FISHERY MANAGEMENT INVESTIGATIONS

IDAHO DEPARTMENT OF FISH AND GAME
FISHERIES MANAGEMENT ANNUAL REPORT

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SOUTHWEST REGION

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SOUTH FORK BOISE RIVER RAINBOW TROUT STATUS

ABSTRACT

The South Fork Boise River (SFBR) downstream of Anderson Ranch Dam is a nationally-renowned tailwater-trout fishery. The Idaho Department of Fish and Game staff has monitored Rainbow Trout *Oncorhynchus mykiss* populations in the SFBR every three years since 1994. In October of 2017, trout densities (≥ 100 mm) were assessed using mark-recapture electrofishing techniques. Mark-recapture estimates of Rainbow Trout density (fish/km; ± 90% CI) for all three sites combined was 1,402 ± 167 fish/km. With the exception of the year following large wildfires, overall SFBR trout density has steadily increased by about 25% for each triennial sampling since 2006. Changes in trout density at individual sampling sites are more difficult to interpret due to wide confidence intervals and varying recapture efficiencies. While overall mark recapture density estimates have showed a steady increase, marking run catch rate comparisons across years are more variable. Further investigation into the best method for long term trend monitoring is needed. Although the overall population appears to be increasing, size structure of wild Rainbow Trout appears to be shifting towards smaller fish, with fewer fish in excess of 400 mm sampled in 2017. The reduction of these larger size classes in the 2014 and 2017 surveys might be an effect of the large 2013 wildfires that burned much of the basin. Future surveys will provide valuable insight into whether the recent shift to a larger number of smaller-sized wild trout in the SFBR is a long-term trend or an artifact of post-wildfire effects.

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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 Idaho Department Fish and Game's (IDFG) 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 also present.

Between Anderson Ranch Dam and its terminus into Arrowrock Reservoir, the SFBR is approximately 43km long and consists of two recreationally distinct sections. The roaded section is approximately 16km long and runs from Anderson Ranch Dam downstream to Danskin Bridge. The canyon section is approximately 27km long and runs from Danskin Bridge downstream to Neal Bridge. The roaded section has a public road and access along the entire reach, resulting in the most angling effort. It is popular for both drift-boat and wade fishing. The canyon section has extremely limited access by foot or road because of high canyon walls and is accessible mostly by raft due to varying levels of whitewater in the section.

The Rainbow Trout population in the SFBR roaded section has been monitored by IDFG staff every three years since 1994. 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. 2015).

The SFBR drainage has undergone some dramatic changes over the past several years. In August of 2013, the Elk-Pony fire complex burned roughly 280,000 acres in the basin. These fires resulted in two separate large debris and sediment flow events that occurred on several tributaries. Notably, sediment flows at Pierce, Granite, Buffalo, and Little Fiddler Creeks created large slack-water runs followed by new and more technical rapids, impacting both fish habitat and floating conditions for anglers. In 2014, the primary objective for IDFG regarding SFBR was 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. In 2017, record snowpack and subsequent runoff further changed the SFBR. Runoff in mid-May exceeded 9,000 cfs at the Anderson Ranch Dam USGS gauge, the highest flows on record for this gauge. These high flows further scoured the sediment inputs from the 2013 slides, further decreasing the depth and length of the slack-water areas and decreasing the difficulty of the resulting rapids.

METHODS

Rainbow Trout abundance was estimated at three sites (Figure 48) within the roaded section of the SFBR a using mark-recapture techniques. In 2017, Mountain Whitefish abundance was not estimated at the upper sight as it had been in previous surveys. Due to the large number of Mountain Whitefish in the river, there was concern that efforts to net all whitefish during shocking runs was resulting in lower efficiency in capturing Rainbow Trout. Therefore, only trout were targeted during the survey. 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). Setting were 25% duty cycle, 60 pulses per second, 300-400 volts, producing 1,000-2,000 watts.

Rainbow Trout and Bull Trout were sampled at the three sites during October of 2017 (Figure 48). Marking runs were conducted at the upper and middle sites on October 11th and the lower site on October 12th. Recapture runs at the upper and middle sites occurred on October 17th and at the lower site on October 18th. Riffles formed the upper and lower reach boundaries. Flow was approximately 8.4 m^3/s. Crews consisted of twelve or thirteen people. Three people operated the mobile anodes, one person guided the canoe and operated the safety switch and controlled the output, the remaining eight or nine people were equipped with dip nets and captured stunned fish. Only trout 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 an 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 (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 or into areas still to be electrofished. During the recapture effort, all 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 total length (mm).

