Burns Paiute Tribe

Evaluate the Life History of Native Salmonids in the Malheur Subbasin
FY 2004 Annual Report

Prepared for:

U.S. Department of Energy
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U.S. Fish and Wildlife
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Evaluate the Life History of Native Salmonids in the Malheur Subbasin

FY 2004 Annual Report
(BPA Project # 199701900)

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By Jason Fenton, Fish and Wildlife Department, Burns Paiute Tribe, Burns OR.

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Chapter 1 Use of Radio Telemetry to Document the Movements of Bull Trout in the Upper Malheur River, Oregon. 2004

by Jason Fenton
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Introduction

In 2004, the Burns Paiute Fish and Wildlife Department (BPFW) continued research on bull trout *Salvelinus confluentus* in the Malheur River above Warm Springs Reservoir (referred to as the upper Malheur River). Bull Trout in the upper Malheur River are at a high risk of extinction and are suppressed by hybridization and competition with brook trout *Salvelinus fontinalis* and habitat degradation (Ratliff and Howell 1992; Buchanan et al., 1997). Fish habitat has been altered significantly since European settlement and has had an impact on bull trout (USFWS 2002a).

Past fish and creel surveys were used to estimate the current distribution of bull trout (Bowers et al. 1993). However, little is known on the seasonal distribution of juvenile bull trout in the upper Malheur River. In 2001 and 2002, Schwabe et al. conducted similar studies on bull trout in the upper Malheur River. It was suggested by the study that adult bull trout (>300 millimeters Fork Length) start to migrate into the headwaters of the upper Malheur River starting in May to mid July. More data is needed to determine the migratory patterns of subadult bull trout in the upper Malheur River.

The Malheur River Bull Trout Workgroup developed the following objectives for bull trout:

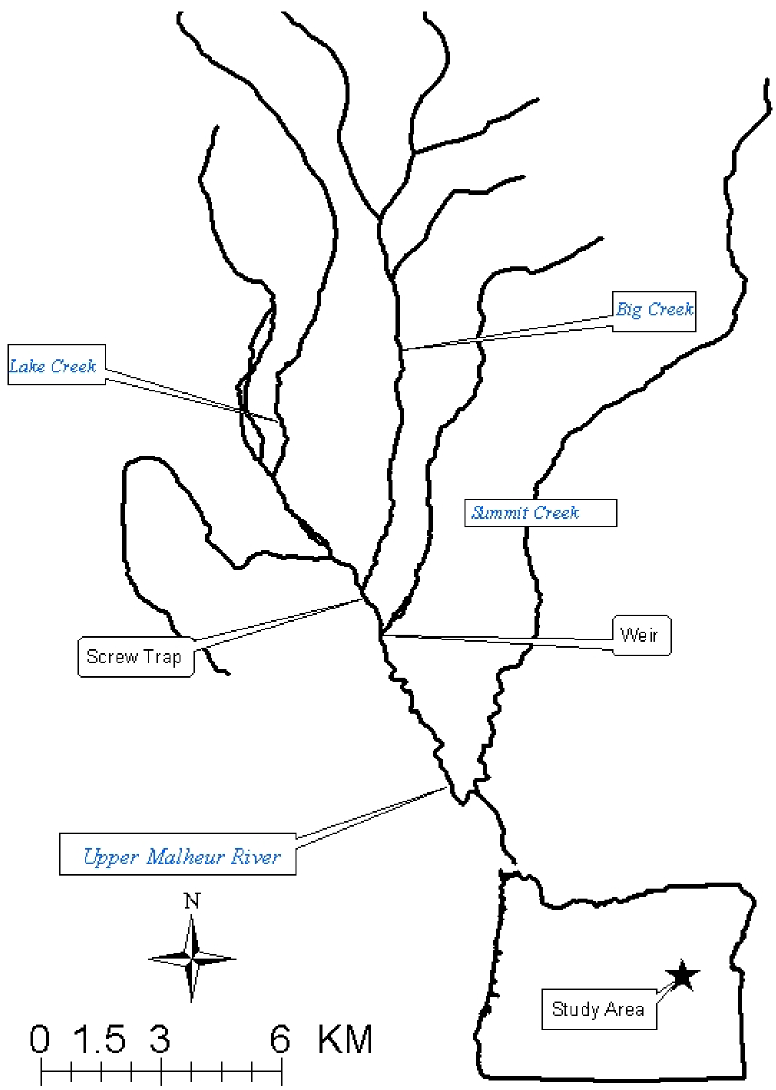
- Document the migratory patterns of subadult bull trout in the upper Malheur River.
- Document the seasonal distribution of subadult bull trout.

This report will reflect the research completed from April 30th to November 8th, 2004.

Study Area

The study area of this project is based in the upper Malheur River and associated headwaters south of the Strawberry Mountains in Grant County, Oregon (Figure 1).

Figure 1. Upper Malheur River Study Area.



Methods

Fish Collection

Weir

A fish weir was set up approximately 120 meters downstream where Bosonberg Creek drains in to the upper Malheur River. The site is downstream of all tributaries to the upper Malheur River that is known to sustain a population of bull trout. The weir was set in place on May 24th, 2004 and fished for 1632 hours. The weir trap, designed to span a width slightly larger than the wetted channel, was installed at a slight angle across the upper Malheur River. The structure used ¾ inch diameter conduit with ¼ inch spaces between the rods. Steel rods anchored in to the stream bed helped stabilize the weir. Sand bags were placed along the base of the weir on the upstream side to prevent scouring of the streambed and associated banks. Sandbags were filled with instream gravels collected upstream of the weir site to avoid the introduction of excess sediments. Upstream and downstream trap boxes were placed near opposite stream banks and were interlocked into the weir panels. All fish caught in the upstream trap were released upstream; fish caught in the downstream trap were released downstream. All salmonids were measured (fl mm) and released. All other species of fish were tallied and then released. The traps were checked at least once a day. The weir was removed on July 30th, 2004 due to low water conditions.

Screw Trap

A five-foot rotary screw trap was placed just below the confluence of Lake Creek and Big Creek in the upper Malheur River. These two creeks converge to form the upper Malheur River. This site was selected as it is below all known bull trout spawning tributaries, road accessibility was good, and the channel narrowed and scored out a deep pool which would increase trapping efficiency and provide sufficient depth for the drum. All salmonids captured were measured (fl mm) and all other fish were tallied. After processing, all fish were released in a pool twenty meters downstream. The screw trap was checked once a day. The screw trap was installed on April 30th, 2004, fished for 1728 hours and was removed on July 11th, 2004 due to low water.

Angling

Angling was used to supplement weir and screw trap bull trout collection operations and was only implemented as needed. To minimize potential harm to the bull trout, only barbless flies were used for the study. Bull trout angled were placed in a five gallon bucket with a fish tank bubbler. After implanted with a radio tag, bull trout were released at the site of capture.

Electroshocking

Electroshocking bull trout for radio tag implants was only to be used if the other techniques proved to not be very effective in capturing fish. The Burns Paiute Fish and Wildlife Department conducted a separate distribution and genetic study in Big Creek using a backpack electroshocker manufactured by Smith-Root (see chapter 2). This study followed the electroshocking guidelines outlined by the National Marine Fisheries

Service (NMFS 2000). Collection of subadult bull trout were radio tagged from Big Creek RD 16 to 1648. Bull trout that were captured by this method were radio tagged and released at the point of capture. Electroshocking was conducted from July 1st, 2004 to July 14th, 2004.

Radio Tags and Passive Intergraded Transponder (PIT) Tags
Radio transmitters manufactured by Advanced Telemetry Systems had external whip antennas that emitted a unique frequency in either the 150 of 151 MHz band. The radio tag weight was 1.9 grams and was guaranteed for 78 days.

All bull trout over 150 mm were implanted in the muscle adjacent to the dorsal fin with a PIT tag using a "BioMark" PIT tag injector and a 1 ¼ inch, 12 gauge injector needle.

Implants
Bull Trout that were ≤300mm fork length were considered candidates for radio implants. Schwabe et al. (2003) determined that at 300 mm, bull trout were about 3 years old. Bull Trout tend to mature between four and seven years of age (USFWS 2002b). In addition to the length requirements, the weight of the implant could not exceed 4 percent of the body weight of the fish. Therefore, bull trout weighing less than 50 grams were not considered for implantation.

Captured bull trout were anesthetized with "MS 222" (tricaine methanesulfonate); they were then measured (fork length in millimeters) and weighed (grams). Radio transmitters were surgically implanted into the peritoneal cavity of the bull trout using the modified shielded needle technique (Ross and Kleiner 1982). The external whip antennas were threaded through the body cavity and exited behind the pelvic fin. During the surgery the gills were bathed with diluted MS 222 (60mg/liter). Synthetic absorbable surgical sutures and super glue sealed the incision. After surgery, the fish were held in fresh water until equilibrium was achieved; they were then released back into the river. Fish tank aerators were used in all holding buckets to assist with recovery.

Tracking
Radio tracking began following the first radio implant on May 19th 2004 and ceased on November 8th 2004. Weekly tracking for the bull trout occurred with an Advanced Telemetry Services receiver, Yagi antenna and a 12 channel hand held Global Positioning System unit. Tracking was conducted by foot, truck or fixed wing airplane. Visual identification for the fish was attempted but rarely possible. All positive locations were documented with a Universal Transverse Mercator (UTM).

Results

Fish Collection
A total of eight bull trout were collected using all the trapping methods. Other fish species were captured in addition to bull trout include: redband trout *Orcorhynchus mykiss*, bridgelip sucker *Catostomus columbianus* , largescale sucker *Catostomus macrocheilus*, long nose dace *Rhinichthys cataractae*, speckled dace *Rhinichthys osculus*,

redside shiner *Richardsonius balteatus,* mountain whitefish *Prosopium williamsoni*, and Sculpin *Cottus spp.* Number of species caught per trapping method can be found in appendix A.

Screw Trap
A total of three bull trout were captured in the screw trap (See appendix A). Two bull trout were caught on May 19th and May 21st. The length and weights of these fish were 184mm, 64grams, and 181mm, 52grams, respectively. These two bull trout were fit with a radio tag. One more bull trout was caught on June 10th and was 172 mm and 50 grams. This bull trout was too small for the study and was not tagged. No other bull trout were captured in the screw trap.

Weir
Two bull trout were captured in the weir during the month of July and both were in the downstream trap (See appendix A). Both of these bull trout were noted to be in poor health. The first fish was captured on July 7th and the second on July 28th. The length and weights of these fish were 290mm, 218 grams, and 227mm, 120grams, respectively. These two bull trout were radio tagged and released downstream.

Electroshocking
The BPFW was conducting a distribution study in Big Creek. During this study, two bull trout were caught 300 meters below the FSRD 1648 and radio tagged. These two fish were caught on July 13th and 14th and released at the sight of capture. The length and weights of these fish were 197mm, 73 grams, and 193mm, 82grams, respectively.

Angling
One bull trout was caught via angling on June 4th, 100 meters above the Meadow Fork Trailhead. This bull trout was 220mm long and weighed 101grams. This fish was radio tagged and released at the sight of capture.

Bull Trout Movement
Seven bull trout were implanted with a radio tag in the upper Malheur River in 2004 (Table 1).

Two bull trout were captured in the screw trap and proceeded to move in opposite directions (Table 2). One bull trout was tracked downstream to a distance of 6.4 kilometers below the screw trap within 32 days after released with a radio tag. This fish then returned upstream 4.9 km over the next 25 days until the radio was found on the shore 1.5 km below the screw trap. The other bull trout proceeded up Lake Creek within 29 days to a total of 5.1 km above the screw trap. For the rest of the study this fish stayed within an area of 0.8 km. The area of Lake Creek that this bull trout resided in is heavily influenced by dams constructed by American Beaver *Castor canadensis* .

Two bull trout were captured in the weir and moved downstream before radio contact was lost (Table 2). Radio signals from the tags could not be detected within two days of the implants. It is unknown what was the fate of these fish. On August 24th, 2004 a plane was used to try to locate these two fish. Only the bull trout that were previously accounted for were located.

Two other bull trout were captured by an electroshocker in Big Creek just below USFSRD 1648 (Table 2). These two fish remained within 0.8 km from their point of capture. The area in which these bull trout resided is in an area that burned in 1990. The stream has many dead trees in and across the water. There are several large pools with woody debris throughout the area.

One bull trout was angled in Meadowfork Creek (Table 2). This fish remained within 0.8 km from the site of capture. Five months later, this bull trout was tracked in the same pool that it had originally been captured.

Table 1. Bull Trout that were radio tagged in 2004. Upper Malheur River.

Date of Implant	Radio Frequency (MHz)	Weight (g)	Fork Length (mm)	Maximum Distance Traveled from Release Site (Km)	Comments
May 19	151.182	64	186	4.3	Alive in Lake Creek Nov. 8
May 21	151.382	52	181	-7.0	Tag Found July 17
June 4	151.084	101	220	.08	Alive in Meadowfork Creek Nov. 8
July 7	151.323	218	290	-1.0	Last tracked on July 20
July 13	151.302	73	197	.05	Alive in Big Creek Nov. 8
July 14	151.222	82	193	.08	Alive in Big Creek Nov. 8
July 28	151.021	120	227	-1.5	Last Tracked on July 30

Table 2. Distance (KM) radio tagged bull trout moved from site of capture. Upper Malheur River. 2004

Frequency	Origin	May 23	May 30	June 6	June 13	June 20	June 27	July	August	Sept.	Oct.	Nov.
151.182	Screw Trap	0 .1	1.2	3.0	4.2	4.2	4.3	4.3	4.3	4.3	4.3	4.3
151.382[t]	Screw Trap	0.0	-4.0	-4.1	-5.9	-7.0	-2.7	-1.5	--	--	--	--
151.084	Meadow Fork	NA	NA	0.0	.03	.08	.06	.08	.02	.06	.03	0.0
151.323*	Weir	NA	NA	NA	NA	NA	NA	-1.0	--	--	--	--
151.302	Below 1648 rd	NA	NA	NA	NA	NA	NA	.01	.05	.02	-.01	.01
151.222	Below 1648 rd	NA	NA	NA	NA	NA	NA	.01	.03	.08	.05	.04
151.021*	Weir	NA	NA	NA	NA	NA	NA	-1.5	--	--	--	--

* Contact with radio was lost. [t]Radio was found on hillside in July.

Discussion

The goal of this study was to capture and radio tag twenty subadult bull trout. With the screw trap, the weir, angling, and electroshocking, we were only able to capture eight bull trout and implant seven sub adult bull trout with a radio tag. In 2000, and 2001 the BPFW conducted similar collection effort and captured 82 and 66 bull trout respectively using only a weir (Schwabe et al. 2001, 2002). During the same time period, 61 bull trout were captured in a weir in 2000 and 77 bull trout in 2001 verses a total of two bull trout captured in a weir in 2004.

Previous studies have suggested that bull trout migrate upstream from below RK 304 in May through mid July (Schwabe et al. 2001, 2002). In 2000, seven subadult bull trout were captured in the weir and radio tagged (Schwabe et al. 2001). These bull trout all migrated up from below RK 304 and into Big Creek. This year, no subadult bull trout migrated from below RK 304 or into Big Creek however there were very few bull trout captured and radio tagged. There were no bull trout captured in the upstream trap box in the weir. This is not what was expected since bull trout have in the past migrated upstream during this time period.

On July 26th, 2003 there was a storm that passed through the headwaters of the upper Malheur River. The result was substantial damage in the upper reaches of Meadowfork Creek and Lake Creek (Schwabe et al. 2004). The BPFW was conducting a distribution study on Lake Creek within the time the storm hit. After the storm there was a decrease in the number of fish captured. (Schwabe et al. 2004). In addition, spawning survey results for bull trout were also very much reduced from the previous years (Perkins 2003). According to past studies, adult fluvial bull trout occupy the reaches of Meadow Fork and Big Creek during this time period (Schwabe 2001 and 2002). It is possible that the storm had a dramatic negative effect on the fluvial population of bull trout in the upper Malheur River. Documented potential mortality rates in excess of over 70% (see **chapter** x) might explain why we did not catch bull trout in the weir.

One bull trout was angled out of a pool in Meadowfork Creek on June 4th. There is a potential upstream barrier .5km above the point of capture that may have been caused by a flood in July of 2003. This bull trout moved upstream to the barrier and back for the next five months. On November 8th this bull trout was tracked to the very same pool that it was captured.

One bull trout that was captured in the screwtrap migrated 5.1km upstream into Lake Creek. This was the first time that a bull trout was documented to migrate into and stay in Lake Creek. This bull trout then stayed within an area of 0.8km for the next five months. This area of Lake Creek is highly inundated with beaver dams and deep pools. In 2003, this area of Lake Creek dried up completely. There is a water diversion upstream on private land that was allegedly diverting all of the water of Lake Creek into the westerly braid. As a result, the east side of Lake Creek dried up completely. With the natural addition of beavers, the area is now inundated with dams and the water levels are up to one meter deep is some area. This diversion needs to be addressed so that future bull trout in the area will not be without water. The lower reach of Lake Creek is considered a potential thermal barrier during the summer and fall months. The bull trout found in Lake Creek was released on May 19th and may have migrated up before Lake Creek became too warm. In previous studies, the BPFW has documented subadult bull trout moving into Lake Creek but these fish did not continued upstream (Schwabe et al.2002). These fish returned to the Malheur River and migrated up Big Creek. Bull trout are present in the upper reach of Lake Creek and it is undetermined if these fish are solely a resident population or a small migratory population.

It is unknown what the effects of low flows have on the population of bull trout in the upper Malheur River. In 2000 and 2001 bull trout were captured in the weir on their way towards the headwaters from below RK 304 (Schwabe 2001, 2002). During low flow years it may be possible that the bull trout stay in the headwaters during the winter months and thus would not be below RK 304. There may be other influences that are unknown such as unscreened diversion ditches. Due to the low numbers of bull trout collected, more research needs to be conducted to help determine the seasonal distribution of bull trout.

Acknowledgments

A special thanks to the Bonneville Power Administration who funded this project for the Burns Paiute Tribe Fish and Wildlife Department. We would also like to thank Eric Hawley, Garret Sam, Kevin Fenn, Jason Fenton, and Lawrence Schwabe for the countless hours that each individual spent in the field checking traps, tracking fish, and all other field work that was contributed to the project.

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U.S. fish and Wildlife Service. 2002b. Chapter 1, Malheur Recovery Unit, Oregon. U.S. fish and Wildlife Service. Bull Trout (Salvelinus confluentus) Draft Recovery Plan. Portland OR.

Appendix A. Species of fish caught in the Upper Malheur River. 2004.

Figure 2. Species of fish collected in the weir. Upper Malheur River 2004.

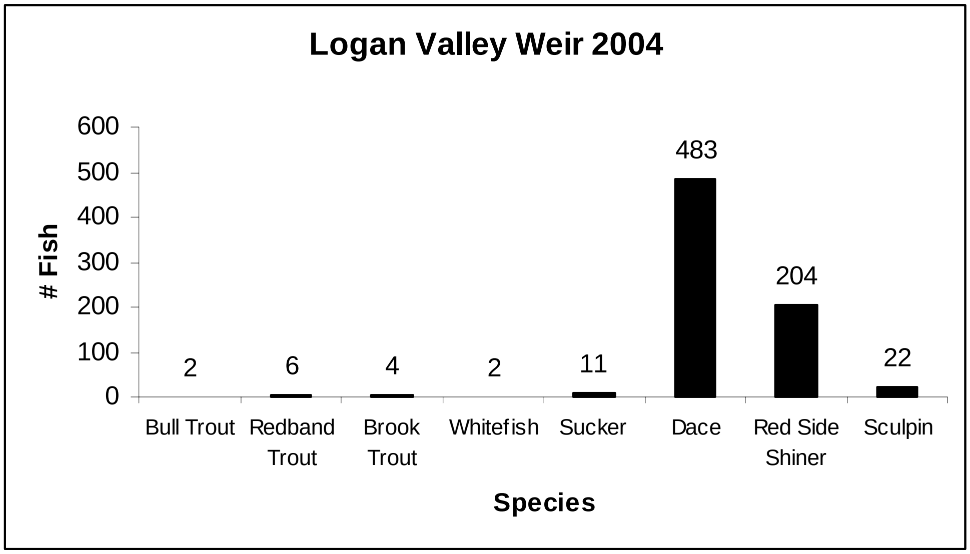


Figure 3. Species of fish collected in the screw trap. Upper Malheur River 2004.

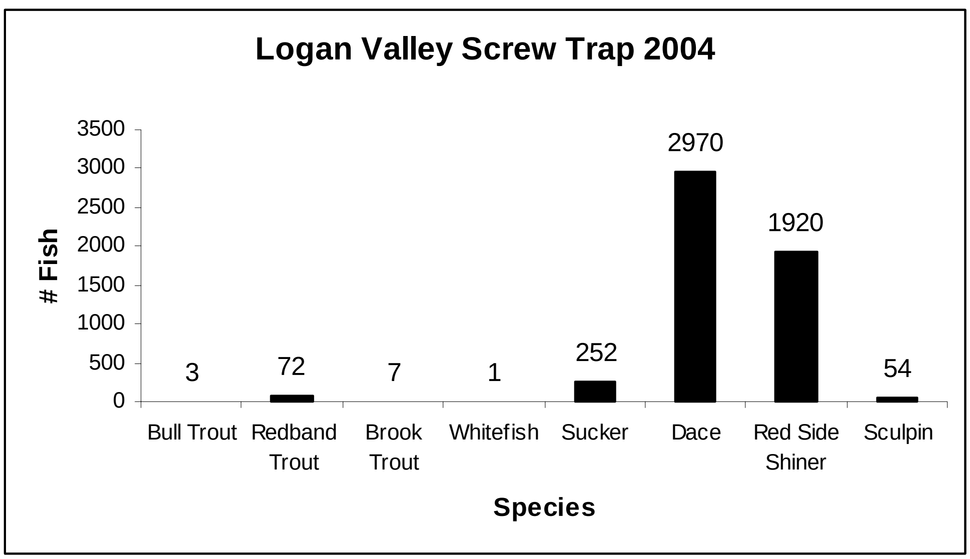


Figure 4. Daily catch of bull trout in the screw trap. Upper Malheur River 2004.

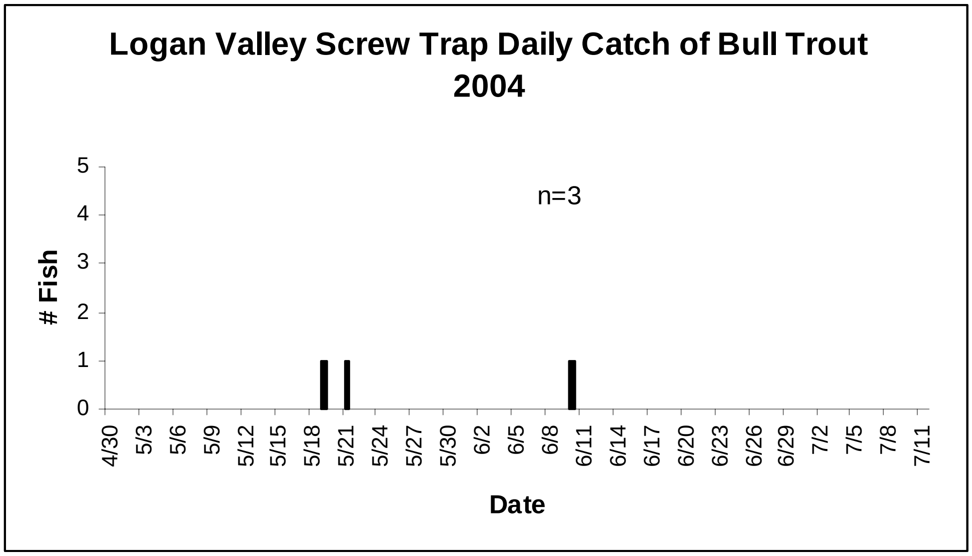


Figure 5. Daily catch of redband trout in the screw trap. Upper Malheur River 2004.

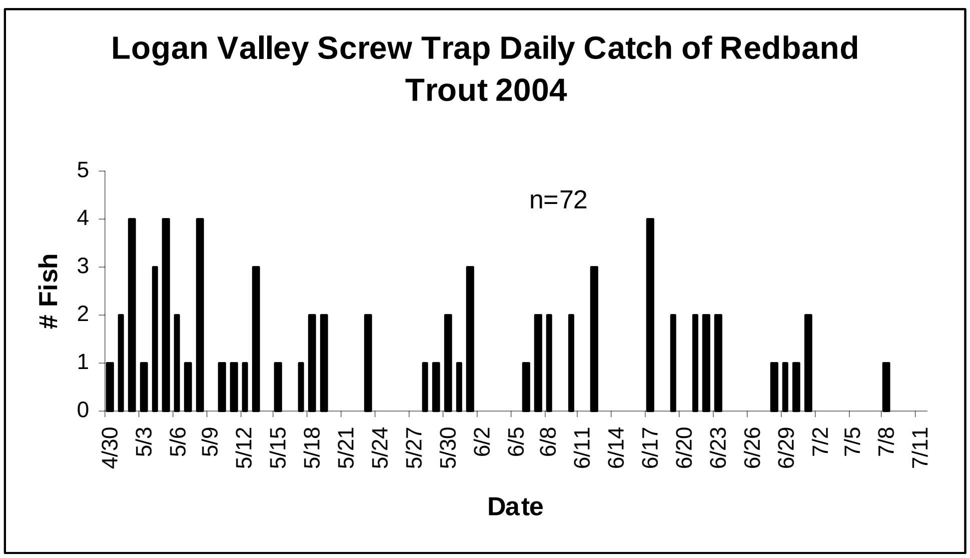


Figure 6. Daily catch of brook trout in the screw trap. Upper Malheur River 2004.

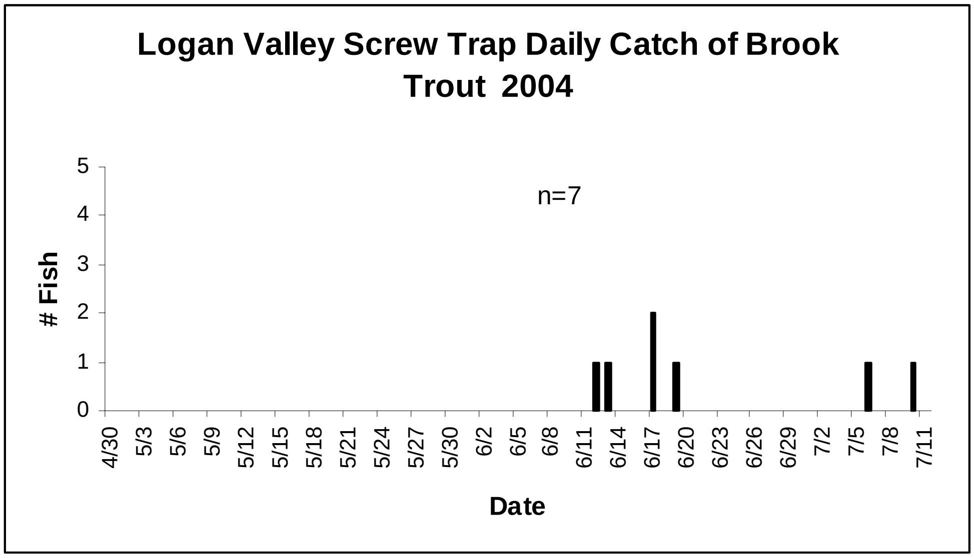


Figure 7. Daily catch of mountain whitefish in the screw trap. Upper Malheur River 2004.

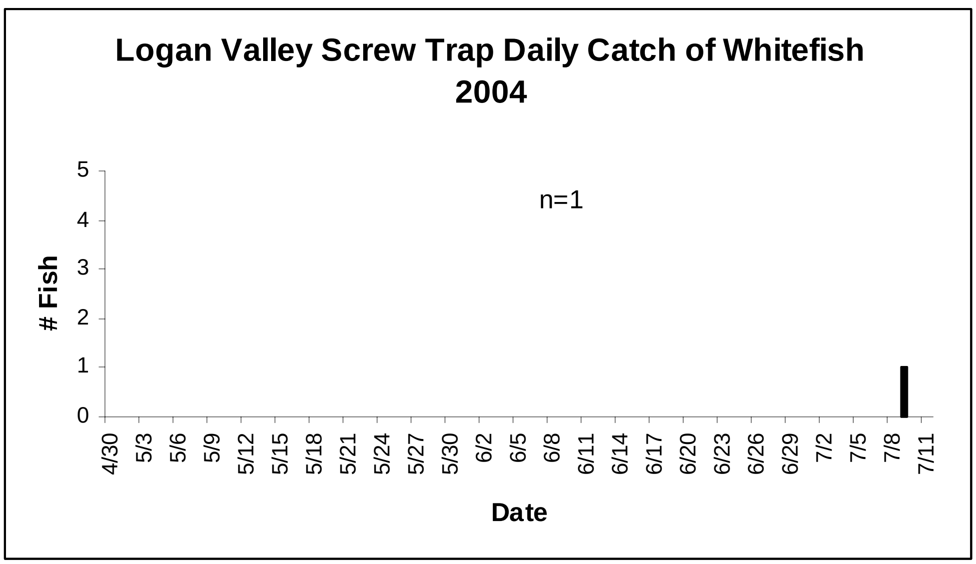


Figure 8. Daily catch of bull trout in the weir. Upper Malheur River 2004.

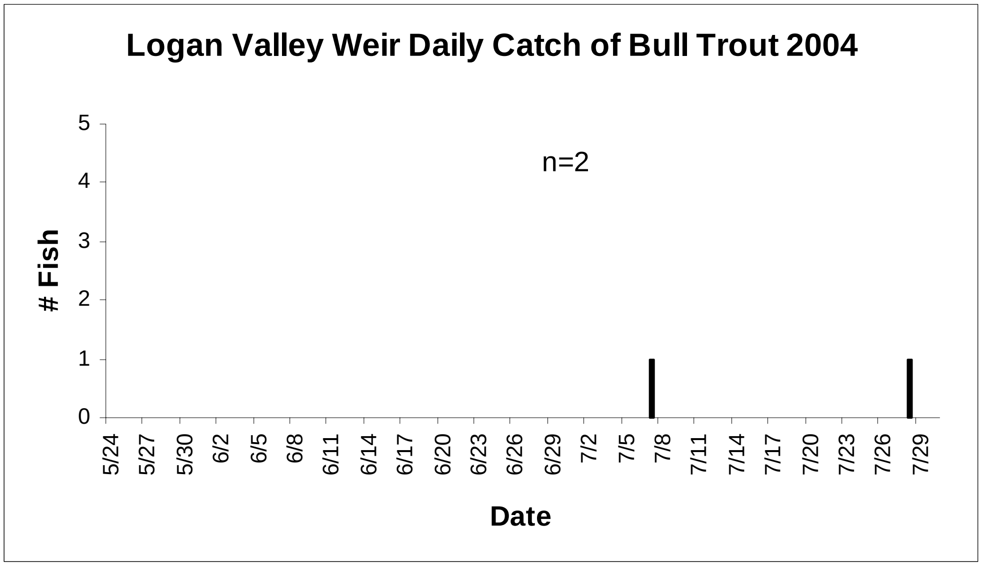


Figure 9. Daily catch of redband trout in the weir. Upper Malheur River 2004.

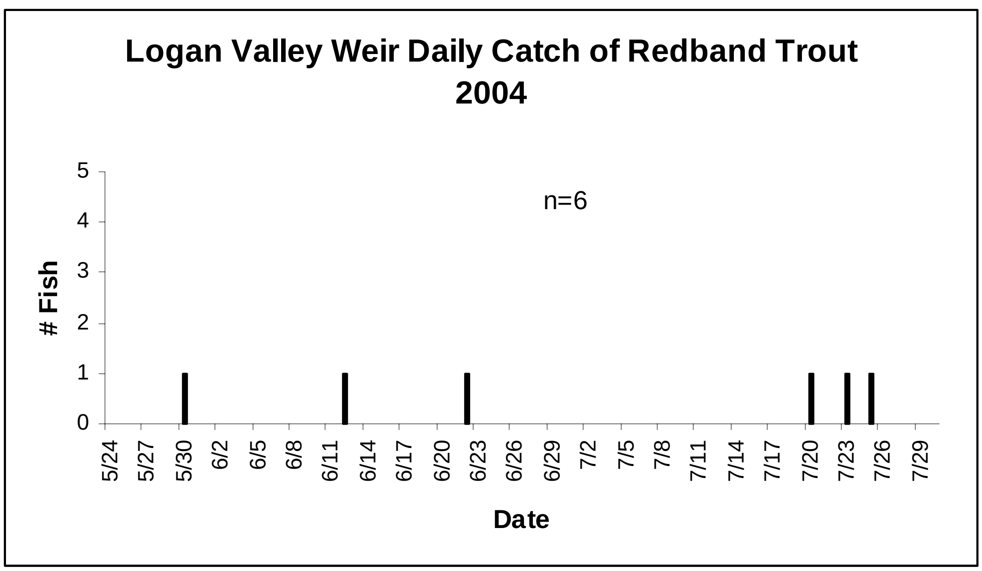


Figure 10. Daily catch of brook trout in the weir. Upper Malheur River 2004.

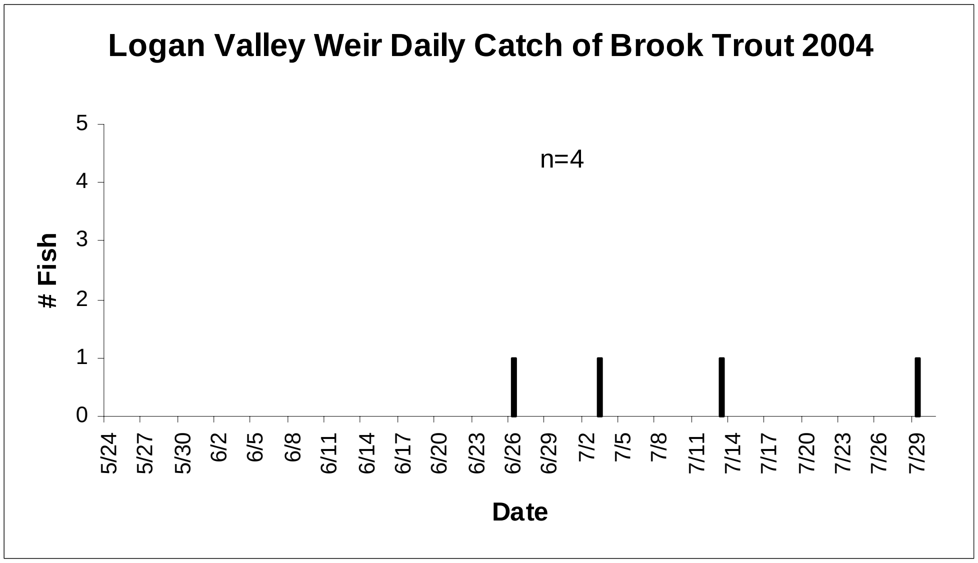
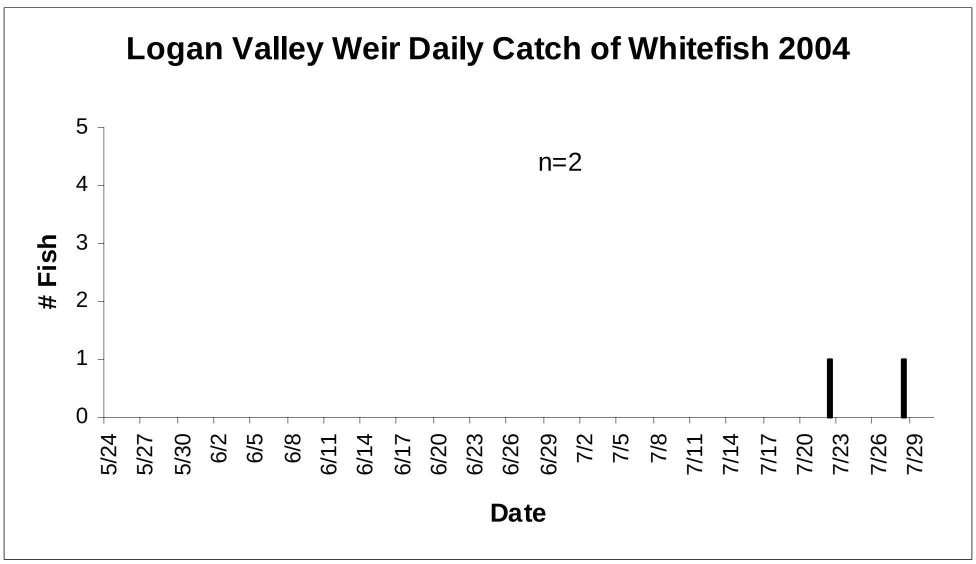


Figure 11. Daily catch of mountain whitefish in the weir. Upper Malheur River 2004.



Appendix B. Tracking points from bull trout implanted with a radio tag in the upper Malheur River, 2004.

Figure 12. Tracking points from bull trout 151.182 released on May 19, 2004. upper Malheur River.

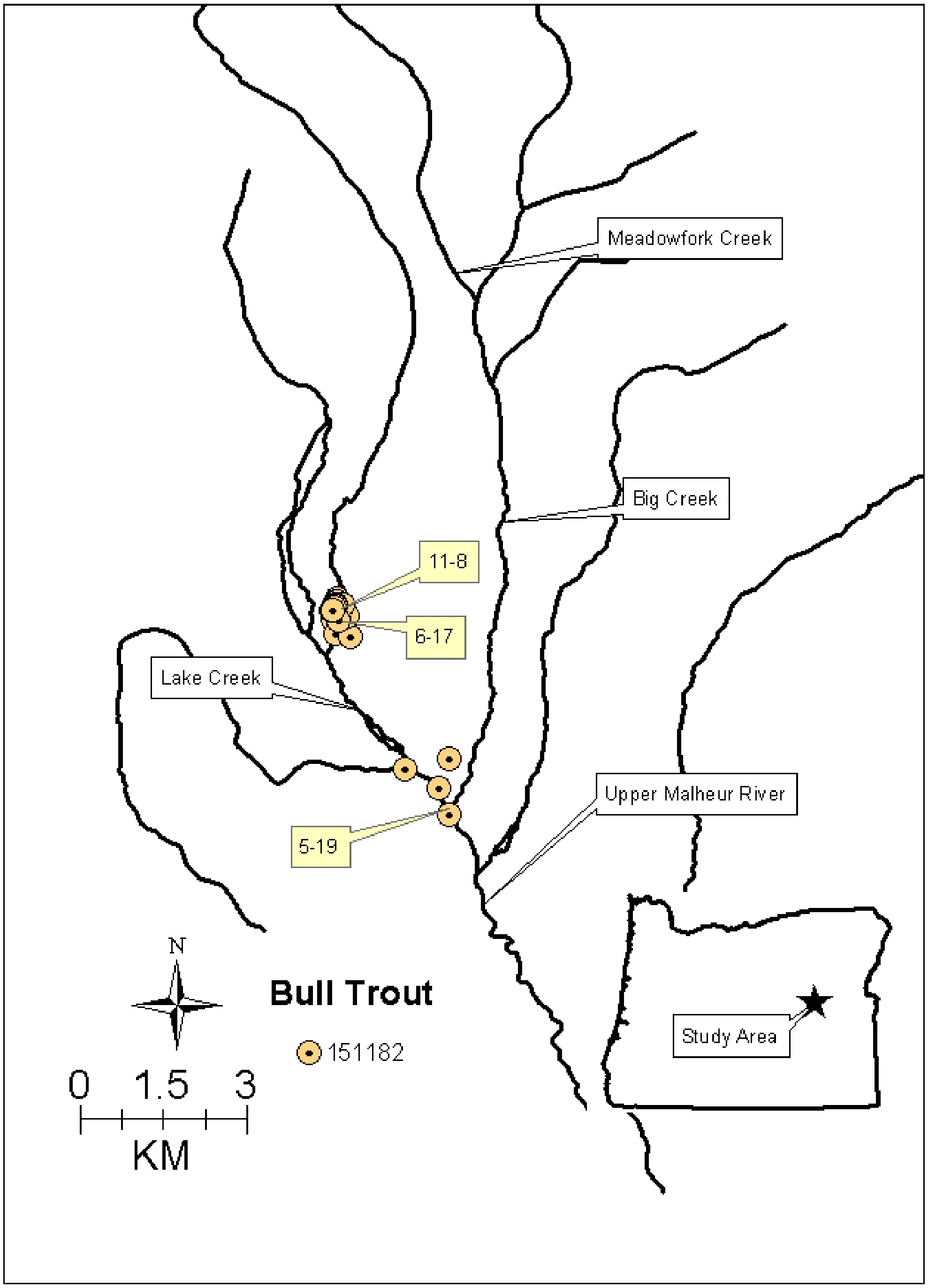


Figure 13. Tracking points from bull trout 151.382 released on May 21, 2004. Upper Malheur River.

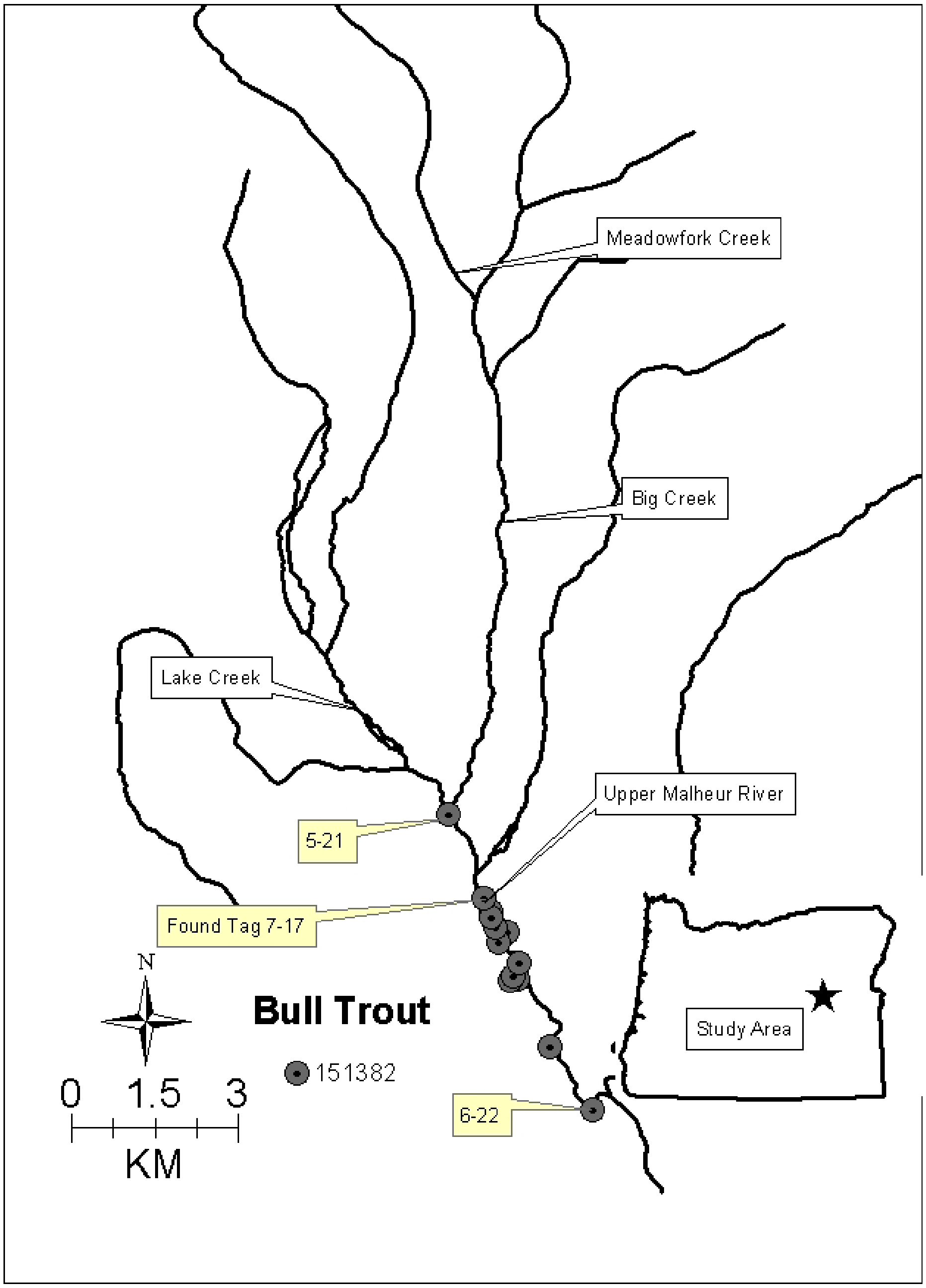


Figure 14. Tracking points from bull trout 151.084 released on June 04, 2004. Upper Malheur River.

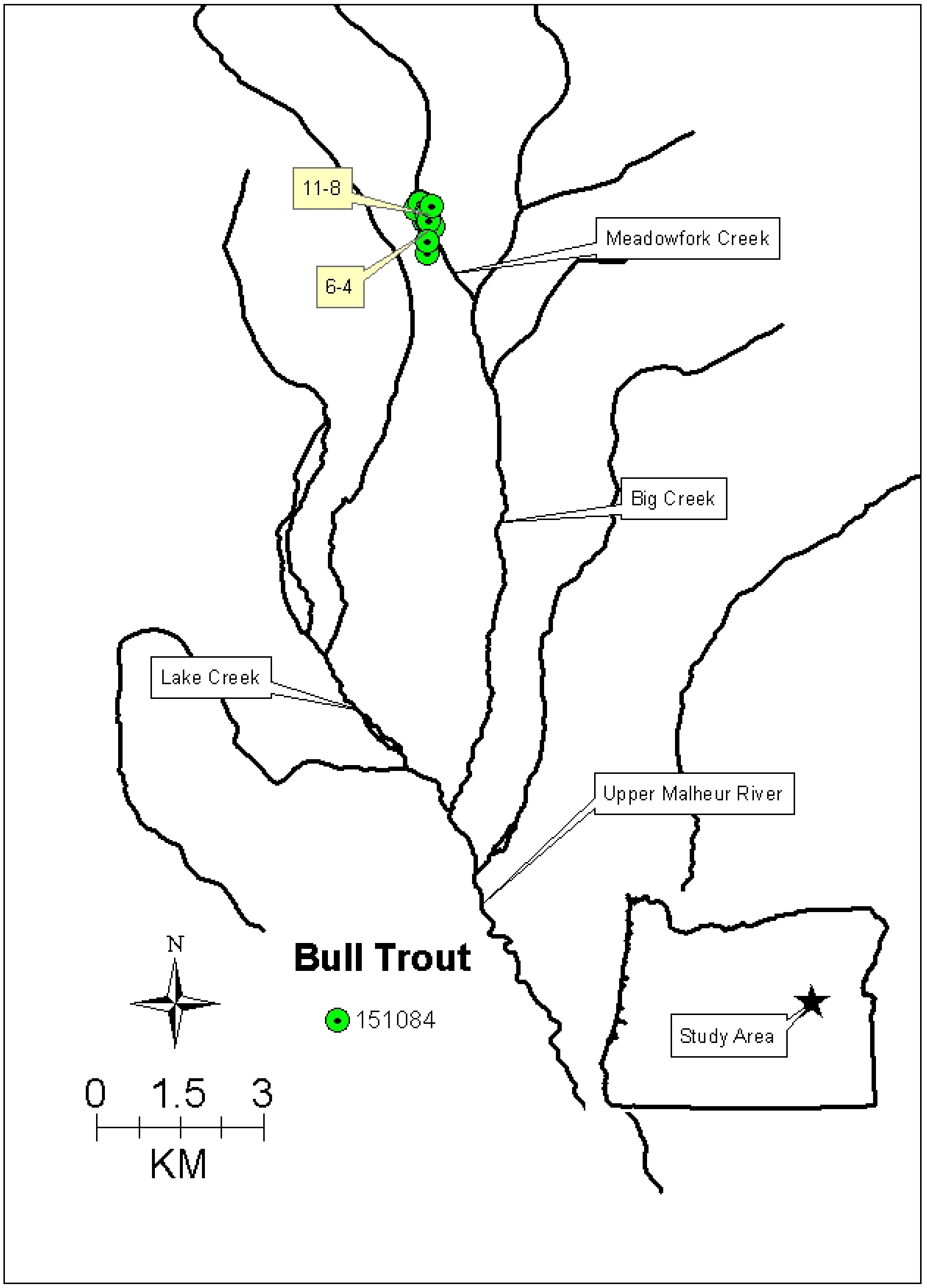


Figure 15. Tracking points from bull trout 151.323 released on July 07, 2004. Upper Malheur River.

