RECLAMATION
Managing Water in the West

Boise and Deadwood River Bull Trout (*Salvelinus confluentus*) Monitoring Activities

Technical Report for Idaho Department of Fish and Game
Permit No. F-10-99

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Chapter One

BOISE AND DEADWOOD RIVER BULL TROUT POPULATION MONITORING AND MITIGATION ACTIVITIES 2008

Executive Summary

The purpose of this report is to summarize the annual monitoring and mitigation activities carried out by the U. S Bureau of Reclamation (Reclamation) which occurred under Idaho Department of Fish and Game (IDFG) Scientific Collection Permit No. F-10-99 in the Boise and Deadwood River Basins.

Since the listing of the Columbia River and Klamath River distinct population segment of bull trout (*Salvelinus confluentus*) as threatened under the Endangered Species Act in 1998, serious consideration has been given to range-wide population size and recovery efforts. Section 7 of the Endangered Species Act (ESA) requires that any actions that may be implemented by a federal government entity that could affect federally listed species must be consulted upon through the federal regulatory agencies: the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS).

Reclamation consulted under section 7 of the ESA with the FWS and NMFS on Operations and Routine Maintenance of twelve Reclamation projects in the Snake River Basin above Brownlee Reservoir. The FWS completed a non-jeopardy Biological Opinion (BiOp) in March 2005. The biological opinion contains a 30 year incidental take statement and corresponding reasonable and prudent measures (RPM) that outline non discretionary actions to minimize take of bull trout (*Salvelinus confluentus)* in the Boise project area. Facilities in the Boise Projects with adfluvial forms of bull trout present include Arrowrock and Anderson Ranch Dams on the Boise River system, as well as Deadwood Dam on the Payette River system. Reclamation developed a monitoring and implementation plan that outlines the field activities and data collection necessary to addresses the RPMs, associated terms and conditions, monitoring, and reporting requirements for the BiOp. The monitoring and implementation plan was submitted to the FWS in March, 2006 (USBR 2006).

Reclamation's field and data collection activities are covered by IDFG Scientific Collection Permit No. F-10-99. This technical report describes the results of Reclamation's 2008 field activities and data collection work. This report is formatted in seven chapters: a general introduction and study area chapter and six chapters that provide data corresponding to different monitoring and mitigation activities Chapters two and three summarize tagging and tracking efforts in Deadwood Reservoir and the Deadwood River below the dam. Chapter four summarizes the IDFG weir operations at Deadwood Reservoir for 2008. Chapter five discusses an effort to develop a population estimate using gill netting in Deadwood Reservoir. Chapter six discusses the concern that angling pressure and public misidentification of bull trout are harming the population at Deadwood. Chapter seven provides data from the trap and transport activities at Lucky Peak Reservoir for 2008.

Angler education has not been a responsibility of Reclamation during this reporting period; however, anglers are frequently encountered during field work. Although Reclamation employees are not authorized to conduct creel surveys many anglers voluntarily share their stories. Based on anecdotal information, the by-catch of bull trout by anglers at Deadwood Reservoir regularly occurs; the effect of angling on the population is unknown. Some bull trout identification signs in the Deadwood River basin are becoming more difficult to read and should be replaced soon and anglers have concern over others being misleading.

STUDY AREA

The Boise and Deadwood River basins are located in southwestern Idaho. The Boise River drains directly into the Snake River while the Deadwood River is a major tributary to the South Fork of the Payette River which then drains into the Snake River.

Three dams are constructed on the upper Boise River system: Arrowrock, Anderson Ranch, and Lucky Peak dams (Figure 1). Lucky Peak Dam, a U.S. Army Corps of Engineers project, is located at the lowest elevation in the Boise River at river kilometer (rkm) 103 with a full pool elevation of 931 meters above sea level. Arrowrock Dam, a Reclamation project, is 19 rkm upstream from Lucky Peak Dam on the mainstem Boise River. Arrowrock Dam has a full pool elevation of 980 meters above sea level. Anderson Ranch Dam, also a Reclamation project, is the most upstream of the three projects, located at rkm 81 of the South Fork of the Boise River with a full pool elevation of 1,272 meters above sea level. These reservoirs are operated collectively as one system for irrigation, flood control, and recreation.

The Boise River basin upstream from Arrowrock Dam covers 5,700 km² (2,200 mile^2) of the granite rock dominated landscape with elevations ranging from 931 m (3057 ft.) to 3,231 m (10,600 ft.) above sea level. The upper Boise River includes three sub-basins: the North, Middle, and South forks. The Boise River system is fed primarily by snowmelt run-off with highest flows occurring in April-May and lowest in September-October. Flows range from 4.25 m³/s (150 ft^3/s) to over 339.8 m³/s (12,000 ft^3/s) in the mainstem Boise River below the North and Middle Fork confluence. Land uses in the Boise River watershed include grazing, recreation, and both commercial and individual timber harvest. The majority of the Boise River basin lies within Forest Service or Wilderness area boundaries.

The Deadwood River is a major tributary to the South Fork Payette (Figure 2). The river is approximately 70 km long from headwaters (2124 meters above seas level) to mouth (1135 meters above sea level). Deadwood Dam, located at rkm 36 was constructed in 1929 and is the only dam on the Deadwood River. Deadwood Reservoir has a capacity of 153,992 acre feet with a maximum pool elevation of 1,628 meters and drains 282 km^2 while the river below the dam drains an additional 332 km^2.

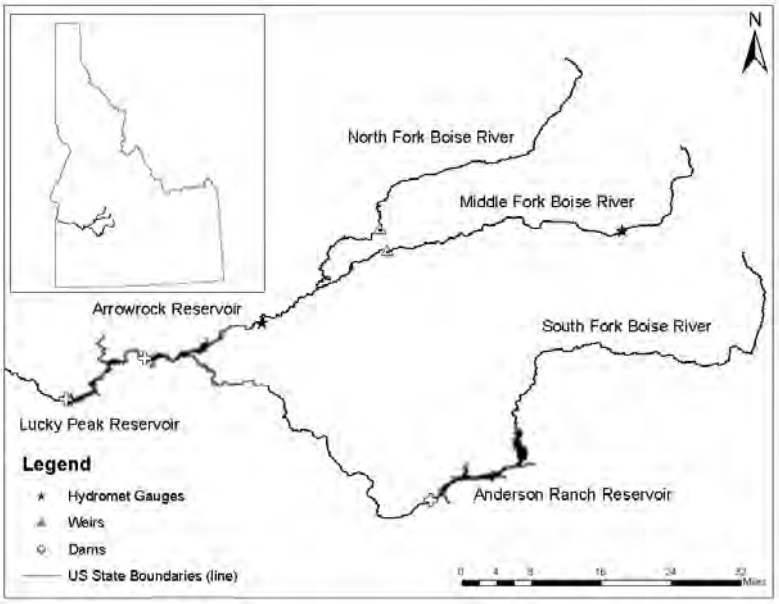

Figure 1. Boise River watershed with Arrowrock, Anderson Ranch and Lucky Peak reservoirs. Arrowrock, Anderson Ranch and Lucky Peak Dams

