FISHERY MANAGEMENT INVESTIGATIONS

IDAHO DEPARTMENT OF FISH AND GAME

FISHERIES MANAGEMENT ANNUAL REPORT

Virgil Moore, Director

SOUTHWEST REGION

2014

Arthur E. Butts, Regional Fishery Biologist
Martin Koenig, Regional Fishery Biologist
Joseph R. Kozfkay, Regional Fishery Manager
Michael P. Peterson, Regional Fishery Biologist
Nicholas Porter, Fisheries Technician

May 2016
IDFG 15-109

2013 SOUTHWEST REGION (NAMPA) FISHERIES MANAGEMENT REPORT

RIVERS AND STREAMS INVESTIGATIONS

STATUS OF RAINBOW TROUT IN THE SOUTH FORK BOISE RIVER

ABSTRACT

The South Fork Boise River (SFBR) downstream of Anderson Ranch Dam is a nationally-renowned tailwater-trout fishery. Idaho Department of Fish and Game staff has monitored Rainbow Trout *Oncorhynchus mykiss* populations in the SFBR every three years since 1994. Age-0 Rainbow Trout production has been assessed since 2009 by monitoring early life-stage abundance in the SFBR. The SFBR fish populations are still undergoing changes as a result of the Elk-Pony complex wildfires that occurred in August 2013, and subsequent sediment and debris flows in 2013 and 2014. Trout densities (≥ 100 mm) are assessed using mark-recapture electrofishing techniques. A total of 241 adult Rainbow Trout were marked in 2014, which represented 51% decline from the 2012 survey. Among individual sites, the decline in numbers of fish marked ranged between 39% and 64%. Mark-recapture estimates of Rainbow Trout density (± 90% CI) among trend sites ranged from 670 ± 293 fish/km in the middle site, to 1,221 ± 1,068 fish/km in the lower site. Density at all three sites combined averaged 1,079 ± 245 fish/km. Overall trout density appears to be stable and comparable to previous surveys. However, changes in trout density at the individual sites were somewhat difficult to interpret due to wide confidence intervals surrounding some of the 2014 estimates. A realistic description of change in the SFBR Rainbow Trout population is best provided by a combination of mark-recapture and catch rate comparisons with previous surveys, which suggests the population was stable or had declined by 50%. In terms of fall and spring fry sampling, overwinter survival for 2013-14 was estimated to be 62%. Mean fall density of age-0 Rainbow Trout was 0.4 fish/m in October 2014. Fall density estimates in 2013 and 2014 (0.4 fish/m) are approximately 80% lower than the mean 2.3 fish/m estimated for years prior to the wildfire events of 2013. Despite this decline in fall fry densities, spring density estimates of age-1 Rainbow Trout were stable, indicating that recruitment has not changed due to the fires and after effects. Therefore, this Rainbow Trout population will not be negatively impacted in the long term.

Author

Arthur Butts
Regional Fishery Biologist

INTRODUCTION

The South Fork Boise River (SFBR) downstream from Anderson Ranch Dam is a nationally-renowned tailwater trout fishery and was the first river section in the Southwest Region to be managed under “Trophy Trout” regulations. This fishery is supported by populations of wild Rainbow Trout *Oncorhynchus mykiss* and Mountain Whitefish *Prosopium williamsoni*. Migratory Bull Trout *Salvelinus confluentus* are present at very low densities, and native nongame fish include Largescale Sucker *Catostomus macrocheilus*, Northern Pikeminnow *Ptychocheilus oregonensis* and sculpin *Cottus sp*. are present also.

Idaho Department of Fish and Game (IDFG) staff has monitored the Rainbow Trout population in the SFBR every three years since 1994 (Butts et al. 2011). These efforts have been accompanied by critical evaluations of electrofishing methodologies which have resulted in changes in techniques and equipment configuration. In 2006, sampling methods for the tailwater section were changed from raft electrofishing to canoe electrofishing in order to increase sampling efficiency and obtain better population estimates. In addition, three 1-km sites were established within the historic survey boundaries for sampling. Kozfkay et al. (2010) demonstrated a pronounced increase in electrofishing efficiency for all size groups of Rainbow Trout resulting from the change in sampling methodologies. In 2012, an additional mobile anode was added to the electrofishing configuration which resulted in further improvement in sampling efficiency, particularly for fish exceeding 350 mm (Butts et al. 2013b).

During the past decade, the Rainbow Trout population in the SFBR has been relatively stable, although the relative paucity of trout in the 200 to 400 mm length range upstream of Danskin Bridge has puzzled anglers and biologists. Concerns over the irregular size structure along with a belief by some anglers that the SFBR lacked spawning habitat led some to conclude that the river was recruitment limited. To evaluate this notion, IDFG revisited age-0 trout sampling transects that were established in 1994 during a whirling disease research study (Elle 1997 and 1998). Biologists sampled high densities of age-0 trout with backpack electrofishing equipment and visually observed many age-0 trout in near-shore habitat throughout the tailwater reach. These survey results and observations suggested reproduction was not limiting the population. These studies have been conducted annually since 2009 and density of age-0 Rainbow Trout was estimated from 2009 through 2012 with a mean age-0 linear density of 2.3 fish/m. Furthermore, population surveys in the canyon section downstream of Danskin Bridge in 2008 and 2012 showed that Rainbow Trout between 250 and 400 mm were present in higher proportions than what was observed in the monitored sections upstream of Danskin Bridge (Butts et al. 2013b).

The SFBR wild trout population is thought to be supported primarily through main stem spawning with little recruitment from tributaries, as migration barriers are exist on most tributaries with spawning habitat. Information on fish populations within these tributaries had not been collected since the late 1970’s when Moore et al. (1979) characterized the majority of the SFBR tributaries below Anderson Ranch and evaluated the presence of spawning trout and spawning habitat. Recognizing land use practices, roads, water management, and climate have changed over the past 30 years and have likely altered conditions in these tributary streams, there was a need to reassess these tributaries and the production of age-0 trout therein. Beginning in 2010, IDFG began to survey a number of SFBR tributaries to acquire information on fish presence and abundance. Specifically, biologists wished to determine whether trout utilized these tributaries for spawning and rearing and whether barriers existed. Pierce, Rock, Cayuse, Bock, Meinecke, and Trail creeks have been identified as spawning and rearing habitats (Butts et al. 2013; Kozfkay et al. 2010). Additional data describing the trout communities in tributaries to the SFBR will help guide conservation and restoration efforts in the future.

The SFBR drainage is still undergoing dramatic changes as a result of the Elk-Pony complex wildfires in August 2013. Following a rainstorm event on September 12, 2013, a number of large debris and sediment flows occurred on at least six tributaries. The loss of vegetation along adjacent hill slopes and tributary riparian areas has created dynamic and unstable conditions. During the first week of August 2014, another series of debris and sediment flows occurred in several south-facing drainages following a series of rainstorms. Notably, Pierce and Granite creeks experienced additional damage, including large sediment flows, further down-cutting and scouring, and the loss of any natural re-vegetation that may have occurred subsequent to the 2013 events. Large debris flows occurred in a few drainages in the canyon section, including Devils Hole and Little Fiddler creeks, and created multiple large rapids. These new rapids are expected to reduce recreational fishing in the canyon because of the technical expertise now required to float the section.

Fire restoration efforts are primarily focused on aquatic, terrestrial, and riparian habitats. Access and grazing closures have been in place since November 2013 to minimize disturbance to wildlife and vegetation in the most heavily damaged areas. The majority of terrestrial vegetation plantings are currently scheduled for early spring 2015. Multiple agencies have been involved with damage assessments and restoration plans for the areas affected by the wildfires and landslides, including US Forest Service (USFS), US Bureau of Reclamation (BOR), Trout Unlimited, and IDFG.

Restoration of aquatic habitat has primarily involved addressing the vast amount of fine sediment that has been deposited into the river. Researchers from University of Idaho modeled sediment transport under various flushing flows to determine the amount and duration of flow required to mobilize sediment and improve habitat. Models suggested that a flushing flow of 68 m^3/s or greater for at least 8 d was needed to mobilize fine sediments (Benjankar and Tonina 2014). Traditional increases in spring flows for Rainbow Trout spawning were postponed for the agreement with BOR to provide flushing flows in the summer. Beginning on August 18, 2014 flows were increased from 48 m^3/s to a maximum of 69 m^3/s on August 23, 2014 (Figure 38). Flows returned to 45 m^3/s by August 29, 2014 and flows were reduced to 8.5 m^3/s (i.e. typical minimum winter flow) by September 19, 2014. The flushing flow improved the condition of the substrate, particularly upstream of Granite Creek. However, the August 2014 rain events at Granite and Pierce creeks have deposited large amounts of sediment into the main stem SFBR. Currently the erosion of alluvial fans created by these sediment flows are exporting sediment into the river and at least 4 km of river between those tributaries are extremely embedded with sand and mud. A combination of terrestrial stabilization and flushing flows will be required for future rehabilitation efforts.

During the past year, the primary objective for IDFG regarding SFBR has been to describe the extent of the effects of the sediment flows on fish populations and habitat. To address this, the triennial main-stem population assessment was rescheduled to 2014 rather than 2015, when it normally would have occurred. Additionally, densities of age-0 trout and overwinter survival were evaluated and compared to pre-fire estimates. Finally, IDFG continues to be a partner with other agencies in planning and prescribing rehabilitation efforts that will take place over the next several years.

METHODS

Mainstem Population Assessment

The SFBR tailwater section is located directly downstream of Anderson Ranch Dam, in Elmore County, approximately 48 km northeast of Mountain Home, Idaho. The tailwater section is approximately 16-km long and the downstream boundary is located at Danskin bridge.

Rainbow Trout abundance was estimated at three sites (Figure 39) within the tailwater section using mark-recapture techniques, whereas Mountain Whitefish abundance was only estimated in the upper site. Fish were collected with a canoe electrofishing unit consisting of a 5.2-m Grumman aluminum canoe fitted with three mobile anodes connected to 15.2-m cables. The canoe served as the cathode and carried the generator, Midwest Lake Electrofishing Systems (MLES) Infinity electrofisher, and a live well for holding fish. Oxygen was introduced to the live well (2 L/min) through an air-stone. Pulsed direct current was produced by a 5,000 watt generator (Honda EG500X). Settings for duty cycle was at 25%, pulse level at 60 pulses per second, voltage at 300-400 volts, and the power output was 800-1,200 watts.

Rainbow Trout and Bull Trout were sampled at the three sites during October 7-14, 2014 (Table 24). Riffles formed the upper and lower reach boundaries. Flow was approximately 8.5 m^3/s. Crews consisted of nine to eleven people. Three people operated the mobile anodes, one person guided the canoe and operated the safety switch and controlled the output, the remaining four or five people were equipped with dip nets and captured stunned fish. Only trout and whitefish were placed in the live well. When the live well was judged to be at capacity the crew stopped at the nearest riffle to process fish.

Fish were marked with a 7-mm diameter hole from a standard paper punch with a upper, middle, or lower caudal fin punch corresponding to the upper, middle, and lower sites, respectively. Differential marking allowed assessment of inter-site movement. Only fish longer than 100 mm were marked. Fish were measured for total length (TL; mm) and a subset was weighed (g). Fish were released 50 to 100 m upstream from the processing site to reduce the potential of movement out of the site. Recapture sampling was completed during October 14-16, 2014. During the recapture effort, all Mountain Whitefish and trouts greater than 100 mm were captured and placed in the live well. Fish were examined for marks on the caudal and anal fins. All fish were measured for total length (mm) and a subset was weighed.

Site length was determined from 1:24,000 topographic maps. Wetted widths (how many) were measured with a hand-held laser range finder (Leupold RX series). Site area was estimated by multiplying the calculated mean widths over a section and by the section length. For braided channels, mean width was measured across the river excluding any distances across islands.

Fisheries Analysis + (FA+), software developed by Montana Fish, Wildlife, & Parks, was used to generate mark-recapture and electrofishing capture efficiency estimates (MFWP 2004). To account for selectivity of electrofishing gear, population estimates (*N*) were calculated using a maximum likelihood estimation to fit the recapture data. A capture probability function of the form

$$Eff = (exp(-5+\beta_1 L+ \beta_2 L^2)) /(1+ exp(-5+\beta_1 L+ \beta_2 L^2))$$

where *Eff* is the probability of capturing a fish of length *L*, and β_1 and β_2 are estimated parameters (MFWP 2004). Then *N* is estimated by length group where M is the number of fish marked by length group:

$$N = M / Eff$$

Population estimates (*N*) were calculated for each site separately and in addition pooled for a comprehensive estimate expressed as # fish/km for comparison to surveys from previous years. Observed mortalities during the marking run were recorded and excluded from the population estimates.

The number of marked fish by site and recapture efficiency were also calculated to assess and compare the basic components of the 2014 survey to previous years. Recapture efficiency (R_{eff}) was simply calculated as

$$R_{eff} = R/C$$

where *R* is the number of recaptures collected and *C* is the total number of fish collected during the recapture run.

To characterize trends in size structure Rainbow Trout, proportional stock density (PSD) was calculated as described by Anderson and Neumann (1996), using 250 mm as stock size and 400 mm as quality size.