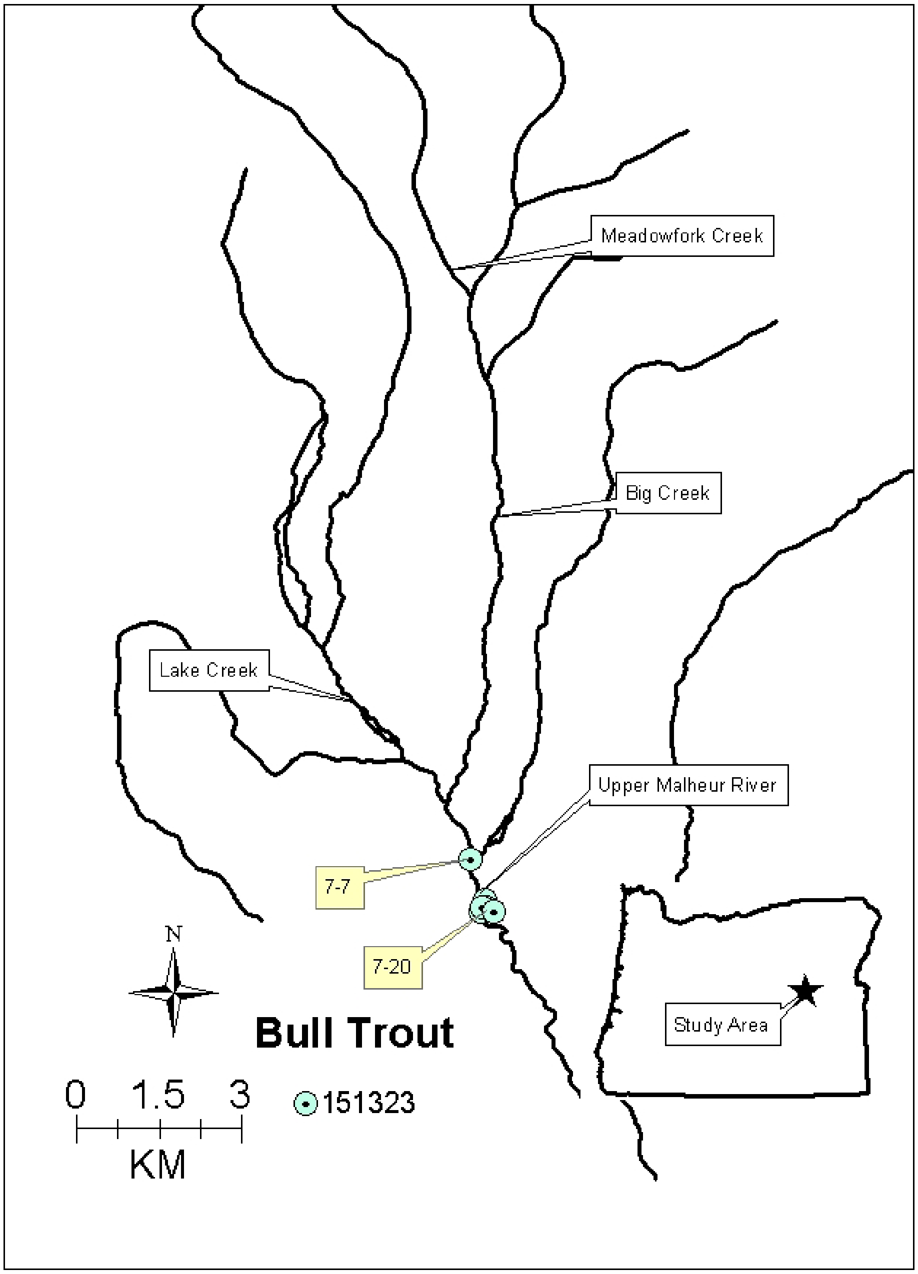


Figure 16. Tracking points from bull trout 151.302 released on July 13, 2004. Upper Malheur River.

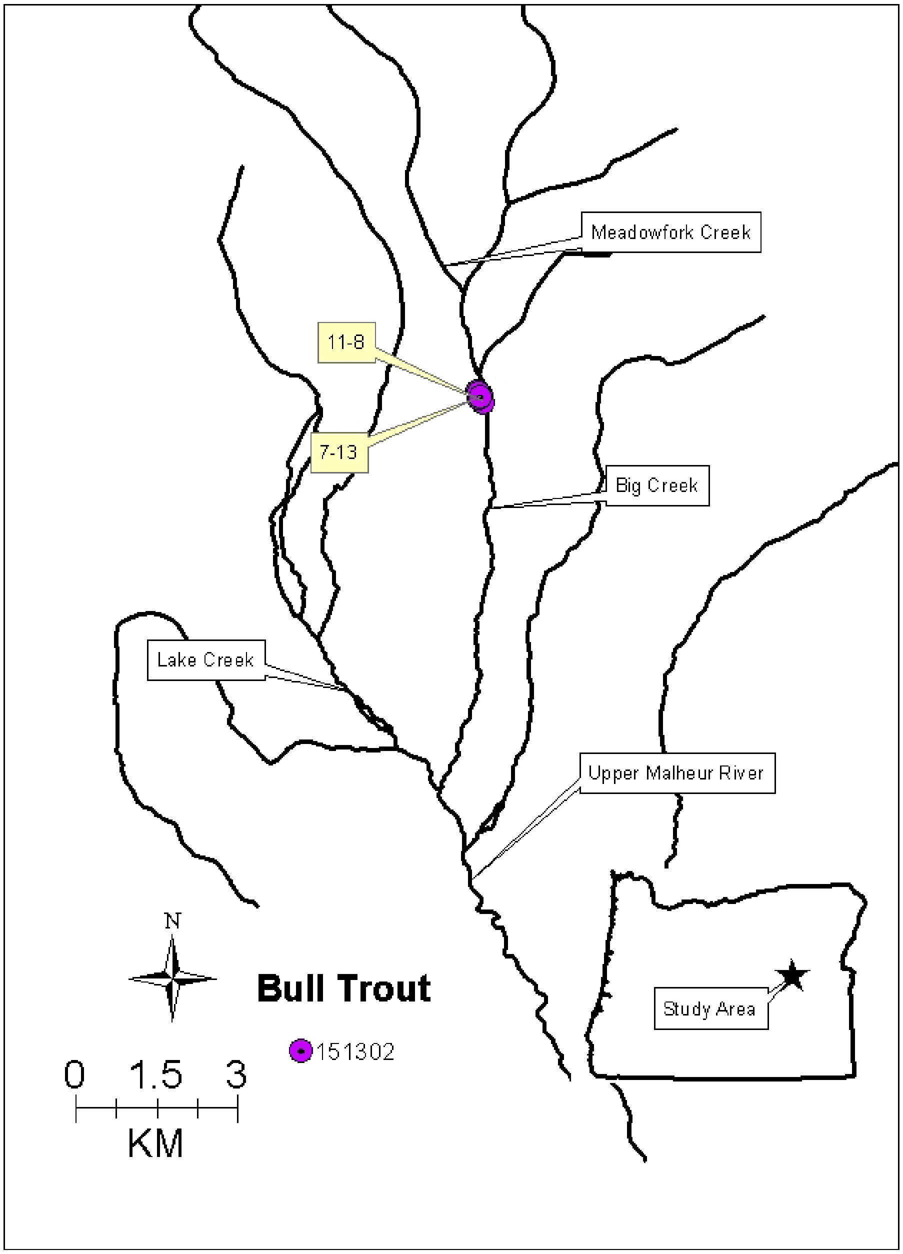


Figure 17. Tracking points from bull trout 151.222 released on July 14, 2004. Upper Malheur River.

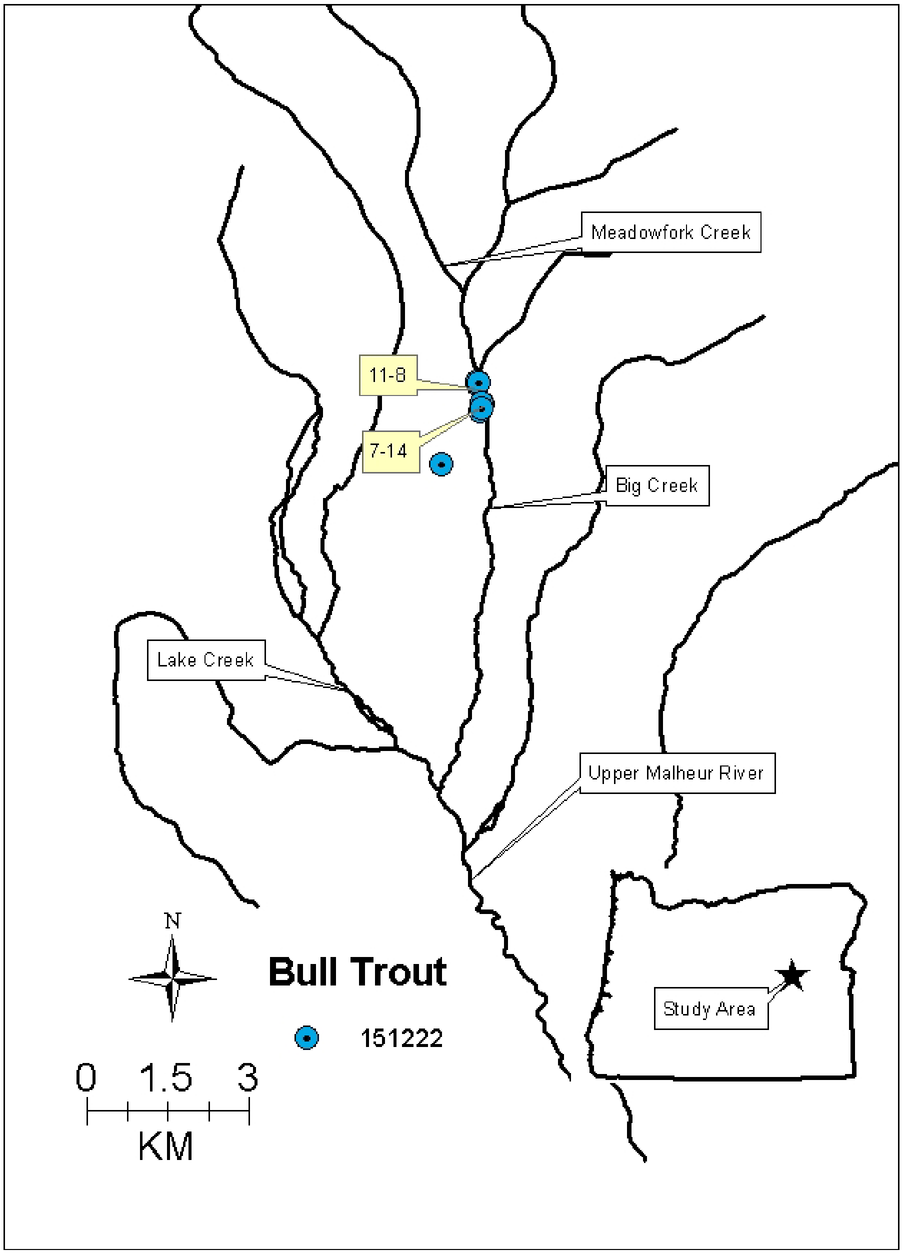


Figure 18. Tracking points from bull trout 151.021 released on July 28, 2004. Upper Malheur River.

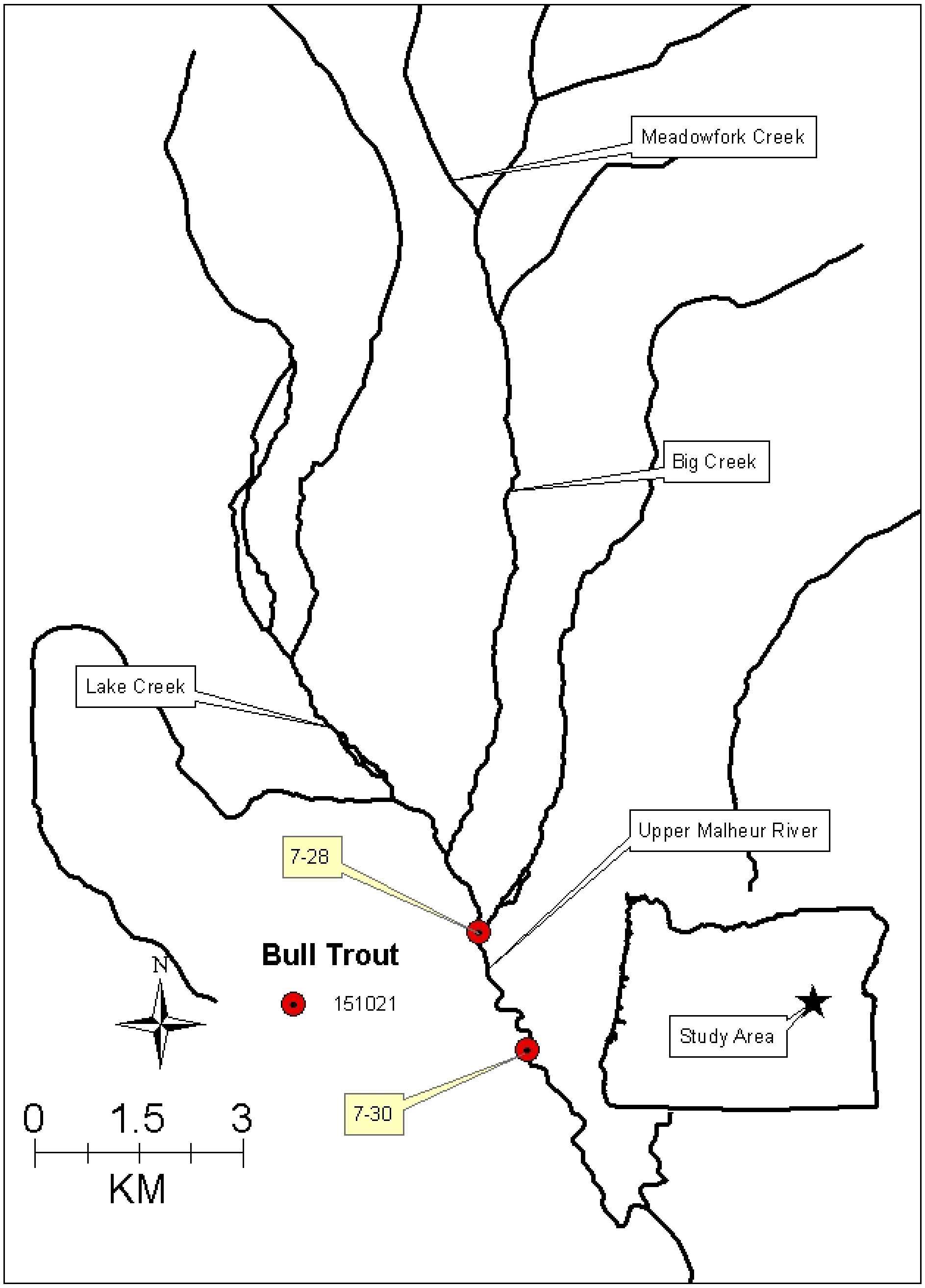
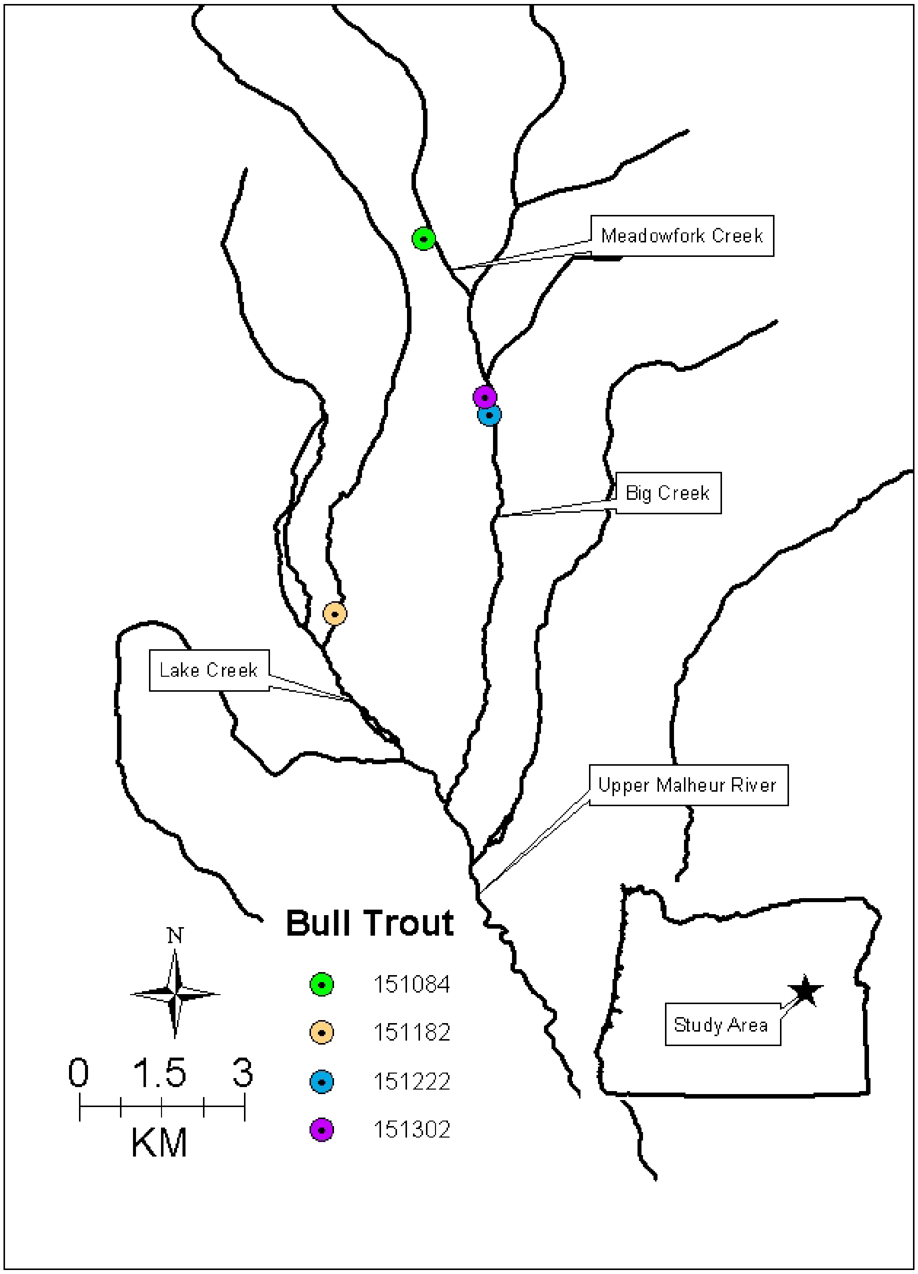


Figure 19. Tracking points of bull trout from plane flight on August 24, 2004. Upper Malheur River.



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Chapter 2 Use of a backpack electrofisher to determine the distribution of fish species in Big Creek and Corral Basin and population size of trout species in Corral Basin

by Kevin Fenn
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Introduction

The Burns Paiute Fish and Wildlife Department has been making an ongoing effort to determine the seasonal distribution of salmonids on the upper Malheur River. Several methods of determining distribution have been utilized including radiotelemetry, snorkeling, angling, spawning surveys, and electrofishing. The most common method of determining distribution is electrofishing. The objectives of electroshocking surveys by the Burns Paiute Tribe are to establish distribution of salmonids, determine population estimates of salmonids in areas uninhabited by bull trout *Salvelinus confluentus*, and obtain genetic samples of salmonids.

The headwaters of Big Creek begin on the south slope of the Strawberry Mountains. Big Creek is one of the main perennial sources of the upper Malheur River, merging with Lake Creek at river kilometer (RK) 306. Tributaries to Big Creek include Snowshoe Creek, Meadow Fork Creek, and Corral Basin Creek. It is believed that bull trout inhabit Big Creek, Meadow Fork, and Snowshoe Creek but not Corral Basin Creek. The upper Malheur River was surveyed by Oregon Department of Fish and Wildlife (ODFW) in 1982, 1989, and 1993-1994. The surveys found that distribution of bull trout in the upper Malheur River is limited to Lake Creek, Big Creek, the upper Malheur River, and tributaries to Lake Creek and Big Creek (Bowers et al. 1993, Buckman et al. 1992). Based on declining populations, bull trout in the Columbia Basin were listed as threatened on June 10, 1998 by the U.S. Fish and Wildlife Service (FR. 1998).

The bull trout population on the upper Malheur River has been classified at “high risk” of extinction (Buchanan et. al. 1996). Buchanan states limiting factors including genetic and random risks, overharvest, passage barriers, exotic salmonid species, habitat loss and degradation, and climatic changes (Buchanan et al. 1996). All of these reasons make the Malheur River bull trout population at high risk of extinction. Genetic and random risks are related to isolated populations and populations with a small number of individuals (Buchanan et al. 1996). These risks are encountered with major events that may affect the population such as fire, flood, or other natural disturbances. There is only one distinct bull trout population on the upper Malheur (USFWS 2002) and it is isolated from North Fork Malheur River bull trout. Historically, bull trout populations were influenced by lack of fishing restrictions (Buchanan et al. 1996), but fishing for bull trout is now prohibited. Passage barriers to the upper Malheur River include Warm Springs Dam as well as many culverts on the upper Malheur that may be difficult if not impossible for fish passage (Miller PC 2005). Exotic species affecting bull trout on the Upper Malheur are brook trout *Salvelinus fontinalis*. Habitat degradation for Malheur River bull trout includes loss of overwintering habitat, loss of access to migration corridors, and degradation of habitat throughout their range (Bauer et al. 2004).

Information on the distribution of salmonids for Big Creek, Snowshoe Creek, and Corral Basin Creek is based on ODFW's surveys, electroshocking and radiotracking by Burns Paiute Fish and Wildlife, and angler observation (Bowers et al. 1993, Buckman et al. 1992, Schwabe et al. 2000, 2001, 2002, 2003, 2004). Information on distribution of bull trout on these creeks is limited due to a limited number of sample sites. In 2004, electrofishing distribution surveys were conducted on Big Creek and Corral Basin with the goal of documenting the distribution of fish species present. The goal of the population survey on Corral Basin was to determine the population size of salmonids present, and to serve as baseline information for potential brook trout eradication efforts.

Methods

Big Creek Distribution

Sampling on Big Creek started on July 1, 2004 and was completed on August 13, 2004. In this time period Big Creek was sampled on 16 work days. The survey started at Forest Service Road (FSR) 16 (RK 3.2) and proceeded upstream ending at RK 12.65 above where Snowshoe/Big Creek trail crosses Big Creek with a total of 189 sites sampled (Figure 2-1).

Fish were collected using a Smith-Root backpack electrofisher. National Marine Fisheries Services (NMFS) electrofishing guidelines were used to minimize the effects of electrofishing on listed bull trout (NMFS 2000). Shocking the stream required a minimum of three individuals, preferably additional personnel were used to decrease sample time. One person walked the stream ahead of the shocking crew observing the stream, and measuring and marking sites. One person operated the shocker, two individuals used dip nets to collect fish, and two individuals on the stream bank processed fish in a timely manner.

Sample sites were measured using a drag tape to measure 50 m (164 feet) of wetted channel parallel to the bank for each site. The beginning of every 5th site was documented using a GPS (Global Positioning System) unit. One-hundred percent of the wetted channel was sampled using a single pass starting at the lower boundary and proceeding upstream to the upper boundary. Block nets were not used for this survey. Fish were collected by dip nets and kept in buckets until electroshocking of each site was completed. All salmonids were measured (fork length (FL) in millimeters (mm)) and all other species were counted. Pelvic fin clips were taken from fish that were identified as bull trout, brook trout, and possible bull/brook trout hybrids for genetic analysis. Fish were identified based on the following morphological characteristics: bull trout—bright spotting on a dark back with clear or uniform colored dorsal fin, brook trout—light green or creamy wavy lines on back with banding present on dorsal fin, hybrids—white spotting present on dorsal fin that extends more than 50% of the total height of the dorsal fin, light green or creamy wavy lines on back with clear or uniform colored dorsal fin, bright spotting on a dark back with banding present on dorsal fin, and distinct areas of both light green or creamy wavy lines on the back as well as bright spotting on a dark back.

Corral Basin Distribution

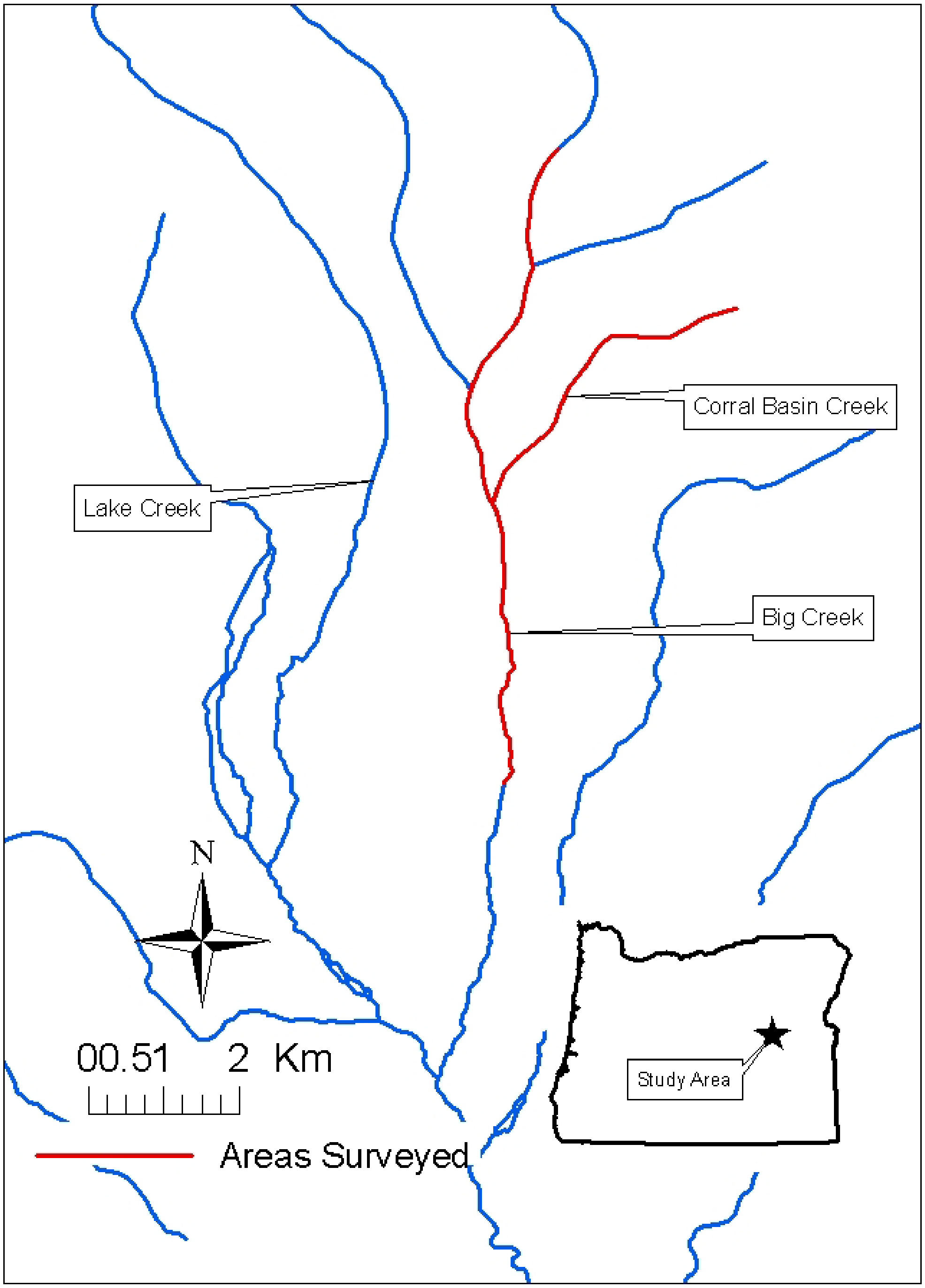
Sampling on Corral Basin began on August 30, 2004 and was completed on September 14, 2004. In this time period Corral Basin was shocked on 10 working days. The survey started at the confluence of Corral Basin and Big Creek and proceeded upstream to the headwaters of Corral Basin where dry channel was reached, (approximately 4.3 km) with a total of 86 sites shocked (Figure 2-1). Extensive sampling was conducted to determine the presence/absence of bull trout in Corral Basin.

Fish were collected using a Smith-Root backpack electrofisher. Shocking the stream involved a minimum of three personnel. Sites were measured using a drag tape to measure 50 m parallel to the channel and mark sites. The beginning of every 4th site was documented using a GPS (Global Positioning System) unit. One-hundred percent of the wetted channel was sampled using a single pass starting at the lower site boundary and proceeding upstream to the upper site boundary. Block nets were used on every 4th site (this was a sub-sample for a population survey). One person operated the shocker, and two individuals used dip nets to collect fish. Fish were held in a 5 gallon bucket until processed upon completion of each site. After processing, fish were released into the nearest sampled pool with the exception of brook trout. All salmonids were measured (FL in mm) and all other species were counted.

Corral Basin Population

A “2/4 pass, 50% population reduction” survey was completed simultaneously with the distribution survey on Corral Basin. Sampling began on August 30, 2004 and was completed September 14, 2004. Sampling began at the confluence of Corral Basin with Big Creek and proceeded upstream approximately 2.5 km, with a total of 13 population sites. Population sites ceased after 2.5 km because of intermittent stream channel conditions. Sample sites were 50 m in length, and each sample site was separated by 150 m of wetted channel. GPS units were used to document the beginning of each sample site. Block nets were placed at the upper and lower boundaries of sites (prior to shocking the population site as well as adjacent distribution sites) to prevent fish escapement and recruitment. The initial pass consisted of shocking from the lower block net to the upper block net and back. A second pass was completed requiring a 50 percent reduction in the collection of age 1+ salmonids (FL $\geq$ 70 mm) for the site to be complete. If reduction criteria were not achieved, two more passes were required using the same methodology. Collected fish were held in buckets and processed at the end of each pass. Collected salmonids were measured and other species were counted. Population estimates will be calculated using ODFW’s population estimation spreadsheet (Dambacher 1997).

Figure 2-1. Areas of Big Creek and Corral Basin Creek surveyed in 2004 by Burns Paiute Fish and Wildlife.



Results

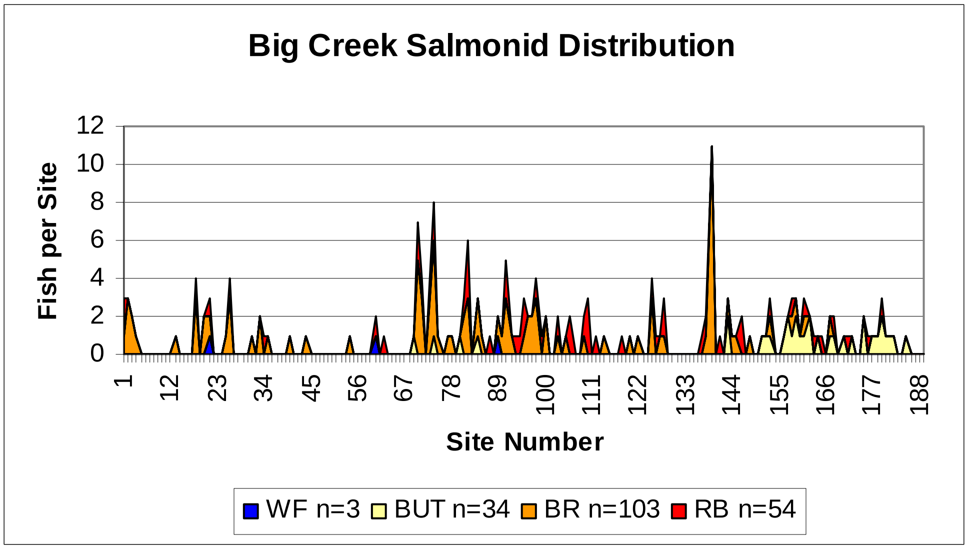
Big Creek Distribution

On Big Creek, 189 sites were sampled with a total linear stream length of 9450 meters. Fish were present in all but 35 of the sampled sites. Four salmonid species were identified and cottids *Cottus spp.* were identified to the genus (Table 2-1). Brook trout were present throughout the sample area to site RK 11.5. Bull trout were mainly present from RK 10.75 to site RK 12.5. Redband trout *Oncorhynchus mykiss* were present throughout the sample area to site RK 12.2. A total of three mountain whitefish *Prosopium willliamsoni* were collected from Big Creek. Relative abundance on Big Creek ranged from 80.2% cottids to 0.3% whitefish (Table 2-1).

Table 2-1. Species present for Big Creek electroshocking survey in 2004.

Species	Total		Relative Abundance
Brook Trout	103	Ratio 3:1	10.5%
Bull Trout	33		3.5%
Redband Trout	54		5.5%
Whitefish	3		.3%
Cottids	783		80.2%
Sites with no fish	35		N/A

Figure 2-2. Distribution of salmonids for Big Creek electroshocking survey in 2004.



Brook Trout

A total of 103 brook trout were collected from 56 of the 189 sites surveyed (Figure 2-3). Brook trout were present from RK 3.2 up to RK 11.5, which is 250 m above where Big Creek Trail crosses the creek. Brook trout were not present in the last 1100 m of sampled channel. Brook trout collected measured between 37 mm to 240 mm, and averaged 122 mm (Figure 2-4). Brook trout were the most relatively abundant salmonid collected from Big Creek (Table 2-1).

Figure 2-3. Distribution of brook trout from Big Creek electroshocking survey 2004.

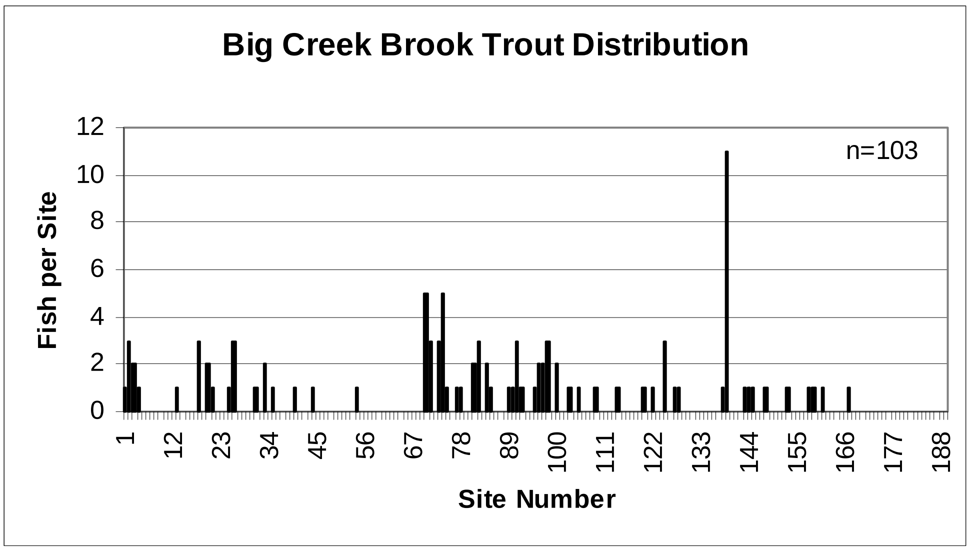
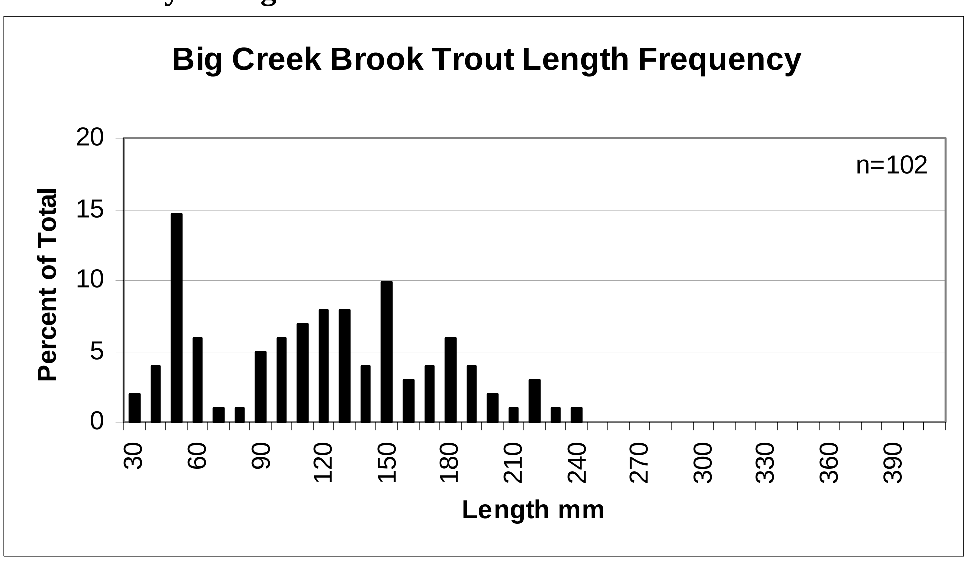


Figure 2-4. Length frequency of brook trout collected from distribution survey on Big Creek in 2004.



Bull Trout

A total of 34 bull trout were collected from 27 of the 189 sites sampled (Figure 2-5). Bull trout were collected from RK 6.7 to RK 12.5, 88% of which were collected between RK 10.75 and RK 12.5, which is 1150 meters above the crossing of Big Creek Trail. Bull trout were not collected in the last 4 sites or 200 meters of sampled channel. Bull trout from Big Creek ranged from 58 mm to 410 mm, and averaged 204 mm (Figure 2-6).

Figure 2-5. Distribution of bull trout from Big Creek electroshocking survey 2004.

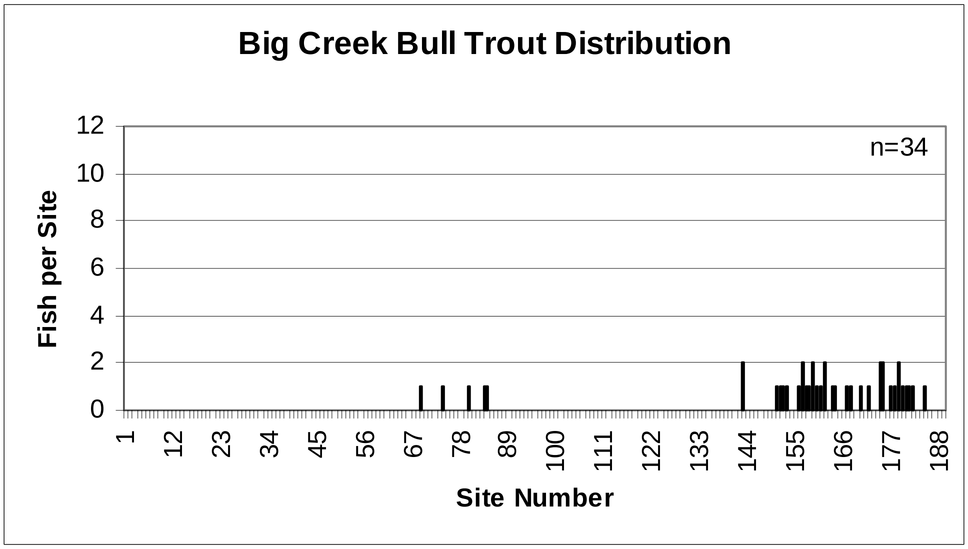
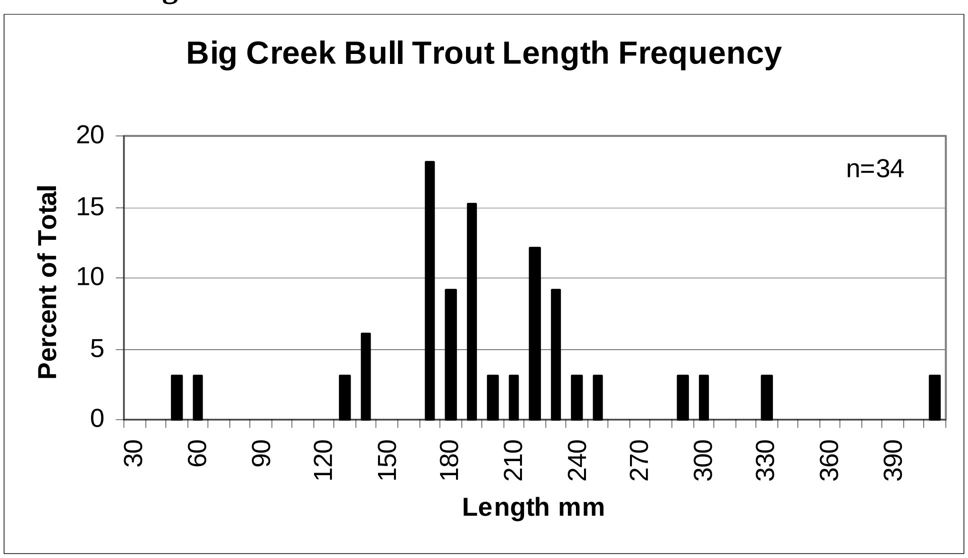


Figure 2-6. Length frequency of bull trout collected from distribution survey on Big Creek in 2004.



Redband Trout

A total of 54 redband trout were collected from 41 of the 189 sites sampled (Figure 2-7). Redband trout were collected from RK 4.1 to RK 12.2, which is 800 meters above the Big Creek Trail crossing. Redband trout were not collected in the last 500 meters of sampled channel. Redband trout from Big Creek measured from 45 mm to 274 mm, and averaged 150 mm (Figure 2-8). Redband trout were the second most relatively abundant salmonids collected from Big Creek (Table 2-1).

Figure 2-7. Distribution of redband trout from Big Creek electroshocking survey 2004.

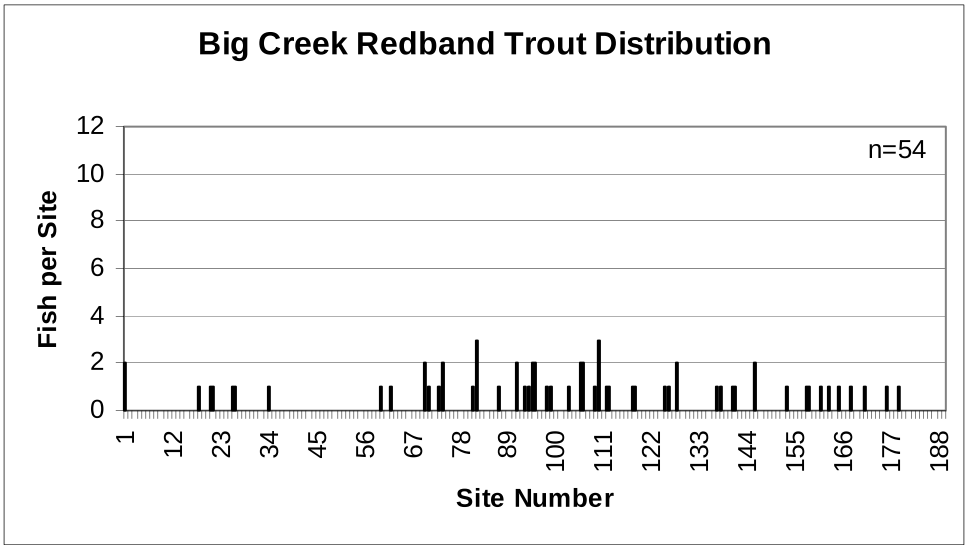
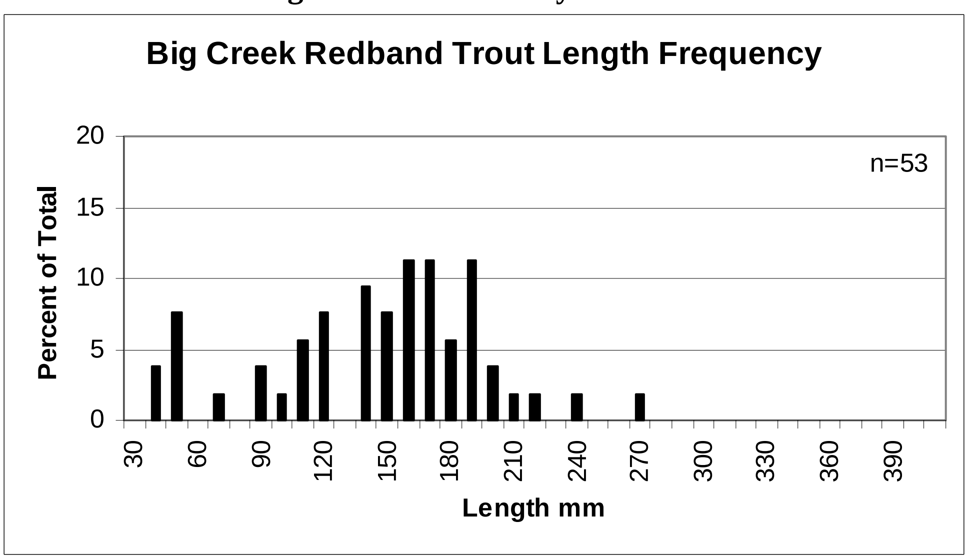


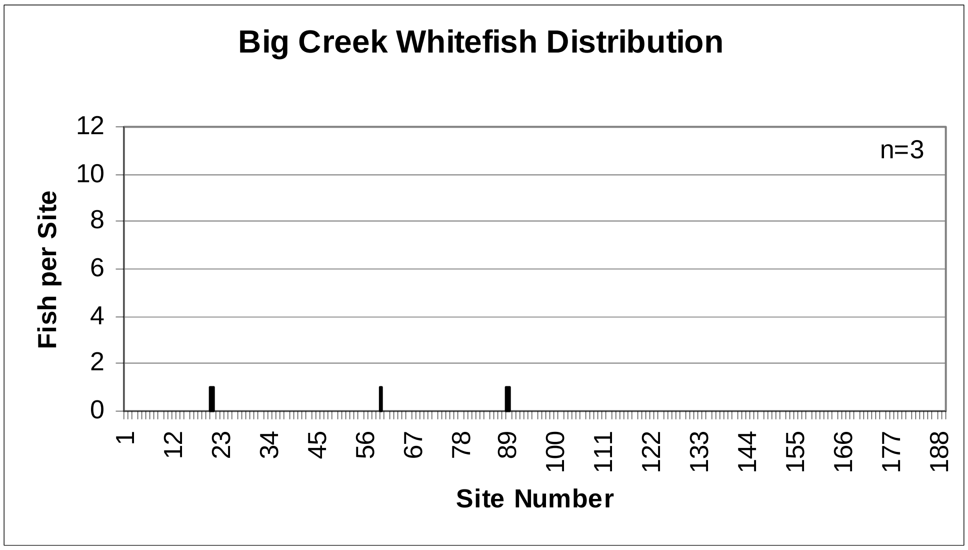
Figure 2-8. Length frequency of redband trout collected from Big Creek electroshocking distribution survey 2004.



Mountain Whitefish

A total of 3 whitefish were collected from 3 of the 189 sites sampled (Figure 2-9). Whitefish were collected at RK 4.25, 6.2, and 6.65 and measured 200 mm, 325 mm, and 170 mm respectively. Whitefish were the least relatively abundant salmonid collected from Big Creek (Table 2.1).

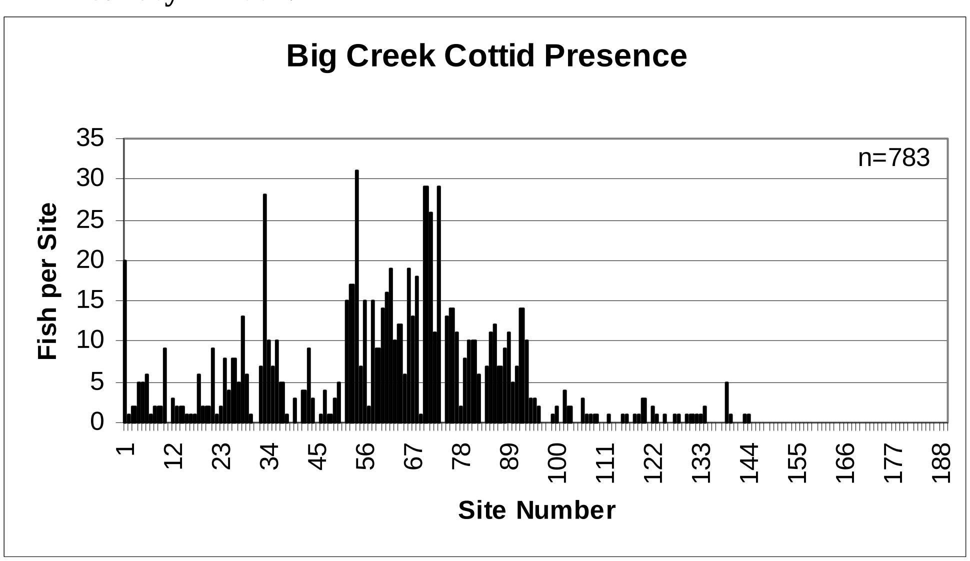
Figure 2-9. Distribution of whitefish on Big Creek from electroshocking survey in 2004.



Cottids

A total of 783 cottids were collected from 114 of the 189 sites sampled (Figure 2-10). Sculpin were collected up to site 144, which is 555 m below the confluence of Snowshoe Creek and Big Creek.

Figure 2-10. Distribution of cottids on Big Creek from electroshocking survey in 2004.



