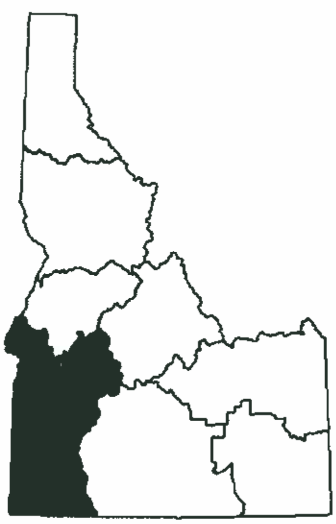
FISHERY MANAGEMENT INVESTIGATIONS

# IDAHO DEPARTMENT OF FISH AND GAME

## FISHERY MANAGEMENT ANNUAL REPORT

Cal Groen, Director



## SOUTHWEST REGION

## 2008


Joseph R. Kozfkay, Regional Fish Biologist
Arthur E. Butts, Regional Fish Biologist
Lance Hebdon, Regional Fish Biologist
Jeff C. Dillon, Regional Fish Manager



January 2010
IDFG 09-130

**2008 Southwest Region (Nampa) Annual Fishery Management Report**

## TABLE OF CONTENTS

## TABLE OF CONTENTS (cont.)

## TABLE OF CONTENTS (cont.)

## 2008 Southwest Region (Nampa) Fishery Management Report

## Lowland Lake Surveys

### Arrowrock Reservoir

# ABSTRACT

Arrowrock Reservoir was sampled in August 2008 to assess vertical temperature profiles and approximate distribution of rainbow trout *Oncorhynchus mykiss*. Three sites were sampled, where water temperatures ranged from 24 °C at the surface to 18 °C at 10 m. Rainbow trout were not captured during three short gill net sets, and 90% of the catch was northern pikeminnow *Ptychocheilus oregonensis*. Results of the sampling suggest that during the summer months, rainbow trout likely inhabit depths > 10 m due to temperature preferences.

## INTRODUCTION

Arrowrock Reservoir is a 1,275-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 Middle Fork and South Fork Boise rivers. Arrowrock Dam is located directly upstream of Lucky Peak Reservoir. Partially due to its close proximity to Boise, the reservoir is a popular recreational area for boaters and anglers. The reservoir provides a sport fishery that includes rainbow trout, kokanee *O. nerka*, and smallmouth bass *Micropterus dolomieu*. An adfluvial population of bull trout *Salvelinus confluentus* also resides in Arrowrock Reservoir. According to historic Idaho Department of Fish and Game (IDFG) gill netting surveys, the fish populations are predominantly composed of two non-game species; northern pikeminnow and largescale sucker *Catostomus macrocheilius*.

During fall 2003, Arrowrock Reservoir was drafted to approximately 1% of capacity for dam repairs. During this period, much of the reservoir was reduced to a shallow, silt-laden river channel which meandered through a number of km of mud flats and the majority of resident fish were either entrained into Lucky Peak Reservoir, resided in the river channels in areas normally inundated by the reservoir, or moved upstream into the Middle Fork and South Fork Boise rivers. Data collected by the Bureau of Reclamation (BOR) suggested that bull trout residing in the channel located within the reservoir boundary experienced high levels of mortality from predation (due to lack of cover) and being buried by collapsing banks (Salow 2005).

In spring 2004, after the reservoir had re-filled, IDFG stocked a total of 151,935 catchable rainbow trout (≥ 6 in.,152 mm), 331,019 fingerling rainbow trout (3-6 in., 76 - 152 mm), and 77,025 fingerling kokanee (3-6 in., 76 - 152 mm; Table 1). During 2004-2008, IDFG has stocked Arrowrock Reservoir with 220,525 catchable, 733,539 fingerling, and 250,320 fry-sized rainbow trout (<3 in., 76 mm). In addition, 147,025 fingerling kokanee have been stocked into the reservoir as well.

Despite stocking a large number of rainbow trout and kokanee, IDFG regional fishery personnel field complaints every summer regarding poor catch rates of rainbow trout, in particular. Many anglers also reported catching only northern pikeminnow during fishing trips. Therefore, IDFG southwest regional fishery along with BOR personnel conducted a vertical gillnetting survey along with basic water chemistry measurements to examine the pelagic fish assemblage at Arrowrock Reservoir during summer months.

## METHODS

Sampling locations were separated into three sections: 1) main reservoir, located in the main channel, approximately 2.5 km upstream from Arrowrock dam, 2) South Fork Boise River arm, approximately 3.5 km upstream from confluence with main reservoir channel, and 3) Middle Fork Boise River arm, approximately 5.3 km upstream from South Fork Boise River arm confluence in main channel of reservoir (Figure 1). One week prior to the netting survey, on August 1$^{st}$, vertical temperature (°C) and dissolved oxygen (D.O.; mg/L) profiles were collected at 1-m depth intervals from surface to bottom (up to 30 m deep). Arrowrock Reservoir was sampled with vertical gill nets on August 6$^{th}$. A single vertical net was set at each site in the evening between 1956 and 2052 h. Net mesh size and dimensions were not recorded during the sampling event, but it is believed that the net fished approximately 0-9 m depth. Nets were retrieved after approximately 2 h beginning at 2155 h. The short soak time was due to concern over incidental mortality of bull trout which reside in the reservoir. Captured fish were identified to species and measured for total length (mm). Catch-per-unit-effort (CPUE) for each net was calculated by summing the total number of fish caught in each net and dividing by the h fished.

## RESULTS AND DISCUSSION

Surface water temperatures ranged from 23 °C in the Middle Fork arm to 24 °C at the main reservoir site (Figure 2). A gradual thermocline began at approximately 6 m depth at all three sites, with water temperatures dropping to 18 °C at 10 m depth. Temperatures continued to gradually decline by depth reaching lows of 12.8 °C (28 m depth) in the South Fork Arm, 14.3 °C (30 m depth) in the main reservoir, and 16.7 °C (15.5 m depth) in the Middle Fork Arm. D. O. measurements ranged from 5 to 9 mg/L at all sites.

A total of 31 fish were captured by combined vertical nets, of which 28 (90%) were northern pikeminnow (Table 2). One kokanee, largescale sucker, and yellow perch *Perca flavescens* were also collected. No rainbow trout were observed during the short sampling event. The majority of northern pikeminnow (23) were captured in the main reservoir section, where depth was greatest. CPUE for northern pikeminnow was highest in the main reservoir section (9.2 fish/h) and lowest in the South Fork arm (0 fish). The mean CPUE for northern pikeminnow for Arrowrock Reservoir was 4.3 fish/h. Northern pikeminnow ranged from 248 to 312 mm, with a mean size of 279 mm (Figure 3).

A literature review of thermal tolerances suggest rainbow trout select water temperatures between 7 to 18 °C, with avoidance of temperatures > 18 °C (Raleigh et al. 1984). The upper thermal tolerance level was 25 °C and avoidance of D.O. levels < 3 mg/L was described. Reported temperature preference information for northern pikeminnow is sparse. However, northern pikeminnow are able to maximize feeding at temperatures of 20 to 24 °C, with an upper thermal tolerance of 29 °C (Brown and Moyle 1981; Vigg and Burley 1991). Brown and Moyle (1981) described a minimum D.O. limit of 0.8 mg/L. Based on this information alone, at Arrowrock Reservoir during summer months, we would expect rainbow trout to occupy depths ≥ 10 m depth while northern pikeminnow should prefer depths ≤ 8 m depth.

Despite the small sample size, data collected during this brief investigation supports observations by anglers. Anglers fishing from shore or trolling near the surface would be unlikely to catch rainbow trout during the summer period because of warmer water temperatures and more likely to catch northern pikeminnow. Anecdotal evidence also suggests that the major drawdown in 2003 may have resulted in a strong year class of northern pikeminnow in spring 2004. Northern pikeminnow may have been able to better adapt to the temporary riverine environment and their high fecundity coupled with higher survival from a reduction in predators likely attributed to an increase in population size. Because IDFG receives few complaints about rainbow trout catch rates at Arrowrock Reservoir during cooler periods in the spring and fall, catch rates are likely more reflective of seasonal habitat conditions rather than actual rainbow trout abundance within the reservoir.

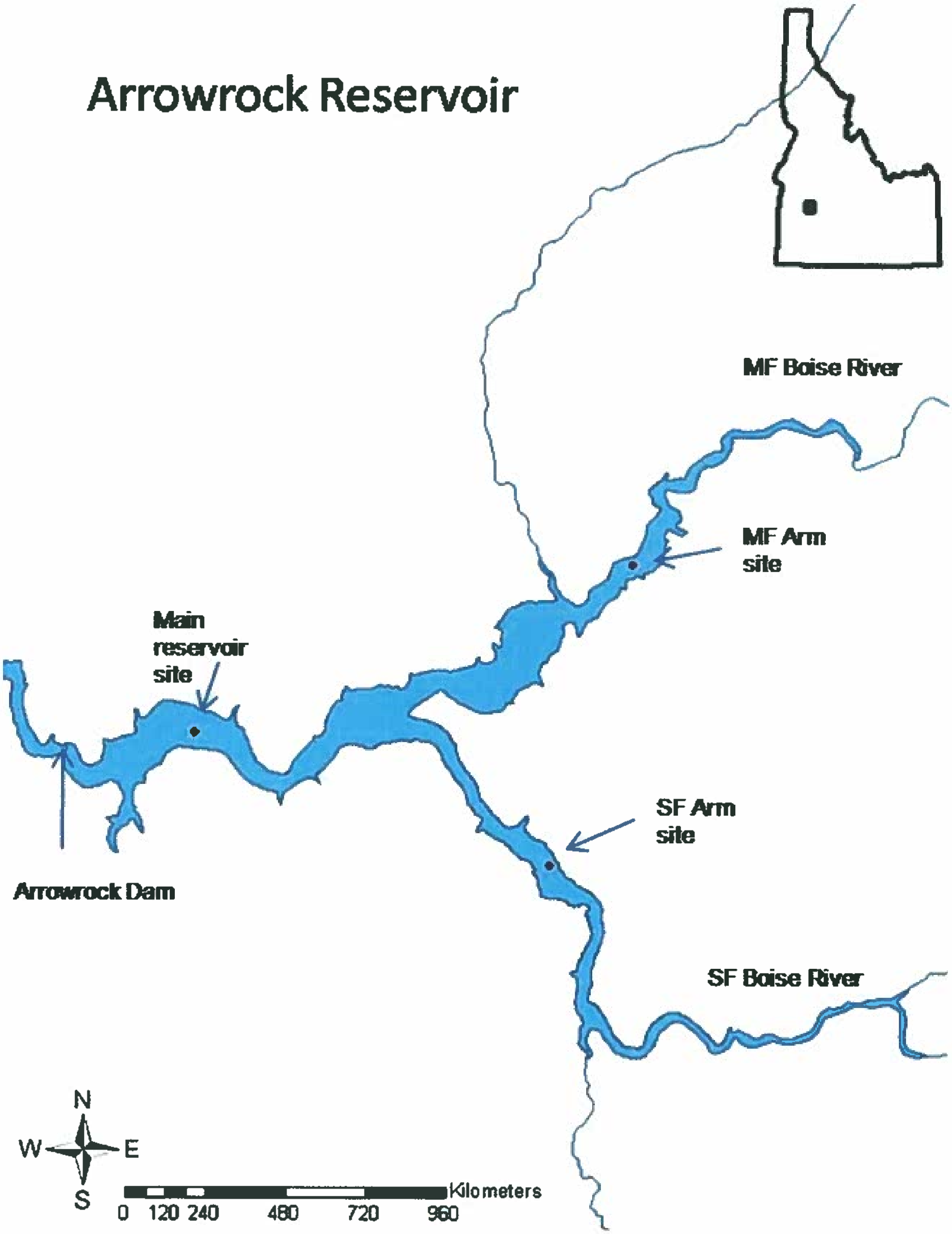



Figure 1. Map of Arrowrock Reservoir showing major tributaries and 2008 sampling sites.

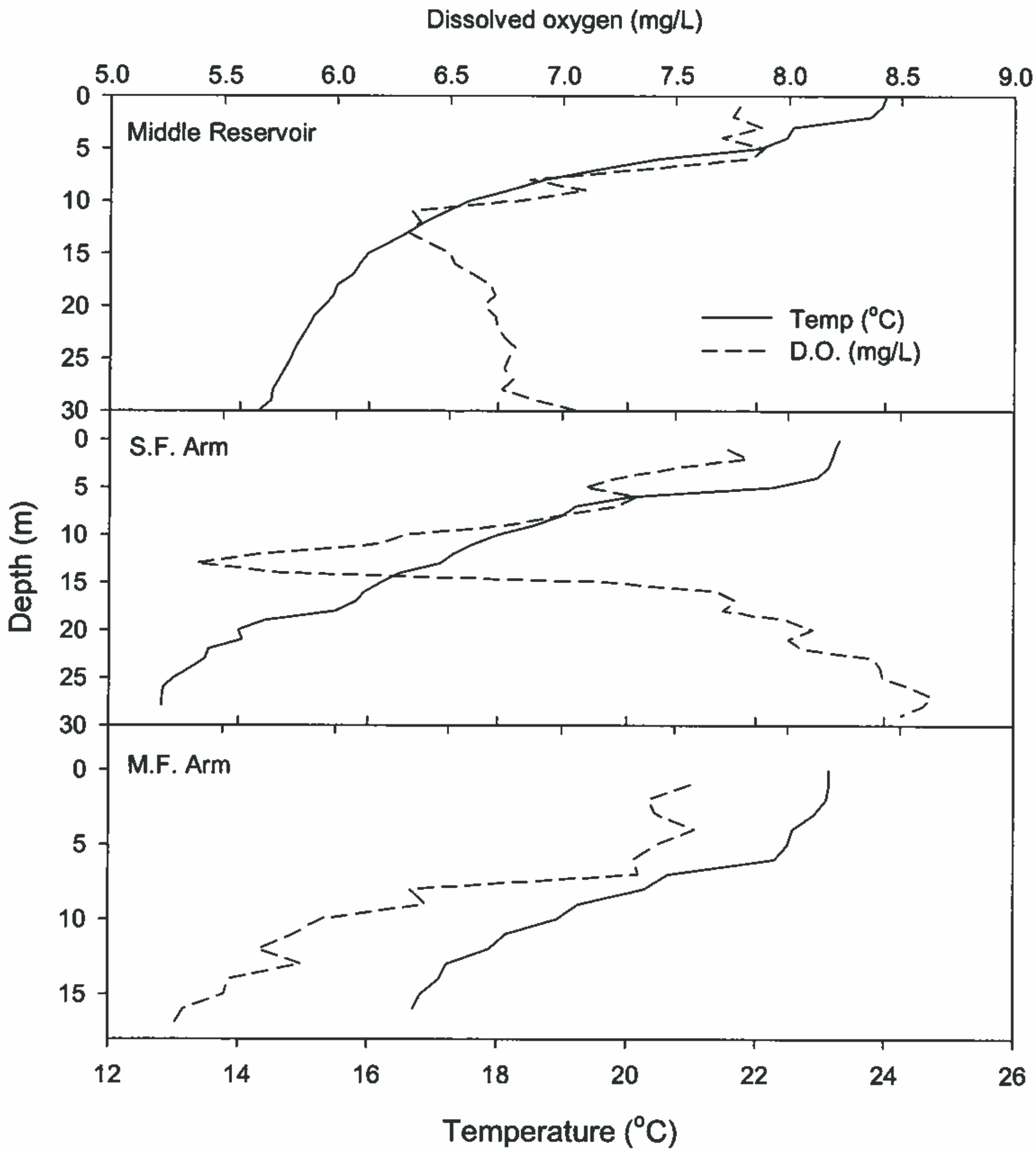



Figure 2. Vertical temperature (°C) and dissolved oxygen (D.O.; mg/L) profiles for three sites at Arrowrock Reservoir on August 1, 2008.

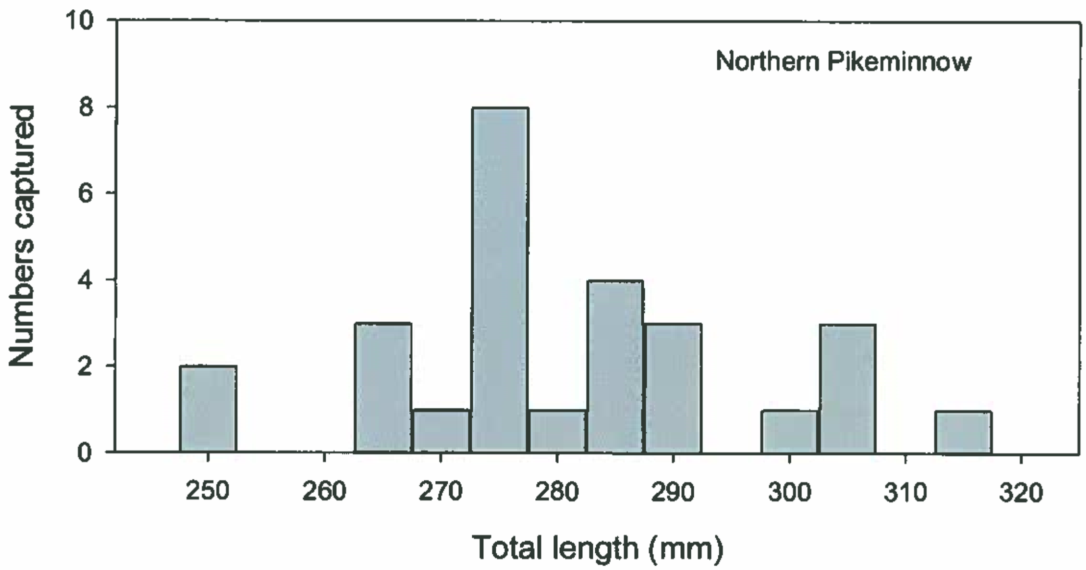



Figure 3. Length frequency distribution of 28 northern pikeminnow captured in vertical gill nets on August 6, 2008 for three combined sites at Arrowrock Reservoir.

Table 1. Arrowrock Reservoir fish stocking data following severe drawdown in 2003.

| Species | 2004 | 2005 | 2006 | 2007 | 2008 | Total |
|---|---|---|---|---|---|---|
| **Rainbow trout** | | | | | | |
| Catchable (≥ 6 ") | 151,935 | 15,500 | 14,040 | - | 39,050 | 220,525 |
| Fingerling (3-6") | 331,019 | 163,170 | 58,630 | 180,720 | - | 733,539 |
| Fry (0-3") | - | - | 91,440 | - | 158,880 | 250,320 |
| **Total** | 482,954 | 178,670 | 164,110 | 180,720 | 197,930 | 1,204,384 |
| **Kokanee** | | | | | | |
| Fingerling (3-6") | 77,025 | - | 70,000 | - | - | 147,025 |

Table 2. Catch per unit effort (CPUE-fish/hr) information for four fish species captured by vertical gillnets at three sites at Arrowrock Reservoir on August 6, 2008.

| Section | Effort (hr) | Northern pikeminnow (n) | Kokanee (n) | Largescale sucker (n) | Yellow perch (n) |
|---|---|---|---|---|---|
| Middle Res. | 2.5 | 9.2 (23) | - | 0.4 (1) | 0.4 (1) |
| S.F. Arm | 2 | - | 0.5 (1) | - | - |
| M.F. Arm | 2 | 2.5 (5) | - | - | - |
| Total CPUE | 6.5 | 4.3 (28) | 0.2 (1) | 0.2 (1) | 0.2 (1) |

## Crane Creek Reservoir


## ABSTRACT

We collected 1,758 fish with three gear types during a standard lowland lake survey of Crane Creek Reservoir on June 12, 2008. In total, 579 black crappie *Pomoxis nigromaculatus*, 16 bluegill *Lepomis macrochirus*, 10 bridgelip sucker *C. columbianus*, 61 brown bullhead *Ameiurus nebulosus*, 215 channel catfish *Ictalurus punctatus*, 182 common carp *Cyprinus carpio*, 1 largemouth bass *M. salmoides*, and 694 white crappie *P. annularis* were sampled. Total CPUE and weight-per-unit-effort indices were 639 and 153, respectively. Crappie populations have remained relatively stable compared to historical levels with trophy-sized individual fish present. Past channel catfish stocking has led to the establishment of a self-sustaining population that has increased in abundance over the last several surveys.

## INTRODUCTION

Crane Creek Reservoir is a 937-ha irrigation reservoir (at full pool) that impounds North, South, and mainstem Crane as well as Hog and Milk creeks. The dam is located approximately 20 km upstream from the confluence of Crane Creek and the Weiser River, which is about 34 km east of Weiser, ID. Largemouth bass, crappies, channel catfish, brown bullhead, and yellow perch have been sampled during surveys conducted in 1995, 1998, and 2001 (Allen et al. 1998; Allen et al. 2001; Flatter et al. 2008).

High turbidity, seasonal reservoir-level drawdowns, and remoteness keep fishing pressure to a low level. During 2007, the Idaho State Department of Agriculture studied water quality of Crane Creek Reservoir and its outlet. They determined that an 80% reduction in total phosphorous would be required to meet total maximum daily load criteria. Suspended sediment concentration did not exceed total maximum daily load criteria due to the small size and weight of suspended clay particles. However, these small clay particles contributed greatly to high turbidity levels and bound with phosphorus, thereby facilitating its transport downstream. Despite poor water quality, the state record white crappie (1.61 kg) was caught from Crane Creek Reservoir during July 2007. Crane Creek Reservoir has been managed under IDFG's general fishing regulations of six trout and six bass (none under 12" – 305 mm) and no size or bag limits on other species. Crane Creek Reservoir has only been stocked eight times since 1967. These plants have included introductory plants of warmwater fish (largemouth bass, crappies, and channel catfish) as well as attempts to produce a put-grow-and take Lahontan cutthroat trout *O. clarkii henshawi* fishery from 1990-92. Due to poor performance, Lahontan cutthroat trout stocking was terminated.

## METHODS

Fish populations in Crane Creek Reservoir were sampled with standard IDFG lowland lake sampling gears on June 12, 2008. Sampling gear included: (1) paired gill nets, (2) trap nets, and (3) night electrofishing. Paired gill net sets included floating and sinking monofilament nets, 46 m x 2 m, with six panels composed of 19, 25, 32, 38, 51, and 64-mm bar mesh. One floating and one sinking net, fished for one night, equaled one unit of gill net effort. Trap nets possessed 15-m leads, 1-m x 2-m frames, crowfoot throats on the first and third of five loops, 19-mm bar mesh, and had been treated with black tar. One trap net fished for one night equaled one unit of trap net effort. For boat electrofishing effort, 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 5-6 amps. One hour of active on-time electrofishing equaled one unit of effort. In total, four trap net, three gill net, and one electrofishing units, composed of three 1,200 second sub-samples, were utilized during 2008 (Figure 4).

Captured fish were identified to species, measured for total length (± 1 mm), and weighed (±1g for fish under 5,000 g or ± 10 g for fish greater than 5,000 g) with a digital scale. In the event that weight was not collected, length-weight relationships were built from fish weighed and measured in 2008 which allowed us to estimate weights of un-weighed fish. Furthermore, for those fish not weighed or measured, average weights were used to calculate biomass estimates. Proportional stock densities (PSD) were calculated for game fish populations as outlined by Anderson and Neuman (1996) to describe length-frequency data. Also, relative weight (Wr), 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. Catch data were summarized as the number of fish CPUE and the weight in kg caught-per-unit-effort (WPUE). These indices were calculated by standardizing the catch of each gear type to one unit of effort and then summing across the three gear types.

## RESULTS

We collected 1,758 fish with the three gear types. In total, 579 black crappie, 16 bluegill, 10 bridgelip sucker, 61 brown bullhead, 215 channel catfish, 182 common carp, 1 largemouth bass, and 694 white crappie were sampled (Table 3). CPUE and WPUE effort indices were 639 and 153 (Table 3 and 4), respectively. Trap nets were the most effective gear type yielding a total CPUE of 284, followed by electrofishing (CPUE = 222), and gill nets ($n$ = 133). Based on CPUE, white and black crappie were the most abundant fishes sampled and combined composed over 64% of the fish community. Common carp (17%) and channel catfish (12%) were the next most abundant species numerically, whereas other species represented less than 3% of the total. Based on WPUE, the fish community consisted of common carp (30%), white crappie (26.4%), channel catfish (21.3%), and black crappie (19%). Remaining species each represented less than 3% of the total biomass and cumulatively less than 5% of the total biomass.

White crappie were the most common game fish sampled with a CPUE of 231.7 fish and WPUE of 40.3. Most white crappie were sampled with trap nets (trap net CPUE = 115 fish/net/night). PSD for white crappie was 27, calculated from 461 stock length fish (≥130 mm) and 122 quality length fish (≥200 mm). This low PSD is indicative of a white crappie skewed towards small individuals (Figure 5). Mean Wr for fish over 100 mm was 116, indicating relatively good average body condition. Wr showed a declining trend across the lengths of fish examined (slope = -0.38; $P < 0.01$; $n$ = 368). For example, mean Wr for black crappie over 200 mm ($n$ = 105) was 97.

Black crappie were the second most common fish sampled with a CPUE of 181.7 fish and a WPUE of 28.2 (Table 3 and 4). Most black crappie were sampled with trap nets (trap net CPUE = 118 fish/net/night). PSD for black crappie was 7, calculated from 284 stock length fish (≥130 mm) and 21 quality length fish (≥200 mm) indicative of a black crappie population highly skewed towards small individuals (Figure 6). Despite this low PSD, a few trophy sized black crappie were caught, including a 439 mm 1,671 g individual. This fish exceeded the current state record by 57 grams. Mean Wr for fish over 100 mm was 116, indicating relatively good average body condition. However, Wr showed a declining trend across the lengths of fish examined (slope = -0.21; $P < 0.01$; $n$ = 214). For example, mean Wr for black crappie over 200 mm ($n$ = 21) was 90.

Channel catfish were the only catfish species sampled with a CPUE of 73.6 and a WPUE of 32.6. Channel catfish were caught equally among the three gear type with 25% of the total being caught with electrofishing, 34% with gill nets, and 41% with trap nets. PSD for channel catfish was 31, calculated from 58 stock length fish (≥280 mm) and 18 quality length fish (≥410 mm) indicative of a balanced population (Figure 7). Based on a wide range of size classes, a self-sustaining population was created by the introduction of 16,000 fingerling hatchery catfish during 1990, despite what appears to be a lack of quality spawning habitat.

Common carp were the most abundant non- game fish sampled with a CPUE of 111 and a WPUE of 30, accounting for 17% of the fish community by number and 30% by weight. Most common carp were sampled with electrofishing gear at a CPUE of 79 fish/hour. Mean condition factor was 1.20. The length frequency was uni-modal with 64% of the common carp measuring from 350 - 450 mm (Figure 8). Few smaller or larger individuals were sampled.

Standardized lowland lake surveys of Crane Creek Reservoir have been completed four times 1995, 1998, 2001, and 2008, allowing comparison of populations across time. Black and white crappie populations have remained stable over time. Comparing gill net and trap net catch for both species of crappie, CPUE for the 1995, 1998, 2001, and 2008 has remained relatively stable with CPUE of 350, 525, 331, and 313.4, respectively (Figure 9). Channel catfish have seemed to have an inverse relationship with brown bullhead, as channel catfish have become more abundant brown bullhead populations have seemed to decline. Gill net catches seem to provide the best trend data for Ictalurids. Channel catfish gill net CPUE has increased in each of the last four surveys (Figure 10), whereas brown bullhead peaked at 15 CPUE in 2001, but declined substantially by 2008. Trap net catches of brown bullhead also peaked in 2001 and declined slightly by 2008. Common carp populations have remained stable to slightly decreasing with at approximately 29, 27, 34, and 24.7 fish/gill net pair/night sampled during the last four surveys (Figure 11). A more severe decline in common carp abundance is indicated by electrofishing CPUE, though no index is available for 1998 or 2001. Bridgelip sucker CPUE has declined for all survey gear types. Yellow perch were sampled in the 1995 survey, but have not been sampled since. Bluegill were sampled in the present survey, but had not been sampled previously.

## DISCUSSION

Despite frequently low winter reservoir levels and poor water quality, fish populations in Crane Creek Reservoir are in fair to good condition. Black and white crappie populations are at high abundances and have remained relatively stable since 1995. These populations are dominated by mostly small individuals; however, a few very large individuals exist, including an angler-caught state record during 2007 and the capture of a black crappie that was larger than the state record during this survey. The introduction of 16,000 channel catfish in 1990 has created a self-sustaining channel catfish population that has increased in abundance in each of the last four surveys. Brown bullhead populations have fluctuated over this time period and are currently at low levels. The largemouth bass population in Crane Creek Reservoir remains an enigma. Catch in the last three surveys has been minimal. However, during fish tissue contaminant sampling during 2007 electrofishing catch rates for largemouth bass were relatively high, though un-quantified, with several year classes present. Additionally several anglers have reported fair catch rates for largemouth bass. Non-game populations, specifically common carp and bridgelip sucker have been relatively stable to slightly decreasing since 1995. Though common carp catch rate was high during 2008, WPUE was low compared to other Southwest Region waters indicating that mean size of common carp in Crane Creek Reservoir was relatively low. For instance, during a 2006 standard lowland lake survey of Lake Lowell, common carp CPUE was about 60% less than Crane Creek Reservoir, but WPUE in Lake Lowell was about 120% higher. High abundance of common carp has been shown to have negative effects on water quality and invertebrate populations in other systems, and is likely negatively affecting water quality in Crane Creek Reservoir and downstream rivers.

## MANAGEMENT RECOMMENDATIONS

1. Use Crane Creek Reservoir as a source population for introductions of white and black crappie into Paddock Reservoir.

2. Monitor water levels in Crane Creek Reservoir, if it appears that Crane Creek Reservoir will drop low enough to severely reduce game fish populations, consider rotenone treatment to remove common carp from the system.

3. Resample Crane Creek Reservoir in 3-5 years to monitor the fish community, especially to determine whether common carp have increased in abundance or biomass.

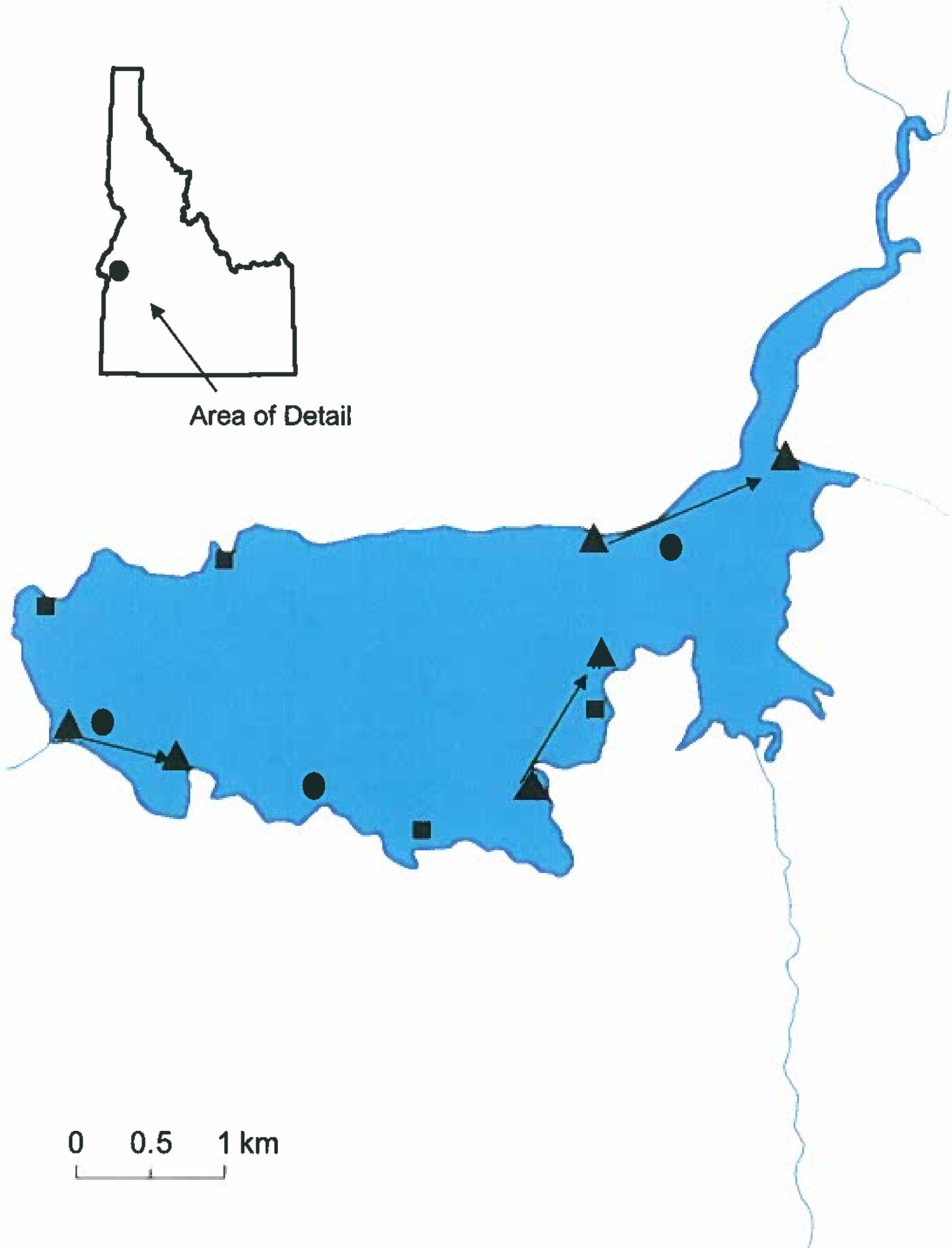



Figure 4. Map of Crane Creek Reservoir, Idaho showing location of 2008 sampling effort. Trap nets locations are denoted with squares, gill nets pairs with circles, as well as start and end points for electrofishing surveys with triangles and shocking direction.

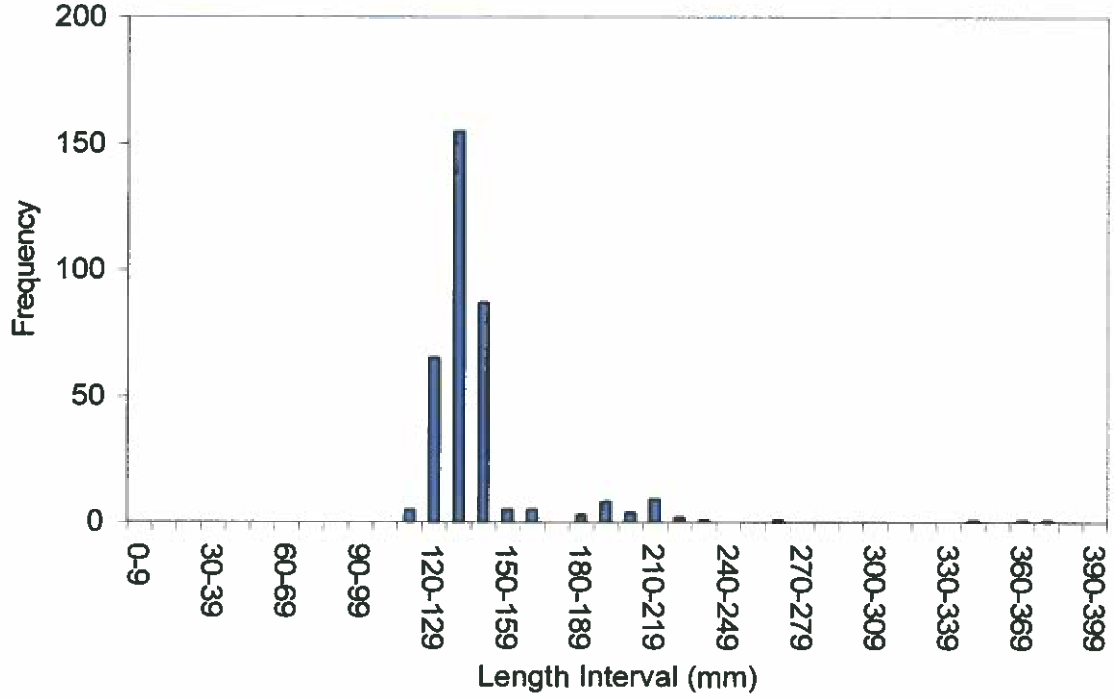



Figure 5. Length frequency of white crappie (n = 694) sampled from Crane Creek Reservoir during 2008.

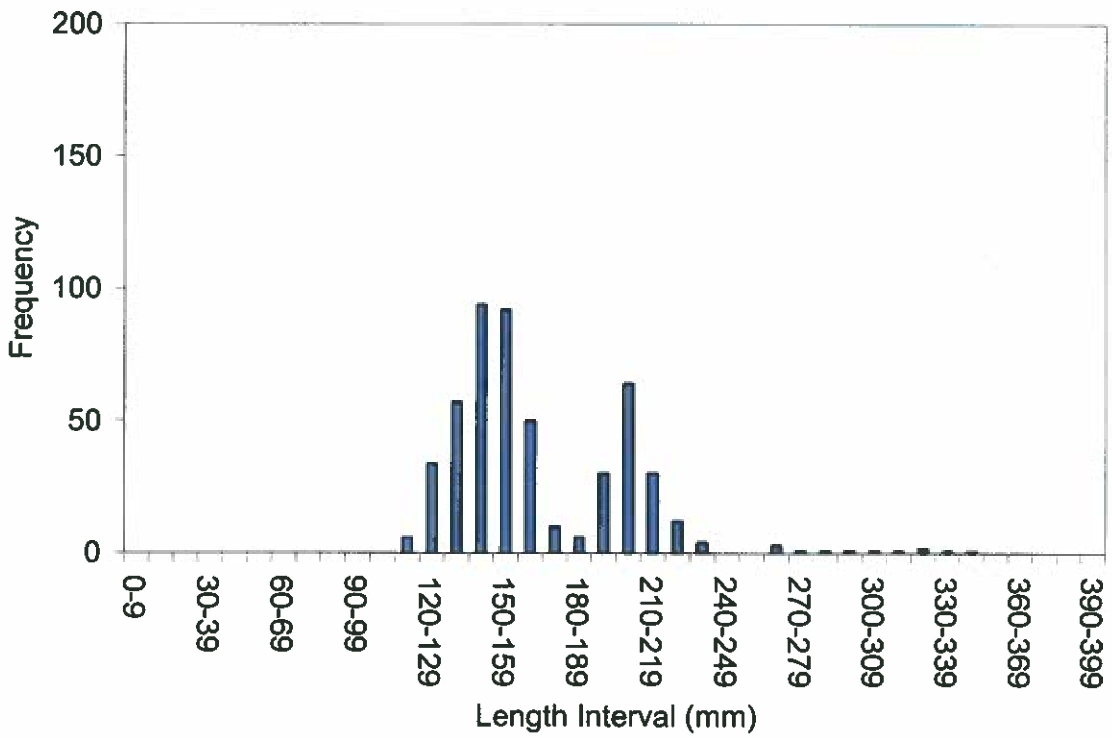



Figure 6. Length frequency of black crappie (n=579) sampled from Crane Creek Reservoir during 2008.

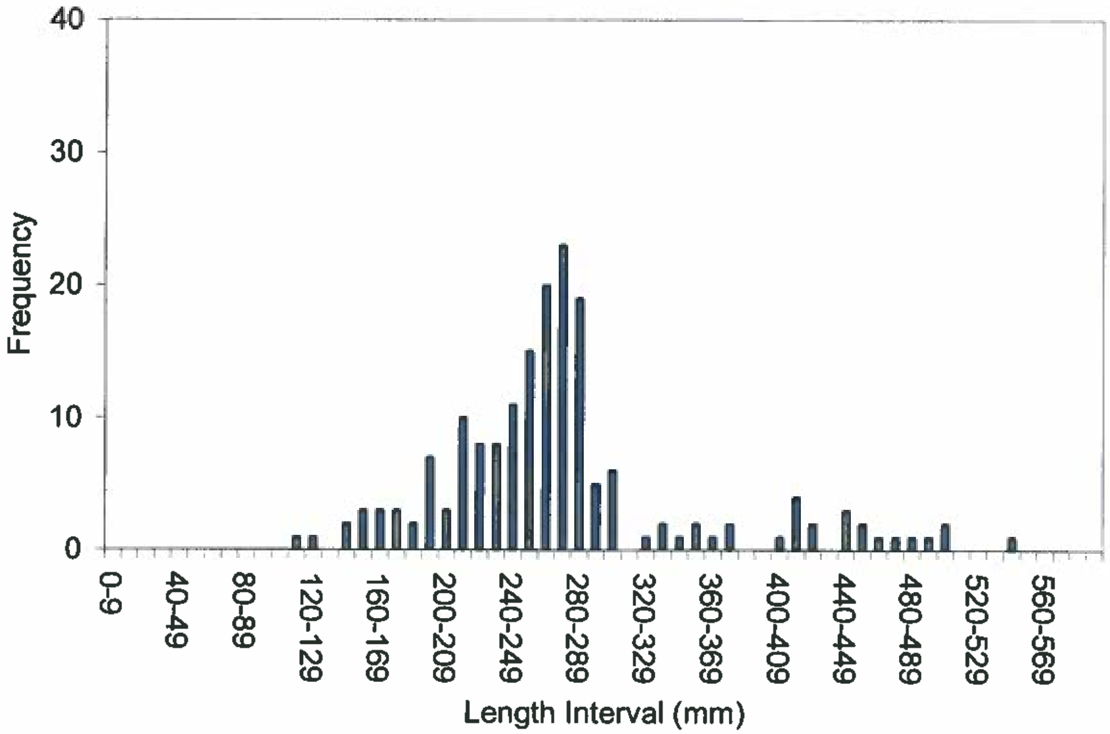



Figure 7. Length frequency of channel catfish (*n* = 215) sampled form Crane Creek Reservoir during 2008.

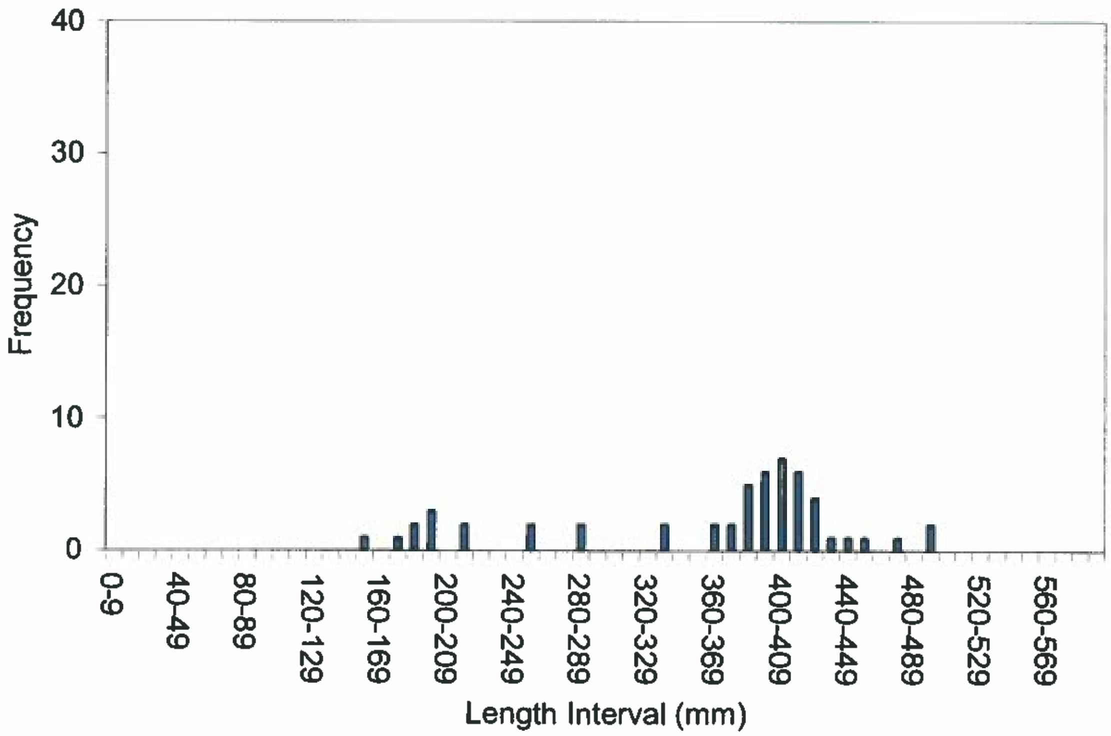



Figure 8. Length frequency of common carp (*n* = 182) sampled from Crane Creek Reservoir during 2008.

