FISHERY MANAGEMENT INVESTIGATIONS

IDAHO DEPARTMENT OF FISH AND GAME

FISHERIES MANAGEMENT ANNUAL REPORT

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SOUTHWEST REGION

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KOKANEE AND RAINBOW TROUT EVALUATIONS AT ARROWROCK AND LUCKY PEAK RESERVOIRS, IDAHO

ABSTRACT

The kokanee *Oncorhynchus nerka* fisheries at Arrowrock and Lucky Peak reservoirs are two of the most popular in the state and have experienced a sizeable increase in angler interest during the last decade. The Idaho Department of Fish and Game is currently evaluating these fisheries using a combination of angler creel, hydroacoustics, and trawling. A total of 487 anglers were interviewed for catch information. Of the anglers interviewed, 225 (46%) anglers had fished at Arrowrock Reservoir and the remaining 262 (54%) anglers had fished at Lucky Peak Reservoir. Catch rates, day type (weekend/weekday), time period (morning/evening), and overall fishing success were similar for both reservoirs in 2014. On average, kokanee anglers harvested 2.8 kokanee at Arrowrock Reservoir and 2.7 kokanee at Lucky Peak Reservoir. At both reservoirs, 66% of kokanee anglers were unable to harvest a kokanee during their trips. Mean catch rates for kokanee declined by 32% at Arrowrock Reservoir and 51% at Lucky Peak Reservoir from 2013 and declines are likely a result of reservoir management during the previous summer. Stocking density appears to be strongly associated with mean fish length of kokanee in the May creel, though only three years of data are included. However, the relationship between the two variables differs considerably between reservoirs. Stocking density (kg/ha) was positively correlated with mean fish length (r = 0.84) at Arrowrock Reservoir, but variables were inversely related at Lucky Peak Reservoir (r = -0.63). There did not appear to be a strong link between daily fishing success and weather variables such as air temperature, wind speed, and barometric pressure.

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INTRODUCTION

Kokanee *Oncorhynchus nerka* are the landlocked form of Sockeye Salmon *O. nerka* and provide recreational fisheries in many waters of the western United States (Foerster 1968; Paragamian 1995; Rieman and Maolie 1995). Kokanee life history differs considerably from other inland salmonids. Kokanee feed and grow in lakes or reservoirs for 2.5 to 3.5 years, then spawn in tributaries or shorelines during fall, then die. Eggs incubate over winter in the streambed or shoreline gravels until hatching in late winter. Alevins remain in the gravel for several more weeks before emerging at night and migrating to the lake or reservoir. Fry commonly migrate directly to pelagic areas (Foerster 1968), but can spend time feeding in the littoral habitats, particularly in lakes or reservoirs with pronounced littoral regions (Burgner 1991; Gemperle 1998). Juvenile and adult kokanee primarily inhabitat pelagic zones in lakes and reservoirs.

Management of kokanee populations is often elusive and complex because of the wide variation of population responses to system productivity, habitat, predation, and angling effort (Paragamian 1995). These responses lead to changes in growth, fecundity, recruitment, age-at-maturity, and survival, which can also vary between year classes and years. A central characteristic of kokanee biology important to fisheries managers is that they exhibit density-dependent growth (Rieman and Myers 1992; Rieman and Maolie 1995; Grover 2006). A strong negative relationship between population density and mean body size has been observed in many kokanee populations in the western United States. Kokanee size and growth influence the number of fish available to anglers and also angler perception of the quality of the fishery (Martinez and Wiltzius 1995; Rieman and Maolie 1995). The tradeoff between density and growth is the key component to kokanee management in most waters and examples of efforts to influence density, growth, and survival are well documented.

During the last decade, kokanee have become increasingly popular with anglers in many areas of the western United States. States including Idaho, Oregon, Washington, and California have experienced increased enthusiasm for kokanee from anglers. This is reflected in fishing magazine articles, social media, kokanee tournaments, and online forums dedicated to kokanee fishing. Information including stocking histories and regional management reports have become more accessible and easier to distribute to anglers through the World Wide Web (WWW). Idaho Department of Fish and Game (IDFG) has observed a notable increase in angler interest in the management of kokanee fisheries across the state, particularly inquiries into stocking rates.

Kokanee fisheries at Arrowrock and Lucky Peak reservoirs are two of the most popular in the state and have experienced a sizeable increase in angler interest. Arrowrock and Lucky Peak reservoirs are two impoundments on the Boise River approximately 10 km east of Boise (Figure 1). Prior to the initiation of annual kokanee stocking in Arrowrock Reservoir, only a marginal fishery existed. This fishery was thought to be supported by kokanee entrained from Anderson Ranch Reservoir. These kokanee may also have spawned in the MF and SF Boise rivers. Since 2009, IDFG has stocked fingerling kokanee on an annual basis. In 2014, the default stocking request for Arrowrock Reservoir was 50,000 fish or 40 fish/ha in May. In addition, the Arrowrock fishery is supported by wild production and entrainment from the Middle Fork Boise River (MFBR) and South Fork Boise River (SFBR), and Anderson Ranch Reservoir. The magnitude and variability of these sources of recruitment are not well understood and are likely influenced by inflows and reservoir levels.

The kokanee population in Lucky Peak Reservoir appears to rely primarily on annual stocking with an unknown amount of entrainment from upstream reservoirs. Although mature kokanee migrate into Mores and Grimes creek in August, spawning is likely unsuccessful because stream temperatures are likely lethal to eggs. The default Lucky Peak Reservoir kokanee fingerling request is 250,000 fish, or 217 fish/ha in May (Table 1). Annual variations in reported catch rates at these reservoirs have led IDFG to examine if the cause of this variability may be attributed to size at stocking, timing of stocking, stocking density, or reservoir conditions. Prior to 2012, IDFG has a sense of which years have produced good fishing from angler reports, but no actual catch or catch rate data. It is difficult to recommend or implement management changes without data on annual kokanee size or angler catch rates for each year class. Due to the growing popularity of kokanee fishing with anglers, IDFG recognizes the need to monitor these fisheries more quantitatively. Specifically, IDFG should more clearly define kokanee management goals for catch rates and size-at-maturity. Additionally, obtaining a better understanding of how reservoir management, spawning conditions, and stocking affect survival and growth of individual year classes should improve IDFG's ability to effectively manage these fisheries. Annual catch rate and fish size, primarily length-at-age and length in the creel, will also be used as indices to help describe the effect of stocking practices or reservoir conditions, and will thus help to better understand the potential of the fisheries and angler preferences.

METHODS

Study Areas

Arrockrock Reservoir is a 3,150-ha dendritic impoundment located approximately 32 km northeast of Boise, Idaho in the upper Boise River drainage (Figure 1). It is a 29 km-long, narrow canyon reservoir that impounds two major tributaries; the MFBR and SFBR. Arrowrock Dam is located directly upstream of Lucky Peak Reservoir and is operated by the U.S. Bureau of Reclamation (BOR). Arrowrock Reservoir is managed primarily for flood control and irrigation. In a typical year, the reservoir is maintained at approximately 60-80% storage capacity during winter months and generally reaches 100% capacity by May. Beginning in June, the reservoir is drafted and approaches 10-20% capacity in September and October, and remains at a low pool elevation through the winter in most years.

Lucky Peak Reservoir is a large mesotrophic impoundment in the Boise River drainage, immediately downstream from Arrowrock Reservoir (Figure 1). It has a mean depth of 32.8 m, a total capacity of 3,615 x 10^5 m^3, and is managed by the U.S. Army Corps of Engineers to provide flood control, irrigation, power generation, recreation, and winter flows in the Boise River. In a typical water year, the reservoir is kept at 20-40% of storage capacity during winter and reaches 100% capacity by early summer; subsequently, Arrowrock Reservoir releases are utilized to keep Lucky Peak Reservoir near full pool for recreation during the summer months. After Labor Day, Arrowrock begins refilling while Lucky Peak is then drafted to lower pool elevations.

Angler catch rate and fish size

We use check stations to collect creel data and index fisheries metrics. Kokanee creel information has been collected at both Arrowrock and Lucky Peak reservoirs during the month of May since 2012. Data was collected by surveying anglers at a check station, similar to a portion of the access-access survey design described by Pollock et al. (1994). Angler counts to estimate total effort were not conducted because of personnel limitations. May was determined as an appropriate month because anecdotal observations and angler reports suggest that May is one of the peak months for angling effort directed at kokanee. May also provides the opportunity to directly target and interact with anglers as recreational boaters do not become a significant portion of reservoir users until after Memorial Day. The focus of creel surveys was on kokanee and Rainbow Trout *Oncorhynchus mykiss,* but we collected data on all fish species reported.

Creel clerks were stationed at a single site to intercept anglers as they left the fisheries. The creel station was just east of state Highway 21 at Spring Shores Road turnoff (Figure 1). This creel station intercepted anglers from Spring Shores Marina, and Mack's Creek ramp, and Arrowrock Reservoir. In 2012, a creel station was also set up near the dam to intercept anglers at Turner Gulch for Lucky Peak Reservoir. Use of this station was discontinued after 2012 because less than 5% of interviews for Lucky Peak were collected at that station. During May 2013, six dates, with three days of both weekday and weekend/holiday sampling units were randomly selected. Two time periods were used: (1) An early time period (0900 - 1500 hours) and (2) a late time period (1500 - 2100 hours).

Data collection focused on completed fishing trips. Each interview or contact was assigned a unique interview number for that day, based on the numerical order by which anglers were contacted. We also recorded fishing license numbers, number of anglers in party, time fishing, target species, and species/number of fish that were harvested or released. Creel clerks were directed to obtain a catch rate per individual angler, although it may be difficult in trolling situations with multiple anglers. Fishing method, gear type, and total length (mm) and weight (g) of harvested fish were also recorded. Mean catch rate ($\widehat{R_2}$) was estimated using the ratio of means (ROM), where trip interviews were considered complete:

$$\widehat{R_2} = \frac{\frac{\sum_{i=1}^{n} c_i}{n}}{\frac{\sum_{i=1}^{n} e_i}{n}}$$

where $\hat{R}$ is the mean catch rate in fish/angler-hour, c_i is the number of fish caught during the trip, and e_i is the length of the trip in hours (equation $\widehat{R_2}$ from Pollock et al 1994). However, this rate will be abbreviated as CPUE hereafter.

When possible, all fish observed in the creel were measured and weighed. Sagittal otoliths were collected from kokanee in order to verify age. Clerks tried to collect at least five fish for every 1-cm length group. During high traffic periods, clerks collected all angler trip time and catch/harvest information, but may have foregone fish measurements to avoid traffic congestion or major inconveniences for anglers.

Relationships between stocking density, catch rates, and fish length were compared by calculating the correlation coefficient (*r*) which measures the linear relationship between two variables. Daily catch rates were examined for correlation between weather variables such as air temperature, wind speed, and barometric pressure. Water temperature was not analyzed for relationships because data was only collected once or twice monthly at both reservoirs. The Pearson correlation coefficient(*r)* was calculated as

$$r = \frac{1}{n-1} \sum_{i=1}^{n} \left(\frac{X_i - \bar{X}}{s_X} \right) \left(\frac{Y_i - \bar{Y}}{s_Y} \right)$$

where X_i *and* Y_i are paired data variables (Zar 1999).

Hydroacoustics

Hydroacoustic surveys were conducted to estimate kokanee abundance and density. Estimating density over multiple years will allow managers to determine adult kokanee size and density relationships for each reservoir. Six transects were sampled with hydroacoustics gear at Arrowrock Reservoir on July 24, 2014, and Lucky Peak Reservoir on July 23, 2014 (Figure 1). Hydroacoustic estimates of fish densities, lengths, and vertical depth distributions were obtained with a Hydroacoustic Technology, Inc. (HTI) Model 241-2 split-beam digital echosounder. The 200 kHz sounder was equipped with a 15° vertically aimed transducer (downlooking) which was suspended at a 1m depth using a retractable pole mounted on the port side of the boat. Boat speed during data collection ranged from 1 to 1.5 m/s. Sampling transects were determined prior to surveys and were followed using Global Positioning System (GPS) coordinates. Data were collected at a sampling rate of 10 pings/s and a transmit pulse width of 0.2 m/s was used. A full description of target tracking and acoustic data analysis can be found in Koenig et al. (2015).

Only pelagic targets located within depths that kokanee inhabit (kokanee layer) were included in density and abundance analysis. All fish in the kokanee layer were assumed to be kokanee. Abundance and density estimates were partitioned by size information collected from converted target strengths and the May creel survey. On May 15, 2014, approximately 49,995 kokanee fry were stocked in Arrowrock Reservoir and 237,120 were stocked into Lucky Peak Reservoir. The mean length of stocked fish was 76 mm (Table 1). Kokanee are known to spawn in the SFBR and MFBR, but the extent to which natural production contributes to the Arrowrock Reservoir kokanee population is unknown. At the time of the survey and during analysis of hydroacoustics data, we assumed that wild age-0 kokanee ranged from 30 to 80 mm and hatchery age-0 kokanee were assumed to range from 81 to 130 mm. Age 1 kokanee were assumed to range from 201 to 320 mm, whereas age-2 kokanee were assumed to range from 321 to 430 mm.

Mid-Water Trawling

Mid-water trawling was conducted to sample age-0 and age-1 kokanee in Arrowrock Reservoir for growth, survival, and size verification on June 27, 2014. Trawling was not conducted at Lucky Peak Reservoir because it proved to be ineffective the previous year (Koenig et. al 2015). Mid-water trawling was conducted at night during the dark (new) moon. Trawling was performed in a stepped-oblique fashion as described by Rieman (1992) and Kline and Younk (1995) with the exception that the otter-boards were replaced by a fixed frame at the net mouth with a 4.5-m^2 opening. Four transects, ranging from 0.9 to 3.1 km in length, were sampled. Starting points for transects were randomly selected but direction of transects were limited to areas where adequate depth was available. The net was towed at 1.5 m/s with a 7.3-m boat.

RESULTS

Angler catch rate and fish size

In 2014, angler use was nearly evenly distributed between the two reservoirs. A total of 487 anglers were interviewed for catch information. Of the 487 anglers interviewed, 225 (46%) anglers had fished at Arrowrock Reservoir and the remaining 262 (54%) anglers had fished at Lucky Peak Reservoir (Table 2). Average trip duration of anglers fishing at Arrowrock and Lucky Peak reservoirs were 4.5 and 4.1 h, respectively. Primary target species for anglers was nearly identical at both reservoirs, with approximately 60% of anglers targeting kokanee and 22% targeting Rainbow Trout (Figure 2). Anglers indicating they had no preference on fish species represented 15% of anglers at both reservoirs. Finally, 6% and 2% of all anglers at Arrowrock and Lucky Peak reservoirs, targeted Smallmouth Bass. A total of 154 (32%) anglers were interviewed during a weekday, while 333 (68%) anglers were interviewed during the weekend/holiday period (Table 2).

Individual catch and catch rates were nearly identical by day type, time period, and were nearly identical for both reservoirs in 2014. On average, anglers targeting kokanee harvested 2.8 kokanee at Arrowrock Reservoir and 2.7 kokanee at Lucky Peak Reservoir. At both reservoirs, 66% of kokanee anglers were unable to harvest a kokanee during that specific trip (Figure 3). Conversely, 6% of kokanee anglers harvested their bag limit at Arrowrock Reservoir and 4% at Lucky Peak Reservoir. At Arrowrock Reservoir, overall CPUE of kokanee was 0.22 fish/h while CPUE at Lucky Peak Reservoir was 0.23 fish/h (Table 3). For anglers targeting kokanee, catch rates were somewhat higher, with 0.32 fish/h estimated for both reservoirs. The majority of kokanee were caught during the weekend/holiday and early time periods at both reservoirs. Trolling with lures during the early period on weekends had the highest mean CPUE for kokanee at both reservoirs (Figure 4). Length of kokanee in the creel from Arrowrock Reservoir ranged from 305 to 487 mm, with a mean of 407 mm (Figure 5). Two age classes were likely represented in the creel based on ages estimated from otoliths (Figure 6). At Lucky Peak Reservoir, fish ranged from 251 to 455 mm, with a mean of 365 mm (Figure 5). Two year classes were represented in the creel at Lucky Peak Reservoir (Figure 6).

Catch rates for Rainbow Trout were also similar between reservoirs and angling methods, but anglers targeting Rainbow Trout experienced greater success at Lucky Peak Reservoir. Overall, anglers targeting Rainbow Trout harvested an average of 1.5 Rainbow Trout at Arrowrock Reservoir and 2.1 Rainbow Trout at Lucky Peak Reservoir. Approximately 69% and 53% of Rainbow Trout anglers were unsuccessful in harvesting Rainbow Trout at Arrowrock and Lucky Peak reservoirs, respectively (Figure 3). Only 2% of anglers harvested their bag limit of Rainbow Trout (six fish) at Arrowrock and Lucky Peak reservoirs. Rainbow Trout were caught at overall rates of 0.14 and 0.12 fish/h at Arrowrock and Lucky Peak reservoirs, respectively (Table 3). Anglers specifically targeting Rainbow Trout caught fish at a rate of 0.13 at Arrowrock Reservoir and 0.24 fish/h at and Lucky Peak Reservoir. Rainbow Trout were caught equally during the weekend/holiday and weekday periods at both reservoirs. Most Rainbow Trout anglers fished during the early time period at Lucky Peak Reservoir (65%) but were equally distributed between time periods at Arrowrock Reservoir (Figure 7). Additionally, the majority of Rainbow Trout were caught by trolling. Rainbow Trout at Arrowrock Reservoir ranged from 244 to 405 mm with a mean of 334 mm, while fish from Lucky Peak Reservoir ranged from 225 to 378 mm with a mean of 300 mm (Figure 8).

Stocking density appears to be strongly associated with mean fish length (mm) of kokanee in the May creel, despite only three years of data. However, the relationship between stocking density and mean fish length differs considerably between reservoirs. Stocking density (number/ha) was positively correlated with mean fish length (r = 0.84) at Arrowrock Reservoir, but variables were inversely related at Lucky Peak Reservoir (r = -0.63; Table 4). At Arrowrock Reservoir, angler catch rate for kokanee does not appear to be predicted by initial stocking density. However, kokanee catch rates at Lucky Peak Reservoir appear to be negatively associated with stocking density (number/ha; r = -0.76). It should be stressed that these relationships were built on few data points (n = 3) and inferences are preliminary.

There did not appear to be a strong link between daily catch rate and weather such as air temperature, wind speed, and barometric pressure. A weak negative association existed between daily catch rates and maximum and mean air temperatures (r = -0.28) at Arrowrock Reservoir (Table 4). Additionally, daily catch rates from both reservoirs combined was also negatively related to mean air temperature but the relationship was weak (r = -0.32). Mean wind speed and barometric pressure do not appear to affect fishing success at either reservoir thus far.

Hydroacoustics

At Arrowrock Reservoir, fish densities at depths that kokanee inhabit ranged from 43 to 373 fish/ha among transects, with the lowest densities occurring towards the dam (Table 5). Mean density for lengths that corresponded with wild age-0 kokanee (30-80 mm) was 117 fish/ha. Mean density for lengths that corresponded with age-0 hatchery kokanee (81-130 mm) was 30 fish/ha. Age-1 kokanee density (131-200 mm) was estimated at 18 fish/ha and age-2 and older fish (>201 mm) was 23 fish/ha Mean fish density of all lengths combined was 198 fish/ha, and total pelagic abundance was 138,536 fish in 2014. These estimates are approximately 74% lower than pelagic estimates obtained the previous year (Koenig et al. 2015).

At Lucky Peak Reservoir, fish densities at depths kokanee inhabit ranged from 59 to 393 fish/ha among transects with the lower densities occurring in the upstream portion of the reservoir (Table 6). Mean fish density for lengths that corresponded with age-0 hatchery kokanee (131 to 200 mm) was 11 fish/ha. Mean fish density for lengths that correspond with age-1 kokanee (201-320 mm) was 39 fish/ha. Mean fish density for lengths that correspond to age-2 kokanee (321 to 430 mm) was 21 fish/ha. Mean fish density of all lengths combined was 128 fish/ha, and total pelagic abundance was 146,182 fish in 2014. Hydroacoustic estimates of pelagic fish abundance at Lucky Peak Reservoir were very similar to 2013 estimates.

Mid-Water Trawling

Mid-water trawling was conducted with the intention of capturing age-0 or age-1 kokanee and to validate hydroacoustic data. A total of six fish, including three wild age-0 kokanee were captured with trawling (Table 7).

DISCUSSION

Proportional effort varies annually among the reservoirs based on catch rates and fish size. In 2014, the proportion of Lucky Peak Reservoir anglers interviewed increased 20% from 2013 with a 26 mm (1 in) increase in mean length. While kokanee in Arrowrock Reservoir were longer than in Lucky Peak Reservoir in 2014, early-season fishing reports were poor and anglers had a difficult time locating fish. This slow beginning to the fishing season contributed to the observed 30% decline in effort from 2013 despite mean kokanee length increasing slightly.

Fishing success for kokanee declined in 2014 from 2013. Mean catch rates for kokanee declined by 32% at Arrowrock Reservoir and 51% at Lucky Peak Reservoir for anglers targeting kokanee. A similar decline was observed at both reservoirs in the proportion of anglers harvesting limits of kokanee. Hydroacoustic estimates of pelagic fish abundance declined by 74% at Arrowrock Reservoir while Lucky Peak Reservoir estimates remained stable from 2013 to 2014 which corroborates the decline in catch rates. Water management at Arrowrock Reservoir during the previous summer likely contributed to the poor fishing observed in 2014 at Arrowrock Reservoir. In 2013, Arrowrock Reservoir was drafted to approximately 20% capacity by the end of July, and was maintained at low levels through September. This period at low reservoir levels coincided with a period of warm air temperatures that was longer in duration than other years (Figure 9). Water temperatures at this time ranged from 18 to 24ºC through the entire water column (Figure 10). It is highly likely that these reservoir conditions resulted in direct mortality or entrainment of kokanee downstream through the dam. Typically, Arrowrock Reservoir begins refilling after the Labor Day weekend, when water managers use storage from Lucky Peak Reservoir to meet demands. Currently, there are no entrainment estimates of sport fishes through Arrowrock Dam to Lucky Peak Reservoir although managers are aware that it occurs. In 2015, we plan on marking (adipose clip) a subsample of hatchery kokanee fingerlings stocked in Arrowrock Reservoir, which may provide a better understanding for the amount of entrainment if marked fish are recovered in Lucky Peak Reservoir. Furthermore, IDFG should work with water managers to ensure that reservoir management practices that occurred in 2013 are not repeated. Alternatives such as using storage from Lucky Peak Reservoir earlier, rather than keeping it full through Labor Day, should be considered in poor water years. Additionally, the stocking request for Arrowrock Reservoir should be doubled to 100,000 kokanee fingerlings in May 2015.

Catch rates for anglers targeting Rainbow Trout also declined from 2013 at both reservoirs. A 46% and 72% decline in CPUE were observed in Arrowrock and Lucky Peak reservoirs, respectively. Rainbow Trout anglers remained at approximately 22% of all anglers interviewed, identical to 2013. Mean lengths of Rainbow Trout in the creel were also similar for both reservoirs compared to 2013, with Arrowrock Reservoir. Rainbow Trout measured approximately 30 mm (1 ¼ inch) longer than fish in Lucky Peak Reservoir.

Initial attempts at linking kokanee catch rates and mean fish length to stocking densities or weather variables were mixed. Predicting relationships of fish length and mean annual CPUE were limited with only three years of data. However, initial results were promising in linking stocking densities to mean fish length in the creel. Interestingly, the linear relationship between stocking density (kg/ha) and fish length was positive at Arrowrock Reservoir (r = 0.84) and negative at Lucky Peak Reservoir (r = -0.63; Table 4). This suggests that Lucky Peak Reservoir may be near carrying capacity for achieving the current desired growth rates. However, the rate and influence of entrainment from Arrowrock Reservoir is also currently unknown and may be complicating our interpretation of these results. Further investigation is warranted into how the relationship between stocking and mean fish length is influenced by reservoir productivity, fish entrainment, and wild fish production. Relationships between angler catch rates and weather variables were not informative. This is a result of the inherent variability of individual angler catch rates across any given day or month. Individual angler catch rates have varied between 0 and 6 fish/h over the past three years and the annual median values reflect the large number of anglers who don't catch fish (Figure 11). Angler catch rates are highly influenced by skill, knowledge, and a host of other variables that are not readily measurable. Accounting for this variation among anglers and relating fishing success with other independent variables is therefore extremely difficult. Angler catch rates should still be useful to compare the same water bodies across years. Due to these factors, angler catch rates may be a poor metric to evaluate management practices. However, the use of check stations is still valuable as much may be learned from length- and age-in-the-creel.

Some of the observed variations in catch rates and angler use may also be attributed to random sampling selection between the years. Through simple random selection, three early and three late time periods, were sampled in 2014. During the previous year, only two late sampling periods were conducted. The overall goal of sampling the May creel is to identify and develop indices using the relationships between stocking size, stocking density, catch rates, and fish size. Therefore sampling design for the check station was scrutinized to determine if fixed dates or randomly selected dates were most appropriate for developing an index. Through literature review and discussion among biologists, it was determined to use a fixed set of sampling periods for future check stations. Therefore, the 2013 sampling design was used during 2014 and will be used for future check stations (Table 8).

The utility of hydroacoustic surveys for monitoring kokanee abundances at both reservoirs is being evaluated and is limited with only two years of data. At both reservoirs, diverse species assemblages appear to limit the ability of this method to index smaller age classes. Target tracking was problematic because of the high densities of overlapping small fish in at least three transects at each reservoir (Tables 5 and 6). Abundance estimates for fish <90 mm were much higher than would be expected for only kokanee considering the stocking rates. Hydroacoustic density and abundance estimates for the size groups that correspond to age-1 and age-2 kokanee are more reasonable. However, interpreting the utility of hydroacoustic results from only two years is difficult. Often multiple years of data are needed to build informative relationships between density, fish size, and catch rates. Mid-water trawling failed to capture kokanee at Lucky Peak Reservoir in 2013 and only six kokanee were captured at Arrowrock Reservoir in 2014. Clearly, mid-water trawling is not effective at either water body given the low densities of kokanee sampled. No future trawling efforts are planned at either reservoir. Instead, staff will participate in a statewide research project that will focus on using experimental curtain nets to monitor kokanee populations.

RECOMMENDATIONS

1. Increase annual stocking in Arrowrock Reservoir to 100,000 kokanee and evaluate changes in catch rates and mean fish length. Mark up to 10,000 hatchery kokanee with adipose clips for release into Arrowrock Reservoir to assess entrainment through Arrowrock Dam into Lucky Peak Reservoir.

2. Monitor the effect of kokanee and Rainbow Trout stocking practices at Arrowrock and Lucky Peak Reservoirs by indexing catch rates using annual check stations during May. A fixed sampling design will be used at the check station between years and should continue through at least 2016.

3. Continue evaluation of hydroacoustics to monitor fish density.

4. Participate in statewide investigation into the use of curtain nets to evaluate kokanee populations and fisheries.

Table 1. Stocking densities, average fish length, and stocking dates by reservoir for kokanee in Arrowrock and Lucky Peak reservoirs, Idaho 2004-2014.

Waterbody	Year	Date	No. Fish	Mean size (mm)	Fish/kg	Stocking density (fish/ha)	Stocking density (kg/ha)
Arrowrock Reservoir	2004	14-Jun	77,025	100	24.8	61	2.5
1,255 ha	2006	9-May	70,000	89	35.8	56	1.6
	2010	3-Jun	29,000	76	52.6	23	0.4
	2011	8-Jun	30,000	76	45.4	24	0.5
	2012	2-May	50,130	76	50.5	40	0.8
	2013	1-May	50,160	69	68.9	40	0.6
	2014	15-May	49,995	76	44	40	0.9
Lucky Peak Reservoir	2004	14-Jun	155,950	90	32.9	135	4.1
1,153 ha	2005	3-Jun	200,150	86	39.1	174	4.4
	2006	24-May	308,050	83	45.8	267	5.8
	2007	31-May	245,000	89	39.7	212	5.4
	2008	3-Jun	195,570	57	130.8	170	1.3
	2009	3-Jun	199,800	83	45.3	173	3.8
	2010	3-Jun	151,050	79	45.7	131	2.9
	2011	8-Jun	174,640	76	42.8	151	3.5
	2012	2-May	200,910	76	48.9	174	3.6
	2013	1-May	251,877	69	67.4	218	3.2
	2014	15-May	237,120	76	44.8	206	4.6

Table 2. Dates, day type, time period, and number of anglers interviewed during each sampling period for creel check stations at Arrowrock and Lucky Peak reservoirs. Dates, day type, and time period were selected randomly.

Date	Day Type	Time Period	Arrowrock	Lucky Peak
5/8	Weekday	Late	22	43
5/10	Weekend/Hol	Late	27	30
5/15	Weekday	Early	31	30
5/17	Weekend/Hol	Early	72	72
5/20	Weekday	Late	10	17
5/25	Weekend/Hol	Early	63	70
Total			225	262

Table 3. Catch rates by time periods, day type, angling methods, and gear types for kokanee and Rainbow Trout at Arrowrock and Lucky Peak reservoirs, Idaho in 2014.

	Kokanee (fish/h)		Rainbow trout (fish/h)	
	Arrowrock	Lucky Peak	Arrowrock	Lucky Peak
Weekday	0.33	0.2	0.21	0.13
Weekend/Hol	0.17	0.25	0.1	0.12
Early Period	0.2	0.26	0.1	0.16
Late Period	0.26	0.17	0.23	0.07
Shore	0.06	0	0.06	0.18
Still boat	0.08	0	0.02	0
Trolling boat	0.27	0.31	0.17	0.12
Lures	0.23	0.28	0.15	0.08
Bait	0.2	0.13	0.12	0.2
Kokanee targeted	0.32	0.32	-	-
Rainbow trout targeted	-	-	0.13	0.24
Overall	0.22	0.23	0.14	0.12

Table 4. Pearson correlations (r) of catch rates (CPUE), stocking densities, air temperature, wind speed, and barometric pressure for kokanee at Arrowrock and Lucky Peak reservoirs, Idaho from 2012 to 2014.

	Stocking density		Air temperature (^{o}C)			Mean wind	Barometric
	no./ha	kg/ha	Maximum	Minimum	Mean	speed	pressure
Arrowrcock CPUE	-0.06	0.13	-0.28	-0.21	-0.28	-0.21	0.04
(Sample size n)	(n=3)	(n=3)	(n=18)	(n=18)	(n=18)	(n=18)	(n=18)
Lucky Peak CPUE	-0.76	-0.43	-0.07	-0.12	-0.13	-0.16	0.05
(Sample size n)	(n=3)	(n=3)	(n=19)	(n=19)	(n=19)	(n=19)	(n=19)
Both CPUE			-0.3	-0.23	-0.32	-0.04	0.13
(Sample size n)	-	-	(n=39)	(n=39)	(n=39)	(n=39)	(n=39)
Arrowrock TL (mm)	0.73	0.84					
(Sample size n)	(n=3)	(n=3)	-	-	-	-	-
Lucky Peak TL (mm)	-0.25	-0.63					
(Sample size n)	(n=3)	(n=3)	-	-	-	-	-

Table 5. Kokanee densities (number/ha) per transect and total abundance estimates calculated by arithmetic and geometric mean densities at Arrowrock Reservoir, Idaho on July 24, 2014.

		Fish densities (number / ha)						
Transect	**Transect length (m)**	**30-80 mm**	**81-130 mm**	**131-200 mm**	**201-320 mm**	**321-430 mm**	**>430**	**Total**
1	1,007	116	33	38	27	13	9	236
2	980	230	58	11	6	3	9	316
3	1,124	136	73	54	33	30	27	353
4	1,045	255	48	20	27	10	12	373
5	985	81	20	15	18	2	2	139
6	1,024	33	5	4	0	0	0	43
	Geometric Mean	**117**	**30**	**18**	**11**	**5**	**6**	**198**
	90% CI	**90 to 152**	**22 to 42**	**13 to 25**	**7 to 19**	**3 to 9**	**4 to 10**	**148 to 265**
	Abundance	**81,838**	**21,311**	**12,663**	**7,911**	**3,683**	**4,190**	**138,536**
		62,798 to 106,586	**15,275 to 29,626**	**9,234 to 17,275**	**4,604 to 13,279**	**2,114 to 6,126**	**2,505 to 6,759**	**103,296 to 185,717**

Table 6. Kokanee densities (number/ha) per transect and total abundance estimates calculated by arithmetic and geometric mean densities at Lucky Peak Reservoir, Idaho on July 23, 2014.

		Fish densities (number / ha)				
Transect	**Transect length (m)**	**131-200 mm**	**201-320 mm**	**321-430 mm**	**>430 mm**	**Total**
1	1,700	2	7	11	38	59
2	1,661	11	19	14	46	90
3	1,593	8	22	27	40	97
4	1,624	17	75	23	57	172
5	1,346	33	218	50	92	393
6	1,538	13	62	17	35	127
	Geometric Mean	**11**	**39**	**21**	**49**	**128**
	90% CI	**8 to 15**	**26 to 59**	**17 to 25**	**43 to 55**	**101 to 162**
	Abundance	**12,740**	**44,490**	**23,608**	**55,378**	**146,182**
		9,438 to 17,072	**29,100 to 67,713**	**19,414 to 28,657**	**48,764 to 62,868**	**115,722 to 184,580**

Table 7. Numbers of kokanee captured during mid-water trawling at Lucky Peak Reservoir on June 27, 2014.

Transect	Distance (m)	Kokanee
1	988	1
2	3,126	0
3	1,503	1
4	2,259	4

Table 8. Fixed May sampling schedule for future creel check stations for Arrowrock and Lucky Peak reservoirs in 2015 through 2016. Sampling begins with the Sunday in the first full week of May.

Week	Day	Primary	Seconday
1	Sunday	Weekend/Hol	Early
1	Monday	Weekday	Late
2	Wednesday	Weekday	Early
3	Friday	Weekday	Early
4	Sunday	Weekend/Hol	Early
4	Friday	Weekend/Hol	Late

Early = 0900-1500 hours
Late = 1500-2100 hours

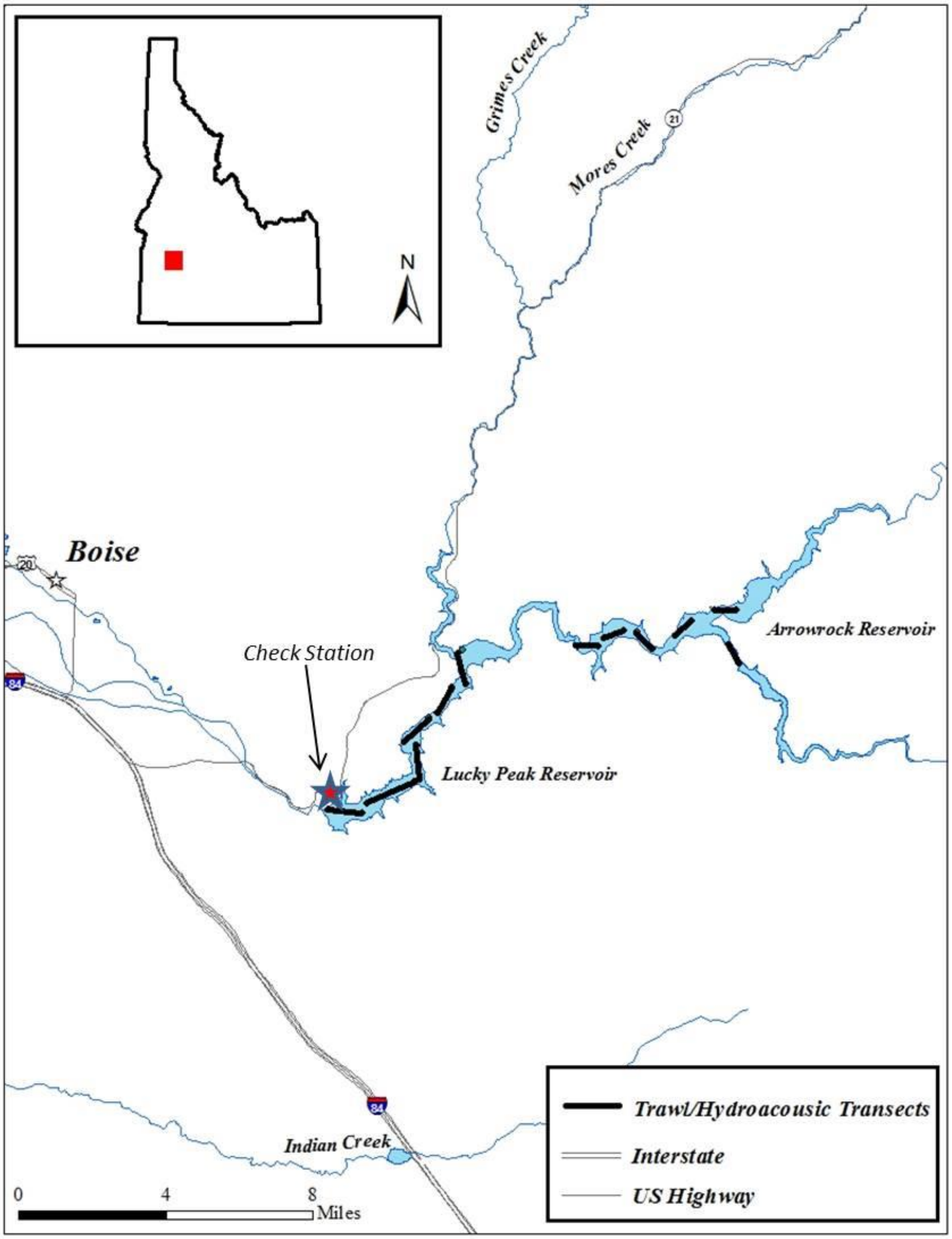

Figure 1. Map of Arrowrock and Lucky Peak reservoir, Idaho, with location of the creel station where clerks can intercept anglers from both waters. Hydroacoustic surveys were conducted in both reservoirs while mid-water trawling was only conducted in Arrowrock Reservoir in 2014.

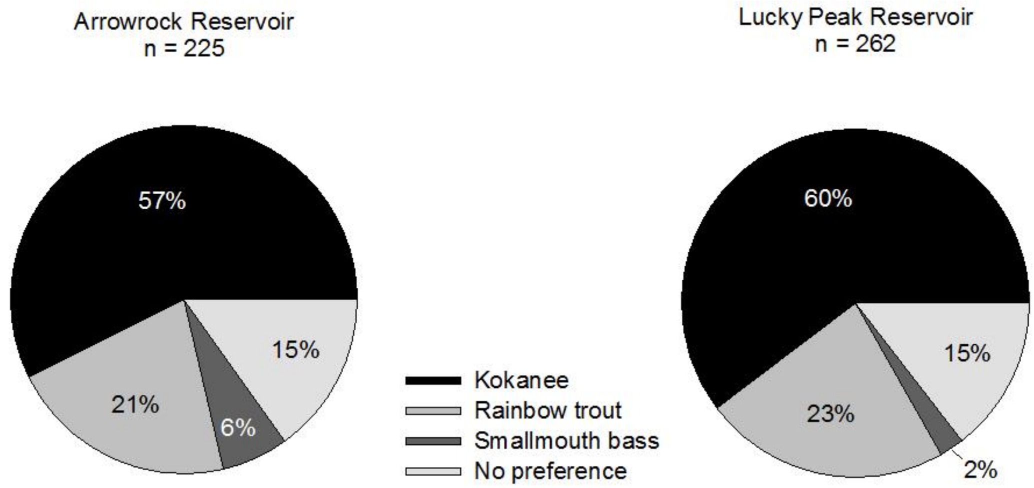

Figure 2. Proportion of anglers targeting game fish species at Arrowrock and Lucky Peak reservoirs in May 2014

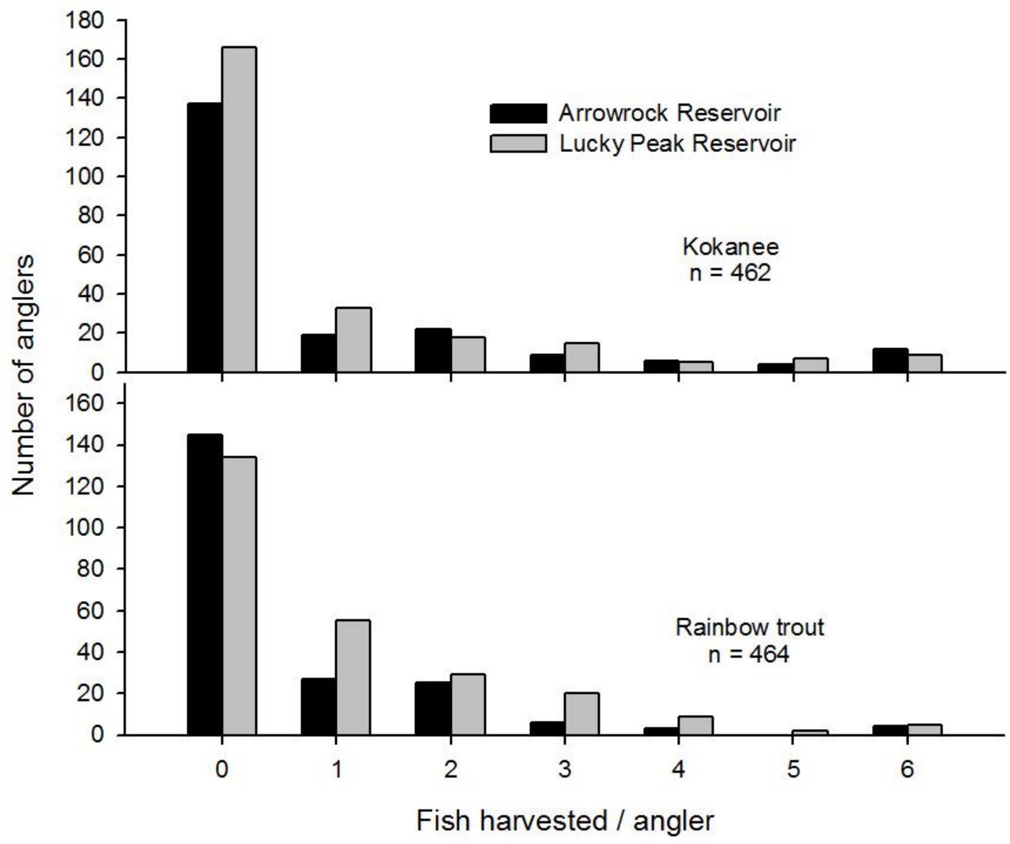

Figure 3. Frequency of harvest by angler for kokanee and Rainbow Trout at Arrowrock and Lucky Peak reservoirs in 2014.

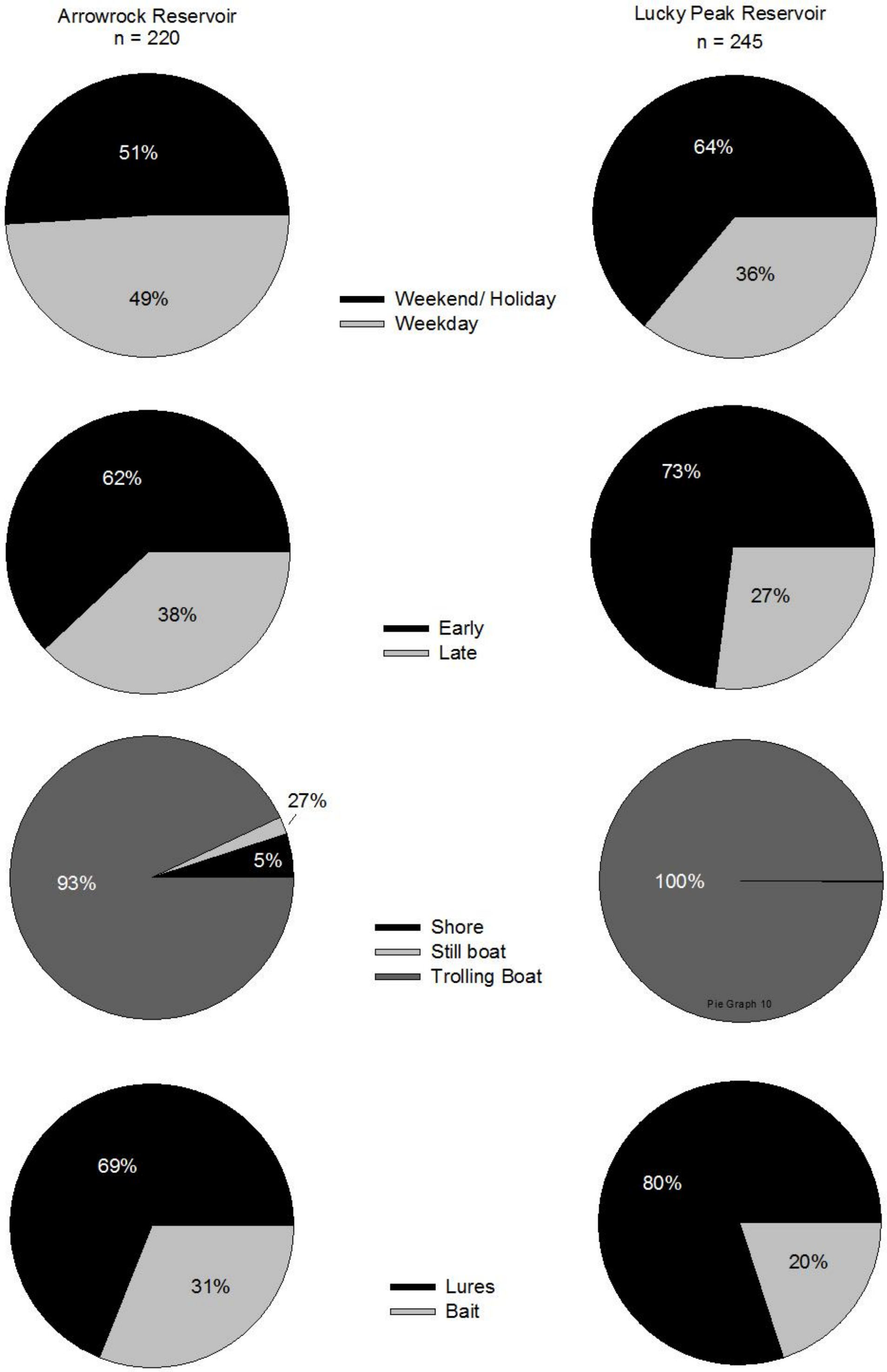

Figure 4. Proportion of kokanee caught during time periods, day types, and by fishing methods and gear types as reported by anglers at Arrowrock and Lucky Peak reservoirs in May 2014.