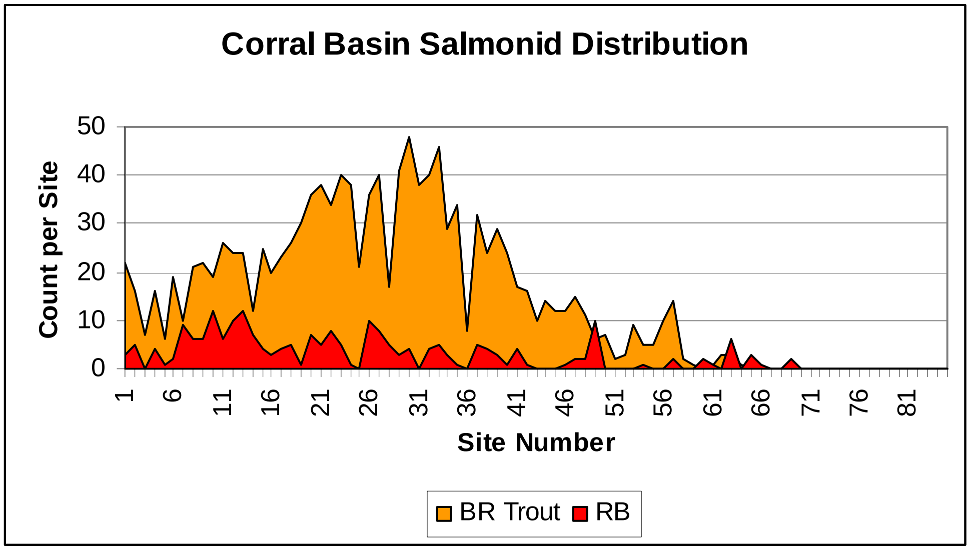
Corral Basin Distribution

For Corral Basin a total of 86 sites were sampled with a total linear stream length of 4300 m. Fish were collected from all but 18 of the sites sampled. The 18 sites with no fish were 68, 69, and 71 to 86. Fish present in Corral Basin include brook trout, redband trout, and sculpin. Relative abundance on Corral Basin ranged from 77% brook trout to 9% cottids (Table 2-2).

Table 2-2. Species present for Corral Basin electroshocking survey in 2004.

Species	Total	Relative Abundance
Brook Trout	1240	77%
Redband Trout	220	14%
Cottids	144	9%
Sites with no fish	18	N/A

Figure 2-11. Distribution of salmonids for Corral Basin electroshocking survey in 2004.



Brook Trout

A total of 1240 brook trout were collected from 63 of the 86 sites sampled (Figure 2-12). Brook trout were present up to RK 3.2 but not in the last 1100 meters of stream sampled. Brook trout collected from Corral Basin measured from 39 mm to 210 mm, and averaged 86 mm (Figure 2-13). Brook trout were the most relatively abundant species collected from Corral Basin (Table 2-2).

Figure 2-12. Distribution of brook trout from electroshocking survey on Corral Basin in 2004.

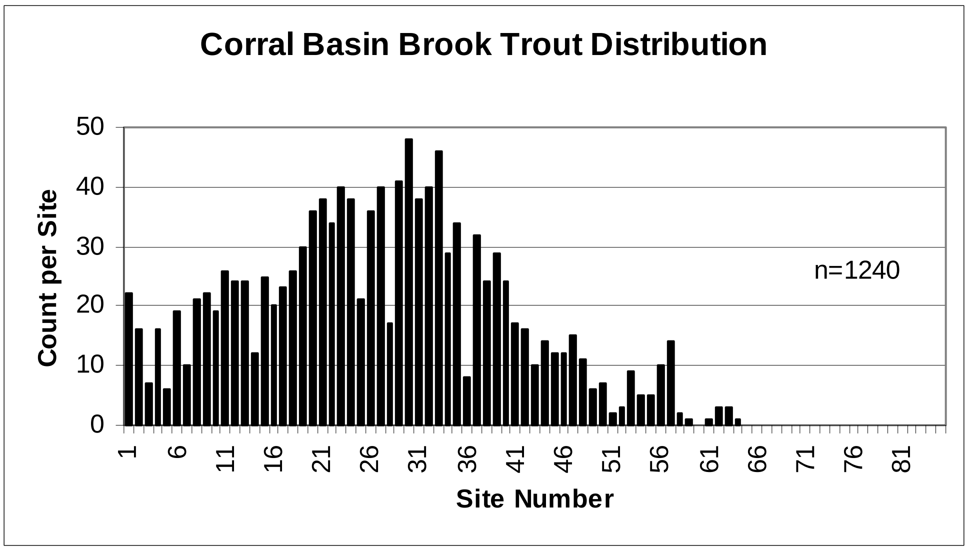
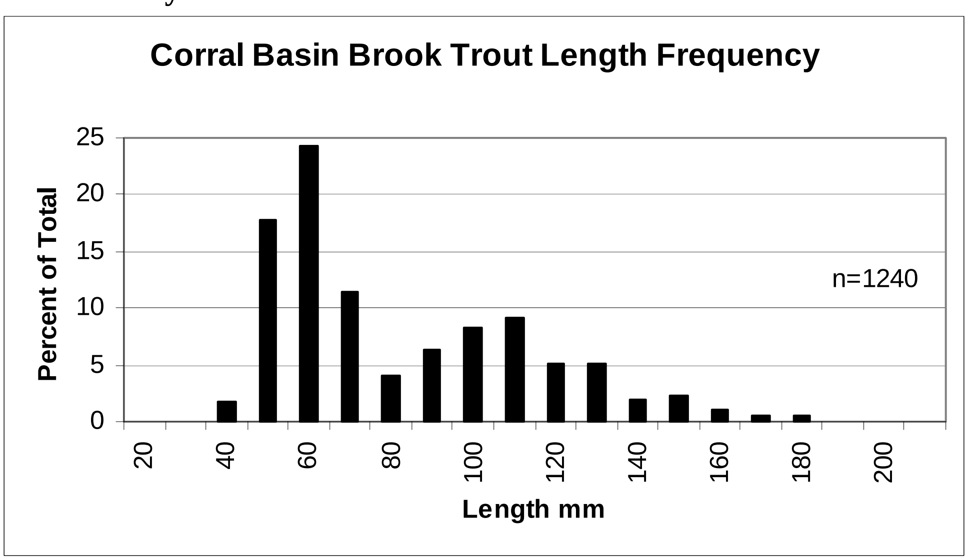


Figure 2-13. Length Frequency of brook trout collected from distribution survey on Corral Basin in 2004.



Redband Trout

A total of 220 redband trout were collected from 50 of the 86 sites sampled on Corral Basin (Figure 2-114). Redband trout were collected up to the last 800 meters sampled. Redband trout collected from Corral Basin measured from 20 mm to 193 mm, and averaged 95 mm (Figure 2-15). Redband trout were the second most relatively abundant species and were present up to site 70 (Table 2.2).

Figure 2-14. Distribution of Redband trout from electroshocking survey on Corral Basin in 2004.

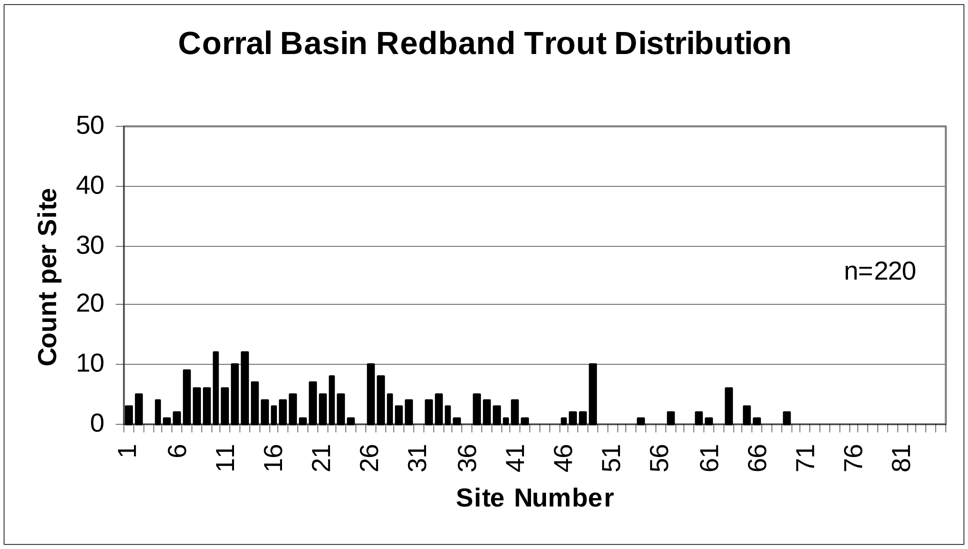
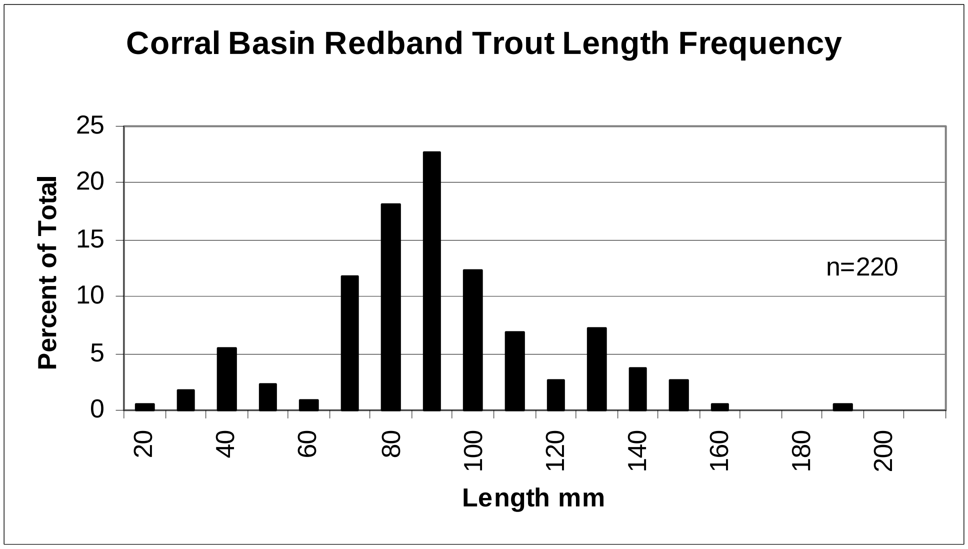


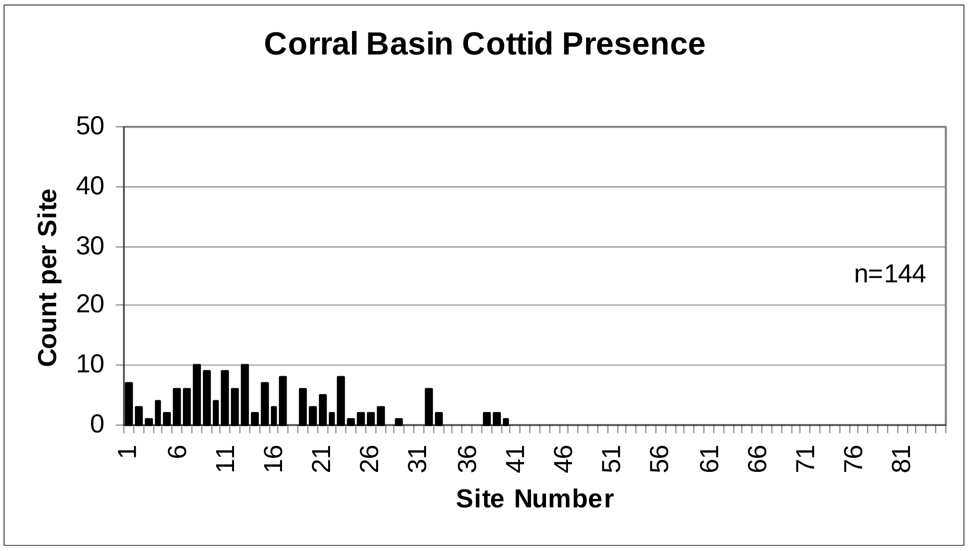
Figure 2-15. Length Frequency of redband trout collected from distribution survey on Corral Basin in 2004.



Cottids

A total of 144 cottids were observed in the distribution survey of Corral Basin up to RK 2.0 (Figure 2-16). Cottids were the least relatively abundant species in Corral Basin and were present up to RK 2 (Table 2-2).

Figure 2-16. Distribution of cottids from electroshocking survey on Corral Basin in 2004.



Corral Basin Population Survey

Population estimates for Corral Basin are not for the entirety of Corral Basin Creek, rather only through RK 2.5, because the channel becomes intermittent. There were a total of 13 sample sites in a linear stream length of 2.5 km. The sample area was approximately 483m^2 or 25% of the total area to site 50. Average width was .75 m and depth was .1 m for the area sampled.

Brook trout (1+) were collected from all 13 population survey sites. A total of 186 brook trout were collected with reduction accomplished at every sample site. The average probability of capture for brook trout was 90%. The population estimate for brook trout in Corral Basin based on ODFW's population estimation spreadsheet is 719 fish with a 95% confidence interval of +/- 217 fish (Table 2-3). The density of brook trout collected from Corral Basin was 0.3595 fish per square meter.

Redband trout (1+) were collected from 11 of the 13 population survey sites. A total of 58 redband trout were collected from the 11 sites with reduction accomplished at all sites with redband trout present. The average probability of capture for redband trout was 92%. The population estimate for redband trout in Corral Basin based on ODFW's population estimation spreadsheet is 268 fish with a 95% confidence interval of +/- 91 fish (Table 2-3). The density of redband trout collected from Corral Basin was 0.134 fish per square meter.

Table 2-3. Population estimates of brook trout and redband trout for Corral Basin electroshocking survey 2004.

	Population Estimate	+/- 95% c.l.	CL % of Estimate	Fish per Sq. Meter	Fish per Lineal Meter
Brook Trout	719	217	30%	.3595	.288
Redband Trout	268	91	34%	.1340	.107

Discussion

During the summer of 2004 both Big Creek and Corral Basin were electroshocked. The purpose of electroshocking on Big Creek was to determine distribution of fish species present with a particular interest in the distribution of allopatric and sympatric populations of brook trout, bull trout, and bull/brook trout hybrids, and to collect genetic samples of bull trout, brook trout, and possible bull/brook trout hybrids encountered. The purpose of electroshocking on Corral Basin was to determine species presence and distribution, and to determine the population size of salmonids present in Corral Basin. To complete these tasks, single pass distribution surveys were completed on both Big Creek and Corral Basin. On a sample of the electrofishing sites for Corral Basin two-pass population reduction survey was completed.

Data indicates that brook trout are the dominant salmonid in Big Creek, outnumbering bull trout 3 to 1. A sympatric population of brook trout and bull trout exists downstream of RK 11.5. Upstream of RK 11.5 it appears as if an allopatric population of bull trout may be present. From this section 13 bull trout were collected, whereas no brook trout were collected. Thirty of the 34 bull trout collected from Big Creek were above RK 10.75, possibly indicating a resident bull trout population in Big Creek. In this section bull trout collected outnumbered brook trout collected 5 to 1. One bull trout over 400 mm was collected indicating the possibility of fluvial fish utilizing the upper reach of Big Creek. Fluvial fish from the North Fork in 1999 averaged 338 mm (Schwabe et al. 2000). Also, in 2000 and 2001 bull trout were documented through radiotelemetry migrating into Snowshoe Creek and Big Creek upstream of Snowshoe Creek (Schwabe et al. 2001 and 2002).

Interestingly, no bull/brook trout hybrids were phenotypically identified from Big Creek. Bull/brook trout hybrids were genetically identified in previous surveys from both Lake Creek and Meadow Fork of Big Creek (Schwabe et al. 2004). In addition, Markle (1992) identified hybrids in Meadow Fork of Big Creek. Although bull/brook trout hybrids were not identified during electroshocking survey from Big Creek this does not eliminate the possibility of occurrence. The presence of hybrids in the tributaries indicates that they could eventually occur in Big Creek.

Only brook trout, redband trout, and cottids were collected from Corral Basin. Brook trout are the dominant fish species in Corral Basin, outnumbering redband trout by over 5 to 1. From the length frequency of brook trout there appears to be at least two age classes. The brook trout of age class 2 range from 80 mm to 130 mm. Numerous redds were observed during the electroshocking survey on Corral Basin. Based on these observations, brook trout on Corral Basin may be spawning at a smaller than normal size. Corral Basin appears to be a spawning and rearing tributary for brook trout. The number of brook trout collected indicates that there is a self-sustaining population on Corral Basin. There appears to be three age classes of redband trout collected from Corral Basin based on the length frequencies. Although redband trout are greatly outnumbered by brook trout there does appear to be a stable population. Based on the length of redband trout collected Corral Basin may act as a spawning and rearing tributary for redband trout.

In summary, brook trout were the dominant salmonid from both Big Creek and Corral Basin. It appears that there may be a resident population of bull trout upstream of RK 10.75 on Big Creek. In addition, salmonid density on Big Creek is approximately 20 salmonids per kilometer and the density on Corral Basin is over 340 salmonids per kilometer. In addition, no hybrids were observed in sampling on both creeks. Results from genetic analysis will confirm the accuracy of identification.

Recommendations

Complete distribution survey on Snowshoe Creek to finish surveys of the Big Creek tributaries. Complete genetic analysis to test possibilities of hybridization. Continue efforts to control or remove brook trout from Corral Basin.

Acknowledgements

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Chapter 3 Use of a backpack electrofisher to determine changes in distribution and species composition of fish species in Meadow Fork and Lake Creek

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Introduction

Lake Creek and Big Creek are the two main tributaries of the upper Malheur River, merging at river kilometer (RK) 306 at the southern end of Logan Valley. The headwaters of both Lake Creek and Big Creek are located on the south slope of the Strawberry Mountains. One of the main tributaries of Big Creek is Meadow Fork. Mud Lake and Little Mud Lake are the primary sources of Meadow Fork. The confluence of Meadow Fork with Big Creek is located at approximately RK 13. High Lake is the uppermost source of Lake Creek with various springs providing the main flows to Lake Creek.

The upper Malheur River was surveyed by Oregon Department of Fish and Wildlife (ODFW) in 1982, 1989, and 1993-94. Surveys from ODFW indicated that the distribution of bull trout *Salvelinus confluentus* was limited to Lake Creek, Big Creek, and tributaries to Lake Creek and Big Creek (Bowers et al. 1993, Buckman et al. 1992). The data also indicated that Meadow Fork is the only stream on the upper Malheur that bull trout outnumber brook trout *Salvelinus fontinalis*. In addition, Meadow Fork also dominates observations of both redds and bull trout during spawning surveys (Perkins, 2003). In 2003, the Burns Paiute Fish and Wildlife noted that brook trout were the dominant salmonid on Lake Creek, whereas on Meadow Fork bull trout were the dominant salmonid (Schwabe et al. 2004). Radiotracking in 2000 and 2001 showed approximately 80% of the radio tagged bull trout migrating into Meadow Fork (Schwabe et al. 2001 and 2002).

Upper Malheur River bull trout were classified at “high risk” of extinction (Buchanan et al. 1997) and on June 10, 1998 the U.S. Fish and Wildlife Service listed Columbia Basin bull trout as threatened due to the decline in populations. This listing includes Malheur River bull trout (FR 1998). Bull trout populations have been declining throughout their inhabited range (Howell and Buchanan 1992, Kostow 1995).

Bull trout populations are declining for several reasons including habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, angler harvest and poaching, diversion losses, and introduction of non-native species (USFWS 2002). All of these limiting factors affect Malheur River bull trout populations in some way. Upper

Malheur River bull trout were isolated from North Fork Malheur River bull trout with the construction of Warm Springs Reservoir in 1919. The dam was built without passage blocking migratory corridors between the upper Malheur River and connecting watersheds. The main water quality issue on the Upper Malheur River is high water temperatures; temperatures at Logan Valley on Lake Creek in July can exceed 26^{o}C (Schwabe et al. 2004). The high water temperatures may act as a potential thermal barrier causing migratory bull trout to bypass Lake Creek (Bower et al. 1993). Historically liberal bag limits had a negative effect on upper Malheur River populations, but harvesting bull trout is now prohibited. Inadvertent mortality is a threat because of incidental catch of bull trout when angling for redband trout *Oncorhynchus mykiss* and brook trout. Diversion losses are present mainly at unscreened irrigation ditches. Possibly the greatest threat to populations of bull trout on the Upper Malheur River is the presence of non-native brook trout (Ratliff and Howell 1992).

It is believed that brook trout were introduced into the Upper Malheur River Watershed in the 1930s. Documented stocking records were not kept until the 1950's, but anecdotal information leads us to believe that brook trout fry were stocked into the high lakes of the Strawberry Mountains by sheepherder volunteers in exchange for free hunting and fishing licenses (Bowers et al. 1993). Brook trout are still present in High Lake (Schwabe et al. 2004) but are believed to not be present above the waterfall barrier on Meadow Fork Creek. Brook trout in High Lake are most likely a constant source of brook trout recruitment into Lake Creek.

Brook trout can impact bull trout through several mechanisms. Bull trout are threatened by habitat competition and bull trout/brook trout hybridization resulting in a loss of genetic integrity (Ratliff and Howell 1992, Leary et al. 1993). Brook trout can survive in areas of more degraded water and habitat quality than bull trout. Also, brook trout tend to be more aggressive and dominant in streams with sympatric populations of bull trout with brook trout possibly outcompeting bull trout for available habitat (Gunkel 2001). In addition, brook trout can mature and spawn at two years (Reiman and McIntyre 1993), whereas bull trout do not mature and spawn until age 4 to 7 (USFWS 2002).

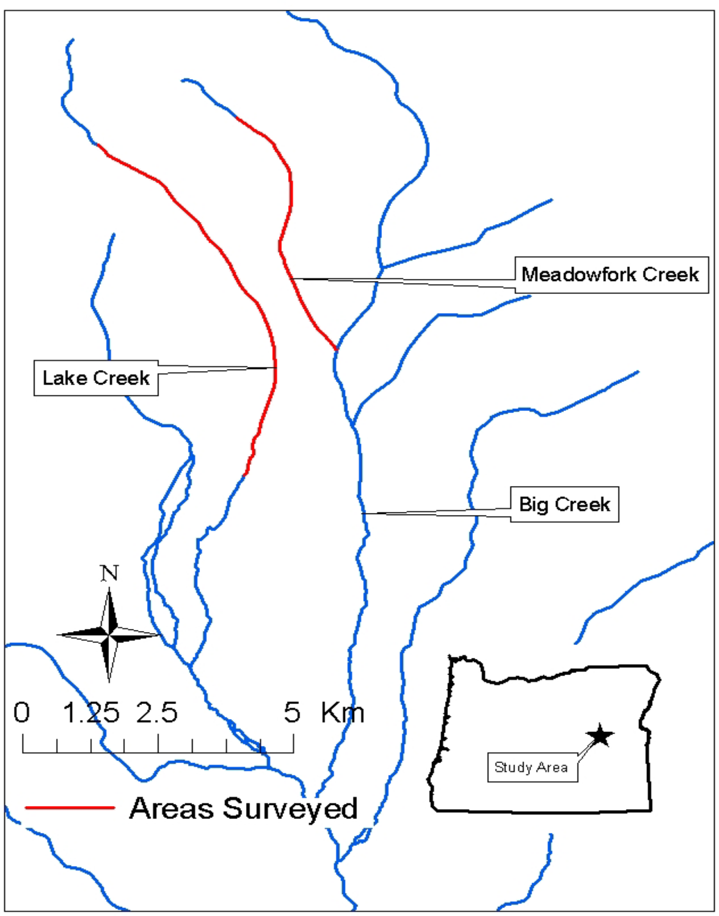
In 2003, Lake Creek was surveyed from Lake Creek Camp (RK 9) to an upstream waterfall barrier (RK 17.2) and Meadow Fork was surveyed from its confluence with Big Creek to an upstream waterfall barrier (RK 5.4) by the Burns Paiute Fish and Wildlife Department (Schwabe et al. 2004). The purpose of the surveys was to determine the distribution of bull trout and brook trout, and to determine the potential for hybridization between bull trout and brook trout. One of the main objectives was to document areas of sympatric and allopatric populations of bull trout and brook trout. Electroshocking distribution survey was the method used for the surveys. The surveys found that brook trout out number bull trout on Lake Creek 8:1, and that bull trout out number brook trout on Meadow Fork 15:1 (Schwabe et al. 2004).

There was a massive localized thunderstorm that impacted the surveyed areas on July 26, 2003. This storm, when coupled with the High-Roberts fire in 2002, resulted in debris flows and high water causing erosion of both riparian and channel habitats. Burns Paiute

Fish and Wildlife personnel observed flood waters flowing over Forest Road 1648. Burns Paiute Fish and Wildlife was in the process of electroshocking Lake Creek when this storm affected the area. Catch rates for fish dropped dramatically after this catastrophic event. Prior to the storm catch rates averaged 6.7 fish per site, but after the storm catch rates dropped to an average low of 1.4 fish per site. Crews also noted fish mortality associated with possible stranding due to sudden lowering of stream levels (Schwabe et al. 2004). Affects of the storm were also evident during 2003 spawning surveys. No redds were observed in Meadow Fork, and only 21 redds were observed in Lake Creek (Perkins 2004).

In 2004, 20 sites on both Lake Creek and Meadow Fork were surveyed to identify any alterations to the distribution of salmonid species and species presence (Figure 3-1). The purpose of resampling was to document changes in relative abundance and distribution of fish species related to recent disturbances, and the effects of removal of brook trout during electroshocking in 2003.

Figure 3-1. Map of areas surveyed on Lake Creek and Meadowfork Creek in 2004.



Methods

Sampling

Sampling on Lake Creek and Meadow Fork followed identical methods. Shocking the stream required a minimum of three personnel. Surveyors used a drag tape to measure 50 meters of wetted channel parallel to the bank for each site. Sites were documented using a GPS (global positioning system) unit. Block nets were not used for these surveys. Sampling a site consisted of shocking from the lower boundary and proceeding upstream to the upper site boundary. Fish were collected using a Smith-Root backpack electrofisher and held in buckets. After sampling each site, electroshocking seconds were recorded as a measure of effort. National Marine Fisheries Services (NMFS) electrofishing guidelines were used to minimize the effects of electrofishing on listed bull trout (NMFS 2000). Upon completion of each site fish were processed. Processed fish were released into the closest pool with the exception of brook trout. All salmonids were measured (fork length (FL) in millimeters (mm)) and all other species were counted. Pelvic fin clips were collected from fish identified as bull trout, brook trout, or possible bull/brook trout hybrids for independent genetic analysis. Also, pictures were taken of the fish for visual comparison.

2003 survey

In 2003, sampling on Meadow Fork started on July 7th and was completed on July 17th. The survey started at the confluence of Meadow Fork with Big Creek and proceeded upstream ending at the waterfall barrier, with 100% of the channel sampled. Sampling on Lake Creek started on July 22nd and was completed on August 7th. Survey on Lake Creek was completed from Lake Creek Campground to the waterfall barrier, with 100% of the channel sampled.

2004 survey

Sampling on Meadow Fork began on July 28, 2004 and completed on August 2, 2004. Sampling began at the confluence of Meadow Fork Creek with Big Creek and ended at a waterfall barrier (approximately 5400 m). Sample sites on Meadow Fork were 50 meters in length and separated by 220 meters of unsampled channel.

Sampling on Lake Creek began on August 3, 2004 and was completed on August 9, 2004. Sampling began at the southern property boundary of Lake Creek Camp and proceeded upstream ending at a waterfall barrier (approximately 8200 m). Sample sites on Lake Creek were 50 meters in length and separated by 360 meters of unsampled channel.

To make data comparable from 2003 to 2004, river kilometer for each site was calculated and sites with the closest starting point were used for comparison (Table 3-1).

Table 3-1. River kilometer comparison for sites sampled on Lake Creek and Meadow Fork in 2003 and 2004.

Site #	Meadow Fork 2004 RK	Meadow Fork 2003 RK		Lake Creek 2004 RK	Lake Creek 2003 RK
1	0	0		9.0	9.0
2	.27	.25		9.41	9.40
3	.54	.55		9.82	9.80
4	.81	.80		10.23	10.25
5	1.08	1.10		10.64	10.65
6	1.35	1.35		11.05	11.05
7	1.62	1.60		11.46	11.45
8	1.89	1.90		11.87	11.85
9	2.16	2.15		12.28	12.30
10	2.43	2.45		12.69	12.70
11	2.70	2.70		13.10	13.10
12	2.97	3.00		13.51	13.50
13	3.24	3.25		13.92	13.90
14	3.51	3.50		14.33	14.35
15	3.78	3.80		14.74	14.75
16	4.05	4.05		15.15	15.15
17	4.32	4.30		15.56	15.50
18	4.59	4.60		15.97	15.95
19	4.86	4.85		16.38	16.40
20	5.13	5.15		16.79	16.80

Analysis

Sites sampled in 2004 were compared to similar sites sampled in 2003. The beginning site for both 2003 and 2004 is the same for the surveys on Lake Creek and Meadow Fork. In 2003, 100% of the wetted channel was sampled for Lake Creek and Meadow Fork, whereas in 2004, only 20 sites from each Lake Creek and Meadow Fork were sampled. The two goals of analyzing data were to test changes related to removal of brook trout and changes caused by recent disturbances. It is assumed that the storm affected all salmonids in a similar manner. To test changes related to the storm, the sample from 2003 must be from before the storm. Unfortunately, the storm occurred before sampling of Lake Creek was completed in 2003. Because of this the results from Lake Creek can not be analyzed for comparison. Results from Meadow Fork from 2003 and 2004 were analyzed to test for significant differences in catch per effort and projected abundances.

Catch per effort was calculated for each individual site using the following calculation:

Catch per Effort=C/E

Where: C=Number of bull trout, redband trout, and bull/ brook trout hybrids collected

E=Seconds shocked on the site

The measure of effort per site is quantified as the number of seconds the shocker was operated and is recorded in the data. Brook trout were not used to calculate catch per effort because they were not returned to the stream during sampling in 2003, and removal of brook trout may bias abundance estimates.

Abundance was calculated for each individual site using the following equation:

Abundance=C/(E*q)

Where: C=Number of bull trout, redband trout, and bull/brook trout hybrids collected

E=Seconds shocked on the site

q=catchability coefficient or probability of capture per one unit effort

An initial value for q was calculated using the average probability of capture (89%) divided by the average effort for pass 1 (880 seconds) on the population survey on upper Lake Creek in 2003 (Schwabe et al. 2004). This is the value for q assuming an 89% probability of capture. We were unable to determine the probability of capture for Meadow Fork because surveys were conducted without blocknets in 2003 and 2004. Because probability of capture could not be calculated we opted to use values from 1 to 100% for the probability of capture to calculate abundance estimates. The abundance estimate is to statistically compare native salmonids observed from 2003 to 2004. Statistical analyses were performed on 2003 and 2004 datasets with Microsoft Excel, using Students' t-tests to compare catch per effort and abundance estimates for the following probability of capture values: 10%, 25%, 50%, and 89%.

Results

Meadow Fork

On Meadow Fork, 20 sites were surveyed with fish collected from 19 of the sampled sites in 2003 and from 14 of the sampled sites in 2004. Three salmonid species and one cottid *Cottus spp.* genus were collected from Meadow Fork in both years. Bull/brook trout hybrids were collected from Meadow Fork in 2003, but were not identified in 2004. In 2003, relative abundance ranged from 72.4% bull trout to 1.4% redband trout and bull/brook trout hybrids (Table 3-2). In 2004, relative abundance ranged from 50% bull trout to 5.3% brook trout (Table 3-2).

Table 3-2. Relative abundance and total of each species collected from Meadow Fork in 2003 and 2004.

Species	Total from 2003		2003 Relative Abundance	Total from 2004		2004 Relative Abundance
Bull Trout	105	Ratio 13:1	72.4%	19	Ratio 9.5:1	50%
Brook Trout	8		5.5%	2		5.3%
Redband Trout	2		1.4%	5		13.2%
Bull/Brook Trout Hybrids	2		1.4%	0		0%
Cottids	28		19.3%	12		31.6%

Brook Trout

A total of 8 brook trout were collected from 5 of the 20 sites in 2003, up to RK 2.5. In 2004, two brook trout were collected from the first site sampled, with no brook trout collected thereafter (Figure 3-2). Brook trout were the second least relatively abundant salmonid from Meadow Fork in 2003 and the least relatively abundant salmonid sampled in 2004 (Table 3-2). Brook trout sampled in 2004 from Meadow Fork measured 185 mm and 195 mm (Figure 3-3).

Figure 3-2. Comparison of brook trout collected from comparative sites sampled in 2003 and 2004 from Meadow Fork electroshocking surveys.

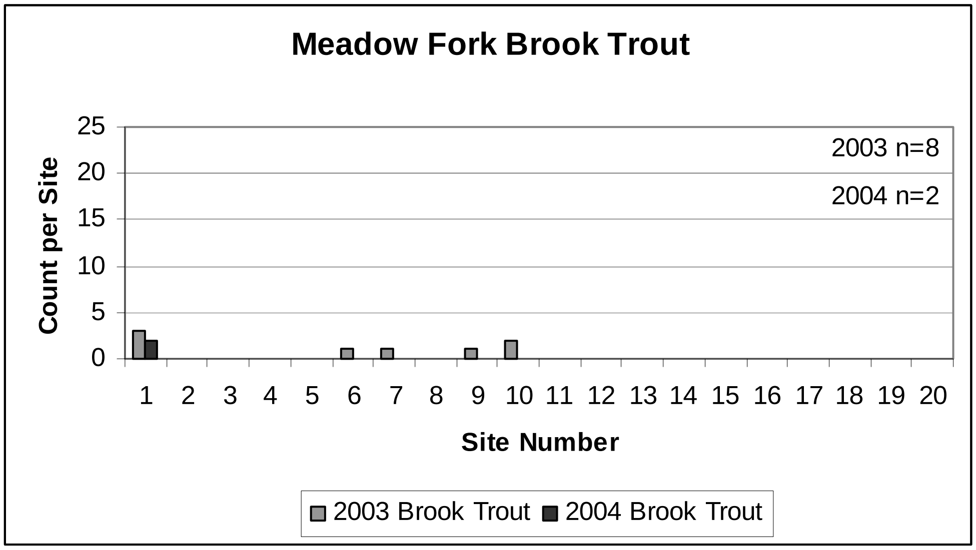
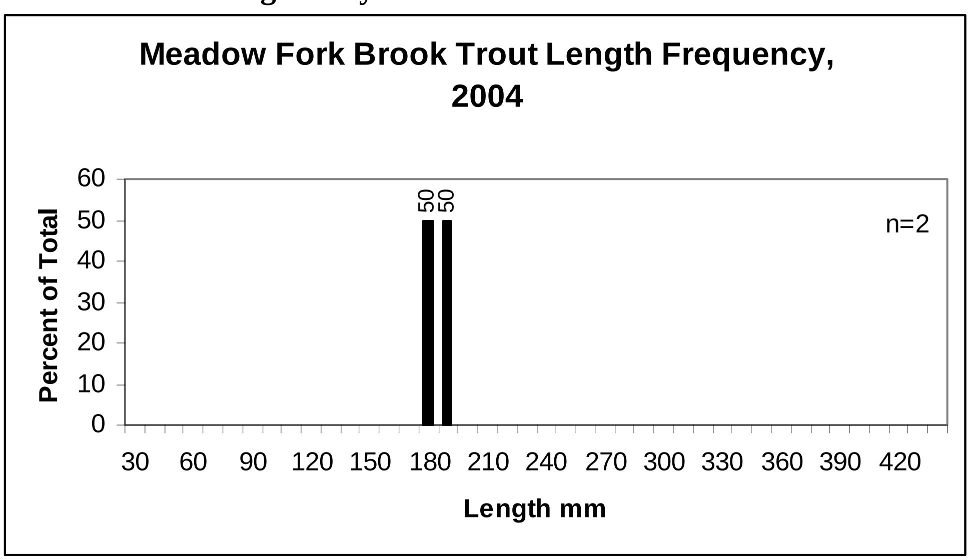


Figure 3-3. Length frequency of brook trout collected from 2004 electrofishing survey of Meadow Fork.



Bull Trout

A total of 105 bull trout were collected from 17 of the 20 sites in 2003, up to RK 5.15. In 2004, a total of 19 bull trout were collected from 12 of the 20 sites sampled, up to RK 4.3 (Figure 3-4). Bull trout were not collected from the last three sites sampled in 2004 (equivalent to 910 meters of stream). Bull trout were the most relatively abundant salmonid collected from Meadow Fork in both 2003 and 2004 (Table 3-2). Bull trout collected in 2004 measured from 30 mm to 325 mm, and averaged 188 mm (Figure 3-5).

Figure 3-4. Comparison of bull trout collected from comparative sites sampled in 2003 and 2004 from Meadow Fork electroshocking surveys.

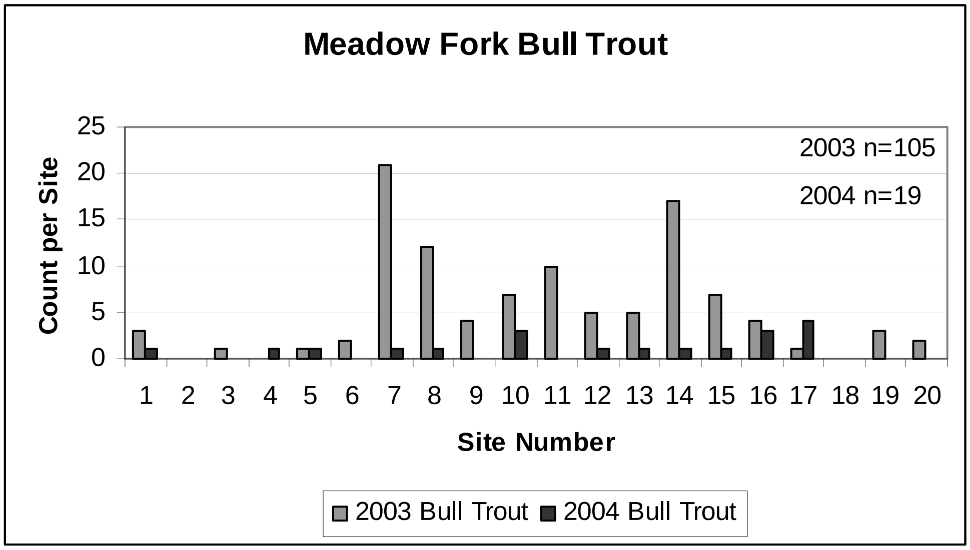
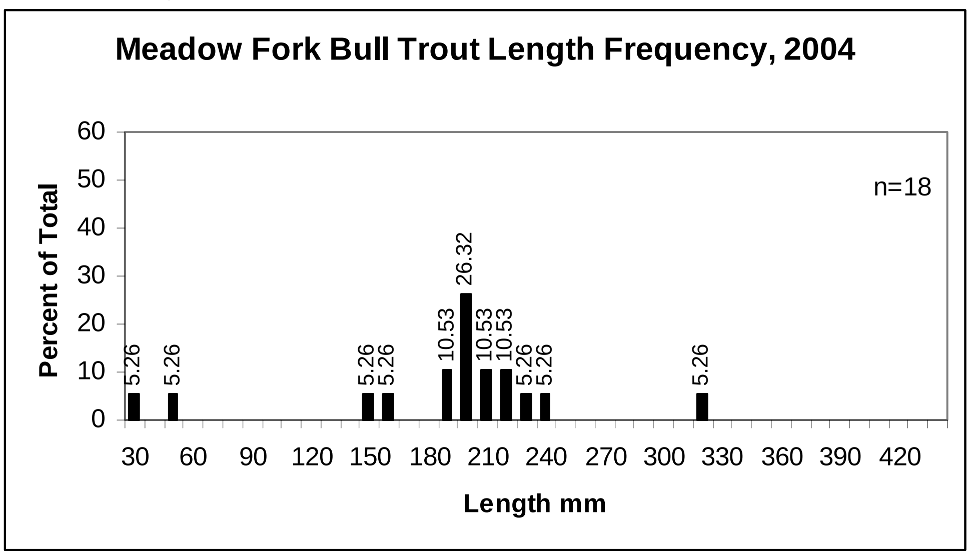


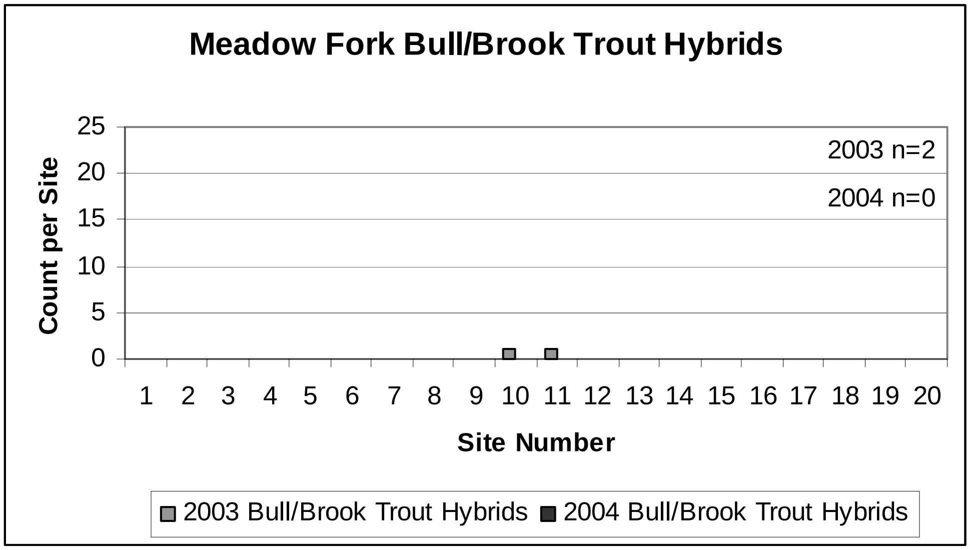
Figure 3-5. Length frequency of bull trout collected from 2004 electrofishing survey of Meadow Fork.



Bull/Brook Trout Hybrids

A total of 2 bull/brook trout hybrids were collected from the 20 sites sampled in 2003 and no hybrids were identified in 2004 (Figure 3-6). In 2003, bull/brook trout hybrids were the least relatively abundant salmonid observed (Table 3-2).

Figure 3-6. Comparison of bull/brook trout hybrids collected from comparative sites sampled in 2003 and 2004 from Meadow Fork electroshocking surveys.



Redband Trout

A total of 2 redband trout were collected from 2 of the twenty sites in 2003, up to RK .8. In 2004, a total of 5 redband trout were collected from the first 3 sites sampled, up to RK 0.55, with no redband trout sampled thereafter (Figure 3-7). Redband trout were the least relatively abundant salmonids sampled in 2003, and the second most relatively abundant salmonid sampled in 2004 from Meadow Fork (Table 3-2). Redband trout collected in 2004 measured between 150 mm to 200 mm, and averaged 173 mm (Figure 3-8).

Figure 3-7. Comparison of redband trout collected from comparative sites sampled in 2003 and 2004 from Meadow Fork electroshocking surveys.

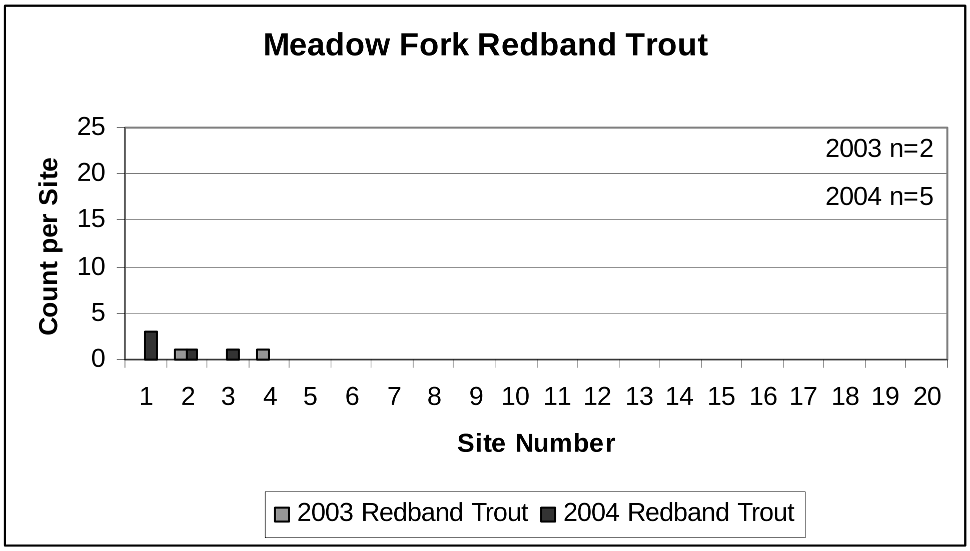
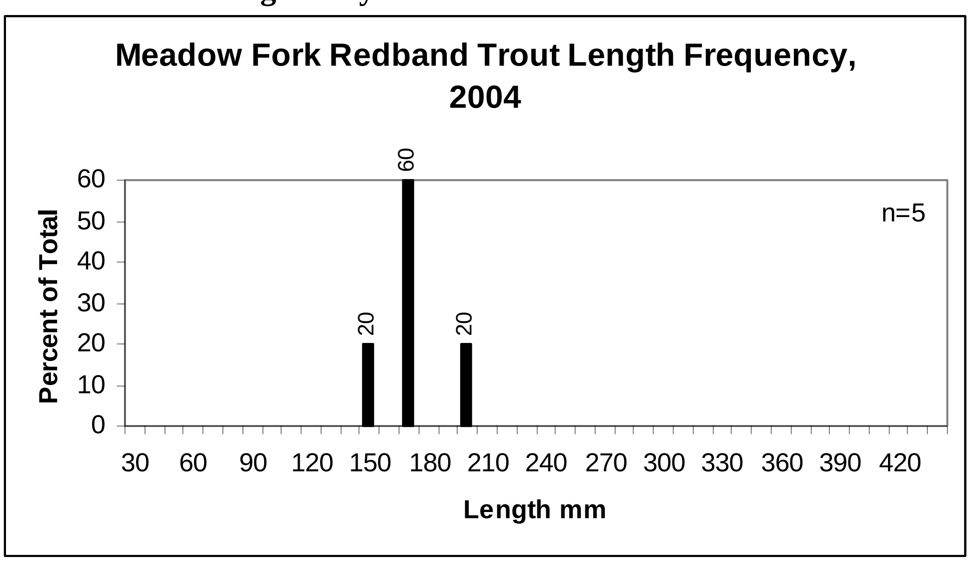


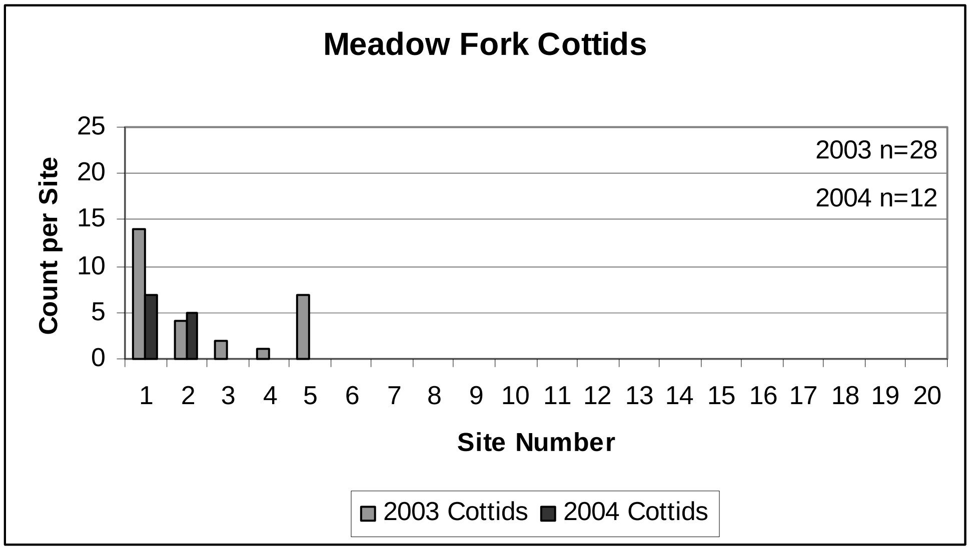
Figure 3-8. Length frequency of redband trout collected from 2004 electrofishing survey of Meadow Fork.



Cottids

A total of 28 sculpin were collected from 5 of the 20 sites in 2003, up to RK 1.1. In 2004, a total of 12 sculpin were collected from the first two sites sampled on Meadow Fork up to RK .25 (Figure 3-9).

Figure 3-9. Comparison of cottids collected from comparative sites sampled in 2003 and 2004 from Meadow Fork electroshocking surveys.



Lake Creek

On Lake Creek, fish were collected from 14 sampled sites in 2003 and 15 of the sampled sites in 2004. Three salmonid species and one cottid genus were identified in 2003, while two salmonid species and one cottid genus were identified in 2004. In 2003, relative abundance ranged from 53.9% brook trout to 1.6% bull/brook trout hybrids (Table 3-3). In 2004, relative abundance ranged from 64.9% brook trout to 1.8% bull trout (Table 3-3).