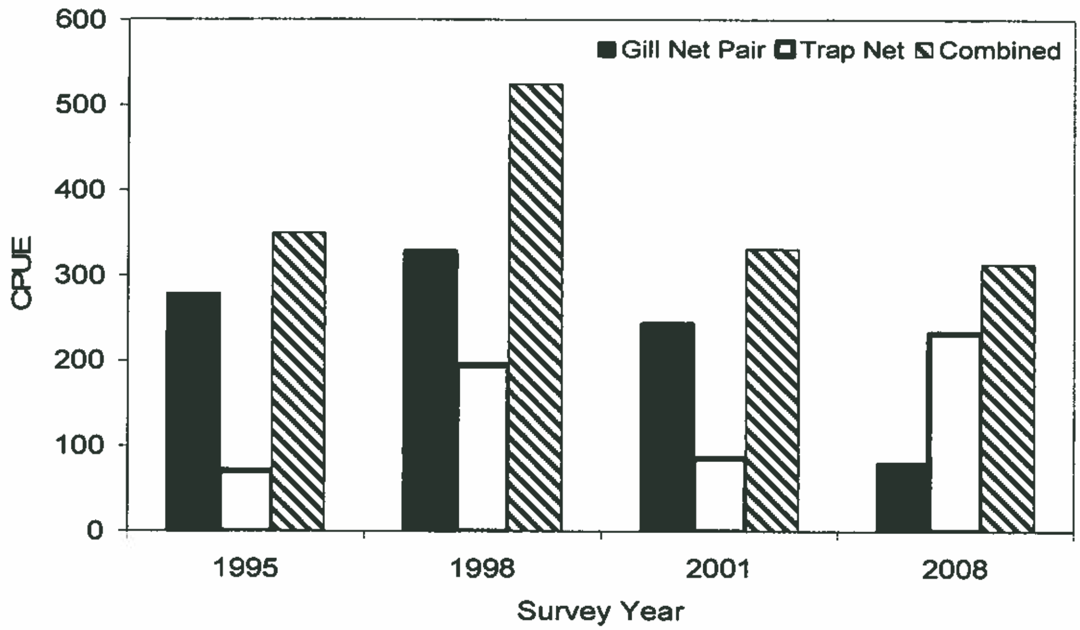



Figure 9. Catch-per-unit-effort for black and white crappie combined in gill net pairs, trap nets, and for these two gear types combined.

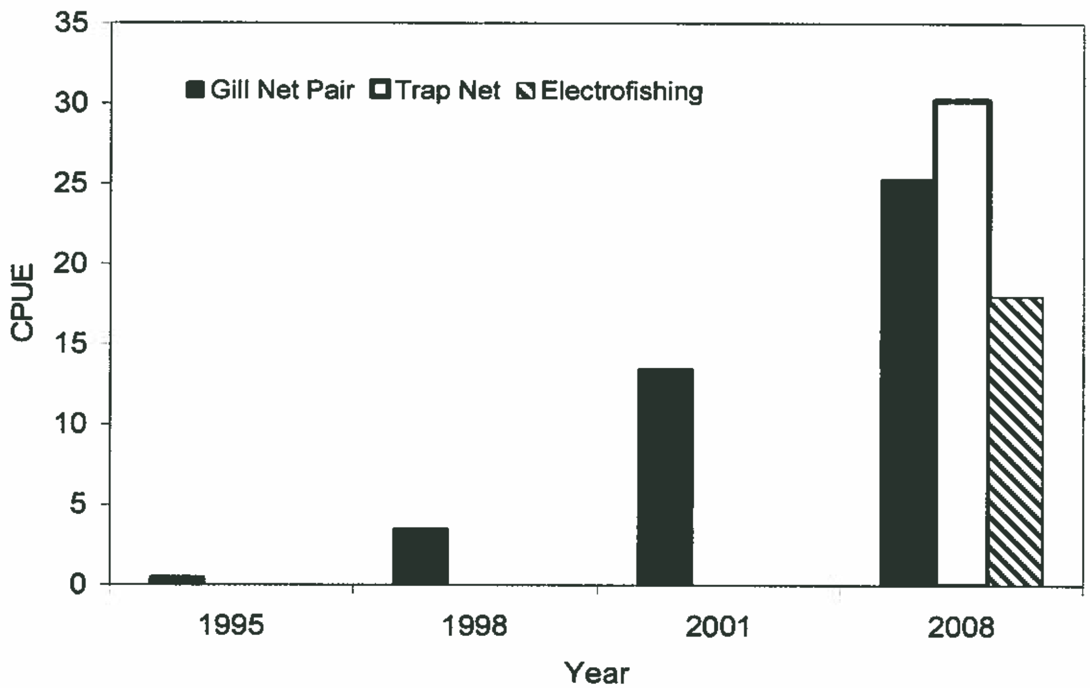



Figure 10. Catch-per-unit-effort for channel catfish sampled with gill net pairs, trap nets, and electrofishing. Electrofishing surveys were not conducted during 1998 or 2001.

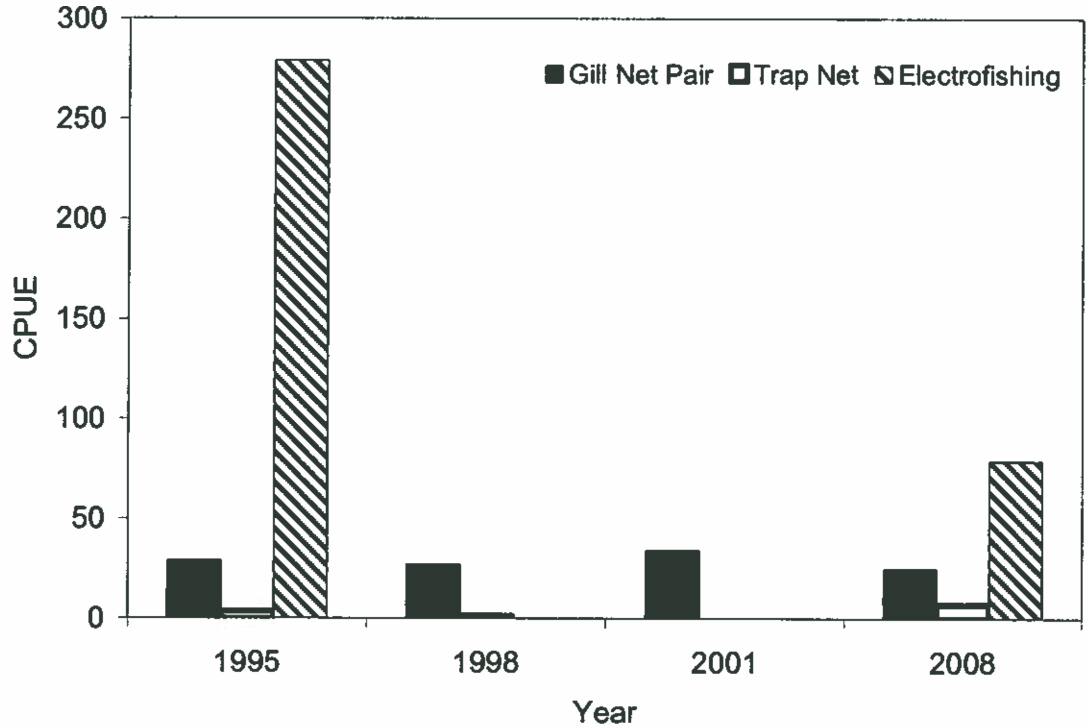



Figure 11. Catch-per-unit-effort for common carp sampled with gill net pairs, trap nets, and electrofishing. Electrofishing surveys were not conducted during 1998 or 2001.

Table 3. Catch and catch-per-unit-effort statistics by species and gear type for a lowland lake survey conducted on Crane Creek Reservoir on June 12, 2008.

| | Electrofish Catch | Electrofish CPUE | Gill Net Catch | Gill Net CPUE | Trap Net Catch | Trap Net CPUE | Total Catch | Total CPUE |
|---|---|---|---|---|---|---|---|---|
| Black Crappie | 42 | 42 | 65 | 21.7 | 472 | 118.0 | 579 | 181.7 |
| Bluegill | 13 | 13 | | | 3 | 0.8 | 16 | 13.8 |
| Bridgelip Sucker | 10 | 10 | | | | | 10 | 10.0 |
| Brown Bullhead | 2 | 2 | 8 | 2.7 | 51 | 12.8 | 61 | 17.4 |
| Channel Catfish | 18 | 18 | 76 | 25.3 | 121 | 30.3 | 215 | 73.6 |
| Common Carp | 79 | 79 | 74 | 24.7 | 29 | 7.3 | 182 | 110.9 |
| Largemouth Bass | | | | | 1 | 0.3 | 1 | 0.3 |
| White Crappie | 58 | 58 | 176 | 58.7 | 460 | 115.0 | 694 | 231.7 |
| Total | 222 | 222 | 399 | 133.0 | 1137 | 284.3 | 1,758 | 639.3 |

Table 4. Total biomass (kg) and weight-per-unit-effort statistics by species and gear type for a lowland lake survey conducted on Crane Creek Reservoir on June 12, 2008.

| | Electrofish Weight | Electrofish WPUE | Gill Net Weight | Gill Net WPUE | Trap Net Weight | Trap Net WPUE | Total Weight | Total WPUE |
|---|---|---|---|---|---|---|---|---|
| Black Crappie | 26.5 | 26.5 | 2.9 | 1.0 | 3.2 | 0.8 | 32.6 | 28.2 |
| Bluegill | 0.2 | 0.2 | 0.4 | 0.1 | | | 0.6 | 0.3 |
| Bridgelip Sucker | | | 1.2 | 0.4 | | | 1.2 | 0.4 |
| Brown Bullhead | 4.0 | 4.0 | 0.2 | 0.1 | 0.6 | 0.2 | 4.7 | 4.2 |
| Channel Catfish | 27.5 | 27.5 | 2.6 | 0.9 | 16.9 | 4.2 | 47.0 | 32.6 |
| Common Carp | 17.7 | 17.7 | 48.6 | 16.2 | 44.9 | 11.2 | 111.2 | 45.1 |
| Largemouth Bass | 1.5 | 1.5 | | | | | 1.5 | 1.5 |
| White Crappie | 35.8 | 35.8 | 6.8 | 2.3 | 9.0 | 2.2 | 51.5 | 40.3 |
| Total | 113.1 | 113.1 | 62.7 | 20.9 | 74.5 | 18.6 | 250.3 | 152.6 |

# Deadwood Kokanee and Bull Trout Monitoring


## ABSTRACT

The kokanee population at Deadwood Reservoir has exhibited drastic cycles of density-dependent growth for many years. From 2003 to 2007, kokanee size at spawning decreased from over 420 mm to 250 mm and angler interest and effort has declined. In 2008, we operated weirs on tributaries to Deadwood Reservoir from early August through mid October. Weir operations served multiple purposes including; 1) reducing kokanee densities by limiting escapement on the main Deadwood River and tributaries upstream of the weir, 2) collecting early spawning kokanee eggs for statewide kokanee management needs, 3) providing a capture point for evaluating population characteristics of the spawning kokanee population and, 4) capturing bull trout to evaluate population characteristics. We captured over 90,000 kokanee and 15 bull trout. Kokanee migration peaked on August 29th at the Deadwood River weir. Mid-water trawling estimated the kokanee population to be at 391,644 (± 353,514) with age-1 being most abundant in number and age-2 fish to comprise over 50% of the biomass. Hydroacoustic and mid-water trawl kokanee abundance estimates collected over the past eight years are summarized and compared. Finally, we discuss future management actions for monitoring and controlling the kokanee population at Deadwood Reservoir.

# INTRODUCTION

Deadwood Reservoir is a 1,260-ha impoundment located on the Deadwood River in Valley County, approximately 40 km southeast of Cascade and 85 km northeast of Boise, Idaho (Figure 12). Deadwood Reservoir provides sport fishing opportunity for kokanee, rainbow trout., and westslope cutthroat trout O. *clarkii lewisi*. Bull trout are present in Deadwood Reservoir at very low numbers. In addition, remnant resident fall chinook *O. tshawytscha*, from a previous stocking program that ended after 1998, have been observed in small numbers.

Over the last 10 years, the kokanee population in Deadwood Reservoir has cycled drastically. Because kokanee exhibit density-dependent growth, increases in population result in decreases in adult fish length. Historically, this relationship has been especially evident at Deadwood Reservoir as the kokanee population experiences relatively low angler pressure and has access to at least five or six tributaries with excellent spawning habitat. In addition, Deadwood Reservoir contains very small populations of piscivorous predators that are not capable of exerting a population level impact upon the kokanee population.

Mean female kokanee length observed at the kokanee spawning trap on the Deadwood River has varied from a low of 208 mm in 1992 to a high of 421 mm in 2003 with mean size decreasing since 2003. The management goal for adult kokanee at Deadwood Reservoir is an average size of 325 mm. Deadwood Reservoir also functions as one of the state's primary egg sources in Idaho, providing early spawn kokanee for stocking throughout the state. However, 2008 was likely the last year for the egg take operation at Deadwood Reservoir because a permanent weir has been constructed on the South Fork Boise River, above Anderson Ranch Reservoir. This new location will likely replace Deadwood Reservoir as a source of early spawning kokanee eggs for the foreseeable future.

Because of Deadwood Reservoir's importance as both a recreational fishery and source for kokanee eggs, efforts to better understand and manage kokanee production were implemented in 2004 (Flatter et al., In press). The rationale for this investigation was that by understanding and controlling escapement into tributaries utilized by kokanee and removing kokanee prior to spawning, a reduction in density within the reservoir might be achieved, which would result in larger kokanee for anglers and more eggs/female per fish handled during annual egg takes. Tributaries to Deadwood Reservoir were surveyed for the presence of spawning kokanee in 2004 and results of these surveys, along with historical records, identified five streams that are primarily utilized by kokanee for spawning. In addition to Deadwood River, where annual egg take efforts have been focused, Basin, Beaver, South Fork Beaver, and Trail creeks had notable spawning escapements, where Trail Creek was observed to hold the largest spawning run that has not been controlled by the Deadwood River weir (Figure 13). Prior to the 2006 escapement, picket weirs were installed on all five streams to block fish passage and allow for the evaluation and control of kokanee escapement in each tributary (Kozfkay et al. In press). Kokanee were not intentionally allowed to pass upstream above the weirs, and were culled after counts and measurements. Although a great deal of effort has been expended on culling kokanee from spawning tributaries from 2006-2008, success has often been hampered by breached weirs, primarily following storm events, and interrupted weir access due to evacuations caused by nearby wildfires. Despite setbacks, IDFG personnel have culled a total of 231,914 kokanee between 2005 and 2007, of which approximately 80% (186,854) were from the Deadwood River trap. Due to the moderate success of the kokanee escapement reduction efforts and the funding cooperation of BOR to continue the weir program for bull trout monitoring, weir operations were continued in 2008.

In addition to tributary investigations, multiple mid-water trawling (2005-06, 2008) and hydroacoustic surveys (2000, 2002-06) have been conducted in hopes of developing a standard method to gauge the abundance of kokanee residing within the reservoir. Results of these surveys need to be evaluated and compared in order to assess the variation in estimates between years and survey type, and to compare abundance estimates to spawner numbers and size. This will allow us to determine whether these types of surveys are effective for population monitoring and fishery forecasting at Deadwood Reservoir.

# METHODS

## Weir Operations

Picket weirs capable of blocking fish passage were installed on Basin Creek, Beaver Creek, South Fork Beaver Creek, Deadwood River, and Trail Creek on August 13 and operated through October 13 to monitor bull trout and limit kokanee escapement. The Deadwood River downstream trap was installed August 26. The downstream traps on all other tributary weirs were installed August 13. Weirs were constructed to trap both upstream and downstream migrating fish except on Basin Creek. Basin Creek had no upstream trap due to a high number of upstream migrating kokanee and its close proximity to the Deadwood River weir.

Weirs were checked one to two times daily for maintenance and fish handling. Kokanee captured at tributary weirs were culled and returned to the creek downstream from the weir. Total lengths were recorded from a subset of kokanee captured at Trail Creek. A number of females spawned for hatchery production were measured and eggs were counted to estimate length / fecundity relationships so that potential egg deposition could be assessed. Total length, weight, and passage direction were recorded for each bull trout captured (Table 5). As part of the cooperative project with BOR, scales and fin clips were taken from each bull trout for age and genetic analyses. Adipose fins were clipped to identify fish as recaptures. Bull trout captured during upstream (pre-spawn) migrations were tagged with passive integrated transponder (PIT) tags. Fish captured in downstream traps during post-spawn periods were radio-tagged if a suitable size tag was available. Any bull trout recaptured with a radio tag was handled as little as possible. All subsequent radio tracking was completed by BOR staff.

Unknown numbers of fish escaped past weirs when they were breached due primarily to storm events. Trail Creek, Beaver Creek and Basin Creek were breached on October 3 by storm events and were repaired the following morning. The Deadwood River weir was laid over by sheets of ice in the system on October 12 and was not repaired due to planned weir removal on October 13.

## Mid-Water Trawling

To estimate kokanee abundance, density, and biomass in Deadwood Reservoir, mid-water trawling was conducted at night during the dark (new) moon on August 4, 2008. Trawling was performed in a stepped-oblique fashion as described by Rieman (1992) and Kline (1994) with the exception that the otter-boards were replaced by a fixed frame at the net mouth with a 4.5 $m^2$ opening. Reservoir elevations in August allowed sampling four standardized trend transects on the east side, but we were unable to sample transects on the west side of the reservoir in 2008 (Figure 12). The net was towed at 1.5 m/s with a 7.3 m boat. Abundance estimates generated by the program were based on lake surface area on day of sampling. Kokanee captured were measured for total length, weighed, and a subset had otoliths removed for estimating age. Density and biomass were estimated using the single section MS Excel Spreadsheet developed by the IDFG's Lake Pend Oreille Fish Recovery Project (Maiolie et al. 2004). Ages were estimated using length frequency graphs. We did not attempt to partition estimates by origin (e.g., hatchery vs. wild).

# RESULTS AND DISCUSSION

## Weir Operations

The Deadwood River weir trapped 64,066 kokanee in 2008 with the peak (6,432) occurring on August 31 (Figure 13). The total number of kokanee culled from all tributary weirs around Deadwood Reservoir totaled 93,240. The peak for Trail Creek (2,319) occurred August 29. The peak for Beaver Creek (19) occurred September 8, and the peak for South Fork Beaver Creek (111) occurred September 6. Average kokanee lengths were 278 mm for males (*n* = 155) and 271 mm for females (*n* = 152; Figure 14). Average fecundity (*n* = 10) was 397 eggs for females from 260 to 300 mm total length. Mean female kokanee length in 2008 increased slightly after four years of decline (Figure 15) but was still below the management goal of an average size of 325 mm for adult kokanee.

Attempts to substantially reduce the wild production of kokanee in Deadwood Reservoir have been hampered by breached weirs, primarily following storm events and interrupted weir access due to evacuations caused by nearby wildfires. Despite setbacks, IDFG personnel have culled a total of 325,154 kokanee from 2005 to 2008, of which approximately 77% (250,920) were from the Deadwood River trap.

Fourteen individual bull trout were handled in 2008 at tributary weirs (Table 5). Lengths ranged from 62 mm to 570 mm (Figure 16). Of the nine bull trout handled in the downstream traps, one adult bull trout was radio tagged in South Fork Beaver Creek on October 3 and released below the weir.

Downstream traps also captured sculpin spp. *Cottus spp.*, redside shiner *Richardsonius balteatus*, mountain whitefish *Proposium williamsoni*, longnose dace *Rhiniichthys cataractae*, and rainbow trout. Large pulses of rainbow trout moved downstream on August 27 (*n* = 94) and September 21 (*n* = 78; Figure 17), while daily catch of redside shiner and sculpin were less than five individuals per day for the entire period. Peak capture of mountain whitefish from the Deadwood River occurred October 4 (*n* = 119; Figure 18). Peak capture of longnose dace occurred September 21 (*n* = 75; Figure 18). Peak capture for trout from Trail Creek occurred October 10 (*n* = 7). Peak capture of trout in Basin Creek occurred September 16 (*n* = 2). Peak capture of trout in South Fork Beaver Creek occurred October 3 (*n* = 2). Peak capture of trout in Beaver Creek occurred October 5 (*n* = 7; Figure 19). Twenty fall chinook were also handled and passed upstream from the Deadwood River weir.

## Mid-Water Trawling

Ninety-one kokanee, ranging in size from 30-280 mm, were captured during the trawling survey on 4 August 2008 (Figure 20). Kokanee population was estimated at 391,644 (±

353,514) and biomass was estimated at 17,224 kg (Table 6). Age-1 kokanee were the most abundant age class numerically, followed by age-0 fish.

Kokanee abundance in Deadwood Reservoir was estimated in 2005, 2006, and 2008 during August using mid-water trawling (Kozfkay et al. In Press; Hebdon et al. In Review; Hebdon et al. 2008). Unfortunately, estimates were not obtained in 2007 because of equipment failure (Hebdon et al. In Review). Error bounds for the 2008 estimates were unusually large compared to previous years. This was likely a result of our inability to sample the two transects on the west side of the reservoir because of drawdown, thus reducing our sample size. When comparing the three most recent trawl events at Deadwood Reservoir, it is difficult to detect any change in the population in terms of abundance because of the large error associated with the estimates (Figure 21). Reservoir drawdown will continue to be a primary concern when conducting trawling surveys because the inability to sample at least 6 transects clearly impacts the usefulness of population estimates. It also appears that estimates of age-0 size classes obtained by trawling are suspect. For example, our estimate of age-0 kokanee in 2005 was 237,871 ± 35% while our 2006 estimate of age-1 fish was 343,430 ± 42%. It is possible that given the small size of the age-0 class (40 - 60 mm), they have not fully recruited to the pelagic region or capture efficiency for this size class was poor. While estimates of age-1 fish appear reasonable, it is difficult to partition estimates of older fish (ages 2-4) in abundance estimates for each age using only length frequency analysis to separate the groups because of overlap in lengths between the size classes.

Examination of the length frequency of trawl catches between years suggests a reduction in kokanee densities, particularly in the 160-200 mm range. Trawl catches also indicate a slight increase in fish over 200 mm has occurred since 2005.

We also compared trawl estimates to 2000-2006 hydroacoustic estimates obtained by IDFG research personnel (Figure 22). Methodologies for hydroacoustic estimates are summarized in Butts et al. (2007). However, there were only two years (2005-06) where abundance was estimated by both trawling and hydroacoustics. Hydroacoustic estimates of kokanee abundance were generally substantially larger than trawl estimates in terms of age class and total abundance for the same years. In 2005, trawl estimates of total abundance was 469,672 ± 47% where hydroacoustics resulted in an estimate of 1,822,344 ± 14%. In 2006, differences between the two methods were not as drastic as kokanee abundance was estimated at 491,681 ± 23.3% by trawling and 701,959 ± 17% by hydroacoustics. Hydroacoustics also appear to be inefficient at estimating age-0 fish (fish < 100 mm), for perhaps the same reasons. While hydroacoustics generate estimates that have smaller error bounds which enable us to better detect population changes between years, there are concerns that estimates might be too high. For example, in 2005, we estimated kokanee escapement to be approximately 71,000 fish in all tributaries. In comparison, the 2005 mid-water trawl estimate of age 2-4 kokanee was 107,681 ± 41% and the hydroacoustic estimate of fish >200 mm was 313,157 ± 17%. However, an unknown portion of these fish may not have been spawners as the average length of spawning kokanee in Deadwood River was approximately 275 mm. Also, escapement estimates may underestimate actual numbers due to periodic weir failure which allowed fish to escape upstream.

Intrinsic errors are also associated with hydroacoustics, such as including targets in the hydroacoustic kokanee estimate that were not kokanee. Although target verification is of primary concern in hydroacoustic assessments in mixed-species fisheries, gillnetting was conducted for target verification purposes during the 2003-2005 surveys, where kokanee was the predominant catch (86%) followed by mountain whitefish (9.7%). Both hydroacoustics and midwater trawling may overestimate abundance when extrapolating density estimates into population estimates using total surface area because not all of the surface area contains habitat utilized by kokanee. Finally, the hydroacoustic and trawl estimates were not calculated for the exact same size and age classes and only general conclusions can be made from the comparisons without performing new analyses with each data set.

The overall management objective for kokanee at Deadwood Reservoir is for the population to maintain an average adult size of at least 325 mm. This minimum average length for adult fish should provide for both a quality kokanee fishery and a potential egg source for the state hatchery system. Recent efforts at Deadwood Reservoir have examined methods for monitoring the overall abundance of kokanee, the average size of adults as represented by spawning fish, and means to control the population when densities are high and size declines. For example, using the 2000-06 hydroacoustic data, the estimated population began to exceed 500,000 in 2004, and the average length of adult female spawners declined dramatically (Figure 23). Over time, if such an index can be developed with this trend data, it would be extremely beneficial to the management of the Deadwood Reservoir kokanee population. At this point, a similar relationship between kokanee length and midwater trawls cannot be examined as annual trawling data has only been collected since 2005, after the population had already fallen below the desired length objective. Midwater trawling and hydroacoustics offer cost efficient alternatives to other popular assessment methods such as creel censuses or mark-recapture methods. Both methods can successfully be conducted in one evening with a minimum crew of two or three people. In fact, both surveys conducted during the same evening or time period may augment one another and can be used in unison. The question as to whether these proposed methods under- or overestimate actual species abundance is likely irrelevant as long as they continue to provide a stable relative population estimate, which offers many of the same advantages as an absolute estimate (Thorne 1983; Yule 2000). However, both methods would require additional sampling of spawning adults in tributaries to evaluate mean length if any relationship between population abundance and mean fish length were to be developed.

A more simplistic and least costly approach to monitoring the kokanee population at Deadwood Reservoir would be to collect and measure a number of fish from both Deadwood River and Trail Creek in order to assess mean length of adults. Fish would be collected by electrofishing near the approximate peak run period at the end of August. Because achieving a minimum mean adult length of 325 mm is the desired objective, this would be the most direct approach to determine whether the population is meeting management goals. A drawback to this approach would be an inability to gauge the relative abundance of younger fish.

Regardless of the approach for kokanee population monitoring, the larger challenge remains controlling or reducing abundance in a system where spawning is virtually unlimited. Efforts to understand, estimate, and manage the kokanee escapement at Deadwood Reservoir have been labor intensive and only partially successful. Escapement reduction efforts only began in earnest in 2006 and limited population level responses in fish size have been observed. Because of the isolated location of Deadwood Reservoir, the costs of constructing and maintaining weirs throughout the escapement period in the major spawning tributaries is extremely high. Weir failure caused by periodic storm events at or near peak escapement can result in tens of thousands of kokanee entering an individual tributary (Hebdon et al. In Press). Maintaining annual efforts to manage the kokanee population on a limited regional budget is therefore unrealistic.

The kokanee population at Deadwood Reservoir has historically exhibited density-dependent growth. The reservoir experiences relatively low angler pressure and kokanee utilize at least five or six tributaries with suitable spawning habitat. Historically, other means to control kokanee escapement and reduce numbers has been tried such as rotenone and stocking pelagic predators at Deadwood Reservoir. However, the use of such methods has been limited since the petition to list bull trout as threatened in 1998 (USFWS 1998). Fall chinook (last stocked in 1998), Atlantic salmon *Salmo salar* (last stocked in 1995), and westslope cutthroat trout (last stocked in 1998) have been introduced to Deadwood Reservoir in hopes of controlling the kokanee population and providing sport fisheries for these species. Re-stocking pelagic predators into Deadwood Reservoir could function as a valuable tool for regulating the kokanee population at Deadwood Reservoir, in addition to providing a sport fishery. However, it must be demonstrated that such actions will have negligible effects on bull trout within the drainage.

## MANAGEMENT RECOMMENDATIONS

1. Continue monitoring the kokanee population in Deadwood Reservoir with midwater trawling and hydroacoustics and sample spawning fish to estimate mean length for an additional year.

2. Evaluate re-stocking pelagic predators into Deadwood Reservoir in terms of potential effects on the local bull trout population within the Payette River drainage.

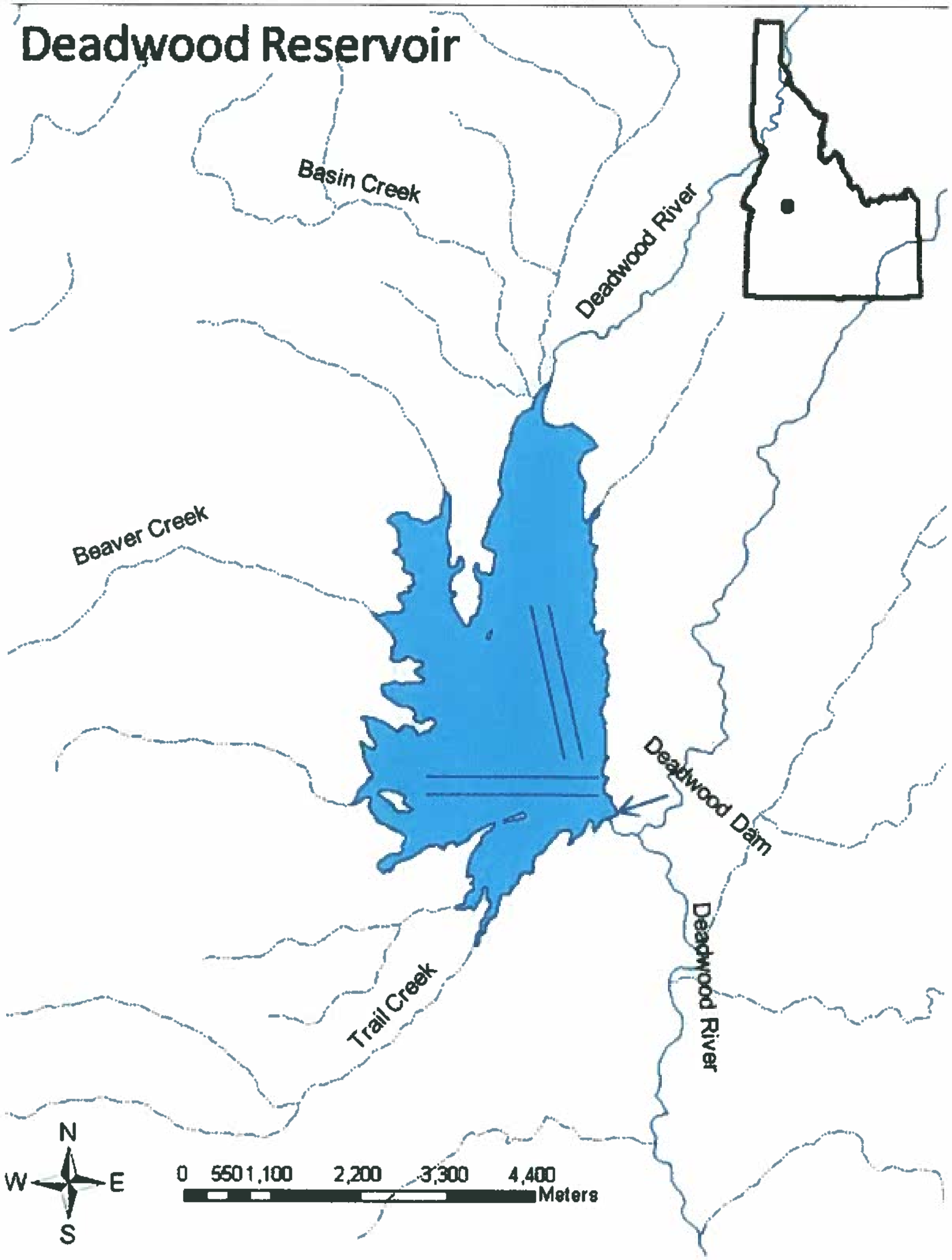



Figure 12. Map of Deadwood Reservoir showing major tributaries and mid-water trawling transects sampled in August 2008.

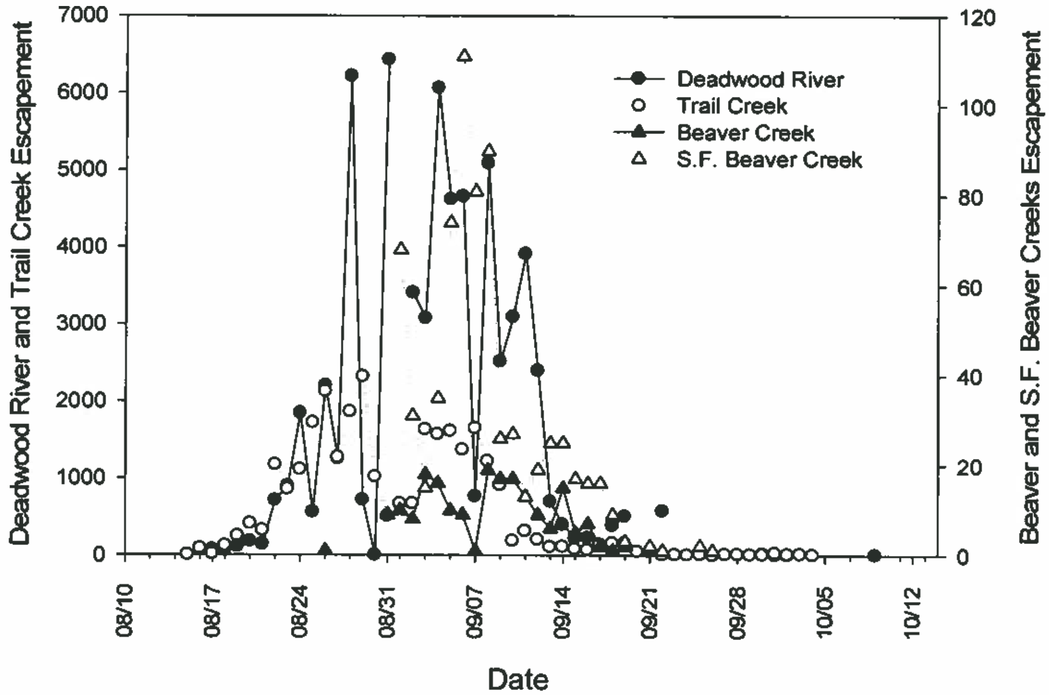



Figure 13. Adult kokanee captured at Deadwood River, Trail Creek, South Fork (SF) Beaver Creek, and Beaver Creek weirs in 2008.

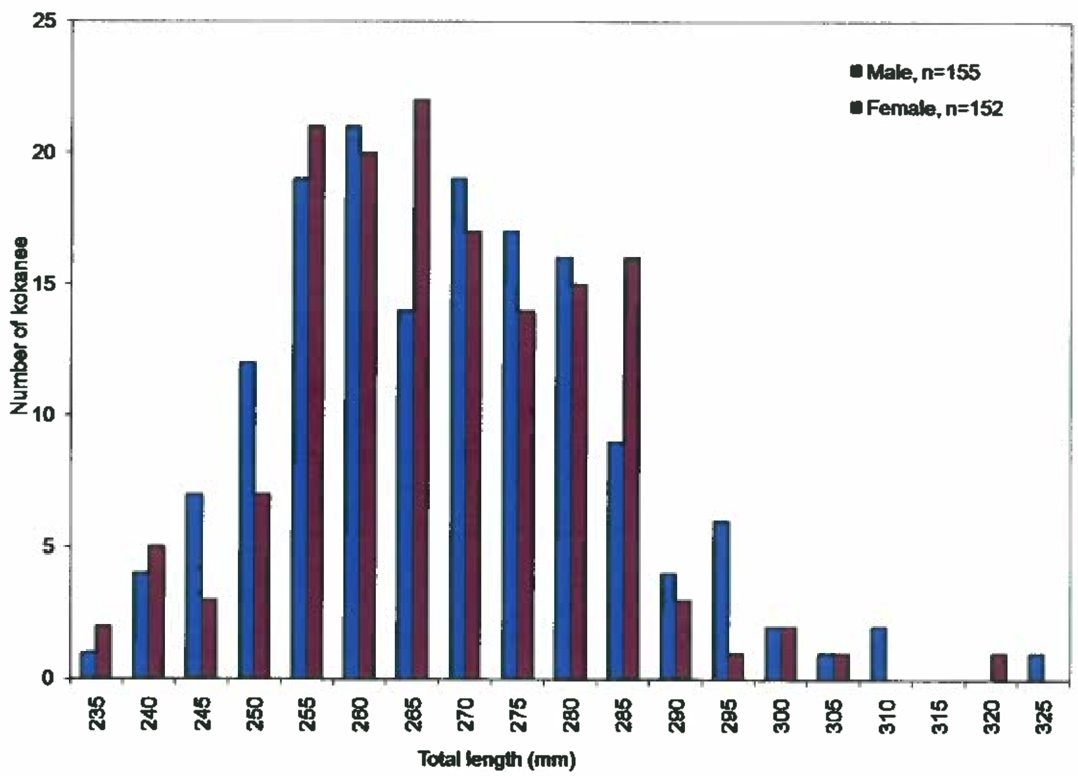



Figure 14. Length frequency of kokanee measured at the Trail Creek and Deadwood kokanee weir during 2008 ($n$ = 307).

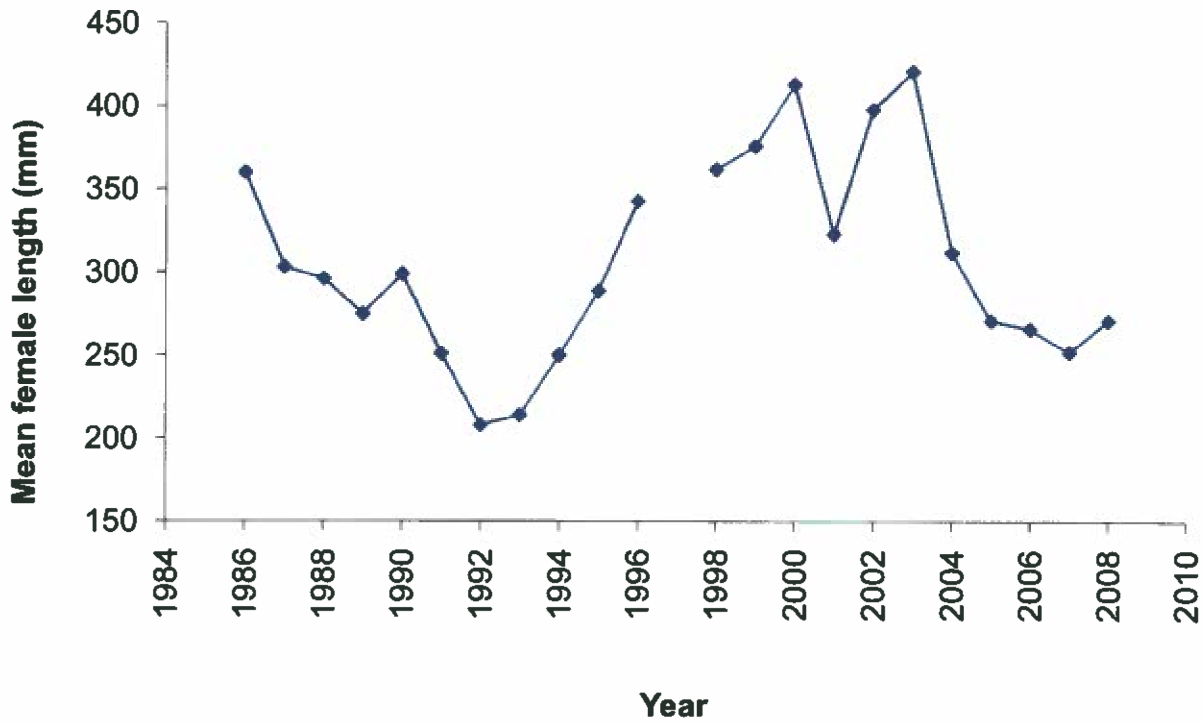



Figure 15. Mean female kokanee length for fish trapped during spawning operations at the Deadwood River weir, 1984 to 2008.

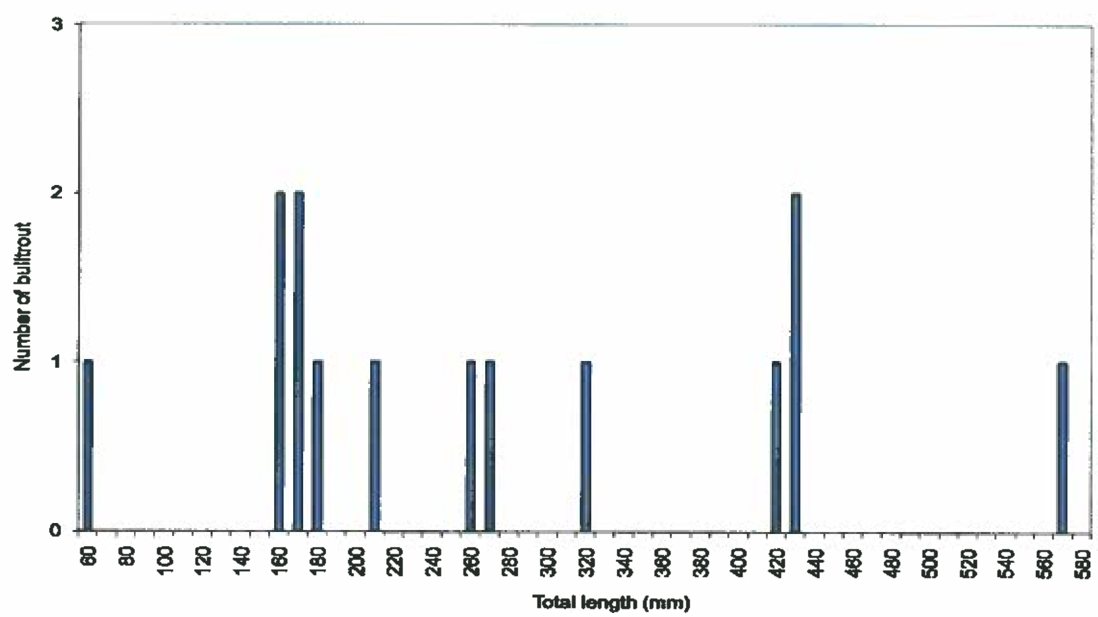



Figure 16. Length frequency of bull trout trapped on Deadwood Reservoir tributaries in 2008. Length groups are in 10 mm increments ($n = 14$).