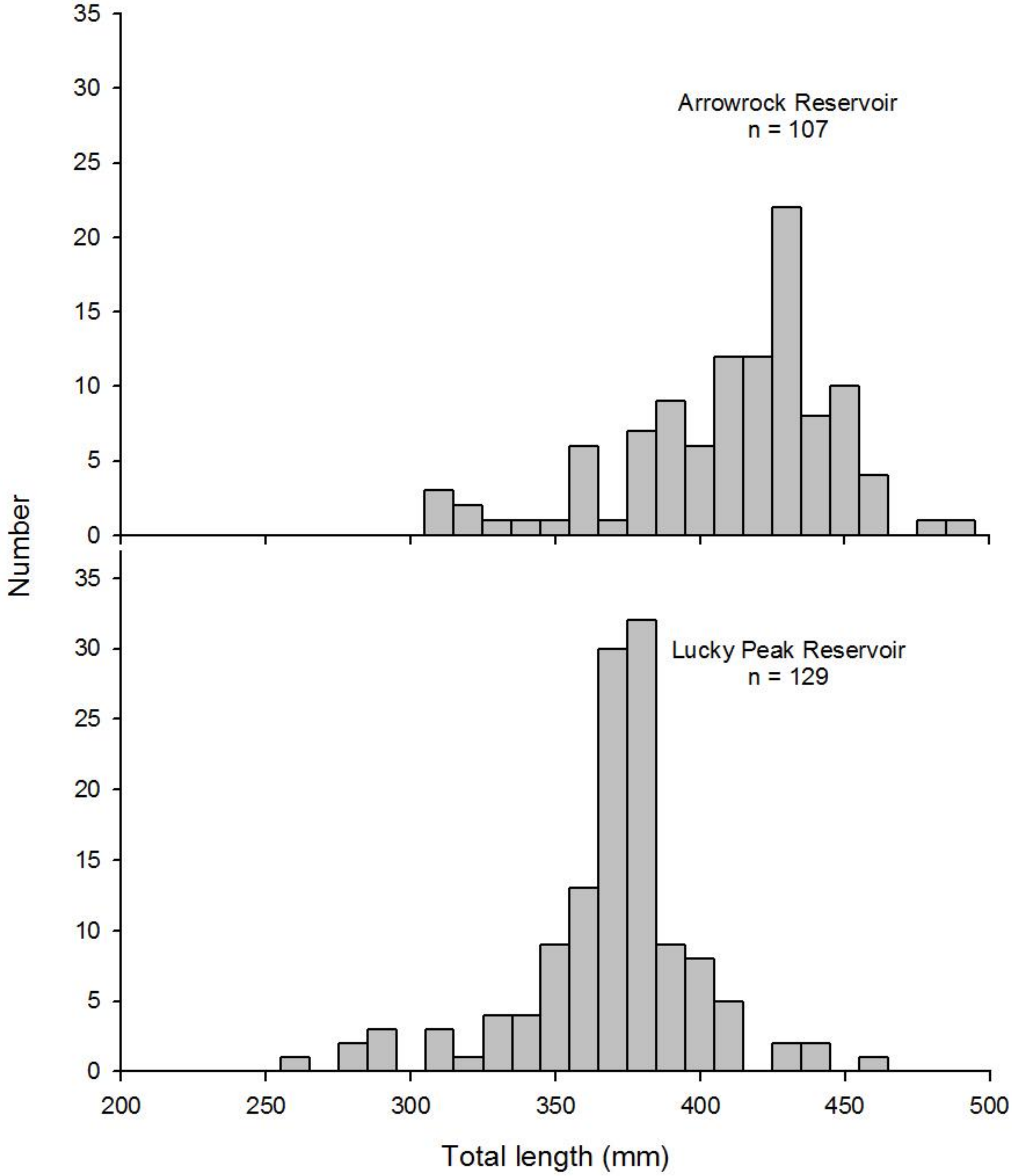

Figure 5. Length frequency distributions of kokanee observed in the creel in May 2014 at Arrowrock and Lucky Peak reservoirs.

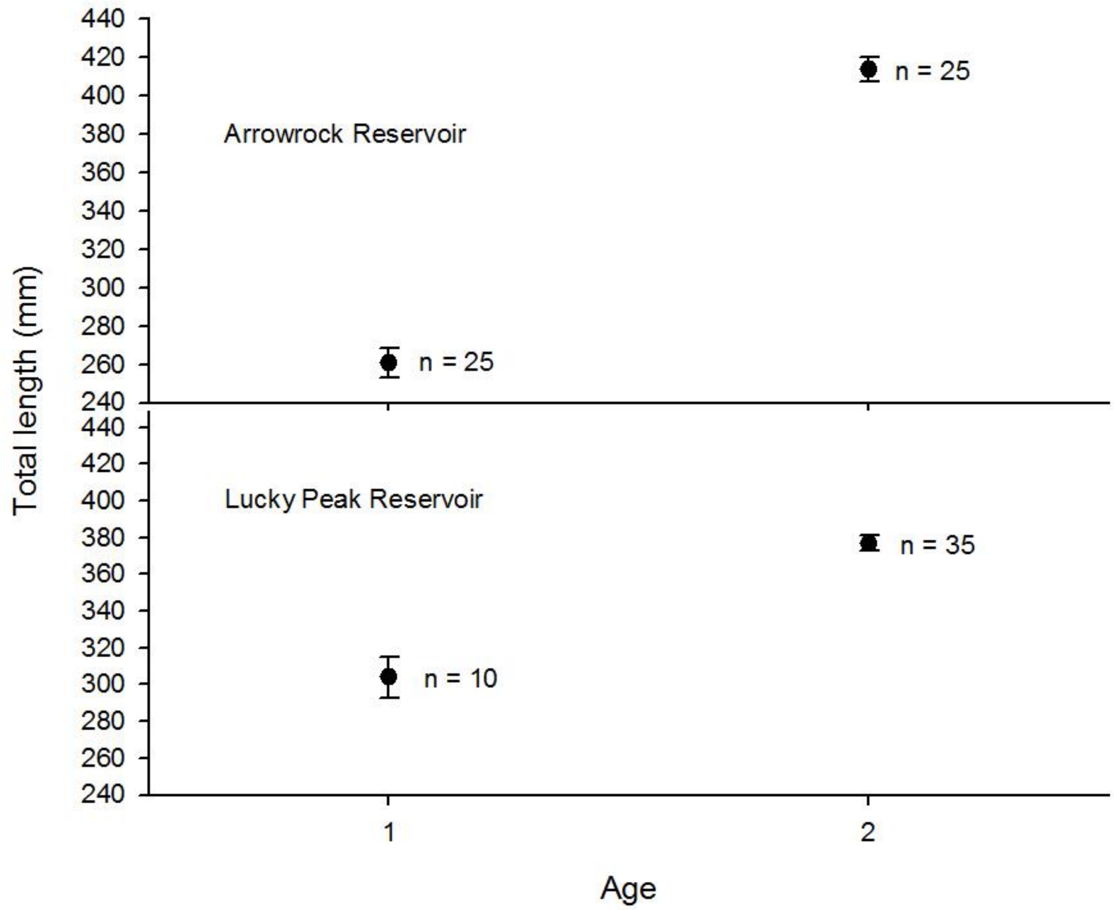

Figure 6. Length-at-age for kokanee sampled during the creel survey in May 2014 at Arrowrock and Lucky Peak reservoirs.

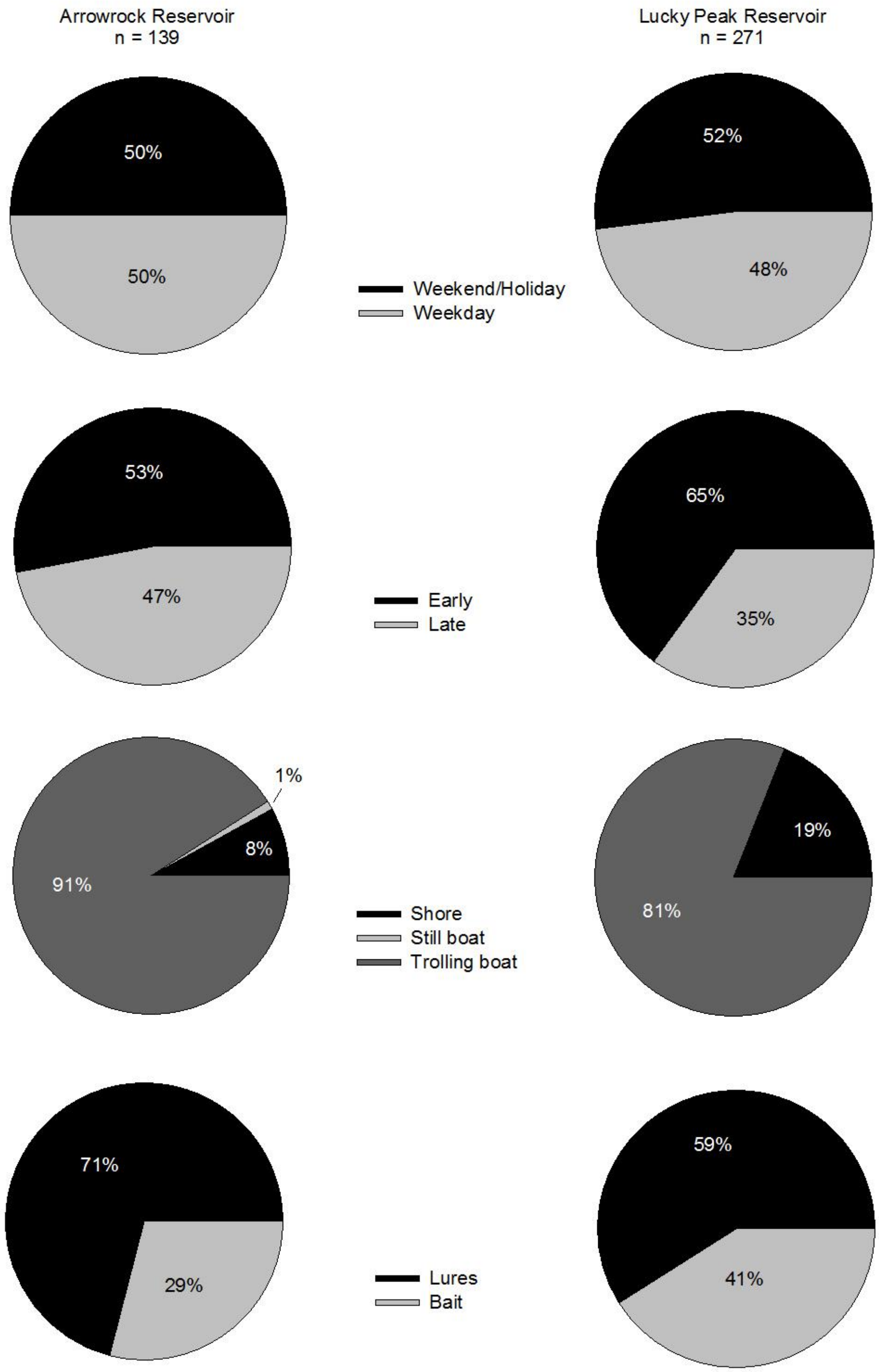

Figure 7. Proportion of Rainbow Trout caught by category (time periods, day type, fishing methods, or gear type) as reported at Arrowrock and Lucky Peak reservoir check stations in May 2014.

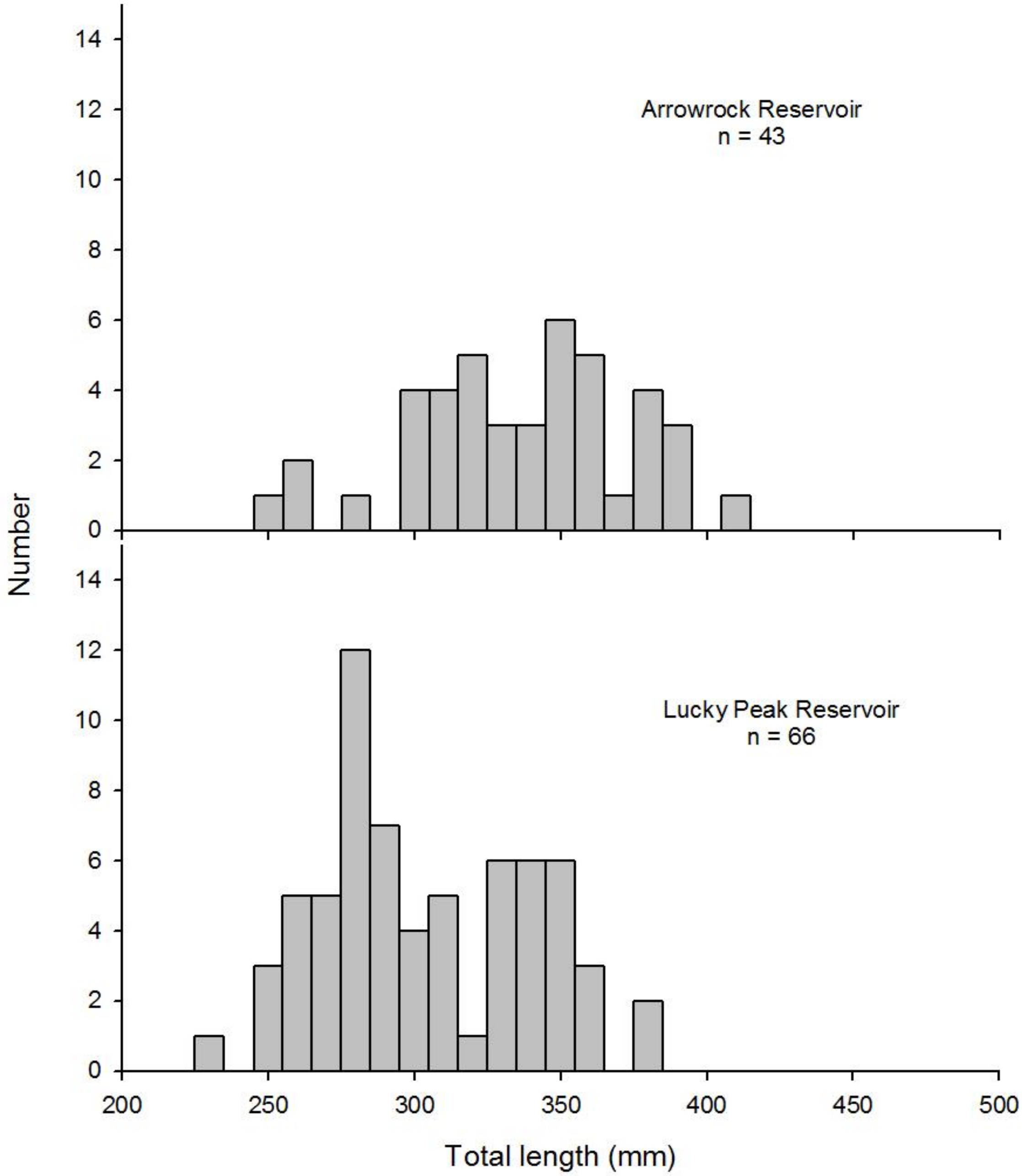

Figure 8. Length frequency distributions of Rainbow Trout observed in the creel in May 2014 at Arrowrock and Lucky Peak reservoirs.

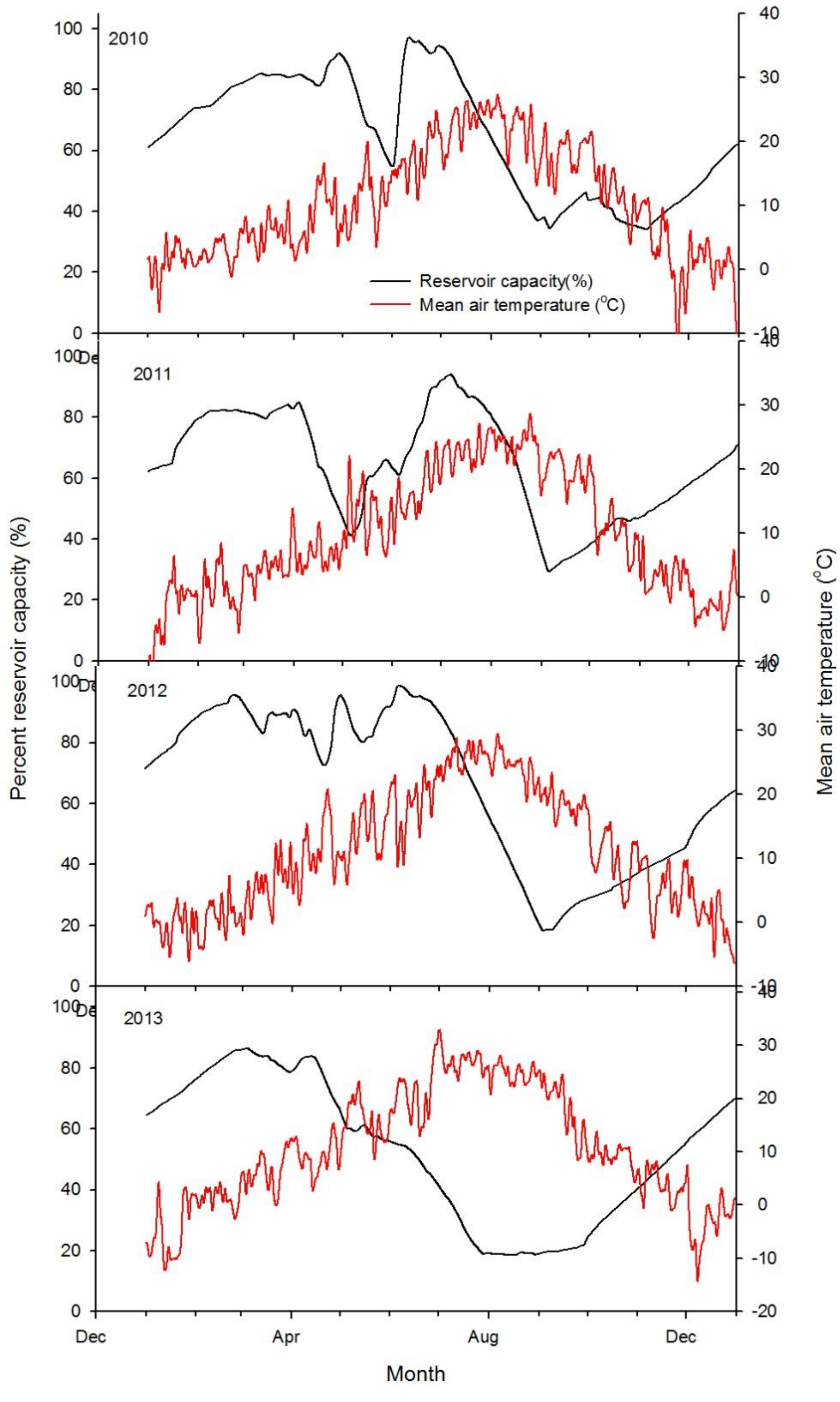

Figure 9. Annual reservoir capacity and mean daily air temperature (ºC) at Arrowrock Reservoir, Idaho 2010-2013.

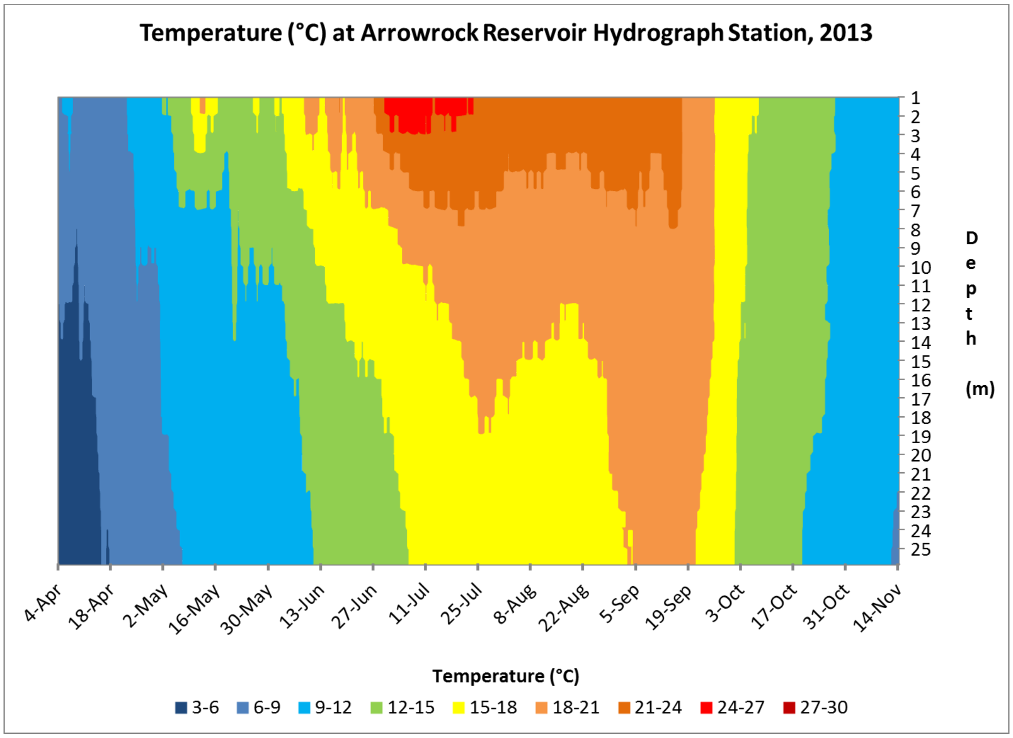

Figure 10. Temperature profiles (ºC) at Arrowrock Reservoir, Idaho between April and November 2013. Data collected by USBR.

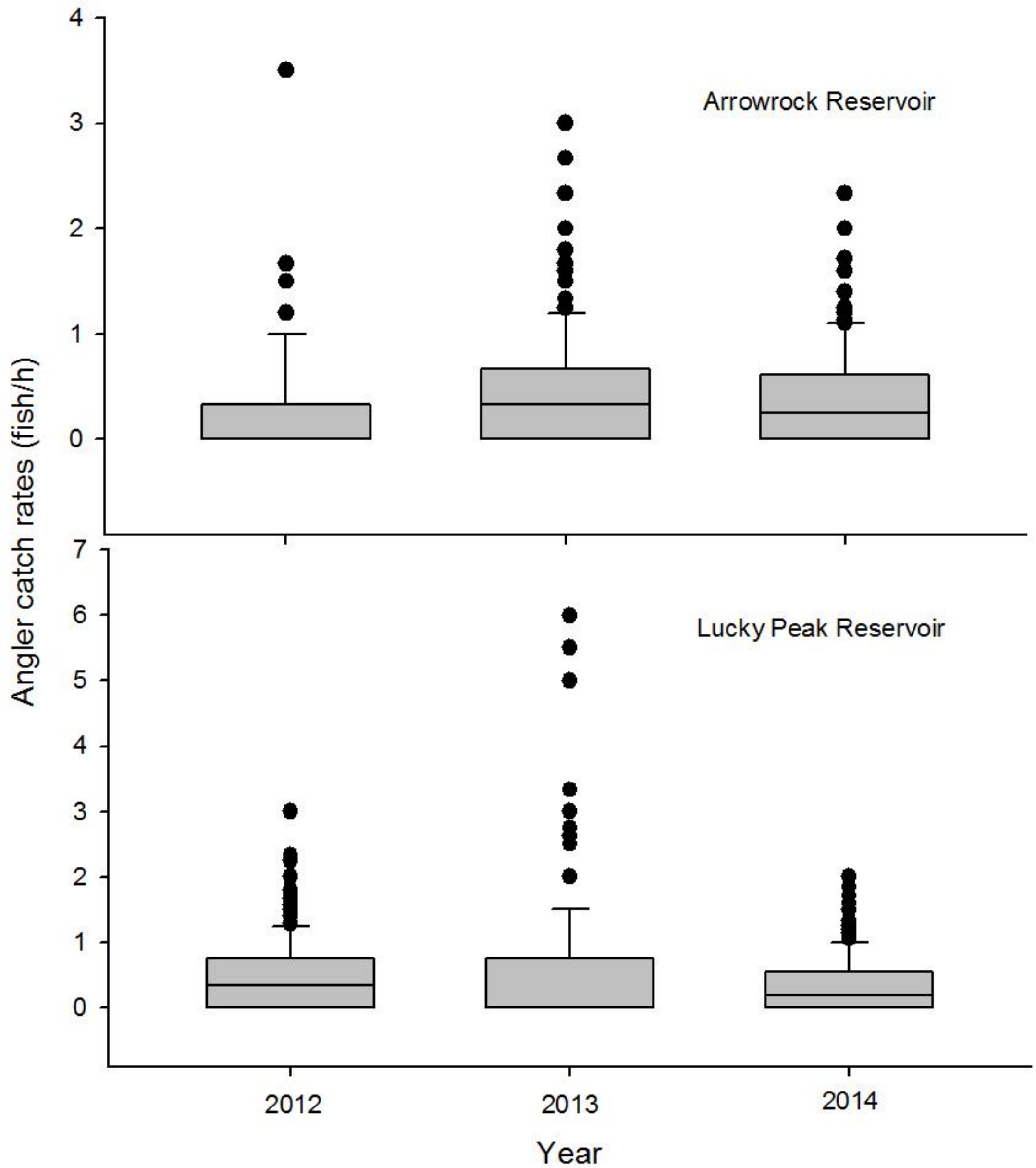

Figure 11. Quartile box plots of individual angler catch rates (fish/h) collected at check stations for Arrowrock and Lucky Peak reservoirs, Idaho 2012-2014. The box represents the first, second (median), and third quartiles. The whiskers are the 10^{th} and 90^{th} percentiles, while outliers (3 x IQR above the third quartile) are represented by dots.

EVALUATION OF CENTRARCHID PREDATION BY AMERICAN WHITE PELICAN AT CJ STRIKE RESERVOIR

ABSTRACT

In southern Idaho, growth of two American White Pelican *Pelicanus erythrorhynchos* nesting colonies (at Lake Walcott and Blackfoot Reservoir) since the early 1990s has generated concern about whether pelican predation is reducing angler catch rates of wild fish. We evaluated this concern at by tagging centrarchids at CJ Strike Reservoir in July 2014. Pelican habitats were scanned to recover tags in September 2014. We inserted PIT tags in a total of 324 centrarchid fishes, including crappie *Pomoxis spp*., Smallmouth Bass *Micropterus dolomieu*, Largemouth Bass *Micropterus salmoides*, and Bluegill *Lepomis macrochirus*. In May and June 2014, Nampa Fisheries Research staff stocked 400 catchable-sized Rainbow Trout *Oncorhynchus mykiss*, marked with PIT tags, and directly fed 95 PIT-tagged trout to pelicans. No PIT tags from centrarchids were recovered at the Lake Walcott pelican nesting colony. However, four tags from stocked catchable trout and two fed tags were recovered at Lake Walcott. The lack of recovery of centrarchid tags relative to stocked catchable trout suggested that pelican predation on centrarchids was low. However, in searching avian loafing areas (primarily pelicans and Double-crested Cormorants *Phalacrocorax auritus)*, we found six PIT tags associated with tagged centrarchids, as well as five from stocked catchables. The lack of tag recoveries at Lake Walcott coupled with the few recoveries made at loafing areas suggests that avian consumption of tagged centrarchids at CJ Strike Reservoir was caused by cormorants or pelicans not associated with a breeding colony. At this time, data needed to expand recovered tags from loafing areas to direct avian predation rates is not available, although the low number of tags recovered suggests that avian predation of centrarchids is not substantial.

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OBJECTIVES

1. Estimate the annual avian predation rate of four common centrarchid species at CJ Strike Reservoir.

METHODS

Smallmouth Bass *Micropterus dolomieu,*, Largemouth Bass *Micropterus salmoides* Bluegill *Lepomis macrochirus*, Black Crappie *Pomoxis nigromaculatus* and White Crappie *Pomoxis annularis* were collected and marked with PIT tags to estimate the annual predation rate by American White Pelicans *Pelecanus erythrorhynchos* and Double-crested Cormorants *Phalacrocorax auritus*. Centrarchid fishes were collected with a combination of boat electrofishing and trap nets on July 7 and July 8, 2014. Electrofishing was conducted along the shoreline at night using a Smith-Root electrofishing boat. Pulsed direct current was set at 120 pulses per second and a pulse width of 40, which yielded an output of 5 - 6 amps. Sample sites for the various gear types were randomly selected throughout the Bruneau and main pools.

Captured fish were identified to species, measured for total length (TL, ± 1 mm), and weighed (± 1 g for fish under 5,000 g or ± 10 g for fish greater than 5,000 g) with a digital scale. Smallmouth Bass, Bluegill, White Crappie, and Black Crappie were tagged with 23-mm half-duplex PIT tags in the abdominal cavity and released. We searched for regurgitated and defecated PIT tags at known pelican and cormorant loafing areas in the Snake River arm and along the Bruneau River delta on September 30, 2014. Loafing areas were scanned for tags using a backpack PIT-tag reader (Oregon RFID HDX Backpack Reader). We did not estimate PIT-tag retention rates or tagging mortality rates. We felt it was appropriate to assume no tag-related mortality or tag loss over the several months that fish were at large, because of the relatively large size of centrarchids and because fish were tagged after the spawning period.

In an effort to evaluate avian predation on stocked trout at the reservoir, Nampa Fisheries Research (NR) staff released tagged hatchery Rainbow Trout *Oncorhynchus mykiss* in May and June 2014. Nampa Fisheries Research staff stocked 400 catchable-sized hatchery Rainbow Trout with 23 mm PIT tags. In addition, NR staff directly fed 95 PIT-tagged hatchery Rainbow Trout to pelicans in an effort to estimate the tag recovery rate at the Minidoka Reservoir nesting colony.

Southwest Region fisheries personnel looked for nesting pelicans on the islands in the Snake River and Bruneau portions of CJ Strike Reservoir in spring of 2013 and 2014. Despite consistent pelican presence, no nests were documented during these surveys. At this time, there are no known nesting colonies in the Southwest Region. The soaring ability of pelicans enables them to forage at distances of up to 300 km from their nests (Johnson and Sloan 1978; Trottier et al. 1980; O'Malley and Evans 1982). Thus, the only colonies within range of pelican foraging at CJ Strike Reservoir are at Lake Walcott in south-central Idaho (201 km away) and Malheur National Wildlife Refuge (NWR) in eastern Oregon (242 km away). The entire Lake Walcott nesting colony was scanned by NR staff for PIT tags implanted in Idaho fisheries, including those stemming from fish tagged at CJ Strike Reservoir. Tag recovery efficiency at the Lake Walcott nesting colony is not known, but the entire nesting colony was searched rigorously, and thus recovery rates probably exceed 90% (K. Meyer, IDFG, personal communication). In addition, the colony at Malheur NWR was searched by scientists from Real Time Research in Oregon (A. Evans, Real Time Research, personal communication).

RESULTS AND DISCUSSION

We tagged a total of 324 centrarchid fishes with PIT tags including seven Black Crappie, 93 White Crappie, 113 Smallmouth Bass, 7 Largemouth Bass, and 104 Bluegill (Table 9). The mean total length (TL) and length range for each species tagged was measured and calculated (Table 9). No tags from centrarchids collected and released at CJ Strike Reservoir were recovered at the Lake Walcott or Blackfoot pelican nesting colonies in fall 2014. In addition, no tags were recovered at the Malheur NWR pelican nesting colony (A. Evans, Real Time Research, personal communication). However, tags from four stocked catchable trout and two directly-fed trout were recovered at Lake Walcott. We recovered a total of 11 PIT tags from avian loafing areas at CJ Strike Reservoir in 2014, including tags from six centrarchids and five stocked catchable trout.

We believe predation on centrarchid species at CJ Strike by pelicans associated with nesting colonies is low. Lake Walcott is the nearest pelican nesting colony to CJ Strike Reservoir, and our recovery rates for PIT tags was 2% for fed tags (trout), 1% for stocked catchable trout, and 0% for tagged centrarchids. Based on tags recovered at Lake Walcott, pelican predation estimates of catchable trout have averaged 26% (range, 4-48%) over the past three years for CJ Strike Reservoir (K. Meyer, personal communication). Four (of 400 total) tags from trout stocked in 2014 were recovered at Lake Walcott. Had pelicans been preying on centrarchids at an appreciable level, we would have expected to recover at least a few of those tags at Lake Walcott as well. Unfortunately, we do not currently have enough tag recovery data to know if pelican predation rates for centrarchids are similar to those for hatchery Rainbow Trout.

While pelican (associated with breeding colonies) predation may be low, cormorant or non-breeding pelican predation may be a more significant factor for centrarchid fishes at CJ Strike Reservoir. The lack of tag recoveries from centrarchids at Lake Walcott pelican nesting colonies (which would be exclusively from pelican predation because this nesting colony is beyond the forage range of cormorants) suggests that tags found at CJ Strike Reservoir loafing areas were more likely to be from cormorants or non-breeding pelicans that frequent the same areas. Tags recovered at loafing areas cannot be used to estimate avian predation, because we cannot confidently state which species of avian predator consumed the PIT-tagged fish. However, considering the number of tagged fish relative to the total population in the reservoir, and considering the six tags we did recover at loafing areas, avian predation on centrarchids may be significant. Moreover, centrarchids were not PIT-tagged until mid-July, whereas centrarchids are most vulnerable to avian predation in May and June when they occupy shallower water during spawning. May and June also coincide with the pelican nesting period when avian predation on fish is highest because of the increased energy demands or rearing young pelicans. Therefore, our results may underrepresent actual avian predation of centrarchids at CJ Strike Reservoir.

RECOMMENDATIONS

1. Consider one additional year of avian predation evaluation on centrarchids in CJ Strike Reservoir by PIT-tagging fish in early May to capture the period when centrarchids are most vulnerable, and avian predation on fish is highest.

2. Scan Lake Walcott and CJ Strike Reservoir loafing areas for PIT tags consumed by avian predators.

3. Use trail cameras at loafing areas to estimate the relative proportion of pelican and cormorant abundance, and to characterize the presence and abundance of other avian predators, in order to more accurately apportion recovered tags among avian predator species.

Table 9. Total number of centrarchid fishes marked with 23 mm PIT tags in July 2014. Mean total length (TL) and length range by species at CJ Strike Reservoir. Tags were recovered from avian loafing areas at CJ Strike Reservoir. No tags were recovered from the Lake Walcott, Blackfoot Reservoir, or Malheur National Wildlife Refuge pelican nesting colonies. Species include Black Crappie (BCR), White Crappie (WCR), Bluegill (BGL), Largemouth Bass (LMB), and Smallmouth Bass (SMB).

Species	Total tagged	Mean TL (SD) (mm)	Min-Max TL (mm)	Tags recovered
BCR	7	184 (10)	170-200	1
BGL	104	171 (14)	150-235	1
LMB	7	377 (76)	245-472	0
SMB	113	295 (65)	114-465	1
WCR	93	196 (37)	155-347	3

DEADWOOD RESERVOIR MONITORING IN 2014

ABSTRACT

Deadwood Reservoir provides important sport fisheries for kokanee *Oncorhynchus nerka* and fall Chinook Salmon *O. tshawytscha*. It is also Idaho's primary egg source, providing early spawning kokanee for stocking throughout the state. Kokanee densities among transects ranged from 458 to 1,518 fish/ha with the highest densities corresponding to age-0 fish. Age-2 and older kokanee comprised the lowest densities (153 fish/ha) of all age classes. Overall, mean kokanee density was 764 (range, 658-886) fish/ha. When expanded to an abundance estimate using the reservoir surface area (1,183 ha) on the survey date, the total kokanee abundance was 911,681 (range, 785,903-1,057,559). Age-0 kokanee comprised 48% of this total or 440,970 (range, 371,756-523,029) fish. Hydroacoustic evaluations of the Deadwood Reservoir kokanee population suggest that that abundance is responding to more intense escapement control efforts implemented in 2010. The kokanee population has declined to approximately 76% of estimated abundance in 2011. In past years, the age-0 year class of kokanee comprised approximately 60% of the total population, but in 2014, this proportion declined to 48%.

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INTRODUCTION

Deadwood Reservoir is a 1,260-ha impoundment located on the Deadwood River in Valley County, approximately 40 km southeast of Cascade, Idaho and 85 km northeast of Boise, Idaho (Figure 16). The reservoir offers a scenic setting and at a relatively high elevation, is a popular destination for many during the summer. Deadwood Reservoir has abundant sport fishing opportunities for kokanee *Oncorhynchus nerka,* resident fall Chinook Salmon *O. tshawytscha*, Rainbow Trout *O. mykiss,* and Westslope Cutthroat Trout *O. clarki lewisi*. Bull Trout *Salvelinus confluentus* are present in Deadwood Reservoir at very low abundance.

Over the last 10-12 years, the kokanee population in Deadwood Reservoir has fluctuated drastically. Because kokanee exhibit density-dependent growth, increased abundance resulted in a decline in mean length at maturity. Historically, this relationship has been evident at Deadwood Reservoir because the kokanee population experiences low angler pressure, has five tributaries with excellent spawning habitat, and abundances have increased quickly when escapement was not managed. In addition, Deadwood Reservoir had low densities of piscivorous predators that were incapable of reducing kokanee abundance.

Deadwood Reservoir's kokanee population also serves as Idaho's primary egg source for early spawning kokanee. In an average year, this population provides over 3 million eggs which are distributed across 15-20 waters statewide. The management goal for adult kokanee at Deadwood Reservoir is an average total length (TL) of 325 mm. Mean female kokanee length observed at the spawning trap on the Deadwood River has varied from a low of 208 mm in 1992 to a high of 421 mm in 2003. From 2006 through 2008, Idaho Department of Fish and Game (IDFG) sought to reduce the kokanee abundance and increase mean length by limiting spawning escapement into a number of the surrounding tributaries (Kozfkay et al. 2010). The effectiveness of these efforts was variable due to high flow events that washed out the picket weirs. However, efforts in 2008 were considered successful, particularly in Trail Creek and the Deadwood River. The egg take operation at Deadwood Reservoir was discontinued for one year in 2009 to evaluate the South Fork Boise River (SFBR) weir location. Egg take operations and escapement control efforts at Deadwood Reservoir resumed in 2010 and are expected to continue for the foreseeable future.

Weekly escapement objectives for the Deadwood River, established using annual hydroacoustic estimates of abundance and mean female fish length determined from gill net samples, and predicted fecundity could prove to be very beneficial for the management of the fishery. Current kokanee population management activities include annual hydroacoustic surveys and limiting and monitoring escapement with weirs on the Deadwood River and Trail Creek. In 2010 and 2011, kokanee escapement was controlled successfully in the Deadwood River, using a picket weir and trap, until the egg quota was met, after which the weirs were removed with an unknown number of prospective spawning kokanee remaining. This practice could have potentially altered the timing of spawning because the population was maintained by fish that spawned after weir operations ceased. To avoid shifting the spawn timing, weir operations from 2012 through 2014 incorporated weekly escapement goals for female kokanee and required that the weir was operated through the entire run. This allowed staff to pass a certain number of males and females above the weir throughout the entire run time to prevent alteration of run timing.

Additionally, IDFG re-instituted fall Chinook Salmon stocking in 2009 to diversify the sport fishery and perhaps assist in reducing kokanee abundance through the introduction of a piscivore. Previously, fall Chinook Salmon were stocked from 1995 through 1998 at densities of 1.6 to 3.7 fish/acre, but the program was discontinued when the kokanee population declined. Stocking was resumed in 2009. Currently, IDFG annually stocks approximately 5,000-7,000 fall Chinook Salmon fingerlings, which equates to a stocking density of 1.6 to 2.3 fish/acre. Despite low stocking densities, biologists need to ensure the fall Chinook Salmon abundance does not increase and consequently depress kokanee abundance so that management goals are not met. Fall Chinook redd counts were conducted between 2000 and 2001 but were discontinued when stocking ceased and abundances waned.

METHODS

Hydroacoustics

Hydroacoustic estimates of fish densities, lengths, and vertical depth distributions were obtained with a Hydroacoustic Technology, Inc. (HTI) Model 241-2 split-beam digital echosounder on July 21, 2014. Hydroacoustic methodology and analysis is described in detail in Butts et al. (2011). However, a new survey design was implemented in 2014, where 12 equal-length transects were located to avoid shallow areas that could damage the transducer (Figure 12). We planned to conduct both the old and new surveys on consecutive nights to make direct comparisons of results from the different transects. However, engine problems prevented collection of data along the old transects.

Curtain Nets

The pelagic fish community in Deadwood Reservoir was assessed with two small-meshed and two larger-meshed curtain nets during July 21-22, 2014 (Figure 12). The target species for sampling gear were kokanee and Chinook Salmon and therefore standard IDFG sampling protocol was not utilized, because the lowland lake sampling protocol targets the littoral region of a study lake. Net curtains were 49 m wide x 6 m deep and were suspended at various depths in the water column. The small mesh was comprised of 19, 25, 32, 38, 51, 76, and 102-mm stretch mesh, while the large-mesh net was comprised of 51, 57, 64, 76, 89, 102, 127, and 152-mm stretch mesh. Each curtain net, fished for one night, equaled one unit of gill net effort.

Captured fish were identified to species, measured for total length (± 1 mm), and weighed (±1 g for fish < 5,000 g or ± 10 g for fish ≥ 5,000 g) with a digital scale. Necropsies were conducted on all captured Chinook Salmon to assess sex, maturity, and diet. Otoliths were removed from kokanee and Chinook Salmon to estimate length-at-age. Catch data were summarized as the number of fish caught per unit of effort (CPUE) and the weight in kg caught per unit of effort (WPUE).

Kokanee Salmon Stream Count

The Deadwood River and Trail Creek weirs were installed on August 5, 2014. A visual count was conducted the following day to assess kokanee escapement above the weir. Individual fish were counted at four locations that were identified as major staging pools the previous year. The total number of kokanee was estimated visually and summarized.

Chinook Redd Surveys

The Deadwood River, from the confluence of Deer Creek downstream to the reservoir mouth (approximately 6-km), was surveyed on October 22, 2014 to index Chinook Salmon abundance (Figure 12). A two-person crew began at the confluence of Stratton Creek and walked downstream while another two-person crew surveyed upstream from the reservoir. All redds and live or dead Chinook Salmon were enumerated. GPS coordinates of redds, fish, and carcasses were recorded.

RESULTS

Hydroacoustics

Hydroacoustic data were analyzed to estimate kokanee abundance. Converted target strengths of fish ranged between 30 and 700 mm, and kokanee were assumed to range between 30 and 300 mm (Figure 13). Fish densities among transects ranged from 458 to 1,518 fish/ha with the highest densities corresponding to age-0 fish (Table 10). The lowest densities (153 fish/ha) among all age classes were age-2 and age-3 kokanee. Over all transects, total mean kokanee density was 764 (range, 658-886) fish/ha. When expanded to a population estimate using the reservoir surface area (1,183 ha) on the survey date, the total kokanee abundance was 911,681 (range, 785,903-1,057,559). Age-0 kokanee composed 48% of this total or 440,970 (range, 371,756-523,029) fish. Population estimates for remaining age classes are reported in Table 10.

Between 2009 and 2011, estimated kokanee abundance increased seven-fold, mostly due to the abundant age-0 year classes in 2010 and 2011 (Figure 14). Since 2011, hydroacoustic estimates suggested a 76% decrease in total kokanee abundance as a result of aggressive control of kokanee escapement beyond the weir. Additionally, age-0 kokanee production was reduced below 1 million in 2014, which will likely result in fish densities favorable to achieving the target length at maturity.

A negative relationship between mean female length (mm) at maturity and fish density (fish/ha) was observed using hydroacoustic estimates of abundance and mean female length at the Deadwood River weir from 2002 through 2014 (Figure 15; $r^2 = 0.52$, $P < 0.05$).

Curtain Nets

A total of 47 fish were captured during the pelagic lake survey on July 21-22, 2014 (Table 11). Approximately 60% of the catch was kokanee (n = 28), followed by Mountain Whitefish *Prosopium williamsoni* (21%; n = 10). Fall Chinook Salmon, Westslope Cutthroat Trout, and Rainbow Trout were also captured. CPUE and WPUE indices for combined species were 11.8 and 2.5, respectively (Table 11). In 2013, pelagic curtain nets proved to be more effective than IDFG standard lowland lake sampling gear at capturing kokanee and fall Chinook Salmon, the target species (Koenig et al. 2015).

The kokanee captured in curtain nets ranged from 240 to 300 mm (Figure 13) and were comprised of two age classes (ages 2-3; Figure 16). Younger fish (age-0) were not captured because available mesh sizes were too large. Kokanee CPUE was 7 fish/net night and WPUE was 1.2 kg/net night with net curtains. Larger kokanee were necropsied to determine sex and maturity, to assess mean length of females during the spawning run. From specimens collected in curtain nets, we projected the average length of a mature female at the weir three weeks later to be 267 mm.

Four other fish species were captured in curtain nets in 2014. One 310-mm fall Chinook Salmon was captured, which was a three year old immature male. This fish had two age-1 kokanee in its stomach, both approximately 105 mm. Fall Chinook Salmon CPUE was 0.3 fish/net-night and WPUE was 0.1 kg/net-night.

Mountain Whitefish, Rainbow Trout, and Westslope Cutthroat Trout were also captured in curtain nets and appear to be providing a valuable sport fishery at Deadwood Reservoir. Mountain Whitefish ranged from 270 to 375 mm and CPUE was 0.2 fish/net night. Rainbow Trout ranged from 355 to 420 mm, with a CPUE of 1.0 fish/net; and, all Rainbow Trout caught in 2014 appeared to be of hatchery origin (Figure 17). Westslope Cutthroat Trout ranged from 323 to 340 mm and all fish appeared to be wild origin as these fish were last stocked as fry in 1998.

Kokanee Stream Count

Several holding pools were identified in 2013 where kokanee congregate during the spawning period. No kokanee were observed during the visual survey of these areas in 2014. The weir was installed approximately 10 d earlier on August 5, 2014 to reduce early escapement into the Deadwood River.

Chinook Salmon Redd Counts

A total of 16 fall Chinook Salmon redds were counted along 6 km of the main stem Deadwood River in 2014 (Figure 12). Of these, 15 were observed between Deer Creek and the reservoir. One carcass and no live fish were surveyed. During the previous two years, only 13 and 7 Chinook Salmon redds were counted during annual October surveys. This suggests the spawning population is not increasing substantially, but annual monitoring should be continued. If Chinook Salmon redds increase substantially, IDFG may wish to reduce or cease stocking Chinook Salmon.

DISCUSSION

Hydroacoustic assessments of the Deadwood Reservoir kokanee population suggest that that the population is responding to control efforts implemented in 2010. The kokanee population has declined to approximately 76% of abundance estimates observed in 2011. Overall, kokanee density is approaching target densities of 500 fish/ha and mean length at maturity of females has increased to 267 mm. This is the first observed increase in mean length at maturity of females since 2009. Additionally, age-0 kokanee production fell below 1 million for the first time since 2009. On average, the age-0 year class of kokanee composed approximately 60% of the total population, but in 2014 this proportion declined to 48%, which should help to achieve the length-at-maturity objective in two years.

While kokanee densities and lengths appear to be moving towards management objectives, aggressive escapement control measures should continue. Annual monitoring has shown how quickly the Deadwood Reservoir population can increase when escapement in snot controlled, as in 2009. Mean length-at-maturity for female kokanee has increased from 2013 to

2014, but is still nearly 60 mm under the management goal length of 325 mm (Figure 18). The model predicts the management goal for kokanee length is met or exceeded when fish densities are near 350 fish/ha. This relationship may be considered when evaluating how many fish to pass through the weir during a spawning run based on the hydroacoustic estimate for that year. Generally, there appears to be a one year lag-time between detected population declines and a response in mean length. Therefore, mean length at maturity of female kokanee is expected to increase and meet objectives in 2015.