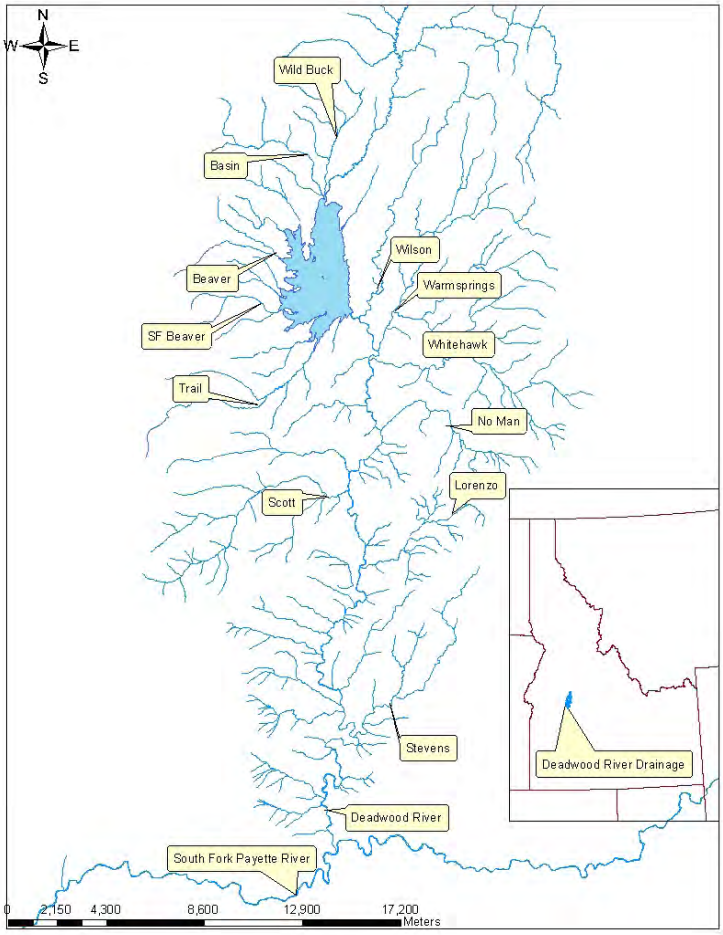

Figure 2: Deadwood Reservoir with Deadwood Dam

Chapter Two

FYKE NETTING AND RADIO TAGGING OF BULL TROUT (*Salvelinus confluentus*) IN DEADWOOD RESERVOIR, Valley County, IDAHO

INTRODUCTION

The U.S. Fish and Wildlife Service (FWS) 2005 Upper Snake Biological Opinion (BiOp) identified that operations at Deadwood Dam cause take of bull trout. Term and condition 3.e, requires Reclamation to minimize entrainment of bull trout due to operations. Understanding bull trout movement and use of the reservoir is the first step in meeting this RPM. The reporting requirements of the 2005 BiOp also directs Reclamation to monitor bull trout take. Reclamation combined its entrainment and mortality tracking efforts to comply with these requirements. In 2008 six bull trout were captured in Deadwood Reservoir using fyke nets and tagged with radio transmitters as part of the entrainment monitoring project. One small bull trout was also captured in a fyke net but not tagged. One fish from the IDFG weir operations was also tagged. Fyke netting occurred from mid June to mid July. A total of seven fish were tagged in the reservoir in 2008. Additionally two bull trout were still being tracked from the 2007 tagging. Confirmed mortalities during this reporting period included three bull trout, one that was tagged in 2007 and two that was tagged in 2008. No tagged bull trout were entrained in 2008. Six bull trout were still being tracked in the reservoir as of October 29, 2008.

STUDY AREA

All of the work discussed in this chapter occurred in Deadwood Reservoir located on the mainstem Deadwood River which flows into the South Fork Payette River in Central Idaho (Figure 1). Deadwood Reservoir stores water from the mainstem Deadwood River as well as several smaller tributaries.

METHODS

Fish were collected using fyke nets from mid June through mid July and one week in October. Fyke nets were set at the mouth of Trail, Beaver, Basin and Wild Buck creeks as well as the mainstem. Bull trout were captured in the Trail, Beaver, and Wildbuck creek nets. The fyke nets were set for 24 hour intervals three days per week. Nets measured 1.22 m x 1.22 m x 0.91 m with 30.48 m x 1.22 m lead lines. All the fyke nets were designed to sink and were treated with an algaecide to prevent decay and had 4 fykes per net (Figure 2) . All of the nets had lead core bottom lines that followed the bottom of the reservoir and foam core top lines to maintain the vertical orientation in the water. Each net had 8 kg weights to anchor the bottom line and 20 cm diameter buoys on the top line for marking location and retrieval.

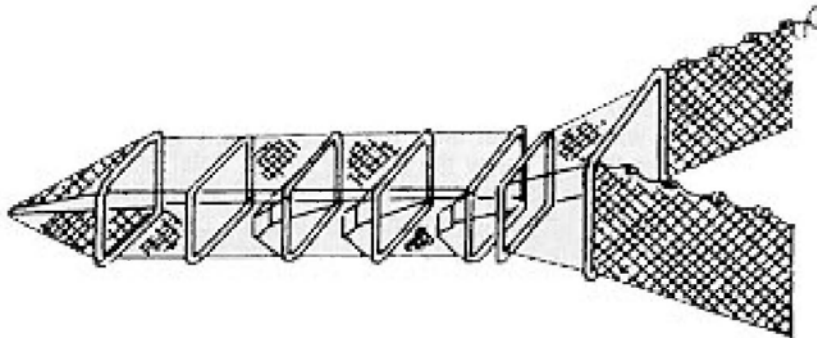

Figure 3. Fyke net used for capturing bull trout

All fish captured were identified to species and enumerated. The first five fish of each species captured had muscle plugs taken from just below their dorsal fin for an associated isotope project. Total length (TL) was recorded for all game species. Gastric lavage was also conducted on all bull trout and up to five fish of each other species captured after July 8th. IDFG personnel sacrificed three rainbow trout and three whitefish to evaluate the effectiveness of the gastric lavage technique Additional procedures for examining trapped bull trout included placing fish in an anesthetic bath containing tricaine methanesulfonate (MS-222; 100 mg/L) buffered with sodium bicarbonate. When a bull trout was considered anesthetized (could not right itself) it was measured (total (TL) and fork length (FL); mm) and weighed (g). Scale samples and fin clips were taken, and the fish was scanned for Passive Integrated Transponder (PIT) tags (Biomark Incorporated, Boise, ID 2007). All bull trout over 100 grams were implanted with radio transmitters and PIT tags. Starting in the fall of 2008 all captured bull trout had their adipose fin clipped as a secondary mark. Radio tags were manufactured by Lotek Wireless and included multiple sizes and data capabilities. Capture and handeling methods for the bull trout captured and tagged in the IDFG weirs are described in Chapter Four.

Radio tags were implanted using a modified shielded needle technique described by Ross and Kleiner 1982. Bull trout were placed ventral side up in a V-shaped surgery cradle. The gills were bathed in anesthetic solution using a turkey baster throughout the surgery. A small incision (1.0 cm to 2.0 cm) was made parallel to the linea alba, a fibrous structure that runs down the midline of the abdomen composed mostly of collagen connective tissue and a sterilized transmitter was inserted into the peritoneal cavity or the space within the abdomen that contains the intestines, the stomach, and the liver. The antenna exit hole was created using a 12 or 14 gauge 7.6 cm (3.0 in.)-long surgical needle inserted through the body wall below the pelvic girdle onto a 1.0-cm x 7.6-cm (0.4-in. x 3.0-in) long steel spatula. The antenna exited the body approximately 1.5 cm to 2.0 cm (0.6 in. x 0.8 in) posterior to the pelvic girdle and slightly to the side of the mid-ventral line. The incision was closed with chromic cat cut sutures. Surgical glue was then applied to the incision after sutures were in place. Bull trout were held and monitored in live wells until full recovery (minimum 15 minutes), and then released into Deadwood Reservoir near their point of capture. Visible infirmity or injuries such as descaling, frayed fins, or dermal lacerations were noted for all bull trout captured.

