SOUTH FORK BOISE RIVER ELECTROFISHING SURVEY

ABSTRACT

We used mark-recapture techniques in the South Fork Boise River (SFBR) to estimate abundance of trout in each section and mountain whitefish in the upper section in October 2012. A total of 798 rainbow trout *Oncorhynchus mykiss* were collected during both mark and recapture runs. Fish lengths ranged from 82-550 mm and multiple modes were observed within the length distributions. During marking efforts, we captured 495 wild rainbow trout greater than 100 mm in the three sections combined. We marked 494 rainbow trout during the marking run and sampled 303 fish during the recapture run, of which, 58 were marked. Rainbow trout density was estimated at 1,099 rainbow trout/km for the overall 9.6 km reaches. Rainbow trout densities and size structures in the SFBR have been relatively stable from 2006-2012. The numbers of trout greater than 400 mm are currently providing an excellent fishery despite the relative lack of smaller trout in the survey section. The canyon section below Danskin Bridge was sampled on July 30, 2012. A total of 11 transects were sampled between Danskin and Neal bridges during the 1-day survey. We captured 123 wild rainbow trout with a size range of 150 to 470 mm and a mean length of 343 mm. Comparison of length frequencies between the 2012 tailwater and canyon sections show a greater proportion of mid-sized rainbow trout between 200 and 450 mm in the canyon section as was observed in 2008.

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INTRODUCTION

The South Fork Boise River below Anderson Ranch Dam (SFBR) is a highly valued trout fishery and was the first river section in Southwest Idaho to be managed under "Quality Trout" regulations. Regulations restrict terminal tackle to no bait and barbless hooks from Neal Bridge (Forest Road 189) upstream to Anderson Ranch Dam. Rainbow trout harvest is restricted to 2 fish, none under 20 inches. The 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 non-game fish include largescale suckers *Catostomus macrocheilus*, northern pikeminnow *Ptychocheilus oregonensis* and sculpin *Cottus sp*.

The SFBR between Anderson Ranch Dam to the confluence of Arrowrock Reservoir is divided into two recreational sections: 1) the tailwater section, approximately 16 km long, runs from Anderson Ranch Dam downstream to Danskin bridge, and 2) the canyon section, approximately 27 km long, runs from Danskin Bridge downstream to Neal Bridge (Figure 49). The tailwater section has a public road and access along the entire reach and receives more angling pressure. It is also a popular destination for drift-boat fishing. The canyon section has extremely limited access by foot or road because of the high canyon walls and is accessible mostly by raft due to the Class II and III rapids in the section.

In 2006, sampling methodologies 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, 3 sections that were approximately 1-km long were identified within the historic surveys' boundaries for sampling. Kozfkay et al. (2010) demonstrated a pronounced increase in electrofishing efficiency for all size groups of rainbow trout resulting from the shift in sampling methodologies.

From 1994 to 2006, rainbow trout population trends in the tailwater section suggested decreasing abundance, an increase in size, and a relative lack of intermediate-size (200-400 mm) fish. Size distribution along with a belief by some anglers that the SFBR lacked spawning habitat led many to express concerns that the river was recruitment limited. To address these concerns IDFG revisited fry sampling transects that were established in 1994 during a whirling disease research study. Biologists observed high densities of age-0 trout within the transects and visual observations of near-shore habitat throughout the tailwater reach suggest recruitment is not a limiting factor in the population.

In 2008, IDFG surveyed the canyon section to compare wild rainbow trout size distribution to the tailrace section, and to establish trend reaches in the canyon for semi-annual monitoring. Because of the difficult access and whitewater conditions, there had not been a documented attempt to assess fish populations within the canyon section prior to this event. Results suggested that size classes of rainbow trout between 200-400 mm were more abundant downstream in the canyon section versus the upstream tailwater section (Kozfkay 2009). It was recommended after that sampling period to repeat the survey during the same year as the tailwater sections when possible.

METHODS

From 1994 to 2004, SFBR rainbow trout populations were monitored using a mark-recapture survey in a 9.6 km section every three years with raft mounted electrofishing gear.

However it was determined that better population estimates could be attained sampling smaller sections more intensively with a canoe and mobile anode setup (Kozfkay et al 2009). Therefore since 2006, rainbow trout populations in the SFBR have been monitored in three approximately 1-km sections every three years (Figure 45). The current three stream reaches are located within the boundaries of the original reach. Kozfkay et al. (2009) describes the location of the stream reaches within the old survey boundaries. Riffles formed the upper and lower reach boundaries. Section length was determined from 1:24,000 topographic maps. Wetted widths were measured with a hand-held laser range finder (Leupold RX series). Section area was estimated by multiplying mean widths and section length. For braided channels mean width was measured across the river excluding any distances across islands.

We used mark-recapture techniques to estimate abundance of trout in each section and mountain whitefish in the upper section. 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/minute) through an air-stone. Pulsed direct current was produced by a 5,000 watt generator (Honda EG500X). Frequency was set at 25-30 pulses per second with an power output of 3,200-3,400 watts. Crews consisted of seven to nine people. Three operators managed the mobile anodes, one person guided the canoe and operated the safety switch controlling the output, the remaining crew of four or five people were equipped with dip nets to capture stunned fish. Only trout and whitefish were placed in the live well.

Marking and recapture runs were conducted with a single pass from upstream to downstream. The canoe was held upstream of the anode operators. Anodes were swept through the water or thrown across the stream and retrieved. Crews with dip nets walked backward facing upstream, while staying downstream of the anodes and capturing stunned fish. Fish 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.

Rainbow trout and bull trout were marked in all three sections on October 13-14, 2012. Whitefish were only marked in the upper section. Fish were marked with a 7 mm diameter hole from a standard paper punch on the upper and lower section of the caudal fin and anal fin, corresponding to their capture reach. Only fish larger than 100 mm were marked. Fish were measured for total length (mm) and a subset was weighed (g). Fish were released 50 to 100 m upstream from the processing site to prevent them from drifting downstream into the next section of water to be sampled. Recapture sampling was completed on October 19-20, 2012. During the recapture effort, all whitefish and trout greater than 100 mm were captured and placed in the live well. Fish were examined for marks on the caudal fin. All fish were measured for length (mm).

Fisheries Analysis + (FA+), software developed by Montana Fish, Wildlife, & Parks, was used to generate mark-recapture and electrofishing 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 were calculated for each reach and pooled for a comprehensive estimate expressed as # fish/km for comparison to previous surveys. Observed mortalities during the marking run were recorded excluded from the population estimates.