Beginning in 2012, IDFG also attempted to manage escapement throughout the spawning run by passing 350-400 females above the weir each week. We arrived at these escapement estimates by projecting the number of kokanee spawners needed to produce 400,000 to 600,000 age-0 kokanee. Female kokanee escapement were assumed to likely double (700-800 females) because spawning fish will be missed before and after weir operations and the potential for weir failure is always present. By operating the weir for the entire spawning run and by passing a limited number of individuals above the weir throughout the spawning run, IDFG should be able to continue aggressive control measures and egg collections without altering spawn timing. In 2015, passage of females should be shaped to follow the natural escapement curve. For example, the peak spawning escapement occurs during the first week of September and therefore passage of females should reflect that peak rather than consistent releases of fish throughout the spawning run. Overall, kokanee abundance estimates and mean length-at-maturity of spawning females in 2014 suggested that keeping the population roughly between 800,000 and 1 million fish provides a quality kokanee fishery in terms of both size and abundance, and also appears sufficient for meeting egg take quotas for the hatchery system (Figure 18).

Pelagic curtain nets proved more useful that standardized gill nets, which target the littoral zone of the lake, at capturing kokanee and Chinook Salmon in 2013. However, 2-3 nights of netting may be needed to obtain a reasonable sample of fish, particularly fall Chinook Salmon. Two nights of netting was originally planned in 2014 but only one night was conducted because of equipment problems. In the future, netting should be continued until at least 15-30 fall Chinook Salmon are collected for growth and diet analysis. Diet analysis will help to substantiate the theory that piscivorous Chinook contribute to limiting kokanee abundance. Collecting kokanee with curtain nets was useful for determining mean length and predicted fecundity of female kokanee and for calculating escapement objectives for the upcoming spawning run in addition to size verification of hydroacoustic data.

RECOMMENDATIONS

1. Continue monitoring the kokanee population in Deadwood Reservoir with hydroacoustics and sample pre-spawning fish with curtain nets to predict mean length in 2015. Compare the number of 2015 age-0 kokanee hydroacoustic estimates to projected escapement objectives.

2. Participate in development of statewide kokanee monitoring evaluations using net curtains.

3. Operate spawning weirs on the Deadwood River and Trail Creek to limit kokanee escapement in both tributaries on an annual basis. Weir installation should occur during the first week of August. Continue to develop and improve escapement goals and protocols.

4. Maintain annual stocking of 5,000 fall Chinook Salmon fingerlings in spring or early summer. Continue to evaluate survival, growth, diet, and maturity of stocked Chinook Salmon during annual net surveys.

5. Continue monitoring natural recruitment of fall Chinook Salmon with October redd counts.

Table 10. Kokanee densities (number/ha) per transect and total abundance estimates calculated by arithmetic and geometric mean densities at Deadwood Reservoir, Idaho on July 21, 2014.

		Fish densities (number / ha)				
Transect	Transect length (m)	Age-0	Age-1	Age-2	Age-3	Total
1	755	269	47	78	64	458
2	754	407	142	112	85	746
3	784	192	141	105	74	512
4	740	428	153	89	56	726
5	938	202	124	102	41	470
6	1612	223	132	96	46	497
7	824	865	396	175	82	1,518
8	660	474	544	317	101	1,436
9	749	449	254	166	86	955
10	856	281	180	171	36	668
11	815	426	265	127	79	897
12	852	717	203	98	41	1,060
	Geometric Mean (GM)	**369**	**181**	**126**	**63**	**764**
	90% CI (GM)	**311 to 438**	**145 to 227**	**109 to 145**	**55 to 71**	**658 to 886**
	Abundance (GM)	**440,970**	**216,497**	**150,295**	**74,719**	**911,681**
		371,756 to 523,029	**173,286 to 270,410**	**130,597 to 172,937**	**65,963 to 84,617**	**785,903 to 1,057,559**

Table 11. Total catch, catch per unit effort (CPUE), total weight (kg) and weight per unit effort (WPUE) by species and gear type for the lowland lake survey conducted in Deadwood Reservoir, Idaho on July 21-22, 2014 using pelagic curtain nets.

Species	Total Catch	Total CPUE	Total Weight	Total WPUE
Kokanee (Early Spawner)	28	7.0	4.9	1.2
Chinook Salmon	1	0.3	0.3	0.1
Mountain Whitefish	10	0.2	2.7	0.7
Rainbow Trout (Hatchery)	4	1.0	0.8	0.2
Westslope Cutthroat Trout	4	1.0	1.2	0.3
Total	47	11.8	9.8	2.5

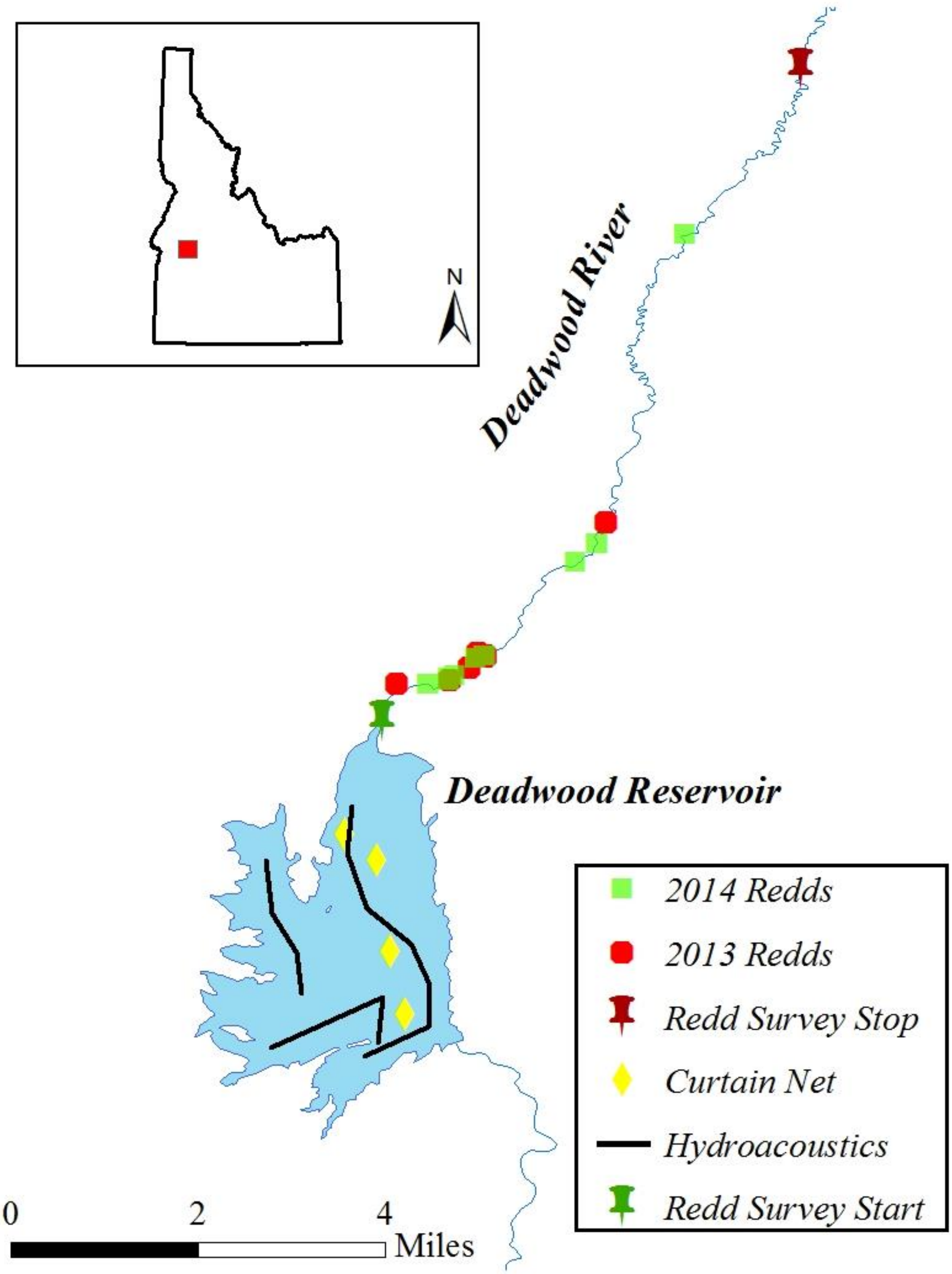

Figure 12. Map of Deadwood Reservoir, Idaho showing hydroacoustic transects, sampling gear locations, and redd survey information during 2014.

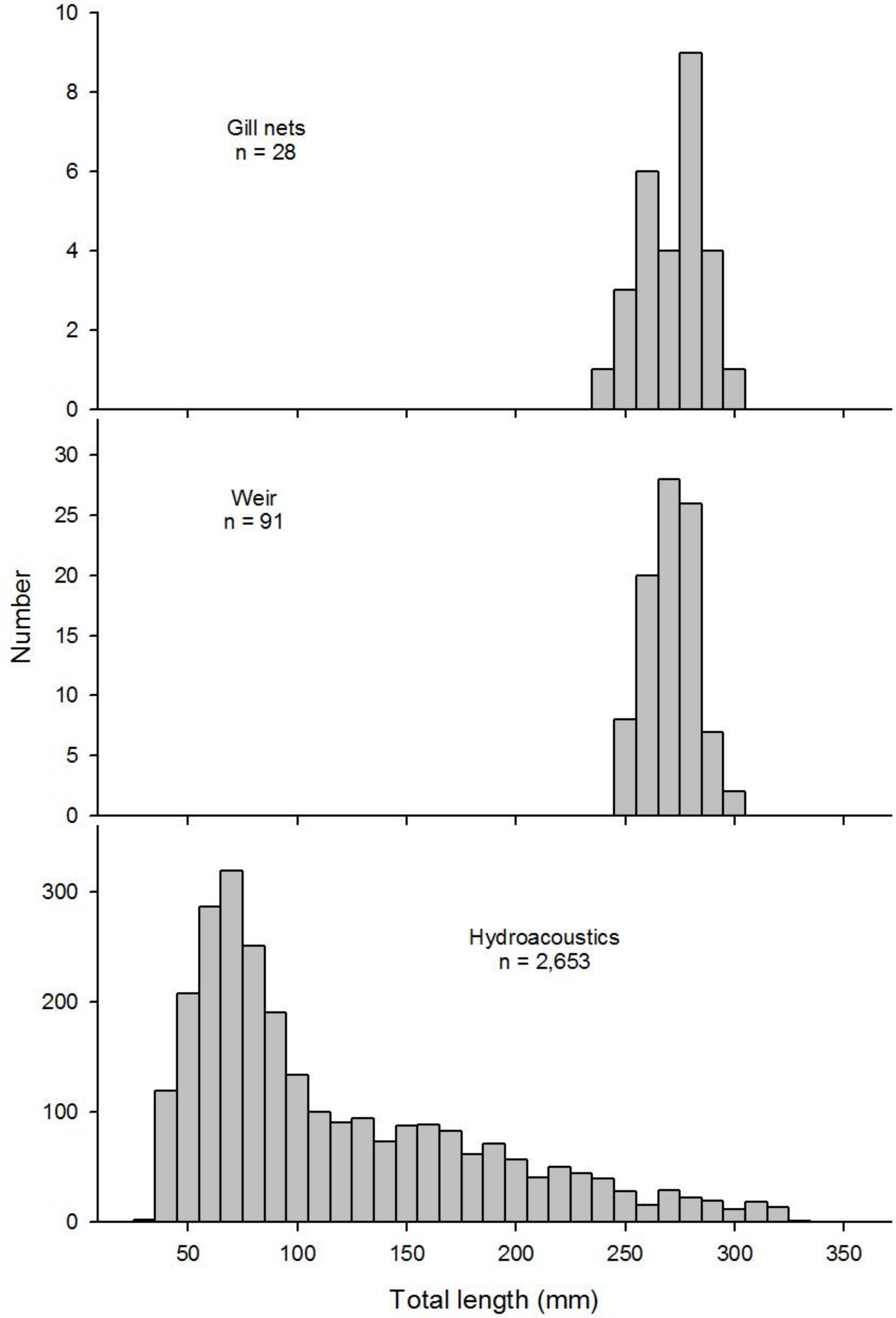

Figure 13. Length distributions of kokanee sampled with curtain nets, weir, and estimated from converted hydroacoustic target strengths at Deadwood Reservoir, Idaho in 2014.

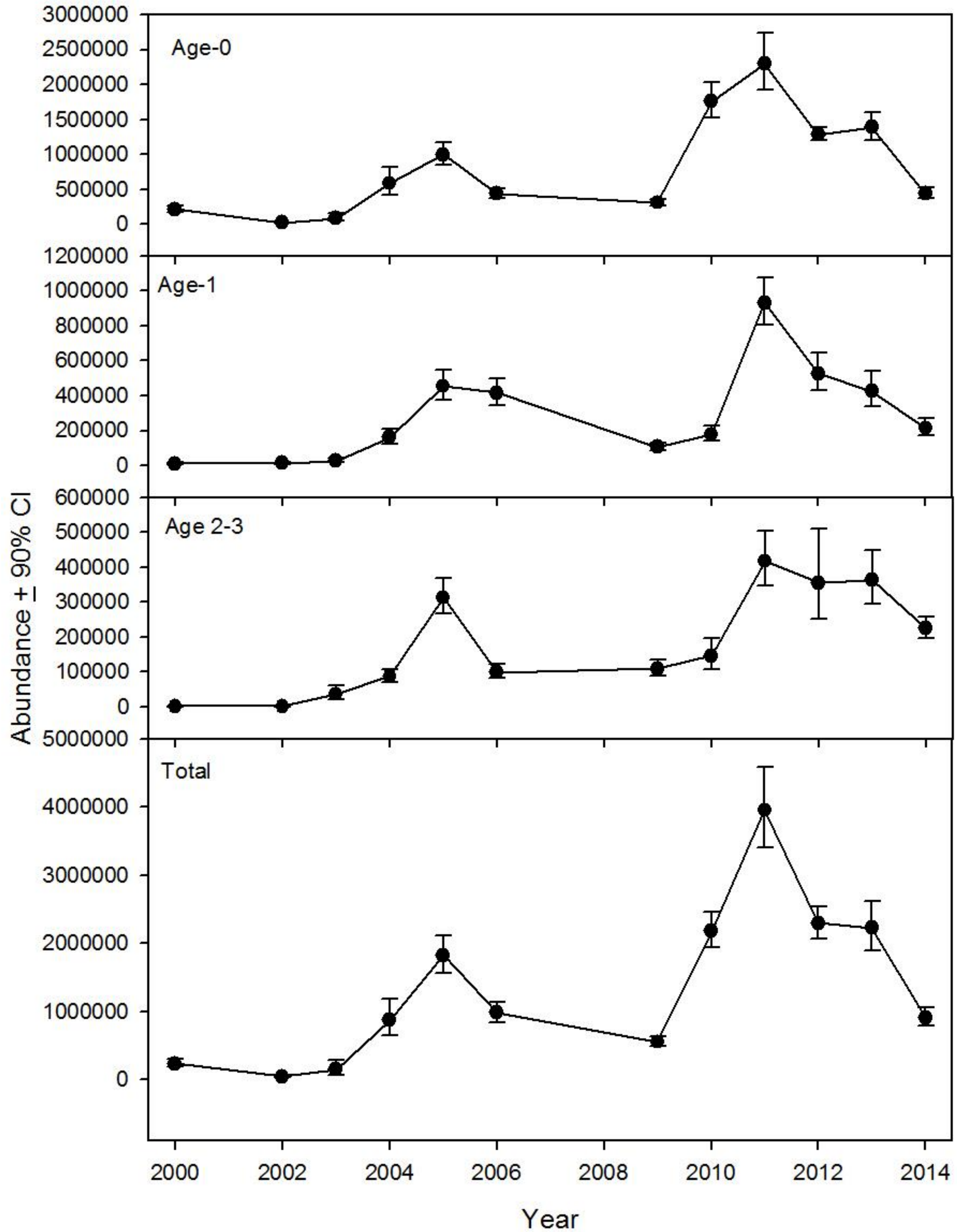

Figure 14. Comparison of kokanee abundance estimates ± 90% Confidence Intervals for fish <100 mm (age-0), 100-199 mm (age-1), ≥ 200 mm (age 2+), and total fish as estimated from annual hydroacoustic surveys from 2000 through 2014 at Deadwood Reservoir, Idaho.

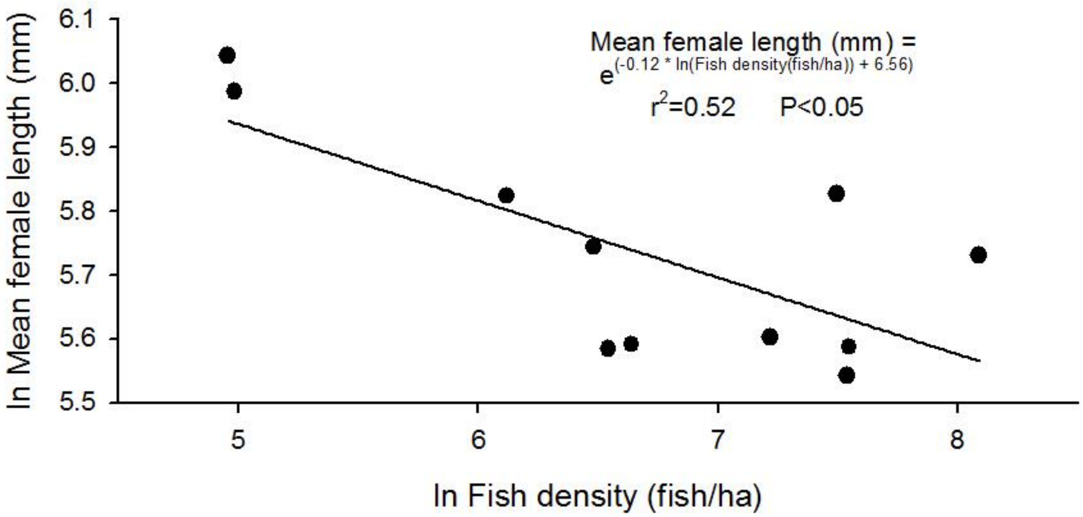

Figure 15. Density-dependent relationship plotted as a function of fish density and length-at-maturity of females, for kokanee at Deadwood Reservoir, Idaho. Fish density was estimated using summer hydroacoustic estimates while mean female length at maturity was obtained from weir data on Deadwood River.

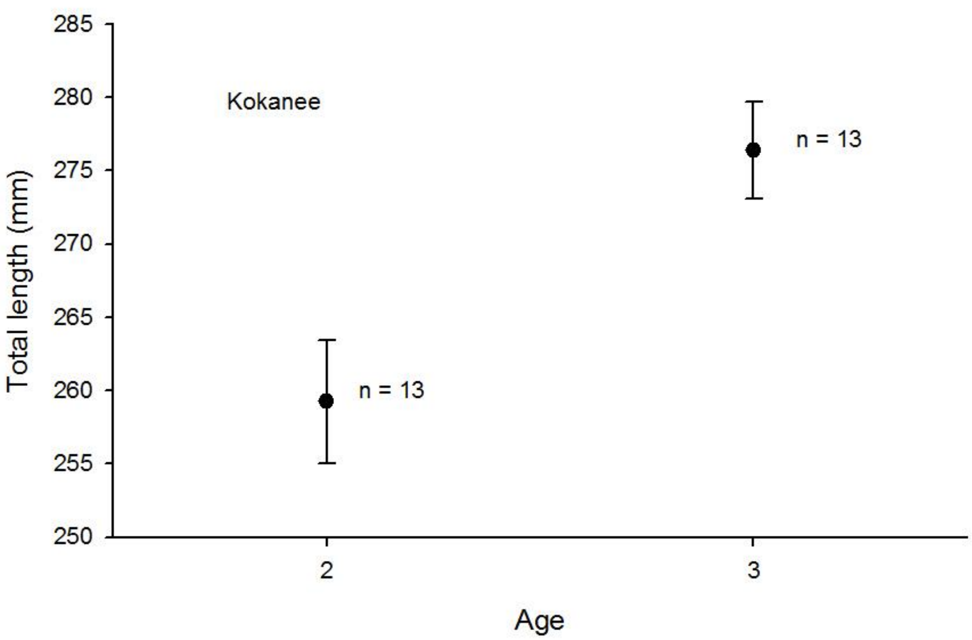

Figure 16. Length at age of kokanee collected in four net curtains at Deadwood Reservoir during July 21-22, 2014. Error bars represent 90% CI.

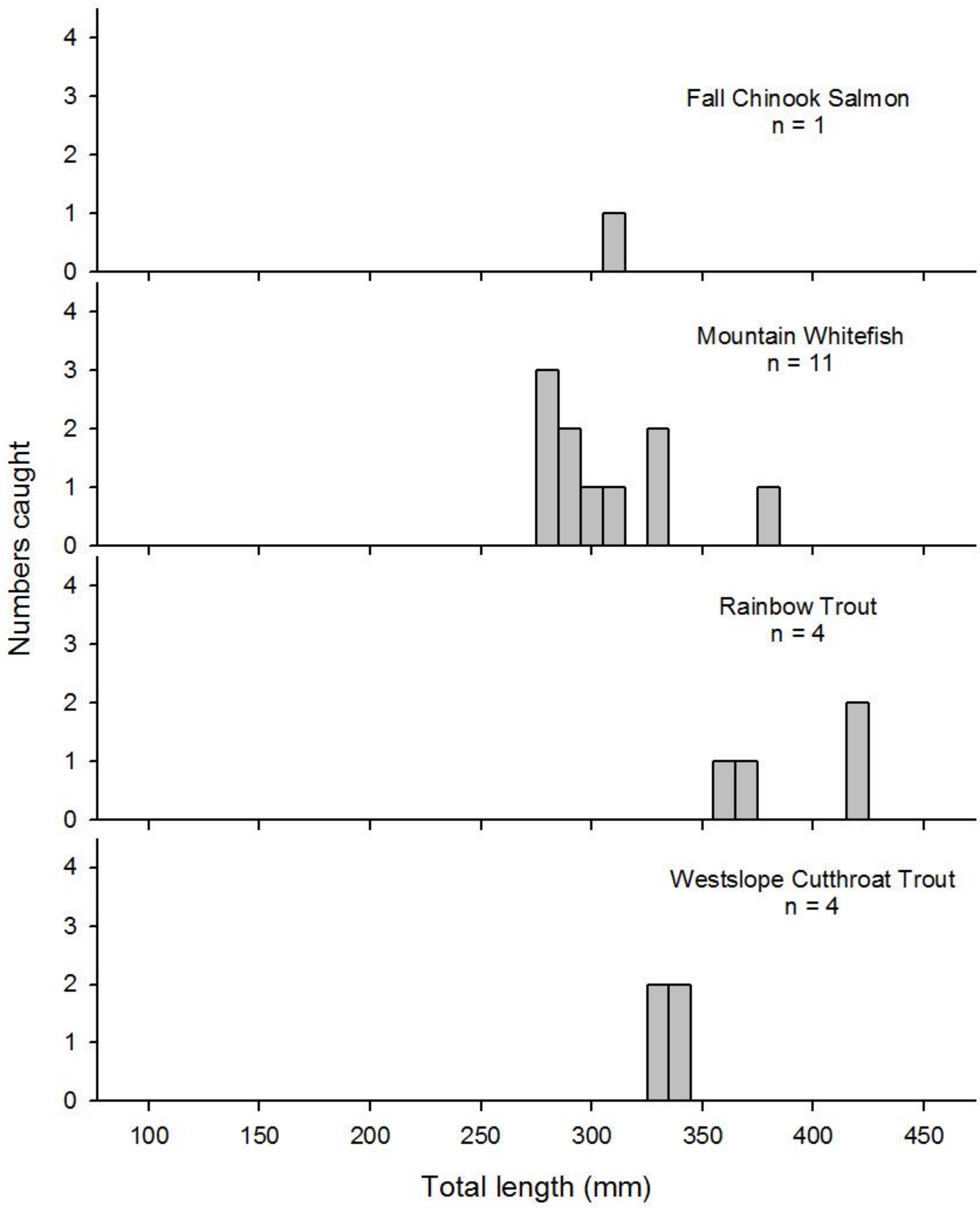

Figure 17. Length distributions for fall Chinook Salmon, Mountain Whitefish, Rainbow Trout, and Westslope Cutthroat Trout caught in curtain nets at Deadwood Reservoir, Idaho on July 21-22, 2014.

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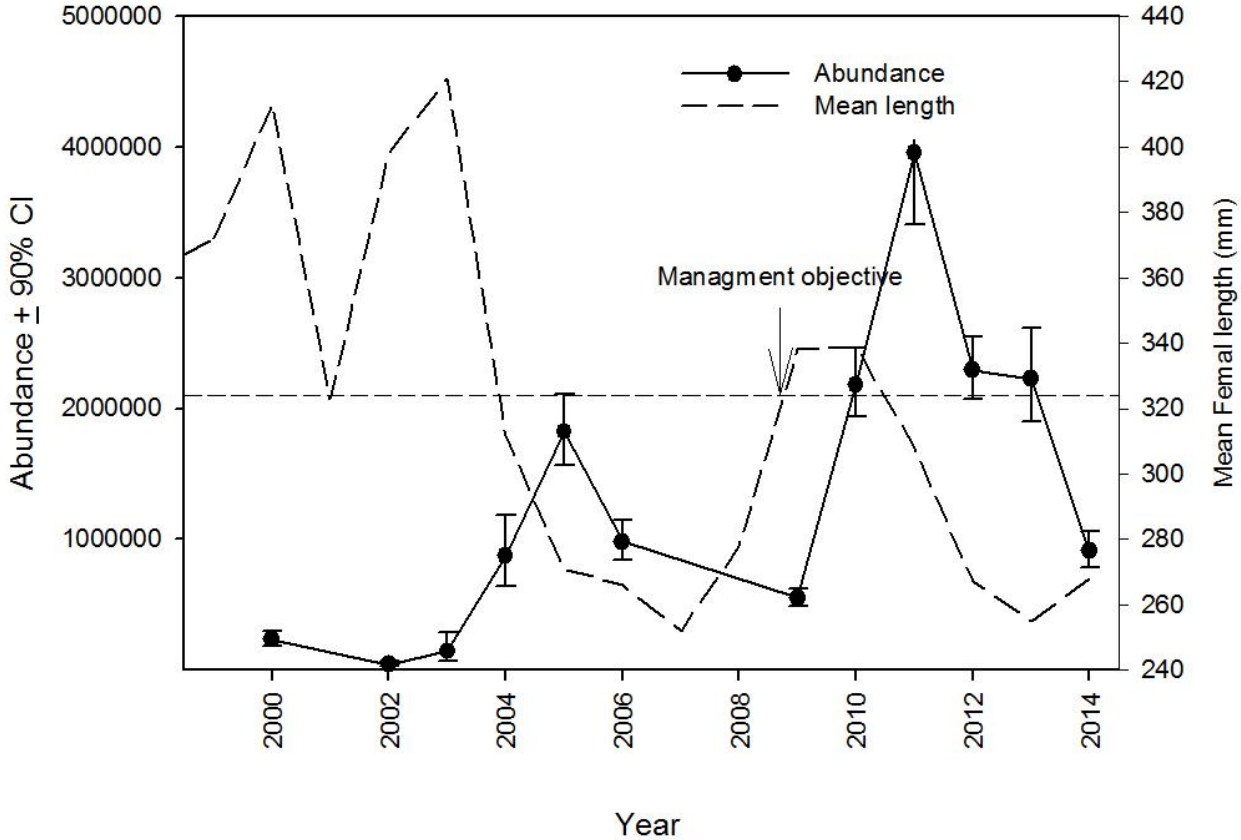

Figure 18. Trend data for 2000-2014 hydroacoustic abundance estimates and mean female total length (mm) collected at the Deadwood River trap from 1998 through 2014. The management goal for mean adult length is represented by the horizontal dotted line.

ASSESSMENT OF LARVAL FISH PRODUCTION IN BROWLEE AND CJ STRIKE RESERVOIRS

ABSTRACT

Southwest Region fisheries staff sampled larval fish in Brownlee and CJ Strike reservoirs during 2014 to monitor trends in crappie reproduction and recruitment. Larval fish density was monitored using a horizontal Neuston trawl net near the waters' surface during the night, at ten or eleven sites within each reservoir. Since 2005, average larval densities in Brownlee Reservoir during the week of maximum abundance have ranged from 5 to 264 crappie/100 m^3, with an average of 72 crappie/100 m^3 (n = 10 years). Densities during 2014 (53 crappie/100 m^3) were below the average (2005-2014) but increased from 2013. From 2005 to 2014, average larval densities in CJ Strike Reservoir during the week of maximum abundance have ranged from 1 to 57 crappie/100 m^3, with an average of 17 crappie/100 m^3 (n = 10). Densities during 2014 (22.9 crappie/100 m^3) were slightly higher than 2013 (15.9 crappie/100 m^3), and similar to average values during the last 10 years of sampling.

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INTRODUCTION

Fisheries for Black Crappie *Pomoxis nigromaculatus* and White Crappie *P. annularis*, Bluegill *Lepomis macrochirus*, and Yellow Perch *Perca flavescens* are popular among anglers in the Southwest Region when abundant. However, reproduction, recruitment, or year-class strength for these species varies widely between years, which often lead to inconsistent catch rates several years later. Year-class strength seems to be determined at early life stages, whether this occurs before or after the first winter is unknown. Fisheries personnel are interested in quantifying year-class strength before fish become vulnerable to anglers, so that anglers may be informed of potential fisheries quality. Newly hatched fish, hereafter referred to as larval fish, congregate at the surface of lakes and reservoirs at night to feed on small zooplankton or insects. Larval fish seek the surface at night because they are less vulnerable to predation during the dark. Monitoring larval fish densities with Neuston nets at night is one way to provide information on reproductive success and potential year-class strength. Documenting years with low larval production could predict years of poor fishing two to three years later, when crappie would typically be vulnerable to capture by anglers. Alternatively, documentation of years with moderate or high production could identify biotic characteristics necessary to successful production. Monitoring of year-class strength in Brownlee and CJ Strike reservoirs was conducted by Idaho Department of Fish and Game (IDFG) fisheries research staff since 2005 as part of a statewide research project. However, that project was discontinued by 2010, and Southwest Region staff has continued this work.

OBJECTIVES

1. Assess reproductive success of recreationally important warm-water fishes

2. Describe abiotic factors that affect reproductive success and recruitment in subsequent year classes of warmwater fishes.

METHODS

Horizontal surface trawls were used to sample larval fish at 11 and 10 sites in Brownlee and CJ Strike reservoirs, respectively. Trawls were conducted throughout each of the reservoirs (Figure 19 and 20) using a 1-m high x 2-m wide x 4-m long Neuston net with 1.3-mm mesh. Trawling commenced at dusk and all sites were completed within three to four hours. Each trawl was 5 min in duration and we used a flow meter fitted to the net to estimate the volume of water sampled. The average water volume sampled was 394 and 255 m^3/tow at Brownlee and CJ Strike reservoirs, respectively. We trawled approximately bi-weekly beginning June 18 and ending July 17, 2013, which overlapped peaks of crappie production in previous years. Specimens were fixed in 10% formalin for 2 weeks then rinsed and stored in 70% ethanol. Sampled fish were viewed under a dissecting microscope and identified to species and measured for total length (mm). If the total number of larval fish exceeded 50 individuals from a site, we randomly selected a subsample of 50 individuals, identified and measured those, then counted the remainder, and extrapolated to the whole sample from the site. Abundance from individual sample sites was averaged for a sample date, then averages were compared over all sample dates to determine the peak average larval fish density. Larval densities were compared to past years and average densities over past years to index year-class strength.

RESULTS

Brownlee Reservoir

We conducted a total of 33 trawls across three sampling dates on June 18, June 30, and July 14, 2014. Smallmouth Bass and crappies were the only species collected, with crappies, composing 99.7% of the identified fish. Peak average larval density of crappies density occurred during our first sample on June 18 (53 fish/100m^3), which was two weeks earlier than 2013. During 2014, densities of larval crappies were highest at the upper most and lower most sites in the reservoir (Figure 21), with only moderate densities throughout the middle portion. The highest density of larval crappies occurred near Brownlee Dam at Site #11 (198 fish/100 m^3) on June 18. However, at the far upper end of Brownlee Reservoir, Site #1 showed the second highest densities of 145 and 141 fish/100 m^3 on both June 18 and June 30, respectively (Figure 21). Since 2005, mean density of larval fishes in Brownlee Reservoir during the week of maximum abundance has ranged from 5 to 264 fish/100 m^3 with a mean of 72 fish/100 m^3 (n = 10). Densities during 2014 (53 fish/100 m^3) were below the 10-year average, but considerably higher than 2013 (10 fish/100m^3).

CJ Strike Reservoir

At CJ Strike Reservoir, we conducted 30 total trawls across three sampling dates. Larval Bluegill, Smallmouth Bass, crappies, and Channel Catfish were all collected, but crappies comprised 96% of the larval fish collected. The highest mean density of larval crappies occurred during the first sample on June 19 at 23 fish/100 m^3, with the majority of fish sampled at sites #2-4 in the Bruneau Arm (Figure 22). Sites #7-10 in the Snake River Arm showed some production of larval crappies (7-22 fish/100 m^3), but only during our last sample on July 17, 2014. Mean density of larval crappies during the week of maximum abundance has ranged from 1.0 to 57.7 fish/100 m^3 over the last ten years. Maximum larval fish densities during 2014 (22.9 fish/100 m^3) were higher than the ten-year average (17 fish/100 m^3), and the highest since 2008.

DISCUSSION

Production of larval crappie in large reservoirs in the Southwest Region shows high spatial and temporal variation. Similar to 2012, maximum larval fish density sampled in CJ Strike and Brownlee reservoirs occurred during the first sample period around June 18-19. It is possible we may have missed the peak larval densities since we did not sample earlier and therefore cannot characterize the ascending limb of the curve. Sampling in 2015 should occur earlier in June to ensure the peak abundance is documented. Larval crappie density was again below average for Brownlee Reservoir, but showed marked increase over 2013. Larval crappie appeared to be dispersed more evenly throughout the reservoir than in past years, with peak densities occurring at both the uppermost and lowermost sites simultaneously (Figure 21). Past data have shown crappie year class strength may be correlated to high densities of larval fish in the upper reservoir. It is possible that larval crappie produced in the lower reservoir suffer high entrainment rates, though it is difficult to substantiate this hypothesis, because of general poor survival of larval crappie and the difficulties with marking and recapturing fish of this size. If true, crappie recruitment may depend largely on production in the upstream portion of the reservoir, suggesting that 2014 may be an average year for crappie production relative to previous samples from the upper reservoir.

Larval fish production in CJ Strike Reservoir during 2014 was near average for this system, but the distribution shifted back towards the Bruneau Arm. Sampling in 2012 and 2013 showed the highest larval crappie densities occurred in the main reservoir pool. However, trends in 2014 reverted to the more typical pattern, where the highest densities of larval fish were sampled in the Bruneau Arm (Figure 22). Despite high production of larval crappies in 2014, recruitment to the fishery is likely to be average due to the high abundance of adult yellow perch.

RECOMMENDATIONS

1. Collect age structures and total lengths from harvested crappies at Brownlee and CJ Strike reservoirs to relate adult abundances to larval abundances.

2. Explore alternative methods to monitor year-class strength of crappies, such as using otter trawls to document relative abundance of advanced age-0 and age-1 crappies.

3. Compare trends in larval crappie catch to Idaho Power Company electrofishing trend surveys. Determine whether larval fish densities correlate to densities of larger juveniles and adults.

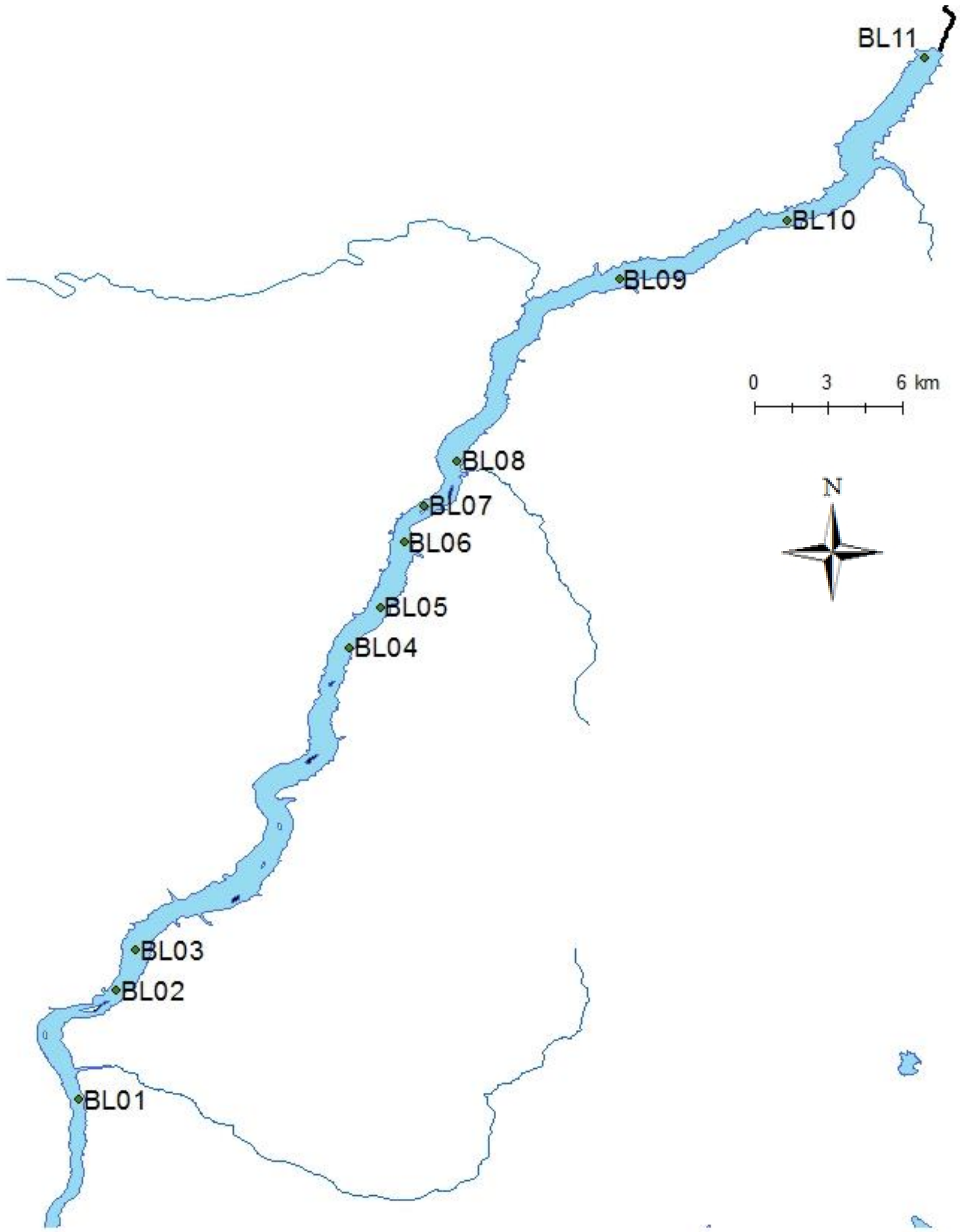

Figure 19. Location of 11 trawl sites used to index the abundance of larval fish in Brownlee Reservoir from 2005 through 2014.

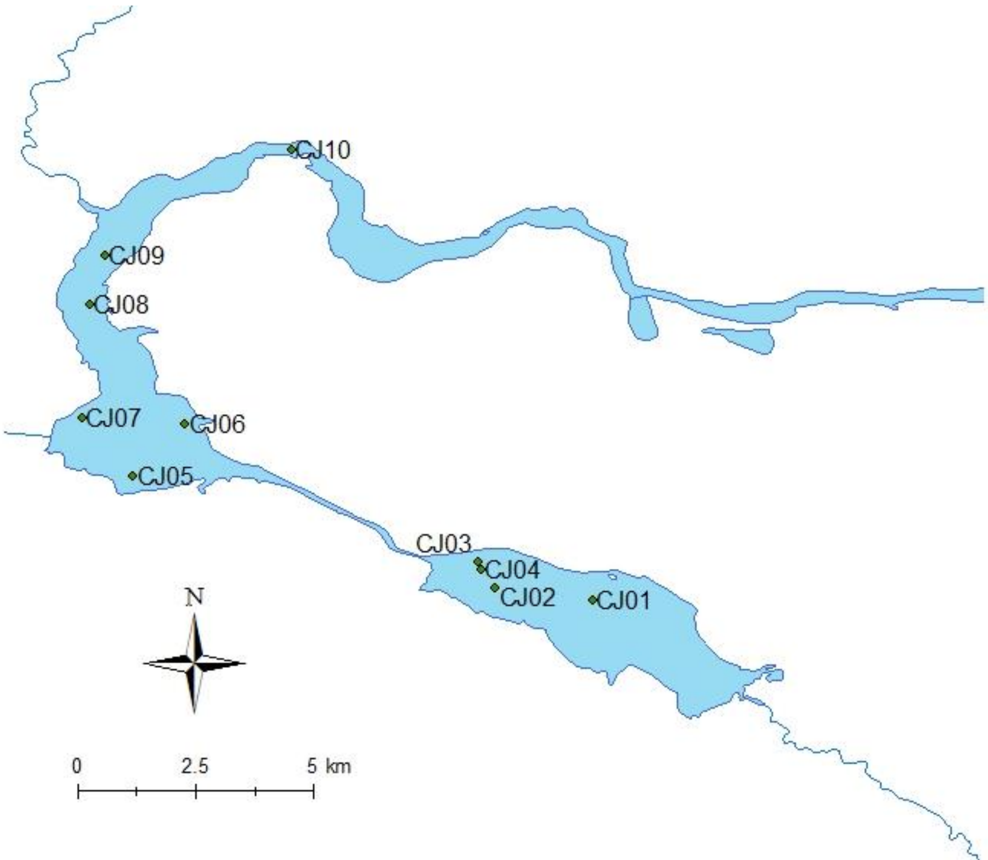

Figure 20. Location of 10 trawl sites used to index the abundance of larval fish in CJ Strike Reservoir from 2005 through 2014.

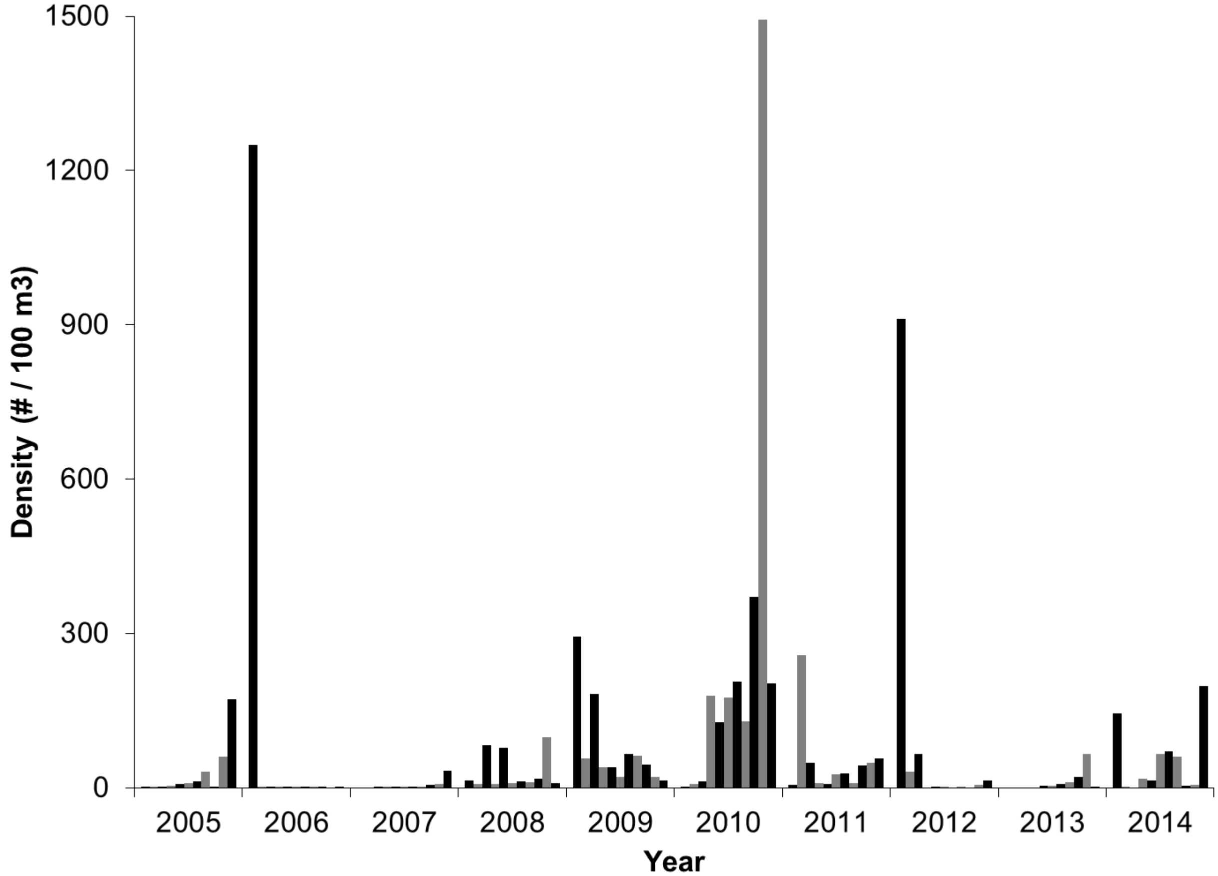

Figure 21. Densities of larval crappies (number/100 m^3) in Brownlee Reservoir from 2005 through 2014. Bars within each year represent 11 individual sites. Site 1 (upstream) through site 11 (near Brownlee Dam) are displayed from left to right within each year.

