FISHERY RESEARCH

IDAHO STEELHEAD MONITORING AND EVALUATION STUDIES

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IDAHO STEELHEAD MONITORING AND EVALUATION STUDIES

Project Progress Report

2008 Annual Report

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The goal of Idaho Steelhead Monitoring and Evaluation Studies is to 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), Big Creek, and the Secesh River during 2008. 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 also collected samples for age determination and genetic analysis. Lastly, we initiated data collection at Lower Granite Dam (LGD) in 2008 as part of the State of Idaho Fish Accord with Bonneville Power. Many of the unmarked fish collected at the dam (46%) were hatchery fish. We estimated 20,078 wild steelhead returned to LGD during August 24—November 25, 2008. Freshwater ages ranged from one to five years; ocean ages ranged from one to three years (n = 1,022). Total ages at LGD ranged from two to seven years. The estimated wild adult steelhead escapement in Fish Creek was 134 fish and in Rapid River was 88 fish. We estimated that juvenile emigration was 15,946 fish from Fish Creek, 5,165 fish from Rapid River, and 55,519 fish from Big Creek. We did not estimate emigrant abundance in the Secesh River because the screw trap was pulled for extended periods. To estimate age composition, 1,680 adult steelhead and 3,599 juvenile steelhead scale samples were collected. At the time of this report, 1,148 adult and 1,445 juvenile samples had been aged. Project personnel collected genetic samples from 1,551 adult and 505 juvenile steelhead. As of this writing, the Idaho Department of Fish and Game Fish Genetics Laboratory genotyped 1,358 samples collected by this project. Water temperature was recorded at 27 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 precipitously 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). While hatchery returns increased, the returns of naturally produced steelhead trout remained 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). A total of 17 demographically independent populations have been identified within Idaho (ICBTRT 2003).

Federal management agencies in the basin are required to mitigate for hydroelectric impacts and recover all ESA-listed salmonid populations, including steelhead. In addition, the Idaho Department of Fish and Game (IDFG) has the long-term goal of preserving naturally-reproducing steelhead populations and recovering them to levels that will provide a sustainable harvest (IDFG 2007). Management to achieve these goals requires an understanding of how salmonid populations function (McElhany et al. 2000) as well as regular status assessments. However, specific data on Idaho steelhead populations are lacking, particularly key parameters such as population density, age composition, genetic diversity, recruits per spawner, and survival rates (ICBTRT 2003). In particular, the keys to assessing population viability of salmonid populations (VSP criteria) 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 and natural steelhead populations in Idaho until they can sustain fisheries. Data were collected in selected spawning tributaries in the Clearwater and Salmon river basins. In May of 2008, the scope of ISMES was amended as a result of the Memorandum of Agreement between Bonneville Power and the State of Idaho for a period of 10 years (one of the so-called Fish Accords). 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 and $150,000 was added to the annual budget. Given the timing of the Accord and the contract process in 2008, we decided to conduct sampling of wild steelhead during the fall at Lower Granite Dam as a pilot VSP assessment at the largest scale. This work used genetic stock identification and age analysis techniques as provided in Objectives 1 and 6 below to assess the feasibility of determining abundance and age structure by major drainage or population. The full results will be reported by spawn year following the inclusion of data from fish sampled at Lower Granite Dam during spring 2009.

OBJECTIVES

1. Estimate adult steelhead escapement, sex ratio, age composition, and run timing at Fish Creek, Rapid River, and Lower Granite Dam.

2. Estimate steelhead parr density in selected tributaries of the Clearwater and Salmon drainages.

3. Estimate abundance, timing, and age composition of juvenile steelhead emigrants from selected tributaries of the Clearwater and Salmon drainages.

4. Estimate smolt survival and migration timing from selected tributaries to Lower Granite Dam, through the hydro system, and to adult return.

5. Develop productivity metrics for wild steelhead populations in Idaho.

6. Describe the temporal and spatial patterns in genetic diversity of steelhead populations in Idaho.

7. Monitor water temperatures in selected tributaries of the Clearwater and Salmon drainages.

METHODS

Adult Escapement

Numbers and Sex Ratio

The aggregate escapement of most Snake River steelhead is measured at Lower Granite Dam. Some of these fish are headed to Washington or Oregon, but the vast majority is destined for Idaho. In Idaho, a portion of the escapement for some populations can be measured at weirs, such as in Rapid River (Little Salmon River population) and in Fish Creek (Lochsa River population; Figure 1). The Fish Creek weir is the only weir in Idaho operated solely for wild B-run steelhead.

Steelhead passing Lower Granite Dam were captured during the collection of fall Chinook hatchery broodstock. Work was conducted during operation of the adult trap (BPA project 2005-002-00). Sample rates for steelhead were partially dependent upon the trapping rate for fall Chinook salmon, which varied from 10% to 20% (Harmon 2009). All steelhead captured were identified by origin (wild, marked hatchery, or unmarked hatchery) by the presence of the adipose fin and fin erosion and measured to fork length (FL, nearest cm). Wild steelhead were subsampled at the trap for collection of scales and tissue samples. Six to eight scales were collected from both sides of the fish, above the lateral line and posterior to the dorsal fin, and stored in coin envelopes for transport to the laboratory. A clip was taken from the caudal fin and stored in a vial with 100% ethanol. Before analysis, samples were subsampled further to maintain an overall sample rate of 8%. Escapement by the three origin categories above was estimated by expanding the trap catch by the sample rate.

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 scanned for the presence of a passive integrated transponder (PIT) tag. Scales were collected and a small portion of the caudal fin was removed as described above. All fish were marked with a right opercular punch and released upstream of the weir. Hatchery steelhead were transported to the Lochsa River and released without processing. Because the weir was breached during the spawning run (see Results), we estimated escapement into Fish Creek using a regression model of the number of PIT-tagged fish detected in the hydrosystem versus escapement to Fish Creek for spawn years 1998-2007.

We assisted hatchery staff at the Rapid River Hatchery to collect and process adult steelhead beginning on March 26, 2008. This fish trap is a velocity barrier with the trap located in the fish ladder. Steelhead were processed as in Fish Creek. Because fish cannot pass the trap without passing through the ladder, adult steelhead escapement was the total number of adults trapped.

Age Composition

Technicians processed scale samples in the laboratory. Scales were examined for regeneration and eight nonregenerated scales were cleaned and mounted between two glass microscope slides. If nonregenerated scales were not available, that sample was not processed. Scales were examined on a computer video monitor using a Leica DM4000B microscope and a Leica DC500 digital camera. A technician chose the best scales for aging the fish and saved them as a digitized image; most were obtained using the 25x magnification. 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 outside of the check for ocean entry. Total age was the sum of freshwater and saltwater ages. Two technicians independently viewed each image to assign ages without reference to 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 to the fish. If a consensus was not attained, the scale sample was excluded from further analysis.

Run Timing

We estimated the timing of adult steelhead from Fish Creek and Rapid River through the hydrosystem. The PTAGIS database (www.ptagis.org) was queried to obtain detection dates of fish PIT tagged in Fish Creek or Rapid River as juveniles and returning as adults between July 1, 2007 and May 30, 2008 at Bonneville, McNary, Ice Harbor, and Lower Granite dams. We calculated the proportion detected at Bonneville Dam that also were detected at upstream dams and the Fish Creek/Rapid River traps.

Parr Density

Snorkel surveys were used to estimate density, distribution, and size structure of steelhead parr. Methods were identical to those used by the Idaho Natural Production Monitoring and Evaluation Project (INPMEP, project 1991-073-00) and fieldwork was planned in coordination with crews from that project. 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). A list of all potential sites in the Clearwater and Salmon basins was obtained from personnel in the Environmental Protection Agency 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 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 11 for Fish Creek and 10 for Rapid River. A list of approximately twice the desired number of sites was drawn for both watersheds.

The site list was narrowed down to a logistically feasible plan before crews began field operations. Some 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; 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.

Field surveys were done after preliminary site evaluations. Site locations and lengths were adjusted by the crew leader based on actual 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. 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 inch while moving slowly upstream. Chinook salmon parr were assigned an age based on length. Nonsalmonid species observed were noted as present. After the crew snorkeled each site, they measured site length and up to ten widths to calculate surface area. Gross habitat characteristics were also evaluated. Data were entered into the IDFG Standard Stream Survey database.

Juvenile Emigrant Abundance

Abundance of emigrating juvenile steelhead was estimated from data collected at rotary screw traps located near the mouths of natal streams. This project operated screw traps in Fish Creek, Rapid River, Big Creek, and the Secesh River. The traps were checked daily, and the number of steelhead captured and tagged was recorded. 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 500 m upstream of the screw traps. Recaptured fish were released downstream of the traps. 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. 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 a nearby bridge to water surface.

Data from each trap are summarized by season in this report. The seasonal designations we used are arbitrary but 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 were computed with the bootstrap option.

Juvenile Emigrant Age Composition

We estimated emigrant age composition using scale samples collected at screw traps. Screw trap tenders from ISMES collected scale samples from juvenile steelhead caught in Fish Creek, Rapid River, Big Creek, and Secesh River (Figure 1). Scale samples were also collected at screw traps operated by the Idaho Supplementation Studies (ISS, project 1989-098-00): Clear, Colt Killed, Crooked Fork, and Marsh creeks; American, Red, Crooked, Salmon (at Sawtooth Fish Hatchery), Pahsimeroi, Lemhi, and South Fork Salmon (at Knox Bridge) rivers and at a trap operated in Johnson Creek by the Johnson Creek Artificial Propagation Enhancement Project (project 1996-043-00). Scales were collected and processed as described above for adults, except that laboratory technicians examined scales using 100x magnification.

Once all samples from a particular location were processed, data were grouped by season before calculation of age proportions and mean lengths at age. Juvenile fish sampled between March 1 and June 14 were placed in the spring period, fish sampled between June 15 and August 14 were placed in the summer period, and fish sampled after August 15 were placed in the fall period. Although these three classes are somewhat arbitrary, the intent was to account for differences in growth among sampling periods. Note that seasons used for age composition are different from those used for abundance estimates in order to be consistent with past ISMES reports.

Smolt Survival

Smolt survival is usually estimated using PIT tags implanted in juvenile steelhead as they leave their natal streams. This project PIT-tagged fish at screw traps in Fish Creek, Rapid River, Big Creek, and Secesh River. We also coordinated steelhead PIT-tagging at the screw traps operated by ISS listed above plus one in Lake Creek. Additional tagging was done at a trap in the lower Lemhi River operated by the Lemhi Habitat Conservation Plan. At most sites, the screw traps were fished continuously from early March until ice-up in November, river conditions permitting. For this report, we only present data from ISMES traps.

We ascertained smolt detection rates and emigration timing during the 2008 emigration using PIT-tagged fish detections downstream of the four 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 all wild steelhead smolts tagged by ISMES. Potential interrogation sites were Lower Granite, Little Goose, Lower Monumental, McNary, John Day, and Bonneville dams; the Clearwater, Salmon, and Snake River smolt traps; and the upper estuary towed array. Passage date at LGR was calculated for three percentiles (10%, 50%, and 90%) for each trap location.

Genetic Diversity

Since 2000, ISMES has collected tissue samples from populations that span the range of geographic, temporal, and phenotypic variability observed in the Salmon and Clearwater basins. In 2008, we analyzed a set of previously collected tissue samples (n = 339). Samples collected at Lower Granite Dam during fall 2008 were also analyzed (n = 1,022). Genetic analyses were conducted by the IDFG Eagle Fish Genetics Laboratory.

Additional samples for future genetic analysis were collected in 2008. Samples were collected from all adult steelhead handled at the Fish Creek weir. Finally, last year we identified a gap in the genetic sample collection in the upper Selway River and continued collecting samples there. All additional samples were stored for future analysis.

Water Temperature Monitoring

Water temperatures were monitored in tributaries throughout the Clearwater and Salmon river drainages with temperature recorders to obtain yearly temperature profiles from streams with wild steelhead populations. The streams span a range of elevation, geomorphic, and vegetative cover found in Idaho's steelhead streams. Water temperature was recorded every 0.25 h to 0.33 h from early spring until late October. Winter water temperatures were recorded every 0.25 h to 1.0 h, depending on recorder data storage capacity, site location, and access. The daily mean, maximum, and minimum water temperatures were calculated for each stream. Air temperature, barometric pressure, and relative humidity were recorded only at Fish Creek. These data are stored in a database located at the IDFG Nampa Fisheries Research office.

RESULTS

Adult Escapement

Lower Granite Dam

Personnel at the Lower Granite Dam adult trap handled 2,568 wild steelhead, 2,095 unmarked hatchery steelhead, and 14,825 marked hatchery steelhead from August 24 to November 25. Expansion of the wild catch yielded an escapement estimate of 20,078 steelhead.

There were 1,534 scale and tissue samples collected from wild adult steelhead at the Lower Granite Dam trap. After subsampling to maintain an 8% sample rate, 1,022 scale samples were viewed to assign ages. Of these, 992 were assigned an ocean age, 939 were assigned both freshwater and ocean ages, and 30 were not aged. There were 29 fish sampled that had been PIT-tagged as juveniles and hence had known ocean ages. Ocean ages assigned to these fish agreed with the known age in 28 cases; accuracy of age assignments was 97%.