Proportional stock density (PSD) indices were calculated using the equation from Anderson (1976) with rainbow trout values from Anderson and Neumann (1996).

*PSD = [Rainbow trout ≥ 400 mm / Rainbow trout ≥ 250 mm] * 100*

Canyon Reach Survey

A raft mounted with electrofishing gear was used to collect fish and estimate size structure in the canyon section during July 30, 2012. Sample sites corresponded to previously sampling efforts in 2008 (Butts et al. 2009) but instead of taking two days to complete, the 2012 survey was completed in a single day (Figure 46). Beginning and ending transect coordinates were recorded for each sampling reach using a Garmin Global Positioning System (GPS). In one case, the canyon walls prohibited the GPS unit from communicating with satellites and the coordinates were estimated afterwards with topographic software. Electrofishing equipment included a raft, generator, MLES Infinity electrofisher, and two booms each supporting a 76-cm ring from which eight dropper anodes were suspended, and 11 m of 0.95-cm, diameter stainless steel cable served as a cathode. Frequency was set at 25-30 pulses per second with a power output of 3200-3400 watts. Electrofishing was conducted with a single pass from upstream to downstream. One person rowed the raft and one person attempted to capture all trout. Only trout and whitefish were placed in the livewell. In addition, one raft carried a crew to process and record information collected from captured fish. Upon completion of a section, or when the livewell was judged to be at capacity, the crew stopped at the nearest riffle to process fish. Fish were identified and measured for total length (mm). River flow during electrofishing was approximately 51 m^3/s which was identical to the July 19-20, 2008 survey.

Fry Monitoring

Rainbow trout fry were monitored using a Smith Root Type VII backpack shocker in six sections of the SFBR on October 30, 2012 (Figure 45). Four of the 33-m sections were monitored in 1996 by Elle (1997) to assess relative abundance of rainbow trout fry in relation to whirling disease and were resampled in 2009. Two additional sites were added in 2010 to correspond with artificial red monitoring sites that were being monitored by BOR. The area from the north shoreline out to approximately 4 m was sampled. A single, upstream electrofishing pass was completed at each site. All fish were identified, counted and measured for total length. Fry density estimates and lengths were compared to those collected in previous years.

RESULTS AND DISCUSSION

A total of 798 rainbow trout were collected during both mark and recapture runs. Fish lengths ranged from 82-550 mm and multiple modes were observed within the length distributions (Figure 47). During marking efforts, we captured 495 wild rainbow trout greater

than 100 mm in the three sections combined. We marked 494 rainbow trout and recaptured 58 of the marked fish. Rainbow trout density was estimated at 1,099 trout/km for the overall 9.6 km reach (Figure 48). During the two previous surveys, estimated rainbow trout densities were 870 trout/km in 2009 and 705 trout/km in 2006 in the combined reaches.

Rainbow trout density estimates were similar between reaches, except for the middle reach, which has been historically problematic (Figure 48). As in previous years, low numbers of recaptured rainbow trout (n=9) influenced the population estimate for the middle reach. This reach also includes a number of deep runs where wading is not possible. Sampling in these stretches consists of attempting to herd fish to the bottom of the runs; however, many fish are likely escaping capture in these areas.

Over the last 12 years, large rainbow trout in the SFBR has increased as indexed by PSD, from 58 in 2000 to a high of 72 in 2009. In 2012, the PSD decreased somewhat to 64 due to the increased numbers of medium-sized fish between 300-400 mm. Since 2000, the proportion of rainbow trout between 102-230 mm (4-9 in.) has increased with every sampling event, from 17% in 2000 to 49% in 2009. However, in 2012, this length group declined to 42% (Figure 49). In contrast, the proportion of fish >406 mm (16 in) increased with each event, from 33% in 2009 to 36% in 2012. The number of fish exceeding 508 mm (20 in.) has remained stable at 3% between 2009-2012 but is still 10% lower than what was observed in 2006.

Mountain whitefish were only collected in the upper section in 2012 to provide trend information. A total of 539 whitefish were collected ranging between 100-570 mm and length distributions were similar between 2006-2012, though the mode of 390 mm was much more pronounced (Figure 50). We marked 355 mountain whitefish and recaptured 67 of the marked fish. Mountain whitefish has also shown to be quite stable between the sampling periods where 1,092 fish/km were estimated for the upper section in 2012 (Figure 48).

We captured 15 bull trout within the combined reaches. Bull trout ranged from 340-510 mm, and the mean size was 448 mm (Figure 51). Ten fish were marked and two was recaptured but sample size was too small to provide valuable estimates of population size or density.

In 2006, the electrofishing gear changed from raft electrofishing with mounted anodes to canoe electrofishing with mobile anodes vastly increased sampling efficiency for smaller fish compared to previous efforts with raft electrofishing (Kozfkay 2009). In 2012, IDFG Southwest Region personnel obtained a new electrofisher, the MLES Infinity. Based on anecdotal evidence of larger trout evading capture when anodes were on separate stream banks, a third anode was added to cover the middle of the stream. Efficiency curves calculated for the 2006-2012 surveys show that capture efficiency has varied between the three surveys and that the addition of a third probe and new electrofisher has increased capture efficiency of rainbow trout $\geq$325 mm (Figure 52). Interestingly, the ability to capture fish between 100-300 mm has varied substantially between surveys. Despite an additional anode, efficiency was lower in 2012 than in 2009 for fish between 100-300 mm. Furthermore, efficiency was dramatically different between 2006 and 2012 for this same size group, despite the same electrofisher and anode setup. The variation in efficiency for smaller fish could be due in part to differences in how intensely individual anode operators were sampling shoreline areas. It may also be related to the number of netters per anode. Both possible issues suggest areas to revisit to further standardize surveys in order to reduce variability in estimates.

Rainbow trout densities and size structure in the SFBR have been relatively stable from 2006-2012. The numbers of trout greater than 400 mm are currently providing an excellent fishery despite the relative lack of smaller trout in the survey section. Despite angler concerns over the atypical size distribution observed in the tailwater section, 2008 and 2012 electrofishing in the canyon section has suggested that rainbow trout between 250-400 mm were present in higher proportions downstream (Kozfkay et al. 2010).