Table 3-3. Relative abundance and total of each species collected from Lake Creek in 2003 and 2004.

Species	Total from 2003		2003 Relative Abundance	Total from 2004		2004 Relative Abundance
Bull Trout	6	Ratio 1:11.5	4.7%	2	Ratio 1:36	1.8%
Brook Trout	69		53.9%	72		64.9%
Redband Trout	6		4.7%	0		0%
Bull/Brook Trout Hybrids	2		1.6%	0		0%
Cottids	45		35.2%	37		33.3%

Brook Trout

A total of 69 brook trout were collected from 14 of the 20 sites in 2003, ranging from RK 9 to RK 16.8. In 2004, a total of 72 brook trout were collected from 13 of the 20 sample sites, from RK 9 to RK 16.8 (Figure 3-10). In 2004, brook trout were not collected from sites 10, 13, and 15-19. Brook trout were the most relatively abundant salmonid collected in both 2003 and 2004 (Table 3-3). Lengths of brook trout collected in 2004 ranged from 40 mm to 245 mm, and averaged 130 mm (Figure 3-11).

Figure 3-10. Comparison of brook trout collected from comparative sites sampled in 2003 and 2004 from Lake Creek electroshocking surveys.

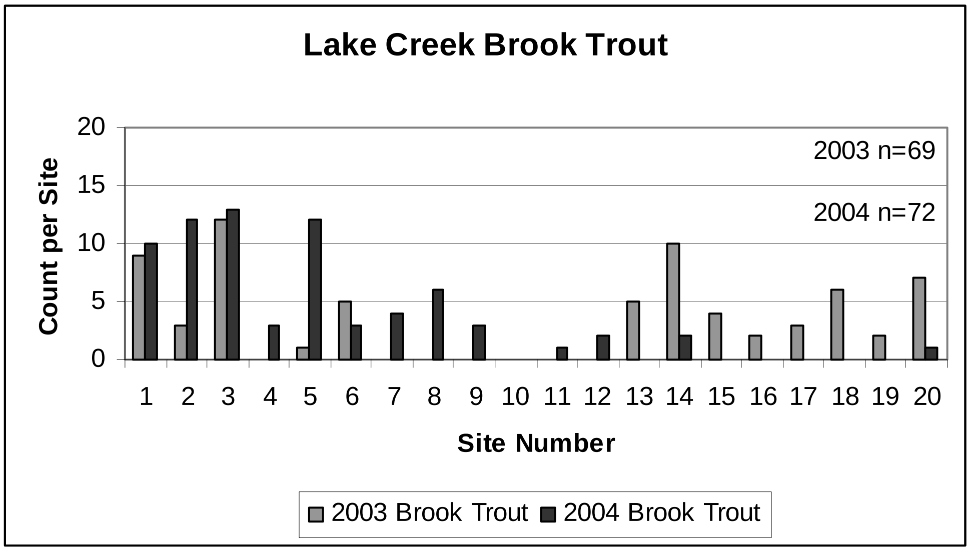
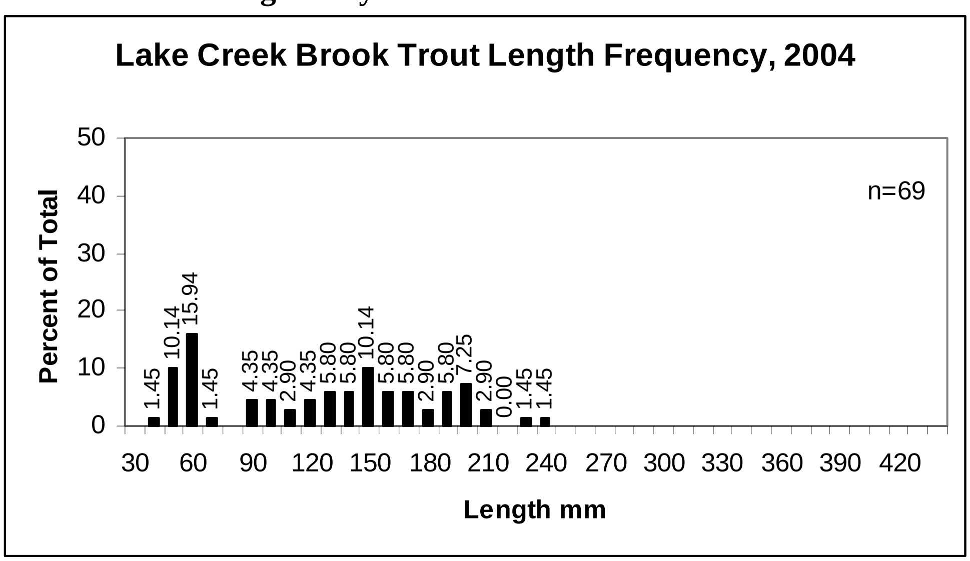


Figure 3-11. Length frequency of brook trout collected from 2004 electrofishing survey of Lake Creek.



Bull Trout

A total of 6 bull trout were collected from 3 of the 20 sites in 2003, ranging from RK 14.35 to RK 15.15. In 2004, a total of two bull trout were collected from Lake Creek, one from site 18 (RK 16) and one from site 20 (RK 16.8) (Figure 3-12). Bull trout were the second least relatively abundant salmonid sampled in 2003 and the least relatively abundant salmonid sampled in 2004 (Table 3-3). Bull trout collected in 2004 measured 233 mm and 300 mm (Figure 3-13).

Figure 3-12. Comparison of bull trout collected from comparative sites sampled in 2003 and 2004 from Lake Creek electroshocking surveys.

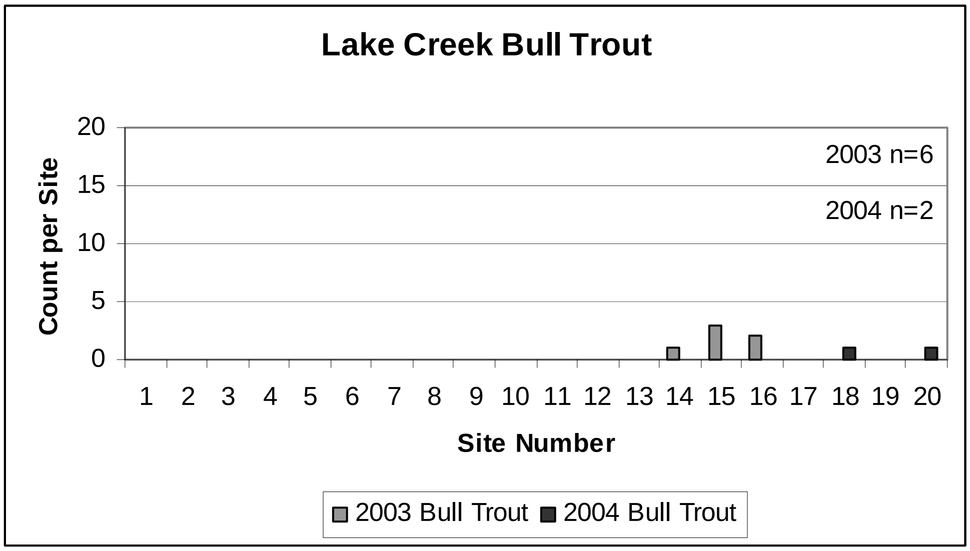
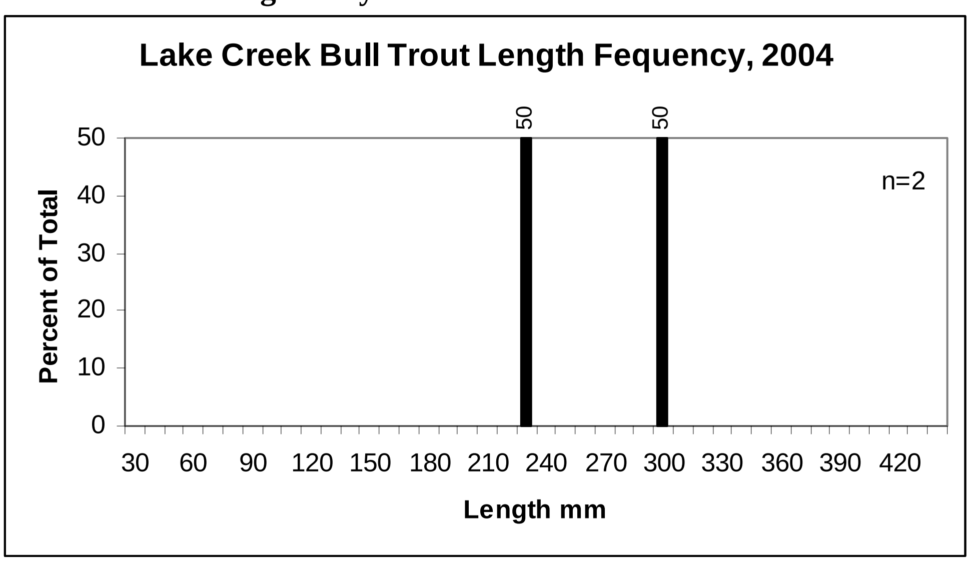


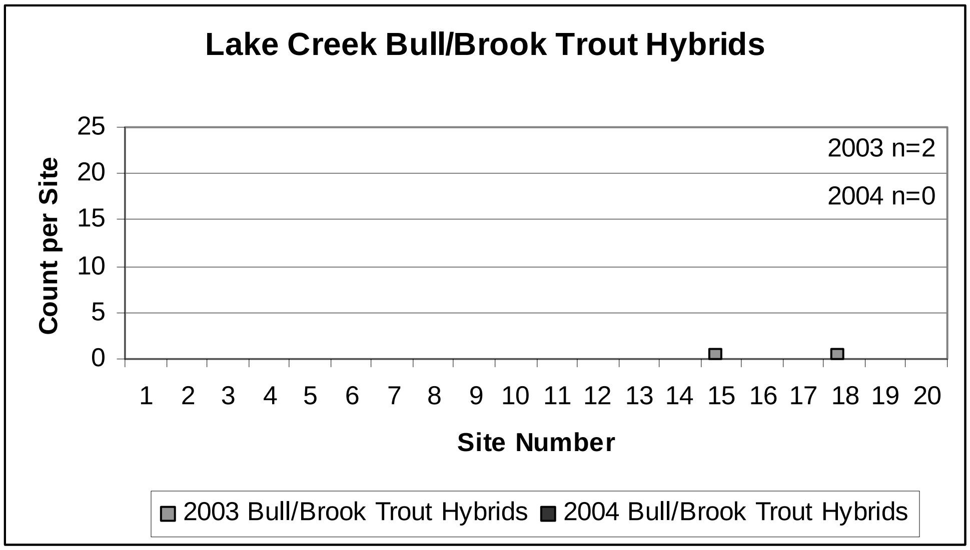
Figure 3-13. Length frequency of bull trout collected from 2004 electrofishing survey of Lake Creek.



Possible Bull/Brook Trout Hybrids

A total of two bull/brook trout hybrids were collected from 2 of the 20 sites in 2003, which is from RK 14.75 to RK 16 (Figure 3-14). No hybrids were identified in the 2004 survey on Lake Creek. In 2003, bull/brook trout hybrids were the least relatively abundant salmonid observed (Table 3-3).

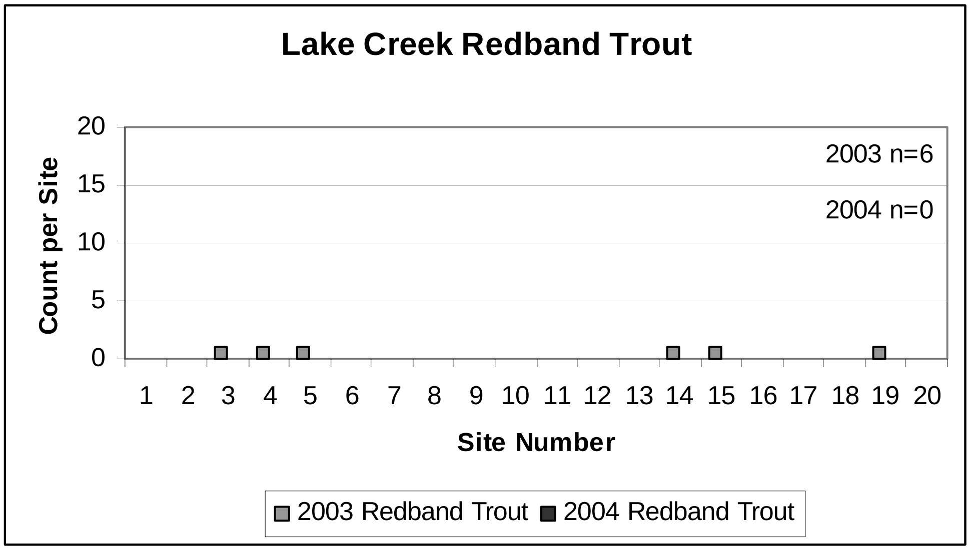
Figure 3-14. Comparison of bull/brook trout hybrids collected from comparative sites sampled in 2003 and 2004 from Lake Creek electroshocking surveys.



Redband Trout

A total of six redband trout were collected from 6 of the 20 sites in 2003, or up to RK 16.4 (Figure 3-15). No redband trout were detected during the survey in 2004. Redband trout were the second least relatively abundant salmonid sampled in 2003 (Table 3-3).

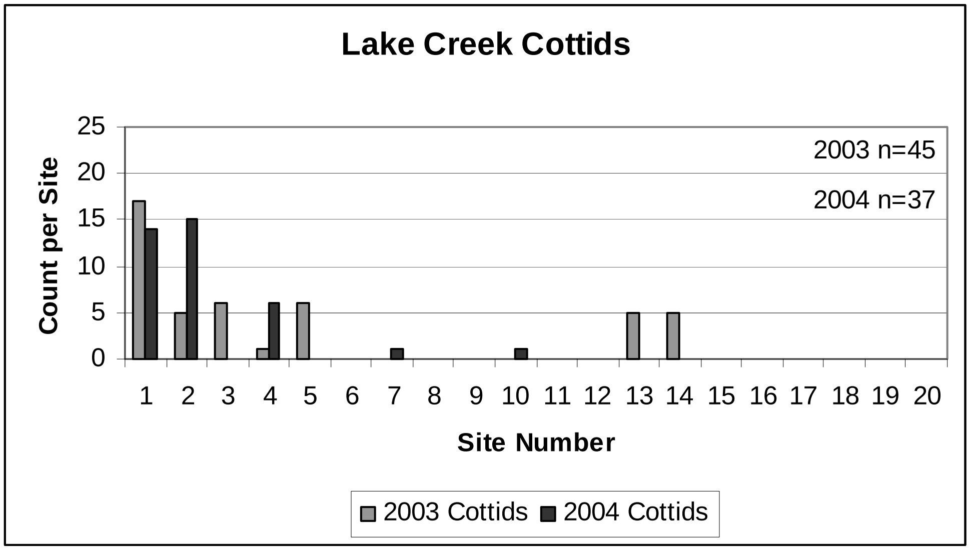
Figure 3-15. Comparison of redband trout collected from comparative sites sampled in 2003 and 2004 from Lake Creek electroshocking surveys.



Cottids

A total of 45 sculpin were collected from 7 of the 20 sites in 2003, or up to RK 14.35 (Figure 3-16). In 2004, a total of 37 sculpin were collected from 5 of the 20 sites, up to RK 12.7 (Figure 3-16). Sculpin were the second most relatively abundant fish sampled in both 2003 and 2004 (Table 3-3).

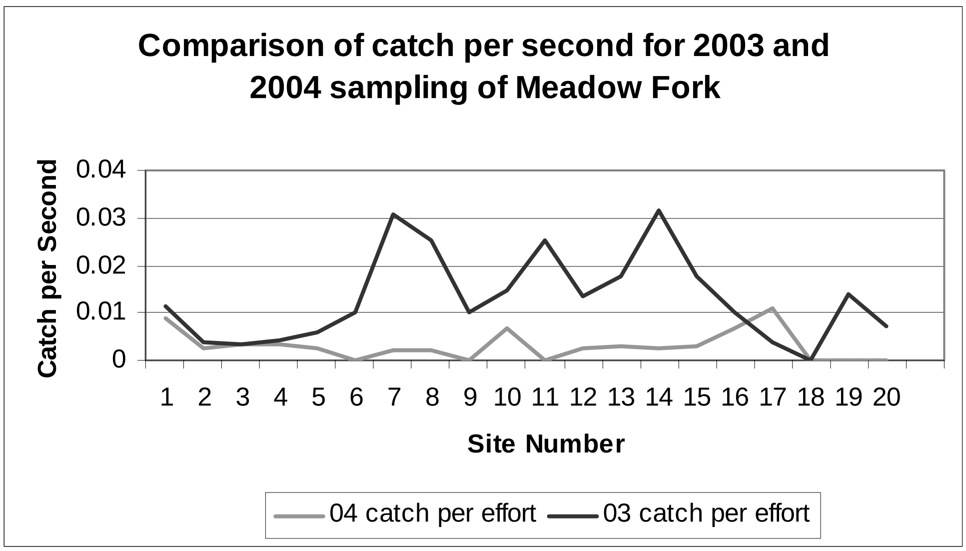
Figure 3-16. Comparison of cottids collected from comparative sites sampled in 2003 and 2004 from Lake Creek electroshocking surveys.



Analysis

Catch per effort and abundance estimates were calculated for all sites sampled in 2004 and comparative sites sampled in 2003 on Meadow Fork. Catch per effort in 2003 ranged from 0 to 0.032 fish per second, and in 2004 catch per effort ranged from 0 to 0.011 fish per second. A selection of abundance estimates are presented in appendix A. Comparisons of catch per effort and abundance estimates from 2003 and 2004 (Figure 3-17) show a significant difference (t-test, $p<0.05$) with a p-value of 0.000130944 for all comparisons. Based on this there is a significant difference in the abundance of salmonids excluding brook trout from 2003 to 2004 that is not influenced by the probability of capture. From 2003 to 2004 there was a 77% decrease in the total number of bull trout, redband trout, and bull/brook trout hybrids collected.

Figure 3-17. Comparative graph for catch per effort from sampling on Meadow Fork from 2003 and 2004.



Discussion

In 2003 and 2004 presence/absence surveys were conducted on Lake Creek and Meadow Fork. The purpose of the 2003 surveys was to establish the distribution of bull trout and brook trout, and to determine areas of allopatric and sympatric populations of bull trout and brook trout and potential for hybridization. On July 26, 2003 a thunderstorm resulted in debris flows and major flooding that altered the channel and riparian areas on both Meadow Fork and Lake Creek. Due to the disturbance, Meadow Fork and Lake Creek were resampled in 2004. Physical damage to the storm was apparent through personal observations, but effects to fish were not known. Possible effects to the fish from these streams was evident during spawning surveys. On Meadow Fork no redds were observed in 2003 and the number of redds on Lake Creek decreased from the prior year (Perkins 2003). The purpose of surveying in 2004 was to document possible changes in species presence, distribution, and relative abundance related to the thunderstorm and resulting debris flows, as well as the effects of removal of brook trout from the previous year. In

2003 and 2004 brook trout were the dominate salmonid from Lake Creek and bull trout were the dominant salmonid from Meadow Fork. Comparisons from 2003 to 2004 are limited by the fact that only 20 sites were surveyed in 2004.

Effects of the thunderstorm and resulting debris flows were evident from significant differences in catch per effort and possible abundance estimates from 2003 to 2004. Based on the results of analysis there was over a 75% decrease in salmonids on Meadow Fork Creek between 2003 and 2004. This decrease can most likely be attributed to the flash flood. In both 2003 and 2004 during spawning surveys, a lack of spawning gravels was noted for Meadow Fork (Walters PC 2005).

The current status of bull trout populations and habitat conditions in the basin emphasize the importance of protecting these populations. Buchanan (1997) lists the upper Malheur River at "high risk of extinction" because of degraded habitat, the presence of brook trout, and low abundance levels. With the decrease in abundance of salmonids on Meadow Fork Creek there is a further increased risk of extinction. In addition, loss of habitat and population isolation increases the risk of extinction (Reiman and McIntyre 1993). The habitat on Meadow Fork has gone through severe changes. These changes may impact the bull trout population in the future. Metapopulation dynamics are of extreme importance to recovery of populations after stochastic events such as the High-Roberts fire in 2002 and the flash flood in 2003. The upper Malheur River is isolated giving bull trout little chance of recolonizing if they should become extinct (Reiman and McIntyre 1993), which further supports the importance of taking effective measures to protect upper Malheur River bull trout. Based on genetic analysis there is a pure strain of bull trout on Meadow Fork and Lake Creek (Schwabe et al. 2004). Allendorf (2001) states that conservation efforts should focus on streams with pure strains of bull trout present.

Meadow Fork

Overall relative abundance was similar from 2003 to 2004 with bull trout being the dominant salmonid sampled from Meadow Fork Creek in both years. Distribution of fish species sampled was consistent as well. Bull trout were documented throughout Meadow Fork up to the waterfall (RK 5.3). Brook trout were not sampled upstream of RK 3 in either 2003 or 2004 indicating that an allopatric population of bull trout continues to inhabit the upper reach of Meadow Fork Creek. Species identified in Meadow Fork remained the same with the exception that no bull/brook trout hybrids were phenotypicially identified in the 2004 sample. This may be due to a small number of bull/brook trout hybrids in Meadow Fork. It is possible that the distribution of brook trout is more limited in 2004 than in 2003. In 2003 brook trout were collected through RK 2.5, whereas in 2004 brook trout were only collected to RK .05. If the distribution of brook trout is more limited it may be attributed to the removal of brook trout in 2003.

To further analyze relative abundance (in 2003) the surveyed area on Meadow Fork was split into three sections. Reach 1 (mouth to RK 1.35) (Figure 3-18 and 3-19) was analyzed separately because it may have represented the upper limits of cottids. Reach 2

(RK 1.4 to RK 3) (Figure 3-20 and 3-21) was analyzed separately due to the absence of brook trout and redband trout upstream of RK 3 in the 2003. Reach 3 (RK 3 to RK 5.4) (Figure 3-22 and 3-23) was analyzed separately due to the presence of bull trout only. In reach 1 species present remained the same from 2003 to 2004. The main change in reach 1 was an increase in the relative abundance of redband trout. In 2003 bull trout, brook trout, redband trout, and bull/brook trout hybrids were collected from reach 2, but only bull trout were collected in 2004. In both 2003 and 2004 bull trout were the only fish collected from reach 3.

Lake Creek

Relative abundance of species sampled from Lake Creek was similar in 2003 and 2004, with brook trout being the dominant salmonid collected in both years. However, in 2004, redband trout and bull/brook trout hybrids were not observed. This may be attributed to a low number of individuals collected prior to the disturbance. Distribution of species appears to remain similar from 2003 to 2004. Bull trout were not sampled downstream of RK 13.25 in either year, indicating a possible resident population upstream of this point. Brook trout were collected up to the waterfall in both years sampled. There was a drop in the presence of brook trout from RK 11 to RK 14 in 2003. The lack of brook trout in this section may be attributed to the thunderstorm and flash flooding as it was sampled in the days following the storm. In 2004, 93% of the brook trout were collected downstream of RK 12.7. In 2003, in addition to presence/absence survey on Lake Creek up to the waterfall, a survey was conducted from the waterfall to High Lake. During both of these surveys brook trout were not returned to the creek. Removing brook trout in the section above the waterfall on Lake Creek may have reduced the potential for recruitment. This would explain the lack of brook trout upstream of RK 12.7. It may take a few years for brook trout to reestablish in this section because of removal during surveys above the waterfall barrier. However, recruitment of brook trout from above the waterfall barrier is inevitable because of the presence of brook trout in High Lake. Brook trout below RK 12.7 were most likely recruited from downstream of the 2003 sample area.

To further analyze relative abundance (in 2003) the surveyed section of Lake Creek was split into two sections. Reach 1 (RK 9 to RK 14.7) (Figure 3-24 and 3-25) was analyzed separately because it may have represented the upper limits for cottids on Lake Creek. Reach 2 (RK 14.7 to RK 17.2) (Figure 3-26 and 3-27) was analyzed separately due to the absence of cottids upstream of RK 14.7. In 2003 brook trout, bull trout, redband trout, bull/brook trout hybrids, and cottids were collected in reach 1. However, in 2004 only cottids and brook trout were collected. The relative abundance of brook trout in this reach increased from 46% in 2003 to 66% in 2004. In 2003, bull trout, brook trout, redband trout, and bull/brook trout hybrids were collected in reach 2. In 2004, brook trout and bull trout were collected from reach 2. Relative abundance of brook trout in reach 2 decreased from 66% in 2003 to 33% in 2004. Relative abundance of bull trout increased from 16% in 2003 to 67% in 2004. The sample size in 2004 was small, limiting relative abundance comparisons.

Recommendations

Meadow Fork has historically been a stronghold for bull trout. It is the only stream on the upper Malheur River where bull trout out number brook trout. In order to maintain a viable population of bull trout on the upper Malheur River, protecting Meadow Fork bull trout is critical. We recommend improving the existing culvert and improving spawning and rearing habitat. We also recommend assessing possible natural barriers caused by the storm. Reassess distribution of fish species on both Lake Creek and Meadow Fork in five years to monitor short term resilience of exotic and native species. Finally, we should consider options for eradication of brook trout from Lake Creek.

Acknowledgements

A special thanks to the Bonneville Power Administration who funded this project. We would also like to send a special thanks to the Youth Opportunity Program crew that assisted us with field work consisting of Daniel Tooke, Derek Hawley, Selina Sam, and Carla Teeman. We would also like to thank Eric Hawley, Garrett Sam, Kevin Fenn, Jason Fenton, and Lawrence Schwabe for field work and processing data.

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Appendix A. Comparisons of catch per effort and selected abundance estimates for Meadow Fork sampling from 2003 and 2004.

Table 3-4. Comparison of abundance estimates for probability of capture of 89% from 2003 and 2004 surveys on Meadow Fork Creek.

Site Number	2003 Catch/Effort	2004 Catch/Effort	2003 Abundance Estimate for p=89%	2004 Abundance Estimate for p=89%
1	0.011320755	0.008830022	11.19	8.73
2	0.003787879	0.002475248	3.75	2.45
3	0.003484321	0.003571429	3.45	3.53
4	0.004115226	0.003484321	4.07	3.45
5	0.005882353	0.002604167	5.82	2.57
6	0.010050251	0	9.94	0.00
7	0.030791789	0.001976285	30.45	1.95
8	0.025369979	0.002	25.08	1.98
9	0.010025063	0	9.91	0.00
10	0.014571949	0.006681514	14.41	6.61
11	0.025345622	0	25.06	0.00
12	0.013404826	0.002590674	13.25	2.56
13	0.017730496	0.002808989	17.53	2.78
14	0.031716418	0.002512563	31.36	2.48
15	0.01754386	0.002777778	17.35	2.75
16	0.010309278	0.006651885	10.19	6.58
17	0.003703704	0.010810811	3.66	10.69
18	0	0	0.00	0.00
19	0.013888889	0	13.73	0.00
20	0.007042254	0	6.96	0.00
Total Abundance Estimate for all sites			257.16	59.10

Table 3-5. Comparison of abundance estimates for probability of capture of 50% from 2003 and 2004 surveys on Meadow Fork Creek.

Site Number	2003 Catch/Effort	2004 Catch/Effort	2003 Abundance Estimate for p=50%	2004 Abundance Estimate for p=50%
1	0.011320755	0.008830022	19.92	15.54
2	0.003787879	0.002475248	6.67	4.36
3	0.003484321	0.003571429	6.13	6.29
4	0.004115226	0.003484321	7.24	6.13
5	0.005882353	0.002604167	10.35	4.58
6	0.010050251	0	17.69	0.00
7	0.030791789	0.001976285	54.19	3.48
8	0.025369979	0.002	44.65	3.52
9	0.010025063	0	17.64	0.00
10	0.014571949	0.006681514	25.65	11.76
11	0.025345622	0	44.61	0.00
12	0.013404826	0.002590674	23.59	4.56
13	0.017730496	0.002808989	31.21	4.94
14	0.031716418	0.002512563	55.82	4.42
15	0.01754386	0.002777778	30.88	4.89
16	0.010309278	0.006651885	18.14	11.71
17	0.003703704	0.010810811	6.52	19.03
18	0	0	0.00	0.00
19	0.013888889	0	24.44	0.00
20	0.007042254	0	12.39	0.00
Total Abundance Estimate for all sites			457.75	105.21

Table 3-6. Comparison of abundance estimates for probability of capture of 25% from 2003 and 2004 surveys on Meadow Fork Creek.

Site Number	2003 Catch/Effort	2004 Catch/Effort	2003 Abundance Estimate for p=25%	2004 Abundance Estimate for p=25%
1	0.011320755	0.008830022	39.85	31.08
2	0.003787879	0.002475248	13.33	8.71
3	0.003484321	0.003571429	12.26	12.57
4	0.004115226	0.003484321	14.49	12.26
5	0.005882353	0.002604167	20.71	9.17
6	0.010050251	0	35.38	0.00
7	0.030791789	0.001976285	108.39	6.96
8	0.025369979	0.002	89.30	7.04
9	0.010025063	0	35.29	0.00
10	0.014571949	0.006681514	51.29	23.52
11	0.025345622	0	89.22	0.00
12	0.013404826	0.002590674	47.18	9.12
13	0.017730496	0.002808989	62.41	9.89
14	0.031716418	0.002512563	111.64	8.84
15	0.01754386	0.002777778	61.75	9.78
16	0.010309278	0.006651885	36.29	23.41
17	0.003703704	0.010810811	13.04	38.05
18	0	0	0.00	0.00
19	0.013888889	0	48.89	0.00
20	0.007042254	0	24.79	0.00
Total Abundance Estimate for all sites			915.50	210.41

Table 3-7. Comparison of abundance estimates for probability of capture of 10% from 2003 and 2004 surveys on Meadow Fork Creek.

Site Number	2003 Catch/Effort	2004 Catch/Effort	2003 Abundance Estimate for p=10%	2004 Abundance Estimate for p=10%
1	0.011320755	0.008830022	99.62	77.70
2	0.003787879	0.002475248	33.33	21.78
3	0.003484321	0.003571429	30.66	31.43
4	0.004115226	0.003484321	36.21	30.66
5	0.005882353	0.002604167	51.76	22.92
6	0.010050251	0	88.44	0.00
7	0.030791789	0.001976285	270.97	17.39
8	0.025369979	0.002	223.26	17.60
9	0.010025063	0	88.22	0.00
10	0.014571949	0.006681514	128.23	58.80
11	0.025345622	0	223.04	0.00
12	0.013404826	0.002590674	117.96	22.80
13	0.017730496	0.002808989	156.03	24.72
14	0.031716418	0.002512563	279.10	22.11
15	0.01754386	0.002777778	154.39	24.44
16	0.010309278	0.006651885	90.72	58.54
17	0.003703704	0.010810811	32.59	95.14
18	0	0	0.00	0.00
19	0.013888889	0	122.22	0.00
20	0.007042254	0	61.97	0.00
Total Abundance Estimate for all sites			2288.75	526.03

Appendix B. Comparison in the relative abundance of fish species in sampled reaches for Meadow Fork and Lake Creek in 2003 and 2004. Sampled reaches are based on distance sampled and not the number of sampled sites. Reach 1 is to RK 1.35 of Meadow Fork. It is sampled separately because it may have represented the upper limit of distribution for cottid species in the 2003 sample of Meadow Fork.

Figure 3-18. Relative abundance of fish species collected from Meadow Fork, reach 1 in 2003.

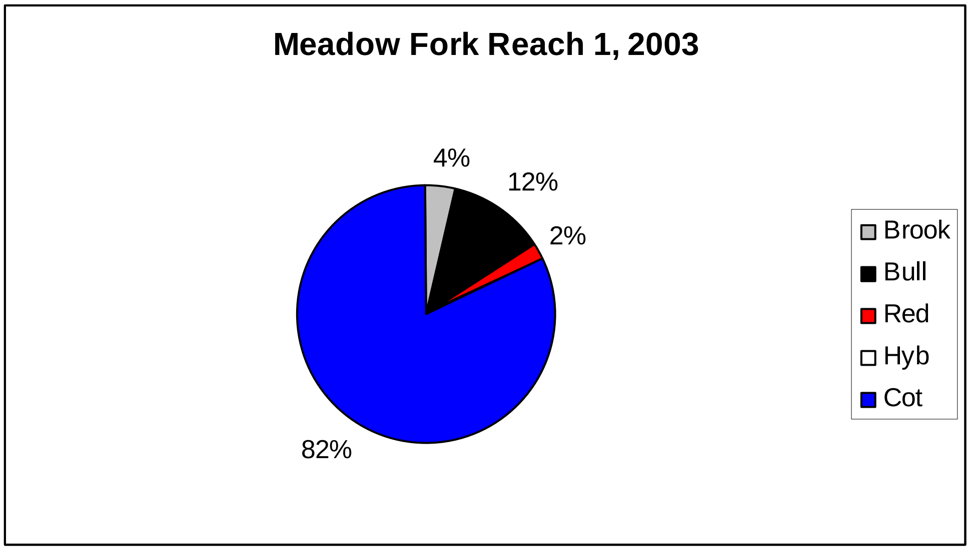
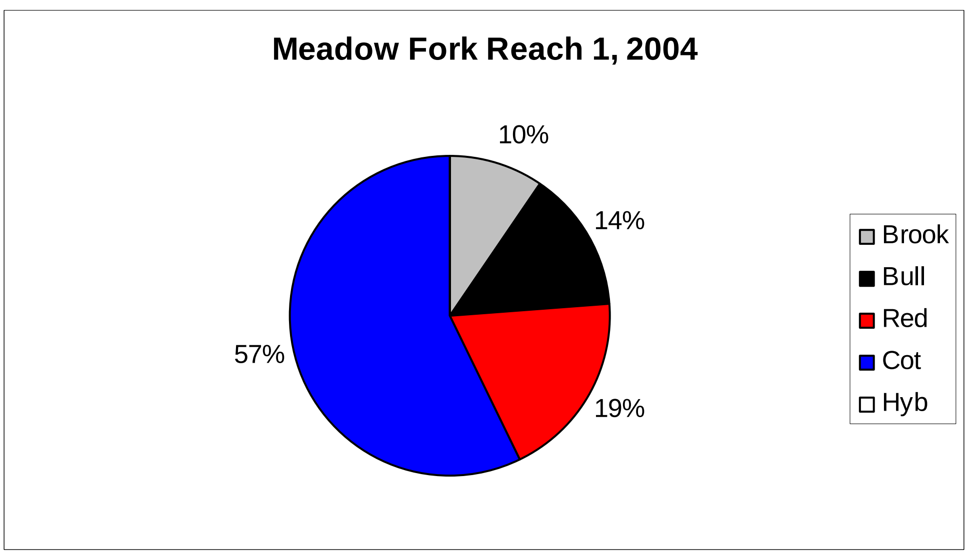


Figure 3-19. Relative abundance of fish species collected from Meadow Fork, reach 1 in 2004.



Meadow Fork Reach 2 is from river kilometer (RK) 1.4 to RK 3. This section was analyzed separately due to the presence of cottids downstream of 1.4 RK and the absence of redband trout and brook trout upstream of 3 RK in the 2003 sample of Meadow Fork.

Figure 3-20. Relative abundance of fish species collected from Meadow Fork, reach 2 in 2003.

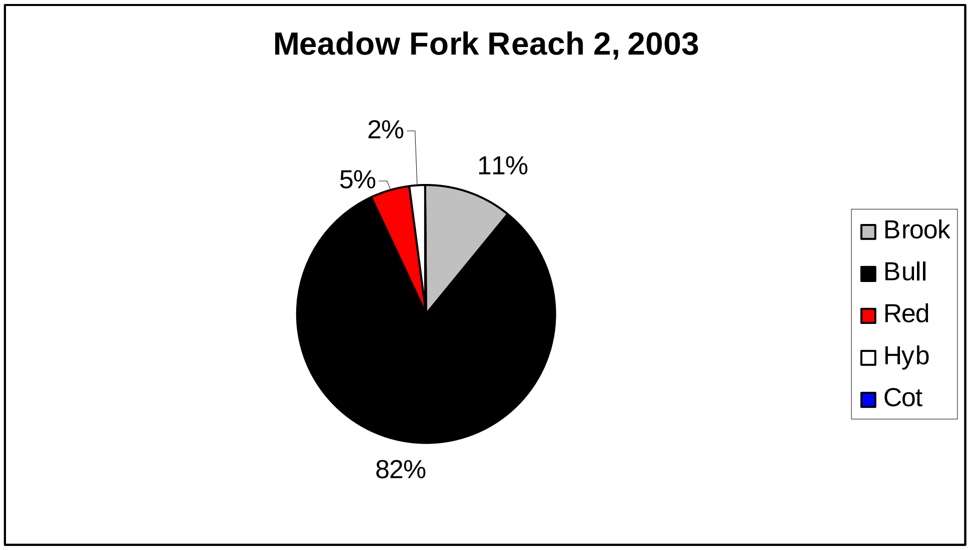
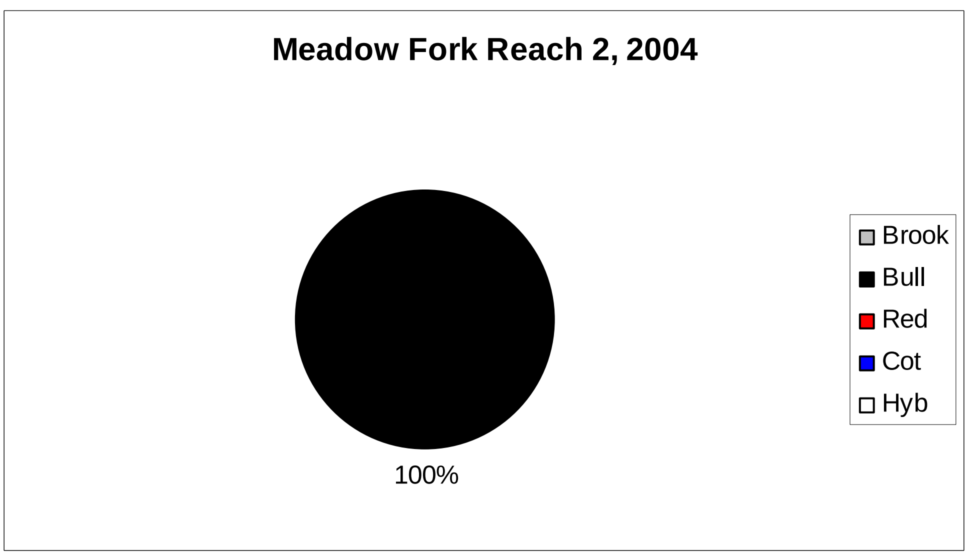


Figure 3-21. Relative abundance of fish species collected from Meadow Fork, reach 2 in 2004.



Meadow Fork Reach 3 is RK 3.05 to RK 5.4. Reach 3 is analyzed separately due to the presence of bull trout only in the 2003 sample of Meadow Fork.

Figure 3-22. Relative abundance of fish species collected from Meadow Fork, reach 3 in 2003.

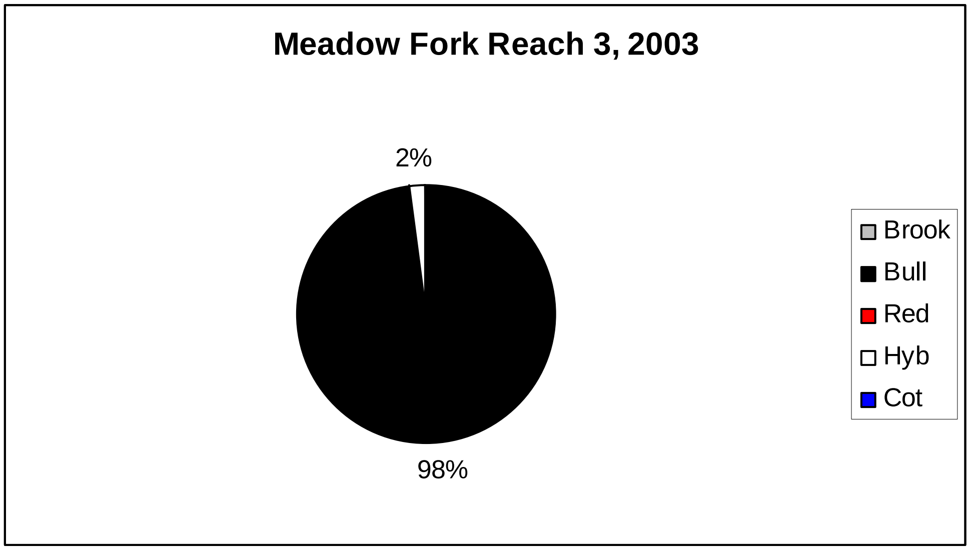
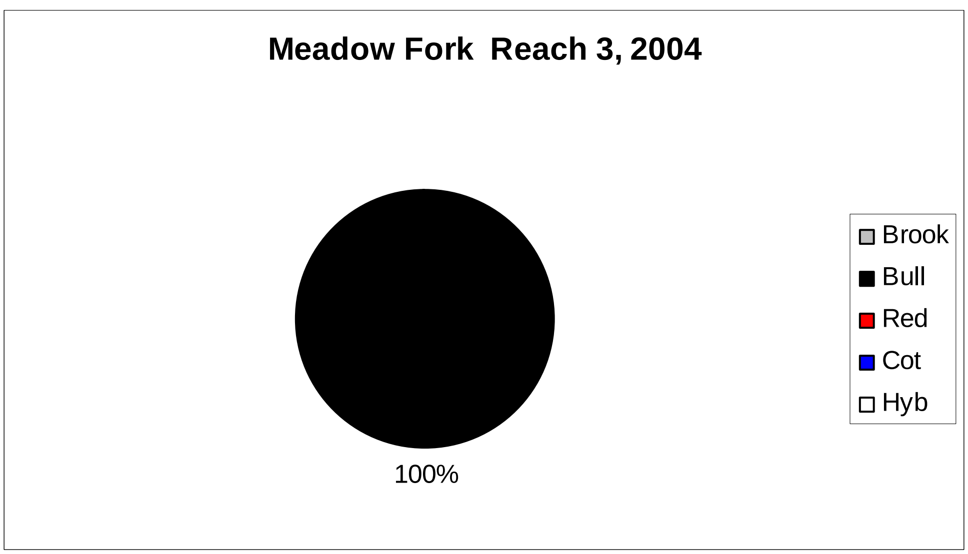


Figure 3-23. Relative abundance of fish species collected from Meadow Fork, reach 3 in 2004.



Lake Creek Reach 1 is from RK 9 to RK 14.7. Reach 1 was analyzed separately due to the absence of cottids upstream of RK 14.7 in the 2003 Lake Creek sample.

Figure 3-24. Relative abundance of fish species collected from Lake Creek, reach 1 in 2003.

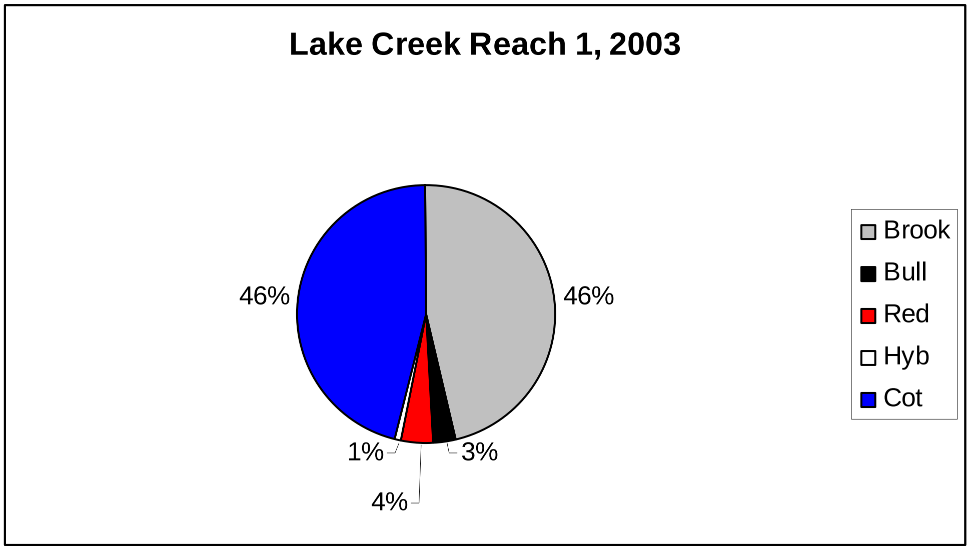
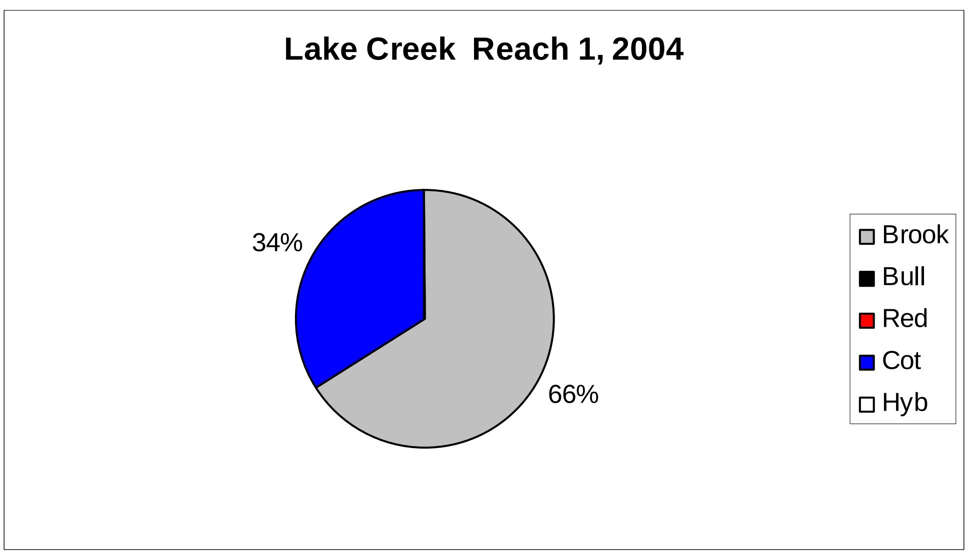


Figure 3-25. Relative abundance of fish species collected from Lake Creek, reach 1 in 2004.



Lake Creek reach 2 is from RK 14.75 to RK 17.2. Reach 2 was analyzed separately due to the absence of cottid species in the 2003 sample of reach 2 from Lake Creek.

Figure 3-26. Relative abundance of fish species collected from Lake Creek, reach 2 in 2003.

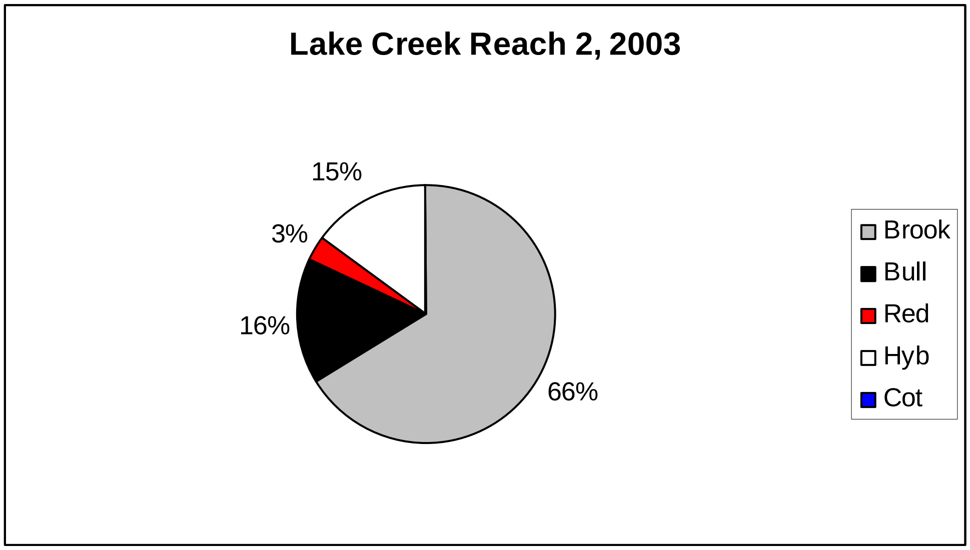
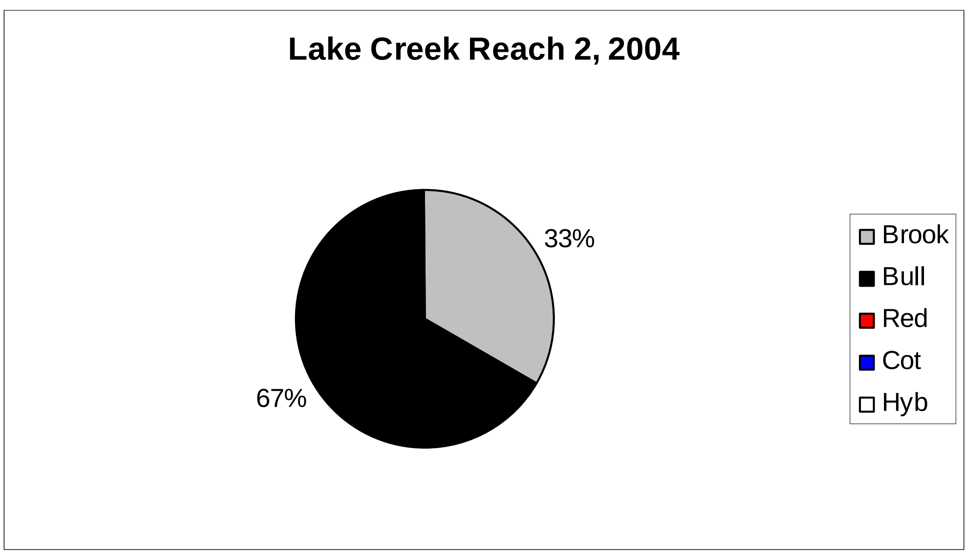


Figure 3-27. Relative abundance of fish species collected from Lake Creek, reach 2 in 2004.