There were 12 age classes among the steelhead that had both freshwater and ocean ages assigned (Table 1). Freshwater ages were from 1 year to 5 years; ocean ages were from 1 year to 3 years. The majority of fish had smolted after two years or three years in freshwater. Most steelhead had spent 2 years in the ocean (52%), although many had spent only 1 year (43%) and some 3 years (5%). Total ages ranged from two years to seven years at time of sampling. Ocean age composition shifted through the sampling period (Figure 2). In general, the proportion of older fish increased with time.

Fish Creek

Operation of the Fish Creek weir began March 12. The 2008 spawning run began on April 12. High flows and large amounts of woody debris compromised trapping during snowmelt. A weir breach occurred on May 4. On May 15, the weir was completely breached and we were unable to repair the damage before the completion of the adult steelhead run. Although we could not complete trapping in 2008, we developed an escapement estimate using PIT tag detections in the hydrosystem. The regression of number of PIT tags detected versus estimated escapement at Fish Creek for spawn years 1998 to 2007 was statistically significant (F = 48.96, p = 0.0001; Figure 3). The 2004 data point was an outlier that greatly increased unexplained variance, so we eliminated this point from the regression to allow more precise prediction (F = 116.9, p <0.0001). The prediction of 2008 escapement from this regression is 134 fish (90% prediction interval ±50).

While the weir was in operation, trap tenders passed 17 fish above the weir (Table 2). The sex ratio was 41% female and 59% male. The mean FL of females and males was 75 cm (95% CI, ±5 cm) and 69 cm (95% CI, ±3 cm), respectively. Females ranged in FL from 66 cm to 84 cm, and males ranged from 64 cm to 80 cm. Trap tenders observed a river otter (*Lontra canadensis*) killing three adult steelhead—two females and one male—in the vicinity of the weir before the breach. Timing of arrival to Fish Creek did not differ between the sexes but sample size was small (Table 3). The first female spawner arrived on April 12. The last female trapped before the weir failure was on May 11. The first male spawner arrived on April 13. The last male trapped before the weir failure was on May 14. No kelts were recovered due to weir failure.

There were 20 detections in the hydrosystem of PIT-tagged adult fish returning to spawn in Fish Creek (Table 4). All were tagged as juveniles in Fish Creek. The median date of passage at Bonneville Dam was September 1, 2007 (n = 19). The conversion rate from Bonneville Dam (n = 19) to McNary Dam (n = 18) was 95%; from Bonneville Dam to Ice Harbor Dam (n = 16) was 84%; and from Bonneville Dam to Lower Granite Dam (n = 14) was 74%. These conversion rates ignore one fish that was detected at Lower Granite Dam but not downstream. Most PIT-tagged fish detected in the hydrosystem did not arrive at Fish Creek before weir failure. Only three were trapped at the Fish Creek weir. Each of the three was detected at Bonneville, McNary, Ice Harbor, and Lower Granite dams. The first PIT-tagged adult to arrive at Fish Creek (April 19) was detected at Bonneville Dam on August 18, 2007 and the last (May 5) was detected at Bonneville Dam on August 31, 2007.

Individuals returning to Fish Creek in 2008 spent 1-3 years in the ocean (Table 5). The overall age composition was 53% 1-ocean, 41% 2-ocean, and 6% 3-ocean (n = 17). Of the seven females, 29% were 1-ocean, 57% were 2-ocean, and 14% were 3-ocean. Of the ten males, 70% were 1-ocean and 30% were 2-ocean.

Rapid River

The 2008 spawning run lasted from March 26 to May 23 in Rapid River. Escapement above the weir was 88 fish: 46 females and 42 males (Table 2). The sex ratio was 52% females and 48% males. The mean FL of females and males was 69 cm (95% CI, ±2) and 66 cm (95% CI, ±2), respectively. Females ranged in length from 58 to 84 cm, and males ranged from 55 to 86 cm.

Timing of arrival to Rapid River differed between sexes (Table 3). The first female spawner arrived on April 14 and the last on May 23. The first male spawner arrived on March 26 and the last on May 20. The median arrival date for female and male spawners was May 8 and May 5, respectively.

There were five detections in the hydrosystem of adult fish returning to spawn in Rapid River (Table 4). Each was detected at Bonneville, McNary, Ice Harbor, and Lower Granite dams. The median date of passage at Bonneville Dam was September 8, 2007. The conversion rate from Bonneville Dam to Lower Granite Dam was 100%. But only three (60%) were detected at Rapid River. All three were tagged as juveniles: one in Rapid River and two at Lower Granite

Dam. The first PIT-tagged adult to arrive at Rapid River (May 8) was first detected at Bonneville Dam on August 12, 2007 and the last (May 16) was first detected at Bonneville Dam on October 6, 2007.

Individuals returning to Rapid River in 2008 spent 1-3 years in the ocean (Table 5). The overall age composition was 68% 1-ocean, 29% 2-ocean, and 3% 3-ocean (n = 84). Of the 46 females, 54% were 1-ocean, 44% were 2-ocean, and 2% were 3-ocean. Of the 42 males, 84% were 1-ocean, 13% were 2-ocean, and 3% were 3-ocean. We were unable to age four fish.

Other locations

In total, there were 184 scale samples taken from wild adult steelhead in Idaho during 2008. Of these, 26 were not aged and 43 had only an ocean age assigned. For one fish sampled at the Pahsimeroi weir, no consensus saltwater age was achieved but a freshwater age of 2 years was agreed upon; this fish was not counted in the following summaries. Total ages were assigned to the rest. Besides Fish Creek and Rapid River, there were samples from Big Creek, the Pahsimeroi River weir, and the Salmon River at Sawtooth Hatchery (Table 6). There were 10 total age categories, nine of which were evident in the Rapid River population. Aged sample sizes were small for Sawtooth (n = 13) and Big Creek (n = 10). However, many of the scales collected at Sawtooth (43%) exhibited a high degree of erosion and were not aged. In general, most spawners in 2008 (65% of the aged sample) were 1-ocean and this was consistent at all five locations.

Parr Density

Because of high and sustained snowmelt, not all planned surveys were completed. The ISMES crew participated with INPMEP snorkel crews to survey the Potlatch River June 11–July 2. The results of that survey are detailed in the INPMEP annual report (Copeland et al. 2009). The Fish Creek survey was completed during July 9-30. This is approximately the same time that Fish Creek had been snorkeled in previous years. The crew was able to sample 17 sites. In addition, one historic GPM site was surveyed. The last survey was conducted in the Rapid River watershed during August 6-13, approximately the same time it had been snorkeled in previous years. The crew was able to sample 12 sites. In addition, six historic GPM sites were surveyed.

Steelhead were the most common salmonid observed in Fish Creek (Table 7). Five salmonid taxa were identified: trout fry *Oncorhynchus sp*., juvenile steelhead, Chinook salmon parr, cutthroat trout *O. clarkii*, and mountain whitefish *Prosopium williamsoni*. The mean steelhead density was 2.73 fish/100 m^2 (SD = 2.66, n = 17) for the basinwide sites and 8.05 fish/100 m^2 for the one historic trend site. The historic site was located among the three downstream-most sites selected for the basinwide assessment. Steelhead parr were most abundant in downstream sites but were present throughout the basin. Trout fry were patchily distributed throughout the basin. Cutthroat trout were present in much of the watershed but most abundant in the extreme headwaters. Chinook salmon were found at only one site in the upper basin and mountain whitefish were found only in one lower basin site.

Steelhead were also the most common salmonid observed in Rapid River (Table 8). Six salmonid taxa were identified: trout fry, juvenile steelhead, wild Chinook salmon parr, hatchery Chinook salmon parr, cutthroat trout, and bull trout *Salvelinus confluentus*. The mean steelhead density was 3.76 fish/100 m^2 (SD = 3.06). Historic trend sites were distributed throughout the stream and average density based on these sites (3.79 fish/100 m^2, SD = 1.35) was similar to the basinwide mean. Steelhead were not observed in the extreme headwaters. Trout fry were observed in the lower half of the basin. Cutthroat trout were only seen at one site in the lower basin. Bull trout were most abundant in the headwaters but were distributed throughout the drainage. Chinook parr were found in the lower quarter of Rapid River.

Juvenile Emigrant Abundance

Fish Creek

The Fish Creek screw trap operated from March 12 to November 7 except for ten days. We estimated 15,946 juvenile steelhead (95% CI 14,697-17,313) emigrated from Fish Creek during that time. Most juvenile steelhead leave during the fall (Figure 4). We trapped 96 fish during spring, 481 fish during summer, and 3,226 fish during fall. Daily catch was <200 fish through most of the fall except for two occasions with peaks of 213 and 606 fish. These peaks corresponded to slight increases in the hydrograph following rainfall. A total of 2,504 fish were marked out of 3,803 trapped throughout the trapping season for trap efficiency analyses. Seasonal trap efficiencies were 12%, 15%, and 27% for the spring, summer, and fall, respectively.

Length frequencies (FL) of Fish Creek steelhead emigrants differed among seasons (Figure 5). During the spring, there were two modes in the length distribution at 80 mm and 175 mm. During the summer, the length distribution was unimodal with an upper tail and mean length 132 mm. During the fall, the length distribution was bell-shaped with mean length 142 mm.

Rapid River

The Rapid River trap operated from March 7 to November 8 except for 20 days. Between March 19 and April 23, the Rapid River trap was operated less than 24 hours per day because of the release of Chinook parr from the Rapid River Hatchery. An alternating schedule of sunrise plus eight hours and sunset minus eight hours was used to sample during this period. The trap was run for eight hours commencing at sunrise on the first day and eight hours before sunset the next day. Fish were not released upstream for trap efficiency before April 24.

We estimated 5,165 juvenile steelhead (95% CI 3,912-6,082) emigrated from Rapid River. Most emigrants leave in the spring (Figure 6). We trapped 363 fish during spring, 58 fish during summer, and 216 fish during fall. Few steelhead were trapped before April 28. Daily catch never exceeded 40 fish. A total of 620 fish were marked out of 634 trapped throughout the trapping season for trap efficiency analyses. Seasonal trap efficiencies were 15%, 4%, and 13% for the spring, summer, and fall, respectively.

Length frequencies (FL) of Rapid River steelhead emigrants differed among seasons (Figure 7). The length frequency distribution of fish collected in the spring had two modes at 85 mm and 180 mm. The summer length distribution was unimodal with a mean length of 97 mm. The fall length distribution had two modes, 90 mm and 165 mm.

Big Creek

The Big Creek trap operated from March 4 to November 12, except for 56 days (primarily during spring runoff). We estimated 55,519 juvenile steelhead (95% CI 43,613–71,331) emigrated from Big Creek from March 4 to November 12, 2008. Most emigrants leave Big Creek during the fall (Figure 8). We trapped 355 fish during spring, 466 fish during summer, and 1,364 fish during fall. Daily catch was fewer than 10 fish until April 14 when 33 were caught.

Spring daily catch then fluctuated between 3 and 52. Daily catch reached 31 fish during the short window of opportunity in early June. Once regular trapping resumed, the daily catch was less than 20 fish until the peak of 75 fish on August 12. The fall daily trap catch was <75 fish. Seasonal trap efficiencies were 3%, 4%, and 4% for the spring, summer, and fall, respectively.

The length frequency distribution (FL) of Big Creek steelhead collected in the spring had two modes at 80 mm and 185 mm. The summer was unimodal with a mean of 103 mm and an extended upper tail (Figure 9). The fall sample had a broad distribution of FLs with an obvious mode at 185 mm and a group of fish <70 mm.

Secesh River

The Secesh River screw trap operated from March 18 to October 23. However, the trap was pulled between April 15 and July 15 due to high water. We did not estimate abundance of juvenile steelhead emigrating from the Secesh River in 2008 due to the irregular trapping schedule. Summer and fall samples were incomplete because the trap was pulled for extended periods (Figure 10). We trapped three fish during spring, 73 fish during summer, and 433 fish during fall. The fall daily trap catch was less than 20 fish except for two days when it was 23 and 27 fish.

The length frequency distribution (FL) of fish collected in the summer had a mode of 160 mm. The fall distribution was bimodal with modes at <70 mm and 165 mm (Figure 11).

Juvenile Emigrant Age Composition

A total of 3,599 scale samples were taken from juvenile steelhead at 16 screw trap locations in 2008 (Table 9): 1,388 samples from the Clearwater River basin and 2,211 samples from the Salmon River basin. Relatively few samples (8%) were collected during the summer. As of this writing, 1,445 samples have been assigned ages.

For this report, we present only the aging results from samples collected by ISMES traps (Table 10). Spring emigrants were ages 1-4 in Fish Creek, Rapid River, and Big Creek, but most were age 3. During the spring, lengths at age for ages 0 and 4 were largest in Big Creek and largest at ages 2 and 3 in Rapid River. Small sample sizes from the Secesh River during the spring and during the summer for any of the four streams preclude analysis. Fall emigrants were ages 0-4, but most were age 2. During the fall, length at age was largest in Big Creek except for age-1 fish.

Smolt Survival

During spring 2008, there were 4,202 unique detections in the hydrosystem of juvenile steelhead tagged in ISMES study streams (Table 11). Most of the detections (76%) were from fish tagged in Fish Creek, where most tagging was done. Of the Fish Creek detections, the vast majority of fish had left the stream from 2006 to 2007 and resided downstream before migrating to the ocean as smolts in 2008. In contrast, all 192 detections from Rapid River in 2008 were from fish tagged that year; however, no fish were tagged prior to 2007. Of the 649 detections from Big Creek in 2008, most were from fish tagged in 2007 (79%). Of the 148 detections from the Secesh River in 2008, 85% were from 2007. Note that these are not true survival rates. In general, over all streams, the majority of fish detected in 2008 had left their natal streams during fall 2007 and overwintered downstream before smoltification.