Pelvic fin rays were collected to estimate the age structure of the Rainbow Trout population in the SFBR. Collection and analysis pelvic fin rays have been shown to provide a non-lethal method of obtaining accurate and precise ages in other salmonid populations (Williamson and Macdonald 1997; Zymonas and McMahon 2009). Removal of rays from pelvic fin is thought to have less impact on growth and survival than dorsal or pectoral fins (Zymonas and McMahon 2006). The leading three pelvic fin rays were clipped and removed near the base from a subsample of Rainbow Trout (5 fish/10-mm TL interval). Individual rays were prepared according the methods described by Koch and Quist (2007) using a mold made from a 2 ml plastic microcentrifuge tube and a cap filled with modeling clay. The proximal end of each spine was placed in the clay vertically to ensure a perpendicular cross section and pressed inside the tube. Fin rays were then encased by filling the molds with Epoxicure 2 epoxy and allowed to cure for 6-8 h. Cured samples were removed from the tubes by tapping with a wooden dowel. Cross sections were cut by placing the cured sample in the chuck of an Isomet low-speed saw (Buehler Inc.). First, we cut the fin rays just above the clay to remove the proximal end of the sample, ensuring a clean section. Next, we cut a 0.7-mm thick cross section as close to the proximal end of the fin ray as possible (DeVries and Frie 1996), which appeared to produce the best clarity (Koch and Quist 2007). Cross sections were lightly polished using 800 grit sandpaper, placed in immersion oil and viewed and photographed using a compound microscope (Leica DM 4000B) equipped with a digital camera at 40X magnification. Fish age was estimated by two independent readers. Samples with disagreements in age were revisited by both readers concurrently to determine a consensus age for further analysis. An age-length key was constructed to develop age frequency for the population from which instantaneous (*Z*) and annual (*A*) mortality rate could be estimated using methods described in Miranda and Bettoli (2007).. A von Bertalanffy growth model was fitted to age-at-length data from fish collected during both M-R and age-0 sampling using FAMS software (Slipke and Maceina 2014). Mean length for age-4 fish was calculated for comparisons with other Idaho fluvial Rainbow Trout populations (Schill 1991).

Juvenile Trout Monitoring

Age-0 Rainbow Trout production has been monitored annually in the fall since 2009 to index early life-stage abundance in the SFBR. These sites and methods have been used to index the abundance of age-0 Rainbow Trout as a measure of production. Beginning in 2012, the same sites were resampled in the spring to assess overwinter survival of the now age-1 fish. Age-0 Rainbow Trout were sampled using a Smith-Root Type VII backpack shocker. Thirty-nine fixed trend sites were sampled on March 19-20, 2014 and October 20-21, 2014 (Figure 40). Sites were 33-m long by 4-m wide and located in the roaded section of the tailwater. A single, upstream electrofishing pass was completed at each site. All fish were identified, counted, and measured for total length. Age-0 density estimates and lengths were compared to those collected in previous years. Mean age-0 Rainbow Trout density was calculated as described by Elle (1996) and Koenig et al. (2015). Overwinter survival S_t was estimated as

$$S_t = \frac{N_t}{N_o}$$

where N_o was the initial abundance in the fall and N_t was the abundance in the spring (Ricker 1975).

RESULTS

Main-stem Population Assessment

Rainbow Trout catch varied between sites with a total of 404 Rainbow Trout (≥ 100 mm) handled during marking and recapture runs in the three sites combined (Table 24). A total of 241 Rainbow Trout were marked during the marking runs, which represented a 51% decline from the 2012 survey (Figure 41). Among individual sites, the decline in numbers of fish marked ranged from 39% to 64%.

The number of Rainbow Trout collected during the recapture runs decreased between 56% and 85% of the initial number marked by site. Mean recapture efficiency, the ratio of recaptured fish to captured fish during the recapture runs among sites was

9% (Figure 41). This was the lowest mean recapture efficiency calculated for a survey since collection methods were changed from raft to canoe shocking in 2006. Previously, recapture efficiency estimates ranged from 15% to 30%.

Rainbow Trout density (± 90% CI) among trend sites ranged from 670 ± 293 fish/km in the middle site to 1,221 ± 1,068 fish/km in the lower site (Figure 42). Density at all three sites combined was 1,079 ± 245 fish/km. Overall trout density appears to be stable and comparable to previous surveys based on mark-recapture point estimates (Figure 42). However, changes in trout density at the individual sites were somewhat difficult to interpret due to wide confidence intervals surrounding some of the 2014 estimates. Rainbow trout density in the middle site was 68% lower than 2012 estimates. Estimates in the upper and middle sites increased 91% and 101%, respectively, but 90% confidence intervals ranged from 40% to 87% of the estimate, making inferences difficult. Combined density estimates were expanded into an overall abundance estimate of 3,364 Rainbow Trout in 2014 in the 3 km that were sampled.

Recapture efficiencies for Rainbow Trout varied by site (Table 24). Recapture efficiency for the upper and lower sites was 0.11 while efficiency at the middle site was 0.17. Overall recapture efficiency for the entire survey was 0.13.

The length distribution of collected fish has changed very little since the previous survey. Length distribution of Rainbow Trout ranged from 120 to 570 mm with multiple modes observed (Figure 43). Approximately 50% of all fish captured were between 120 and 240 mm, a slight increase from the 2012 survey (Figure 44). Rainbow Trout between 410 and 490 mm comprised 23% of the catch while 7% exceeded 500 mm. Density (fish/km) of Rainbow Trout >129 mm increased, continuing an upwards trend observed in recent surveys (Figure 45). Density of fish >239 decreased slightly from 2012. The PSD for the SFBR Rainbow Trout population did not change significantly since the 2012 survey and was 62 in 2014 (Figure 46).

Annuli were discernable and provided reasonable age estimates in approximately 45% of the sectioned pelvic fin rays that were collected. Age estimates ranged from 1 to 8 years and mean length-at-age was calculated (Figure 47). The instantaneous mortality rate (Z), or slope of the regression line of age and population estimate within a year class was -0.76 (Figure 47). The annual mortality rate (A) for the Rainbow Trout population in SFBR was estimated to be 0.53. A von Bertalanffy growth model for SFBR Rainbow Trout was also constructed and presented in Figure 48. Mean age for an age-4 fish was 404 mm. The results provided values for L_∞ = 602.6 mm, K = 0.24, and t_0 = -0.314.

In 2014, 240 Mountain Whitefish were marked in the upper site compared to 355 in 2012, a 33% decline (Table 24). The recapture rate for Mountain Whitefish was 21% in 2014. Mountain Whitefish length ranged from 108 to 575 mm in 2014 and length distribution remained similar to previous years (Figure 49). Mountain whitefish density was 1,667 ± 382 fish/km, a 53% increase from 2012 (Figure 50).

Bull Trout were infrequently collected during the survey and low numbers prevented calculation of precise or accurate population estimate. A total of six Bull Trout were collected, with four fish marked and none recaptured. Bull Trout ranged from 403-610 mm.

Juvenile Rainbow Trout Monitoring

During the spring survey (39 sites) catch of age-1 Rainbow Trout ranged from 0 to 41 fish/site, with a mean linear density of 0.3 fish/m (Figure 51). Rainbow Trout length ranged from 41 to 139 mm with a mean of 69 mm (Figure 52). Using age-0 Rainbow Trout density estimates from the previous October (Koenig et al. 2015), overwinter survival for 2013-14 was estimated to be 62% (Fig 51). Overwinter survival for the 2012-13 winter was estimated to be much lower (15%) but the resulting spring density estimate of age-1 fish was the same for both years (0.3 fish/m).

In October 2014, age-0 Rainbow Trout catch ranged from 0 to 35 fish/site. Age-0 Rainbow Trout lengths ranged from 31-100 mm and mean length was 56 mm (Figure 52). Mean density of age-0 Rainbow Trout was 0.4 fish/m (Figure 53). Mean density of age-0 Rainbow Trout in fall 2013 and 2014 (0.4 fish/m) were approximately 80% lower than the mean density (2.3 fish/m) estimated for years prior to the wildfire-related events.

DISCUSSION

The overall goal of the 2014 mainstem assessment was to determine the impact that wildfire-related events had on the SFBR Rainbow Trout population. The two methods that were used to examine the population resulted in somewhat conflicting results. The mark-recapture point estimates suggest that the population has not changed significantly between 2012 and 2014. Confidence intervals for the 2014 estimates were wider than in previous years, yielding less precise estimates. This is due, in part, to abnormally low capture efficiency when compared to previous years. This could be a result of differences in water temperature, conductivity, fish behavior, or survival. For example, the highest capture efficiencies have historically occurred within the lower site, and have ranged from 23% to 70%. In 2014, the recapture efficiency was 11% (Table 24). This may be explained by a shorter duration (2 d) between marking and recapture runs. The short period between capture events resulted from equipment malfunctioning during the previous week. In the future, efforts should be made to ensure a minimum of 7 d between capture events. It should also be noted that the error for efficiency estimates was lowest in 2014 because of less variation in catch between sites.

A realistic description of change in the SFBR Rainbow Trout population is best provided by a combination of mark-recapture and catch rate comparisons with previous surveys. Although the mark-recapture estimates show little overall change, the number of fish marked during the initial run showed substantial decline in all sites (range 39-64%) and a 51% decline in total fish collected during the marking run. This was despite a concerted effort to increase the number of netters from four to six during marking runs. Therefore it is reasonable to conclude that the SFBR Rainbow Trout population experienced a post-fire decline despite point estimates similar to the previous survey.

Analysis of length-at-age data from fin rays yielded valuable models for estimating mortality and growth in the SFBR Rainbow Trout population. Components from this analysis can be used for comparing growth and mortality to similar populations or predicting impacts of different management scenarios. The use of pelvic fin rays as structures for estimating age of Rainbow Trout appears promising. Zymonas and McMahon (2009) found high rates of precision and annuli formation in both pelvic fin rays and otoliths in Bull Trout. However, over half (55%) of the fin rays collected in the field during this effort were found to be unusable after sectioning. Thus, a large amount of time spent embedding and sectioning rays and verifying or removing samples from the analyses was wasted. In many of the smaller fish, annuli were not distinguishable. Additionally, a number of samples appeared to be “missing” annuli as a result of not severing the ray at its base. Proper collection methods were determined to be important for obtaining fin rays that included all annuli in Zymonas and McMahon (2009) as well. Ensuring proper fin ray collection methods are followed in future surveys will be important. Finally, while precision between usable samples appeared good, age verification was not conducted using other structures and the accuracy of age estimates is unknown.

Fall densities of age-0 Rainbow Trout continued to be lower than before the fire and subsequent debris slides. From 1996 through 2012, annual fall age-0 Rainbow Trout densities had appeared to be stable. However, since the fires, fall density estimates have declined by approximately 80%. The decline in fall age-0 Rainbow Trout density estimates could be attributed to a number of factors including reduced spawning habitat quality due to higher fine sediment levels, poor survival, or direct mortality from extended exposure to suspended sediment and debris (Bozek and Young 1994; Rieman et al. 2012). The low density of age-0 Rainbow Trout observed in fall 2014 could also be a result of delayed spring flow increases that were negotiated in exchange for flushing flows provided later in the season. Flows are typically increased from 8.5 to 17 m^3/s at the beginning of April to increase available spawning habitat for Rainbow Trout. The change in flow regime may have delayed spawning or reduced available habitat, resulting in lower fall densities. However, if delayed spawning occurred, it should be reflected in a smaller mean length of age-0 trout in October 2014, which was not observed.

Spring densities of age-1 Rainbow Trout have been relatively stable despite widely differing fall trout densities, suggesting that fall age-0 trout densities may not be the appropriate index of year-class strength and recruitment. For instance during the 2012-2013 winter, a large number of age-0 Rainbow Trout entered the winter, but mortality was relatively high. In contrast during the 2013-2014 winter, relatively few age-0 trout entered the winter, but mortality was low. From these limited observations, it appears that year-class-strength may be constrained by the carrying capacity of winter habitat rather than overall abundance of age-0 trout at the start of winter. Also, it appears that overwinter survival of age-0 trout may be size-dependent as very few fry <50 mm survived the winter. This finding is similar to other observations of winter-related lipid depletion and mortality, where fish <50 mm were unlikely to survive a 150-d winter (Biro et al. 2004). A number of studies have implicated the amount of suitable habitat as the primary factor regulating overwinter survival of age-0 salmonids (Cunjak 1996; Mitro et al. 2003; Koenig 2006). However, additional years of overwinter survival data need to be collected to fully assess this notion.

Delayed effects to fish populations from wildfires have been documented in several systems and can occur for a decade or more following wildfires (Meyer and Pierce 2003; Rieman et al 2012). Currently, many hillsides and drainages such as Pierce and Granite creeks are very unstable and prone to additional erosion events. Restoration efforts beginning in the spring of 2015 are expected to hasten the recovery and stabilization of many of these areas. In contrast, a number of beneficial results are also expected from the fire and related events: increased spawning gravel as fine sediments are flushed, an influx of woody debris, nutrients, and perhaps increased fish growth.

RECOMMENDATIONS

1. Conduct mark-recapture estimates in the three adult trend sites during fall 2017 to assess abundance and length distributions of trouts and Mountain Whitefish.

2. Continue to use annual shoreline electrofishing in the spring and fall to monitor age-0 Rainbow Trout production and overwinter survival; relate age-0 trout densities to adult abundance, flows, or other environmental variables as data become available.