Canyon Reach Survey

A total of 11 transects were sampled between Danskin and Neal bridges during the 1-day survey. We captured 123 wild rainbow trout (Table 35) with a size range of 150 to 470 mm and a mean length of 343 mm (Figure 53). Comparison of length frequencies between the 2012 tailwater and canyon sections show a greater proportion of mid-sized rainbow trout between 200 and 450 mm in the canyon section as was observed in 2008 (Figure 53; Kozfkay 2009). However, proportion of rainbow trout <180 mm and >480 mm were also much higher in the tailwater section. Length frequencies and current knowledge of available spawning habitats suggest that spawning and early rearing occurs in the tailwater section and tributaries above Danksin Bridge. It also appears that once fish reach 180 mm, many may be dropping downstream into the canyon section. This suggests possible segregation based on size or habitat. However, comparing relative abundance between the two sections for rainbow trout <180 mm is problematic because of the differences in sampling efficiencies for smaller fish between the two sampling methods. Rainbow trout <180 mm are generally found in shallow near-shore habitats with less flow which are less likely to be sampled efficiently by the raft gear. Additionally, electrofishing is size-selective for larger individuals and without correction, often results in biased estimators of population size and size structure for smaller and slower growing individuals (Anderson 1995). Overall, raft electrofishing is less efficient for all size classes as the ability to capture fish is decreased by the limited mobility of the anodes and netter and by the inability to shock both banks. A total of 153 mountain whitefish were also captured (range = 180-520 mm; Figure 53). Mountain whitefish length distributions were similar between the two sections although a greater proportion of fish >400 mm were captured in the canyon section.

Fry monitoring

We collected 340 rainbow trout fry among the four sections ranging between 25-77 mm. As in previous years, most of the fish were in section 4 (43%), directly above Cow Creek bridge, and section 2 (36%). IDFG estimated overall mean fry density to be 2.3 $\pm$ 2 fish / m in October 2012 (Figure 54). Fry density appears to be rather stable since 1996, ranging from 2.2 $\pm$ 0.7 fish/m in 1996 to 3.1 $\pm$ 3.4 fish/m in 2009. Though conclusions may be limited from 4 years of data spaced 16 years apart, fry monitoring may provide valuable information on recruitment and survival if implemented on an annual basis. These baselines may be particularly important as IDFG, in cooperation with BOR and Trout Unlimited (TU) study stranding issues during declining flows in the fall.

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor rainbow trout population trends in the tailwater (roaded) section on 3 year intervals or less. However consider replacing the middle section with a more suitable site for sampling methodology.

2. Continue to monitor the downstream canyon section and examine the possibility of pit-tagging smaller fish to see if they migrate upstream to the tailwater section as they grow.

3. Continue to use annual shoreline electrofishing at established sites to monitor spawning success and fry production; relate fry densities to adult abundance, flows, or other environmental variables as data becomes available.

Table 35. Transect lengths and number captured by fish species during the July 30, 2012 electrofishing survey of the canyon section of the South Fork Boise River between Danskin and Neal bridges. Transects were established in 2008 and lengths were estimated from start and end GPS coordinates and transect site descriptions.

Transect	Transect length (km)	Mountain whitefish	Rainbow trout	Bull trout	Kokanee	Total
Transect 1	0.7	13	6	-	-	19
Transect 2	0.7	9	5	-	-	14
Transect 3	1.3	22	12	-	1	35
Transect 4	0.5	11	13	1	-	25
Transect 5	1.6	29	23	-	-	52
Transect 6	0.9	19	9	-	-	28
Transect 7	0.8	18	18	-	-	36
Transect 8	0.5	2	4	-	-	6
Transect 9	0.7	10	3	-	-	13
Transect 10	1	3	5	-	-	8
Transect 11	1.3	17	25	-	-	43
Total	10	153	123	1	1	279

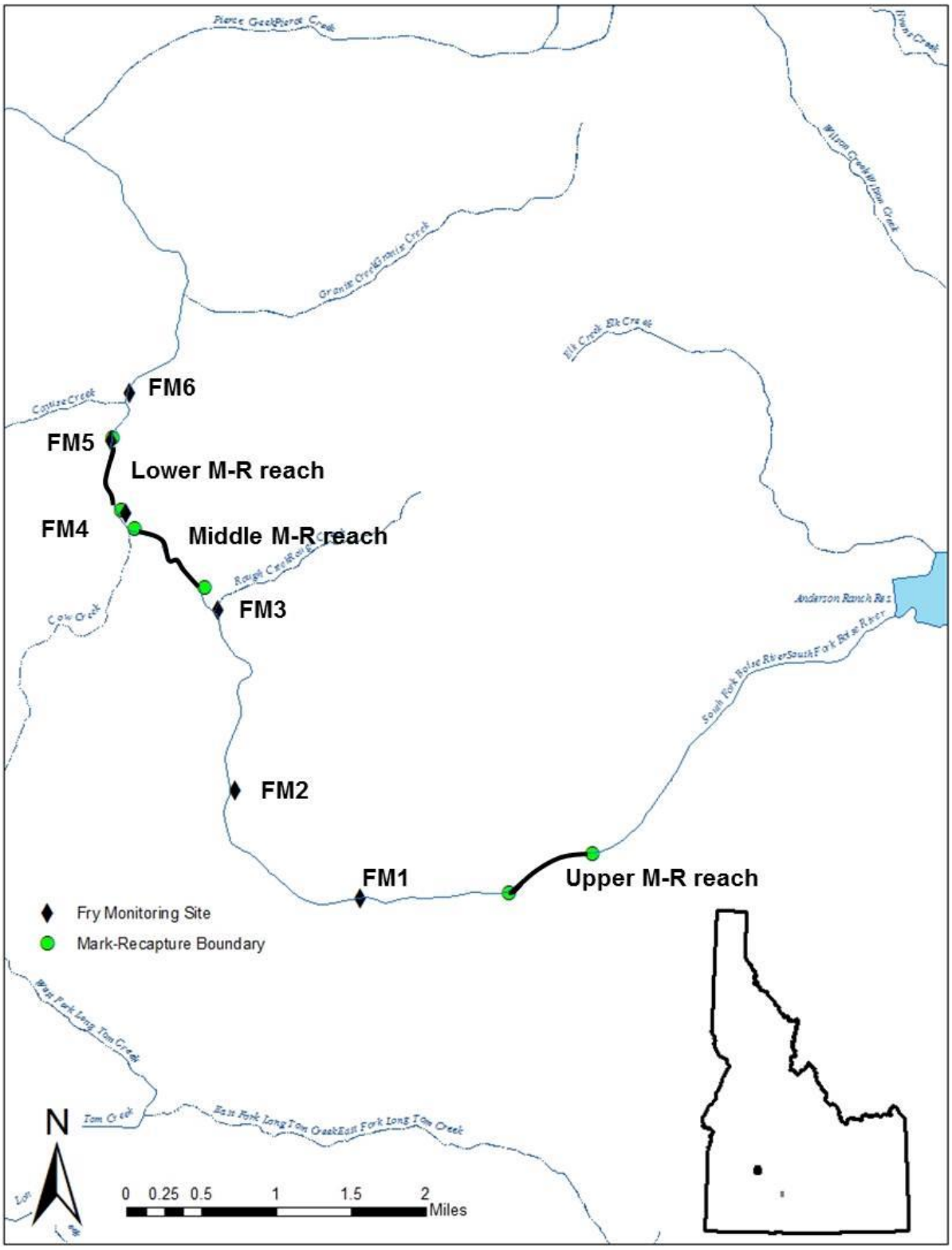

Figure 45. Map of South Fork Boise River, Idaho tailwater section showing location of 2012 mark-recapture section boundaries and fry monitoring sites.