Median arrival times at Lower Granite Dam were similar among populations (Table 12). For Fish Creek smolts, the median arrival date at Lower Granite Dam was May 7 (range April 17—June 19). Rapid River smolts had the latest median arrival date on May 11 (range May 3—May 30); however, no fish were tagged prior to 2007. For Big Creek smolts, median arrival date was May 8 (range April 19—May 23). Timing for Secesh River smolts was very similar with a median of May 5 (range April 18—May 20).

Genetic Diversity

Two efforts were made towards describing genetic diversity in 2008: collection of new genetics samples and analysis of archived samples. New samples were collected from 505 juvenile steelhead and 1,551 adult steelhead (Table 13). Adult samples were collected from fish handled at the Fish Creek weir (n = 17) and at Lower Granite Dam (n = 1,534). Juvenile samples were primarily from Big Creek (n = 232) but also from three Selway River tributaries: Little Clearwater River (79), Selway River at Hells Half Acre Creek (92), and White Cap Creek (102). Many *O. mykiss X clarkii* hybrids were captured but we did not take tissue samples from them.

As of this writing, the Eagle Genetic Laboratory genotyped 1,428 samples for ISMES. Of these, 1,092 were from adults sampled at Lower Granite Dam during fall 2008. Full reporting from these and the spring 2009 sampling will be given in next year's report on a spawn year basis; however, preliminary results are given in Appendix A. The other 336 samples genotyped were used to round out the available baseline for genetic stock identification or address population-level concerns, such as impacts of hatchery straying. Currently, some samples for the latter purpose still await processing (n = 90). Also, we will screen 100 steelhead from the Potlatch River with single-nucleotide-polymorphism markers for comparison purposes to aid transition to the new marker baseline that is being constructed.

Water Temperature Monitoring

Water temperatures were recorded at 27 locations in the Clearwater River and Salmon River drainages (Table 14). Besides water temperature, we recorded air temperature, barometric pressure, and humidity at Fish Creek. The Fish Creek water temperature recorder was lost during the spring runoff. The Big Creek water temperature data were not downloaded before this report was written.

DISCUSSION

The profile of Idaho's wild steelhead populations has continued to increase relative to hydropower mitigation requirements and ESA recovery plans. The Federal Columbia River Power System Biological Opinion (NMFS 2008) specifically addressed gaps in wild B-run steelhead monitoring information. Regional planning efforts have been hampered by the lack of productivity estimates for steelhead in Idaho (e.g., the USFWS Columbia River hatchery review process). Although ISMES is the only project funded by Bonneville Power Administration specifically to collect demographic or genetic data on wild steelhead in Idaho, the project has been limited in its geographic scope. In 2008, a Memorandum of Agreement between the State of Idaho and the action agencies in the Federal Columbia River Power System mandated that the scope of ISMES activities be expanded to provide additional B-run steelhead population status information. In short, there is more regional emphasis on monitoring abundance and productivity for wild steelhead populations in Idaho.

Abundance and productivity are perhaps the most important of the criteria used to judge risk of extinction. The initial effort towards additional steelhead monitoring was to sample the adult return to Lower Granite Dam in 2008. We computed an escapement estimate of 20,078 wild steelhead, but it is likely biased high to some degree because fallback rates were not included in calculations. Boggs et al. (2004) found that the steelhead fallback rate at Lower Granite Dam varied from 2.7% to 8.4% during 1996-2001. We also conducted genetic stock identification of the run at large to get abundance by genetic group. Resolution was at a scale less than major population group but above the population level in most cases (Appendix A). By estimating age structure by group, productivities can be derived over time. However, it will take several years of continued sampling to develop a series of adult-to-adult productivity measures. Currently, the Interior Columbia Basin Technical Recovery Team is attempting to develop a juvenile-to-juvenile productivity measure using parr densities from snorkel surveys to fill the productivity information gap until better measures can be derived (Charlie Petrosky, personal communication).

The 2008 Lower Granite Dam sampling was approached as a feasibility study. Although operations proceeded well logistically, several issues need resolution in order to provide quality data for addressing steelhead abundance and productivity. First, approximately 13% of the fall run passed before the trap was in operation (Figure 12). Sampling during August may always be problematic due to high water temperatures but the validity of extrapolating the early fall sample to this period needs to be explored. Second, in order to complete sampling of the entire spawn year, spring immigrants over Lower Granite Dam need to be sampled. This task is planned for spring 2009. Third, project personnel were not kept up-to-date on changes in the trapping rate as the season progressed. This issue was driven by sampling goals for fall Chinook salmon. Fortunately, these changes were detected quickly enough so that subsampling rates were adjusted to collect more than the desired number of samples. We then post-stratified samples to achieve the target sample rate. Efforts are being made to participate in 2009 preseason planning so that communication with personnel directing trap operation will be facilitated. Finally, the issue of non-adipose-clipped hatchery fish in window counts of 'wild steelhead' needs resolution. Hatchery-origin fish composed 46% of the unmarked catch in the Lower Granite Dam adult trap. Window counts at the dam included these fish with wild steelhead, greatly inflating wild steelhead escapement estimates. Obviously, even given that resolution of genetic stock identification is sufficient, the methodology of developing wild steelhead escapement estimates must be refined in order to produce statistically valid and accurate abundances.

The ultimate focus for recovery monitoring is on adult fish at the population level. Opportunities to collect adult steelhead in Idaho are limited. Originally, ISMES began with the weir on Fish Creek and then expanded to Rapid River, where hatchery personnel operate a permanent trap with passage of wild adult steelhead as an incidental task. We have made efforts to coordinate collection of wild adult data at other hatchery weirs in Idaho. For example, this year we reported ages of wild adult steelhead trapped at the Sawtooth and Pahsimeroi hatchery weirs (Table 6). However, escapement estimates will require assessment of weir efficiency. Although only the Pahsimeroi weir covers most of a population as defined by the TRT, information from other hatchery weirs would be valuable indicators of the status of the populations they are located within. Opportunities may exist at the Clear Creek, Crooked River, and Red River hatchery weirs.

The most complete data on juvenile steelhead are generated by screw traps, although geographic coverage is limited. We have increased coverage by coordinating with other projects operating screw traps (Idaho Supplementation Studies, Johnson Creek Artificial Propagation Enhancement, Potlatch River Steelhead Monitoring and Evaluation). These data should provide information on the range of abundance, age, emigration timing, and survival. The intent is to integrate this information, along with stream temperature and conductivity, into a model of juvenile productivity (egg to smolt) that can be applied to a wider area.

We anticipated that the 2008 trapping season would be challenging and it was. The most successful field operation was at Rapid River. The hatchery Chinook releases cleared the system before the main pulse of the juvenile steelhead emigration. Loss of trapping time was minimal for this screw trap. The Fish Creek screw trap stayed in operation but was pulled in close to the bank for much of May, reducing efficiency. The Fish Creek weir was compromised and the adult abundance estimate derived PIT tag detections in the hydrosystem has wide confidence bounds. Running the weir always gives better precision. The Big Creek screw trap was pulled for 56 days due to freezing in the early spring months, high flows from spring run-off during May and June, and summer rain events that caused blowouts upstream in the Big Creek drainage. The Secesh trap was dismantled and stored on shore in anticipation of high run-off on May 3 and not re-installed until July 16. The remote location of this trap makes it hard to be responsive to changes in river conditions and placement affords no safe harbor during high flows, so its management has been extremely conservative. For logistical reasons, operation of this trap will be taken over by Integrated Status and Evaluation Monitoring Project (ISEMP) and the Nez Perce Tribe in 2009.

The snorkel season was also challenging. High flows through July reduced coverage and crew efficiency. The latter issue will be covered in the INPMEP report. The ISMES snorkel effort is now fully integrated with INPMEP in terms of planning, coordination, and cooperation. In 2009, the ISMES snorkel crew will participate in group training in the Potlatch River drainage again. Intensive efforts will continue in the Fish Creek and Rapid River drainages at established, probabilistically-chosen sites, 15 sites minimum for each. The ISMES snorkel crew will assist INPMEP crew to survey historic trend sites in the upper Salmon River drainage and the South Fork Clearwater drainage.

Perhaps the most cutting-edge portion of ISMES has been the genetic work. The genetic baseline for steelhead populations in the Pacific Northwest is being finalized (Matt Campbell, Eagle Genetics Laboratory, personal communication). The next step is to apply this baseline to differentiate newly sampled steelhead to population of origin. The collection of samples at Lower Granite Dam will provide an excellent test of the baseline. Currently, the genotyping has been completed for these samples and the preliminary results presented in Appendix A. While this work will supply valuable data at large scales, there are still genetic concerns at smaller scales that need to be addressed (e.g., hatchery straying, diversity, and residency). Furthermore, the baseline needs to remain current and sampling will be needed for maintenance. These issues need to be recognized during planning for the future.

During 2009, several large issues will impinge on ISMES. First, the *United States v. Oregon* Management Agreement completed in 2008 specifies that work to initiate supplementation of selected steelhead populations in Idaho will begin in 2010. Second, the ISMEP project mandated by the 2008 Biological Opinion has become operational in the Salmon River drainage. Third, the ESA recovery plans are being finalized and NOAA Fisheries is specifying the data that will be necessary for ESA status reports. Several regional processes are currently underway to develop the required monitoring plans. Lastly, the Bonneville Power proposal solicitation process will begin in 2009. We will try to anticipate the regional data needs implied by these projects to shape how ISMES goes forth in the future.

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Table 1. Number of individuals assigned to freshwater and ocean ages from steelhead sampled at Lower Granite Dam during 2008. X = only saltwater age assigned.

	Freshwater age						
Ocean age	**X**	**1**	**2**	**3**	**4**	**5**	**Total**
1	13	5	180	204	27	1	430
2	35	2	286	168	25	0	516
3	5	0	20	20	1	0	46
Total	53	7	486	392	53	1	992

Table 2. The number and mean length, by sex, of adult steelhead captured at Fish Creek and Rapid River during 2008. Fork length 95% confidence interval is in parentheses.

	Adults	**Fork length (cm)**		
Sex	**trapped**	**Mean**	**Maximum**	**Minimum**
Fish Creek				
Female	7	75 (5)	84	66
Male	10	69 (3)	80	64
Total	17	72 (3)	84	64
Rapid River				
Female	46	69 (2)	84	58
Male	42	66 (2)	86	55
Total	88	68 (2)	86	55

Table 3. Capture date percentiles of adult steelhead at the Fish Creek and Rapid River weirs in 2008. N = number of fish.

		Date percentile attained						
Sex	**N**	**First**	**10%**	**25%**	**50%**	**75%**	**90%**	**Last**
Fish Creek								
Female	7	4/12	4/12	4/16	4/29	5/6	5/11	5/11
Male	10	4/13	4/13	4/19	4/26	5/5	5/11	5/14
Total	17	4/12	4/13	4/19	4/29	5/5	5/11	5/14
Rapid River								
Female	46	4/14	4/17	4/29	5/8	5/15	5/16	5/23
Male	42	3/26	4/14	4/17	5/5	5/8	5/16	5/20
Total	88	3/26	4/14	4/29	5/7	5/15	5/16	5/23

Table 4. Individual adult steelhead detected during the 2007-2008 spawning run that were PIT-tagged in Fish Creek and Rapid River as juveniles. Detection sites were at Bonneville (BON), McNary (MCN), Ice Harbor (ICH), and Lower Granite (LGR) dams and the Fish Creek or Rapid River weirs.

		Detection at:				
PIT tag number	**Tag date**	**BON**	**MCN**	**ICH**	**LGR**	**Weir**
			Fish Creek			
3D9.1BF1699D81	09/10/03	09/23/07	10/15/07	12/12/07		
3D9.1BF1396484	10/10/03	10/01/07	10/12/07			
3D9.1BF1CB4C77	07/10/04	08/31/07	10/13/07	10/15/07	10/20/07	05/05/08
3D9.1BF1CBCD09	08/08/04	09/24/07	10/24/07			
3D9.1BF1CBCB02	08/14/04	08/21/07	09/03/07	09/05/07	09/12/07	
3D9.1BF1C6638E	08/25/04	08/15/07	09/28/07	10/01/07	10/07/07	
3D9.1BF1CBB8B0	08/26/04	08/30/07	09/25/07	10/04/07	10/11/07	
3D9.1BF1C4D81E	08/29/04	08/13/07	09/23/07	09/25/07	10/02/07	
3D9.1BF1CBCBC7	09/15/04	09/05/07	09/11/07	11/25/07	12/08/07	04/26/08
3D9.1BF1C4AE5C	10/17/04				11/15/07	
3D9.1BF1CC01CE	10/29/04	08/24/07	10/26/07	10/28/07	11/02/07	
3D9.1BF1A24914	06/26/05	08/18/07				
3D9.1BF1C70DDC	07/12/04	09/05/07	09/25/07	09/27/07	10/04/07	
3D9.1BF16BD3E1	07/11/04	09/15/07	10/14/07	10/20/07	11/12/07	
3D9.1BF1A26772	06/07/05	09/11/07	10/07/07	10/13/07		
3D9.1BF1AE8C0	08/13/05	09/01/07	09/26/07	10/30/07		
3D9.1BF1F9B8FB	08/20/05	09/08/07	09/19/07	10/09/07	10/16/07	
3D9.1BF1A27131	09/05/05	08/18/07	09/18/08	09/24/07	10/02/07	04/19/08
3D9.1BF1A7C3D2	09/08/05	09/11/07	09/23/07	09/26/07	10/03/07	
3D9.1BF1A19D8F	09/21/05	08/31/07	10/06/07	10/08/07	10/14/07	
			Rapid River			
3D9.1BF1A2CE70	09/17/04	09/11/07	09/18/07	09/22/07	09/27/07	
3D9.1BF1A2D70B	10/21/04	10/06/07	10/13/07	10/18/07	10/24/07	05/14/08
3D9.1BF1A95433	05/03/05	09/02/07	09/10/07	09/13/07	09/21/07	
3D9.1BF1BF8F43	05/11/05	09/08/07	09/24/07	11/15/07	11/27/07	05/16/08
3D9.1BF0FC7245	04/25/06	08/12/07	08/25/07	09/16/07	04/23/08	05/08/08

Table 5. Age composition and mean fork length (FL, cm), by sex, of adult steelhead captured at the Fish Creek and Rapid River weirs during 2008. The 95% CIs of mean fork lengths at age are in parentheses.