3. Establish a minimum of seven days between marking and recapture events during population surveys.

Table 24. Number of fish by species collected during marking and recapture runs at each site in the South Fork Boise River, Idaho during October 2014 population assessments. Recapture efficiencies for Rainbow Trout were assessed in all three sites, while Mountain Whitefish were assessed in the upper site only. Bull Trout population estimates were not calculated because of low sample size.

Site		Marking run October 7-8, 14*, 2014		Recapture run October 14-15, 16*, 2014		
Transect length	Species	No. Captured	No. Marked	No. Captured	No. Recaptured	R/C
Upper	Rainbow Trout	63	63	35	4	0.11
1.04 km	Mountain Whitefish	243	240	135	28	
	Bull trout	1	1	1	0	
Middle	Rainbow Trout	55	55	47	8	0.17
1.05 km	Bull Trout	3	3	1	0	
Lower*	Rainbow Trout	125	123	79	9	0.11
1.03 km	Bull Trout	0	0	0	0	
Total	Rainbow Trout	243	241	161	21	0.13
3.12 km	Mountain Whitefish	243	240	135	28	
	Bull trout	4	4	2	0	

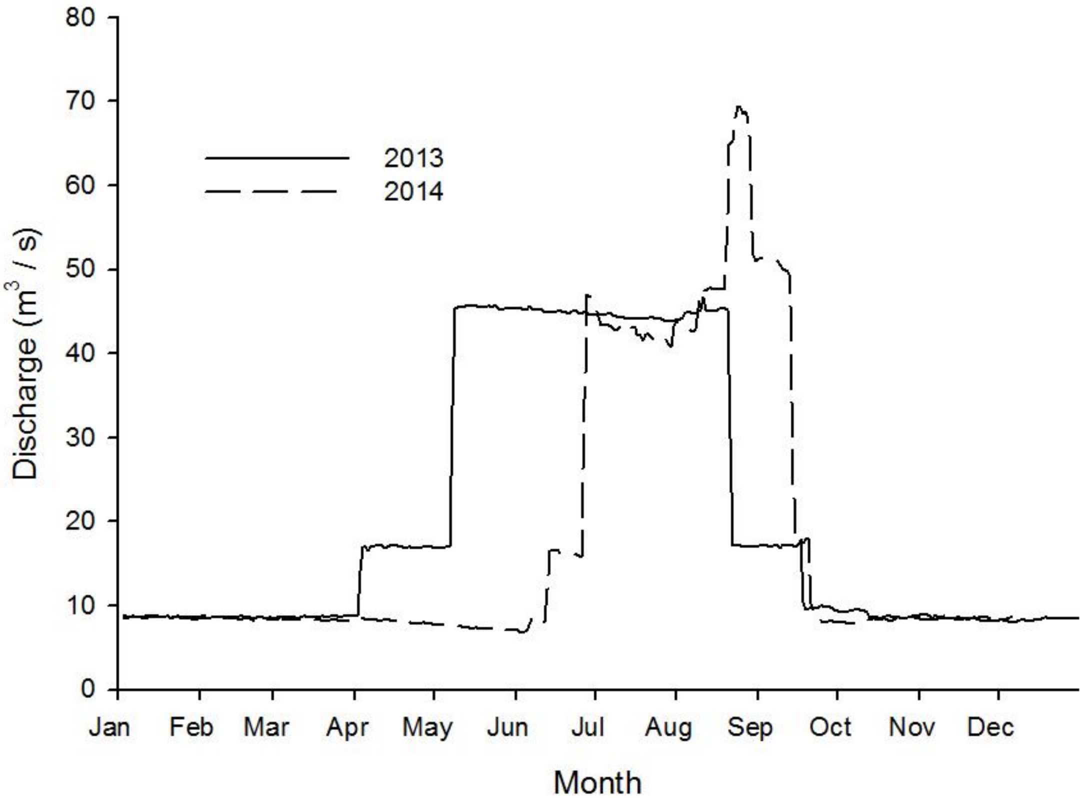

Figure 38. Discharge in the South Fork Boise River (SFBR), downstream from Anderson Ranch Dam, Idaho in 2013 and 2014. Flows in 2013 were typical for the SFBR while 2014 spring flows were reduced delayed so that flushing flows could be released later in the summer.

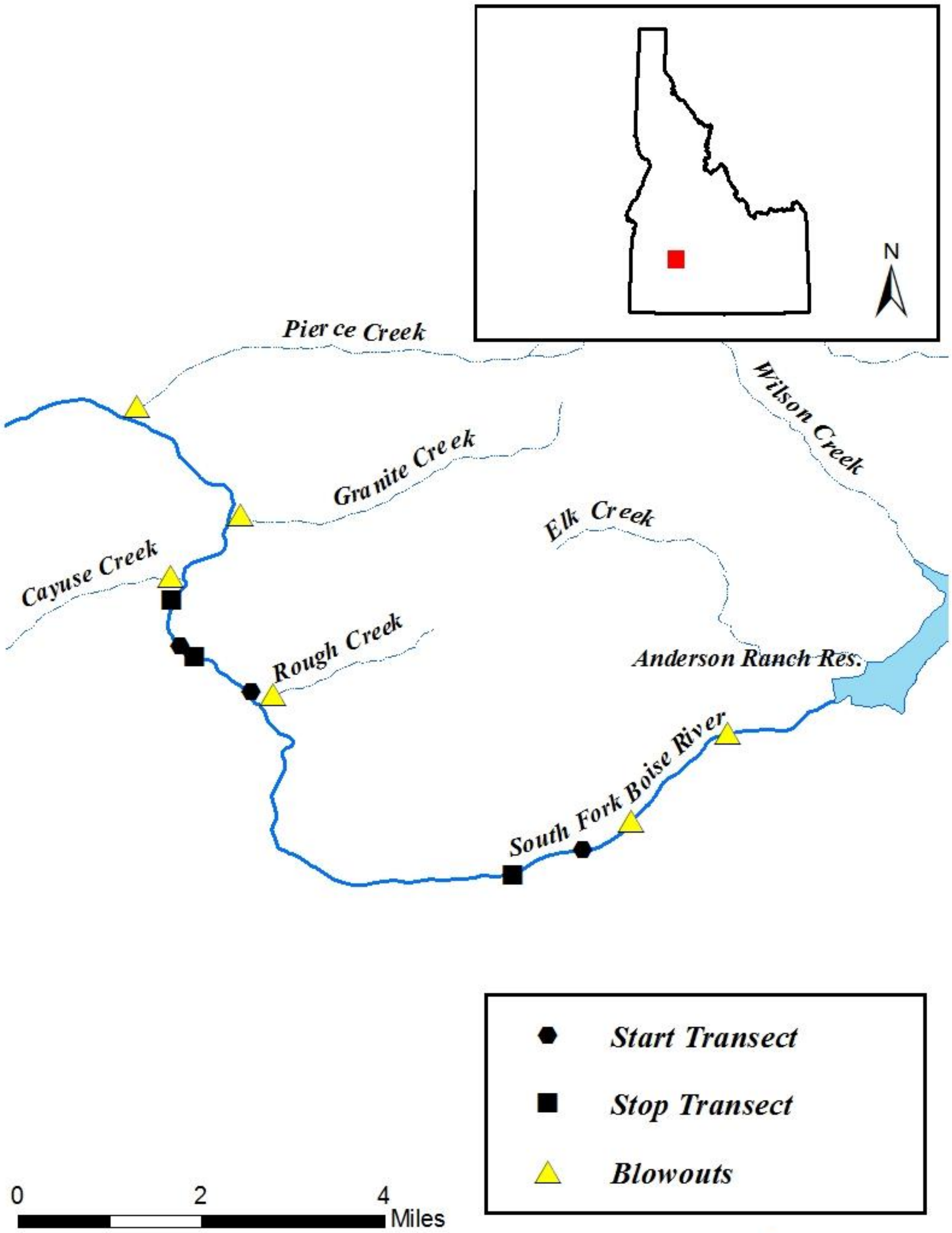

Figure 39. Map of South Fork Boise River, Idaho tailwater section showing sampling locations in Pierce Creek in July 2014 and major debris slides in September 2014.

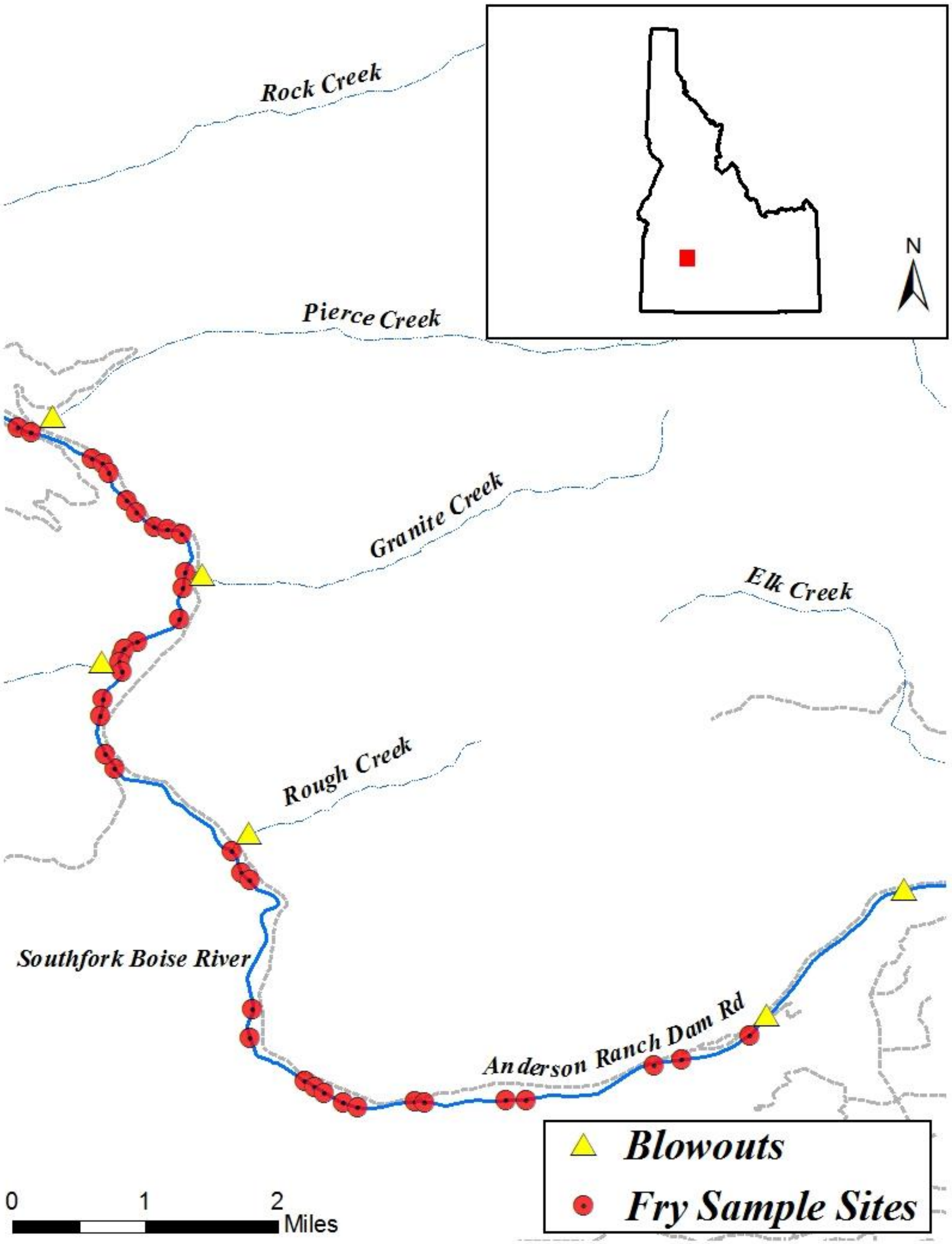

Figure 40. Map of South Fork Boise River, Idaho tailwater section showing location of major debris slides near age-0 Rainbow Trout monitoring sites.

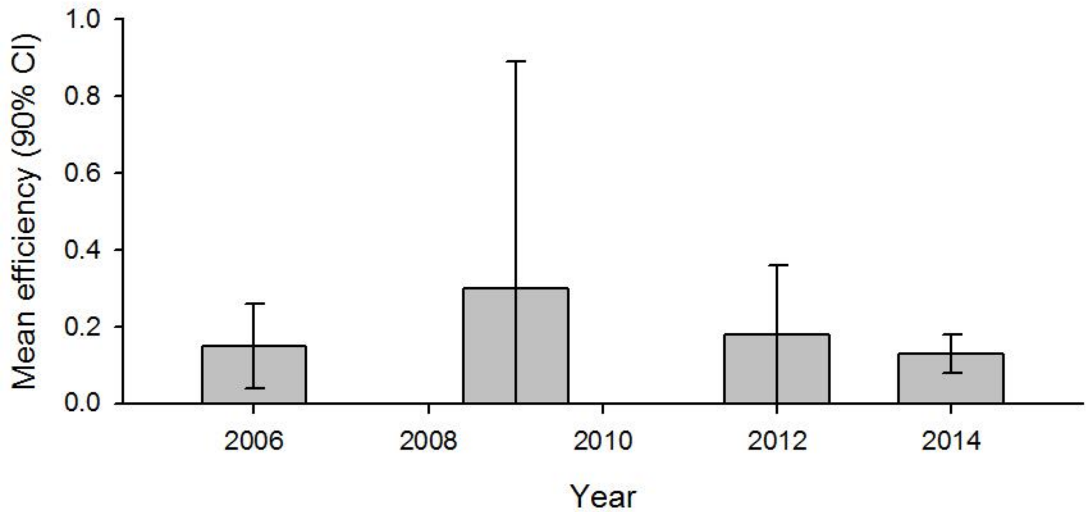

Figure 41. Capture efficiencies for Rainbow Trout (≥ 100 mm) during population surveys tri-annual population surveys at the South Fork Boise River below Anderson Ranch Dam from 2006 through 2014.