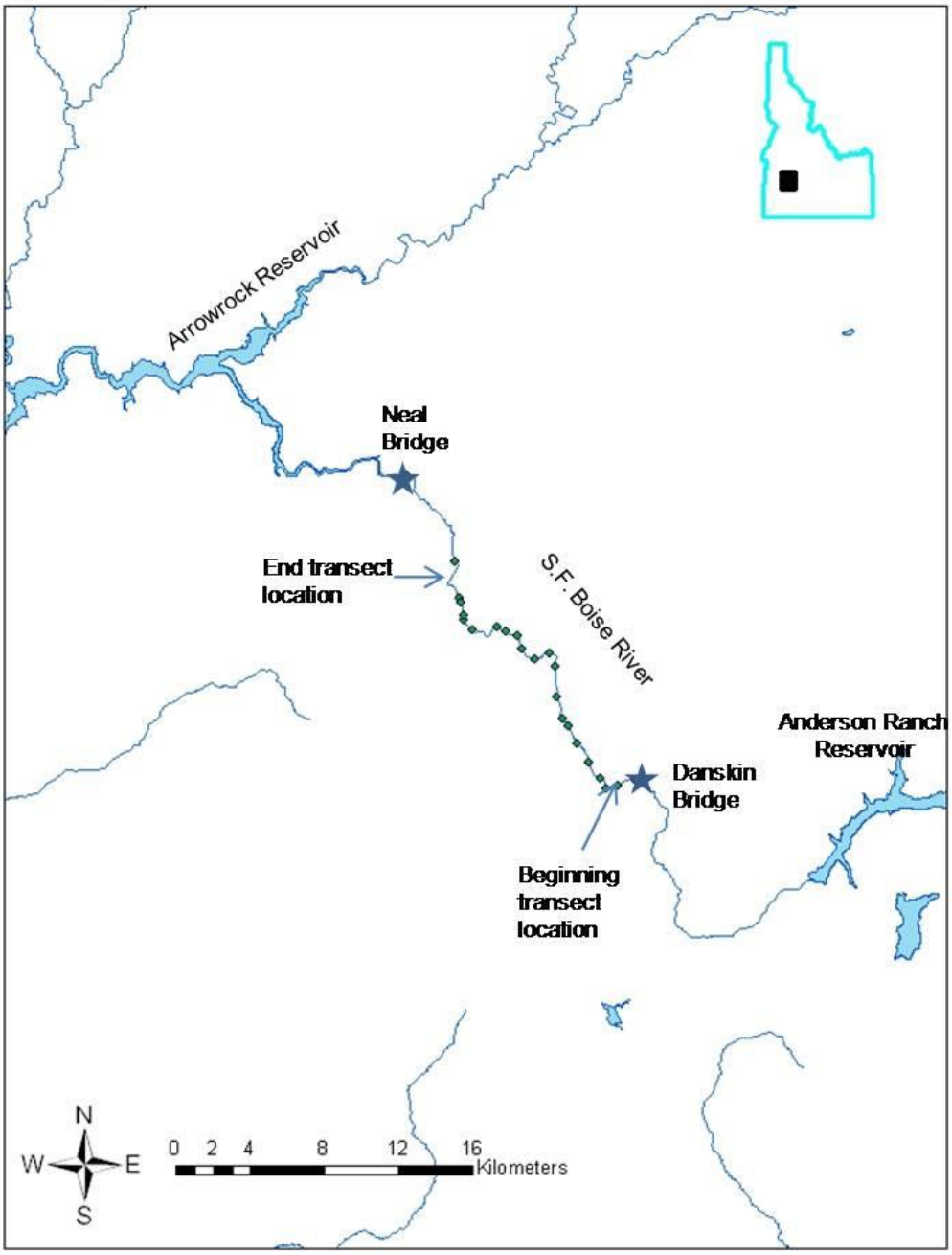

Figure 46. Map of South Fork Boise River, Idaho canyon section showing location of 2012 canyon electrofishing reach boundaries.