		Ocean age 1		Ocean age 2		Ocean age 3	
Stream	**Sex**	**N**	**FL**	**N**	**FL**	**N**	**FL**
Fish Creek	F	2	68 (4)	4	77 (6)	1	84
	M	7	68 (2)	3	73 (8)	0	-
Rapid River	F	21	62 (2)	22	75 (2)	2	80
	M	32	64 (1)	6	74 (11)	1	78

Table 6. Ages assigned to adult steelhead sampled at weirs during spring 2008. Age values before the period denote freshwater ages and values after denote saltwater ages. X means a freshwater age was not assigned.

	Age												
Location	**1.2**	**2.1**	**2.2**	**2.3**	**3.1**	**3.2**	**3.3**	**4.1**	**4.2**	**5.1**	**x.1**	**x.2**	**x.3**
Fish Creek		3	3	1	3	2					3	2	
Rapid River		19	8	1	20	11	1	3	1	1	10	8	1
Big Creek		1			2			1			6		
Sawtooth		3	2		1						4	3	
Pahsimeroi	1	16	8		2						4	1	1

Table 7. Densities (fish/100 m^2) of salmonids observed at basinwide and historic trend sites snorkeled in the Fish Creek drainage during 2008. Trout fry = all trout <50 mm. Sites are arranged in upstream to downstream order.

		Density				
Site	**Stream**	**Trout Fry**	**Steelhead**	**Wild Chinook Salmon**	**Cutthroat Trout**	**Whitefish**
Basinwide sites						
57378	Fish Creek	0.00	0.67	0.00	3.00	0.00
24610	Fish Creek	0.00	0.34	0.00	2.41	0.00
33698	Hungery Creek	0.56	0.85	0.00	1.41	0.00
164770	Hungery Creek	0.96	1.45	0.00	3.62	0.00
17314	Hungery Creek	0.00	5.76	0.00	0.72	0.00
96194	Fish Creek	0.00	0.62	0.00	1.73	0.00
167874	Fish Creek	0.00	0.00	0.13	0.00	0.00
151490	Fish Creek	0.00	0.00	0.00	0.00	0.00
20418	Fish Creek	0.00	1.14	0.00	0.00	0.00
102338	Fish Creek	0.00	0.00	0.00	0.00	0.00
58050	Hungery Creek	0.00	6.38	0.00	0.92	0.00
221890	Willow Creek	0.40	2.38	0.00	2.38	0.00
156354	Willow Creek	0.00	6.32	0.00	0.00	0.00
172738	Fish Creek	0.00	2.78	0.00	1.03	0.00
41666	Fish Creek	0.26	6.70	0.00	0.97	0.06
74434	Fish Creek	0.00	6.55	0.00	2.10	0.00
12994	Fish Creek	0.49	4.48	0.00	0.55	0.00
	Mean	0.16	2.73	0.01	1.23	<0.01
	SD	0.28	2.66	0.03	1.15	0.02
Historic trend site						
GPM2	Fish Creek	0.09	8.05	0.00	1.33	0.19

Table 8. Densities (fish/100 m^2) of salmonids observed at basinwide and historic trend sites snorkeled in the Rapid River drainage during 2008. Trout fry = all trout <50 mm. Sites are arranged in upstream to downstream order.

		Density					
Site	**Stream**	**Trout Fry**	**Steelhead**	**Hatchery Chinook Salmon**	**Wild Chinook Salmon**	**Cutthroat Trout**	**Bull Trout**
Basinwide sites							
90194	Rapid River	0.00	0.00	0.00	0.00	0.00	1.46
155730	Rapid River	0.00	0.00	0.00	0.00	0.00	1.71
192402	Rapid River	0.00	1.76	0.00	0.00	0.00	1.47
126866	Rapid River	0.00	2.58	0.00	0.00	0.00	1.15
17298	Rapid River	0.00	2.79	0.00	0.00	0.00	0.09
122258	Rapid River	0.00	5.39	0.00	0.00	0.00	0.19
15762	Rapid River	0.00	5.55	0.00	0.00	0.00	0.00
163218	W Fork Rapid River	0.16	3.60	0.00	0.00	0.00	0.31
193426	Rapid River	0.38	4.09	0.00	0.31	0.00	0.00
127890	Rapid River	0.00	3.04	0.00	0.08	0.00	0.23
19346	Rapid River	3.14	11.56	0.00	2.42	0.27	0.36
215954	Rapid River	4.40	4.78	0.64	1.98	0.00	0.26
	Mean	0.67	3.76	0.05	0.40	0.02	0.72
	SD	1.48	3.06	0.18	0.85	0.08	0.64
Historic trend sites							
Paradise Bridge	Rapid River	0.00	1.61	0.00	0.00	0.00	0.91
Copper Creek	Rapid River	0.00	2.76	0.00	0.00	0.00	0.20
Castle Creek	Rapid River	0.00	5.31	0.00	0.00	0.00	0.37
Cora Cliff	Rapid River	0.35	4.54	0.00	0.00	0.00	0.35
Cliff	Rapid River	0.08	4.41	0.00	0.00	0.00	0.08
04	Rapid River	0.00	4.09	0.00	0.00	0.00	0.00
	Mean	0.07	3.79	0.00	0.00	0.00	0.38
	SD	0.14	1.35				0.32

Table 9. The number of scale samples from juvenile steelhead, by date, collected at rotary screw traps during 2008 by ISMES personnel and cooperators.

	Date			
Trap	**3/1–5/31**	**6/1–8/14**	**8/15–11/31**	**Total**
Clearwater River Drainage				
American River	26	29	41	96
Clear Creek	25	0	0	25
Colt Killed Creek	163	2	33	198
Crooked Fork Creek	235	19	253	507
Crooked River	64	33	0	97
Fish Creek	90	2	324	416
Red River	11	19	19	49
Salmon River Drainage				
Big Creek	132	0	271	403
Johnson Creek	94	172	0	266
Lemhi River	37	1	104	142
Marsh Creek	69	81	99	249
Pahsimeroi River	40	14	56	110
Rapid River	300	0	195	495
Salmon River at Sawtooth	20	4	14	38
Secesh River	2	0	203	205
SF Salmon at Knox Bridge	113	0	190	303

Table 10. Mean fork length at age of juvenile steelhead captured at screw traps in three streams during 2008 by date. Number of fish aged is in parentheses.

	Fork length (mm)				
Season/stream	**Age 0**	**Age 1**	**Age 2**	**Age 3**	**Age 4**
3/1 – 5/31					
Fish Creek	—	88 (5)	129 (24)	168 (42)	179 (8)
Rapid River	—	91 (12)	158 (22)	183 (204)	195 (52)
Big Creek	—	93 (33)	152 (17)	177 (56)	203 (16)
Secesh River	—	—	—	174 (1)	182 (1)
6/1 – 8/14					
Fish Creek	—	—	159 (2)	—	—
Rapid River	—	—	—	—	—
Big Creek	—	—	—	—	—
Secesh River	—	—	—	—	—
8/15 – 11-31					
Fish Creek	—	122 (97)	155 (195)	174 (20)	—
Rapid River	84 (7)	143 (44)	171 (121)	191 (18)	—
Big Creek	100 (2)	128 (108)	173 (118)	201 (27)	212 (2)
Secesh River	—	150 (1)	163 (112)	182 (74)	193 (4)

Table 11. Number of PIT-tagged steelhead smolts that were detected in the hydrosystem during 2008 by population and year tagged. See Methods for a list of interrogation sites.

	Year tagged				
Stream tagged	**2005**	**2006**	**2007**	**2008**	**Total**
Fish Creek	2	272	2905	34	3,213
Rapid River	0	0	0	192	192
Big Creek	3	3	511	132	649
Secesh River	5	16	126	1	148

Table 12. Percentile dates of arrival at Lower Granite Dam for PIT-tagged steelhead smolts detected in spring 2008.

	Percentile		
Stream	**10%**	**50%**	**90%**
Fish Creek	April 27	May 7	May 17
Rapid River	May 7	May 11	May 18
Big Creek	April 23	May 8	May 13
Secesh River	April 19	May 5	May 12

Table 13. Number of genetic samples collected from juvenile and adult steelhead during 2008.

Location	Juvenile	Adult
Fish Creek	0	17
Little Clearwater River	79	0
Selway River at Hells Half Acre Creek	92	0
White Cap Creek	102	0
Big Creek	232	0
Lower Granite Dam	0	1,534

Table 14. Streams sampled for water temperatures in 2008. 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
East Fork Salmon River
East Fork Salmon River, 100 m upstream of Bowery Hot Springs
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
Secesh River at screw trap site
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, 100 m upstream of screw trap site (backup)
Fish Creek #3, 2 km upstream of Hungery Creek
Gedney Creek #1
Gedney Creek #2, 2 km upstream of mouth
Hungery Creek
Indian Creek (tributary of Selway River)
Little Clearwater River (tributary of Selway River)
O'Hara Creek, 2 km downstream of Hanby Fork
Red River, 1 km upstream of SF Red River
Selway River, at Magruder Cabin
White Cap Creek (tributary of Selway River), downstream of Paradise Cabin
Willow Creek (tributary of Fish Creek)

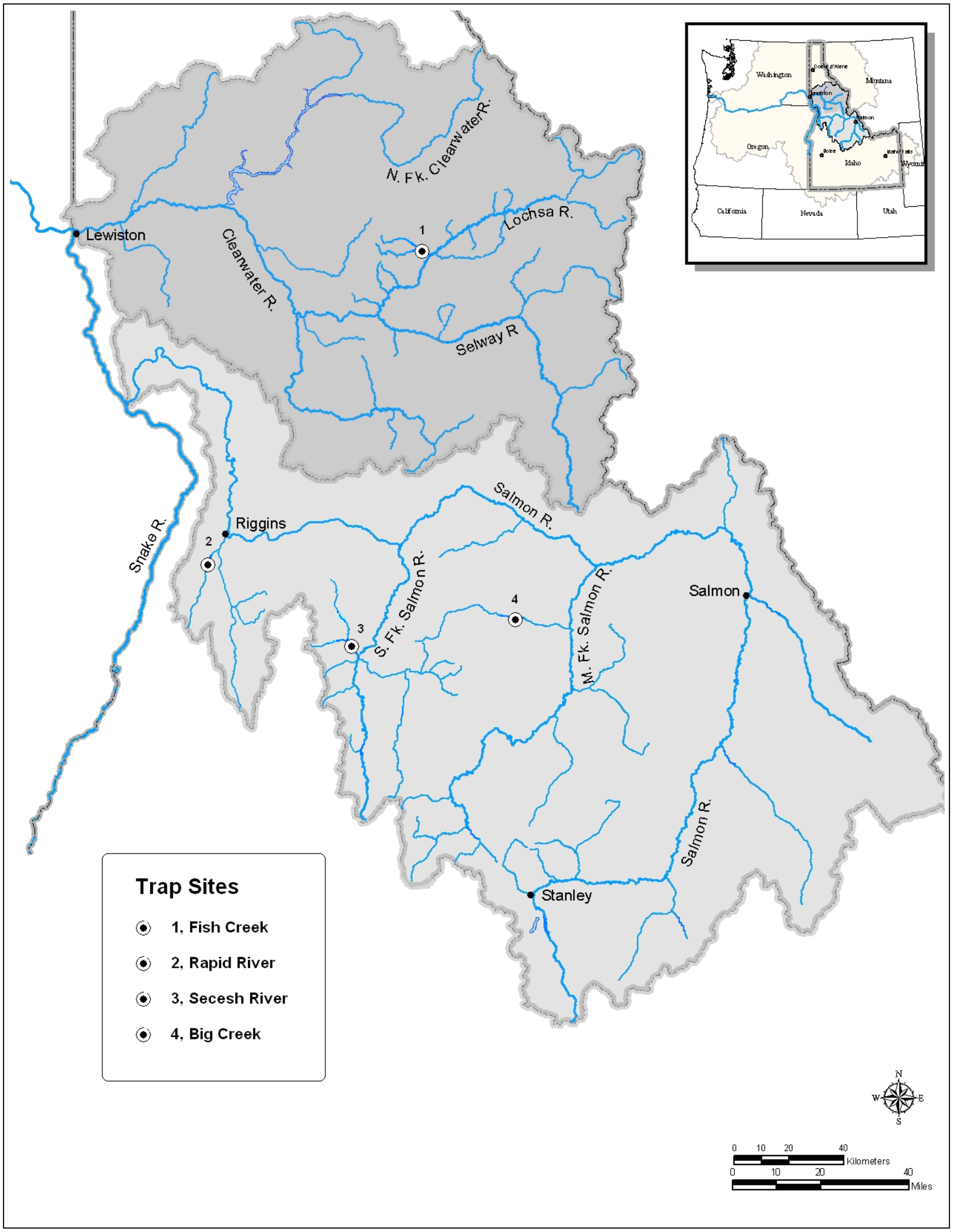

Figure 1. Map of the Clearwater River and Salmon River drainages showing the locations of the locations of the adult and juvenile traps on Fish Creek and Rapid River, and the juvenile traps on Secesh River, and Big Creek. The inset shows the position of the study in the Columbia River basin.