Radio tagged fish were tracked monthly by helicopter throughout the year and bi-weekly on the ground during the summer. A remote tracking station that operates continuously has been set up on the dam to monitor for entrainment since 2006. When a radio tagged fish was located the following data was recorded at that location: time, GPS location, pressure (water depth) and temperature at the fish's location (if the tags were equipped with those sensors) and general comments. For each survey day the following data were also recorded: general weather, surface ice cover for the reservoir and river, reservoir pool elevation, general comments, and if surface ice was present pictures were taken.

Migration timing, during the fall spawning run, was estimated for radio tagged fish leaving the reservoir and returning to the reservoir. Migration timing estimates were based on when the fish were last observed in the reservoir and first observed in the tributaries and visa versa. Exact migration times are not able to be determined because radio tracking only occurred bi-weekly.

Fin clips and muscle plugs were collected from all sampled bull trout. Fin clips will be sent to the Abernathy Labs (FWS) for genetic analysis allowing possible assignment to natal streams in the drainage. Muscle plugs are being used in an associated isotope study. The collection of fin clips and muscle plugs were non lethal and occurred while the bull trout were being fitted with radio tags.

RESULTS

A total of 797 fish, representing nine species, were captured using fyke nets (Table 1). Seven bull trout were captured (two recaptures), which represented 0.88% of the total fish captured. Redside Shiners (*Richardsonius balteatus*) were the least abundant fish captured. The most abundant fish captured was the Mountain Whitefish (*Prosopium williamsoni)*, comprising 49% of all fish captured. Also noteworthy were Speckled Dace (*Rhinichthys osculus*), comprising 19% of the total fish captured.

Of the seven bull trout captured in fyke nets during 2008, four were captured in fyke nets at the mouth of Trail Creek, one was captured in a fyke net at the mouth of Beaver Creek, one was captured in a fyke net at the mouth of Wildbuck Creek, and one was caught in the South Fork Beaver weir moving downstream presumably after spawning (Table 2). The bull trout ranged from 86 mm to 574 mm TL and 8 g to 2106 g in weight. One of the bull trout captured this year was a very small fish probably outmigrating from Wildbuck Creek at the time of capture. This fish was too small to be PIT or radio tagged. One bull trout was recaptured from 2006 and one was recaptured from 2007. Both of these recaptures already had radio tags. Three bull trout died during the 2008 field season.

Table 1: Number of fish sampled in fyke nets and catch per unit effort (CPUE), Deadwood Reservoir 2008.

Species	CPUE (All Fish)	0.54
	Total Fish	797
	Total Hours	1464
	Number Caught	*CPUE*
Bull Trout (*Salvelinus confluentus*)	7	0.005
Cutthroat Trout (*Oncorhynchus clarki lewisi*)	91	0.062
Kokanee (*Oncorhynchus nerka kennerlyi*)	4	0.003
Long Nosed Dace (*Rhinichthys cataractae)*	30	0.020
Rainbow Trout (*Oncorhynchus mykiss*)	105	0.072
Rainbow/Cutthroat hybrid	4	0.003
Redside Shiner (*Richardsonius balteatus)*	1	0.001
Sculpin *Cottus spps.*	16	0.011
Speckled Dace (*Rhinichthys osculus)*	150	0.1.02
Mountain Whitefish (*Prosopium williamsoni*)	389	0.266

Table 2: Length, weight, sampling location and date captured of all bull trout handled by Reclamation staff in Deadwood Reservoir or the Deadwood River weir in 2008.

Date	Site	Fork Length (mm)	Total Length (mm)	Weight (g)
6/17/2008	Wildbuck Creek	85	86	8
7/9/2008	Trail Creek Fyke Net	552	574	2106
7/10/2008	Trail Creek Fyke Net	450	467	1036
7/10/2008	Trail Creek Fyke Net	411	426	800
7/14/2008	Beaver Creek Fyke Net	507	528	1780
7/14/2008	Trail Creek Fyke Net	219	230	124
7/17/2008	Trail Creek Fyke Net	412	428	846
10/3/2008	SF Beaver Creek Weir	415	435	666

Table 3: Summer (July through September) bull trout temperatures.

July Through September Fish Temperatures

Year	Average ˚C	Max ˚C	Min ˚C	Median	Standard Deviation
2006	12.6	18.0	8.4	12	2.04
2007	12.5	19.6	8.0	12	2.13
2008	12.1	17.2	7.6	12	3.25

Table 4: Fish migration and mortality summary 2006-2008.

	Average Dates Of All Fish					
Year	Migration out of Reservoir	Migration Back to Reservoir	# Days in Tributary	Migration Distance range (miles)	Distance average (miles)	Mortality Rates
2006	8/23/2006	10/2/2006	43	0.25-1.25	0.87	38%
2007	7/9/2007	9/24/2007	78	0.5-15.0	4.52	78%
2008	8/7/2008	9/29/2008	56	0.25-1.75	0.94	34%

With over 600 individual tracking locations for fish in the Deadwood system (above Deadwood dam) some generalizations can be used to explain movement patterns (Figure 4). During spring and fall when the reservoir is not stratified bull trout movements seem to be sporadic. Late in the spring as stratification begins bull trout tend to be found near the surface in the "warmer" water. As summer progresses and the surface water in the reservoir is warmed significantly, bull trout tend to do one of three things. Begin their spawning migration, stay near the mouths of tributaries or move to deeper water. When the reservoir is stratified and multiple temperatures are available for bull trout (July-September), they tended to stay around a median of 12˚C in all three years (Table 3). In 2007 some fish exceeded the ten meter maximum detection depth for a radio tag as they swam deeper where the preferred temperatures were available. Average temperatures (tag readings) for bull trout during the spawning migration were 9.9°C in 2007, compared to 5.3°C in 2006 and 5.7°C in 2008.