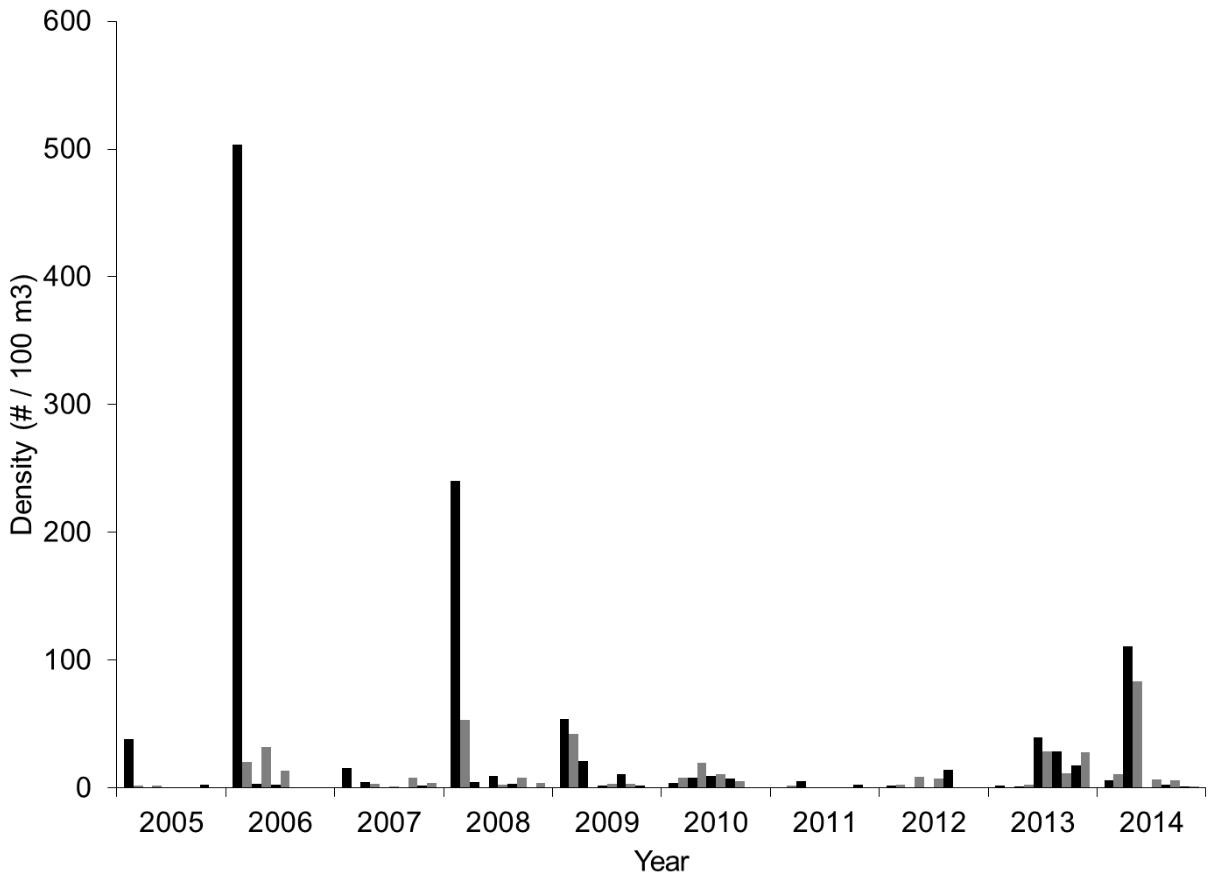

Figure 22. Densities of larval crappies (number/100 m^3) measured in CJ Strike Reservoir from 2005 through 2014. Bars within each year represent 10 individual sites. Sites 1 through 10 are displayed from left to right within each year.

EXPLOITATION AND USE RATES OF CHANNEL CATFISH IN LAKE LOWELL

ABSTRACT

Lake Lowell is a 4,000-hectare irrigation reservoir located 10 km southwest of Nampa, Idaho. Due to its' proximity to southwest Idaho's population center, Lake Lowell receives substantial fishing pressure for Largemouth Bass *Micropterus salmoides*, several panfish species, and Channel Catfish *Ictalurus punctatus*. The Idaho Department of Fish and Game stocks Channel Catfish at Lake Lowell annually. Current fishing regulations do not specify any daily bag limits or length restrictions for Channel Catfish. The goal of this study was to describe the size structure and angler exploitation rates of Channel Catfish in Lake Lowell. We tagged and released 316 Channel Catfish during the summer of 2013 with an additional 180 tagged fish in 2014. Mean total length of tagged Channel Catfish (90% confidence intervals) was 556 mm (± 6) with a range of 244 to 845 mm. Proportional stock density indicated the population was primarily composed of quality-length fish (410 mm) and longer. Tag reports were collected through November 2014. First-year tag reports for the 2013 release group indicated 10% harvest and 18% total use. Second year tag reports were much lower, with only 3 additional tag reports. Including second year tag reports, harvest and total use for the 2013 release group were 11.2% and 19.5% respectively. First year tag reports for the 2014 release group (9 tags) indicated 6.2% harvest and 10.4% total use. Stocked Channel Catfish appear to be capable of living at least 8-10 years, so we recommend continuing to monitor tag reports to evaluate harvest and total use which may accrue over several years.

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INTRODUCTION

Lake Lowell is a 4,000-hectare irrigation reservoir located 10 km southwest of Nampa, Idaho. Inflow through New York Canal and outflow through two dams are administered by the Bureau of Reclamation. The reservoir was built from 1906 to 1909 by forming four embankments around a naturally-occurring low lying area. Shortly thereafter, the lands surrounding the reservoir were incorporated into the National Wildlife Refuge system and continue to be managed by the U. S. Fish and Wildlife Service (USFWS). Uniquely, no streams or rivers flow into the reservoir; instead, water is supplied by the New York Canal, which diverts water from the Boise River. The reservoir is fairly shallow with a maximum depth of 11 m. Much of the littoral zone is occupied by extensive beds of smartweed (*Polygonum* spp.).

Due to its' proximity to southwest Idaho's population center, Lake Lowell receives substantial fishing pressure. Largemouth Bass *Micropterus salmoides* are targeted most often by anglers and several tournaments are held annually. Panfish fisheries (including Black Crappie *Pomoxis nigromaculatus*, Bluegill *Lepomis macrochirus*, and Yellow Perch *Perca flavescens*) are also popular. However, these populations have fluctuated widely leading to inconsistent fishing. Lake Lowell is managed under general fishing regulations, except for Largemouth Bass and Smallmouth Bass *Micropterus dolomieu*. Bass are managed under a no-harvest regulation from January 1 thru June 30 and a two fish, 305-406 mm protected slot limit thereafter. Additionally, the USFWS restricts motor boat usage on the lake from April 15 and September 30. Because of this, only small portions of the reservoir are accessible to anglers during much of the year.

The Idaho Department of Fish and Game (IDFG) stocks Channel Catfish *Ictalurus punctatus* at Lake Lowell yearly. Until 2014, the annual stocking goal was 10,000 fish. However, the number stocked has varied from approximately 6,000 to 10,000 since 2003 (Table 12). Beginning in 2014, managers reduced the annual stocking request to 5,000 Channel Catfish due to financial constraints. Under the current general fishing regulations, there are no bag limits or length restrictions for Channel Catfish. Very little data currently exist to describe exploitation and use rates for Channel Catfish at Lake Lowell, or whether current stocking programs are effective. This study aims to describe the size structure and harvest rates of Channel Catfish in Lake Lowell.

OBJECTIVES

1. Describe the size structure and exploitation and use rates of Channel Catfish in Lake Lowell.

METHODS

We collected Channel Catfish using tandem baited hoop nets as described by Michaletz and Sullivan (2002), and used successfully in northern Idaho waters (Get citation). Each set of hoop nets consisted of three nets set in tandem order attached bridle to cod end. An anchor was attached to the rear of the last net, and the front end of the first net to aid in stabilizing the series while fishing. Additional anchors were added between the middle and front net to prevent the nets from collapsing while removing fish. Each net series was baited with at least two mesh bags filled with commercially available soybean cake. We used model HN-16 hoop nets from

Miller Net Company. Nets were constructed from 91-cm diameter hoops measuring approximately 3.4 m in length, made up of seven metal hoops constructed of #15 twine with 25.4-mm bar mesh, and equipped with 6-m bridles that separated consecutive nets. Two-fingered crow foot throats were attached to the second and fourth hoop. To prevent escapement from the cod end, the rear throat was narrowed with 25-mm rope. Nets were set along randomly along the shore of Lake Lowell in each of three basins, along gently sloping shorelines in water depths of 2-4 m. Nets were soaked for 2 to 4 d, after initial 1 d soaks showed low catch rates.

All Channel Catfish captured were measured for total length (mm), weighed (nearest g), and tagged using Carlin dangler tags (Wydoski and Emery 1983). Each Carlin dangler tag was threaded to the mid-point of a 200 mm piece of stainless steel wire. After the tag was positioned at the mid-point of the wire, we twisted the wire five times to lock it in place. A pair of hypodermic needles affixed to a wooden dowel, was inserted through the fish's body below and slightly posterior to the dorsal spine. The end of the tag wire was inserted through the hypodermic needles to pass through the fish. The needles were then removed, and the wire ends were twisted about five times on the opposite side of the fish and trimmed. Each tag included a unique identification number, the abbreviation IDFG, and the Tag-You're-It! tag reporting hotline phone number (1-866-258-0338). Anglers could report tagged fish using the phone number on the tag, or through a tag reporting portal available on IDFG's website (https://fishandgame.idaho.gov/feedback/fish/forms/reportTaggedFishAngler.cfm). Tagged fish were released in open water away from trap sites to encourage random mixing and avoid repeated capture.

Proportional stock densities (PSD) were calculated as described by Anderson and Neumann (1996) and Neumann et al. 2012, using 280 mm as "stock size" and 410 mm as "quality size". Relative weight (W_r) was calculated as an index of general fish body condition where a value of 100 is considered average. Values greater than 100 describe robust body condition, whereas values less than 100 indicate less than ideal foraging conditions.

Tag return data were queried from the Tag-You're-It! database in November 2014 and separated by the year released and returned. Adjusted exploitation and adjusted total use (harvest plus catch-and-release) were calculated according to the methods in Meyer et al. (2010). There is no species-specific tag reporting rate for catfish in Idaho, so we used a mean tag reporting rate of 53%, based on an overall average statewide reporting rate across all species (Meyer et al. 2010). We compared these reporting rates with those calculated using the 72% tag reporting rate for Channel Catfish in Missouri (Michaletz et al. 2008).

RESULTS

We tagged and released a total of 496 Channel Catfish, 316 during summer 2013, and 180 during summer 2014. Fish were collected, tagged and released weekly from June 12 to July 22, 2013, and again on March 8, and June 25-26, 2014. Sampling was discontinued in late summer as water quality degraded and lake levels became too low to operate boats safely. Sampling in 2014 ceased after approximately 500 total tagged Channel Catfish were released.

Mean total length of captured and tagged Channel Catfish was 556 mm (90% CI, 6) with a range of 244 to 845 mm (Figure 23). The sample was composed primarily of large adult fish, with the median total length of 568 mm. This differed from previous sampling in 2006, when the mean total length of catfish was 427 mm (22), ranged from 240 to 720 mm, with a median of 381 mm (Figure 23). Mean weight of tagged Channel Catfish was 1,896 g (70) with a range of

124 to 5,030 g. Mean PSD of Channel Catfish was 95, indicating the sample was primarily composed of quality-sized fish and larger (Figure 23). Mean relative weight (W_r) was 105 (2), indicating tagged fish were in above-average body condition.

As of November 15, 2014, a total of 42 tags had been reported, with one having been found dead on the bank (41 live fish caught). For the 2013 release group, 17 fish were reported as harvested, while 12 were released (41%). When adjusted for the nonreward tag reporting rate, exploitation and total use of Channel Catfish were 10.0% and 17.7%, respectively (Table 13). Second year tag reports were much lower, with only 3 additional tags reported. Including second year tag reports, harvest and total use for the 2013 release group were 11.2% and 19.5% respectively. Using the higher 72% tag reporting rate of Michaletz et al. (2008), exploitation and total use decrease to 8.4% and 14.6%, respectively (Table 13). Of the 180 tags released in 2014, nine were reported by November 2014. First year tag reports for the 2014 release group (9 tags) indicated 6.2% harvest and 10.4% total use. Using the higher 72% tag reporting rate of Michaletz et al. (2008), calculated exploitation and total use decrease to 4.7% and 7.8%, respectively (Table 13). Except for one tag caught in March 2014, all reported tags were caught between May and September.

DISCUSSION

Compared to previous sampling at Lake Lowell in 2006, our 2013 sample contained a higher proportion of large catfish. The median total length from 2006 to 2013 changed from 381 to 570 mm, respectively. Furthermore, the sample contained a large percentage of quality-sized fish. The 2006 sampling used a variety of gill nets with varying mesh sizes and trap nets, whereas only baited hoop nets were used in 2013. It is possible that hoop nets select for larger Channel Catfish, misrepresenting the size distribution in the reservoir. Michaletz and Sullivan (2002) found that hoop nets created unbiased length distributions for Channel Catfish longer than 250 mm. Our results are very similar, as we caught very few fish shorter than 250 mm, though gill nets did collect these smaller sizes in previous years (Figure 23). Hoop nets may not be effective for collecting hatchery Channel Catfish shortly after stocking, but should be effective at sampling once they reach 300 mm. Our sample of 496 fish should accurately describe the size structure of Channel Catfish longer than 250 mm in Lake Lowell, based on a recommended sample size of 300 fish (Michaletz and Sullivan 2002).

Of the 316 Channel Catfish tagged during 2013, 15% (48) had adipose fin clips. All Channel Catfish stocked in 2005 and 2006 were marked with adipose fin clips. These fish are now 8-9 years old, suggesting they are surviving well. Having 15% of the sample composed of 2 marked cohorts indicates these hatchery catfish are contributing significantly to the total catfish population in the reservoir, if not entirely. Previous assessments in 2008 found the 2005 and 2006 marked cohorts composed 12% of Channel Catfish sampled (Kozfkay et al. 2010). Our current proportion of 15% marked fish, eight years later, suggests these hatchery cohorts are surviving much better than previously thought. Considering that we now know hatchery Channel Catfish will live 8-9 years in Lake Lowell, we plan to monitor tag reports for several years after tagging. Given the longevity of these fish, tags may be returned several years after initial release.

Exploitation and total use estimates, using our 53% tag reporting rate, indicate that the current catfish stocking program is successful. When we used the 72% tag reporting rate from Michaletz et al. (2008), estimated exploitation and total use were much lower (Figure 24). Channel Catfish exploitation from Lake Lowell is much lower compared to small community ponds throughout southwest Idaho. Kozfkay et al. (2011) reported exploitation rate of similar-sized Channel Catfish transferred to small community ponds was 27%. This is not surprising considering the intense fishing pressure present at these ponds (Hebdon et al. 2008). In a similar study, Michaletz et al. (2008) evaluated harvest patterns and rates of Channel Catfish across 14 small Missouri impoundments. Exploitation of stocked hatchery Channel Catfish varied as much as 10-fold across the waters studied. Most harvest occurred during the year after stocking, and exploitation rates ranged from 0 to 65%, with a mean across all waters of 15%. Exploitation rates of Channel Catfish at Lake Lowell were comparable with the average exploitation rate they reported, using our 53% reporting rate. The rates we observed might be considered much higher, considering Lake Lowell is a much larger waterbody (4,000 ha) with limited shoreline access compared to the small waters (8 – 178 ha) Michaletz et al. (2008) were studying. Relative to other larger Idaho waters such as Fernan, Hauser, Cocolalla, and Jewel lakes in northern Idaho, exploitation rates for Lake Lowell were substantially higher. Exploitation of Channel Catfish in 2011 at Fernan Lake was estimated at 4%, and tag reports were near zero for all three of the other lakes (IDFG, unpublished data).

Tag reports indicate anglers primarily catch Channel Catfish between May and September. Only one tag was reported outside of these months (in March 2014), with most tags being returned in July and August. Only three tags were returned in September, with none returned after September 23, 2013, suggesting few catfish were caught in the fall. Low fall reservoir levels, reduced shoreline and boat ramp access, and poor water quality may explain why few tags are reported after mid-September. While Lake Lowell is open for fishing all year, access restrictions likely affect exploitation of Channel Catfish. Boats are only allowed on the lake between April 15 and September 30, and shoreline access for fishing is restricted to the two dams during the non-boating season. The timing of tag reports suggest catch of catfish mostly overlaps the boating season.

Smaller fish did not appear to be caught at the same rates as larger fish. Figure 23 shows a slight bias in tag reports towards larger fish, with no tagged Channel Catfish less than 425 mm having been reported. Michaletz et al. (2008) observed size-related patterns in catch by anglers in small Missouri impoundments. They reported that probability of capture and harvest increased with total length. However, their study was primarily composed of hatchery Channel Catfish between 150 and 450 mm, while our study contained many larger catfish between 280 and 800 mm.

We expected exploitation rates for Channel Catfish tagged in 2013 to increase after the second year because tagged catfish were not available to anglers for half of the season and we thought those tags released in 2013 would be vulnerable to anglers for another whole season and would accrue at a similar rate. However, the reporting of tags released in 2013 did not increase as anticipated for reasons unknown. Fish not caught and reported in 2013 may have moved to other portions of the lake, where capture probability declined. Additional tag reports from the 2014 release group will help to better understand exploitation rates and to accurately assess the value of stocking channel catfish.

RECOMMENDATIONS

1. Continue collecting tag reports through 2016 to assess exploitation and total use rates of Channel Catfish over several years after tagging which accounts for the longevity for this species.

2. Continue stocking hatchery Channel Catfish annually.

3. Under current exploitation and stocking rates, avoid restricting harvest. Instead this fishery should be publicized to increase utilization of this resource.

Table 12. Total number of fingerling Channel Catfish and stocking date at Lake Lowell from 2003 to 2014.

Stocking date	Total number
8/19/2003	9,063
7/7/2004	6,897
8/10/2005	5,955
7/19/2006	13,716
7/11/2007	7,828
7/16/2008	7,673
7/15/2009	9,434
7/14/2010	7,992
7/20/2011	10,000
6/12/2013	10,005
7/16/2014	5,005

Table 13. Total number of tagged Channel Catfish released in the summers of 2013 and 2014. Tags reported as fish harvested or fish released, and adjusted exploitation and adjusted total use (harvest plus releases), both with 90% confidence intervals (CIs) for Lake Lowell through November 2014.

Date	**Tags released**	**Reported harvested**	**Reported released**	**Adjusted exploitation**	**90% CI**	**Adjusted total use**	**90% CI**
			Using 54% mean reporting rate				
2013	316	19	13	12.8%	5.4%	21.6%	7.3%
2014	180	6	3	6.2%	5.1%	10.4%	6.6%
			Using 72% Michalezt et al. (2008) reporting rate				
2013	316	19	13	9.7%	5.4%	16.3%	7.3%
2014	180	6	3	4.7%	5.1%	7.8%	6.6%

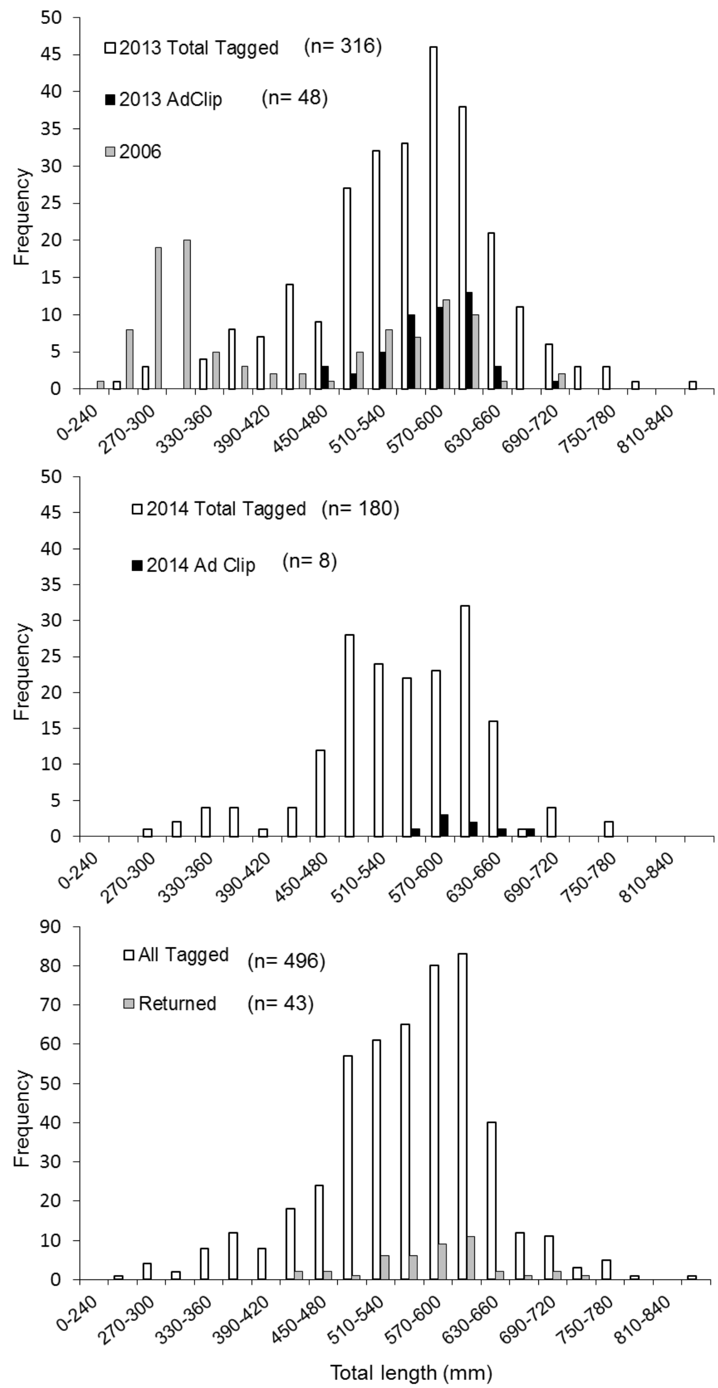

Figure 23. Length-frequency distribution of Channel Catfish showing ad-clipped (black bars), non-clipped (white bars) collected with hoop nets, tagged, and released in Lake Lowell during 2013 (n = 316) and 2014 (n = 180). Gray bars in the top panel show the length distribution of Channel Catfish collected during previous surveys in 2006 (n = 106) using a combination of gill nets and trap nets. Bottom panel shows length distribution of all tagged Channel Catfish released (2013-2014) and those reported caught by anglers (gray bars).

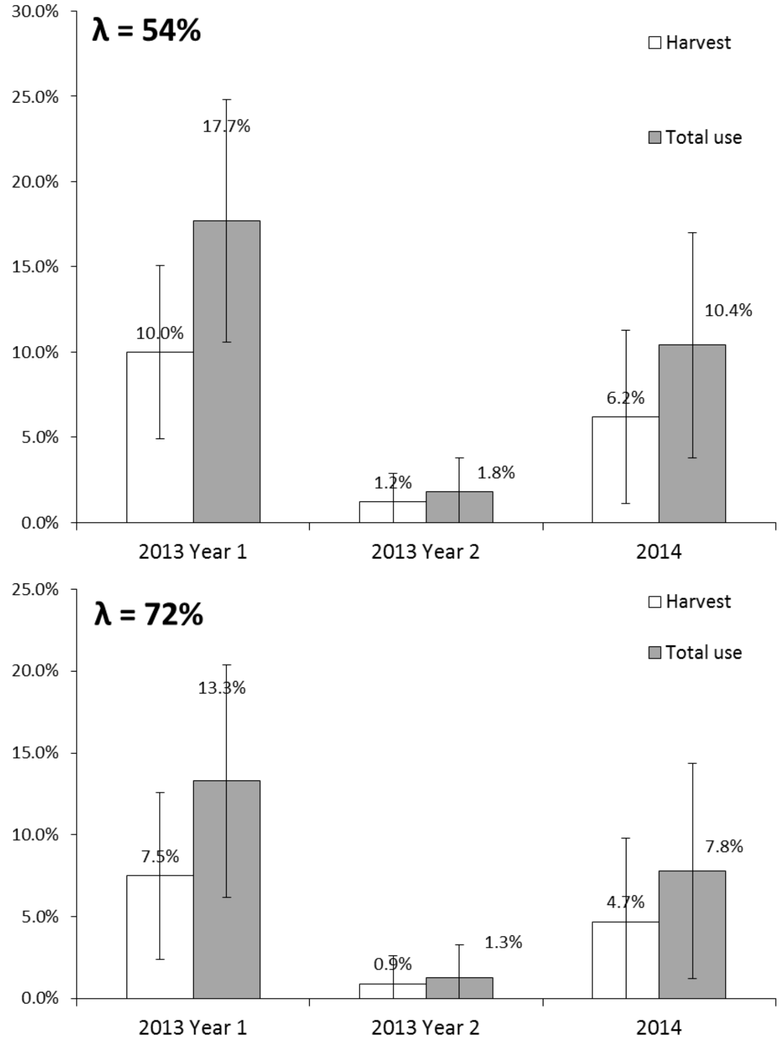

Figure 24. Harvest and total use (harvest plus release) rates for tagged Channel Catfish in Lake Lowell for fish tagged in 2013 (returned up to two years later) and 2014. Estimates are calculated using the mean tag reporting rate for Idaho (top panel) and the tag reporting rate from Michaletz et al. (2008) (bottom panel) based on tags returned through November 2014 and shown with 90% confidence intervals.

EXPLOITATION AND USE PATTERS FOR LARGEMOUTH BASS ABOVE THE SLOT LENGTH AT LAKE LOWELL

ABSTRACT

Lake Lowell is a 4,000 hectare irrigation reservoir located 10 km southwest of Nampa, Idaho. Lake Lowell receives substantial fishing pressure for Largemouth Bass *Micropterus salmoides*, which are managed under restrictive harvest regulations. We evaluated catch and harvest patterns of Largemouth Bass longer than the slot limit using tagged fish reported by anglers. From March to November 2014, estimated exploitation and total use rates (mean ± 90% CI) for Largemouth Bass greater than 406 mm was 21 ± 6% and 92 ± 15%, respectively. After harvest opened July 1, 48% (10 of 21) of tags were reported as harvested, suggesting that harvesting bass is popular with anglers at Lake Lowell. Most tags were returned between April and July, which characterizes the primary months of bass fishing effort. More information about total annual mortality rates for Largemouth Bass at Lake Lowell is needed. We recommend future sampling to collect age structure data to differentiate natural and fishing mortality and estimate whether current exploitation rates are acceptable.

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INTRODUCTION

Lake Lowell is a 4,000 hectare irrigation reservoir located 10 km southwest of Nampa, Idaho. The reservoir was built from 1906 to 1909 by forming four embankments around a naturally-occurring low lying area. Shortly thereafter, the lands surrounding the reservoir were incorporated into the National Wildlife Refuge system and continue to be managed by the U. S. Fish and Wildlife Service (USFWS). Uniquely, no streams or rivers flow into the reservoir; instead, water is supplied by the New York Canal, which diverts water from the Boise River. Inflow through New York Canal and outflow through two dams are administered by the Bureau of Reclamation. The reservoir is fairly shallow with a maximum depth of 11 m. Much of the littoral zone is occupied by extensive beds of smartweed (*Polygonum* spp.). Fish populations within the reservoir are managed by the Idaho Department of Fish and Game (IDFG).

Due to its' proximity to southwest Idaho's population center, Lake Lowell receives substantial fishing pressure. Largemouth Bass *Micropterus salmoides* are mostly commonly sought by anglers. Panfish fisheries (Black Crappie *Pomoxis nigromaculatus* , Bluegill *Lepomis macrochirus*, and Yellow Perch *Perca flavescens*) are also present, however, abundances for these populations have fluctuated widely leading to inconsistent fishing. Lake Lowell has general fishing regulations except for Largemouth Bass and Smallmouth Bass *Micropterus dolomieu*. Regulations prohibit bass harvest from January 1 through June 30, with a two fish, 305-406 mm protected slot limit thereafter. Additionally, the USFWS restricts motor boat usage on the lake to the period between April 15 and September 30. Given the special harvest restrictions and substantial fishing pressure, we recognized the need to describe catch and harvest patterns for Largemouth Bass at Lake Lowell.

METHODS

Largemouth Bass were collected by multiple methods over five occasions between March and July 2014 (Table 14). We collected Largemouth Bass using bycatch from commercial beach seines targeting Common Carp *Cyprinus carpio*. Bass were also sampled from the first (and largest) bass tournament held at the reservoir on April 19, 2014. Electrofishing was conducted along the shoreline, during the day, using a Smith-Root electrofishing boat. Pulsed direct current was set at 120 pulses per second and a pulse width of 40, which yielded an output of 5-6 amps. Largemouth Bass longer than the slot limit (≥ 400 mm) were tagged using 70 mm (51 mm of tubing) fluorescent orange Floy® FD-68BC T-bar anchor tags treated with algaecide. Each tag included a unique identification number, the abbreviation IDFG, and the Tag-You're-It! tag reporting hotline phone number (1-866-258-0338). Anglers could report tagged fish caught using the phone number on the tag, or through a tag reporting portal available on IDFG's website (https://fishandgame.idaho.gov/feedback/fish/forms/reportTaggedFishAngler.cfm). Total length (mm) and weight (g) of each tagged bass was recorded prior to release. Tagged fish were released in the middle of the lake to encourage random mixing and avoid repeated capture.

Tag reports were collected from anglers through November 3, 2014. We calculated exploitation (fish harvested) and total use (harvested and caught but released) rates according to the methods presented in Meyer et al. (2010) and Koenig (2012). Tag reports were adjusted for tagging mortality, angler reporting rate and tag loss. We used average tag reporting rate of 39.2%, a first year tag loss rate of 13.1% and 0.8% tagging mortality based on previous IDFG tag studies (Meyer et al. 2010). To reduce bias from exploitation estimates, anglers that reported harvesting bass, only because they were tagged, as determined from a question in the reporting survey, were not included. We calculated the median days at-large (time until fish was caught or harvested) for each release group. Information from fish that were reported multiple times were used to adjust harvest and total use estimates. Harvest information from fish reported twice was used to estimate additional harvest for fish that were caught and released without tags. No adjustments were made to account for hooking mortality.

RESULTS AND DISCUSSION

From March to November 2014, harvest of Largemouth Bass in 2014 ranged from 0% to 22% for individual release groups. Exploitation rate of Largemouth Bass over the slot size during 2014 was 18 ± 6% (mean ± 90% CI). When we accounted for anglers that caught and released fish but removed the tag, exploitation was estimated as 21 ± 6% (Table 14). However, of the tags reported after July 1, 48% (10 of 21) were reported as harvested, suggesting that harvesting Largemouth Bass is popular with anglers at Lake Lowell. Total use ranged from 0% to 109% for individual release groups. Mean total use for over-slot size Largemouth Bass was 82 ± 14%, but was to 92 ± 15% after accounting for fish released without tags (Table 14). Mean total length of tagged bass reported by anglers was similar between tagging methods, suggesting no size-related bias in sampling methods (Figure 25). Our 21% exploitation rate estimate may have underestimated total fishing mortality because it did not account for hooking mortality of released fish. However, hooking mortality for largemouth bass is highly variable and depends on many factors including water temperature, and whether fish are retained in live wells. Zagar and Orth (1986) used a conservative hooking mortality of 10% for Largemouth Bass to simulate effects of fishing harvest rules. Studies of tournament-caught Largemouth Bass show initial hooking mortality can range from 2.2% to 25%, while additional delayed mortality can range from 1% to 26% (Wellborn and Barkley 1974; Archer and Loyacano 1975; Plumb et al. 1975; Seidensticker 1975; Moody 1975; Wilde 1998; Edwards et al. 2004). We expect typical catch-and-release hooking mortality at Lake Lowell to be lower than rates reported for bass retained during tournaments. Most bass caught by anglers would be quickly released and would not typically be subjected to additional stresses associated with prolonged retention in live wells and handling during weigh-in events that may increase mortality.

Most anglers released tagged Largemouth Bass reported prior to the opening of the harvest season (July 1), but we did find some evidence of illegal harvest. Before July 1, 87% of tags reported that the fish associated with the tag was released, suggesting that 13% were harvested. After July 1, 48% of reported tags indicated that the fish was harvested. While tag reports indicate harvest primarily occurs after the designated opening date (July 1), tag reports probably grossly underestimate illegal harvest, since anglers illegally harvesting bass are unlikely to report tagged fish. Southwest Region enforcement staff indicated illegal harvest of bass prior to the July 1 start date was not uncommon in 2014. During the period of April 15 to July 1 2014, enforcement staff made roughly 500 angler contacts. Enforcement staff issued 11 citations and seven warnings for transporting live bass, with an additional 13 citations and two warnings for possessing one fish over the limit (M. O'Connell, *Personal Communication*).

Largemouth Bass fishing is very popular in early summer during the spawning period. Lake levels are also highest in early summer, flooding shoreline vegetation, creating excellent habitat for Largemouth Bass. As the summer progresses, reservoir levels recede and bass may become less vulnerable to angling. By late summer, high water temperatures and low reservoir levels likely reduced fishing effort. The majority of effort for Largemouth Bass at Lake Lowell occurs between April and July (Figure 26). Fredericks et al. (2002) noted similar patterns of tag reports at three lakes in the Coeur d' Alene system. Most tags were reported prior to July 1, and creel surveys showed that 77% of bass fishing effort occurred from April through June. In a more recent study across six lakes in the same area, Hardy et al. (2010) found 73% of tagged Largemouth Bass were caught between May and June. Fewer tags were reported during late summer and fall. This may have been a result of fewer tags being available (previously caught), or changing vulnerability of fish to angling. No tags were reported after September 22, 2014, suggesting that most of the fishing effort is associated with the boating season.

In addition to moderate exploitation rates, tag reporting data indicate Lake Lowell supports a robust catch-and-release Largemouth Bass fishery. Of the 58 Largemouth Bass reported as having been released, eight were caught twice, and three were later harvested. “Total use” is likely underestimated, for two reasons. Firstly, 59% of tagged Largemouth Bass released were initially collected by anglers at a bass tournament. However, this first catch occasion is not included in estimates of total use. Total use is also further underestimated when many anglers removed the tags prior to releasing the fish. Of the 58 fish that were reported as having been caught and released, 30 (52%) were released without the tags. Removing tags as the season goes on would bias the total use rate to be lower than the true value. Tagged fish caught multiple times would not be reported after the tags were removed by other anglers. We were able to account for this to some extent by using additional information from bass reported several times, but this rate is still likely to be somewhat biased. Voluntary release of black bass is a common practice among anglers; often under the perception that it will conserve or improve the resource (Bryan 1980; Goudy 1981; Bryan 1983; Garner et al. 1987). Quinn (1989) concluded that catch/release can maintain or improve largemouth bass fishing quality by effectively “recycling” fish. The 92% total use we estimated suggests this is occurring at Lake Lowell and may be a key component to maintaining higher catch rates. We will continue to collect more tag reports in 2015 to improve our understanding of harvest patterns. More information about total annual mortality rates for Largemouth Bass at Lake Lowell is needed to determine whether these exploitation rates are acceptable. Future sampling should collect age structure data to compare the relative proportions of natural and fishing mortality.

Point estimates for exploitation and total use rates of Largemouth Bass at Lake Lowell were much higher than reported for other waters in Idaho. Fredericks et al. (2002) reported exploitation and total use rates for small lakes in the Coeur d’Alene drainage averaged 6% and 17%, respectively. When total length was considered, harvest of 400-499 mm Largemouth Bass was 9%. He concluded low total annual mortality of bass was a result of low natural mortality and increased popularity of catch-and-release angling. In a more recent study of the same area, Hardy et al. (2010) used tag reports and estimated exploitation rate of Largemouth Bass in six lakes of the Coeur d’Alene system averaged 10.5% in 2009. Exploitation rates of Largemouth Bass at two of these waters with 406-mm minimum length limit were 0% and 4%. Largemouth Bass exploitation rate at Hayden Lake (also with a 406-mm minimum length limit) in 2013 was 3% (*C. Watkins, unpublished data*). Most of these are natural lakes primarily used by boat anglers with limited shoreline access. In this respect, Lake Lowell differs considerably. Lake Lowell offers more access for wading and boat access and likely sees a wider spectrum of anglers and attitudes towards bass harvest.

RECOMMENDATIONS

1. Tag a wider length distribution of Largemouth Bass to better describe total use of fish within and outside the 12-16” slot limit size.

2. Collect comprehensive Largemouth Bass age structure data to determine natural mortality rates. Separating natural mortality from fishing mortality will be necessary to inform bass fishing rule changes at Lake Lowell, if needed.

3. Periodically monitor bass exploitation rate every three years to detect changing harvest patterns.

Table 14. Exploitation and total use (harvest plus release) rates by release date of Largemouth Bass tagged in 2014 at Lake Lowell.

Release Date	Capture Method	Tags Released	Harvested	Released	Adjusted Harvest	Total Use	Median Days At Large
3/8/2014	Commercial net	71	4	11	17 ± 10%	63 ± 20%	68
4/19/2014	Tournament Anglers	165	12	41	22 ± 8%	99 ± 19%	41
6/27/2014	Electrofish	19	1	5	16 ± 19%	109 ± 43	17
7/2/2014	Electrofish	20	0	0	0	0	-
7/10/2014	Electrofish	6	0	1	0	49 ± 56%	11
	Combined	281	17	58	18 ± 6%	82 ± 14%	
	Overall[1]				21 ± 6%	92 ± 15%	

[1] Harvest and total use adjusted to reflect rates of fish released without the tag.

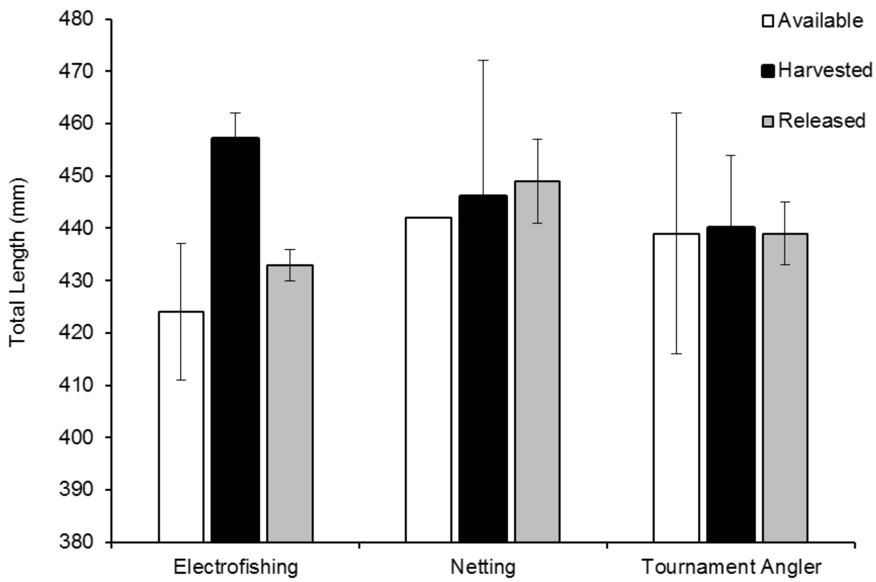

Figure 25. Mean total length at capture by collection method (shown with 90% confidence intervals) for tagged Largemouth Bass reported by anglers.

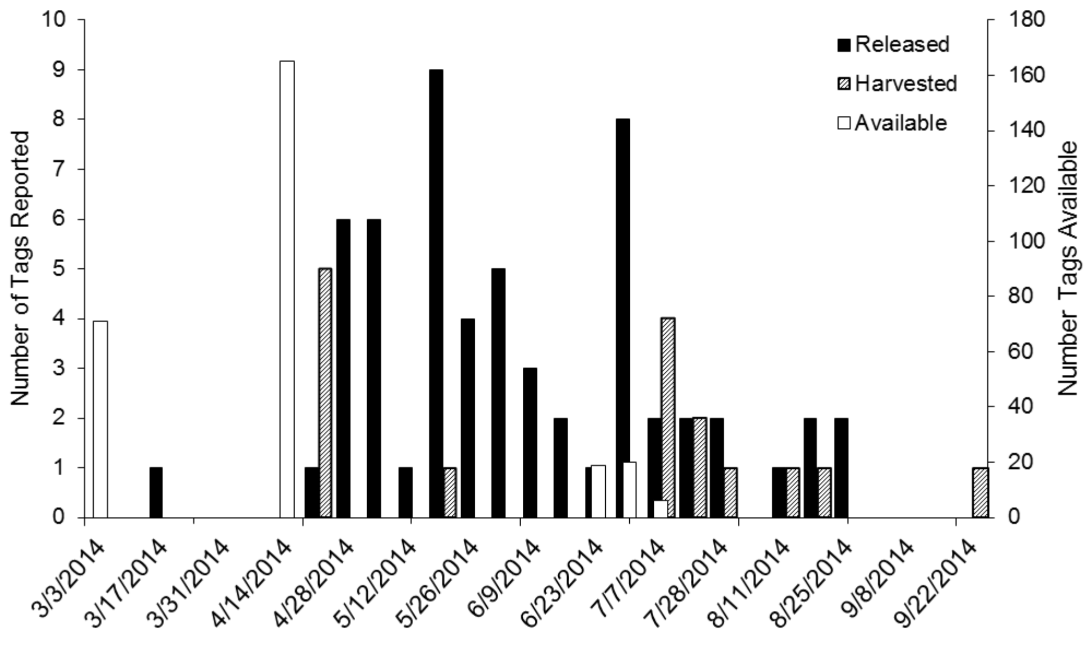

Figure 26. Number of newly tagged Largemouth Bass available (released) and reported as harvested and released Lake Lowell in 2014. Tag reports were collected through November 3, 2014. Reported tags were not removed from totals available.

2014 SOUTHWEST REGION (NAMPA) FISHERIES MANAGEMENT REPORT

COMMUNITY POND INVESTIGATIONS

EXPLOITATION, USE, AND TIME TO HARVEST OF HATCHERY TROUT AT FOUR COMMUNITY PONDS AFTER INITIATING A TWO-TROUT LIMIT

ABSTRACT

Community ponds are an important fishing resource that attract intense fishing pressure in the Southwest Region (Hebdon et al. 2008a), and may play a vital role in recruiting and retaining new anglers. We evaluated if changing from a six-trout to a two-trout daily creel limit increased the days-at-large of stocked Rainbow Trout, hopefully making fishing more consistent between stocking events. The effect of the two-trout limit on days-at-large for stocked hatchery trout was inconsistent across ponds, while exploitation rate remained unchanged. Mean exploitation (harvest) and mean total use (harvest or released) rate prior to two-trout limit ranged from 20% to 58% and 38% to 83%, respectively. During this same period, mean and median days-at-large ranged from 6 to 22 d and 2 to 15 d, respectively. After implementing the two-trout limit, mean exploitation and total use rates in 2014 remained largely unchanged, ranging from 20% to 56% and 31% to 89%, respectively. After the two-trout limit in 2014, mean and median days-at-large ranged from 3 to 9 d and 7 to 17 d, respectively, but results varied between ponds. Despite the lower daily bag limit, exploitation rates suggest angler participation and success remained largely unchanged. We discuss several mechanisms that might explain this pattern. Future bag limit changes should incorporate angler opinion data to describe expectations. Additionally, comprehensive creel data should be collected to quantify the frequency of catch, catch rate patterns between stocking events and changes in angler participation in response to rule changes.

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INTRODUCTION

Idaho Department of Fish and Game's (IDFG) Southwest Region manages fisheries in nearly 40 small public community fishing ponds, hereafter referred to as ponds. Most ponds are located within urban or semi-urban settings and receive intense fishing pressure (Hebdon et al. 2008a). IDFG views ponds an important resource for providing easily-accessible, family-friendly fishing opportunities. When managed properly, community fishing ponds are a vital tool for recruiting and retaining anglers (Eades et al. 2008). Balsman and Shoup (2008) argue that community fishing ponds are important in developing support for statewide fisheries programs (Schramm and Dennis 1993) and increase clientele knowledge and concern for the environment (Kellert and Westervelt 1983). These ponds typically offer put/take angling for hatchery Rainbow Trout *Onchorhynchus mykiss*, and options for several warmwater species. Catchable-sized Rainbow Trout are stocked from September through June when water temperatures allow. Warm water temperatures during late summer are unsuitable for trout and preclude stocking during those times. Stocking frequency varies from monthly to weekly, depending on the pond and measured or perceived fishing pressure. Ponds have been managed under general fishing regulations (open all year with a daily bag limit of six trout). Rules are designed to be simple to encourage new angler participation and a family-friendly fishing experience.

A comprehensive evaluation of hatchery catchable exploitation rates (i.e. return-to-creel) in Idaho's predominant put-and-take fisheries began in 2011 under the Hatchery Trout Evaluation project (Koenig 2012; Cassinelli and Koenig 2013a). Recent evaluations in Southwest Region community ponds indicated that hatchery Rainbow Trout can be caught quickly after stocking (Koenig 2012; Cassinelli and Koenig 2013b; Koenig et al. 2015). From 2011 to 2013, the median days-at-large for hatchery Rainbow Trout in community ponds was 25. However, days-at-large ranged from 3 to 57, indicating anglers quickly harvested most trout from some ponds. At Wilson Springs and McDevitt ponds, two very popular ponds, the median days-at-large for stocked trout was 3-4 (Koenig et al. 2015). When most stocked trout are harvested within days of stocking, catch rates suffer until the next stocking event. Reducing daily bag limits from six trout to two trout might increase the extent that trout are available to catch, provide more consistent fishing, and distribute the catch among more anglers.

Current hatchery production capacity and funding are not increasing, while demand for hatchery catchable trout remains steady or is increasing. At this time, stocking more fish is not an option to meet fishing pressure demands, so available hatchery resources must be used judiciously. Beginning on January 1, 2013, IDFG adopted a daily bag limit of two trout on four ponds in the Southwest Region: McDevitt, Parkcenter, Weiser Community and Wilson Springs ponds. This rule change was intended to increase the amount of time that stocked Rainbow Trout were available to anglers. In this chapter, we evaluate whether this rule change was effective in changing catch and harvest patterns on these four community ponds.

OBJECTIVES

1. Evaluate whether adopting a two-trout limit on four community ponds has increased days-at-large of stocked Rainbow Trout.

2. Describe how exploitation and total use rates of hatchery rainbow trout may have changed in response to reduced bag limits.

METHODS

We tagged hatchery Rainbow Trout and calculated exploitation (fish harvested) and total use (harvested or caught, but released) rates according to the methods presented in Meyer et al. (2010) and Koenig (2012). Hatchery Rainbow Trout were individually measured for total length (mm) and tagged using 70 mm (51 mm of tubing) fluorescent orange Floy® FD-68BC T-bar anchor tags treated with algaecide. Tagged fish were loaded onto hatchery stocking trucks as part of the normal stocking allotment, allowed to mix, and were stocked as usual so that tag reports reflected normal stocking practices. We distributed tags during normally scheduled spring and fall stocking events to more accurately characterize exploitation rates at these ponds.

Exploitation and total use rates utilized the tag reporting rate specific to rainbow trout in lentic fisheries, based on yearly reports of $50 reward tags (Cassinelli and Koenig 2013a). For tags released in 2011, we used an average tag reporting rate of 46.1%. For tags released in 2012, and 2014 we used an average reporting rate of 33.0% and 40.9%, respectively. We calculated exploitation (harvest) and total use (harvested or released) rates for tags returned within 365 d of each release group, except for the 2014 groups. Tag return data for the 2014 release groups were summarized through January 5, 2015. Fish that were reported as harvested only because they were tagged were not included. We calculated mean and median days-at-large (time until fish was caught or harvested) for all tags combined across release groups for each water body. Therefore, mean days-at-large is presented for each water body as an average across all tags released and returned for up to one year since the date of release. We graphically compared the cumulative number of tags returned over time (in days after stocking) to evaluate patterns in angler exploitation rates across years.