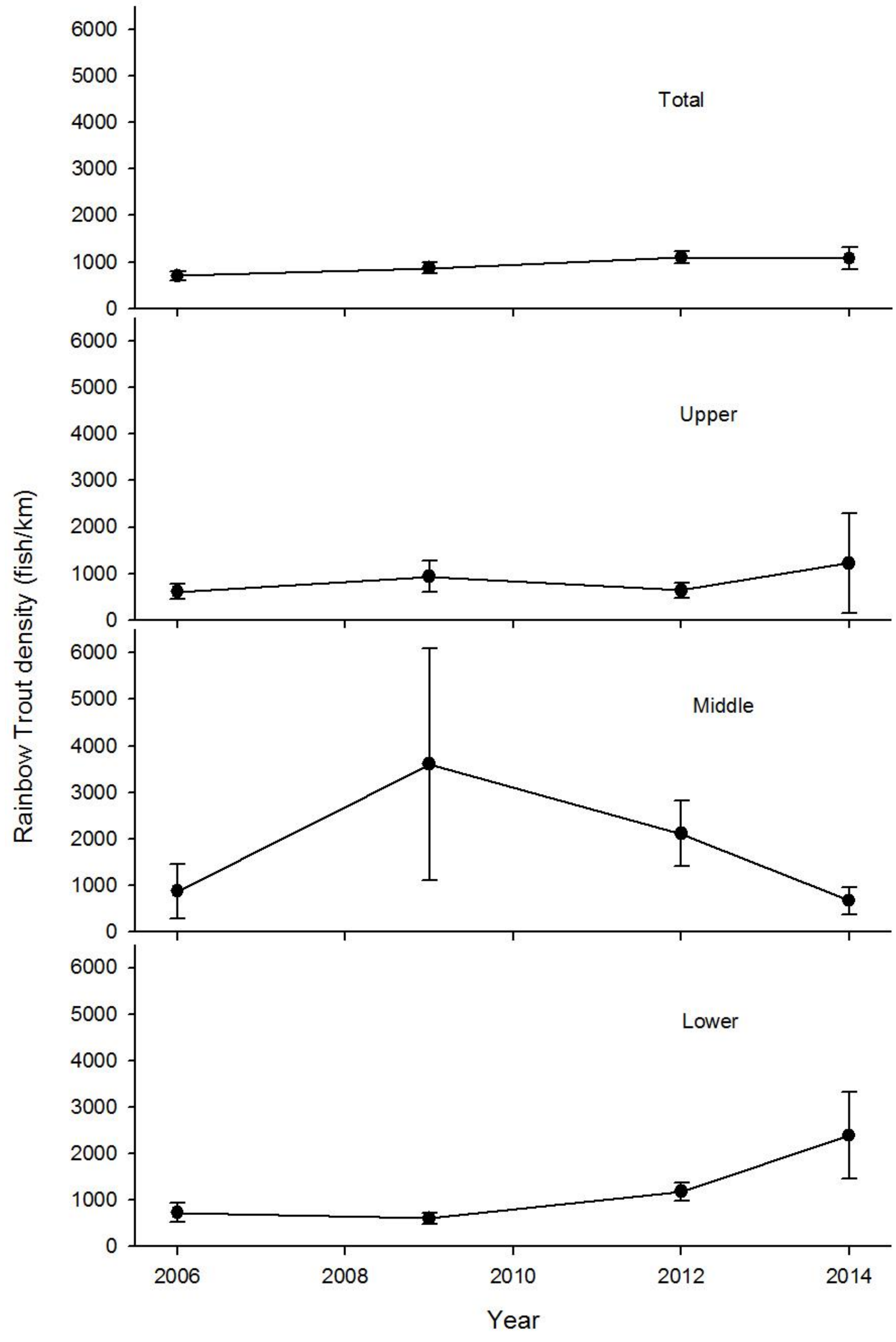

Figure 42. Linear density estimate trends for Rainbow Trout (≥ 100 mm) by reach for the South Fork Boise River from 2006 through 2014 from maximum likelihood estimation. All sites (top figure) refer to the combined estimate from pooling the data from all three sites.

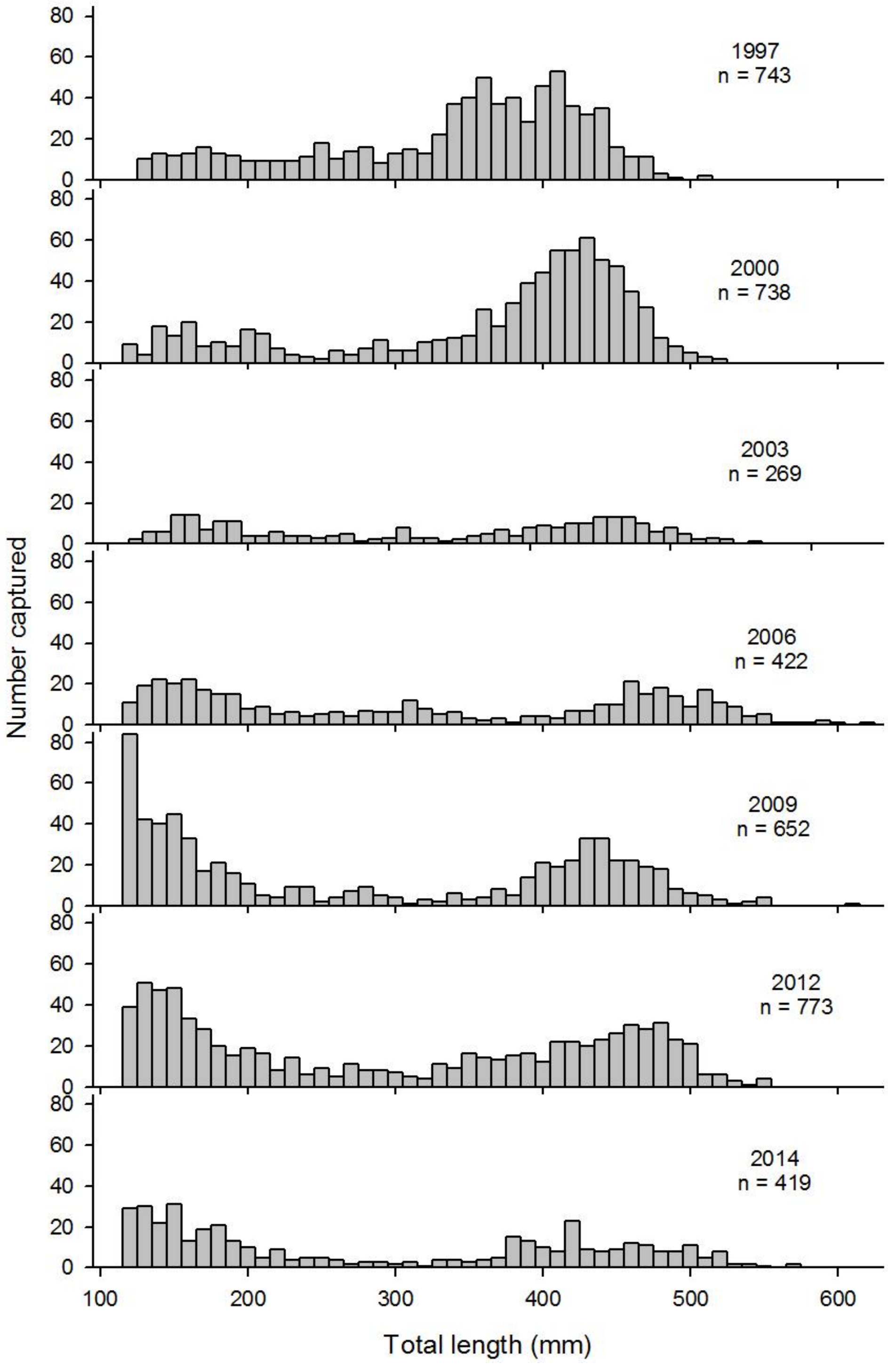

Figure 43. Length distributions of Rainbow Trout (≥ 100 mm), during population surveys at the South Fork Boise River below Anderson Ranch Dam in 1997-2014.

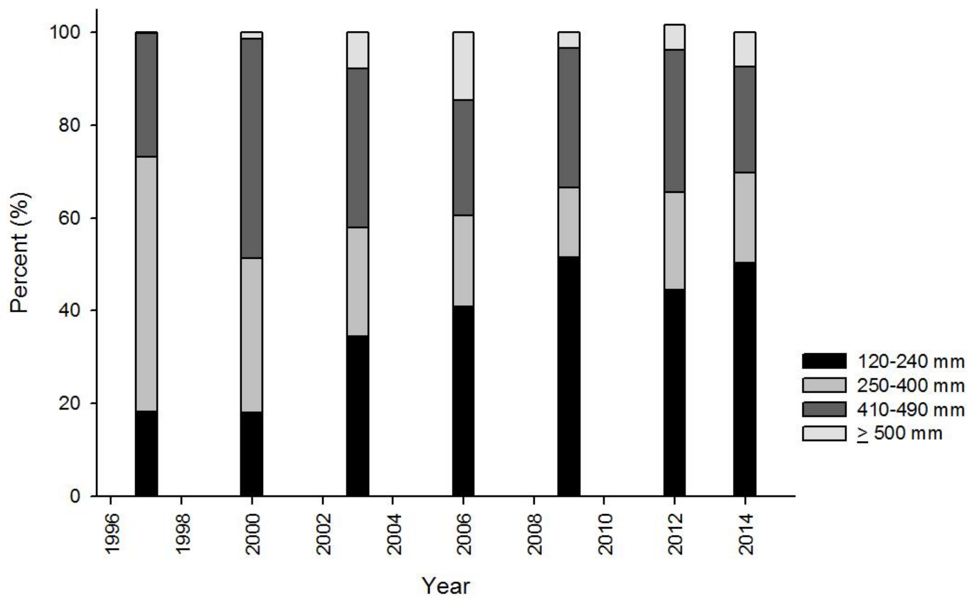

Figure 44. Length composition trends of Rainbow Trout, calculated as proportion of total catch, during population surveys at the South Fork Boise River below Anderson Ranch Dam from 1996 to 2014.

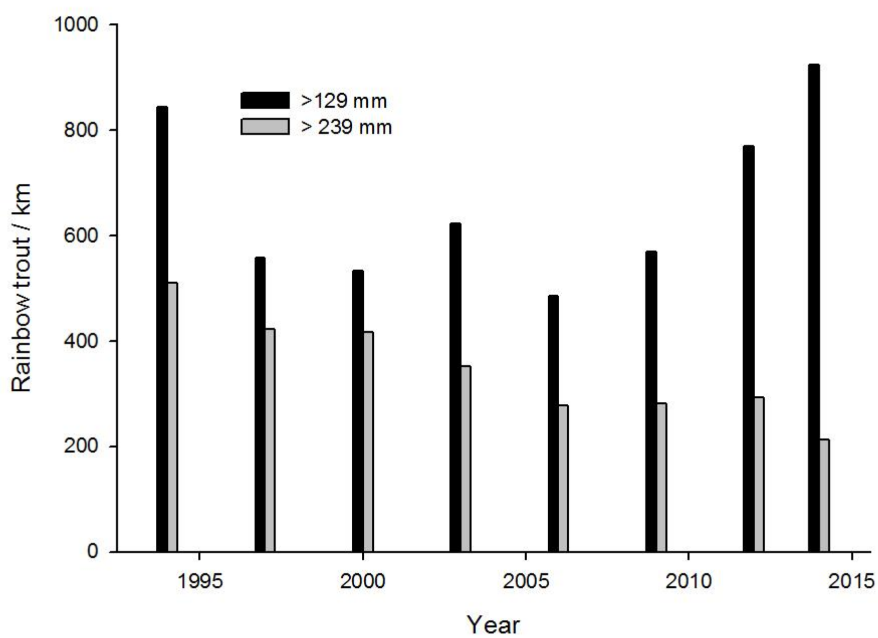

Figure 45. Linear density trends by length group for Rainbow Trout on the South Fork Boise River downstream from Anderson Ranch Dam between 1994 and 2014. Estimates were for rainbow trout >129 mm and >239 mm.