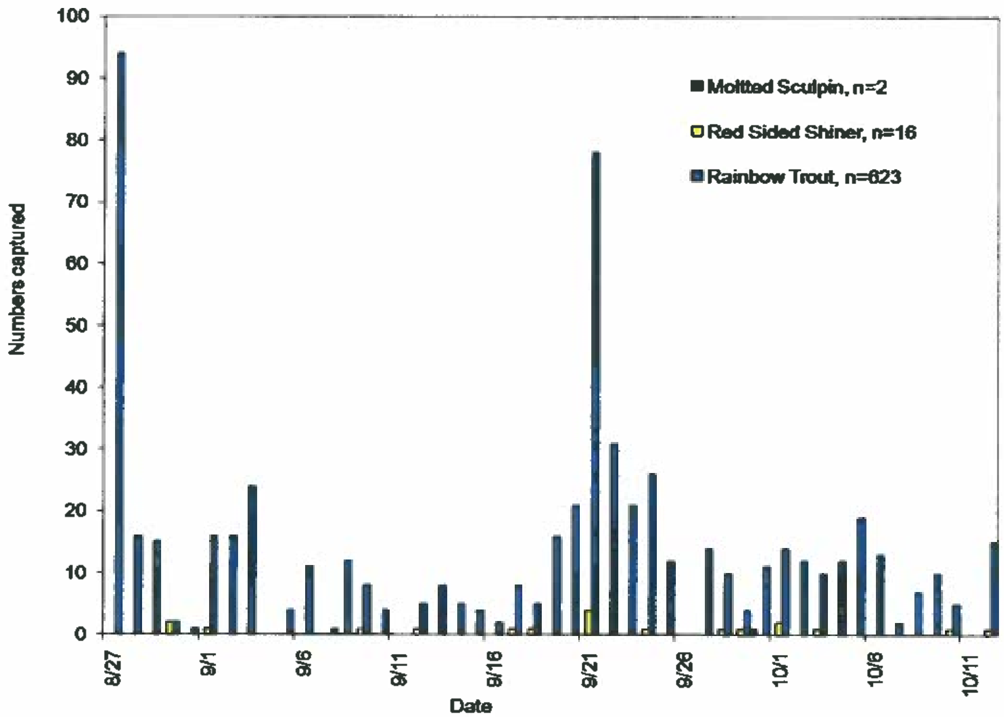



Figure 17. Catch data for mottled sculpin, redside shiner, and rainbow trout at the Deadwood River downstream trap, operating from August 18 to October 13, 2008.

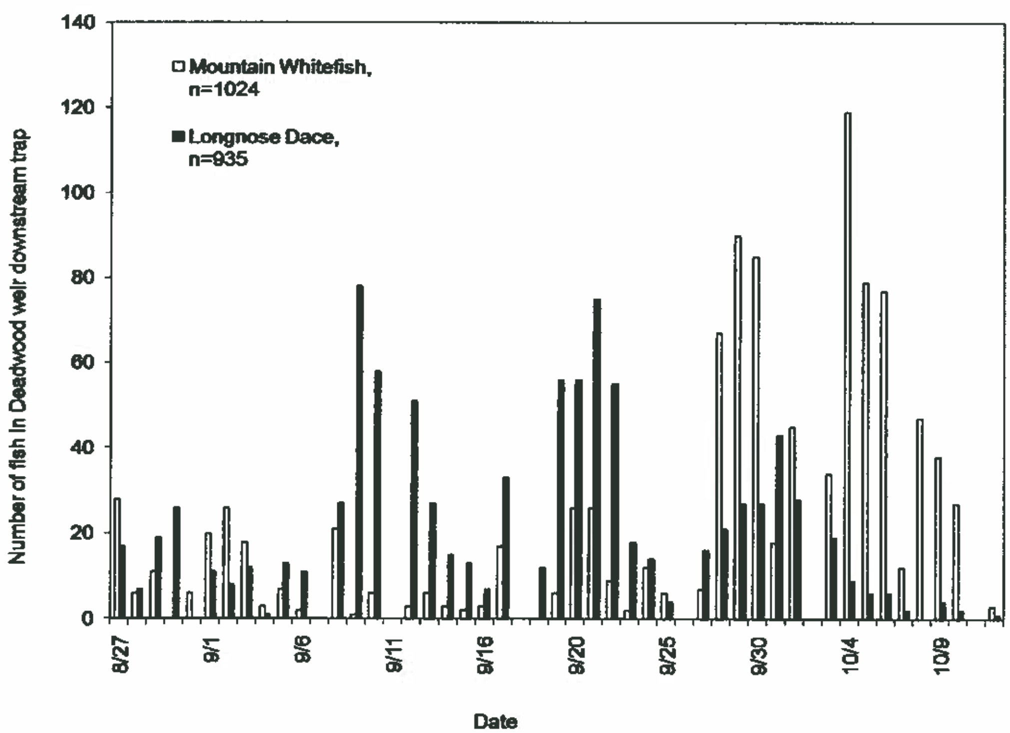



Figure 18. Catch data for mountain whitefish and longnose dace at the Deadwood River downstream trap, operating from August 18 to October 13, 2008.

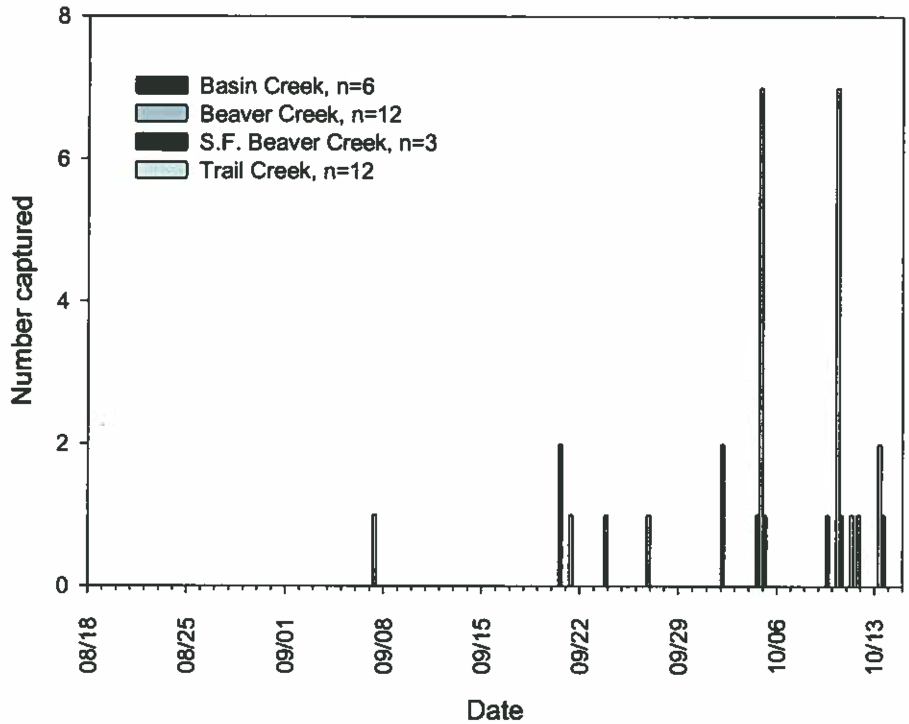



Figure 19. Daily downstream catch data for rainbow trout at Basin Creek, Beaver Creek, S.F. Beaver Creek, and Trail Creek from August 18 to October 13, 2008.

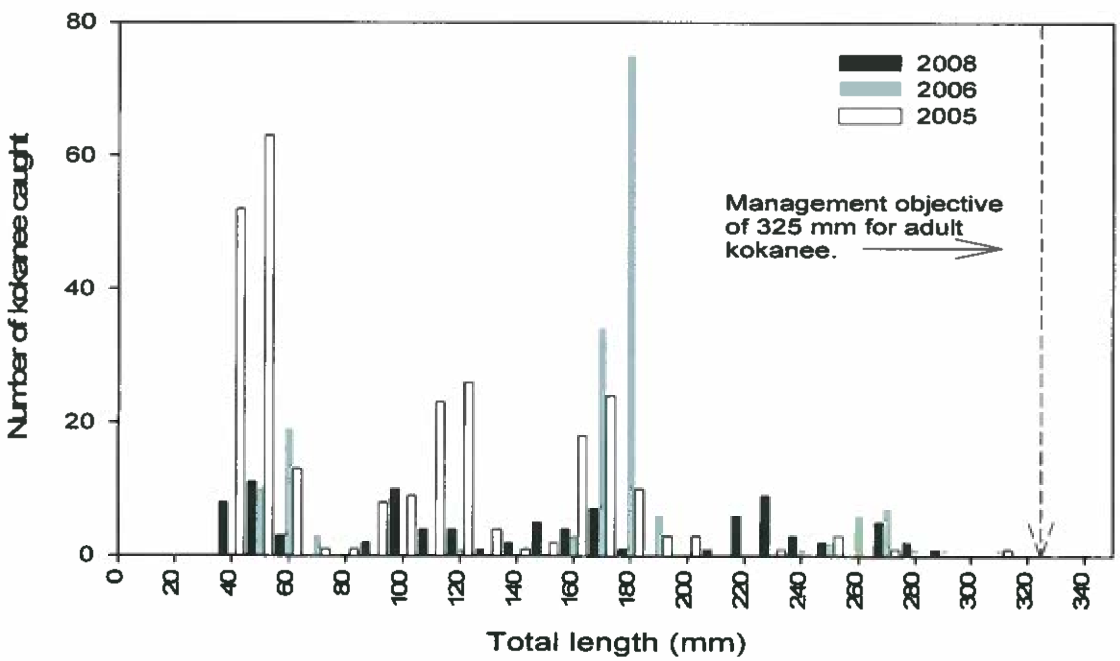



Figure 20. Size distribution of kokanee captured in mid-water trawls in August 2005, 2006, and 2008.

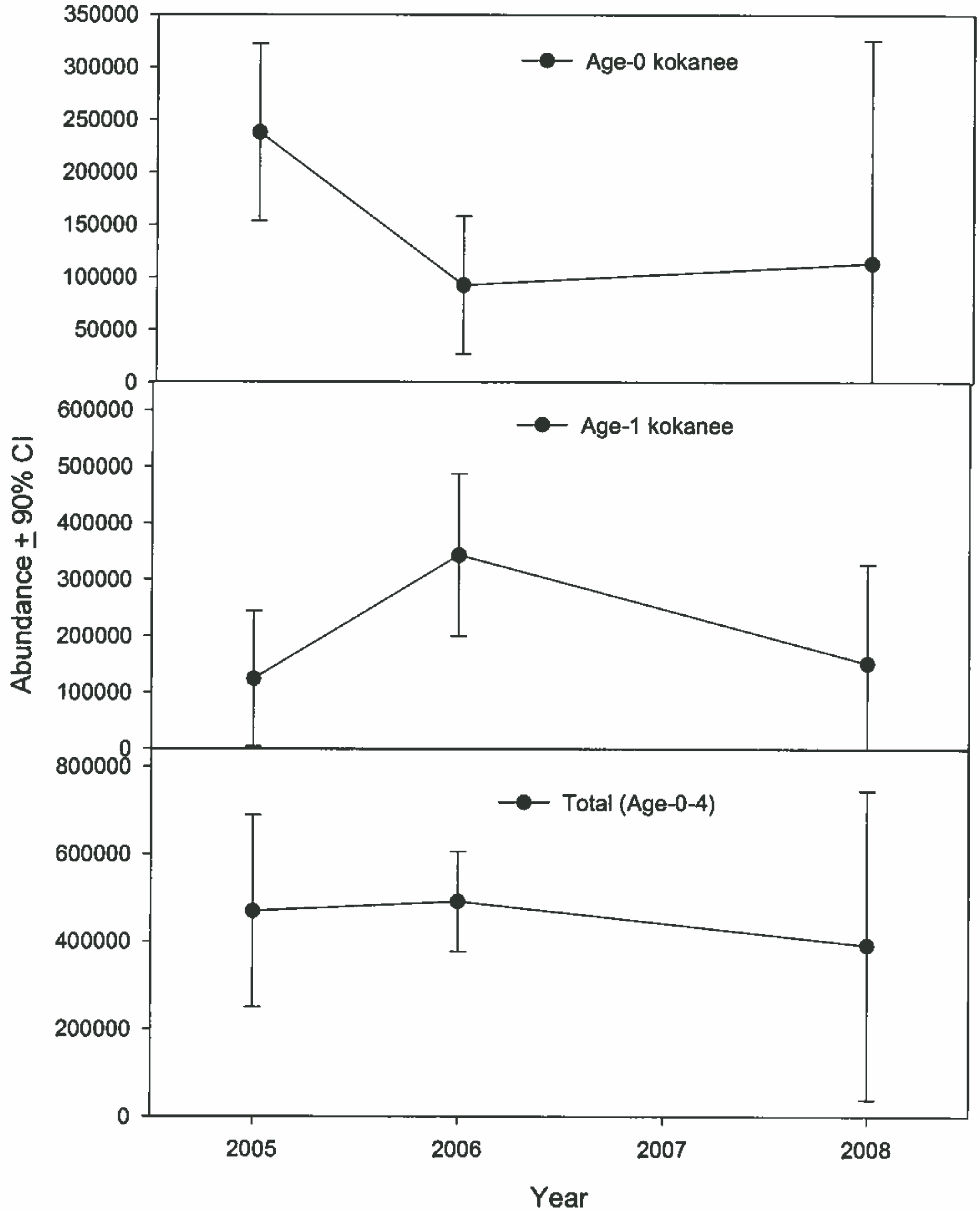



Figure 21. Comparison of 2005, 2006, and 2008 mid-water trawl estimates for age-0, age-1, and total population. Mid-water trawling was not conducted in 2008 due to equipment failure.

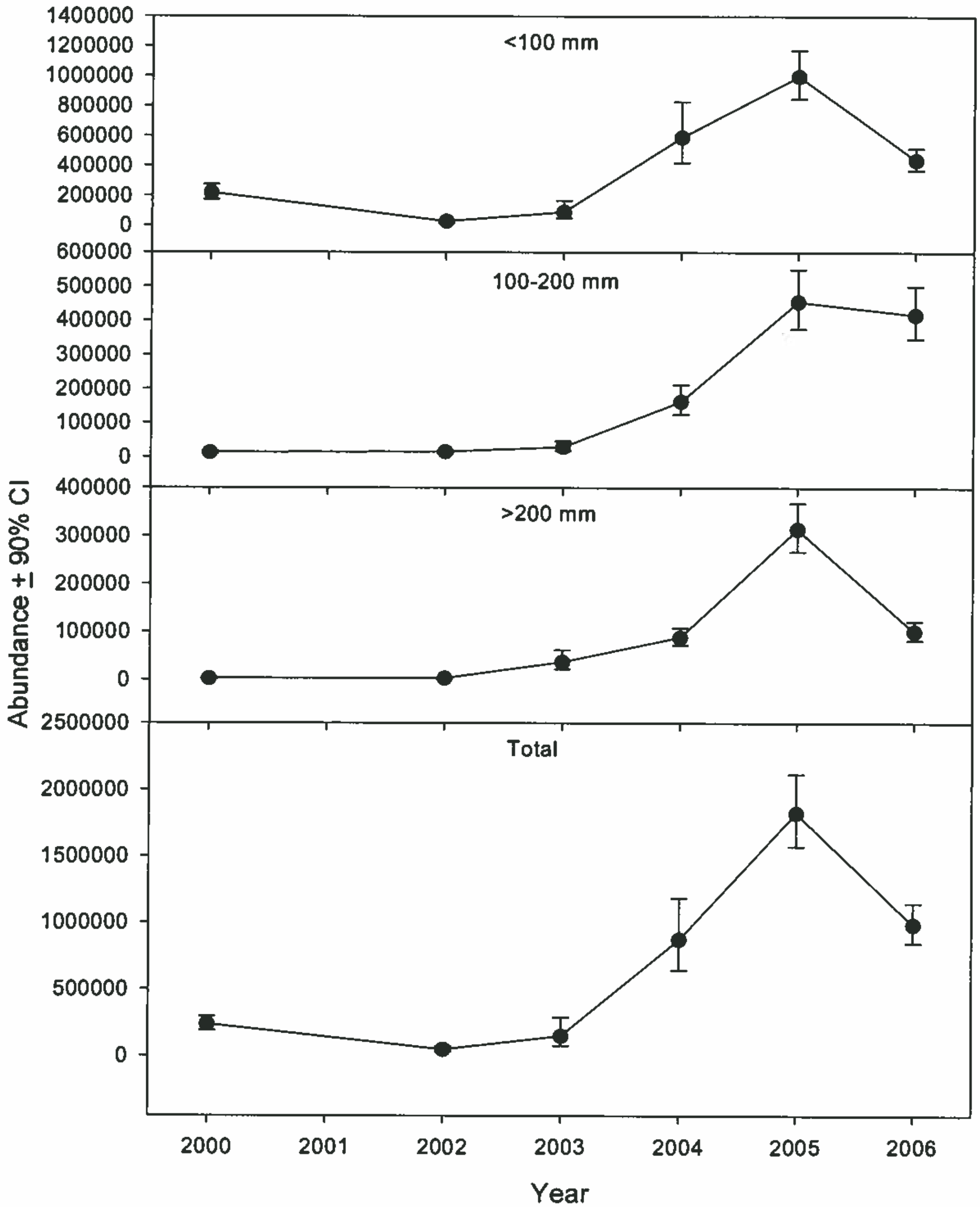



Figure 22. Comparison of 2000-2006 hydroacoustic estimates of kokanee abundance for three size groups and total population. Data were collected by IDFG research personnel.

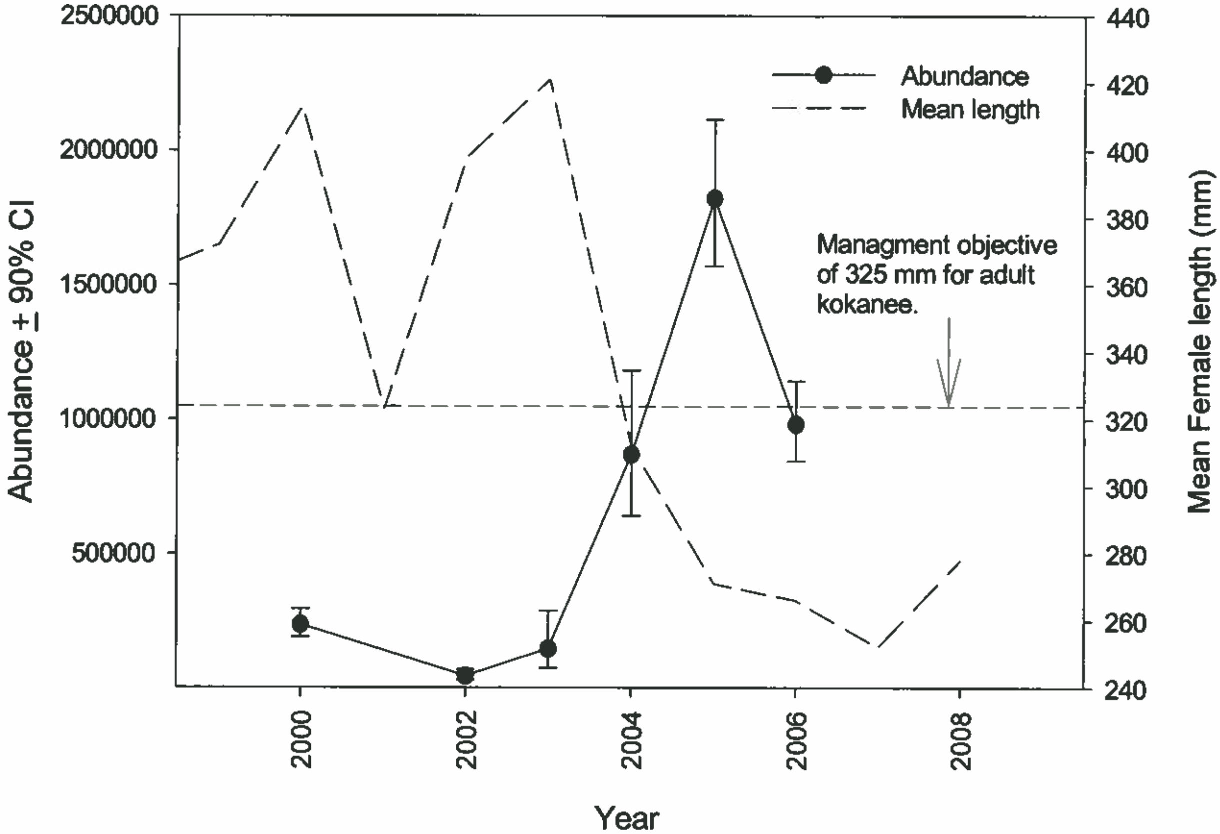



Figure 23. Trend data for 2000-2006 hydroacoustic abundance estimates and mean female total length (mm) collected at the Deadwood River trap from 1998-2008. The management objective for minimum adult length is also shown.

Table 5. Bull trout handled at tributary weirs of Deadwood Reservoir. Direction indicates migration direction of the fish when intercepted, PIT= passive integrated transponder.

| Date | Tributary | Weight (g) | Length (mm) | Direction | Pit Tag # | Comments |
|---|---|---|---|---|---|---|
| 8/14/2008 | Trail Creek | | 570 | up stream | didn't register | Had a radio tag in it |
| 8/13/2008 | Trail Creek | | 267 | up stream | tagged | no pit reader available |
| 8/19/2008 | Trail Creek | 226 | 315 | up stream | 457729697B | ad clipped,scales,genetics |
| 8/24/2008 | Trail Creek | | 415 | up stream | 45772C7E10 | scales,genetics taken |
| 8/25/2008 | Beaver Creek | 28 | 155 | down stream | 457812441D | ad clipped,scales,genetics |
| 8/30/2008 | Deadwood River | 560 | 430 | down stream | 45795D3C72 | ad clipped,scales,genetics |
| 9/2/2008 | Beaver Creek | 44 | 180 | down stream | 45794D3B13 | ad clipped,scales,genetics |
| 9/4/2008 | Beaver Creek | 28 | 163 | down stream | 45781331346 | ad clipped,scales,genetics |
| 9/13/2008 | South Fork Beaver | 192 | 62 | up stream | 45772C207F | ad clipped,scales,genetics |
| 9/25/2008 | Deadwood River | 94 | 213 | down stream | 4577066F6A | ad clipped,scales,genetics |
| 9/29/2008 | Deadwood River | 178 | 270 | below the dam | 457A1D4D27 | radio tagged fish |
| 10/3/2008 | South Fork Beaver | 666 | 435 | down stream | 4578496D52 | ad clipped,scales,genetics |
| 10/10/2008 | Basin Creek | 48 | 172 | down stream | 457A4A110E | ad clipped,scales,genetics |
| 10/12/2008 | Trail Creek | 38 | 169 | down stream | 45780B386A | ad clipped,scales,genetics |
| 10/13/2008 | Trail Creek | 36 | 163 | down stream | 4578353B3A | ad clipped,scales,genetics |

Table 6. Population (N), biomass (kg), and standing stock (kg/ha) estimates calculated from mid-water trawling on August 4, 2008.

| | Age 0 | Age 1 | Age 2 | Age 3 | Total |
|---|---|---|---|---|---|
| N | 113,563 | 151,700 | 95,520 | 30,861 | 391,644 |
| 90% CI | 211,782 | 174,879 | 85,950 | 35,876 | 353,514 |
| | 186% | 115% | 90% | 116% | 90% |
| Biomass Estimates (kg) | 66.07 | 2,999.86 | 9,112.13 | 5,045.79 | 17,223.86 |
| Standing Stock Estimates (kg/ha) | 0.06 | 2.70 | 8.19 | 4.53 | 15.48 |

# Lake Lowell Forage, Catfish Stocking, and Recruitment Assessment


## ABSTRACT

Regional staff conducted gill netting, larval trawl, and limnological surveys of Lake Lowell during 2008 to gain a better understanding of the forage base, the success of recent channel catfish *Ictalurus punctatus* plants, and warm water fish recruitment patterns. A total of 161 fish were caught in nine small-mesh experimental gill net pair sets, yielding an average CPUE of 17.9 fish/net pair/night. Few forage-sized fish, especially juvenile yellow perch *Perca flavescens* or black crappie *Pomoxis nigromaculatus* were caught. Larval fish production, primarily bluegill *Lepomis macrochirus*, was approximately 5% of levels documented during 2006-07. Zooplankton indices indicated a sharp decline of large zooplankton species during mid-summer. Fewer marked channel catfish were sampled during 2008 than previously. Low reservoir levels over the last several years, high common carp *Cyprinus carpio* abundance, and low adult panfish population abundances may be negatively affecting recruitment and year-class strength of panfish populations.

## INTRODUCTION

Lake Lowell is a 4,000 hectare Bureau of Reclamation 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. 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. Due to recent leakage at the upper embankment, maximum full pool was lowered from 771.5 m (2,531.2 ft) to 770 m (2,526.0 ft) during June 2005. Additionally, the lake was lowered to 766 m (2,514 ft) during fall 2007 to allow repair work. 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 Idaho's population center, Lake Lowell receives substantial fishing pressure. Largemouth bass *Micropterus salmoides* receive the majority of the attention and several tournaments are held annually. Panfish fisheries (black crappie *Pomoxis nigromaculatus*, bluegill *Lepomis macrochirus*, and yellow perch *Perca flavescens*) are also popular; however, population abundances have fluctuated widely leading to inconsistent use. IDFG stocks both channel catfish *Ictalurus punctatus* and Lahontan cutthroat trout *Oncorhynchus clarkii henshawi* in the reservoir. Since 2003, approximately 6,000 to 9,000 fingerling channel catfish have been planted annually. Additionally, recent plants of Lahontan cutthroat trout fingerlings have ranged from 40,000 to 103,000 annually. Lake Lowell is managed under general regulations, except for largemouth bass which are managed under a no harvest regulation from January 1 thru June 30 and a 2 fish, 305-406 mm protected slot limit thereafter.

## OBJECTIVES

1. Characterize the structure and relative abundance of potential prey-sized fish to assess whether proposed predator introductions would have an adequate forage base.
2. Assess reproductive success of recreationally important warm-water fishes.
3. Characterize zooplankton community structure and abundance.

## METHODS

Standard lowland lake sampling protocols are not specifically designed to capture prey-sized fish species (typically under 152 mm). Therefore, we used small-mesh, experimental gill nets at approximately monthly intervals from June 2 to August 5, 2008 to better index and describe the abundance and composition of potential prey-sized fish species. Floating and sinking monofilament nets, 46 m x 2 m, with six panels composed of 19, 25, 32, 38, 51, and 64 mm bar mesh were used. One floating and one sinking net, fished for one night, equaled one unit of gill net effort. Captured fish were identified to species, measured (± 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.

Horizontal surface trawls were used to index the abundance of larval fish in the reservoir. Trawls were made with a 1 m x 2 m x 4 m long Neuston net at six sites spread throughout the reservoir (Figure 24). Mesh size was 1.3 mm. The net was fit with a flow meter to estimate the volume of water sampled. Tow duration was 5 minutes and an average of 607 $m^3$ was sampled per tow. Two tows were made in each of the three sections of the reservoir. Tows were made on a bi-weekly basis beginning June 2, 2008 until few larval fish were sampled in early August. Specimens were stored in 10% formalin and viewed under a dissecting microscope. Sampled fish from each tow were identified to species and measured for length, unless the total number of larval fish exceeded 50 individuals. For large samples, we randomly selected 50 individuals, identified and measured those, and counted the remainder. Furthermore, we scanned the entire sample for the presence of larval channel catfish.

Zooplankton community structure was monitored at the three of the six sampling locations. At each point, three vertical zooplankton tows were made using plankton nets fitted with 153, 500, and 750 micron mesh netting. Samples were stored in 95% ethanol and processed within 2 weeks of sampling. Zooplankton samples were summarized using ZQI and ZPR indices (Teuscher 1999). These indices describe the structure, size, overall abundance, and abundance of large individuals within zooplankton communities.

## RESULTS

A total of 161 fish were caught in nine, small-mesh gill net pair sets, yielding an average CPUE of 17.9 fish/net pair/night. Common carp represented 58% of the catch by number, followed by channel catfish at 27%, and black crappie at 6%. yellow perch, kokanee *Oncorhynchus nerka*, bluegill, largemouth bass, smallmouth bass *M. dolomieui*, largescale sucker *Catostomus macrocheilus* and northern pikeminnow *Ptychocheilus oregonensis*, represented cumulatively 8% of the catch. Black crappie were the most common prey-sized fish sampled. Mean CPUE for black crappie equaled 1.1 fish/net pair/night. Most of the black crappie were putative age-0 fish (<70 mm). Yellow perch CPUE was 0.44 fish/net pair/night, the lowest catch rate recorded over the last 3 years.

During 2008, we caught a total of 187 larval fish with the Neuston net during 30 separate tows (six fixed sites on five sampling dates; Figure 25). Fish species sampled included bluegill, yellow perch, channel catfish, and black crappie. Most of the larval fish, (63%) were caught in the eastern half of the reservoir (sites 4, 5, & 6). Bluegill were by far the most numerous species (96%) captured, followed by yellow perch (2%), black crappie (1%), and channel catfish (1%).

Overall zooplankton abundance in Lake Lowell was on the higher end of the spectrum for Idaho waters. Average weight for the 153 micron net was 1.47 g/m over the three sampling sites and five sampling dates. The overall ratio of preferred to usable size zooplankton values (ZPR) were moderate with an average of 0.47. ZPR was highly variable during 2008 (Figure 26). ZPR was lower in the upper reservoir, site 5, where ZPR averaged 0.31. Mean ZPR was highest, 0.60, at site 3. The abundance of larger zooplankton relative to total abundance (ZQI) was lower than many Idaho waters. ZQI indices averaged 0.47 (Figure 27). ZQI at Site 5 had the lowest average and showed little seasonal variation. ZQI at the other two sites showed a very similar pattern. At these sites, ZQI values were relatively high in June, declined to very low levels by early July, and then increased in subsequent samples.

Incidental to prey-sized fish, channel catfish were also sampled in small-mesh, experimental gill net sets. A total of 44 channel catfish were caught ranging in length from 214 to 666 mm (Figure 28). All channel catfish stocked in Lake Lowell during 2005 and 2006 were marked by excision of the adipose fin. Only four clipped channel catfish were noted and these fish ranged from 214 to 300 mm. As clipped channel catfish of up to 385 mm were sampled during 2007, we expected to sample more clipped channel catfish in the 214 - 400+ mm range. Within this range of sizes, only 4 of 34 fish were noted as marked (12%). This is a large decrease in the percentage of marked fish compared to the previous years when ad clipped rates exceeded 70%.

## DISCUSSION

Small-mesh gill netting efforts during 2008 indicated that Lake Lowell supports few prey-size fish in pelagic areas. Results were similar to 2006 & 2007 when few prey sized fish were caught, though catch rates during 2008 were even lower. Younger age classes of panfish, especially black crappie and yellow perch, were nearly absent. Recruitment of yellow perch and black crappie to these age classes is still below levels necessary to rebuild fishable populations or to support additional pelagic predator introductions. Furthermore, few adult-sized yellow perch and black crappie were sampled, which may further delay rebuilding of these populations once conditions improve without intervention.

Bluegill were once again the most abundant larval fish sampled. Larval bluegill distribution was skewed towards the eastern half of the reservoir as had been documented during 2006 and 2007. However, peak abundances were much lower than 2006 and 2007, when larval bluegill densities approached 1 larval bluegill/m$^3$. The maximum density observed during 2008 was 5% of these densities. Furthermore, larval abundances of other species, black crappie, yellow perch, and channel catfish, were very low.

The mean abundance of all sizes of zooplankton in Lake Lowell (1.47 g/m) was near the mid-point compared to other waters in Idaho (range 0.02 - 2.68 g/m; Teuscher 1999). The ratio of preferred to usable size zooplankton (ZPR) was moderate on average, and also highly variable among sites and dates. ZQI was low and showed a sharp decline during the mid summer. These trends indicate that both useable and preferred zooplankton sizes were being cropped during mid-summer.

Marked hatchery channel catfish were determined to be a large component of the catfish population in Lake Lowell during 2006 and 2007. We saw a far lower percentage of marked fish during 2008. This result was not consistent with previous data and expected mortality rates of clipped fish stocked during 2005 and 2006. Previously stocked and clipped channel catfish were either misidentified or suffered higher mortality rates than in previous years.

## MANAGEMENT RECOMMENDATIONS

1. Continue channel catfish stocking program as it has produced a healthy population.

2. Consider supplementation of existing yellow perch and black crappie stocks if population levels remain depressed after the reservoir refills. Any supplementation should be followed by continued assessment of larval fish abundance to note responses.

3. Evaluate costs and benefits of suppressing common carp as a strategy for restoring panfish populations.

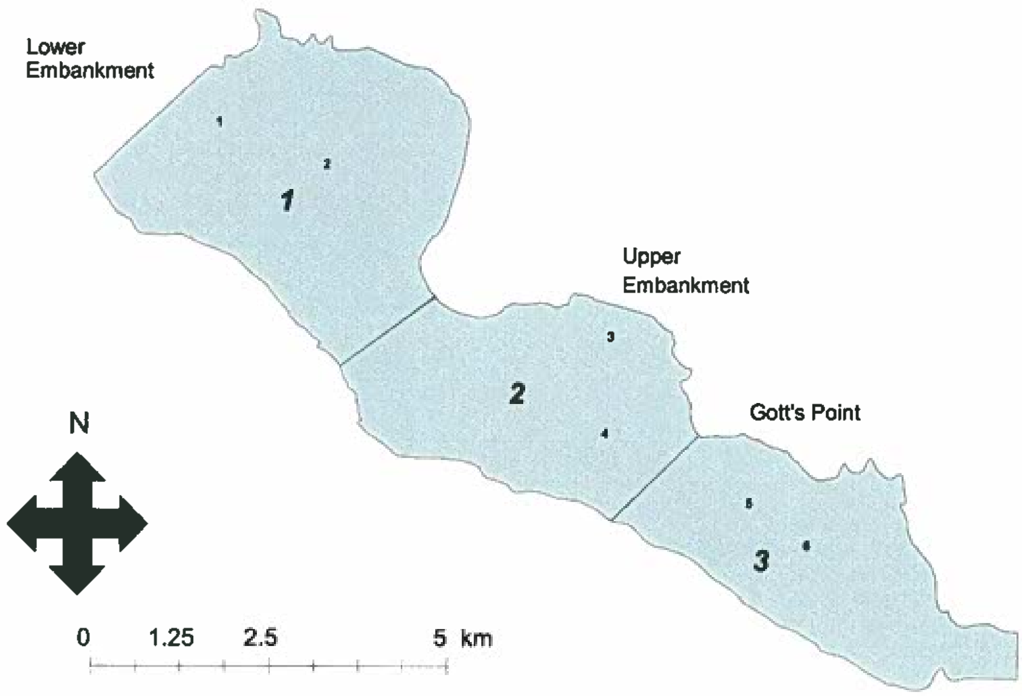



Figure 24. Lake Lowell sampling sections (Large bolded text #1-3), larval fish towing sites (Small text #1-6), and zooplankton sampling sites (Small text #1, #3, & #5) used during 2008 for fish and invertebrate surveys.

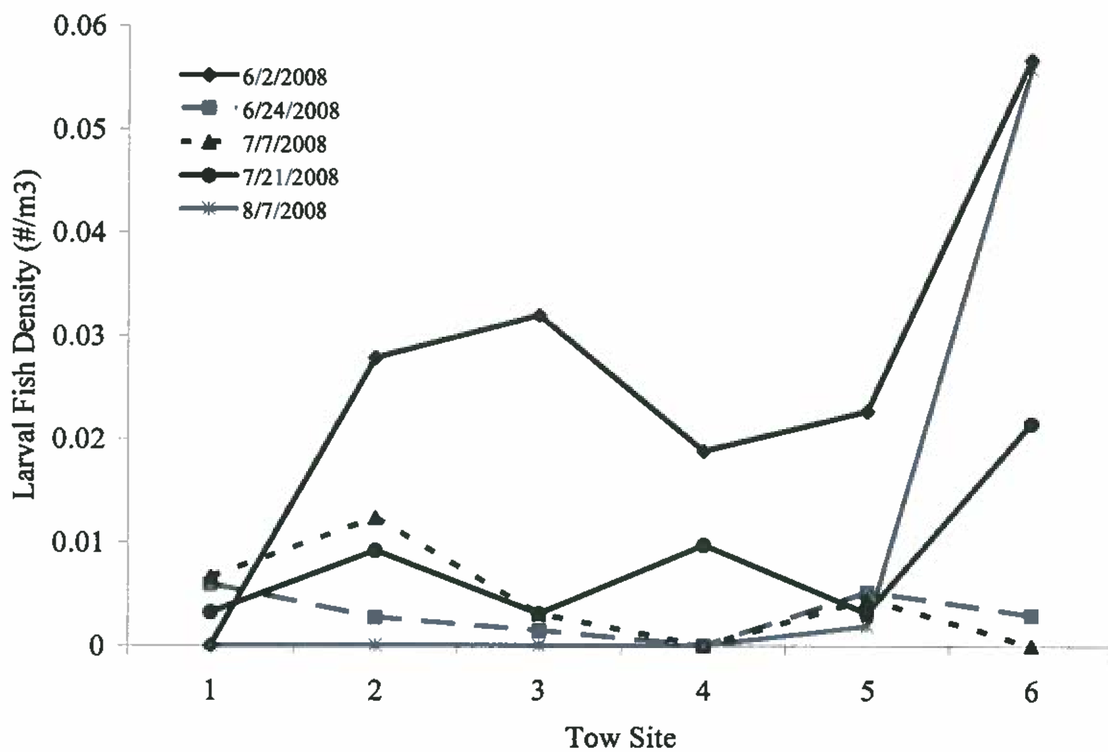



Figure 25. Larval fish abundance for six sites in Lake Lowell sampled with a Neuston net. Samples were collected from June 2 to August, 7 2008.

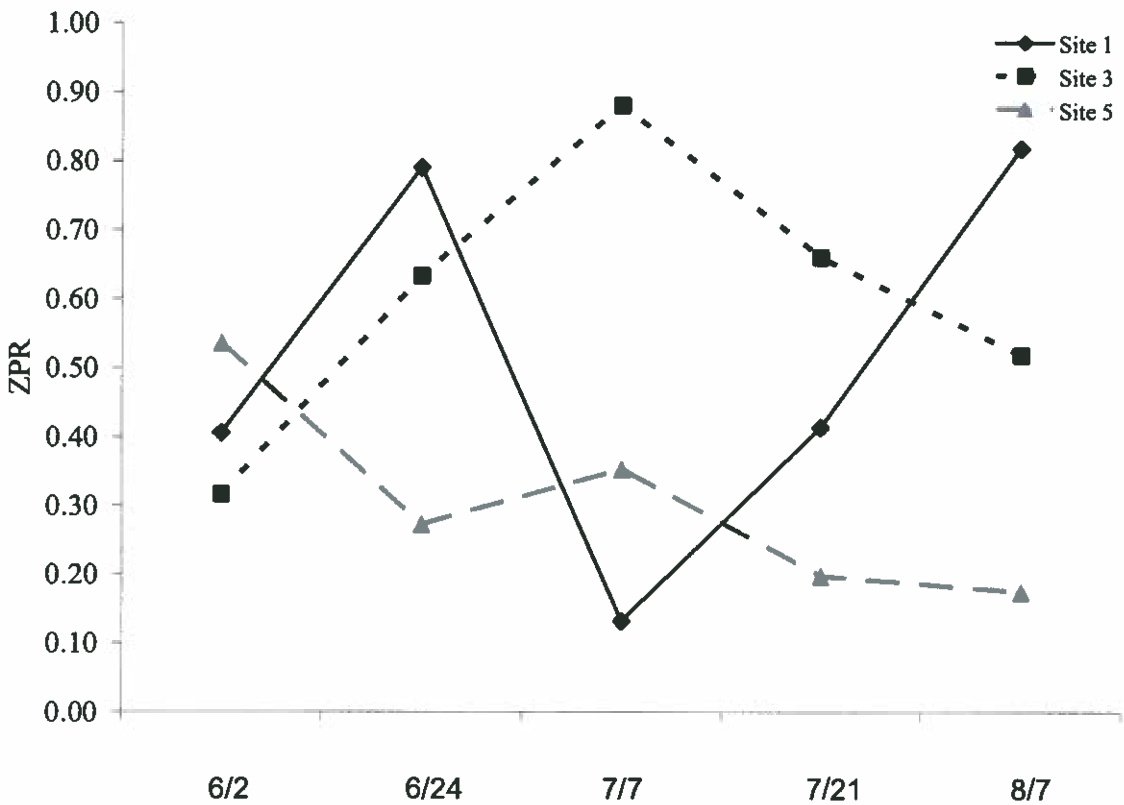



Figure 26. Zooplankton production ratio (ZPR) values for sites monitoring sites on Lake Lowell. Samples were collected from June 2 to August, 7 2008.

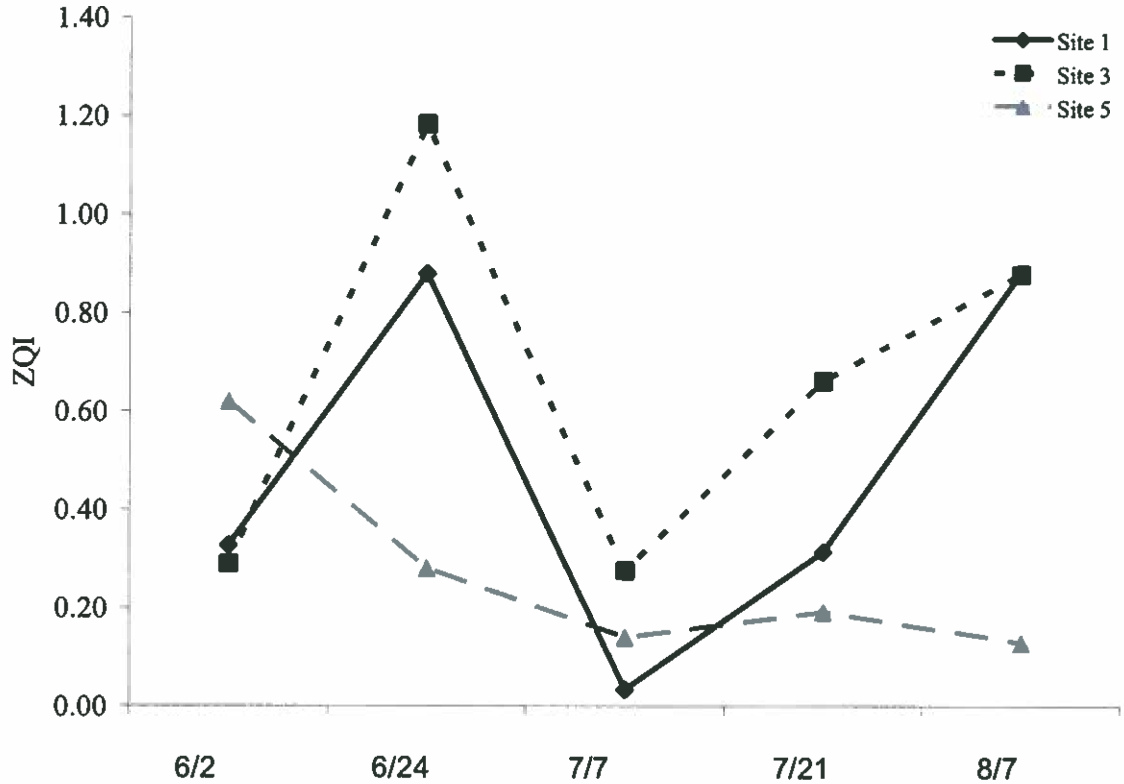



Figure 27. Zooplankton quality index values for three monitoring sites on Lake Lowell. Samples were collected from June 2 to August 7, 2008.