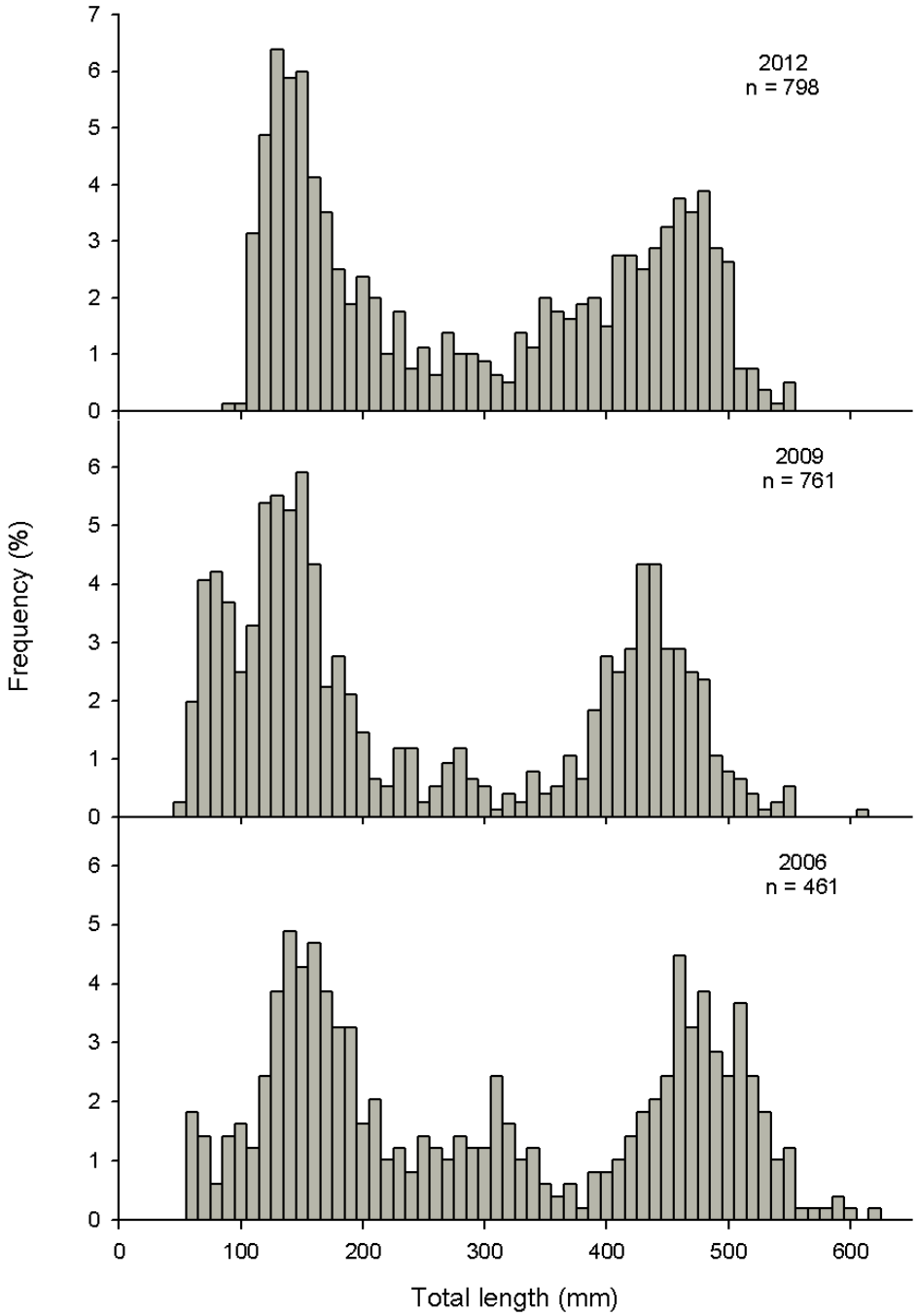

Figure 47. Length distributions of rainbow trout, calculated as proportion of total catch, during population surveys at the South Fork Boise River below Anderson Ranch Dam between 2006-2009. Only trout larger than 100 mm are included in population estimates.

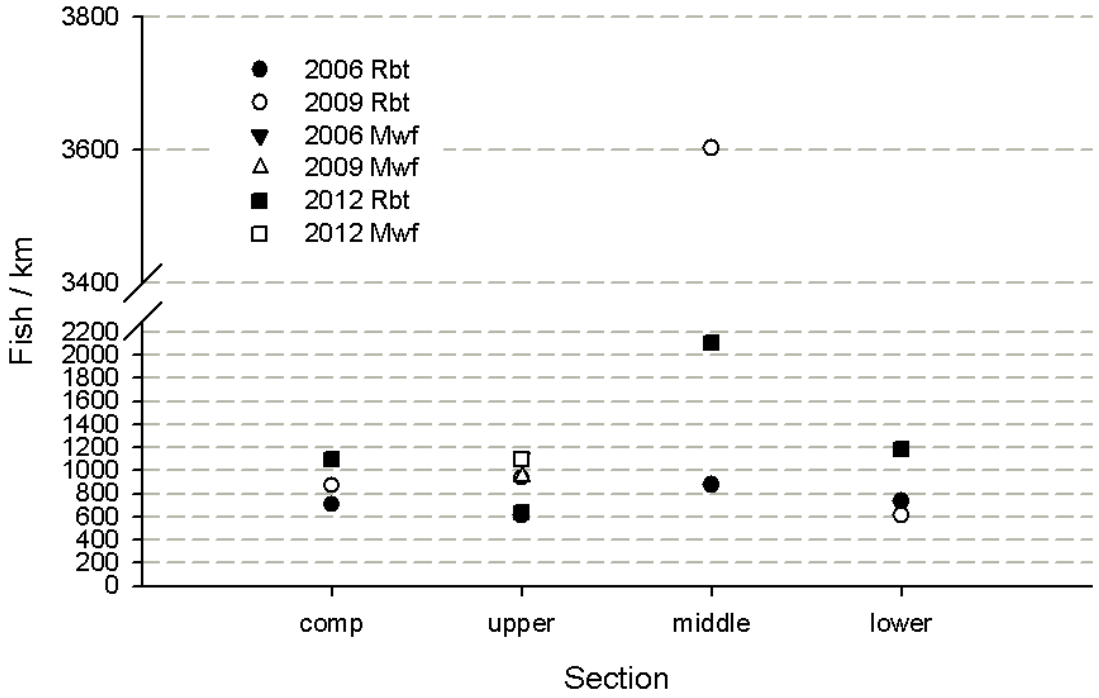

Figure 48. Linear density estimates for rainbow trout (>100mm) by reach for the South Fork Boise River in 2009 from maximum likelihood estimation. Comp is the estimate from pooling the data from all three reaches.