Site length was determined from 1:24,000 topographic maps. Ten Wetted widths from each site 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 2017 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 300 mm, 350 mm, and 400 mm as quality size.

RESULTS

A total of 730 Rainbow Trout (≥ 100 mm) were sampled during marking and recapture runs at the three sites combined (Table 28). A total of 439 Rainbow Trout were marked during the marking runs and an additional 291 (38 of which were recaptures) were collected during the recapture runs. Mean recapture efficiency, the ratio of recaptured fish to captured fish during the recapture runs among sites, was 13% (Table 28). This was an increase from 2014, which had the lowest mean recapture efficiency (7%) calculated for any survey since collection methods were changed from raft to canoe shocking in 2006. From 2006 to 2012, recapture efficiency estimates ranged from 15% to 30%. Site-specific recapture efficiencies for 2017 were variable (Table 28). Recapture efficiency for the upper site was 11% while efficiency at the middle site was 4% and the lower site was 27%.

Rainbow Trout density (± 90% CI) among trend sites ranged from 1,254 ± 702 fish/km in the upper site to 4,495 ± 3,242 fish/km in the middle site (Figure 49). Density at all three sites combined was 1,402 ± 167 fish/km. After a leveling off from 2012 to 2014 following the large fires, overall trout density once again steadily increased from previous surveys based on mark-recapture point estimates (Figure 49). As in previous years, site-specific changes in trout density remain difficult to interpret due to wide confidence intervals surrounding those estimates. Rainbow Trout density in the upper site remained nearly identical to the 2014 estimate, increasing by 3%, while the lower site showed a 39% decrease from 2014. The middle site estimate showed a greater than five-fold increase from 2014 to 2017. This site has historically shown the greatest fluctuations in density estimates and also typically has the largest confidence bounds (Figure 49). Combined density estimates were expanded into an overall abundance estimate of 4,501 Rainbow Trout in 2017 in the 3.1 km that were sampled.

The length distribution of sampled fish has shifted towards smaller fish since the previous survey. Length distribution of Rainbow Trout ranged from 120 to 560 mm (Figure 50).

Similar to 2014, approximately 50% of all fish captured were between 120 and 240 mm (Figure 51). Rainbow Trout between 410 and 490 mm comprised 16% of the catch while 4% exceeded 500 mm. In 2017, the PSD-300 and PSD-350 were the lowest values since these surveys began, while the PSD-400 was the lowest since 1997 (Figure 52).

A total of four Bull Trout were collected, with two fish marked and none recaptured. Bull Trout ranged from 358 to 576 mm. No population estimate was generated for Bull Trout.

DISCUSSION

The mark-recapture point estimates suggest that the overall Redband Trout population in the SFBR has been steadily increasing. Since 2006, the overall population density estimate has doubled from 705 to 1,402 fish/km. With the exception of the 2014 post-fire sampling where the density estimate was 2% lower than the previous estimate (2012), fish/km estimates have increased roughly 25% every three years since 2006.

While the overall mark-recapture estimates have steadily increased, the catch-per-unit-effort (CPUE) of the initial marking run has been variable. In fact, the lowest single pass catch occurred in 2014, yet the mark-recapture estimate for that year was the third highest across all sample periods (Figure 53). Variations in recapture run catch and recapture efficiencies of marked fish are the largest concerns when comparing temporal mark-recapture estimates, as both fluctuate across sample years and sites. The highest recapture efficiencies have historically occurred within the lower site, and have ranged from 7 to 18%. In 2017, the recapture efficiency in this site was 11% (Table 28). Overall average recapture efficiency since 2006 (all three sites combined) has been 9.1% and ranged from 7 to 12%. In 2017 our overall recapture efficiency was 7%. Additionally, the overall number of fish captured in the recapture run has been even more variable ranging from 42 to 71% (average 59%) of the total caught in the marking run. Factors such as variation in sampling crew (especially netters) and changes to trend sight habitat between sampling years can impact recapture efficiencies. In an effort to limit variation in sampling efficiency due to netter bias, we've begun to be more selective in personnel conducting the surveys as well as utilizing more netters with the hope of missing fewer fish. Additionally, Mountain Whitefish are no longer sampled at the same time as trout, in an effort to minimize the number of trout that are missed due to efforts to capture whitefish. A realistic description of change in the SFBR Rainbow Trout population is likely best provided by a combination of mark-recapture and catch per unit effort (CPUE) comparisons with previous surveys.

