Steelhead Supplementation in Idaho Rivers

Annual Report
2001

DOE/BP-00009949-1

March 2002

This Document should be cited as follows:

Byrne, Alan, "Steelhead Supplementation in Idaho Rivers", Project No. 1990-05500, 68 electronic pages, (BPA Report DOE/BP-00009949-1)

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

FISHERY RESEARCH

STEELHEAD SUPPLEMENTATION IN IDAHO RIVERS

ANNUAL PROGRESS REPORT
January 1, 2001 – December 31, 2001

Prepared by:

Alan Byrne
Senior Fishery Research Biologist

IDFG Report Number 02-28
March 2002

STEELHEAD SUPPLEMENTATION IN IDAHO RIVERS

Project Progress Report

2001 Annual Report

By

Alan Byrne
Senior Fishery Research Biologist

Idaho Department of Fish and Game
600 South Walnut Street
P.O. Box 25
Boise, ID 83707

To

Peter Lofy, Project Manager
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, OR 97283-3621

Project Number 199005500
Contract Numbers DE-B179-89BP01466

IDFG Report Number 02-28
March 2002

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

List of Tables, Continued

Page

List of Tables, Continued

Page

LIST OF FIGURES

List of Figures, Continued

Page

List of Figures, Continued

Page

LIST OF APPENDICES

ABSTRACT

In 2001, Idaho Department of Fish and Game (IDFG) continued an assessment of the Sawtooth Hatchery steelhead *Oncorhynchus mykiss* stock to reestablish natural populations in Beaver and Frenchman creeks in the upper Salmon River. Crews stocked both streams with 20 pair of hatchery adults, and I estimated the potential smolt production from the 2000 adult outplants.

In the Red River drainage, IDFG stocked Dworshak hatchery stock fingerlings and smolts from 1993 to 1999 to assess which life stage produces more progeny when the adults return to spawn. In 2001, IDFG operated the Red River weir to trap adults that returned from these stockings, but none were caught from either group.

Wild steelhead populations in the Lochsa and Selway river drainages were assessed and the chinook salmon *Oncorhynchus tshawytscha* escapement was enumerated in Fish Creek. I estimated that 75 wild adult steelhead and 122 adult chinook salmon returned to Fish Creek in 2001. I estimated that slightly more than 30,000 juvenile steelhead migrated out of Fish Creek. This is the largest number of steelhead to migrate out of Fish Creek in a single year since I began estimating the yearly migration in 1994. Juvenile steelhead densities in Lochsa and Selway tributaries were somewhat higher in 2001 than those observed in 2000.

Crews from IDFG collected over 4,800 fin samples from wild steelhead in 74 streams of the Clearwater, Snake, and Salmon river drainages and from five hatchery stocks during the summer of 2000 for a DNA analysis to assess Idaho's steelhead stock structure. The DNA analysis was subcontracted to Dr. Jennifer Nielsen, Alaska Biological Science Center, Anchorage. Her lab developed protocols to use for the analysis in 2001 and is continuing to analyze the samples. Dr. Nielsen plans to have the complete set of wild and hatchery stocks analyzed in 2002.

Author:

Alan Byrne
Senior Fishery Research Biologist

INTRODUCTION

The Steelhead Supplementation Study (SSS) was designed to assess the effects of supplementation on wild fish stocks. A detailed experimental design for this project was submitted to Bonneville Power Administration in 1992, and fieldwork began in 1993 (Byrne, 1994). This report documents the work conducted from January 1, 2001 to December 31, 2001. Previous reports have summarized the work performed before January 1, 2001 (Byrne 1996, Byrne 1997, Byrne 1999, Byrne 2001a, and Byrne 2001b). In 2001, our effort focused on three objectives:

Objective 1: Assess the performance of hatchery and wild brood sources to reestablish steelhead *Oncorhynchus mykiss* in streams where expirated.

The original plan was to assess the performance of hatchery stock with wild stock with a paired watershed study in tributaries of the upper Salmon River (Byrne 1994). This approach was not done, because wild steelhead abundance declined and Idaho Department of Fish and Game (IDFG) decided that "mining" a wild stock for this experiment was not appropriate at the time. Wild steelhead were subsequently listed under the Endangered Species Act (ESA) in 1997. In 2001, Sawtooth Hatchery personnel stocked hatchery adult steelhead that returned to the Sawtooth Fish Hatchery in Beaver and Frenchman creeks. An SSS crew assessed the juvenile production of the adults that were stocked in the spring 2000 with a snorkel survey of the streams in August.

Objective 2: Evaluate the ability of returning adults from hatchery smolt and fingerling releases to produce progeny in streams.

This experiment was implemented in the Red River drainage, a tributary of the South Fork (SF) Clearwater River, with the Dworshak hatchery stock. Fingerlings were stocked yearly in the SF Red River from 1993 to 1996. Smolts were stocked in Red River in the spring from 1996 to 1999. In 2001, IDFG operated the Red River weir to identify and count returning adults, and an SSS crew assessed juvenile density with a snorkel survey of the streams in June. Adult returns from the fingerling and smolt stockings are expected to continue until 2003.

Objective 3: Assess the abundance, habitat, and life history characteristics of existing wild and natural steelhead populations in the Clearwater and Salmon River drainages.

Steelhead Supplementation Study crews assessed juvenile steelhead abundance with snorkel surveys during the summer in tributaries of the Selway and Lochsa rivers, tagged wild steelhead throughout the Salmon and Clearwater river drainages with Passive Integrator Transponder (PIT) tags, and recorded stream temperature. The SSS personnel operated a screw trap in Fish and Boulder creeks and coordinated the PIT tagging of wild steelhead at other trapping sites throughout Idaho. The Fish Creek adult weir was left in the stream until September 19, 2001 to determine the escapement of wild steelhead and chinook salmon.

Dr. Jennifer Nielsen at the Alaska Biological Science Center in Anchorage continued the genetic analysis of the wild and hatchery steelhead stocks IDFG collected in 2000. Her lab has over 4,800 tissue samples from 74 wild stocks and five hatchery stocks to analyze. She expects the analysis to be completed in 2002.

METHODS 2000

Objective 1

Collecting and Outplanting Adult Steelhead

Sawtooth hatchery personnel installed a temporary weir at the upstream and downstream boundary of a 1 km stream segment in Beaver and Frenchman creeks and stocked adults in this section. The stocking location in both streams was the same stream segment used for this experiment since 1993. The hatchery adults that were outplanted were randomly sorted from fish that returned to the Sawtooth Fish Hatchery. Personnel from IDFG stocked 20 pair of hatchery adult steelhead in Beaver Creek and 20 pair in Frenchman Creek on April 24, 2001. I assumed that all females remained in the outplant section and spawned successfully. I used the mean eggs per female obtained from the total green egg take and the number of females spawned at Sawtooth Hatchery to estimate the number of eggs deposited in Beaver and Frenchman creeks.

Evaluation of Spawner Success

I used the mean age-1 juvenile steelhead density abundance (fish/100 m^2) in strata 1 of Frenchman Creek and strata 2 of Beaver Creek as an index of reproductive success (Appendix 1). I assumed that all age-1 steelhead in Beaver and Frenchman creeks were the progeny of the previous years' hatchery adult outplants. I estimated the age-1 population in each stream and then estimated the number of age-3 smolts that could be produced from the age-1 population assuming a 50% over-winter mortality rate. I assumed that all fish become smolts at age-3 (two winters and one additional summer of stream rearing). Eighty-one percent of the steelhead smolts that were PIT tagged at the Salmon River screw trap at Sawtooth Fish Hatchery and detected at downriver dams were age-3, based on a scale analysis (A. Byrne, n = 37, unpublished data). I estimated the number of smolts per female produced in Beaver and Frenchman creeks from the 2000 adult outplant and then determined the smolt-to-adult survival rate (SAR) needed to return two adult spawners.

Snorkel Procedures for Fish Densities and Population Totals

Each snorkel site consists of a single distinct habitat type (pool, pocket water, riffle, or run) and was chosen randomly throughout the stream. Crews snorkeled at least seven sites per kilometer of stream. The number of snorkel sites of each habitat type was allocated proportional to the type's abundance in the stream strata. One to five snorkelers counted fish in each site, depending on the stream size. Each snorkel site was separated by at least one distinct habitat type change from a prior site. Snorkelers estimated the size of all fish except chinook salmon *Oncorhynchus tshawytscha* parr, dace *Rhinichthys sp.,* and sculpin *Cottus sp.* to the nearest inch. After the crew snorkeled each site, they measured its length and three to six widths to calculate the surface area.

Chinook salmon parr and steelhead parr were aged based on observed size. Chinook salmon parr were counted and classified as age-0 (<100 mm) or age-1 (≥100 mm). Steelhead parr were classified as age-1, length 3 in to 5 in (76 mm to 127 mm); and age-2+, length >5 in (127 mm). Because steelhead fry (age-0, <75 mm) are indistinguishable from cutthroat trout

O. clarki fry, snorkelers classified both as trout fry. I did not partition cutthroat trout, bull trout *Salvelinus confluentus*, brook trout *S. fontinalis*, or mountain whitefish *Prosopium williamsoni* into age classes. Mean densities (fish/100 m^2) by habitat type in each stream strata were calculated for trout fry, the two age classes of steelhead and chinook salmon, resident trout, and mountain whitefish.

I calculated the mean stream density (m_t) for each species as:

$$m_t = \sum p_i \overline{d_{it}}$$

where p_i = proportion of habitat i in the stream,
$\overline{d_{it}}$ = mean age t parr density (fish/100 m^2) in habitat i,
t = fish species (and age class, if steelhead or chinook), and
i = pool, riffle, run, pocket water.

I estimated the age-1 steelhead population (N) and confidence intervals in Beaver and Frenchman creeks using the stratified sampling estimates of Scheaffer et al. (1986):

$$N = \sum A_i \overline{d_{i1}}$$

where N = population total,
A_i = total surface area (m^2) of habitat i,
$\overline{d_{i1}}$ = mean age-1 parr density (fish/m^2) of habitat i, and
i = pool, riffle, run, pocket water.

An approximate 95% confidence interval (CI) on the age-1 steelhead population estimate was calculated as:

$$CI = 2\sqrt{\sum A_i^2 \left(\frac{A_i - a_i}{A_i}\right)\left(\frac{s_i^2}{x_i}\right)}$$

where A_i = total surface area of habitat i,
s_i^2 = the sample variance of the mean age-1 parr density (fish/m^2) in habitat i,
a_i = total surface area that was snorkeled in habitat i,
x_i = number of habitat i sites snorkeled, and
i = pool, run, pocket water, or riffle habitat.

I treated A_i and a_i as constants when calculating the confidence interval and assumed that the variance was due to differences of densities in each snorkel site, not area measurements. The total surface area (A_i) of each habitat type in the stream was calculated as:

$$A_i = l p_i w_i$$

where l = length of the study section (m) in each stream,
p_i = proportion of habitat i in the study section, and
w_i = mean width of habitat i.

Objective 2

This objective was designed to assess the juvenile production of returning adults that were stocked as fingerlings or smolts. I wanted to determine what life stage of release would be best for supplementation by comparing the juvenile production of returning adults using age-1 parr abundance as the evaluation point. Personnel from IDFG stocked Dworshak hatchery fingerlings in the SF Red River yearly from 1993 to 1996 and Dworshak hatchery smolts in Red River yearly from 1996 to 1999 (Byrne 2001a). Clearwater Hatchery personnel installed the Red River weir on March 27, 2001. The weir was intact throughout the steelhead run and was kept in place to trap chinook salmon adults during the summer. Adult steelhead were scanned for a coded-wire tag (CWT) and a PIT tag, and were inspected for fin clips to determine if the fish was released as a fingerling or smolt for this study before release upstream of the weir.

A steelhead supplementation crew snorkeled the SF Red River from its mouth upstream to the West Fork (WF) SF Red River to assess juvenile steelhead densities, using the procedures outlined in the Methods section for Objective 1. The Red River fish densities, upstream of the SF Red River to Shissler Creek, were obtained from nine stream transects that are snorkeled yearly by IDFG Clearwater Region crews. There may be several habitat types within each Red River snorkel transect. The Red River juvenile steelhead densities were calculated as the average density of the nine snorkel transects.

Objective 3

Adult Weir in Fish Creek

A SSS crew installed a temporary weir in Fish Creek and closed it on March 14, 2001. Unlike past years, the weir was left in the stream until September 19, 2001 to capture adult chinook salmon that returned to the stream. This was the first year since the study began that a substantial number of naturally-produced adult chinook salmon returned to Fish Creek. The chinook salmon adults were the progeny of hatchery chinook salmon that strayed and spawned in Fish Creek in 1998. In addition to passing chinook salmon adults upstream, crews surveyed Fish and Hungery creeks on several occasions between August 11 and September 17 to count salmon redds.

Adult steelhead and salmon enter a holding box that is checked throughout the day. When adults were present, the trap tender removed them with a net and placed them in a 100-gallon plastic water trough. The trap tender determined the sex, measured fork length to the nearest cm, collected scales, snipped a small portion of the anal fin for future DNA analysis, and used a paper punch to mark the right opercule before releasing the adult upstream of the weir. Steelhead kelts were collected and checked for a right opercule punch, sexed, and measured for length. If the kelt was alive, the trap tender punched the left opercule and passed it downstream of the weir. The trap tender recorded the stream conductivity, TDS, pH, and the river level at the U.S. Forest Service (USFS) gauge located near the mouth of Fish Creek daily.

Juvenile Fish Densities

Steelhead supplementation snorkeling is done to: (1) evaluate the success of hatchery outplants done for Objective 1 and 2 experiments in Beaver Creek, Frenchman Creek, and the

SF Red River, and (2) to monitor steelhead densities in wild production streams. The SSS crews use the same snorkel procedures outlined in the Objective 1 Methods section in the wild production streams. During the summer of 2001, SSS crews snorkeled Gedney, WF Gedney, and O'Hara creeks in the Selway River drainage and Canyon, Crooked Fork, Deadman, Fish, Bald Mountain, Boulder, Weir, Post Office, and Lake creeks in the Lochsa River drainage.

PIT Tagging

This project operates screw traps in Fish and Boulder creeks and coordinates steelhead tagging at screw traps used in the chinook supplementation study. In addition to Fish and Boulder creeks, steelhead were tagged at eight screw traps operated by IDFG: Crooked Fork Creek, Colt Killed Creek, Red River, South Fork Salmon River at Knox Bridge, South Fork Salmon River one kilometer downstream of the Secesh River, Pahsimeroi River, Marsh Creek, and Salmon River at Sawtooth Hatchery; three traps operated by the Nez Perce Tribe in the South Fork Salmon drainage: Lake Creek, Secesh River, and Johnson Creek; and one trap operated by the U.S. Fish and Wildlife Service in Clear Creek. The screw trap in Clear Creek was only fished until June 15, 2001. Steelhead were not tagged at the Lake Creek and Secesh River screw traps after July 16, 2001. At most other sites, the screw traps were fished continuously from early March until ice-up in November, river conditions permitting. 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 tagged previously. All steelhead >80 mm were PIT tagged, measured (fork length) to the nearest mm, and weighed to the nearest 0.1 g.

In addition to the screw traps, SSS crews PIT tagged wild steelhead that they collected flyfishing in Fish, Boulder, Gedney, Lick, and O'Hara creeks during the summer. The SSS crews fished Fish Creek from June 23-24 and from July 13-15, Gedney Creek from July 20-22 and from August 28-30, Boulder Creek from August 20-21, and Lick Creek on several occasions between July 24 and August 28. I combined all fishing occasions in each stream for the data analysis. Steve Achord, from the National Marine Fisheries Service, collected and tagged juvenile steelhead in Bear Valley Creek, Big Creek, Elk Creek, Herd Creek, Lake Creek (Secesh drainage), Marsh Creek, Rush Creek, South Fork Salmon River, Secesh River, and Valley Creek from July 25 to August 27.

I calculated the mean steelhead length, weight, and condition factor at each screw trap site for the spring (start of trapping to May 31), summer (June 1 to August 31), and fall (September 1 to end of trapping) periods. I calculated the mean length, weight, and condition factor of steelhead collected in streams by flyfishing and electrofishing. At all sites, the PIT-tagged fish were grouped into 5 mm length classes (class 70 = fish 70-74 mm, class 75 = fish 75-79 mm, etc.) and the length frequency was plotted. I determined the date that 10%, 25%, 50%, 75%, and 90% of the fish were tagged at all screw trap sites except Boulder Creek, Lake Creek, and Secesh River.

Juvenile Steelhead Migration Estimate in Fish Creek

The trap tender released PIT-tagged steelhead about 600 m upstream of the Fish Creek screw trap and recorded the number of recaptures at the trap daily to estimate trap efficiency. All recaptures were released downstream of the trap. When more than 50 steelhead were tagged in a day, 50 fish were released upstream of the trap and the remainder downstream of

the trap. When less than 50 steelhead were tagged in a day, all the newly tagged fish were released upstream of the trap. I split the trapping season into periods based on flow and time of year and determined the number of steelhead trapped, fish released upstream (marks), and recaptured fish in each period. I used a maximum likelihood estimator (Wu and Steinhorst 2000) to estimate the number of migrants and a 95% CI that left the stream during each period, during the entire year, and from August 15 to November 12.

Growth

The growth rate of individual juvenile steelhead was calculated from previously PIT-tagged fish that were recaptured in Boulder, Fish, Gedney, Johnson, Lake, and Marsh creeks and the Secesh River. I was also able to calculate growth rates of steelhead tagged in Brushy Fork Creek by an IDFG Natural Production crew supervised by Russell Kiefer that were recaptured in the Crooked Fork Creek screw trap. I put the recaptured fish into two groups: (1) fish tagged and recaptured in 2001, and (2) fish tagged in 1999 and recaptured in 2001. I omitted the fish from the analysis if it was recaptured ≤30 days after tagging. I calculated the daily growth rate (DGR) of a fish as:

$$DGR = \frac{L_2 - L_1}{D_2 - D_1}$$

where L_1 = length at first capture,
L_2 = length at second capture,
D_1 = date the fish was tagged and,
D_2 = date the fish was recaptured.

I also calculated the instantaneous growth rate (IGR) as:

$$IGR = 100\left[\frac{\ln(L_2) - \ln(L_1)}{(D_2 - D_1)}\right]$$

I calculated the mean growth rate and 95% CI in each stream for fish tagged in 2001 and recaptured more than 30 days after tagging and for fish tagged in 2000 and recaptured in 2001. I did an ANOVA to test for differences between DGR and IGR in Boulder Creek, Fish Creek, and Brushy Fork Creek fish tagged and recaptured in 2001. I used the same streams plus Gedney Creek for an ANOVA to test for differences in DGR and IGR of fish tagged in 2000 and recaptured in 2001. If significant differences were found, I used Tukey's HSD for all pairwise comparisons. I only used Boulder, Brushy Fork, Fish, and Gedney creeks in the ANOVA. Other streams were excluded from the ANOVA because of the small number of steelhead that were recaptured.

Smolt Detections in 2001

I obtained the date and dam of detection, date of tagging, and the length and weight at tagging of all wild steelhead smolts detected at Lower Granite, Little Goose, Lower Monumental, McNary, John Day, and Bonneville dams from SSS tagging sites from the PTAGIS database on January 28, 2002. For each release site, I calculated the number of smolt detections from steelhead tagged from March 1, 2001 to May 31, 2001; August 15, 2000 to December 15, 2000;

June 1, 2000 to August 14, 2000; fish tagged in 2000 before June 1; and fish tagged before January 1, 2000. For each tag period, I determined the total number of steelhead juveniles tagged and the number of steelhead juveniles ≥125 mm tagged and calculated the percent of tagged fish detected in 2001.

I calculated the mean length of smolts at the time of tagging from each stream for steelhead tagged between August 15, 2000 and May 31, 2001. Steelhead PIT tagged between August 15, 2000 and May 31, 2001 and detected as smolts were grouped into 5 mm length classes (class 70 = fish 70-74 mm, class 75 = fish 75-79 mm, etc.), and the length frequency was plotted. I determined the date that 10%, 25%, 50%, 75%, and 90% of the total number of smolt detections at Lower Granite Dam (LGR) were attained regardless of the date the fish was PIT tagged. I determined the median travel time (and 90% CI) from release site to LGR of fish tagged and detected in 2001. Travel time was calculated as kilometers traveled per day from release site to detection at LGR. I excluded Clear Creek from the travel time analysis because fish were often held several days at the trap site before release, whereas fish were tagged and released daily at all other sites.

Steelhead Scale Samples

Trap tenders collected scales from adult steelhead trapped at the Fish Creek and Rapid River weirs. Personnel from IDFG collected scales from juvenile steelhead in Brushy Fork Creek, Crooked Fork Creek, Colt Killed Creek, Fish Creek, Gedney Creek, Marsh Creek, SF Salmon River, Salmon River at Sawtooth Hatchery, and Pahsimeroi River. The collector measured the fork length of each fish and obtained scales from the preferred area (MacLellan 1987). This area is located just above the lateral line, posterior of a vertical line drawn from the posterior end of the dorsal fin.

A technician began aging steelhead juveniles from the scale samples that were collected from 1998 to 2000. Nearly 3,000 juvenile scales were mounted and aged by one reader in 2001; however, at least one additional independent reader will need to age each scale before a final age is assigned to the fish.

Juvenile Steelhead DNA Sampling

Idaho Department of Fish and Game received funding in 2000 to determine the evolutionary significance and genetic population structure of Idaho's steelhead assemblage. The total genomic DNA will be extracted and used for PCR amplification microsatellite genetic markers. All samples were collected during the summer 2000 (Byrne, 2001b). Dr. Jennifer Nielsen at the Alaska Biological Science Center, Anchorage is doing the genetic analysis as a subcontractor to IDFG.

The hypotheses to be tested are:

HO1—Unique evolutionary and biogeographic structure occurs in natural populations of steelhead in Idaho. Steelhead tissues collected from Idaho for this study contain distinct genetic allelic structure when compared to other coastal and interior steelhead populations. Tests of this hypothesis could be used to look at genetic substructure within and between river basins in comparison with sample collections from other parts of the distribution of *O. mykiss* throughout their range.

HO2—Introgression by straying hatchery-produced steelhead has had no major effect on the natural genetic diversity found in Idaho steelhead. Hatchery fish used for supplementation in the same geographic area may carry diminished genetic diversity due to bottleneck effects induced through common husbandry practices.

