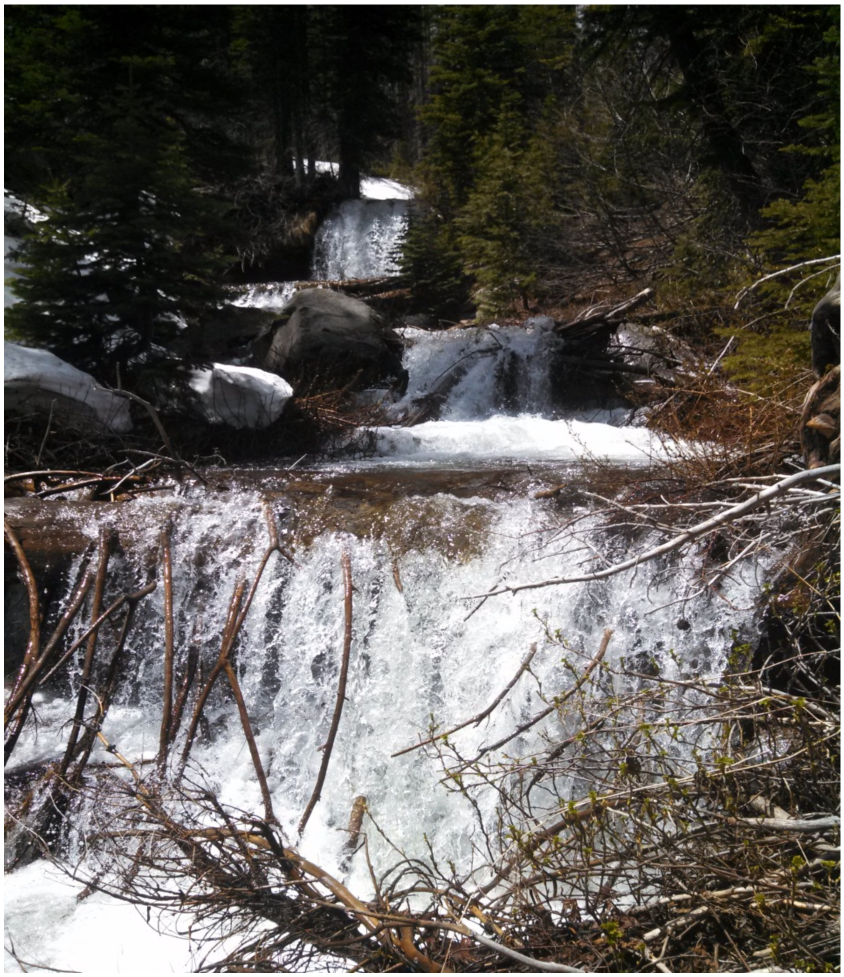
Evaluate the Life History of Native Salmonids in the Malheur Subbasin

Burns Paiute Tribe, Natural Resources Department, Fisheries Program



Project # 1997-019-00, Contract # 56472
For work completed 01/13-12/13
FY 2013 Annual Report

Prepared for

Bonneville Power Administration
Northwest Power and Conservation Council

Background

In 2013 the Burns Paiute Tribe Natural Resources Department Fisheries Program (BPT) completed multiple complementary statements of work via funding through Bonneville Power Administration (BPA) Project 1997-019-00, as well as through one additional federal contract. In this Annual Report we summarize work completed under all contracts in the 2013 field season, if they occurred in the Malheur River, since all Fisheries Program contracts in FY2013 were used for brook trout removal activities.

The BPA Statement of Work (SOW) for FY2013 for 1997-019-00 included the first year of continuous electrofishing removal of brook trout in approximately nine miles of Lake Creek; the third year of operation of an exclusionary weir at the lower end of brook trout removal in Lake Creek; the first year of an exclusionary weir at the putative upstream end of brook trout distribution and below bull trout spawning grounds in Meadow Fork of Big Creek; and continuous temperature monitoring on the Logan Valley Wildlife Mitigation Property. All Work Elements were included in the FY2013-2017 SOW, as proposed in the FY2012 Resident Fish Categorical Review, and subsequently approved by the Northwest Power and Conservation Council and vetted through the Independent Scientific Review Panel. The BPT has not deviated from this five year proposal, other than some proposed Work Elements were not implemented (e.g. redband trout abundance and distribution study) due to no corresponding increase in BPA funding for this project. BPT was also able to implement the five-year proposal for the Lake Creek drainage one year early, starting in 2012 with rigorous brook trout abundance estimates (baseline, yeas 1 and 5), which was proposed in the Categorical Review to start in 2013. This allowed the continuous electrofishing removal (years 2-4) to begin in 2013 instead of 2014.