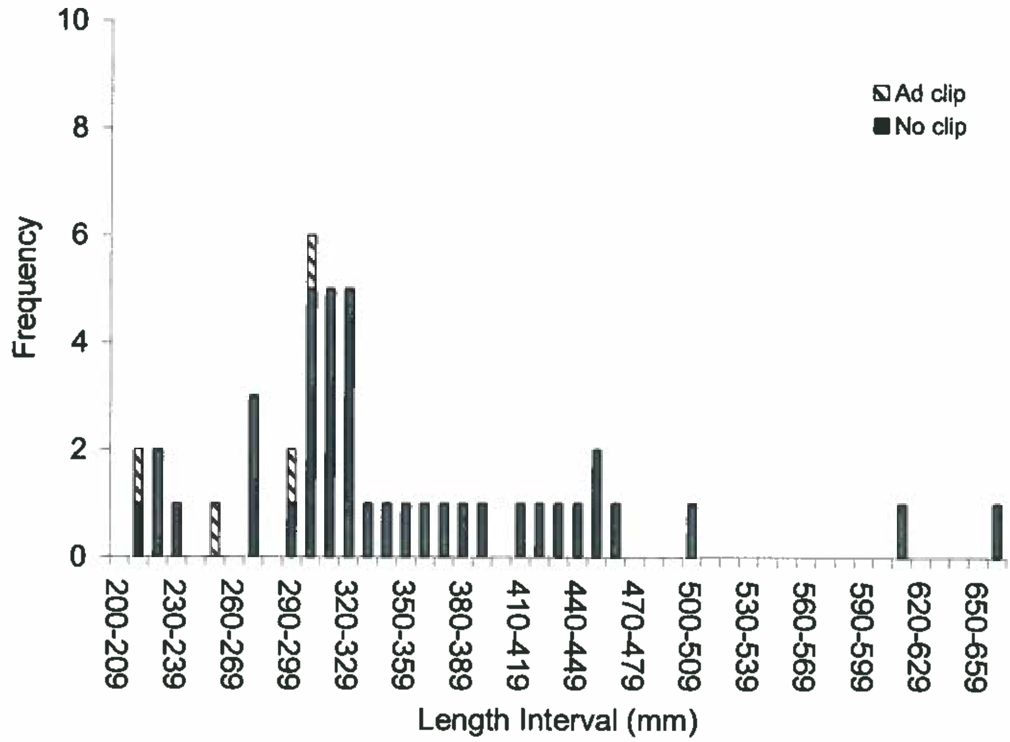



Figure 28. Length frequency of channel catfish sampled incidentally during small mesh gill net sets in Lake Lowell during 2008.

## Paddock Valley Reservoir


## ABSTRACT

We collected 623 fish with the three gear types during a lowland lake survey of Paddock Valley Reservoir on June 4, 2008. In total, 46 black crappie, 227 bluegill, 80 brown bullhead, 230 largemouth bass, 30 pumpkinseed *L. gibbous*, and 10 hatchery rainbow trout were sampled. Largemouth bass were present at high densities; however, few quality sized largemouth were present and Wr were low. Bluegill were sampled at moderate densities. A wide range of sizes were sampled. Largemouth bass and bluegill populations have appeared to rebound well after re-introduction efforts, though larger individuals are not present yet. Black crappie populations still remain at depressed levels with little evidence of successful reproduction during 2007.

# INTRODUCTION

Paddock Valley Reservoir is a 482-ha irrigation reservoir (at full pool) that impounds Little Willow Creek, a tributary to the lower Payette River. Paddock Valley Reservoir is located 30 km east of Weiser, ID and lies at 980 msl. Largemouth bass, bluegill, black crappies, and brown bullhead have been sampled in past fish population surveys (Flatter and Allen 2001). When adequate winter water levels are sustained for several years, Paddock Valley Reservoir has the ability to produce high yield fisheries for black crappie and bluegill as well as high catch rates for largemouth bass. For instance, 68,918 crappie were harvested during 1987 (Mabbott and Holubetz 1989). Additionally, the reservoir is well known for producing large, brown bullhead.

Reservoir levels have been variable and often low during the winter months. Paddock Valley Reservoir was nearly dewatered during the winter months for four straight years from 1990 through 1993. Most recently, Paddock Valley Reservoir was dewatered almost entirely during the winter of 2005-06. In order to re-establish warmwater fish populations, we captured 444 largemouth bass, 693 bluegill, and 3,522 black crappie during spring 2006 from several local waters and transferred them to Paddock Valley Reservoir (Kozfkay et al. In press). Additionally, 27,300 surplus steelhead smolts were stocked during April 2006. Since then, a partial fish kill occurred during June 2007. Laboratory analyses of diseased fish noted motile aeromonad septicemia bacterial infections in kidney tissue as well as external parasites in gill tissue (Keith Johnson, IDFG, pers. comm.). Paddock Valley Reservoir has been managed under IDFG's general fishing regulations of six trout and six bass (none under 12"; 305 mm) and no size or bag limits on other species since 1983, when the bass length limit was instituted (Reid and Mabbott 1987).

# METHODS

Fish populations in Paddock Valley Reservoir were sampled with standard IDFG lowland lake sampling gears on June 4, 2008. Sampling gear included: (1) paired gill nets, (2) trap nets, and (3) night electrofishing. Paired gill net sets included floating and sinking monofilament nets, 46 m x 2 m, with six panels composed of 19, 25, 32, 38, 51, and 64 mm bar mesh. One floating and one sinking net, fished for one night, equaled one unit of gill net effort. Trap nets possessed 15 m leads, 1-m x 2-m frames, crowfoot throats on the first and third of five loops, 19-mm bar mesh, and had been treated with black tar. One trap net fished for one night equaled one unit of trap net effort. For boat electrofishing effort, 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 5-6 amps. One hour of active on-time electrofishing equaled one unit of effort. In total, four trap net, three gill net, and one electrofishing units were utilized during 2008 (Figure 29).

Captured fish were identified to species, measured for total length (± 1 mm), and weighed (±1g for fish under 5,000 g or ±10 g for fish greater than 5,000 g) with a digital scale. In the event that weight was not collected, length-weight relationships were built from fish weighed and measured in 2008 which allowed us to estimate weights of un-weighed fish. Proportional stock densities (PSD) were calculated for game fish populations as outlined by Anderson and Neuman (1996) to describe length-frequency data. Also, Wr 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. Catch data were summarized as the number of fish caught per unit of effort (CPUE) and the weight caught per unit effort (WPUE). These indices were calculated by standardizing the catch of each gear type to one unit of effort and then summing across the three gear types.

## RESULTS

We collected 623 fish with the three gear types including 46 black crappie, 227 bluegill, 80 brown bullhead, 230 largemouth bass, 30 pumpkinseed, and 10 hatchery rainbow trout. Electrofishing was the most effective gear type and yielded 449 fish, followed by gill nets ($n$ = 110), and trap nets ($n$ = 64; Table 7). Catch per unit effort and weight per unit effort indices followed a similar trend in terms of efficiency. Total catch per unit effort equaled 502 fish. Species composition based on number was largemouth bass (45%), bluegill (43%), and brown bullhead (5%). Black crappie, pumpkinseed, and hatchery rainbow trout, individually, represented three percent of less of the total catch by number. Based on weight per unit effort, species composition was largemouth bass (57%), bluegill (25%), and brown bullhead (14%; Table 8). Black crappie, pumpkinseed, and hatchery rainbow trout, individually, represent two percent or less of the total catch by weight.

Largemouth bass was the most common game fish sampled with a CPUE of 225 fish and WPUE of 41 kg. Most largemouth bass were sampled with electrofishing gear (Electrofishing CPUE = 223 fish/hr). Since 1995, the 2008 electrofishing CPUE was the second highest outside of the 1999 survey when largemouth bass were sampled at a rate of 652 fish/hr (Figure 30). Proportional stock density for largemouth bass was 10, calculated from 156 stock length fish (≥200 mm) and 15 quality length fish (≥ 300 mm). This low PSD is indicative of a largemouth bass population skewed towards small individuals (Figure 31). Mean Wr for fish over 150 mm was 90, indicating relatively poor body condition. Wr showed no trend across the length of fish examined (slope = -0.02; $P$ = 0.43; $n$ = 136).

Bluegill was the second most common fish sampled with a CPUE of 217 fish and a WPUE of 17 kg (Table 7 and 8). Most bluegill were sampled with electrofishing gear (Electrofishing CPUE = 214 fish/hr). This catch rate was the third highest out of the last nine surveys; however, it was still over 10-fold less than the catch rate for 1999 when bluegill electrofishing CPUE equaled 2,787 fish/hr (Figure 32). Proportional stock density for bluegill was 56, indicative of a balanced bluegill population, though few fish over 200 mm were sampled (Figure 33). Mean Wr for fish over 80 mm was 109, indicating above average body condition. Wr tended to decrease as length increased (slope = -0.09; $P$ = 0.06; $n$ = 147).

Brown bullhead was the only *Ictalurid* present in Paddock Valley Reservoir. CPUE for brown bullhead was 27 fish and WPUE was 10 kg. PSD for brown bullhead was high, 94, indicating a sample skewed towards larger sized fish (Figure 34). Small bullhead were not sampled. Mean Wr was 137, indicating that bullhead were in well above average condition. Wr tended to decrease as length increased (slope = -0.26; $P$ < 0.01; $n$ = 80). Black crappie (Figure 35), hatchery rainbow trout (Figure 36), and pumpkinseed (Figure 37) were present at low densities with few adult sized fish sampled.

## DISCUSSION

Largemouth bass, bluegill, and brown bullhead population have begun to rebound after the most recent, severe reservoir drawdown which occurred during the winter of 2005-2006. The current fish community is dominated by a high-density largemouth bass population, which is primarily made up of individuals less than 305 mm that are in relatively poor condition. The bluegill population has also seemed to rebound well as moderate densities and a wide range of sizes were sampled though higher densities and larger individuals have been noted in past years. Despite no Ictalurids being reintroduced in 2006, brown bullheads are still present in the reservoir and either survived in the minimal remaining pool or in small tributary streams. Black crappie populations remain at low densities. The 3,522 adult pre-spawn black crappie re-introduced during 2006 seemed to produce a year class immediately after stocking, but not during 2007. Few adult sized black crappie remain in the reservoir and the reestablishment of this fishery may require additional re-introduction efforts. No non- game fish were sampled and only a few rainbow trout were sampled. The rainbow trout were part of a resident hatchery research study and seemed to be in relatively poor condition due to inadequate water temperature/quality. Unfortunately, reservoir levels were low during fall 2008 and may further delay the recovery of these fisheries.

## MANAGEMENT RECOMMENDATIONS

1. If adequate spring reservoir levels exist, supplement the existing black crappie population with additional adults to increase spawning potential.

2. Conduct another lowland lake survey in three to five years to assess the status of re-introduced populations.

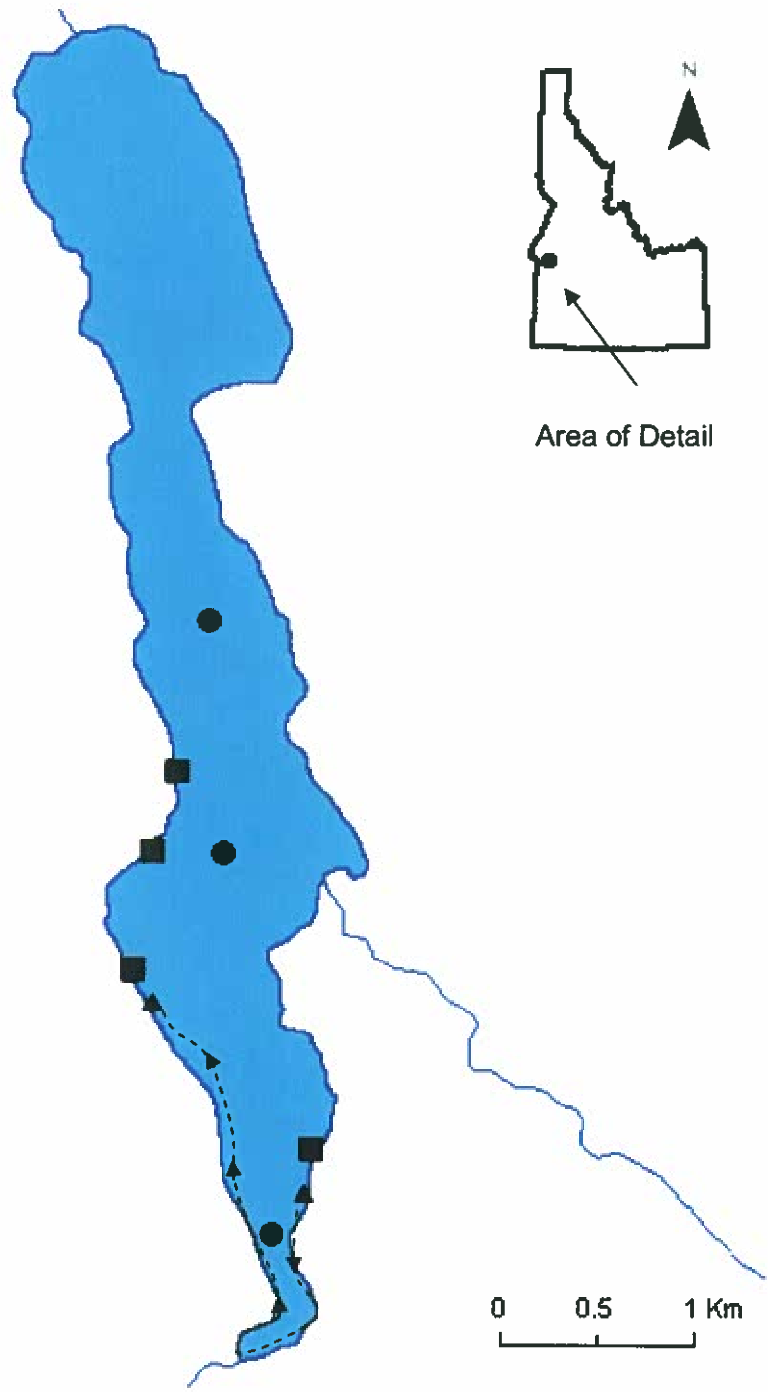



Figure 29. Map of Paddock Valley Reservoir, Idaho showing location of 2008 sampling effort. Trap nets locations are denoted with squares and gill nets pairs with circles. Start and endpoints for electrofishing surveys are denoted with triangles and arrows show the direction of boat travel.

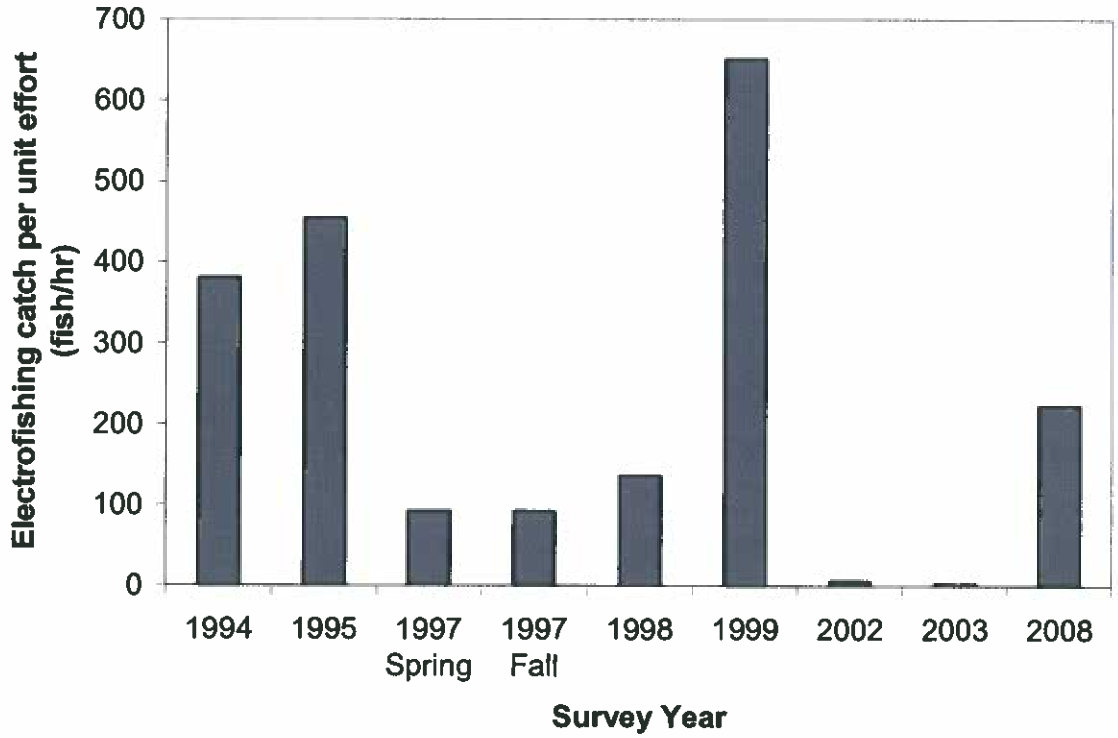



Figure 30. Largemouth bass catch per unit effort (fish/hr) for electrofishing surveys conducted during the last 15 years in Paddock Reservoir.

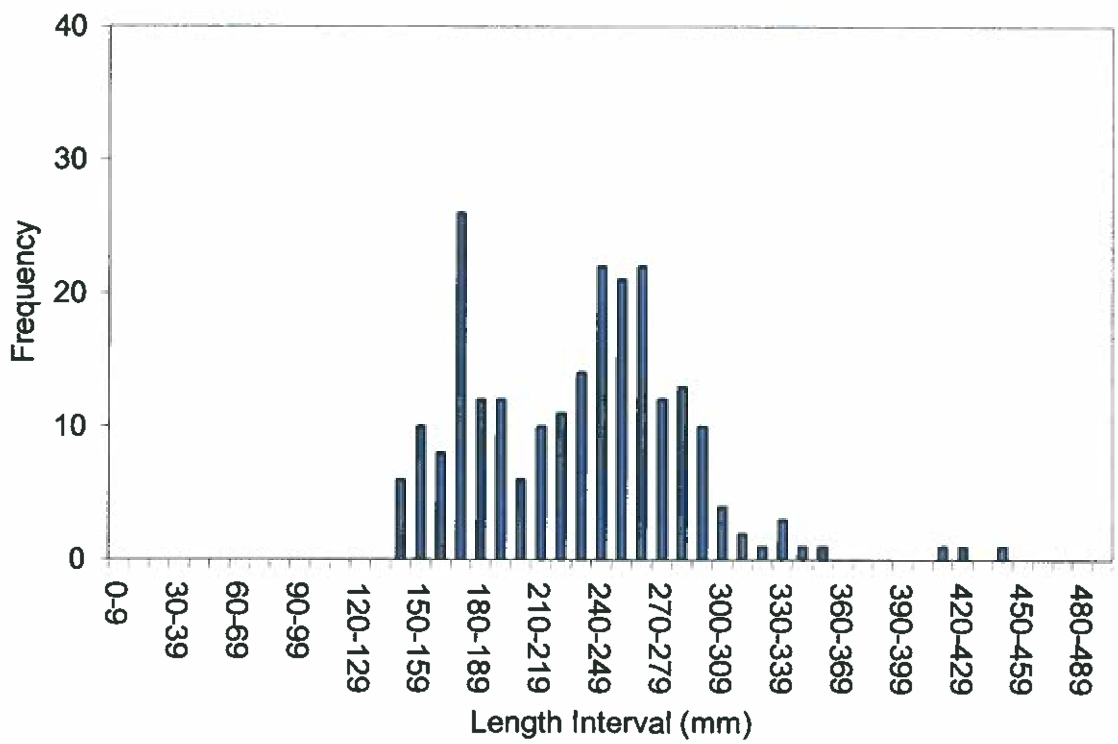
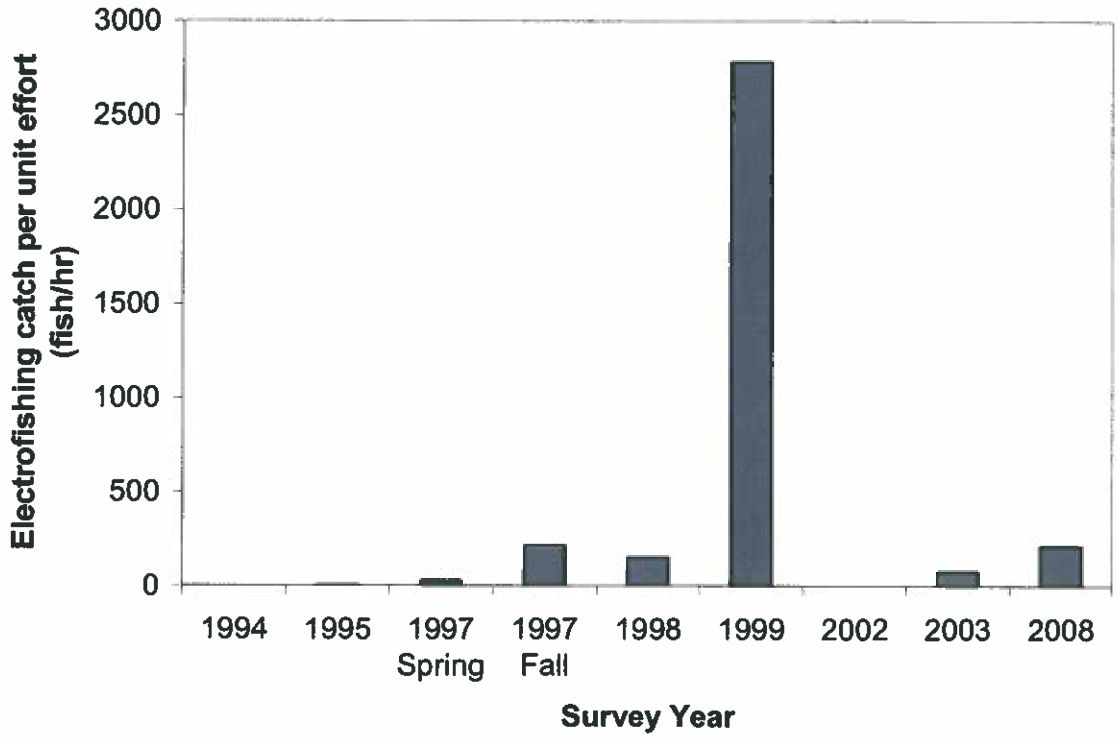



Figure 31. Length frequency of largemouth bass ($n$ = 230) sampled from Paddock Valley Reservoir during 2008.

Figure 32. Bluegill catch per unit effort (fish/hr) for electrofishing surveys conducted during the last 15 years in Paddock Reservoir.



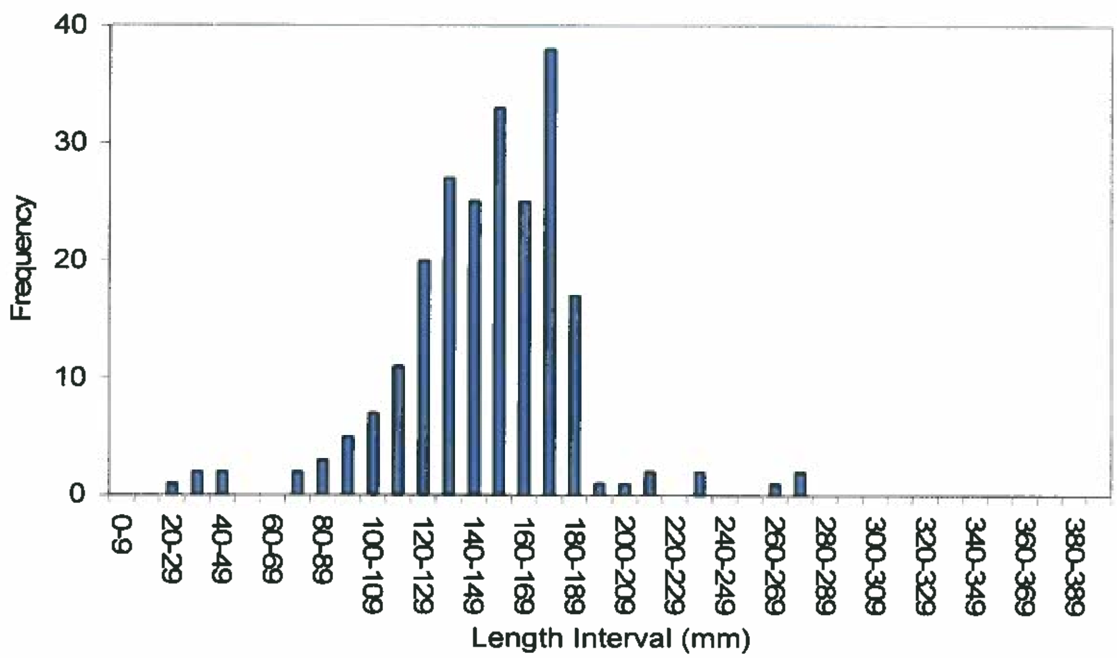




Figure 33. Length frequency of bluegill ($n$ = 227) sampled from Paddock Valley Reservoir during 2008.

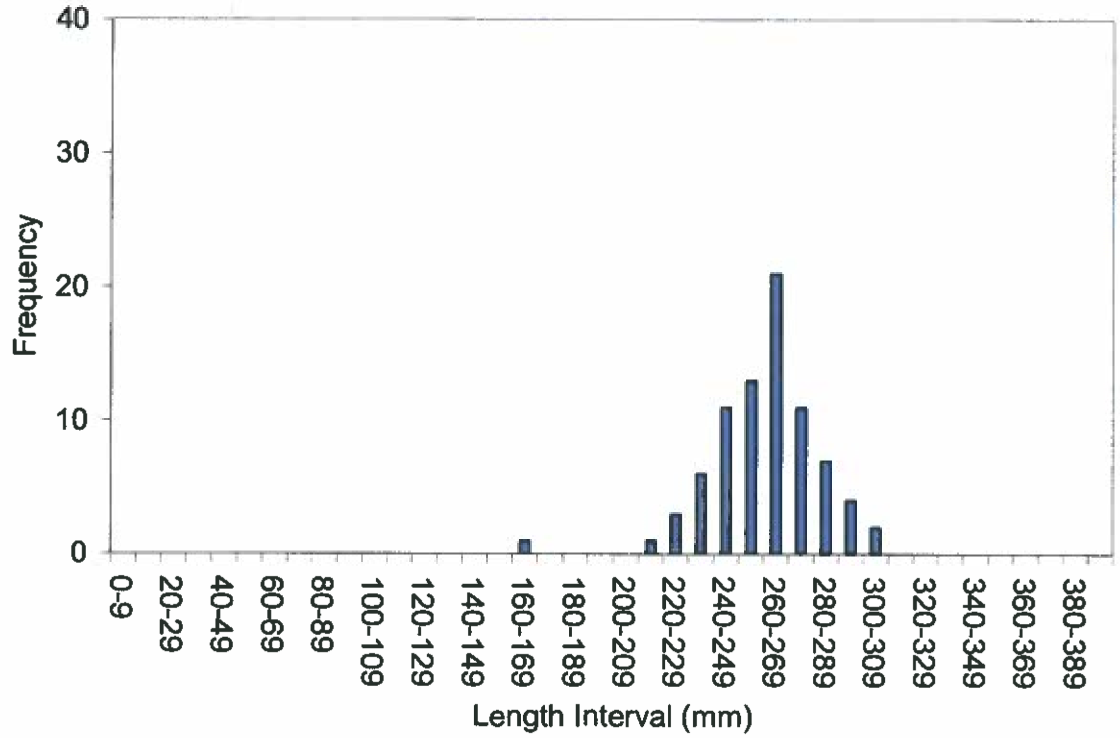



Figure 34. Length frequency of brown bullhead ($n$ = 80) sampled from Paddock Valley Reservoir during 2008.

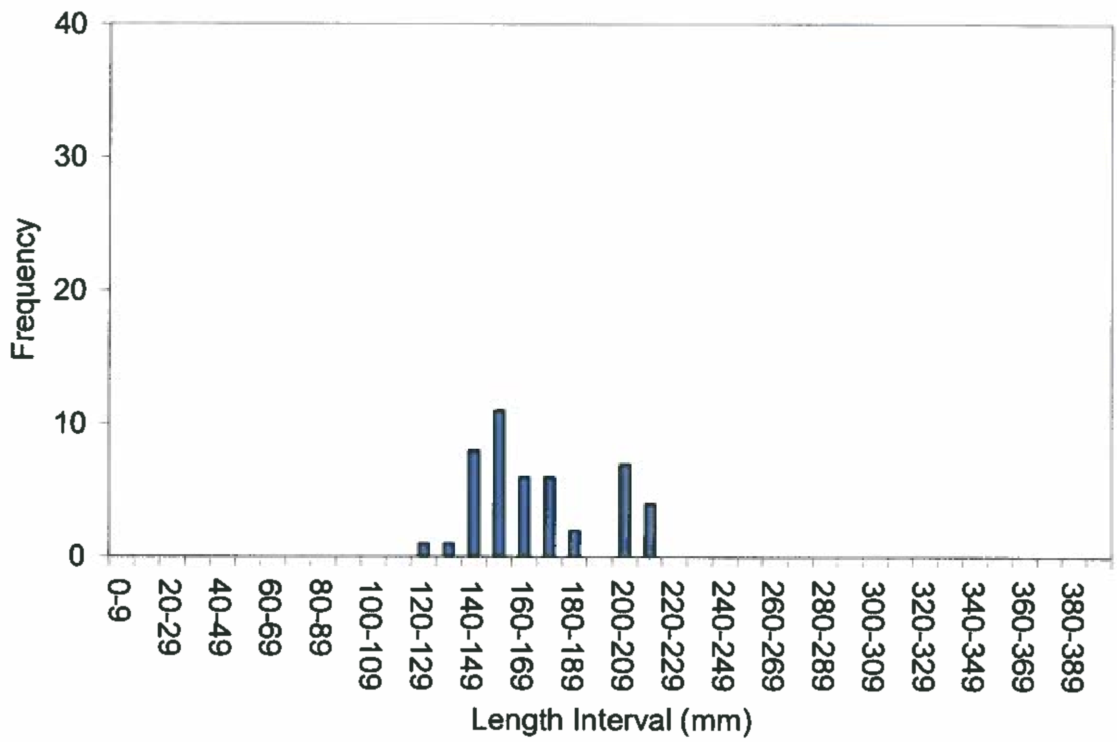



Figure 35. Length frequency of black crappie ($n$ = 46) sampled from Paddock Valley Reservoir during 2008.

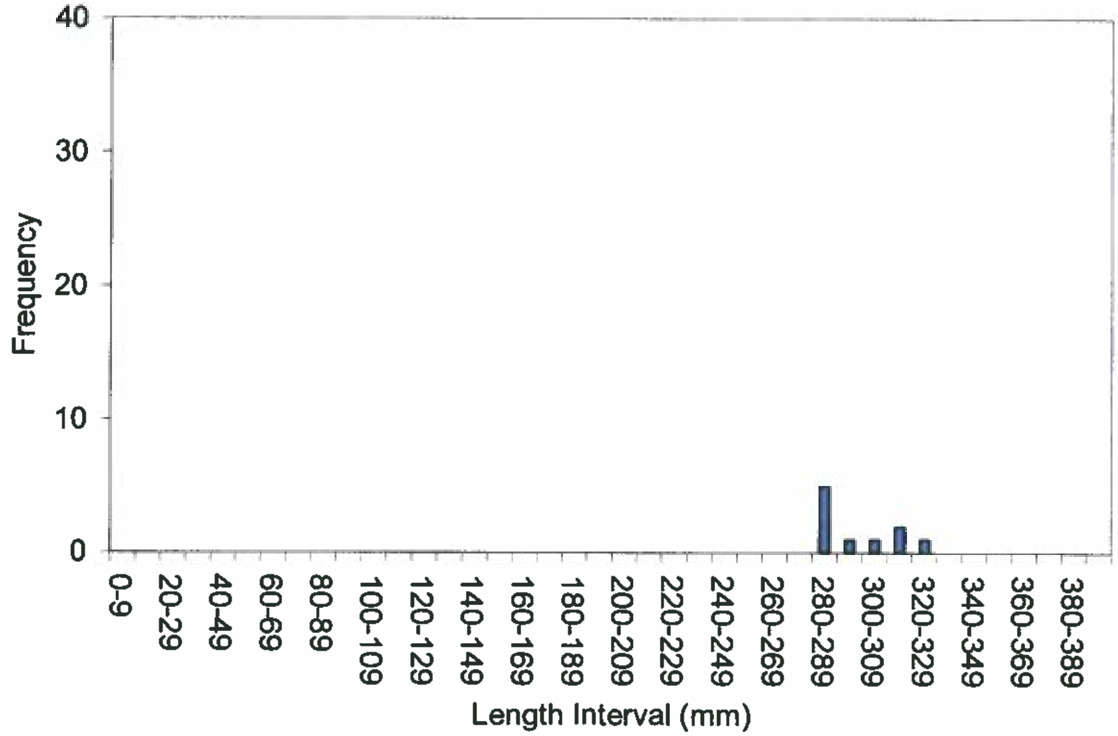



Figure 36. Length frequency of hatchery rainbow trout ($n$ = 10) sampled from Paddock Valley Reservoir during 2008.

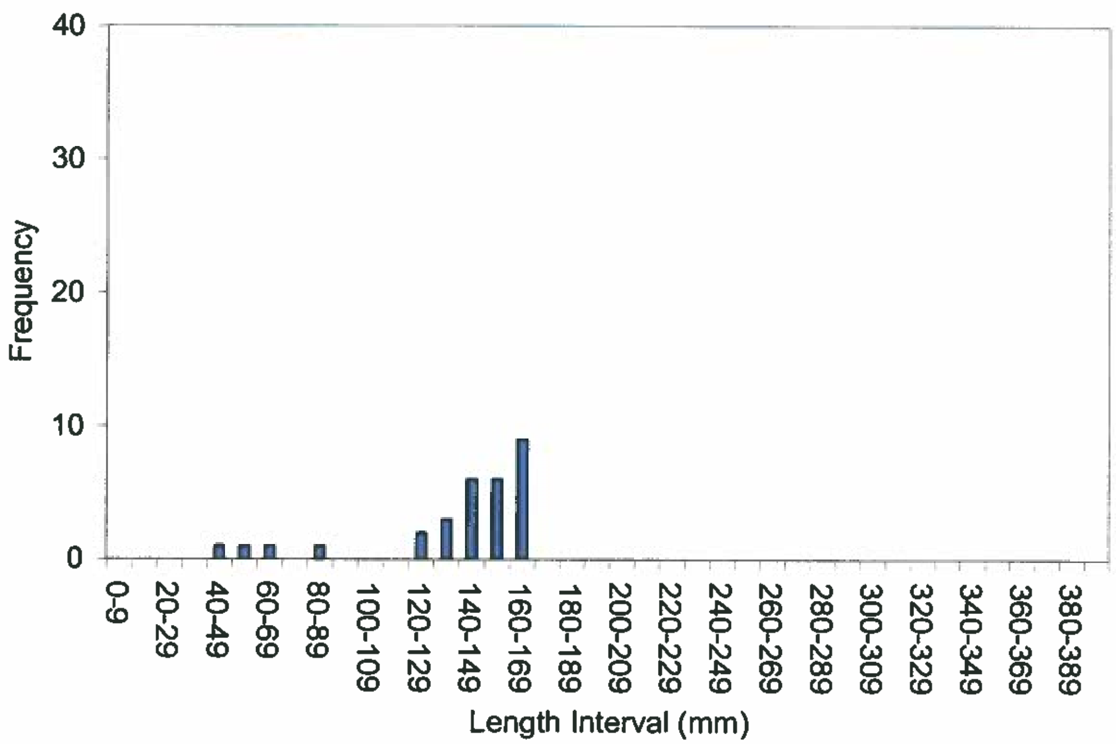



Figure 37. Length frequency of pumpkinseed ($n$ = 30) sampled from Paddock Valley Reservoir during 2008.

Table 7. Catch and Catch per unit effort statistics by species and gear type for a lowland lake survey conducted on Paddock Valley Reservoir on June 4, 2008.

| | Electrofish Catch | Electrofish CPUE | Gill Net Catch | Gill Net CPUE | Trap Net Catch | Trap Net CPUE | Catch Total | Total CPUE |
|---|---|---|---|---|---|---|---|---|
| Black Crappie | 2 | 2 | 36 | 12.0 | 8 | 2 | 46 | 16.0 |
| Bluegill | 214 | 214 | 1 | 0.3 | 12 | 3 | 227 | 217.3 |
| Brown Bullhead | 3 | 3 | 61 | 20.3 | 16 | 4 | 80 | 27.3 |
| Largemouth Bass | 223 | 223 | 7 | 2.3 | | | 230 | 225.3 |
| Pumpkinseed | 6 | 6 | | | 24 | 6 | 30 | 12.0 |
| Rainbow Trout | 1 | 1 | 5 | 1.7 | 4 | 1 | 10 | 3.7 |
| Total | 449 | 449 | 110 | 36.7 | 64 | 16 | 623 | 501.7 |

Table 8. Total biomass (kg) and weight per unit effort statistics by species and gear type for a lowland lake survey conducted on Paddock Valley Reservoir on June 4, 2008.

| | Electrofish Weight | Electrofish WPUE | Gill Net Weight | Gill Net WPUE | Trap Net Weight | Trap Net WPUE | Total Weight | Total WPUE |
|---|---|---|---|---|---|---|---|---|
| Black Crappie | 0.2 | 0.2 | 2.8 | 0.9 | 0.8 | 0.2 | 3.9 | 1.4 |
| Bluegill | 18.0 | 18.0 | 0.2 | 0.1 | 1.2 | 0.3 | 19.5 | 18.4 |
| Brown Bullhead | 1.1 | 1.1 | 22.8 | 7.6 | 5.6 | 1.4 | 29.6 | 10.2 |
| Largemouth Bass | 40.6 | 40.6 | 1.4 | 0.5 | | | 42.0 | 41.1 |
| Pumpkinseed | 0.1 | 0.1 | | | 2.2 | 0.5 | 2.3 | 0.7 |
| Rainbow Trout | 0.3 | 0.3 | 1.4 | 0.5 | 1.1 | 0.3 | 2.7 | 1.0 |
| Total | 60.4 | 60.4 | 28.6 | 9.5 | 10.9 | 2.7 | 99.9 | 72.7 |

## Fish Habitat Structure Placement in Regional Waters

## ABSTRACT

The Idaho Bass Federation initiated a project to improve fish habitat in Black Canyon Reservoir by adding artificial structure. IDFG employees assisted with all aspects of this project and approximately 300 tree structures were placed in Black Canyon Reservoir on July 20$^{th}$. In addition, we placed about 65 structures in Park Center, Quinns, and Sawyers ponds during June. Future habitat projects should focus on smaller waters.

## METHODS

The Idaho Bass Federation initiated a project to improve fish habitat in Black Canyon Reservoir by adding artificial structure. We assisted them in all aspects of the project including acquiring the necessary permits, collection of juniper trees, as well as constructing and deploying structures. In addition, IDFG personnel added habitat structures to Park Center, Quinns, and Sawyers ponds. Most structures were constructed by placing single 1.5 – 3.5 m juniper trees into molded paper-fiber nursery containers, either 37.5 or 46.0 L depending on tree size, and then filling the containers with concrete. Broken off or trimmed juniper limbs were used to create additional, smaller structures in the same fashion. We waited 24 h for the concrete to cure then sunk structures in aggregates usually on relatively flat bottom contours in 7 m or greater depths to avoid creating a boating or swimming hazard. All juniper trees were acquired from the Bureau of Land Management (BLM) property near Jordan Valley with a free, special use permit.

## RESULTS

Approximately 300 tree structures were placed in Black Canyon Reservoir on July 20th. About 75 structures were placed at each of 4 sites (Table 9). In addition, we placed about 65 structures in Park Center, Quinns, and Sawyers ponds during June.

## DISCUSSION

Reviews of habitat improvement projects across the country have shown mixed results in achieving desired fish populations responses. Black Canyon Reservoir currently has depressed gamefish and prey fish populations, probably due to high sedimentation rates, high turbidity, and low productivity. Several researchers have suggested than habitat improvement projects in standing waters need to have a treatment area equivalent to 10-35% of the surface area of the receiving water to affect fish populations (Bolding et al. 2004). Due to the large size of Black Canyon and the limited number of volunteers and funds, it was impossible to achieve this level of treatment. Therefore, this effort, though well intended, is unlikely to improve fish populations on a reservoir wide basis. Despite this limitation, the addition of habitat structures may improve juvenile fish survival and may increase angling catch rates near structures. Future efforts should be targeted in smaller systems for which higher treatment rates can be achieved or in larger systems with healthy fish populations (e.g. C. J. Strike Reservoir) as a means to concentrate fish making them easier to catch or harvest.

## MANAGEMENT RECOMMENDATION

1. Focus future club efforts at improving fish habitat in the Southwest Region on CJ Strike Reservoir or on smaller systems such as urban ponds.

Table 9. Location of juniper tree structures in Black Canyon Reservoir.

| Deployment Site Description | Zone | UTM-E | UTM-N |
|---|---|---|---|
| Upper Cove on North Bank | 11 | 548022 | 4863029 |
| Lower Cove on North Bank | 11 | 547890 | 4863008 |
| North Bank Across from Day use Park | 11 | 546764 | 4863275 |
| Red Rocks | 11 | 547796 | 4863352 |

# Use of Transplanted Catfish to Provide Enhanced Summer Fishing Opportunities in Small Ponds and Reservoirs


## ABSTRACT

The Southwest Region is considering two alternatives for improving summer fishing in small ponds: (1) buying fingerling and sub-catchable sized channel catfish from commercial suppliers and having hatchery personnel stock them, or (2) using regional staff to capture wild channel catfish and transfer them to ponds. The purchase of 2,924 sub-catchable sized channel catfish or 1,044 lbs for seven ponds in the Southwest Region cost the fisheries program $2,610. Including fleet equipment costs of $417 and personnel costs of $561, the cost of this program to IDFG in 2008 was $3,588. Average stocking number equaled 418 fish per pond with an average size of 0.36 lbs per fish. Purchasing and stocking sub-catchable sized channel catfish cost an estimated $3.44 per pound of fish stocked. In August, we collected 612 adult channel catfish (2,179 lbs) from the Snake River and transferred them to seven small ponds. Average stocking number equaled about 77 fish per pond. The cost of capturing and transferring channel catfish totaled $1,978, including $1,495 in personnel and $483 in fleet costs. Capturing and transferring adult-sized catfish cost the department about $0.91 per pound of fish. It is probably safe to assume that capturing and transferring is the more viable alternative based on cost and pounds stocked. Growth and survival rates for stocked fish would have to be extremely high to make purchasing and stocking a more cost effective option.

## INTRODUCTION

IDFG Southwest Region manages about 20 small ponds and reservoirs. The majority are located within urban or semi-urban settings. These waterbodies receive significant fishing pressure and are important resources that provide easily-accessible, family-friendly fishing opportunities regarded as vital in agency angler recruitment and retention efforts. Most ponds have self-sustaining largemouth bass and bluegill populations. Additionally, most ponds receive seasonal plants of catchable sized rainbow trout. Catchable sized rainbow trout are usually stocked on a bi-weekly basis from September through June. Summer water temperatures exceed thermal limits for rainbow trout, requiring a stocking cessation during July and August, occasionally stretching into June and September during warm years (Hebdon et al. 2008). Unfortunately, stocking cessations coincide with peak fishing effort periods.

Regional staff is interested in improving fisheries quality in a portion of the Southwest Region's urban ponds during peak effort periods through a channel catfish stocking program. We are currently in the early stages of assessing the costs and benefits of two options: (1) buying fingerling and sub-catchable sized channel catfish from commercial suppliers and having hatchery personnel stock them, or (2) using regional staff to capture wild, adult-sized channel catfish and transfer them to ponds. We used 2008 to investigate methods and locations for capture and transferring efforts, and to assess relative cost. In future years, we plan to assess the relative benefit of these two options with a tagging study to assess return to creel rates.