Chinook Salmon Parr, Resident Trout, and Dace Trapped at Fish Creek Screw Trap

Trap tenders collected data from cutthroat trout, bull trout, longnose dace, speckled dace, and chinook salmon parr that were caught in the Fish Creek screw trap. The number of dace, chinook salmon parr, cutthroat trout, and bull trout trapped daily was recorded. The trap tenders PIT tagged all bull trout and chinook parr and up to five cutthroat trout each day. All chinook parr, cutthroat trout, and bull trout were measured to the nearest mm and weighed to the nearest 0.1 g. All dace were counted, and a subsample was measured and weighed daily. Data for chinook parr, cutthroat trout, and bull trout was analyzed in a similar manner as juvenile steelhead.

Stream Temperature

I recorded stream temperature in tributaries throughout the Clearwater and Salmon river drainages with HOBO™ temperature recorders. The water temperature was recorded every 0.5 h to 1.6 h from early spring until late October. The recorders were reset to measure stream temperature every 0.5 h to 2.5 h, depending on location and access, throughout the winter. The daily mean, maximum, and minimum temperatures were calculated for each stream.

RESULTS

Objective 1

Sawtooth Hatchery personnel obtained 2,867,634 green eggs from 633 female steelhead, yielding an average of 4,530 eggs per female (Brent Snider, Sawtooth Hatchery, personal communication). Based on this number, I estimated that 90,600 eggs were deposited in Beaver Creek and 90,600 eggs deposited in Frenchman Creek by the adult steelhead that were stocked on April 24, 2001.

Crews snorkeled Beaver and Frenchman creeks on August 16 and August 17. The mean age-1 steelhead density (fish/100m^2) was 6.6 and 2.42 in Beaver and Frenchman creeks, respectively (Figure 1). I estimated the age-1 parr production from the adults that were stocked in 2000 was 738 (± 226) fish in Beaver Creek and 205 (± 238) fish in Frenchman Creek. The projected number of age-3 smolts per female of this brood year is 12 and 3 in Beaver and Frenchman creeks, respectively. At this level of production, the smolt-to-adult survival rate needed to return two adults to Beaver and Frenchman creeks is 16.7% and 66.7%, respectively (Table 1).

Objective 2

Twelve PIT-tagged adults that were detected at LGR were expected to return to Red River and spawn in the spring 2001. Eight of the adults were from the 1998 smolt release (2-ocean fish), and four were from the 1999 smolt release (1-ocean fish). None of the 12 PIT-tagged adults detected at LGR were trapped at the Red River weir. No adult steelhead returned from the fingerling releases. Four adult steelhead of wild origin and one of hatchery origin (not part of this study) were trapped at the weir and released upstream.

A SSS crew snorkeled the SF Red River on June 26 and 27. A crew from the Clearwater Region snorkeled Red River on July 7. The mean stream density of age-1 steelhead was 2.47 and 0 in the SF Red River and Red River, respectively. The age-2+ mean stream density was 1.17 and 0.11 in the SF Red River and Red River, respectively (Figure 2).

Objective 3

Adult Steelhead Escapement in Fish Creek

The adult escapement in Fish Creek was 57 females and 18 males. This year's escapement is similar to that of 1998 and 1999 and is an increase of 46 fish from the estimated 2000 escapement (Table 2 and Figure 3). The first adult was trapped on April 7, 2001 and the last on May 28, 2001. The median date of arrival was May 4 and May 8 for male and female adults, respectively (Figure 4). The mean fork length of female adults was 77 cm (95% CI $\pm$ 2 cm) and the mean fork length of males was 78 cm (95% CI $\pm$ 6 cm). The range of male lengths was greater than females, as the smallest and largest fish that entered Fish Creek were males (Figure 5).

Trap tenders recovered 35 (26 females and 9 males) of the 75 adults that were passed upstream of the weir as kelts. The first kelt, a female, was recovered on May 9, and the last kelt, also a female, was recovered on July 1. The median date of kelt recoveries was May 27 for males and June 11 for females (Figure 6). Nineteen of the 24 female kelts recovered were alive (79%) as were five of the nine male kelts (56%). All five dead female kelts were completely spawned out.

Juvenile Fish Densities

Snorkel crews began their surveys on June 26 and completed them on August 18. Snorkel conditions in all streams were excellent this year. The juvenile steelhead densities in pool and run habitat exceeded those observed in pocket water and riffle habitat in most streams (Table 3 and Table 4). The highest mean stream densities of age-1 steelhead were 14.76 and 12.41 fish/100m^2 in the WF Gedney Creek and Deadman Creek, respectively. The highest mean stream densities of age-2+ steelhead were 4.56 and 4.16 fish/100m^2 in the WF Gedney Creek and Fish Creek, respectively (Table 5). The combined age-1 and age-2+ steelhead in the smaller Lochsa River tributaries ranged from 6.96 to 14.92 fish/100m^2, an increase from the densities observed in 2000 (Figure 7). The combined age-1 and age-2+ steelhead densities in Fish and Gedney creeks ranged from 12.91 to 19.31 fish/100m^2 and were similar to those observed in 2000 (Figure 8).

PIT Tagging

Trap tenders tagged 9,036 juvenile steelhead at the six screw traps in the Clearwater River drainage and 4,628 juvenile steelhead at the eight screw traps in the Salmon River drainage. In the Clearwater River drainage, most of the steelhead were tagged at the Crooked Fork Creek and Fish Creek traps. The mean fork length of the PIT-tagged steelhead in the Clearwater drainage ranged from 179 mm (± 3 mm) at Colt Killed Creek to 127 mm (± 7 mm) at Red River (Table 6 and Figure 9). In the Salmon River, more than 70% of the steelhead were tagged at the Johnson Creek, Pahsimeroi River, and Salmon River traps. The mean fork length of the PIT-tagged steelhead in the Salmon drainage ranged from 157 mm (± 1 mm) at Johnson Creek to 111 mm (± 4 mm) at Marsh Creek (Table 7 and Figure 10).

Field crews PIT tagged 2,224 steelhead that were captured flyfishing and 1,629 steelhead that were collected electrofishing in July and August. The mean fork length of steelhead captured electrofishing was smaller in all streams except Herd Creek compared to the steelhead caught flyfishing (Table 8, Figures 11 and 12).

The migration pattern of steelhead at screw traps that were fished for the entire trapping season was, in general, similar in all streams except Fish Creek and to some extent the SF Salmon River (Figure 13). At most sites, the 10% quartile was attained in April and the median attained before August 1. The duration from the date the 10% quartile was attained to the date that the 90% quartile was attained exceeded 130 days at all trap sites except Fish Creek (52 days) and the SF Salmon River (87 days). Although the Fish Creek trap was in operation from March 16 to November 12, trap tenders tagged 80% of the total between August 23 and October 14. Although the SF Salmon River trap had the second shortest duration between the 10% and 90% quartile date, the date of the 90% quartile was attained earlier than any other site.

Juvenile Steelhead Migration Estimate in Fish Creek

I split the trapping season into 14 periods based on flow and time of year. From the start of the season until April 24 (Period 1), the river level was less than 3.0 feet except for a brief time. During this period, the trap tenders were able to fish the screw trap in more or less the same location in the stream. After April 24 and until May 29 (Period 2), the river level was usually above 3.5 feet, and the trap was fished near the shore. The river level began a rapid decline after May 30 except for a brief interval in early June (Period 3), allowing the trap tenders to gradually move the screw trap back toward the thalweg. Beginning June 16, the trap tenders were able to fish the screw trap in the thalweg for the remainder of the year, and the trapping periods were usually a 14-day duration (Table 9 and Figure 14).

The number of steelhead that migrated past the screw trap during the entire year (March 16 to November 12) was 31,347 (95% lower CI = 27,622; 95% upper CI = 83,647). The wide interval for the upper CI was caused by the low trap efficiency during Period 2 (only one recaptured fish). Period 2 was the time of year that the Fish Creek flow was at its highest level, and the trap had to be fished near shore. When I combined trap periods 2 and 3 (river level usually greater than 3.0), the migration estimate for the entire year was 30,029 (95% lower CI = 27,338; 95% upper CI = 35,290). The migration estimate during the fall period, from August 15 to November 12, was 21,365 (95% lower CI = 22,951; 95% upper CI = 24,794) steelhead. This

years' steelhead migration estimate for the entire year and during the fall is the highest I have calculated since IDFG began trapping in 1994 (Figure 15).

Growth

I calculated growth rates for steelhead PIT tagged and recaptured in 2001 from six streams; however, the number of recaptures was ≤10 in Johnson, Lake, and Marsh creeks. The growth rates from Boulder and Brushy Fork creeks are probably biased low, as all fish were tagged in August and recaptured within 90 days. The growth rates from Fish Creek were calculated from steelhead tagged and recaptured throughout the year. The highest daily and instantaneous growth rates (and CIs) were observed in Johnson, Lake, and Marsh creeks (Table 10 and Figure 16). The daily and instantaneous growth rates differed among Fish, Boulder, and Brushy Fork creeks (ANOVA, $p < 0.001$ for both rates). The daily and instantaneous growth rate was significantly higher in Fish Creek than Boulder or Brushy Fork creeks (Tukey's HSD, $p < 0.002$ for both comparisons). The daily and instantaneous growth rates were not significantly different in Boulder and Brushy Fork creeks (Tukey's HSD, $p > 0.74$ for both comparisons).

I calculated growth rates for steelhead tagged in 2000 and recaptured in 2001 from seven streams; however, the number of steelhead recaptured was ≤11 in Johnson Creek, Lake Creek, and the Secesh River. The highest daily and instantaneous growth rates (and CIs) were observed in Lake Creek and the Secesh River (Table 10 and Figure 16). The daily and instantaneous growth rates differed among Fish, Boulder, and Brushy Fork creeks (ANOVA, $p = 0.004$ for daily growth rate and $p < 0.001$ for instantaneous growth rate). Tukey's pairwise comparisons revealed that the daily growth rate differed in Fish and Boulder creeks ($p = 0.033$) and Fish and Brushy Fork creeks ($p = 0.021$). The other pairwise comparisons of the daily growth rate were not significant. Tukey's pairwise comparisons revealed that the instantaneous growth rate differed in Fish and Boulder creeks ($p = 0.025$) and Fish and Brushy Fork creeks ($p < 0.001$). The other pairwise comparisons of the instantaneous growth rate were not significant.

Smolt Detections in 2001

There were 4,956 steelhead smolts detected in 2001 that were tagged in Clearwater River tributaries. The majority of the fish were tagged at the Fish Creek screw trap. The detection rate of fish larger than 125 mm when tagged at the Crooked Fork Creek and Clear Creek screw traps during the spring 2001 exceeded 70% (Table 11). The detection rates of steelhead larger than 125 mm when tagged at the Crooked Fork Creek, Colt Killed Creek, and Fish Creek screw traps during fall 2000 exceeded 60%. The mean length of the smolts at the time of tagging ranged from 186 mm in Colt Killed Creek to 144 mm in O'Hara Creek (Table 12 and Figure 17).

There were 1,282 steelhead smolts detected in 2001 that were tagged in Salmon River tributaries. Sixty-four percent of the detections were from fish tagged in Johnson Creek. The Lower SF Salmon River was the only other site that had more than 100 smolt detections. The detection rates for steelhead tagged in the spring 2001 (Period 1) and fall 2000 (Period 2) were less than those observed from the Clearwater River sites (Table 11). With the exception of Johnson Creek and the lower SF Salmon River screw traps, detection rates of fish larger than 125 mm when tagged during the spring 2001 and fall 2000 were less than 40%. The mean

smolt length, at the time of tagging, ranged from 180 mm in the Secesh River to 168 mm in the Pahsimeroi River (Table 12 and Figure 18).

The steelhead smolt migration at LGR from the Clearwater River tagging sites began earlier and occurred over a shorter time span than sites in the Salmon River drainage (Table 13 and Figure 19). The median date of arrival at LGR from the eight Clearwater River sites ranged from April 29, 2001 to May 3, 2001, whereas the median date ranged from May 3, 2001 to May 18, 2001 from the six sites in the Salmon River. The smolt travel time from tagging site to LGR of smolts tagged in the spring 2001 ranged from 19.6 km/day at Fish Creek to 51.8 km/day at the Pahsimeroi River (Table 14). The relation between travel time and distance from release site to LGR was significant ($r^2 = 0.64$, $p = 0.017$). Smolts tagged further upstream of LGR traveled more kilometers per day than sites located closer to LGR (Figure 20).

Steelhead Scale Samples

Personnel from IDFG collected 104 scales from adult steelhead and 1,227 scales from juvenile steelhead in 2001 (Table 15). About 3,000 juvenile scales that were collected from 1998 to 2000 were aged; however, they have not yet been verified by another independent reader. I plan to have all scales that were collected from 1998 to 2001 aged by December 31, 2002.

Juvenile Steelhead DNA Sampling

Dr. Nielsen's laboratory developed five post-PCR multiplex conditions for analysis of 15 microsatellite loci for steelhead in the Snake River:

1) Omy325 x Ots1 x Ots4, annealing temperature 53°C, 35 cycles. Primers are direct labeled.

2) Omy77 x Ogo1a x Oneu8, annealing temperature 50°C, 40 cycles, 30 minute extension at 72°C for 1 cycle. Omy77 is direct labeled; Ogo1a and Og3 are M13 tailed.

3) Ogo3 x Omy207 x Oneu14, annealing temperature 52°C, 40 cycles, 30 minute extension at 72°C for 1 cycle. Ogo3 is M13 tailed; Omy207 and Oneu14 are direct labeled.

4) Oneu11 x Ogo4 x Omy27, annealing temperature 50°C, 40 cycles, 30 minute extension at 72°C for 1 cycle. Primers are M13 tailed.

5) Oneu10 x Ots100 x Ots3, annealing temperature 50°C, 40 cycles, 30 minute extension at 72°C for 1 cycle. Primers are M13 tailed.

The results from these loci were standardized across two platforms: ABI 377 and the LI-COR® automatic sequencer. These loci overlap to varying degrees with work currently underway on steelhead by the National Marine Fisheries Service in Seattle, Washington; the Washington Department of Fish and Wildlife in Olympia; Matt Powell at the University of Idaho; Paul Spruel at the University of Montana; Gary Thorgard at Washington State University, and hatchery and wild analyses performed in Dr. Nielsen's laboratory on *O. mykiss* over the last 12 years. This will allow researchers to address additional questions and standardize among labs.

The array of allelic diversity found using these loci will allow researchers to address issues at multiple temporal and spatial scales. Preliminary results of the allelic diversity are presented in Table 16. Dr. Nielsen currently has data from these loci on seven steelhead stocks: Big Canyon Creek (wild, n = 61), East Fork Potlatch River (wild, n = 52), Clear Creek (wild, n = 60), Johns Creek (wild, n = 50), Fish Creek (wild, n = 59), East Fork Salmon River "B" (hatchery, n = 40), and Dworshak Hatchery (hatchery, n = 60). Preliminary data from these populations was given in a presentation by Dr. Jennifer Nielsen at the Western Division of the American Fisheries Society in Spokane, Washington, April 2002.

Dr. Nielsen's laboratory has also developed an RFLP analysis protocol for testing introgression between cutthroat and rainbow trout populations. In this protocol, PCR amplification of the mitochondrial NADH Dehydrogenase 5/6 (ND5/6) region is cut with *Dde*-I, *Hinf*-I, *Hea*-III, and *Rsa*-I, and Cytochrome b (Cyt b) region is cut with *Dde*-I, *Hea*-III, *Hinf*-I and Hha-I to provide RFLP assays that will determine the maternal contribution of individual genotypes. Initial screening of putative pure rainbow and cutthroat population are underway in the laboratory. Other tests searching for diagnostic microsatellite loci allowing determination of parental origin based on species allelic variation are currently in process in the laboratory.

Chinook Salmon Parr, Resident Trout, and Dace Trapped at Fish Creek Screw Trap

Although juvenile steelhead were the most abundant fish captured in the Fish Creek screw trap, data is collected from other species that are trapped. During the year, 15 bull trout, 301 chinook salmon parr, 527 cutthroat trout, 1,758 longnose dace, 641 speckled dace, and another 2,311 dace that were not identified to species were trapped (Table 17). Trap tenders PIT tagged 14 bull trout, 209 chinook salmon parr, and 419 cutthroat trout.

Trap tenders recaptured 18 cutthroat trout that were previously PIT tagged. The mean daily and instantaneous growth rates of the 10 cutthroat that were tagged in 2000 were 0.13751 mm/day and 0.05228, respectively. Seven of the recaptured cutthroat were tagged in 1999 and had mean daily and instantaneous growth rates of 0.17562 mm/day and 0.06455, respectively.

Little movement of fish downstream of the trap occurred prior to July. The earliest median date attained was on August 27, 2001 for dace, and the latest was October 14, 2001 for chinook salmon parr (Figure 21).

Chinook Salmon Escapement

I determined that 11 chinook salmon PIT tagged in Fish Creek during the fall 1998 were detected at Bonneville or Lower Granite dams between April 3, 2001 and May 23, 2001. I estimated that 30–50 adult chinook could return to Fish Creek in 2001 based on the SAR of the PIT-tagged fish and the estimated number of chinook parr and smolts that migrated out of Fish Creek. Because of the returning adult chinook salmon, IDFG kept the Fish Creek weir in the stream until September 19, 2001 to enumerate the chinook salmon escapement. These adults were the progeny of hatchery adult chinook that strayed into and spawned in Fish Creek in 1997. This was the first year since IDFG began operating the weir that a significant number of naturally-produced chinook salmon adults returned to Fish Creek.

The first adult chinook salmon was trapped on May 22, 2001 and the last on September 14, 2001. One hundred twenty-two adult chinook salmon were passed upstream of the weir.

Most of the chinook adults returned before July 15 (nearly 80%), and few adults entered the stream between July 16 and September 5, 2001. A surge of adults, mostly males in poor condition, entered the stream after September 5, 2001 (Figure 22). The trap tenders observed that most of the adults that were passed upstream in September remained within 0.5 km of the weir.

Trap tenders were able to positively identify 42 adults as males and 43 as females. The mean lengths of the male and female adults were 78 cm (95% CI ± 1 cm) and 75 cm (95% CI ± 1 cm), respectively. The mean length of all 122 adults was 75 cm (Table 17). Nearly all females ranged from 71 cm to 77 cm, whereas males were distributed over a larger range of lengths (Figure 23).

Personnel from SSS walked sections of Fish and Hungery creeks on 11 days between August 11, 2001 and September 22, 2001 to locate and count chinook salmon redds (Table 18). They counted nine redds upstream of the weir and eight redds downstream of the weir. Personnel from SSS found 25 adult chinook carcasses upstream of the Fish Creek weir. Most of the carcasses were recovered within 500 meters of the weir. Fifteen of the 25 carcasses had a CWT in their snout, indicating the fish was of hatchery origin (adipose fin was not clipped). The IDFG CWT lab in Lewiston determined that all 15 adults were from a 1999 Nez Perce Tribe hatchery release in Boulder Creek.

Stream Temperature

The daily mean, maximum, and minimum water temperature of the streams that had temperatures recorded (Table 19) has been calculated and entered into an IDFG database at the Nampa Fisheries Research Office. The temperature data is available upon request. A plot of the daily mean, maximum, and minimum stream temperature for 2001 from Fish Creek is in Figure 24.

SUMMARY

Two ongoing experiments are assessing the use of hatchery stocks for supplementation in streams where the original stock has been expirated. Personnel from IDFG have stocked Sawtooth Hatchery adults and estimated potential smolt production since 1993 in the upper Salmon River tributaries of Beaver and Frenchman creeks. This summer, crews estimated the age-1 parr population produced from the adults stocked in 2000. I estimated the potential smolt per female was 12 and 3 in Beaver and Frenchman creeks, respectively.

The second experiment assesses which life stage of release is best for supplementation and is being done in the Red River drainage with the Dworshak Hatchery stock. Hatchery fingerling and smolts were stocked previously, and adults are expected to return yearly until 2003. Twelve adults released as smolts were detected at LGR during the fall 2000, but none were trapped at the Red River weir during the spring 2001. I planned this experiment to return at least 10 spawning females per release group. Although some adult returns may return from the smolt outplant during the spring of 2002, there may not be enough spawners to document a change in juvenile parr production in the stream.

During 2001, most of the effort was spent collecting data from wild steelhead populations. Personnel from SSS estimated juvenile steelhead abundance with snorkel surveys in Lochsa and Selway River tributaries, coordinated steelhead PIT tagging at chinook supplementation screw traps, and continued the intensive monitoring of the Fish Creek steelhead population. Although the Fish Creek steelhead escapement in 2000 was one of the lowest recorded, the age-1 parr abundance in 2001 was at its highest level since 1995. The mean stream densities of all steelhead parr except fry in 2001 were similar to those observed in 2000 in Fish and Gedney creeks and rose slightly in other Lochsa River tributaries.

This year the temporary weir in Fish Creek remained in the stream until September 19, 2001 to enumerate chinook salmon escapement. Trap tenders passed 122 chinook salmon adults upstream of the weir. Most of the fish were probably the progeny of hatchery chinook salmon that spawned in Fish Creek in 1997; however, unmarked hatchery adults were also passed upstream of the weir.

Table 1. The number of hatchery adult female steelhead stocked in Beaver and Frenchman creeks and the age-1 parr population produced the next year. The estimated smolt yield assumes a 50% over-winter mortality rate and that all age-1 parr become smolts at age-3. The smolt-to-adult survival rate (SAR) is the survival rate needed to return two adult steelhead to the stream based on the smolt per female production. CI = confidence interval, ns = not stocked.

				Age-1 Parr Produced				Age-3 Smolt		
Year Stocked	Date Stocked	Females Stocked	Eggs Deposited	Population	95% CI	Per Female	Egg to Age-1 Survival	Total yield	Per Female	SAR
Beaver Creek										
1993	4/30 and 5/6	6	23,124	1,134	± 282	189	4.90%	284	47	4.3%
1994	4/28 and 5/6	8	38,888	543	± 257	68	1.40%	136	17	11.8%
1995	4/28 and 5/9	7	29,337	879	± 258	126	3.00%	220	31	6.5%
1996	4/30 and 5/8	13	62,647	644	± 189	50	1.03%	161	12	16.7%
1997	4/30 and 5/7	12	55,776	284	± 142	24	0.51%	71	6	33.3%
1998	5/1 and 5/8	10	45,380	462	± 127	46	1.02%	116	12	16.7%
1999	5/6	15	62,880	668	± 217	45	1.06%	167	11	18.2%
2000	4/13	15	68,100	738	± 226	49	1.08%	185	12	16.7%
2001[a]	4/24	20	90,600							
					Mean:	74	1.75%	—	19	10.5%
					Median:	49	1.07%	—	12	16.7%
Frenchman Creek										
1993	4/29	12	46,248	595	± 376	50	1.29%	149	12	16.7%
1994[b]	4/25	10	48,610	274	± 146	27	0.56%	69	—	—
1995	ns	0	0	20	± 16	—	—	—	—	—
1996	ns	0	0	0	0	—	—	—	—	—
1997	4/30 and 5/7	11	49,918	166	± 91	15	0.33%	42	4	50.0%
1998	ns	0	0	0	0	—	—	—	—	—
1999	5/6	10	41,920	352	± 140	35	0.84%	88	9	22.2%
2000	4/13	15	68,100	205	± 238	14	0.30%	51	3	66.7%
2001[a]	4/24	20	90,600							
		Mean (exclude 1994, 1995, 1996, and 1998):				28	0.69%		7	28.6%
		Median (exclude 1994, 1995, 1996, and 1998):				25	1.06%		6	33.3%

[a] IDFG crews will estimate the age-1 parr production from the adults stocked in 2001 during the summer 2002.