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Chapter 4 Snorkeling of Lake Creek and Big Creek at the Logan Valley Mitigation Site to determine species composition and relative abundance of species present.

by Kevin Fenn
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Introduction

Logan Valley is located at the base of the Strawberry Mountains near the headwaters of the upper Malheur River. Lake Creek and Big Creek converge at the southern end of Logan Valley at river kilometer (RK) 306 to form the upper Malheur River. In April of 2000, 1760 acres of Logan Valley were acquired by the Burns Paiute Tribe with funding from Bonneville Power Administration. The land was acquired as a Fish and Wildlife Mitigation Site.

There are several tributaries to Lake Creek including Crooked Creek and McCoy Creek. Tributaries to Big Creek include Meadow Fork, Snowshoe Creek, and Corral Basin. Electroshocking distribution surveys have been conducted on all of these tributaries by the Burns Paiute Fish and Wildlife Department (BPFW) with the exception of Snowshoe Creek (Schwabe et al. 2000-2004 and Chapter 2). Big Creek has been surveyed from Forest Road 16 (RK 3.2) to its headwaters (RK 12.65), and Lake Creek has been surveyed from Lake Creek Camp (RK 9.0) to High Lake. Information on species presence on the deeded property is limited. Based on past telemetry studies it is believed that bull trout *Salvelinus confluentus* seasonally utilize the areas of Lake Creek and Big Creek on the deeded property of the Burns Paiute Tribe (Schwabe et al. 2001 and 2002).

The portions of Lake Creek and Big Creek on the Logan Valley Mitigation site consists of approximately 11 kilometers of stream, with 6 km of Lake Creek and 5 km of Big Creek. Distribution of bull trout in the summer at Logan Valley may be limited due to seasonally high water temperatures causing thermal barriers (Bower et al. 1993). The DEQ stream temperature standard for bull trout is 10^{o}C and for other salmonids is 17.8^{o}C (Buchanan and Gregory 1997). The period from July 15^{th} to August 15^{th} has been deemed as a critical period for fish rearing (Perkins 1999) and coincides with annual water temperature maximums. From the year 2000 to 2003 maximum water temperatures at Lake Creek on Logan Valley have exceeded 22^{o}C every year. On Big Creek at Logan Valley maximum stream temperatures have not been quite as high, ranging from 15^{o}C to 19.5^{o}C, from 2000 to 2003 (Schwabe et al. 2004).

The deeded property of the Burns Paiute Tribe has no record of sampling. The goal of surveying Big Creek and Lake Creek is to determine seasonal species composition and relative abundance of fish species on the deeded property, and to provide baseline information to determine aquatic species response to changes in land management. One of the key management goals for the deeded property at Logan Valley is restoration of stream channel morphology and natural function for Lake Creek and Big Creek (Wenick et al. 2002). Steps are being taken to decrease instream water temperatures on the deeded property. Current projects include a seasonal flood irrigation study (Boyd and Zamora 2003) and planting of riparian vegetation. Snorkeling was the method used for this survey because it is the least invasive method of sampling to observe distribution and species presence, and so that the survey can be repeated in the future.

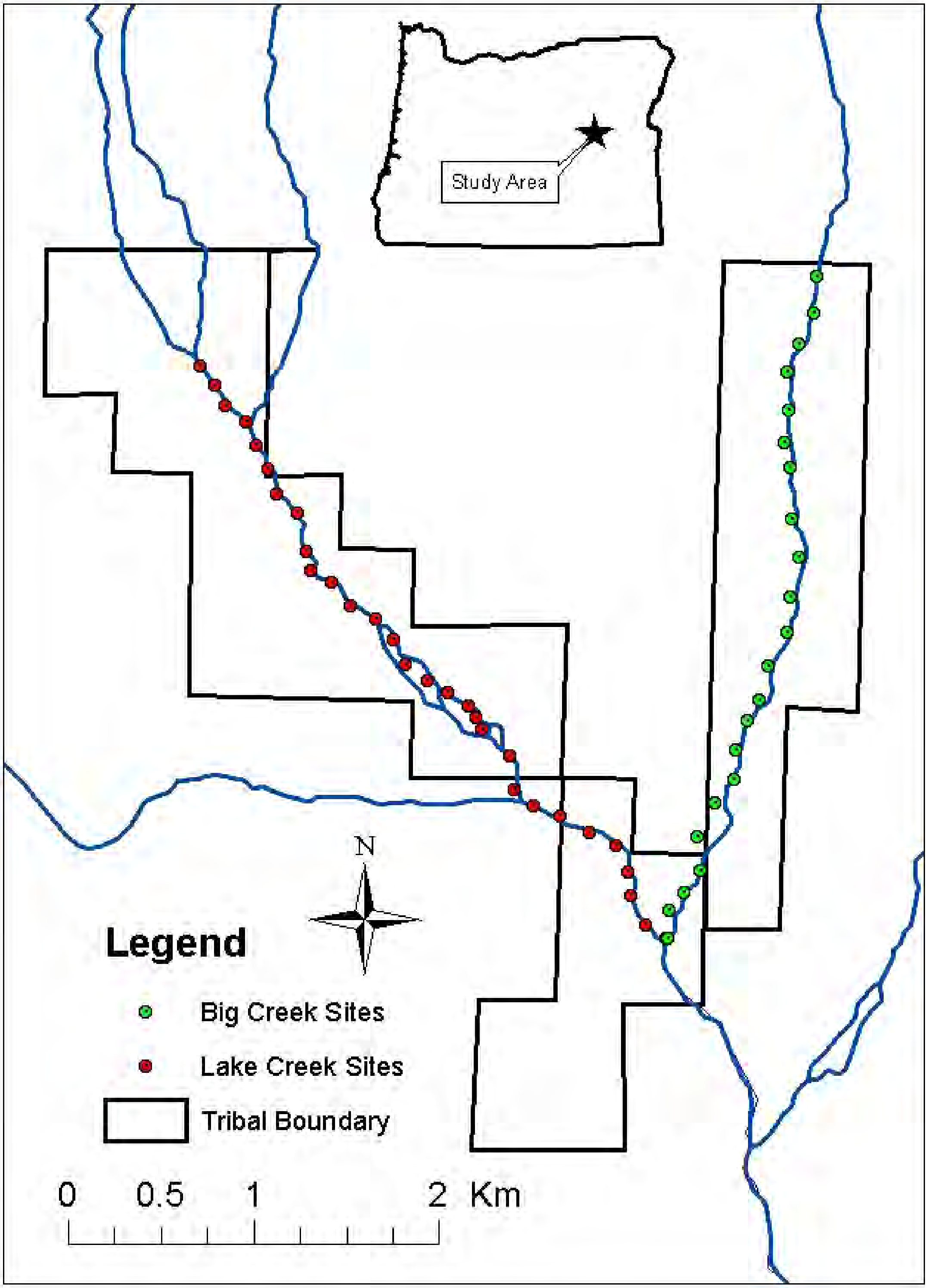
Methods

Snorkeling was conducted from the confluence of Lake Creek and Big Creek to the northern property boundaries of the Logan Valley Mitigation site. Snorkeling was conducted in 2004 from June 7th to 10th and June 14th to 16th, August 16th to 20th, and October 18th to 21st. The June survey was conducted during high flows and cold water (spring); the August survey was conducted during low flows and warm water (summer); and the October survey was conducted during low flows and cold water (fall). Snorkeling was completed at night because bull trout are most active at night increasing the chances of observation (Goetz 1991).

The length of the surveyed area for Lake Creek was approximately 6 km, and for Big Creek was approximately 5 km (Figure 4-1). Snorkel sites for both creeks were 50 m in length. On Lake Creek 30 sites were sampled, each separated by 150 m of unsampled channel. On Big Creek 22 sites were sampled, each separated by 180 m of unsampled channel. Sites were measured starting at the confluence using a rolotape to measure 50 m of bank parallel to the wetted channel. The unsampled sections were measured in the same manner. The beginning and end of each site was marked using a Global Positioning System and fence posts with ribbon tape so the same sites could be sampled on all three occasions.

Snorkeling a site consisted of two individuals proceeding from the lower boundary of the site upstream to the upper boundary of the site. Snorkelers were side by side concentrating on opposite banks to maximize potential for observation. If a side channel was encountered on a sample site one snorkeler would proceed up the side channel and the other snorkeler would continue up the main channel. This was possible because most of the channel is narrow enough for one snorkeler to observe. Snorkelers counted the numbers of each species observed and estimated lengths of salmonids. Accompanying the snorkelers were two individuals on the bank, recording data from snorkelers and habitat data for each surveyed site. Habitat data was taken for each survey site. Data recorded for each site included unit type (riffle, riffle with pockets, lateral pool, plunge pool, and dam pool), length of each type (meters), width of each type (meters), average depth (meters), large wood count (greater than 15 cm in diameter and 3 meters in length), and substrate composition (% of cobble, gravel, and fine sediments).

Figure 4-1. Areas surveyed in 2004 at the Logan Valley Mitigation site.



Results

Lake Creek

Thirty sites were snorkeled on Lake Creek in June, August, and October. Sites started at the confluence with Big Creek and ended at the northern property boundary of the Burns Paiute mitigation property at Logan Valley. All species observed are native to the area with the exception of brook trout. From Lake Creek a total of eight species and 8,445 fish were observed. Fish species observed include brook trout *Salvelinus fontinalis*, bull trout, redband trout *Oncorhynchus mykiss,* mountain whitefish *Prosopium williamsoni,* and redside shiner *Richardsonius balteatus*. Cottids *Cottus spp*., dace *Rhinichthys spp*., and suckers *Catostomus spp.* were observed as well, but were only identified to the genus. A total of 96% of the fish observed from Lake Creek were dace and redside shiners.

Salmonids

Only one bull trout (100 mm) was observed in Lake Creek. Bull trout were the least relatively abundant salmonid observed in the June survey and were not observed in August or October. A total of 36 brook trout were observed in Lake Creek. Brook trout observed in Lake Creek ranged from 75 mm to 375 mm, and averaged 201 mm (Figure 4-16). Brook trout were the second most relatively abundant salmonid observed in June and the most relatively abundant in October. A total of 30 redband trout were observed in Lake Creek. Redband trout observed in Lake Creek ranged from 75 mm to 400 mm, and averaged 178 mm (Figure 4-17). Redband trout were the most relatively abundant salmonid observed in June and the second most relatively abundant salmonid observed in October. Only one whitefish (250 mm) was observed in Lake Creek. Whitefish were the least relatively abundant salmonid observed in the October sample, but were not observed in either June or August. The relative abundance of all salmonids in August is less than 1%.

In June, a total of 1,065 fish and 7 species were observed from the Lake Creek survey (Table 4-1). Relative abundance of fish observed in June ranged from 64.7% dace to 0.1 % bull trout. Salmonids observed in the June survey include 12 brook trout, 1 bull trout, and 24 redband trout.

Table 4-1. Total of each fish species observed and relative abundance for the June snorkel survey on the section of Lake Creek on the Logan Valley Mitigation site.

	Lake Creek June	
	Count	Relative Abundance
Brook Trout	12	1.1%
Bull Trout	1	0.1%
Redband Trout	24	2.3%
Unid Trout	2	0.2%
Whitefish	0	0
Hybrid	0	0
Cottids	7	0.7%
Dace	689	64.7%
Redside Shiner	257	24.1%
Sucker	73	6.9%

In August, a total of 6,149 fish and 6 species were observed (Table 4-1). Relative abundance of fish observed in August ranged from 52.2% dace to 0.03% redband trout. Salmonids observed in the August survey of Lake Creek included 2 brook trout, 2 redband trout, and one trout that was not visually identified to the species.

Table 4-2. Total of each fish species observed and relative abundance for the August snorkel survey on the section of Lake Creek on the Logan Valley Mitigation site.

	Lake Creek August	
	Count	Relative Abundance
Brook Trout	2	0.03%
Bull Trout	0	0
Redband Trout	2	0.03%
Unid Trout	1	0.02%
Whitefish	0	0
Hybrid	0	0
Cottids	3	0.05%
Dace	3209	52.2%
Redside Shiner	2794	45.4%
Sucker	138	2.2%

In October, a total of 1231 fish and 6 species were observed from Lake Creek (Table 4-1). Relative abundance of fish observed in October ranged from 76.4% redside shiner to 0.1% whitefish. Salmonids observed in the October survey included 22 brook trout, 4 redband trout, and one whitefish.

Table 4-3. Total of each fish species observed and relative abundance for the October snorkel survey on the section of Lake Creek on the Logan Valley Mitigation site.

	Lake Creek October	
	Count	Relative Abundance
Brook Trout	22	1.8%
Bull Trout	0	0
Redband Trout	4	.3%
Unid Trout	0	0
Whitefish	1	.1%
Hybrid	0	0
Cottids	0	0
Dace	251	20.4%
Redside Shiner	941	76.4%
Sucker	12	1%

Big Creek

Twenty-two sites were snorkeled on Big Creek in June, August, and October. Sites started at the confluence with Lake Creek and ended at the northern property boundary of the Logan Valley Mitigation site. All species observed are native to the area with the exception of brook trout. From Big Creek a total of 531 fish and 8 species were observed. Fish species observed when snorkeling Big Creek include brook trout, bull trout, bull/brook trout hybrid, redband trout, whitefish, and redside shiners. In addition cottids, dace, and suckers were observed but only identified to the genus.

Salmonids

A total of 3 bull trout were observed in Big Creek. Bull trout ranged from 100 mm to 150 mm, and averaged 133 mm (Figure 4-19). Bull trout were the least relatively abundant salmonid observed in June and August in Big Creek, but were not observed in October. A total of 137 brook trout were observed when snorkeling Big Creek. Brook trout ranged from 25 mm to 425 mm, and averaged 148 mm (Figure 4-18). Brook trout were the most relatively abundant fish species observed in June, and were the third most relatively abundant fish species observed in August and October. A total of 170 redband trout were observed in Big Creek. Redband trout ranged from 50 mm to 400 mm, and averaged 127 mm (Figure 4-20). Redband trout were the second most relatively abundant species observed in June and August, and were the most relatively abundant species observed in October. A total of 32 whitefish were observed in Big Creek. Whitefish ranged from 75 mm to 450 mm, and averaged 213 mm (Figure 4-21). Whitefish were the third most relatively abundant salmonid observed in all three samples.

In June, a total of 210 fish and 8 species were observed from Big Creek (Table 4-2). Relative abundance of fish observed in June ranged from 39.1% brook trout to 0.5% sucker. Salmonids observed during the June Big Creek survey include 82 brook trout, 2 bull trout, 46 redband trout, and 6 whitefish.

Table 4-4. Total of each fish species observed and relative abundance for the June snorkel survey on the section of Big Creek on the Logan Valley Mitigation site.

	Big Creek June	
	Count	Relative Abundance
Brook Trout	82	39.1%
Bull Trout	2	1%
Redband Trout	46	20.5%
Unid Trout	0	0
Whitefish	6	3%
Hybrid	0	0
Cottids	43	20.5%
Dace	25	11.9%
Redside Shiner	5	2.4%
Sucker	1	0.5%

In August, a total of 152 fish and eight species were observed during the snorkel survey on Big Creek (Table 4-2). Relative abundance of fish observed in August ranged from 32.2% dace to 0.7% bull trout and sucker. Salmonids observed from the August Big Creek survey include 23 brook trout, 1 bull trout, 40 redband trout, and 14 whitefish.

Table 4-5. Total of each fish species observed and relative abundance for the August snorkel survey on the section of Big Creek on the Logan Valley Mitigation site.

	Big Creek August	
	Count	Relative Abundance
Brook Trout	23	15.1%
Bull Trout	1	0.7%
Redband Trout	40	26.3%
Unid Trout	1	0.7%
Whitefish	14	9.2%
Hybrid	0	0
Cottids	21	13.8%
Dace	49	32.2%
Redside Shiner	2	1.3%
Sucker	1	0.7%

In October, a total of 169 fish and 7 species were observed from the Big Creek survey (Table 4-2). Relative abundance of fish observed in October ranged from 49.7% redband trout to 0.6% bull/brook trout hybrid. Salmonids observed from the October Big Creek survey include 33 brook trout, 84 redband trout, 12 whitefish, and 1 bull/brook trout hybrid.

Table 4-6. Total of each fish species observed and relative abundance for the October snorkel survey on the section of Big Creek on the Logan Valley Mitigation site.

	Big Creek October	
	Count	Relative Abundance
Brook Trout	33	19.5%
Bull Trout	0	0
Redband Trout	84	49.7%
Unid Trout	0	0
Whitefish	12	7.1%
Hybrid	1	.6%
Cottids	34	20.1%
Dace	2	1.2%
Redside Shiner	3	1.8%
Sucker	0	0

Lake Creek and Big Creek Habitat

Habitat data were collected by observers during the snorkel survey on Lake Creek and Big Creek. Habitat types observed on Lake Creek included lateral pool (57%), riffle (24%), and riffle with pockets (19%) (Table 4-3). Pool habitat on Lake Creek averaged 58.7% per site (Figure 4-22). No large woody debris were observed on Lake Creek (Figure 4-24). Substrate composition on Lake Creek consisted of 10.7% cobble, 46.5% gravel, and 42.8% fine sediments (Figure 4-26).

Table 4-7. Description of each type of habitat sampled on Lake Creek on the Logan Valley Mitigation site in August of 2004.

Habitat Type	Length	Area	Percent Area	Average Width	Average Depth
Lateral Pool	852 m	2515.5 m^2	57 %	3 m	.67 m
Riffle	379 m	1036 m^2	24 %	2.6 m	.2 m
Riffle With Pockets	277 m	841.5 m^2	19 %	3.1 m	.39 m

Habitat types observed on Big Creek include lateral pool (40%), plunge pool (1%), riffle (33%), and riffle with pockets (26%) (Table 4-4). Pool habitat on Big Creek averaged 42.6% per site (Figure 4-23). A total of 5 pieces of large woody debris were observed on Big Creek (Figure 4-25). Substrate composition on Big Creek consisted of 28.3% cobble, 60.6% gravel, and 11.1% fine sediments (Figure 4-27).

Table 4-8. Description of each type of habitat sampled on Big Creek on the Logan Valley Mitigation site in August of 2004.

Habitat Type	Length	Area	Percent Area	Average Width	Average Depth
Lateral Pool	487 m	1541 m^2	40 %	3.1 m	.67 m
Plunge Pool	8 m	28 m^2	1 %	3.5 m	.7 m
Riffle	354 m	1264.5 m^2	33%	3.6 m	.27 m
Riffle with Pockets	261 m	998.5 m^2	26 %	3.8 m	.35 m

Discussion

The purpose of research on Lake Creek and Big Creek was to determine seasonal species composition and relative abundance, and to provide baseline data on fish species presence to assist in land management planning at the Logan Valley Mitigation site. This was accomplished by completing snorkel survey on both creeks in June, August, and October. The methods are standardized making the results comparable to possible future surveys. Snorkel surveys are one of the least invasive ways of monitoring seasonal species presence associated with changes in riparian conditions.

Salmonid presence is more prevalent in Big Creek than in Lake Creek. Salmonids composed sixty-four percent of the observed fish from Big Creek, whereas they only composed one percent from Lake Creek. Possible reasons for the differences in observation include water temperature, riparian vegetation, habitat quality, and management differences.

Data from the Malheur Subbasin Plan (Bauer et al. 2004) suggest water temperatures on Lake Creek are 50% of the historic average, but on Big Creek water temperatures are comparative with historic averages. Riparian conditions on Lake Creek are less than 25% of historic. There riparian vegetation has been severely degraded throughout the surveyed area of Lake Creek. Big Creek lacks riparian vegetation in the lower half of the surveyed area, but in the upper half of the surveyed area there is healthy riparian vegetation. Habitat quality and complexity on Big Creek also exceeds that on Lake Creek, riparian conditions at 25% of the historic average. On Big Creek there is more instream woody debris and active undercut banks to provide cover for trout. Management differences for Lake Creek and Big Creek are mainly present through grazing practices. Grazing of cattle on Big Creek is limited, but on Lake Creek cattle occupy a large portion of the adjacent meadows.

Lake Creek

The most significant observation from Lake Creek was the relative abundance of fish species present. Relative abundance varies for the three surveys but dace and redside shiners are consistently the most abundant species observed from Lake Creek (Figure 4-10, 4-11, and 4-12). Dace and redside shiners composed 96% of the fish observed. From June to August the number of dace observed increases 5-fold and the number of redside shiners observed increases 10-fold. From August to October the number of dace observed decreases over 10-fold and the number of redside shiners observed decreases by approximately 3-fold. The greater relative abundance of dace and redside shiners may be attributed to their ability to survive and possibly thrive in warmer degraded water.

By sampling multiple times the results show when salmonids occupy the portions of Lake Creek and Big Creek on the deeded property at Logan Valley. Bull trout appear to only occupy Lake Creek early in the summer season (Figure 4-3). In the summer of 2000 bull trout were radio tagged below the confluence of Lake Creek and Big Creek and then tracked. None of the tagged fish were documented migrating into Lake Creek (Schwabe et al. 2001). In 2004 juvenile bull trout were radio tagged and tracked in the same manner. One bull trout was documented migrating into Lake Creek during this study. Stream temperatures may be the biggest factor influencing bull trout presence on Lake Creek. In August temperatures can exceed 24^{o}C possibly deterring bull trout from entering Lake Creek (Schwabe et al, 2004). Because of the temperature barrier migratory bull trout may bypass Lake Creek and go directly into Big Creek.

In addition to bull trout presence in Lake Creek; brook trout, redband trout, and whitefish were present as well. Brook trout were present in all three of the samples on Lake Creek, but in the greatest concentration in the October sample (Figure 4-2). Redband trout were also present in all three samples from Lake Creek, but had the greatest concentration in the June sample (Figure 4-4). Whitefish were only present in the October sample (Figure 4-5).

Big Creek

The most notable observation from Big Creek was in the relative abundance of salmonids present. Salmonids composed 64% of the fish observed in Big Creek.

Bull trout were present in the June and August surveys on Big Creek (Figure 4-7). In 2000 bull trout were radio tagged and all were tracked through Big Creek. From the snorkel survey it has shown that bull trout continue to utilize the portion of Big Creek at the Logan Valley Mitigation site. Snorkel survey supports the results of radiotelemetry in 2000 observing bull trout migrating from May to August (Schwabe et al. 2002). Brook trout, redband trout, and whitefish appear to utilize the portions of Big Creek at the Logan Valley Mitigation Site throughout the season sampled. Brook trout concentrations were highest in June, whereas redband trout concentrations were highest in October. Whitefish presence was lowest in June, in August and October whitefish observations were similar.

Recommendations

Continue to monitor water quality at Logan Valley through temperature monitoring and riparian observation using Rosgen level III stream channel assessment protocols. Reconduct stream habitat surveys on the entire channel of Lake Creek and Big Creek on the deeded property to quantify habitat changes from 2000 stream habitat survey data. Continue to monitor stream flows on Lake Creek and identify annual discharge sites in Big Creek to monitor. Continue riparian area restoration efforts on Lake Creek and Big Creek utilizing vegetation planting and longterm livestock exclusion using permanent riparian fencing. Continue to plant and monitor riparian vegetation on Lake Creek and Big Creek. Continue working with the Forest Service on the management of Lake Creek and Big Creek. Continue monitoring fish distribution at the Logan Valley Mitigation site at time intervals no less than five years.

Acknowledgements

A special thanks to the Bonneville Power Administration who funded this project for the Burns Paiute Fish and Wildlife Department. We would also like to thank Nick Miller, Lindsay Aschim, Eric Hawley, Garrett Sam, Kevin Fenn, Jason Fenton, and Lawrence Schwabe for their time put into snorkeling.

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Appendix A. Distribution of fish species observed for snorkel surveys of Lake Creek and Big Creek at the Logan Valley Mitigation site in 2004.

Figure 4-2. Distribution of brook trout for Lake Creek snorkel surveys at the Logan Valley Mitigation site in 2004.

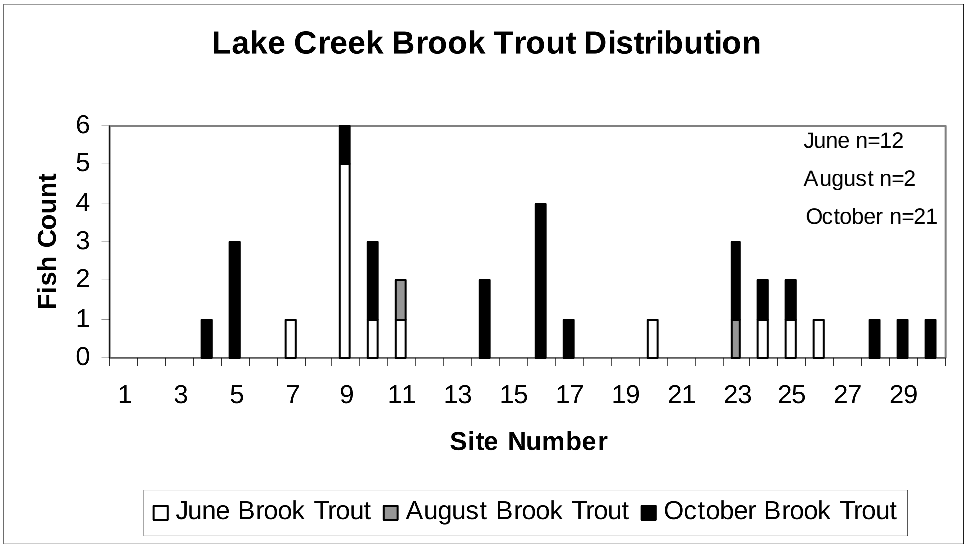


Figure 4-3. Distribution of bull trout for Lake Creek snorkel surveys at the Logan Valley Mitigation site in 2004.

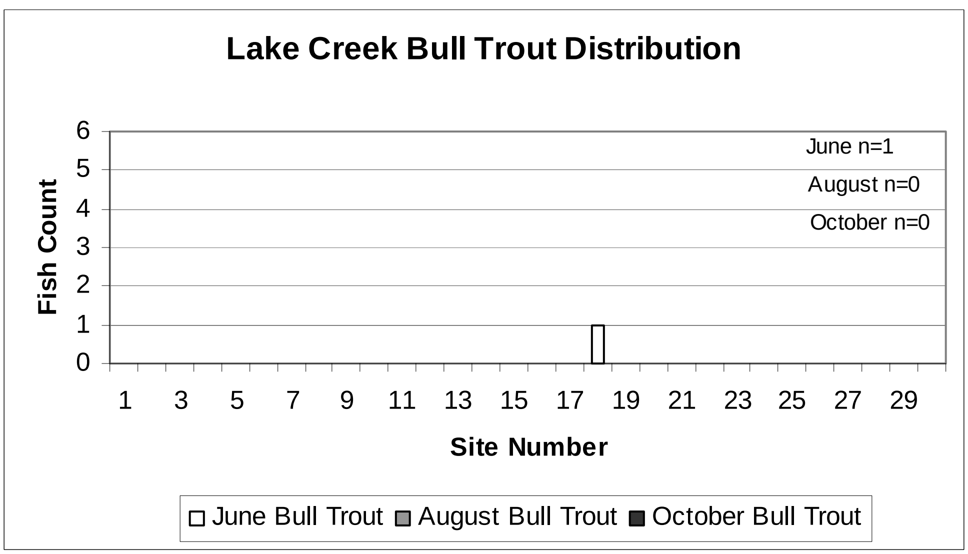


Figure 4-4. Distribution of redband trout for Lake Creek snorkel surveys at the Logan Valley Mitigation site in 2004.

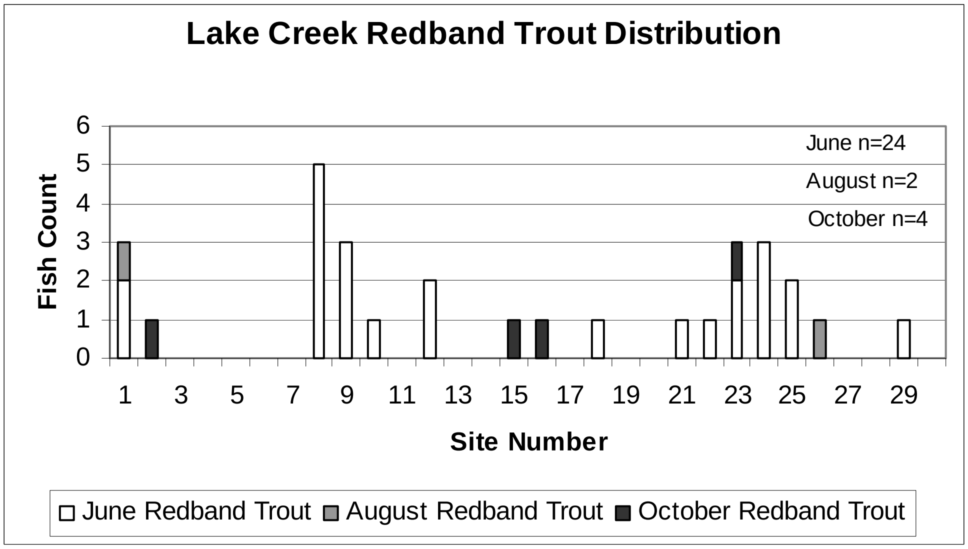


Figure 4-5. Distribution of whitefish for Lake Creek snorkel surveys at the Logan Valley Mitigation site in 2004.

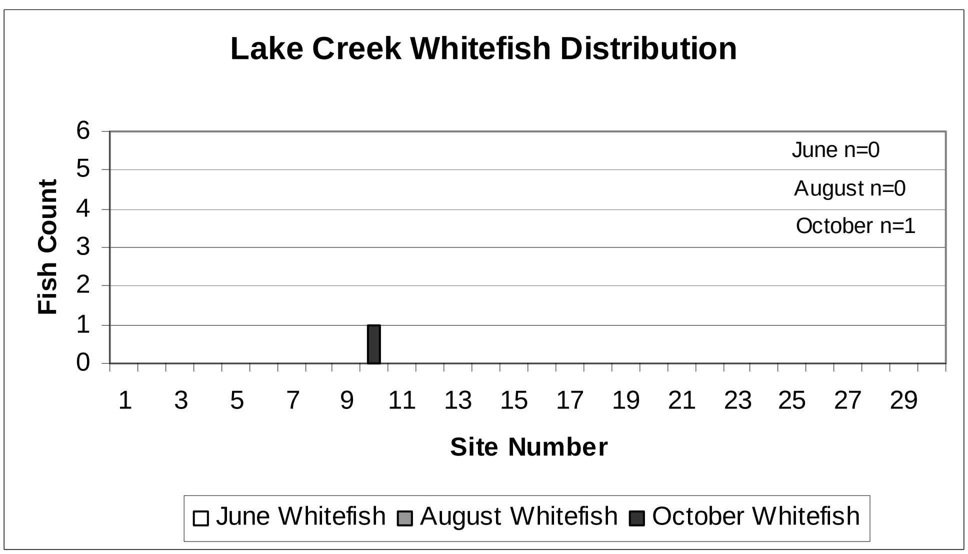


Figure 4-6. Distribution of brook trout for Big Creek snorkel surveys at the Logan Valley Mitigation site in 2004.

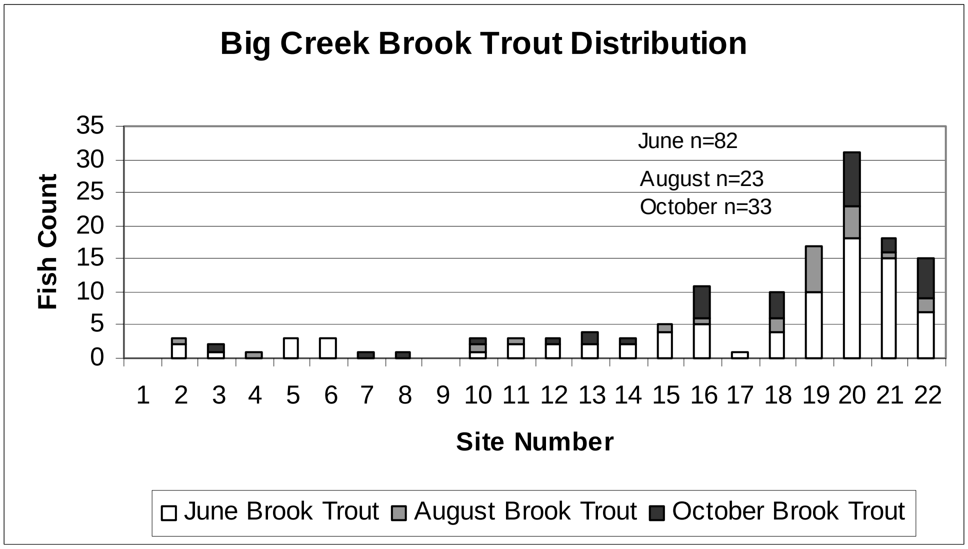


Figure 4-7. Distribution of bull trout for Big Creek snorkel surveys at the Logan Valley Mitigation site in 2004.

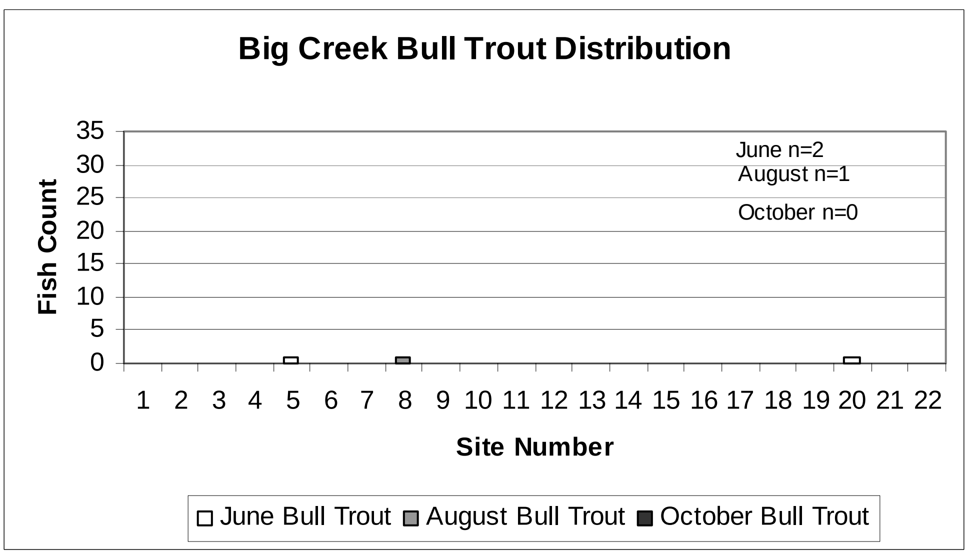


Figure 4-8. Distribution of redband trout for Big Creek snorkel surveys at the Logan Valley Mitigation site in 2004.

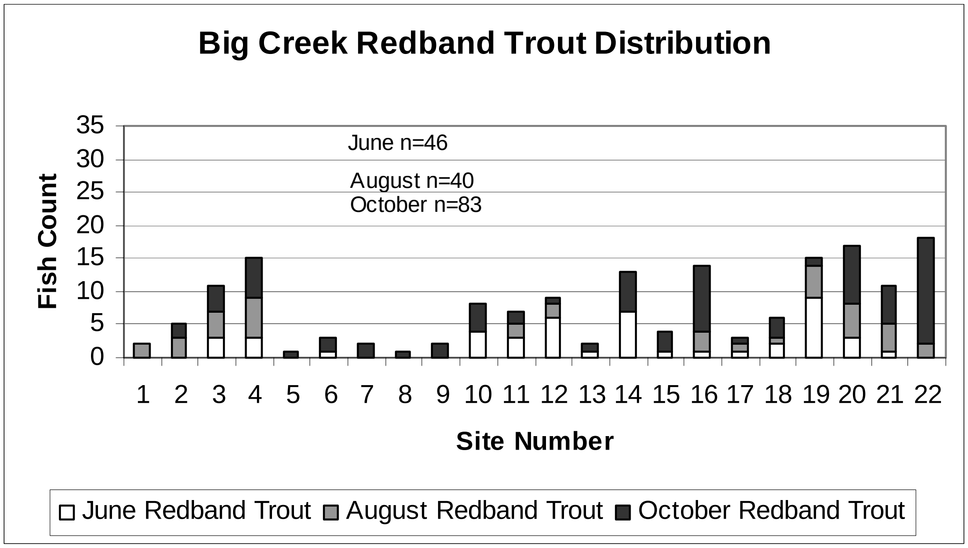
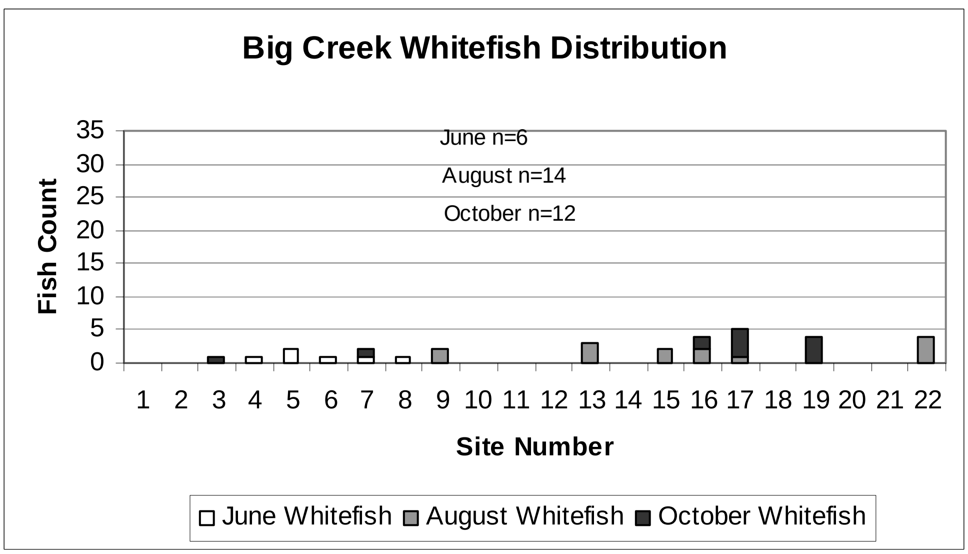


Figure 4-9. Distribution of whitefish for Big Creek snorkel surveys at the Logan Valley Mitigation site in 2004.



Appendix B. Relative Abundance of fish species observed for snorkel surveys of Lake Creek and Big Creek at the Logan Valley Mitigation site in 2004. *There are separate relative abundance graphs for each of the surveys in June, August, and October. Fish species codes: brook trout (BT), bull trout (BUT), Cottids (COT), dace (DACE), redband trout (RB), redside shiner (RSS), sucker (SU), unidentified trout (UNID TR), and whitefish (WF).*

Figure 4-10. Relative abundance of fish species for Lake Creek at the Logan Valley Mitigation site for the June 2004 snorkel survey.

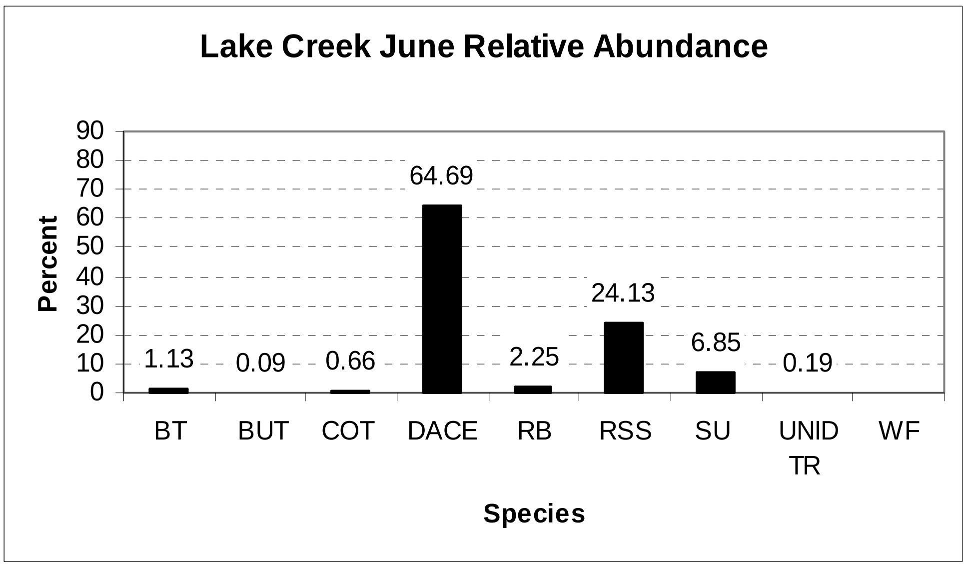


Figure 4-11. Relative abundance of fish species for Lake Creek at the Logan Valley Mitigation site for the August 2004 snorkel survey.

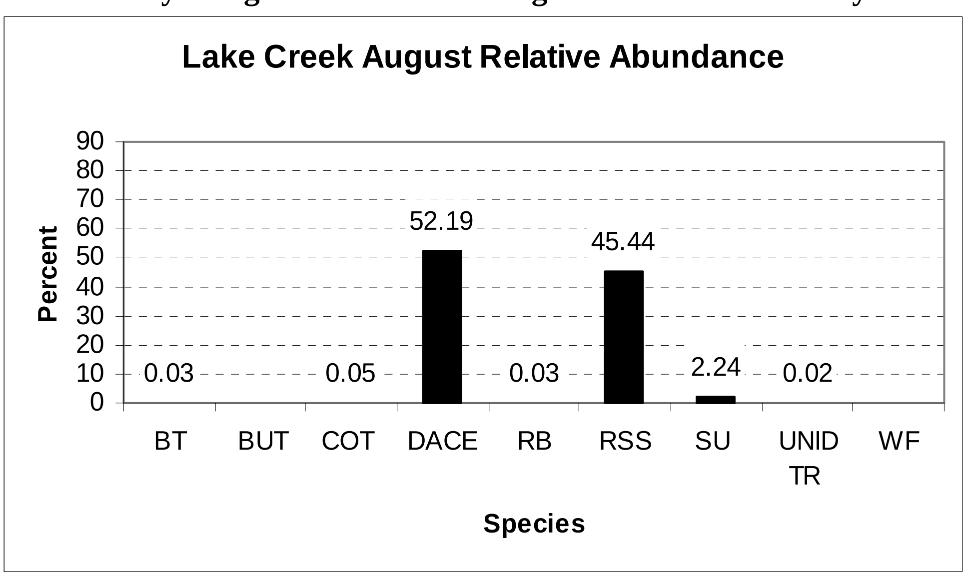


Figure 4-12. Relative abundance of fish species for Lake Creek at the Logan Valley Mitigation site for the October 2004 snorkel survey.

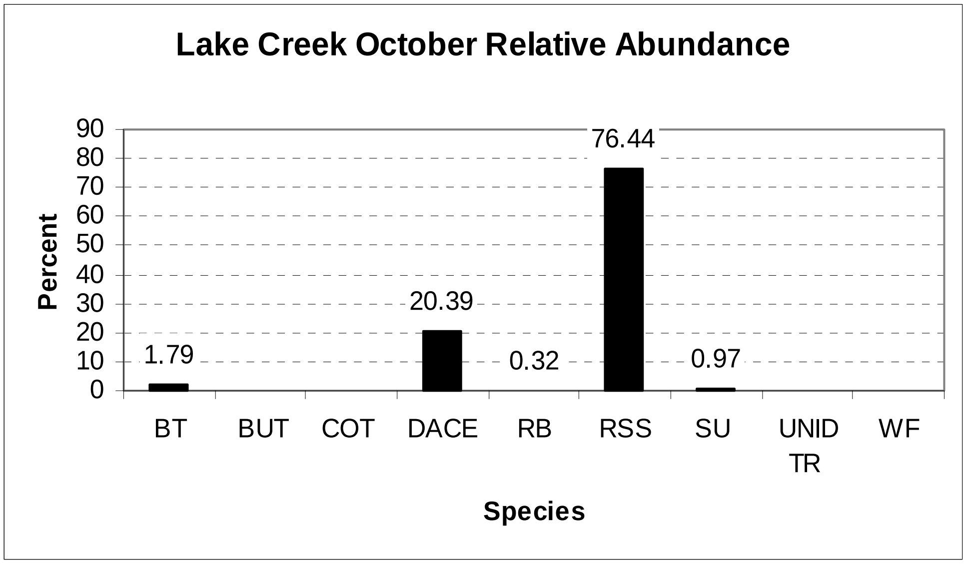


Figure 4-13. Relative abundance of fish species for Big Creek at the Logan Valley Mitigation site for the June 2004 snorkel survey.

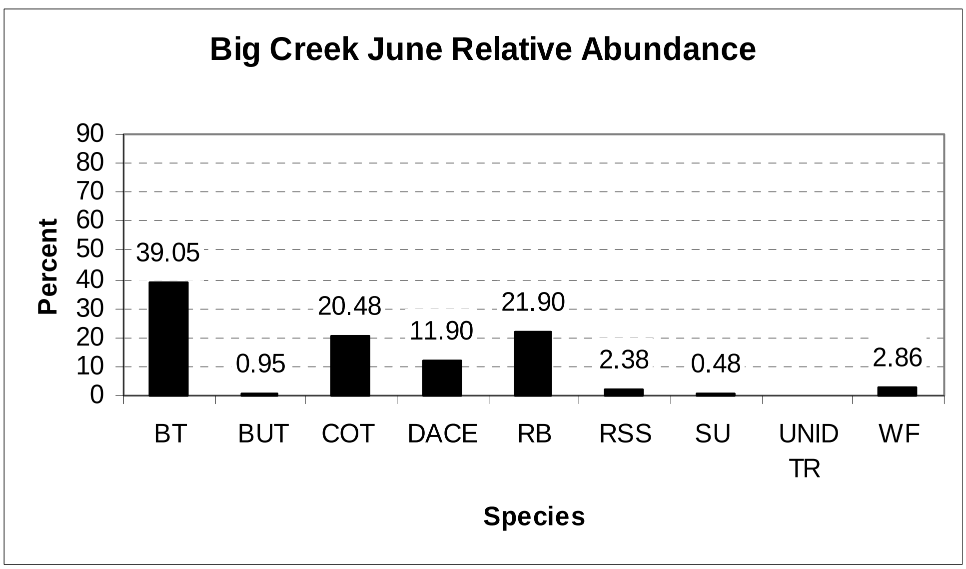


Figure 4-14. Relative abundance of fish species for Big Creek at the Logan Valley Mitigation site for the August 2004 snorkel survey.