The lower raw catch observed in 2014 followed the large wildfires that occurred in the SFBR basin in 2013. Catch in 2014 was 49% of the pre-fire 2012 catch. These results were outlined in Butts et al. (2014) and concluded the SFBR Rainbow Trout population experienced a post-fire decline. However, despite the concern that there could be continued and prolonged post-fire effects on the fish population as previously observed in other systems (Meyer and Pierce 2003; Rieman et al. 2012), 2017 catch was 85% of the pre-fire 2012 catch, and it appears that the wild Rainbow Trout population is rebounding relatively quickly following the fires and subsequent landslides.

While the overall fish population has increased since 2014, one area of concern is the change is size structure of the wild Rainbow Trout population through time. The average size of captured wild Rainbow Trout has steadily decreased over time (Figure 50). Catch was likely biased towards larger fish in surveys conducted from 1997-2003 as those surveys were conducted using raft electrofishing. However, since sampling locations and methodologies were standardized in 2006, size structure has continued to shift towards smaller fish. This shift is primarily driven by a decrease in fish greater than 400 mm since 2012. The reduction of those larger fish in 2014 immediately following the wildfires was likely a direct result of the fire activity and subsequent sediment loads (Rieman et al. 2012). Additionally, July-September water temperatures recorded at the Neal Bridge USGS gauge in 2013, were the highest on record since the gauge began recording river temperature in 2011 (Figure 54). This gauge is at the lower end of the drainage and increased water temperatures this low in the system were likely most influenced by warmer tributary inputs post-fire. Since the SFBR is a tailwater river, temperatures were likely less variable closer to the Anderson Ranch Dam outlet. While mainstem temperatures were nowhere near lethal, these documented increases (12% warmer in 2013 than any other year since 2011) further emphasize the impacts large-scale wildfires can have on a river system (Dunham et al. 2007). All size classes of trout were captured in reduced numbers during 2014 sampling. The continued decrease of larger fish in the 2017 surveys is likely an artifact of the direct losses immediately following the fire events. Additionally, the overall shift in size structure is likely further exacerbated by what appears to be an increase in those fish ranging from 250 to 350 mm. This size class of fish have been noticeably underrepresented in past sampling years, but were more numerous in the 2017 sampling. Finally, similar to past sampling years there appears to be a large population of fish less than 200 mm.

The SFBR basin has experienced some unprecedented conditions over the last five years including basin-wide wildfires that resulted in significant landslides and debris flows as well as historically (post dam construction) high spring flows. These events have reshaped significant portions of the river, changing fish habitat in many areas. While the overall wild Rainbow Trout population appears healthy, there does appear to be some changes in size structure when compared to past years. The 2020 triennial sampling will provide further insight into trends in the size structure of the wild Rainbow Trout population in the SFBR.

RECOMMENDATIONS

1. Conduct mark-recapture estimate in one adult trend site during fall 2018 to assess abundance and length distributions of Mountain Whitefish.

2. Conduct mark-recapture estimates in the three adult trend sites during fall 2020 to assess abundance and length distributions of trout.

Table 28. Number of fish by species collected during marking and recapture runs at each site in the South Fork Boise River, Idaho during October 2017 population assessments. Recapture efficiencies for Rainbow Trout were assessed in all three sites. Bull Trout population estimates were not calculated because of low sample size.