[b] River otters entered the study section and killed at least seven females after the fish were stocked. The number of eggs deposited is the number expected had all females spawned successfully.

Table 2. The number of adults handled at the Fish Creek weir (trapped in live box, marked, and passed upstream plus the number of unmarked kelts recovered) from 1992 to 2001. The date breached column is the date the weir was breached from high flow, and fish could pass the weir freely thereafter. The mean proportion column is the average proportion of adults that had passed the weir in the years 1993, 1994, 1998, 2000, and 2001 on the date the weir was breached. I omitted 1992 because there were many openings in the weir that year and most adults were handled as kelts. The additional adult column is the estimated number of fish that entered the stream after the weir was breached, except in 2000. In 2000, the maximum likelihood estimate of the total escapement was 29; hence, the additional adult column is the number of fish that passed the weir unhandled. NB = not breached; the weir was intact for the entire spawning run. The 95% CI on mean length (± cm) is in parenthesis.

	Fish Handled									Mean Fork Length (cm)	
Year	Male	Female	Total	% Female	Date Breached	Mean Proportion	Additional Adults	Estimated Escapement	Estimated Females	Male	Female
1992	27	78	105	74.3%	NB		0	105	78	75 (4)	78 (1)
1993	63	204	267	76.4%	NB		0	267	204	80 (2)	79 (1)
1994	33	37	70	56.1%	NB		0	70	37	82 (3)	78 (1)
1995	15	17	32	53.1%	5/2/95	0.455	38	70	37	84 (4)	81 (2)
1996	11	21	32	65.6%	5/19/96	0.815	7	39	26	71 (7)	76 (3)
1997	11	10	21	55.0%	5/11/97	0.726	8	29	14	81 (9)	85 (4)
1998	27	48	75	63.5%	NB		0	75	47	76 (4)	76 (1)
1999	14	58	72	80.6%	5/24/99	0.933	5	77	62	79 (4)	78 (1)
2000	11	15	26	57.7%	NB		3	29	16	73 (7)	79 (3)
2001	18	57	75	76.0%	NB		0	75	57	76 (6)	77 (2)

Table 3. Mean fish densities (fish/100 m^2) by habitat type in streams of the Clearwater River drainage snorkeled during the summer 2001. Area = total area snorkeled (m^2); N = number of sites snorkeled; Trout fry = all trout (except brook trout) ≤75 mm; Age-1 steelhead = juvenile steelhead 76 mm to 127 mm; Age-2+ steelhead = all juvenile steelhead >127 mm; Brook fry = all brook trout <75 mm; Brook parr = all brook trout ≥75 mm; PW = pocketwater.

							Steelhead Parr		Chinook Parr							
Stream	Date	Habitat Type	Strata	N	Area	Trout Fry	Age-1	Age-2+	Age-0	Age-1	Cutthroat	Bull	Brook Fry	Brook Parr	Whitefish	Total Salmonid
Bald Mountain Creek	8/18	Pool	1	5	157	2.63	23.83	4.50	0.00	0.00	25.17	0.00	0.00	0.00	0.00	56.13
Bald Mountain Creek		PW	1	15	1,891	3.05	6.61	1.57	0.00	0.00	6.17	0.05	0.00	0.00	0.00	17.44
Bald Mountain Creek		Run	1	2	73	2.65	14.02	2.65	0.00	0.00	8.16	0.00	0.00	0.00	0.00	27.47
Boulder Creek	8/4	Pool	1	7	799	1.06	18.31	8.62	0.00	0.51	1.79	0.00	0.00	0.10	0.00	30.39
Boulder Creek	and	PW	1	23	9,050	1.65	8.84	3.72	0.01	0.01	0.20	0.01	0.00	0.01	0.00	14.45
Boulder Creek	8/5	Run	1	6	999	1.15	13.44	4.00	0.00	0.00	0.12	0.12	0.00	0.09	0.00	18.92
Canyon Creek	8/7	Pool	1	5	196	17.89	14.97	4.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.55
Canyon Creek		PW	1	12	1,850	7.86	6.74	1.81	0.00	0.00	0.05	0.00	0.00	0.00	0.00	16.47
Canyon Creek		Riffle	1	3	201	19.54	7.35	0.66	0.00	0.00	0.66	0.00	0.00	0.00	0.00	28.21
Canyon Creek		Run	1	5	312	20.52	10.91	1.71	0.30	0.00	0.30	0.00	0.00	0.00	0.00	33.75
Crooked Fork Creek	8/21	Pool	1	3	1,212	2.20	0.07	0.00	3.19	0.00	0.64	0.17	0.00	0.00	47.48	53.75
Crooked Fork Creek		Run	1	3	1,980	1.02	0.03	0.03	1.22	0.00	0.45	0.00	0.00	0.00	0.68	3.44
Deadman Creek	8/7	Pool	1	4	164	20.72	23.72	6.38	0.41	0.00	0.92	0.00	0.00	0.00	0.00	52.14
Deadman Creek		PW	1	10	1,412	20.28	10.55	1.74	0.14	0.00	0.00	0.00	0.00	0.00	0.00	32.70
Deadman Creek		Riffle	1	3	286	19.07	13.71	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.72
Deadman Creek		Run	1	6	439	31.78	13.63	3.99	0.90	0.00	0.24	0.00	0.00	0.00	0.00	50.53
Fish Creek	7/6	Pool	1	9	1,497	2.37	15.56	8.85	0.79	0.05	2.51	0.00	0.00	0.00	0.00	30.13
Fish Creek	to	PW	1	26	11,533	2.13	7.53	3.98	0.50	0.00	0.86	0.01	0.00	0.00	0.03	15.05
Fish Creek	7/11	Riffle	1	6	2,447	1.77	4.95	1.37	0.17	0.00	0.64	0.00	0.00	0.00	0.00	8.89
Fish Creek		Run	1	18	5,163	1.62	12.35	5.04	0.64	0.00	0.84	0.03	0.00	0.00	0.03	20.56
Gedney Creek	7/19	Pool	1	7	962	3.69	13.99	5.72	6.22	0.00	0.94	0.15	0.00	0.00	0.52	31.22
Gedney Creek	to	PW	1	24	9,163	8.13	9.03	2.53	2.34	0.01	0.06	0.00	0.00	0.00	0.40	22.50
Gedney Creek	7/24	Riffle	1	6	2,485	9.12	6.55	0.92	1.76	0.00	0.11	0.00	0.00	0.00	0.46	18.93
Gedney Creek		Run	1	11	2,655	12.19	13.18	3.24	5.16	0.00	0.48	0.03	0.00	0.00	0.59	34.86
Gedney Creek	7/20	Pool	2	4	240	5.79	24.05	5.10	0.00	1.03	0.00	0.00	0.00	0.00	0.00	35.98
Gedney Creek	and	PW	2	9	1,330	3.93	9.18	1.95	0.06	0.00	0.00	0.00	0.00	0.00	0.00	15.12
Gedney Creek	7/21	Run	2	3	231	3.49	13.21	4.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.39
WF Gedney Creek	7/20	Pool	1	4	468	11.95	25.97	7.10	0.00	0.00	0.54	0.00	0.00	0.00	0.45	46.00
WF Gedney Creek	and	PW	1	7	1,706	8.28	9.63	3.63	0.00	0.00	0.09	0.00	0.00	0.00	0.23	21.86
WF Gedney Creek	7/21	Riffle	1	3	702	10.21	8.24	1.89	0.00	0.00	1.50	0.00	0.00	0.00	0.20	22.03
WF Gedney Creek		Run	1	4	571	17.55	19.31	5.28	0.62	0.00	0.47	0.17	0.00	0.00	0.00	43.40

Table 3. Continued.

Stream	Date	Habitat Type	Strata	N	Area	Trout Fry	Steelhead Parr		Chinook Parr		Cutthroat	Bull	Brook Fry	Brook Parr	Whitefish	Total Salmonid
							Age-1	Age-2+	Age-0	Age-1						
Lake Creek	8/21	Pool	1	5	533	3.13	8.04	7.96	0.00	0.00	1.24	0.29	0.00	0.00	0.00	20.66
Lake Creek		PW	1	7	1,813	2.35	4.01	1.50	0.00	0.00	0.38	0.00	0.00	0.00	0.00	8.24
Lake Creek		Riffle	1	5	663	3.44	4.07	1.21	0.00	0.00	0.17	0.00	0.00	0.00	0.00	8.88
Lake Creek		Run	1	5	612	2.73	4.48	1.60	0.00	0.00	2.07	0.00	0.00	0.00	0.00	10.88
O'Hara Creek	8/6	Pool	1	3	163	13.04	17.17	3.03	0.00	0.00	0.59	0.00	0.00	0.00	0.00	33.82
O'Hara Creek		PW	1	10	1,776	8.88	6.80	1.25	0.30	0.00	0.07	0.00	0.00	0.00	0.00	17.30
O'Hara Creek		Riffle	1	5	933	13.56	3.78	0.57	0.52	0.00	0.00	0.00	0.00	0.00	0.00	18.43
O'Hara Creek		Run	1	4	455	15.52	10.01	0.63	0.86	0.00	0.34	0.00	0.00	0.00	0.00	27.37
Hanby Fork	8/6	Pool	1	4	179	18.02	20.62	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.14
Hanby Fork		PW	1	4	620	12.04	8.95	1.04	0.00	0.00	0.26	0.00	0.00	0.00	0.00	22.28
Hanby Fork		Run	1	3	126	18.82	16.00	2.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.83
Post Office Creek	8/17	Pool	1	4	104	30.90	9.18	0.85	0.00	0.00	11.10	0.00	0.00	0.00	0.00	52.03
Post Office Creek		PW	1	4	456	34.55	9.54	0.29	0.00	0.00	2.46	0.15	0.00	0.00	0.00	46.99
Post Office Creek		Riffle	1	8	509	43.15	3.72	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	47.47
Post Office Creek		Run	1	6	346	55.25	10.05	0.94	0.00	0.00	5.77	1.60	0.00	0.00	0.00	73.61
SF Red River	6/26	Pool	1	3	220	0.00	5.69	5.38	0.00	0.00	2.17	0.00	0.00	0.00	0.00	13.25
SF Red River	and	PW	1	4	566	0.00	2.58	1.97	0.00	0.00	0.23	0.00	0.00	0.00	0.00	4.79
SF Red River	6/27	Riffle	1	4	526	4.66	2.68	1.48	0.00	0.00	0.30	0.00	0.00	0.00	0.00	9.12
SF Red River		Run	1	9	983	0.00	5.05	2.26	0.00	0.00	0.75	0.00	0.00	0.16	0.00	8.21
SF Red River	6/26	Pool	2	5	611	0.00	4.10	1.02	0.00	0.00	2.15	0.31	0.00	0.00	0.00	7.58
SF Red River	and	PW	2	4	465	0.00	1.10	0.24	0.00	0.00	2.63	0.00	0.00	0.14	0.00	4.12
SF Red River	6/27	Riffle	2	9	1,120	0.00	1.13	0.00	0.00	0.00	1.29	0.76	0.00	0.00	0.00	3.18
SF Red River		Run	2	16	1,294	0.00	0.64	1.05	0.00	0.00	3.33	0.71	0.00	0.89	0.00	6.61
WF SF Red River	6/27	Pool	1	2	46	0.00	2.16	0.00	0.00	0.00	15.05	0.00	0.00	0.00	0.00	17.21
WF SF Red River		Riffle	1	3	87	0.00	0.00	0.00	0.00	0.00	2.08	0.00	0.00	0.00	0.00	2.08
WF SF Red River		Run	1	4	183	0.60	1.72	1.13	0.00	0.00	5.37	0.00	0.00	0.00	0.00	8.82
Trapper Creek	6/27	Pool	1	2	55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trapper Creek		PW	1	5	232	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trapper Creek		Riffle	1	1	34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trapper Creek		Run	1	3	154	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weir Creek	8/16	Pool	1	4	122	7.96	16.41	3.27	0.00	0.00	23.59	0.00	0.00	0.00	0.00	51.24
Weir Creek		PW	1	5	618	3.79	3.95	0.00	0.39	0.00	2.62	0.00	0.00	0.00	0.00	10.75
Weir Creek		Riffle	1	7	252	9.83	3.93	0.00	0.26	0.00	2.23	0.00	0.00	0.00	0.00	16.25
Weir Creek		Run	1	6	349	6.07	11.46	0.00	0.22	0.00	7.09	0.00	0.00	0.00	0.00	24.85

Table 4. Mean fish densities (fish/100 m^2) by habitat type in streams of the Salmon River drainage snorkeled during the summer 2001. Area = total area snorkeled (m^2); N = number of sites snorkeled; Trout fry = all trout (except brook trout) ≤75 mm; Age-1 steelhead = juvenile steelhead 76 mm to 127 mm; Age-2+ steelhead = all juvenile steelhead >127 mm; Brook fry = all brook trout <75 mm; Brook parr = all brook trout ≥75 mm; PW = pocketwater.

							Steelhead Parr		Chinook Parr							
Stream	Date	Habitat Type	Strata	N	Area	Trout Fry	Age-1	Age-2+	Age-0	Age-1	Cutthroat	Bull	Brook Fry	Brook Parr	Whitefish	Total Salmonid
Basin Creek	8/18	Pool	1	1	188	2.65	1.59	0.00	3.71	0.00	0.00	3.71	0.00	0.00	5.31	16.98
Basin Creek		Riffle	1	2	399	5.01	0.76	0.00	1.47	0.00	0.00	0.00	0.00	0.00	0.26	7.50
Basin Creek		Run	1	2	364	11.69	4.96	1.52	11.54	0.00	0.00	0.00	0.00	0.00	0.88	30.59
Beaver Creek	8/16	Pool	2	4	126	10.95	13.09	0.88	35.17	0.00	36.52	34.89	2.16	1.08	0.00	134.73
Beaver Creek		PW	2	3	226	9.59	6.35	0.45	0.00	0.00	0.00	0.00	0.45	0.00	0.00	16.84
Beaver Creek		Riffle	2	7	442	5.90	2.21	0.00	0.00	0.00	19.97	15.74	0.33	0.00	0.00	44.16
Beaver Creek		Run	2	11	661	10.03	7.93	0.67	4.45	0.00	35.77	24.49	0.44	0.44	0.00	84.24
Frenchman Creek	8/17	Pool	1	5	58	51.83	4.89	0.00	0.00	0.00	0.00	0.00	11.60	11.99	0.00	80.32
Frenchman Creek		PW	1	3	129	31.67	2.20	0.00	0.00	0.00	0.00	0.00	1.28	0.00	0.00	35.16
Frenchman Creek		Riffle	1	5	177	27.06	1.70	0.00	0.00	0.00	0.00	0.00	8.93	0.00	0.00	37.69
Frenchman Creek		Run	1	12	480	43.19	2.34	0.64	0.00	0.00	0.00	0.00	5.37	1.90	0.00	53.44

Table 5. The mean stream density (fish/100^{2}m) of juvenile steelhead, chinook parr, cutthroat trout, bull trout, brook trout, and mountain whitefish in streams snorkeled in 2001.

			Steelhead Parr		Chinook Parr							
Stream	**Strata**	**Trout Fry**	**Age-1**	**Age-2+**	**Age-0**	**Age-1**	**Cutthroat**	**Bull**	**Brook Fry**	**Brook Parr**	**Whitefish**	**Total Salmonid**
Fish Creek	1	1.98	8.75	4.16	0.51	0.00	0.91	0.01	0.00	0.00	0.02	16.36
Gedney Creek[a]	1	8.73	9.84	2.67	3.09	0.01	0.21	0.02	0.00	0.00	0.45	25.02
	2	3.96	10.70	2.53	0.05	0.08	0.00	0.00	0.00	0.00	0.00	17.31
WF Gedney Creek	1	10.91	14.76	4.56	0.12	0.00	0.34	0.03	0.00	0.00	0.23	30.93
SF Red River	1	1.69	3.72	2.05	0.00	0.00	0.54	0.00	0.00	0.06	0.00	8.06
	2	0.00	1.20	0.61	0.00	0.00	2.49	0.59	0.00	0.42	0.00	5.30
	1 & 2	0.47	2.14	1.17	0.00	0.00	1.76	0.38	0.00	0.28	0.00	6.21
Bald Mountain Creek	1	3.02	7.47	1.71	0.00	0.00	7.00	0.05	0.00	0.00	0.00	19.25
Boulder Creek[a]	1	1.58	9.65	3.98	0.01	0.03	0.27	0.02	0.00	0.02	0.00	15.56
Canyon Creek	1	13.40	9.09	2.18	0.06	0.00	0.16	0.00	0.00	0.00	0.00	24.89
Deadman Creek	1	23.33	12.41	2.51	0.35	0.00	0.11	0.00	0.00	0.00	0.00	38.70
Weir Creek	1	7.02	6.81	0.15	0.27	0.00	4.79	0.00	0.00	0.00	0.00	19.03
Post Office Creek	1	42.61	7.41	0.41	0.00	0.00	3.55	0.44	0.00	0.00	0.00	54.42
Beaver Creek	2	8.86	6.60	0.48	5.59	0.00	29.23	21.50	0.56	0.34	0.00	73.17
Frenchman Creek	1	41.10	2.42	0.48	0.00	0.00	0.00	0.00	6.26	2.29	0.00	52.55

[a] No riffles were snorkeled in Boulder Creek or in strata 2 of Gedney Creek. I assumed that riffle density was 70% of the density in pocketwater habitat when calculating the mean stream density.

Table 6. Length and weight statistics of wild steelhead juveniles PIT tagged at trap sites in the Clearwater River drainage in 2001. The tagging date columns have the date the first and last steelhead were tagged at each site. CI = 95% confidence interval (±).

Release site	Tagging date		Fork length (mm)				Weight (g)			Condition factor	
	First	Last	Number	Mean	CI	Median	Number	Mean	CI	Mean	CI
Spring period (start of trapping to 5/31)											
Clear Creek[a]	3/12		108	165	3	165	108	44.0	2.4	0.96316	0.01169
Crooked Fork Creek	3/24		203	169	4	170	203	47.0	2.5	0.91522	0.01146
Colt Killed Creek	3/28		139	187	3	186	137	60.6	2.8	0.90382	0.01372
Fish Creek	3/16		124	143	6	144	124	33.1	6.6	0.98136	0.01501
Red River	4/8		23	124	16	130	23	22.4	7.3	1.00893	0.06035
Summer period (June 1 to August 31)											
Boulder Creek	6/23		51	133	6	130	46	27.5	4.1	1.05948	0.04658
Crooked Fork Creek			512	137	3	132	502	32.9	2.0	1.06741	0.00911
Colt Killed Creek			17	140	15	140	17	33.6	10.5	1.06279	0.04240
Fish Creek			680	140	2	140	665	30.6	1.4	1.03276	0.00566
Red River			28	118	9	116	28	19.5	4.1	1.09902	0.06221
Fall period (September 1 to end of trapping)											
Boulder Creek		11/5	115	148	3	149	115	32.5	1.9	0.97242	0.01172
Crooked Fork Creek		11/9	885	157	2	160	839	40.4	1.2	0.97272	0.00561
Colt Killed Creek		11/3	63	172	3	171	59	48.5	3.0	0.93793	0.01316
Fish Creek		11/12	6,063	148	<1	150	4,656	34.4	0.4	0.98615	0.00140
Red River		10/26	23	141	12	143	0	—	—	—	—
Year totals											
Boulder Creek	6/23	11/5	166	143	3	143	161	31.1	1.8	0.99730	0.01658
Crooked Fork Creek	3/24	11/9	1,600	152	2	158	1,544	38.8	1.0	0.99594	0.00522
Clear Creek[a]	3/12	6/15	110	164	3	165	110	43.7	2.4	0.96462	0.01201
Colt Killed Creek	3/28	11/3	219	179	3	182	213	55.1	2.4	0.92596	0.01155
Fish Creek	3/16	11/12	6,867	147	<1	148	5,445	33.9	0.4	0.99173	0.00148
Red River	4/8	10/26	74	127	7	130	51	20.8	3.8	1.05839	0.04404

[a] Trap was operated by the U.S. Fish and Wildlife Service. The year totals include two steelhead trapped and tagged in June 2001.

Table 7. Length and weight statistics of wild steelhead juveniles PIT tagged at trap sites in the Salmon River drainage in 2001. The tagging date columns have the date the first and last steelhead were tagged at each site. CI = 95% confidence interval (±).