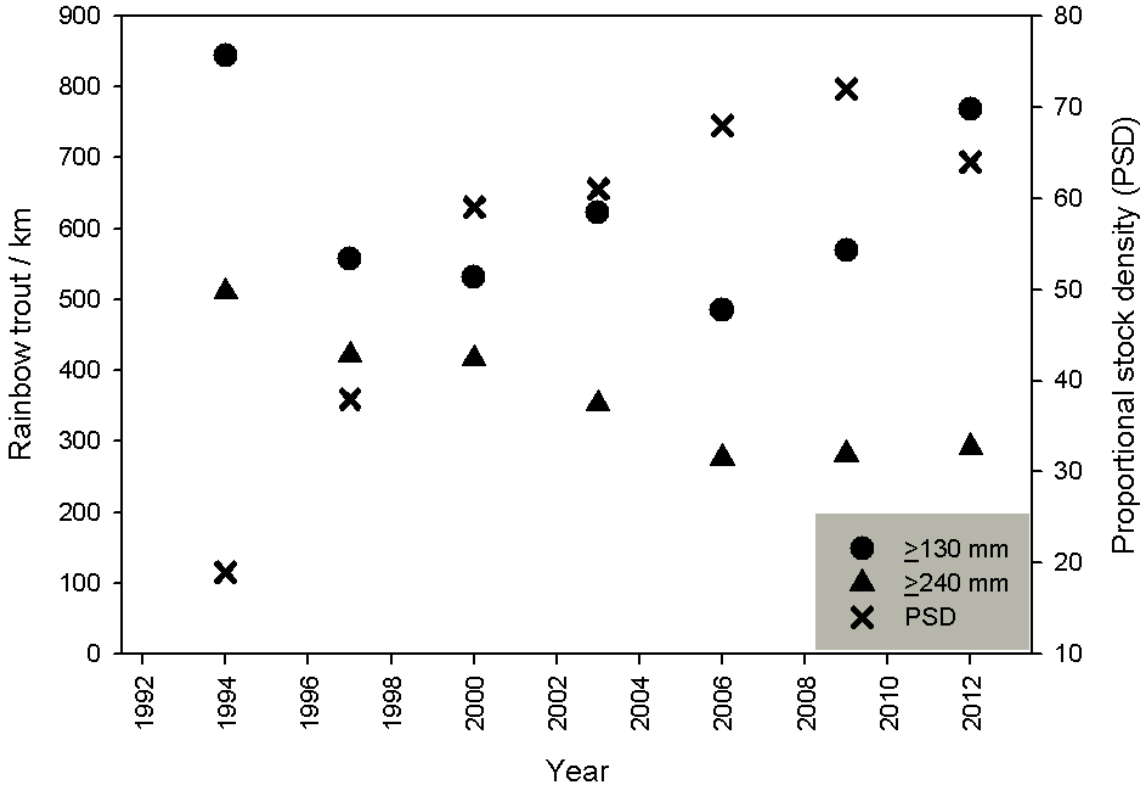

Figure 49. Linear density and Proportional Stock Density (PSD) for rainbow trout on the South Fork Boise River downstream from Andersen Ranch Dam between 1994 and 2012. Estimates were for rainbow trout ≥130 mm and ≥240 mm.

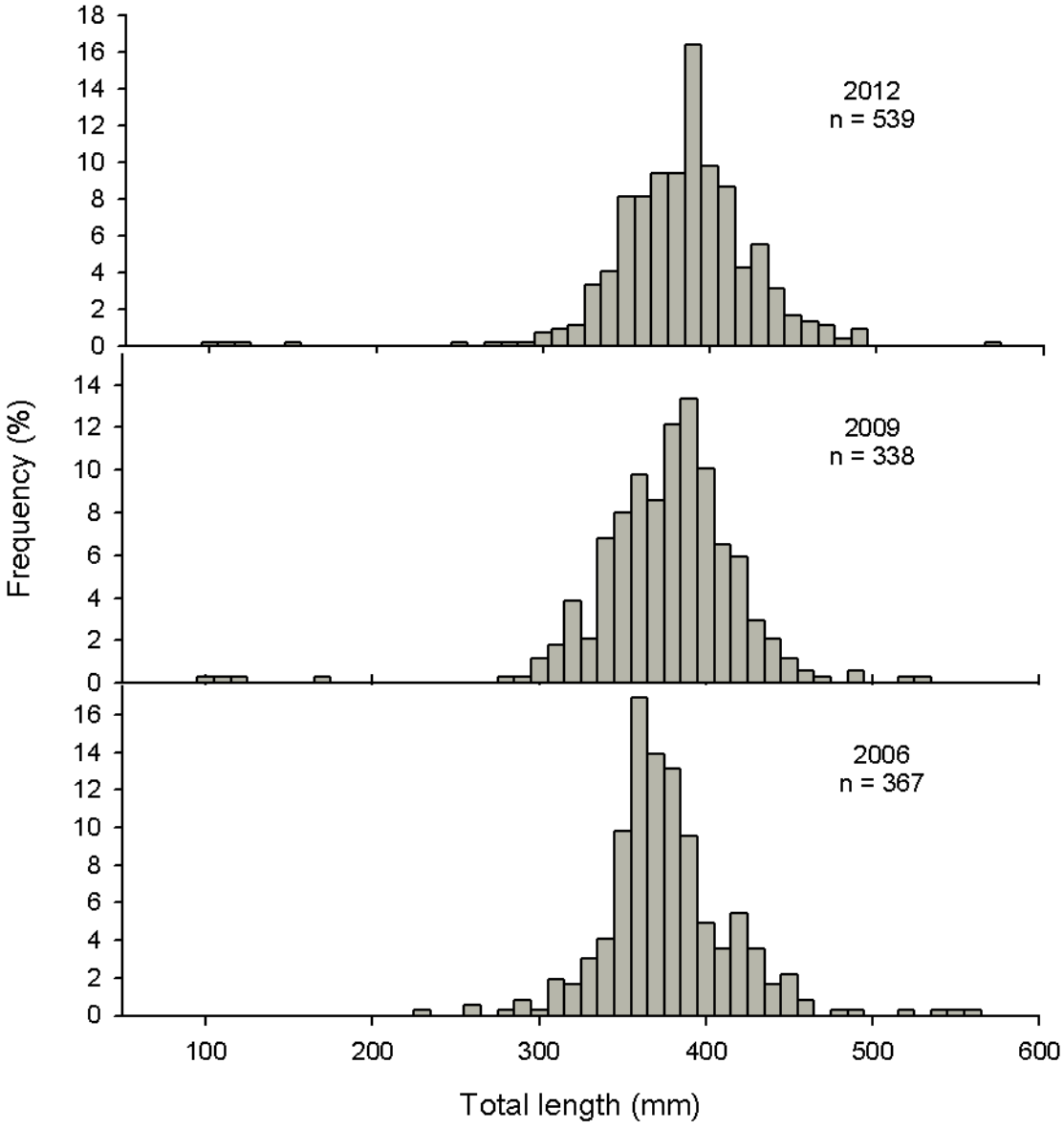

Figure 50. Length distributions of mountain whitefish, calculated as proportion of total catch, during population surveys at the South Fork Boise River below Anderson Ranch Dam in 2006-2012. Only whitefish larger than 100 mm are included.