## METHODS

Sub-catchable sized channel catfish were purchased from Fish Breeders of Idaho, Inc. in Hagerman, ID. In total, the Southwest Region received 10,602 channel catfish from this supplier; however, the majority ($n$ = 7,678) were destined for Lake Lowell (Table 10). The remaining 2,924 channel catfish or 1,044 lbs were stocked in seven ponds. The seven ponds included Caldwell #1, Caldwell #3, Ester Simplot, Park Center, Quinns, Sawyers, and Veterans Park ponds (Figure 38). Fish Breeders of Idaho charged IDFG $2.50 per lb. Catfish were transported to Boise by a Hagerman State Fish Hatchery culturist with the use of a 2 ½-ton fish transport truck. Upon arriving in Boise, channel catfish were re-distributed to a ¾-ton and a 1-ton fish transport trucks then stocked by four Nampa Fish Hatchery personnel.

Based on proximity and high catch rates during fish population surveys (Kozfkay et al. In press), catfish collection efforts were conducted on the Snake River from Walters Ferry to Nyssa, OR. Both baited hoop net and electrofishing efforts were attempted. Baited hoop net efforts were ineffective and discontinued. For electrofishing efforts, a jet sled equipped with two boom-mounted anodes and a 5,000-watt generator were used. Output was controlled by a Smith Root VVP-15. Frequency was set at 120 pulses per second and a pulse width of 40, which yielded an output of 5-6 amps.

Captured fish were held in a 75-gallon live well equipped with a re-circulating pump and supplemental oxygen. After approximately 50-75 fish had been collected, catfish were transferred to a 300-gallon fish transport trailer at a boat ramp. After several runs and the accumulation of 225-300 fish, fish were transported to local ponds. Ponds were stocked with approximately 75 catfish once per month in June, July, and August (Table 11). Though channel catfish were the primary target species, we did capture and transfer, flathead catfish *Pylodictis olivaris* occasionally, but only in small numbers (approximately 2% of the total). Capture and transferring efforts required two, ½-ton trucks, one jet boat electrofishing unit, one fish transport trailer, and four IDFG employees. Usually, it required about three days of effort to complete the capture and transferring efforts for seven ponds. The seven ponds included Beaches (Wilson Ponds), Caldwell #2, Horseshoe Bend Mill, McDevitt, Park Center, Quinns, and Sawyers ponds (Table 10).

Estimated costs for these activities were calculated by summing fleet mileage charges and fixed usage charges for trucks and boats, wages excluding benefits, and miscellaneous expenditures such as per diem. For capture and transferring, only the cost of one month (August) will be considered for cost comparison as only one rotation of commercially purchased catfish was stocked.

## RESULTS

The purchase of 2,924 sub-catchable sized channel catfish or 1,044 lbs for seven ponds in the Southwest Region cost the fisheries program $2,610 (Table 12). Including fleet equipment costs of $417 and personnel costs of $561, the cost of this program to IDFG in 2008 was $3,588. Average stocking number equaled 418 fish per pond with an average size was 0.36 lbs per fish. Purchasing and stocking of sub-catchable sized channel catfish in these seven ponds cost an estimated $3.44 per pound of fish stocked.

For June, July, and August, we captured and transferred 1,877 catfish. Average weight was 3.56 lbs per fish for a total of 6,682 lbs. During August, we captured and transferred 612 catfish or an estimated 2,179 lbs. Average stocking number equaled about 77 fish per pond. The cost of stocking channel catfish in seven ponds during August was $1,978, including $1,495 in personnel and $483 in fleet costs (Table 13). Captured and transferred adult-sized catfish cost the department about $0.91 per pound of fish.

## DISCUSSION

These two options provide substantially different products for anglers. Purchase of commercially-grown catfish allows for stocking densities of about five- to six-times higher than were provided by capture and transfer efforts. Although, the purchasing option provided higher densities, it cost almost four times as much. Furthermore, the purchasing option only provided small fish, which may yield high initial catch rates, but fish size at stocking (10.2") was likely smaller than anglers would harvest. Requesting larger fish from commercial suppliers would likely be cost prohibitive. Small size at stocking might not be a problem, if growth or survival rates were high allowing harvest of stocked channel catfish in subsequent years. Currently, we have no information on either growth or survival rates of stocked catfish. It is probable that growth rates are low in some of the ponds, such as Quinns or McDevitt ponds, which possess low habitat complexity, few available prey items, or are small in size. In systems of this type, captured and transferred catfish are probably a better option. In the larger more complex ponds with better prey resources, only a structured tagging project may provide definite answers as too what option may provide high return to creel or yield rates on a per dollar invested basis.

In the absence of this data, it is probably safe to assume that capturing and transferring is the more viable alternative based on cost and pounds stocked. For instance, if we spent an equal amount of money on the two alternatives, we would achieve an average stocking rate of 418 fish per pond at an average size of 0.36 lbs each (151 total lbs) for the purchase and stock option. If we spent the same amount of money on capture and transferring, this would equal a transferring rate of 271 fish per pond at an average size of 3.56 pounds each (965 total lbs). Growth and survival rates for transferred fish would have to be extremely high to make purchasing and transferring a more cost effective option.

During 2008, wild channel catfish could be captured in side channels of the Snake River at high rates, often 75 to 100 fish per hour. At this rate, a fish transport trailer could be filled in less than three hours and sent to stock ponds which would take as much as 5-6 hours. This often led to down time for the shocking crew. Greater efficiency could be achieved if additional transport equipment was available. The stocking of large numbers of large channel catfish in small ponds may create a regulation problem. Currently, there is no bag limit on channel catfish. If anglers are able to catch captured and transferred channel catfish at high rates, then the low numbers of fish could be removed by a few anglers in a short time.

## MANAGEMENT RECOMMENDATIONS

1. Use tagged fish and voluntary angler return of tags to assess the return to the creel rates of purchased and stocked as well as captured and transferred channel catfish in a subset of catfish ponds

2. Seek funds to buy an additional fish transport trailer designed for stocking large channel catfish.

3. Monitor harvest patterns in some ponds, and, if necessary, consider a reduced bag limit for channel catfish in ponds receiving captured and transferred catfish.

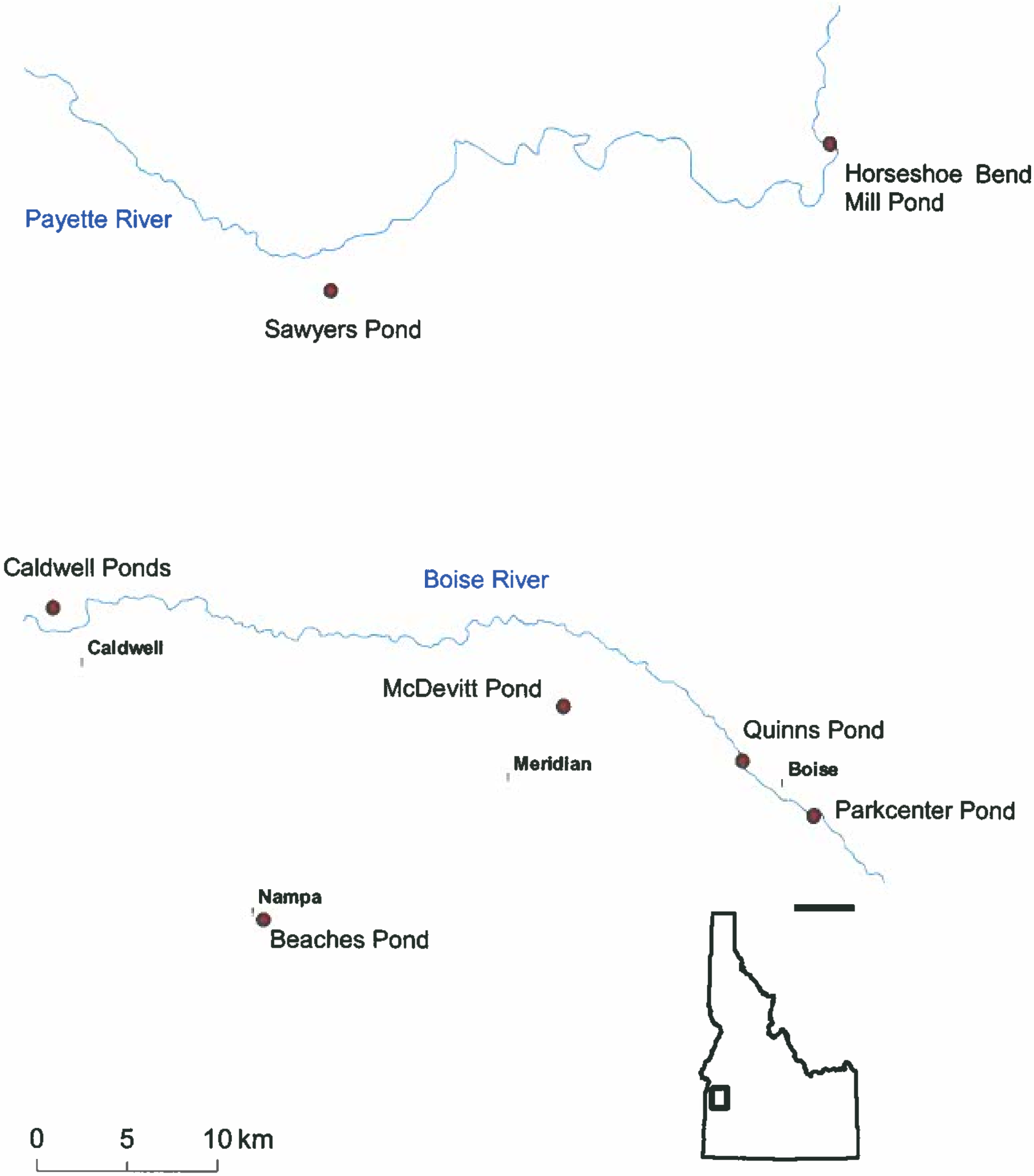



Figure 38. Location of ponds that received captured and transferred catfish during 2008.

Table 10. Name and stocking information for waters of the Southwest Region stocked with sub-catchable channel catfish purchased from Fish Breeders of Idaho, Inc. during 2008.

| Water Body | Stocking Request | Stocking Date | Number Stocked | Pounds Stocked |
|---|---|---|---|---|
| Caldwell Pond #1 | 300 | 7/23 | 300 | 107 |
| Caldwell Pond #3 | 500 | 7/23 | 498 | 178 |
| Ester Simplot Pond | 300 | 7/23 | 300 | 107 |
| Lake Lowell | 7,500 | 7/16 | 7,678 | 2,646 |
| Park Center Pond | 300 | 7/23 | 300 | 107 |
| Quinns Pond | 300 | 7/23 | 300 | 107 |
| Sawyers Pond | 800 | 7/23 | 728 | 260 |
| Veterans Park Pond | 500 | 7/23 | 498 | 178 |
| Total | 10,500 | | 10,602 | 3,690 |

Table 11. Number of catfish captured and transferred into seven ponds and reservoirs in the Southwest Region by 2008 stocking date.

| | Beaches Pond | Caldwell Pond #2 | Horseshoe Bend Mill Pond | McDevitt Pond | Parkcenter Pond | Quinns Pond | Sawyers Pond | Total |
|---|---|---|---|---|---|---|---|---|
| 19-Jun | | | 73 | 68 | 82 | | | |
| 20-Jun | | 31 | | | | 83 | 77 | |
| 26-Jun | 71 | 39 | | | | 69 | | |
| 8-Jul | | | 119 | | | | | |
| 18-Jul | | | | 70 | 70 | 65 | | |
| 23-Jul | | 91 | 79 | | | | | |
| 24-Jul | 91 | | | | | | 87 | |
| 21-Aug | | 77 | 75 | | | | 75 | |
| 22-Aug | | | | | 70 | 70 | | |
| 2-Sep | 100 | 45 | | 100 | | | | |
| Total | 262 | 283 | 346 | 238 | 222 | 287 | 239 | 1,877 |

Table 12. Cost associated with stocking sub-catchable channel catfish purchased from Fish Breeders of Idaho, Inc. in seven ponds in the Southwest Region during 2008.

| | Fixed vehicle charges ($) | Cost per unit ($/unit) | Units | Number of Units | Cost ($) |
|---|---|---|---|---|---|
| 2.5 ton stocking truck | 45.56 | 0.85 | $/mile | 270 | 275.06 |
| Culturist stocking | | 13.14 | $/h | 12 | 157.68 |
| 2.5 ton stocking truck disinfection | | 16.00 | $/h | 2 | 32.00 |
| 3/4 ton stocking truck | 27.34 | 0.46 | $/mile | 80 | 64.14 |
| Assistant hatchery mgr stocking | | 19.37 | $/h | 5 | 96.85 |
| Hatchery laborer | | 8.00 | $/h | 5 | 40.00 |
| 3/4 ton stocking truck disinfection | | 16.00 | $/h | 2 | 32.00 |
| 1 ton stocking truck | 24.05 | 0.54 | $/mile | 100 | 78.05 |
| Culturist stocking | | 13.14 | $/h | 5 | 65.70 |
| General laborer stocking | | 8.00 | $/h | 5 | 40.00 |
| 1 ton disinfection | | 16.00 | $/h | 2 | 32.00 |
| Miscellaneous | | | $ | | 65.00 |
| Commercial channel catfish cost | | 2.50 | $/lb | 1044 | 2,610.00 |
| Total | | | | | 3,588.48 |

Table 13. Cost of catfish capture and stocking efforts during the month of August. Trapped fish were stocked in seven ponds in the Southwest Region during 2008.

| | Fixed vehicle charges ($) | Cost per unit ($/unit) | Units | Number of Units | Cost ($) |
|---|---|---|---|---|---|
| 1/2 ton pickup for transport trailer | 61.98 | 0.37 | $/mile | 360 | 195.18 |
| Transport trailer disinfection | | 21.00 | $/h | 2 | 42.00 |
| 1/2 ton pickup for jet boat | 61.98 | 0.37 | $/mile | 216 | 141.90 |
| Jet boat electrofishing unit | 33.33 | 16.03 | $/h | 7 | 145.54 |
| Fisheries biologist | | 21.21 | $/h | 24 | 509.04 |
| Fish technician | | 12.43 | $/h | 26 | 323.18 |
| Data technician | | 10.50 | $/h | 26 | 273.00 |
| Data technician | | 10.50 | $/h | 26 | 273.00 |
| Miscellaneous | | | $ | | 75.00 |
| Total | | | | | 1,977.84 |

## River and Stream Investigations

## Boise River Creel Survey (2007-2008)

# ABSTRACT

A year-long roving-roving creel survey was conducted on the lower Boise River from Barber Dam to Americana Boulevard Bridge to assess angler effort, catch rates, and harvest of trout. From June 2007-2008, 1,358 anglers were interviewed and 233 instantaneous angler counts were conducted on 107 separate dates. Total estimated effort for the survey area was 33,056 h with 3,463 h (11%) attributed to fly anglers and 22,667 hours (89%) by bait and lure (non-fly) anglers. Monthly effort was highest during November when steelhead were stocked into the river during a three-week period. Rainbow trout catch rates were highest for non-fly anglers in October (1.5 fish/h) and highest for fly anglers in September (1.9 fish/h). Mean annual catch for combined gear was 0.6 fish/h. Total rainbow trout catch was highest in July (5,241.6 ± 2,692.8 fish) and October (6,176.1 ± 2,005.7 fish) with an overall annual catch of 20,704 (± 4,067.7) fish. Fly anglers released 82% of the rainbow trout caught, while non-fly anglers released 78%, and the overall release rate of rainbow trout was 79%. Catch rates, total catch, and harvest were also estimated for brown trout *Salmo trutta*, mountain whitefish and steelhead.

# INTRODUCTION

The lower Boise River is a heavily used urban fishery (Hebdon et al. 2008). The river downstream from Lucky Peak Dam has historically been managed with general trout regulations. During 1990, a trophy trout regulation section, restricting harvest of trout between 12 and 20 inches, was established from Eagle Road upstream to the head of Eagle Island inclusive of both channels. The trophy trout regulation section was maintained through 1995. In 1996 the trophy regulation on the Eagle Island reach of the Boise River was removed and a quality trout regulation section was established and still exists on the lower Boise River between the Loggers Creek Diversion and the East Boise River Footbridge (3.4 km). During the public comment period prior to the 2007-2008 regulation setting period, a contingent of local anglers approached IDFG about expanding the quality trout reach of the lower Boise River. In order to gain a better understanding of the lower Boise River, a creel survey was proposed with the objectives of estimating angler use, estimating catch, harvest and release rates for rainbow trout and brown trout in the reach.

# METHODS

In an effort to better understand the lower Boise River trout fishery, we conducted a creel survey encompassing the current special regulation section from June 19, 2007 through June 14, 2008. The survey encompassed an 11.1-km section on the Boise River, from Barber Dam downstream to the Americana Boulevard Bridge (Figure 39). A roving-roving survey design was selected because the Boise River within the survey reach is characterized as having unlimited access points for angler entrance into the fishery. We estimated fishing effort using instantaneous angler counts conducted from a bicycle ridden downstream on the greenbelt through the survey area. Travel time through the survey reach was estimated at 45 minutes which we determined to be instantaneous (Pollock et al. 1994). During training, creel clerks were instructed to keep to the schedule and complete the count within the allotted 45-60 minutes. Count data were recorded by sub-reaches to simplify data handling in the field. The sub-reaches boundaries were from Barber Dam downstream to the Loggers Creek Diversion (3.2 km), Loggers Creek Diversion downstream to the East Boise River Footbridge (special regulation section; 3.4 km), and the East Boise River Footbridge downstream to Americana Boulevard (4.5 km). We included all anglers observed in the count including anglers who were not actively fishing but had fishing gear. Anglers were classified by gear type as either fly anglers or non-fly anglers, which included anglers using either bait or lures.

Angler interviews occurred either during or between instantaneous counts depending on the clerk's schedule. Anglers were surveyed for time spent fishing, method of angling, and numbers and species harvested and released. If anglers were in a position where creels could be examined without disrupting their trip, harvested fish were identified and measured for total length. If creel included rainbow trout, fish were visibly identified as either wild or hatchery origin.

Sampling days were selected using two-stage, simple random sampling without replacement. Days were stratified by month and weekend/weekday type. For each month five weekdays and five weekend days were randomly selected. Sampling rates were higher for weekend days because of the expectation that more effort is expended on weekends/holidays than weekends. Only the following major holidays were considered as weekend days (New

Years Day, President's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving and Christmas). Available daylight for angling was determined from a monthly average of sunrise and sunset times for Boise, Idaho. Sampling times were randomly selected to be either early or late time periods with total daylight hours evenly split. We selected start time randomly and conducted three counts for each time period for the June through August 2007 dates and two counts per time period for the remainder of the survey.

Mean catch rate $\hat{R}$ were estimated using the mean of ratios:

$$\hat{R} = \frac{\sum_{i=1}^{n} \frac{c_i}{e_i}}{n}$$

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 R1 from Pollock et al 1994). Harvest rate was calculated using the equation above and replacing fish caught with fish harvested. All trips less than 0.5 h were excluded from the catch rate calculations. Daily, monthly, and annual catch rates and effort, and numbers of fish caught and harvested by species were calculated using the methods and software described by Thomas and Chamberlain (2000). Confidence intervals (90%) were calculated for effort and catch using methods described by Zar et al. (1999).

## RESULTS AND DISCUSSION

A total of 1,358 anglers (1,001 non-fly, 357 fly) were interviewed by creel clerks between June 2007-2008. A total of 233 instantaneous angler counts on 107 separate dates were conducted in unison with interviews. As anglers were interviewed while fishing, all trips were considered incomplete. We were unable to estimate angler effort and catch rate by stream section as sample sizes were too limited to provide meaningful estimates.

Monthly effort for combined gear types (fly and non-fly anglers) ranged from a low of 435 (± 294) h in January 2008, a summer peak of 4,103.3 (± 707) h in July 2007, and the highest effort occurred during November 2007, where 5,790.8 (± 2,616) h were estimated (Figure 40). The November fishing effort estimate was the highest for all months during the entire creel survey. The high angler effort the river experienced in November can be attributed to the release of 1,000 adult steelhead. Total annual effort for the sections was 33,056 h for all gear types. We estimated fly angler effort to be 4,571 (± 598) h and non-fly anglers to be 28,485 (± 2,689) h. Effort increased in spring until high flows from flood control were released from Lucky Peak Reservoir in May. As flows subsided, effort again increased from June to August. An estimated 24,074 (± 4,265) fish were caught, with 4,927 (± 1,277) fish harvested, which equated to an overall release rate of 79%.

Angler catch rates varied by month, species, and gear type (Figure 41). Rainbow trout catch rates were highest for non-fly anglers in October (1.5 fish/h) and highest for fly anglers in September (1.9 fish/h). Mean annual catch rates for combined gear was 0.6 fish/h. However, these numbers were highly influenced by a small number of anglers that reported high catch rates. Total rainbow trout catch was highest in July (5,242 ± 2,693 fish) and October (6,176 ± 2,006 fish) with an overall annual catch of 20,704 (± 4,068) fish (Table 14).

Overall release rates for fly anglers ranged from 51% in August to 100% from December through February. Non-fly angler release rates ranged from 49% in May to 100% from December through February. Anglers released 79% of rainbow trout caught, with group release rates of 82% for fly anglers, and 78% for non-fly anglers. Based on visual examination of creels, the proportion of rainbow trout considered to be wild was estimated at 16%. Using this proportion, an estimated 3,313 ± 651 wild rainbows were caught and 684 ± 172 harvested.

Approximately, 1,000 adult steelhead were stocked over the course of three weeks at Glennwood, Americana, Broadway, and Parkcenter bridges and at Barber Park. Steelhead were obtained from the fish trap at Hell's Canyon Dam and were stocked as part of an ongoing mitigation program. The stocking of steelhead created a short, but intense fishery within the creel survey area during November and early December. November steelhead catch rates were 0.09 for fly anglers and 0.11 for non-fly anglers. Overall steelhead catch rate for combined gears for November was 0.1 fish/h, and 0.02 fish/h through the November-December period. The estimated total number of steelhead caught was 636 (± 708) fish and none were released (Table 15).

Brown trout were reported infrequently in the creel throughout the year. Non-fly anglers experienced their highest catch rates for brown trout in September (0.05 fish/h) and fly anglers their highest catch rates of 0.3 fish/h in both June and September, though sample sizes were small. Mean annual catch rates for combined gear was 0.01 fish/h. Total brown trout catch was highest in October (69 ± 123 fish) with an overall estimated catch of 330 (± 202) fish (Table 14). No brown trout were recorded as harvested during the creel survey and thus brown trout had an estimated 100% release rate.

Mountain whitefish catch rates were highly variable throughout the duration of the survey. Catch rates were highest for both fly and non-fly anglers in June and annual overall catch rate was 0.06 fish/h. A total of 2,070 (± 1,491) mountain whitefish were caught during the creel survey with and estimated 15 (± 2) fish harvested or a release rate of 99% (Table 15).

Anglers using bait and lures (non-fly) outnumbered fly anglers by a 6:1 ratio. The discrepancy between angling type is also reflected in total estimated catch, where non-fly anglers caught 16,041 (± 3,105) fish whereas fly anglers caught 2,678 (± 664) fish. However, fly and non-fly anglers displayed similar tendencies to release fish as 81% of fish caught by fly anglers were released while non-fly anglers released 79% of fish caught. Only 4,928 (± 1,277) fish were harvested of a total 24,074 (±4,265) fish caught for an overall release rate of 79%.

The harvest rates for wild rainbow and brown trout do not appear to be high in relation to the population density estimates last obtained in fall 2007 (Hebdon et al., In review). Within the creel survey section of the Boise River, expanded population estimates for fish >100 mm were 13,908 wild rainbow trout, 2,398 wild brown trout, and 34,754 mountain whitefish. In addition, approximately 20,000 hatchery rainbow trout are stocked annually. Population estimates did not include hatchery rainbow trout. Using the 2007 abundance estimates, roughly 5% of the wild rainbow trout population was harvested during the year-long creel survey. Furthermore, brown trout harvest was not observed during the creel survey and mountain whitefish harvest was considered negligible. Currently, efforts are underway to evaluate the age and growth of the wild rainbow and brown trout to better understand the dynamics of these populations and the potential for a population response with more restrictive harvest regulations. These findings will be published in the 2009 annual report.

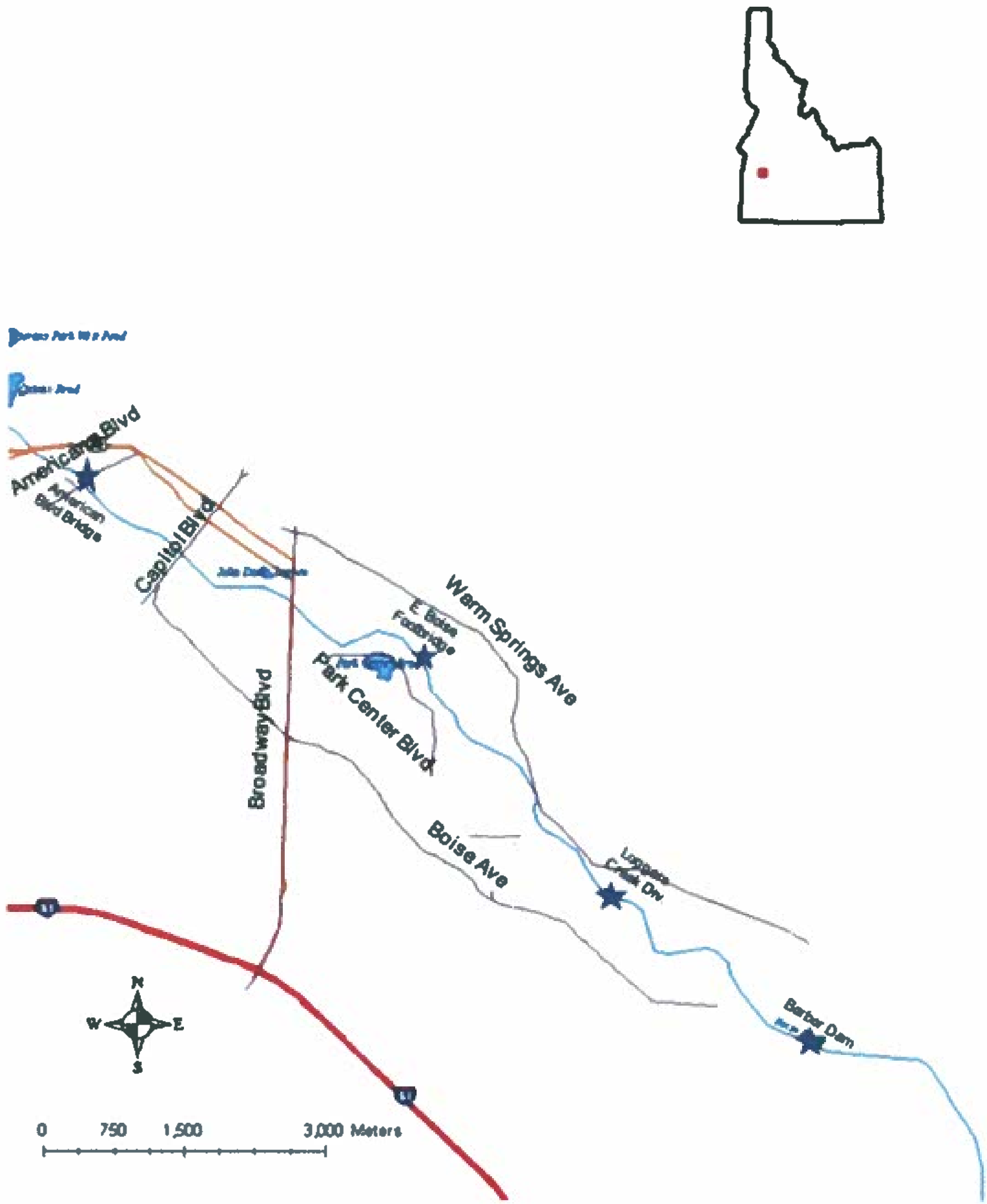



Figure 39. Map of lower Boise River creel survey sections in 2007-2008.

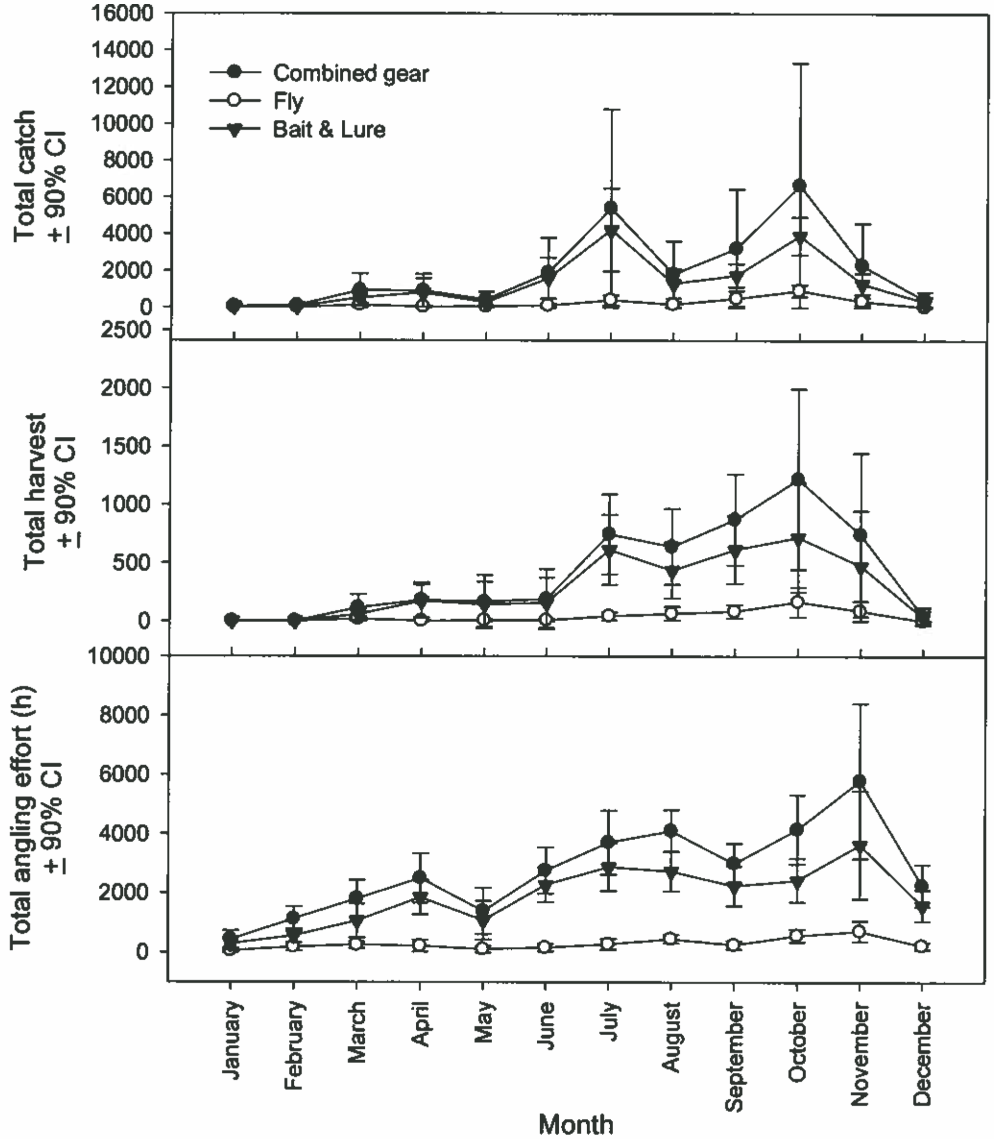



Figure 40. Total catch, harvest, and angling effort estimated during the lower Boise River creel survey in 2007-2008.

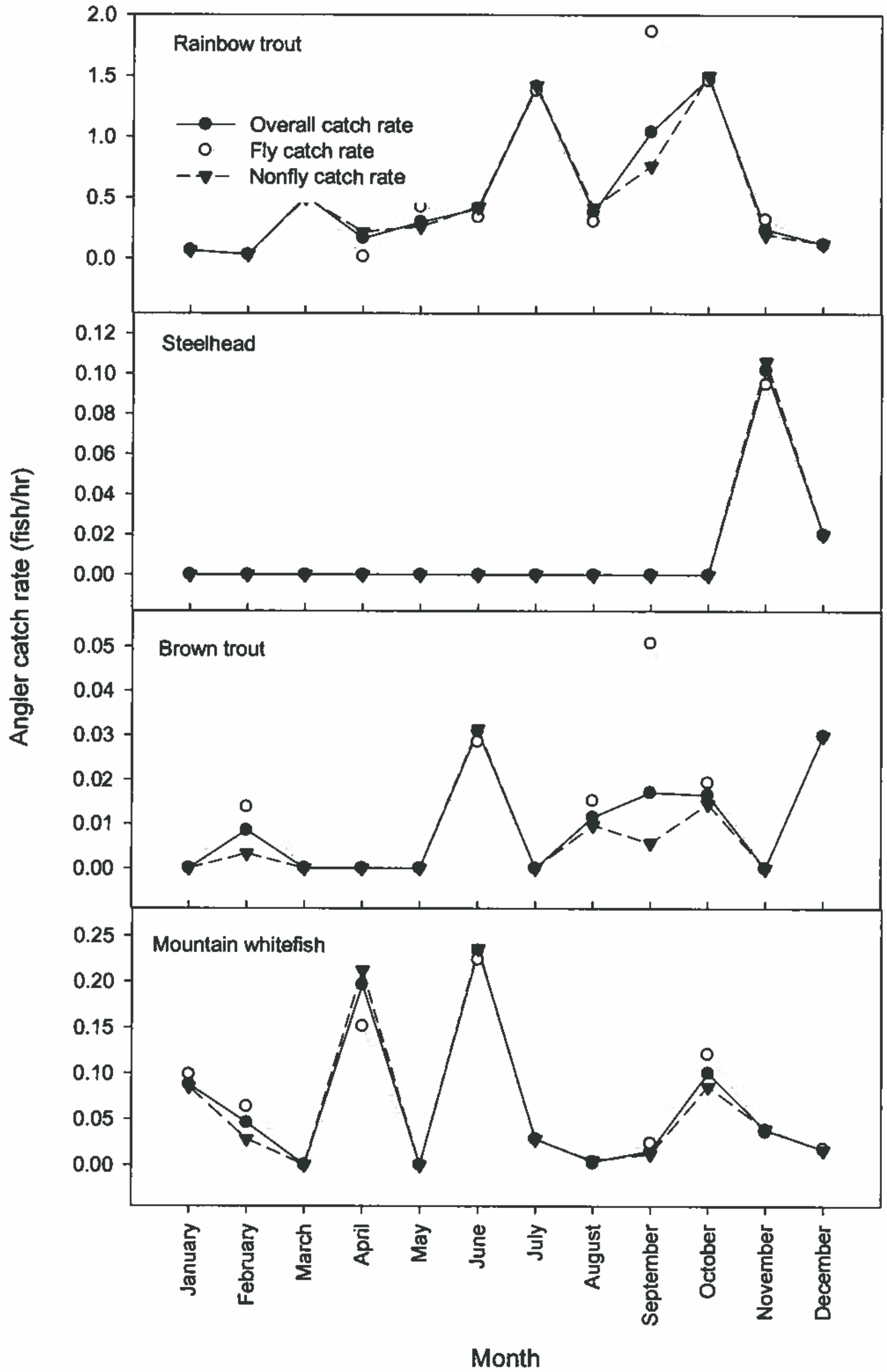



Figure 41. Monthly angler catch rates (fish/hr) for salmonids during the lower Boise River creel survey in 2007-2008.

Table 14. Monthly and annual total catch and harvest estimates for rainbow trout and brown trout during the 2007-2008 creel survey in the lower Boise River.

| Month | | Rainbow trout | | | Brown trout | | |
|---|---|---|---|---|---|---|---|
| | | Fly | Bait & Lure | Total | Fly | Bait & Lure | Total |
| January | Total catch | 3.1 (9.1) | 18.5 (36.6) | - | - | - | - |
| | Total harvest | - | - | - | - | - | - |
| | % Harvested | - | - | - | - | - | - |
| February | Total catch | 5.7 (6.6) | 17.8 (21.5) | - | 2.6 (4.3) | 1.9 (3.2) | 9.6 (15.2) |
| | Total harvest | - | - | - | - | - | - |
| | % Harvested | - | - | - | - | - | - |
| March | Total catch | 130.5 (99.6) | 526.2 (430.6) | 917.8 (824.9) | - | - | - |
| | Total harvest | 19.7 (20.0) | 57.6 (55.1) | 116.6 (112.3) | - | - | - |
| | % Harvested | 15% | 11% | 13% | - | - | - |
| April | Total catch | 3.5 (6.0) | 403.2 (325.1) | 413.7 (329.1) | - | - | - |
| | Total harvest | 3.5 (6.0) | 171.9 (142.4) | 182.5 (151.2) | - | - | - |
| | % Harvested | 100% | 43% | 44% | - | - | - |
| May | Total catch | 44.5 (54.3) | 281.6 (234.9) | 415.0 (384.5) | - | - | - |
| | Total harvest | 7.3 (10.4) | 144.8 (193.8) | 166.8 (229.9) | - | - | - |
| | % Harvested | 16% | 51% | 40% | - | - | - |
| June | Total catch | 54.9 (58.6) | 964.6 (453.9) | 1,129.2 (529.5) | 4.6 (5.9) | 71.5 (65.4) | 85.5 (48.8) |
| | Total harvest | 10.5 (11.0) | 158.2 (216.4) | 189.5 (258.7) | - | - | - |
| | % Harvested | 19% | 16% | 17% | - | - | - |
| July | Total catch | 380.9 (390.2) | 4,099.0 (2,254.0) | 5,241.6 (2,692.8) | - | - | - |
| | Total harvest | 44.7 (34.1) | 614.1 (301.7) | 748.3 (343.7) | - | - | - |
| | % Harvested | 12% | 15% | 14% | - | - | - |
| August | Total catch | 137.8 (136.4) | 1,142.7 (807.0) | 1,556.1 (988.1) | 6.9 (13.1) | 26.7 (43.0) | 47.4 (72.0) |
| | Total harvest | 66.9 (58.3) | 426.0 (233.7) | 626.6 (322.2) | - | - | - |
| | % Harvested | 49% | 37% | 40% | - | - | - |
| September | Total catch | 471.0 (390.2) | 1,707.8 (607.2) | 3,120.7 (1,590.4) | 12.8 (20.5) | 12.8 (22.0) | 51.3 (82.5) |
| | Total harvest | 86.1 (59.0) | 615.1 (291.1) | 873.5 (391.3) | - | - | - |
| | % Harvested | 18% | 36% | 28% | - | - | - |

Table 14 (cont.). Monthly and annual total catch and harvest estimates for rainbow trout and brown trout during the 2007-2008 creel survey in the lower Boise River.

| | | Rainbow trout | | | Brown trout | | |
|---|---|---|---|---|---|---|---|
| **Month** | | **Fly** | **Bait & Lure** | **Total** | **Fly** | **Bait & Lure** | **Total** |
| **October** | **Total catch** | 834.9 (355.7) | 3,662.4 (1,199.5) | 6,167.1 (2,005.7) | 11.1 (18.1) | 35.6 (53.9) | 68.7 (123.3) |
| | **Total harvest** | 166.3 (129.6) | 721.5 (441.2) | 1,220.4 (775.4) | - | - | - |
| | **% Harvested** | 20% | 20% | 20% | - | - | - |
| **November** | **Total catch** | 230.6 (189.6) | 716.6 (389.1) | 1,408.5 (882.5) | - | - | - |
| | **Total harvest** | 21.0 (22.9) | 89.6 (96.9) | 152.5 (159.7) | - | - | - |
| | **% Harvested** | 9% | 13% | 11% | - | - | - |
| **December** | **Total catch** | 25.7 (12.1) | 194.8 (177.0) | 271.8 (235.9) | 6.6 (4.8) | 47.5 (63.1) | 67.5 (84.4) |
| | **Total harvest** | - | - | - | - | - | - |
| | **% Harvested** | 0% | 0% | 0% | - | - | - |
| **Annual** | **Total catch** | 2,323.0 (654.1) | 13,735.1 (2,876.9) | 20,704.0 (4,067.7) | 44.7 (31.6) | 196.0 (116.2) | 329.9 (202.4) |
| | **Total harvest** | 426.0 (161.3) | 2,998.7 (736.3) | 4,276.7 (1,075.7) | - | - | - |
| | **% Harvested** | 18% | 22% | 21% | - | - | - |

Table 15. Monthly and annual total catch and harvest estimates for steelhead and mountain whitefish trout during the 2007-2008 creel survey in the lower Boise River.

| | | Steelhead | | | Mountain whitefish | | |
|---|---|---|---|---|---|---|---|
| Month | | Fly | Bait & Lure | Total | Fly | Bait & Lure | Total |
| January | Total catch | - | - | - | 4.7 (5.3) | 24.0 (32.1) | 38.1 (46.6) |
| | Total harvest | - | - | - | - | - | - |
| | % Harvested | - | - | - | - | - | - |
| February | Total catch | - | - | - | 11.9 (11.0) | 15.7 (15.1) | 51.5 (46.7) |
| | Total harvest | - | - | - | - | - | - |
| | % Harvested | - | - | - | - | - | - |
| March | Total catch | - | - | - | - | - | - |
| | Total harvest | - | - | - | - | - | - |
| | % Harvested | - | - | - | - | - | - |
| April | Total catch | - | - | - | 32.8 (49.9) | 394.1 (635.1) | 492.6 (798.0) |
| | Total harvest | - | - | - | - | - | - |
| | % Harvested | - | - | - | - | - | - |
| May | Total catch | - | - | - | - | - | - |
| | Total harvest | - | - | - | - | - | - |
| | % Harvested | - | - | - | - | - | - |
| June | Total catch | - | - | - | 36.4 (43.4) | 537.6 (858.0) | 646.8 (1,025.4)) |
| | Total harvest | - | - | - | - | - | - |
| | % Harvested | - | - | - | - | - | - |
| July | Total catch | - | - | - | 7.8 (11.2) | 81.3 (128.9) | 104.8 (171.5) |
| | Total harvest | - | - | - | - | - | - |
| | % Harvested | - | - | - | - | - | - |
| August | Total catch | - | - | - | 0.8 (1.1) | 12.9 (24.2) | 15.4 (28.5) |
| | Total harvest | - | - | - | 0.8 (1.1) | 12.9 (24.2) | 15.4 (28.5) |
| | % Harvested | - | - | - | 100% | 100% | 100% |
| September | Total catch | - | - | - | 6.1 (8.3) | 27.1 (38.5) | 45.3 (55.9) |
| | Total harvest | - | - | - | - | - | - |
| | % Harvested | - | - | - | - | - | - |

Table 15 (cont.). Monthly and annual total catch and harvest estimates for steelhead and mountain whitefish during the 2007-2008 creel survey in the lower Boise River.

| | | Steelhead | | | Mountain whitefish | | |
|---|---|---|---|---|---|---|---|
| **Month** | | **Fly** | **Bait & Lure** | **Total** | **Fly** | **Bait & Lure** | **Total** |
| **October** | **Total catch** | - | - | - | 69.2 (112.6) | 209.3 (338.9) | 416.9 (658.6) |
| | **Total harvest** | - | - | - | - | - | - |
| | **% Harvested** | - | - | - | - | - | - |
| **November** | **Total catch** | 68.1 (85.2) | 386.0 (471.7) | 590.3 (703.5) | 26.0 (28.4) | 142.4 (170.4) | 220.5 (245.7) |
| | **Total harvest** | 68.1 (85.2) | 386.0 (471.7) | 590.3 (703.5) | - | - | - |
| | **% Harvested** | 100% | 100% | 100% | - | - | - |
| **December** | **Total catch** | 4.4 (3.1) | 32.1 (57.8) | 45.5 (76.2) | 4.0 (2.5) | 26.2 (35.3) | 38.2 (52.5) |
| | **Total harvest** | 4.4 (3.1) | 32.1 (57.8) | 45.4 (76.2) | - | - | - |
| | **% Harvested** | 100% | 100% | 100% | - | - | - |
| **Annual** | **Total catch** | 72.5 (85.3) | 418.1 (475.2) | 635.8 (707.6) | 199.8 (135.0) | 1,470.6 (1,142.2) | 2,069.9 (1,490.9) |
| | **Total harvest** | 72.5 (85.3) | 418.1 (475.2) | 635.8 (707.6) | 0.8 (1.1) | 12.9 (28.5) | 15.4 (28.5) |
| | **% Harvested** | 100% | 100% | 100% | 0% | 1% | 1% |

# Dry Creek Redband Trout Survey

## ABSTRACT

Dry Creek, located in the Boise foothills, was sampled in order to determine the presence of redband trout. A total of 44 redband trout, ranging in size between 80 - 210 mm, were sampled from two sites and we estimated a fish density of 0.2 fish/$m^2$ in the lower site. Genetic analyses indicated that these redband trout are genetically pure with no evidence of introgression with coastal rainbow trout.