One additional federal contract was granted to support the FY2013 SOW. Collaborative Forest Landscape Restoration Plan (CFLR) funds were awarded to the Malheur National Forest (MNF) in 2012. The BPT was granted a small amount from the U.S. Forest Service (USFS) from annual CFLR funds to bolster implementation of brook trout removal on the MNF. Project 1997-019-00 was used to attract CFLR cost-share to brook trout removal in the Upper Malheur River watershed. The BPT anticipates similar cost-share opportunities over the next several fiscal years.

The SOW's of two additional and complementary contracts were not completed due to wildfires in FY2013. The BPT was awarded two multiple year contracts by the U.S. Bureau of Reclamation (USBR) Native Affairs Program. The first is a four year grant to mechanically remove brook trout in High Lake, a geologically isolated seed source of downstream brook trout recruitment to Lake Creek populations. FY2013 was intended to be the fourth and final year of this contract. The second is a four year grant to develop the use of environmental DNA (eDNA) field and laboratory methodologies to eventually have the ability to utilize collection of eDNA as a proxy for traditional methodologies in quantifying presence/absence and/or abundance. The goal of this grant is to scientifically develop this methodology into a cost-efficient strategy to gauge the effectiveness of brook trout removal efforts. This was to be the third year of this contract.

Implementation of both USBR contracts was delayed until 2014 due to a naturally-caused wildfire at High Lake in August 2013. Access to High Lake was prohibited by the USFS for the remainder of 2013. Both contracts have been extended so that the 2013 SOWs can be completed in 2014, at which point BPT anticipates that safe access will again be permitted.

One additional federal contract was not completed because the terms of this contract were not triggered in FY2013. The BPT has a multiple year agreement with the USBR to conduct bull trout salvage activities (trap and haul) in the tailrace of Agency Valley Dam (Beulah Reservoir) during spring spill events. There was no spill over the dam in 2013; therefore, these trap and haul activities were not conducted in 2013. The purpose of this contract is to capture entrained bull trout via angling for release in the North Fork Malheur immediately above Beulah Reservoir. The last time this contract was utilized was in 2011, upon the last spill through the spillways rather than through the flow valves.

Spawning surveys were reinstated by the Oregon Department of Fish and Wildlife (ODFW) in 2013 after a one year hiatus. Historically, BPT has provided a majority of the survey staff. However, in recognition that the current spawning survey methodology does not provide statistically-rigorous trend data, the BPT has encouraged development of alternative methodology. The BPT has also encouraged more detailed review of assumptions underlying current spawning survey methodology, if the BPT is to participate in a meaningful capacity. BPT recognizes that there is an outstanding need to quantify bull trout population response to brook trout removal and other recovery actions, and that such quantification will require a more rigorous methodology, and one that takes into consideration metrics additional to solely abundance and distribution, and this will need to result from a multi-agency effort. Results from the 2013 bull trout spawning surveys are included in this Annual Report, since Annual Reports to BPA have traditionally been the chosen forum for summarizing Malheur River bull trout research and monitoring activities, even if they are not directly led by BPT or funded by BPA.

Coordination efforts were central to the FY2013 SOW. In January 2013, at the Malheur River Bull Trout Meeting hosted annually by BPT, an interagency Malheur River Bull Trout Technical Advisory Committee (TAC) was formed. This group met several times throughout 2013, to prioritize bull trout recovery actions in the Upper Malheur River Watershed, and to identify pathways to implementation of these actions. The 2013 TAC consisted of BPT, U.S. Forest Service, Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, U.S. Bureau of

Reclamation, and the U.S. Bureau of Land Management. The TAC will continue to meet at minimum quarterly during FY2014, with the purpose of advancing bull trout recovery actions in the Upper Malheur and North Fork Malheur River Watersheds.

The TAC formed in response to BPT advocating for basin-wide brook trout removal in the 80-100 miles of estimated affected area in the Upper Malheur River. Accordingly, in 2013 the TAC began to evaluate options and feasibility for implementing basin-wide removal, and potentially shifting from rotational and mechanical control methods, to targeting eradication via piscicides. Out of TAC discussions, BPT drafted the “Malheur Bull Trout Recovery Program” which outlines a 15-25 year phased approach to recovery of bull trout populations in the Upper Malheur. This document will likely be disseminated outside of the TAC once a funding strategy can finalized and public engagement can begin. We anticipate that TAC coordination will increase in 2014, in order to prepare for implantation of larger and more rigorous bull trout recovery actions in the Malheur River. All of this is in attempt to implement discreet solutions with defined targets and rigorous effectiveness-monitoring to ecological and biological problems in the Malheur River, versus continuing with actions that require on-going investment.