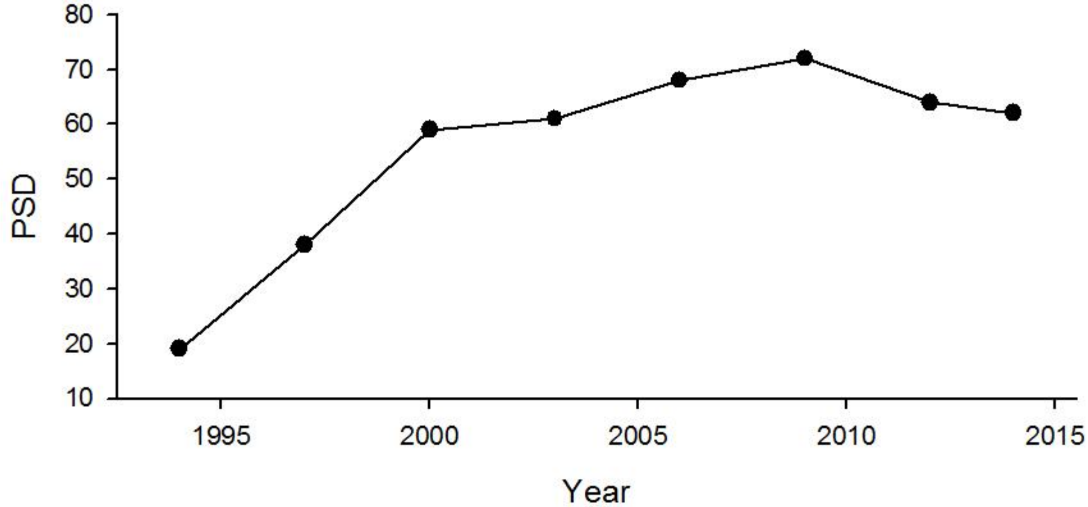

Figure 46. Proportional stock density (PSD) for Rainbow Trout collected during approximately triennial mark-recapture surveys on the South Fork Boise River downstream from Andersen Ranch Dam from 1995 through 2014.

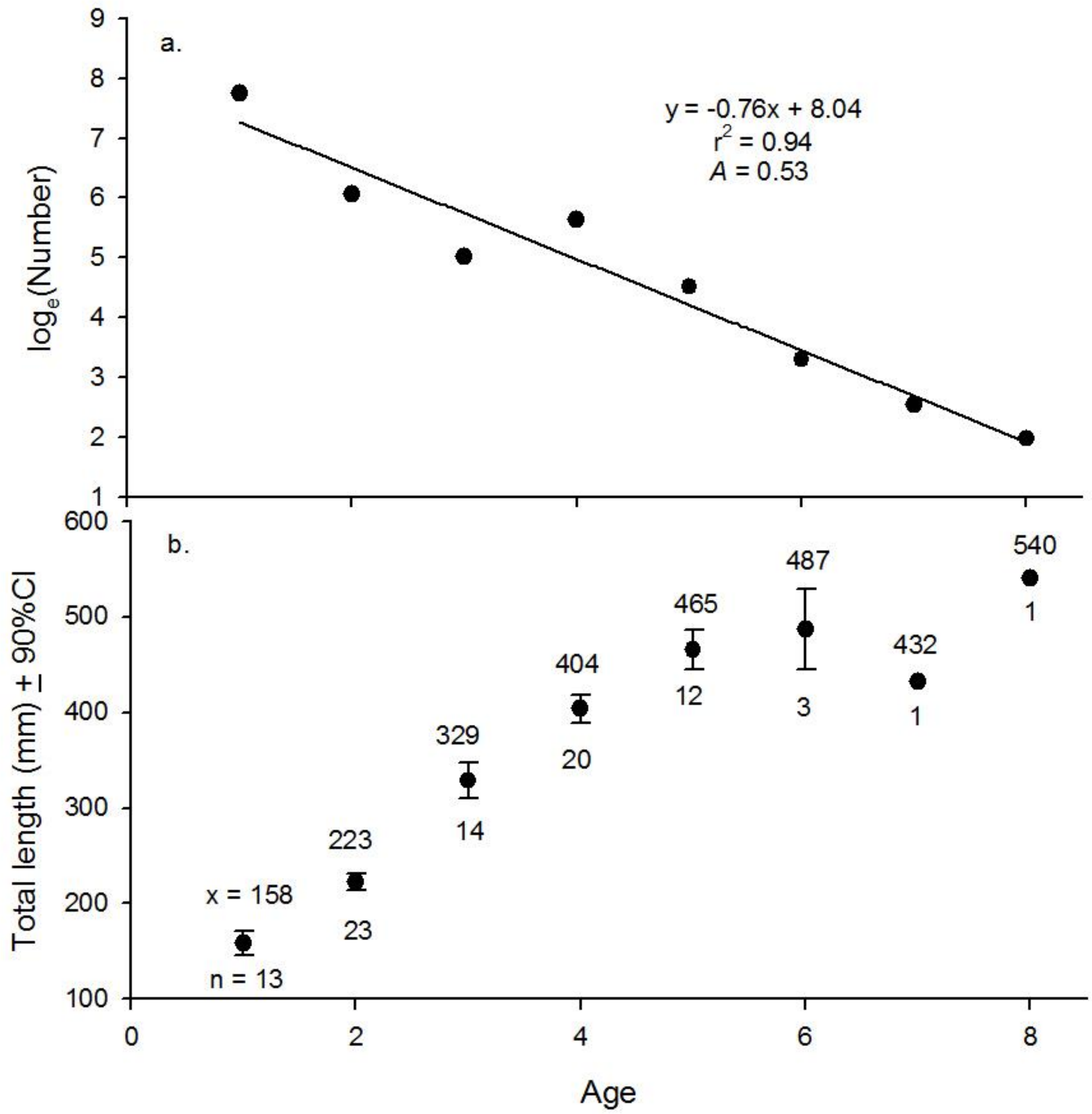

Figure 47. Catch curve (a) and mean length at age (b) for Rainbow Trout in the SFBR in October 2014. Mark-recapture population estimates and an age-length key was constructed for 10-mm length intervals (for fish between 100 and 540 mm). Ages were assigned using cross-sectioned pelvic fin rays. Mean length and sample size for each age are denoted at the top and bottom of each estimate, respectively. Error bars indicate 90% CI.

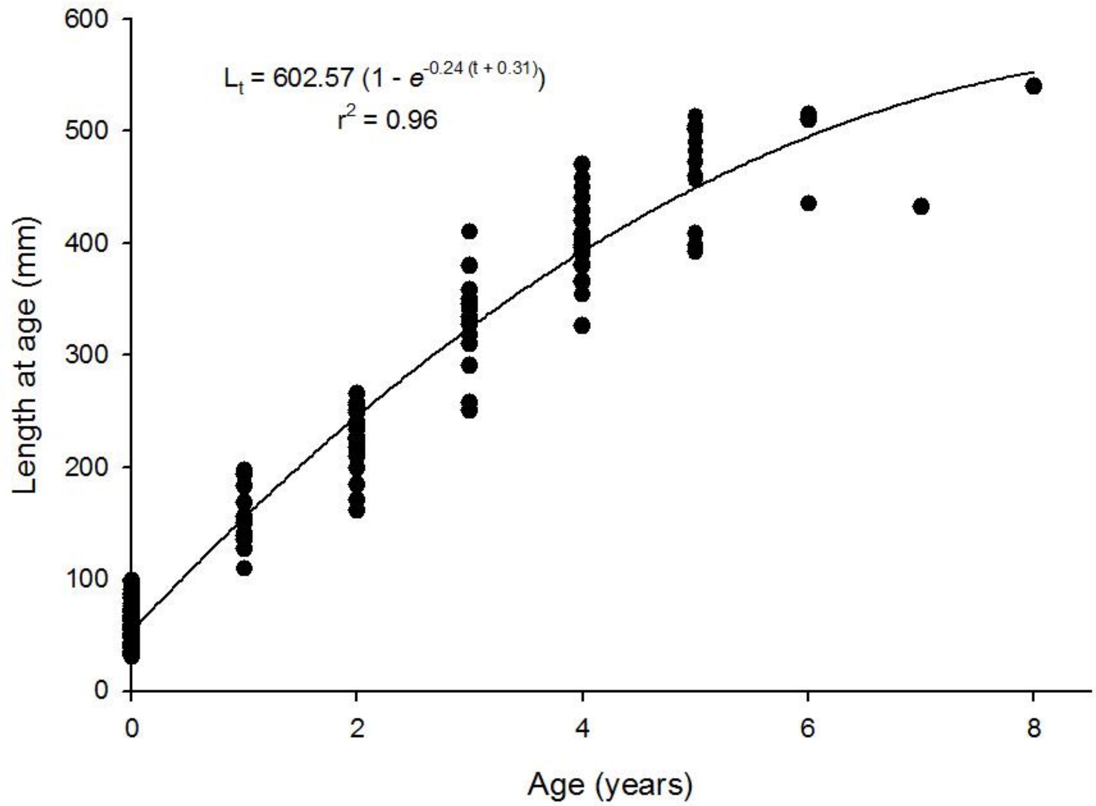

Figure 48. Von Bertalanffy growth model for Rainbow Trout in the SFBR, Idaho. Ages were assigned using cross-sectioned pelvic fin rays of fish collected during mark-recapture population estimates and age-0 monitoring in October 2014.

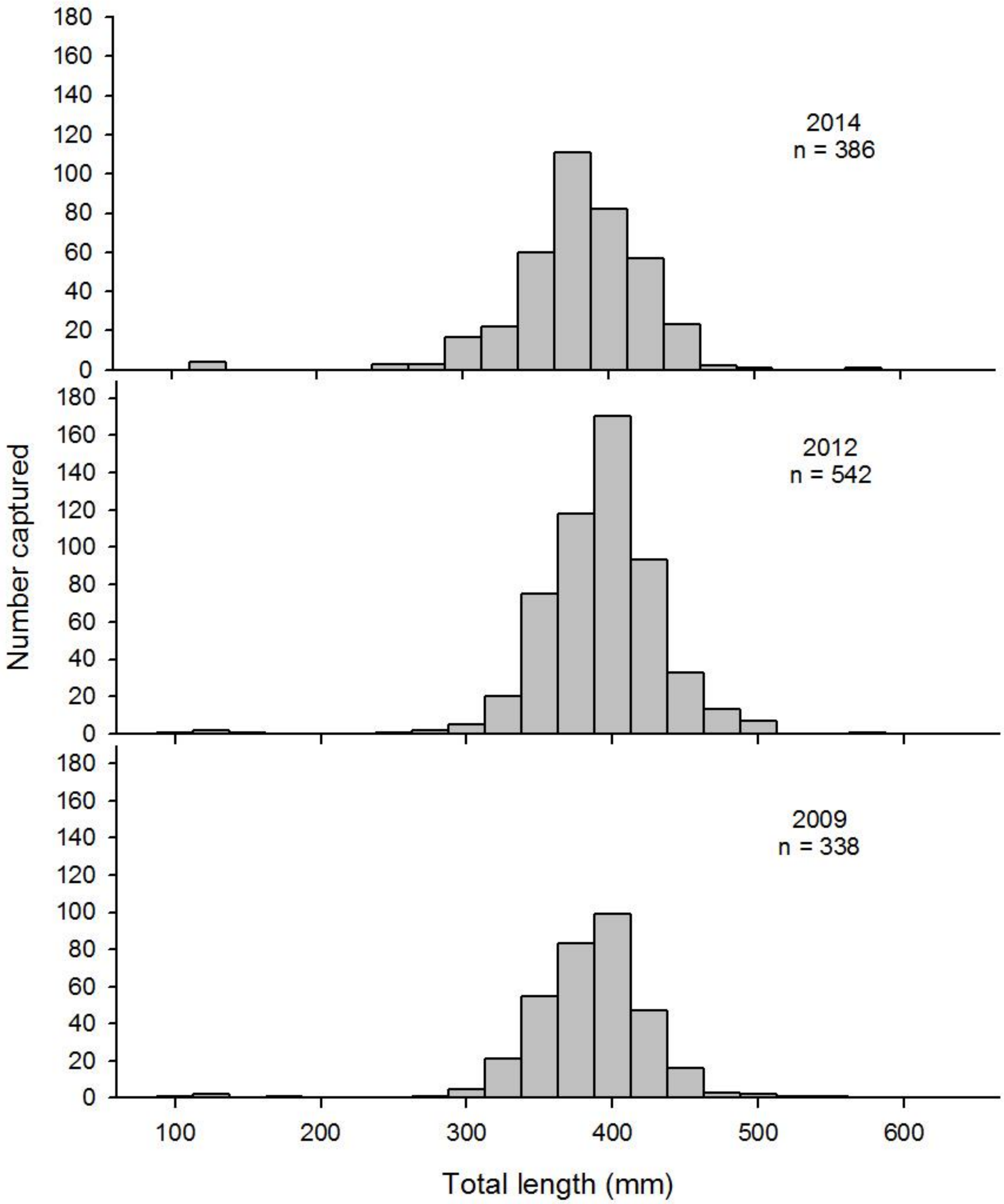

Figure 49. Length distributions of Mountain Whitefish (≥ 100 mm) sampled at the upper site of the South Fork Boise River downstream of Anderson Ranch Dam during 2009, 2012, and 2014.