## INTRODUCTION

Dry Creek is a first-order stream located in the Boise Foothills of Ada County (Figure 42). This tributary to the Boise River becomes intermittent in the lower reaches though in some years Dry Creek carries a substantial volume of spring runoff. The upper sections of Dry Creek have perennial stream flow and were expected to support redband trout. The purpose of the survey was to determine the presence and density of redband trout in Dry Creek.

## METHODS

Dry creek was surveyed on July 22, 2008. Two crews surveyed Dry Creek using a Smithroot backpack electrofisher (Model 15-B). Two sites were selected upstream of where Dry Creek crosses Bogus Basin Road. The lower site (Dry Creek #1) was located approximately 0.6 km upstream of Bogus Basin Road and was 63 m in length with an average wetted width of 1.97 m (Figure 42). The upper Site (Dry Creek #2) was located at the confluence of Dry Creek and Shingle Creek, this site served only to document presence and evaluate length frequency. A depletion estimate was conducted on the Dry Creek #1 site. Fin clips were taken from all fish for the purpose of assessing the genetic makeup of the sampled fish.

Tissue samples were collected from 40 redband trout to assess the purity and diversity of this putative redband trout population. All lab work, analyses and summary were provided by Matthew Campbell and the staff of the Eagle Fish Genetics Laboratory, Eagle Idaho. Samples were genotyped with 17 microsatellite loci (Stephenson et al. 2008, Nielsen et al 2009) and 2 single nucleotide polymorphism assays diagnostic between redband trout and hatchery rainbow trout (Campbell et al., In Prep). In addition to these genetic markers, all samples were also screened with a modified Y-specific assay (*IDFG-OMY-SEX*) that differentiates sex in *O. mykiss* (IDFG unpublished data; >99% accurate, ~500 known hatchery females, ~500 known hatchery males). The sample set was tested for Hardy–Weinberg equilibrium with GENEPOP on the Web (Raymond and Rousset 1995). Genetic diversity was measured by the number of alleles per locus ($N_A$) and expected heterozygosity ($H_E$) using the Microsatellite Toolkit for Microsoft excel ™ (Park 2001).

## RESULTS AND DISCUSSION

Twenty-eight redband trout were captured at Dry Creek #1 in three electrofishing passes (Figure 43). The estimated redband trout population >100mm in the section was 27 (25-33, 95% CI) for a density of 0.2 fish/m$^2$. Only three redband trout <100 mm were captured during the first sampling pass. Sixteen redband trout were captured in the upper section, Dry Creek #2 (Figure 43). Over 50% of the redbands captured at site #2 were <100 mm compared to 10% at Site #1.

Sample DRY-02 exhibited an identical genotype to DRY-03 (34 alleles). Sample DRY-05 exhibited an identical genotype to DRY-06. Sample DRY-36 exhibited an identical genotype to DRY-38. Samples DRY-03, 06, and 38 were subsequently dropped from the analyses. Of the remaining 37 samples, 17 were identified as females (46%) and 20 were identified as males (54%). Tests for Hardy-Weinberg equilibrium revealed that genotypes were in expected proportions (Chi$^2$ = 34.08; p-value = 0.198). There was no evidence of inbreeding. Tests on each individual locus are shown in Table 16. Of the 17 microsatellite loci genotyped on these samples, 13 had been previously screened on 62 *O. mykiss* populations from southwest Idaho

(Kozfkay et al. In Prep) allowing for comparisons of genetic diversity (Table 17). Samples from Dry Creek exhibited levels of diversity lower than the median level observed in the larger dataset (expected heterozygosity of 67% versus 69% median; number of alleles of 5.1 versus 6.8 median).

Results from both the microsatellite screening and the SNP screening suggest that this is a pure redband trout population. Assignment tests based on 13 microsatellite loci were performed using the software program ONCOR http://www.montana.edu/kalinowski/ONCOR.htm. Samples were assigned back to two reporting groups: "redband trout" (9 populations) or "hatchery rainbow trout" (13 populations). All samples from Dry Creek assigned to the "redband trout" reporting group with 100% probability (data not shown). The diagnostic SNP screening supported these results with no diagnostic "hatchery" alleles observed in any of the Dry Creek samples. Instead, the population exhibits SNP allele frequencies similar to reference pure redband trout (Table 18).

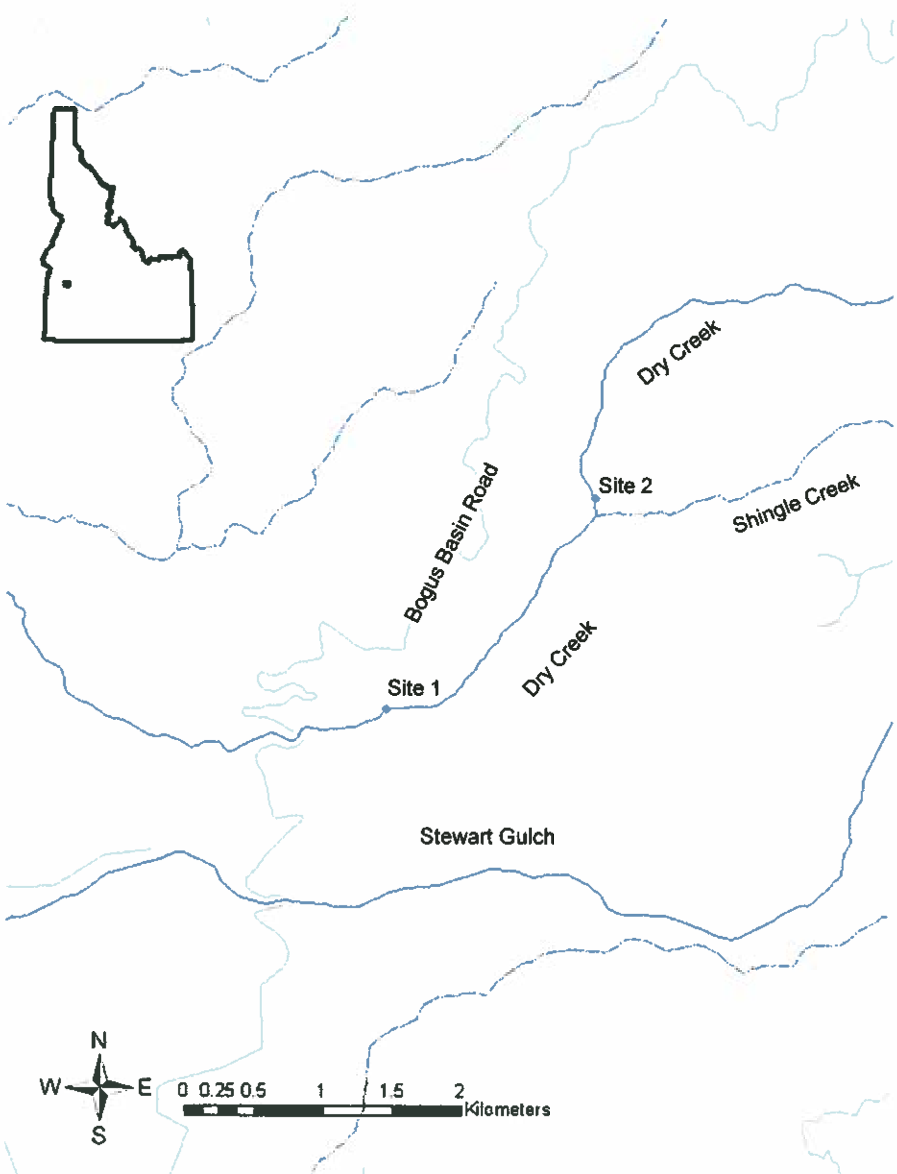



Figure 42. Map of Dry Creek with locations of two electrofishing sites sampled on July 22, 2008.

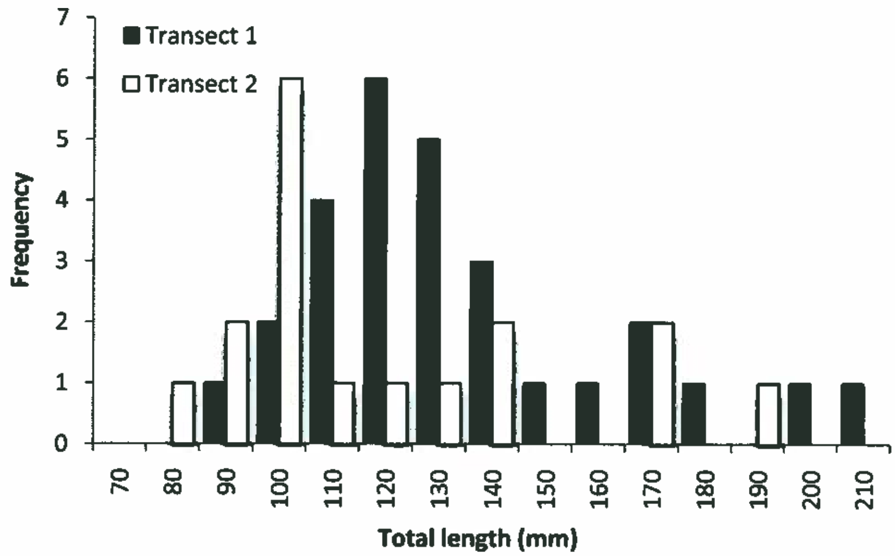


Figure 43. Length frequency of redband trout from Dry Creek July 22, 2008.

Table 16. Hardy-Weinberg probability test for each of the 17 loci. FIS (inbreeding coefficient) estimated according to Weir and Cockerham 1984 (W&C) and Robertson and Hill 1984 (R&H).

| LOCUS | P-val | S.E | $F_{IS}$ (W&C) | $F_{IS}$ (R&H) |
|---|---|---|---|---|
| Ogo4 | 0.656 | 0.007 | -0.119 | -0.073 |
| Omy1001 | 0.036 | 0.005 | 0.100 | 0.079 |
| Omy7 | 0.463 | 0.012 | -0.016 | -0.028 |
| Oki23 | 0.214 | 0.008 | 0.093 | 0.024 |
| Omy1011 | 0.211 | 0.016 | -0.015 | -0.012 |
| Ots3m | 0.552 | 0.008 | 0.090 | 0.067 |
| Ssa407 | 0.444 | 0.022 | -0.054 | -0.023 |
| Ssa408 | 0.445 | 0.009 | 0.112 | 0.035 |
| Ogo1a | 1 | 0.000 | -0.014 | -0.014 |
| Omy27 | 0.288 | 0.005 | -0.003 | -0.007 |
| Oneu14 | 1.000 | 0.000 | 0.022 | 0.002 |
| Oneu8 | 0.958 | 0.005 | -0.064 | -0.061 |
| Ots4 | 1 | 0.000 | -0.009 | -0.018 |
| Omy325 | 0.262 | 0.013 | -0.120 | -0.091 |
| Oke4 | 0.044 | 0.004 | 0.150 | 0.146 |
| Ots100 | 0.614 | 0.010 | -0.150 | -0.098 |
| Ssa289 | 0.613 | 0.006 | -0.044 | -0.049 |

Table 17. Population, Sample size, expected heterozygosity ($H_E$) and number of alleles per locus ($N_A$) of Dry Creek samples and 62 O. *mykiss* populations from Southwest Idaho (13 microsatellite loci).

| Population | Sample size | $H_E$ | $N_A$ |
|---|---|---|---|
| Jarbidge | 46 | 0.79 | 10.8 |
| LSFBoise | 23 | 0.78 | 8.3 |
| Squaw | 30 | 0.77 | 7.9 |
| Beaver | 29 | 0.77 | 9.9 |
| Squaw Sec | 31 | 0.76 | 9.4 |
| Boise RE | 31 | 0.75 | 9.8 |
| Willow | 62 | 0.75 | 10.0 |
| Tripod | 29 | 0.74 | 7.4 |
| Jordan | 57 | 0.74 | 9.3 |
| Salmon Falls | 40 | 0.74 | 8.6 |
| Bruneau | 19 | 0.74 | 7.0 |
| Keithley | 16 | 0.74 | 7.1 |
| Petes | 30 | 0.74 | 7.8 |
| SalmonFNF | 30 | 0.73 | 7.8 |
| EFWood | 28 | 0.73 | 6.7 |
| UpMFBoise | 56 | 0.73 | 8.8 |
| Cottonwood | 35 | 0.73 | 7.5 |
| Juniper | 30 | 0.72 | 8.2 |
| Jumps | 43 | 0.72 | 5.9 |
| BigWoodStar | 28 | 0.72 | 7.6 |
| RoaringR | 58 | 0.71 | 8.3 |
| Indian | 30 | 0.71 | 6.8 |
| LitWeiser | 30 | 0.71 | 8.2 |
| Williams | 85 | 0.71 | 7.2 |
| BigJacks | 29 | 0.71 | 6.8 |
| Hornet | 29 | 0.71 | 7.6 |
| Deer | 57 | 0.70 | 7.3 |
| Sinker | 29 | 0.70 | 6.9 |
| UpBigSmokey | 35 | 0.70 | 7.4 |
| PikesFork | 57 | 0.70 | 8.6 |
| Smith | 56 | 0.70 | 7.6 |
| LitCanyon | 32 | 0.70 | 6.8 |
| WhiskeyJack | 54 | 0.69 | 8.2 |
| Johnson | 58 | 0.69 | 8.8 |
| UpManns | 31 | 0.69 | 7.2 |
| EightMile | 29 | 0.69 | 8.0 |

Table 17 (cont.). Population, Sample size, expected heterozygosity (HE) and number of alleles per locus (NA) of Dry Creek samples and 62 *O. mykiss* populations from Southwest Idaho (13 microsatellite loci).

| Population | Sample size | $H_E$ | $N_A$ |
|---|---|---|---|
| Clear | 22 | 0.67 | 7.3 |
| ShoshoneMF | 23 | 0.67 | 6.3 |
| RedWarrior | 59 | 0.67 | 6.1 |
| Owyhee | 28 | 0.67 | 5.5 |
| Shack | 30 | 0.67 | 5.3 |
| Dry Creek | 37 | 0.67 | 5.1 |
| Dive | 38 | 0.66 | 6.7 |
| Bennet | 31 | 0.66 | 6.3 |
| Fawn | 30 | 0.66 | 6.2 |
| NFThompson | 25 | 0.66 | 6.2 |
| McMullen | 27 | 0.65 | 5.8 |
| EFBigWood | 23 | 0.65 | 6.4 |
| Duncan | 73 | 0.63 | 6.5 |
| Longs | 30 | 0.63 | 5.9 |
| CedarUp | 29 | 0.62 | 5.8 |
| OwyheeNF | 29 | 0.61 | 4.5 |
| Silver | 39 | 0.61 | 7.7 |
| Shoefly | 30 | 0.61 | 5.5 |
| Wickahoney | 49 | 0.61 | 4.8 |
| ColdSpring | 63 | 0.60 | 5.8 |
| Copper | 29 | 0.59 | 6.8 |
| LittleJacks | 65 | 0.58 | 5.8 |
| Shasta | 69 | 0.57 | 5.4 |
| ES | 47 | 0.56 | 4.2 |
| ULitWood | 14 | 0.52 | 4.4 |
| Jump | 58 | 0.51 | 3.2 |
| CrabMid | 35 | 0.48 | 3.2 |

Table 18. Allele frequencies of reference redband trout populations, reference hatchery rainbow trout populations, and the study population (Dry Creek "DRYC") at the MYO211*G and SOD-WSU*152 SNP loci.

Reference Redband Populations

| LOCUS | ALLELE | BENN | BIGJ | HATC | NFOW | SHAC | UPJE | UPRI | WOLF | DWOR | KOOT | NFCA | UPJU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MYO211 | G | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| SOD-WSU | 152 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |

Reference Hatchery Populations

| LOCUS | ALLELE | EAGL | FISH | HARD | HARR | HAY1 | HAY2 | ERWI | MCCO | SHAS | MTWH | MTLD | MTLH | ARLE | SHEA | SHEM | HOFE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MYO211 | G | 0.317 | 0.667 | 0.391 | 0.453 | 0.415 | 0.189 | 0.350 | 0.450 | 0.333 | 0.465 | 0.385 | 0.390 | 0.349 | 0.609 | 0.413 | 0.212 |
| SOD-WSU | 152 | 0.183 | 0.348 | 0.281 | 0.197 | 0.447 | 0.255 | 0.400 | 0.017 | 0.133 | 0.205 | 0.770 | 0.380 | 0.193 | 0.270 | 0.402 | 0.394 |

Test Population

| LOCUS | ALLELE | DRYC |
|---|---|---|
| MYO211 | G | 0.000 |
| SOD-WSU | 152 | 0.000 |

# Mason Creek Fish Survey


## ABSTRACT

The section of Mason Creek that runs through Lakeview Park in Nampa, Idaho, was sampled in 2008 to assess the fish community and whether or not it was suitable for stocking rainbow trout into the section. The fish community was composed of almost entirely non-game species and no rainbow trout were sampled. Additionally, maximum daily stream temperatures suggested that survival of stocked fish would be poor during the summer months because of warm temperatures.

## INTRODUCTION

Mason Creek is a 29-km stream located in the southern portion of the lower Boise River watershed, Idaho. Mason Creek flows through both Ada and Canyon counties in a northwest direction from its origin at the New York Canal to its confluence with the Boise River, southeast of Caldwell. Mason Creek can be divided into two sections: (1) the upper section, between New York Canal and Ridenbaugh Canal, is intermittent, only flowing during the irrigation season, and (2) the lower section, from Ridenbaugh Canal to the Boise River, which is perennial (IDEQ 2001). During irrigation season, the New York Canal discharges directly into Mason Creek, via the Mason Creek feeder, which flows for approximately 14 km to the Ridenbaugh Canal, which dewaters nearly all of Mason Creek. The remaining 15 km of Mason Creek, from Ridenbaugh Canal to the Boise River, is constantly charged by groundwater from the high surrounding water table. Relatively little data exists on the fish assemblage within this lower portion of Mason Creek, although historical records indicate that a small number of rainbow trout had been observed prior to 1975 (IDEQ 2001).

An approximate 0.8-km section of the lower portion of Mason Creek flows through Lakeview Park, a popular recreational area within the city of Nampa, Idaho (Figure 44). The stream is low gradient and <3 m in width throughout this reach. Because of the popularity of Lakeview Park, IDFG personnel evaluated the fish assemblage in the section of stream within the park to determine if rainbow trout were present and if the section was a suitable location for stocking rainbow trout.

## METHODS

Mason Creek was surveyed on March 19, 2008. The crew consisted of one person with a Smith Root backpack electrofisher (Model 15-B) and one netter. A single pass was sampled through a 138-m section of stream within the park. Fish were identified by species, enumerated, and measured for total length (mm).

A HOBO™ temperature data logger (Onset Computer Corporation) was deployed within the sampled stream section on June 24th through 26th August 2008. Water temperatures (°C) were recorded every hour to examine daily mean, minimum, and maximum stream temperatures during the summer period.

## RESULTS AND DISCUSSION

Ninety-four fish were collected during the sampling event. The fish community was composed of non-game fish largely (98%; Table 19). Rainbow trout were not sampled. Only two species of game fish, one (121 mm) bluegill and one (172 mm) largemouth bass were observed. Chiselmouth *Acrocheilus alutaceus* were the predominant species (51%), followed by largescale suckers (27%). Other species present included northern pikeminnow, redside shiner, and oriental weatherfish *Misgurnus anguillicaudatus*.

Mean daily stream temperature for the Lakeview Park section of Mason Creek was 18.4 °C (Figure 45). The maximum stream temperature of 24 °C was recorded on June 25th while the minimum temperature of 14 °C was recorded on August 26th. Daily stream temperatures reached or exceeded 20 °C on 54 of the total 62 days the logger was deployed.

Rainbow trout were not detected within the section of Mason Creek in Lakeview Park. Habitat and water temperature limitations are likely to limit the survival of hatchery rainbow trout. Aside from the park, relatively few areas of the stream are accessible to anglers, thereby limiting the value of dispersed hatchery fish should a stocking program be implemented.

## MANAGEMENT RECOMMENDATION

1. Continue current management practices of Mason Creek and do not stock rainbow trout because of habitat and water temperature limitations.

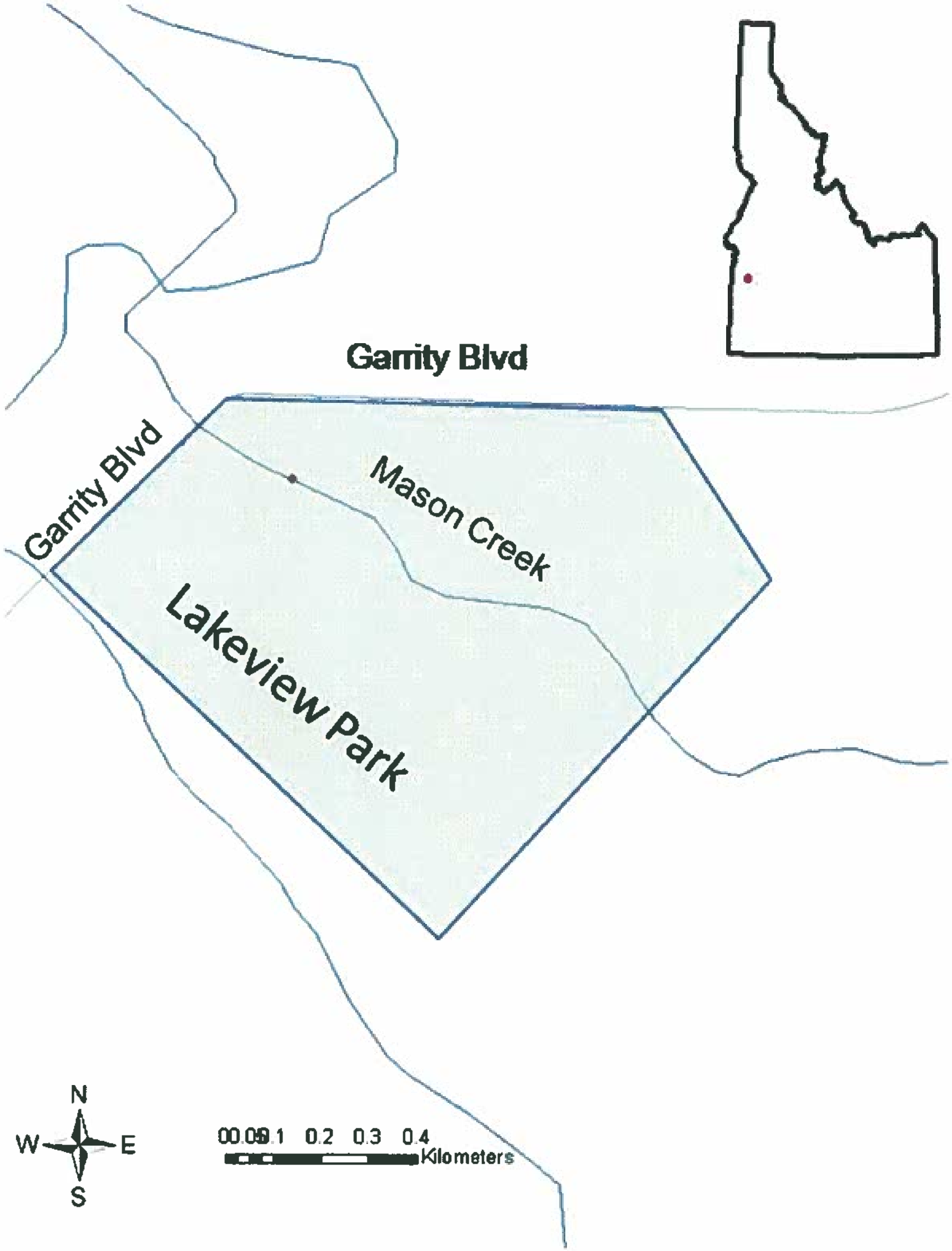



Figure 44. Map of Mason Creek and approximate area of Lakeview Park, Nampa, Idaho.

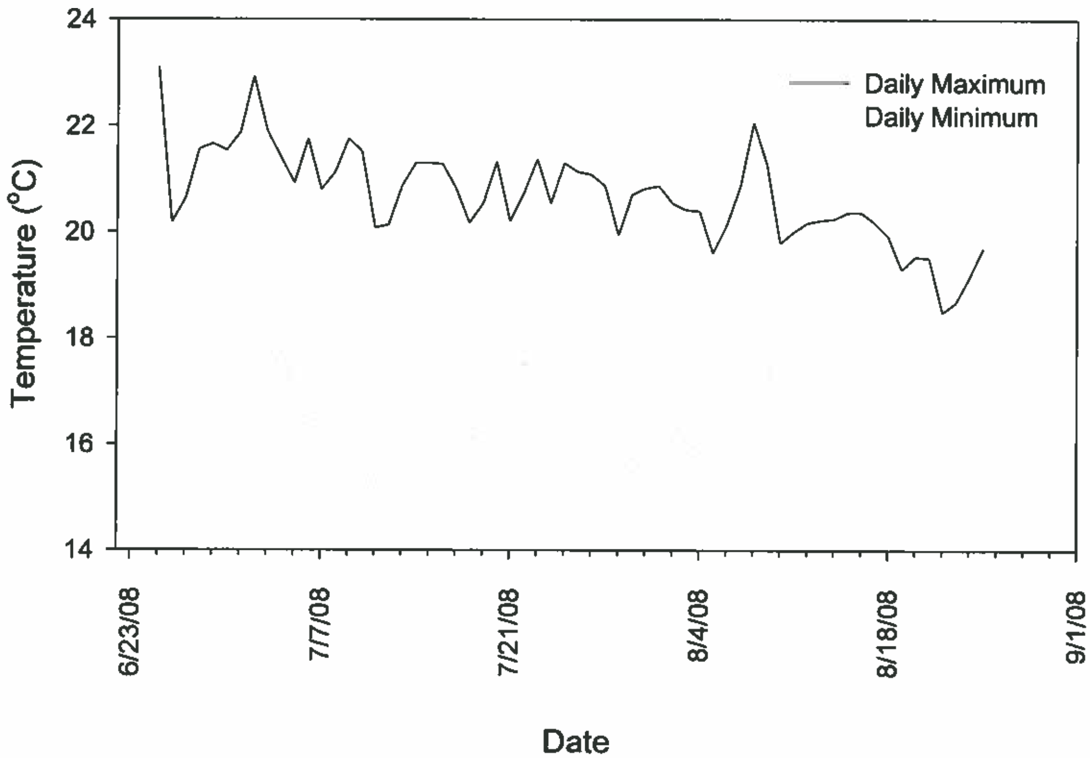



Figure 45. Daily maximum and minimum water temperatures within the sampled section of Mason Creek at Lakeview Park, Nampa, Idaho during summer 2008.

Table 19. Fish collected within a 138 m section of Mason Creek at Lakeview Park, Nampa, Idaho on 19 March 2008.

| Species | Number collected | Percentage (%) of sample |
|---|---|---|
| Bluegill | 1 | 1% |
| Chiselmouth | 48 | 51% |
| Largemouth Bass | 1 | 1% |
| Largescale Sucker | 25 | 27% |
| Northern Pike Minnow | 5 | 5% |
| Oriental Weatherfish | 6 | 6% |
| Redside Shiner | 8 | 9% |

## Long-term Monitoring of Redband Trout Populations in Desert Basins of the Bruneau, Owyhee, and Snake River Drainages


## ABSTRACT

As part of a long-term redband trout monitoring effort, IDFG and BLM personnel agreed to sample 63 stream sites within the Bruneau, Owyhee, and Snake river drainages from 2008-2010. During 2008, we completed 12 fish population surveys in the Jordan Creek drainage, a tributary to the Owyhee River. Redband trout were captured at 11 of the 12 sites. Average redband trout density equaled 32.5 ±19.3 trout/100 $m^2$ of stream (mean ± 90% CI). This average density is intermediate to past surveys. Capture probability varied among the two size classes used for this analysis. For redband trout less than 100 mm, capture probability was 59%. For fish greater than or equal to 100 mm, capture probability was 82%. For all the 2008 sites combined, a total of 416 redband trout were sampled, and overall, 41% of the fish sampled were less than 100 mm, whereas 59% were greater or equal to 100 mm. These percentages closely resemble size structures documented during the last two surveys in this drainage. Redband trout populations have remained relatively stable in terms of distribution, abundance, and size structure in the Jordan Creek drainage since 1970.

## INTRODUCTION

Redband trout are native to all major river drainages in Southwestern Idaho. Within this large and diverse geographical area, redband trout have adapted to a variety of stream habitats including those of montane and desert areas. Some controversy has existed regarding whether adaptation to these disparate habitats has led to speciation at some level. Recently, those redband trout that reside in desert locales were petitioned for listing under the federal Endangered Species Act (ESA), under the assumption that they could be considered a separate subspecies. The petition was denied. Since that time, additional research has indicated that only one species of resident stream dwelling redband trout may exist in Southwest Idaho (Cassinelli 2008). Regardless of species designations, it is important to monitor redband trout population status across their full distribution. Population status of the redband trout from montane habitats has been studied extensively in Southwestern Idaho. However, due to remoteness and little angling interest, the redband trout from desert habitats has received less attention. These habitats include tributaries of the Bruneau, Owyhee, and Snake River drainages most often in headwater areas. As these populations are near the southern extent of their range and water temperatures are projected to increase, it has become especially important to monitor these populations closely.

A long-term assessment of redband trout distribution, density, and size structure was completed by Zoellick et al. (2005). This assessment compared 1993-2003 redband population characteristics at 43 sites within the Bruneau, Owyhee, and Snake river drainages to data collected at the same sites during 1977-1982. As a continuation of this effort, IDFG and U. S. BLM personnel agreed to resample these 43 sites over a three-year period beginning in 2008. Also, an additional 20 sites were added to more fully encompass redband trout distribution in the high desert environs of Southwest Idaho.

## METHODS

Multiple-pass depletion methods were used to estimate fish population characteristics at all sites. Sites were located using descriptions, photographs, or coordinates. Block nets were installed at the upstream and downstream end of each transect. Fish capture efforts utilized a Smith Root backpack electrofisher (Model 15-B) and a two- or three-person crew each of which was equipped with a dip net. Captured fish were held in small buckets and transferred to a livewell placed downstream of the site. Capture efforts focused on redband trout, but non-game species were also captured, identified, and visually categorized as sparse (1-10), many (10-50), or abundant (>50). A minimum of two passes were completed, however, if catch remained high (over 25% of the previous pass) a third pass was completed. Also, herpetofauna identified to species and recorded as eggs, larval form, juvenile, or adult. We sampled 12 sites during 2008 in the Jordan, Cow, Rock, and Flint creeks drainages. These sites are near but mostly south of Jordan Valley, OR and Silver City, ID (Figure 46). Population estimates were calculated using MicroFish 3.0 (Van Deventer 2006). Due to size related catchability differences, population estimates were calculated for two strata: (1) trout less than 100 mm, and (2) trout greater than or equal to 100 mm, then summed.

## RESULTS

Redband trout were captured at 11 of the 12 sites sampled during 2008. No redband trout were sampled at the Rock Creek (#20) site, despite being sampled at low densities at this site during 2002. One redband trout was sampled at the Josephine Creek site, though none had been sampled at this site previously. Total catch at the remaining sites ranged from 9 to 78 redband trout. No nonnative trout were sampled in this subset of sample sites, even though brook trout had been sampled at Jordan Creek site #14 during 1977.

Redband trout density for the 12 sites monitored during 2008 averaged 32.5 ± 19.3 trout/100 $m^2$ of stream (mean ± 90% CI). This density is intermediate to past surveys for these 12 sites. During 1977-1982, average density of redband trout was approximately 40% lower (19.7 ± 11.3 trout/100 $m^2$; Figure 47). However, during 1993-2003, redband trout average densities were on average about 20% higher than documented during 2008 (39.3 ± 21.6 trout/100 $m^2$). For the 9 sites with redband tout densities greater than 5 trout/100 $m^2$ in both of the last two surveys, density increased in three sites from 1993-2003 to the present effort, whereas densities declined in six other sites over the same time period. No density increases were noted at elevations less than 1,600 m; however, at higher elevations redband trout densities fluctuated both positively and negatively (Figure 48).

Capture probability varied among the two size classes used for this analysis. For fish less than 100 mm, mean capture probability was 59%. For fish greater than or equal to 100 mm, mean capture probability was 82%. For all the 2008 sites combined, a total of 416 redband trout were sampled with 41% < 100 mm, whereas 59% ≥ 100 mm. These percentages closely resemble size structures documented during the last two surveys in the Jordan Creek drainage. During the 1970s, 44% of the fish sampled were < 100 mm, whereas 56% were ≥ 100 mm ($n$ = 238). For the 1990s, 47% of the fish sampled were < 100 mm, whereas 53% were ≥ 100 mm ($n$ = 468).

## DISCUSSION

Redband trout populations have remained relatively stable in the Jordan Creek drainage since 1970. We saw no evidence of range constriction, expansion of potential predator or competitors, nor a decline in population abundance in this drainage. Snowpack in the Owyhee Mountains during the winter of 2006-2007 was less than 50% of normal and led to lower than normal stream flows during the following season. In theory, this should have substantially reduced recruitment and the survival of older age classes. However, we saw no evidence of population impacts due to recent drought conditions. Abundances were only 20% less than documented during the 1990s and were 40% higher than seen in the 1970s. Furthermore, the size structure of these populations has remained relatively unchanged over this period.

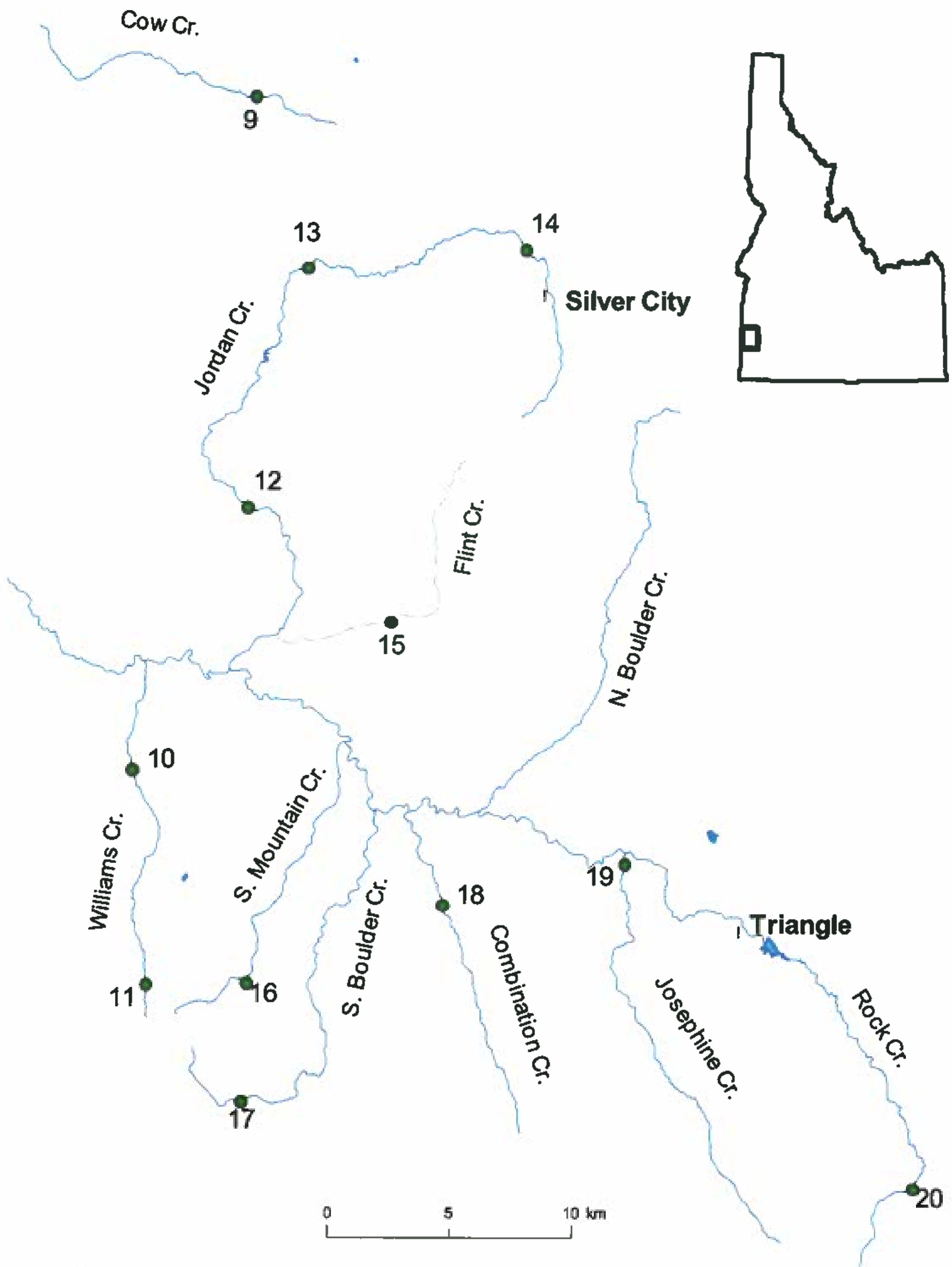



Figure 46. Location of 12 redband trout trend monitoring sites within the Jordan Creek drainage within Owyhee County, Idaho. Dots denote sampling sites.

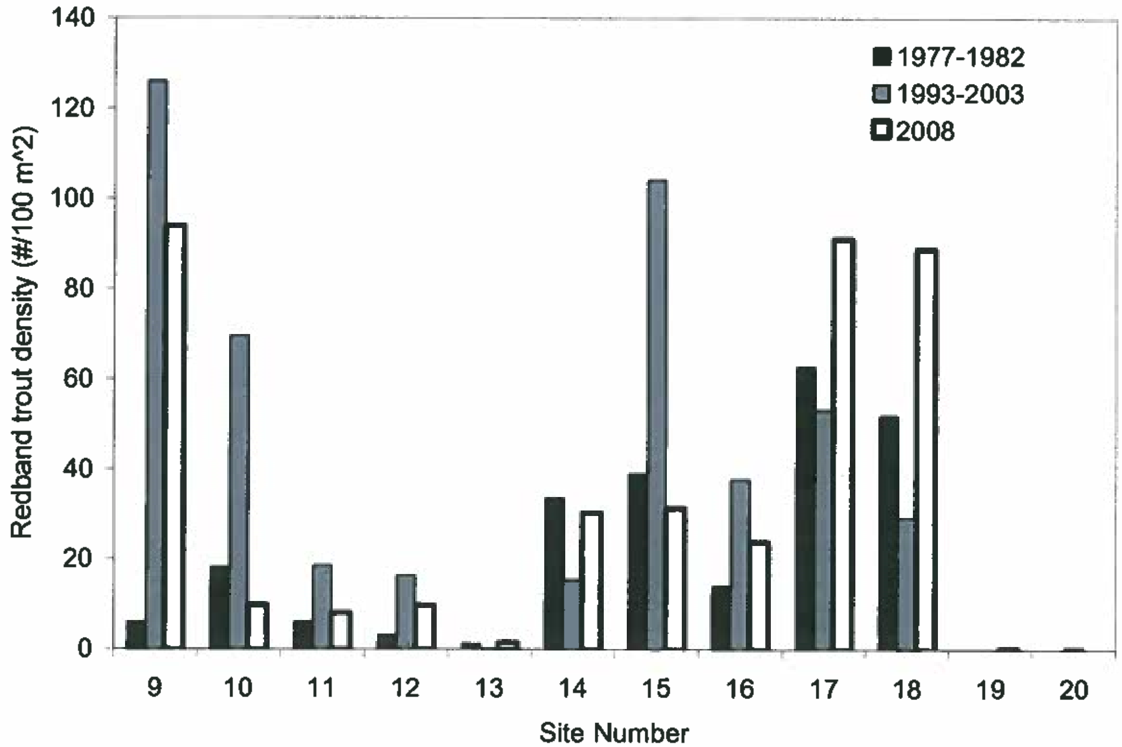



Figure 47. Redband trout density (#/100 $m^2$) at trend monitoring sites within the Jordan Creek drainage.

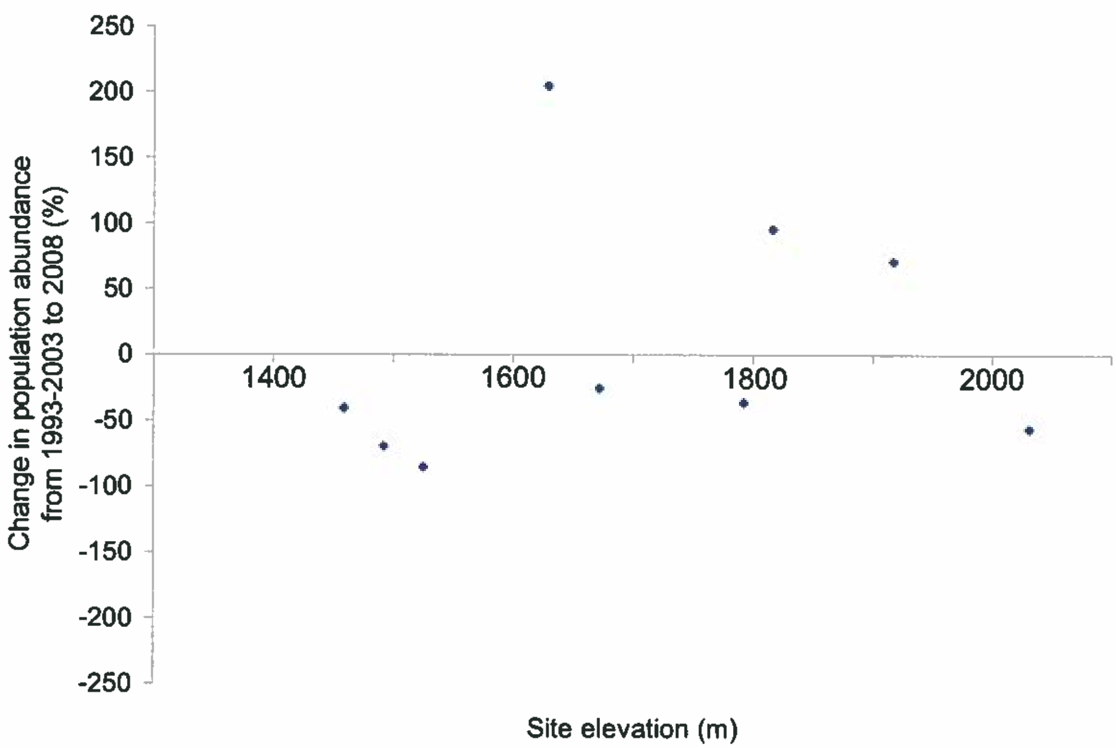



Figure 48. Percent change in population abundance at 9 of 12 redband trout trend monitoring sites surveyed during 2008. Population abundance was too low in 3 of the sites to allow comparisons.