	Tagging dates		Fork length (mm)				Weight (g)			Condition factor	
Release site	**First**	**Last**	**Number**	**Mean**	**CI**	**Median**	**Number**	**Mean**	**CI**	**Mean**	**CI**
Spring period (start of trapping to 5/31)											
Johnson Creek	3/7		489	175	2	176	489	52.7	2.0	0.94438	0.00599
Lake Creek	4/6		57	127	8	120	57	24.9	1.9	1.01644	0.02799
Lower SF Salmon River	3/24		85	166	3	167	78	44.4	3.3	0.95691	0.01919
Marsh Creek	5/30		10	104	18	97	10	13.6	8.2	1.03390	0.05869
Pahsimeroi River	3/1		490	139	3	132	490	32.8	2.0	1.07282	0.00844
Salmon River at Sawtooth	4/14		255	122	4	108	255	22.2	2.3	0.98362	0.01403
Secesh River	4/11		106	108	4	108	106	14.1	2.0	0.99634	0.02093
SF Salmon River, Knox bridge	4/18		29	154	10	159	29	40.6	6.8	1.06493	0.04982
Summer period (June 1 to August 31)											
Johnson Creek			934	143	2	143	933	32.9	1.2	1.01377	0.00487
Lake Creek		7/16	79	130	8	122	77	29.9	7.8	1.08103	0.03074
Lower SF Salmon River			113	117	5	107	74	18.3	4.1	1.04697	0.02518
Marsh Creek			176	117	6	102	175	23.0	4.6	1.07778	0.01482
Pahsimeroi River			107	127	5	123	107	26.8	3.5	1.13135	0.02284
Salmon River at Sawtooth			200	142	4	146	198	32.5	2.4	1.02427	0.01161
Secesh River		7/16	193	114	4	109	184	18.2	2.1	1.12157	0.01497
SF Salmon River, Knox bridge			264	121	3	118	262	21.9	1.7	1.11405	0.01373
Fall period (September 1 to end of trapping)											
Johnson Creek		9/26	275	157	2	158	275	39.1	1.8	0.95005	0.00703
Lower SF Salmon River		10/30	102	160	5	160	89	43.0	4.9	0.95674	0.01840
Marsh Creek		11/2	71	129	5	126	71	23.1	2.8	0.98372	0.01821
Pahsimeroi River		11/27	333	115	3	110	333	18.8	1.9	1.05446	0.01196
Salmon River at Sawtooth		11/1	231	113	5	92	230	19.4	2.7	0.96590	0.01027
SF Salmon River, Knox bridge		10/13	29	137	8	137	29	27.7	4.8	1.01739	0.02732
Year totals											
Johnson Creek[a]	3/7	9/26	1,698	155	1	157	1,697	39.6	1.0	0.98345	0.00374
Lake Creek[a]	4/6	7/16	136	128	6	122	134	27.8	5.2	1.05355	0.02174
Lower SF Salmon River	3/24	10/30	300	145	4	147	241	35.8	2.8	0.98450	0.01297
Marsh Creek	5/30	11/2	257	120	4	111	256	22.7	3.3	1.04998	0.01253
Pahsimeroi River	3/1	11/27	930	129	2	120	930	27.1	1.4	1.07298	0.00684
Salmon River at Sawtooth	4/14	11/1	686	125	3	120	683	24.2	1.4	0.98944	0.00731
Secesh River[a]	4/11	7/16	299	112	3	108	290	16.7	1.5	1.07580	0.01399
SF Salmon River, Knox bridge	4/18	10/13	322	125	3	123	320	24.1	1.7	1.10084	0.01267

Table 8. Length and weight statistics of wild steelhead juveniles captured flyfishing, electroshocking, or with minnow and box traps and PIT tagged in 2001. Data was combined for all dates of collection at each site. CI = 95% confidence interval (±); SD = standard deviation.

	Collection dates		Fork length (mm)				Weight (g)			Condition factor	
Release site	**Begin**	**End**	**Number**	**Mean**	**CI**	**Median**	**Number**	**Mean**	**CI**	**Mean**	**CI**
Fish captured flyfishing											
Boulder Creek	8/20	8/21	254	153	3	150	252	38.8	2.3	1.01474	0.00080
Fish Creek	6/23	7/14	550	148	2	149	543	38.2	1.4	1.10530	0.00566
Gedney Creek	7/22	8/30	781	136	2	133	778	28.9	1.1	1.03422	0.00451
Lick Creek	7/24	8/28	639	133	2	130	402	26.3	1.6	1.06978	0.01021
Fish captured electrofishing											
Bear Valley Creek	7/25	7/29	534	104	2	99	465	14.9	0.9	1.23740	0.01325
Big Creek	8/22	8/22	234	118	3	115	83	17.9	2.0	1.10981	0.02126
Elk Creek	7/31	7/31	78	110	4	105	78	16.9	2.4	1.19442	0.03513
Herd Creek	8/13	8/13	138	146	3	145	138	38.2	2.8	1.17987	0.01873
Lake Creek	8/27	8/27	87	108	4	103	0	—	—	—	—
Marsh Creek	8/3	8/6	92	109	4	104	85	16.8	2.4	1.18144	0.03344
Rush Creek	8/22	8/22	45	118	7	110	33	21.0	5.4	1.12096	0.02174
SF Salmon River	8/16	8/17	147	113	4	109	121	19.1	2.3	1.20697	0.02174
Secesh River	8/25	8/25	147	102	3	98	0	—	—	—	—
Valley Creek	8/7	8/9	127	127	3	126	102	26.5	2.4	1.26148	0.00800
Fish captured in minnow traps											
Fish Creek	3/15	6/10	100	95	4	89	99	9.2	1.2	0.97931	0.01051
Fish captured in box trap											
Boulder Creek	9/20	10/12	56	155	4	156	26	37.6	2.6	0.98384	0.02535

Table 9. The number of wild steelhead juveniles that were captured in the Fish Creek screw trap, number of marked fish released upstream of the trap, number of recaptures, migration estimate (Migrants), and 95% CI of the migration estimate for each trap period in 2001.

Period	Start Date	End Date	Catch	Marks	Recaps	Migrants	95% CI	
							Lower	Upper
1	3/16	4/24	66	58	4	948	412	3,042
2	4/25	5/29	56	57	1	3,164	719	55,450
3	5/30	6/15	146	133	10	1,934	1,108	3,849
4	6/16	6/29	132	109	14	1,023	639	1,801
5	6/30	7/13	63	68	8	531	287	1,161
6	7/14	7/27	52	42	9	239	138	489
7	7/28	8/14	139	113	28	558	402	816
8	8/15	8/28	229	175	42	951	726	1,290
9	8/29	9/10	646	186	52	2,304	1,840	2,975
10	9/11	9/24	1,628	626	196	5,195	4,613	5,899
11	9/25	10/8	1,506	605	195	4,668	4,146	5,301
12	10/9	10/15	2,409	375	110	8,201	7,035	9,703
13	10/16	10/29	526	350	150	1,225	1,075	1,414
14	10/30	11/12	121	88	26	406	293	599
Fall period, 8/15 to 11/12						22,951	21,365	24,794
Entire year						31,347	27,622	83,647
Entire year, periods 2 and 3 combined						30,029	27,338	35,290

Table 10. The mean daily growth rate (mm/day) and the mean instantaneous growth rate of wild steelhead and cutthroat trout recaptured in 2001. Fish tagged and recaptured in 2001 are coded with a zero in the Winters column. Fish tagged in 2000 or 1999 are coded with a one or two in the Winters column, respectively. The 95% CI is in parenthesis.

Stream	Winters	Number	Daily Growth Rate	Instantaneous Growth Rate
Steelhead				
Boulder Creek	0	17	0.06168 (0.02290)	0.03983 (0.01400)
Boulder Creek	1	17	0.08180 (0.01558)	0.05739 (0.01087)
Brushy Fork Creek	0	51	0.07701 (0.01863)	0.04683 (0.01139)
Brushy Fork Creek	1	36	0.08737 (0.00897)	0.05451 (0.00671)
Fish Creek	0	177	0.12964 (0.01184)	0.08903 (0.00880)
Fish Creek	1	76	0.10942 (0.00892)	0.08040 (0.00760)
Gedney Creek	1	28	0.09136 (0.01917)	0.06444 (0.01461)
Gedney Creek	2	6	0.07236 (0.02127)	0.05251 (0.02067)
Johnson Creek	0	10	0.26053 (0.11219)	0.14545 (0.05965)
Johnson Creek	1	9	0.06867 (0.03170)	0.03410 (0.01594)
Lake Creek	0	9	0.29876 (0.16295)	0.19963 (0.11878)
Lake Creek	1	9	0.11516 (0.03521)	0.09039 (0.03506)
Marsh Creek	0	9	0.26127 (0.07009)	0.18710 (0.05161)
Secesh River	1	11	0.13713 (0.10011)	0.10776 (0.03071)
Cutthroat trout				
Fish Creek	1	10	0.13751 (0.04334)	0.05229 (0.02297)
Fish Creek	2	7	0.17562 (0.03499)	0.06539 (0.01286)
Fish Creek	1 and 2	17	0.14975 (0.02862)	0.05733 (0.01352)

Table 11. The number of wild steelhead detected as smolts in 2001, the number of steelhead tagged, and the percent of tagged fish detected as smolts. Tagging periods are defined as: Period 1 = March 1, 2001 to May 31, 2001; Period 2 = August 15, 2000 to November 20, 2000; Period 3 = June 1, 2000 to August 14, 2000; Period 4 = March 1, 2000 to May 31, 2000; <2000 = all fish tagged before January 1, 2000; NA = not applicable, no fish were tagged during the period.

	Number of smolts detected						Number of fish tagged				Percent of tagged fish detected				Percent >125mm	
Release site	All	Period 1	Period 2	Period 3	Period 4	<2000	Period 1	Period 2	Period 3	Period 4	Period 1	Period 2	Period 3	Period 4	Period 1	Period 2
Clearwater River drainage																
Boulder Creek	95	0	0	95	0	0	0	0	559	0	na	na	17%	na	na	na
Crooked Fork Creek	483	138	267	30	27	21	203	437	154	100	68%	61%	19%	27%	74%	62%
Clear Creek	81	80	0	1	0	0	108	0	24	204	74%	na	4%	0%	74%	na
Colt Killed Creek	138	104	30	1	0	3	140	45	7	56	74%	67%	14%	0%	73%	68%
Deadman Creek	9	0	9	0	0	0	0	58	0	0	na	16%	na	na	na	38%
Fish Creek	232	1	0	197	13	21	86	0	596	93	1%	na	33%	14%	14%	na
Fish Creek screw trap	3,616	55	2,983	95	5	478	126	5,259	546	68	44%	57%	17%	7%	69%	64%
Gedney Creek	188	0	78	64	0	46	0	328	405	0	na	24%	16%	na	na	34%
O'Hara Creek	81	0	77	0	0	4	0	702	0	0	na	11%	na	na	na	20%
Red River	33	8	6	6	11	2	24	27	84	96	33%	22%	7%	11%	62%	27%
Salmon River drainage																
Bear Valley Creek	4	0	0	2	0	2	0	0	205	0	na	na	1%	0%	na	na
Big Creek[a]	10	0	0	0	0	10	0	0	0	0	na	na	0%	0%	na	na
Camas Creek[a]	7	0	0	0	0	7	0	0	0	0	na	na	0%	0%	na	na
Elk Creek	2	0	0	2	0	0	0	0	80	0	na	na	3%	0%	na	na
Herd Creek	3	0	3	0	0	0	0	31	0	0	na	10%	na	na	na	11%
Johnson Creek	816	288	327	161	0	40	489	620	339	184	59%	53%	47%	0%	60%	53%
Lake Creek	16	0	2	5	3	6	58	41	89	15	0%	5%	6%	20%	0%	4%
Lick Creek[a]	23	0	0	0	0	23	0	0	0	0	na	na	na	na	na	na
Loon Creek[a]	12	0	0	0	0	12	0	0	0	0	na	na	na	na	na	na
Lower SF Salmon River	124	64	36	4	0	20	89	74	17	40	72%	49%	24%	0%	72%	58%
Marsh Creek	12	0	0	0	2	10	10	0	7	25	0%	na	0%	8%	0%	na
Pahsimeroi River	76	46	27	3	1	0	485	544	36	246	9%	5%	8%	0%	15%	7%
Salmon River	48	42	6	0	0	0	256	24	9	10	16%	25%	0%	0%	39%	26%
Secesh River	61	4	24	24	1	11	106	185	332	16	4%	13%	7%	6%	7%	32%
SF Salmon River	60	11	10	14	0	25	31	42	36	10	35%	24%	39%	0%	38%	30%
Valley Creek	8	0	5	3	0	0	0	67	21	0	na	7%	14%	na	na	9%

[a] Steelhead were not tagged in this stream in 2000. All smolt detections were from steelhead tagged in 1999.

Table 12. Length (mm) statistics of wild steelhead smolts at the time of tagging that were detected in 2001. All fish were tagged between August 15, 2000 and May 31, 2001.

Stream	Number	Mean Length	95% CI (± mm)	Median Length	Minimum Length	Maximum Length
Clearwater River drainage						
Crooked Fork Creek	405	174	2	174	140	230
Clear Creek	80	167	4	169	137	169
Colt Killed Creek	132	186	3	185	110	230
Fish Creek	95	164	3	164	120	196
Fish Creek screw trap	3,036	155	<1	156.5	109	216
Gedney Creek	78	162	4	161	122	202
O'hara Creek	77	144	4	142	116	183
Red River	15	152	11	145	130	206
Salmon River drainage						
Johnson Creek	615	175	1	175	140	227
Lower SF Salmon River	99	169	4	170	132	219
Pahsimeroi River	72	168	8	174	103	233
Salmon River	48	165	7	168	108	200
Secesh River	26	180	7	178.5	156	211
SF Salmon River, Knox bridge	21	169	8	166	144	204
Valley Creek	5	147	28	152	115	174

Table 13. The number of wild steelhead smolts from each release site that were detected at Lower Granite Dam in 2001 and the date that 5%, 10%, 25%, 50%, 75%, and 90% of the total number of detections was attained. I only included sites that had >20 smolt detections at Lower Granite Dam.

		Date quartile was attained						Duration of quartile (days)			
Release site	Number	5%	10%	25%	50%	75%	90%	10-25%	25-50%	50-75%	75-90%
Clearwater River drainage											
Boulder Creek	88	4/27	4/29	4/30	5/1	5/3	5/6	1	1	2	3
Crooked Fork Creek	433	4/28	4/29	4/30	5/1	5/3	5/5	1	1	2	2
Clear Creek	77	4/19	4/25	4/27	4/29	4/30	5/2	2	2	1	2
Colt Killed Creek	128	4/28	4/29	5/1	5/3	5/10	5/16	2	2	7	6
Fish Creek	3,578	4/28	4/29	4/30	5/1	5/3	5/9	1	1	2	6
Gedney Creek	177	4/25	4/26	4/29	4/30	5/2	5/7	3	1	2	5
O'Hara Creek	79	4/20	4/24	4/26	4/29	5/3	5/10	2	3	4	7
Red Creek	32	4/26	4/27	4/29	5/3	5/14	5/21	2	4	11	7
Salmon River drainage											
Johnson Creek	768	4/28	4/30	5/2	5/5	5/9	5/17	2	3	4	8
Lower SF Salmon River	116	4/28	4/30	5/2	5/5	5/12	5/17	2	3	7	5
Pahsimeroi River	73	4/29	5/2	5/12	5/18	5/24	5/28	10	6	6	4
Salmon River	45	5/3	5/3	5/12	5/15	5/22	5/27	9	3	7	5
Secesh River	59	4/24	4/27	4/30	5/3	5/8	5/15	3	3	5	7
SF Salmon River, Knox bridge	59	4/27	4/28	5/2	5/5	5/8	5/18	4	3	3	10

Table 14. The median smolt travel time and 90% lower and upper CI (Lower and Upper) of wild steelhead smolts from release site to Lower Granite Dam (LGR). Only those fish tagged from March 1, 2001 to May 31, 2001 were included in the travel time analysis.

Stream	Number Detected	Distance (km) To LGR	Travel Time (Days)			Travel Time (km/Day)		
			Median	Lower	Upper	Median	Lower	Upper
Clearwater River drainage								
Crooked Fork Creek	121	324	9	8	10	36.0	40.5	32.4
Clear Creek	76	176	9	7	10	19.6	25.1	17.6
Colt Killed Creek	96	322	8	7	8	40.3	46.0	40.3
Fish Creek screw trap	50	248	11	9	15	22.5	27.6	16.5
Salmon River drainage								
Johnson Creek	262	407	12	11	13	33.9	37.0	31.3
Lower SF Salmon River	59	403	10	9	12	40.3	44.8	33.6
Pahsimeroi River	44	621	12	11	14	51.8	56.5	44.4
Salmon River	39	747	16	14	19	46.7	53.4	39.3
SF Salmon River	11	456	11	9	13	41.5	50.7	35.1

Table 15. The number of scales collected to age steelhead in 2001.

Stream	Species	Life Stage	Number
Fish Creek	Steelhead	Adult	75
Rapid River	Steelhead	Adult	29
Brushy Fork Creek	Steelhead	Juvenile	25
Colt Killed Creek	Steelhead	Juvenile	66
Crooked Fork Creek	Steelhead	Juvenile	198
Fish Creek	Steelhead	Juvenile	539
Gedney Creek	Steelhead	Juvenile	103
Lower SF Salmon River	Steelhead	Juvenile	90
Marsh Creek	Steelhead	Juvenile	119
Pahsimeroi River	Steelhead	Juvenile	126
Salmon River at Sawtooth	Steelhead	Juvenile	50
SF Salmon River, Knox bridge	Steelhead	Juvenile	30

Table 16. Preliminary results of the allelic diversity in Idaho steelhead stocks.

Locus	Number of alleles
Ogo1a	5
Ogo3	6
Ogo4	8
Ots1	11
Ots3	4
Ots4	6
Ots100	11
Oneu10	6
Omy27	5
Omy77	12
Omy207	16
Omy325	21
Oneu8	11
Oneu11	3
Oneu14	7

Table 17. The number of chinook salmon parr and resident fish trapped and PIT tagged at the screw trap and the number of adult chinook salmon trapped at the adult weir in Fish Creek during 2001. The 95% CI of the mean fork length and condition factor is in parenthesis. The sample size for the length statistics of the adult chinook salmon equals the number trapped. The sample size for the mean length and condition factor of chinook salmon parr, bull trout, and cutthroat trout equals the number tagged. Sample size for calculating the mean length of longnose and speckled dace is 778 and 407, respectively. Dace spp. = dace not identified to species.

Species	Number Trapped	Number Tagged	Fork Length (mm)		Condition Factor
			Mean	Maximum	
Resident species					
Bull trout	15	14	276 (17)	311	0.96946 (0.04248)
Cutthroat trout	527	419	213 (6)	394	0.93206 (0.00678)
Longnose dace	1,758	0	109 (1)	152	—
Speckled dace	641	0	93 (1)	131	—
Dace spp.	2,311	0	—	—	—
Chinook salmon					
Chinook salmon parr	301	209	87 (1)	109	1.07218 (0.00872)
Adult females	43	0	740 (10)	850	—
Adult males	42	0	780 (10)	930	—
All adults[a]	122	0	750 (10)	930	—

[a] Trap tenders were unable to positively identify the sex of 37 chinook salmon adults that were trapped at the weir.

Table 18. The dates and location of ground surveys to count chinook salmon redds in the Fish Creek drainage in August and September, 2001. Only newly constructed redds were reported for each survey date.

Date	Area Surveyed	Number Of Chinook		Redds
		Alive	Dead	
8/11	Lower 1 km of Hungery Creek to Pagoda Creek	6	0	0
8/12	Pagoda Creek to weir	0	0	0
8/23	Lower 2 km of Hungery Creek to Pagoda Creek	4	0	0
8/24	Pagoda Creek to weir	0	0	0
9/1	2.4 km upstream of Doubt Creek to Fish/Hungery junction	2	1	1
9/2	1 km upstream of Poker Creek to Fish/Hungery junction	6	1	4
9/8	Lower 1 km of Hungery Creek to Pagoda Creek	8	0	2
9/8	Pagoda Creek to weir	0	0	0
9/10	0.6 km upstream of weir to weir	0	1	0
9/10	Weir to mouth of Fish Creek	3	3	6
9/12	Portable Soup Camp to 1 km downstream of Bowl Creek	0	0	0
9/17	0.6 km upstream of weir to weir	3	0	2
9/22	0.6 km upstream of weir to weir	0	0	0
9/22	Weir to mouth of Fish Creek	0	0	2
	Redds counted upstream of weir:			**9**
	Redds counted downstream of weir:			**8**

Table 19. Streams that had water temperatures recorded in 2001. The winter recording interval in the Salmon River drainage was used from January 1 to April 26 and from October 26 to December 31. The winter recording interval in the Clearwater River drainage was used from January 1 to March 21 and from November 3 to December 31. The Fish Creek air temperature, relative humidity, and barometric pressure were measured at the trailhead. The water temperature was measured within 1 km of the mouth of each stream unless noted. NR = not recorded.

Stream	Recording Interval (Hours)	
	Winter	Other
Salmon River drainage		
Basin Creek, 500 m upstream of hot springs	2.5	1.5
Beaver Creek, 2 km upstream of irrigation diversion	1.0	1.0
East Fork Salmon River, upstream of Bowery Hot Springs	2.5	1.5
East Fork Salmon River	2.5	1.5
Frenchman Creek, first meadow upstream of mouth	1.0	1.0
Germania Creek	2.5	1.5
Marsh Creek, 100m downstream of screw trap site	2.5	1.5
Pole Creek, 2 km upstream of irrigation diversion	1.0	1.0
Redfish Lake Creek at weir	2.5	1.5
Salmon River at Sawtooth Hatchery	1.0	1.0
Valley Creek, 200 m upstream of Meadow Creek	2.5	1.5
West Pass Creek, at irrigation diversion	2.5	1.5
Clearwater River drainage		
Bald Mountain Creek	2.0	1.0
Bimerick Creek	2.0	1.0
Boulder Creek	1.0	1.0
Brushy Fork Creek	1.0	1.0
Canyon Creek[a]	1.0	1.0
Crooked Fork Creek, 50 m upstream of Brushy Fork Creek	1.0	1.0
Deadman Creek	2.0	1.0
Fish Creek #1, at tag site	0.5	0.5
Fish Creek #2, 100m upstream of tag site	1.0	0.5
Fish Creek #3, 2 km upstream of Hungery Creek	1.0	1.0
Fish Creek, Air temperature	2.0	1.0
Fish Creek, Barometric pressure	NR	1.0
Fish Creek, Relative humidity	NR	1.0
Gedney Creek #1	1.0	0.5
Gedney Creek #2, upstream of mouth about 2 km	1.0	1.0
Hungery Creek	1.0	1.0
Lost Creek	2.0	1.0
O'Hara Creek, 2 km downstream of Hanby Fork[a]	1.0	1.0
Post Office Creek[a]	1.0	1.0
Red River, 1km upstream of SF Red River	1.0	1.0
SF Red River #1, at Schooner Creek	1.0	1.0
SF Red River #2, 1.5 km upstream of Trapper Creek	1.0	1.0
Squaw Creek	2.0	1.0
Trapper Creek	1.0	1.0
Weir Creek[a]	1.0	1.0
Wendover Creek	2.0	1.0
WF Gedney Creek	1.2	1.2
Willow Creek (tributary of Fish Creek)	1.0	1.0

[a] A two-hour interval was used from January 1, 2001 to March 21, 2001.