RESULTS

The effect of the two-trout limit on days-at-large for stocked hatchery trout was inconsistent across ponds, while exploitation rate remained unchanged. Tag reporting indicated high exploitation and use rates of hatchery trout at the four studied ponds. Mean exploitation and mean total use rates during 2011 and 2012 (prior to two-trout limit) ranged from 20% to 58% and 38% to 83%, respectively. After implementing the two-trout limit, mean exploitation and total use rates in 2014 remained largely unchanged, ranging from 20% to 56% and 31% to 89%, respectively (Table 15). Before the two-trout limit, mean and median days-at-large ranged from 6 to 22 and 2 to 15, respectively. After the two-trout limit in 2014, mean and median days-at-large ranged from 3 to 9 and 7 to 17, respectively, but results varied between ponds (Table 15). No before/after comparisons were available for Weiser Community Pond because we did not stock tagged trout prior to initiating the two-trout limit. However, 2014 tag reports indicated exploitation (51%) and total use (70%) rates were high, similar to Wilson Springs Ponds, where fishing pressure is intense. At McDevitt Pond, the rule change appeared to have increased the days-at-large of trout and increased exploitation (Table 15). Tag reports showed a slight decrease in the percent of tags reported within the first two days, suggesting a brief increase in days-at-large (Figure 27). The median days-at-large increased from 4 to 9, while the average days-at-large increased from 11 to 17, through 90% confidence intervals indicate this was not statistically significant. Additionally, exploitation rates of hatchery trout increased from 33% to 40% (Table 15). Parkcenter Pond showed the opposite pattern, where mean and median days-at-large decreased from 22 to 11 (not statistically significant), and from 15 to 5, respectively. Average exploitation remained equal at 20%. Mean exploitation rate and days-at-large appeared largely unchanged at Wilson Ponds (Table 15). Tag report data exhibited similar patterns in the timing of catch, with cumulative tag reports remaining similar before and after initiating a two-trout limit (Figure 27).

DISCUSSION

Community ponds continue to be an important fishing resource that attracts significant angler participation throughout Southwest Idaho (Hebdon et al. 2008a). Anecdotal evidence from anglers and tag reports suggest that trout fishing is very good in the days following stocking, but quickly declines until trout are stocked again. We hypothesized that adopting a two-trout limit at these ponds would improve the days-at-large that trout were available to anglers between stocking events. We also expected catch to be distributed among more anglers. Initiating a two-trout limit appeared to increase days-at-large of hatchery trout at McDevitt Pond, but did little to affect days-at-large at other study ponds.

Despite reducing the daily trout limit from six to two, mean exploitation rate remained consistent or increased across all ponds. This implies that angler participation and success remained largely unchanged following the reduced bag limit which might be explained by several possible mechanisms. For example, if the proportion of anglers keeping six trout previously was low, reduced bag limits did not change harvest from previous patterns. Alternately, compliance with the new rules could be low, so that exploitation rates were similar with exploitation rates before the rule change. Another possibility is that harvest may have been distributed more evenly across more anglers, maintaining high exploitation rates despite the lower daily limit. For example, Parkcenter pond exploitation stayed the same, but the average time that fish were available actually decreased by half. Radomski et al. (2001) warned that reduced creel limits may be offset by changes in angler behavior. They cautioned that lowering creel limits might increase effort if more anglers are successful. This might attract more return trips or new anglers, increasing fishing effort overall, thereby reducing the days-at-large. Unfortunately, we did not measure the frequency of anglers keeping limits in this study. This highlights some of the limitations of using tag reports for evaluating creel limit changes. Future evaluations should measure the number of trout in the creel to monitor changes in the distribution of catch among anglers (Smith 1990; Mosel et al. 2015).

Some fisheries managers advocate for a probabilistic approach to creel limits that set the expectations of success and reflect the production capabilities and biological realities of the fishery (Cook et al. 2001). Additionally, these authors argued that angler satisfaction would be maximized with realistic creel limits that are at least occasionally attained. In this respect, adopting a two-trout limit for community ponds could result in a net benefit to angler satisfaction, while average exploitation remained unchanged. Angler survey data to quantify values and expectations would be useful to evaluate future creel limit changes at community ponds. Additionally, future creel surveys should be used to quantify the frequency of limits, changes in angler participation and redistribution of catch in response to changes in bag limits.

RECOMMENDATIONS

1. Collect social science (angler opinion survey) data to describe angler values and expectations for trout fishing at community ponds to inform future bag limit changes.

2. Estimate the frequency of catch in the creel at general regulation ponds and at special regulation ponds and evaluate whether reduced trout limits would redistribute catch to more anglers in community ponds.

3. Collect comprehensive creel data between trout stocking events to examine if cyclical patterns in catch rates occur.

4. Describe any changes in angler participation in response to adopting two-trout limit rule changes.

Table 15. Exploitation, total use (harvest and release) rates, median and mean days-at-large (DAL) by pond and year. No reward tags were included.

Year	Water body	Tagging date	NonRWD released	Harvested	BT harvested	Released	Adjusted exploitation	Adjusted total use	Mean D.A.L. (90% CI)	Median D.A.L.
2011	McDevitt P.	4/6/2011	150	30	6	15	39%	67%	11 ± 4	4
		10/19/2011	125	17	1	5	27%	36%		
							33%	*52%*		
2014	McDevitt P.	2/13/2014	45	6	2	3	42%	78%	17 ± 5	9
		4/8/2014	45	7	1	3	49%	78%		
		4/22/2014	50	5	0	2	32%	44%		
		6/12/2014	50	9	0	3	57%	76%		
		10/16/2014	49	3	1	4	19%	52%		
							40%	*66%*		
2012	Parkcenter P.	2/14/2012	50	1	0	0	5%	5%	22 ± 9	15
		4/3/2012	50	6	1	6	30%	65%		
		6/4/2012	50	6	1	1	30%	40%		
		10/12/2012	48	3	1	4	16%	42%		
							20%	*38%*		
2014	Parkcenter P.	2/14/2014	90	11	1	4	39%	56%	11 ± 3	5
		4/8/2014	90	6	1	2	21%	32%		
		6/12/2014	100	3	0	0	10%	10%		
		10/6/2014	90	3	1	3	11%	25%		
							20%	*31%*		
2014	Weiser Community P.	2/19/2014	50	1	1	3	6%	32%	13 ± 3	12
		4/8/2014	50	16	2	4	102%	140%		
		6/6/2014	50	5	1	1	32%	44%		
		10/16/2014	50	3	4	3	19%	64%		
							51%	*70%*		
2011	Wilson Springs P.	2/1/2011	199	90	5	12	89%	106%	6 ± 1	2
		4/1/2011	200	63	1	11	62%	74%		
		7/1/2011	99	20	9	12	40%	81%		
		8/1/2011	100	23	2	8	45%	65%		
		10/1/2011	200	42	4	15	53%	77%		
							58%	*81%*		
2012	Wilson Springs P.	2/1/2012	50	14	2	3	70%	96%	8 ± 3	4
		4/20/2012	50	10	7	2	50%	96%		
		8/2/2012	50	12	0	1	60%	65%		
		10/3/2012	50	10	0	5	50%	76%		
							58%	*83%*		
2014	Wilson Springs P.	2/13/2014	40	8	1	1	63.5%	79.4%	7 ± 2	3
		2/28/2014	40	8	2	7	63.5%	135.0%		
		4/4/2014	40	10	2	1	79.4%	103.2%		
		4/24/2014	40	9	2	4	71.5%	119.1%		
		6/6/2014	40	4	1	0	31.8%	39.7%		
		6/26/2014	40	1	1	5	7.9%	55.6%		
		10/24/2014	40	9	1	1	71.5%	87.3%		
							56%	*89%*		

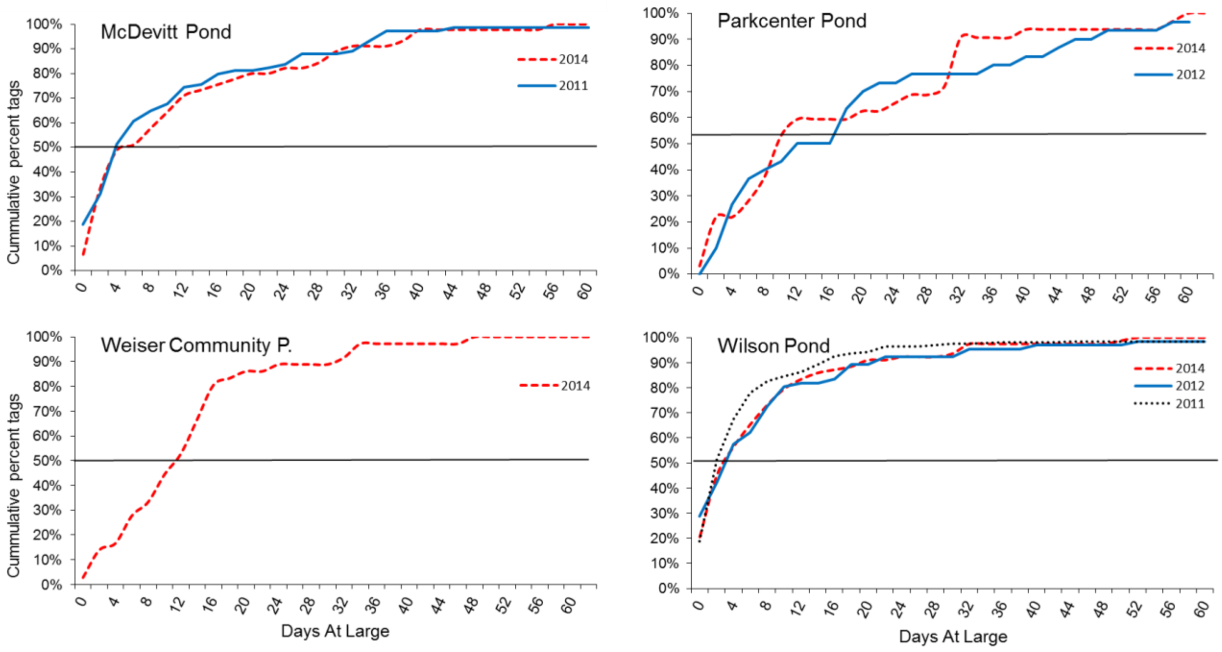

Figure 27. Cumulative percent of total tags returned within 70 d by year for tagged hatchery Rainbow Trout released during 2011-2014. Trout bag limits were changed from six trout/day to two trout/day in 2013. Cumulative percent was calculated across all release groups and refers to the percent of total tags returned, not the exploitation rate.

WARMWATER FISH POPULATION ASSESSMENT AT FOUR COMMUNITY PONDS

ABSTRACT

Idaho Department of Fish and Game's (IDFG) Southwest Region currently contains nearly 40 small public community fishing ponds. These ponds are an important resource for providing easily-accessible, family-friendly fishing opportunities. The goal of this study was to collect basic warmwater fish population data from several ponds in the Southwest Region, and estimate angler exploitation and total use rates of Largemouth Bass transferred to ponds from other local waters.

Bluegill appear to be naturally reproducing in these ponds, but Duff Lane and Horseshoe Bend ponds were the only ponds with appreciable numbers of stock-length (80 mm) Bluegill, while quality-length (150 mm) Bluegill were rare at all ponds. CPUE of stock-length Bluegill and Largemouth Bass varied widely among ponds. Bluegill CPUE ranged from 14 (Settlers Park Pond) to 424 fish/h (Horseshoe Bend Pond). Mean relative weight (W_r) of Bluegill varied across ponds, but was generally above 100 indicating good body condition. CPUE of Largemouth Bass ranged from 8 to 137 fish/h . Except for Duff Lane Pond, mean W_r of Largemouth Bass was above or near 100. Parkcenter Pond had the highest Largemouth Bass proportional stock density (46), but catch rates were low at only 23 fish/h. Young age classes of Largemouth Bass were present in most ponds, except for Settlers Park Pond. On average, exploitation rates of tagged Largemouth Bass was 34% and ranged from 0% (Settlers Pond) to 88% (transfers to McDevitt Pond). Mean total use rate of Largemouth Bass was 65% and ranged from 27% to 132% within the first summer after being tagged. Except for Settlers Park Pond, exploitation rates for transferred Largemouth Bass ranged from 25% to 88%, suggesting that translocating Largemouth Bass for put/take stocking is not a sustainable strategy. The future management direction of community ponds in the Southwest Region needs to be informed with angler preference data. Specific management goals for each pond should be considered, as fish sampling data and tag return information show ponds vary widely in their type of fishing opportunities.

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INTRODUCTION

Idaho Department of Fish and Game's (IDFG) Southwest Region currently contains nearly 40 small public community fishing ponds. Most ponds are located within urban or semi-urban setting and receive significant fishing pressure. IDFG views ponds as an important resource for providing easily-accessible, family-friendly fishing opportunities. When managed properly, community fishing ponds are a vital tool for recruiting and retaining anglers (Eades et al. 2008). Community fishing ponds are important in developing support for statewide fisheries programs and help increase angler knowledge, skill level, and concern for the environment (Kellert and Westervelt 1983; Schramm and Dennis 1993; Balsman and Shoup 2008).

These ponds typically offer angling for hatchery rainbow trout, and several warmwater species including Largemouth Bass *Micropterus salmoides*, Bluegill *Lepomis macrochirus*, Pumpkinseed *Lepomis gibbosus* and Channel Catfish *Ictalurus punctatus*. Warmwater species in Southwest Region ponds (except the Wilson Trophy Pond) fall under general fishing regulations. Fishing is open all year, and anglers may harvest up to six bass per day (with a minimum length of 12"), with no limits or size restrictions on sunfish or catfish. Catchable-sized rainbow trout are usually stocked on a bi-weekly or monthly basis from September through June when water temperatures allow. Summer water temperatures at ponds are often not suitable for stocking trout, requiring a stocking cessation until waters cool in the fall (Hebdon et al. 2008b). Unfortunately, stocking cessations coincide with peak fishing effort periods. IDFG tries to maintain populations of warmwater fishes in community ponds for recreational angling during summer periods when trout stocking is discontinued. Stocking Bluegill and Largemouth Bass is a popular strategy for sustaining fishing in small ponds in other areas of the country (Schramm and Willis 2012). However, IDFG does not have the hatchery facilities needed to produce warmwater fishes. While trout are supplied regularly by Nampa Hatchery, warmwater fish populations depend on natural reproduction or transfers from other waters. Warmwater fish are commonly transferred to community ponds, but angler use from these efforts is seldom evaluated with quantitative data.

Little data currently exists to describe the warmwater species assemblage in these ponds. Information describing fish density, size distribution, growth rates, reproduction and exploitation rates are needed to inform management decisions to maintain or improve fishing in local ponds. The goal of this study was to collect basic warmwater fish population data in several Southwest Idaho ponds. In addition, we wanted to estimate exploitation rates of Largemouth Bass transferred to ponds from other local waters. We sampled the fish community at four ponds (Duff Lane, Horseshoe Bend Mill, Parkcenter, and Settlers Park ponds) and evaluated exploitation rates of transferred Largemouth Bass at three additional ponds (Beach's, McDevitt, and Riverside, ponds).

Study Site

The ponds included in this evaluation represent only a few examples across the spectrum of ponds present in the Southwest Region. Community ponds in the Southwest Region range from small ponds within city parks to larger waters in more rural settings. Habitat, water quality, and fishing pressure can vary widely between ponds. The four study ponds support a mixed community of Bluegill, Largemouth Bass, and Pumpkinseed and are stocked with hatchery Rainbow Trout monthly in the spring and fall. Some ponds also receive occasional adult Channel Catfish transplanted from nearby waters.

Duff Lane Pond

Duff Lane Pond is located 8 km west of Star, Idaho in Canyon County. It is a 2.2-ha pond with a mean depth of 2.2 m. IDFG owns the pond and manages the property. Basic facilities include two fishing docks, a temporary toilette (seasonally), and a small parking lot with a dirt trail around most of the pond. Extensive milfoil, woody debris, shoreline trees, and brush provide ample cover for Largemouth Bass and Bluegill. Shoreline vegetation also limits angling access to some portions of the perimeter.

Horseshoe Bend Mill Pond

Horseshoe Bend Mill Pond is situated on the banks of the Payette River north of the town of Horseshoe Bend in Boise County. This is a 5.1-ha pond with a mean depth of 2.8 m and can be described as a “rural pond” given its distance from the Treasure Valley. IDFG owns the pond and manages the property. Facilities include a concrete boat ramp (with dock), picnic tables, ample parking, and a dirt trail around most of the pond. This pond receives one annual stocking of transplanted adult Channel Catfish during the summer. Pond surface water elevation during summer is maintained by a combination of diverted Payette River water, groundwater, and well pumping. As a result, the pond is fed by cool, low conductivity, river water during the summer and is drawn down during the winter.

Parkcenter Pond

Parkcenter Pond is an urban community pond located just east of downtown Boise. Surface area is 3.2 ha with a mean depth of 4.9 m and is located in a city park. This pond has well developed facilities, including public toilettes, two fishing docks, and concrete walkways around the pond. Cover for warmwater fish species is limited to mainly aquatic vegetation. The pond is primarily surrounded by lawn, with a few trees, and bushes, but shoreline access is very open.

Settlers Park Pond

Settlers Park Pond is also an urban community pond located in central Meridian. The City of Meridian owns and manages the pond and associated facilities located within the city’s popular Settlers Park. This is a small 0.3-ha pond with a mean depth of 3.6 m with ample access. The shoreline primarily surrounded by lawn, and is entirely accessible. Shorelines are steep with very limited cover for warmwater fish species. A pipe supplies well water to the pond, which is then used to irrigate the surrounding park grounds. During irrigation, pond surface water levels can decline rapidly before refilling from the well source.

METHODS

We sampled the fish community at all ponds between May 12 and June 18, 2014. All ponds were sampled at night with electrofishing using pulsed-DC (60 Hz) waveform with a 10-20% duty cycle. Electrofishing gear was mounted to an aluminum drift boat fitted with an outboard motor. We sampled the entire shoreline of each pond at night two times; once each for marking and recapture. Captured fish were identified to species, measured for total length (TL) to the nearest millimeter, and weighed to the nearest gram. During the marking sample, Bluegill, Largemouth Bass and Pumpkinseed were sampled as above, but also marked with a caudal fin punch and released.

Proportional stock density (PSD) was calculated according to Guy et al. (2007) and represents the number of fish ≥ quality-length divided by the number of fish ≥ stock-length. We defined stock and quality-length, respectively, for Bluegill (80 mm / 150 mm), largemouth bass (200 mm / 300 mm) and pumpkinseed (100 mm / 180 mm) based on values presented in Anderson and Neumann (1996). Confidence intervals for PSD (95%) were calculated according to Gustafson (1988). We described fish body condition using Relative weight (W_r), calculated according to Wege and Anderson (1978) using the slope and intercept parameters for standard weights (W_s) presented in Blackwell et al. (2000). Relative weight was only calculated for fish greater than the minimum stock lengths for Bluegill (80 mm), Largemouth Bass (150 mm) and Pumpkinseed (50 mm) as recommended by Blackwell et al. (2000). Mean W_r was calculated for each standard length category so that condition data were comparable to other ponds across the United States (Bonar et al. 2009).

We calculated Catch-per-unit-effort (CPUE) as the number of fish stock-length (and greater) fish captured per hour of electrofishing (Bonar et al. 2009). CPUE was calculated for both marking and recapture runs (but did not include recaptured marked fish) and reported as the average of the two. We compared our CPUE data to national average catch rates presented in Bonar et al. (2009) for small lentic waters. We estimated the total population of stock-length Bluegill (80 mm), Largemouth Bass (200 mm) and Pumpkinseed (100 mm) for each pond. Estimates were only calculated for fish longer than stock length. Population estimates for Bluegill, Largemouth Bass and Pumpkinseed were calculated using the Chapman estimator (Seber 1982), with 95% confidence for small numbers of recaptures using the Poisson distribution as presented by Chapman (1948).

Fish age was estimated using cross-sectioned dorsal spines from a subsample of up to 10 fish per 10 mm length interval by species. We only collected samples from fish that were at least 100 mm. We removed the first three dorsal spines by cutting as close to the skin as possible (DeVries and Frie 1996, Koch et al. 2008). Spines were prepared according the methods described by Koch and Quist (2007) using a mold made from a 2-ml plastic microcentrifuge tube with the 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. Spines were then encased by filling the molds with Epoxicure 2 epoxy and curing it for 6-8 hours until hard. 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 spines 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 spine 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 and the consensus age was used in further analysis. We estimated the age distribution of Bluegill and Largemouth Bass by assigned the proportion of ages in the subsamples to the total sample using an age length key as described by Quist et al. (2007) and Quist et al. (2012). Age distribution was then used to estimate instantaneous (and annual) mortality rates using a linearized catch curve for the age classes fully recruited to the gear (Miranda and Bettoli 2007). Mean length-at-age was calculated using only fish from the aged subsample.

We estimated angler exploitation (fish harvested) and use (harvested or caught but released) rates of Largemouth Bass using T-bar anchor tags. Tagging date varied according to whether bass were tagged during fish population sampling (May, June), or while transferring bass (June, July) from nearby waters (Table 19). This probably under estimated bass exploitation rate, since tags were not available during April-May of the warmwater fishing season. Only Largemouth Bass collected of legal harvest size (≥ 300 mm) were tagged using 70 mm (51 mm of tubing) fluorescent orange Floy® FD-68BC T-bar anchor tags treated with algaecide. In Parkcenter and Settlers ponds, few legal size bass were sampled. Additional bass were collected from nearby Lake Lowell and Indian Creek Reservoir to increase the number of tags available to better estimate exploitation rates. We released additional tagged bass at McDevitt, Riverside and Beach's ponds to evaluate exploitation and use rates of transferred bass in these waters. Tag return data were collected using the IDFG Tag-You're-It phone system and IDFG website. We calculated exploitation and total use rates of Largemouth Bass from reported tags and the analysis methods presented in Meyer et al. (2010) and Koenig (2012). Tag reports were adjusted using the non-reward tag reporting rate previously reported for Idaho waters by Meyer et al. (2010) as 39.2%, with a 1-year tag loss rate of 13.1% and a 7-day tagging mortality rate of 0.8%. Tag return data were analyzed for tags reported through November 10, 2014, which we assumed was late enough in the fishing season to encompass most of the warmwater fishing at these community ponds.

RESULTS

CPUE of stock-length Bluegill varied widely among ponds, ranging from 14 (Settlers Park Pond) to 424 fish/h (Horseshoe Bend Pond). PSD for Bluegill was very low across all ponds except for Settlers Park Pond, where the sample size of stock-length fish (n = 11) was too small for meaningful comparisons (Table 16). Bluegill appear to be reproducing naturally in these ponds based on small sizes present in the length-frequency distributions (Figure 28). However, Duff Lane and Horseshoe Bend Mill ponds were the only locations with appreciable numbers of stock-length Bluegill, while quality-length Bluegill (150 mm) were rare at all ponds (Figure 28). Body condition of Bluegill was average or above at all ponds. Mean relative weight was close to the standard (W_r = 100) at Duff Lane and Horseshoe Bend Mill ponds, but was higher at Parkcenter and Settlers ponds (Table 17). Relative weight of Bluegill at Duff Lane Pond decreased with length, indicating larger Bluegill were in poorer condition, while W_r of Bluegill was more consistent at other ponds (Figure 29).

CPUE of stock-length Largemouth Bass varied widely among ponds, ranging from 8 (Settlers Park Pond) to 137 fish/h (Duff Lane Pond; Table 18). Catch rates of stock-length Largemouth Bass were higher than the national average at Duff Lane and Horseshoe Bend ponds, but were substantially lower in Parkcenter and Settlers Park ponds. In most cases, population estimates lacked precision because of low catch during marking runs and few recaptured fish (Table 18). Largemouth PSD was moderate, but low compared to national averages for similar sized waters. Parkcenter Pond had the highest bass PSD (46), but CPUE was low at only 23 fish/h (Table 18). Young age classes of Largemouth Bass were sampled in each pond, except for Settlers Park Pond, where bass less than 150 mm were absent (Figure 28). Except for Duff Lane Pond, W_r of Largemouth Bass was above or near 100, suggesting most bass were in good condition (Table 17). There were no obvious trends in W_r as length increased; indicating condition was consistent across size classes (Figure 29).

The average exploitation rate of tagged Largemouth Bass was 34% and ranged from 0% (five resident bass in Settlers Pond) to 88% (transfers to McDevitt Pond). Mean total use rates of Largemouth Bass was 65% and ranged from 27% to 132% within the first summer after being tagged. Median days-at-large ranged from 1 to 33, but varied across waters (Table 19). Annual mortality of Bluegill and Largemouth Bass varied across ponds. Annual mortality rates ranged from 0.55 to 0.88 and 0.25 to 0.62 for Bluegill and Largemouth Bass, respectively (Figures 29 – Figure 32). However, mortality rate estimates from Settlers Park Pond are likely less reliable, due to the small sample size.

DISCUSSION

Bluegill populations at these ponds are composed primarily of small individuals. Novinger and Legler (1978) proposed target PSD values of 20-40 for Bluegill and 40-60 for Largemouth Bass for balanced pond communities. These ranges are based on extensive pond data showing moderate Largemouth Bass densities, low mortality, consistent annual reproduction, and moderate growth rates (Reynolds and Babb 1978). Bluegill PSD values in our study ponds ranged from 3 to 13, except for Settlers Park Pond, where very few stock-length Bluegill were sampled. Small size of Bluegill in these ponds may be a result from over harvest, or stunting from too little predation from Largemouth Bass.

Duff Lane Pond

Length distributions and mean relative weights for Duff Lane Pond suggest the pond may have a high density population of Bluegill and slow-growing Largemouth Bass. Bluegill mean relative weight was low at larger sizes, indicating larger Bluegill could be competing with abundant small Bluegills for food resources. Mean length-at-age for Bluegill was similar to national averages (and above those for Ecoregion 10) reported by Bonar et al. (2009), suggesting that growth rates were good for this area. Low PSD with good relative weight and growth rates suggest anglers are excessively harvesting larger Bluegills. Largemouth Bass length-at-age was similar to other nearby waters, with bass reaching 300 mm at age-5. However, bass TL remained similar between age-5 to age-8 while relative weight remained low, suggesting poor body condition and limited feeding opportunities. Total annual mortality of adult Largemouth Bass was 59% (ages 4-8). Exploitation and total use rates were estimated at 33% and 77%, respectively, suggesting moderate fishing pressure. Very few Largemouth Bass greater than 350 mm were present, probably a result of harvest combined with slow growth rates.

These data correspond to observations described in Novinger and Legler (1978), where excessive vegetation can limit bass predation of Bluegill, resulting in overabundant small Bluegill and high densities of 200-300 mm Largemouth Bass. Under these conditions, recruitment of Largemouth Bass to quality length may be low. Abundant vegetation at Duff Lane Pond is a well-known problem. The pond has been stocked with grass carp and has been treated several times with Navigate®, but additional or more consistent actions to reduce aquatic vegetation may be needed to improve Bluegill size structure. Deepening ponds to discourage vegetation growth should also be considered here and during future pond construction. Current exploitation rates appear to be slightly greater than natural mortality, suggesting that harvest should be reduced

Horseshoe Bend Mill Pond

Length distribution and low PSD for Bluegill at Horseshoe Bend Mill Pond indicated the population was primarily composed of stock-length Bluegill with few quality-length individuals. While CPUE of Bluegill was very high, relative weight was slightly below national average. Mean length-at-age was lower than other nearby ponds, with little growth between age-4 and age-6 (Figure 30). Annual mortality of Bluegills was 88%; higher than values typically reported. Spotte (2007) reported total mortality rates for Bluegills of 37-86% across 11 Michigan lakes. The few Bluegills that reach acceptable sizes may be removed by anglers, but data suggest that Bluegills are overabundant and additional predation may be needed to improve size structure. CPUE of Largemouth Bass were higher than the national average, with PSD at 35. Total annual mortality of Largemouth Bass was 52% (age 4-9), while fishing mortality was estimated at 17%, suggesting that exploitation rates are not currently excessive.

These conditions are similar to those present at Duff Lane pond, and are likely a result of excessive vegetation limiting bass predation on Bluegills. Overabundant Eurasian Watermilfoil *Myriophyllum spicatum* is a well-known problem at Horseshoe Bend pond, and this may result in abundant small Bluegill and bass in the 200-300 mm range (Novinger and Legler 1978). Herbicide was applied here in 2014, but this pond would likely benefit from regular treatments to help improve Bluegill size structure. As long as Largemouth Bass exploitation rates do not increase significantly, we expect their size to improve as lower vegetation density makes Bluegill more available.

Parkcenter Pond

PSD and length distribution indicate the Bluegill population at Parkcenter Pond is composed primarily of fish less than stock length, with few quality Bluegill available. CPUE of stock-length Bluegill was far below the national average, but W_r values suggest fish are in good condition. Annual mortality of Bluegills was 85%; higher than expected from typical values reported (Spotte 2007). Relative weight and PSD of Largemouth Bass at Parkcenter Pond suggest these fish are in good condition, with some quality-length fish available. Length distributions indicate bass are reproducing, as shown by the frequency of age-0 fish (Figure 28). This suggests the habitat is capable of supporting a self-sustaining Largemouth Bass population. Largemouth Bass in Parkcenter Pond reached 300 mm within three to four years, almost a full year faster than other ponds (Figure 31). One 500 mm individual was six years old, compared to similar length bass in Horseshoe Bend Mill and Duff Lane ponds which were 12 years old.

Despite reproduction and fast growth, Largemouth Bass were in low abundance. CPUE of stock-length Largemouth Bass in Parkcenter Pond (23 fish/h) were far below the national median (81 fish/h, Bonar et al. 2009), with a population estimate of only 42 individuals. Exploitation and total use rates of tagged Largemouth Bass were 32% and 56%, respectively, while annual mortality was 62%. However, total use rates of transferred bass (a larger sample) was 68%, indicating intense fishing effort. These data suggest overharvest of Bluegill and Largemouth Bass are likely. If Bluegill size was limited by crowding, we would expect higher Bluegill CPUE and relative weight to be low, with more fish in the 75-150 mm length range. A minimum length restriction may help to improve Bluegill size. However, bass harvest would also need to be reduced to ensure adequate predation on Bluegill to maintain growth to preferred sizes and avoid a Bluegill-crowded situation.

Settlers Park Pond

CPUE data from Settlers Park Pond indicate Bluegill and Largemouth Bass are present in very low abundance. Habitat in this pond may not be capable of sustaining a self-supporting warmwater fish community that provides acceptable fishing opportunity. Settlers Park Pond is a very small pond with very few aquatic plants or habitat features. The pond is used primarily to irrigate the surrounding city park, which may cause low water retention times. Such low retention times might negatively affect the fish community by reducing food availability or directly entraining young fish into the irrigation system. Tag return data from stocked trout in 2012 indicate fishing pressure is intense. Forty percent of tagged Rainbow Trout were harvested quickly (median value of 7 days at large), with 101% total use (Koenig et al. 2015). Despite Largemouth Bass exploitation rates of only 13% at Settlers Pond, total use was 61% with median days-at-large of 1. These data suggest intense fishing pressure and most of the tagged bass were caught soon after release. Increasing the size of this pond or making habitat improvements to improve complexity and provide fish some refuge may be initial steps toward improving the warmwater fish community. However, reducing harvest is currently necessary to account for the small surface area and completely accessible shoreline.

Few demographic surveys of fish assemblages within community ponds had previously been attempted in the Southwest Region. In the future, CPUE data may be a more reliable and efficient indicator of fish population abundance in community ponds. Mark/recapture estimates require two sampling occasions, doubling the amount of effort needed to sample ponds. We decided to only mark Bluegill of at least stock length. This became problematic at several ponds because of the low abundance of stock-length Bluegill. We also had difficulties in recapturing enough marked individuals to make accurate estimates in most cases. CPUE data would require half the effort (only one sampling event) and is readily comparable to other waters when collected using standardized methods (Bonar et al. 2009). More ponds could be surveyed for abundance during the field season, helping to improve our understanding of warmwater fish assemblages in ponds across the region.

We wanted to gain more information regarding catch and harvest of resident and transferred bass. Our tag data probably under estimate bass exploitation, since tags were released between mid-May and July and missed April-May of the warmwater fishing season. Largemouth Bass are occasionally collected from nearby waters and transferred to community ponds to boost or establish self-sustaining warmwater populations. These efforts require considerable time and effort, but results are rarely evaluated. We tagged and transferred legal-length Largemouth Bass to Beach's, Riverside, and McDevitt, ponds. Exploitation and total use rates of Largemouth Bass at Beach's Pond appears to be high, considering the pond had been dry for most of the year as a result a pump failure. Tagged bass were only released in July, so fishing effort must have been significant during the 3.5 months that tags were collected. These results indicate fishing pressure resumed quickly after the pump was repaired, and fish were transplanted to reestablish a Largemouth Bass/Bluegill community. Because most Largemouth Bass require 5 years to reach the legal harvestable length of 305 mm, natural reproduction is unlikely to meet this harvest demand at Beach's Pond. Additionally, Brittle Naiad *Najas minor* was discovered in Beach's Pond in August 2014. This invasive aquatic plant has spread throughout the pond and might require herbicide treatment in 2015 to maintain fishing opportunity here.

Exploitation (88%) and total use (132%) rates of Largemouth Bass at McDevitt Pond also indicated intense fishing pressure. Median days-at-large was 3.5, indicating fish were caught quickly after stocking. Due to the high exploitation rates, transfers of legal-length bass should not be expected to provide natural reproduction at McDevitt Pond unless harvest is reduced. Harvest and total use from Riverside Pond (36%, 54%) were similar to previously reported rates for hatchery rainbow trout, where harvest and total use were 36%-60% and 43%-60% (Koenig et al. 2015). Under these conditions, transferring Largemouth Bass for put/take stocking may only provide short-term benefits.

Many of the ponds in the Southwest Region are located in close proximity to urban settings, where fishing pressure is intense. Hebdon et al. (2008a) estimated the effort at Boise community ponds at 1,222 trips/ha. This is a tremendous amount of effort compared to Brownlee (19 trips/ha) and CJ Strike (25 trips/ha) reservoirs, which are two of the regions premier warmwater fisheries. This presents a unique set of challenges where traditional management strategies often fail (Eades and Lang 2012). Future management of community pond fisheries in the Southwest Region needs to be informed with angler preference data. Mail surveys, focus groups, or creel surveys could be helpful to develop management strategies to meet local angler expectations (Eades and Lang 2012). IDFG should also strive to provide a diversity of fishing options across the multitude of ponds available in the Southwest Region (Balsman and Shoup 2008). While providing good options to recruit new anglers is important, anglers interested in other opportunities such as quality bass or Bluegill may decrease participation due to the lack of diversity with current pond management strategies. Specific management goals for each pond should be developed, as more fish demographic data and tag return information identify how each pond can be improved.

According to the 2013-2018 IDFG Fisheries Management Plan, ponds in the Southwest Region are to be managed to “provide opportunities for novice anglers and youth.” Current pond management strategy focuses primarily on put/take trout fishing for recruiting young anglers through family-friendly experiences. In addition to trout, quality Bluegill fisheries would attract young anglers. Bass-Bluegill ponds must maintain some sort of balance to provide good fishing. Swingle (1950) described the idea of the balanced bass-Bluegill pond. He describes a balanced pond as having reproduction of both predators and prey, food available for all sizes of predators, fast growth rates, and annual harvest proportional to productivity. This balance is maintained by managing angler harvest. More specifically, manipulating Largemouth Bass harvest is the primary tool for managing Bluegill and Largemouth Bass size distribution and density. Eades and Lang (2012) recommended community ponds have minimum length limits of 381 mm for Largemouth Bass, with 533 mm being preferable and recommend creel limits of 1-3 bass, with lower limits with larger minimum lengths.

Latitudinal variation in predator-prey dynamics is common, and ponds in northern latitudes should be managed according to local conditions affecting pond productivity. Schramm and Willis (2012) caution that managers should employ conservative largemouth bass harvest strategies to control Bluegill production based on the lower bioenergetics demands of northern populations. Expectations of PSD for “preferred” or “memorable” bass may need to be adjusted to reflect pond productivity and the typical growth season. Additionally, fishing pressure is very intense in community ponds, making it difficult to maintain self-supporting fish populations (Eades and Lang 2012). In these cases, put-and-take may be the only option, which is unlikely to be implemented in the near future due to the lack of rearing facilities and funding. .

RECOMMENDATIONS

1. Continue treating aquatic vegetation at Duff Lane and Horseshoe Bend Mill ponds to increase Bluegill size structure and improve fishing access. Initiate herbicide treatment at Beach's Pond to reduce the density of Brittle Naiad and allow better access to fishing.

2. Manage Settlers Park Pond for put/take trout fishing only, as the pond does not have potential for quality warmwater fishing. Work with park staff to increase pond size and depth to increase water retention time and improve fish habitat.

3. Avoid transferring legal-length Largemouth Bass to ponds without first implementing more restrictive length and bag limits; unless the objective is to only establish or re-establish a population.

4. Collect data on angler preferences and expectations to develop specific management goals and provide a more diverse angling experiences.

5. Work with municipalities to recommend pond design, by maximizing depth and surface area for future pond construction projects.

Table 16. Proportional stock density (PSD) by waterbody and species with associated sample sizes (*n*) and 95% confidence intervals. National average PSD values from Bonar et al. (2009) for small lentic waters are presented for comparison.

Waterbody - species	n	Stock (n)	Quality (n)	PSD	*National avg*
Duff Lane Pond					
Bluegill	199	60	8	13 ± 11	*41.1*
Largemouth Bass	117	95	33	35 ± 11	*55.7*
Pumpkinseed	170	10	3	30 ± 40	-
Horseshoe Bend Pond					
Bluegill	673	596	44	7 ± 2	*41.1*
Largemouth Bass	194	156	53	34 ± 8	*55.7*
Pumpkinseed	16	14	3	21 ± 32	-
Parkcenter Pond					
Bluegill	170	72	2	3 ± 5	*41.1*
Largemouth Bass	1066	26	12	46 ± 23	*55.7*
Pumpkinseed	82	54	0	0	-
Settlers Park Pond					
Bluegill	95	11	5	45 ± 45	*41.1*
Largemouth Bass	9	8	3	38 ± 57	*55.7*
Pumpkinseed	91	26	9	35 ± 24	-

Table 17. Relative weight (W_r) of stock-length and quality-length fish by waterbody and species with associated samples sizes (*n*). National average W_r values from Bonar et al. (2009) for small lentic waters are presented for comparison.

Waterbody - species	Stock	n	*National avg.*	Quality	n	*National avg.*
Duff Lane Pond						
Bluegill	98	46	*106*	93	7	*104*
Largemouth Bass	88	61	*92*	81	32	*93*
Pumpkinseed	78	4	-	70	3	-
Horseshoe Bend Pond						
Bluegill	96	309	*106*	96	28	*104*
Largemouth Bass	99	36	*92*	95	18	*93*
Pumpkinseed	82	8	-			-
Parkcenter Pond						
Bluegill	112	78	*106*	109	3	*104*
Largemouth Bass	111	12	*92*	110	8	*93*
Pumpkinseed	86	56	-			-
Settlers Park Pond						
Bluegill	109	1	*106*	118	8	*104*
Largemouth Bass	117	5	*92*	111	3	*93*
Pumpkinseed	86	25	-	80	1	-

Table 18. Electrofishing catch per unit effort (CPUE; fish/h), number fish marked (n1) and number recaptured (m2), and abundance estimate with associated 95% confidence bounds. National median electrofishing catch rate for small lentic waters from Bonar et al. (2009) is included for comparison.

WaterBody	CPUE avg (fish/hr)	*National median*	Marked (n_1)	Recap run (n_2)	Marked recaps (m_2)	Abundance estimate	95% Confidence bounds
Duff Lane Pond							
Bluegill	98	*127*	10	42	1	236	30 - 8,185
Largemouth Bass	137	*81*	42	53	7	289	125 - 688
Pumpkinseed	10	-	6	1	0	-	-
Horseshoe Bend Pond							
Bluegill	424	*127*	165	339	2	18,812	4,290 - 157,793
Largemouth Bass	107	*81*	92	63	7	743	325 - 1,791
Pumpkinseed	10	-	6	8	0	-	-
Parkcenter							
Bluegill	80	*127*	24	44	0	-	-
Largemouth Bass	23	*81*	8	18	3	42	11 -177
Pumpkinseed	56	-	24	34	1	437	59 - 15,903
Settlers Park Pond							
Bluegill	14	*127*	3	7	1	15	2 - 409
Largemouth Bass	8	*81*	4	4	3	5	1 - 8
Pumpkinseed	46	-	13	21	2	102	21 -770

Table 19. Total number of Largemouth Bass tagged and released by waterbody and associated totals of fish harvested and released. Exploitation and use (harvest + release) rates are shown with 90% confidence intervals. Treatment indicates whether bass were transferred from other waters or resident in the pond at the time they were tagged. The median days-at-large (DAL) is listed by pond.

Water Body	Treatment	n	Tag release dates	Harvested	Harvest Because Tagged	Released	Total use	Adjusted harvest	Adjusted use	Median DAL
Beach's Pond	Transfer	35	7/10 - 7/21/14	3	0	3	6	25 ± 18 %	51 ± 24%	31
Duff Ln	Resident	27	5/15 - 5/20/14	3	0	4	7	33 ± 23%	77 ± 32%	33
Horseshoe Bend	Resident	51	6/10 - 6/17/14	3	0	5	8	17 ± 12%	46 ± 20%	15
McDevitt	Transfer	27	5/28, 7/2/14	8	0	4	12	88 ± 34%	132 ± 39%	3.5
Parkcenter	Resident	11	6/18 - 6/22/14	1	0	0	1	27 ± 32%	27 ± 32%	-
Parkcenter	Transfer	26	6/27/2014	3	0	3	6	34 ± 23%	68 ± 32%	18.5
Parkcenter Total	All	37		4	0	3	7	32 ± 19%	56 ± 25%	18
Riverside	Transfer	33	5/27, 7/2/14	4	0	2	6	36 ± 21%	54 ± 26%	25
Settlers	Resident	5	5/12 - 5/19/14	0	1	0	1	0%	59 ± 66%	-
Settlers	Transfer	39	5/28, 7/2/14	2	0	6	8	15 ± 13%	61 ± 25%	1
Settlers Total	All	44		2	1	6	9	13 ± 12%	61 ± 24%	1

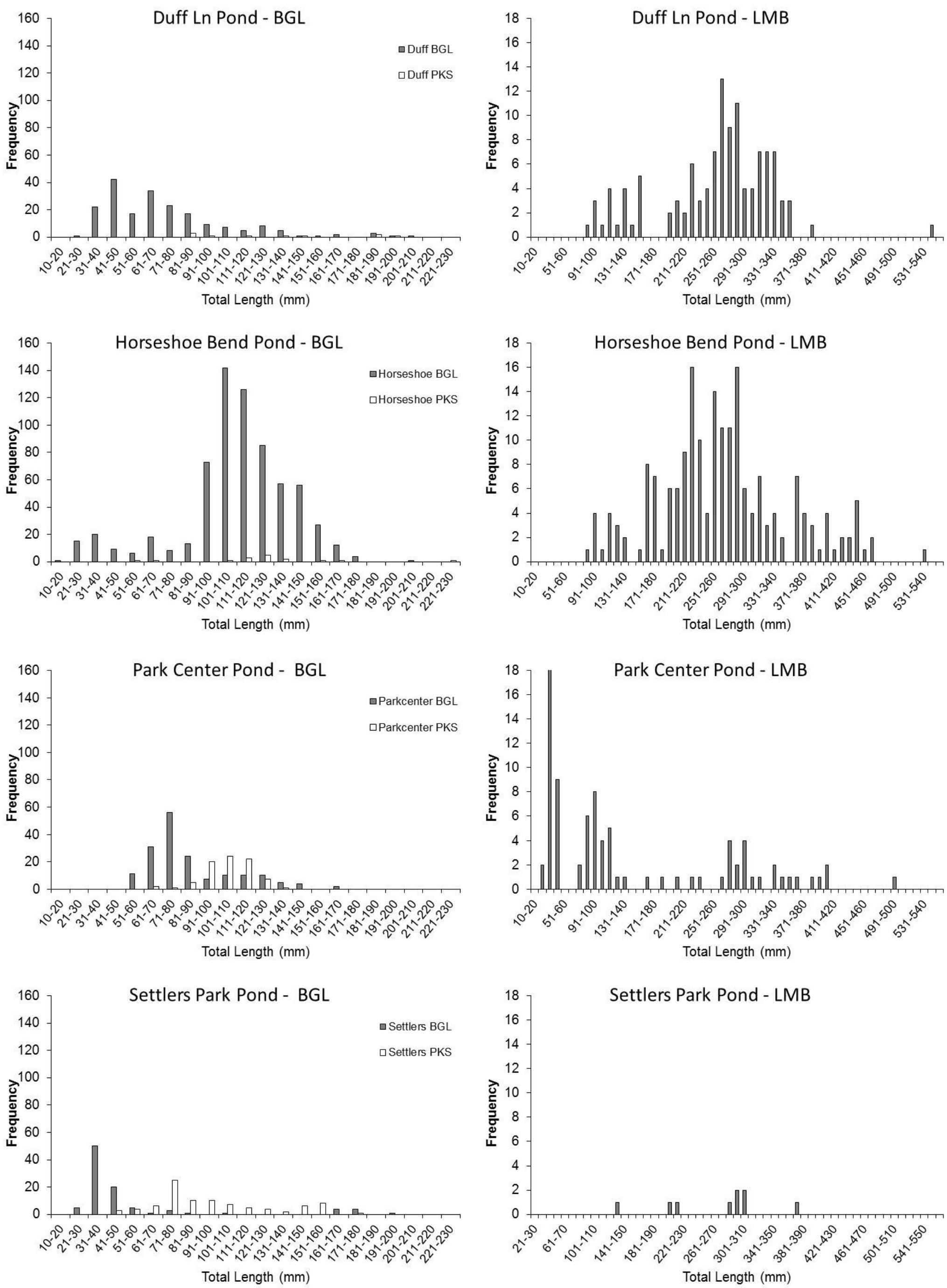

Figure 28. Length-frequency distribution of Bluegill (BGL) and Largemouth Bass (LMB) by study pond sampled in spring 2014.