Site		Marking run October 10-11, 2017		Recapture run October 17-18, 2017		
Transect Length	Species	No. Captured	No. Marked	No. Captured	No. Marked	R/C
Upper	Rainbow Trout	131	106	39	4	0.04
1.03 km	Bull Trout	1	1	1	0	
Middle	Rainbow Trout	148	148	108	4	0.03
1.09 km	Bull Trout	1	1	0	0	
Lower	Rainbow Trout	210	185	153	20	0.11
0.99 km	Bull Trout	1	1	0	0	
Total	Rainbow Trout	489	439	300	28	0.06
3.11 km	Bull Trout	3	3	1	0	

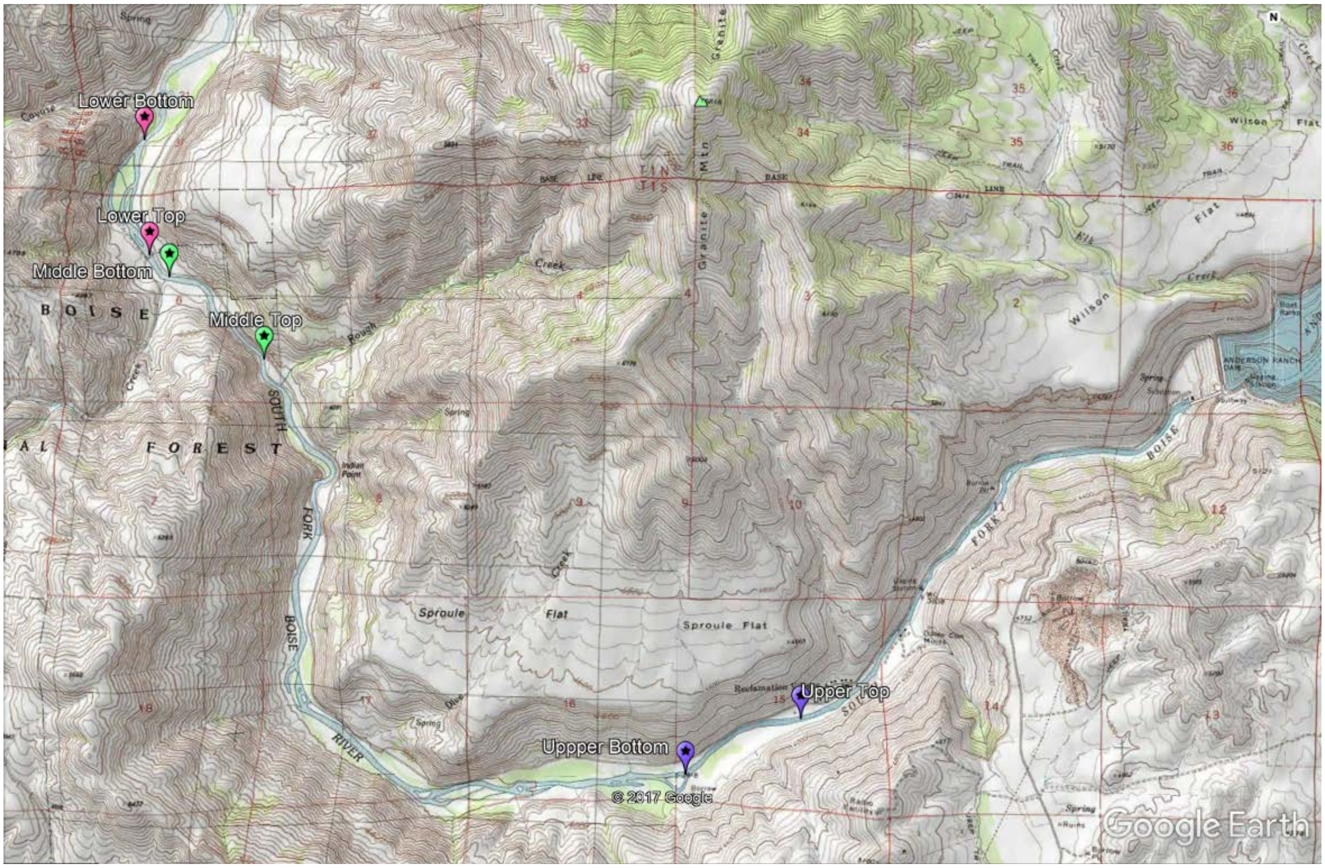

Figure 48. Upper and lower boundaries of three trend mark/recapture sampling sites on the South Fork Boise River, Idaho below Anderson Ranch Dam.