The Fisheries Program staff in FY2013 (April to December) consisted of Erica Maltz (Fisheries Program Manager), DJ Brown (Lead Fisheries Technician), Derek Hawley (Fisheries Technician), Zach Adams (Fisheries Technician), Gabe First Raised (Fisheries Technician), Brandon Haslick (Fisheries Field Biologist), and Kris Crowley (Fish Biologist).

Erica Maltz, Fisheries Program Manager

1 March 2014

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FY 2013 Annual Report
BPA Project #199701900
Contract #56472
For Work Completed 01/2013-12/2013
June 2014

Contents

Bull Trout Spawning Survey Report, 2013

Shannon Hurn, ODFW Malheur Fish District

January, 2014

1.1 Introduction

Bull trout *(Salvelinus confluentus*) were known to exist in the North Fork and upper Malheur River watersheds prior to 1992. Due to increased interest in the status of bull trout, ODFW began bull trout spawning surveys in the North Fork Malheur River watershed in 1992 to track trends in spawning bull trout abundance. The North Fork watershed was selected for initial surveys because brook trout (*Salvelinus fontinalis*) were not present in the system. Brook trout are present in the upper Malheur River system, and spawn timing overlaps with that of bull trout.

Survey timing and location have varied slightly over the years. Initial stream reaches were selected using data from stream habitat surveys and population estimates completed in 1991-2 for tributaries of the upper North Fork. Between 1992 and 1996, the reach of stream surveyed varied. Many ending points were moved upstream and entire stream reaches were added or dropped as a result of an improved understanding of spawning locations. During the early years, survey timing remained similar, with surveys occurring in mid-September and mid-October. In 1997, stream reaches were surveyed in late August for the first time. Between 1997 and 2002, crews surveyed stream reaches three times: late August, mid-September, and late September. In 2003, timing changed again. Volunteers surveyed one stream section (upper Little Crane Creek) in late August. The remaining stream reaches were surveyed in mid-September and mid-October. Between 2004 and 2007, three stream reaches were surveyed in late August, and all stream reaches were surveyed in mid-September and mid-October. Surveys were conducted from August through mid-October to separate bull trout and brook trout spawning counts in the upper Malheur River watershed. A comparson of data from the North Fork and mainstem Malheur River indicated that bull trout spawn earlier than brook trout. To the best of our knowledge, the core bull trout spawning areas in the North Fork Malheur River basin are being surveyed.

Spawning surveys began in the upper Malheur River watershed in 1998. As with the North Fork watershed, stream reaches were selected using information from stream habitat surveys and population estimates conducted in 1993-4. Early spawning surveys were completed in 1994 on Meadow Fork, Snowshoe, Big, and Lake Creeks. Since initiating spawning surveys, streams have been added and/or dropped, to take advantage of new information and changes in personnel. Stream reaches in lower Summit and Bosonberg creeks were added for a couple of years and then dropped because bull trout spawning activity was not observed. A stream reach on upper Summit Creek was added and surveyed for eight years, but dropped in 2007 due to a lack of personnel and new survey information indicating bull trout were no longer present. The survey reach on Big Creek has been continually adjusted. From 2004 to 2007, Meadow Fork was surveyed three times, first in late August, then again in mid-September and mid-October. The reaches on other streams were surveyed in mid-September and again in mid-October. All streams reaches in the upper Malheur River with known bull trout populations are currently being surveyed. Stream reaches may be extended or dropped in the future to incorporate new information. This report summarizes data collected through 2013.

1.2 Methods

We have reduced the number of objectives for this project to the three listed below. All three objectives apply to both watersheds.

Objectives

1. Determine where bull trout spawn.
2. Determine when bull trout spawn.
3. Determine the number of spawning bull trout.

Spawning surveys were completed on streams in the North Fork Malheur and upper Malheur watersheds that were known or suspected to support bull trout spawning. One or more people surveyed each stream reach while walking in an upstream direction with at least one experienced surveyor leading each team. When multiple surveyors were present, they would walk on opposite sides of the stream whenever possible. Between 2003 and 2010, crews counted redds, determined redd size, noted redd visibility, and recorded numbers and estimated total length (inches) of all bull trout observed. All redds, except for those first observed on the final survey, were flagged to avoid double counting on subsequent surveys. All flags were pulled on the last survey.

Each crew used a GPS unit to record starting and ending locations of each stream reach, as well as the location of individual redds. GPS readings were transferred to data sheets manually during surveys. Each GPS unit was set to record coordinates in decimal degrees and use NAD 1983 as the datum. All GPS coordinates were entered into GIS and mapped. Attempts were made to correct for GPS unit or recording errors when points were mapped.

In the upper Malheur Watershed, distinguishing between bull trout and brook trout redds is impossible without identifying the fish creating each redd. Very few fish were identified and associated with redds. Therefore, redds enumerated and mapped in the upper Malheur watershed are an aggregate of both species with estimates for the number of bull and brook trout redds based on spawn timing.