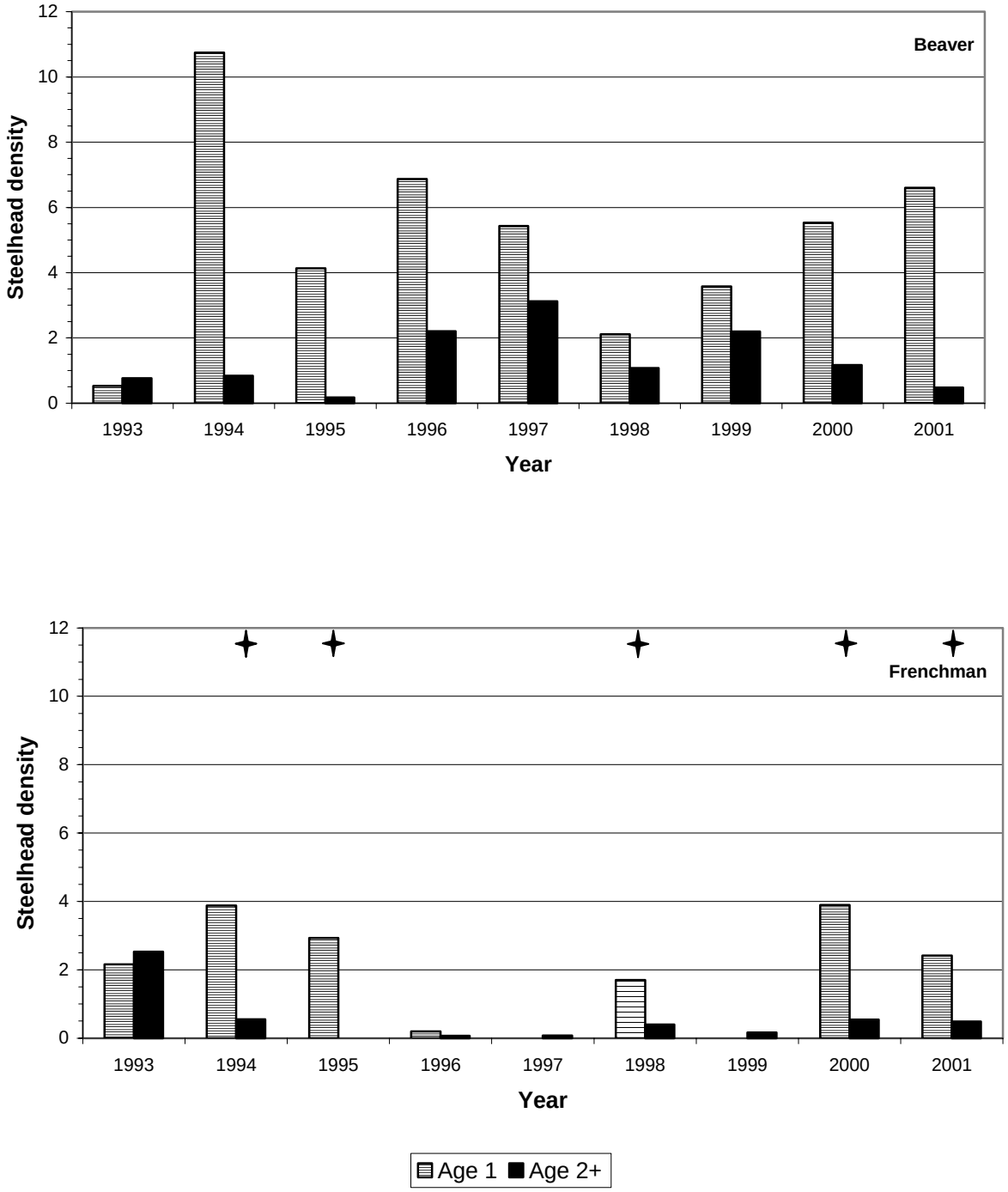


Figure 1. The mean density (fish/100m^2) of age-1 and age-2+ steelhead in Beaver (top) and Frenchman (bottom) creeks from 1993 to 2001. The years marked with a star in the Frenchman Creek graph indicate that adult steelhead were stocked the previous year.

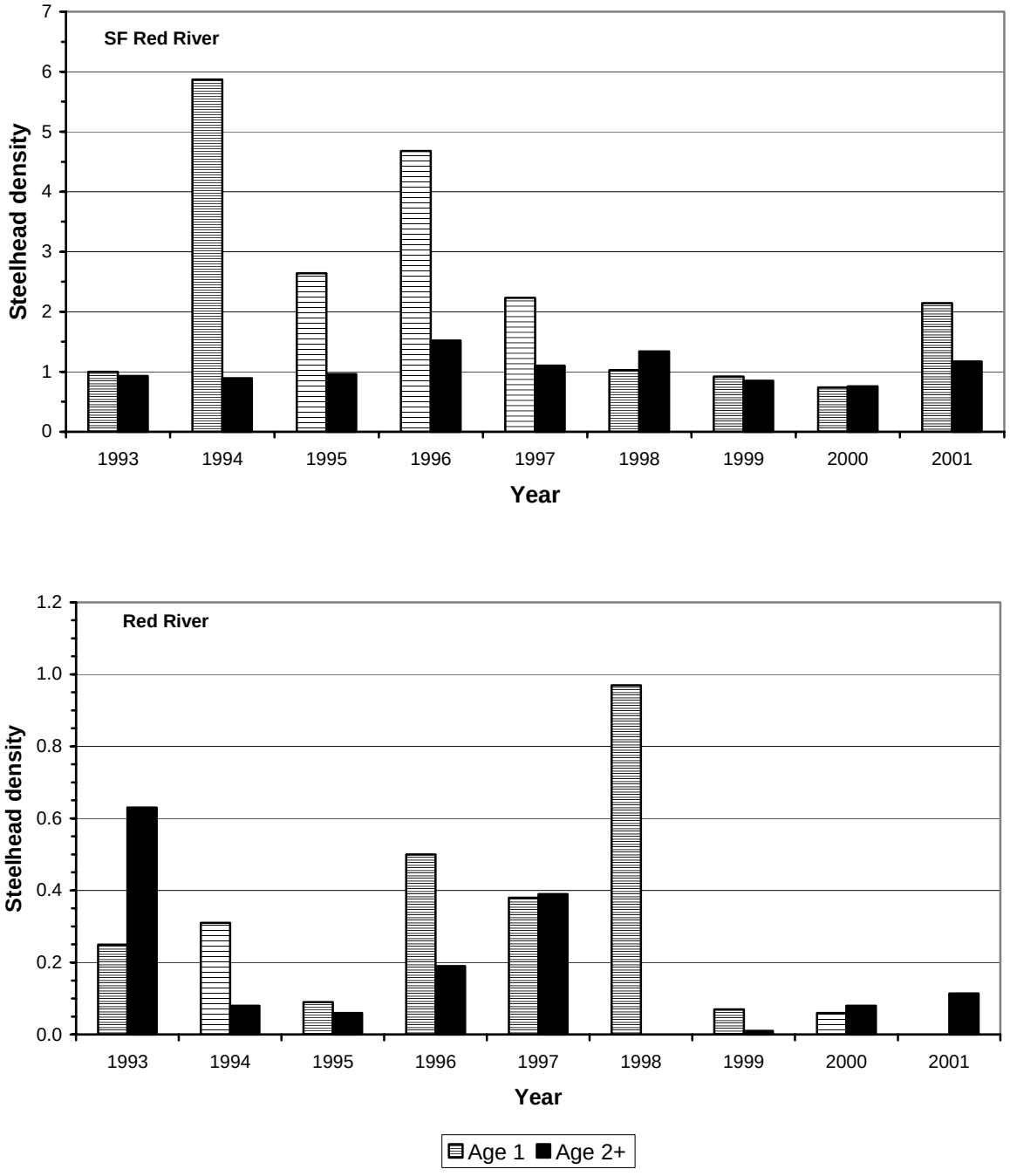


Figure 2. The mean stream density (fish/100 m^2) of age-1 and age-2+ steelhead from 1993 to 2001 in the South Fork (SF) Red River (top) and Red River (bottom) upstream of the SF Red River.

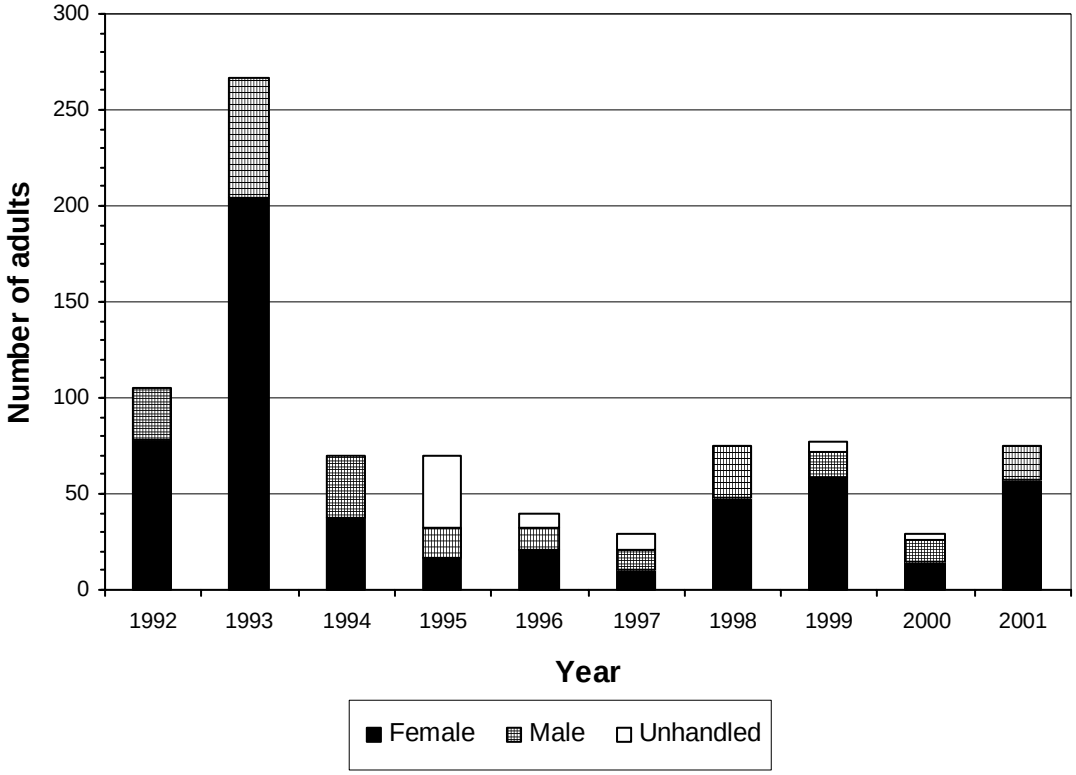


Figure 3. The steelhead escapement in Fish Creek from 1992 to 2001 based on the number of adult steelhead trapped at the weir and the number of unmarked kelts recovered. The weir was intact for the entire spawning season from 1992 to 1994, 1998, 2000, and 2001. The weir was opened on May 2, 1995 to prevent otter predation and breached in three years on May 18, 1996, May 11, 1997, and May 24, 1999. The open rectangle in the years 1995, 1996, 1997, and 1999 is the estimated number of adults that entered the stream after the weir was opened based on the mean proportion of adults that had arrived in the years the weir was intact. The open rectangle in the year 2000 is the maximum likelihood estimate of the escapement.

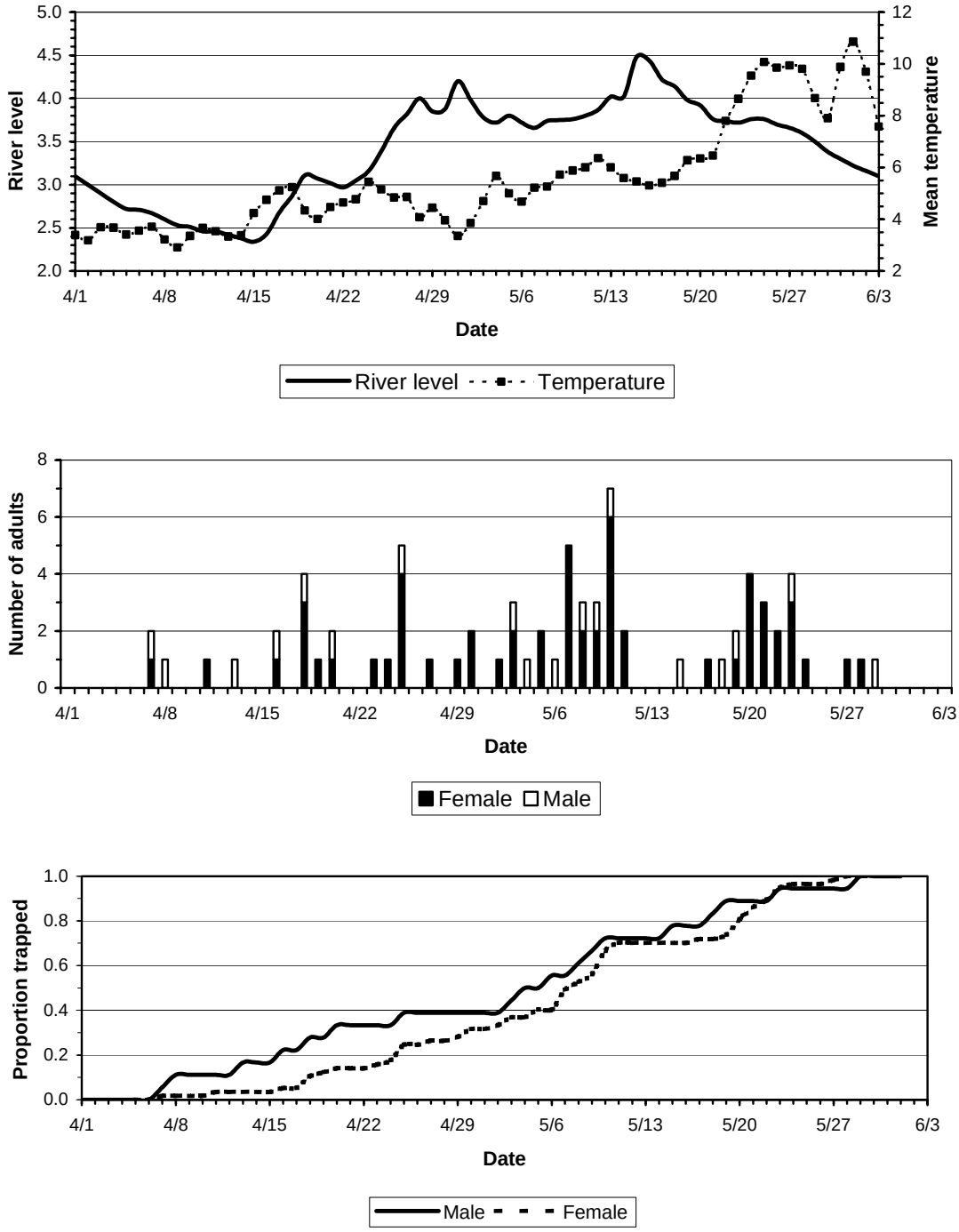


Figure 4. The daily river level and mean stream temperature (top), the number of adult steelhead trapped each day (middle), and the cumulative proportion of adults trapped (bottom) in Fish Creek during the spring 2001.

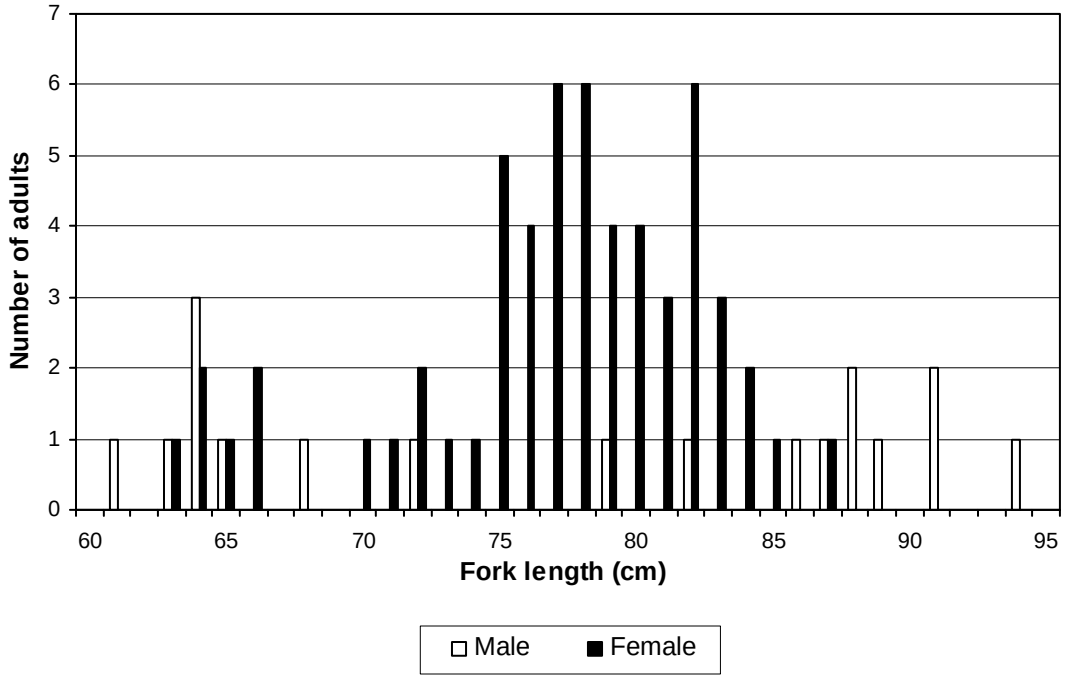


Figure 5. The length frequency of male and female wild steelhead trapped at the Fish Creek weir in 2001.

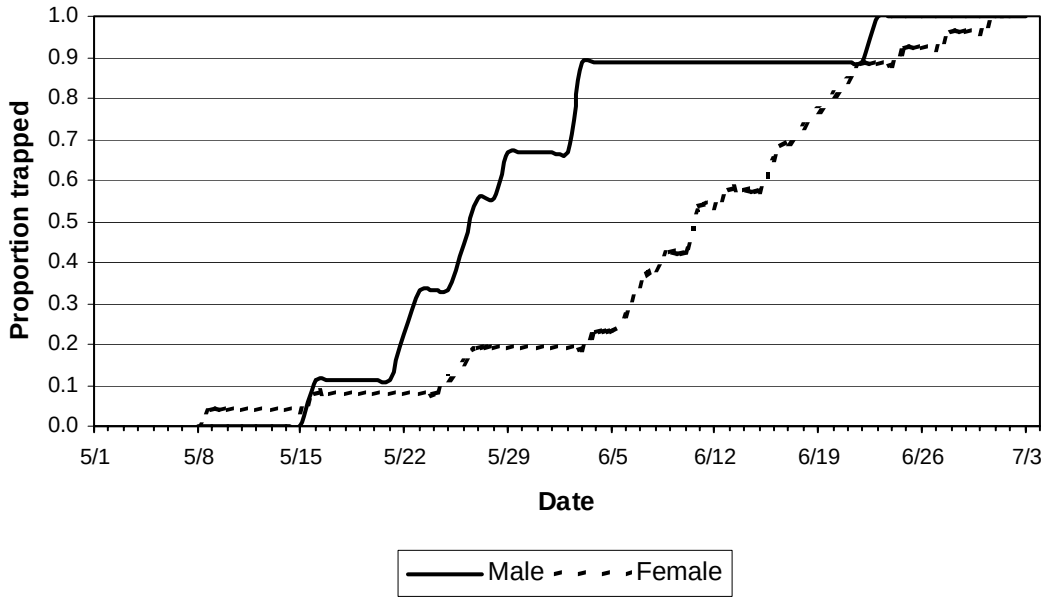


Figure 6. The cumulative proportion of kelts captured at the Fish Creek weir in 2001.

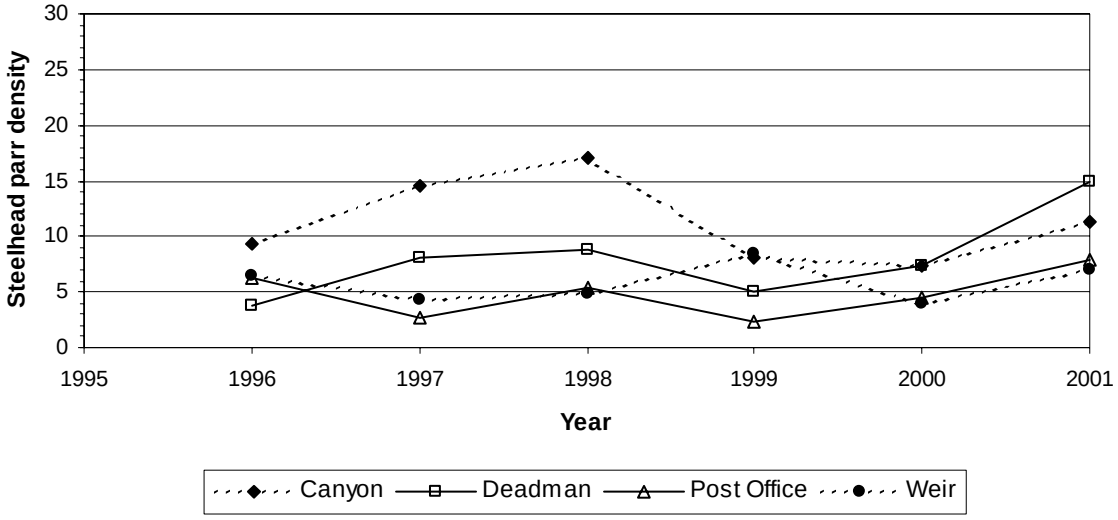


Figure 7. The mean stream density (fish/100m^2) from 1995 to 2001 of all juvenile steelhead (except fry) in the Lochsa River tributaries Canyon, Deadman, Post Office, and Weir creeks.