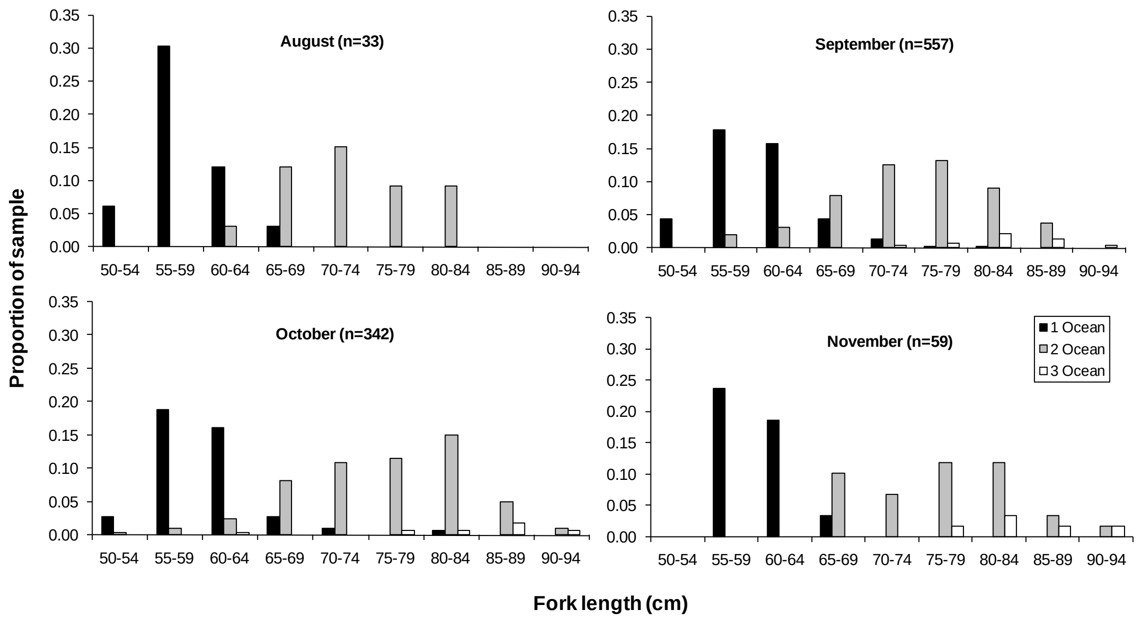

Figure 2. Ocean age composition of scale samples collected at Lower Granite Dam during fall 2008 by month.

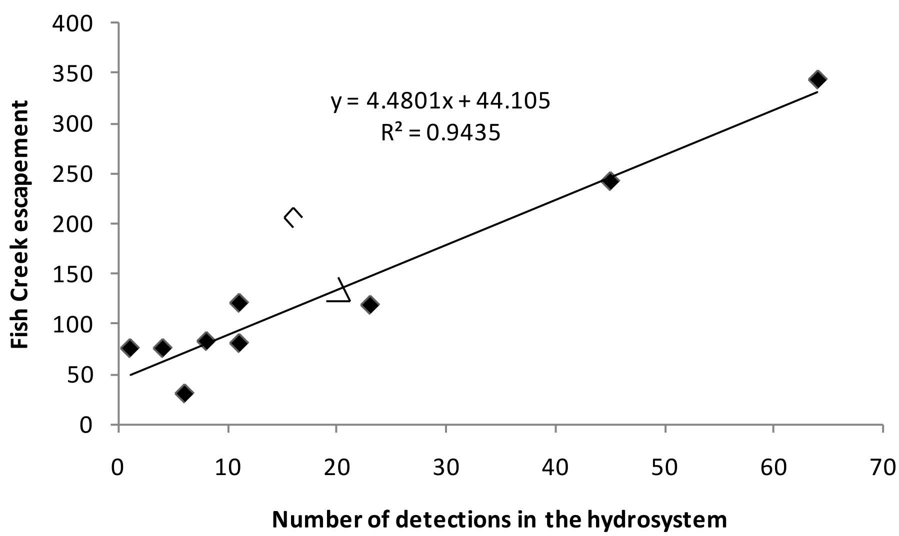

Figure 3. Number of PIT-tag detections in the hydrosystem of adult steelhead tagged as juveniles in Fish Creek versus estimated escapement into Fish Creek for each spawn year 1998-20. The trend line was fitted to all observations except spawn year 2004 (hollow diamond). The hollow triangle is the spawn year 2008 prediction.

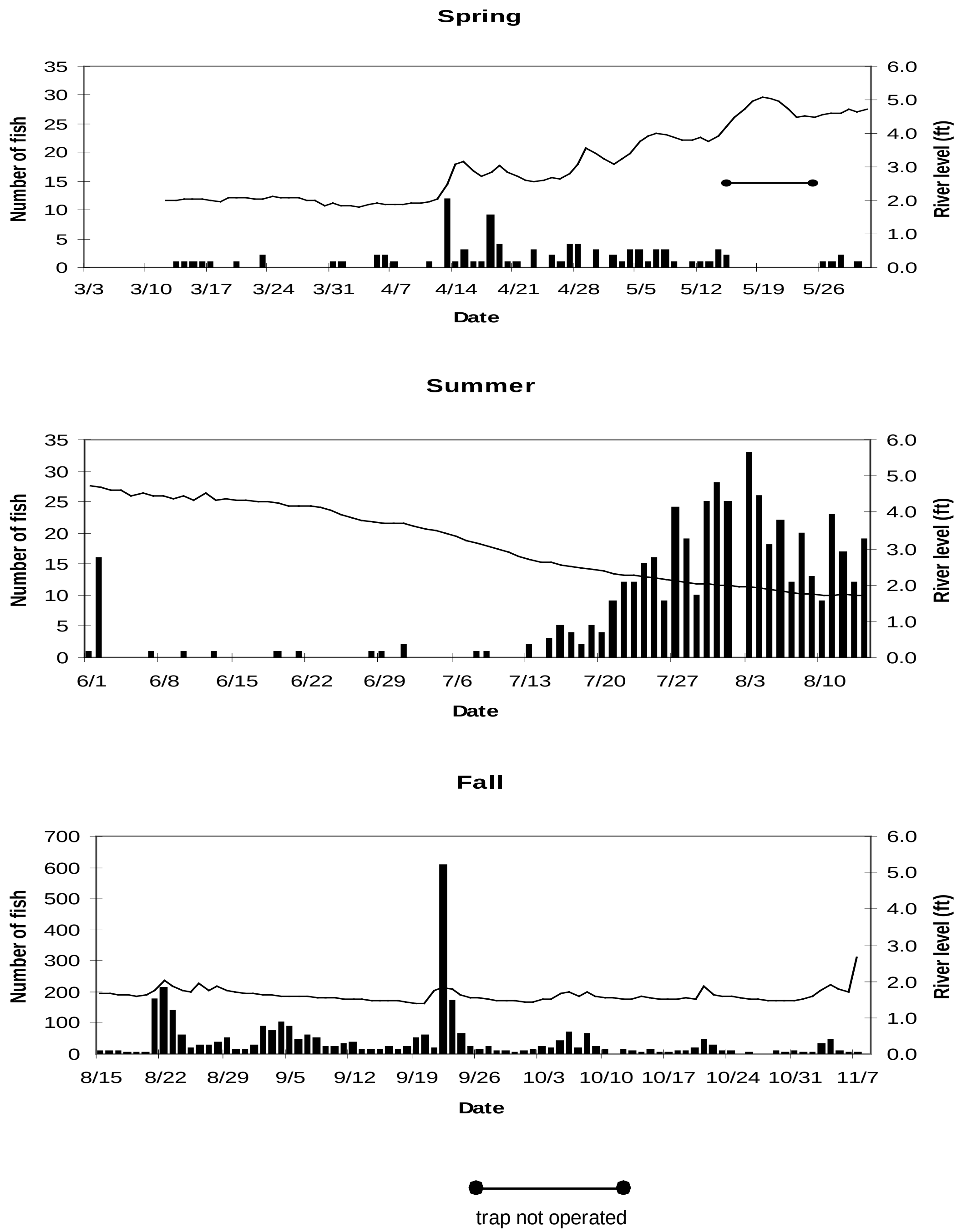

Figure 4. Daily number of steelhead juveniles captured in the Fish Creek screw trap (bars) and river level (line; ft) during 2008. Spring (n = 96) is top panel; summer (n = 481) is middle panel; and fall (n = 3,226) is bottom panel. Note difference in the y-axis scale in bottom panel.

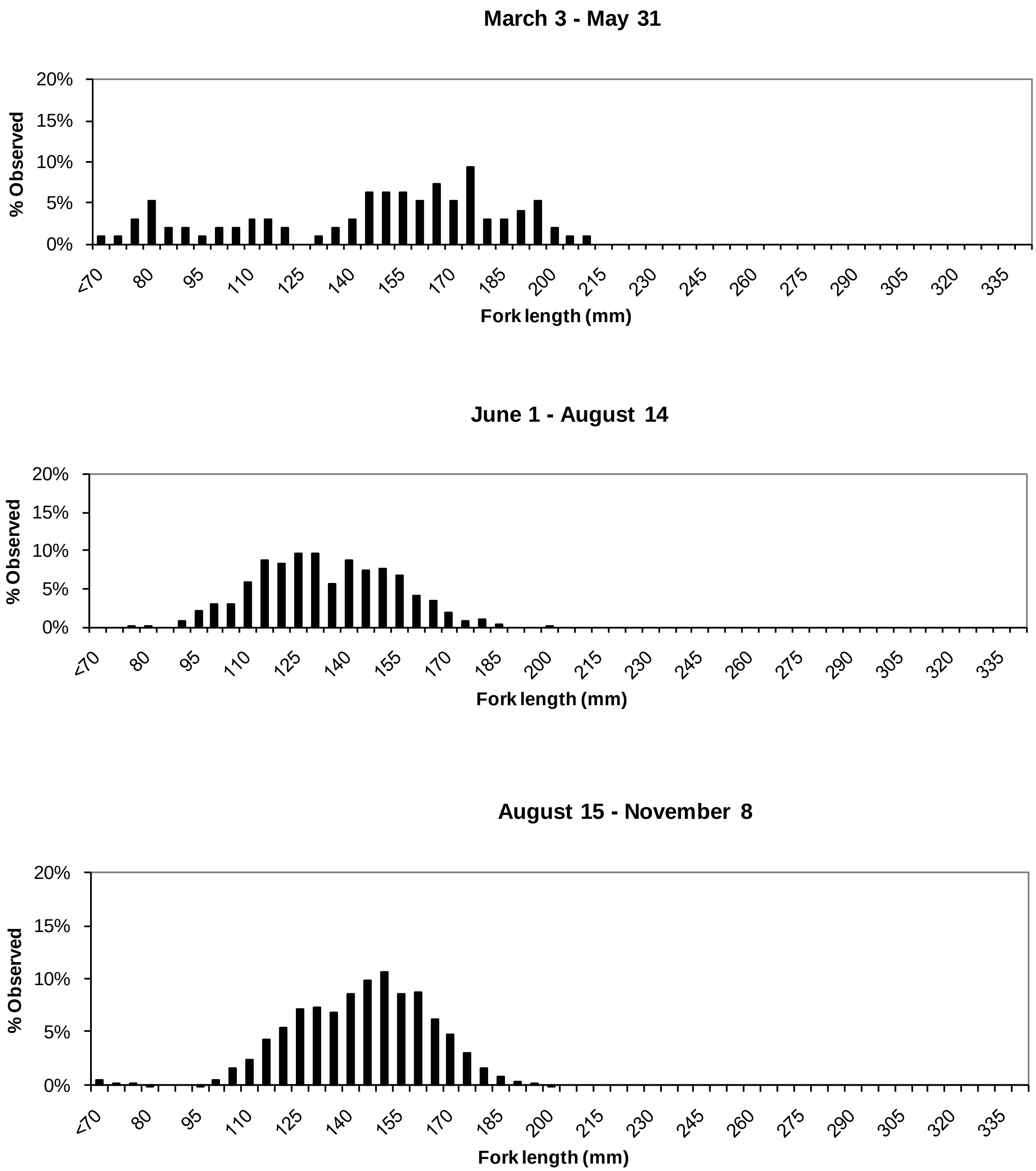

Figure 5. Length frequency of steelhead juveniles captured in the Fish Creek screw trap during 2008. Spring (n = 96) is top panel; summer (n = 481) is middle panel; and fall (n = 3,221) is bottom panel.