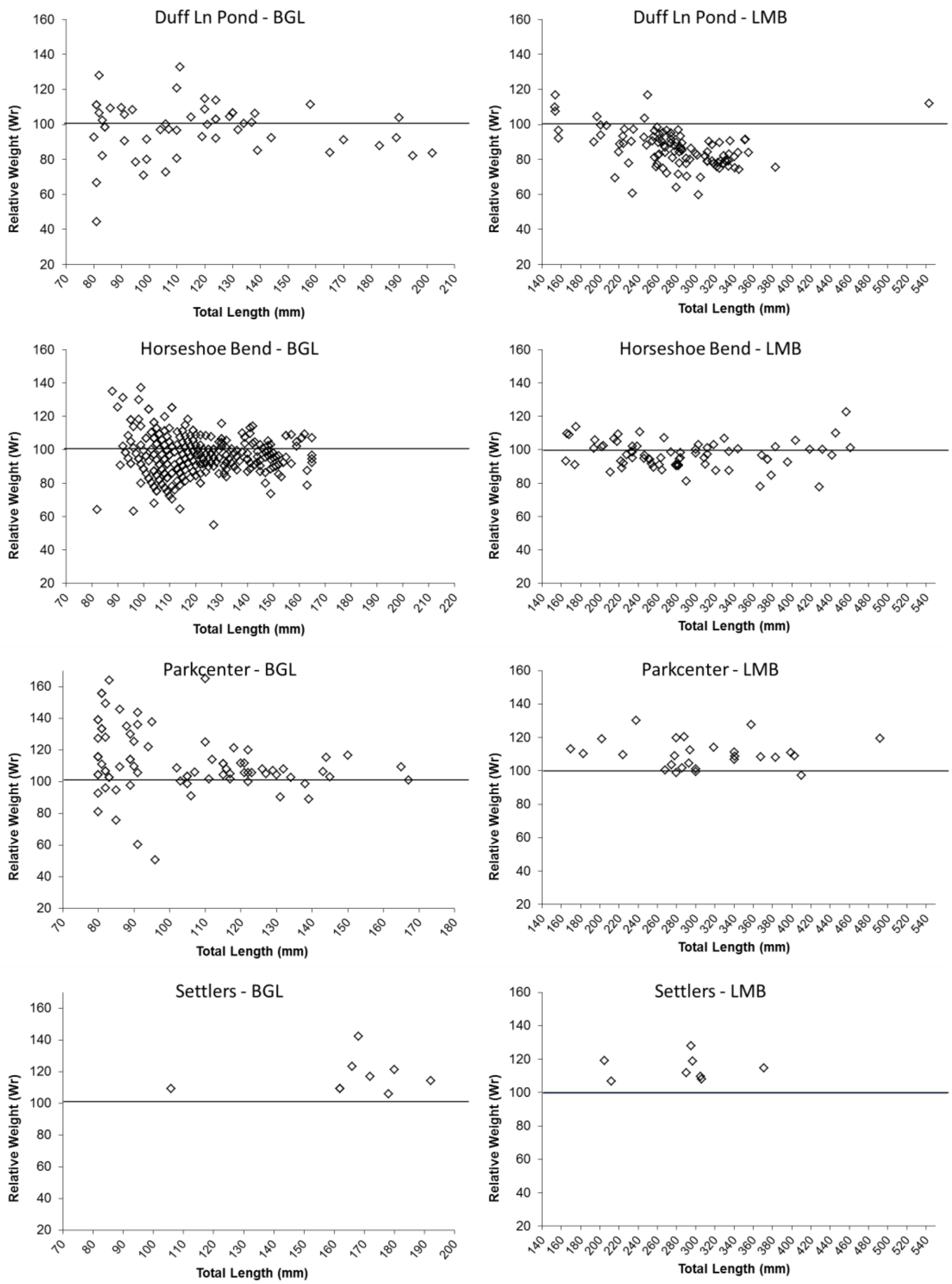

Figure 29. Relative weight distribution of Bluegill (BGL), and Largemouth Bass (LMB) by study pond. Samples were collected during spring 2014. Relative weight (W_r) was only calculated for fish longer than stock lengths for Bluegill (80 mm) and Largemouth Bass (150 mm) as recommended by Blackwell et al. (2000).

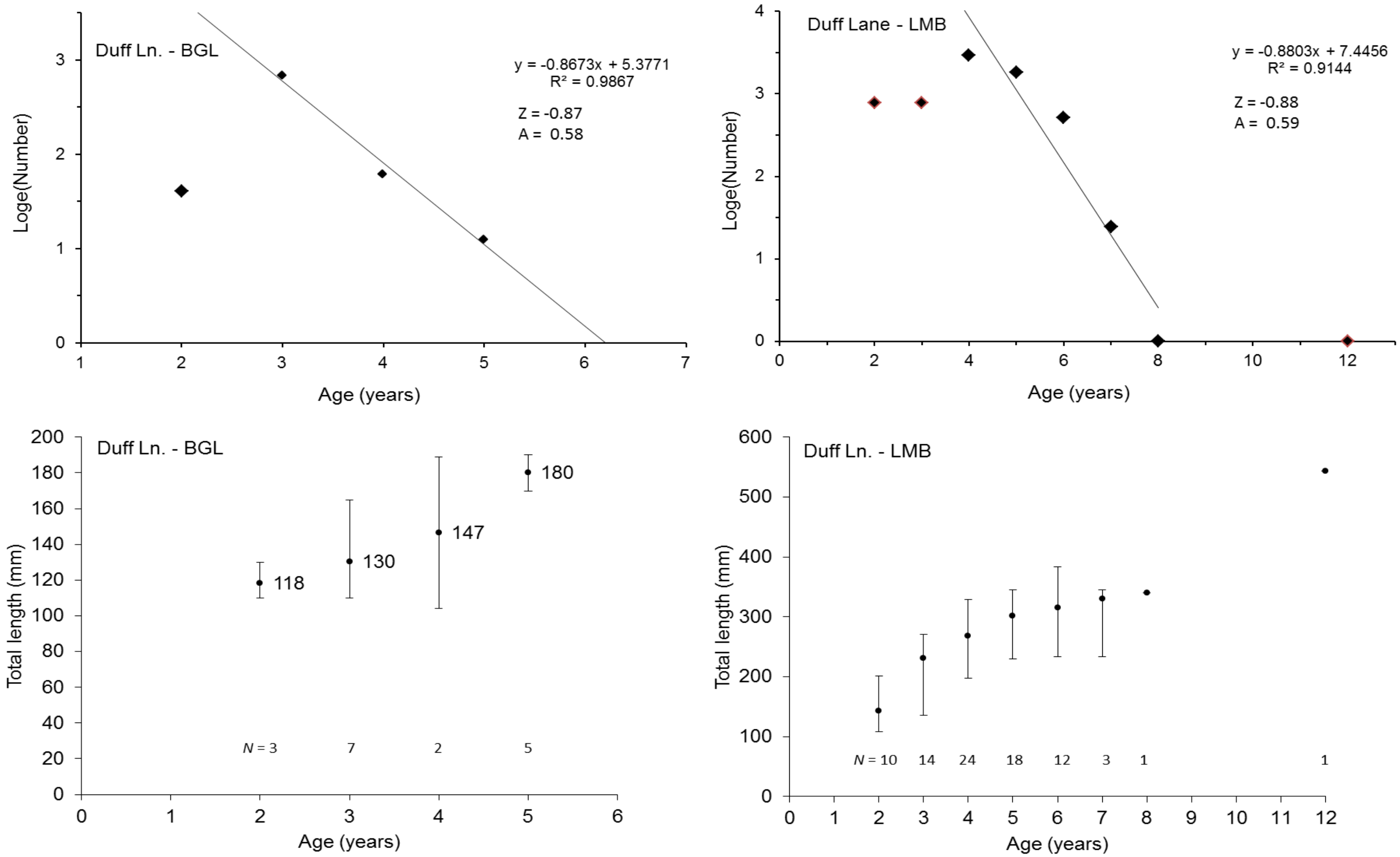

Figure 30. Catch curve (top panels) and mean length-at-age (bottom panels) for Bluegill and Largemouth Bass from Duff Lane Pond sampled in May 2014. Age distribution for catch curves were assigned from and age-length key developed from subsample of aged fish using dorsal spine cross sections. Curves were fit for Bluegill and Largemouth Bass for ages 3-5 and 4-8, respectively. Sample sizes for mean length-at-age for the number of aged samples are shown across the bottom. Error bars indicate minimum and maximum values.

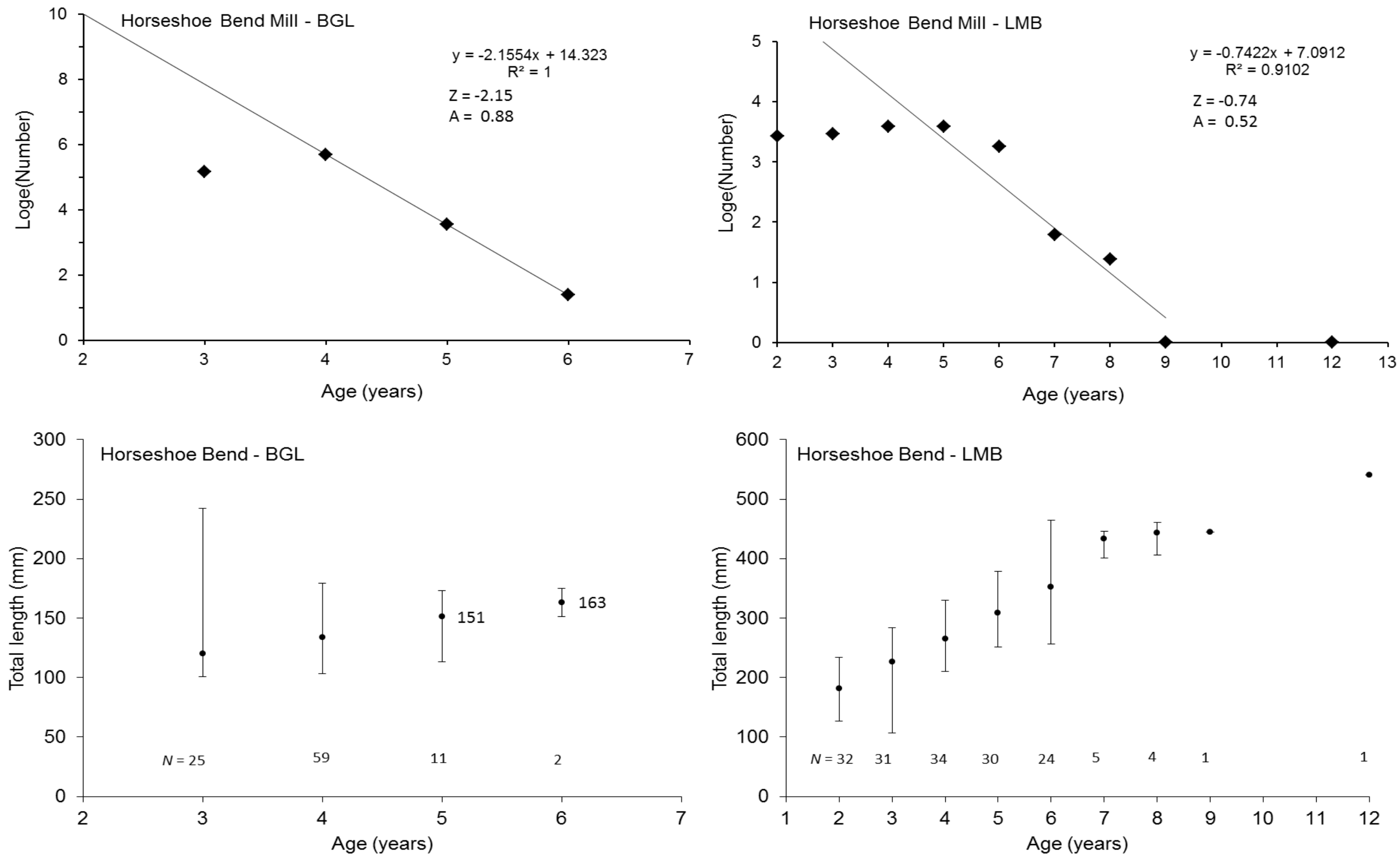

Figure 31. Catch curve (top panels) and mean length-at-age (bottom panels) for Bluegill and Largemouth Bass from Horseshoe Bend Mill Pond sampled in May 2014. Age distribution for catch curves were assigned from and age-length key developed from subsample of aged fish using dorsal spine cross sections. Curves were fit for Bluegill and Largemouth Bass for ages 3-5 and 4-8, respectively. Sample sizes for mean length-at-age for the number of aged samples are shown across the bottom. Error bars indicate minimum and maximum values.

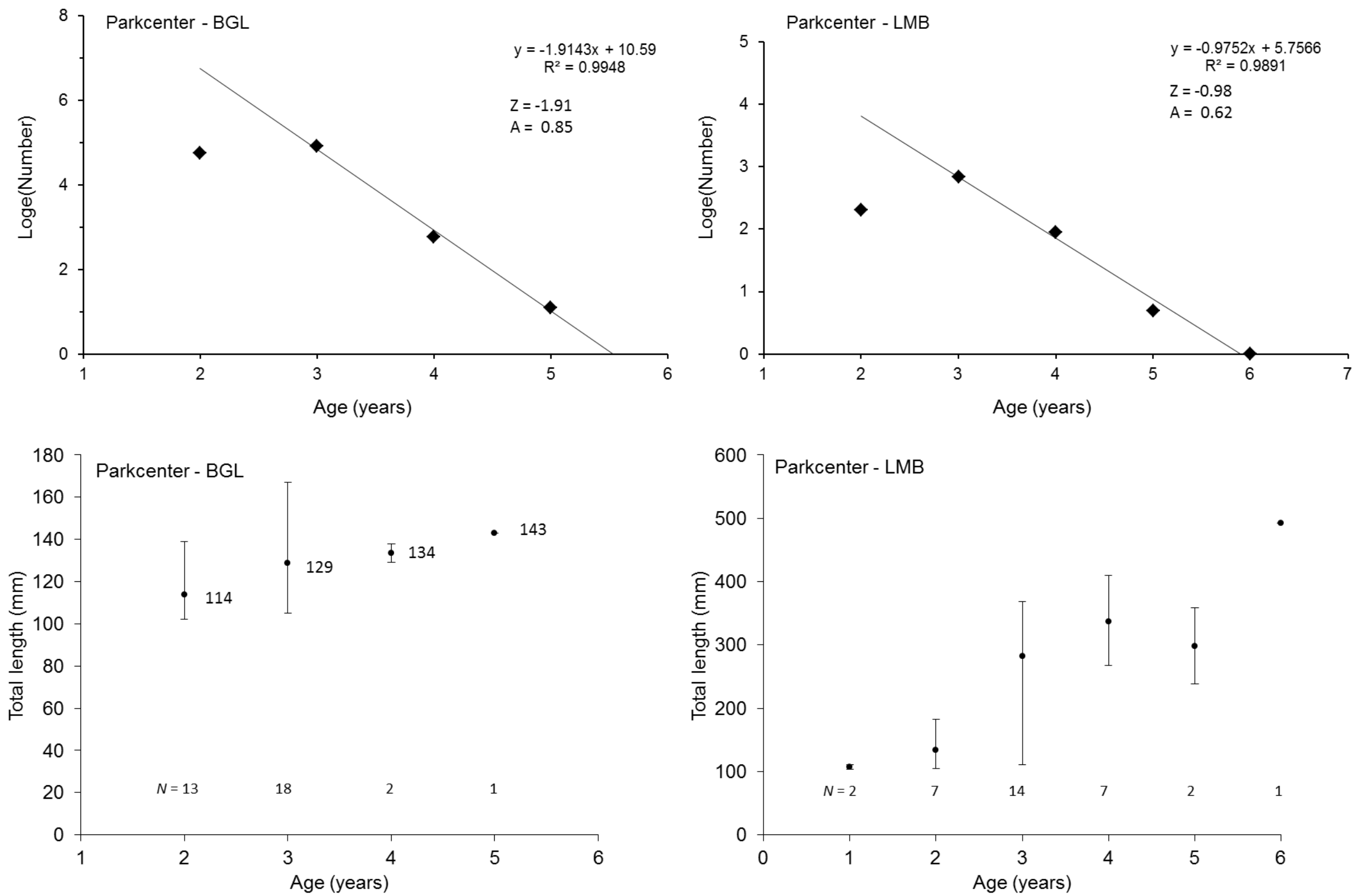

Figure 32. Catch curve (top panels) and mean length-at-age (bottom panels) for Bluegill and Largemouth Bass from Parkcenter Pond sampled in June 2014. Age distribution for catch curves were assigned from and age-length key developed from subsample of aged fish using dorsal spine cross sections. Curves were fit for Bluegill and Largemouth Bass for ages 3-5 and 4-8, respectively. Sample sizes for mean length-at-age for the number of aged samples are shown across the bottom. Error bars indicate minimum and maximum values.

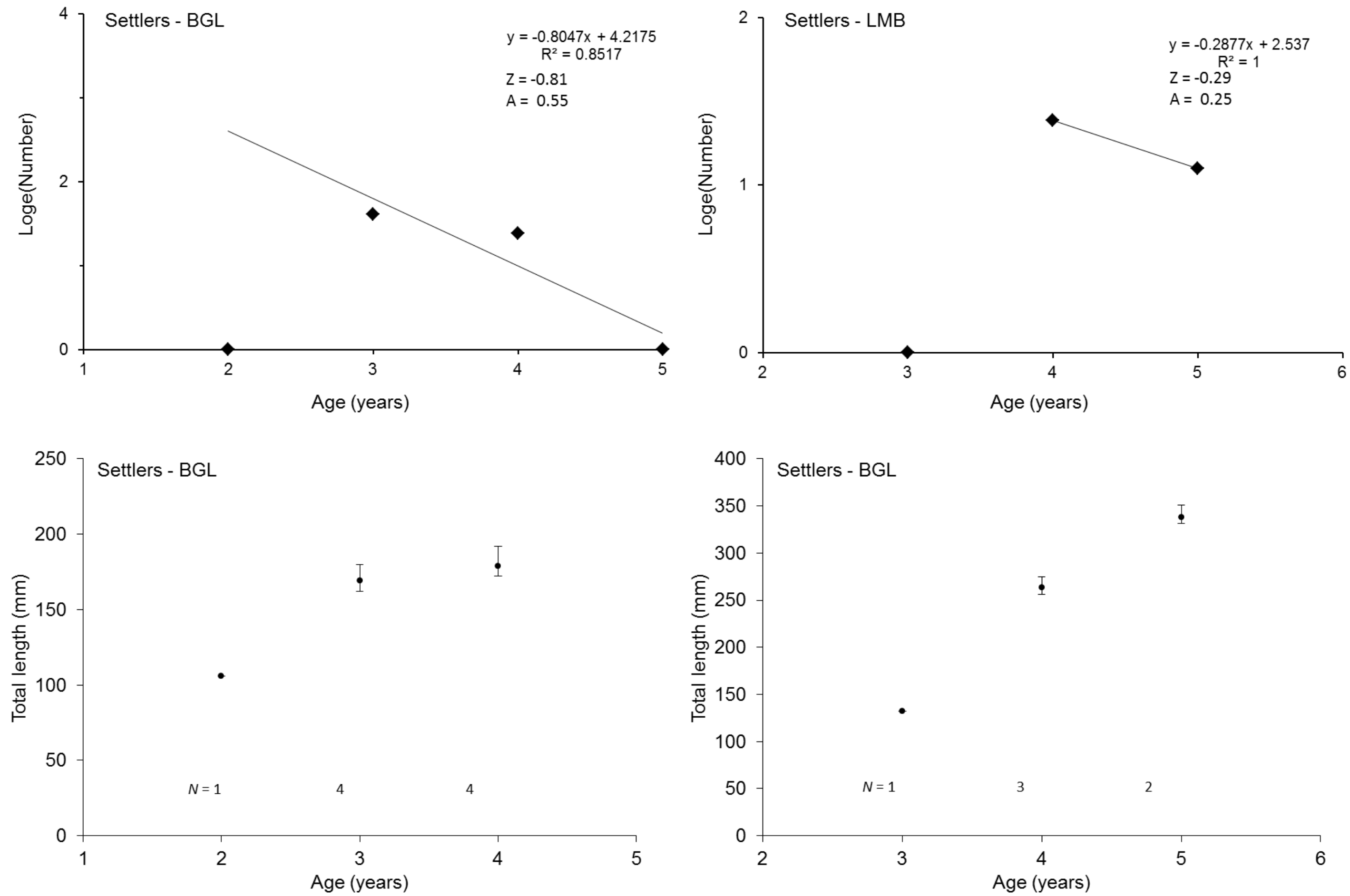

Figure 33. Catch curve (top panels) and mean length-at-age (bottom panels) for Bluegill and Largemouth Bass from Settlers Park Pond sampled in May 2014. Age distribution for catch curves were assigned from and age-length key developed from subsample of aged fish using dorsal spine cross sections. Curves were fit for Bluegill and Largemouth Bass for ages 3-5 and 4-8, respectively. Sample sizes for mean length-at-age for the number of aged samples are shown across the bottom. Error bars indicate minimum and maximum values.

LICENSE TYPE AND PURCHASE HISTORY OF ANGLERS USING COMMUNITY FISHING PONDS IN THE SOUTHWEST REGION, IDAHO 2011-2013

ABSTRACT

A major component of community fisheries in the Southwest Region is small ponds, often located within municipal parks. The number of community ponds in southwestern Idaho has increased over the past decade, and now totals approximately 40. From 2007 through 2012, the number of community ponds that IDFG stocks with hatchery catchable Rainbow Trout has increased from 11 to 24. The focus of this study was to characterize the types of licenses and the purchase history of anglers who use these ponds. This information complements the demographic information collected during a previous creel survey of community ponds in 2011-2012 to further describe and understand the anglers that use these waters. Ten different license types were observed from the 869 community pond anglers that were contacted previously during creel surveys. The adult fishing license was by far the most frequently observed license type among community pond anglers with 55% (474) of all license types. The second most observed license type was the adult combination license (17%) followed by the senior combination license (10%). The number of successive years that community pond anglers have purchased licenses ranged between 1 and 22. Approximately half (51%) of these anglers had consecutively purchased licenses for three or fewer years. First time anglers or anglers who did not purchase a license in the previous year comprised 22% of community pond anglers.

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INTRODUCTION

In southwestern Idaho, Boise and the surrounding metropolitan area, known as the Treasure Valley, contains approximately 43% of the state's population (U.S. Census Bureau 2011). Ada and Canyon counties alone contain over 580,000 people, or 37% of the state's population. Although the Idaho Department of Fish and Game (IDFG) does not have a formal community fisheries management program, managers have been responsive to meeting the needs for nearby, easily accessible fishing opportunities.

A major component of community fisheries in the Southwest Region is small ponds, often located within municipal parks. These ponds are either former gravel pits that are filled with ground water or irrigation ponds where fishing is a secondary use. In most cases, IDFG is responsible solely for fisheries management in the ponds, while city parks departments are responsible for land and facility management activities. Most ponds contain naturally reproducing Bluegill *Lepomis macrochirus* and Largemouth Bass *Micropterus salmoides*. Hatchery Rainbow Trout *Oncorhynchus mykiss* are stocked typically on a monthly basis from September through June, when water temperatures are not lethal to trout. Water temperatures during July and August are not typically suitable for Rainbow Trout stocking. Adult Channel Catfish *Ictalurus punctatus* are captured and moved from the Snake River during these periods of high water temperature to provide a summer fisheries in selected ponds.

The community fishing ponds have been popular with city leaders, park departments, and local anglers. This is reflected in the increase in number of community ponds over the past decade, which now totals approximately 40. From 2007 through 2012, the number of community ponds that IDFG stocks with hatchery catchable Rainbow Trout has increased from 11 to 24. The growth of this fishery program has placed considerable demand upon IDFG hatchery and management budgets as well as personnel. In 2010, IDFG stocked approximately 114,000 catchable Rainbow Trout into community ponds, which equates to 41% of the region's catchable-sized trout allocation. Based on an estimated cost of $0.84/fish to raise a catchable-sized trout, IDFG spends approximately $96,000/year to stock community ponds with trout in the Southwest Region.

Given the substantial resources that are currently directed towards providing and managing fisheries in southwestern Idaho community ponds, there is a need to evaluate this program. Specifically, managers wanted have more information on anglers that use the community ponds and whether the ponds play a role in angler recruitment and increasing the frequency of annual license purchases or reducing churn. Churn is defined as the rate at which anglers annually discontinue purchase a license in successive years. In May 2011, staff initiated a year-long creel survey on four community ponds, with the objective of describing demographics of community pond anglers (Butts et al. 2013). Findings included that the mean age of anglers and their dependents was 30, and 87% of anglers were male. Approximately 86% of anglers were Caucasian and the mean travel distance was 5.9 mi. The average years of angling experience was 27.3 years, because many anglers reported being introduced to fishing at ages 4-5. Anglers estimated that on average they fished 66.3 d/year. Anglers also estimated that over half of the trips on an annual basis were to a community pond. Nearly half of the anglers classified themselves as currently unemployed or retired (43%). Only 33% of anglers were fishing with children at the community ponds.

The notion that community ponds were visited primarily by novice anglers or families looking for close and convenient recreational opportunities was not supported; instead, ponds were frequented by very experienced anglers. Collection of license numbers that allowed us to track individual anglers allowed us to assess the types of licenses purchased by community pond anglers and their patterns of license purchases. This information will complement the demographic information collected during the creel survey by further describing and understanding anglers who use community ponds.

The focus of this study was to characterize the types of licenses and the purchase history of anglers who use community ponds in the Southwest Region, Idaho. The license type purchased by an individual angler offers insight into lifestyle characteristics and avidity of people fishing at community ponds. It also provides information on economic contribution towards stocking efforts such as community ponds since prices vary widely among different license types. Successive years of license purchases were also examined as a gauge of avidity and whether the ponds play a role in angler recruitment and perhaps reducing churn.

METHODS

License information for anglers fishing Southwest Regional community ponds was collected from two sources: 1.) Annual tag reports from fish released through 2011-2013 and 2.) A creel survey conducted on four community ponds during 2011 and 2012. Rainbow Trout were tagged and stocked into various community ponds as part of a statewide research project investigating use and exploitation of hatchery trout in Idaho. During 2011-2013, 3,472 tagged Rainbow Trout were stocked into 17 different community ponds located across the Southwest Region (Table 20). Fish were tagged using a 70 mm (51 mm of tubing) fluorescent orange Floy® FD-68BC T-bar anchor tags treated with algaecide. A full description of tagging and stocking methods is reported in Koenig (2012). The statewide tag report database containing information from voluntary tag reports was queried for angler contact information for each tag report from community ponds in the Southwest Region. Angler information in the tag report database was matched to anglers in the IDFG license database to obtain license type and purchase history. Anglers are not required to supply license numbers when reporting a tag, so not all tag reports could be matched with an angler. Unmatched reports were summarized into four categories: 1) Not in system (NIS), a person not in IDFG license database such as a youth angler under age of 14, or a person that has never purchased an IDFG license, 2) Incorrect (INC), person provided incorrect or missing information that precluded us from finding a match, 3) Multiple Anglers (MA), where there were multiple anglers with the same name in the same zip code which prevented making a definitive license match, and 4) Illegal (ILL), where anglers were matched to a previous license purchase and did not have a valid license for the year that the tag was reported.

Additionally, a roving-roving creel survey that included on-site interviews was conducted at Settlers Pond in Meridian, McDevitt and Riverside ponds in Boise, and Merrill Pond in Eagle beginning in May 2011 through April 2012 (Butts et al. 2013a; Butts et al 2013b). During angler interviews, license numbers were collected through creel interviews so that a contact list of community pond anglers could be compiled for future surveys or panel groups as recommended by Schill (1996). License type was coded by the first three digits in the license number and license buying history was queried from the IDFG license database.

Currently IDFG sells 11 different license types that allow fishing for Idaho residents and 4 for nonresidents (Table 21). This excludes lifetime licenses which can be purchased at various ages and prices. Anglers under the age of 14 are not required to purchase a fishing license. License information from both tag reports and creel were grouped into the license types outlined in Table 20. License buying history was also examined. License buying history was derived by counting the successive years that an angler had purchased a license.

RESULTS

Anglers reported a total of 906 tags during the three-year hatchery trout evaluation. We were able to match 635 anglers in the IDFG license database to these tag reports. Anglers reporting multiple tags during the period were only counted once. Ten different license types were observed in the 869 community pond anglers that we associated with a tag report (Figure 34). The distribution of license types were very similar between those collected from creel and the three years of tag reports and were therefore pooled for analysis. The adult fishing license was by far the most frequently observed license type among community pond anglers with 55% (474) of all license types. The second most observed license type was the adult combination license (17%) followed by the senior combination license (10%). The disabled combination license composed approximately 5% (43) of all license types. Each individual remaining license category composed 3% or less of the total. No lifetime licenses were observed during this study. Approximately 41% of anglers reported being unemployed during the creel survey

The number of successive years that community pond anglers had purchased licenses ranged from 1 to 22 (Figure 35). Approximately half (51%) of these anglers had consecutively purchased licenses for three or fewer years. First time anglers or anglers who did not purchase a license in the previous year composed 22% of community pond anglers. Around 30% of community pond anglers had purchased licenses for 5 to 10 consecutive years. Anglers with 20 or more years of consecutive license purchases composed 4% of the total.

We were unable to find a license number match for 261 (29%) of the tag reports that were made from 2011 through 2013 (Figure 36). Nearly half of these were anglers that were not found in the IDFG license database. These are most likely children under the age of 14 that are not required to purchase a license to fish in Idaho. However, there is a possibility that some of these anglers have never purchased a license in Idaho. Nineteen percent (49) of the anglers in this group did not have a valid fishing license for the year that they reported catching a tagged fish. These anglers were matched to license purchases in previous years and were fishing illegally. Finally, approximately 33% of unmatched anglers were a result of incorrect information or multiple anglers with the same name and zip code that prevented definite categorization.

DISCUSSION

Our hypothesis that a large majority of community pond anglers are adults that only buy fishing licenses (21%) was not supported. Nearly 40% of pond anglers also participate in hunting activities as indicated by the purchase of a combination or sportsman's package license that allows hunting. This suggests that nearly half of community pond anglers participate in multiple outdoor activities. This is supported by the fact that 41% of these anglers have purchased some type of IDFG license for five or more consecutive years. Butts et al. (2013b) found that the mean angling experience was 27 years, and anglers reported fishing an average of 66 d/year, further supporting the notion that many community pond anglers are very avid and experienced.

Community ponds also appear to be frequented by a number of new or lapsed anglers that have not purchased licenses in consecutive years. If anglers who were not in the license database were children under the age of 14, then they encompass about 15% (126) of the anglers. Combined with youth fishing and combination licenses, this would suggest that about 21% of community pond anglers are younger than 19 years old. During the creel survey, where ages of children were collected, an estimated 33% of community pond anglers were younger than 14 years old with a total of 38% of all anglers younger than 19 years old.

License buying histories showed that 22% of anglers were either new or had not bought a license the previous year. Together, this suggests that the community ponds play a valuable role in angler recruitment and retention. This study would have been improved by separating first-time license buyers and lapsed anglers during data collection but unfortunately this was not done. Butts et al. (2013) found that only 7% of community pond anglers were new to the sport. Therefore, it is likely that many of the anglers described above were lapsed anglers.

Disabled and senior citizen anglers, who qualify for reduced license prices, composed approximately 17% of anglers at community ponds. Senior citizens composed approximately 10% of anglers in both this study and the previous creel survey (Butts et al. 2013). Therefore, community ponds are providing opportunities for anglers that may be limited from participating at waters that may be more physically demanding such as rivers or steep shorelines. Furthermore, approximately 41% of anglers reported being unemployed during the creel survey. Disabled anglers are able to purchase an annual fishing license for $5.00 or three years for $11.50. Considering the cost of $0.84 per stocked catchable, a disabled license offsets the cost of about six catchables. A senior combination license costs $11.75, and offsets the cost of about 14 catchables per annual license fee (Butts et al. 2013b). Considering the number of days spent fishing at these water by these license buying types, inequalities may exist in funding the stocking of these ponds.

Anglers fishing illegally without a valid license were discovered in both creel and tag reports at community ponds. During the three years of tag reports, 49 anglers (8%) who reported tags did not have a valid fishing license for that year. These were verified anglers that had purchased a license in previous years and were in the IDFG license database. During the creel surveys, nine anglers (4%) were interviewed who did not have valid fishing licenses. To avoid discouraging anglers from reporting tags, a conscious decision was made to not use the tag hotline as an enforcement tool. Overall, people fishing illegally represented about 7% of the 869 community pond anglers evaluated in this study (creel and tag reports combined). This likely underestimates illegal activities since it does not include 126 anglers that were not in the license database. These were assumed to be children under the age of 14, but it is likely that they include a number of anglers who never purchased a license in Idaho. This suggests that there are opportunities for enforcement and education to improve compliance at community ponds in the Southwest Region.

Investigating license types and buying histories of anglers using community ponds complements the demographic study conducted in 2012. Furthermore, this study provides insight on the types of useful information that managers can obtain from the tag reporting database, particularly tag reports linked to an angler in the IDFG license database. Age, gender, location, license type, and buying histories can all be investigated using the license database. Linking the two databases provides managers with demographic or contact information for anglers who fish specific waters which is particularly useful when soliciting public input. During this study, we spent a great deal of time manually going through both databases and matching anglers to their respective license numbers. The tag reporting database would be greatly enhanced by taking this step during the initial data entry of a tag report.

RECOMMENDATIONS

1. Work with Fishery Research section to incorporate license numbers into tag return database.

2. Work with regional enforcement staff to prioritize additional enforcement and education efforts to improve license-buying compliance in community pond fisheries.

Table 20. Number (No) of tagged hatchery Rainbow Trout stocked and reported at various southwestern Idaho community ponds during 2011-2013. Fish were tagged as part of a large statewide study on exploitation and angler reporting was voluntary.

Year	Waterbody	Tags Released	Tags Returned
2011	Caldwell Rotary Pond	250	91
	Eagle Island Park Pond	250	72
	McDevitt Pond	275	74
	Wilson Springs Pond	799	319
2012	Caldwell Ponds #2	108	30
	Ed's Pond	75	20
	Horseshoe Bend Mill Pond	247	22
	Parkcenter Pond	198	30
	Sawyers Pond	200	18
	Wilson Springs Pond	200	66
2013	Duff Lane Pond	99	9
	Kleiner Pond	100	27
	Payette Greenbelt Pond	129	23
	Quinn's Pond	50	2
	Riverside Pond	120	24
	Settler's Pond	20	10
	Ten Mile Pond	223	38
	Veteran's Pond	49	5
	Wilson Springs Pond	80	26
Total		3,472	906

Table 21. Fishing license types sold by Idaho Department of Fish and Game in 2014.

Class	License Type	2014 Price (U.S. $)
	No License*	
Resident	Adult Combination	$ 33.50
	Adult Fishing	$ 25.75
	Sportsmans Package	$ 124.25
	Senior Combination	$ 11.75
	Junior Combination	$ 17.50
	Junior Fishing	$ 13.75
	Furlough Combination	$ 17.50
	Furlough Fishing	$ 17.50
	Disabled Combination	$ 5.00
	Disabled Fishing	$ 5.00
	Daily Fishing	$ 11.50
Nonresident	Combination	$ 240.00
	Fishing	$ 98.25
	Daily Fishing	$ 12.75
	Junior Fishing License	$ 21.75

*No license includes children under the age of 14 who are not required to purchase a fishing license.

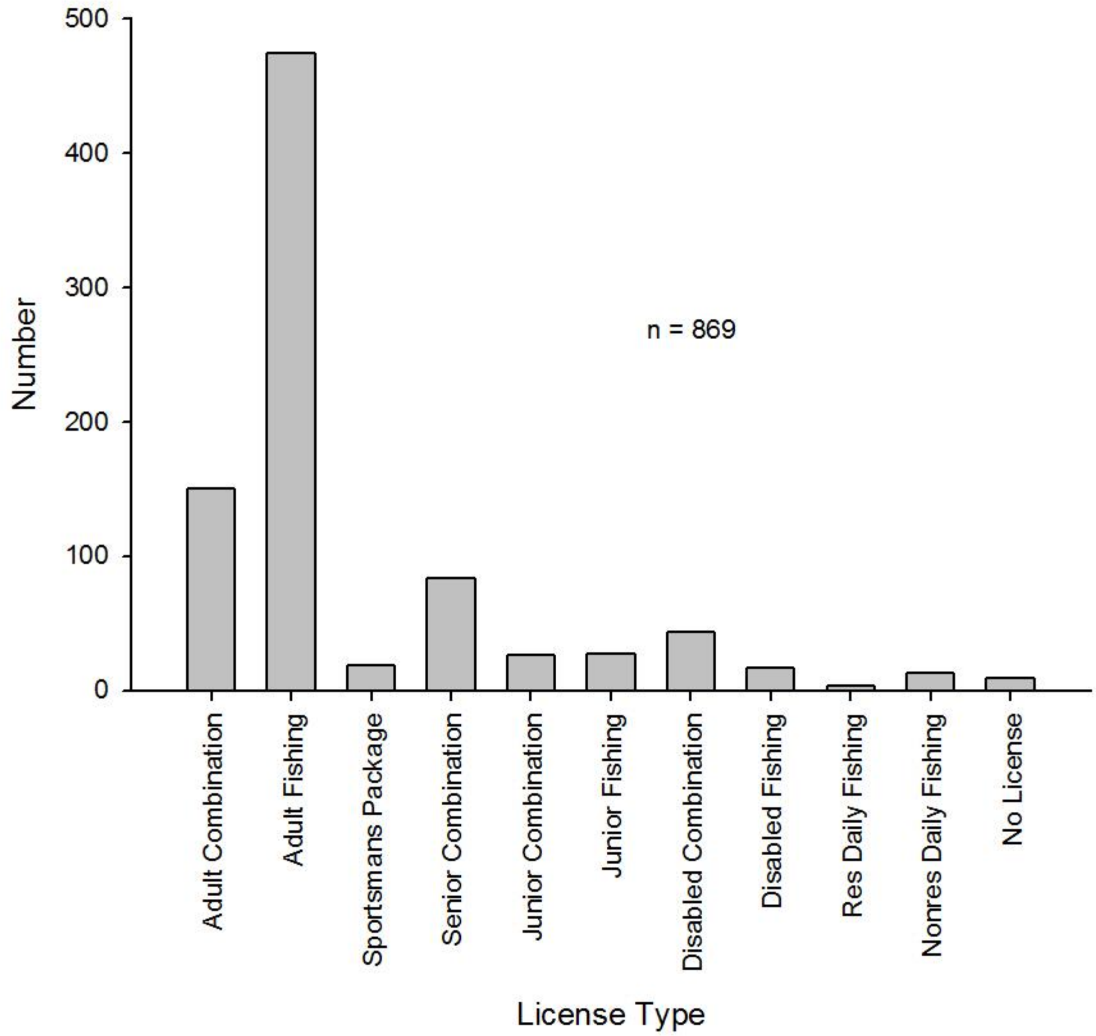

Figure 34. Distribution of license types purchased by community pond anglers in the Southwest Region from 2011 to 2013.

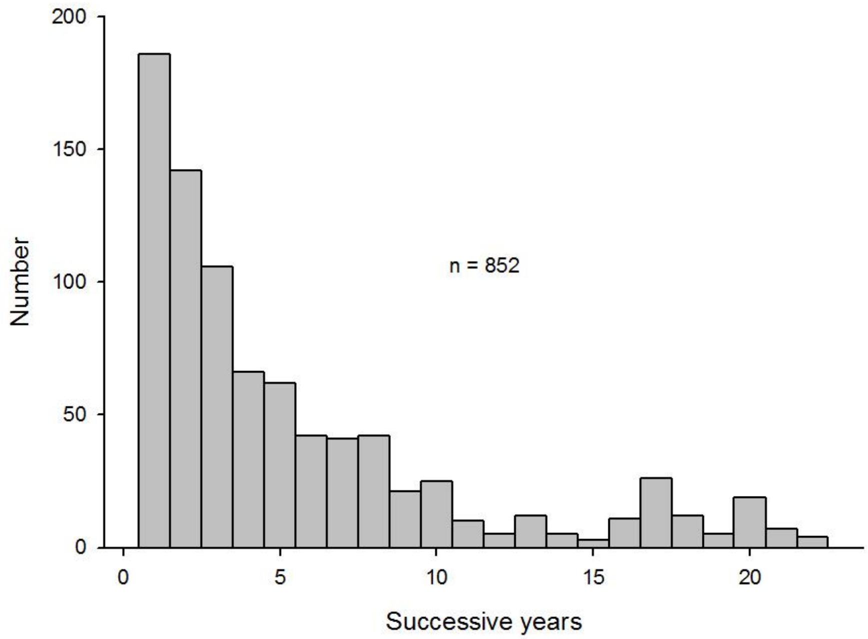

Figure 35. Distribution of successive years of licenses purchased by community pond anglers in the Southwest Region from 2011 to 2013.

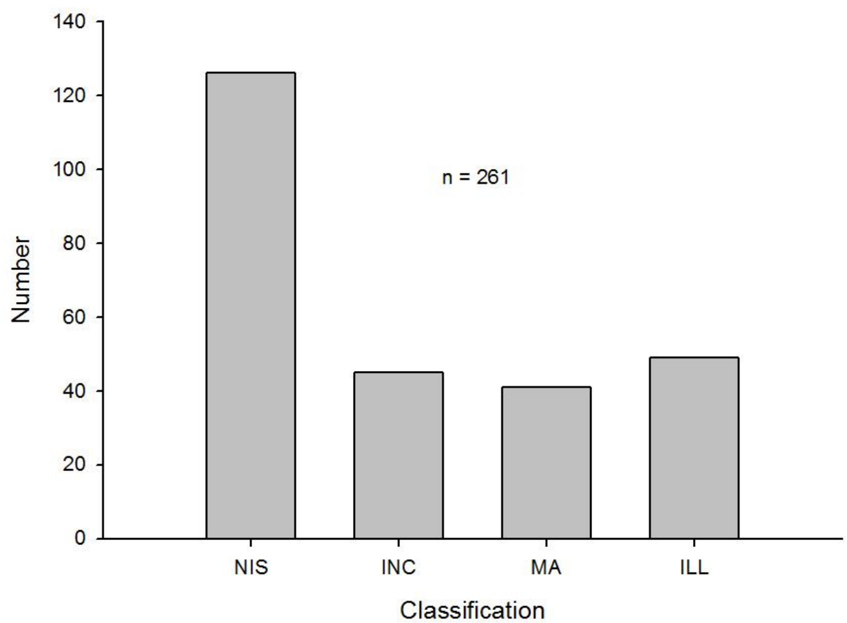

Figure 36. Distribution of classifications of reasons tag reports were not matched with a valid license number for community pond anglers in Southwest Idaho, 2011-2013. Classifications were not in system (NIS), incorrect or missing information (INC), multiple anglers with same name in zip code (MA), or anglers failing to purchase a valid license for the year of the tag report (ILL).

WARM WATER FISH TRANSFERS TO COMMUNITY PONDS

ABSTRACT

Southwest Region fisheries staff transferred four species of warmwater fish to 10 waters during 2014 to supplement natural populations and increase catch rates at existing fisheries. We transferred a total of 1,646 fish including: 1,025 Bluegill *Lepomis macrochirus*, 290 Channel Catfish *Ictalurus punctatus*, 148 Largemouth Bass *Micropterus salmoides*, and 183 Pumpkin Seed *Lepomis gibbosus*. We will continue transferring Channel Catfish to community fishing waters, as these fisheries have become popular with anglers and are cost effective. Transferring Largemouth Bass to supplement community ponds is not recommended because of rapid harvest and difficulty in collecting them.

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INTRODUCTION

The Southwest Region contains about 40 small public community fishing ponds. These ponds offer a variety of angling options for both hatchery Rainbow Trout *Oncorhynchus mykiss*, and several warmwater species. While trout are supplied regularly by Nampa Hatchery, warmwater fish populations depend on natural reproduction or transfers from other waters. Idaho Department of Fish and Gamer (IDFG) maintains populations of warmwater fishes in community ponds for recreational angling. In 2014, IDFG fisheries staff transferred Bluegill *Lepomis macrochirus*, Channel Catfish *Ictalurus punctatus*, Largemouth Bass *Micropterus salmoides*, and Pumpkin Seed *Lepomis gibbosus* to community fishing ponds and reservoirs throughout the Southwest Region to improve fishing opportunities. Also, two new community ponds in Boise, ID (Terry Day and Marianne Williams) were stocked with Bluegill and Largemouth Bass to establish self-sustaining warmwater fish communities. We also continued annual transfers of adult Channel Catfish to community fishing ponds to provide summer put-and-take fishing opportunities.

OBJECTIVES

1. Continue providing Channel Catfish fishing opportunities in community ponds.

2. Supplement naturally reproducing populations of Largemouth Bass and Bluegill in community ponds when needed through transfers of fish from local waters.

METHODS

We utilized boat electrofishing to capture warmwater fishes from local waters for transfer to regional ponds. Source waters included public waters at Indian Creek Reservoir, Horseshoe Bend Mill Pond, Crane Falls Reservoir, and the Snake River, while attempts were also made at CJ Strike Reservoir and Lake Lowell. We collected fish during daytime hours from May 16 to July 23, 2014 using a Smith-Root electrofishing boat, a drift boat equipped with a Coeffelt VVP-15B electrofishing unit, or a jet-powered electrofishing boat equipped with a Coeffelt VVP-15B electrofishing unit. Pulsed direct current was produced by a 5,000 watt generator. Frequency was set at 120 pulses per second and a pulse width of 40, which yielded an output of 4-5 amps. After capture, fish were transferred to live wells and held until sufficient numbers were captured to fill a transport truck or trailer. Once loaded, fish were provided supplemental oxygen at the rate of 2.0 L/min.

RESULTS AND DISCUSSION

Southwest region personnel transferred four species of warmwater fish to 10 waters during 2014 to supplement natural populations and increase catch rates at existing community pond fisheries (Table T3). We transferred a total of 1,646 fish including: 1,025 Bluegill, 290 Channel Catfish, 148 Largemouth Bass, and 183 Pumpkin Seed. We will continue transferring Channel Catfish to community fishing waters, as these fisheries have become popular with anglers and are cost effective. Distribution and allocation of fish will be modified based on tag reports, pond size, and fishing pressure. However, tag reports from transferred Largemouth Bass (see chapter in this report) indicate some to even most fish are harvested quickly after stocking. Under the current six-fish limit, transferring bass to supplement community pond fisheries is not an effective strategy. Largemouth Bass are too difficult to collect and are harvested too quickly to be a cost effective option for improving warmwater fishing in community ponds. However, Largemouth bass translocation may still be needed to re-establish populations after de-watering or to create populations in new ponds.

In 2014, collection efforts were most successful at Lake Lowell (Largemouth Bass), Indian Creek Reservoir (Bluegill) and Sawyers Pond (Bluegill) and Horseshoe Bend Mill Pond. Water elevations in Indian Creek Reservoir were so low, we did not expect that any fish survived until 2015. We found the best combination for collecting warmwater fishes in small ponds was using an aluminum drift boat and outboard motor set up for electrofishing. This configuration allowed us to sample small ponds effectively without having to rely on launching our larger electrofishing boats. Horseshoe Bend Mill Pond and Sawyers Pond appeared to have abundant small Bluegill that may provide excellent sources for future transplants.

RECOMMENDATIONS

1. Continue transferring Channel Catfish to community fishing waters.

2. Discontinue transplanting Largemouth Bass to supplement community ponds, unless stocking new ponds or waters that have recently refilled.

Table T3. Collecting water, total number, and mean total length (TL) and mean weight (WT) of Bluegill (BGL), Pumpkin Seed (PKS), Channel Catfish (CAT), and Largemouth Bass (LMB) captured and transferred to community ponds in 2014.