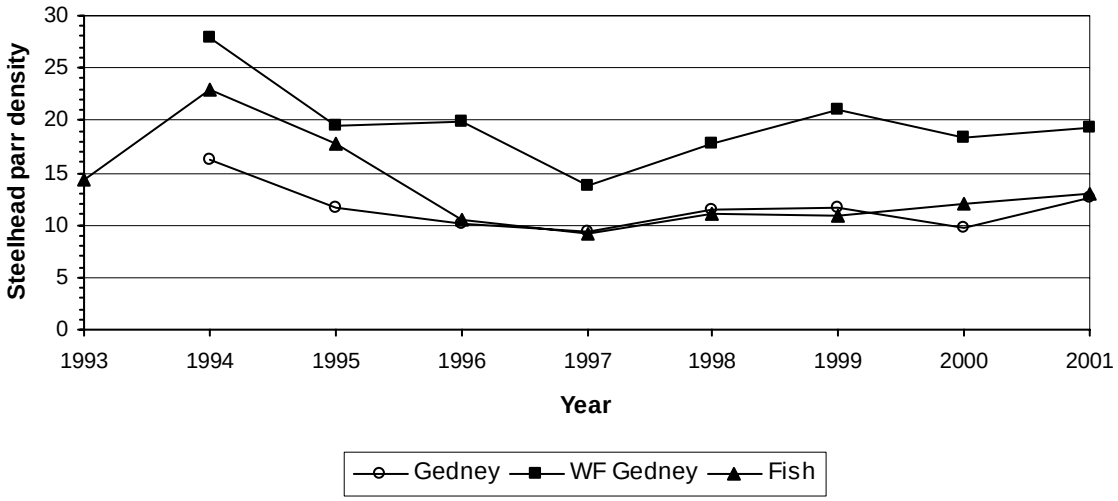


Figure 8. The mean stream density (fish/100m^2) from 1993 to 2001 of all juvenile steelhead (except fry) in Fish Creek, Gedney Creek, and West Fork Gedney Creek.

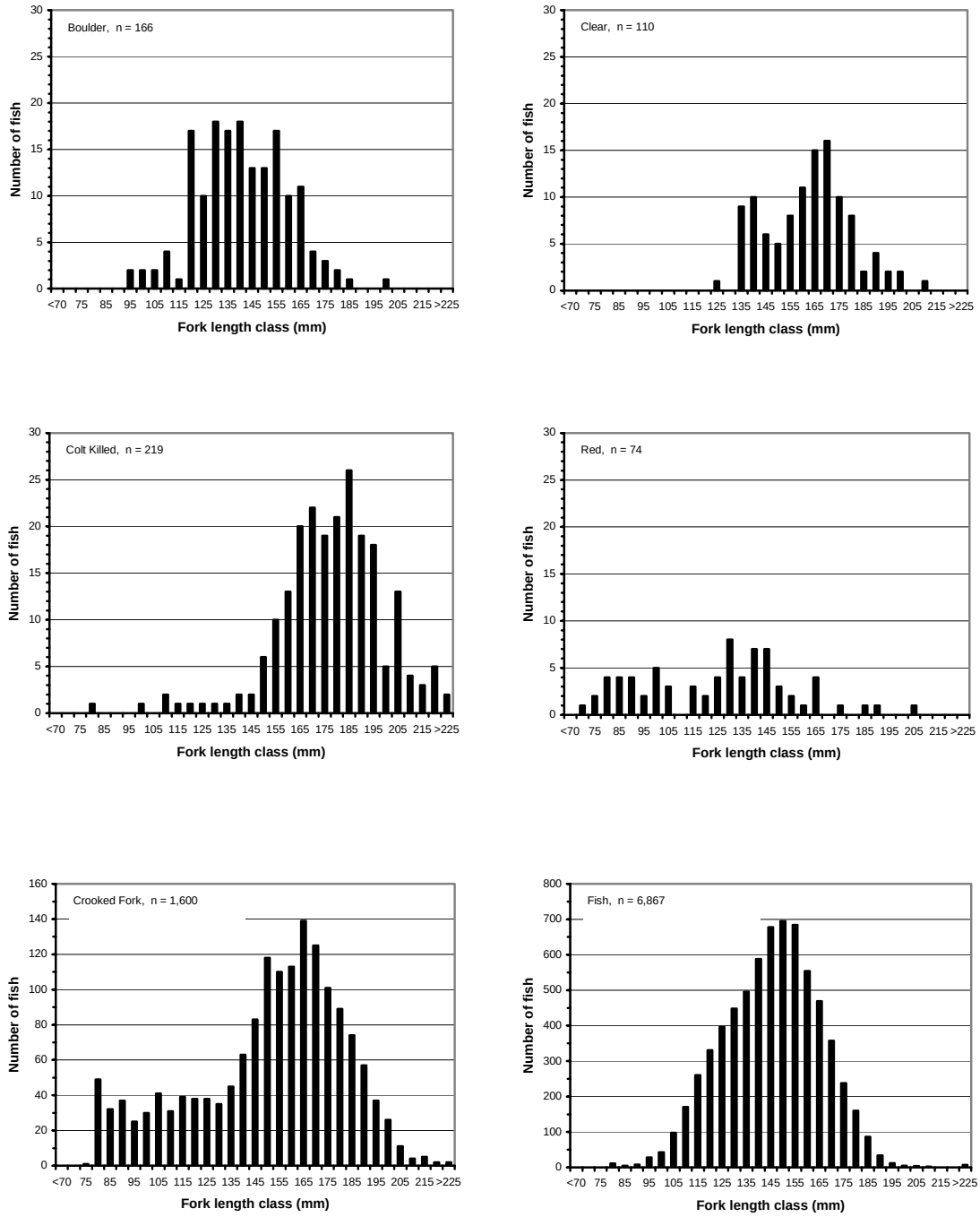


Figure 9. Length frequency of PIT-tagged wild steelhead juveniles captured in screw traps located in tributaries of the Clearwater River drainage during 2001.

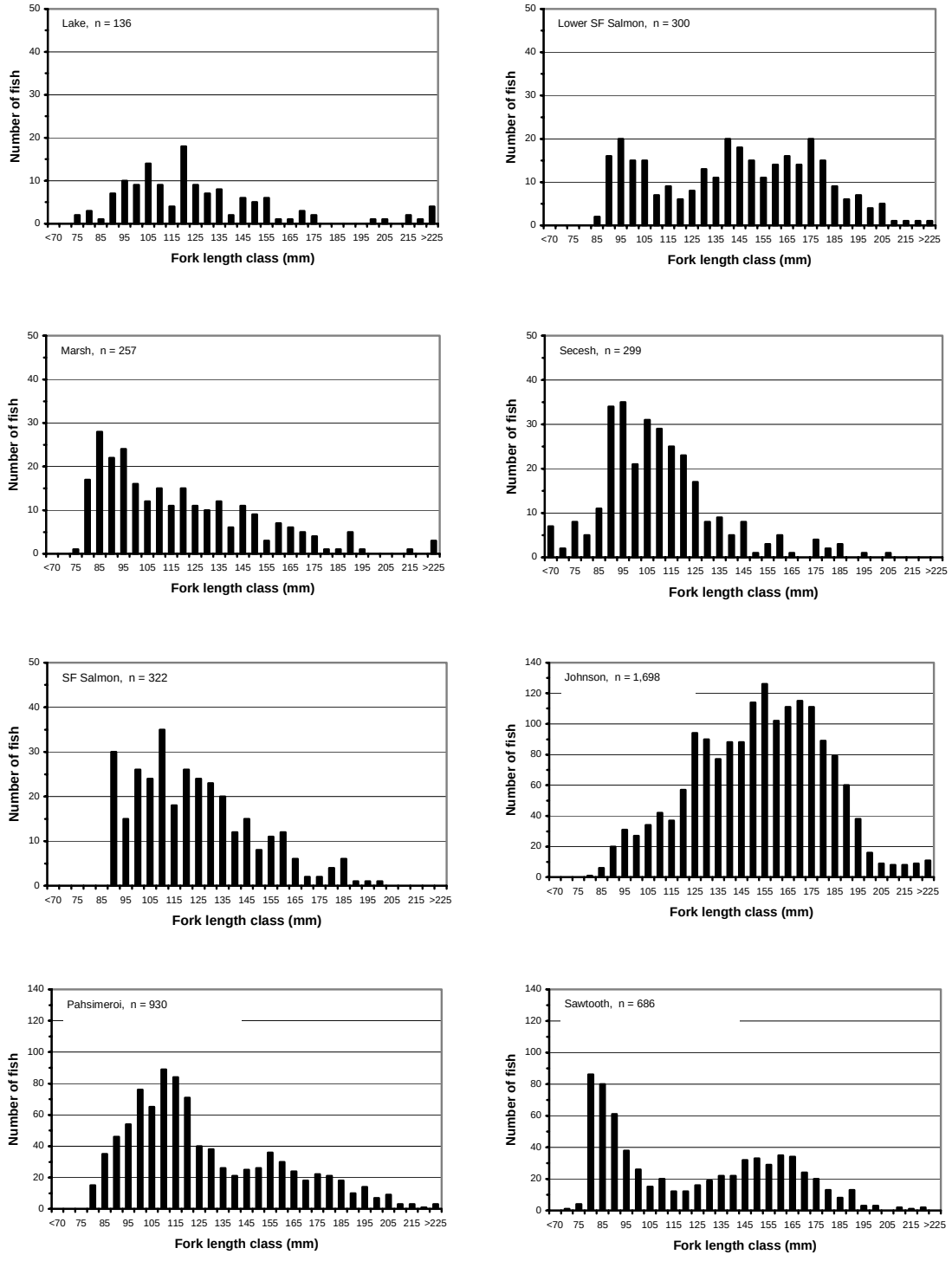


Figure 10. Length frequency of PIT-tagged wild steelhead juveniles captured in screw traps located in tributaries of the Salmon River drainage during 2001.

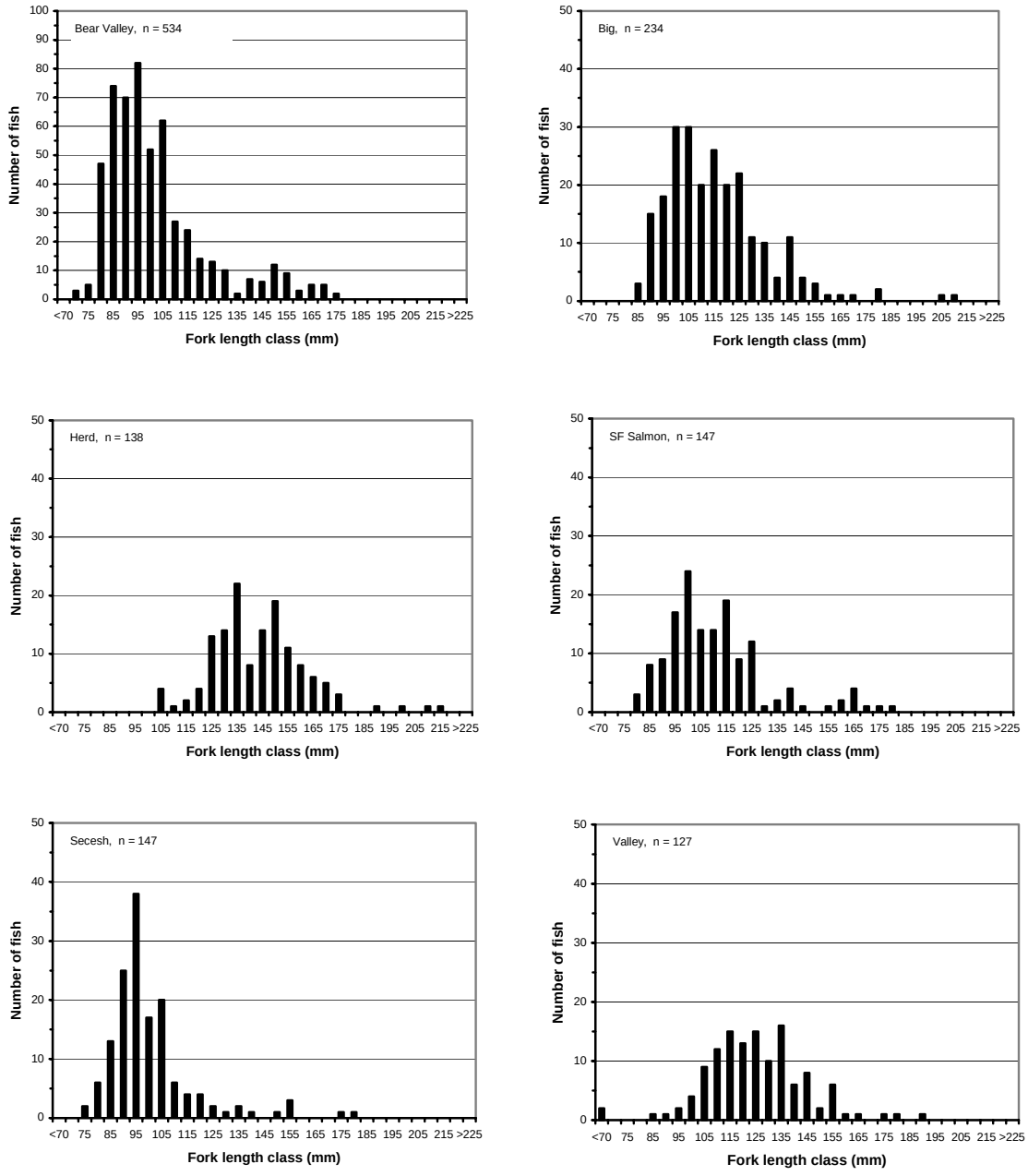


Figure 11. Length frequency of PIT-tagged wild steelhead juveniles captured electrofishing in tributaries of the Salmon River drainage during 2001.

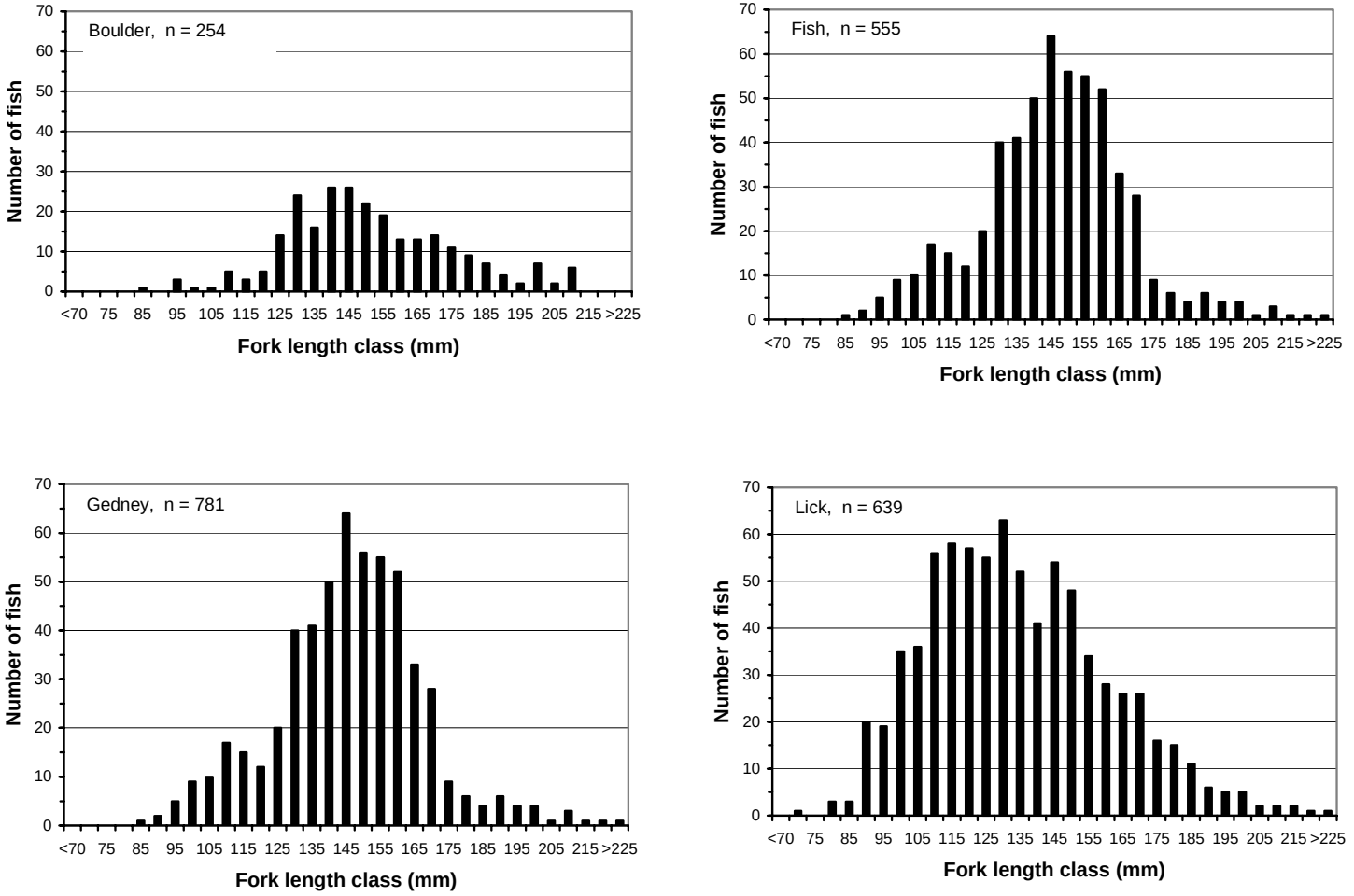


Figure 12. Length frequency of PIT-tagged wild steelhead juveniles captured flyfishing during the summer of 2001.

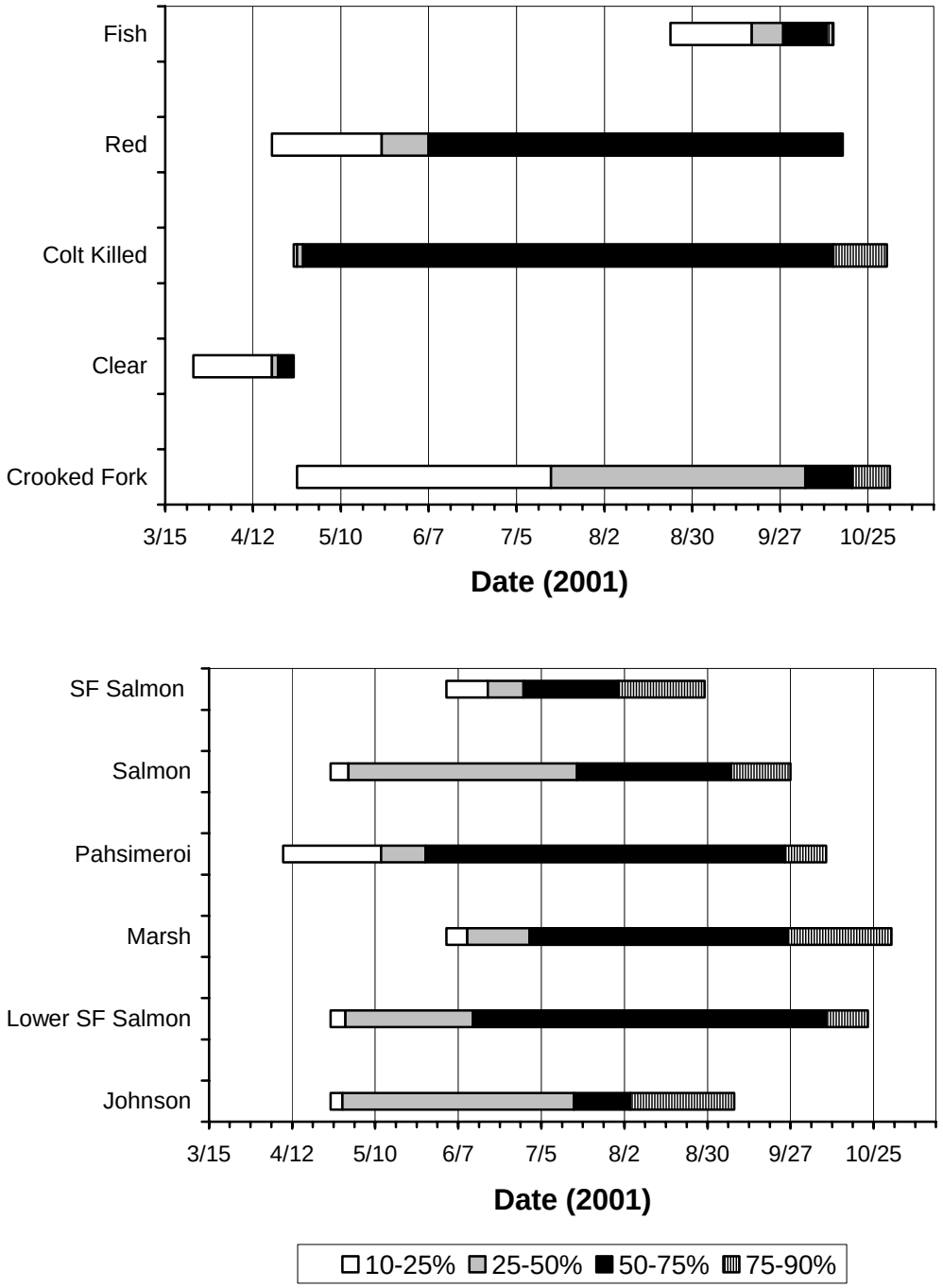


Figure 13. The date that 10%, 25%, 50%, 75%, and 90% of the total number of steelhead tagged at screw traps fished in the Clearwater River drainage (top) and Salmon River drainage (bottom) in 2001 was attained. The left edge of each block is the date that the lower quartile of the block was reached. The Clear Creek trap was only fished until June 15, 2001.