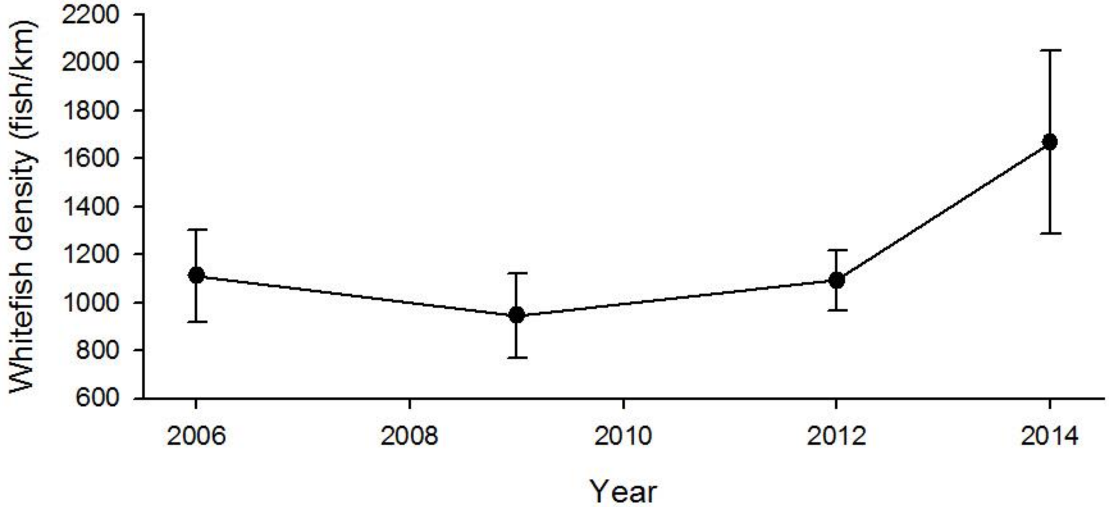

Figure 50. Linear density estimate trends for Mountain Whitefish (≥ 100 mm) at the upper site of South Fork Boise River. Estimates were calculated at approximately three year intervals from 2006 through 2014.

.

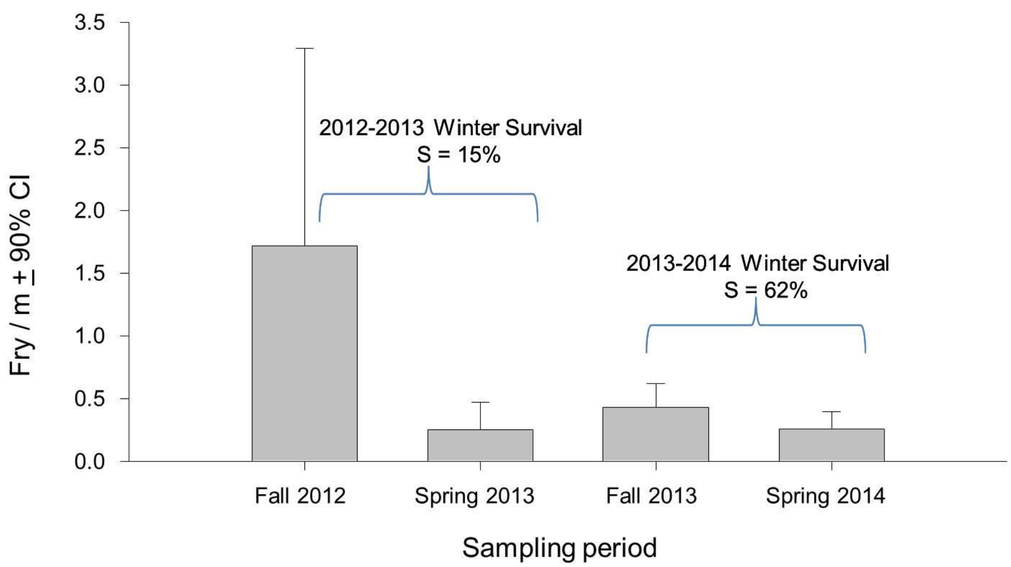

Figure 51. Comparison of mean densities age-0 and age-1 Rainbow Trout collected at 39 3-m long shoreline trend sections between fall and spring 2012 and 2014 at the South Fork Boise River, Idaho. Overwinter survival was estimated at 62% in 2014 and spring density was 0.3 fish/m.

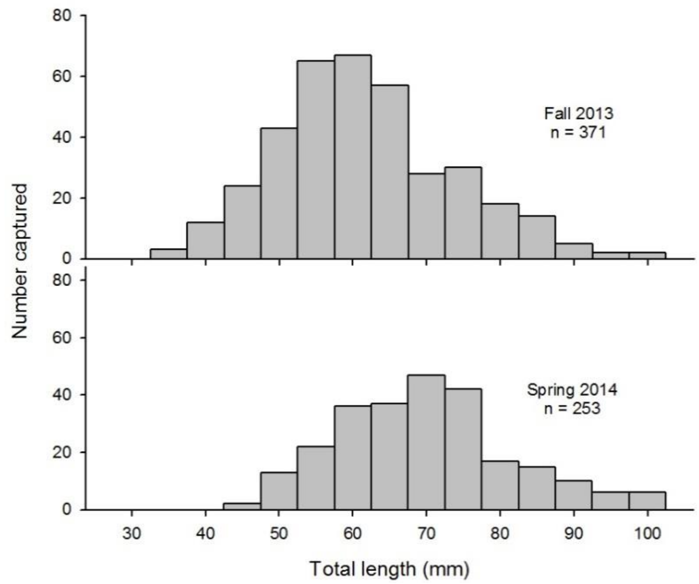

Figure 52. Length distributions of age-0 and age-1 Rainbow Trout, sampled during fry surveys during October 2013 and March 2014 in the South Fork Boise River downstream of Anderson Ranch Dam.

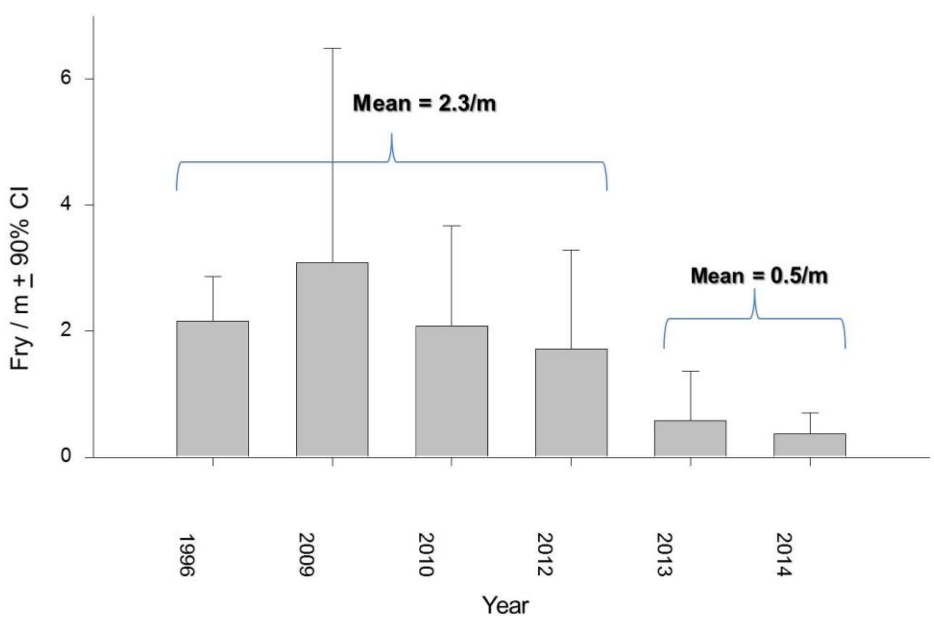

Figure 53. Comparison of mean age-0 Rainbow Trout densities collected at 39 33-m long shoreline trend sites from 1996 through 2014 at the South Fork Boise River, Idaho.

MONITORING TROUT POPULATIONS IN TRIBUTARIES TO THE SOUTH FORK BOISE RIVER

ABSTRACT

Trend sites at Bock, Mennecke, Pierce, Rattlesnake and Trail creeks were sampled in 2014 to evaluate presence and abundance of Rainbow Trout *Oncorhynchus mykiss* and Bull Trout *Salvelinus confluentus*. The streams are all southern tributaries to the South Fork Boise River (SFBR) between Anderson Ranch Dam and Arrowrock Reservoir. Trout density and size structure varied widely among streams in 2014. A total of 889 Rainbow Trout were collected in three streams and four Bull Trout were collected at three sites in Rattlesnake Creek. Bock Creek had the highest densities of Rainbow Trout, of which nearly all were age-0 fish. No fish were observed in Pierce and Trail creeks in 2014. Bock and Mennecke creeks appear to be utilized as spawning and rearing tributaries for SFBR Rainbow Trout. Relative contribution to the main-stem population is unknown. The sites in Bock and Mennecke creeks were also resampled in December and age-0 Rainbow Trout appear to overwinter in the tributaries rather migrate to the main-stem SFBR. The absence of trout in Pierce and Trail creeks is troubling but not entirely unexpected. Stream grade barriers were discovered on both streams that are likely blocking the upstream migration of spawning Rainbow Trout. These barriers are a result of down-cutting in the alluvial fan of the sediment and debris flows. Stream grade restoration should be considered to restore connectivity for spawning fish.

Author:
Arthur E. Butts
Regional Fishery Biologist

INTRODUCTION

The South Fork Boise River (SFBR) below Anderson Ranch Dam is a nationally-renowned tailwater trout fishery and was the first river section in the Southwest Region to be managed under “Trophy Trout” regulations. This fishery is supported by a population of wild Rainbow Trout *Oncorhynchus mykiss* and Mountain Whitefish *Prosopium williamsoni*. Migratory Bull Trout *Salvelinus confluentus* are present at very low densities, and native nongame fish including Largescale Sucker *Catostomus macrocheilus*, Northern Pikeminnow *Ptychocheilus oregonensis* and sculpin *Cottus sp*.

The SFBR wild trout population is thought to be mainly supported through main-stem spawning of fish with little recruitment from tributaries, as migration barriers are known to be present on most tributaries with spawning habitat (Moore et al. 1979). Recent information on fish populations within these tributaries had not been collected since the late 1970’s when Moore et al. (1979) characterized the majority of the SFBR tributaries below Anderson Ranch and evaluated the presence of spawning trout and spawning habitat. Recognizing that changes in land use practices, roads, and climate over the past 30 years have likely altered conditions in these streams, there existed a need to revisit these tributaries. Beginning in 2010, IDFG began to revisit a number of SFBR tributaries to acquire current information on fish presence, abundance, and age structure within these tributaries. Specifically, biologists wished to determine whether the tributaries currently had fish populations, contained spawning habitat, and if tributary spawning and recruitment could be enhanced by removing migration barriers and improving habitat. Surveys have identified a number of tributaries that are utilized as spawning and rearing habitat, most notably Pierce, Rock, Cayuse, Bock, Meinecke, and Trail creeks (Butts et al. 2013; Kozfkay et al. 2010). Although the SFBR Rainbow Trout population is thought to be primarily driven by main-stem spawning, data describing the trout communities in tributaries will help guide conservation and restoration efforts in the future.

Some migratory Bull Trout (adfluvial and fluvial) overwinter in the SFBR, travel downstream to Arrowrock Reservoir in mid-May through early June, and proceed to migrate upstream towards a number of higher elevation spawning tributaries in the North Fork and Middle For Boise River drainages (Flatter 2000). Spawning generally occurs in August and September, after which fish move back downstream to wintering areas. There does not appear to be a resident component of the Bull Trout population in the main-stem SFBR below Anderson Ranch Dam. Tributary use by Bull Trout is not well understood and is thought to be limited by adequate flows or temperature.

METHODS

Trend sites at Bock, Mennecke, Pierce, Rattlesnake, and Trail creeks were surveyed in 2014 to evaluate presence and abundance of Rainbow Trout and Bull Trout, and habitat suitability. The streams are all southern tributaries to the SFBR between Anderson Ranch Dam and Arrowrock Reservoir. Bock, Mennecke, and Trail creeks are located downstream of Danskin Bridge (Figure 54). The confluence of these tributaries with the SFBR mainstem is on private land owned by Danskin Cattle Co. and managed for grazing and hay production. All stream drainages, except Rattlesnake Creek, were burned during the 2013 wildfires. Pierce Creek also experienced at least two major debris and sediment flows in 2013 and 2014. Sampling at Bock, Mennecke, and Pierce creeks were initially conducted on July 28-29 2014. Bock and Mennecke creeks were re-sampled on December 2, 2014 to investigate whether fish overwintered in those tributaries. The United States Forest Service (USFS) trend sites in Rattlesnake Creek were sampled during September 17-18, 2014 and Trail Creek was sampled on August 28, 2014 (Figure 55).

Fish Sampling

Depletion (multiple pass) electrofishing was used to estimate the abundance of salmonids, using a backpack electrofisher (Smith-Root Model 15-D) with pulsed DC. However, only a single pass was conducted when no fish were observed during the first pass. Nongame fish and amphibian species were also recorded if observed. Fish were identified, enumerated, measured to the nearest millimeter (total length, TL) and gram, and then released downstream of the study sites. Block nets were installed at the upper and lower ends of the sites to prevent fish from leaving or entering a study site during the survey. When multiple passes were conducted, maximum-likelihood abundance and variance estimates were calculated with the MicroFish software package (Van Deventer and Platts 1989; Van Deventer 2006). When all trout were captured on the first pass, we estimated abundance to be the total catch. Because electrofishing is characteristically size selective (Sullivan 1956; Reynolds 1996), trout were separated into two length groups (<100 mm TL and ≥100 mm TL) and abundance and capture efficiencies were estimated for each length group.