Date	Collecting Water	Receiving Water	Species	Number	Mean TL (mm)	Mean WT (g)
7/10/2014	Lake Lowell	Beachs P.	BGL	102	131	73
7/10/2014	Lake Lowell	Beachs P.	LMB	15	237	183
7/17/2014	Sawyers P.	Beachs P.	BGL	528	121	139
7/17/2014	Sawyers P.	Beachs P.	LMB	37	245	557
7/17/2014	Sawyers P.	Beachs P.	PKS	69	109	
7/21/2014	Horseshoe Bend Mill P.	Beachs P.	BGL	360		
7/21/2014	Horseshoe Bend Mill P.	Beachs P.	LMB	41	201	
7/21/2014	Horseshoe Bend Mill P.	Beachs P.	PKS	69		
7/3/2014	Lake Lowell	Caldwell Gun Club	CAT	20	540	1978
7/3/2014	Lake Lowell	Caldwell Rotary	CAT	20	540	1978
7/16/2014	Snake River	Eds P.	CAT	20	540	1978
7/16/2014	Snake River	Horseshoe Bend Mill P.	CAT	50	540	1978
5/27/2014	Indian Creek Reservoir	Riverside P.	BGL	26	165	118
5/27/2014	Indian Creek Reservoir	Riverside P.	LMB	12	308	708
5/27/2014	Indian Creek Reservoir	Riverside P.	PKS	26	150	101
5/28/2014	Indian Creek Reservoir	McDevitt	BGL	9	168	124
5/28/2014	Indian Creek Reservoir	McDevitt	LMB	16	296	367
5/28/2014	Indian Creek Reservoir	McDevitt	PKS	19	148	99
7/3/2014	Lake Lowell	McDevitt	CAT	17	540	1978
6/27/2014	Lake Lowell	Parkcenter	LMB	27	355	
7/3/2014	Lake Lowell	Parkcenter	CAT	40	540	1978
7/16/2014	Snake River	Quinns P.	CAT	73	540	1978
7/16/2014	Snake River	Sawyers P.	CAT	50	540	1978

CHEMICAL TREATMENT OF NUISANCE AQUATIC PLANTS IN SMALL WATERS

ABSTRACT

Excessive aquatic plant growth in Horseshoe Bend Mill and Payette Greenbelt ponds was hampering boating and fishing opportunities. In order to maintain fisheries quality, we treated these waters with aquatic herbicide (Navigate®, a granular 2, 4-D) at application rates of 150 lb/acre. Submerged aquatic plant abundance was reduced by late summer. Furthermore, we purchased and stocked Grass Carp *Ctenopharyngodon idella* into two ponds (Duff Lane and Horseshoe Bend Mill Pond) to reduce plant re-growth and hopefully increase the interval (i.e. number of years) between chemical treatments. Effective long-term weed management will require vigilance and finding a balance between aquatic plant eradication and maintaining adequate amounts and types of aquatic plants for invertebrates and as cover for fish.

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INTRODUCTION

Idaho Department of Fish and Game's (IDFG) Southwest Region manages fisheries in about 40 publicly-accessible small ponds and reservoirs. These waters receive significant fishing pressure and are an important resource for providing family-friendly fishing opportunities. Excess plant growth especially during the summer months, in some ponds may limit access or in extreme cases may totally preclude fishing. Furthermore, excess plant growth may create other problems such as high oxygen consumption during decomposition or may provide too much cover for juvenile fish, leading to high abundances and small average sizes. Excess plant growth was reducing fishing opportunities and potentially impacting fish populations in Horseshoe Bend Mill (12.5 acres) and Payette Greenbelt (5.5 acres) ponds. Eurasian Watermilfoil *Myriophyllum spicatum* was the predominant species present. Regional personnel using financial assistance from the Idaho Department of Agriculture treated these waters with granular herbicide to reduce nuisance plant abundance and biomass. Furthermore, Grass Carp *Ctenopharyngodon idella* were stocked to reduce plant re-growth post chemical treatment. Target stocking rates were 25 Grass Carp per acre.

METHODS

We selected Navigate, a granular 2, 4 D, to treat these waters, based on past efficacy in nearby waters and low fish toxicity. Recommended treatment levels for Eurasian Watermilfoil were 150 lb/surface acre. We used Geographic Information Systems (ArcView version 11) to estimate surface acreage. Herbicide was applied using a granular fertilizer spreader mounted the front of a small boat that was powered with an outboard motor. On May 7, 2014, we treated the western half of Horseshoe Bend Mill Pond with 940 lb of Navigate. On June 6, 2014, we treated the eastern half with an equal amount of Navigate. Also, at Horseshoe Bend Mill Pond, a total of 310 Grass Carp was released on August 11, 2014. At Payette Greenbelt Pond, we applied 825 lb of Navigate to the entire surface area of the pond on June 26, 2014. No Grass Carp were stocked at Payette Greenbelt Pond during 2014. Lastly, a total of 130 Grass Carp was stocked in Duff Lane Pond (5.5 acres) on August 11, 2014, a waterbody that had been treated with Navigate during 2013.

RESULTS AND DISCUSSION

Herbicide treatments were effective in ponds treated during 2014. Based on visual estimates, > 90% of rooted submerged vegetation was killed at Horseshoe Bend Mill and Payette Greenbelt ponds. No significant plant re-growth occurred at these two ponds prior to fall. At this time, survival of Grass Carp and their contribution to plant control is not known. Despite the lack of survival estimates, it was apparent that at least some Grass Carp survived to fall as several were observed in near the shore. Continued effective aquatic plant management will require vigilance and finding a balance between plant eradication and maintaining aquatic plants for invertebrates and as cover for fish.

RECOMMENDATIONS

1. Monitor plant mortality and re-growth in ponds treated during 2013 and 2014. Apply herbicide or stock Grass Carp on a semi-annual basis or as needed.

2. Monitor aquatic plant abundance in other waters that have a tendency to possess nuisance levels and initiate treatments where necessary.

3. Conduct multi-species mark-recapture population estimates at ponds in which Grass Carp have been stocked. Determine whether Grass Carp stocking densities and survival are adequate to contribute to the control of nuisance levels of aquatic plants.

2014 ALPINE LAKE SURVEYS

ABSTRACT

Idaho Department of Fish and Game (IDFG) staff surveyed 27 alpine lakes during August 2014 in the Southwest Region. Sampling efforts covered the Feather River (SF Payette), Headwaters of the South Fork of the Payette River, Lower Middle Fork Boise River, and Upper North Fork Boise River watersheds (HUC 5). The majority of the lakes had not been surveyed since 1995 or had never been surveyed by IDFG. Data were collected at each site and described both fish and amphibian habitat and presence. Species of trout were found at 10 of the 27 lakes sampled, with Rainbow Trout *Oncorhynchus mykiss* occurring in four, Westslope Cutthroat Trout *Oncorhynchus clarkii* occurring in six, and Westslope Cutthroat Trout x Rainbow Trout hybrids in two lakes. Amphibians were found at 11 of the 27 lakes, and were sympatric with trout in seven lakes. The species composition of amphibians varied among lakes and included Western Toad *Bufo boreas*, Columbia Spotted Frog *Rana preriosa*, and Long-toed Salamander *Ambystoma macrodactylum*.

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OBJECTIVES

1. Describe the distribution, relative abundance, and species composition of fish and amphibian populations at alpine lakes in the Southwest Region.

2. Adjust stocking where appropriate to use hatchery resources efficiently and minimize impacts to native fauna while preserving fishing opportunity where practical.

METHODS

Alpine lakes were surveyed during July 30-31, and August 11-15, 2014 across four watersheds (HUC 5) including, Feather River, Headwaters of the South Fork of the Payette River, Lower Middle Fork of the Boise River, and the Upper North Boise River (Table 22). These lakes were chosen because they either had never been sampled, or had not been sampled within the last ten years. At each lake, we assessed fish and amphibian presence/absence, human use, and basic fish habitat characteristics. Unless fish were observed, no angling surveys occurred in shallow lakes and ponds without suitable habitat. In lakes with suitable depths, fish were sampled with hook/line angling, gill nets, or both to collect species, total length (TL, mm), and weight (g) information. Gill nets were floating experimental nets, measuring 46 m long by 1.5 m deep, with 19, 25, 30, 33, 38, and 48 mm bar mesh panels set in the evening, perpendicular to shore, and fished overnight. Nets were pulled the following morning or as soon as possible thereafter.

Habitat surveys consisted of measuring limnological and morphological characteristics at lake, tributaries, and outlets. Lake length and width were measured using a laser rangefinder (Bushnell yardage-Pro). Mean depth was calculated from nine depth measurements recorded at along three equally-spaced cross-sectional transects, using a hand-held sonar device (Strikemaster Polar Vision). Maximum depth was estimated as the greatest depth observed during these measurements. Surface water temperatures were recorded along the lake shore at one point. A visual assessment of salmonid spawning habitat availability was conducted at each lake and its inlets and outlets. Salmon spawning habitat quality was qualitatively described based on substrate size and quality, flow, and gradient.

Amphibian surveys were conducted by walking the perimeter of each lake and visually inspecting shoreline and near-shore habitats, including areas under logs and rocks. For amphibians detected, we recorded the species, number, and life stage. Life stages were classified as adult, juvenile, larvae, or egg.

Human use was evaluated based on general appearance of use, number and condition of campsite, number of fire rings, access trail conditions trail distance and difficulty, and presence of litter. General levels of human use were categorized by Idaho Department of Fish and Game (IDFG) staff as rare, low, moderate, and high based on an overall assessment of the factors described above.

RESULTS AND DISCUSSION

Feather River- South Fork of the Boise River

Big Trinity and Little Trinity lakes supported amphibians, but trout were only sampled in Big Trinity Lake. Rainbow Trout *Oncorhynchus mykiss* fry, and Westslope Cutthroat Trout *Oncorhynchus clarkii* fry are stocked annually in both Big and Little Trinity Lakes (Table 22). Western Toads *Bufo boreas*, and Columbia Spotted Frogs *Rana preriosa* were observed in both lakes (Table 23). Sampling in Big Trinity Lake occurred 1 day before the annual trout stocking, and there appeared to be hold-over trout present (mean TL = 262 mm) from previous stocking. Evidence suggested intense recreational use at Little Trinity Lake, despite not having sampled any fish. Perhaps this lake is subject to occasional winter kill. Due to high use and limited suitable spawning habitat, current stocking strategies are appropriate.

Headwaters South Fork Payette River

Fall Creek Lakes #1-3 comprise a group of large, deep, and remote lakes ranging in maximum depth from 4 to 8 m. Trout were only observed in Fall Creek Lake #2, while no other fish or amphibians were sampled in the other two lakes (Table 22). Fall Creek Lake #1 was last stocked in 2007 with Artic Grayling *Thymallus arcticus,* which was subsequently discontinued. Fall Creek Lake #2 contained Westslope Cutthroat Trout (mean TL = 335 mm). There have been no fish stocked since 1995, suggesting some natural recruitment is likely. No fish or amphibians were sampled in Fall Creek Lake #3, despite recent Rainbow Trout stocking in 2010 and 2013. This is the largest lake of the three lakes at 3.9 hectares. Future stocking in these remote lakes should be discontinued, due to lack of success from recent stocking, probable natural recruitment, or rare human use.

In the Lake Creek drainage, we surveyed seven lakes (Lake Creek lakes #1-7) and found a mix of lakes with Westslope Cutthroat, Rainbow Trout and several fishless lakes with Long-toed Salamander *Ambystoma macrodactylum* (Table 22). Lake Creek Lake #1 is a large deep lake with Westslope Cutthroat Trout, Rainbow Trout, and Rainbow Trout x Cutthroat Trout hybrids. Mean TL of sampled trout was 333 mm and ranged from 240 to 460 mm indicating a quality alpine fishery (Figure 37). The presence of trout fry and adult hybrid trout suggest some natural reproduction is occurring. Recent default stocking requests include triploid Rainbow Trout on a three year rotation. Lake Creek Lake #2 contained Westslope Cutthroat Trout with mean TL of 250 mm, and ranged from 120 to 320 mm (Table 22, Figure 37). Stocking was discontinued in 2002 because of suspected natural reproduction and this lake appears to still be providing excellent angling. We did not sample fish in Lake Creek Lake #3, but Long-Toed Salamanders were abundant at this lake (Table 23). Stocking was discontinued in 1995 due to the small size of this lake and the high density of amphibians. Two unnamed lakes adjacent to Lake Creek Lake #3 (LLID 1151307440324, and 1151298440320) did not appear to support fish or amphibians, despite their close proximity to an adjacent salamander population. This group of lakes should remain fishless and provide habitat for native fauna. Lake Creek Lake #4 and #5 contained Westslope Cutthroat Trout (mean TL = 197 and 192 mm, respectively) with no records of stocking. The presence of fingerlings and lack of stocking confirms that natural reproduction is likely occurring in these lakes. Fish stocking is currently unnecessary because of natural reproduction. Perhaps trout have colonized these smaller lakes by moving downstream from Lake Creek Lake #2 above. No stocking is necessary in this lake due to the presence of fish without any history of stocking, indicating that natural production is occurring. Lake Creek Lake #7 is a small fishless lake located at the headwaters of the Lake Creek drainage with no prior stocking record. This lake is a shallow, small, lake with no fish or amphibians. We recommend leaving this lake fishless because of its very remote location, rare human usage, marginal fish habitat, and potential for providing amphibian habitat in the future.

Pinchot Creek Lake sampling found Westslope Cutthroat Trout with a mean TL of 280 mm, ranging from 240 to 360 mm (Figure 37). This is a large, deep, lake with fair spawning habitat. This lake had last been stocked in 1990 with Golden Trout *Oncorhynchus aguabonita* and in 2011 with Artic Grayling, neither of which were sampled. Stocking Golden Trout was discontinued and Artic Grayling is the default request with a six-year cycle (Table 22). The presence of fingerlings and fair spawning habitat suggest natural recruitment of Westslope Cutthroat Trout was occurring. No fish or amphibians were sampled at Pinchot Creek Lake #1. Stocking requests for this lake are for Golden Trout every three years, with the last stocking in 2011. Stocking densities should be increased to improve this fishery. If no improvements are noted after stocking adjustment, stocking should then be discontinued and the allotment shifted to nearby Pinchot Creek Lake.

Pitchfork Lake contained Westslope Cutthroat (mean TL = 235 mm) and ranged in length from 160 to 380 mm (Table 22, Figure 37). No amphibians were observed during sampling. Lack of fish stocking and the presence of fingerling trout indicated natural reproduction was occurring. Unnamed Lake 3 (LLID 1150945440077) and Unnamed Lake 4 (LLID 1150985440084) were both absent of fish and amphibians. These are small, shallow, lakes with poor trout habitat not suitable for stocking.

<u>Lower Middle Fork Boise River</u>

Big Roaring River Lake is a 4.2-ha lake with Rainbow Trout and Western Toads. Rainbow Trout sampled had a mean TL of 192 mm, ranging from 120-260 mm. Stocking was discontinued in 1999 because of natural production. This lake receives high human use because of developed camping and vehicle access. Nearby Little Roaring River Lake is a 2.7-ha lake which contains Rainbow Trout and Rainbow Trout x Cutthroat Trout hybrids. Mean total length was 219 mm and length ranged from 130 to 400 mm (Figure 37). Western Toads and Columbia Spotted Frog were found sympatric with trout in this lake. This lake had good spawning substrate and the presence of both fry and fingerlings. Stocking was discontinued in 1999, and continued fish presence indicates natural reproduction is maintaining the trout population in this lake. Current management strategies in place should continue as this lake has good angling without stocking.

All four of the East Fork Roaring River Lakes were small, shallow, and fishless and were inhabited by a variety of amphibian species (Table 23). East Fork Roaring River Lake #1 is a small shallow lake that had moderate densities of Columbia Spotted Frogs and high densities of Western Toads (Table 23). East Fork Roaring River Lake #2 had low densities of Long-Toed Salamanders. East Fork Roaring River Lake 3 had low densities of Western Toads and high densities of Columbia Spotted Frogs. East Fork Roaring River Lake 4 was dry at the time of sampling. Habitat conditions and amphibian presence indicate that no future stocking should occur in these lakes.

No fish were collected at Twin Sister Lake #1, but Western Toads were observed. Rainbow Trout were last stocked in 2009, and was discontinued because of frequent winter kill. Twin Sister Lake #2 is stocked every two years with Rainbow Trout and currently contains a low density trout population. Only two fish were sampled from this lake (Figure 37), indicating that current stocking is providing limited angling opportunity and could be increased to provide higher fish densities.

Upper North Fork Boise River

Cow Lake is the only lake in this drainage that was sampled in 2014. Cow Lake is 2.2 ha with a history of Westslope Cutthroat Trout stocking, but is currently stocked with triploid Rainbow Trout (Table 22). Weather conditions at the time of sampling prevented gill netting and no trout were found. However, Western Toads were found in low densities. Anecdotal evidence from local anglers indicates this is a popular quality alpine lake fishery and stocking should be continued.

RECOMMENDATIONS

1. Discontinue stocking at Fall Creek lakes #1, #2, #3. Natural reproduction (Fall Creek L. #2), lack of previous stocking success, and rare human use do not justify continued stocking.

2. Increase stocking at Twin Sister Lake #2 to provide higher fish densities.

Table 22. Physical characteristics, fish presence, mean fish total length (90% CI), stocking history, and amphibians observed in alpine lakes 2014. The most recent year of fish stocking is shown in parenthesis.

Lake name	Elevation (m)	Area (ha)	Max depth (m)	Fish observed	Mean length (mm)	Stocking	Amphibians observed
Feather River-South Fork Boise River							
Big Trinity Lake	2365	10.32	17.9	RBT, WCT	262 (± 30)	RBT_T (2014)[5], WCT (2014)[5]	CSF, WT
Little Trinity Lake	2374	3.7	12.0	-	-	RBT_T (2014)[5]	CSF, WT
Headwaters South Fork Payette River							
Fall Creek Lake #1	2617	1.4	4.0	-	-	GRY (2007)[1]	-
Fall Creek Lake #2	2617	2.1	8.0	WCT	353 (± 25)	WCT (1995)[1]	-
Fall Creek Lake #3	2653	3.9	6.1	-	-	RBT_T (2013)[3]	-
Lake Creek Lake #1	2559	5.9	18.9	RBT, HYB	333 (± 29)	RBT_T (2013)[3]	-
Lake Creek Lake #2	2470	1.6	5.6	WCT	250 (± 29)	WCT (2002)[1]	-
Lake Creek Lake #3	2653	3.9	6.1	-	-	WCT (1993)[1]	LTS
Lake Creek Lake #4	2347	0.4	8.5	WCT	197 (± 20)	-	-
Lake Creek Lake #5	2375	0.2	3.1	WCT	190 (± 19)	-	-
Lake Creek Lake #6	2554	0.2	3.0	-	-	-	LTS
Lake Creek Lake #7	2554	0.6	0.9	-	-	-	-
Pinchot Creek Lake	2523	3.1	4.0	WCT	280 (± 16)	GDN (1990)[1], GRY (2011)[4]	-
Pinchot Creek Lake #1	2653	1.4	4.5	-	-	GRY (1999)[4],GDN (2011)[3]	-
1151307440324	2506	0.1	3.2	-	-	-	-
1151298440320	2507	0.3	3.8	-	-	-	-
1150985440084	2609	0.2	1.0	-	-	-	-
1150945440077	2605	0.1	1.0	-	-	-	-
Pitchfork Lake	2396	6.9	8.0	WCT	235 (± 92)	GDN (1990)[1], GRY (2002)[1]	-
Lower Middle Fork Boise River							
Big Roaring River Lake	2456	4.2	16.6	RBT	192 (± 23)	RBT_T (1999)[1]	WT
East Fork Roaring River Lake #1	2223	0.2	2.5	-	-	-	CSF, WT
East Fork Roaring River Lake #2	2533	1.0	2.0	-	-	-	CSF, WT, LTS
East Fork Roaring River Lake #3	2534	0.1	1.5	-	-	-	CSF
East Fork Roaring River Lake #4	2547	0.1	*	-	-	-	*
Little Roaring River Lake	2386	2.7	9.8	RBT, HYB	219 (± 15)	RBT (1999)[1]	CSF, WT
Twin Sisters Lake #1	2434	0.6	3.4	-	-	RBT_T (2009)[2]	WT
Twin Sisters Lake #2	2426	1.6	3.7	RBT	243 (± 1026)	RBT_T (2013)[2]	-
Upper North Fork Boise River							
Cow Lake	2398	2.15	7	-	-	WCT (2012)[2], RBT_T (2013)[2]	WT

$_T$ Triploid

[1] Stocking discontinued

[2] Stocking rotation every 2 years

[3] Stocking rotation every 3 years

[4] Stocking rotation every 6 years

[5] Stocking rotation every year

* Lake was dry

Table 23. Counts of amphibian species by life stage and fish presence for alpine lakes surveyed in August 2014.

Lake name	Western toad			Columbia spotted frog			Long-toed salamander			Fish present
	Adult	Juvenile	Larvae	Adult	Juvenile	Larvae	Adult	Juvenile	Larvae	
Feather River-South Fork Boise River										
Big Trinity Lake	9	260	-	4	65	-	-	-	-	Yes
Little Trinity Lake	-	50	-	1	150	-	-	-	-	No
Headwaters South Fork Payette River										
Fall Creek Lake #1	-	-	-	-	-	-	-	-	-	No
Fall Creek Lake #2	-	-	-	-	-	-	-	-	-	Yes
Fall Creek Lake #3	-	-	-	-	-	-	-	-	-	No
Lake Creek Lake #1	-	-	-	-	-	-	-	-	-	Yes
Lake Creek Lake #2	-	-	-	-	-	-	-	-	-	Yes
Lake Creek Lake #3	-	-	-	-	-	-	1	100	-	No
Lake Creek Lake #4	-	-	-	-	-	-	-	-	-	Yes
Lake Creek Lake #5	-	-	-	-	-	-	-	-	-	Yes
Lake Creek Lake #6	-	-	-	-	-	-	-	320	-	No
Lake Creek Lake #7	-	-	-	-	-	-	-	-	-	No
Pinchot Creek Lake	-	-	-	-	-	-	-	-	-	Yes
Pinchot Creek Lake #1	-	-	-	-	-	-	-	-	-	No
1151307440324	-	-	-	-	-	-	-	-	-	No
1151298440320	-	-	-	-	-	-	-	-	-	No
1150985440084	-	-	-	-	-	-	-	-	-	No
1150945440077	-	-	-	-	-	-	-	-	-	No
Pitchfork Lake	-	-	-	-	-	-	-	-	-	Yes

Table 23. Continued.

Lake name	Western toad			Columbia spotted frog			Long-toed salamander			Fish present
	Adult	Juvenile	Larvae	Adult	Juvenile	Larvae	Adult	Juvenile	Larvae	
Lower Middle Fork Boise River										
Big Roaring River Lake	5	471	-	-	-	-	-	-	-	Yes
East Fork Roaring River Lake #1	10	4	200	11	12	75	-	-	-	No
East Fork Roaring River Lake #2	8	9	50	52	33	300	11	-	-	No
East Fork Roaring River Lake #3	-	-	-	1	11	30	-	-	-	No
East Fork Roaring River Lake #4	-	-	-	-	-	-	-	-	-	No
Little Roaring River Lake	-	10	400	3	20	-	-	-	-	Yes
Twin Sisters Lake #1	4	100	-	-	-	-	-	-	-	No
Twin Sisters Lake #2	-	-	-	-	-	-	-	-	-	Yes
Upper North Fork Boise River										
Cow Lake	2	4	-	-	-	-	-	-	-	No

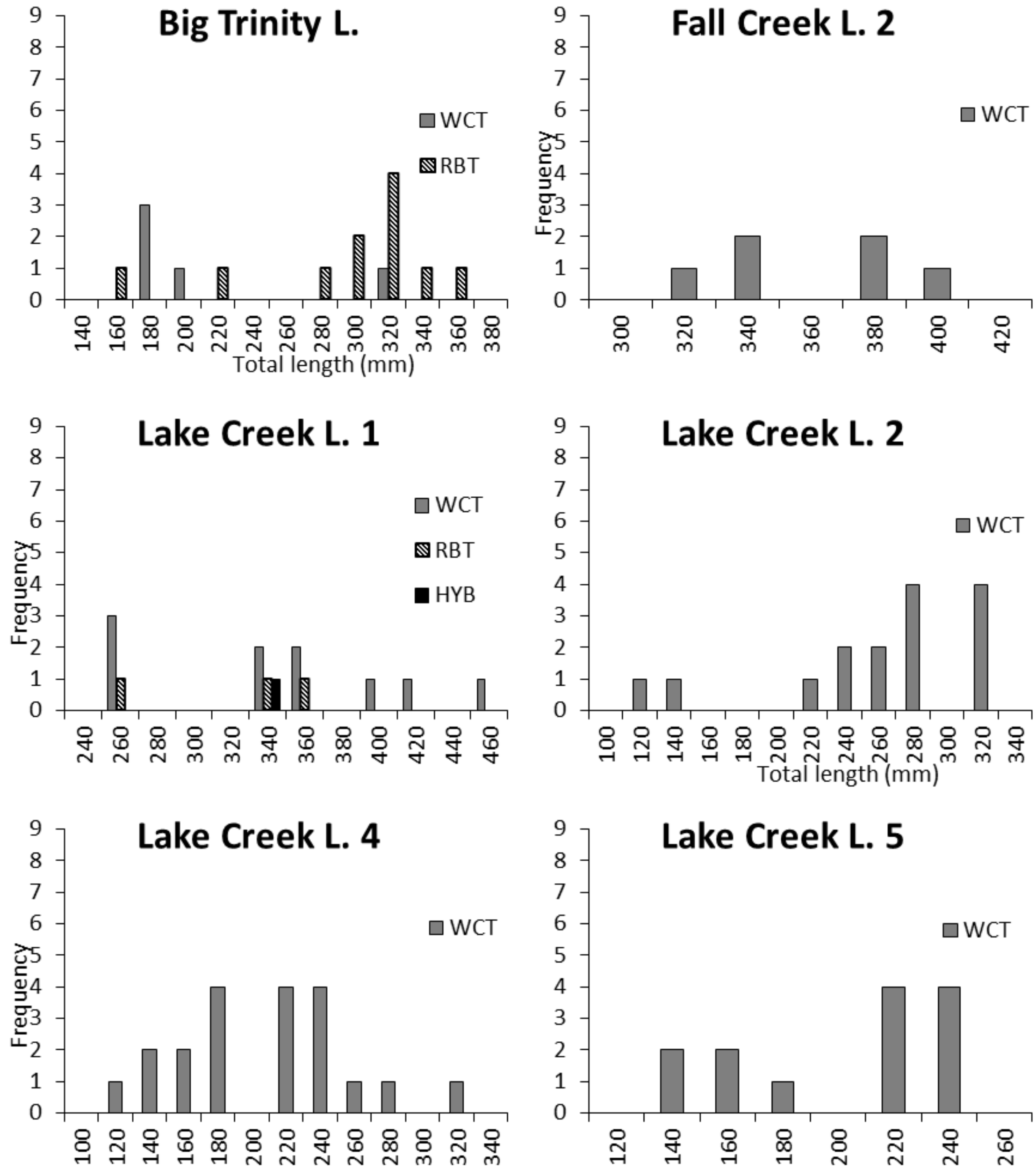

Figure 37. Length frequency of trout species Westslope Cutthroat (WCT), Rainbow (RBT), and hybrid Rainbow Trout x Cutthroat Trout (HYB) in alpine lakes 2014.

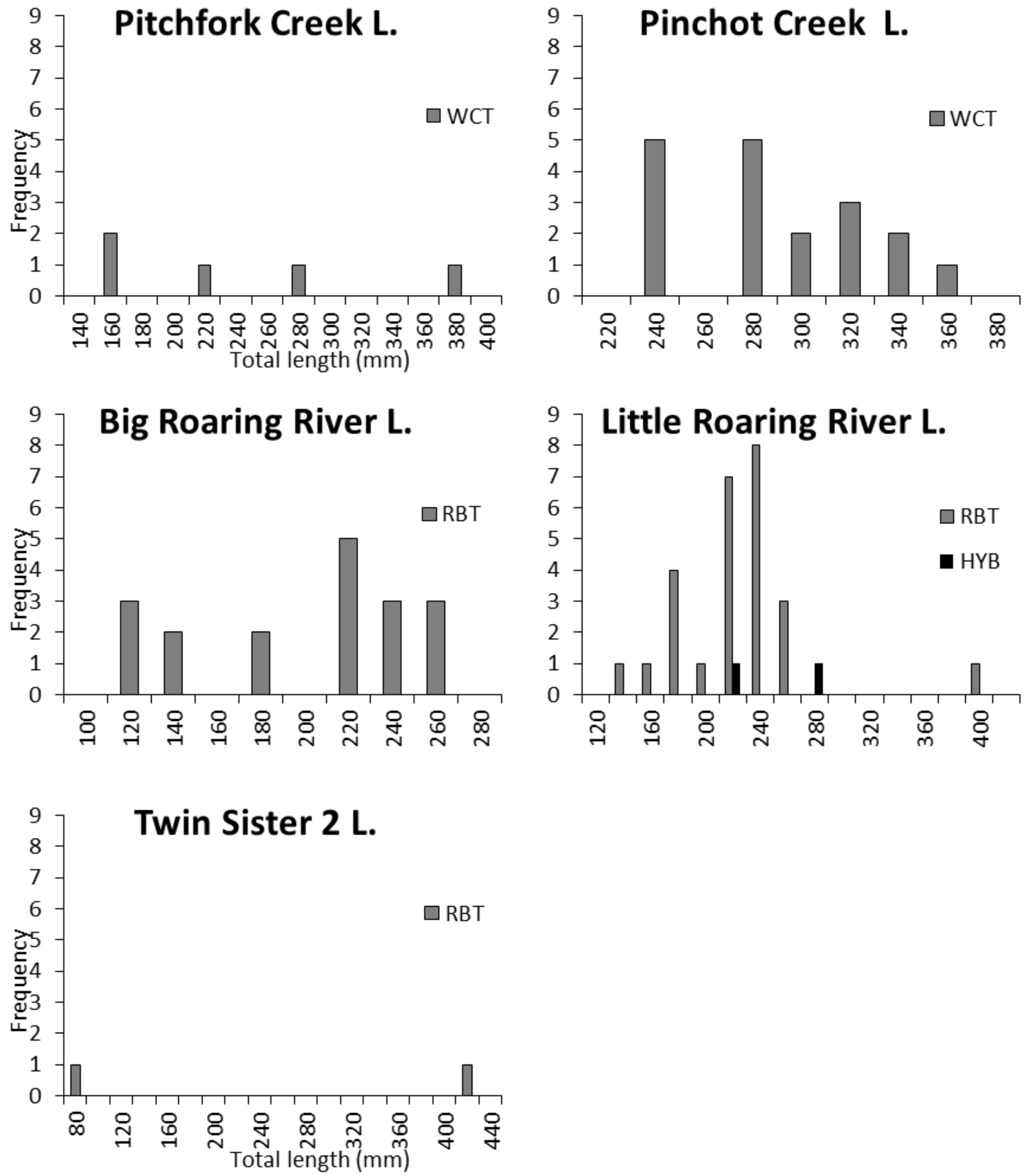

Figure 37. Continued.

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.

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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 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	

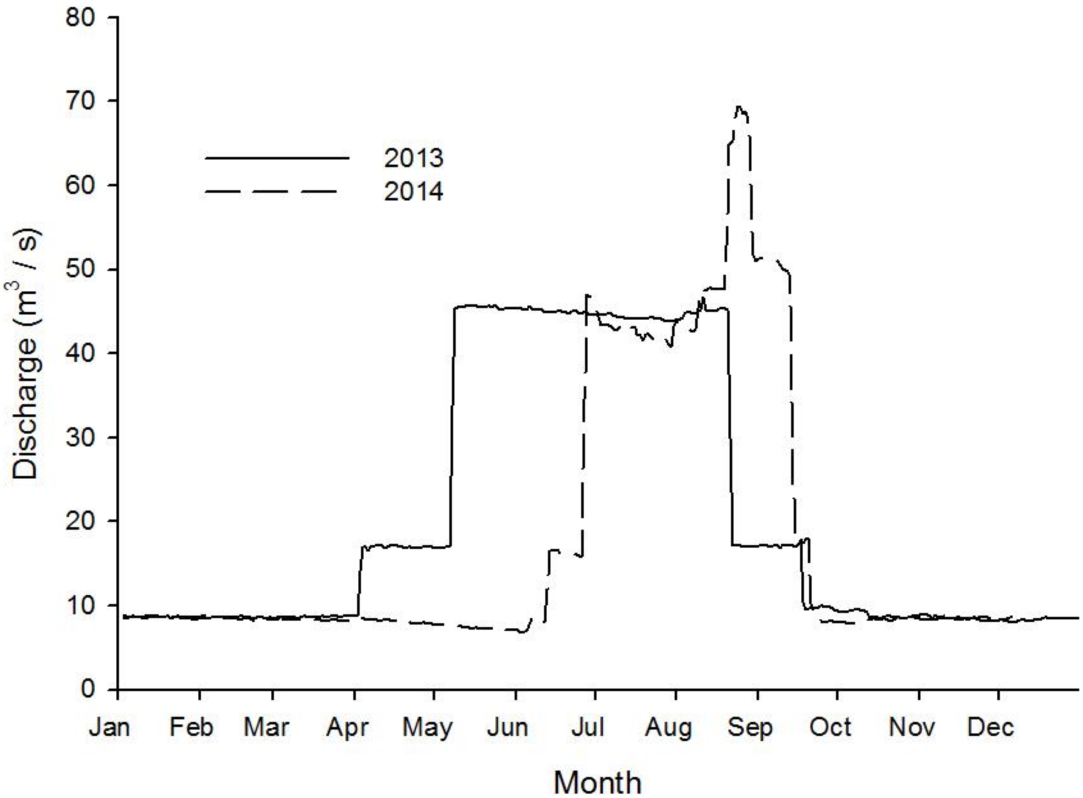

Figure 38. Discharge in the South Fork Boise River (SFBR), downstream from Anderson Ranch Dam, Idaho in 2013 and 2014. Flows in 2013 were typical for the SFBR while 2014 spring flows were reduced delayed so that flushing flows could be released later in the summer.

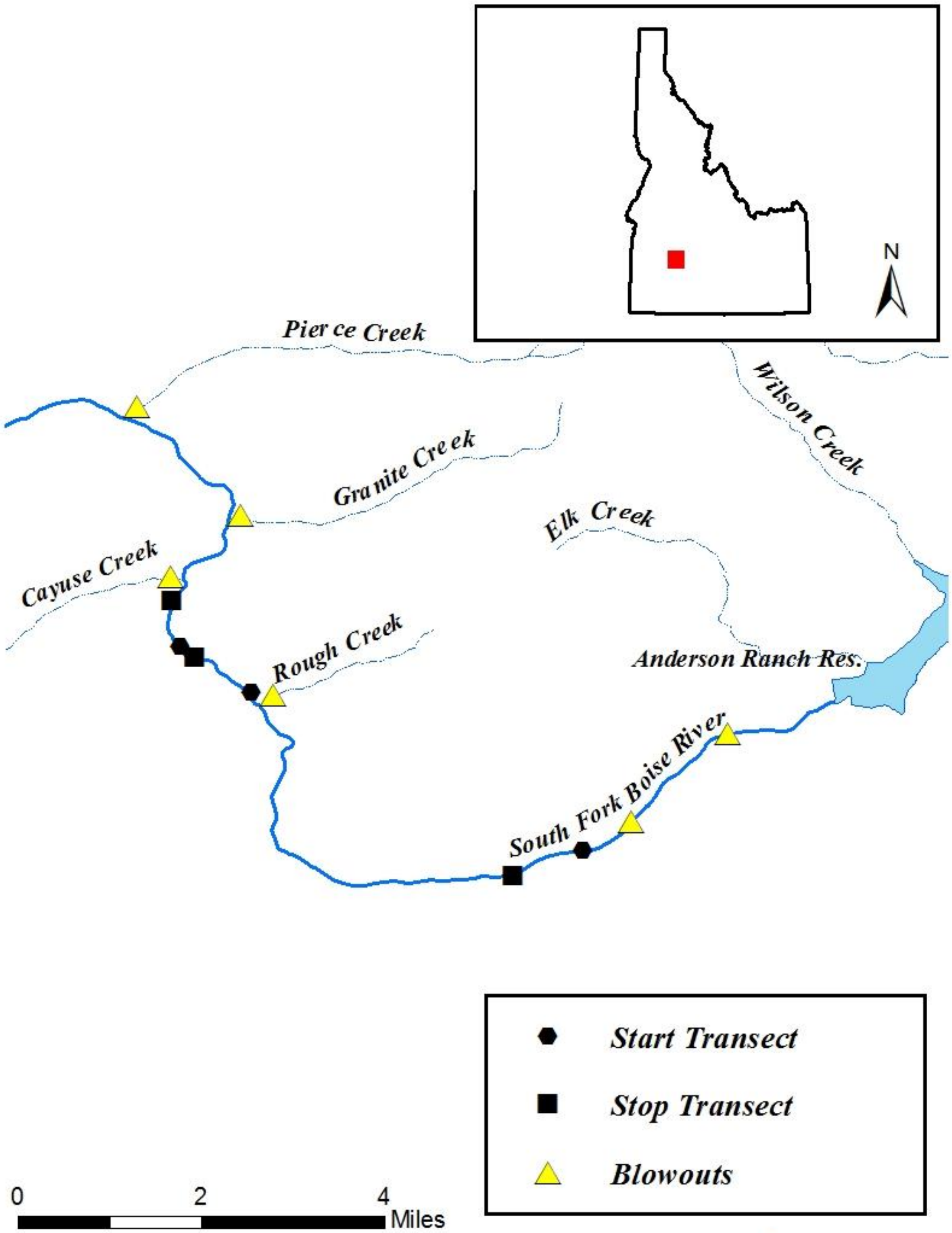

Figure 39. Map of South Fork Boise River, Idaho tailwater section showing sampling locations in Pierce Creek in July 2014 and major debris slides in September 2014.

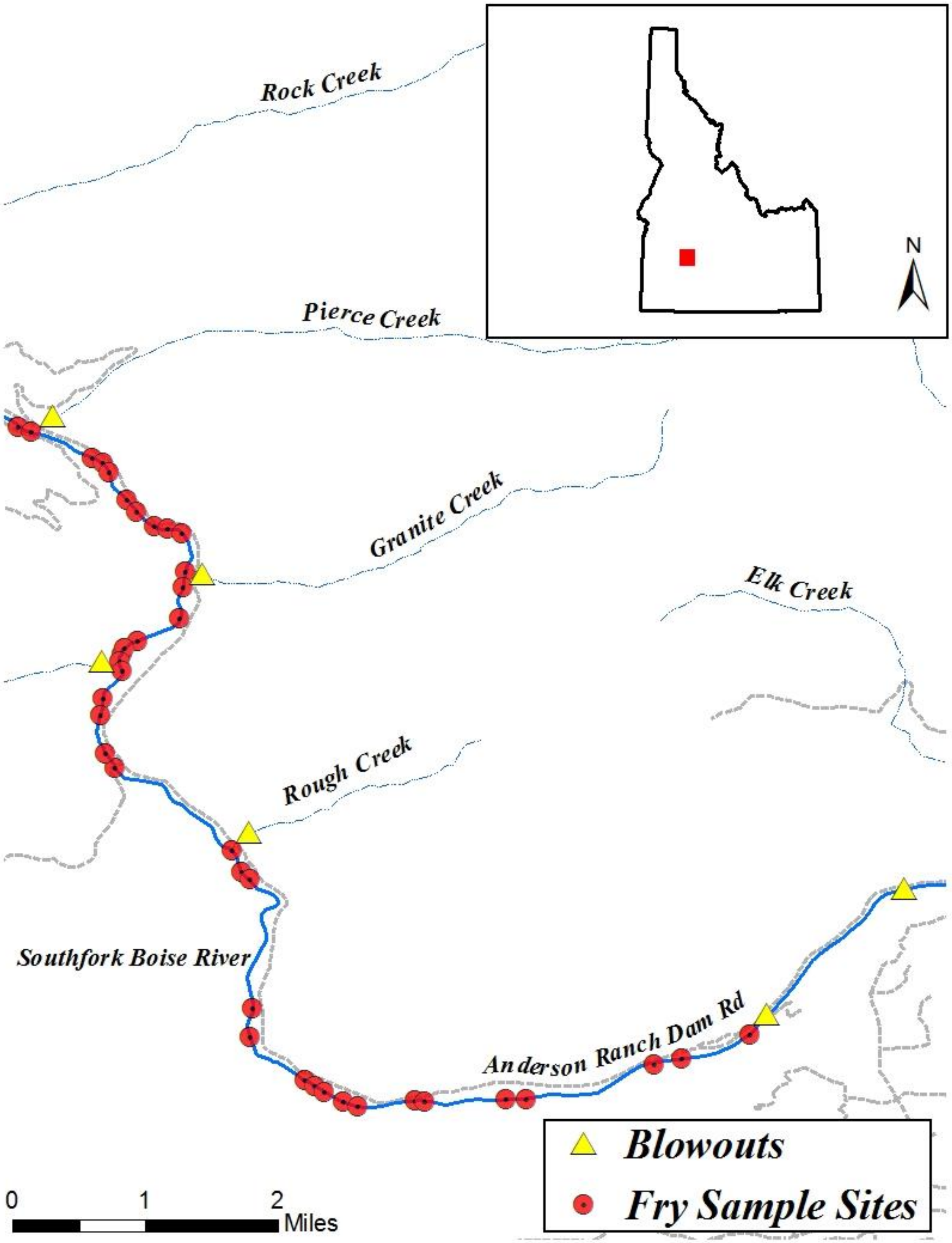

Figure 40. Map of South Fork Boise River, Idaho tailwater section showing location of major debris slides near age-0 Rainbow Trout monitoring sites.

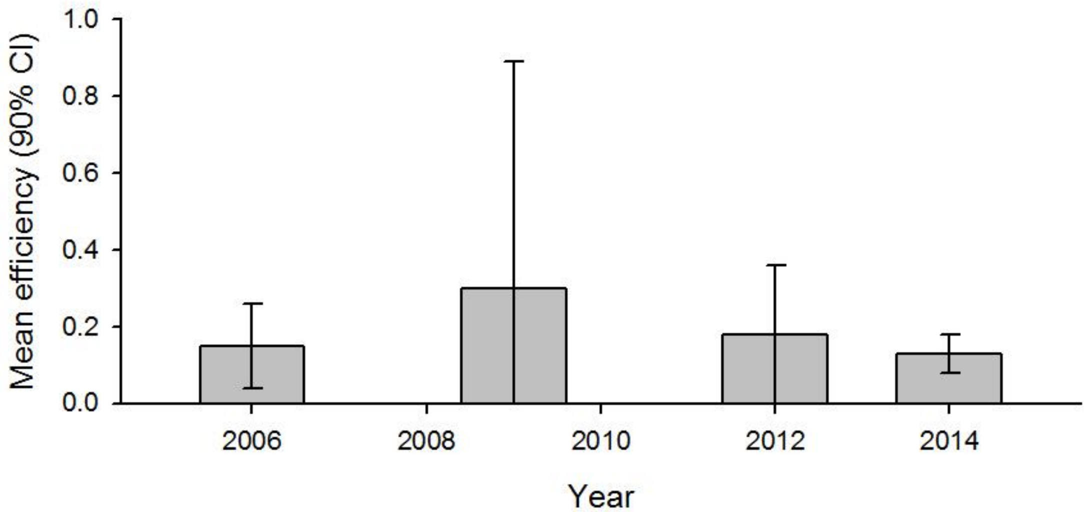

Figure 41. Capture efficiencies for Rainbow Trout (≥ 100 mm) during population surveys tri-annual population surveys at the South Fork Boise River below Anderson Ranch Dam from 2006 through 2014.

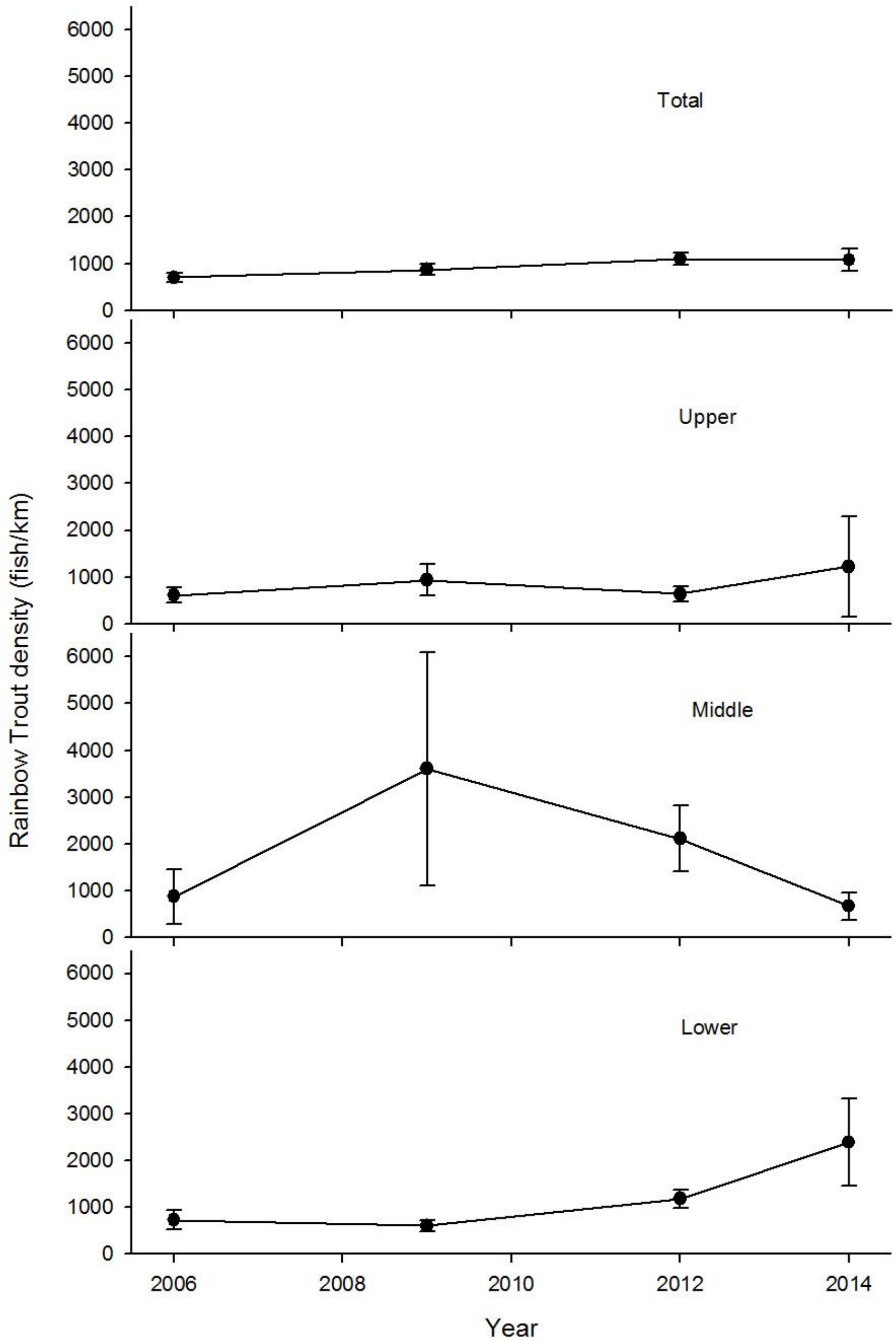

Figure 42. Linear density estimate trends for Rainbow Trout (≥ 100 mm) by reach for the South Fork Boise River from 2006 through 2014 from maximum likelihood estimation. All sites (top figure) refer to the combined estimate from pooling the data from all three sites.