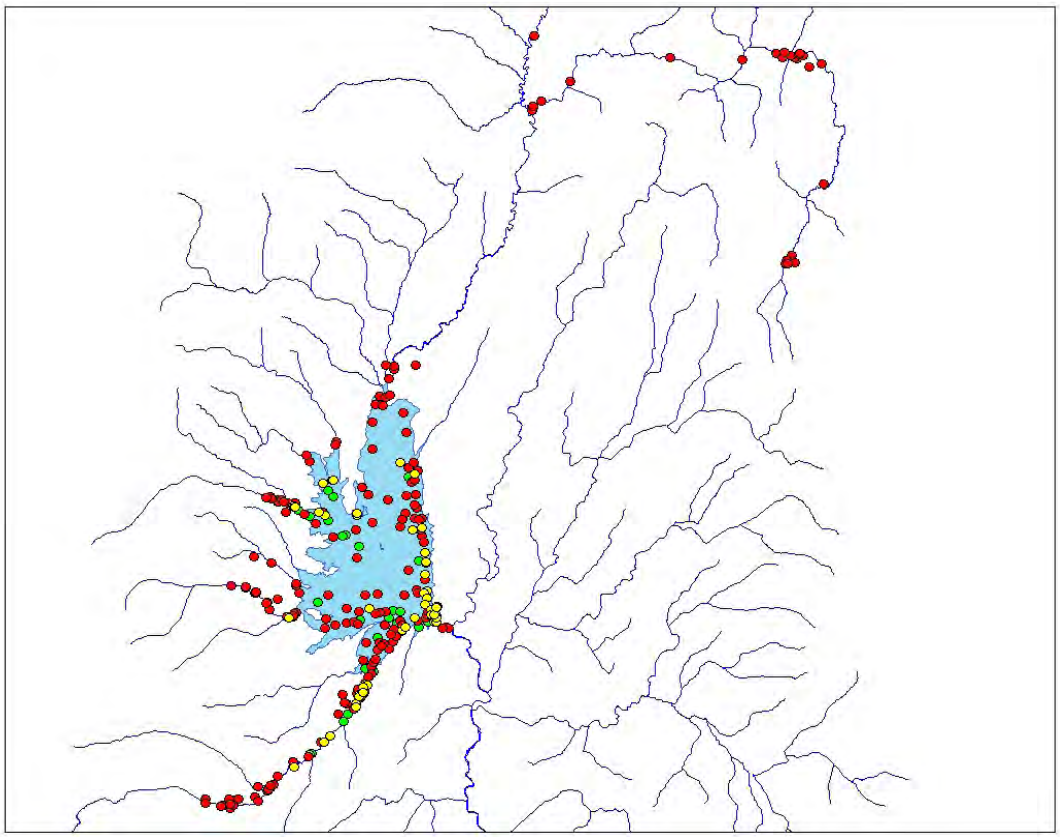

Figure 4: Bull trout locations 2006-2008. Green- 2006 Red- 2007 Yellow-2008

Fish movement also varied year to year. In 2006 tagged fish spent the least amount of time in the spawning tributaries (43 days on average) as well as having the shortest migration distance (0.87 miles on average). In 2007 fish spent the longest amount of time in spawning tributaries (78 days on average) and had the longest migration distance (4.52 miles on average). In 2008 fish spent 56 days on average in the spawning tributaries and migrated 0.94 miles on average to get there.

In 2006 all of the tagged fish migrated into Trail Creek. In 2007 tagged bull trout migrated into four different tributaries while in 2008 tagged fish were once again only tracked migrating into Trail Creek. On average fish migrated into the spawning tributaries on August 23 in 2006. In 2007 bull trout were tracked moving upstream over a wide range of dates but on average bull trout migrated out of the reservoir on July 9th. In 2008 bull trout averaged an August 7th departure from the reservoir. Average migration dates back into the reservoir were October 2nd in 2006, September 24th in 2007 and September 29th in 2008 (Table 4).

The average life expectancy of a tagged bull trout in Deadwood Reservoir is around 200 days (14 days to 835 + days). Mortality rates for the three years of the study were 37.5% in 2006, 78% in 2007 and 34% so far in 2008 (Table 4). The majority of confirmed mortalities, based on where radio tags were found, occurred in the transition zone of the reservoir (eight) as fish were either migrating up to or back down from spawning. Mortality rates were next highest in the spawning tributaries (five) and a few fish died while they were in the reservoir (three). One of the three mortalities in the reservoir was a consequence of the tagging itself. The remainder of the tags have not been recovered.

DISCUSSION

Bull trout in Deadwood Reservoir were mainly captured in the Trail Creek arm of the reservoir, but were tracked moving throughout the rest of the reservoir over time. All of the bull trout captured in fyke nets were caught within 30 m of the transition zone of Trail Creek accept; one which was captured at the mouth of Beaver Creek and a very small one captured in the mouth of Wildbuck Creek. Three bull trout that were tagged at the Trail Creek weir in 2005 were migrating upstream presumably to spawn. In the spring of 2006 a large male with a very large tag scar was captured in a fyke net. A decision was then made to only implant radio tags into fish before the middle of July or into downmigrating fish at the weirs to reduce the chances of tag expulsion during spawning. During the late spring and early summer bull trout seemed to be spending part of their time holding in the cooler water coming out of Trail Creek.

In 2006 no bull trout were captured or tracked near the mouth of the mainstem Deadwood River, the general thought was because the mainstem river warmed quicker than the other tributaries the bull trout had already migrated before our trapping efforts started. In 2007 efforts were made to start trapping earlier in the spring. Fyke netting began in mid May but still no bull trout were caught near the mainstem Deadwood River. The first bull trout wasn't captured until the first of June. Tracking records show that radio tagged bull trout were dispersed throughout the reservoir, usually near the shore, early in the year. As the reservoir warmed the radio tagged fish congregated near the mouths of tributaries and spent time at deeper depths.

Large numbers of predators; bears and raptors, were seen feeding on kokanee where the tributaries run through the dewatered sections of the reservoir. The majority of bull trout mortalities coming from their short amount of time spent migrating through the transition zone on their way to or from the reservoir. This distance bull trout had to travel through the sections of tributaries in the dewatered portion of the reservoir was greatest in 2007 correlating to the increased mortality rates. Kokanee have been seen struggling to swim upstream at the mouth of multiple tributaries and predators congregated in these areas. Even after the kokanee made it past the shallow water in the delta areas the lack of cover made it easy for predators to capture them. No bull trout were seen in these dewatered sections but it can be assumed they have similar problems associated with shallow water and predation.

Temperatures for bull trout while in the spawning tributaries were much higher in 2007 than 2006 or 2008. In 2007 bull trout also moved further up into the tributaries than they did in 2006 or 2008. In many cases bull trout moved up as far as possible in their spawning tributary and ran into waterfalls before they could reach colder temperatures. This increased travel distance for a large fish in a small tributary could have also attributed to the increased mortality rates in 2007. Migration distances may not seem comparable with fish migrating into different tributaries in 2007 than they did in 2006 or 2008. The furthest migration distances in 2007 were from fish that migrated up the mainstem and then into Deer Creek. Distances from 2006 and 2008 become more comparable to 2007 when the fact that 2 fish that migrated into Deer Creek in 2007 had migrated into Trail Creek the previous year. One fish that had a radio tag implanted as it downmigrated through the mainstem weir in 2007 migrated into Trail Creek in 2008. This suggests that spawning site fidelity might not be important for Deadwood bull trout.

With only three years of data more information is needed to verify some of the relationships we have seen so far. Reclamation plans to continue to track fish in the reservoir through fall of 2009. Additional radio tagging efforts may also be conducted in the spring of 2009.

Chapter Three

MONITORING BULL TROUT MOVEMENT BELOW DEADWOOD RESERVOIR USING RADIO TELEMETRY

ABSTRACT

The FWS 2005 Upper Snake BiOp identified operations at Deadwood Dam cause harm and harassment to bull trout. Bull trout captured and tagged below Deadwood Dam could help address all of the terms and conditions associated with Deadwood Dam. The terms and conditions discuss possible harm and harassment associated with low winter stream flows, low summer temperatures, the lack of biologically significant ramping rates, and disruption of migratory cues below the dam as well as entrainment over or through the dam. Since September of 2007 fourteen bull trout have been collected from the stilling basin below the dam and implanted with radio tags. Individual fish have been tracked up to 20 miles downstream, but not fish have ever been tracked moving into any tributary or the South Fork of the Payette.