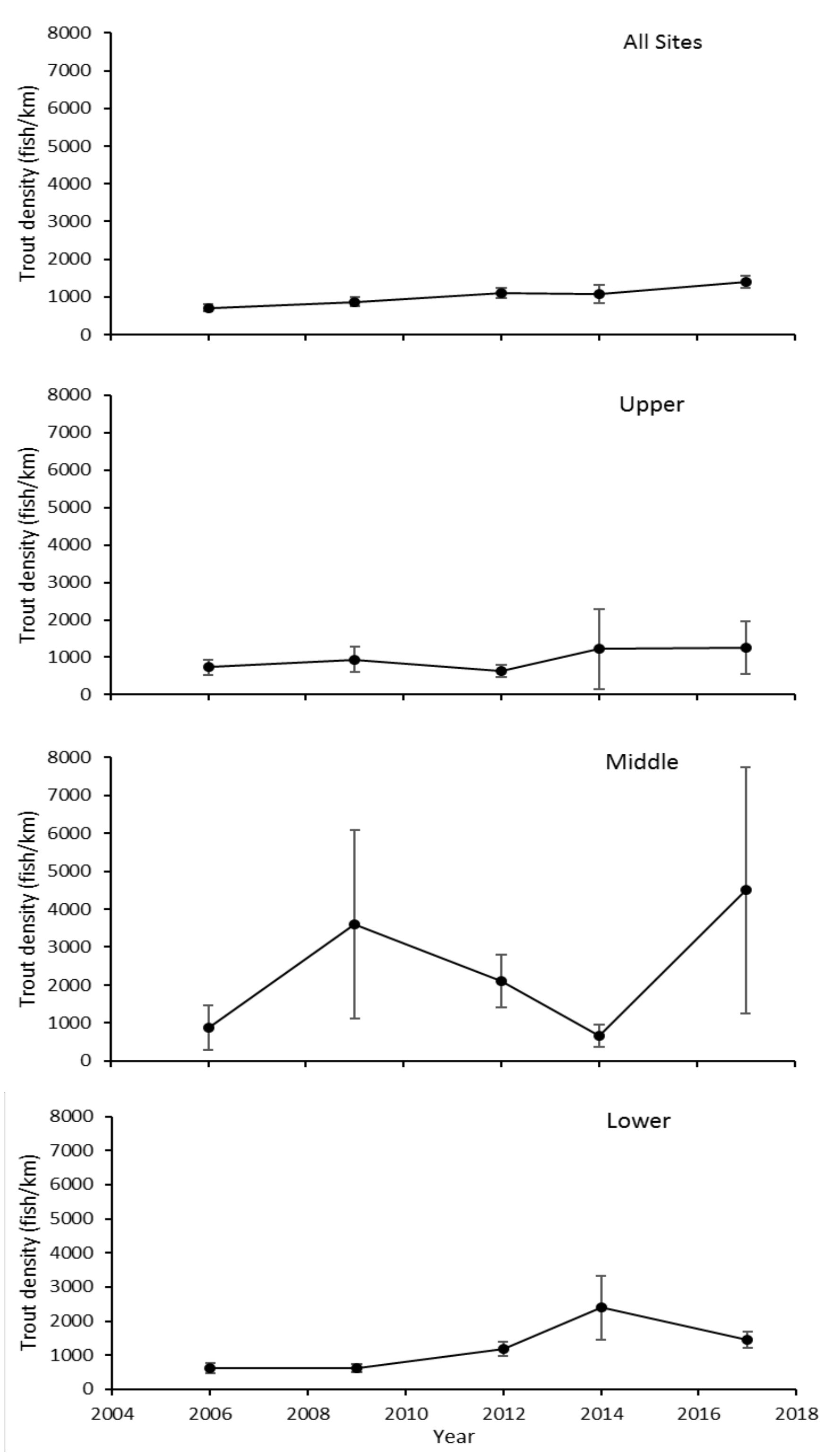

Figure 49. Linear density estimate trends for Rainbow Trout (≥ 100 mm) by reach for the South Fork Boise River from 2006 through 2017 from maximum likelihood estimation. All sites (top figure) refer to the combined estimate from pooling the data from all three sites.