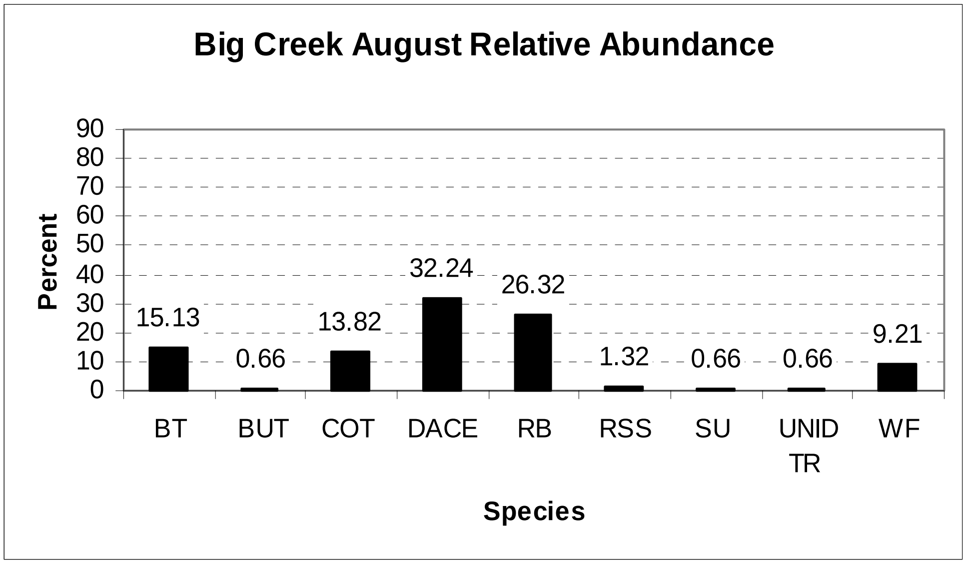
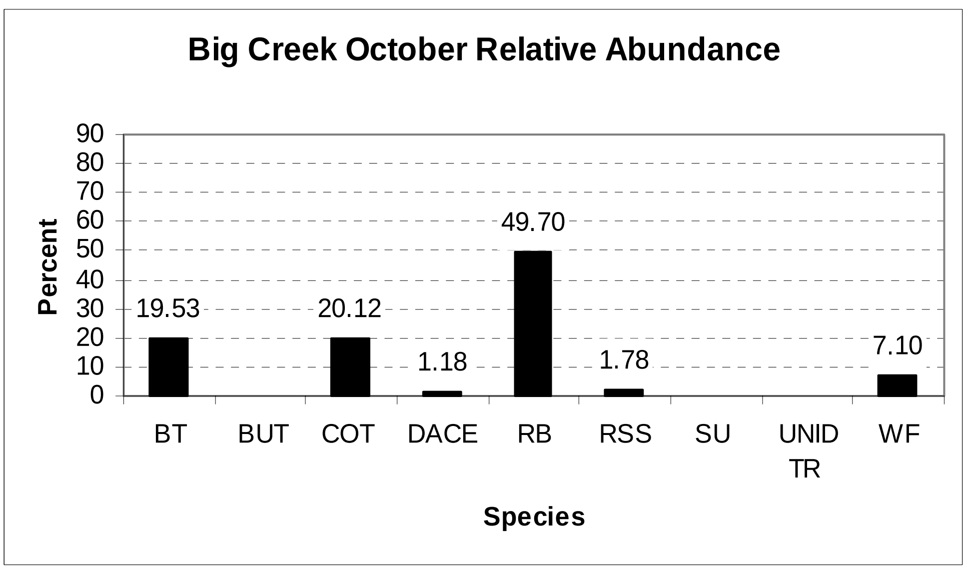


Figure 4-15. Relative abundance of fish species for Big Creek at the Logan Valley Mitigation site for the October 2004 snorkel survey.



Appendix C. Length Frequency of fish species observed for snorkel surveys of Lake Creek and Big Creek at the Logan Valley Mitigation site in 2004.

Figure 4-16. Length frequency of brook trout observed during 2004 snorkel sampling surveys of Lake Creek at the Logan Valley Mitigation site.

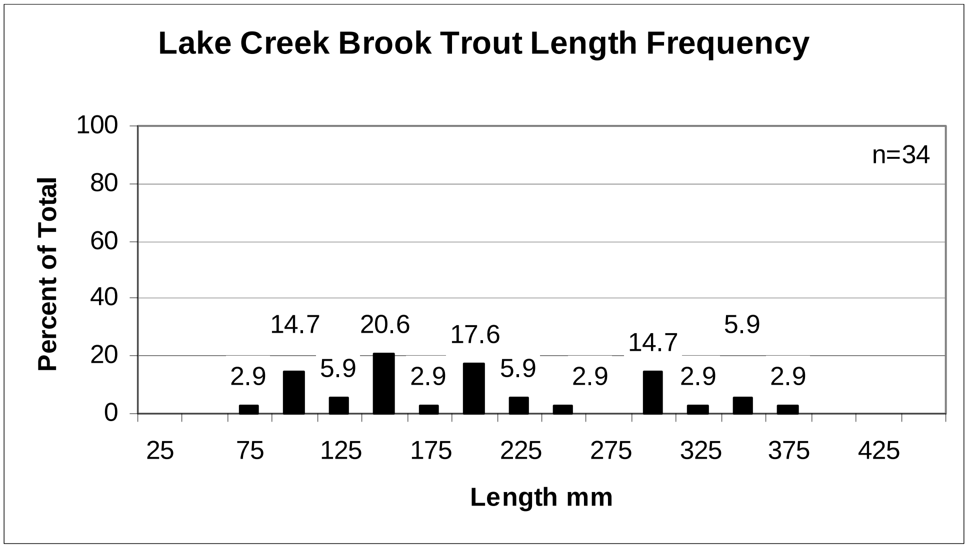


Figure 4-17. Length frequency of redband trout observed during 2004 snorkel sampling surveys of Lake Creek at the Logan Valley Mitigation site.

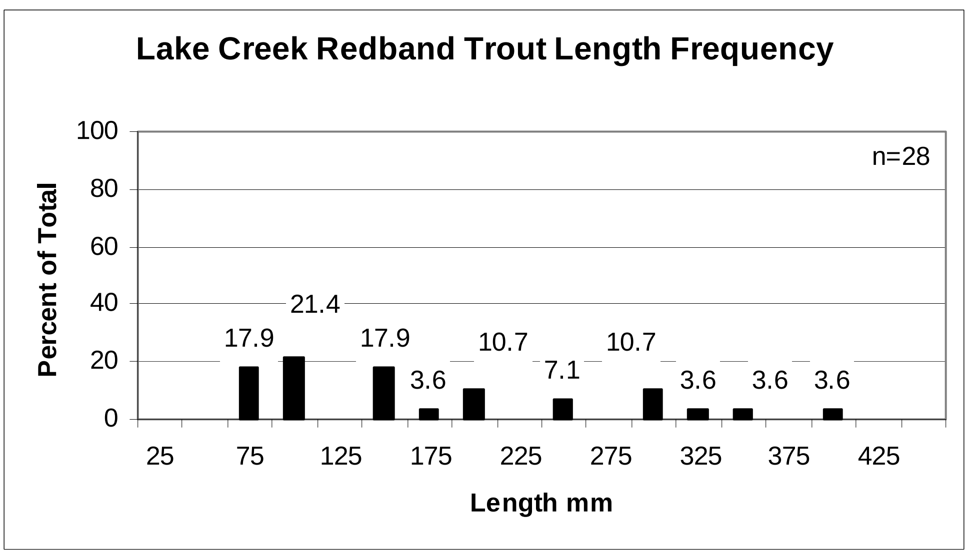


Figure 4-18. Length frequency of brook trout observed during 2004 snorkel sampling surveys of Big Creek at the Logan Valley Mitigation site.

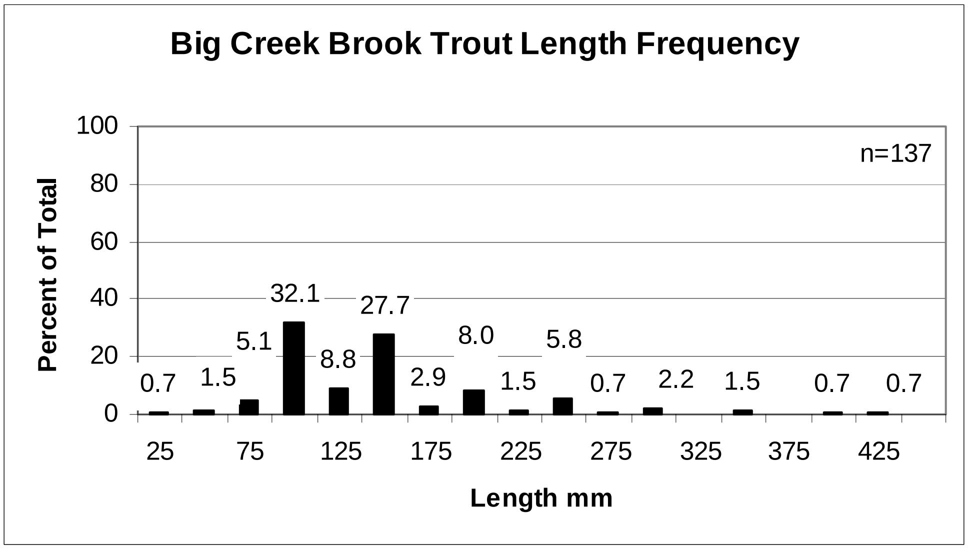


Figure 4-19. Length frequency of bull trout observed during 2004 snorkel sampling surveys of Big Creek at the Logan Valley Mitigation site.

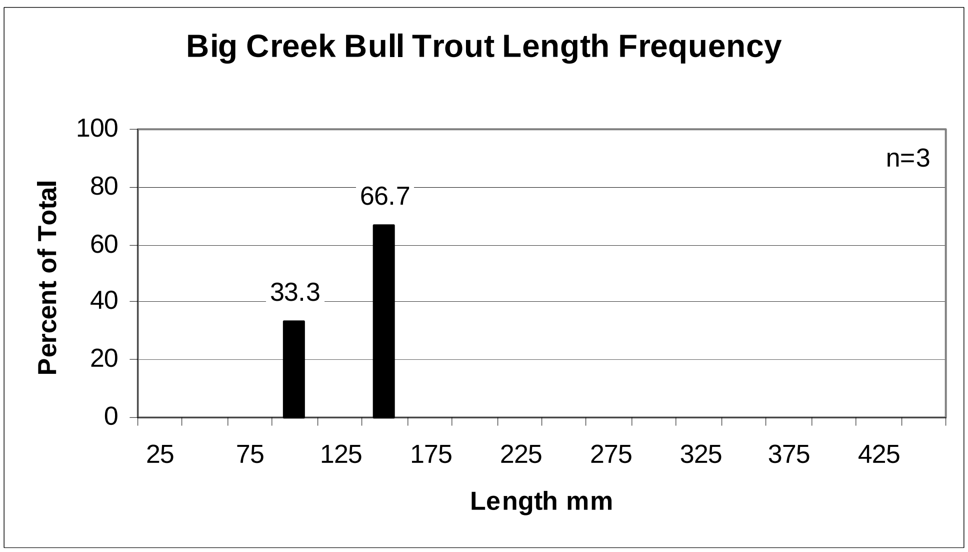


Figure 4-20. Length frequency of redband trout observed during 2004 snorkel sampling surveys of Big Creek at the Logan Valley Mitigation site.

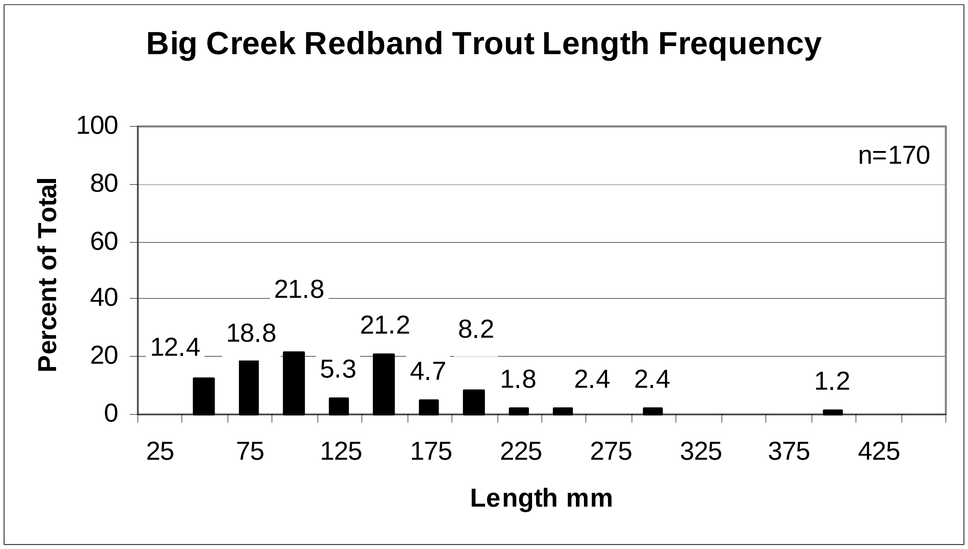
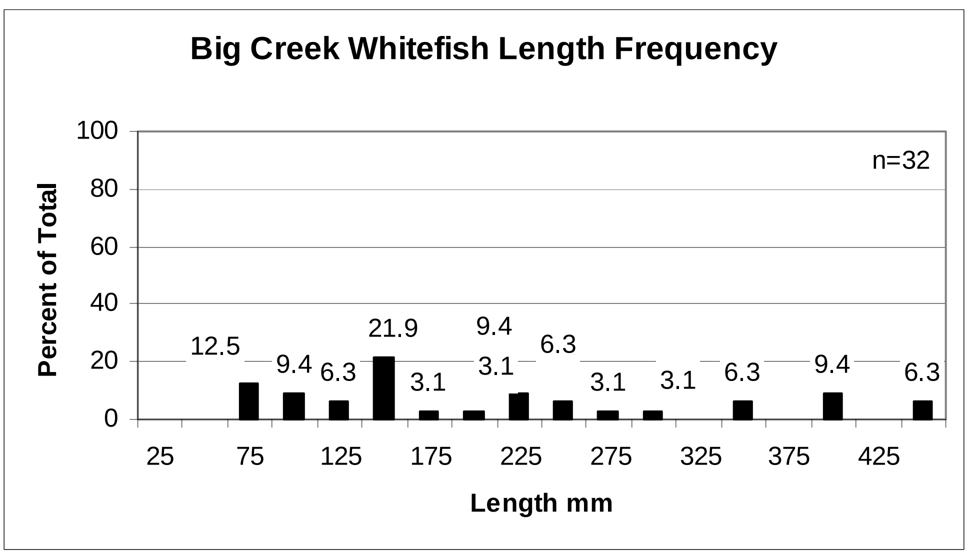


Figure 4-21. Length frequency of whitefish observed during 2004 snorkel sampling surveys of Big Creek at the Logan Valley Mitigation site.



Appendix D. Habitat Graphs for Lake Creek and Big Creek from data recorded during the August snorkel survey at the Logan Valley Mitigation site.

Figure 4-22. Percent of pool per site sampled on Lake Creek in August from snorkel survey at the Logan Valley Mitigation site.

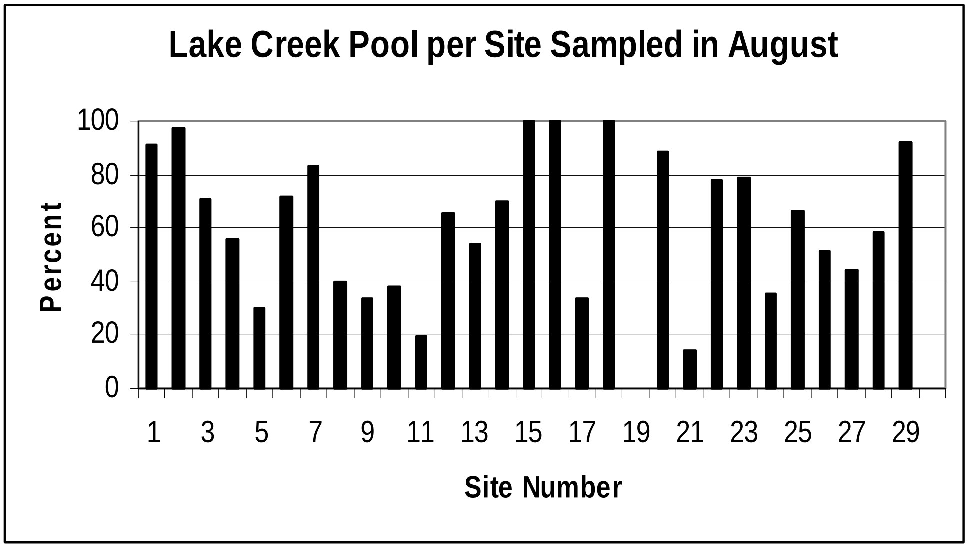


Figure 4-23. Percent of pool per site sampled on Big Creek in August from snorkel survey at the Logan Valley Mitigation site.

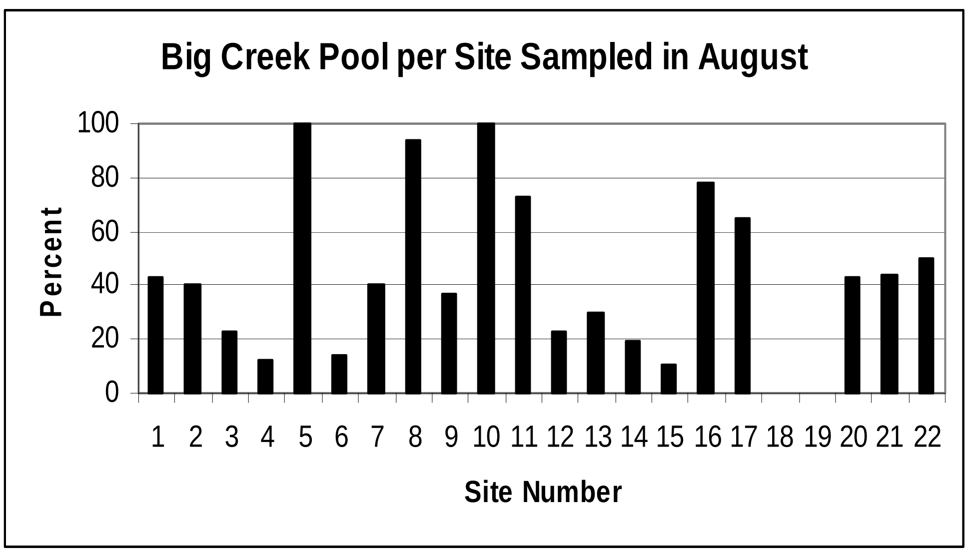


Figure 4-24. Large Woody Debris observed in Lake Creek in August from snorkel survey at the Logan Valley Mitigation site.

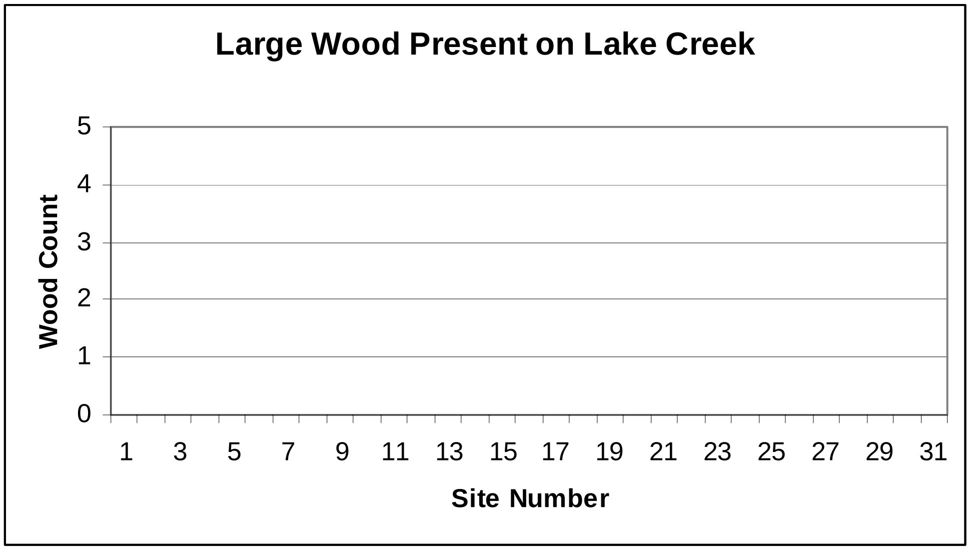


Figure 4-25. Large Woody Debris observed in Big Creek in August from snorkel survey at the Logan Valley Mitigation site.

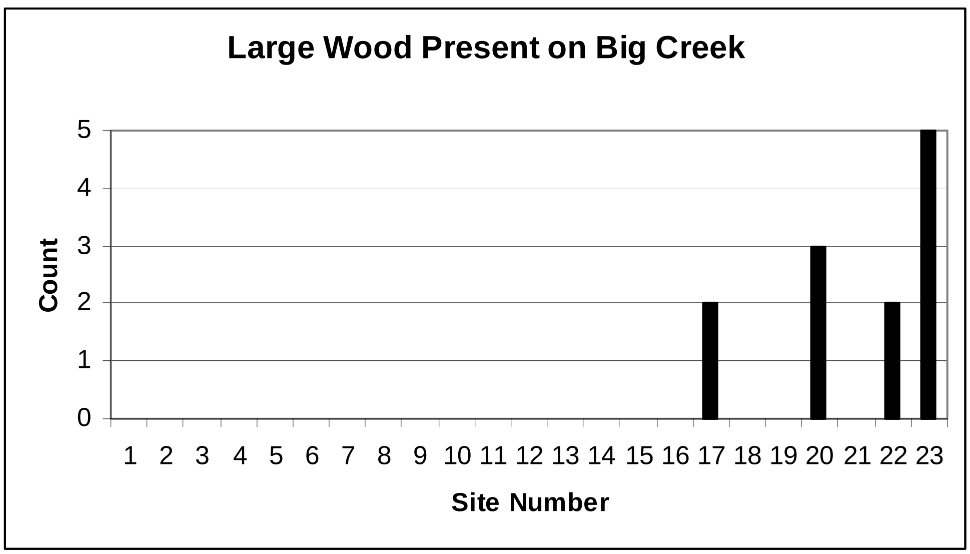


Figure 4-26. Substrate Composition for sampled areas of Lake Creek in August from snorkel survey at the Logan Valley Mitigation site.

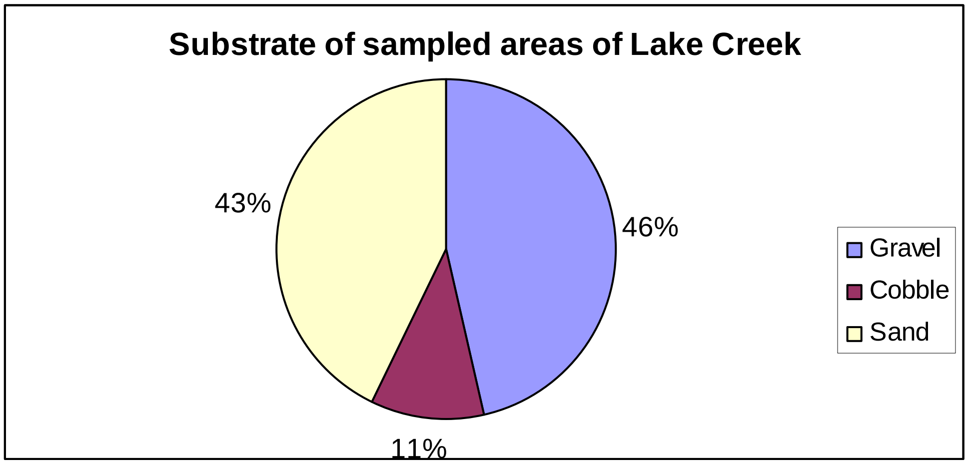
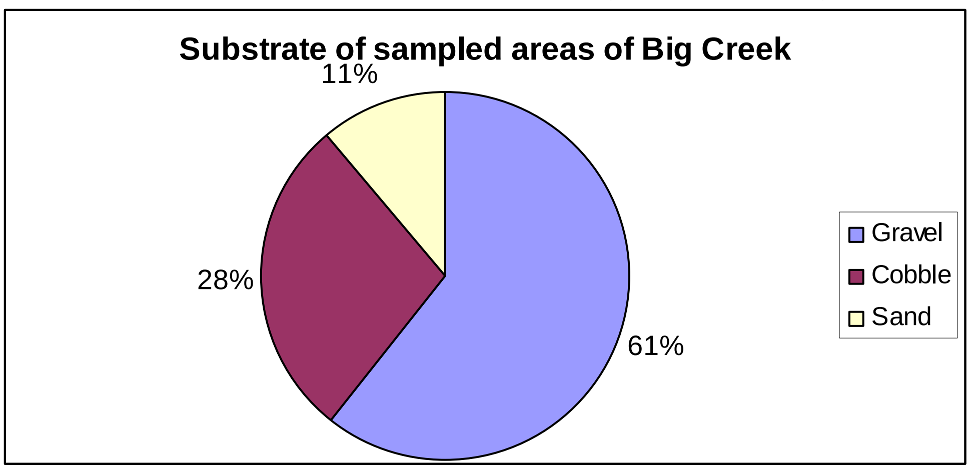


Figure 4-27. Substrate Composition for sampled areas of Big Creek in August from snorkel survey at the Logan Valley Mitigation site.



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Chapter 5 Use of Reservoir Traps and a Weir to Determine the Presence/Absence of Bull Trout in Beulah Reservoir

Author: Jason Fenton, Burns Paiute Tribe Fish and Wildlife Department

Introduction

Beulah Reservoir (North Fork Malheur River) was created in 1935 with the completion of Agency Valley Dam. There is no upstream passage for fish at this facility and has thus cut off the spawning grounds for entrained bull trout *Salvelinus confluentus*. Soon after the 1991 ban on bull trout harvest in the Malheur system, research on the life history and distribution of the North Fork Malheur River bull trout began in 1992 with redd counts (Bowers et al. 1993).

The Burns Paiute Tribe Fish and Wildlife Department (BPFW) in cooperation with the U.S. Bureau of Reclamation and the Oregon Department of Fish and Wildlife have been monitoring bull trout in Beulah Reservoir since 1998, with the exception of 2000 and 2001(Schwabe et al. 1999, 2000, 2003, 2004). Bull trout in the North Fork Malheur River have exhibited adfluvial life history patterns (Gonzalez 1999, Schwabe et al 2000). During low water years, there is no minimum pool left in the reservoir. The effects of this on the North Fork Malheur River bull trout population is not clear (USFWS 2005).

Bull trout have been negatively impacted by past land management activities, construction of dams, and fish eradication projects (poisoning) in the North Fork Malheur River reducing the number of native species in the Malheur River basin (Bowers et al. 1993). Survival of remaining bull trout populations are severely threatened (Buchanan et al. 1997). The North Fork Malheur River bull trout population is currently the largest in the Malheur River Subbasin (Perkins 2002) and is assumed to be the most stable.

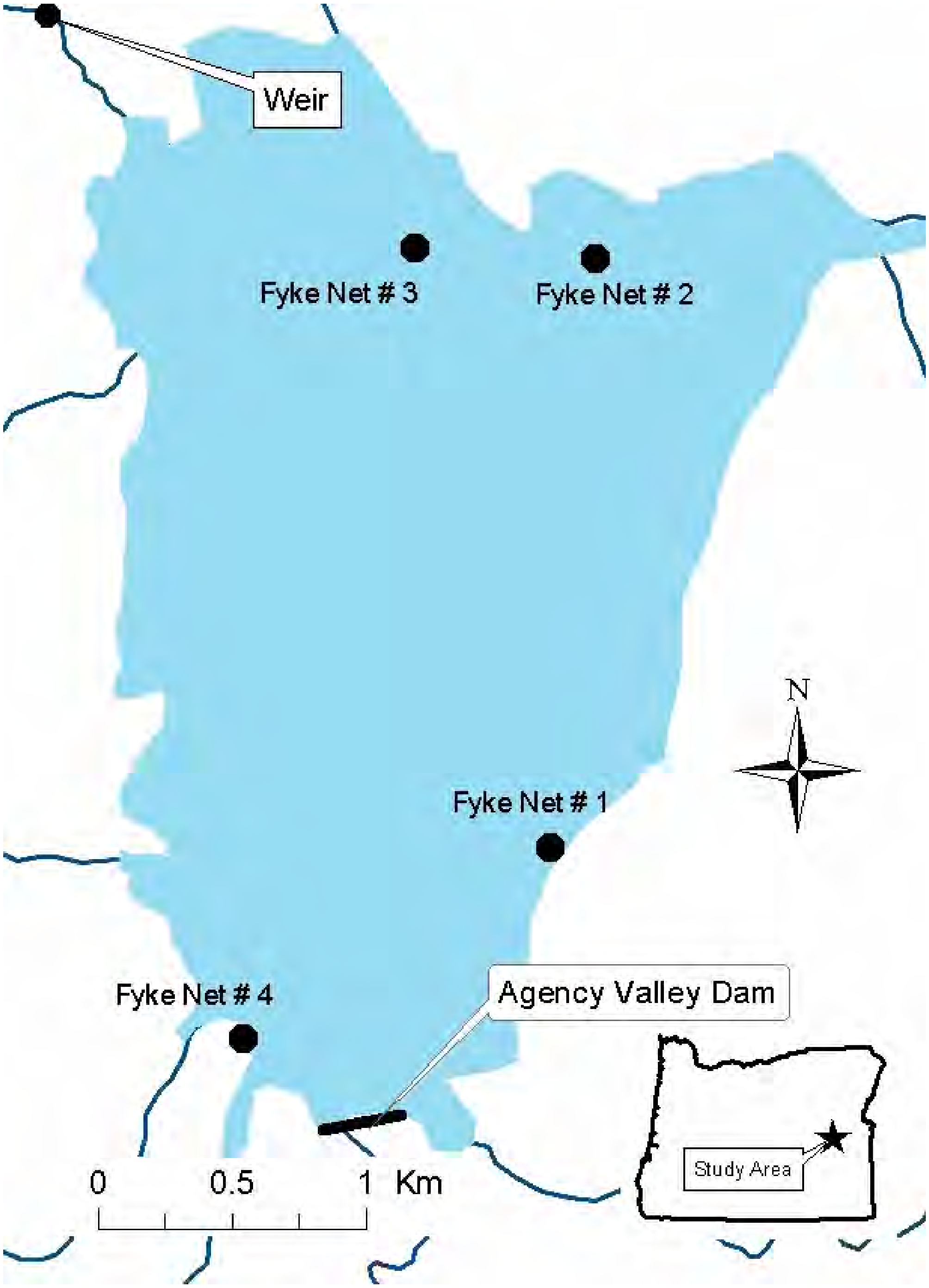
The BPFW has determined that the reservoir is utilized by bull trout in the fall through early spring (Gonzalez 1999, Schwabe et al. 2000). However, little is known about the use of Beulah Reservoir by juvenile bull trout. Currently, there is limited data on juvenile bull trout migratory patterns and adult bull trout during low water years. This data is necessary to improve the understanding of Malheur River subbasin bull trout life history and to provide effective population management. In 2004, research was conducted on bull trout in the North Fork Malheur River at Beulah Reservoir (Figure 1).

The objectives of this study were:

- Determine the seasonal use of Beulah Reservoir by sub adult bull trout.

- Document entrainment of bull trout through Agency Valley Dam.

Figure 1. Study area and Fyke net placement in Beulah Reservoir. North Fork Malheur River, Oregon.



Methods

Fyke Nets
Four Fyke nets with 1/4 inch mesh were placed in Beulah Reservoir to capture bull trout. Fyke nets were deployed on March 30th, 2004 in Beulah Reservoir (Figure 1). The nets in the reservoir fished for a total of 4224 hours. The nets were checked on a daily basis. However, if the weather was too severe for boat travel, the nets were pulled from shore and reset the next day. All fish were held in a bucket with a fish tank aerator until processing was complete. All salmonids and crappie were measured (fork length (fl) mm). All other fish species were tallied. The fish (except crappie) were then released back in the reservoir. Figure one shows the location of the Fyke nets. Due to low water and high algae conditions, the nets were removed on May 13th, 2004

Angling
Angling began on March 18th, 2004 and sporadically continued until April 30th, 2004. BPFW employees angled for a total of 103 hours. BPFW personnel angled below the reservoir in the spillway using various angling methods. Any other anglers that were present when fisheries staff was in the area were creeled to determine what was caught. Data collected during angle surveys included: date, hours fished, the number of fish, and species. If a bull trout was captured it was measured (fl mm), weighed (g), and placed in a bucket of water with an air bubbler to be released above the dam in Beulah Reservoir.

Weir
The weir was installed on October 4th, 2004 at river kilometer (RK) 33 approximately one kilometer upstream from Beulah Reservoir pool (Figure 1). The weir was in place for 1080 hours. The weir trap, designed to span a width slightly larger than the wetted channel, was installed at a slight angle across the North Fork Malheur River. The structure used ¾ inch diameter conduit with ¼ inch spaces between the rods. Steel rods anchored in to the stream bed helped stabilize the weir. Sand bags were placed along the base of the weir on the upstream side to prevent scouring of the streambed and associated banks. Sandbags were filled with instream gravels collected upstream of the weir site to avoid the introduction of excess sediments. Upstream and downstream trap boxes were placed near opposite stream banks and interlocked into the weir panels. The traps were checked at least once a day. All fish caught in the upstream trap were released upstream; fish caught in the downstream trap were released downstream. All salmonids were measured (fl mm) and released. All other species of fish were tallied and then released. Due to cold weather the weir iced up and blew out on November 20th, 2004.

Snorkel and Angling above Beulah

Snorkeling was included midway through the study to determine if bull trout were holding behind the weir. Snorkeling was commenced on November 16th, 2004 after daylight hours. Three personnel snorkeled downstream towards the weir starting 500 meters upstream. Each snorkeler used a flashlight to illuminate the area. One person on the bank recorded what was observed. As close to 100% of the wetted channel as possible was sampled. The sample ended at the weir.

Angling began on November 2nd, 2004 and ended on November 13th, 2004 with a total of 6.5 hours. Personnel angled up to 500 meters upstream of the weir to determine if any bull trout were present.

Results

Fyke Nets

Fish species that were captured in the Reservoir in 2004 included: redband trout *Orcorhynchus mykiss*, mountain whitefish *Prosopium williamsoni*, speckled dace *Rhinichthys osculus*, long nose dace *Rhinichthys cataractae*, red side shiner *Richardsonius balteatus*, northern pikeminnow *Ptychocheilus oregonensis*, large scale sucker *Catostomus macrocheilus*, bridgelip sucker *Catostomus columbianus*, sculpin *Cottus spp*, and white crappie *Pomoxis annularis* (Table 1)(Appendix B).

Redband trout caught in the nets ranged from 67mm to 457mm (fl). Average length was 176mm (Table 1). Daily and cumulative totals for redband trout captures along with reservoir levels are included in appendix A. Four white crappie were caught in the Fyke nets. These fish measured 120mm, 125mm, 155mm, and 165mm. No bull trout were captured in the Fyke nets in Beulah Reservoir in 2004. (Table 1)

Angling

Species caught include: redband trout, northern pikeminnow, large scale sucker, bridgelip sucker, chiselmouth *Acrocheilus alutaceus*, and one catfish *Ictaluridae spp*. No bull trout were angled below the dam in 2004. (Table 1)(Appendix B).

Weir

No bull trout were captured in the weir at Beulah Reservoir in 2004. Fish species that were captured in the weir include: redband trout, mountain whitefish, northern pike minnow, bridgelip sucker, long nose dace, speckled dace and red side shiner. One long nose dace was captured in the upstream trap, all other fish captured in the weir were in the downstream trap (Table 1). Due to very cold weather conditions, the weir froze and blew out due to ice build up on November 18th, 2004.

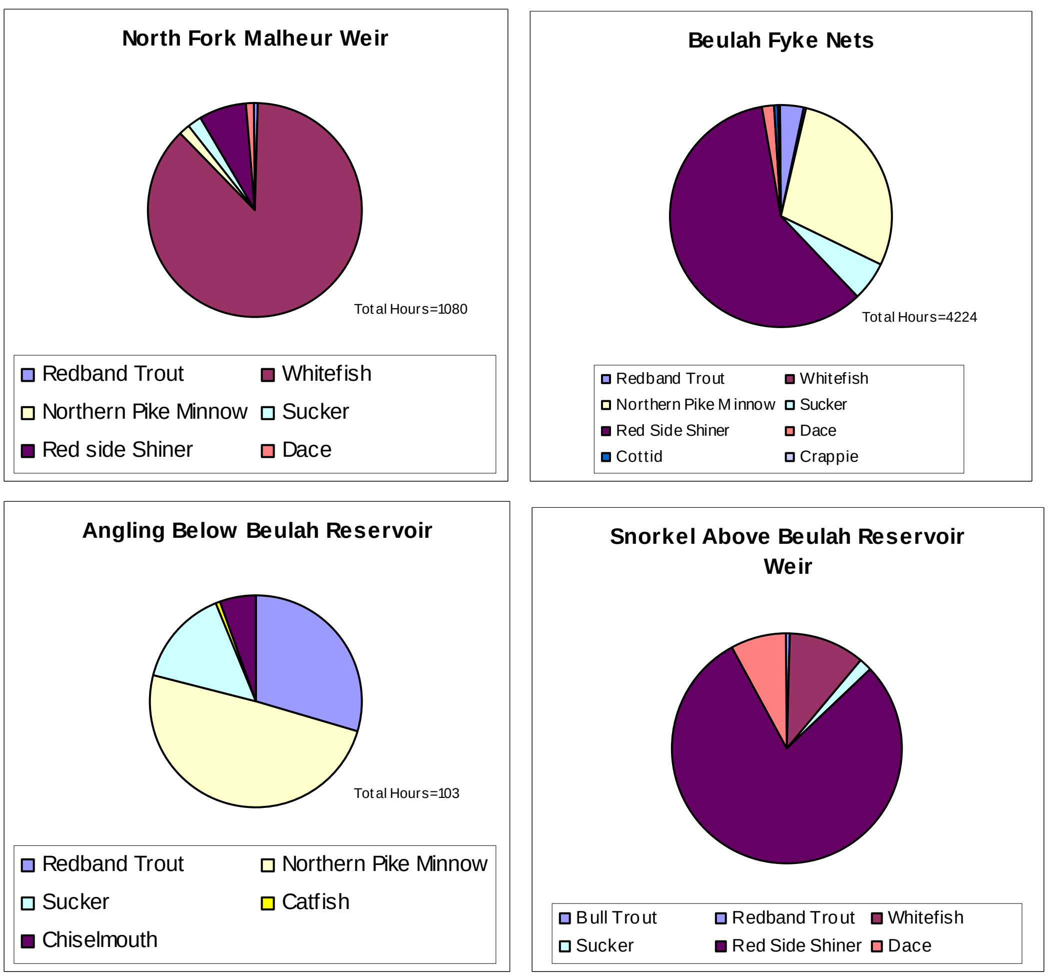
Snorkel and Angling above Beulah

One bull trout was observed above the weir while snorkeling in between RK 33 and 34. Other species counted include: redband trout, mountain whitefish, sucker, dace, and red side shiner (Table 1). Thirty-seven redband trout were captured while angling above the weir between RK 33 and 34. No other species were captured via angling.

Table 1. Species and quantities of fish observed in the North Fork Malheur River, Oregon. 2004.

Species	Fyke Nets in Beulah Reservoir	Weir Above Beulah Reservoir	Angling Below Agency Valley Dam	Snorkel Above Beulah Weir
Bull Trout	0	0	0	1
Redband Trout	78	2	49	3
Mountain Whitefish	5	361	0	84
Northern Pikeminnow	611	7	82	0
Sucker	126	10	25	12
Dace	40	5	0	59
Sculpin	12	0	0	0
Crappie	4	0	0	0
Catfish	0	0	1	0
Chiselmouth	0	0	9	0
Red Side Shiner	1278	29	0	607

Figure 2. Relative abundance of observed fish in the North Fork Malheur River and Beulah Reservoir. 2004



Discussion

One bull trout was observed while snorkeling in the North Fork Malheur River above the Weir. The river is about ten meters wide and in some places one and a half meters deep. Water clarity was poor the night that the river was snorkeled. It is possible that the bull trout observed was not identified properly, since only one person saw the bull trout. The purpose of the snorkeling and angling above the weir was to determine if bull trout were holding behind the weir and not proceeding into the reservoir. Previous studies showed that the bull trout sometimes tend to hold and then proceed downstream when the weir is removed (Schwabe et al. 2002). When the sampling efforts were completed we were satisfied that we were not holding bull trout behind the weir.

No bull trout were captured using the previously described methods during 2004.
In past studies bull trout have been captured in the reservoir using Fyke nets (Gonzalez 1999, Schwabe et al 2000, 2003). It is interesting to note that when the reservoir levels are run of river in the fall, the bull trout count is also zero for the Fyke nets in the following spring (Table 2). This may indicate that the reservoir levels directly impact the population of the adfluvial bull trout in the North Fork Malheur River.

No bull trout were captured in the weir above Beulah Reservoir. The BPFW expected to capture bull trout returning to the reservoir in the fall as had been documented in previous studies (Gonzalez 1999, Schwabe et al 2000). Previous studies have documented that adult bull trout migrate back into the reservoir in October, however for the past two years there have been no bull trout caught in the weir during the fall in the North Fork Malheur River. With the reservoir lowered to zero acre feet, there may be no food base for the bull trout to sustain the population. When the reservoir is drawn down to little or no minimum pool there is an effect on water quality such as higher temperatures (Peterson 2001) and in result a negative effect on the preyfish that reside in the reservoir year round. However, in 2004 the Fyke nets caught more red side shiner than the previous two years with less effort (Table 3). It is unknown just how many preyfish are needed to sustain a population of bull trout in the reservoir in the fall and winter months. It is possible that the bull trout return to find little suitable prey species available to sustain the population and return upriver.

Table 2. Number of bull trout captured in relation to water levels in Beulah Reservoir the previous year. North Fork Malheur River, Oregon.

Year	# Bull Trout Captured	Date Nets Set	Date Nets Removed	# of nets Used	Lowest Reservoir Level (Acre Feet)	Earliest Date of Lowest Level	# of redds observed*
1997	NA	NA	NA	0	22882	10-07-97	64
1998	33	March 30	April 27	6	24498	10-15-98	74
1999	19	March 29	May 4	6	21120	10-17-99	115
2000	NA	NA	NA	0	10582	10-08-00	153
2001	NA	NA	NA	0	2003	10-01-01	125
2002	3	March 29	May 16	6	0	8-10-02	99

2003	0	March 23	May 16	6	0	8-10-03	63
2004	0	March 29	May 13	4	NA	NA	64

* Redds counted from: North Fork Malheur, Horseshoe Creek, Swamp Creek, Sheep Creek, Elk Creek, and Little Crane Creek.

Table 3. Trap hours and number of red side shiners captured in Beulah Reservoir.

Year	2002	2003	2004
Fyke Net Trap Hours	5888	7632	4224
Red Sided Shiners Captured	359	509	1278

The BPFW has documented adult bull trout migrating out of the reservoir in May and returning late October through December (Gonzalez 1999, Schwabe et al 2000). The effects of the current drought and low water in the reservoir are not fully understood. It could be possible that the bull trout return to the reservoir even later than November during low water years. However, unless the bull trout leave earlier in the spring than what has been documented in the past, we should have captured some in the spring with the Fyke nets. Preliminary data suggests that when the water levels are low the number of bull trout in the reservoir is reduced the following spring. Redd counts for the North Fork Malheur River also drop when the reservoir lowers to zero acre feet (Perkins 2005)(Table **2**). With the lack of bull trout captured in the reservoir it might be suspected that there would be a direct impact on the spawning population. However, in 2003 and 2004 there was a 100% reduction of bull trout caught in the reservoir as compared to previous years but the redd counts only dropped by less than 50%. This would indicate that during low flow years, winter distribution may change and bull trout tend to stay in the river above the reservoir. Without the push of higher water the migratory bull trout might not return to Beulah reservoir in the fall.

Unscreened diversions may also contribute to the lack of bull trout in Beulah Reservoir. There are a few irrigation ditches upstream of Beulah Reservoir that may not have fish screens in place. With less water in the stream, an unscreened diversion may entrain more bull trout. More research needs to be conducted to find out what obstacles bull trout might be encountering on the return trip to the reservoir.

The presence of crappie in the reservoir may impact bull trout. Introduced species could have long term negative effects on the indigenous populations such as bull trout. It is unknown just what the presence of crappie in the reservoir will do to effect the bull trout population. When the reservoir was drained in 2002, local biologists were hopeful that the crappie population would be eradicated (USFWS 2005). With the presence of crappie this year it is obvious that the population is still present and may pose a risk to bull trout populations.

No bull trout were collected while angling in the tailrace below the dam. This may be a result of low numbers of bull trout in the reservoir. The BPFW has conducted angling surveys since 1999 and have observed no bull trout below the reservoir from 2001 to present. Although this may be a result of different water release practices, another influencing factor may be a decreased presence of bull trout in the reservoir. Entrainment was documented over the spillway during a good water year (1999) with high inflow volumes and high reservoir levels. (Schwabe et al. 2000) Entrainment of bull trout through the water valves during low volume inflow years and low reservoir levels has not been determined. It is suspected that other species of fish were entrained through the dam.

Recommendations

Monitoring during various water years should be conducted to determine the effects of water release practices on entrainment. Conducting studies on a more stable fish population present in the reservoir such as rainbow/redband trout may provide better insight into when and at what reservoir levels the risk of fish entrainment is through the water valves.

There is a need to continue the research on bull trout in the North Fork Malheur River. The zero catch rate of bull trout in Beulah Reservoir may have been influenced by regional drought conditions. Future monitoring of bull trout populations during below average water years is recommended and will provide local agencies with critical information and knowledge for fish and land management decisions.

Acknowledgments

A special thanks to the Bonneville Power Administration and the Bureau of Reclamation who funded this project for the Burns Paiute Tribe Fish and Wildlife Department. We would also like to thank Eric Hawley, Garret Sam, Kevin Fenn, Jason Fenton, and Lawrence Schwabe for the countless hours that each individual spent in the field checking traps and all other field work contributed to the project.

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Appendix A. Water levels and catches of fish in the North Fork Malheur River. 2004

Table 4. Beulah Reservoir levels and daily catches of redband trout and mountain whitefish in fyke nets. North Fork Malheur River, Oregon. 2004.

Date	Reservoir Level Acre Feet	Redband		White Fish	
		Daily	Cumulative	Daily	Cumulative
3/30	39697.09	6	6	3	3
3/31	40528.47	0	6	0	3
4/1	41276.63	8	14	0	3
4/2	41948.57	17	31	0	3
4/3	42649.98	0	31	0	3
4/4	42952.66	1	32	0	3
4/5	43673.78	0	32	0	3
4/6	44590.66	9	41	0	3
4/7	46370.40	0	41	0	3
4/8	47247.88	2	43	1	4
4/9	48068.54	0	43	0	4
4/10	48878.64	4	47	0	4
4/11	49611.19	0	47	0	4
4/12	50153.90	0	47	0	4
4/13	50624.46	0	47	0	4
4/14	51075.95	3	50	0	4
4/15	51457.49	0	50	0	4
4/16	51718.21	1	51	0	4
4/17	51926.02	0	51	0	4
4/18	52088.56	2	53	0	4
4/19	52104.82	0	53	0	4
4/20	52052.80	1	54	0	4
4/21	51961.77	0	54	0	4
4/22	51788.15	0	54	0	4
4/23	51562.41	5	59	0	4
4/24	51317.59	0	59	0	4
4/25	51040.97	1	60	1	5
4/26	50780.26	0	60	0	5
4/27	50573.59	0	60	0	5
4/28	50312.87	0	60	0	5
4/29	50069.42	0	60	0	5
4/30	49763.93	2	62	0	5
5/1	49455.33	2	64	0	5
5/2	49149.84	0	64	0	5
5/3	48878.64	0	64	0	5
5/4	48623.03	0	64	0	5
5/5	48402.32	0	64	0	5
5/6	48166.53	0	64	0	5
5/7	47933.80	1	65	0	5

5/8	47698.02	0	65	0	5
5/9	47465.30	3	68	0	5
5/10	47263.20	0	68	0	5
5/11	47079.46	1	69	0	5
5/12	46846.74	0	69	0	5
5/13	46599.99	9	78	0	5

Table 5. Average daily temperature and flows for the North Fork Malheur River above Beulah Reservoir. Daily catches of redband trout and mountain whitefish in the weir in the North Fork Malheur River, Oregon. 2004

	Ave. Daily			Redband		Whitefish	
Date	Flow (cfs)	Min. (°F)	Max. (°F)	Daily	Cumulative	Daily	Cumulative
10/5	39.68	50.50	61.60	0	0	0	0
10/6	39.94	51.40	61.90	0	0	0	0
10/7	40.49	55.50	64.80	0	0	0	0
10/8	40.67	53.10	63.10	0	0	2	2
10/9	40.25	54.30	60.90	0	0	1	3
10/10	45.10	47.70	57.10	0	0	1	4
10/11	43.76	45.80	56.10	0	0	26	30
10/12	41.63	46.20	58.00	0	0	6	36
10/13	41.84	48.30	58.60	0	0	19	55
10/14	41.74	47.80	58.80	0	0	10	65
10/15	41.39	48.40	58.60	0	0	6	71
10/16	41.27	48.20	58.00	0	0	0	71
10/17	42.86	50.30	54.10	0	0	2	73
10/18	47.51	46.50	51.40	0	0	3	76
10/19	48.58	44.60	47.90	0	0	12	88
10/20	55.75	44.70	49.50	1	1	21	109
10/21	56.06	44.50	50.70	0	1	6	115
10/22	51.32	43.80	47.70	0	1	0	115
10/23	55.74	45.90	48.90	0	1	3	118
10/24	53.60	41.50	46.60	0	1	5	123
10/25	48.73	38.80	46.30	0	1	5	128
10/26	52.64	42.80	44.50	0	1	1	129
10/27	58.00	42.90	47.30	0	1	3	132
10/28	60.47	45.70	47.50	0	1	3	135
10/29	56.13	45.50	49.50	0	1	8	143
10/30	50.70	43.40	49.00	0	1	7	150
10/31	48.23	40.10	46.30	0	1	4	154
11/1	43.35	35.90	43.50	0	1	3	157
11/2	50.06	39.20	45.90	0	1	1	158
11/3	50.48	41.20	45.90	0	1	19	177
11/4	46.46	37.30	44.70	0	1	19	196
11/5	47.23	36.80	44.70	0	1	3	199
11/6	45.60	36.60	44.50	0	1	1	200

11/7	46.26	36.70	44.80	0	1	3	203
11/8	46.36	37.30	45.20	0	1	0	203
11/9	46.07	41.10	47.50	0	1	8	211
11/10	47.14	43.00	46.70	0	1	11	222
11/11	52.55	45.90	48.60	0	1	32	254
11/12	54.82	42.90	47.20	0	1	47	301
11/13	50.15	43.80	47.60	0	1	13	314
11/14	48.49	44.30	48.40	0	1	4	318
11/15	47.53	42.20	46.40	0	1	1	319
11/16	47.85	44.70	48.60	1	2	16	335
11/17	47.29	43.60	45.10	0	2	13	348
11/18	46.54	39.10	43.70	0	2	13	361
11/19	44.15	34.70	39.50	0	2	0	361
11/20	38.01	34.10	37.00	0	2	0	361

Appendix B. Species of fish caught in the North Fork Malheur River. 2004

Figure 3. Number and Species of fish caught in the Weir. North Fork Malheur River, Oregon.