STUDY AREA

All of the work discussed in this chapter occurred on the lower Deadwood River between the dam and the South Fork of the Payette River (Figure 1).

METHODS

Sampling below the dam for bull trout has been attempted every year since 2004. Hook and line sampling was completed in the river below the dam in the spring of 2004. One crew spent a week sampling the upper 2 miles below the dam while another crew sampled the lower 9 miles up from the confluence of the South Fork Payette. A spring electroshocking and hook and line sampling effort was conducted during the spring of 2005 in the upper 2 miles below the dam. Weirs were also installed and run on Wilson and Warmsprings Creeks from mid June through mid September. During a maintenance project in 2006 when the dam was cut back to only 5cfs a more extensive sampling effort was conducted. One crew spent a week sampling the stilling basin and the upper 2 miles below the dam using gill nets, backpack electroshockers as well as hook and line sampling. Another crew electroshocked two 1 ½ mile sections of the river near Stevens and Julie Creeks.

Because no bull trout were captured in any of these sampling efforts no sampling was planned below the dam in 2007. During his lunch hour a Reclamation electrician caught two bull trout within a week directly below the dam in the fall of 2007. An informal sampling effort followed involving setting one fyke net in the tailwater of the stilling basin and several hours of angling over a period of three weeks. Due to time constraints with weir operations in the reservoir, the fyke net below the dam was only periodically set for 24 hour periods. The fyke net was a sinking 1.22 m x 1.22 m x 0.91 m net with a

30.48 m x 1.22 m lead line (Figure 2). The net had a lead core bottom line that followed the bottom of the river and a foam core top line to maintain the vertical orientation in the water. The net was secured to the bridge at the upstream end and the lead line was stretched downstream and anchored with an 8 kg weight. A similar time frame was used for hook and line sampling as well as fyke net deployment in the fall of 2008 as well as additional hook and line sampling in the spring of 2008. Sampling in the river below the dam was mainly restricted to the stilling basin in 2008 because of time limitations and logistics. Some angling was done during tracking efforts to try to recapture fish for growth information and tag replacement.

Captured bull trout were anesthetized using diluted tricaine methanesulfonate (MS-222) (approximately 100 mg/L). When a bull trout was considered anesthetized (could not right itself) it was measured and weighed. Scale samples and fin clips were taken, and the bull trout was scanned for Passive Integrated Transponder (PIT) tags (Biomark Incorporated, Boise, ID 2007). The first five bull trout had muscle plugs taken for an associated isotope study. Gastric lavage was also conducted on all bull trout and up to five fish of each other species captured after July 8th. All bull trout over 100g were implanted with radio transmitters, four of which contained temperature and depth sensors. Bull trout were placed ventral side up in a V-shaped surgery cradle. The gills were bathed in anesthetic solution using a bilge pump and shower system throughout the surgery. The surgical methodology used was a modified shielded needle technique (Ross and Kleiner 1982). A small incision (1.0 cm to 2.0 cm) was made parallel to the linea alba, a fibrous structure that runs down the midline of the abdomen, composed mostly of collagen connective tissue, and a sterilized transmitter was inserted into the peritoneal cavity or the space within the abdomen that contains the intestines, the stomach, and the liver. The antenna exit hole was created using a 12 or 14 gauge 7.6 cm (3.0 in.)-long surgical needle inserted through the body wall below the pelvic girdle onto a 1.0-cm x 7.6-cm (0.4-in. x 3.0-in) long steel spatula. The antenna exited the body approximately 1.5 cm to 2.0 cm (0.6 in. x 0.8 in) posterior to the pelvic girdle and slightly to the side of the mid-ventral line. The incision was closed using absorbable surgical sutures. Surgical glue was then applied to the incision after sutures were in place. Bull trout were held and monitored in live wells until full recovery (minimum 15 minutes), and then released back into the Deadwood River below the dam near their point of capture. Visible infirmity or injuries such as descaling, frayed fins, or dermal lacerations were noted for all bull trout captured.

Radio tagged fish were tracked monthly by helicopter. Fish that were located in the stilling basin or within the first 2 miles of the Deadwood River below the dam were ground tracked throughout the summer however; most tracking was performed in a helicopter because of the remote and rugged terrain throughout most of the study area. When a radio tagged fish was located the following data was recorded at that location: time, GPS location, pressure (water depth) and temperature at the fish's location (if the tags were equipped with those sensors) and general comments. For each survey day the following data was also recorded: general weather, surface ice cover for the reservoir and river, reservoir pool elevation, general comments, and if surface ice was present pictures

were taken. For fish that were ground tracked below the stilling basin photos were taken of their approximate location.

Fin clips were collected from all sampled bull trout and muscle plugs were collected from the first five bull trout captured each year. Fin clips were sent to the Abernathy Labs (FWS) for genetic analysis allowing assignment to natal streams in the drainage (above or below the reservoir). Muscle plugs are being used in an associated isotope study.

RESULTS

A total of fourteen bull trout were captured using a fyke net and hook and line sampling in the stilling basin below Deadwood Dam in the fall of 2007, spring of 2008 or fall of 2008. (Table 5). Captured bull trout ranged from 247 mm to 379 mm TL and 114 g to 514 g in weight. Thirteen of these bull trout were implanted with radio transmitters, one fish was recaptured and the tag has been replaced another fish was recaptured and released. Six of these bull trout continue to be tracked by helicopter or ground surveys. Tracking activities are planned to be ongoing through the end of 2011.

Bull trout captured in the stilling basin have been tracked moving up to 20 miles downriver in the mainstem Deadwood River (Figure 5). There has only been one confirmed mortality (7%).

Fin clips from all eleven bull trout captured in 2007 were sent to Abernathy Labs for genetic analysis. One sample did not amplify but the other 10 fish were fish are more closely related to bull trout from tributaries above the dam than they are bull trout from tributaries below the dam (Table 5).

Table 5: Bull trout captured in Deadwood River (DWD) below the dam in 2008.

Date	Site	Fork Length (mm)	Total Length (mm)	Weight (g)	Comments
7/3/2008	Stilling Basin	336	355	464	
7/9/2008	Stilling Basin	234	247	114	
9/17/2008	Stilling Basin	345	358	398	Recapture
9/29/2008	Stilling Basin	255	270	178	
7/3/2008	Stilling Basin	324	344	466	Recapture

DISCUSSION

During an extensive interagency effort of electroshocking, gill netting, and hook and line sampling in the fall of 2006 no bull trout were captured in the river below the dam (Prisciandaro, 2006). Small resident bull trout have been electroshoked in two separate tributaries to the Deadwood River Below the dam (Warmsprings and Scott creeks) but, 2007 was the first year bull trout were captured in the mainstem river itself. All of the bull trout collected in 2007 were captured in the stilling basin directly below the dam.

Bull trout captured below the dam(n=13), on average, were smaller (312 mm, 298 g vs. 423 mm, 836 g) than their counterparts captured in fyke nets in the reservoir(n=21). All of the bull trout captured in the stilling basin looked healthy. One fish looked as if it

may have suffered a broken back at some point but was healthy and swimming fine at the time of capture. Genetics samples were taken from these fish to determine their origin. The genetic information suggests these fish are more closely related to the population above the dam which suggest the fish were entrained. With lower capture rates in 2006 and 2008 as well as two of the five fish captured in 2008 being recaptures from 2007 it is plausible that the actual entrainment happened in 2007.