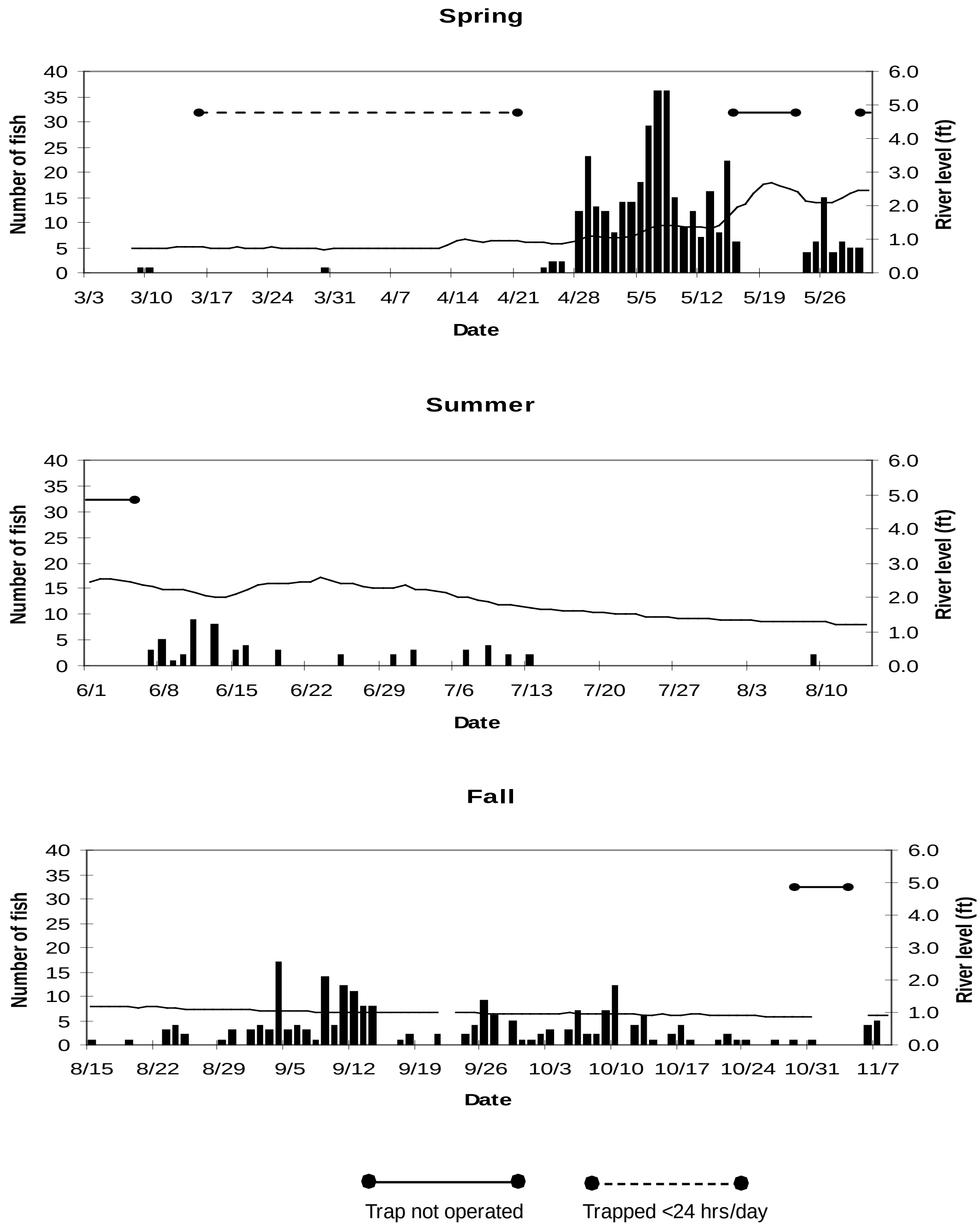

Figure 6. Daily number of steelhead juveniles captured in the Rapid River screw trap and river level (ft) during 2008. Spring (n = 363) is top panel; summer (n = 58) is middle panel; and fall (n = 216) is bottom panel.

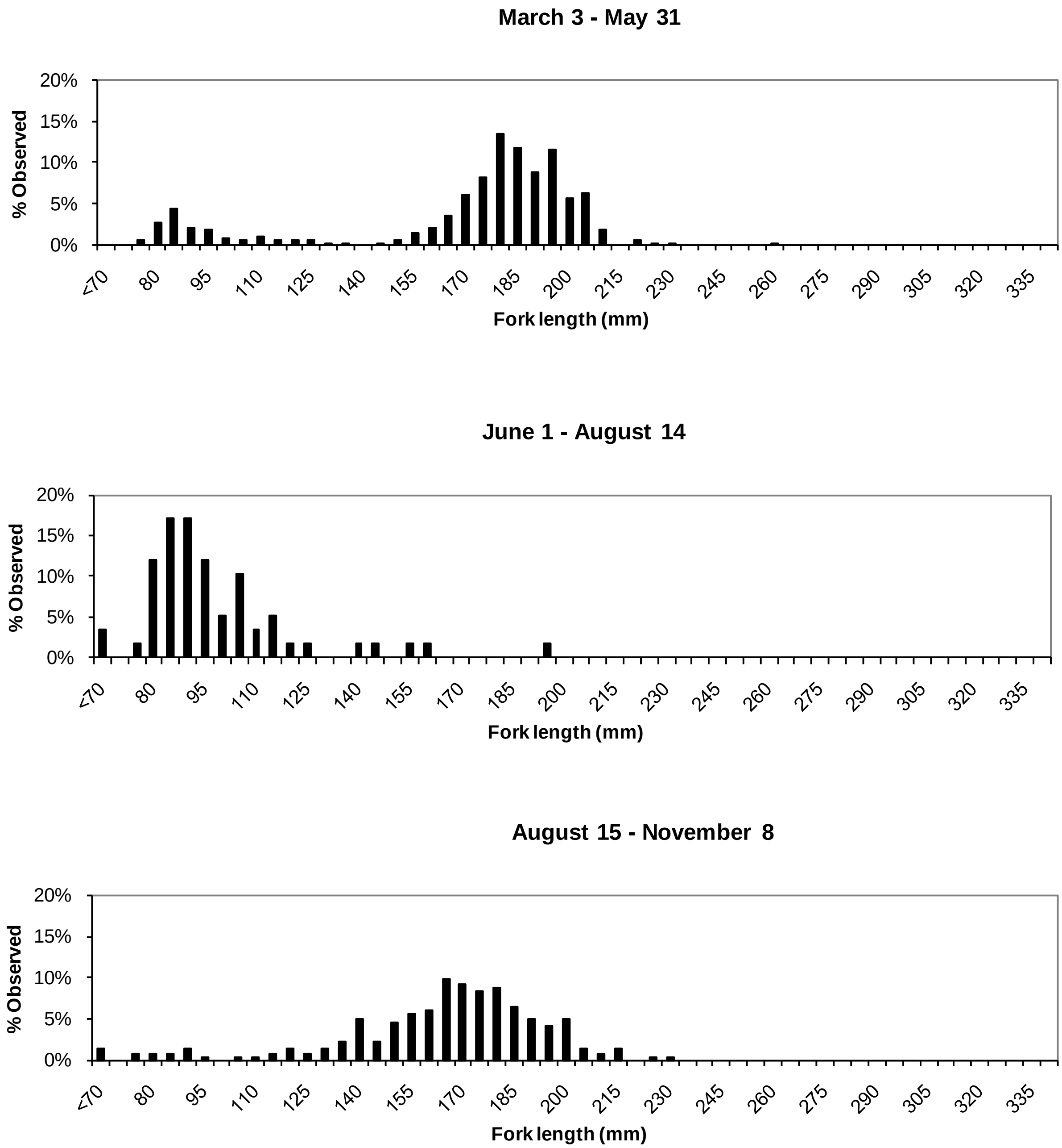

Figure 7. Length frequency of steelhead juveniles captured in the Rapid River screw trap during 2008. Spring (n = 363) is top panel; summer (n = 58) is middle panel; and fall (n = 214) is bottom panel.

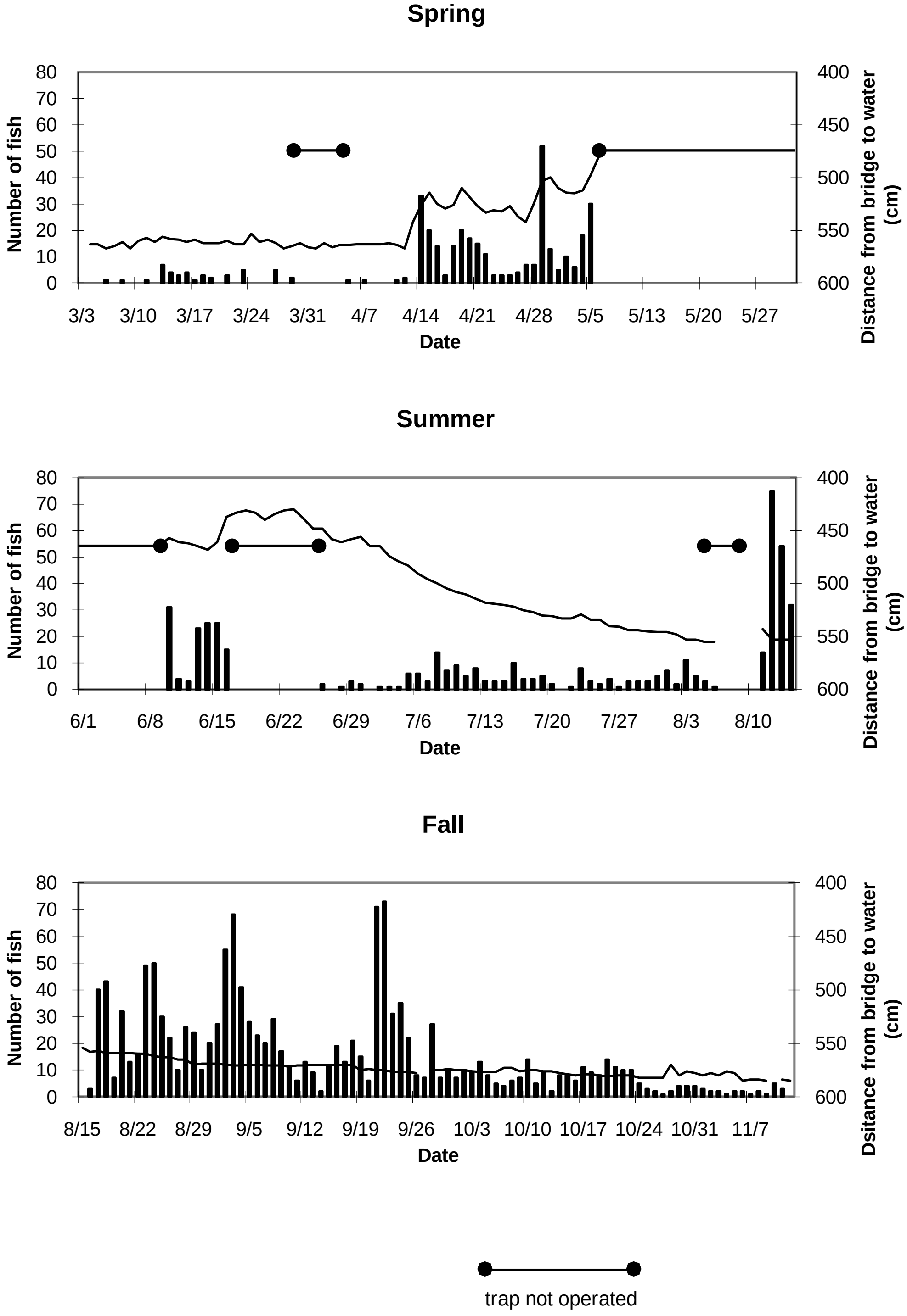

Figure 8. Daily number of steelhead juveniles captured in the Big Creek screw trap and distance from pack bridge to water surface (cm) during 2008. Spring (n = 355) is top panel; summer (n = 466) is middle panel; and fall (n = 1,364) is bottom panel.