# South Fork Boise River Canyon Electrofishing Survey


## ABSTRACT

The South Fork Boise River canyon section below Danskin Bridge was sampled with raft electrofishing equipment the first time during October 2008. Objectives for the survey included characterizing the size structure of the rainbow trout population for comparison to the upper tailwater section, and identifying sections that could serve as trend sites for future sampling. Eleven transects were sampled and a total of 211 rainbow trout were captured and measured. Rainbow trout between 250 - 400 mm were present in higher proportions than in the upper tailwater section, which is sampled every three years. Larger rainbow trout (>508 mm) were encountered at a higher rate in the tailwater section, but were not sampled in the canyon section. Ten of the 11 transects sampled in 2008 met criteria for serving as future sites for trend monitoring and mark-recapture studies. Future investigations will determine which sites to use and how often the surveys should occur.

# INTRODUCTION

Rivers downstream from dams form some of the most valued trout fisheries in the western United States. The South Fork Boise River (SFBR) below Anderson Ranch Dam is a highly-valued trout fishery and was the first river section in Southwest Idaho to be managed under "quality trout" regulations. Regulations restrict terminal tackle to no bait and barbless hooks from Neal Bridge (Forest Road 189) upstream to Anderson Ranch Dam. Rainbow trout harvest is restricted to 2 fish, none under 20 inches (508 mm). The fishery is supported by a population of wild rainbow trout and mountain whitefish. Migratory bull trout are present at very low densities.

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

Rainbow trout populations in the tailwater section of SFBR have been monitored in a 9.6-km section every three years since 1994 using mark-recapture techniques. The section starts at the boat ramp near Reclamation Village (4.2 km downstream from the dam) and ends at the take-out 1.1 km downstream from Cow Creek Bridge (Flatter et al. 2003). In 2006, sampling methodologies for the tailwater section were changed from raft electrofishing to canoe electrofishing in order to increase sampling efficiency and obtain better population estimates. In addition, 3 sections that were approximately 1-km long were identified within the historic surveys' boundaries for sampling. Kozfkay et al. (In press) demonstrated a pronounced increase in electrofishing efficiency for all size groups of rainbow trout resulting from the shift in sampling methodologies. From 1994 to 2006, rainbow trout population trends in the tailwater section indicate decreasing abundance, an increase in size structure, and a relative lack of intermediate-size (200 - 400 mm) fish.

Because of the difficult access and whitewater conditions, there has not been a documented attempt to assess fish populations within the canyon section. In 2008, IDFG decided to implement an electrofishing survey of the canyon section to compare with wild rainbow trout size distribution for the tailrace section, and to establish trend reaches in the canyon for semi-annual monitoring.

# METHODS

A raft mounted with electrofishing gear was used to collect fish and estimate size structure in the canyon section during September 19-20, 2008. Sample sites were selected on site during the downstream float. Reaches were selected when flow and habitat conditions were visibly conducive to safe navigation, electrofishing, and capturing fish for a distance $\geq$ 200 m. Beginning and ending transect coordinates were recorded for each sampling reach using a Garmin Global Positioning System (GPS). In one case, the canyon walls prohibited the GPS unit from communicating with satellites and the coordinates were estimated afterwards with topographic software. Electrofishing equipment included a raft, generator, Coffelt VVP-15, and two booms each supporting a 76-cm ring from which eight dropper anodes were suspended, and 11 m of 0.95-cm, diameter stainless steel cable served as a cathode. VVP settings used to collect fish were 350 V and approximately 3 A, pulsed direct current. Electrofishing was conducted with a single pass from upstream to downstream. One person rowed the raft and one person attempted to capture all trout. Only trout and whitefish were placed in the livewells. In addition, two catarafts carrying overnight camping provisions and equipment followed the raft during the survey. Upon completion of a section, or when the livewell was judged to be at capacity, the crew stopped at the nearest riffle to process fish. Fish were identified and measured for total length (mm). River flow during electrofishing was approximately 51 $m^3/s$.

## DISCUSSION AND RESULTS

A total of 11 transects were sampled between Danskin and Neal bridges during the 2-d survey. We captured 211 wild rainbow trout (Table 20) with a size range of 104 to 551 mm and a mean length of 284 mm (Figure 50). Comparison of length frequencies between the 2006 tailwater section and 2008 canyon section show a greater proportion of mid-sized rainbow trout between 200 and 450 mm in the canyon section, while proportionally more fish >450 mm existed in the tailwater section (Figure 51). The proportion of rainbow trout <250 mm were similar between the two sections, fish between 250-400 mm were captured at a higher frequency in the canyon section, while larger fish, particularly fish >508 mm were encountered at a higher rate in the tailwater section (Figure 51). Fish <100 mm were captured infrequently in the tailwater section and none were captured in the canyon section (Figure 49). However, comparing relative abundance between the two sections for rainbow trout < 100 mm is problematic because of the differences in sampling efficiencies for smaller fish between the two sampling methods. Rainbow trout <100 mm are generally found in shallow near-shore habitats with less flow which are less likely to be sampled efficiently by the raft gear. Additionally, electrofishing is size-selective for larger individuals and, without correction, often results in biased estimators of population size and size structure for smaller and slower growing individuals (Anderson 1995). Overall, raft electrofishing is less efficient for all size classes as the ability to capture fish is decreased by the limited mobility of the anodes and netter and by the inability to shock both banks. A total of 137 mountain whitefish were also captured (range = 89-547 mm; Figure 52). Mountain whitefish length distributions were similar between the two sections although a greater proportion of fish >400 mm were captured in the canyon section.

To examine potential sampling bias in rainbow trout length frequencies due to gear type, we compared both raft (2003) and canoe (2006) samples for the tailrace section to the 2008 raft sampling in the canyon. In the tailrace, both sample gears generated very similar length frequencies, with a noticeable lack of fish in the 250-400 mm size classes (Figure 52). Raft electrofishing clearly captured proportionately more 250-400 mm fish in the canyon section. We believe this is an accurate reflection of population differences for fish >100 mm between the tailrace and canyon section.

Aside from estimating size structure of rainbow trout within the canyon section, an objective of the 2008 canyon survey was to identify approximately 1-km-long sections of river that could be re-sampled in the future and perhaps be used for mark-recapture abundance estimates. A total of 11 transects were sampled, varying in length between 0.5-1.6 km (Table 20). Based on transects surveyed in 2008 nearly all sampled sections aside from transect 4 were close to containing approximate one km sections of river that were not interrupted by abrupt changes in habitat such as rapids. From this information, 3 or more transects could easily be chosen for future sampling events. However, because of the width of the river, attempts at estimating abundance using mark-recapture techniques will likely require two rafts concurrently sampling near each bank, which may be problematic in terms of acquiring adequate equipment and personnel for two separate marking and recapture events. Furthermore, it may be beneficial to conduct the canyon survey during the same year as the tailwater section for comparison purposes. At a minimum, this effort has established baseline size structure data for wild rainbow trout which will be easily repeatable in the future.

## MANAGEMENT RECOMMENDATIONS

1. Continue to monitor rainbow trout population trends in canyon section using 3-4 previously sampled transects within next 3 years.

2. Attempt mark-recapture population estimate in canyon section using two rafts concurrently for both mark and recapture events.

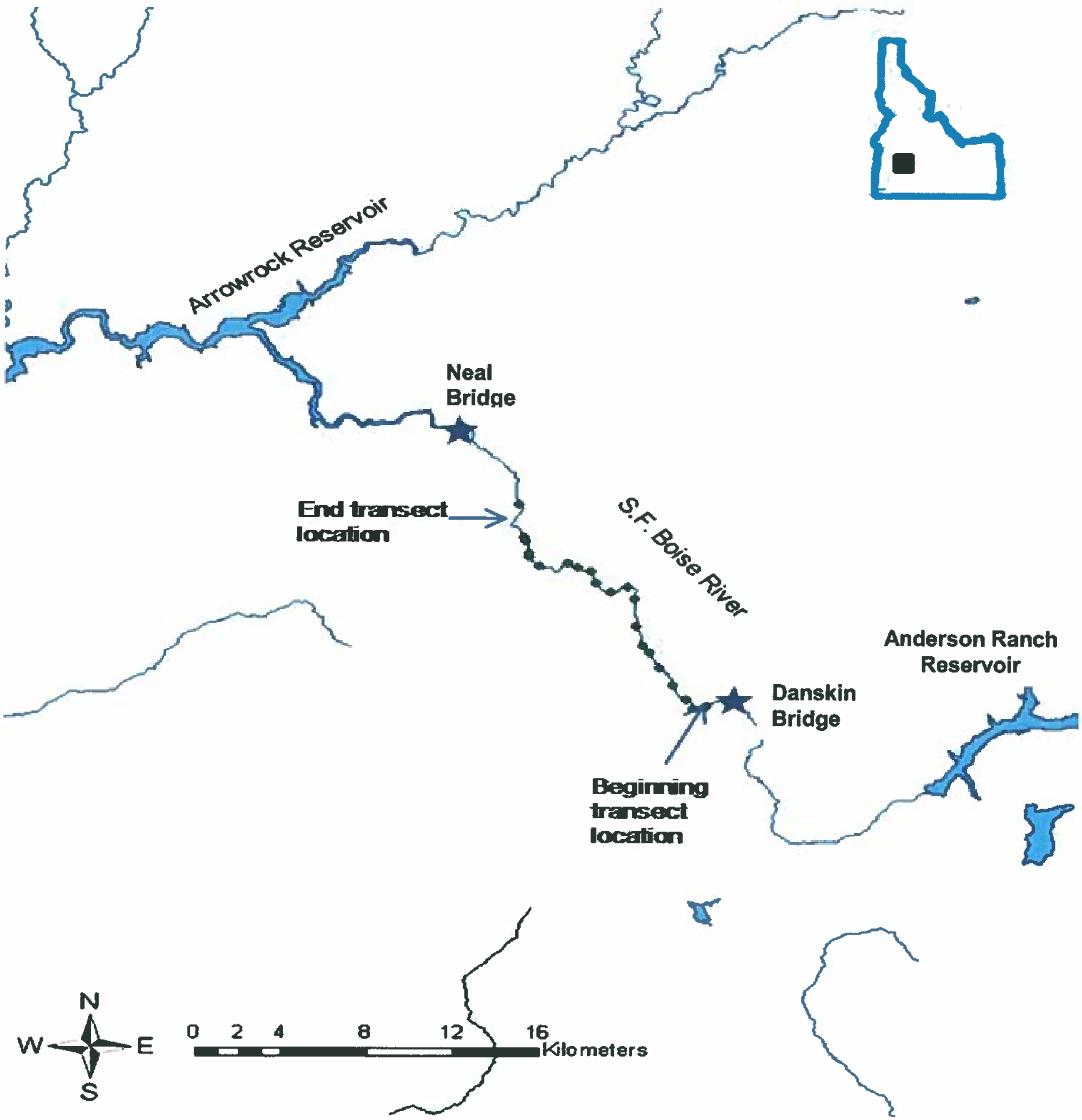



Figure 49. Map of South Fork Boise River and the starting and ending locations for all 11 transects sampled in the canyon section in 2008.

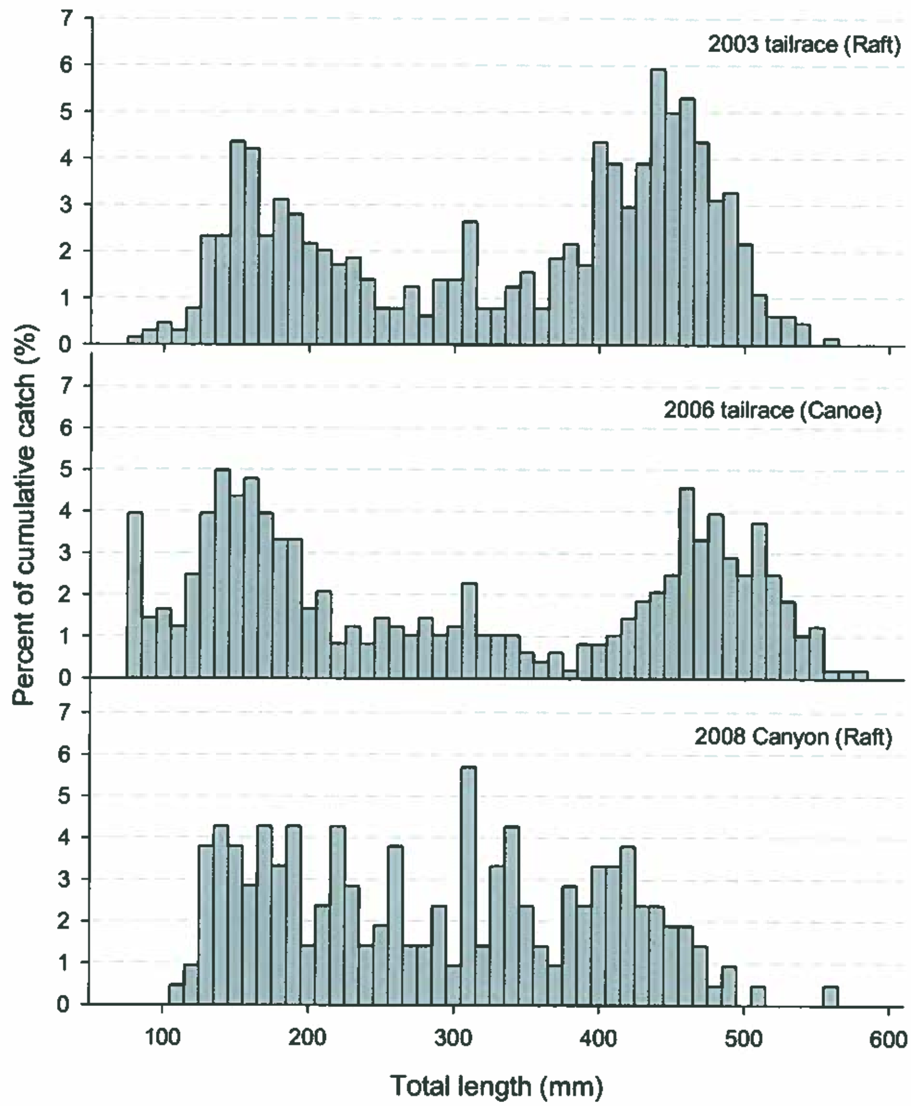



Figure 50. Rainbow trout length frequency distributions, calculated as proportion of total catch, for the 2003 and 2006 tailwater surveys and the 2008 canyon survey. The 2006 tailwater section was sampled by canoe electrofishing methods while the 2003 tailwater and 2008 canyon section was sampled by raft electrofishing.

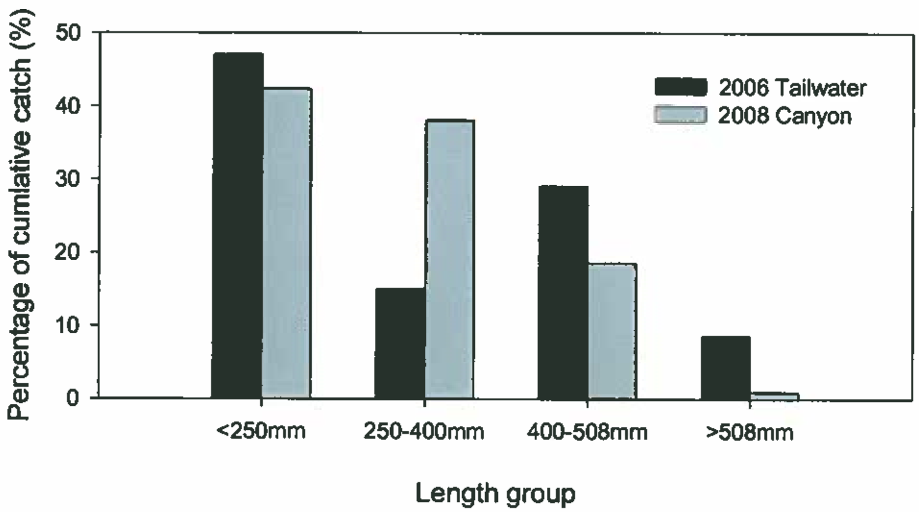



Figure 51. Comparison of proportion of rainbow trout captured by length groups between the 2006 tailwater survey and the 2008 canyon survey.

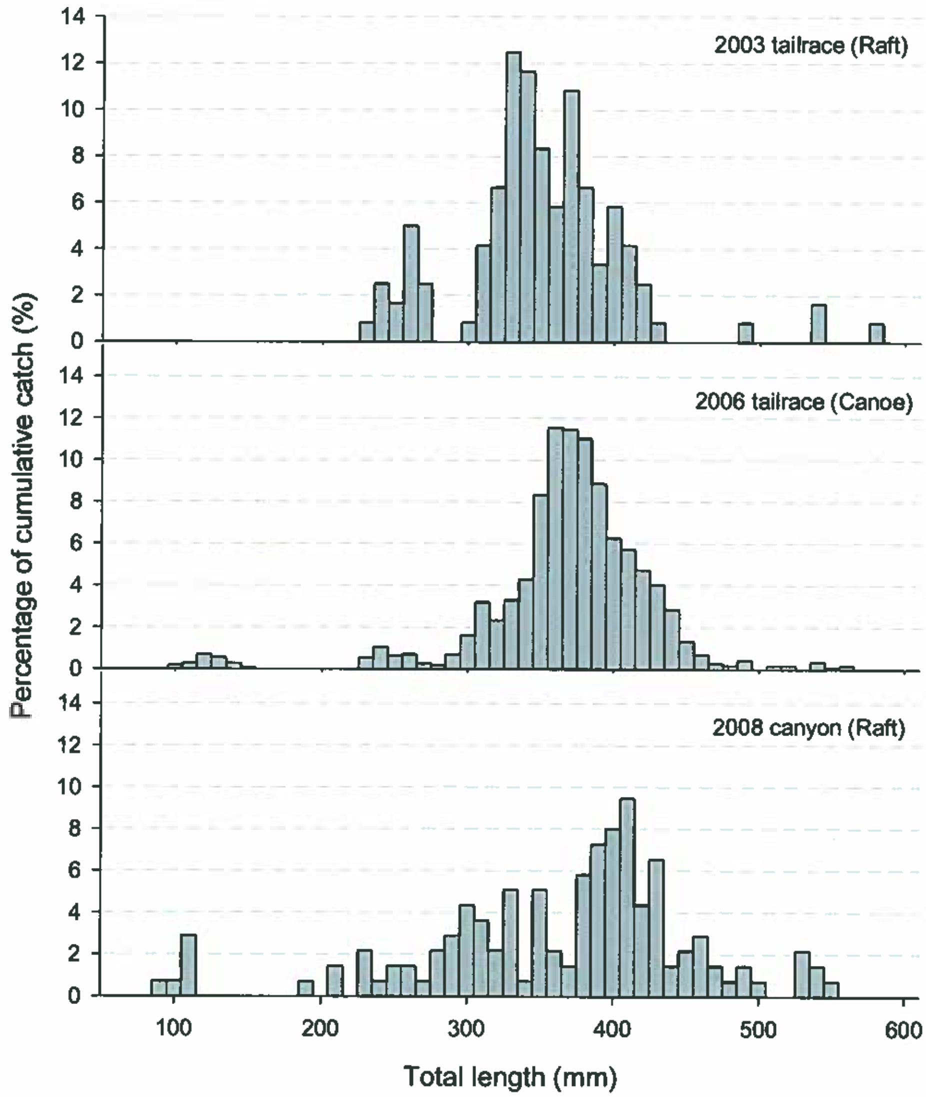



Figure 52. Mountain whitefish length frequency distributions, calculated as proportion of total catch, for the 2003 and 2006 tailwater surveys and the 2008 canyon survey. The 2006 tailwater section was sampled by canoe electrofishing equipment while the 2003 tailwater and 2008 canyon section was sampled with raft electrofishing equipment.

Table 20. Transect lengths and number of rainbow trout and mountain whitefish captured in each transect and for the entire survey. Transect lengths were estimated from start and end GPS coordinates and transect site descriptions.

| Sites | Transect length (km) | Mountain whitefish | Rainbow trout | Total |
|---|---|---|---|---|
| Transect 1 | 0.7 | 22 | 3 | 25 |
| Transect 2 | 0.7 | 11 | 23 | 34 |
| Transect 3 | 1.3 | 20 | 9 | 29 |
| Transect 4 | 0.5 | 21 | 19 | 40 |
| Transect 5 | 1.6 | 18 | 28 | 46 |
| Transect 6 | 0.9 | 29 | 16 | 45 |
| Transect 7 | 0.8 | 15 | 35 | 50 |
| Transect 8 | 0.5 | | 8 | 8 |
| Transect 9 | 0.7 | | 14 | 14 |
| Transect 10 | 1.0 | | 30 | 30 |
| Transect 11 | 1.3 | 1 | 26 | 27 |
| **Total** | 10.0 | 137 | 211 | 348 |

## Recreational Catch of White Sturgeon in the Snake River Downstream of C. J. Strike Dam

## ABSTRACT

We initiated a year-long creel survey of white sturgeon *Acipenser transmontanus* anglers in the Snake River reach from C. J. Strike Dam to Grandview Bridge. From May 2007 through April 2008, effort, catch rate, and loss rate were estimated using a roving-access creel survey supplemented with post cards to obtain completed trip information. Completed trip data were obtained from 90% of the post cards given to anglers. Of 1,063 completed trips that expended fishing effort, 1,046 (98%) were obtained from bank anglers and 17 (2%) were from boat anglers. Catch rate for bank anglers averaged 0.048 fish/h. Boat catch rates were two and a half times higher than bank catch rates, and boat anglers lost 41% of the fish they hooked, whereas bank anglers lost 61% of the fish they hooked. In total, 35,062 h were expended by boat and bank angler targeting white sturgeon. A total of 4,361 white sturgeon were hooked and fought, 1,996 were landed (46%) and 2,365 were lost (54%). The most recent population survey estimated that 566 white sturgeon over 70 cm reside in this reach. According to these data, an average sturgeon in this population was hooked 7.7 times during one year, including being landed 3.5 times and lost an additional 4.2 times. Non-sturgeon bank anglers expended an additional 26,769 h in this reach.

# INTRODUCTION

Prior to significant modification of the their riverine habitat, white sturgeon in Idaho likely exhibited long distance seasonal migrations within the Snake River and farther downstream to preferred spawning, feeding, and over-wintering habitats. Upstream movements of white sturgeon within the Idaho section of the Snake River were blocked by the completion of nine main-stem Snake River dams downstream of Shoshone Falls from 1901 through 1972 (Cochnauer 2002). Additionally, recreational angler harvest of white sturgeon probably exceeded replacement levels until 1972 when catch and release regulations were enacted.

Presently, nine sub-populations of white sturgeon exist in Idaho within their native range. Only two of which may be deemed healthy. The populations downstream of Hells Canyon and Bliss dams exhibit natural reproduction, normally shaped length/age frequencies, and possess adult populations of over 3,000 individuals (Idaho Department of Fish and Game 2008). Another six sub-populations exist in a depressed state with low population abundance (less than 200 individuals) as well as inadequate recruitment.

The remaining sub-population resides within the Snake River from C. J. Strike Dam, completed in 1952, downstream approximately 58 rkm to Swan Falls Dam, hereafter referred to as the C. J. Strike population. C. J. Strike Dam was completed in 1952, whereas Swan Fall Dam has been operational since 1901. This population possesses an intermediate abundance of adult sized fish when compared to other Idaho sturgeon populations. Idaho Power estimated that the C. J. Strike white sturgeon population was comprised of 725 individuals > 70 cm total length during 1996-1997 (Idaho Power Company 2003). A more recent population survey indicated that the white sturgeon population during 2005-2006 had declined to 566 individuals (Lepla 2008). Unfortunately, the length frequencies for both of these surveys indicated a paucity of fish less than 92 cm. Anecdotal reports by sport anglers support this notion as small fish have been caught infrequently. Inadequate recruitment has likely caused this population imbalance.

In modified habitats, sturgeon populations are often prone to recruitment failure. Blocked migration routes, reservoir capture of spring high flows, modification of thermal regimes, low adult population abundance, and inadequate lengths of free-flowing river segments have been implicated in the declines of other sturgeon populations usually through disruption of successful recruitment. Some or all of these factors have contributed to the recent decline and the continued existence of the C. J. Strike population at depressed levels.

Furthermore, the effects of fishing mortality may be contributing to the low population abundance of white sturgeon below C. J. Strike dam. The C. J. Strike population supports a year-round, focused, and presumably intense catch-and-release fishery. A very high percentage of the total fishing effort occurs immediately below the dam within the tailrace, where sturgeon concentrate. In addition, jet boat anglers target white sturgeon mostly upstream of Grandview, ID. Little sturgeon fishing effort occurs downstream of Grandview, ID. Post release mortality rates and possible sub-lethal effects of this fishery are unknown and may be difficult, if not impossible to estimate. Despite these limitations, it is still important to gain an understanding of the magnitude and nature of this fishery to determine whether current fishing levels could be reasonably assumed to be affecting recruitment success and, therefore, population abundance.

# OBJECTIVES

1. To estimate fishing effort, catch rate, and total annual catch of white sturgeon in the Snake River from C. J. Strike Dam to Grandview, Idaho (Hwy 67 Bridge).

2. To compare total annual catch to recent population size estimates to determine the average number of times sturgeon from this population are caught annually.

3. To compare fishing effort and catch rates among months as well as between weekdays and weekends/holidays.

# METHODS

Recreational fishing effort, catch rate, and total annual catch of white sturgeon between C. J. Strike Dam and Grandview, ID (Figure 53) were estimated using a combination creel survey method: the roving-access design (Pollock et al. 1994). Estimates of effort and catch rate were summarized by month from May 1, 2007 to April 30, 2008. Sampling periods were determined using a stratified random sampling methodology. Within months, primary sampling units were days. Days were stratified into two categories: 1) weekdays, and 2) weekends and holidays. Four primary sampling units were selected from each of these two categories for a total of eight sampled days per month. Days were then divided into three, eight-h periods (secondary sampling units). These periods included morning (4 am to 12 pm), afternoon (12 pm to 8 pm), and night (8 pm to 4 am). Secondary sampling units were selected with non-uniform probabilities based on effort information provided by IDFG conservation officers and Idaho Power dam operators (Stanovich and Nielsen 1991). During suspected high use periods (February-September), time periods were selected at probabilities of 0.10 for morning, 0.4 for afternoon, and 0.5 for night. During the suspected low use periods (October-January), time periods were selected at probabilities of 0.10 for morning, 0.60 for afternoon, and 0.30 for night (see Appendix).

We used roving instantaneous counts to estimate effort. Instantaneous counts of fishing effort were made by roving through the fishery on foot and with a vehicle on nearby roads where sturgeon anglers were counted using binoculars. In addition, the number of boat trailers were counted at the two ramp sites (Wooden bridge and Grandview city ramps) used by sturgeon anglers. The number of boat anglers was expanded by determining the average number of sturgeon anglers per boat. To complete these counts, a consistent route was followed. The route began on foot at Idaho Power's Scout Park, then proceeded by truck to the south side of the tailrace, then westward on Rim and Hayland roads along the north side of the river to highway 67. After crossing the Highway 67 Bridge, creel clerk(s) turned eastward and traveled on River Road along the south side of the river to the point of origin. Within a randomly selected secondary sampling unit, three instantaneous counts were conducted at the mid-point of randomly selected hours. For each survey day, a mean instantaneous count was determined and then divided by the selection probability. Daily effort values were averaged for the two primary sampling units separately. Average effort values were then expanded by the number of weekdays or weekend/holidays days per month. Furthermore, we enumerated the number of non-sturgeon angler fishing in this reach, though no catch information was collected from these anglers due to time constraints.

Catch rates were determined from a combination of angler interviews, sturgeon report cards, and follow up phone calls. Only completed trip information was used for catch rate estimation. Creel clerks conducted on site interviews on the same days as instantaneous counts. As anglers often fished for several days, creel clerks filled out cards for anglers that had fished previous days or had finished fishing for the day. For incomplete trips and future days, creel clerks handed out pre-paid, self-addressed sturgeon report cards (Figure 54) to sturgeon anglers. Anglers were asked to fill out the card and return it through the mail, at several nearby drop boxes, or to IDFG personnel. If report cards were not returned within two weeks (to reduce recall and non-response bias) of initial contact, follow-up phone calls were made to collect effort and catch information. If anglers could not be re-contacted after three attempts report cards were considered incomplete. Total catch for the month was divided by the total # of hours fished per month to determine average catch rate (i.e. ratio of means). In addition, anglers were asked to document the size of the fish they landed and the number of fish they hooked, fought, and lost during each trip.

## RESULTS

A total of 1,282 sturgeon report cards were either completed on site by creel clerks or provided to anglers. Completed individual daily trip information was available from 1,152 of these report cards (90%). Of the 1,152 cards, 18% were returned thru the mail, 27% were completed by creel clerks, 22% were collected in drop boxes, and 32% were completed with follow-up phone calls. Completed report cards from 89 of these individual trips indicated that no effort occurred on that particular day. Thus, monthly catch per unit effort indices were calculated from the remaining 1,063 completed trips that expended fishing effort with 1,046 (98%) coming from bank anglers and 17 (2%) coming from boat anglers.

For bank anglers only, we collected information from an average of 87 completed trips per month with a minimum of 19 in December to a maximum of 163 in May. Over the year long creel survey, catch per unit effort for bank anglers averaged 0.048 fish/h or one fish landed for every 21 h of angling effort (Table 21). No white sturgeon were landed during January 2008. Catch rates were generally higher (> 0.45 fish/h) during the early summer (May – June) and Fall (Sep - Nov) periods. The highest average monthly catch rate, 0.103 fish/h, occurred during June when one white sturgeon was caught for every 9.7 h of bank fishing effort. The number of fished hooked, fought, and lost followed a similar pattern, but at a higher rate. The average loss rate over this 12 month period was 0.064 fish/h or one fish lost every 16 hours of fishing effort, approximately 32% higher than the average catch rate. The highest loss rate, 0.107 fish/h, occurred during May when one white sturgeon was lost for every 9 h of bank fishing effort.

Over the same time period, monthly effort estimates (by bank anglers only) ranged from a minimum of 1,160 hours expended during October to a maximum of 4,713 h expended during June. Within our monthly estimates, fishing effort for the weekend/holiday strata (174.3 h/day) was on average about 2.8 times higher than for weekdays (62.3 h/day). Overall, white sturgeon bank fishing effort averaged 2,931 h/month and totaled 31,164 h. Using both effort and catch rates, we estimate that a total of 1,489 white sturgeon were caught by bank anglers over this year and an additional 2,013 white sturgeon were hooked, fought, and lost.

Too few contacts were made with boat anglers to allow statistical comparison of catch rates between boat and bank anglers across all months. Only 22 completed report cards were collected from boat anglers, with five indicating no effort. The majority of completed cards with fishing effort were collected during April and May with six each. From these limited samples, it appeared that catch rates from boat anglers were higher than those of bank anglers and the relative rate at which fish were lost from boats was lower. For April, boat catch rates (0.172 fish/h) were over four times greater than for bank anglers (0.036 fish/h; Table 22). For May, the difference was less pronounced; however, boat catch rates (0.109 fish/h) still exceeded those of bank anglers (0.067 fish/h) by 63%. For bank anglers, in April and May, loss rates were 53% and 58% higher than the catch rate for their respective months. For boat anglers, in April and May loss rates were 40 and 20% lower than the catch rates for their respective months indicating that in a relative sense, boat angler were more efficient than bank anglers at landing sturgeon once hooked. By combining catch and loss data from April and May, we estimate that boat catch rates were two and a half times higher than bank catch rates. Furthermore, for April and May combined, boat anglers, lost 41% of the fish they hooked and fought, whereas bank anglers lost 61% of the fish they hooked and fought.

The magnitude of effort expended by boat anglers targeting white sturgeon was much less then expended by bank anglers, especially during the winter months. Furthermore, boat anglers were much more difficult to contact and therefore to acquire completed trip information from. We determined that boats contained an average of 2.1 white sturgeon anglers. We estimate that white sturgeon boat fishing effort averaged 325 h/month and totaled 3,898 h for the year (Table 23). Expanding this number by catch and lost rates, we estimate that boat anglers hooked and fought 859 white sturgeon, of 507 were landed and 352 were lost.

Combining these statistics with bank anglers we estimate that a total of 35,062 h were expended targeting white sturgeon, 89% by bank anglers and 11% by boat anglers. A total of 4,361 white sturgeon were hooked and fought, 1,996 were landed (46%) and 2,365 were lost (54%). Of the total hooked, 80% were hooked by bank anglers and 20% by boat anglers. Overall, a white sturgeon was hooked for every eight hours of fishing effort. The most recent population survey estimated that 566 white sturgeon over 70 cm reside in this reach. According to these data, an average sturgeon in this population was hooked 7.7 times during one year, including being landed 3.5 times and lost an additional 4.2 times.

Across the entire year, sturgeon anglers expended most of their fishing effort from late morning to late evening. For instance, 73% of the cumulative effort was reported as being expended from 10 am to 10 pm (Figure 55). Effort decreased sharply after 10 pm. Very little effort occurred in the early morning hours. Only 5% of the cumulative effort occurred from 2 am to 8 am.

According to angler reported sizes of landed sturgeon, this population is highly skewed towards large fish with very few young fish present. Over the entire year, 2% of the fish landed measured less than 92 cm, 45% between 92 and 183 cm, and 53% greater than 183 cm. The most recent population estimate conducted by Idaho Power indicated that the this population was even more skewed towards large fish (Lepla 2008). During their survey, 1% of the fish landed measured less than 92 cm, 29% were between 92 and 183 cm, and 70% were greater than 183 cm.

In addition to white sturgeon angling, the Snake River from C. J. Strike Dam to Grandview bridge supports popular fisheries for rainbow trout, smallmouth bass, yellow perch, and black crappie. Non-sturgeon bank fishing effort ranged from 402 h in October to 7,229 h in August and totaled 26,769 h over the year (Table 24). Non-sturgeon fishing effort from boats was insignificant. No catch rate information was collected from either bank or boat anglers. Combining sturgeon and non-sturgeon fishing effort, this reaches supported 61,831 h of effort during one calendar year.

# DISCUSSION

The use of this creel survey design, especially the addition of post cards, improved our ability to monitor angler use and catch statistics for this fishery. Gathering adequate amounts of completed trip information may have been difficult otherwise, due to sturgeon angler behavior which included trip durations longer than our count periods (>8 h), effort heavily skewed towards weekends, multiple day trips, and nocturnal fishing habits. We offered several avenues for anglers to return cards and all were used. We saw no evidence that reported rates were different among return option suggesting that if desired other surveyors could choose to only use a subset of these options. Even though we received the most completed trip information from follow up phone calls, this method was the most labor intensive. If cost was a concern, this option could be dropped at least during high use months when adequate information would be provided by the other return options.

In this survey, sampling effort was assigned uniformly between primary sampling units: four weekdays and four weekends/holidays. In retrospect, more precise estimates could have been obtained if more sampling effort would have been expended in the weekend/holiday strata where approximately 75% of the effort occurred. Furthermore, the definition of strata could be modified to improve precision. For instance, counts conducted on Friday afternoons and nights were more representative of weekend fishing effort and counts conducted on Sunday afternoon and nights more representative of weekday counts. Defining primary sampling units based on the expectation of use, high versus low, may be more appropriate than calendar day.

The use of proportional allocation of secondary sampling units can be used as a method to increase precision of estimates. Based on local knowledge we assigned sampling probabilities for February thru September as 0.10 for morning, 0.4 for afternoon, and 0.5 for night and for October thru January as 0.10 for morning, 0.60 for afternoon, and 0.30 for night. In reality, the transition in hours expended coincided with the warm, longer days of May thru September. Based on reported fishing effort, we likely over-sampled the night period from February thru April, which likely negatively biased our effort estimates during these months. In retrospect, it would be more appropriate to assign sampling probabilities for May-September as 0.23 for morning, 0.45 for afternoon, and 0.32 for night and for the remainder of the year as 0.22 for morning, 0.57 for afternoon, and 0.21 for night.

Catch rates for white sturgeon showed a bimodal pattern. Catch rates were high in May and June and again during September, October, and November. Loss rates followed a similar pattern except that relatively high loss rates included the months of March and April. Effort was also relatively high during May and June leading to nearly 50% of the reported total catch occurring during these two months and about 40% of the total loss. Little total catch or loss occurred in December thru the end of February. Combining all angling types and including non sturgeon anglers, this relatively short river reach 13 rkm received a high amount of angling pressure, 61,831 h, making it an important fishery from a regional perspective.

Frequency of capture either for individual fish or averaged across populations is rarely reported in the primary literature. We are aware of only two such studies. In a section of the Yellowstone River, Yellowstone cutthroat trout were caught an average of 9.7 times during a two month fishing season (Schill et al. 1986). In Ridge Lake, IL, largemouth bass from were caught an average of two times per season; however, a range of catchability was reported with some individuals never being caught while another had been caught 20 times during the four-year study (Burkett et al. 1986). We are aware of no such studies on white sturgeon. However, popular mixed catch-and- release and harvest fisheries exist on the Columbia and Fraser rivers. Our estimates of being hooked 7.7 times and landed 3.5 in one year are within the range of these two studies. However, this comparison fails to account for longevity. White sturgeon may achieve some of the oldest ages in freshwater. Thus, a white sturgeon in the C. J. Strike reach could be hooked and fought several hundred times during its lifespan.

The point estimates for the two most recent white sturgeon population estimates in this reach indicate that abundance has declined 22% over the last nine years. Also, these surveys and the current effort indicate that there is little successful reproduction or recruitment in this reach. The potential reasons for this problem can be broken down into two categories: (1) inadequate spawning and early rearing habitat or (2) the effects of the fishery. The infrequency of high spring flows, disrupted temperature regimes, and the lack of access to preferred spawning areas may make attainment of a self-sustaining population in this reach unrealistic. Amelioration of habitat problems, except for water quality improvements, under current or long term (<50 yrs) constraints is unlikely. Secondly, allowing a fishery of this magnitude especially at the times when sturgeon are concentrated and preparing or attempting to spawn may be contributing to the declining population trend and recruitment failure. At a minimum, catch-and-release fishing and associated direct mortality, though un-quantified, is likely contributing to this population decline, even if a very low mortality rate (<0.5%) per capture is assumed. Furthermore, sub-lethal effects of catch and release fishing on pre-spawn or spawning sturgeon are poorly understood. If habitat conditions were adequate during high flow years, the possible repeated capture of the few gravid sturgeon attempting to spawn in a given year may negatively influence spawning success.

In light of declining adult population trends, low abundance, and lack of recruitment, it is important to manage these fish in a more conservative manner, even if the goal is to only maintain current catch rates in the existing fishery. More conservative management may require a reduction in fishing effort to reduce catch and release associated mortality. Secondly, it may require more proactive methods to stabilize and rebuild this population such as translocating fish from self-sustaining populations or stocking hatchery reared sturgeon.

## MANAGEMENT RECOMMENDATIONS

1. Seek a better understanding of direct and delayed mortality rates of white sturgeon in recreational fisheries in Idaho. If mortality is significantly contributing to population decline develop management actions to reduce mortality.

2. Translocate or stock white sturgeon to the C. J. Strike reach to increase population abundance and improve fishery. This reach is currently below suspected carrying capacity.

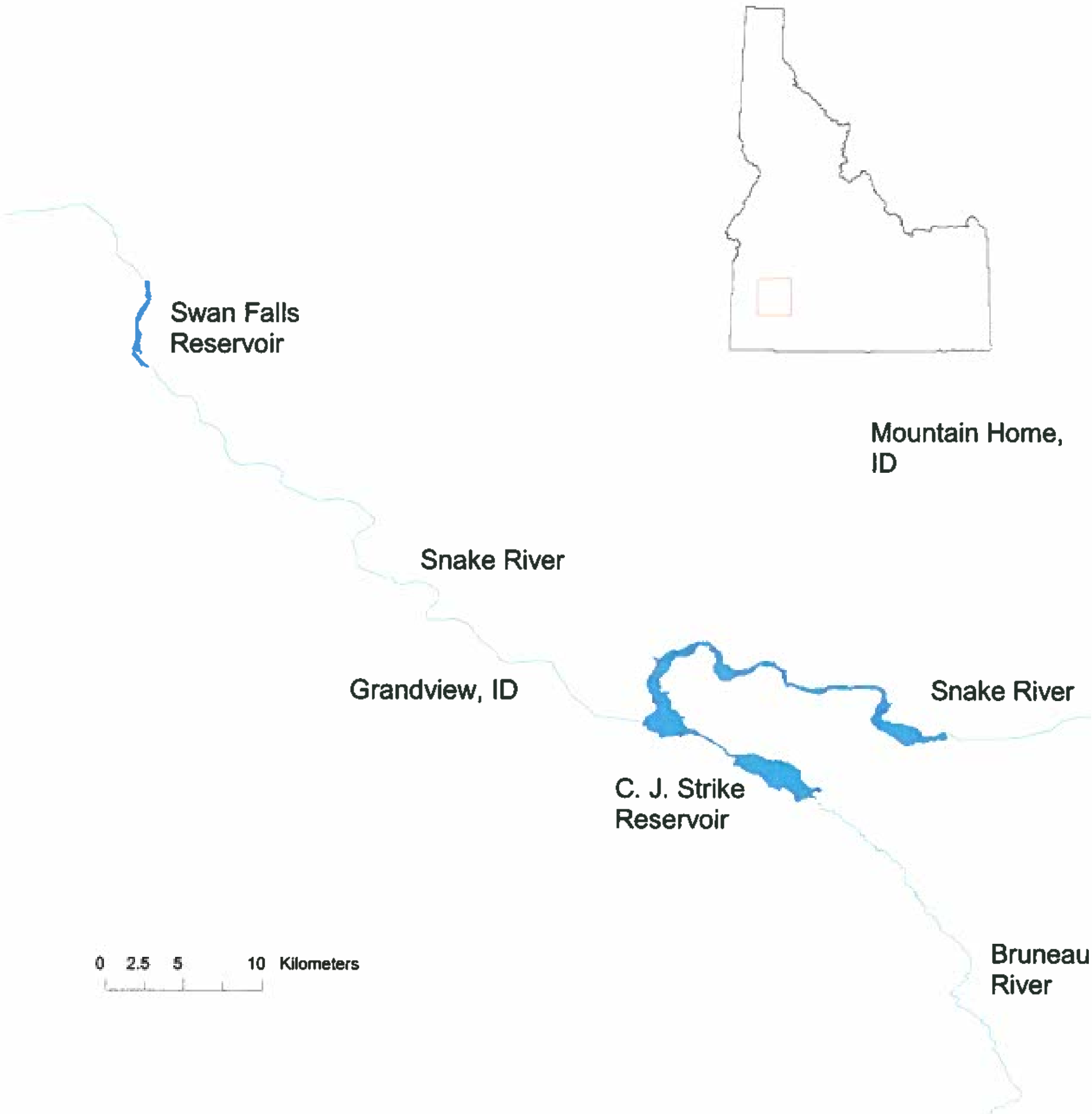



Figure 53. Map of the Snake River in southwestern Idaho. Creel survey efforts were focused from Grandview, ID to C. J. Strike Dam.