Since 1992, stream reaches have been surveyed multiple times to better identify spawn timing.

Between 1993 and 1996, stream reaches were surveyed during mid-September and mid-October.

Between 1997 and 2002, stream reaches were surveyed three times; the last week of August, mid-September, and the last week of September.

Starting in 2003, the number of times streams reaches were surveyed was reduced to match reductions in personnel from all participating agencies. In 2003, all stream reaches in both watersheds were surveyed twice, once in mid-September and again in mid-October. In addition, volunteers walked Little Crane Creek on September 1, 2003.

In 2004 and 2005, Little Crane, lower Sheep, upper Swamp, and Meadow Fork stream reaches were surveyed three times: in late August, mid- September and in mid-October. All other stream reaches were surveyed twice, once in mid-September and again in mid-October.

In 2006, all stream reaches were surveyed three times (similar to 1997-2002 surveys). The Burns Paiute Tribal staff walked a majority of the stream reaches primarily due to further reductions in Oregon Department of Fish and Wildlife staff time.

In 2007, we reverted back to the 2004-2005 survey timing.

In 2008, timing and survey reaches were modified to accommodate further reductions in personnel and incorporate new information on redd locations and redd visibility through time. We conducted an analysis of the available location data from the 1999-2007 surveys and visibility data from the 2003-7 surveys. The location data was used to determine which stream reaches could be dropped while minimizing the impact to the precision of the counts. Visibility data was used to determine the maximum amount of time that can be taken between surveys before affecting the precision of the counts. In 2008, streams reaches were surveyed during the second week of September and again during the last week of September. Major changes to some stream reaches occurred. These changes included dropping the lower 4.2 miles of Little Crane Creek, the upper 0.5 miles of Sheep Creek, the lower 1.5 miles of Swamp Creek, and the lower 1.0 miles of the North Fork Malheur River. In the upper Malheur River watershed the lower 0.25 miles of Meadow Fork was dropped, and approximately 1.0 mile of Big Creek between Meadow Fork and Snowshoe Creeks was added. The 2009 and 2010 stream reaches and survey periods were similar to the 2008 surveys.

No spawning surveys were conducted in 2012. In 2013, several ODFW staff and volunteers completed spawning surveys on all index reaches except Swamp Creek.

1.3 Results

North Fork Malheur River Watershed

North Fork Malheur River

Upper North Fork Malheur River reach was surveyed twice in 2013. The survey began at the bridge just upstream of the confluence with Horseshoe Creek and ended 1.35 miles upstream. Three redds were observed in total; 2 redds on August 18 and 1 redd on September 24 (Table 1).

Table 1. Bull trout redds observed in the mainstem of the North Fork Malheur River.

YEAR	REDDS	MILES	REDDS/MILE
1992a	1	5.9	0.2
1993	1	15.5	0.1
1994	0	7.3	0
1995	0	6	0
1996	6	3.9	1.5
1997	10	2.3	4.4
1998	3	3.8	0.8
1999	9	3.5	2.6
2000	16	3.5	4.3
2001	5	3	1.7
2002	8	2.3	3.5
2003	0	3.8	0
2004	3	2.5	1.2
2005	3	2.5	1.2
2006	7	2.6	2.7
2007	5	1.5	3.3
2008	7	1.6	4.4
2009	20	1.6	12.5
2010	3	1.6	1.9
2011	5	1.4	3.6
2012			
2013	3	1.35	2.2

[a]- Does not include 14 questionable redds observed by volunteers included in earlier reports.

Horseshoe Creek

Horseshoe Creek reach was surveyed twice in 2013. The survey began at the culvert on USFS RD 28 and ended approximately 1 mile upstream. A total of 11 redds were observed; 7 on August 29 and 4 on September 24 (Table 2).

Table 2. Bull trout redds observed in Horseshoe Creek, tributary to North Fork Malheur River.

YEAR	REDDS	MILES	REDDS/MILE
1998	4	0.4	10
1999	4	0.8	5
2000	7	0.8	6.3
2001	6	0.6	10.3
2002	3	1.2	2.5
2003	1	0.8	1.3
2004	1	0.8	1.3
2005	4	1.2	3.3
2006	15	1.1	11.8
2007	3	1.1	2.7
2008	6	1.2	5
2009	2	1.2	1.7
2010	8	1.2	6.7
2011	8	1.1	7.3
2012			
2013	11	1.1	10

Swamp Creek

Swamp Creek reach was not surveyed in 2013 due to lack of staff and poor weather conditions.

Table 3. Bull trout redds observed in Swamp Creek, tributary to North Fork Malheur River.