Mortality rates from fish tagged in the stilling basin could be misleading because confirming mortalities is nearly impossible in the majority of the rugged lower Deadwood River canyon. The fish captured below the dam were also smaller on average than the fish captured in the reservoir so smaller shorter life tags were used further complicating mortality confirmation. We are currently tracking six of the fourteen fish. In most cases the battery on the tag died without us being able to confirm if the fish was alive or not so mortality rates should be more of a range from 7-57%.

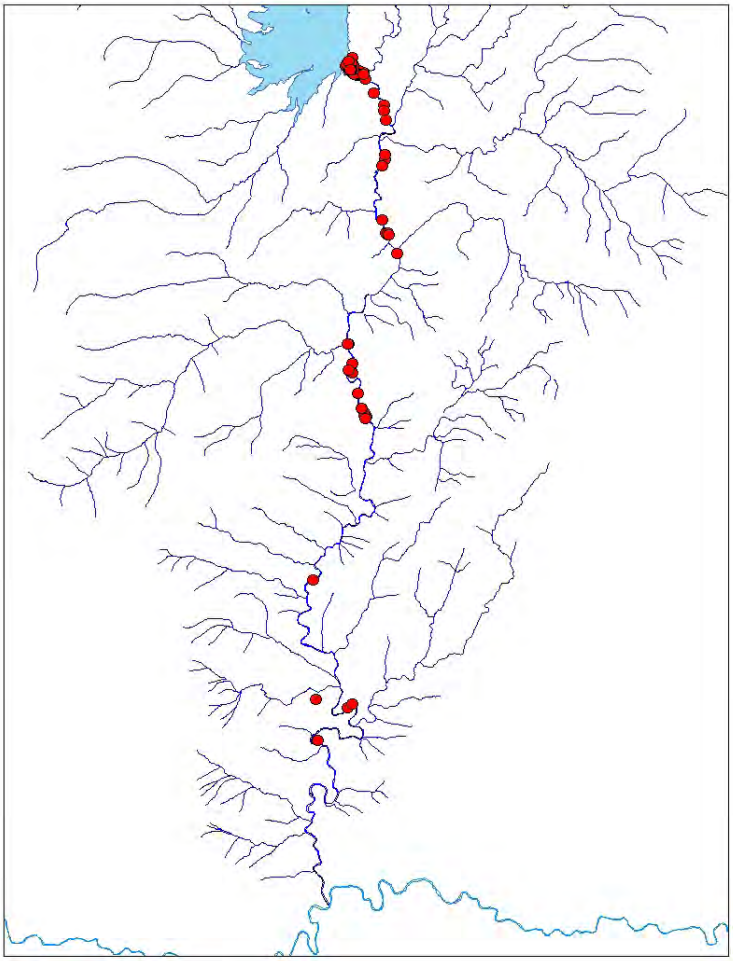

Figure 5: Radio tagged bull trout locations in the Deadwood River below Deadwood Dam between October 6, 2007 and October 28, 2008.

Chapter Four

SUMMARY OF ADFLUVIAL BULL TROUT (*Salvelinus confluentus)* HANDLELED BY THE IDAHO DEPARTMENT OF FISH AND GAME, DEADWOOD RESERVIOR, IDAHO

ABSTRACT

In a collaborative effort between the U.S. Bureau of Reclamation and the Idaho Department of Fish and Game, temporary picket weirs were installed on tributaries to Deadwood Reservoir to and evaluate bull trout *Salvelinus confluentus* populations as described in BOR contract number 06PG110095. A total of fifteen bull trout were handled at all weir sites combined. This was the third year in a three year contract with IDFG.

INTRODUCTION

The FWS Draft Recovery Plan (FWS 2002) includes guidelines for management agencies to facilitate bull trout recovery. The federal bull trout recovery team has outlined several important objectives for bull trout recovery. These are: 1) maintenance and restoration of the distribution of bull trout 2) maintenance and restoration of habitat for all life history forms 3) conservation of genetic diversity, and 4) implementation of recovery actions and assessment of their success (FWS 2002). Meeting recovery objectives requires that accurate estimates of population size, assessments of distribution, and trends in abundance are known for bull trout populations within each recovery unit. The Deadwood River below the dam is in the Southwest Basin Recovery Unit. In 2005, Reclamation, IDFG and Boise National Forest (BNF) developed a cooperative program to begin gathering baseline data to be used to meet the recovery objectives. Work began in July 2005 and is ongoing through the 2008 field season. The purpose of the work is to assess temperature, precipitation, reservoir conditions and stream discharge conditions as they relate to bull trout movement, population size, and survival on a large-watershed scale. Weirs were first installed on the tributaries to the Deadwood River to capture kokanee in 1986. In 2006 kokanee operations were expanded and the time frame was extended in an attempt to capture adfluvial bull trout as they returned to the reservoir after spawning.

STUDY AREA

All of the work discussed in this chapter occurred in tributaries to Deadwood Reservoir located in Central Idaho (Figure 1). Deadwood Reservoir stores water from the mainstem Deadwood River as well as several smaller tributaries.

METHODS

Weirs were operated across the major migratory corridors into Deadwood Reservoir: Basin Creek, South Fork Beaver Creek, Beaver Creek, Trail Creek, and the Deadwood River between August 13 and October 13. A steel picket style weir with upstream and downstream traps was constructed across the full width of each tributary. The weirs were constructed of angle iron frames with steel conduit pickets spaced 1.25 cm (0.5 in.) apart.

All fish captured were identified to species and enumerated. Bull trout were anesthetized using tricaine methanesulfonate (MS-222) (80 mg/L dilution). When the bull trout were considered anesthetized (could not right itself) their total length and weight were recorded. Scale samples and fin clips were taken, and the fish were scanned for Passive Integrated Transponder (PIT) tags (AVID computer corporation, Norco, CA 1999). All bull trout > 100 mm TL which did not carry tags were tagged with 2.5 mm x 14 mm, 125 kHz PIT tags. Bull trout were held and monitored in live wells until full recovery (minimum 15 minutes), and then returned to the river. Bull trout captured moving downstream were released downstream of the weir and bull trout moving upstream were released upstream of the weir. Direction of migration as well as date and time of capture was noted.

RESULTS

IDFG personnel handled a total of 15 bull trout in 2008. One bull trout captured at the weirs in 2008 was implanted with a radio tag for the associated tracking study. Complete results will be in the 2008 DEADWOOD TRIBUTARY WEIR OPERATIONS FINAL REPORT BULL TROUT *Salvelinus confluentus* POPULATION MONITORING from IDFG.

DISCUSSION

Weirs were breached again in 2008 and tagged bull trout passed downstream without being stopped by the weirs. Six smaller (<200 mm) bull trout were captured in the downstream trap boxes at the weirs. Even though weirs have not been able to produce a viable population estimate of adult spawners this has been the best method to capture these small bull trout. More discussion can be found in the 2008 DEADWOOD TRIBUTARY WEIR OPERATIONS FINAL REPORT BULL TROUT *Salvelinus confluentus* POPULATION MONITORING from IDFG.

