	3,439	0.10	34,643	30,795	39,040	2,119
	Smolt	940	0.10	9,331	7,554	11,672	1,027
	Total	5,236	0.10	55,887	50,010	61,952	3,109
2008	Parr	2,954	0.06	49,770	39,950	63,804	6,072
	Presmolt	8,120	0.12	66,150	59,792	72,914	3,298
	Smolt	1,684	0.11	15,820	13,637	18,730	1,297
	Total	12,758	0.11	131,740	119,358	147,121	7,126
2009	Parr	4,282	0.09	47,215	40,569	55,291	3,679
	Presmolt	20,391	0.17	118,191	110,102	127,402	4,513
	Smolt	1,903	0.11	17,862	15,292	20,640	1,364
	Total	26,576	0.14	183,268	172,544	195,316	5,989
2010	Parr	6,399	0.07	88,705	74,147	107,733	8,700
	Presmolt	25,005	0.17	148,835	134,580	164,719	7,645
	Smolt	977	0.09	10,371	8,004	13,561	1,452
	Total	32,381	0.12	247,912	227,312	271,816	11,500

Table 2. Estimated survival (proportion) to Lower Granite Dam by brood year and life stage of naturally produced juvenile Chinook salmon PIT tagged at the IDFG screw trap in lower Big Creek, Middle Fork Salmon River, operated from May 2007 through 2012. Survival estimates were computed using software by Lady et al. (2010).

Brood year	Life stage	Number tagged	Survival estimate	Standard error
2005	smolt	23	--	--
2006	parr	328	--	--
	presmolt	5126	0.073	0.0048
	smolt	725	0.228	0.0221
2007	parr	586	0.295	0.0230
	presmolt	2599	0.420	0.0128
	smolt	829	0.681	0.0350
2008	parr	1123	0.202	0.0287
	presmolt	3219	0.415	0.0420
	smolt	1315	0.598	0.0345
2009	parr	1611	0.219	0.0131
	presmolt	3476	0.314	0.0111
	smolt	1369	0.619	0.0340
2010	parr	1494	0.148	0.0111
	presmolt	1920	0.280	0.0147
	smolt	668	0.548	0.0319

Table 3. Annual catch by species at the Big Creek rotary screw trap for all years of operation.

Species	Total annual catch					
	2012	**2011**	**2010**	**2009**	**2008**	**2007**
Steelhead Trout juveniles	1,685	3,077	3,165	2,427	2,029	5,877
Chinook Salmon juveniles	19,538	33,935	27,406	12,825	5,531	11,876
Chinook Salmon adults	1	3	0	0	0	1
Bull Trout	217	384	407	200	231	226
Cutthroat Trout	485	814	749	532	498	458
Mountain Whitefish	41	167	32	150	88	72
Sucker *sp.*	1	11	76	100	85	115
Dace *sp.*	282	201	473	365	269	844
Northern Pikeminnow	1	0	0	1	3	0
Sculpin *sp.*	29	22	190	31	41	44
Total Annual Catch	**22,280**	**38,614**	**32,503**	**16,632**	**8,775**	**19,512**

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