YEAR	REDDS	MILES	REDDS/MILE
1992	0	1.2	0
1993	3	2.2	1.4
1994	9	3.9	2.3
1995	0	3.9	0
1996	8	3.8	2.1
1997	21	4.1	5.1
1998	24	4.2	5.7
1999	35	4.1	8.5
2000	40	4.1	9.8
2001	22	4.2	5.3
2002	19	2	9.5
2003	13	4.2	3.1
2004	19	4.3	4.5
2005	20	4.2	4.8
2006	32	4.2	7.6
2007	36	4.3	8.4
2008	20	2.6	7.3
2009	18	2.3	7.8
2010	16	2.8	5.7
2011	10	2.7	3.7
2012			
2013			

Sheep Creek

The lower and upper reaches of Sheep Creek were surveyed once in 2013. The lower reach began at the confluence with the North Fork and continued upstream approximately 2.0 miles. The upper reach began where the lower section ended and continued upstream an additional 1.9 miles. Six redds were observed in total on August 29 (Table 5).

Table 4. Bull trout redds observed in Sheep Creek, tributary to North Fork Malheur River.

YEAR	REDDS	MILES	REDDS/MILE
1992	0	1.1	0
1993	0	2.2	0
1994	0	2.2	0
1995	2	2.9	0.7
1996	13	3.4	3.8
1997	8	2.9	2.8
1998	17	3.5	4.9
1999	22	3	7.3
2000	25	4	6.3
2001	15	3.5	4.3
2002	17	3.5	4.9
2003	12	3.9	3.1
2004	14	2.9	4.8
2005	15	3.9	3.8
2006	17	2.9	5.9
2007	34	3.9	8.2
2008	16	3.2	5
2009	18	2.9	6.2
2010	11	3.9	2.8
2011	10	3.9	2.6
2012			
2013	6	3.9	1.5

Elk Creek

Elk Creek was surveyed twice in 2013. The survey began at the culvert under Forest Road 16 and extended approximately 0.6 miles upstream to the confluence of North Fork Elk and South Fork Elk. The survey continued up the South Fork 0.6 miles and up the North Fork 1.3 miles. A total of 7 redds were observed (Table 6).

Table 5. Bull trout redds observed in Elk Creek and its two tributaries, the North and South forks.

YEAR	REDDS	MILES	REDDS/MILE
1992	1	1	1
1993	1	2.3	0.4
1994	0	2	0
1995	1	4	0.3
1996	3	4.1	0.7
1997	9	4.1	2.2
1998	6	3.5	1.7
1999	12	3	4
2000	5	3	1.7
2001	3	3.2	0.9
2002	7	2.8	2.5
2003	7	3.2	2.2
2004	5	2.5	2
2005	10	3.5	2.9
2006	12	3.7	3.2
2007	9	3	3
2008	12	2.4	5
2009	6	2.5	2.4
2010	8	2.6	3.1
2011	10	2.6	3.8
2012			
2013	6	2.5	2.4

Little Crane Creek

Little Crane Creek was surveyed twice in 2013. The survey started at Forest Road 16 culvert and continued upstream approximately 1.7 miles to Forest Service Road 1665-0498. A total of 8 redds were observed August 28; 4 redds on September 24 (Table 7).

Table 6. Bull trout redds observed in Little Crane Creek, tributary to North Fork Malheur.

YEAR	REDDS	MILES	REDDS/MILE
1992			
1993	3	5.6	0.5
1994	4	7.5	0.5
1995	6	6	1
1996	8	6	1.3
1997	16	4.2	3.8
1998	20	6	3.3
1999	33	6.1	5.4
2000	60	6.1	9.8
2001	74	6.2	12
2002	45	2.8	16.1
2003	30	6.1	4.9
2004	22	3.2	6.9
2005	15	6.1	2.5
2006	14	2.6	5.4
2007	25	2	12.5
2008	14	1.8	7.8
2009	18	1.8	10
2010	9	1.9	4.7
2011	9	1.8	5
2012			
2013	12	1.7	7

The following streams in the North Fork Malheur River Watershed were not surveyed in 2011: Crane Creek, Cow Creek, Little Cow Creek, Deadhorse Creek, Flat Creek and Spring Creek.

Results

Upper Malheur River Watershed

Snowshoe Creek

Snowshoe Creek was surveyed once in 2013. This survey began at the confluence with Big Creek and ended approximately 0.95 miles upstream near the wilderness boundary sign. A total of 4 redds were observed on August 30 (Table 8).

Table 7. Redds observed in Snowshoe Creek, tributary to Big Creek, from late August to late September.