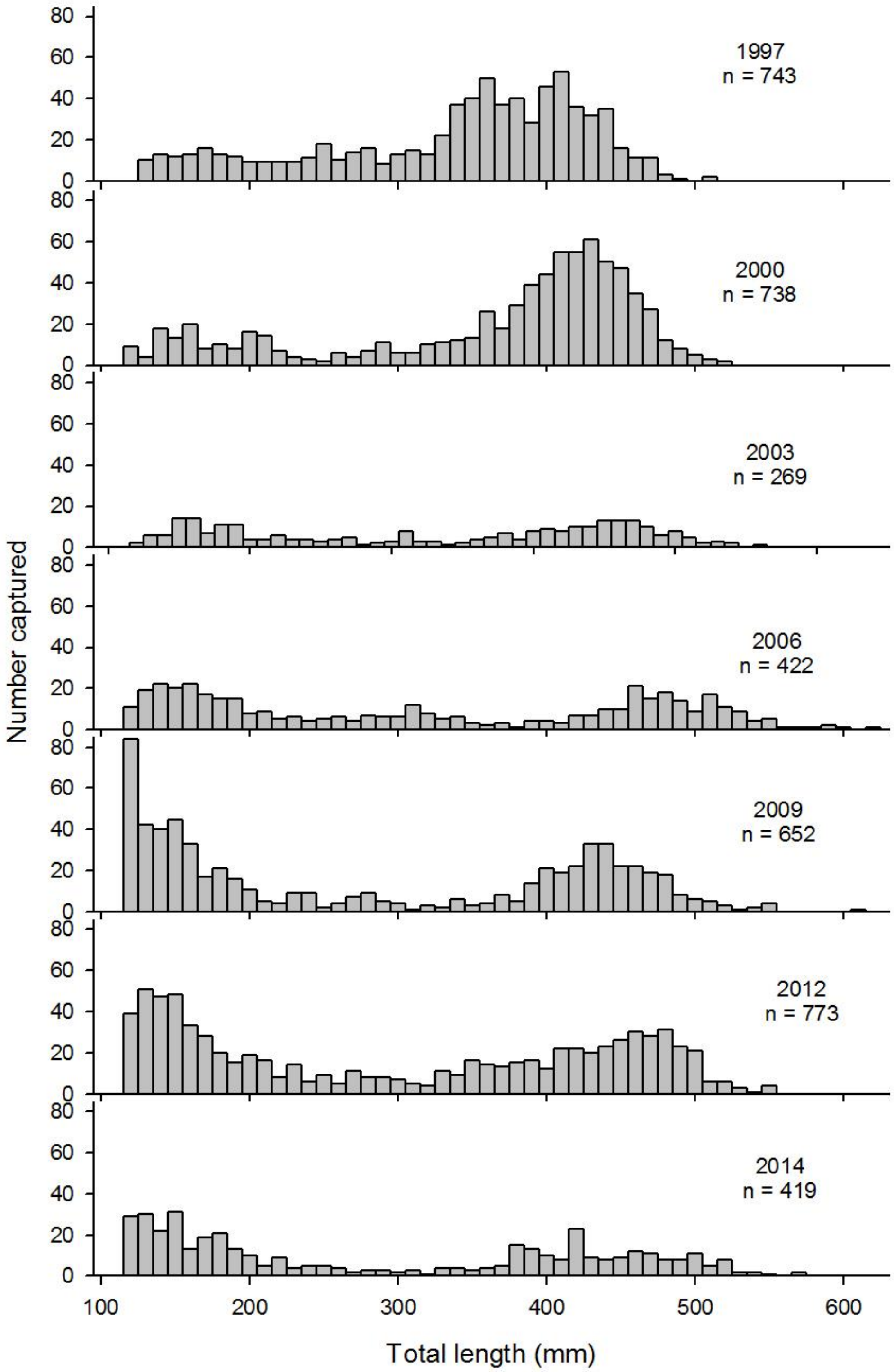

Figure 43. Length distributions of Rainbow Trout (≥ 100 mm), during population surveys at the South Fork Boise River below Anderson Ranch Dam in 1997-2014.

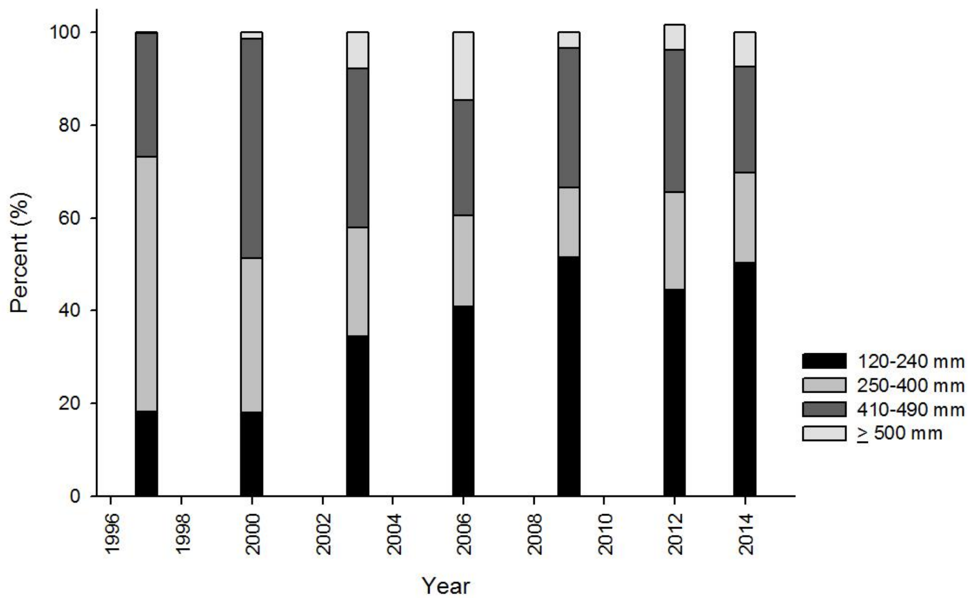

Figure 44. Length composition trends of Rainbow Trout, calculated as proportion of total catch, during population surveys at the South Fork Boise River below Anderson Ranch Dam from 1996 to 2014.

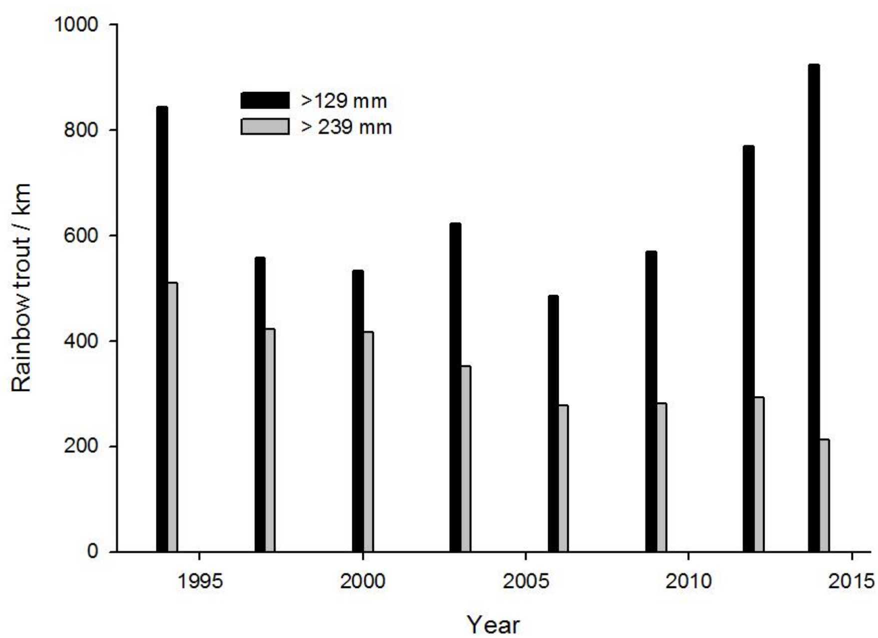

Figure 45. Linear density trends by length group for Rainbow Trout on the South Fork Boise River downstream from Anderson Ranch Dam between 1994 and 2014. Estimates were for rainbow trout >129 mm and >239 mm.

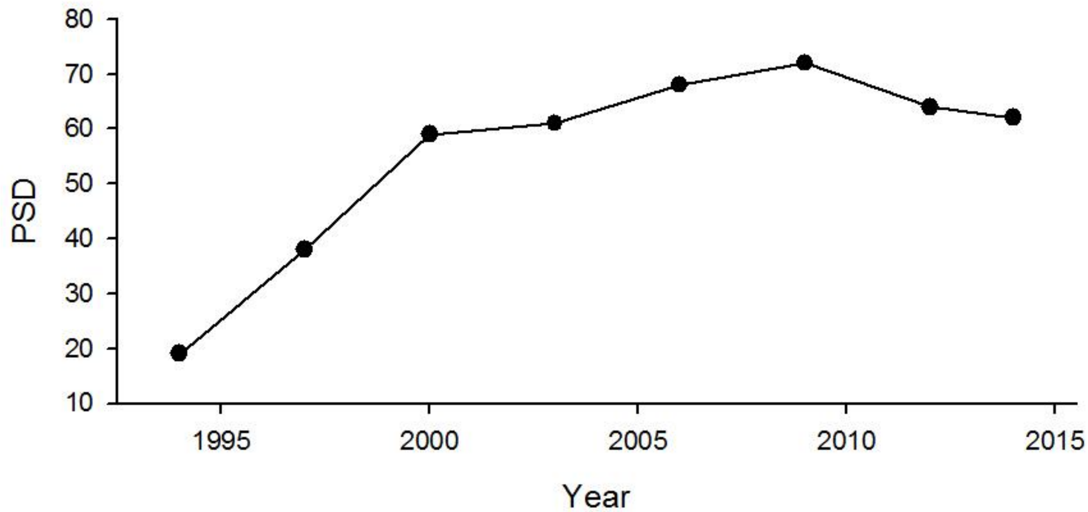

Figure 46. Proportional stock density (PSD) for Rainbow Trout collected during approximately triennial mark-recapture surveys on the South Fork Boise River downstream from Andersen Ranch Dam from 1995 through 2014.

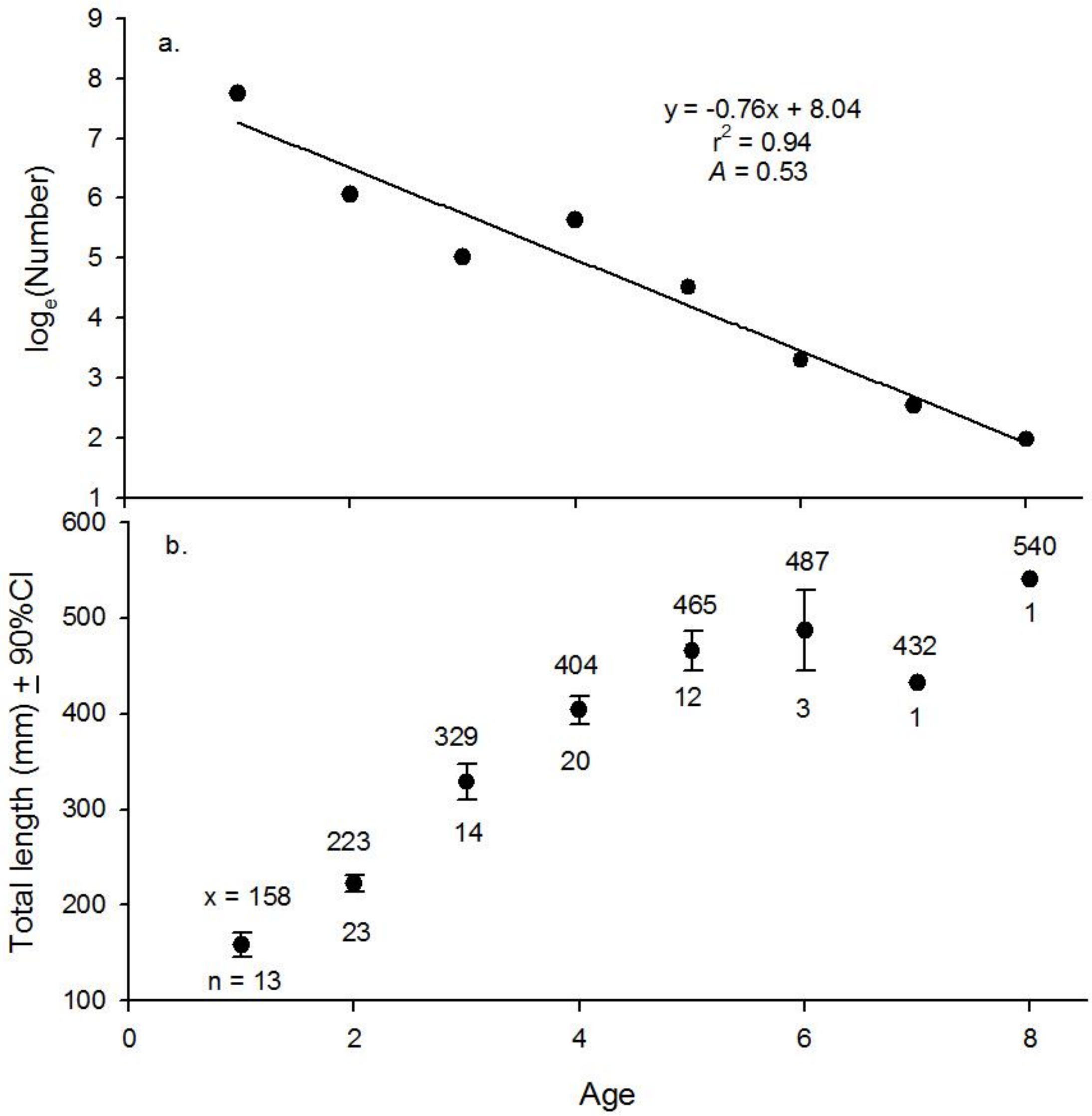

Figure 47. Catch curve (a) and mean length at age (b) for Rainbow Trout in the SFBR in October 2014. Mark-recapture population estimates and an age-length key was constructed for 10-mm length intervals (for fish between 100 and 540 mm). Ages were assigned using cross-sectioned pelvic fin rays. Mean length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

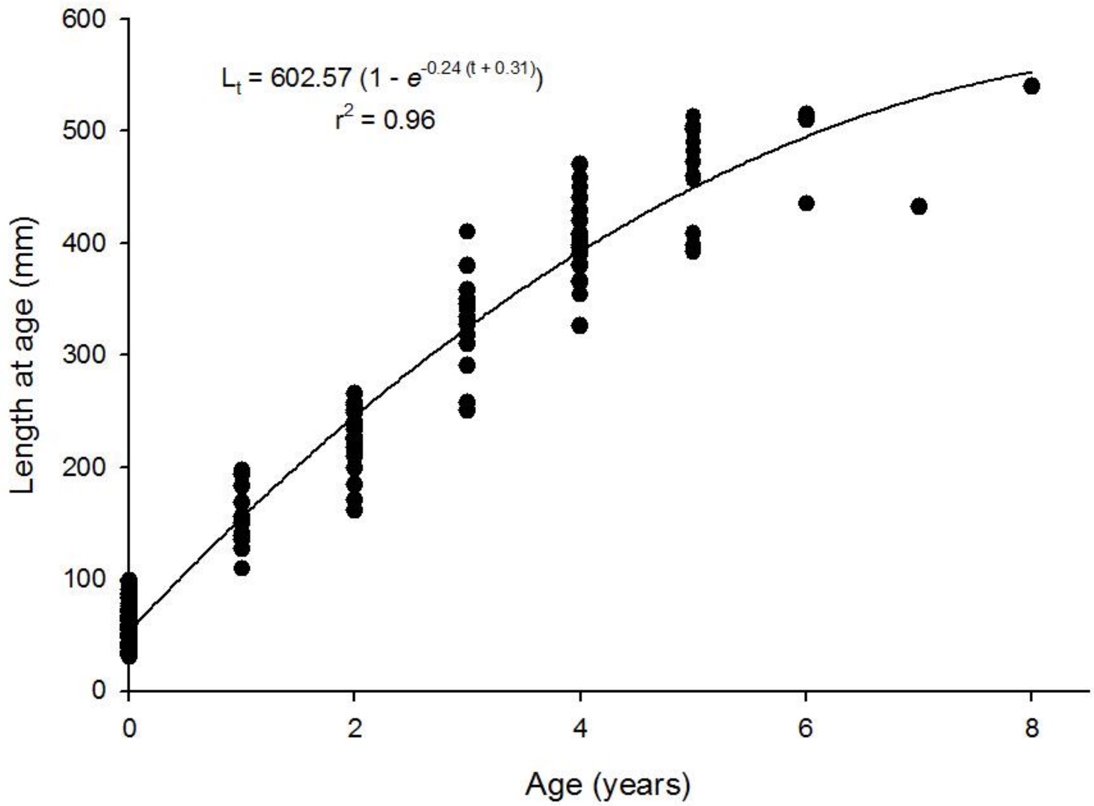

Figure 48. Von Bertalanffy growth model for Rainbow Trout in the SFBR, Idaho. Ages were assigned using cross-sectioned pelvic fin rays of fish collected during mark-recapture population estimates and age-0 monitoring in October 2014.

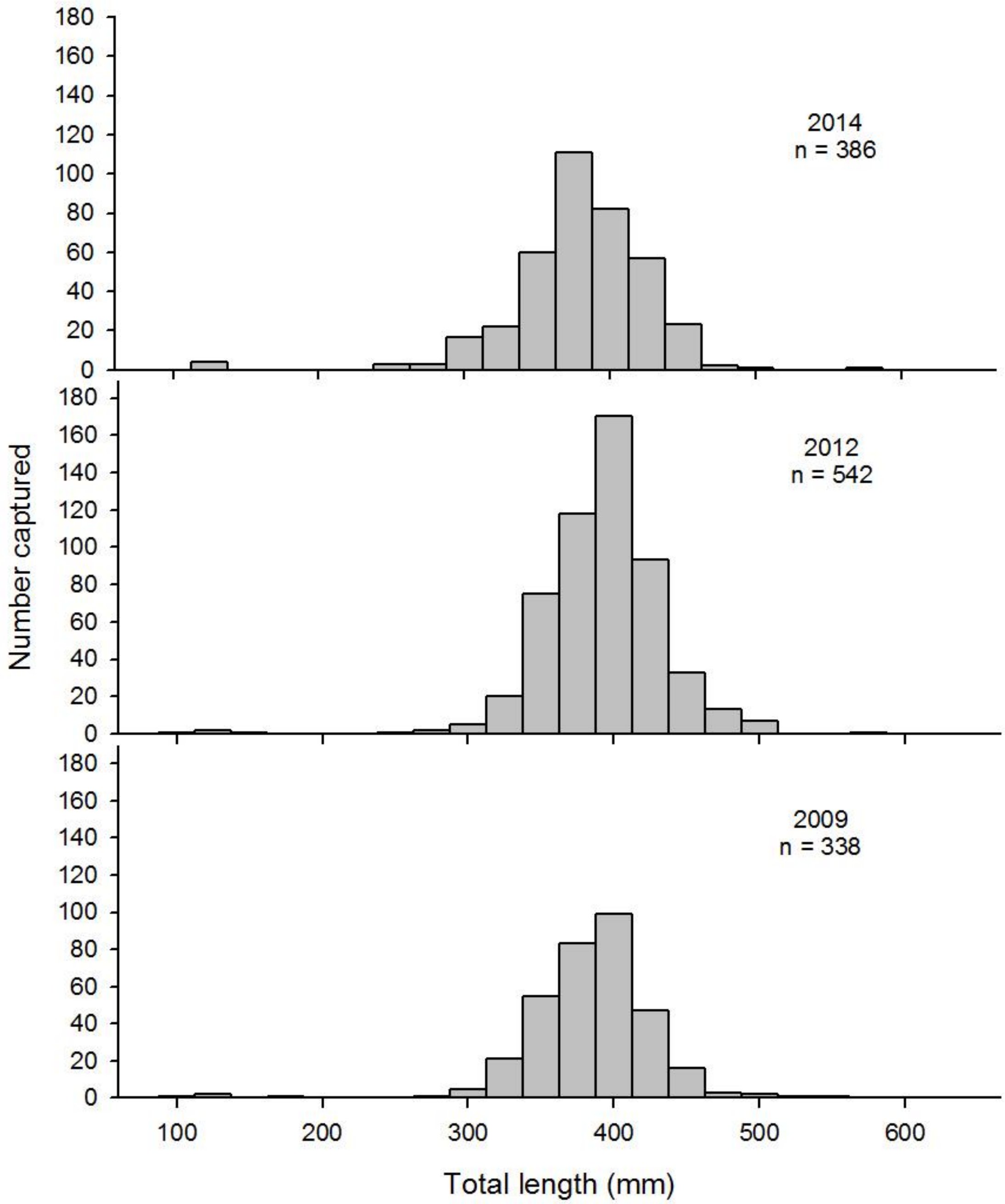

Figure 49. Length distributions of Mountain Whitefish (≥ 100 mm) sampled at the upper site of the South Fork Boise River downstream of Anderson Ranch Dam during 2009, 2012, and 2014.

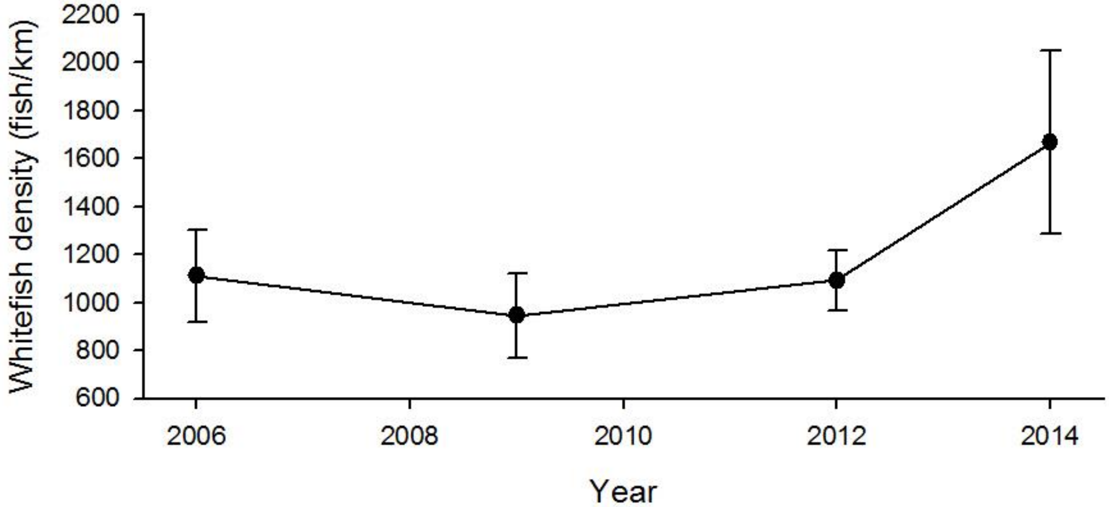

Figure 50. Linear density estimate trends for Mountain Whitefish (≥ 100 mm) at the upper site of South Fork Boise River. Estimates were calculated at approximately three year intervals from 2006 through 2014.

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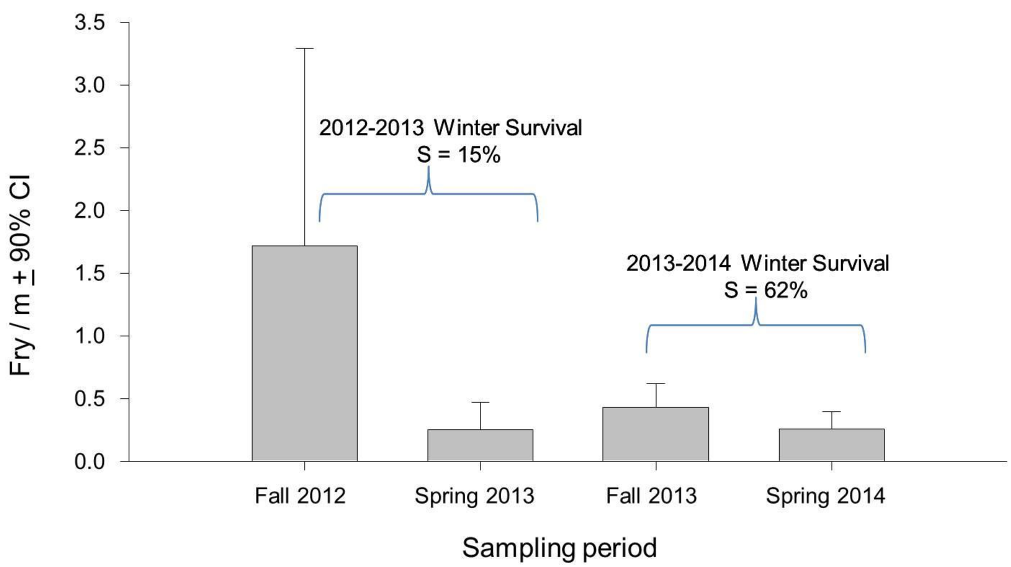

Figure 51. Comparison of mean densities age-0 and age-1 Rainbow Trout collected at 39 3-m long shoreline trend sections between fall and spring 2012 and 2014 at the South Fork Boise River, Idaho. Overwinter survival was estimated at 62% in 2014 and spring density was 0.3 fish/m.

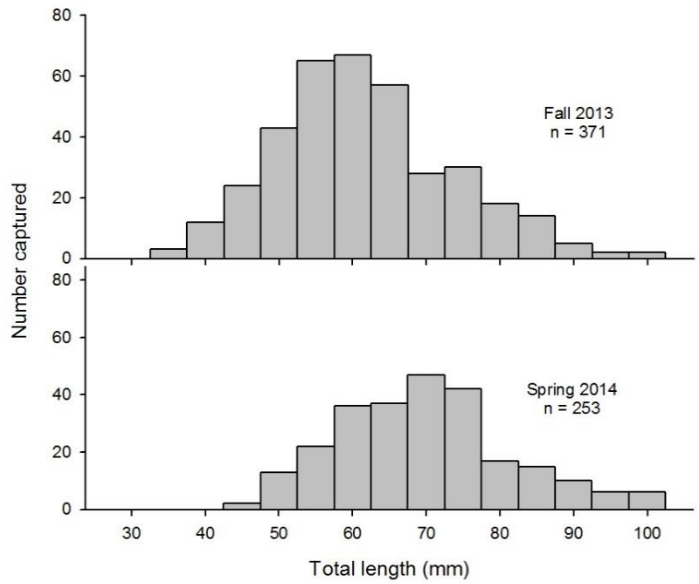

Figure 52. Length distributions of age-0 and age-1 Rainbow Trout, sampled during fry surveys during October 2013 and March 2014 in the South Fork Boise River downstream of Anderson Ranch Dam.

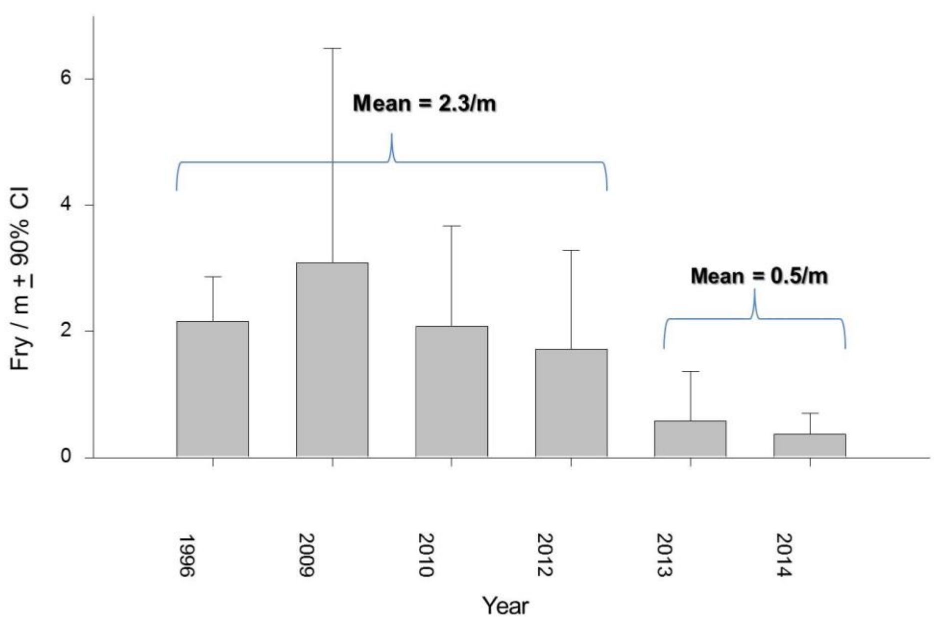

Figure 53. Comparison of mean age-0 Rainbow Trout densities collected at 39 33-m long shoreline trend sites from 1996 through 2014 at the South Fork Boise River, Idaho.

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.

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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 $\geq$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	-	-	-	-	-	-	-	-	-

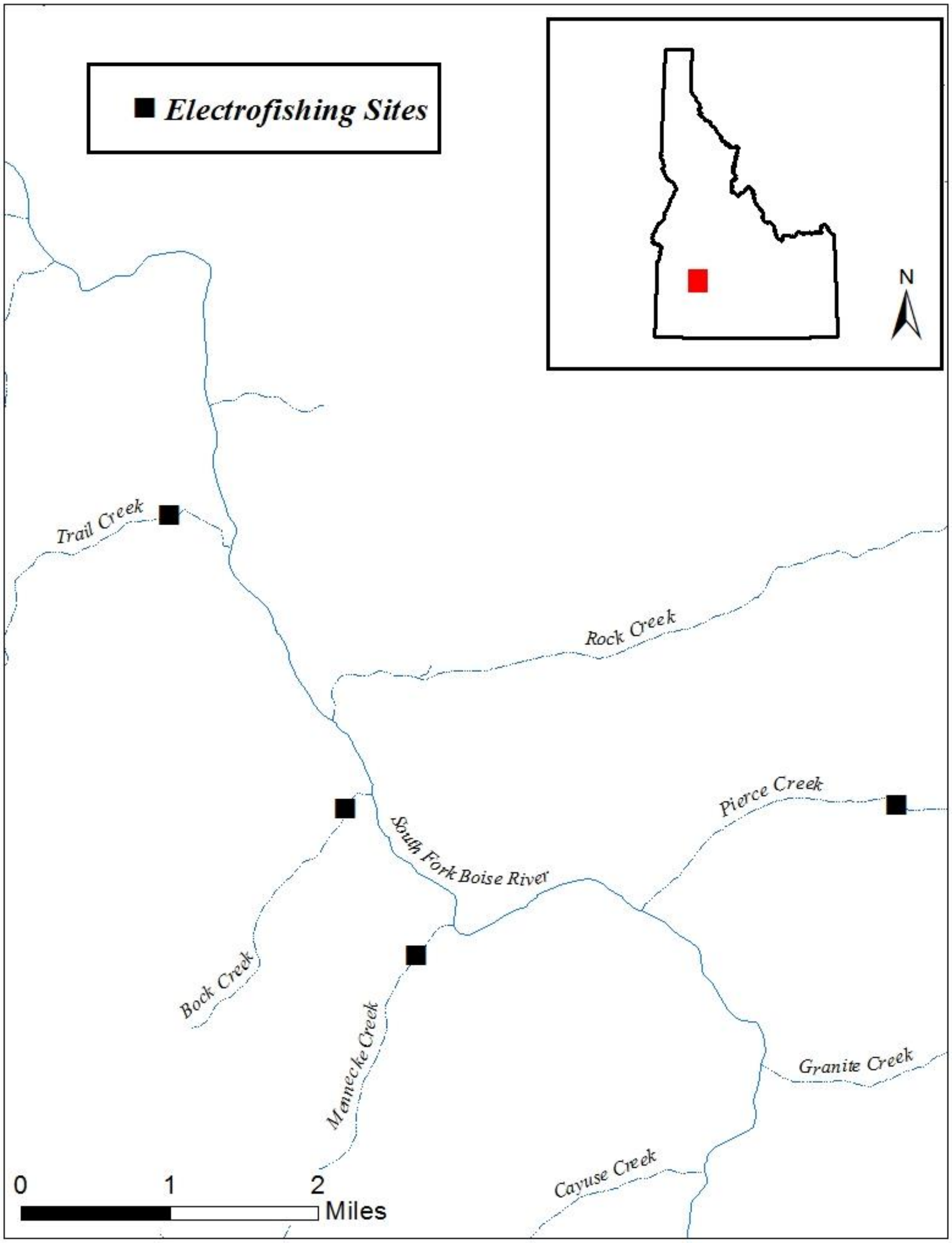

Figure 54. Location of sampling sites within four tributaries in the South Fork Boise River drainage, Idaho in 2014.

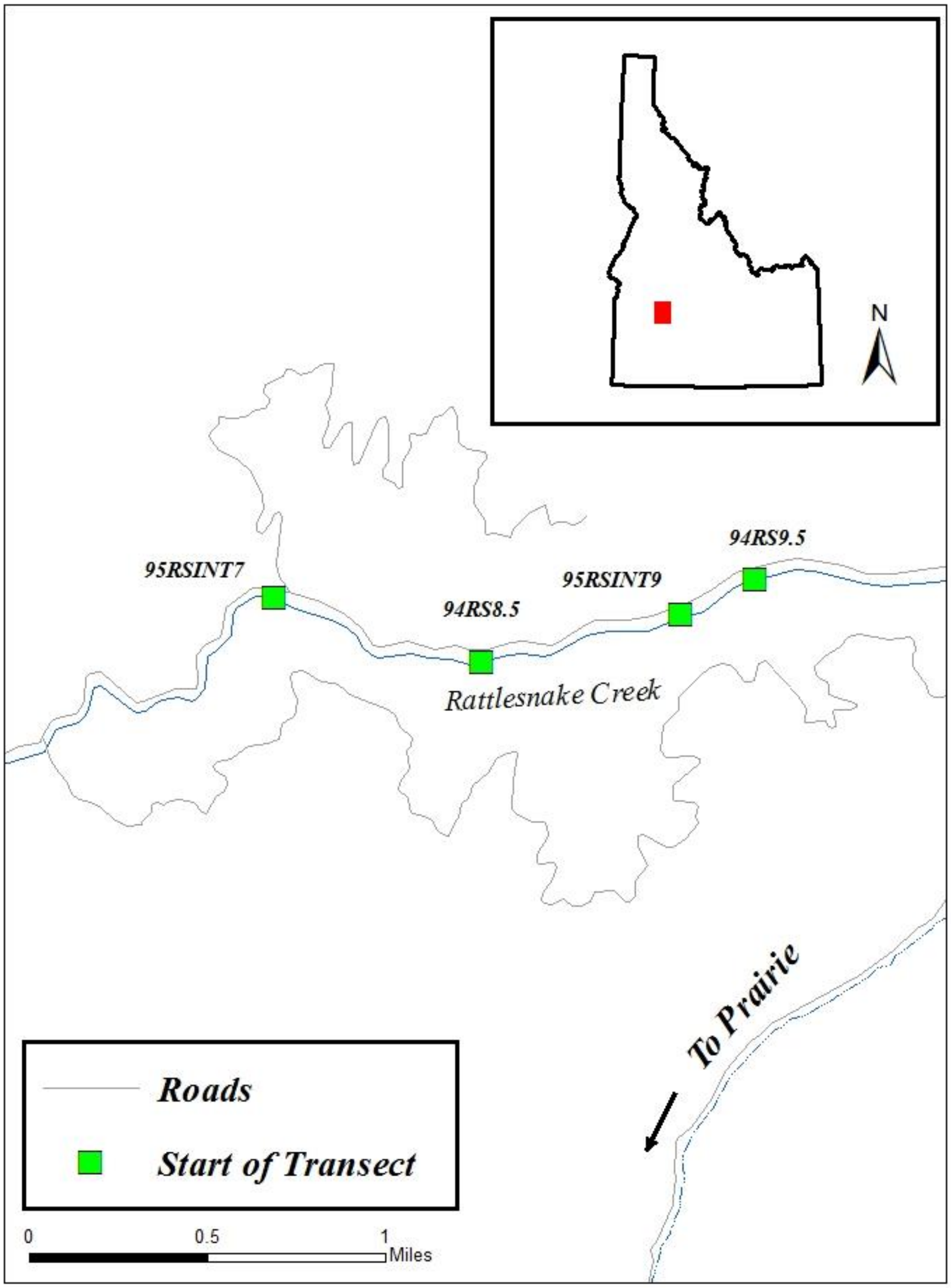

Figure 55. Location of four sampling sites in Rattlesnake Creek, a tributary to the South Fork Boise River drainage, Idaho in 2014.

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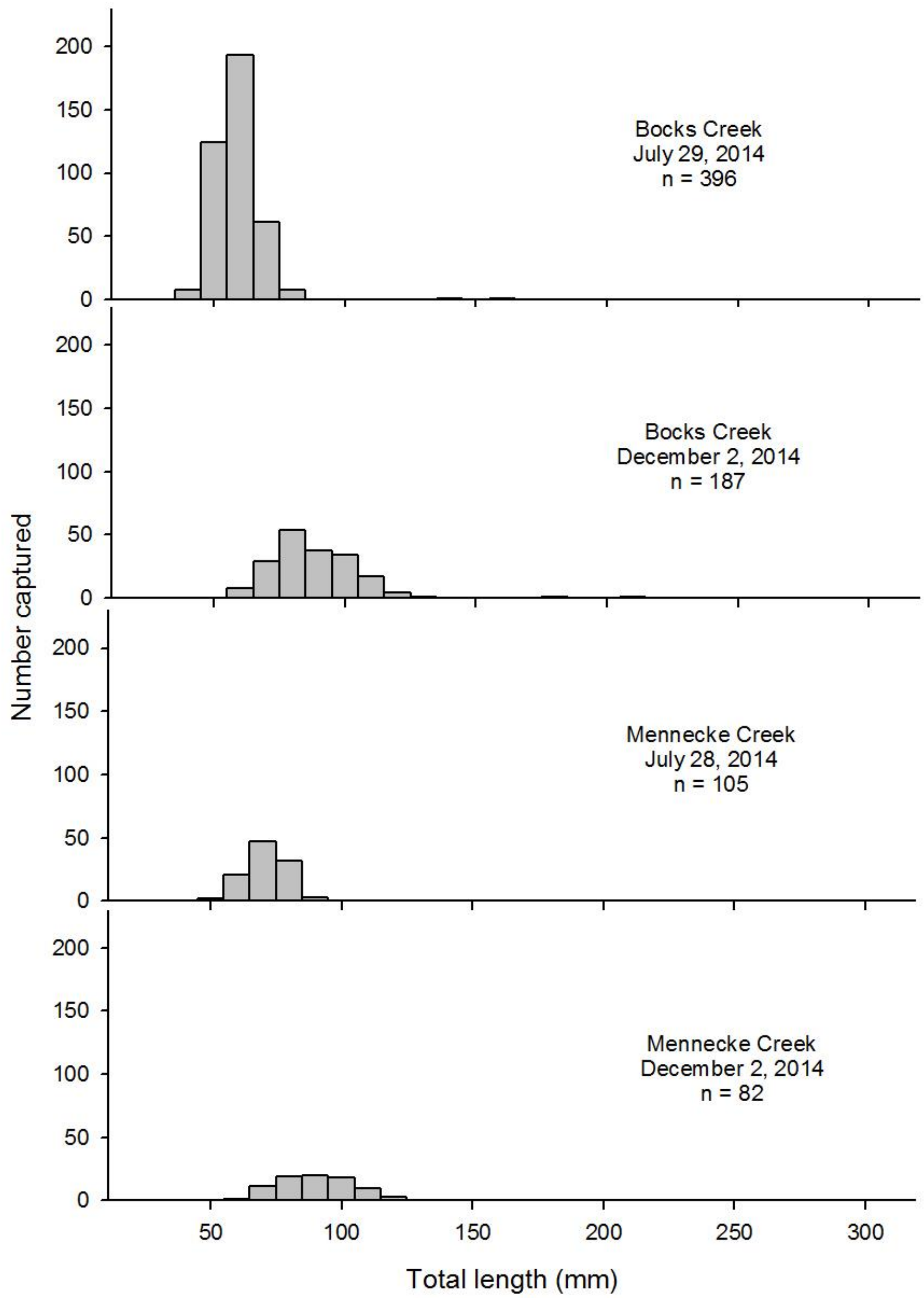

Figure 56. Length distribution of Rainbow Trout sampled during depletion population estimates in Bock and Mennecke creeks in July and December 2014. Both streams are tributaries to the South Fork Boise River, Idaho.

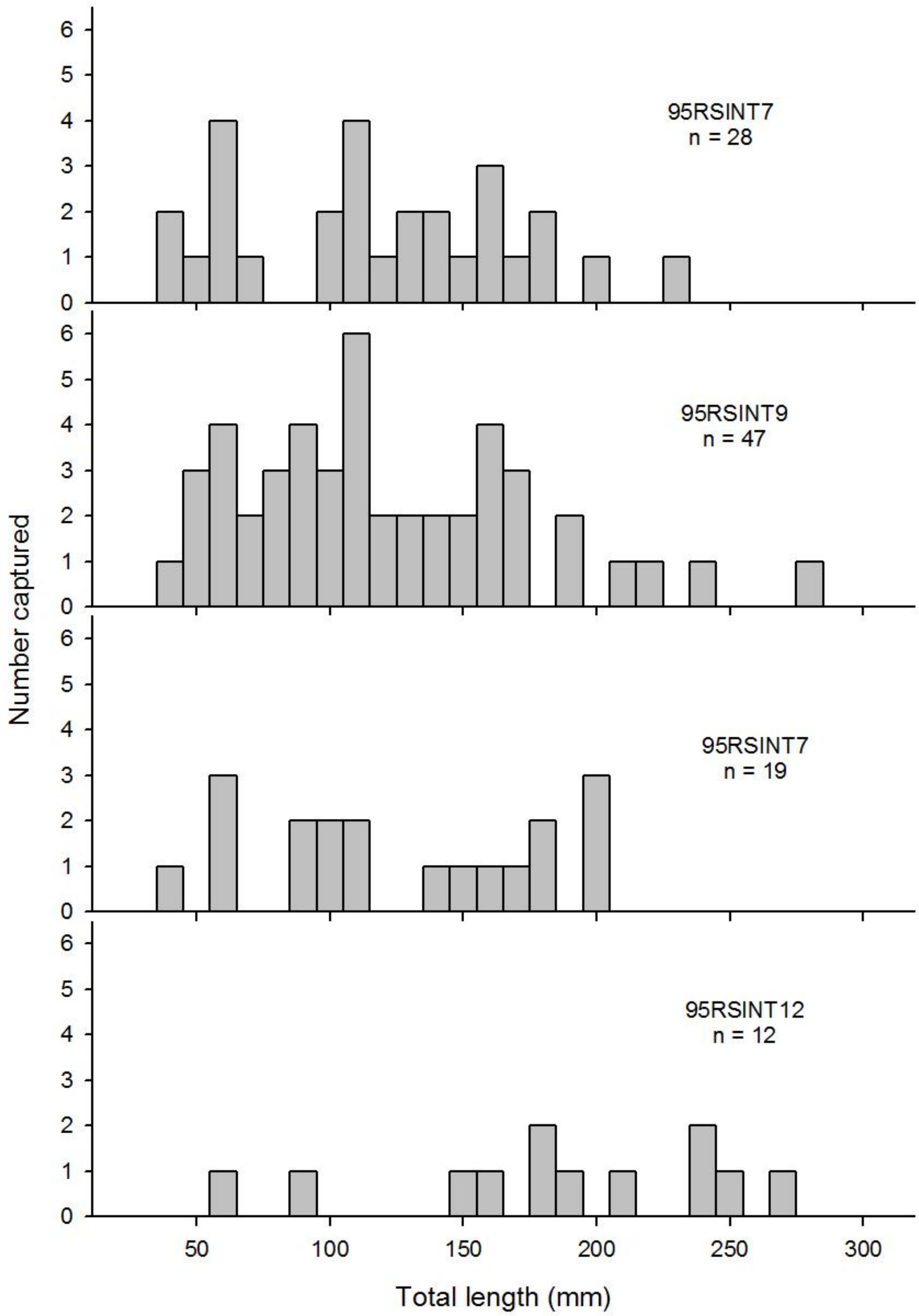

Figure 57. Length distributions of Rainbow Trout sampled by site during depletion population estimates in Rattlesnake Creek in September 2014. Rattlesnake Creek is a tributary to the South Fork Boise River, Idaho.

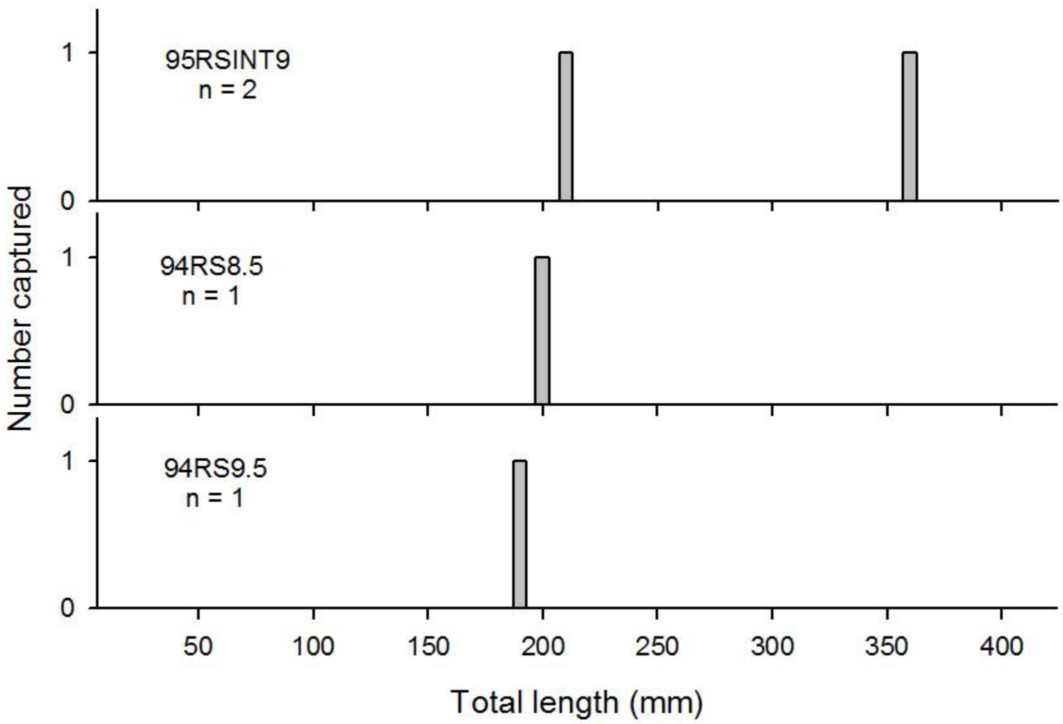

Figure 58. Length distributions of Bull Trout sampled by site during depletion population estimates in Rattlesnake Creek in September 2014. Rattlesnake Creek is a tributary to the South Fork Boise River, Idaho.

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