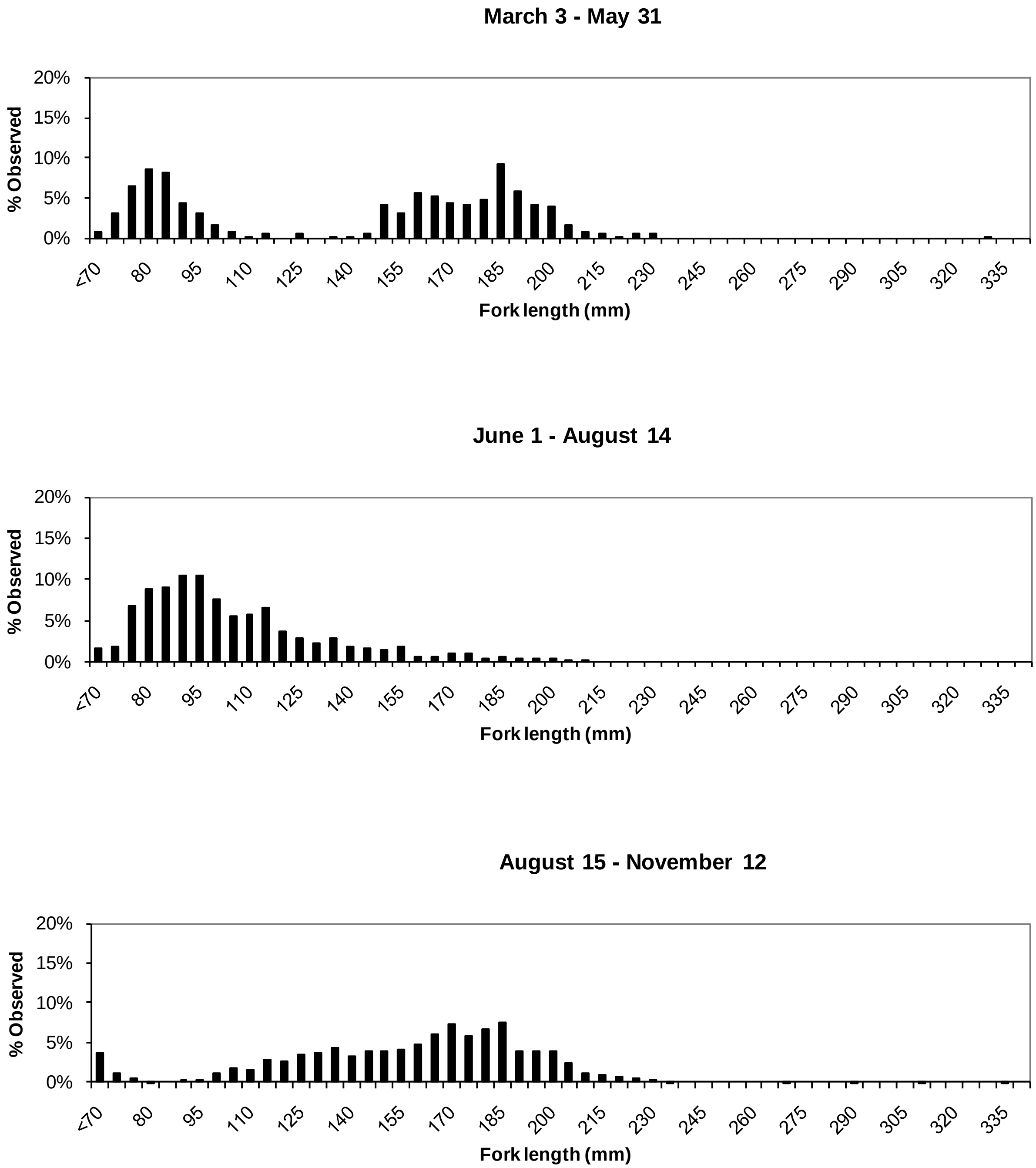

Figure 9. Length frequency of steelhead juveniles captured in the Big Creek screw trap during 2008. Spring (n = 355) is top panel; summer (n = 465) is middle panel; and fall (n = 1,364) is bottom panel.

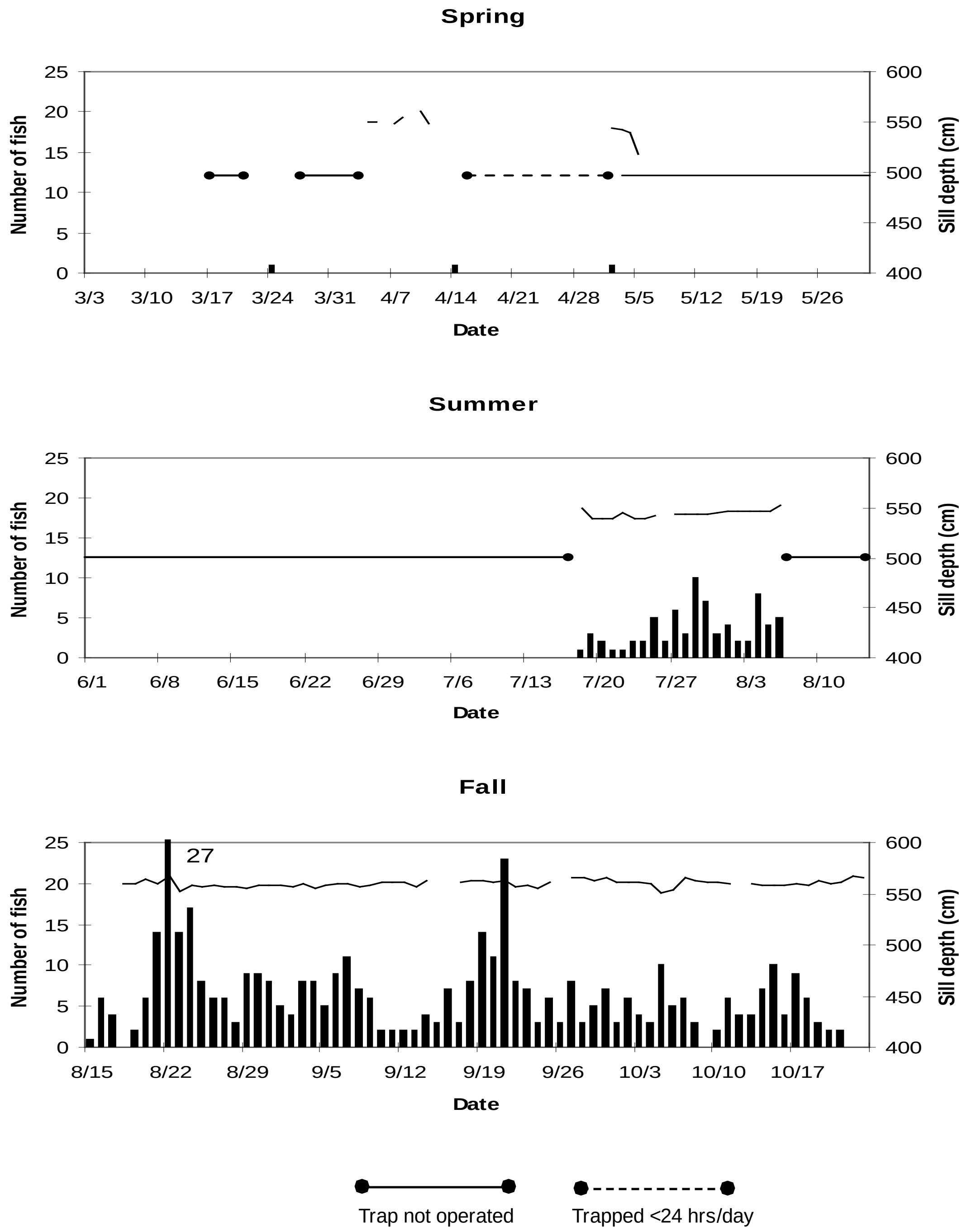

Figure 10. Daily number of steelhead juveniles captured in the Secesh River screw trap and sill depth (cm) during 2008. Spring (n = 3) is top panel; summer (n = 73) is middle panel; and fall (n = 433) is bottom panel.

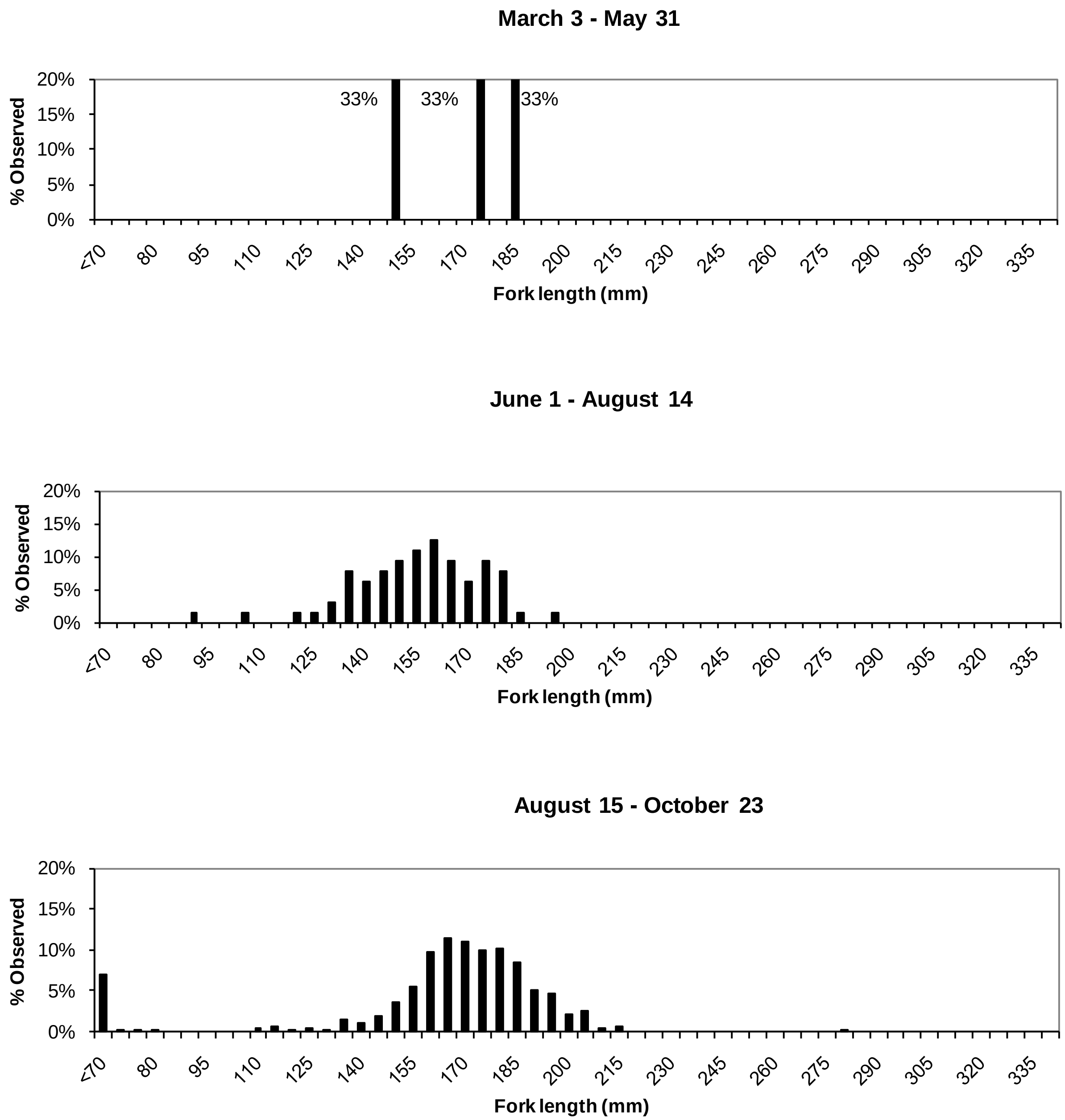

Figure 11. Length frequency of steelhead juveniles captured in the Secesh River screw trap during 2008. Spring (n = 3) is top panel; summer (n = 64) is middle panel; and fall (n = 433) is bottom panel.

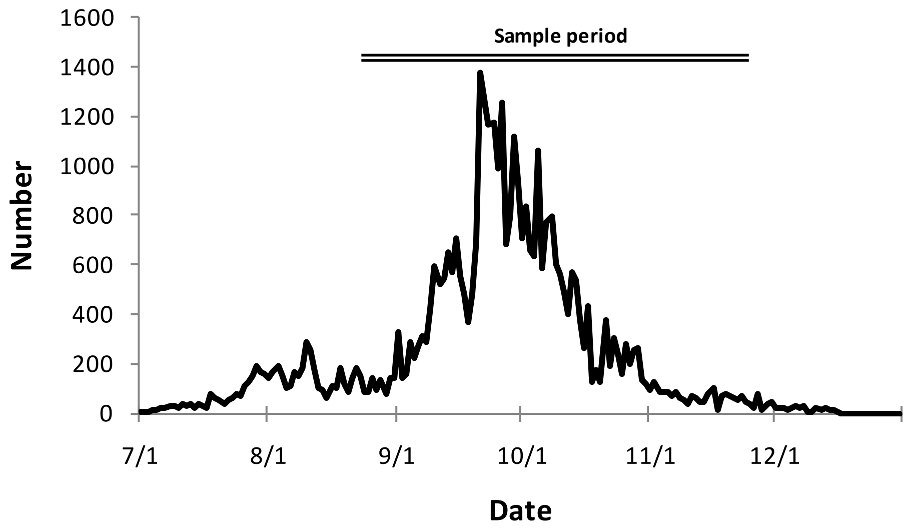

Figure 12. Number of wild steelhead crossing Lower Granite Dam in 2008, based on window counts. The period when scale samples were collected is denoted by a horizontal bar.

APPENDICES

Appendix A. Genetic stock identification of wild steelhead at Lower Granite Dam

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METHODS

A genetic baseline of 85 Snake River basin *O. mykiss* populations was available as part of a multi-laboratory, collaborative effort to build a standardized coastwide microsatellite baseline for steelhead (SPAN, in preparation). All of these populations (4,686 samples) had been genotyped with a standardized set of 13 microsatellite loci (Stephenson et al. 2008). Of the 85 populations, 19 were removed because they were hatchery populations or due to issues associated with low sample sizes, departures from Hardy-Weinberg equilibrium, or sample location (above barriers, non-anadromous). This left 66 populations to serve as a baseline for genetic stock identification purposes (3,803 samples; Table A.1 and Figure A.1). One additional steelhead population (Bogachiel hatchery) from outside the Snake River basin was included for reference purposes (96 samples).