## STURGEON REPORT CARD

What time did you start and stop fishing today? M Tu Wed Th Fr Sa Su Date__________

1st time Start time: __________ am or pm Stop time: ____________ am or pm

2nd time Start time: __________ am to pm Stop time: ____________ am or pm

**NOTE: Noon = 12 pm Midnight = 12 am**

Did you land any sturgeon today? ☐ No ☐ Yes If yes, how many? _______

How many of the sturgeon you landed to day were: Less than 3 ft? ______________

3 ft. to 6 ft.? ________________

More than 6 ft? ______________

Did you hook, fight, & lose any sturgeon today: ☐ Yes If yes, how many? __________

☐ No

Comments: ______________________________________________________________

# ______________________ Office Use: ☐ mail ☐ IDFG personnel ☐ drop box ☐ follow-up phone

Figure 54. Example of a sturgeon report card that was given to anglers during 2007-08 creel survey efforts.

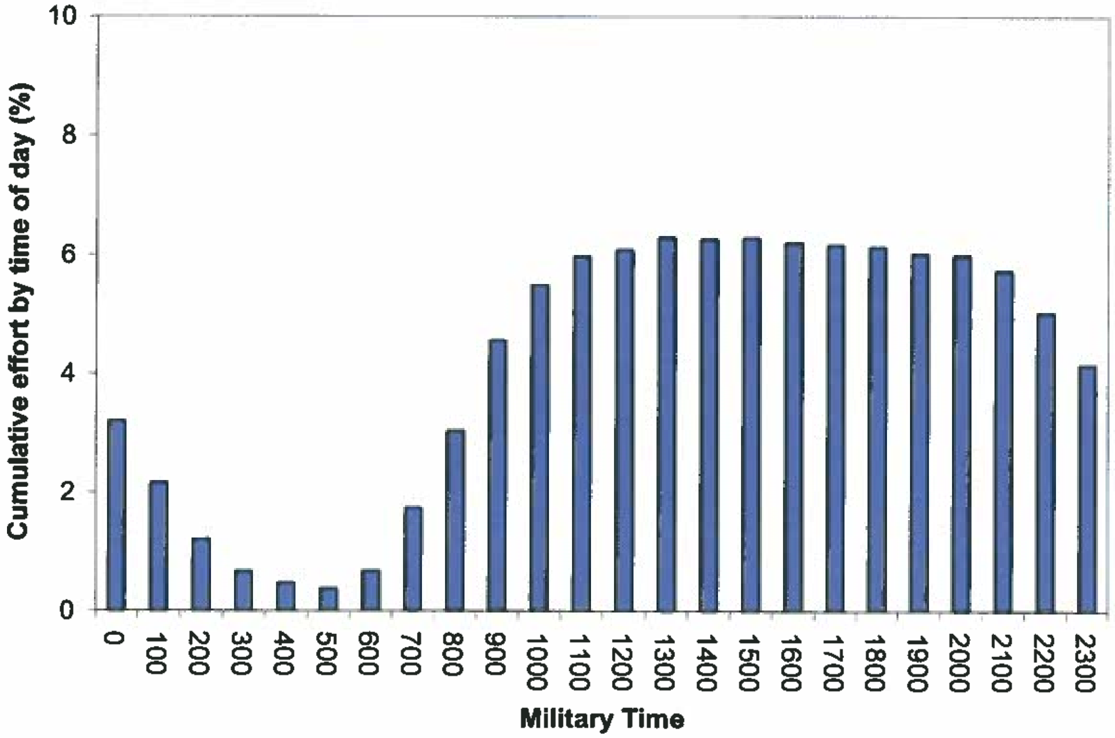



Figure 55. Distribution of fishing effort by hour calculated as a cumulative percent of all hours fished from May 2007 to April 2008.

Table 21. Effort, catch rate, loss rate, catch, and the number of white sturgeon hooked fought and lost in the C. J. Strike reach of the Snake River from May 2007 thru April 2008 by bank anglers only.

| Month | Daily effort (h) | SD | Monthly Effort (h) | SD | CPUE Caught (fish/h) | Variance CPUE Caught | CPUE Losst (fish/h) | Variance CPUE Loss | Catch (fish /month) | Variance of catch | Loss (fish/ month) | Variance of loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| May | 91.2 | 26.5 | 2,828 | 821 | 0.067 | 0.021 | 0.107 | 0.079 | 190 | 186,399 | 301 | 696,302 |
| Jun | 157.1 | 21.6 | 4,713 | 648 | 0.103 | 0.038 | 0.083 | 0.031 | 486 | 869,052 | 390 | 714,285 |
| Jul | 67.2 | 11.9 | 2,084 | 369 | 0.034 | 0.009 | 0.038 | 0.030 | 71 | 39,884 | 79 | 133,430 |
| Aug | 103.7 | 22.0 | 3,214 | 682 | 0.033 | 0.038 | 0.024 | 0.004 | 105 | 414,752 | 78 | 47,536 |
| Sep | 103.2 | 18.7 | 3,096 | 561 | 0.045 | 0.012 | 0.088 | 0.036 | 139 | 121,609 | 272 | 358,968 |
| Oct | 37.4 | 9.8 | 1,160 | 304 | 0.069 | 0.093 | 0.046 | 0.009 | 80 | 134,029 | 53 | 13,489 |
| Nov | 114.1 | 33.9 | 3,422 | 1018 | 0.046 | 0.020 | 0.111 | 0.039 | 156 | 253,640 | 380 | 504,268 |
| Dec | 29.2 | 17.4 | 904 | 541 | 0.011 | 0.005 | 0.016 | 0.007 | 10 | 5,745 | 15 | 7,457 |
| Jan | 24.7 | 9.2 | 767 | 286 | 0.000 | 0.000 | 0.011 | 0.003 | 0 | 0 | 9 | 2,275 |
| Feb | 45.6 | 14.4 | 1,322 | 417 | 0.015 | 0.003 | 0.005 | 0.007 | 19 | 6,111 | 6 | 12,742 |
| Mar | 96.0 | 26.8 | 2,977 | 832 | 0.021 | 0.009 | 0.058 | 0.060 | 62 | 90,783 | 172 | 571,585 |
| Apr | 155.9 | 28.6 | 4,676 | 857 | 0.036 | 0.007 | 0.055 | 0.011 | 170 | 170,262 | 257 | 240,625 |
| Totals | | | 31,164 | | | | | | 1,489 | | 2,013 | |

Table 22. Effort, catch rate, loss rate, catch, and the number of white sturgeon hooked fought and lost in the C. J. Strike reach of the Snake River from May 2007 thru April 2008 by boat anglers only. Boat catch rates for all months except April and May were estimated by multiplying bank catch rates by a factor of 2.5. Boat effort for Oct-Jan was reduced by 90%, based on conservation officer contacts, due to the preponderance of waterfowl hunters and trappers using the river. Due to these estimation procedures, variances for total catch and the total number of fish lost were incalculable.

| Month | Daily effort (h) | SD | Monthly Effort (h) | SD | CPUE Caught (fish/h) | CPUE Lost (fish/h) | Catch (fish /month) | Loss (fish/ month) |
|---|---|---|---|---|---|---|---|---|
| May | 9.0 | 3.8 | 279 | 119 | 0.109 | 0.087 | 30 | 24 |
| Jun | 32.3 | 9.8 | 970 | 294 | 0.259 | 0.058 | 251 | 176 |
| Jul | 8.2 | 6.5 | 256 | 200 | 0.086 | 0.026 | 22 | 15 |
| Aug | 13.1 | 6.0 | 406 | 184 | 0.082 | 0.017 | 33 | 23 |
| Sep | 14.1 | 9.9 | 424 | 298 | 0.113 | 0.062 | 48 | 33 |
| Oct | 0.2 | 1.5 | 5 | 46 | 0.172 | 0.032 | 1 | 1 |
| Nov | 3.4 | 8.0 | 103 | 241 | 0.115 | 0.078 | 12 | 8 |
| Dec | 1.6 | 9.6 | 49 | 297 | 0.027 | 0.011 | 1 | 1 |
| Jan | 0.5 | 3.3 | 17 | 104 | 0.000 | 0.008 | 0 | 0 |
| Feb | 6.5 | 2.1 | 189 | 61 | 0.037 | 0.003 | 7 | 5 |
| Mar | 28.3 | 12.7 | 879 | 393 | 0.052 | 0.041 | 46 | 32 |
| Apr | 10.7 | 6.1 | 322 | 183 | 0.172 | 0.103 | 56 | 33 |
| Totals | | | 3,898 | | | | 507 | 352 |

Table 23. Comparison of unexpanded effort, catch, and the number of white sturgeon lost as well as their respective rates on the C.J. Strike Reach of the Snake River From May 2007 thru April 2008.

| Time Period | Sample Size | Effort | Catch | Lost | Catch Rate | Loss Rate |
|---|---|---|---|---|---|---|
| **Bank Anglers** | | | | | | |
| April | 130 | 1185.25 | 43 | 65 | 0.036 | 0.055 |
| May | 163 | 1427.5 | 96 | 152 | 0.067 | 0.106 |
| April and May combined | 293 | 2612.75 | 139 | 217 | 0.053 | 0.083 |
| **Boat Anglers** | | | | | | |
| April | 6 | 29 | 5 | 3 | 0.172 | 0.103 |
| May | 6 | 46 | 5 | 4 | 0.109 | 0.087 |
| April and May combined | 12 | 75 | 10 | 7 | 0.133 | 0.093 |

Table 24. Effort expended by non-sturgeon targeting bank anglers in the Snake River between C. J. Strike and Grandview Bridge from May 2007 to April 2008.

| Month | Daily effort (h) | SD | Monthly Effort (h) | SD |
|---|---|---|---|---|
| May | 81.4 | 22.4 | 2,522 | 694 |
| Jun | 162.8 | 28.7 | 4,883 | 862 |
| Jul | 67.1 | 7.3 | 2,080 | 226 |
| Aug | 233.2 | 118.9 | 7,229 | 3,686 |
| Sep | 52.7 | 15.1 | 1,582 | 454 |
| Oct | 13.0 | 3.8 | 402 | 117 |
| Nov | 32.0 | 8.6 | 960 | 259 |
| Dec | 23.6 | 6.6 | 732 | 204 |
| Jan | 16.1 | 8.3 | 500 | 258 |
| Feb | 29.5 | 9.2 | 855 | 267 |
| Mar | 51.0 | 26.2 | 1,580 | 812 |
| Apr | 114.8 | 46.4 | 3,445 | 1,392 |
| Total | | | 26,769 | |

# APPENDIX

Effort was estimated as

$$\hat{e}_i = I_i \times T$$

Total effort was estimated as

$$\hat{E} = \sum_{i=1}^{n} (\hat{e}_i / \Pi_i)$$

Catch was estimated as

$$\hat{C} = \hat{E} \times R_1$$

Catch rate from completed trips was calculated as

$$R_1 = \sum_{i=1}^{n} c_i \Big/ \sum_{i=1}^{n} L_i$$

Where,

$I_i$ = mean of 3 instantaneous counts within a morning, afternoon, or night
$T$ = time period length which equaled 8 hours for this study
$\Pi_i$ = probability of selecting morning, afternoon, or night
$R_1$ = ratio of means estimator used to calculate mean catch rate by month
$c_i$ = catch of sturgeon for an individual completed fishing trip
$L_i$ = duration of effort (hours) for an individual completed fishing trip

## Upper Middle Fork Salmon River Chinook Salmon Redd Counts

## ABSTRACT

Spawning ground surveys were conducted along 11 historical trend monitoring transects in Bear Valley, Elk, and Sulphur creeks from August 25 thru 27, 2008 to index the abundance of wild Chinook salmon. A total of 101 redds were counted along six transects in Bear Valley Creek. Overall, this represents a 35% increase from 2007 (75 redds), but represents a 72% decline when compared to more the recent high of 2003 (364 redds) and an 85% decline from the highest count ever noted during 1961. A total of 132 redds were counted along three transects in Elk Creek. Overall, the 2008 count represents a 50% increase from 2007 (88 redds), a 65% decline from the recent high of 2002 (377 redds), and an 80% decline from the historical high of 1961 (654 redds). A total of 33 redds were counted along two transects in Sulphur Creek. Overall for Sulphur Creek transects, the 2008 count (33 redds) represented a 27% increase from 2007 (26 redds), but represents a 65% decline from the recent high of 2002 (93 redds), and a 91% decline from the historical high of 1957 (381 redds).

# INTRODUCTION

Tributaries of the upper Middle Fork Salmon River, including Bear Valley, Elk, and Sulphur creeks possess some of the best remaining spring/summer Chinook salmon spawning habitat in the Snake River basin. IDFG has conducted annual spawning ground surveys on these systems since 1957 to primarily, enumerate the number of Chinook salmon redds as an index of adult population abundance. Initially, surveys were conducted along fairly long transects (6 - 8 km) using aerial counts or, less often, on foot; however, beginning in about 1989, transects were split into shorter segments (3 - 4 km) and have been surveyed on foot annually during the last week of August (Hassemer 1993).

Despite the abundance of high quality spawning and juvenile rearing habitat, overall numbers of wild Chinook salmon have declined precipitously from highs observed during the late 1950 and 1960s. This led to federal listing of Snake River Chinook salmon as threatened under the Endangered Species Act during April 1992. Since then, returning adult abundances have remained critically low, except for a three year period from 2001-2003, when adult numbers rebounded temporarily. During 2004-05, this trend reversed, and adult abundances returned to near historical low levels of the late 1990s.

# OBJECTIVES

1. To index the abundance of returning wild adult Chinook salmon by counting redds within historical trend monitoring transects in Bear Valley, Elk, and Sulphur creeks during 2008.
2. To compare current redd count information to historical data.

# METHODS

Spawning ground surveys were conducted along 11 historical trend monitoring transects in Bear Valley, Elk, and Sulphur creeks (Figure 56) from August 25 thru 27, 2008. The timing of surveys conducted along Bear Valley and Elk creeks occurred within the interval of past sampling dates, at a time when nearly all adult Chinook salmon had recently spawned.

All surveying techniques followed the protocol outlined by Hassemer (1992). Prior to conducting surveys, surveyors were required to attend an IDFG sponsored training session taught by experienced biologists. Afterwards, pairs of surveyors walked upstream through each transect. After locating a prospective redd site, surveyors determined and recorded whether a redd, multiple redds, or a test dig had been excavated and documented its location with a global positioning system. For each site, surveyors also recorded the number of live and dead adult Chinook salmon observed, as well as their age and sex. Biological samples were collected from salmon carcasses and provided to the Idaho Natural Production Monitoring and Evaluation Project.

# RESULTS AND DISCUSSION

A total of 101 redds were counted along six transects in Bear Valley Creek during 2008 surveys. Overall, this represents a 35% increase from 2007 (75 redds), but represents a 72% decline when compared to more the recent high of 2003 (364 redds) and a 85% decline from the highest count ever noted during 1961 (675 redds; Figure 57, 58, and 59). In Bear Valley Creek, redds were concentrated in the one site below the mouth of Elk Creek (WS-10a) and the two sites above (WS-9c & WS-9d). Eighty of the 101 redds were located within these three sites. The number of redds counted in the three remaining Bear Valley Creek sites was less than 10 each. This included six redds in each of sites WS-9a & WS-9b, the two uppermost sites on Bear Valley Creek, where over the previous three years only one redd had been counted. A total of 66 live adult Chinook salmon were observed in Bear Valley Creek.

A total of 132 redds were counted along three transects in Elk Creek during 2008 surveys. Similar to Bear Valley Creek, this represents an increase from 2007, but represents a decline from recent and historical highs (Figure 60). Overall, the 2008 count represents a 50% increase from 2007 (88 redds), a 65% decline from the recent high of 2002 (377 redds), and an 80% decline from the historical high of 1961 (654 redds). The majority of redds were concentrated in the two most upstream monitoring sites. The highest count (69 redds) occurred in the most upstream transect, WS-11a. Whereas, 53 and 10 redds were counted in the middle (WS-11b) and lower (WS-11c) transects along Elk Creek. A total of 63 live adult Chinook salmon were observed in Elk Creek.

A total of 33 redds were counted along two transects in Sulphur Creek during 2008 surveys. Similarly to Bear Valley and Elk creeks, redd counts for Sulphur Creek were slightly higher than 2007. However, 2007 redd counts were still much lower than recent and historical highs (Figure 61). Overall for Sulphur Creek transects, the 2008 count (33 redds) represented a 27% increase from 2007 (26 redds), but represents a 65% decline from the recent high of 2002 (93 redds), and a 91% decline from the historical high of 1957 (381 redds). Three live adult Chinook salmon were observed in Sulphur Creek.

Over the three monitoring streams and 11 trend monitoring transects combined, a total of 266 redds were counted in 2008. This total is a notable increase of 41% over the 2007 count of 189 redds. Despite this increase, total redd counts in this area are still much lower than the high of 1440 redds counted across these streams in 1957 and the consistently high counts document during the 1960s. During this decade, cumulative counts in this area exceeded 770 redds in all years except 1965 when 536 redds were counted. Furthermore, total redd counts during 2008 were still only about 42% of recent highs documented during 2001-2003, when cumulative counts averaged 643 redds for this three-year period.

# MANAGEMENT RECOMMENDATIONS

1. Continue to index the abundance of wild adult Chinook salmon by counting redds in Bear Valley, Elk, and Sulphur creeks.

2. Continue to pursue strategies that improve down river and ocean survival of these stocks.

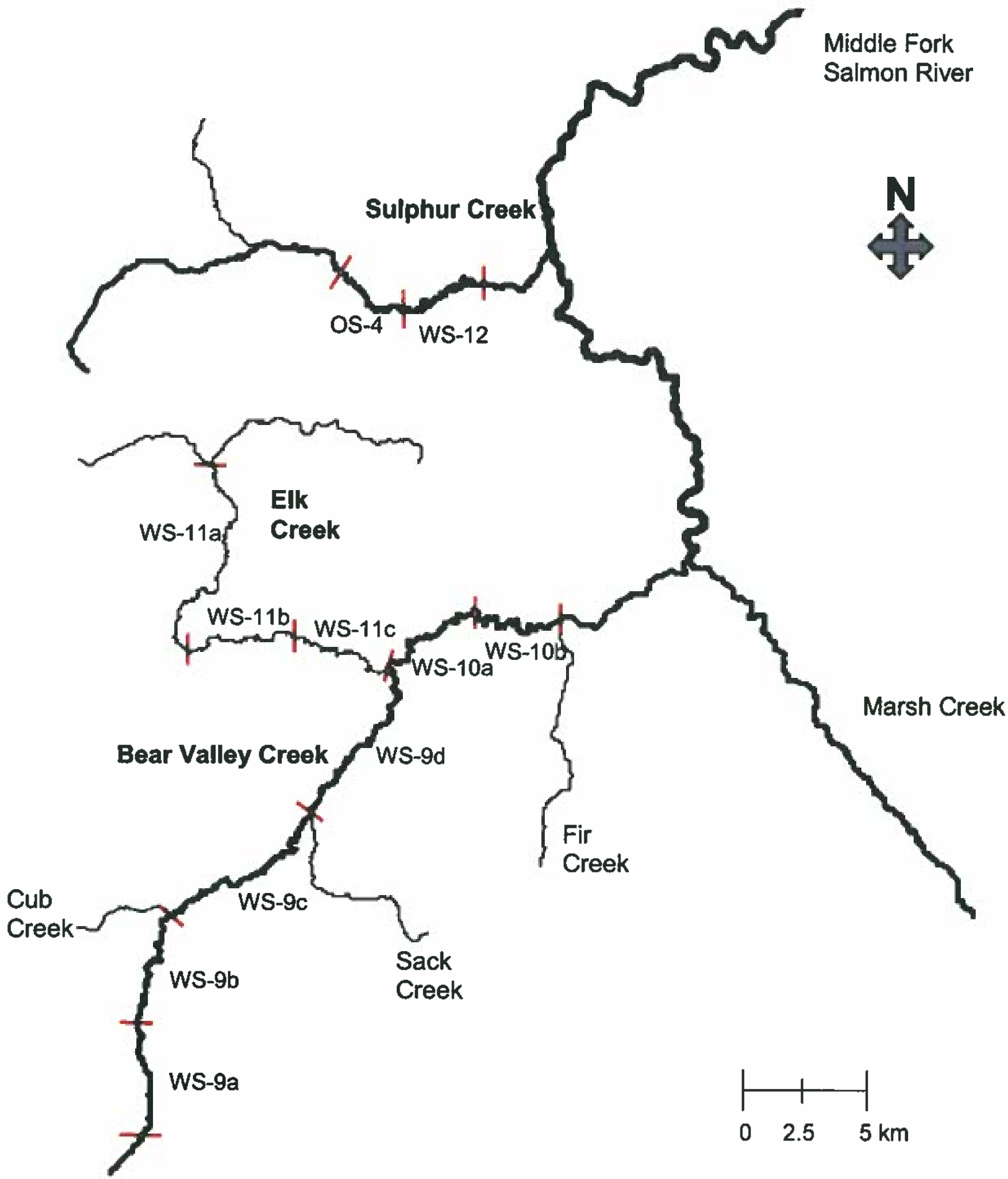



Figure 56. Location of 11 redd count trend transects on Bear Valley, Elk, and, Sulphur creeks used to index the abundance of wild spring/summer-run Chinook Salmon in the upper Middle Fork Salmon River Drainage, ID. Red lines denote transect boundaries.

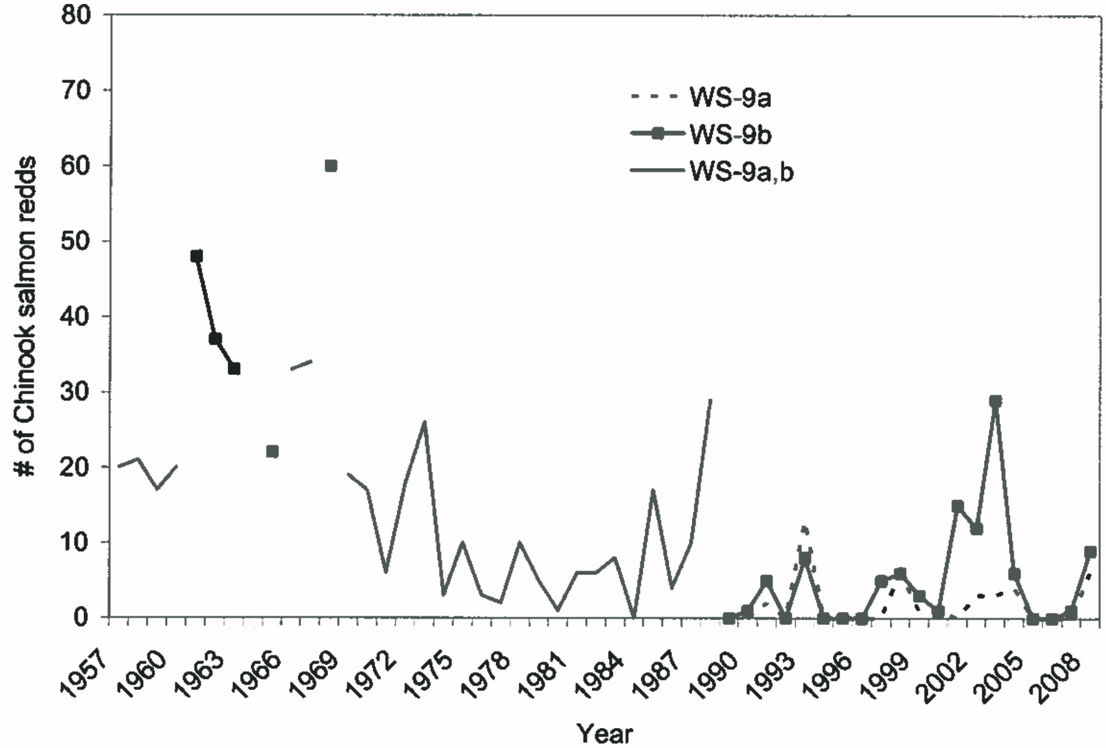



Figure 57. Number of Chinook salmon redds counted along upper Bear Valley Creek index transects from 1957-2008. The solid black line represents a cumulative count for WS-9a & b that was monitored in most years from 1957 to 1989.

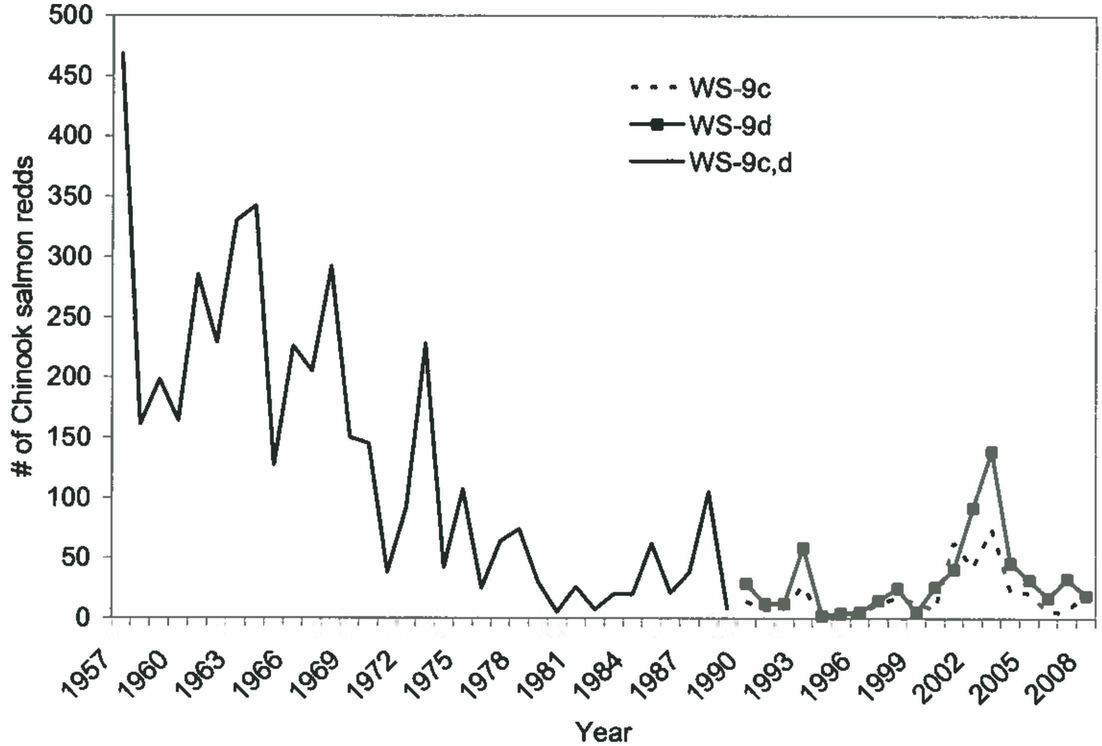



Figure 58. Number of Chinook salmon redds counted along middle Bear Valley Cr. index transects from 1957-2008. The solid black line represents cumulative counts for WS-9c & d.

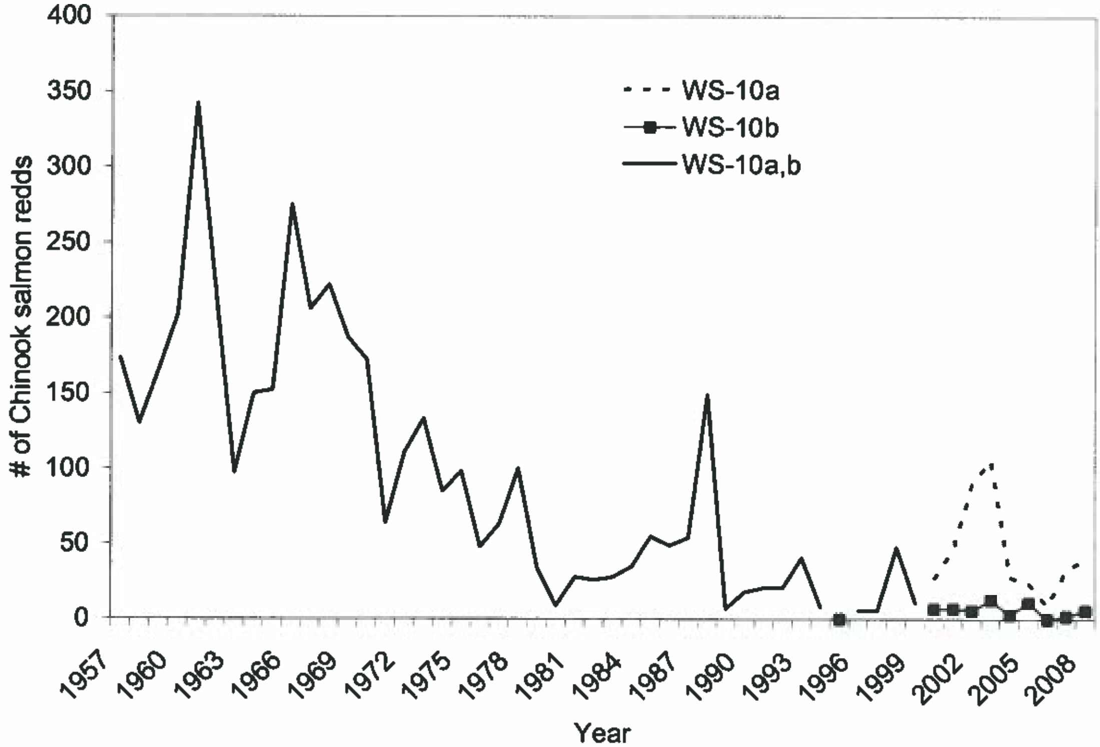



Figure 59. Number of Chinook salmon redds counted along lower Bear Valley Cr. index transects from 1957-2008. The solid black line represents cumulative counts for WS-10a & b.

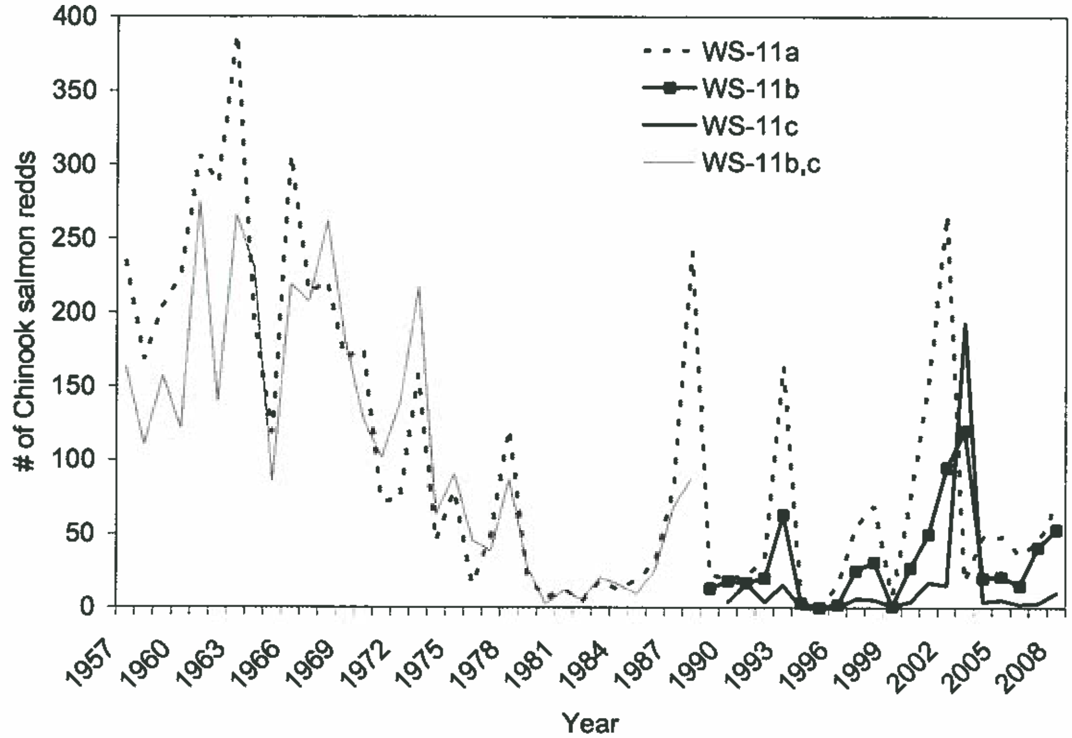



Figure 60. Number of Chinook salmon redds counted along Elk Creek index transects from 1957-2008. The solid thin line represents a cumulative count for WS-11b and WS-11c, whereas all other lines represent individual transects.

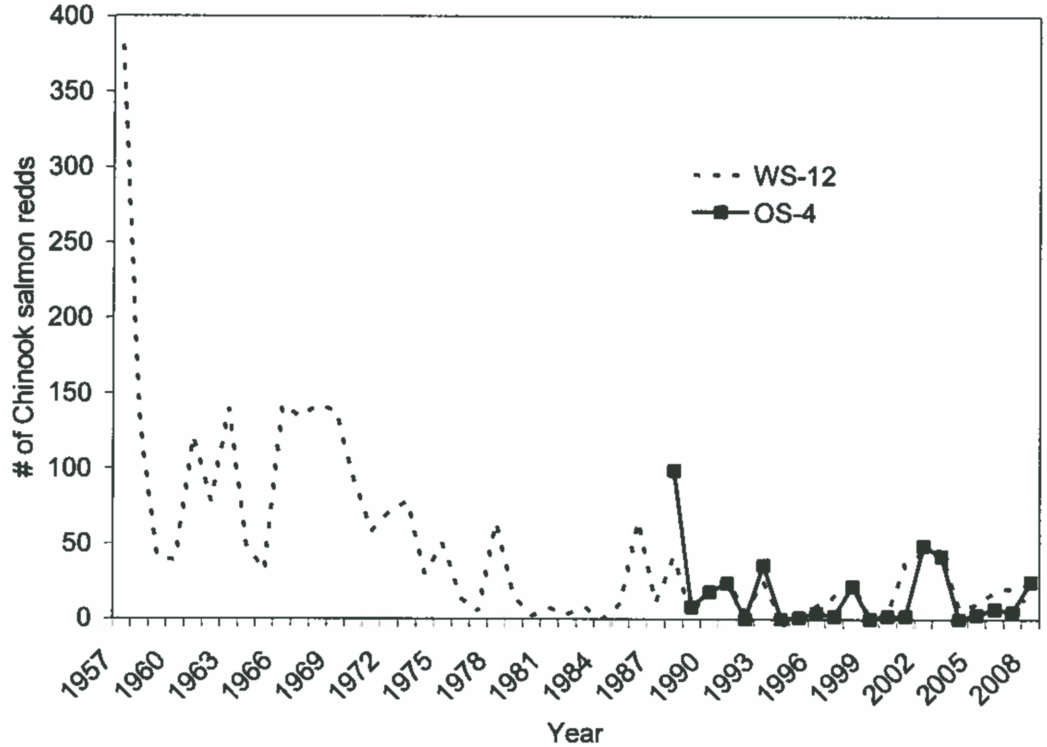



Figure 61. Number of Chinook salmon redds counted along Sulphur Creek index transects from 1957-2008.

# LITERATURE CITED


Allen, D. B., S. P. Yundt, and B. J. Flatter. 1998. Regional Fisheries Management Investigations-Southwest Region, Idaho Department of Fish and Game, 1995. Job Performance Report. Program F-71-R-20. Boise

Allen, D.B., B. J. Flatter and F. S. Elle. 2001. Regional fisheries management investigations-Southwest Region, Idaho Department of Fish and Game, 1998 Job Performance Report Project F-71-R-23. Boise.

Anderson, C.S. 1995. Measuring and correcting for size selection in electrofishing mark-recapture experiments. Transactions of the American Fisheries Society 124:663-676.

Anderson, R.O. 1976. Management of small water impoundments. Fisheries 1(6):5-7, 26-28.

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Bolding, B., S. Bonar, and M. Divens. 2004. Use of artificial structure to enhance angler benefits in lakes, ponds, and reservoirs: a literature review. Reviews in Fisheries Science 12:75-96.

Brown, L. R., and P. B. Moyle. 1981. The impact of squawfish on salmonid populations: a review. N. Am. J. Fish. Manage. 1: 104-111.

Butts, A. E., P. Kennedy, K. A. Meyer. 2007. Lake and reservoir research. Job performance report. Grant F-73-R-27 Project 5. Idaho Department of Fish and Game. Boise.

Campbell M.R., Kozfkay, C. C., S.R. Narum, and N.R. Campbell. In Prep. Diagnostic Single Nucleotide Polymorphisms for assessing hatchery rainbow trout introgression in interior Columbia River redband trout populations.

Cassinelli, J. 2008. Effects of water temperature on growth and physiology of different populations of redband trout (*Oncorhynchus mykiss gairdneri)*. Master's thesis. University of Idaho, Moscow.

Cochnauer T. C. 2002. Response of a white sturgeon population to catch and release regulations-now what? Pages 83-88 *in* W. Van Winkle, P.J. Anders, D.H. Secor, and D. A. Dixon, editors. Biology, management, and protection of North American sturgeon. American Fisheries Society, Symposium 28, Bethesda, Maryland.

Flatter, B. J. and D. B. Allen. 2001. Regional fisheries management investigations-Southwest Region, Idaho Department of Fish and Game, 1999. Job Performance Report Project F-71-R-24. Boise.

Flatter, B., L. Hebdon, and J. Dillon. In Press. Southwest Region-Nampa 2004 Fishery Management Report. Idaho Department of Fish and Game, Boise.

Flatter, B. J., K. Plaster, and J. Dillon. 2004. Regional fisheries management investigations-Southwest Region, Idaho Department of Fish and Game, 2001. Job Performance Report Project F-71-R-26. Boise.

Hassemer, P. F. 1992. Manual of standardized procedures for counting Chinook salmon Redds. Idaho Department of Fish and Game, Boise.

Hassemer, P. F. 1993. Salmon spawning ground surveys, 1989-92. Project F-73-R-15. Pacific Salmon Treaty Program. Award Number NA17FP0168-02. Idaho Department of Fish and Game, Boise.

Hebdon, J. L., J. C. Dillon, and T. McArther. 2008. Angler Use, Spending, and Economic Values of Urban Fisheries in Southwest Idaho. Pages 209-218 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67 Bethesda, Maryland.

Hebdon, L., B. J. Flatter, A. Knight, and J. Dillon. 2008. Regional Fisheries Management Investigations-Southwest Region, Idaho Department of Fish and Game, 2005. Job Performance Report. Program F-71-R-31.

Hebdon, L., J. R. Kozfkay, J. Dillon. In Review. Southwest Region-Nampa 2007 Fishery Management Report. Idaho Department of Fish and Game, Boise.

Idaho Department of Environmental Quality. 2001. Mason Creek Subbasin Assessment. December 2001.

Idaho Department of Fish and Game. 2008. Management plan for the conservation of Snake River white sturgeon in Idaho. Authored by J. Dillon and S.A. Grunder. Boise.

Kozfkay, C. C., M. R. Campbell, K.A. Meyer, and D.J. Schill. In Prep. Genetic population structure of redband trout in southwest Idaho.

Kozfkay, J. R., L. Hebdon, A. Knight, and J. Dillon. In press. Regional Fisheries Management Investigations-Southwest Region, Idaho Department of Fish and Game, 2006. Job Performance Report. Program F-71-R-31.

Lepla, K. 2008. Report C. Population assessment of white sturgeon in the Snake River between C.J. Strike and Swan Fall dams, 2006-2007. Pages 43 to 65 *in* Snake River white sturgeon conservation plan: Implementation of measures for white sturgeon below Bliss and C.J. Strike dams. 2007 Annual Report. Idaho Power Company, Boise, 118 p.

Mabbott, B. and T. Holubetz. 1989. Regional fisheries management investigations-Southwest Region, Idaho Department of Fish and Game, 1987 Job Performance Report Project F-71-R-12. Boise.

Maiolie, M., W. Harryman, W. Ament. 2004. Lake Pend Oreille Fishery Recovery IDFG Report Number 04-24. Project 2002 Annual Report. Bonneville Power Administration Project No. 199404700 (BPA Report DOE/BP-00004003-3)

Nielsen, J.L., A. Byrne, S.L. Graziano, and C.C. Kozfkay. 2009. Steelhead genetic diversity at multiple spatial scales in a managed basin: Snake River, Idaho. North American Journal of Fisheries Management 29:680–701, 2009.

Park, S.D.E. 2001. Trypanotolerance in West African cattle and the population genetic effects of selection. PhD Thesis. University of Dublin.

Pollock, K.H., C.M. Jones, and T.L. Brown. 1994. Angler survey methods and their applications in fisheries management. American Fisheries Society Special Publication 25.

Raleigh, R.F., T. Hickman, R.C. Soloman, and P.C. Nelson. 1984. Habitat suitability information: Rainbow trout. U.S. Fish Wild. Serv. FWS/OBS-82/10.60. 64 pp.

Raymond M. and F. Rousset. 1995. GENEPOP (version 1.2): population genetics software for exact tests and ecumenicism. Journal of Heredity 86:248-249.

Reid, W. and B. Mabbott. 1987. Regional fisheries management investigations, Idaho Department of Fish and Game, 1985 Job Performance Report Project F-71-R-10. Boise.

Robertson A. and W.G. Hill. 1984. Deviations from Hardy-Weinberg proportions : sampling variances and use in estimation of inbreeding coefficients. Genetics 107:713-718.

Salow, T. 2005. Arrowrock Dam Outlet Works Rehabilitation Endangered Species Monitoring and Mitigation Project: Compilation of monthly summaries for radio telemetry investigations for listed bull trout (*Salvelinus confluentus*), Boise, Idaho 2003. U.S.D.I., Bureau of Reclamation, BOR/OALS#00-912/1009.2700. 71 pp.

Stanovich, J. S. and L. A. Nielsen. 1991. Assigning nonuniform sampling probabilities by using expert opinion and multiple-use patterns. American Fisheries Society Symposium 12:189-194.

Teuscher, D. 1999. A simple method for monitoring zooplankton forage and evaluating flatwater stocking programs. Fisheries Research Brief, Idaho Department of Fish and Game No. 99-02. Boise.

Thomas, H.M., and C. Chamberlain. 2000. Development of roving creel survey data management and statistical analysis program for Utah Division of Wildlife Resources. Utah Department of Natural Resources, Publication Number 00-28 4th Edition, Salt Lake City.

Thorne, R. E. 1983. Hydroacoustics. Pages 239-260 in L. A. Nielsen and D. L. Johnson, editors. Fisheries Techniques, 1st edition. American Fisheries Society. Bethesda, Maryland.

USFWS (U.S. Fish and Wildlife Service). 1998. Final rule to list Columbia River and Klamath River population segments of the bull trout as a threatened species. Federal Register 63:31647-31674.

Vigg, S., and C.C. Burlev. 1991. Temperature-dependent maximum daily consumption of juvenile salmonids by northern squawfish (Ptychocheilus oregonensis) from the Columbia River. Canadian Journal of Fisheries and Aquatic Sciences. 48: 2494-2498.

Weir B.S. and C.C. Cockerham. 1984. Estimating F-statistics for the analysis of population structure. Evolution 38:1358-1370.

Yule, D. L. 2000. Comparison of purse seine and horizontal acoustic estimates of trout densities and sizes in eleven Wyoming waters. North American Journal of Fisheries Management 20:759-775.

Zar, J.H. 1999. Biostatistical analysis. Simon and Schuster, Upper Saddle River, New Jersey.

Zoellick, B. W., D. B. Allen, and B. J. Flatter. 2005. A long-term comparison of redband trout distribution, density, and size structure in Southwestern Idaho. North American Journal of Fisheries Management 25: 1179-1190.

Prepared by:

Joseph R. Kozfkay
Regional Fishery Biologist

Arthur E. Butts
Regional Fishery Biologist

Lance Hebdon
Regional Fishery Biologist

Jeff C. Dillion
Regional Fishery Manager

Approved by:

**IDAHO DEPARTMENT OF FISH AND GAME**

Edward B. Schriever, Chief
Fisheries Bureau

William D. Horton
State Fishery Manager