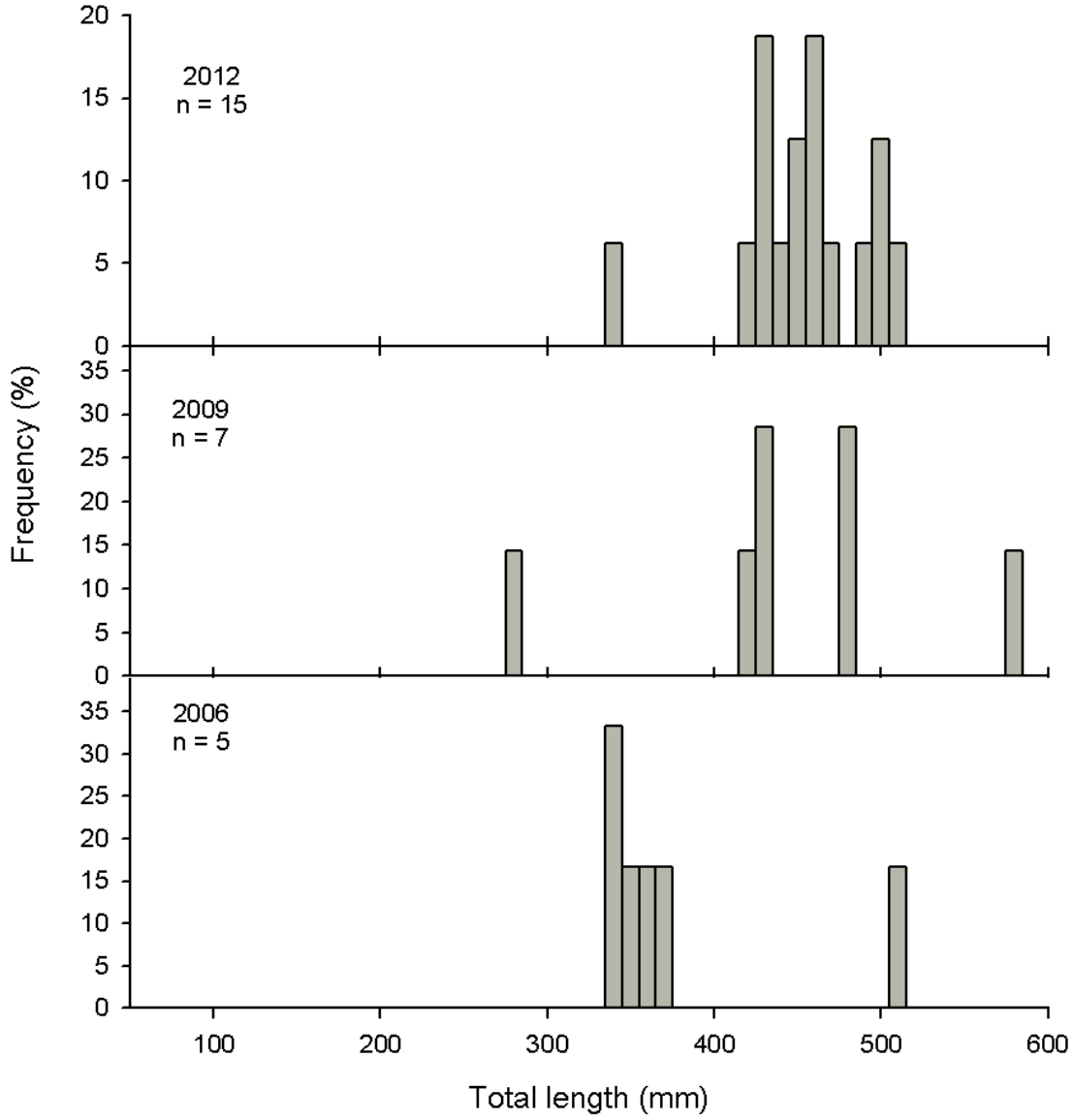

Figure 51. Length distributions of bull trout, calculated as proportion of total catch, during population surveys at the South Fork Boise River below Anderson Ranch Dam in 2006 and 2009.

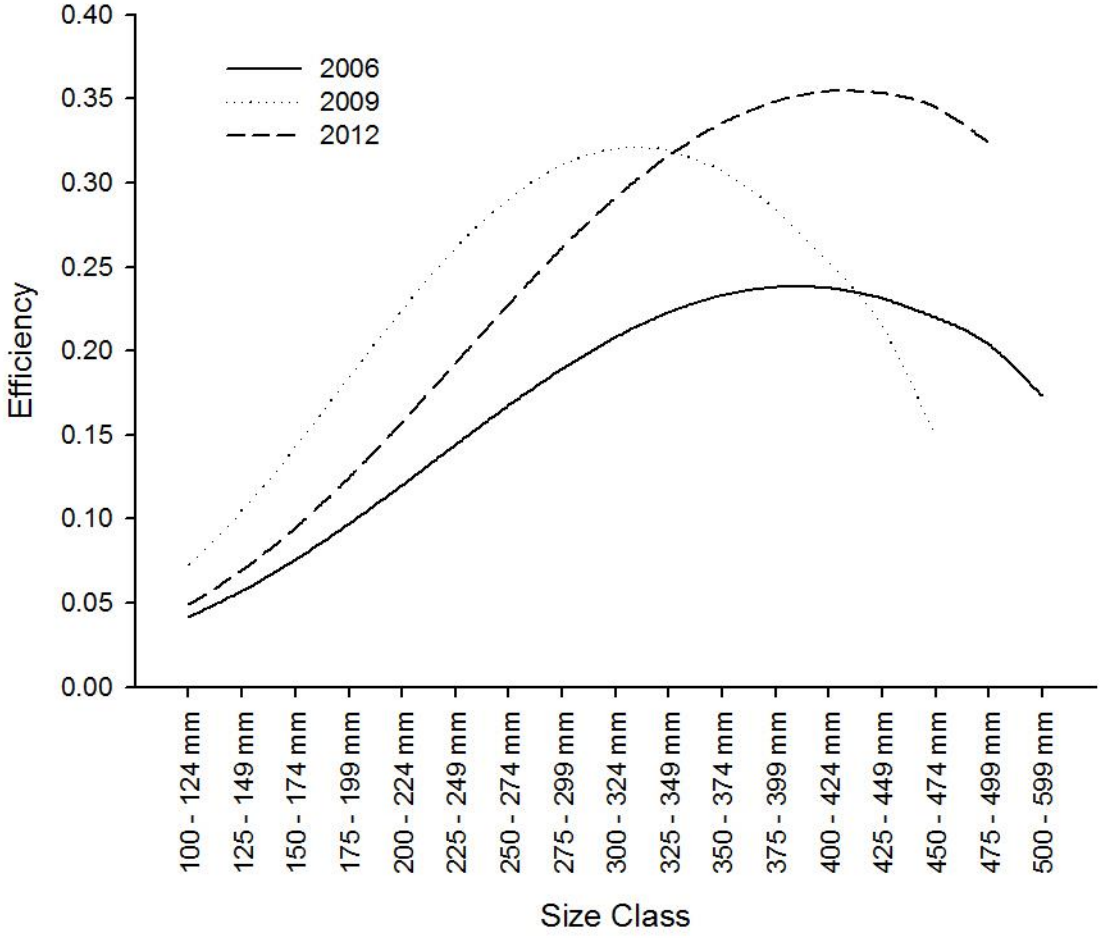

Figure 52. Capture efficiency curves for rainbow trout mark-recapture surveys on the South Fork Boise River downstream from Andersen Ranch Dam between 2006-2009 when two throw probes were used and 2012 when three throw probes were used.