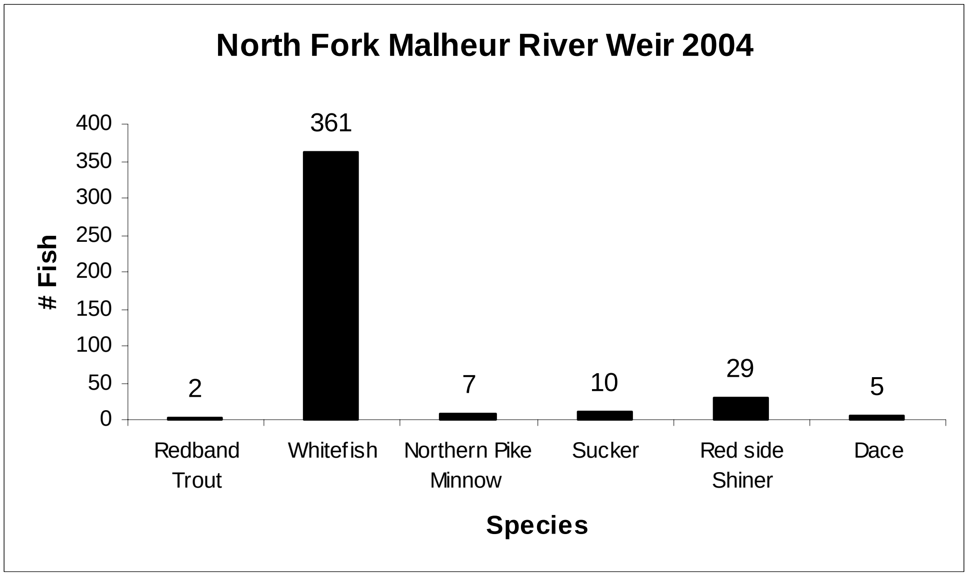


Figure 4. Number and Species of fish caught in the Fyke nets. North Fork Malheur River, Oregon.

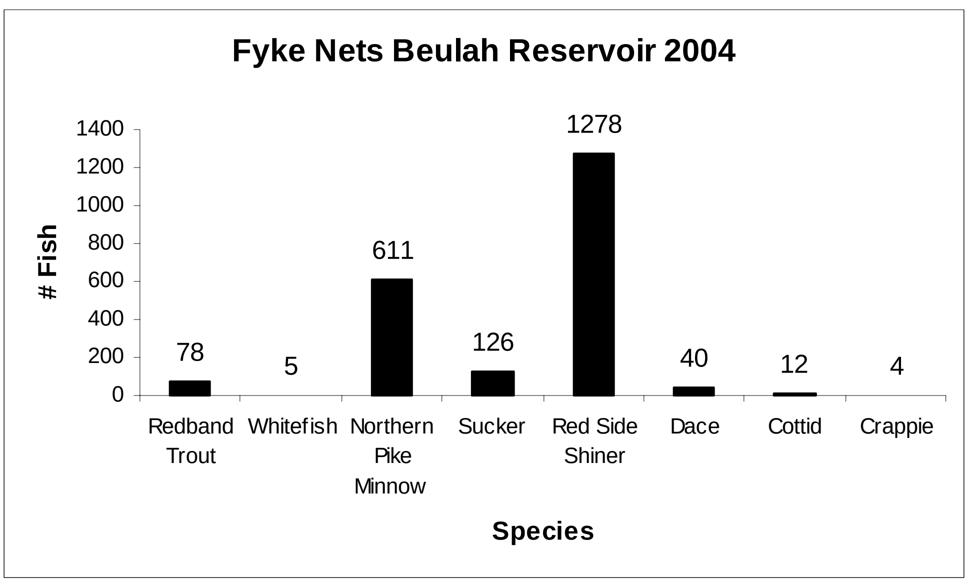


Figure 5. Redband trout caught in the Weir. North Fork Malheur River, Oregon.

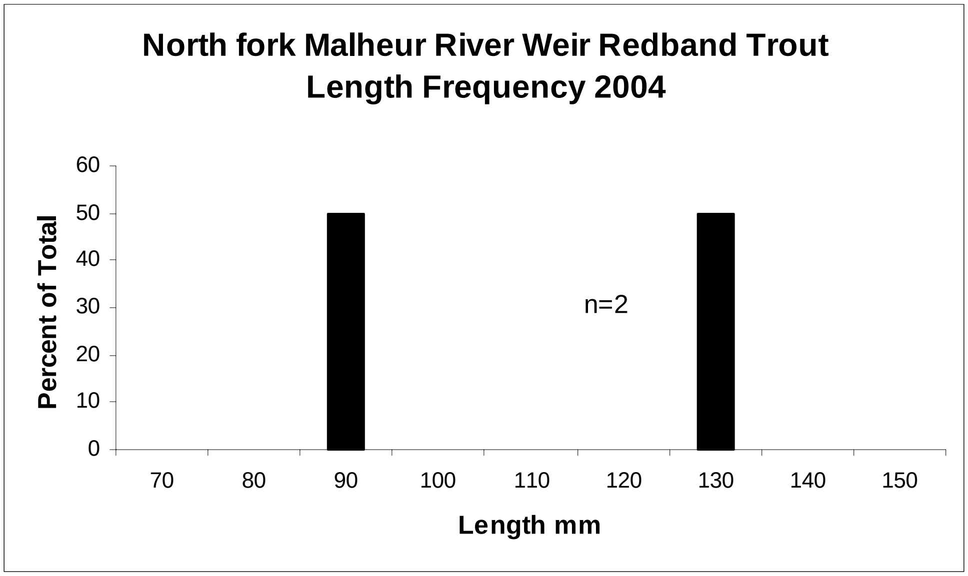


Figure 6. Mountain whitefish caught in the Weir. North Fork Malheur River, Oregon.

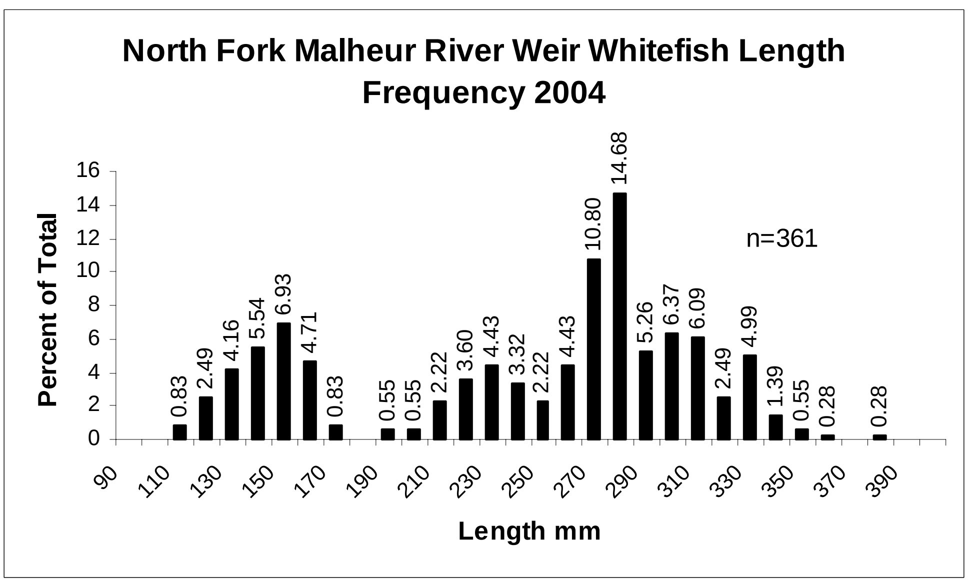


Figure 7. Redband trout caught in the Fyke nets. North Fork Malheur River, Oregon.

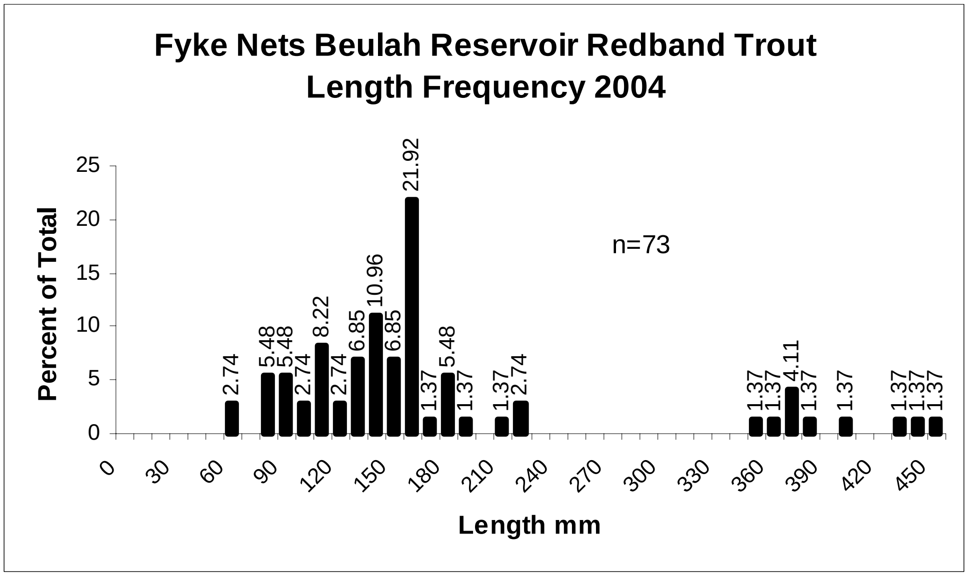


Figure 8. Mountain whitefish caught in the Fyke nets. North Fork Malheur River, Oregon.

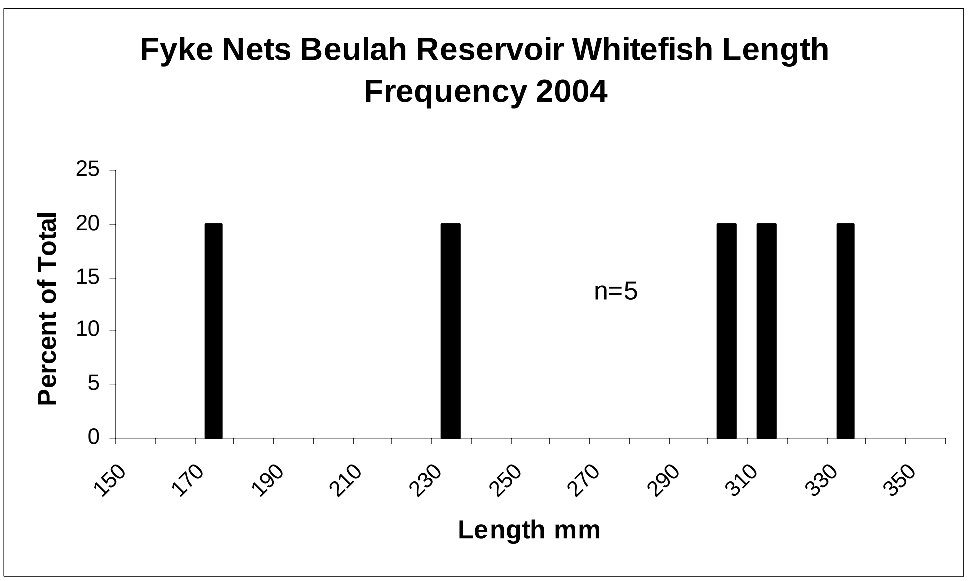


Figure 9. Daily catch of redband trout in the Fyke nets. North Fork Malheur River, Oregon.

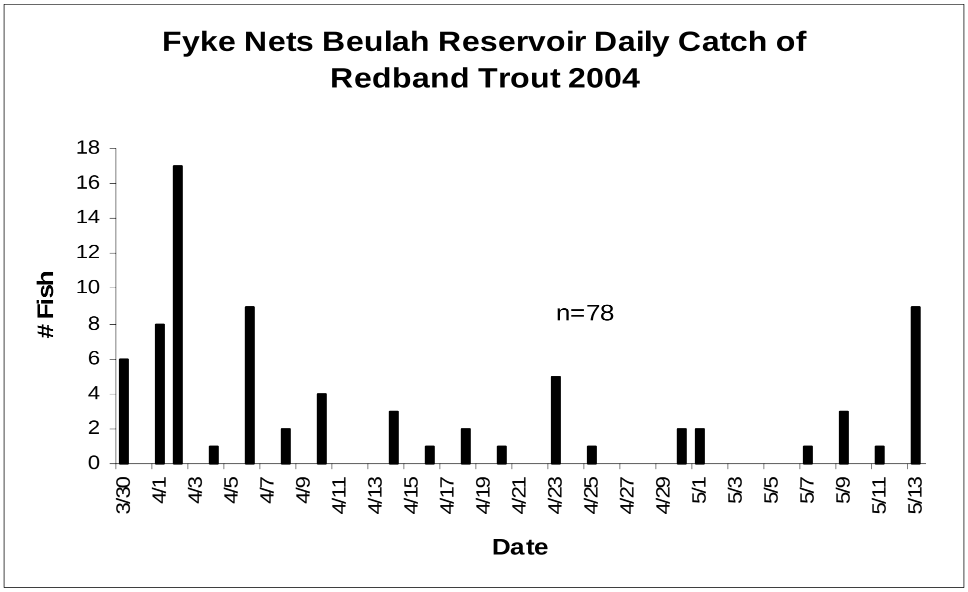


Figure 10. Daily catch of mountain whitefish in the Fyke nets. North Fork Malheur River, Oregon.

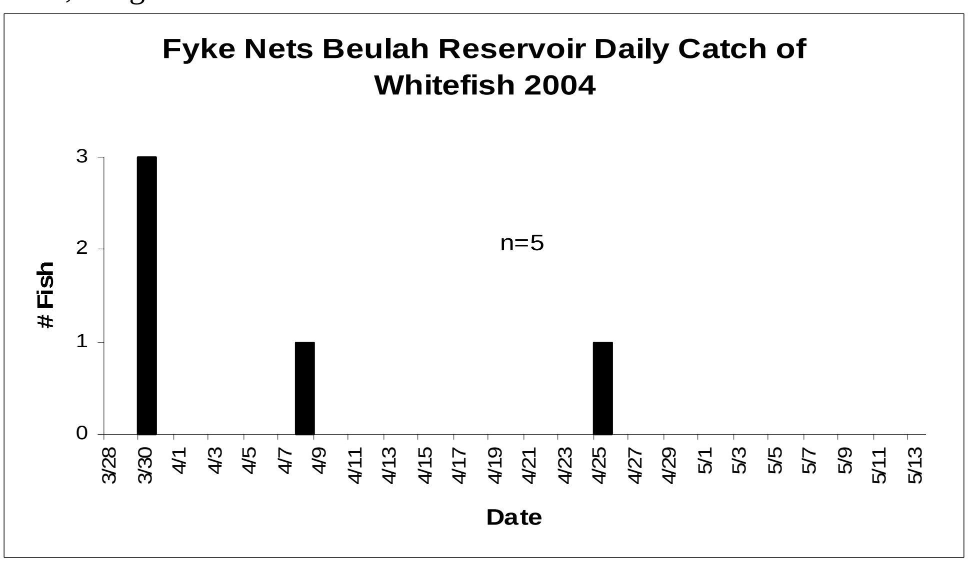


Figure 11. Daily catch of redband trout in the weir. North Fork Malheur River, Oregon.

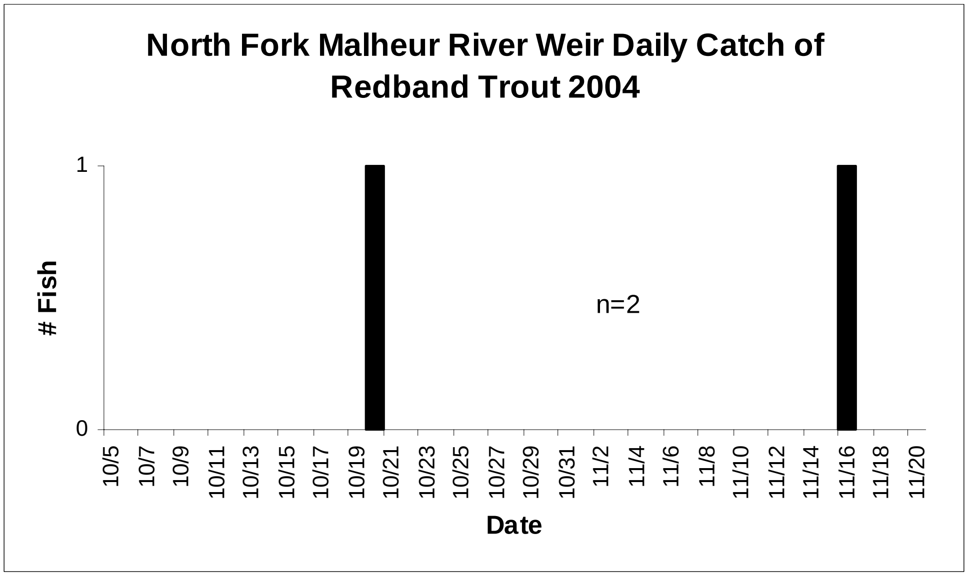


Figure 12. Daily catch of mountain whitefish in the weir. North Fork Malheur River, Oregon.

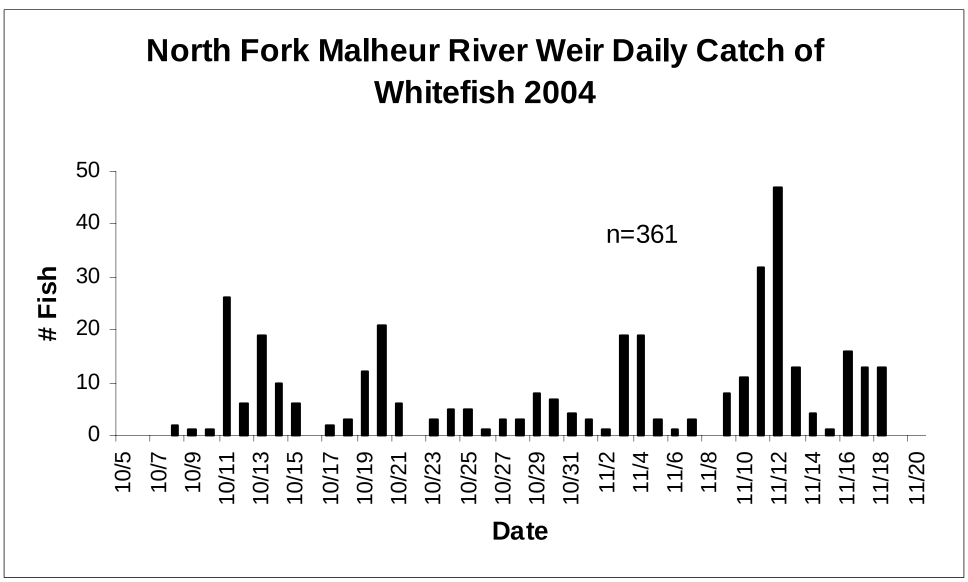
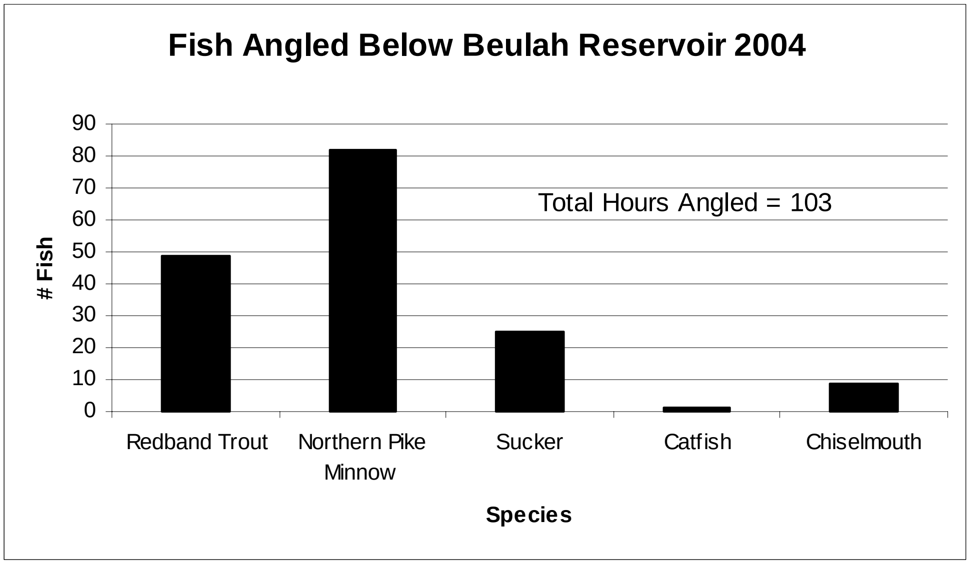


Figure 13. Species of fish angled below Beulah Reservoir. North Fork Malheur River.



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Chapter 6 Use of a Tote Barge Electroshocker to Determine Relative Abundance and Species Presence at the Malheur River Mitigation Site, 2004.

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Burns Paiute Tribe, Burns, OR

Introduction

The Malheur River Mitigation site is located on highway 20, approximately 8 miles east of Juntura, Oregon. The Malheur River Mitigation site consists of 6,700 acres of deeded property and approximately 25,000 acres of lease land from the U.S. Bureau of Land Management and the State of Oregon. Approximately 11 kilometers of the Malheur River flows through the deeded property. In November 2000 the property was acquired by the Burns Paiute Tribe with funding provided by Bonneville Power Administration. Current management practices at the Malheur River Mitigation site by the Burns Paiute Tribe are in an effort to benefit fish, wildlife, and vegetation species.

Information on the presence of bull trout *Salvelinus confluentus* and other salmonids in the mainstem Malheur River is limited. Historically bull trout, chinook salmon *Oncorhynchus tshawytscha*, steelhead *Oncorhynchus mykiss*, possibly coho salmon *Oncorhynchus kisutch* and pacific lamprey *Lampetra tridentata* utilized the majority of the Malheur basin (Thompson and Haas 1960). The Malheur River was used by bull trout and redband trout *Oncorhynchus mykiss* as a migratory corridor and as overwintering habitat, and was most likely a migratory corridor for spawning salmonids as well (Bauer et al. 2004). With the construction of Warm Springs Dam in 1919 and Agency Valley Dam (Beulah Reservoir) in 1935, anadromous salmonids were cut off from the headwaters of the Malheur River. In addition, Bully Creek Dam (1963) does not have fish passage facilities. Lack of passage isolated fish species above the reservoirs. In addition, construction of dams on the Columbia and Snake Rivers further reduced the possibility of access for anadromous salmonids to the Malheur sub-basin.

Bull trout were observed below Agency Valley dam in 1999 and 2000 during angler surveys (Schwabe et al. 2001). These fish were entrained over the spillway. In angler surveys from 2001 to 2004 no bull trout were observed below the dam (Schwabe et al., 2004). This may be attributed to the change in water release procedures. In 2000, water releases from Agency Valley Dam were switched from the spillway to flow valves near the base of the dam (Schwabe et al. 2002). The changes from historically natural conditions to storing water and irrigation releases from Beulah Reservoir and from Warm Springs Reservoir have significantly altered the flow regimes by decreasing peak flows in the spring and increasing sustained summer flows (Hanson et al. 1990). A discharge of cold water from the base of Beulah Reservoir and Warm Springs Reservoir during the irrigation season helps with seasonal temperatures. This discharge of cool water helps make areas of the Malheur River from Namorf Dam (river kilometer 111) to Warm

Springs Dam suitable habitat for trout production (Hanson et. al. 1990). The bull trout recovery core area extends from Namorf Dam to the headwaters which includes the Malheur River Mitigation Site (USFWS 2002). However, under current conditions if bull trout were present at the Malheur River Mitigation site high water temperatures would limit their summer survival. At the Malheur River Mitigation site in August water temperatures often exceed 23^{o}C (Hanson et al. 1990).

The Malheur River Mitigation site was sampled by the Burns Paiute Fish and Wildlife Department in 2002 and 2003. Sampling in 2002 was conducted using a tote barge with the river at mid summer low flow, when reservoir levels were low and inflow equaled outflow. An additional attempt to sample was made in October 2002, but the river had already began to freeze making shocking impossible (Schwabe et al. 2003). The 2003 sample was conducted during high water summer flow from irrigation releases (Schwabe et al. 2004). In 2003 a driftboat electroshocker was used to sample because high water conditions did not permit effective use of the tote barge. A total of seven core native nongame species (bridgelip sucker *Catostomus columbianus*, largescale sucker *Catostomus macrocheilus*, chiselmouth chub *Acrocheilus alutaceus*, northern pikeminnow *Ptychocheilus oregonensi* , redside shiner *Richardsonius balteatus*, speckled dace *Rhinichthys osculus,* and longnose dace *Rhinichthys cataractae*) composed the bulk of the sample in both years. In addition to the native nongame fish, redband trout and nonnative game fish have been observed (Schwabe et al. 2003 and 2004). Additional sampling was conducted at the Malheur River Mitigation site in the spring and fall of 2004. This sampling is in an effort to supplement data on seasonal presence of fish species at the Malheur River Mitigation site.

The purpose of electroshocking the Malheur River Mitigation site is to:

1) Determine the seasonal presence/absence of fish species, particularly salmonids.

2) Determine the relative abundance of fish species present.

3) Provide baseline fish data for management of the Malheur River Mitigation Site.

Methods

Sampling of the Malheur River Mitigation site was conducted in the spring of 2004 before irrigation releases from Beulah and Warm Springs Reservoir and in the fall of 2004 after water releases were shut off from Beulah and Warm Springs Reservoir. Sampling in the spring was conducted on April 5th, 7th, and 9th. Sampling in the fall was conducted on November 1st, 3rd, and 4th.

Sampling was conducted using a Smith-Root 6 foot long tote barge. National Marine Fisheries Services (NMFS) electrofishing guidelines were used to minimize the effects of electrofishing on the fish shocked (NMFS 2000). The barge was equipped with a generator, a push handle for maneuvering and built in safety switch, and two handheld shocker probes with safety switches. All safety switches must be engaged in order for the boat to operate. Shocking the stream involved five individuals. One person maneuvered the tote barge and observed others for safety, two individuals operated the handheld shocker probes, and two individuals dip netted fish from each of the persons with the handheld shocker probes. Fish were collected in dip nets and placed in a holding bucket until the entire site was sampled. Fork length (fl mm) was measured on a portion of all fish species collected. Fish that were not measured were counted. After processing, fish were released into the nearest pool.

Nine units along an 11-kilometer reach of the Malheur River Mitigation site were selected as sample habitat sites in August of 2002 (Schwabe et al. 2003)(Figure 6-1, Table 6-1). These sites were documented with GPS points. The same sites were sampled in 2004. Each unit had at least two riffles and two pools. The group started shocking at the downstream end of the unit and proceeded upstream to the end, which, if possible, was at the end of a pool going into a riffle.

Figure 6-1. Locations of sites surveyed at the Malheur River Mitigation site in 2004.

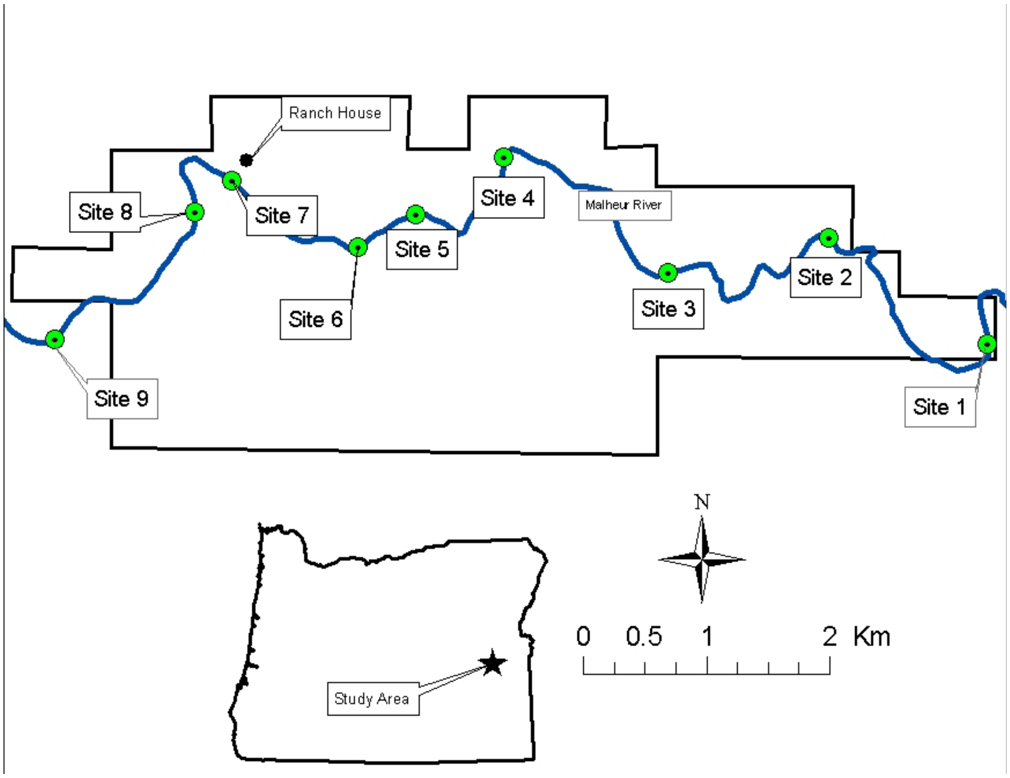


Table 6-1. Location and site descriptions for electrofishing sample sites at the Burns Paiute Malheur River Mitigation site in 2004.

	Site Coordinates	Site Description
Site 1	UTM 0431358 4848618	Starts just upstream of bridge on highway 20 at eastern most boundary of tribal property, near RK 125 (RM 75)
Site 2	UTM 0430069 4849471	Approximately 530m downstream of the confluence of Indian Creek with the Malheur River.
Site 3	UTM 0428771 4849119	Approximately 540 m upstream of the confluence of Indian Creek with the Malheur River.
Site 4	UTM 0427378 4850372	Approximately 150 m upstream of the confluence of Big Swamp Creek with the Malheur River.
Site 5	UTM 0426704 4849876	Starts at the old railroad bridge abutments.
Site 6	UTM 0426193 4849655	Near RK 134. (RM 80)
Site 7	UTM 0425247 4849973	Starts below bridge at ranch house and ends at old bridge abutment supports.
Site 8	UTM 0424703 4849674	Approximately 1400 m above site 7.
Site 9	UTM 0423771 4848660	Ends just below the diversion dam at the western boundary of the tribal property.

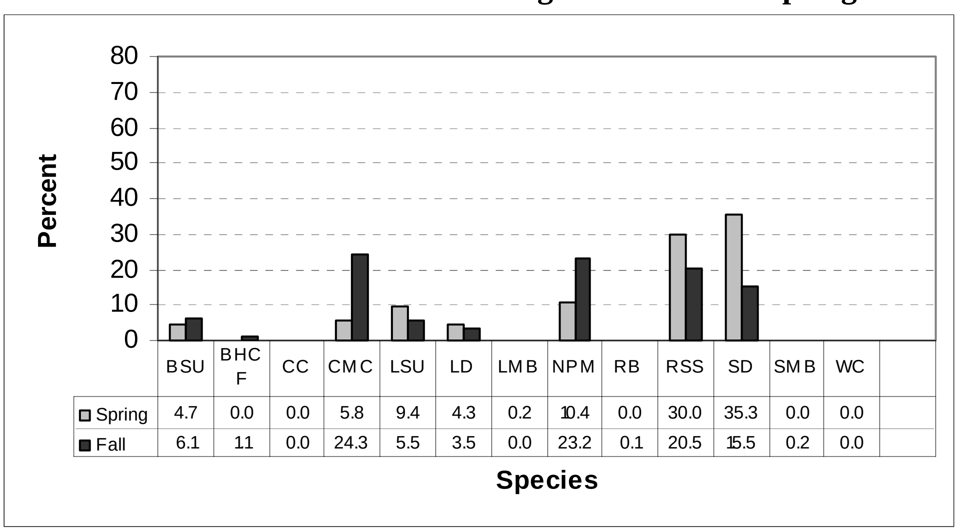
Results

A total of nine sites on the Malheur River were sampled in the spring and re-surveyed in the fall. In the spring a total of 556 fish were collected consisting of 8 species (Table 6-2). In the fall a total of 990 fish were collected consisting of 10 species (Table 6-2). One redband trout was collected in the fall at site 3. Non-native fish species included one largemouth bass *Micropterus salmoides* in the spring, and 11 brown bullhead catfish *Ameiurus nebulosus* and two smallmouth bass *Micropterus dolomieu* in the fall. Bull trout were not observed in either the spring or the fall sample. Relative abundance of redside shiner and speckled dace were highest in the spring sample while relative abundance of chiselmouth chub and northern pikeminnow were highest in the fall (Figure 6-2).

Table 6-2. Totals of each fish species collected from 2004 presence/absence survey from the Malheur River Mitigation site.

	Spring	Fall
Bridgelip Sucker (BSU)	26	60
Largescale Sucker (LSU)	52	54
Chiselmouth Chub (CMC)	32	241
Longnose Dace (LD)	24	35
Speckled Dace (SD)	196	153
Northern Pikeminnow (NPM)	58	230
Redside Shiner (RSS)	167	203
Redband Trout (RB)	0	1
Largemouth Bass (LMB)	1	0
Smallmouth Bass (SMB)	0	2
Bullhead Catfish (BHCF)	0	11

Figure 6-2. Relative abundance of fish species collected from the Malheur River on the Malheur River Mitigation site in the spring and fall of 2004.



Native nongame species

Bridgelip sucker—A total of 26 bridgelip suckers were collected from 7 of the 9 sites sampled in the spring and a total of 60 bridgelip suckers were collected from 9 of the 9 sites sampled in the fall (Table 6-2). Bridgelip suckers collected measured between 65 mm to 480 mm, and averaged 122 mm (Figure 6-13). Of the seven core native nongame species, bridgelip suckers were the second least relatively abundant sampled in the spring and third least relatively abundant sampled in the fall (Figure 6-2).

Largescale sucker—A total of 52 largescale suckers were collected from 9 of the 9 sites sampled in the spring and a total of 54 largescale suckers were collected from 7 of the 9 sites sampled in the fall (Table 6-2). Largescale suckers collected measured between 69 mm to 525 mm, and averaged 276 mm (Figure 6-14). Of the seven core native nongame species, largescale suckers were the fourth least relatively abundant sampled in the spring and the second least relatively abundant sampled in the fall (Figure 6-2).

Chiselmouth chub—A total of 32 chiselmouth chub were collected from 6 of the 9 sites sampled in the spring and a total of 241 chiselmouth chub were collected from 7 of the 9 sites sampled in the fall (Table 6-2). Chiselmouth chub collected measured between 60 mm to 350 mm, and averaged 140 mm (Figure 6-15). Of the seven core native nongame species, chiselmouth chub were the third least relatively abundant sampled in the spring and were the most relatively abundant sampled in the fall (Figure 6-2).

Longnose dace—A total of 24 longnose dace were collected from 7 of the 9 sites sampled in the spring and a total of 35 longnose dace were collected from 6 of the 9 sites sampled in the fall (Table 6-2). Longnose dace collected measured between 53 mm to 97 mm, and averaged 65 mm (Figure 6-16). Of the seven core native nongame species, longnose dace were the least relatively abundant sampled in the spring and the least relatively abundant sampled in the fall (Figure 6-2).

Speckled dace—A total of 196 speckled dace were collected from 9 of the 9 sites sampled in the spring and a total of 153 speckled dace were collected from 9 of the 9 sites sampled in the fall (Table 6-2). Speckled dace collected measured between 30 mm to 85 mm, and averaged 62 mm (Figure 6-17). Of the seven core native nongame species, speckled dace were the most relatively abundant sampled in the spring and the fourth most relatively abundant sampled in the fall (Figure 6-2).

Northern pikeminnow—A total of 58 northern pikeminnow were collected from 5 of the 9 sites sampled in the spring and a total of 230 northern pikeminnow were collected from 8 of the 9 sites sampled in the fall (Table 6-2). Northern pikeminnow collected measured between 40 mm to 500 mm, and averaged 174 mm (Figure 6-18). Of the seven core native nongame species, northern pikeminnow were the third most relatively abundant sampled in the spring and the second most relatively abundant sampled in the fall (Figure 6-2).

Redside shiner—A total of 167 redside shiner were collected from 6 of the 9 sites sampled in the spring and a total of 203 redside shiner were collected from 9 of the 9 sites sampled in the fall (Table 6-2). Redside shiner collected measured between 42 mm to 120 mm, and averaged 83 mm (Figure 6-19). Of the seven core native nongame species, redside shiner were the second most relatively abundant sampled in the spring and the third most relatively abundant sampled in the fall (Figure 6-2).

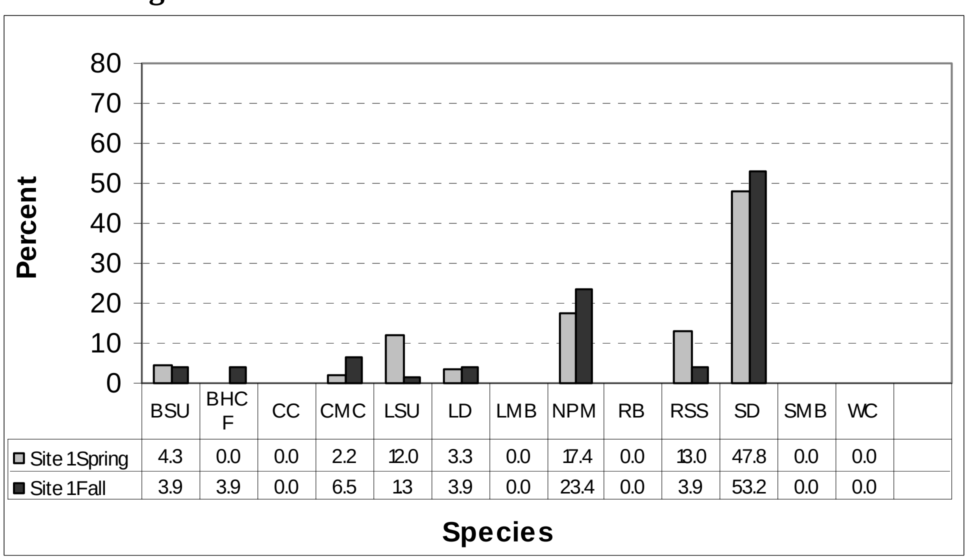
Site 1

From site 1 a total of 92 fish and 7 species were collected in the spring, and a total of 77 fish and 8 species were collected in the fall (Table 6-3). Fish collected from site 1 were all endemic to the Malheur River subbasin other than 3 bullhead catfish collected in the fall. Relative abundance of fish species collected from site 1 ranged from 47.8 percent speckled dace to 2.2 percent chiselmouth chub in the spring and 53.2 percent speckled dace to 1.3 percent largescale sucker in the fall (Figure 6-3).

Table 6-3. Totals of each fish species collected from site 1 of presence/ absence survey conducted on the Malheur River Mitigation site in 2004.

	Spring	Fall
Bridgelip Sucker	4	3
Bullhead Catfish	0	3
Chiselmouth Chub	2	5
Largescale Sucker	11	1
Longnose Dace	3	3
Northern Pikeminnow	16	18
Redside Shiner	12	3
Speckled Dace	44	41

Figure 6-3. Relative abundance of fish species collected in the spring and fall samples from site 1 of presence/absence survey on the Malheur River Mitigation site from 2004.



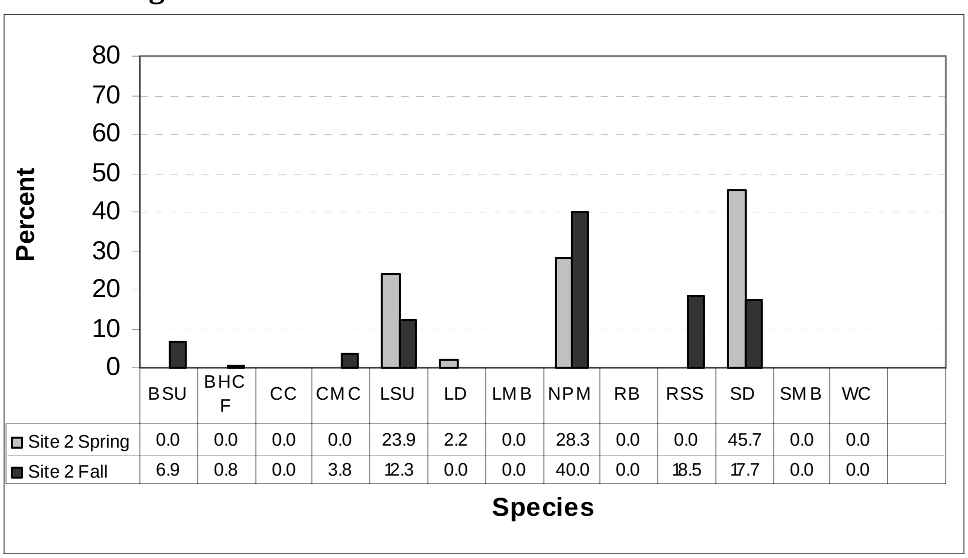
Site 2

From site 2 a total of 46 fish and 4 species were collected in the spring and a total of 130 fish and 7 species were collected in the fall (Table 6-4). Fish collected from site 2 were all endemic to the Malheur River subbasin other than 1 bullhead catfish collected in the fall. Relative abundance of fish species collected from site 2 ranged from 45.7 percent speckled dace to 2.2 percent longnose dace in the spring and 40 percent northern pikeminnow to 0.8 percent bullhead catfish in the fall (Figure 6-4).

Table 6-4. Totals of each fish species collected from site 2 of presence/ absence survey conducted on the Malheur River Mitigation site in 2004.

	Spring	Fall
Bridgelip Sucker	0	9
Bullhead Catfish	0	1
Chiselmouth Chub	0	5
Largescale Sucker	11	16
Longnose Dace	1	0
Northern Pikeminnow	13	52
Redside Shiner	0	24
Speckled Dace	21	23

Figure 6-4. Relative abundance of fish species collected in the spring and fall samples from site 2 of presence/absence survey on the Malheur River Mitigation site from 2004.



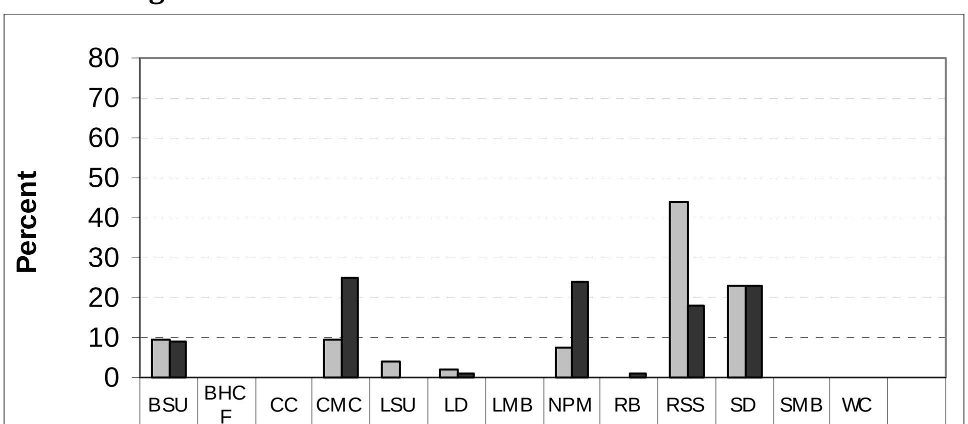
Site 3

From site 3 a total of 52 fish and 7 species were collected in the spring and a total of 101 fish and 7 species were collected in the fall (Table 6-5). All species collected from site 3 were endemic to the Malheur River subbasin. The only salmonid collected at the Malheur River Mitigation site was a redband trout from site 3 in the fall. Relative abundance of fish species collected from site 3 ranged from 44.2 percent redside shiner to 1.9 percent longnose dace in the spring and 24.8 percent chiselmouth chub to 1 percent longnose dace and redband trout in the fall (Figure 6-5).

Table 6-5. Total of each fish species collected from site 3 of presence/absence survey conducted on the Malheur River Mitigation site in 2004.

	Spring	Fall
Bridgelip Sucker	5	9
Chiselmouth Chub	5	25
Largescale Sucker	2	0
Longnose Dace	1	1
Northern Pikeminnow	4	24
Redband Trout	0	1
Redside Shiner	23	18
Speckled Dace	12	23

Figure 6-5. Relative abundance of fish species collected in the spring and fall samples from site 3 of presence/absence survey on the Malheur River Mitigation site from 2004.



	BSU	BHCF	CC	CMC	LSU	LD	LMB	NPM	RB	RSS	SD	SMB	WC
Site 3 Spring	9.6	0.0	0.0	9.6	3.8	19	0.0	7.7	0.0	44.2	23.1	0.0	0.0
Site 3 Fall	8.9	0.0	0.0	24.8	0.0	10	0.0	23.8	10	17.8	22.8	0.0	0.0

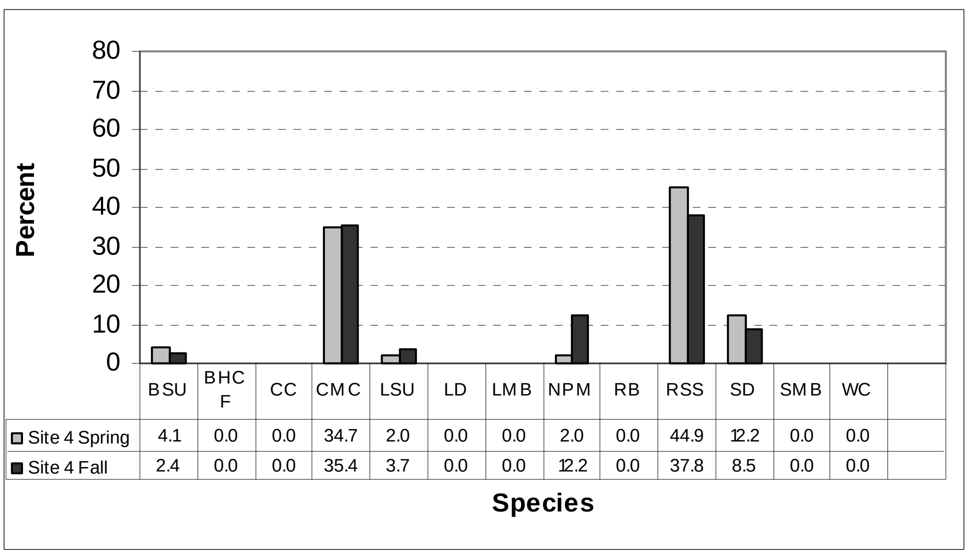
Site 4

From site 4 a total of 49 fish and 6 species were collected in the spring and a total of 82 fish and 6 species were collected in the fall (Table 6-6). All species collected from site 4 were endemic to the Malheur River subbasin. Relative abundance of fish species collected from site 4 ranged from 44.9 percent redside shiner to 2 percent northern pikeminnow and largescale sucker in the spring and 37.8 percent redside shiner to 2.4 percent bridgelip sucker in the fall (Figure 6-6).

Table 6-6. Total of each fish species collected from site 4 of presence/absence survey conducted on the Malheur River Mitigation site in 2004.

	Spring	Fall
Bridgelip Sucker	2	2
Chiselmouth Chub	17	29
Largescale Sucker	1	3
Northern Pikeminnow	1	10
Redside Shiner	22	31
Speckled Dace	6	7

Figure 6-6. Relative abundance of fish species collected in the spring and fall samples from site 4 of presence/absence survey on the Malheur River Mitigation site from 2004.