Chapter Five

FALL GILL NETTING AND REDD COUNT EFFORTS FOR POPULATION ESTIMATES, DEADWOOD RESERVIOR, IDAHO

ABSTRACT

With the difficulty of getting a population estimate from weir counts at Deadwood Reservoir a mark recapture gill netting effort as well as a redd count effort were attempted. Two crews spent a week setting vertical and horizontal gill nets in an attempt to mark enough bull trout and rainbow trout to attempt a recapture effort. No bull trout (*Salvelinus confluentus*) were captured and only 15 rainbow trout (*Oncorhynchus mykiss*) were marked. An additional 11 rainbow trout were marked by hook and line sampling. A recapture effort was not attempted because of the low numbers of fish captured. The lower two miles of Trail Creek were walked in an attempt to count bull trout redds during spawning. Four radio tagged bull trout were seen during the survey but the high numbers of kokanee (*Oncorhynchus nerka kennerlyi*) redds made identifying bull trout redds impossible.

INTRODUCTION

The FWS Draft Recovery Plan (FWS 2002) includes guidelines for management agencies to facilitate bull trout recovery. The federal bull trout recovery team has outlined several important objectives for bull trout recovery. These are: 1) maintenance and restoration of the distribution of bull trout 2) maintenance and restoration of habitat for all life history forms 3) conservation of genetic diversity, and 4) implementation of recovery actions and assessment of their success (FWS 2002). Meeting recovery objectives requires that accurate estimates of population size, assessments of distribution, and trends in abundance are known for bull trout populations within each recovery unit. Weirs were first installed on the tributaries to the Deadwood River to capture kokanee in 1986. In 2006 kokanee operations were expanded and the time frame was extended in an attempt to capture adfluvial bull trout as they returned to the reservoir after spawning in order to develop a population estimate. Population estimates from weir counts on the Boise system have been successful in past years but working at higher elevations in a different environment has had its problems and a Deadwood population estimate from weir counts has not been possible. Redd counts as well as an extensive gill netting effort were planned in the fall of 2008 in an attempt to get a population estimate.

STUDY AREA

All of the work discussed in this chapter occurred in Deadwood Reservoir and its tributaries located in Central Idaho (Figure 1). Deadwood Reservoir stores water from the mainstem Deadwood River as well as several smaller tributaries.

METHODS

During ground tracking of radio tagged bull trout on their spawning migration in the fall of 2008 the lower two miles of Trail Creek were surveyed for bull trout redds. Two Reclamation employees walked one on each side of the river looking for redds. An attempt to differentiate between kokanee redds and bull trout redds was made. When a radio tagged bull trout was found a more extensive survey was done in an attempt to identify the redd. Redd and bull trout locations were collected using a GPS.

During the week of October 6th 2008 vertical, horizontal floating, and horizontal sinking gill nets were deployed for 30 to 60 minute sets. Fyke nets were also set at the mouths of Trail and South Fork Beaver Creek as well as the mainstem Deadwood River for 24 hr intervals. Horizontal gill nets were concentrated in the near shore habitat while vertical gill nets were set at depth (Figure 6). Horizontal gill nets were set for a total of 50 hours, vertical gill nets were set for a total of 37 hours, and trap nets were set for 216 hours. Hook and line sampling in between sets was also conducted for a total of seven hours during the week. All rainbow trout captured had a total length taken and their adipose fin was clipped, to determine recaptures, before their release. All other species captured were counted and released. Due to the low numbers of fish marked the recapture effort was not attempted.

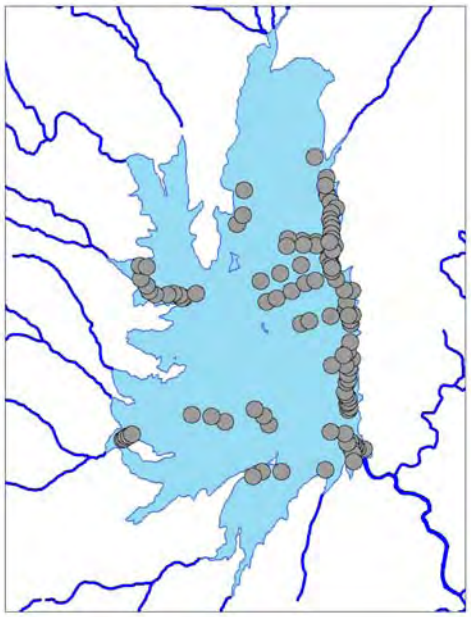

Figure 6: Fall of 2008 population effort sampling locations.

RESULTS

A total of 143 fish of six different species were captured during the population estimate sampling effort (Table 6). Mountain Whitefish (*Prosopium williamsoni*) were the most abundant species captured at 49%. Rainbow trout (23%) and Cutthroat trout (*Oncorhynchus clarki lewisi*; 13%) were the next most abundant species captured. No bull

trout were captured. All thirty three rainbow trout were marked, but no recapture effort was made. A breach of the Trail Creek weir had allowed kokanee to migrate up into the creek and make their own redds.

Table 6: Fish collected during population estimate effort October, 2008.

Species	Vertical Gill Nets	Horizontal Gill Nets	Trap Nets	Hook and Line	**Total**
Bull Trout (*Salvelinus confluentus*)	**0**	**0**	**0**	**0**	**0**
Cutthroat Trout (*Oncorhynchus clarki lewisi*)	4	12	1	1	**18**
Kokanee (*Oncorhynchus nerka kennerlyi*)	9	0	1	0	**10**
Rainbow Trout (*Oncorhynchus mykiss*)	5	10	7	11	**33**
Speckled Dace (*Rhinichthys osculus)*	0	0	12	0	**12**
Mountain Whitefish (*Prosopium williamsoni*)	16	46	8	0	**70**
Total	**34**	**68**	**29**	**12**	**143**

DISCUSSION

Because of the large number of kokanee and kokanee redds in the system it was determined that counting bull trout redds was unreliable. Even though bull trout redds were identified this was only because of their size and the presence of tagged bull trout. Other redds that looked too large to be from a kokanee had kokanee on them.
With no bull trout and only 33 rainbow trout being captured during the marking effort for a reservoir population estimate a recapture effort the following week was not attempted. Past IDFG overnight gill nets sets in the 1990's collected multiple bull trout (IDFG unpublished data). Past Reclamation horizontal sinking gill netting in the spring provided no bull trout and very few fish at all. With all of the bull trout back in the reservoir from spawning Reclamation assumed using four different types of gear, capture of at least a few individuals would be feasible. The lack of bull trout captured in this effort as well as the low numbers of bull trout captured in other efforts described in this report lead us to believe the population of adfluvial adult bull trout in Deadwood Reservoir is quite small. The low numbers of fish captured overall during this effort might also be a result of high water clarity and not being able to sample much after dark because of freezing equipment. A similar effort during late spring or early fall might give us more information on the juvenile and subadult bull trout in the reservoir. Due to their spawning migration this type of effort would not give us an accurate population estimate for adfluvial adults. More thought is needed in determining a population estimate using the spring trap netting effort even though annual changes in water level and temperature have been shown to greatly change capture efficiencies and very few juveniles and subadults have ever been captured using trap nets. Only a few methods of capture are left to attempt a mark recapture effort and get more information on the juvenile and subadult bull trout in the reservoir. Floating merwin traps and shoreline boat electroshocking are possibly ways to capture and mark more individual fish.