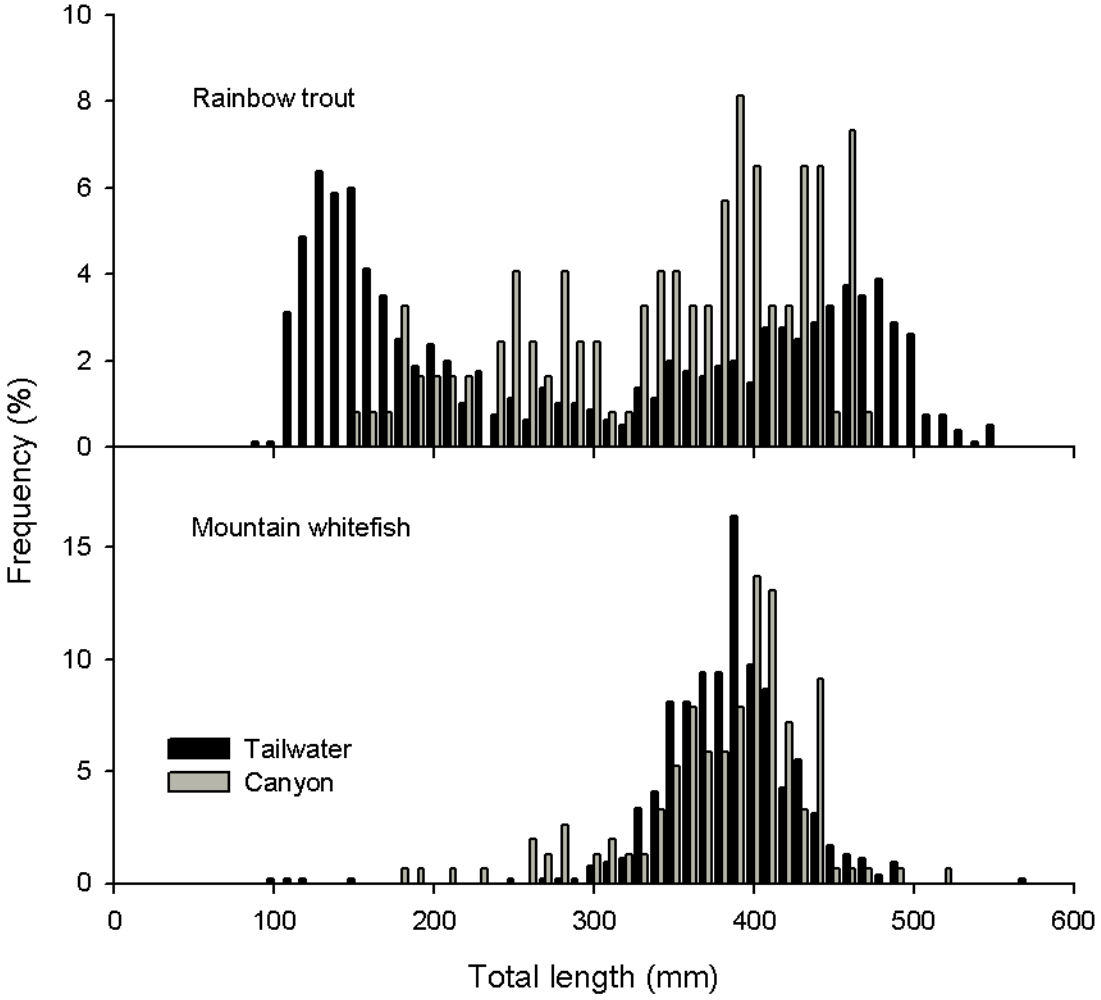

Figure 53. Length distributions of rainbow trout and mountain whitefish, calculated as proportion of total catch, during July 30, 2012 electrofishing survey in the canyon section of the South Fork Boise River between Danskin and Neal bridges and the tailwater section during October 13-20, 2012.

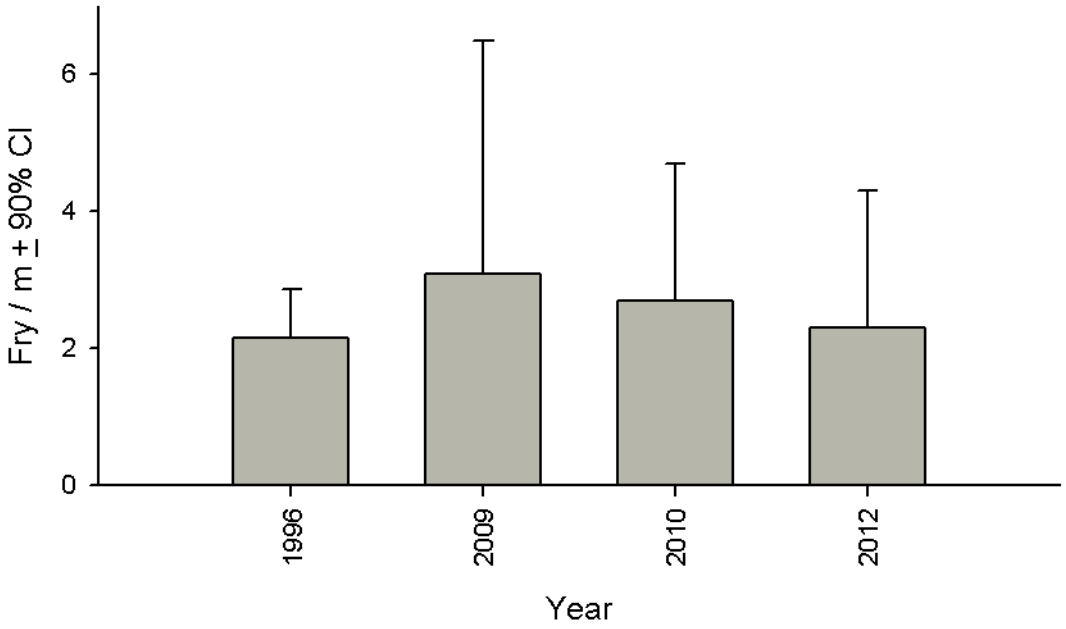

Figure 54. Comparison of mean rainbow trout fry linear density of fish collected at four 33-m long shoreline trend sections between 1996-2012 at the South Fork Boise River, Idaho.