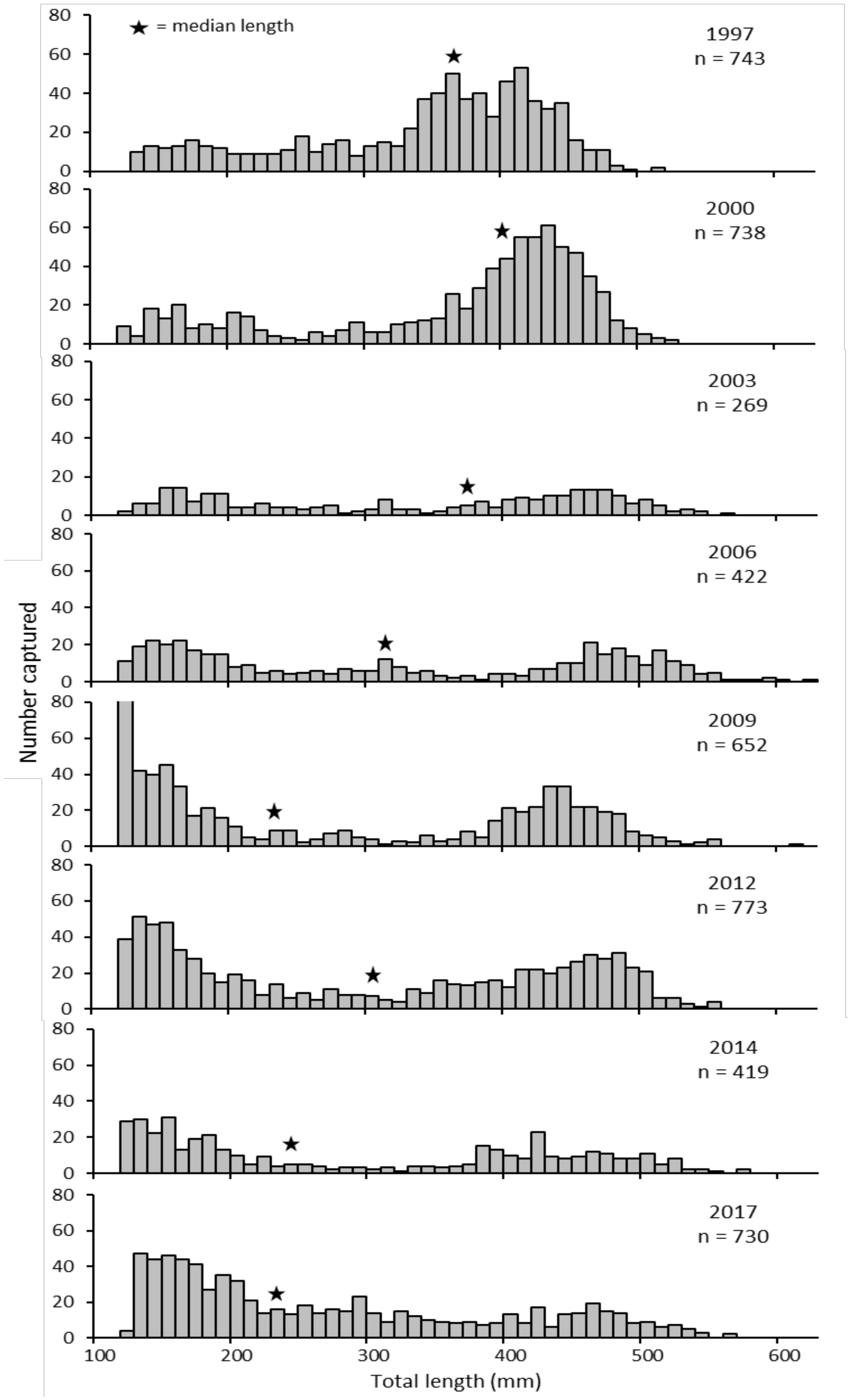
★ = median length
1997
n = 743
2000
n = 738
2003
n = 269
2006
n = 422
2009
n = 652
2012
n = 773
2014
n = 419
2017
n = 730
Number captured
Total length (mm)
0
20
40
60
80
100
200
300
400
500
600

Figure 50. Length frequency distributions of Rainbow Trout (≥ 100 mm), during population surveys at the South Fork Boise River below Anderson Ranch Dam in 1997-2014.