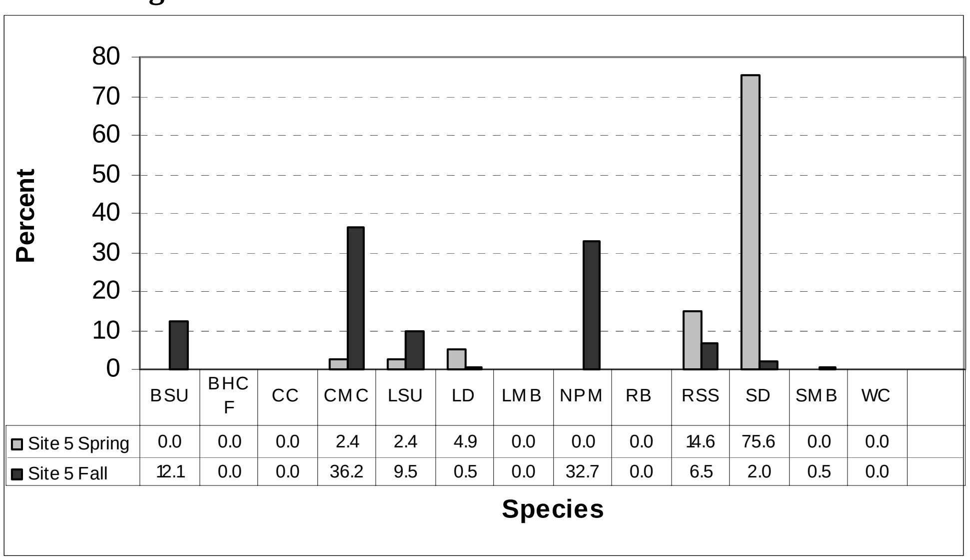
Site 5

From site 5 a total of 41 fish and 5 species were collected in the spring and a total of 199 fish and 8 species were collected in the fall (Table 6-7). All species collected from site 5 were endemic to the Malheur River subbasin other than 1 smallmouth bass collected in the fall. Relative abundance of fish species collected from site 5 ranged from 75.6 percent speckled dace to 2.4 percent chiselmouth chub and largescale sucker in the spring and 36.2 percent chiselmouth chub to .5 percent smallmouth bass in the fall (Figure 6-7).

Table 6-7. Total of each fish species collected from site 5 of presence/absence survey conducted on the Malheur River Mitigation site in 2004.

	Spring	Fall
Bridgelip Sucker	0	24
Chiselmouth Chub	1	72
Largescale Sucker	1	19
Longnose Dace	2	1
Northern Pikeminnow	0	65
Redside Shiner	6	13
Speckled Dace	31	4
Smallmouth Bass	0	1

Figure 6-7. Relative abundance of fish species collected in the spring and fall samples from site 5 of presence/absence survey on the Malheur River Mitigation site from 2004.



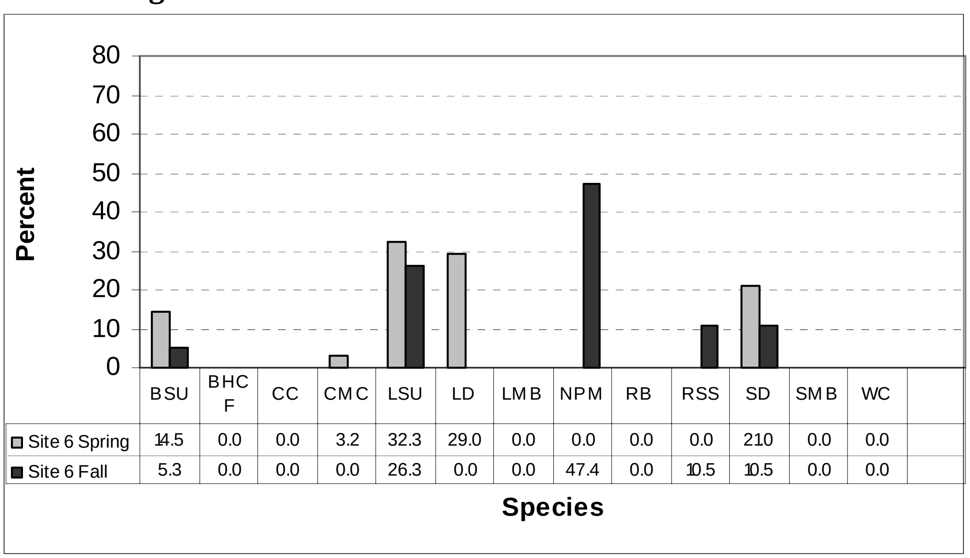
Site 6

From site 6 a total of 60 fish and 5 species were collected in the spring and a total of 19 fish and 5 species were collected in the fall (Table 6-8). All species collected from site 6 were endemic to the Malheur River subbasin. Relative abundance of fish species collected from site 6 ranged from 32.3 percent largescale sucker to 3.2 percent chiselmouth chub in the spring and 47.4 percent northern pikeminnow to 5.3 percent bridgelip sucker in the fall (Figure 6-8).

Table 6-8. Total of each fish species collected from site 6 of presence/absence survey conducted on the Malheur River Mitigation site in 2004.

	Spring	Fall
Bridgelip Sucker	9	1
Chiselmouth Chub	2	0
Largescale Sucker	20	5
Longnose Dace	18	0
Northern Pikeminnow	0	9
Redside Shiner	0	2
Speckled Dace	13	2

Figure 6-8. Relative abundance of fish species collected in the spring and fall samples from site 6 of presence/absence survey on the Malheur River Mitigation site from 2004.



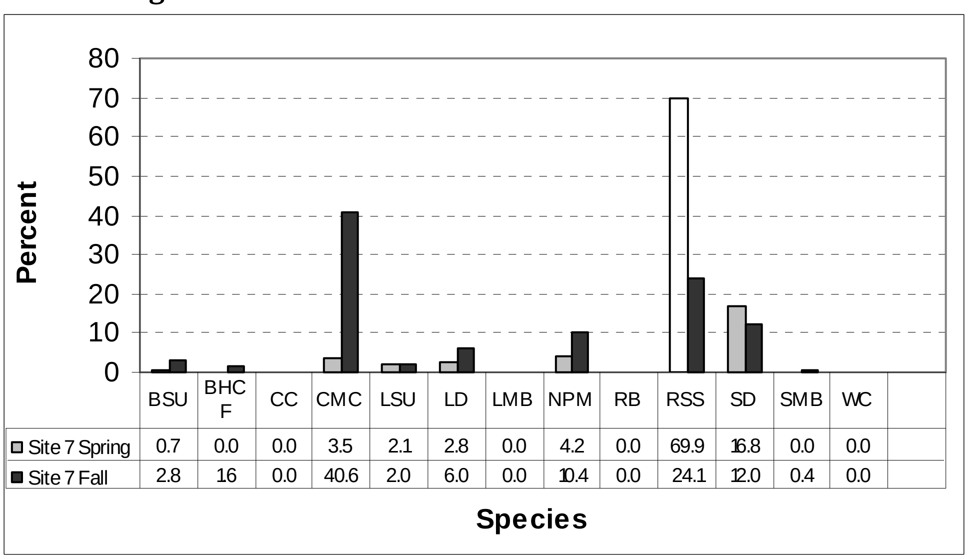
Site 7

From site 7 a total of 143 fish and 7 species were collected in the spring and a total of 249 fish and 9 species were collected in the fall (Table 6-9). All species collected at site 7 were endemic to the Malheur River subbasin with the exception of 4 bullhead catfish and 1 smallmouth bass collected in the fall. Relative abundance of fish species collected from site 7 ranged from 69.9 percent redside shiner to .7 percent bridgelip sucker in the spring and 40.6 percent chiselmouth chub to .4 percent smallmouth bass in the fall (Figure 6-9).

Table 6-9. Total of each fish species collected from site 7 of presence/absence survey conducted on the Malheur River Mitigation site in 2004.

	Spring	Fall
Bridgelip Sucker	1	7
Bullhead Catfish	0	4
Chiselmouth Chub	5	101
Largescale Sucker	3	5
Longnose Dace	4	15
Northern Pikeminnow	6	26
Redside Shiner	100	60
Speckled Dace	24	30
Smallmouth Bass	0	1

Figure 6-9. Relative abundance of fish species collected in the spring and fall samples from site 7 of presence/absence survey on the Malheur River Mitigation site from 2004.



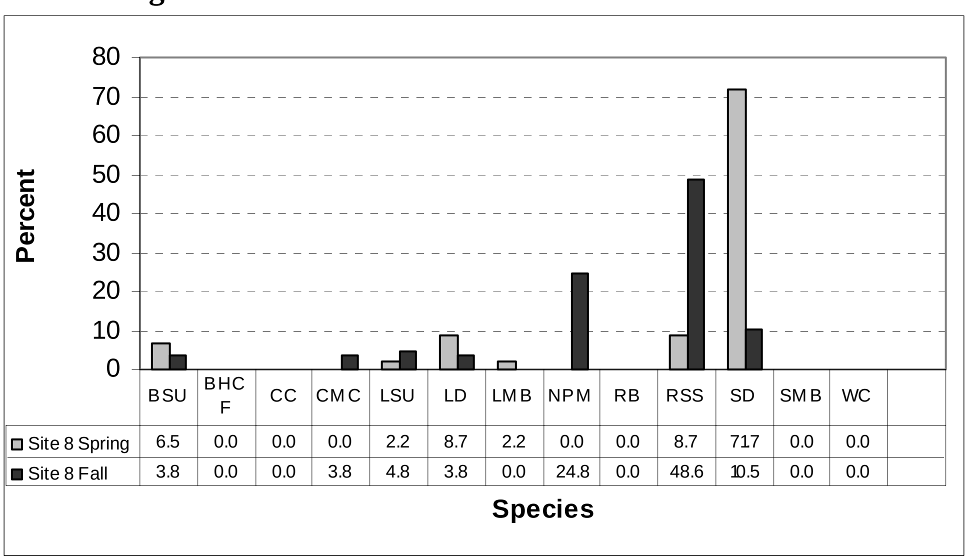
Site 8

From site 8 a total of 46 fish and 6 species were collected in the spring and a total of 105 fish and 7 species were collected in the fall (Table 6-10). All species collected from site 8 were endemic to the Malheur River subbasin with the exception of 1 largemouth bass collected in the spring. Relative abundance of fish species collected from site 8 ranged from 71.7 percent speckled dace to 2.2 percent largescale sucker and largemouth bass in the spring and 48.6 percent redside shiner to 3.8 percent longnose dace, chiselmouth chub, and bridgelip sucker in the fall (Figure 6-10).

Table 6-10. Total of each fish species collected from site 8 of presence/ absence survey conducted on the Malheur River Mitigation site in 2004.

	Spring	Fall
Bridgelip Sucker	3	4
Chiselmouth Chub	0	4
Largescale Sucker	1	5
Longnose Dace	4	4
Largemouth Bass	1	0
Northern Pikeminnow	0	26
Redside Shiner	4	51
Speckled Dace	33	11

Figure 6-10. Relative abundance of fish species collected in the spring and fall samples from site 8 of presence/absence survey on the Malheur River Mitigation site from 2004.



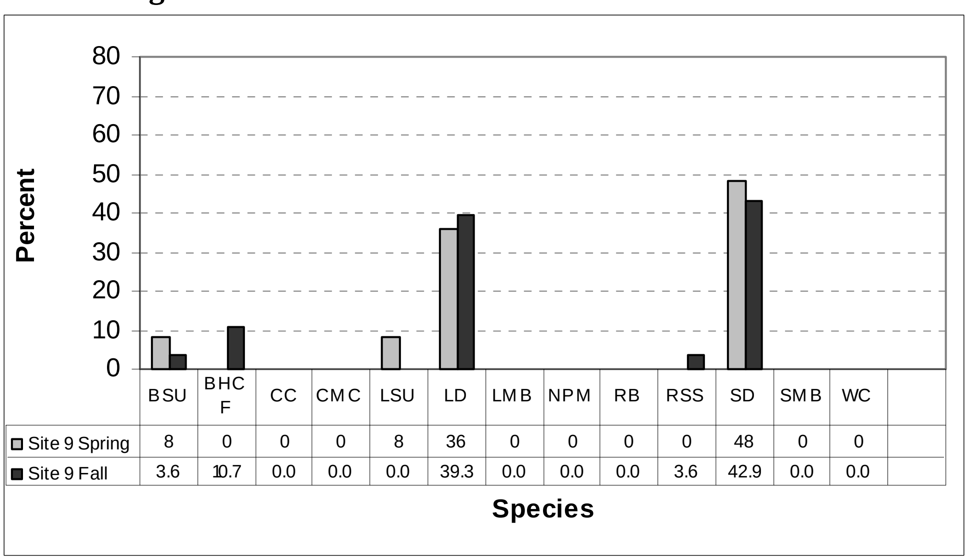
Site 9

From site 9 a total of 25 fish and 4 species were collected in the spring and a total of 28 fish and 5 species were collected in the fall (Table 6-11). All species collected from site 9 were endemic to the Malheur River subbasin with the exception of 3 bullhead catfish collected in the fall. Relative abundance of fish species collected from site 9 ranged from 48 percent speckled dace to 8 percent largescale sucker and bridgelip sucker in the spring and 42.9 percent speckled dace to 3.6 percent redside shiner and bridgelip sucker in the fall (Figure 6-11).

Table 6-11. Total of each fish species collected from site 9 of presence/absence survey conducted on the Malheur Mitigation site in 2004.

	Spring	Fall
Bridgelip Sucker	2	1
Bullhead Catfish	0	3
Largescale Sucker	2	0
Longnose Dace	9	11
Redside Shiner	0	1
Speckled Dace	12	12

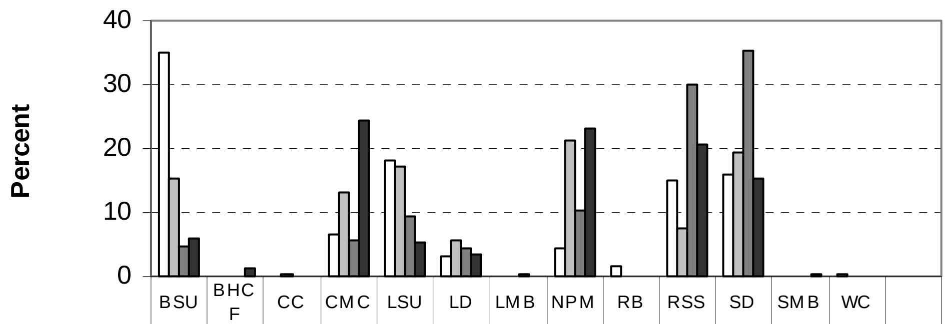
Figure 6-11. Relative abundance of fish species collected in the spring and fall samples from site 9 of presence/absence survey on the Malheur River Mitigation site from 2004.



Discussion

The Malheur River Mitigation site has been sampled for three consecutive years, starting in 2002. The purpose of sampling multiple times was to determine differences in seasonal fish species presence, specifically bull trout and redband trout, and seasonal relative abundance. Seven native nongame species were present at most sites. The seven core species consistently sampled include bridgelip sucker, largescale sucker, chiselmouth chub, longnose dace, speckled dace, northern pikeminnow, and redside shiner. In addition to the native nongame fish, various nonnative game fish and redband trout were observed in much lower numbers.

Figure 6-12. Relative abundance of fish species collected from the Malheur River Mitigation site from 2002, 2003, and 2004.



	BSU	BHCF	CC	CMC	LSU	LD	LMB	NPM	RB	RSS	SD	SMB	WC
2002%	35.0	0.0	0.0	6.4	18.3	3.2	0.0	4.5	16	14.9	16.0	0.0	0.2
2003%	15.4	0.0	0.4	13.2	17.2	5.7	0.0	21.1	0.0	7.5	19.4	0.0	0.0
Spring 04	4.7	0.0	0.0	5.8	9.4	4.3	0.2	10.4	0.0	30.0	35.3	0.0	0.0
Fall 04	6.1	11	0.0	24.3	5.5	3.5	0.0	23.2	0.1	20.5	15.5	0.2	0.0

Species

It is likely that bull trout do not currently utilize areas of the mainstem Malheur River. The last time bull trout were detected below Beulah Reservoir was in the spillway in 2000 (Schwabe et al. 2001). Prior to this they were detected in 1999 as far downstream on the North Fork Malheur River as RK 15 near Chukar Park (Schwabe et al. 2000). In the three years that presence/absence surveys have been conducted on the Malheur River Mitigation site bull trout have not been observed. Bull trout entrainment may have ceased because of a change in release practices at Beulah Reservoir from over the spillway to tubes at the base of the reservoir. Reservoir levels have not been high enough since changing release methods to merit releasing water over the spillway. If water levels get high enough to make release over the spillway necessary, entrainment of bull trout would be possible. This would in turn increase the chance of observing bull trout below Beulah Reservoir. If bull trout were entrained through Beulah Reservoir they would be isolated below the dam with no fish passage, poor water and habitat quality, and lack of spawning habitat. Factors that influence water quality include alterations from the historic flow regimes and high water temperatures. Historical low flows are in summer and fall. Currently, dams are spilling for irrigation and are maintaining high flows during this time. Low flows now occur in the fall, winter, and early spring.

It is possible that redband trout seasonally utilize areas of the Malheur Mitigation site as a migratory corridor. In 2002, 15 redband trout were collected, while in 2003 no redband trout were collected and in 2004 only one redband trout was collected in the fall sample. The redband trout collected in 2002 may have been influenced by carry over of the ODFW stocking of redband trout at the Malheur Mitigation site in 2001. Differences may be attributed to changes in sampling times and methods. The conditions for the fall sample in 2004 were optimal for redband trout. It was at a time of year when the water temperatures were cool and redband trout migration could be expected.

Nonnative game fish collected from the Malheur River Mitigation site include white crappie (WC) *Promoxis annularis*, channel catfish (CC) *Ictaluras punctatus*, bullhead catfish, and smallmouth bass. White crappie were collected at the Malheur River Mitigation site in 2002, but not in 2003 or 2004. White crappie were documented in Beulah Reservoir and in the tailrace of Beulah Reservoir in 2002 (Schwabe et al. 2003). Most likely, the white crappie were entrained from either Beulah Reservoir or Warm Springs Reservoir. The most likely source of the channel catfish, bullhead catfish, and smallmouth bass is entrainment from Warm Springs Reservoir. The numbers of nonnative game fish sampled are low regardless of the season indicating that self sustaining populations at the Malheur River Mitigation site are unlikely.

Reccomendations

We recommend completing habitat data survey on the section of the Malheur River that flows through the mitigation property to monitor habitat changes over time. In addition, sample at the mitigation site at five year intervals to monitor fish populations, and detect changes in species composition and relative abundance.

Acknowledgements

A special thanks to Bonneville Power Administration for funding this project and to USFWS for providing the tote barge electroshocker. We would also like to thank Lindsay Aschim, Eric Hawley, Garrett Sam, Lucas Samor, Todd Richards, Kevin Fenn, Jason Fenton, and Lawrence Schwabe for completing field work.

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Appendix A. Length frequency of fish species collected from the Malheur River Mitigation site from 2004 presence/absence surveys. Graphs for redband trout (230 mm) and largemouth bass (167 mm) are not included because only one of each was collected. A graph is not included for smallmouth bass because the smallmouth bass collected were not measured.

Figure 6-13. Length frequency of bridgelip sucker collected from presence/absence survey on the Malheur River Mitigation site in 2004.

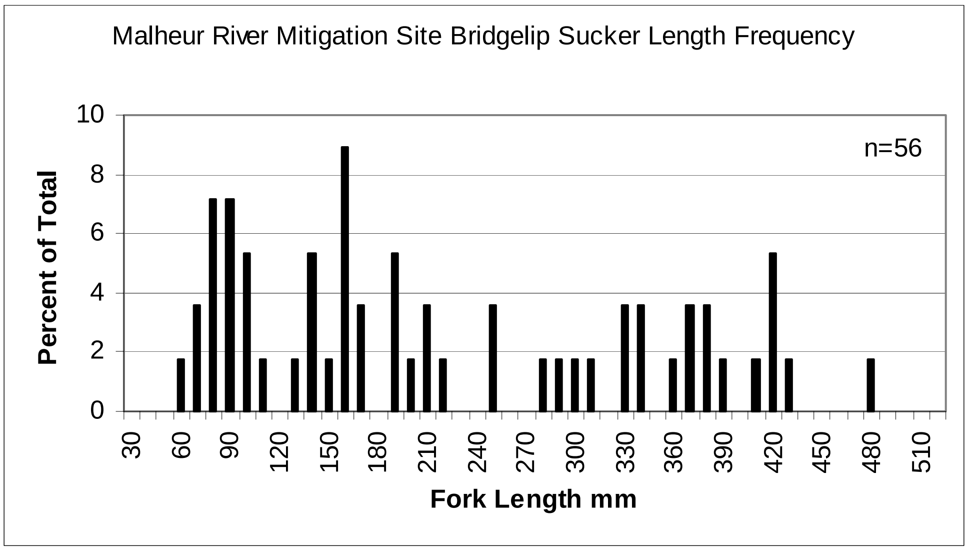


Figure 6-14. Length frequency of largescale sucker collected from presence/absence survey on the Malheur River Mitigation site in 2004.

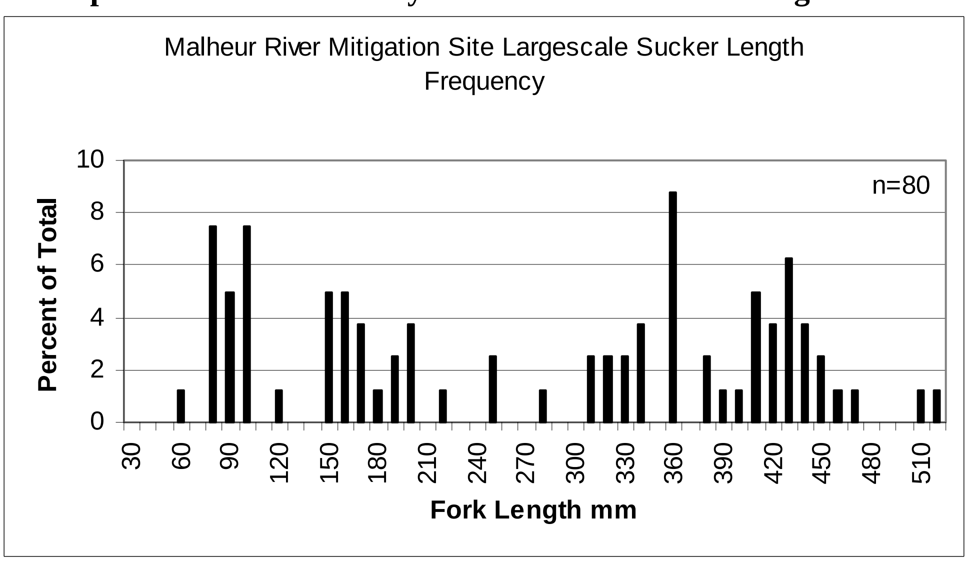


Figure 6-15. Length frequency of chiselmouth chub collected from presence/absence survey on the Malheur River Mitigation site in 2004.

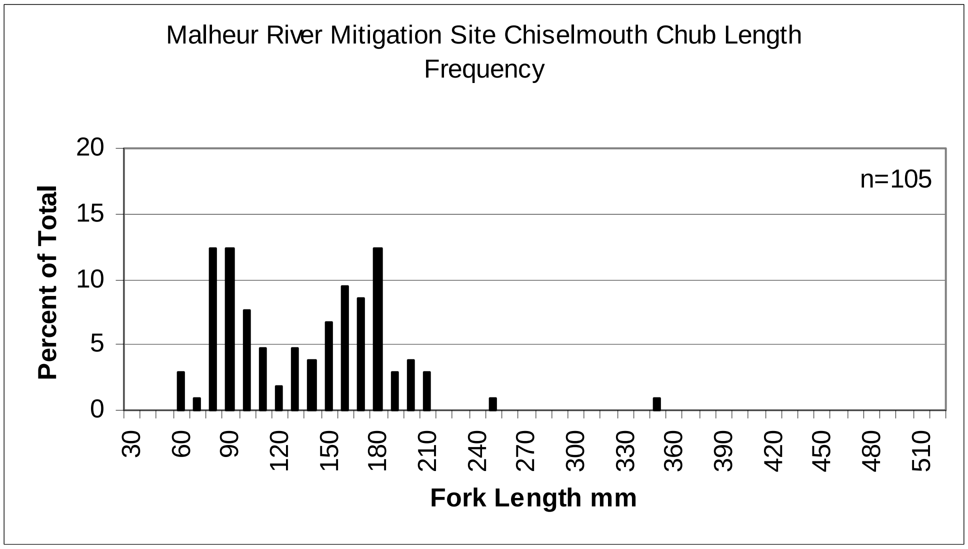


Figure 6-16. Length frequency of longnose dace collected from presence/absence survey on the Malheur River Mitigation site in 2004.

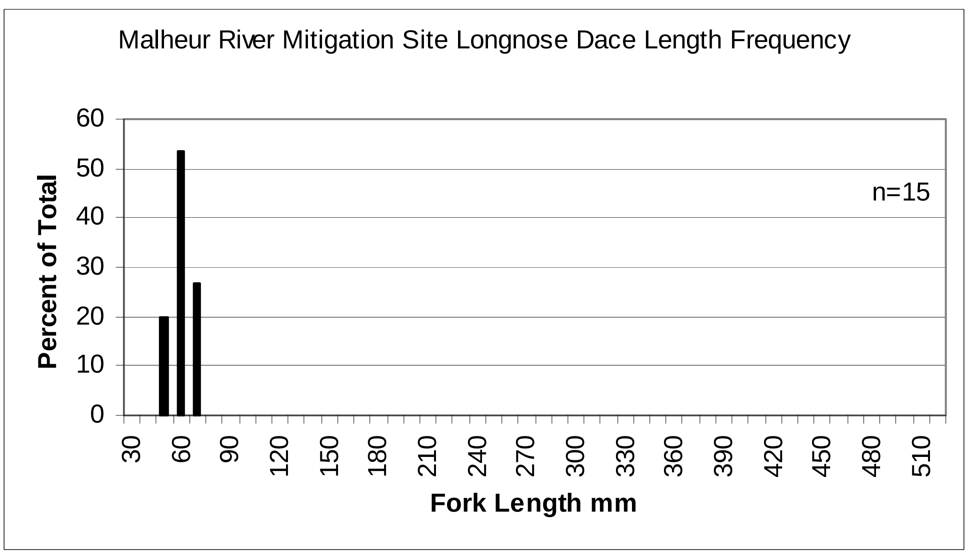


Figure 6-17. Length frequency of speckled dace collected from presence/absence survey on the Malheur River Mitigation site in 2004.

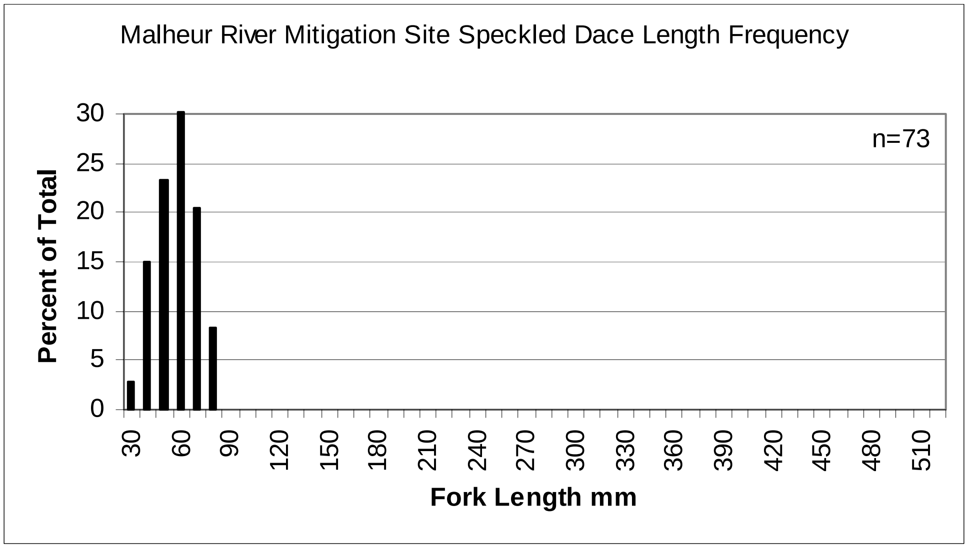


Figure 6-18. Length frequency of northern pikeminnow collected from presence/absence survey on the Malheur River Mitigation site in 2004.

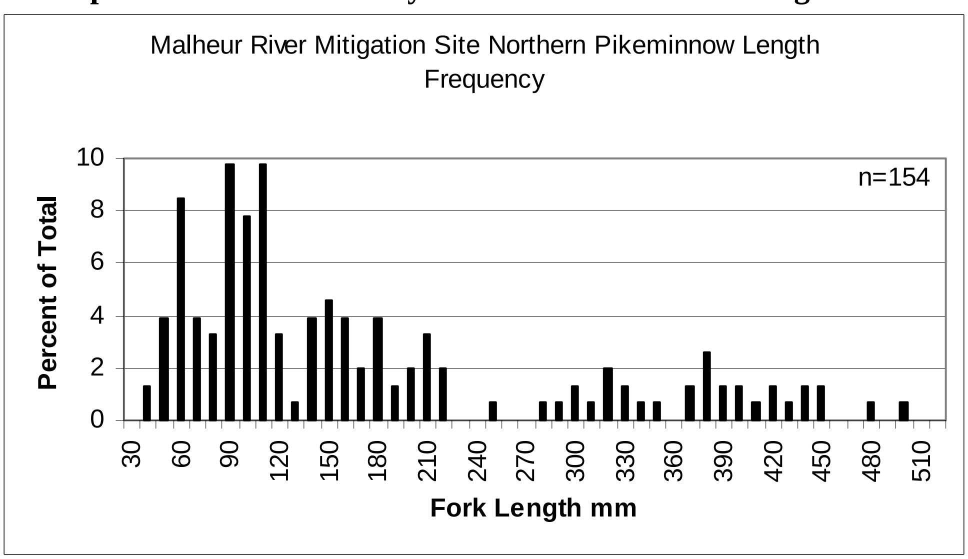


Figure 6-19. Length frequency of redside shiner collected from presence/absence survey on the Malheur River Mitigation site in 2004.

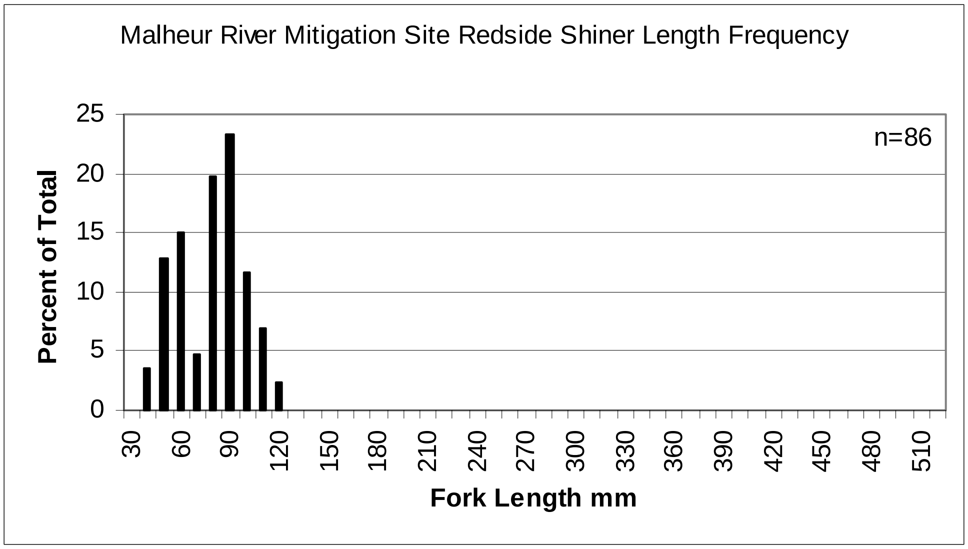
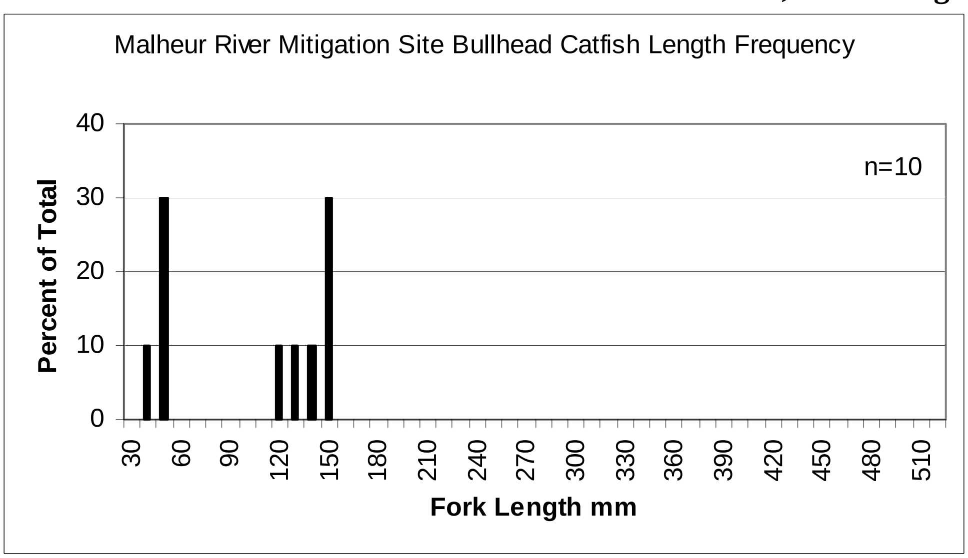


Figure 6-20. Length frequency of bullhead catfish collected from presence/absence survey on the Malheur River Mitigation site in 2004. Bullhead catfish measured from 45 mm to 158 mm, and averaged 105 mm.



Contents

Stream temperature monitoring on streams flowing through the Logan Valley Wildlife Mitigation Property, 2004.

Chapter 7

Stream temperature monitoring on streams flowing through the Logan Valley Wildlife Mitigation Property, 2004.

Author: Lawrence Schwabe, Burns Paiute Tribe Fish and Wildlife Department, Burns, OR

Introduction

The Burns Paiute Tribe (BPT), United States Forest Service (USFS), United States Bureau of Land Management (BLM), and Oregon Department of Fish and Wildlife (ODFW) have coordinated efforts and have maintained stream temperature sites in the Upper Malheur River. The information collected provides land and fish management agencies stream temperature trend data.

The Eastern Oregon Agricultural Research Center (EOARC) have been monitoring stream temperatures on Lake Creek in response to flood irrigation (Boyd and Zamora 2003). The EOARC conducted pre-irrigation stream temperature monitoring of Lake Creek in 2002. The EOARC and the Tribe irrigated the meadows in 2004 and continued to monitor stream temperatures in Lake Creek. The theory being tested is that flood irrigation of the meadows in Logan Valley will decrease depth of the water table in the meadow and should result in increased groundwater inputs into the stream and increase water storage in the soil profile. The increased ground water inputs into the stream are suspected to decrease water temperatures during the summer months.

The Burns Paiute Tribe acquired the Logan Valley Oxbow Ranch in April 2000. The land purchase was funded by the Bonneville Power Administration and is intended to benefit fish and wildlife resources. The restoration of stream channel morphology and natural function is one of the primary goals stated in the Logan Valley Wildlife Mitigation Plan (Wenick 2002).

The lower reaches of Big and Lake Creeks flow through the deeded land. These drainages support a population of threatened bull trout *Salvelinus confluentus*. The current status of this population of bull trout is at a “high risk of extinction” (Buchanan et al. 1997). Thermal barriers on many Logan Valley tributaries may limit bull trout production in the Upper Malheur River watershed (Bowers et al. 1993).

Changes in the composition, vigor, and density of riparian vegetation produce corresponding changes in water temperature (Rosgen 1996). The goals outlined in the Logan Valley Management Plan will encourage the restoration of native riparian vegetation, stream channel morphology, and will be managed for fish and wildlife populations native to the site and surrounding areas. In 2000, stream temperature sites on the property were established. These sites will be used to monitor the trends of stream temperatures that are associated with the management of Logan Valley. Through the current and future management of Logan Valley, the following is anticipated:

1. Decrease in seasonal, maximum stream temperatures.
2. Decrease in the daily low and high stream temperatures.

Methods

The BPT, ODFW, BLM and USFS have coordinated the effort to strategically place thermographs throughout the Malheur River Subbasin. Five temperature sites on the Logan Valley property have been monitored since 2000 (Table 7-1)(Figure 7-1).

A commonly used technique for gathering water temperature is the use of continuous data recorders. StowAway data loggers manufactured by Onset Computer, Inc. were used at stream temperature monitoring sites. Loggers were checked for accuracy using methods recommended by Oregon's Water Quality Monitoring Guide Book (The Oregon Plan for Salmon and Watersheds 1999).

Table 7-1. Names of the five stream temperature sites in Logan Valley, Oregon that have been maintained since 2000.

Site Number	Location
1	Lake Creek below McCoy Creek
2	Lake Creek below Crooked Creek
3	Malheur River below Lake and Big Creek
4	Big Creek approximately one mile below the 16 road
5	Big Creek below the 16 road

<u>Data analysis</u>

Data was analyzed for the 5 temperature sites identified in 2004. Temperature data were analyzed based on rolling daily maximum temperatures averaged over a seven day period that is referred to as a Maximum Weekly Average Temperature (MWAT). Maximum, minimum, and average daily temperatures have been identified and are illustrated in Appendix A.

Water temperatures are well suited for native salmonids in the late fall, winter and early spring. Through years of data collection, the Oregon Department of Fish and Wildlife has concluded that maximum water temperatures usually occur between mid-July through mid-August, but can also occur as early as June or as late as September. The Oregon Department of Fish and Wildlife identify July 15 through August 15 as a critical period for summer rearing in regards to fish rearing (Perkins 1999).

Using the identified 32-day critical period, the data was analyzed for the following attributes:

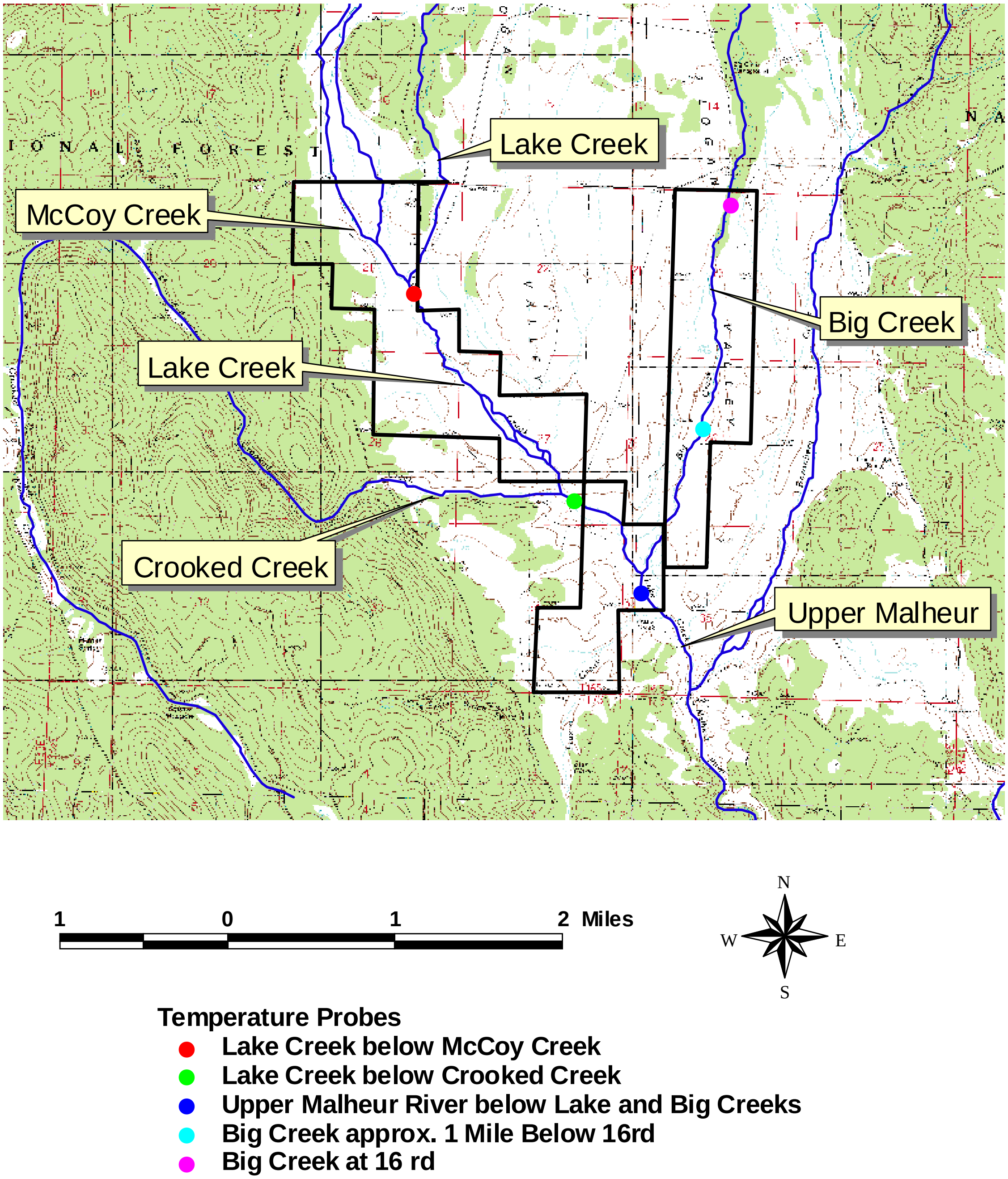
Annual Water Temperature Average: Daily average stream temperature data collected each year at the same site will be averaged for the critical period (July 15 through August 15). Daily average stream temperatures were figured averaging the daily maximum and minimum stream temperatures. Annual Water Temperature Average was figured by taking the average of each of the daily averages for the days identified in the critical period.

Annual Water Temperature Maximum: Daily maximum stream temperature data collected each year at the same site will be averaged for the critical period (July 15 through August 15). This will be the Annual Water Temperature Maximum.

Annual Water Temperature Minimum: Daily minimum stream temperature data collected each year at the same site will be averaged for the critical period (July 15 through August 15). This will be the Annual Water Temperature Minimum.

Annual ΔT: Daily temperature ranges, or the differences between daily maximums and daily minimums, were calculated for each day at each site and averaged for the critical period (July 15 through August 15). This is the Annual ΔT.

Figure 7-1. Locations of Temperature Probes in Logan Valley.



1.

Results

Only three sites provided sufficient data for analysis that include both sites on Lake Creek and one site on the Malheur River. The two sites on Big Creek did not provide sufficient data due to programming errors. Maximum temperatures occurred during the last week of July and first week of August (Table 7-2). All three sites monitored exceed the Oregon Department of Water Quality temperature standards for salmonids (17.8^{o}C) and bull trout (10^{o}C). The upstream most site on Lake Creek exceeded the temperature standard for salmonids for 73 days, lower Lake Creek site exceed the temperature standard for salmonids for 83 days and Malheur River site exceeded the temperature standard for salmonids for 60 days. The Malheur site exceeded stream temperature standards for bull trout for 155 days while both Lake Creek sites exceeded bull trout temperature standards for their full duration of data collection (Table 7-3).

Table 7-2. Stream temperature probe sites on the BPT land acquisition property in the Upper Malheur River Subbasin in 2003. Maximum temperatures are noted both for the year and week and the dates these temperatures occurred.

Site	Maximum Temperature (^{o}C)	Date Maximum Temperature Occurred	MWAT (^{o}C)	Week MWAT Occurred
Site 1 (Upper Lake Cr.)	26.48	7/31/04	25.35	7/25/04 to 7/31/04
Site 2 (Lower Lake Cr.)	26.66	7/31/04	25.25	7/21/04 to 7/26/04
Site 3 (Malheur River Site)	22	7/31/04 and 8/1/04	20.87	7/25/04 to 7/31/04
Site 4 (Lower Big Cr.)	NA	NA	NA	NA
Site 5 (Upper Big Cr.)	NA	NA	NA	NA

Table 7-3. Number of days the Maximum Weekly Average Temperature exceeded the DEQ stream temperature standard in Lake Creek, Big Creek and Malheur River located on the wildlife mitigation property in Logan Valley, OR. The temperature criteria for streams with bull trout is 10^{o}C and for other salmonids the criteria is 17.8^{o}C.

	Number of MWAT days > 10^{o}C	Number of MWAT days > 17.8^{o}C	No of days Site was Monitored
Site 1	100	73	100
Site 2	100	83	100
Site 3	155	60	161
Site 4	NA	NA	NA
Site 5	NA	NA	NA

Annual Water Temperature Average

Annual Water Temperature Average was figured for all sites from 2000 to 2004. Table 7-4 is the annual average water temperatures for the critical period at the temperature sites located at the Logan Valley Wildlife Mitigation Property managed by the Tribe.

Table 7-4. Annual Water Temperature Averages for Logan Valley Streams in Oregon from 2000 through 2004. Annual Water Temperature Average is the average of the daily averages for the critical period (July 15 to August 15).

	2000	2001	2002	2003	2004
Site 1	17.44°C	16.88°C	16.69°C	17.54°C	18.04°C
Site 2	18.80°C	Na	17.59°C	18.99°C	18.91°C
Site 3	15.24°C	14.21°C	14.96°C	15.99°C	15.11°C
Site 4	14.06°C	13.52°C	14.01°C	Na	Na
Site 5	12.48°C	10.79°C	Na	13.24°C	Na

Annual Water Temperature Maximums

Annual Water Temperature Maximums was figured for all sites from 2000 to 2004. Table 7-5 is the average maximum temperatures for the critical period at the temperature sites located within the boundaries of the Logan Valley Wildlife Mitigation Property managed by the Tribe.

Table 7-5. Annual Water Temperature Maximums for Logan Valley Streams in Oregon from 2000 through 2003. Annual Water Temperature Maximum is an average of the daily maximum temperatures recorded through the critical period (July 15 to August 15).

	2000	2001	2002	2003	2004
Site 1	23.75	22.79	22.87	22.11	23.31
Site 2	24.27	NA	22.80	24.11	23.84
Site 3	20.84	19.03	20.54	21.01	19.91
Site 4	19.40	18.66	19.53	NA	NA
Site 5	16.96	15.03	NA	17.49	NA

Annual Water Temperature Minimums

Annual Water Temperature Minimums was figured for all sites from 2000 to 2004. Table 7-6 is the average minimum temperatures for the critical period at the temperature sites located within the boundaries of the Logan Valley Wildlife Mitigation Property managed by the Tribe.

Table 7-6. Annual Water Temperature Minimums for Logan Valley Streams in Oregon from 2000 through 2004. Annual Water Temperature Minimum is an average of the daily minimum temperatures recorded through the critical period (July 15 to August 15).

	2000	2001	2002	2003	2004
Site 1	11.13	10.97	10.50	12.97	12.76
Site 2	13.32	NA	12.39	13.68	13.98
Site 3	9.63	9.38	9.38	10.96	10.32
Site 4	8.72	8.38	8.50	NA	NA
Site 5	8.01	6.55	NA	9	NA

Annual ΔT

The average change in temperature, or average ΔT, was figured for the critical period at sites located within the boundaries of the Logan Valley Mitigation Property managed by the Tribe (Table 7-7).

Table 7-7. Annual ΔT, or the daily average temperature range, was figured for the days within the identified critical period (July 15 to August 15). All sites are stream temperature monitoring sites on the mitigation property in Logan Valley, OR.

	2000	2001	2002	2003	2004
Site 1	12.62	11.8	12.38	9.14	10.56
Site 2	10.95	NA	10.41	10.62	9.86
Site 3	11.2	9.64	11.16	10.05	9.58
Site 4	10.68	10.28	11.03	NA	NA
Site 5	8.95	8.47	NA	8.49	NA

Discussion

Concurrent research at the Logan Valley Wildlife Mitigation Site suggest that flood irrigation of the meadows adjacent to Lake Creek do appear to provide a cooling effect to Lake Creek (Boyd and Zamora 2003). Nevertheless, improved channel and riparian condition due to cattle exclusion since 2000 has been noted but direct effects of better habitat conditions in relation to stream temperature has not been determined. The temperature analyses on Lake Creek for the identified critical rearing period fail to provide any significant trend in stream temperatures.

Missing data from the Big Creek sites do not allow for an analysis of stream temperature data throughout the property.

As riparian and channel conditions improve, it is expected that aquatic habitat, stream temperatures and flows will change. Long term monitoring of established sites is expected to provide data for land managers with the anticipation of trend data in relation to conservation management by the Burns Paiute Tribe. The following list is additional recommended monitoring activities that need to be conducted concurrently with the stream temperature monitoring to adequately measure aquatic habitat trends on the Logan Valley Mitigation property:

- Establish and maintain stream discharge sites to monitor flow changes over time.
- Continue monitoring stream temperature sites on Logan Valley. Place two thermographs at each temperature site minimize data loss from equipment failure or personnel error.
- Collect air temperature and precipitation data from Logan Valley.

Acknowledgements

A special thanks to Bonneville Power Administration and Eastern Oregon Agricultural Research Center for providing funding and technical assistance. Research conducted by Chad Boyd will assist the Tribe with the water management of the Logan Valley. The effort expended by Jimmy Zamora (EOARC) is also greatly appreciated in the collection of extensive stream temperature data collected on Lake Creek.

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