Habitat Sampling

Total site length was measured then divided by 10 to determine and place cross-sectional transects. Various habitat measurements were recorded at transects within the sample site. Wetted stream width was measured at each transect and depth (m) was measured at ¼, ½, and ¾ distance across the channel. The sum of these depth measurements was divided by four to account for zero depths at the stream margins for trapezoidal channels (Platts et al. 1983; Arend 1999). Mean wetted stream width (m) was calculated from all transect measurements. In most cases, stream temperature (°C) and conductivity (µS/cm) were measured at the downstream of a site with a calibrated hand-held meter accurate to ± 2%. Various other habitat measurements such as percent substrate composition, percent shading, and bank stability were measured but the results are not reported here.

RESULTS

Fish Sampling

Trout density and size structure varied widely among streams in 2014. A total of 889 Rainbow Trout and four Bull Trout were sampled in three streams. Bull Trout were only observed in Rattlesnake Creek. Bock Creek had the highest densities of Rainbow Trout, of which nearly all were age-0. No fish were observed in Pierce and Trail creeks in 2014.

Bock Creek contained extremely high densities of age-0 Rainbow Trout during both summer and winter sampling periods. In July, trout ranged from 36 to 155 mm, and in December, fish ranged from 51 to 206 mm (Figure 56). Total trout density was 299.3 fish/100 m^2 in summer and 153.1 fish/100 m^2 in winter (Table 25).

Mennecke Creek was similar to Bock Creek as catches were primarily age-0 Rainbow Trout. In July, Rainbow Trout ranged from 49 to 82 mm and in December, trout ranged from 57 to 115 mm (Figure 56). Total fish density was 74.8 fish/100 m^2 in summer and 65.7 fish/100 m^2 in winter (Table 25).

Rainbow Trout ranged from 40 to 245 mm among the four sites in Rattlesnake Creek (Figure 57). Trout ≥ 100 mm composed 61-83% of the catch at these sites. Trout densities ranged from 2.0/100 m^2 at 94RS9.5 to 9.2/100 m^2 at 95RSINT9 (Table 25). Four Bull Trout, ranging from 190 to 360 mm, were collected at three sites in Rattlesnake Creek (Figure 58).

DISCUSSION

The use of tributaries by Rainbow Trout for spawning habitat in the SFBR has been documented in earlier studies and contribution to the overall main-stem population is unknown but assumed to be low (Moore et al. 1979). However, the continued use of tributaries for spawning is important in maintaining a diversity of life history strategies within the SFBR Rainbow Trout population. Additionally, monitoring changes in the use of these tributaries by spawning Rainbow Trout may provide insight into changes in habitat, land management practices, water supply, and even climate change. During summer 2014, Rainbow Trout densities were 299.3 fish/100 m^2 in Bock Creek and 74.8 in Mennecke Creek. By comparison, in 2011, Rainbow Trout densities in Bock and Mennecke creeks was 54.4 fish/100 m^2 and 128.6 fish/100m^2, respectively (Butts et al. 2013). It is unknown whether the observed shifts in densities within the streams represent natural variation in annual tributary use by spawners or some other change. Stream temperatures in both streams were much warmer in 2014 than they were during August 2011, likely a result of the loss of riparian2 shading from the 2013 Elk-Pony complex fire that burned both drainages. Stream temperature in Bock Creek increased from 13ºC in 2011 to 18ºC in 2014 while temperature increased from 16 to 26ºC over the same period in Mennecke Creek (Butts et al. 2013). While the warmer temperatures may increase growth, summer temperatures in Mennecke Creek approached upper lethal temperatures reported for Rainbow Trout (27-30ºC; Hillman et al. 1999).

The sites in Bock and Mennecke creeks were also resampled in December to determine whether age-0 Rainbow Trout utilize tributaries during winter or migrate to the main-stem SFBR. Densities of age-0 trout decreased by 55% and 26% between August and December in Bock and Mennecke creeks, respectively. However, high densities were still observed in both creeks in December. Additionally, juvenile trout ≥ 100 mm were present at both streams suggesting that the tributaries provide rearing habitat for some fish for a couple of years before migrating to the main-stem SFBR. Because both streams are utilized as spawning and rearing habitat, they should be considered for restoration efforts.

Rattlesnake Creek contained a range of size classes of Rainbow Trout and Bull Trout and is perhaps large enough to support resident populations of both species. One 360-mm Bull Trout collected at 95RSINT9 was possibly an adfluvial fish that migrated into Rattlesnake Creek. All four sites sampled in 2014 were located along USFS road 217.

The absence of fish in Pierce and Trail creeks is concerning, but not entirely unexpected. Both drainages burned in 2013 and experienced large sediment and debris flows shortly afterwards. Additionally, Pierce Creek experienced another substantial sediment and debris flow in August 2014. Fish barriers were identified on both streams that are likely keeping spawning Rainbow Trout from migrating to spawning areas. These barriers are a result of down-cutting in the alluvial fan of the debris flows. Both tributaries had reasonably high densities of age-0 Rainbow Trout prior to the 2013 fire (Butts et al. 2013). Riparian and hillside restoration efforts should be planned for both drainages to prevent or minimize future sediment flows. Stream-grade restoration should be considered to improve connectivity especially for Rainbow Trout spawning.

A number of tributaries to the SFBR appear to provide spawning and rearing habitat for wild trout. Knowledge of which tributaries are utilized by wild trout helps prioritize habitat protection or restoration projects or detrimental land management practices. Additionally, knowledge of which tributaries are not currently used by fish allows comparative description of key biotic variables that explanation the lack of use, such as flow, temperature, or presence of barriers. Finally, the extent to which tributaries such as Bock and Mennecke creeks contribute to the main-stem Rainbow Trout population is entirely unknown. A better understanding of the SFBR Rainbow Trout population could be achieved by investigating the use of otolith microchemistry in delineating origins of adult Rainbow Trout in the mainstem. If tributaries differ significantly enough in trace elements from one another and the mainstem SFBR, then this would provide valuable insight into the contributions provided by tributaries in the SFBR system.

RECOMMENDATIONS

1. Resample Bock and Mennecke creek sites in 3-5 years.

2. Collect otoliths from age-0 trout in Bock, Mennecke, and mainstem SFBR for otolith microchemistry analysis to determine if enough variation exists to delineate adult origin.

Table 25. Species captured by stream and site, stream temperature, and fish densities during electrofishing surveys in five tributaries to the South Fork Boise River in 2014.

					< 100 mm			≥ 100 mm			Total		
Stream	Date	Site	Temp (°C)	Passes	n	Estimate	95% CI	n	Estimate	95% CI	n	Estimate	fish/100m^2
Bock Creek	7/29/2014	1	18.2	2	394	426	21	2	2	0	396	428	299.3
	12/2/2014	1	5.3	2	161	193	29	26	26	1	187	219	153.1
Mennecke Creek	7/28/2014	1	25.5	2	107	107	4	0	0	0	107	107	74.8
	12/2/2014	1	7.1	2	79	79	18	15	15	1	94	94	65.7
Pierce Creek	7/28/2014	1	19.3	1	-	-	-	-	-	-	-	-	-
Rattlesnake Creek	9/17/2014	95RSINT9	13.1	2	18	19	5	29	32	8	47	51	9.2
	9/18/2014	94RS8.5	11.9	2	7	7	2	11	11	2	18	18	3.1
	9/17/2014	94RS9.5	11.5	2	2	2	0	10	10	3	12	12	2
	9/18/2014	95RSINT7	12.2	2	10	10	1	18	21	10	28	31	5.5
Trail Creek	8/28/2014	1	17.1	1	-	-	-	-	-	-	-	-	-

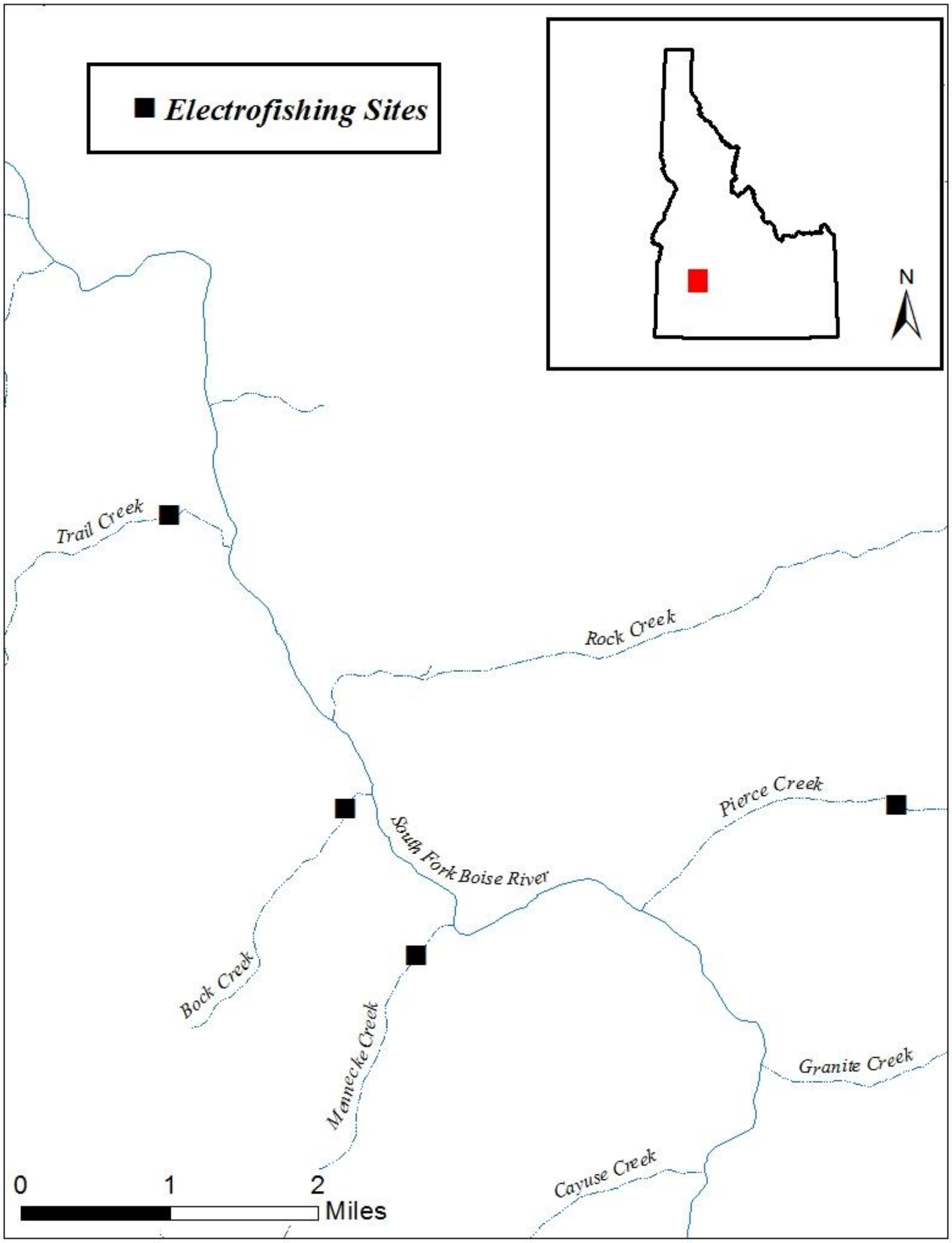

Figure 54. Location of sampling sites within four tributaries in the South Fork Boise River drainage, Idaho in 2014.