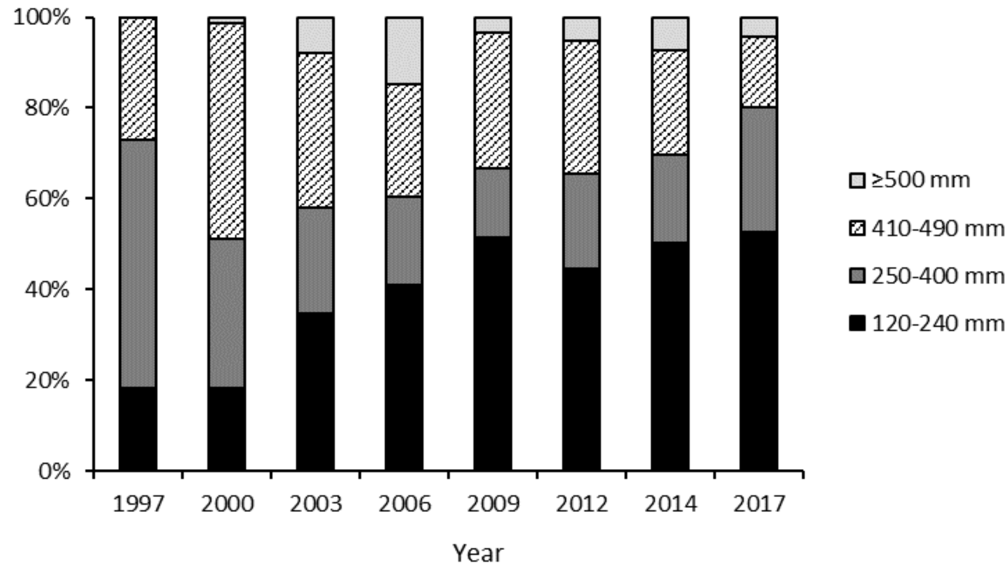

Figure 51. Length composition trends of Rainbow Trout, calculated as proportion of total catch, during population surveys at the South Fork Boise River below Anderson Ranch Dam from 1997 to 2017.

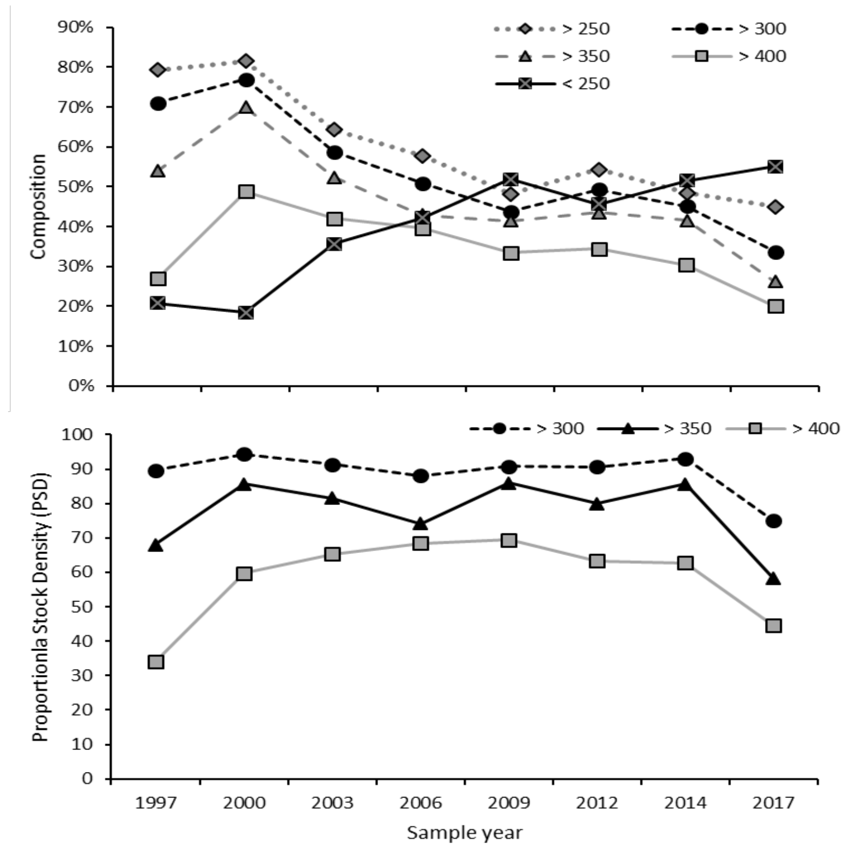

Figure 52. Percent composition and Proportional stock density (PSD) for Rainbow Trout of various size classes, collected during approximately triennial mark-recapture surveys on the South Fork Boise River downstream from Andersen Ranch Dam from 1997 through 2017. For PSD calculations, 250 mm was used as stock size.