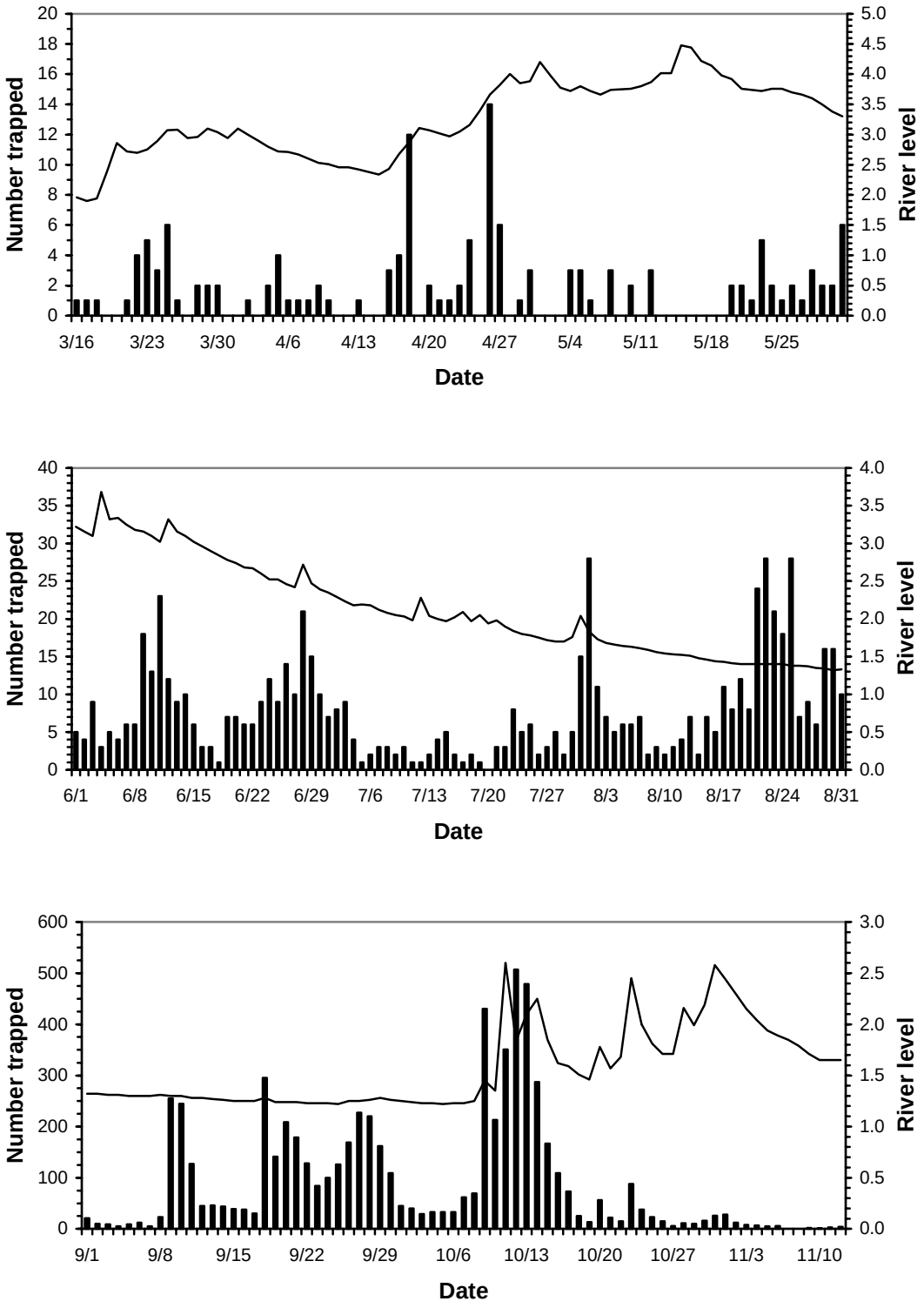


Figure 14. The daily river level and the number of wild steelhead juveniles trapped (excluding fish recaptured for trap efficiency estimate) at the Fish Creek screw trap from March 16, 2001 to November 12, 2001.

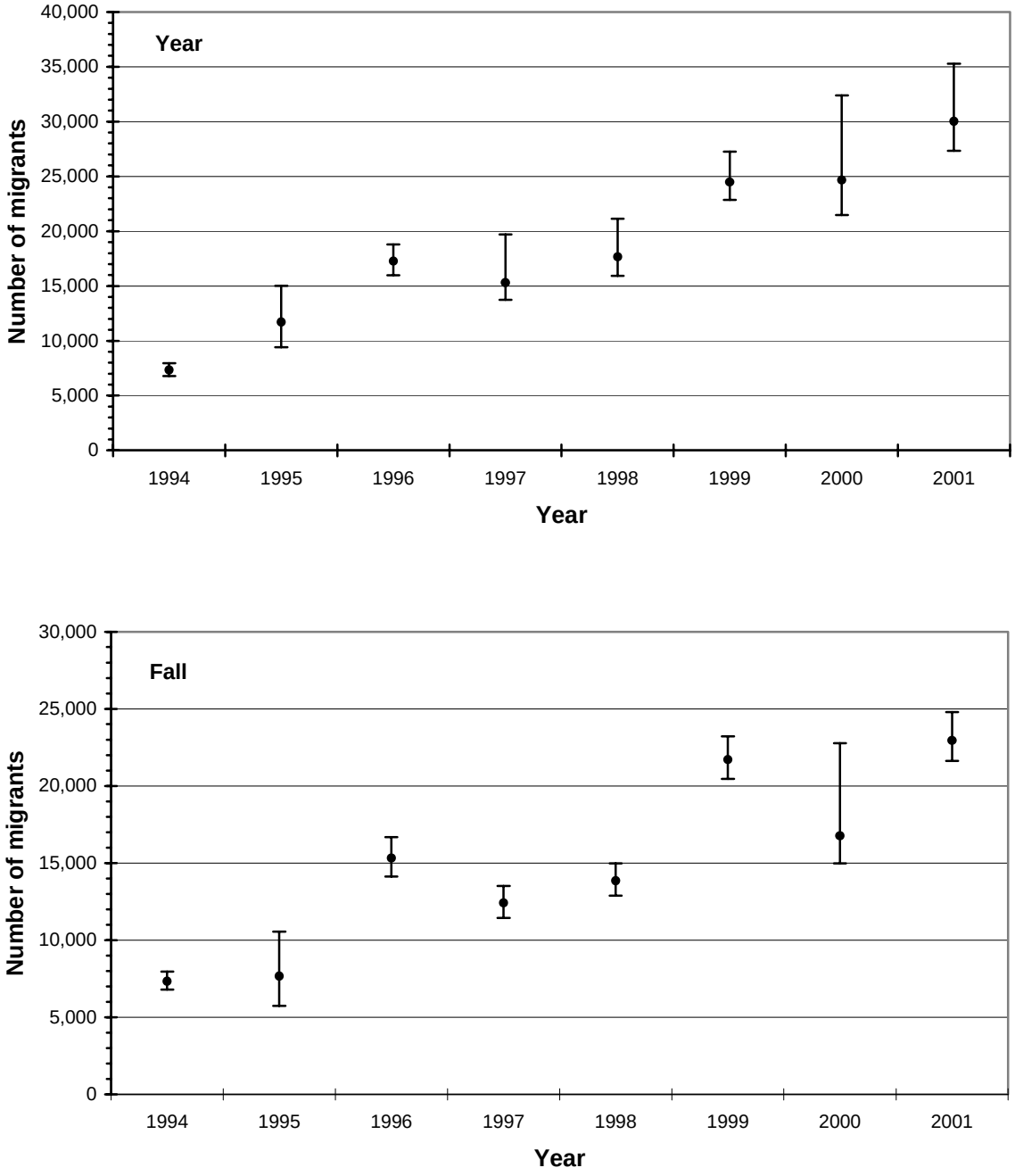


Figure 15. The number of juvenile steelhead (and 95% CI) that migrated past the screw trap in Fish Creek during the entire trapping season (Year, top graph) and from August 15 to the end of trapping in November (Fall, bottom graph) from 1994 to 2001. The 2001 estimate was made by combining the catch, mark, and recapture numbers of periods 1 and 2. In 1994, the trap was fished from September 22 to November 2. In 1995, the trap was fished from March 16 to June 14 and from August 18 to November 2. Beginning in 1996, IDFG crews have fished the trap (conditions permitting) continuously from mid-March until early November.

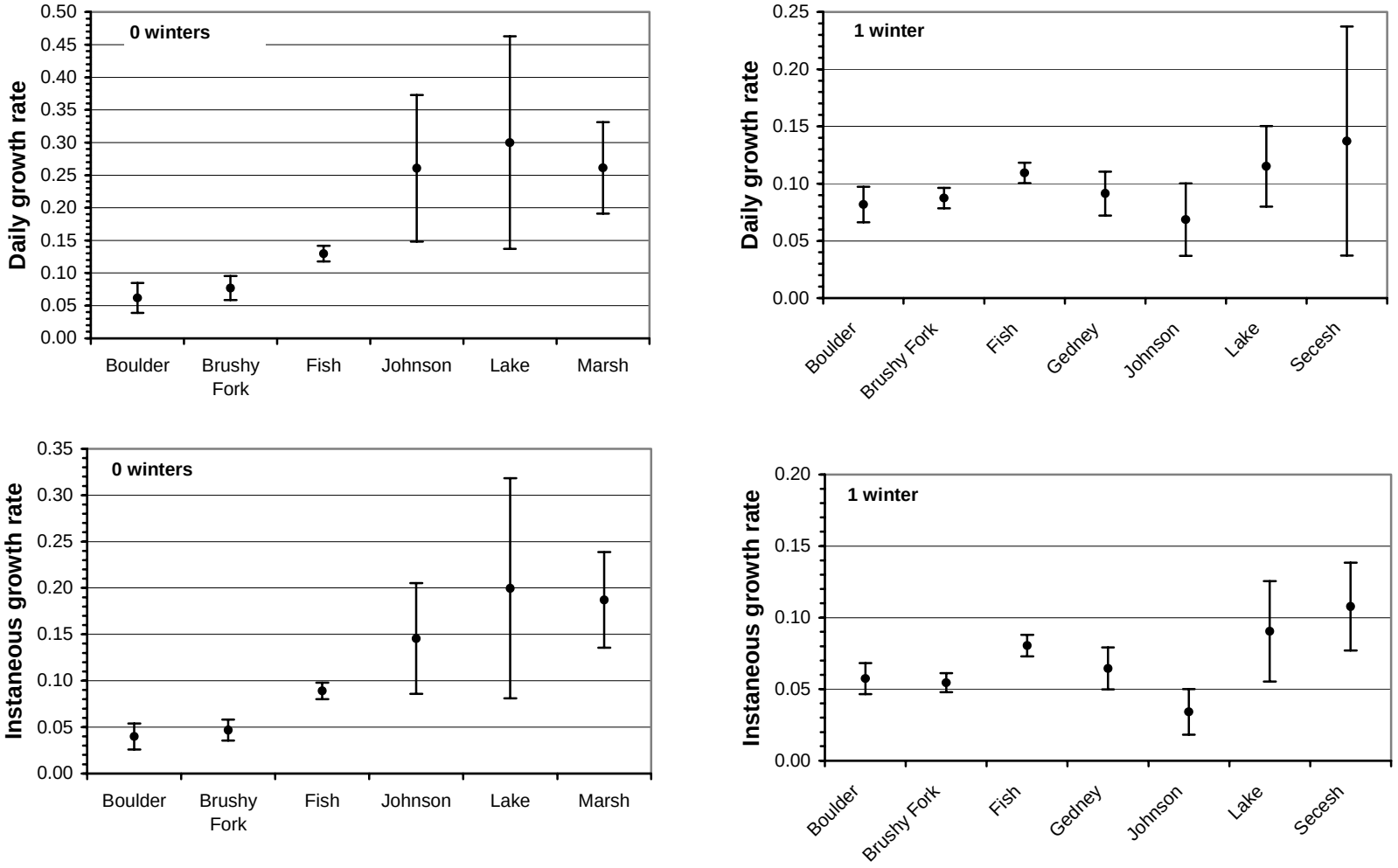


Figure 16. The daily growth rate (mm/day) and instantaneous growth rate of wild steelhead PIT tagged and recaptured in 2001 (0 winters) and those tagged in 2000 and recaptured in 2001 (1 winter). Vertical lines show the upper and lower 95% confidence interval.

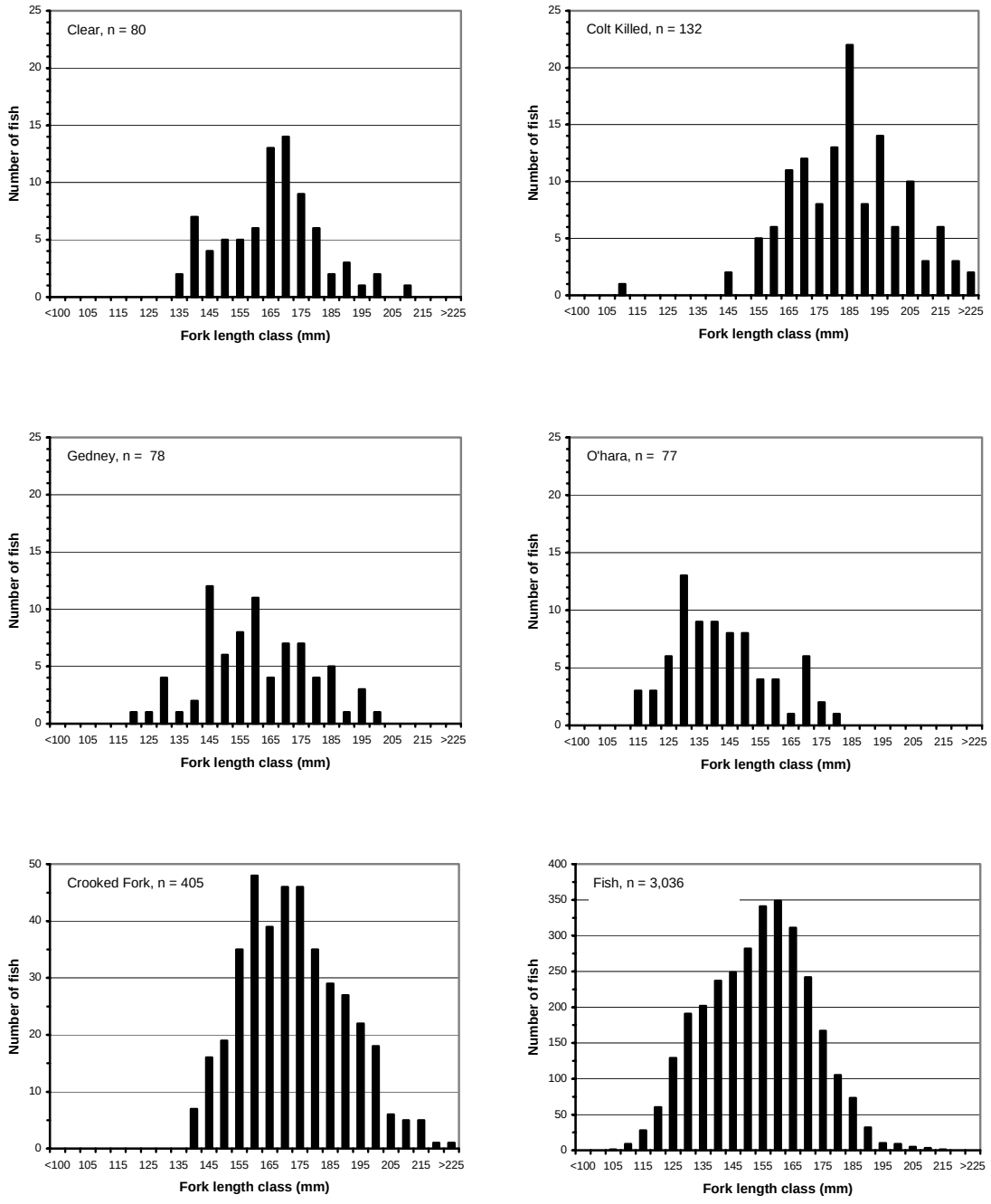


Figure 17. The length frequency of wild steelhead tagged in Clearwater River tributaries from August 15, 2000 to May 31, 2001 and detected as smolts during 2001 at dams on the lower Snake River.

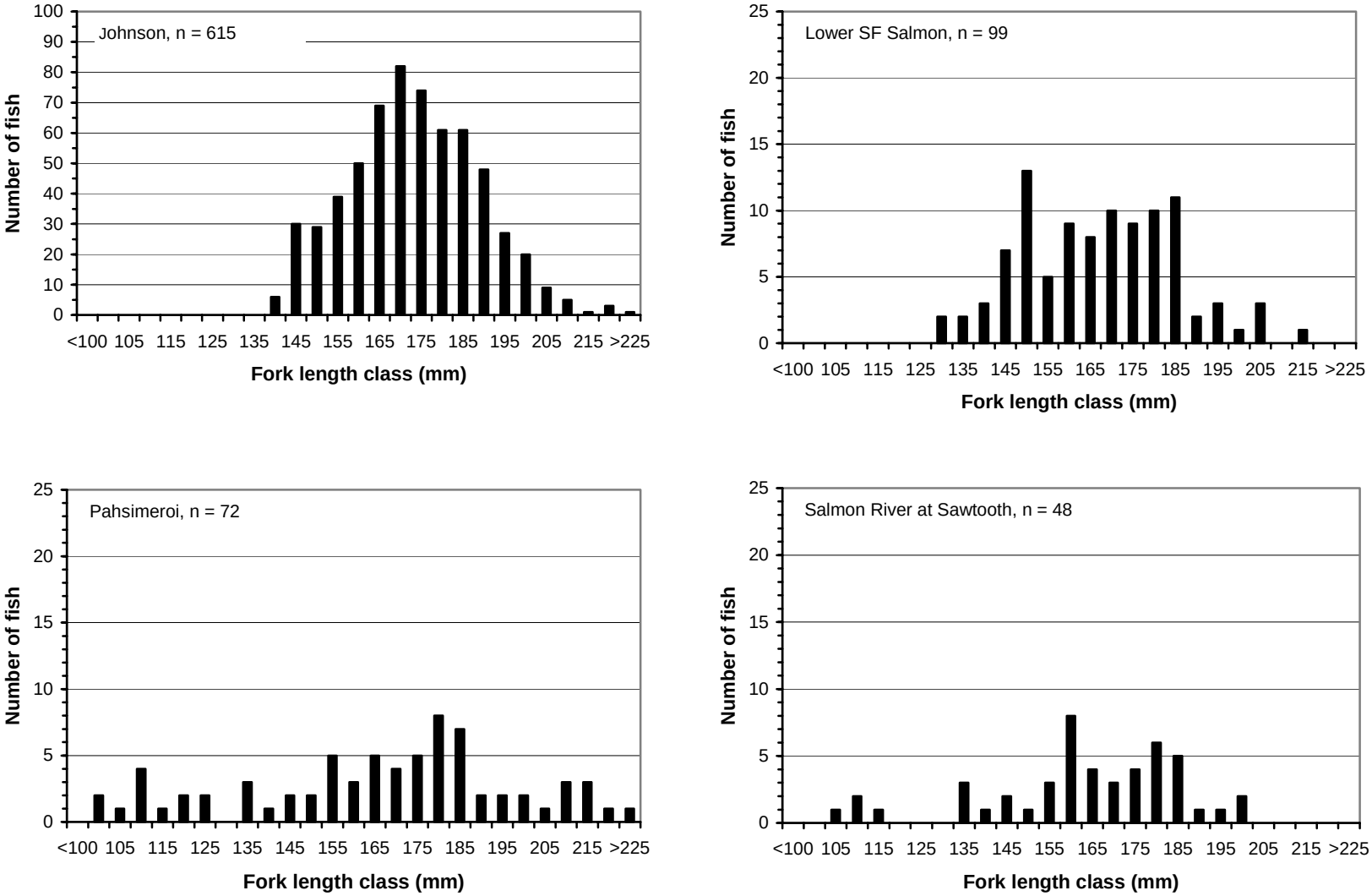


Figure 18. The length frequency of wild steelhead tagged in Salmon River tributaries from August 15, 2000 to May 31, 2001 and detected as smolts (n ≥ 48 smolt detections) during 2001 at dams on the lower Snake River.

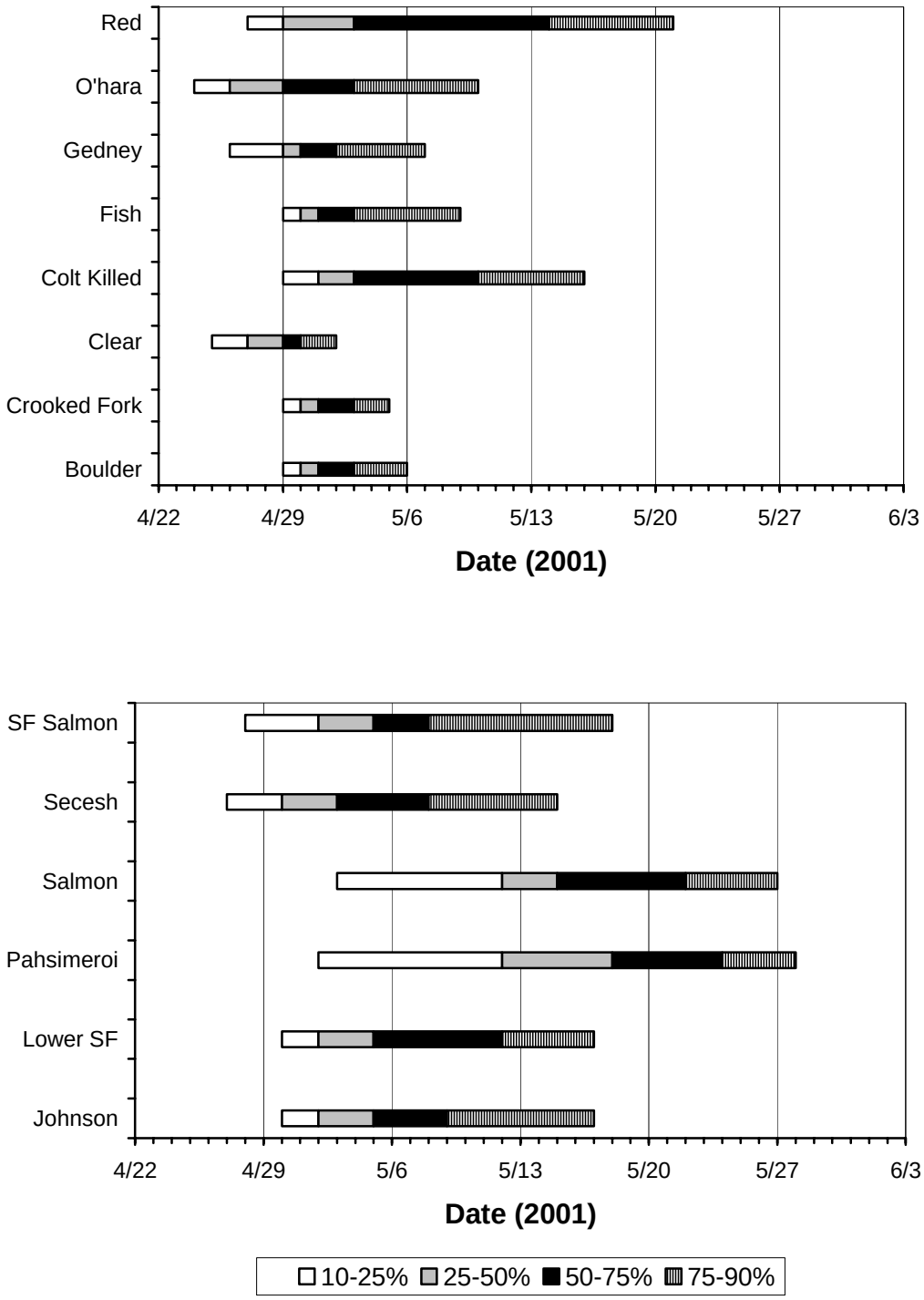


Figure 19. The date that 10%, 25%, 50%, 75%, and 90% of the total number of steelhead smolt detections at Lower Granite Dam in 2001 was attained from tributaries of the Clearwater River (top graph) and Salmon River (bottom graph). The left edge of each block is the date that the lower quartile of the block was reached.