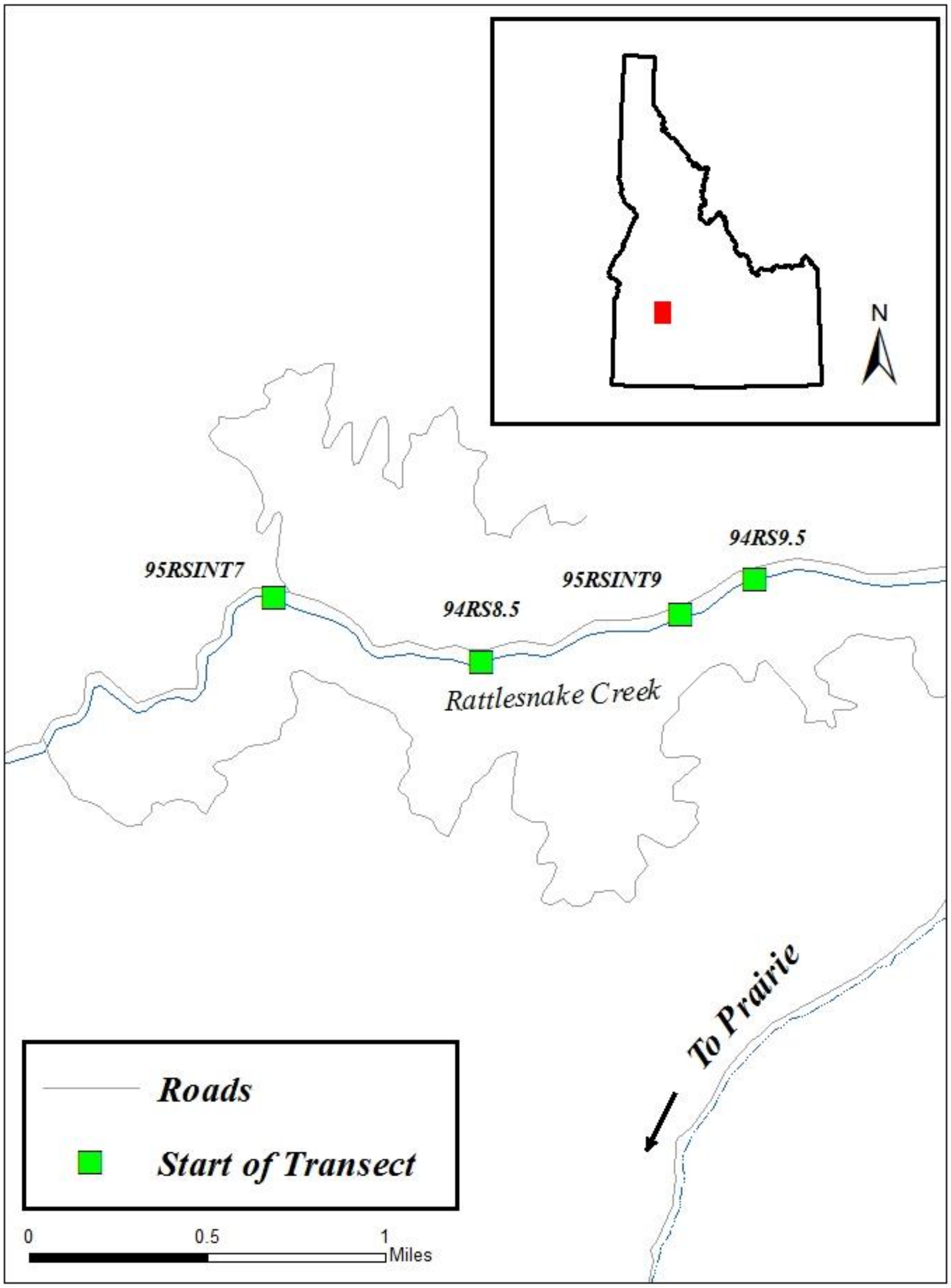

Figure 55. Location of four sampling sites in Rattlesnake Creek, a tributary to the South Fork Boise River drainage, Idaho in 2014.

.

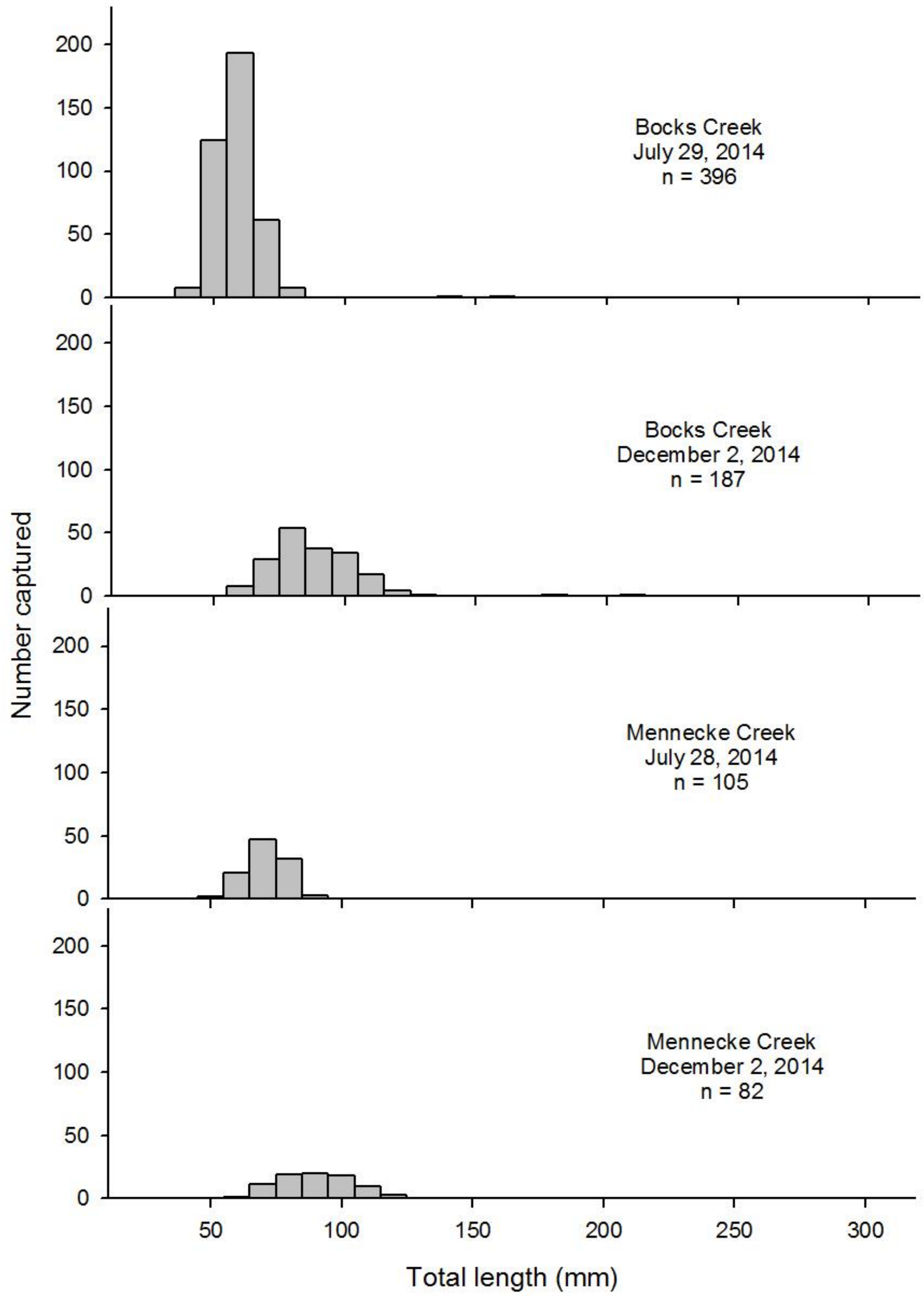

Figure 56. Length distribution of Rainbow Trout sampled during depletion population estimates in Bock and Mennecke creeks in July and December 2014. Both streams are tributaries to the South Fork Boise River, Idaho.

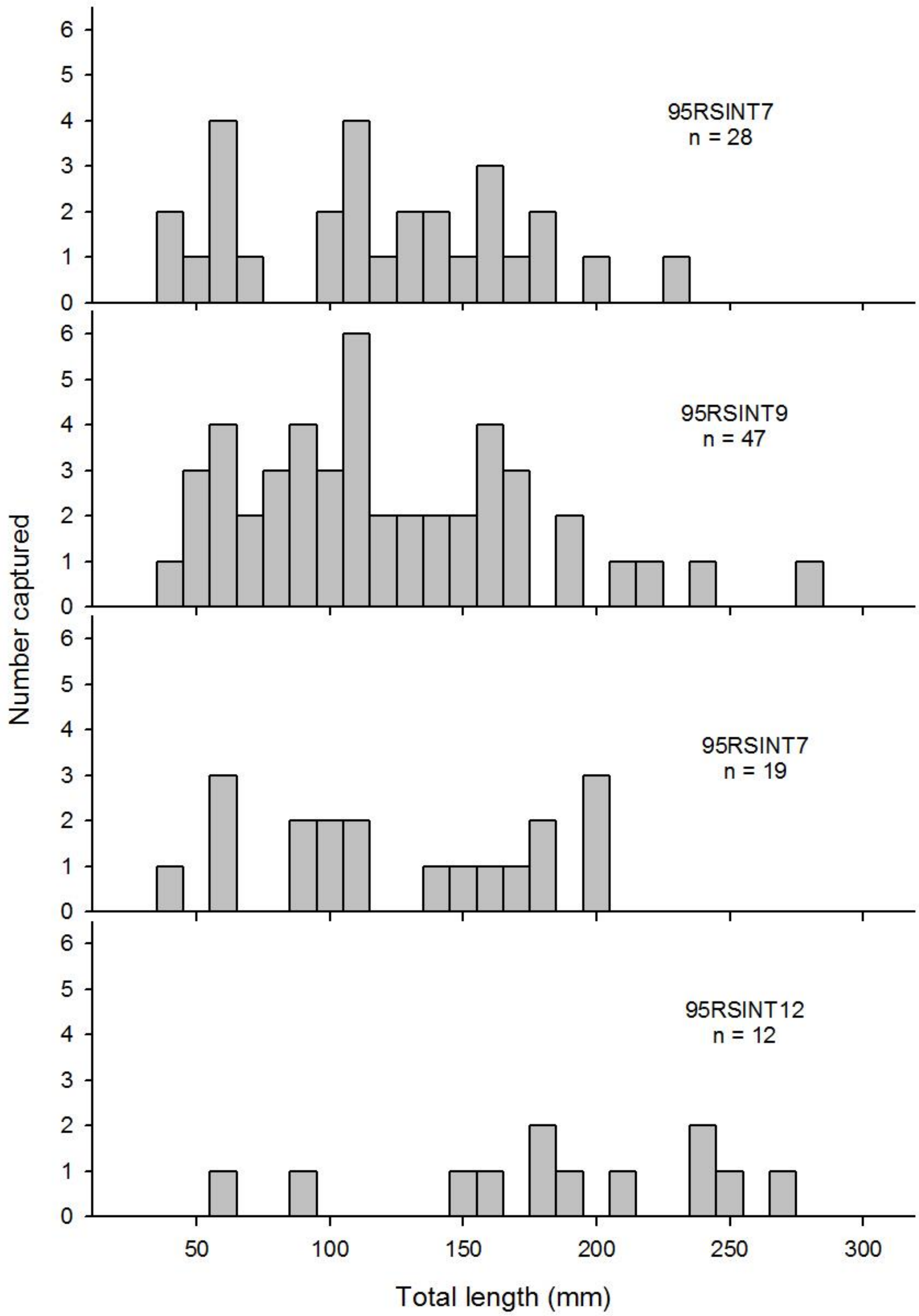

Figure 57. Length distributions of Rainbow Trout sampled by site during depletion population estimates in Rattlesnake Creek in September 2014. Rattlesnake Creek is a tributary to the South Fork Boise River, Idaho.

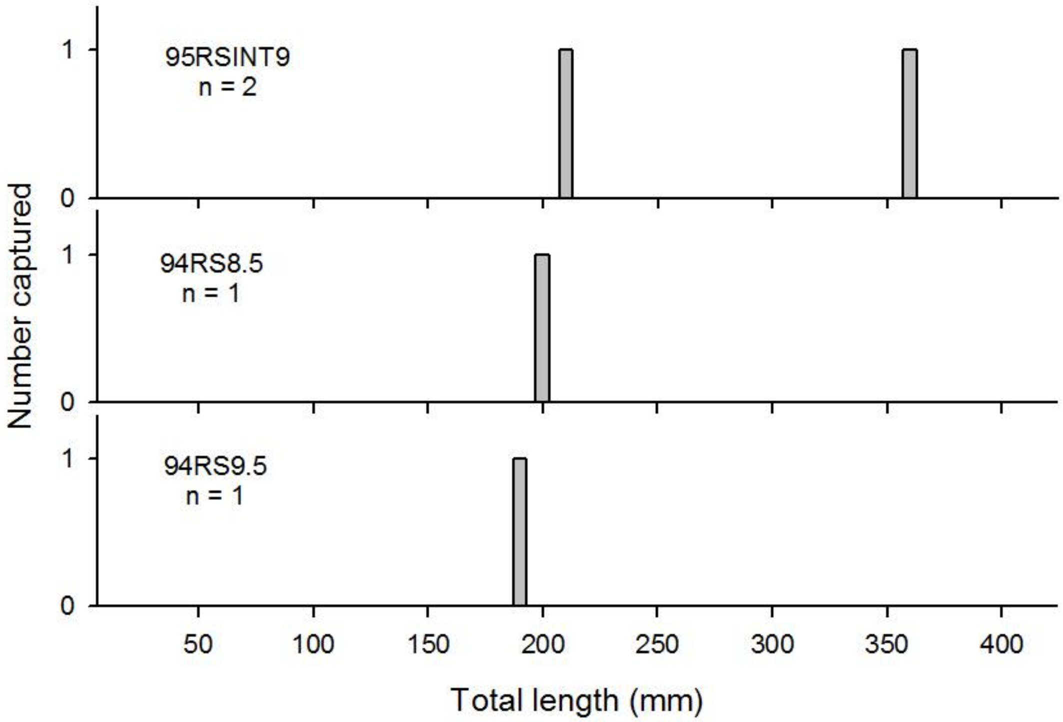

Figure 58. Length distributions of Bull Trout sampled by site during depletion population estimates in Rattlesnake Creek in September 2014. Rattlesnake Creek is a tributary to the South Fork Boise River, Idaho.

ACKNOWLEDGEMENTS

We would like to express our gratitude to the many people whose assistance, cooperation, and hard work allowed us to complete these projects. We thank Pete Gardner, Nick Porter, Lela Work, and Lorenzo Valdez who comprised the 2014 field crew. Their work and dedication to their jobs was invaluable. We also thank IDFG's enforcement, fisheries bureau, hatchery, and regional staff as well as our management partners at the US Fish and Wildlife Service, Bureau of Reclamation, Bureau of Land Management, and Forest Service for assistance provided in 2014.