YEAR	REDDS	MILES	REDDS/MILE
1998	10	1.7	5.9
1999	25	1.7	14.7
2000	3	1.7	1.8
2001	16	1.7	9.4
2002	0	1.4	0
2003	6	1.1	5.5
2004	9	0.6	15
2005	3	0.8	3.8
2006	8	0.9	8.9
2007	32	0.9	35.6
2008	6	0.7	8.6
2009	2	0.4	5
2010	5	0.9	5.6
2011	4	0.4	10
2012			
2013	0	0.9	0

Big Creek

Upper Big Creek was surveyed twice and the middle section of Big Creek once in 2013. The middle stream reach began above the confluence with Meadow Fork and ended .95 miles upstream. The upper stream reach began at the trail crossing and continued upstream 0.25 miles. Two redds were observed in the middle section on August 27th, 2 redds were observed in the upper section, August 30th and September 24th (Table 9).

Table 8. Redds observed in Big Creek, tributary to Upper Malheur River, from late August to late September.

YEAR	REDDS	MILES	REDDS/MILE
1998	0	2.3	0
1999	8	4.6	1.7
2000	22	4.6	4.8
2001	31	5.2	5.9
2002			
2003			
2004	5	0.8	6.3
2005	2	0.6	3.3
2006	3	0.7	4.3
2007	1	0.5	2
2008	4	1.6	2.5
2009	0	0.3	0
2010	3	2.1	1.4
2011	1	2.1	0.5
2012			
2013	4	1.25	3.2

Meadow Fork Big Creek

Meadow Fork was surveyed once in 2013. The survey reach began at the USFS bridge at river mile 0.2 and continued upstream approximately 3.0 miles to a waterfall. Nine redds were observed on September 10 (Table 10).

Table 9. Redds observed in Meadow Fork Big Creek, tributary to Big Creek, from late August to late September.

YEAR	REDDS	MILES	REDDS/MILE
1998	39	3.3	11.8
1999	25	3.3	7.6
2000	51	3.3	14.8
2001	92	3.2	28.9
2002	16	3.2	5
2003	0	3.2	0
2004	2	3.2	0.6
2005	7	3.2	2.2
2006	16	3.2	5
2007	10	3.2	3.1
2008	17	3	5.7
2009	8	3	2.7
2010	12	3	4
2011			
2012			
2013	9	3	3

Lake Creek

Both reaches of Lake Creek were surveyed once in 2013. The lower stream reach began at the 1648 road culvert and ended approximately 1.0 miles upstream. The upper stream reach began at the Lake Creek Trailhead and ended 1.2 miles upstream. A gap of approximately 0.4 miles was not surveyed. Seventeen redds were observed in total; 5 redds in the upper reach and 12 redds in the lower reach on September 23 (Table 11)..

Table 10. Redds observed in Lake Creek, tributary to Upper Malheur River, from mid-August to late September.

YEAR	REDDS	MILES	REDDS/MILE
1998	34	2.1	16.2
1999	21	4.3	4.9
2000	22	4.3	5.1
2001	44	4.2	10.5
2002			
2003	21	4.2	5
2004	55	4.2	13.1
2005	51	4.2	12.1
2006	25	4.3	5.8
2007	74	4.2	17.6
2008	65	4.2	15.5
2009	9	2	4.5
2010	52	4.4	11.8
2011	16	4.1	3.9
2012			
2013	17	2.2	7.7

The following streams in the upper Malheur River Watershed were not surveyed in 2013; Summit Creek and Bosonberg Creek.

1.4 Discussion

Survey data can be compared effectively from 1996 to the present. Survey techniques and timing varied between 1992 and 1995 on the North Fork Malheur. During those years, project personnel were struggling with uncertainties related to spawn timing and location. Consequently, there was variation in timing of surveys and areas surveyed. In addition, livestock were abundant in some spawning areas during those years, making identification of redds difficult. Since 1996, survey areas and timing have been standardized. Expertise of surveyors has also increased and some are familiar with all survey reaches. Furthermore, a change in livestock management has reduced stream disturbance and made redds more easily identifiable.

In 2013, sufficient personnel participated in the surveys to complete all stream reaches except Swamp Creek at least once. However the survey period was increased from two days to five days each week.

Thirty-eight redds were observed in the North Fork Malheur watershed in 2013 compared to 53 redds in 2011, a decrease of 28 percent (Appendix A-1). Redd counts in individual streams ranged from 3 to 12. Little Crane and Horseshoe creeks continue to be prime spawning areas for bull trout in this watershed, containing 60 percent of all redds counted.

Based on spawn timing comparisons between the North Fork and upper Malheur Rivers, redds observed prior to mid-September in the upper Malheur River have the highest probability of being bull trout redds. In 2013, 7 redds were counted in the upper Malheur watershed prior to mid-September, with 2 of those observed in Meadow Fork (Appendix A-2). The redd count continues to indicate that the adult spawning population in the upper Malheur River watershed is very low.