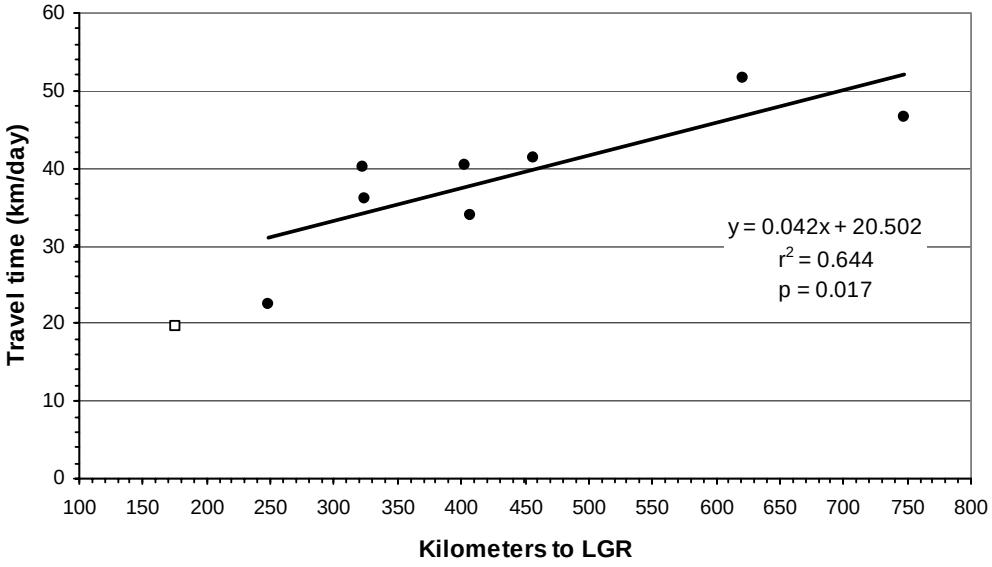


Figure 20. The relation between median smolt travel time from tag site to Lower Granite Dam (LGR) and the distance from the tag site to LGR. The data point for Clear Creek (open square) was omitted from the regression.

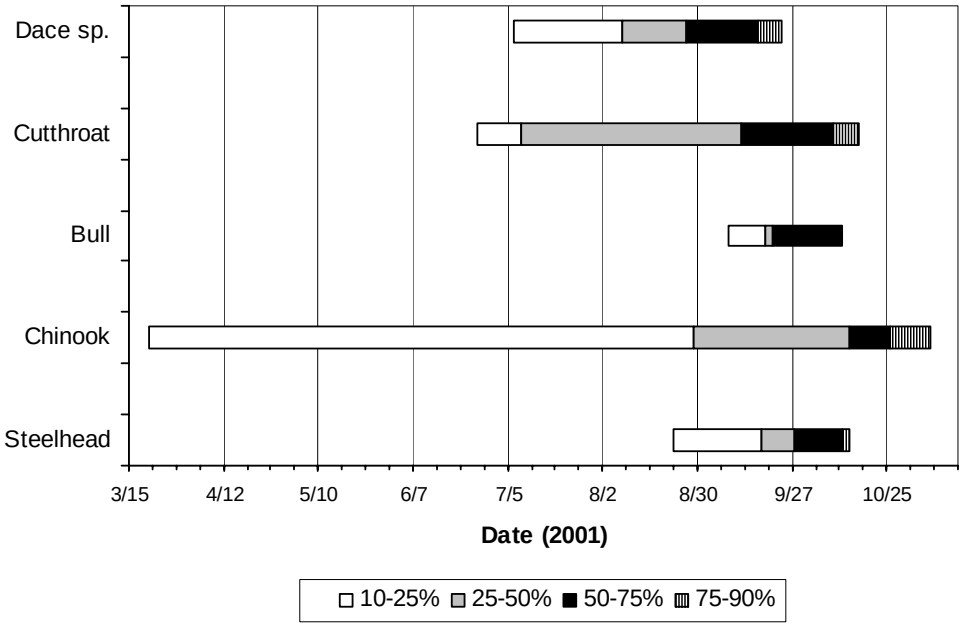


Figure 21. The date that 10%, 25%, 50%, 75%, and 90% of the total number of bull trout, cutthroat trout, chinook salmon parr, longnose dace, speckled dace, and dace not identified to species (Dace sp.) captured at the Fish Creek screw trap in 2001 was attained. The steelhead quartiles are for the fish that were captured in the screw trap and PIT tagged. The left edge of each block is the date that the lower quartile of the block was reached.

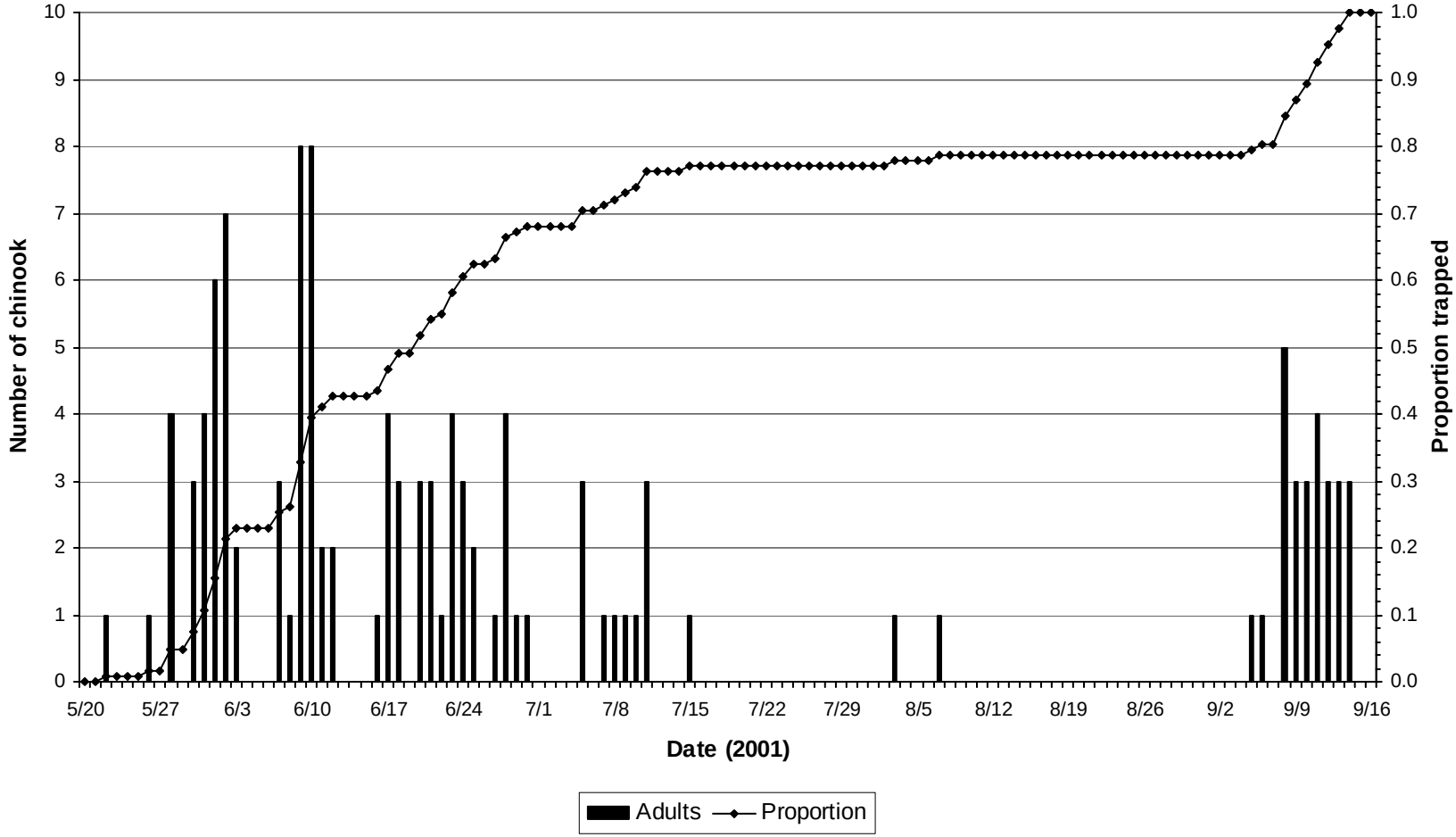


Figure 22. The number of chinook salmon adults that were trapped daily and the cumulative proportion of the total trapped that had entered Fish Creek from May 20, 2001 to September 16, 2001.

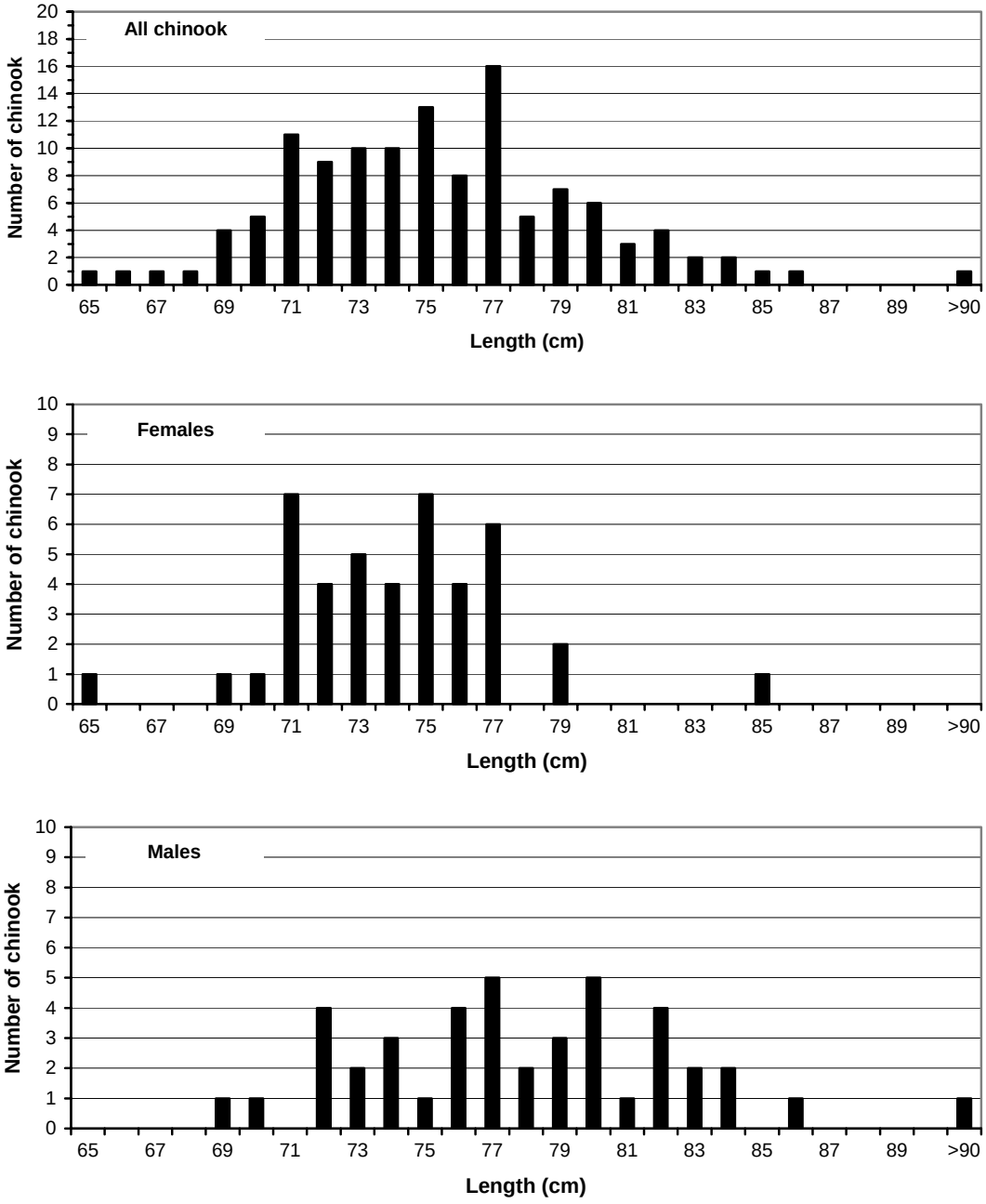


Figure 23. The length frequency of all adult chinook salmon (top, n = 122), fish identified as male (middle, n = 42), and fish identified as female (bottom, n = 43) trapped at the Fish Creek weir in 2001.

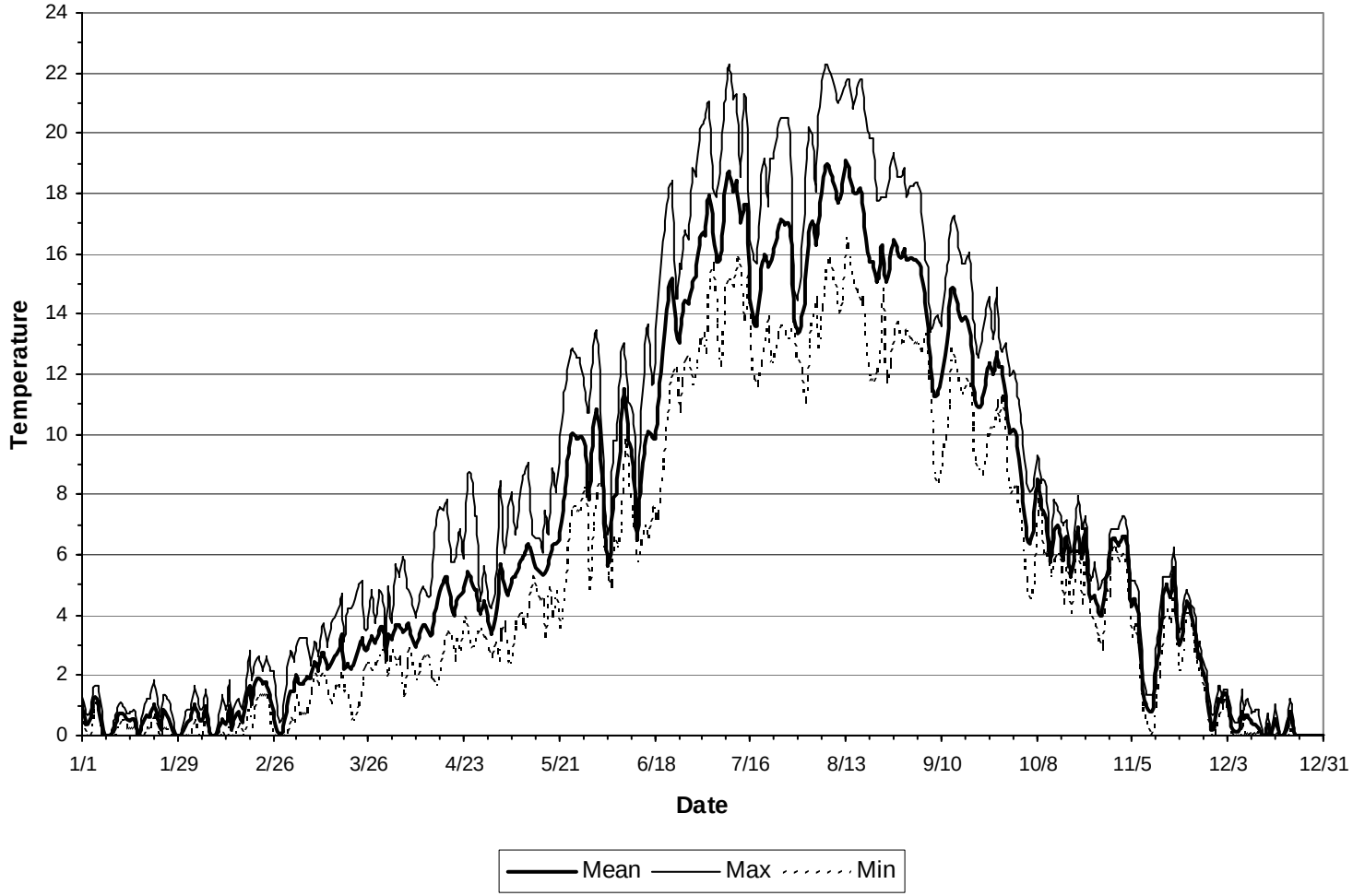


Figure 24. The daily mean, maximum, and minimum stream temperature (°C) recorded in Fish Creek during 2001.

LITERATURE CITED

Byrne, A. 1994. Steelhead supplementation studies in Idaho rivers. Experimental design. Idaho Department of Fish and Game, Boise, Idaho. 90 pp.

Byrne, A. 1996. Steelhead supplementation studies in Idaho rivers. 1993 Annual Report to the U.S. Department of Energy, Bonneville Power Administration. Idaho Department of Fish and Game, Boise, Idaho. 60 pp.

Byrne, A. 1997. Steelhead supplementation studies in Idaho rivers. 1994 Annual Report to the U.S. Department of Energy, Bonneville Power Administration. Contract No. DE-B179-89BP01466, Project No. 90-055. Idaho Department of Fish and Game, Boise, Idaho. 90 pp.

Byrne, A. 1999. Steelhead supplementation studies in Idaho rivers. 1995 Annual Report to the U.S. Department of Energy, Bonneville Power Administration. Contract No. DE-B179-89BP01466, Project No. 90-055. Idaho Department of Fish and Game, Boise, Idaho. 90 pp.

Byrne, A. 2001a. Steelhead supplementation studies in Idaho rivers. Summary Report for 1993 through 1999 to the U.S. Department of Energy, Bonneville Power Administration. Contract No. DE-B179-89BP01466, Project No. 199005500. Idaho Department of Fish and Game, Boise, Idaho. 125 pp.

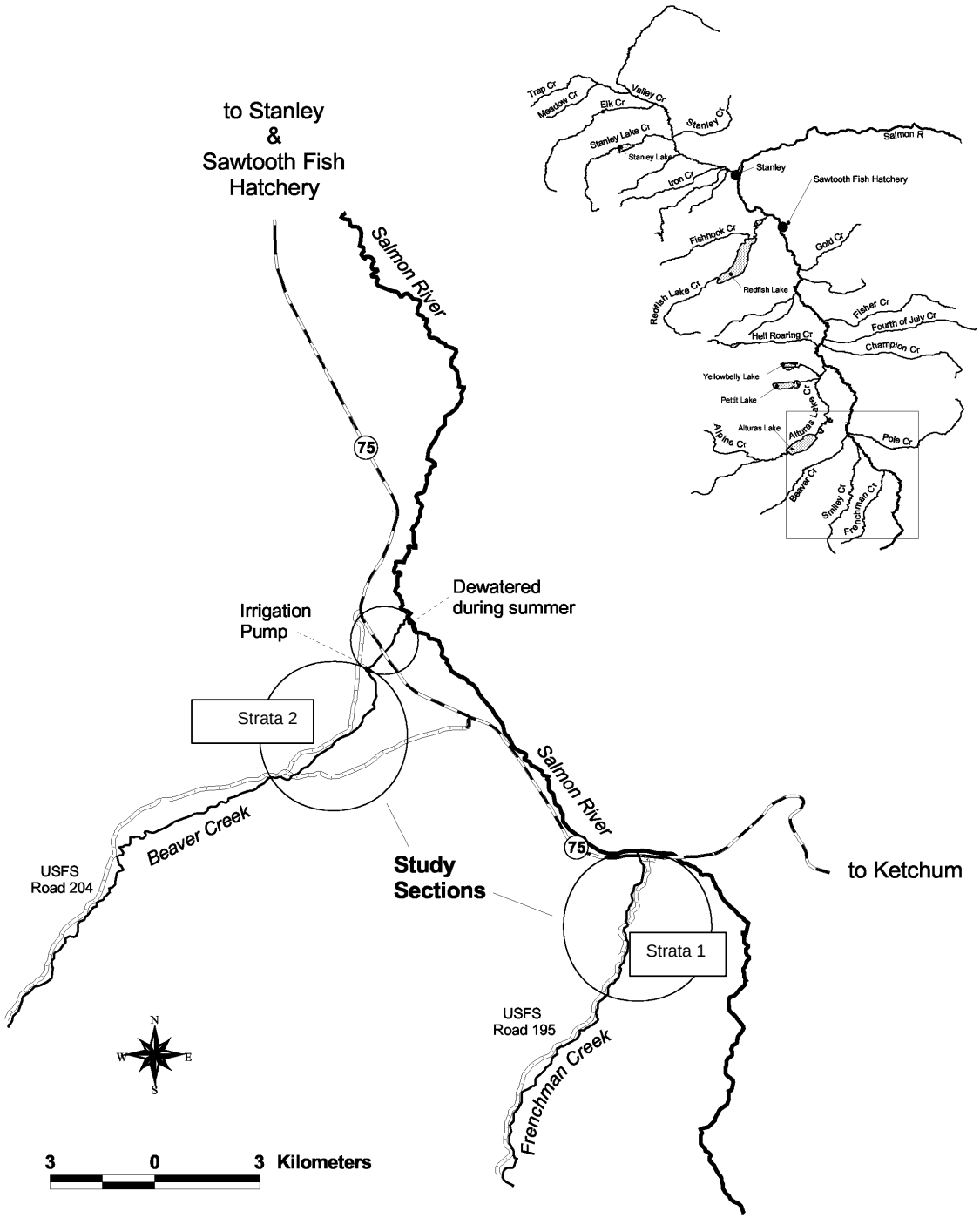
Byrne, A. 2001b. Steelhead supplementation studies in Idaho rivers. 2001 Annual Report to the U.S. Department of Energy, Bonneville Power Administration. Contract No. DE-B179-89BP01466, Project No. 199005500. Idaho Department of Fish and Game, Boise, Idaho. 62 pp.

MacLellan, S. E. 1987. Guide for sampling structures used in age determination of Pacific salmon. Department of Fisheries and Oceans, Fisheries Research Branch, Pacific Biological Station. Nanaimo, British Columbia, Canada. 27 pp.

Scheaffer, R., W. Mendenhall, and L. Ott. 1986. Elementary survey sampling. Duxbury Press. Boston, Massachusetts. 324 pp.

Wu, Y., and K. Steinhorst. 2000. Confidence intervals for escapement estimates derived from stratified samples. Report of the University of Idaho Statistical Consulting Center to the Idaho Department of Fish and Game, Boise, Idaho.

APPENDICES



Appendix 1. The location of the hatchery adult steelhead outplants and the summer snorkel surveys to estimate resulting parr production in Beaver and Frenchman creeks.

Prepared by:

Alan Byrne
Senior Fishery Research Biologist

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Virgil K. Moore, Chief
Bureau of Fisheries

Steve Yundt
Fishery Research Manager