DNA was extracted from samples take at Lower Granite dam during August-November 2008 using a Nexttec Genomic DNA Isolation Kit for Fish Tissue according to the manufacturer's instructions (www.nexttec.biz). Samples were amplified with the same set of 13 standardized microsatellite locus set as baseline samples (*Ogo4, Oke4, Oki23 Omy1001, Omy1011, Omy7, Oneu14, Ots100, Ots3m, Ots4, Ssa289, Ssa407, Ssa408*). Primer sequences for these loci can be found in Stephenson et al. (2008). Specific polymerase chain reaction (PCR) amplification protocols for all loci, as well as thermal cycling conditions, are available from the Eagle Genetics Laboratory upon request.

Data Analysis

To assess the appropriate number and composition of baseline reporting groups of which to assign mixtures, samples were analyzed with the software program Bayesian Analysis of Population Structure (BAPS. 5.2). BAPS assigns populations to *k* clusters using a partition based mixture model that minimizes deviations from Hardy–Weinberg equilibrium and linkage equilibrium within each cluster. BAPS has been demonstrated to infer the correct number of clusters even at low levels of population differentiation (Latch et al 2006).

To evaluate the potential accuracy of selected reporting groups for GSI, we followed the preferred methods of Anderson et al. (2008) in the software program ONCOR (http://www.montana.edu/kalinowski) to perform 100% simulations. These procedures test each population under the scenario that the mixture is solely comprised of that population. A 90% or greater correct allocation indicates that the reporting group is highly identifiable (Seeb et al. 2007). The number of mixture samples to generate for each population was set at 1,000 with a mixture sample size of 400. Simulated baseline sample sizes were the same as in the actual baseline. Following identification of suitable reporting groups, mixture analyses, to estimate stock composition, were performed with ONCOR.

RESULTS

Baseline samples

Results of group level mixture analysis on baseline populations using BAPS indicated that the number of clusters in the optimal partition was 10 with a log -marginal likelihood of -191524.04 and a posterior probability of 1. These 10 clusters were used as reporting groups for subsequent mixed-stock analysis. Clusters generally were comprised of geographically proximate populations (Figure A.1). While genetic clusters were generally comprised of multiple populations, two were comprised of single populations: the reference population from outside the Snake River ESU (Bogachiel hatchery); and Elk Creek, located in the Joseph Creek drainage in Oregon (lower Grande Ronde River drainage).

Results from the 100% simulations in ONCOR, using the 10 reporting groups, indicated that 8 of groups exhibited >90% mean correct allocation (Table 1). The two reporting groups exhibiting less than 90% correct allocation were “Upper Salmon” (82.1%) and “Lower Salmon” (89.0%). In the “Upper Salmon,” the population exhibiting the least accuracy was “Squaw Creek Weir Wild” (66.7%).

Lower Granite Dam Stock Composition

Of the adults sampled for genetics at Lower Granite Dam, 1,092 were extracted and genotyped (due to budget constraints). Of these, 1,076 (98.5%) yielded complete genotypes (≥14 loci). The bulk of the run was comprised of three reporting groups: Snake/Lower Clearwater, Upper Clearwater, and Lower Salmon. The largest was the Lower Clearwater/Snake reporting group (36.1%), followed by the Upper Clearwater reporting group (15.4%) and the Lower Salmon reporting group (13.9%). The remaining reporting groups each contributed less than 10% to the overall mixture: Imnaha (9.5%), Upper Salmon (9.2%), South Fork Clearwater (7.6%), Middle Fork Salmon (5.1%), South Fork Salmon (2.7%), and Elk Creek (0.5%). As expected, no contributions from Bogachiel Hatchery were detected in this analysis.

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Table A.1. Baseline samples and site numbers with sample size (N). Assigned reporting group is shown with observed accuracy to group from 100% simulations in ONCOR. The 95% confidence intervals are in parentheses.

Sample	N	Reporting Group	Accuracy
Elk Creek	96	Elk Creek	0.96 (0.93-0.98)
Cottonwood Creek	96	Lower Snake/Clearwater	0.94 (0.91-0.97)
Asotin Creek	110	Lower Snake/Clearwater	0.87 (0.82-0.92)
Mission Creek	51	Lower Snake/Clearwater	0.96 (0.94-0.99)
Crooked Creek	141	Lower Snake/Clearwater	0.96 (0.93-0.99)
EF Potlatch River	41	Lower Snake/Clearwater	0.97 (0.95-0.99)
Tucannon River	74	Lower Snake/Clearwater	0.88 (0.83-0.93)
Wenaha River	94	Lower Snake/Clearwater	0.91 (0.87-0.95)
Little Bear Creek 07	42	Lower Snake/Clearwater	0.90 (0.85-0.94)
EF Potlatch River	62	Lower Snake/Clearwater	0.97 (0.95-0.99)
Big Bear Creek 08	20	Lower Snake/Clearwater	0.89 (0.84-0.93)
Little Bear Creek 08	11	Lower Snake/Clearwater	0.93 (0.89-0.96)
Big Bear Creek 07	12	Lower Snake/Clearwater	0.78 (0.71-0.83)
Little Bear Creek	50	Lower Snake/Clearwater	0.98 (0.97-1.00)
Tenmile Creek	47	South Fork Clearwater	0.96 (0.93-0.98)
Crooked River	80	South Fork Clearwater	0.93 (0.89-0.96)
Canyon Creek	34	Upper Clearwater	0.99 (0.98-1.00)
Storm Creek	39	Upper Clearwater	1.00 (0.99-1.00)
NF Moose Creek	50	Upper Clearwater	0.99 (0.98-1.00)
Colt Creek	58	Upper Clearwater	1.00 (0.99-1.00)
Lake Creek	52	Upper Clearwater	1.00 (0.99-1.00)
Clear Creek	45	Upper Clearwater	0.91 (0.87-0.94)
Three Links Creek	57	Upper Clearwater	1.00 (0.99-1.00)
Fish Creek	80	Upper Clearwater	0.99 (0.98-1.00)
Gedney Creek	114	Upper Clearwater	0.98 (0.96-1.00)
O’Hara Creek	47	Upper Clearwater	0.97 (0.94-0.99)
Johns Creek	31	Upper Clearwater	0.75 (0.69-0.80)
Gedney Creek	46	Upper Clearwater	0.98 (0.96-1.00)
Bear Creek	45	Upper Clearwater	0.99 (0.98-1.00)
Crooked Fork Creek	47	Upper Clearwater	1.00 (0.98-1.00)
Canyon Creek	47	Upper Clearwater	0.94 (0.91-0.97)
N.F. Moose Creek	47	Upper Clearwater	0.99 (0.99-1.00)
Camp Creek	136	Imnaha	0.98 (0.96-1.00)
Gumboot Creek	93	Imnaha	0.97 (0.94-0.99)
Horse Creek	117	Imnaha	0.91 (0.87-0.95)
Lightning Creek	67	Imnaha	0.82 (0.77-0.88)
Boulder Creek	47	Lower Salmon	0.93 (0.89-0.97)
Hazard Creek	44	Lower Salmon	0.69 (0.63-0.76)
Slate Creek	47	Lower Salmon	0.88 (0.83-0.92)
Rapid River	266	Lower Salmon	0.98 (0.96-0.99)
Bargamin Creek	45	Lower Salmon	0.93 (0.90-0.97)
Rapid River	43	Lower Salmon	0.99 (0.97-1.00)
Chamberlain Creek	64	Lower Salmon	0.88 (0.82-0.92)
Whitebird Creek	58	Lower Salmon	0.96 (0.93-0.98)

Appendix A. Continued.

Table A.-1. Continued.

Sample	N	Reporting Group	Accuracy
Bargamin Creek	45	Lower Salmon	0.87 (0.82-0.92)
Whitebird Creek	50	Lower Salmon	0.80 (0.74-0.85)
Secesh River	28	South Fork Salmon	0.99 (0.98-1.00)
Stolle Meadows	44	South Fork Salmon	0.94 (0.91-0.97)
EF SF Salmon R	46	South Fork Salmon	0.91 (0.87-0.94)
Secesh River	45	South Fork Salmon	0.95 (0.92-0.98)
Camas Creek	52	Middle Fork Salmon	0.92 (0.88-0.95)
Pistol Creek	23	Middle Fork Salmon	0.90 (0.85-0.94)
Sulphur Creek	53	Middle Fork Salmon	0.98 (0.96-0.99)
Loon Creek	59	Middle Fork Salmon	0.95 (0.92-0.98)
Marsh Creek	57	Middle Fork Salmon	0.99 (0.98-1.00)
Big Creek	42	Middle Fork Salmon	0.83 (0.78-0.88)
Rapid River	45	Middle Fork Salmon	0.91 (0.87-0.94)
Big Creek	47	Middle Fork Salmon	1.00 (0.99-1.00)
Morgan Creek	45	Upper Salmon	0.86 (0.81-0.90)
Pahsimeroi R 05	41	Upper Salmon	0.77 (0.72-0.83)
Pahsimeroi R 06	47	Upper Salmon	0.89 (0.84-0.93)
Sawtooth Weir	29	Upper Salmon	0.76 (0.70-0.82)
Squaw Creek Weir	21	Upper Salmon	0.67 (0.60-0.73)
W.F. Yankee Fork	47	Upper Salmon	0.91 (0.88-0.95)
Upper Valley Creek	25	Upper Salmon	0.92 (0.88-0.96)
Lower Valley Creek	19	Upper Salmon	0.78 (0.72-0.84)
Bogachiel Hatchery	96	Bogachiel	1.00 (1.00-1.00)

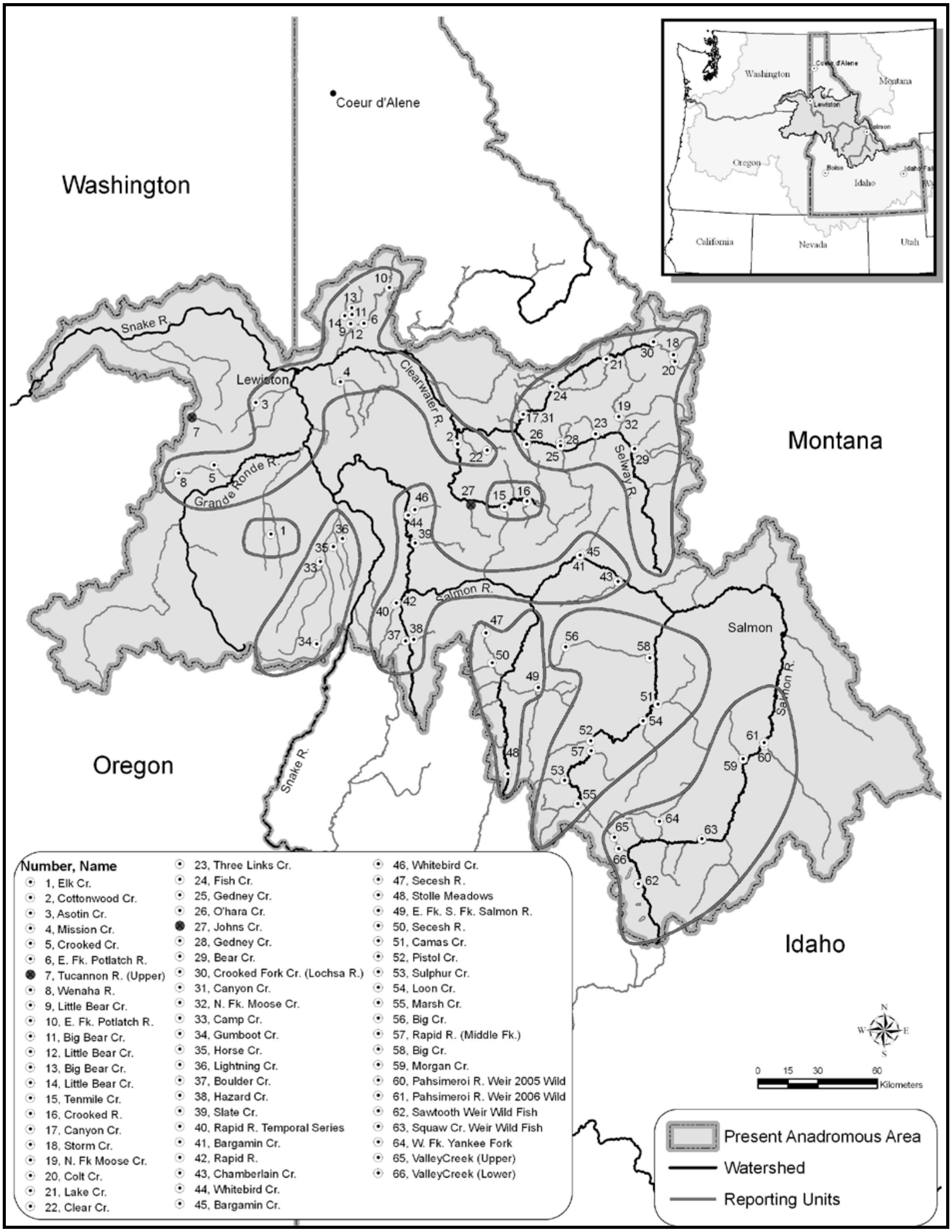

Figure A.1. Locations of the Snake River steelhead populations that served as baseline populations for GSI mixture analyses.

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