During 2013, the peak of bull trout spawning appeared to occur in mid-August. Several large bull trout (>14”) were observed in Horseshoe Creek during this period. Redd counts observed in the NF Malheur River were very low this year. However, adjusted counts based on missed survey reaches bring both the NR Malheur River redd counts (57) and the upper Middle Fork redd counts (30) within the ten year average.

Several issues have been noted recently regarding the survey reaches in NF Elk Creek in the NF Malheur River subbasin, as well as on Big Creek and Snowshoe Creek of upper Middle Fork Malheur subbasin. NF Elk Creek has cut though a sediment bank, abandoned the existing channel, and has created a tunnel that appears to be a partial barrier to fish migration. No redds or adult trout were observed in the mile above this feature, however one juvenile trout (~50mm) was observed just above it. Big Creek has split into three channels above the confluence with Snowshoe Creek. Surveyors attempted to check all three during 2013, however it is likely redds were missed. It is recommended at least three surveyors are used in 2014 on this reach. Snowshoe Creek from the confluence with Big Creek is inundated with alders. Surveyors were unable to see into the gravel due to the cover and shading from the trees. It is recommended this reach be abandoned due to lack of survey effectiveness and surveys begin above the alder thicket (approximately .5 miles from the confluence of Big and Snowshoe Creek).

No law enforcement issues were reported by surveyors in 2013. However, ODFW surveyors counted seven redds on the lower end of the Little Crane Creek reach within the exclosure again on August 28, 2013. Spawning surveyors with USFS checked this area a few days later and noticed significant trampling of the previously marked redds.

Snowpack for the 2013 water year was below average (<60%). It is likely that redd counts during 2014 will continue to be depressed in the North Fork Malheur and upper Malheur River.

1.5 Literature Cited

Hemmingsen, A. R., S.L. Gunckel, J.K.Shappart, B.L. Bellerud, D.V. Buchanan, and P.J. Howell. 1997. Bull Trout Life History, Genetics, Habitat Needs, and Limiting Factors in Central and Northeast Oregon. 1997 Annual Report. Report to Bonneville Power Administration, Contract No.00000228, Project No.199505400, 42 electronic pages (BPA Report DOE/BP-00000228-1).

APPENDIX A

Total redds observed and redds per mile in the upper Malheur River and North Fork Malheur Watersheds from Aug-Oct. 1992-2013, Baker and Grant Counties, Oregon.

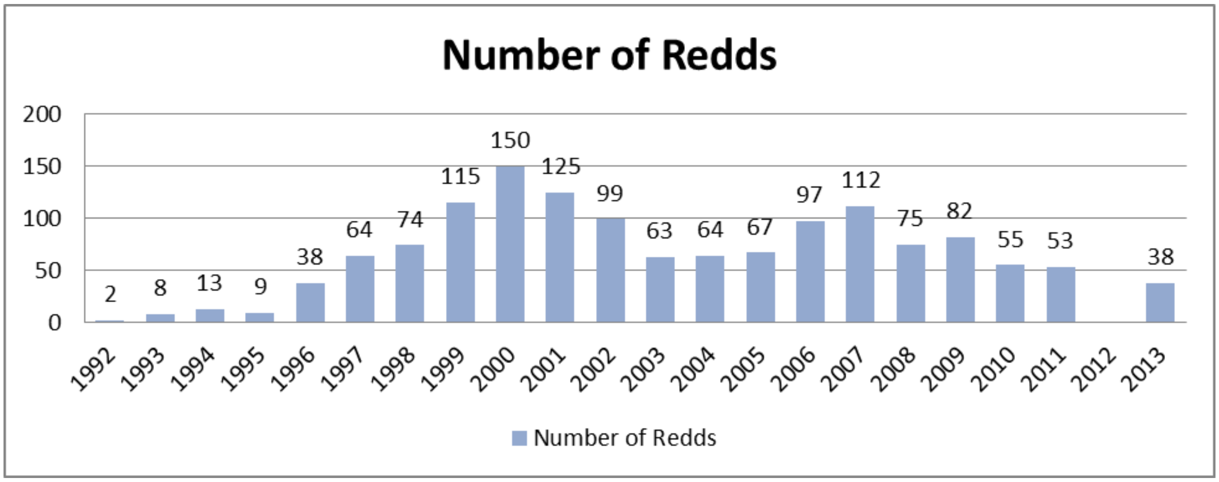

Figure A-1. The number bull trout redds observed in the North Fork Malheur River watershed from 1992-2013.