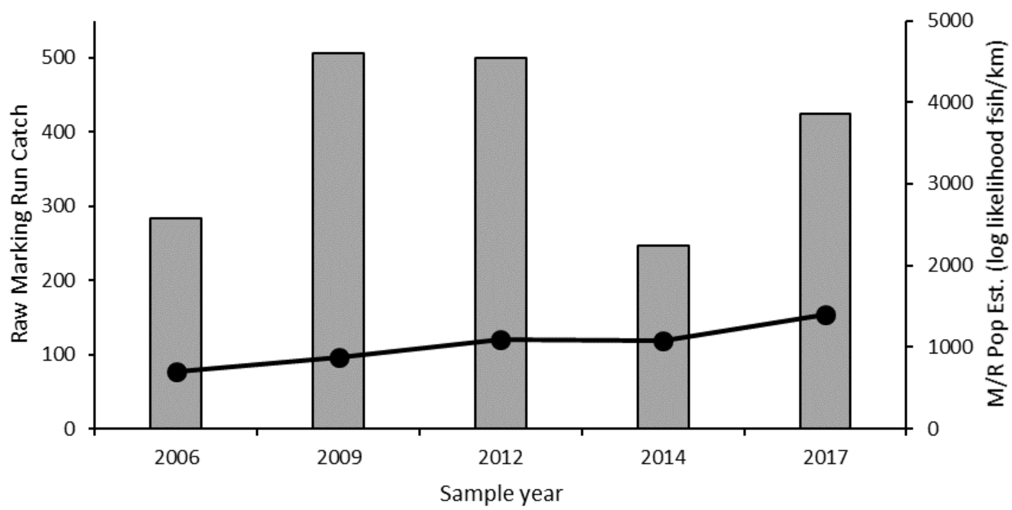

Figure 53. Single pass raw catch of wild Rainbow Trout (gray bars) in the South Fork Boise River vs. mark-recapture density estimates (fish/km; black dots) for all sampling since 2006.

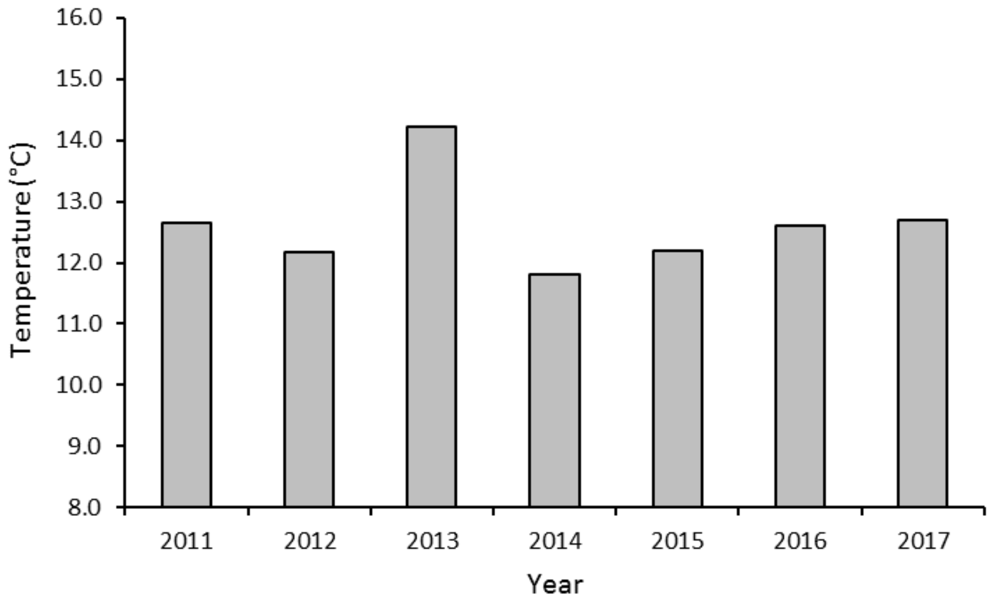

Figure 54. Average July-September South Fork Boise River water temperatures (°C), by year, recorded at the Neal Bridge United States Geological Survey Station.