Chapter Six

TRAP AND TRANSPORT OF BULL TROUT (*Salvelinus confluentus*) FROM LUCKY PEAK RESERVOIR TO ARROWROCK RESERVOIR, IDAHO

ABSTRACT

The FWS 2005 Upper Snake BiOp identified operation of Arrowrock dam to cause take of bull trout by entrainment over the spillway and through the outlet works of the Arrowrock dam. Reclamation was issued a term and condition with a Reasonable and Prudent Measure (RPM) to implement a trap and transport program below Arrowrock dam to minimize permanent dislocation of bull trout from the Boise River system above Arrowrock reservoir. In 2008 bull trout (*Salvelinus confluentus)* were captured in Lucky Peak Reservoir using weighted monofilament gill nets and transported above Arrowrock Dam and released into Arrowrock Reservoir. Trapping occurred between the months of April and June. A total of five bull trout were captured ranging from 380 mm to 560 mm in total length and 550 g to 2085 g in weight.

STUDY AREA

All of the sampling discussed in this chapter occurred in Lucky Peak Reservoir on the mainstem Boise River (Figure 3). Lucky Peak Reservoir primarily stores water from the mainstem Boise River and from one small watershed, Mores Creek.

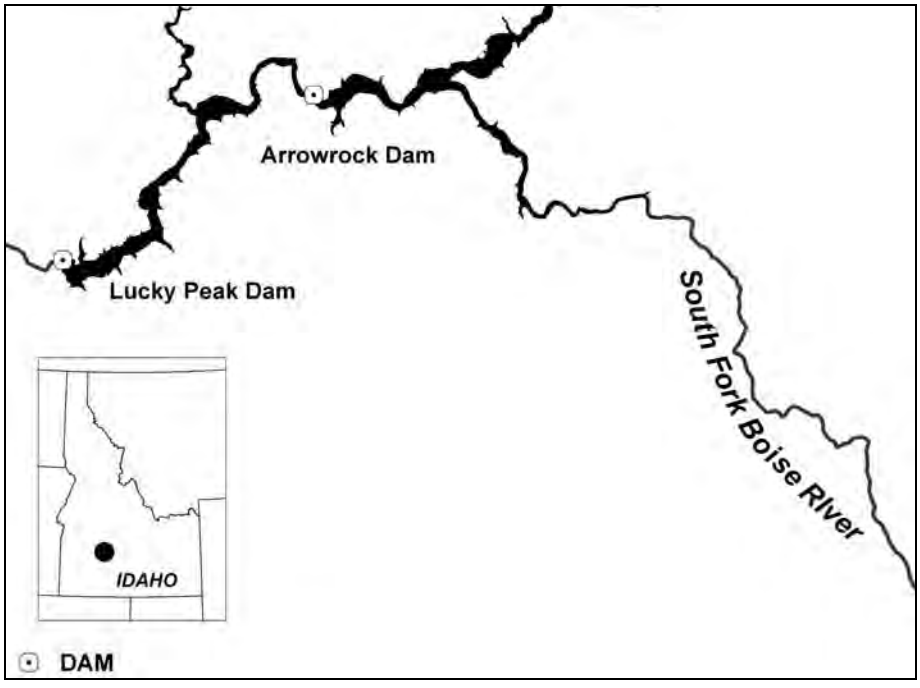

Figure 7. Lucky Peak and Arrowrock Reservoirs on the Boise River in Southwestern Idaho.

METHODS

Fish were collected using experimental mesh, monofilament gillnets between late April and early June. Gillnets were set for 20 minute intervals during the daylight period between 0800 to 2000 hours four days per week. Nets were 30.5 m long x 1.25 m deep with four equal-length panels. Each panel had one of four mesh sizes: 3.18 cm, 5.04 cm, 6.35 cm, and 7.62 cm. The nets had lead core bottom lines that followed the bottom contour of the reservoir and foam core top lines to maintain the vertical orientation in the water. Each net had 8 kg weights to anchor the bottom line and 20 cm diameter buoys on the top line for marking location and retrieval. Catch rates for each species were calculated for hours that the nets were fished.

All captured bull trout were held in the boat's 227 liter live well with periodic water exchange until the end of each sampling day. The fish were then transported to Arrowrock reservoir, measured, tagged with PIT tags, and released. Fin clip samples for genetics and scale samples for aging were also collected. The seasonal period of trapping was chosen to increase efficiency of capture as bull trout were anticipated to be staging below Arrowrock Dam in preparation for the upstream spawning migration each spring (Flatter 2000).

All fish captured were identified to species and enumerated. Total length (TL) was recorded for all game species. Bull trout were anesthetized using diluted tricaine methanesulfonate (MS-222) (approximately 100 mg/L). When a bull trout was considered anesthetized (could not right itself) it was measured and weighed. Scale samples and fin clips were taken, and the fish was scanned for Passive Integrated Transponder (PIT) tags (AVID computer corporation, Norco, CA 1999). All bull trout captured that were > 100 mm were tagged with 2.5 mm x 14 mm, 125 kHz PIT tags in accordance with instruction from IDFG personnel (Russ Kiefer, IDFG, pers. comm.). Bull trout were held and monitored in live wells until full recovery (minimum 15 minutes), and then released into Arrowrock Reservoir. If surface water temperatures in Arrowrock Reservoir exceeded 18°C (65°F), bull trout were driven by boat to the areas of cooler water near river transition zones in the reservoir. Visible infirmity or injuries such as descaling, frayed fins, or dermal lacerations were noted for all bull trout captured.

RESULTS

A total of 355 fish, representing ten species, were captured (Table 7). Gillnetting was used as the primary method of capture based on previous work in the Boise River system (Flatter 2000). A total of five bull trout were captured ranging from 380 mm to 560 mm in total length and 550 g to 2085 g in weight. The five bull trout captured represented less than 2% of the total fish captured. Although found at low numbers Bull trout were not the least abundant fish captured. The most abundant fish captured was the largescale sucker (*Catostomus macrocheilus*), comprising 29% of all fish captured. Also

noteworthy were bridgelip sucker (*Catostomus columbianus*) and kokanee (*Oncorhynchus nerka*) compromising 27% and 21% of the population respectively.

Table 7. Catch data listed for gill net captures for all species in Lucky Peak Reservoir

Species	CPUE (mean)	2.32
	Total Fish	357
	Total Hours	153.8
	Number Caught	*CPUE*
Bull trout (*Salvelinus confluentus*)	2	0.01
Cutthroat trout (*Oncorhynchus clarki lewisi*)	6	0.04
Largescale sucker (*Catostomus macrocheilus*)	110	0.72
Rainbow trout (*Oncorhynchus mykiss*)	78	0.51
Northern Pikeminnow (*Ptychocheilus oregonensis*)	40	0.26
Mountain whitefish (*Prosopium williamsoni*)	45	0.29
Chiselmouth (*Acrocheilus alutaceus*)	14	0.09
Bridgelip sucker (*Catostomus columbianus*)	7	0.05
Smallmouth bass (*Micropterus dolomieu*i)	22	0.14
Kokanee (*Oncorhynchus nerka*)	33	0.21

DISCUSSION

Sampling for three separate weeks in three different months gave us a better idea for when to sample in the future. Catch rates may be affected by turbidity and soak times. Sampling at Deadwood Reservoir and discussions on gill net soak times with IDFG and FWS may allow us to increase set times during future trap and haul efforts in Lucky Peak.

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