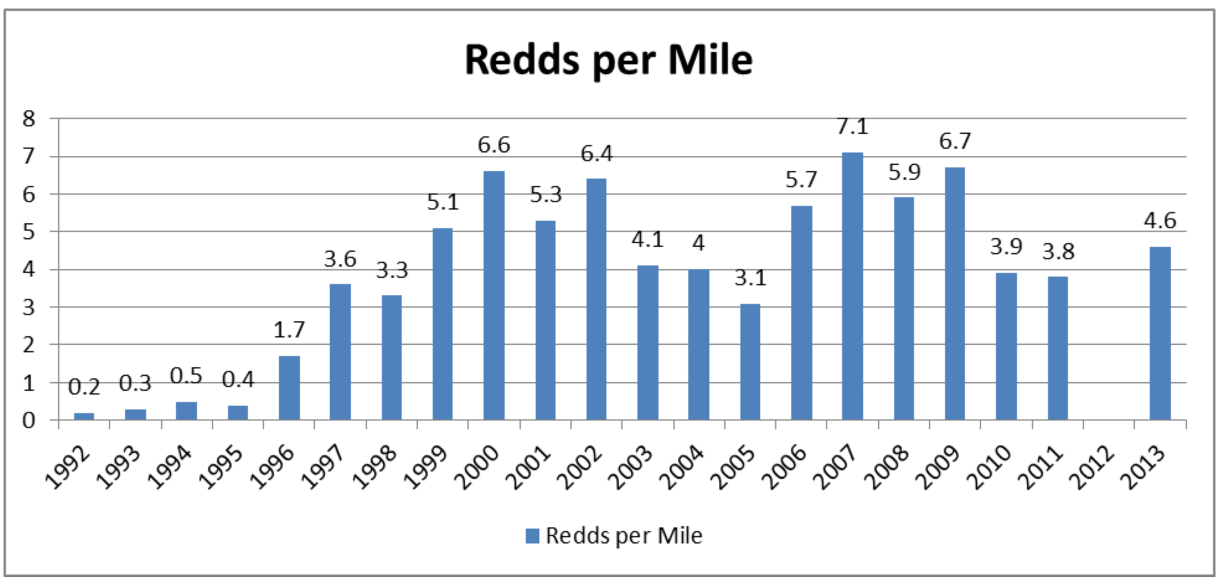

Figure A-2. The number bull trout redds per mile of stream observed in the North Fork Malheur River watershed from 1992-2013.

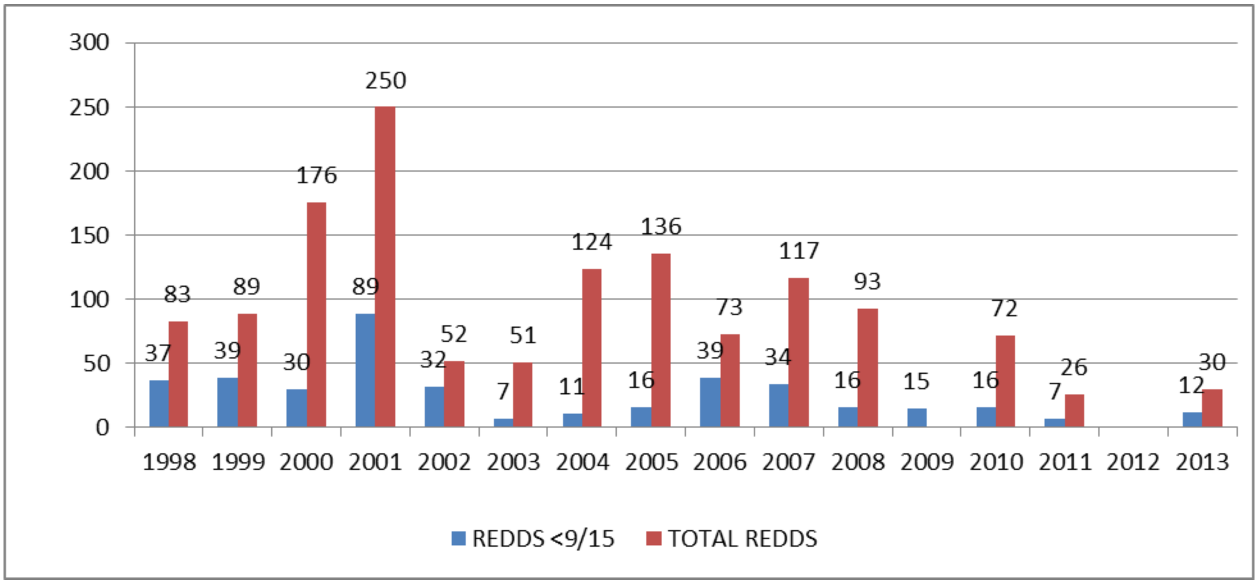

Figure A-3. The number of redds observed in the upper Malheur River watershed, 1998-201e. The blue bars represent the number redds counted prior to September 15. The red bars represent the total number of redds counted.

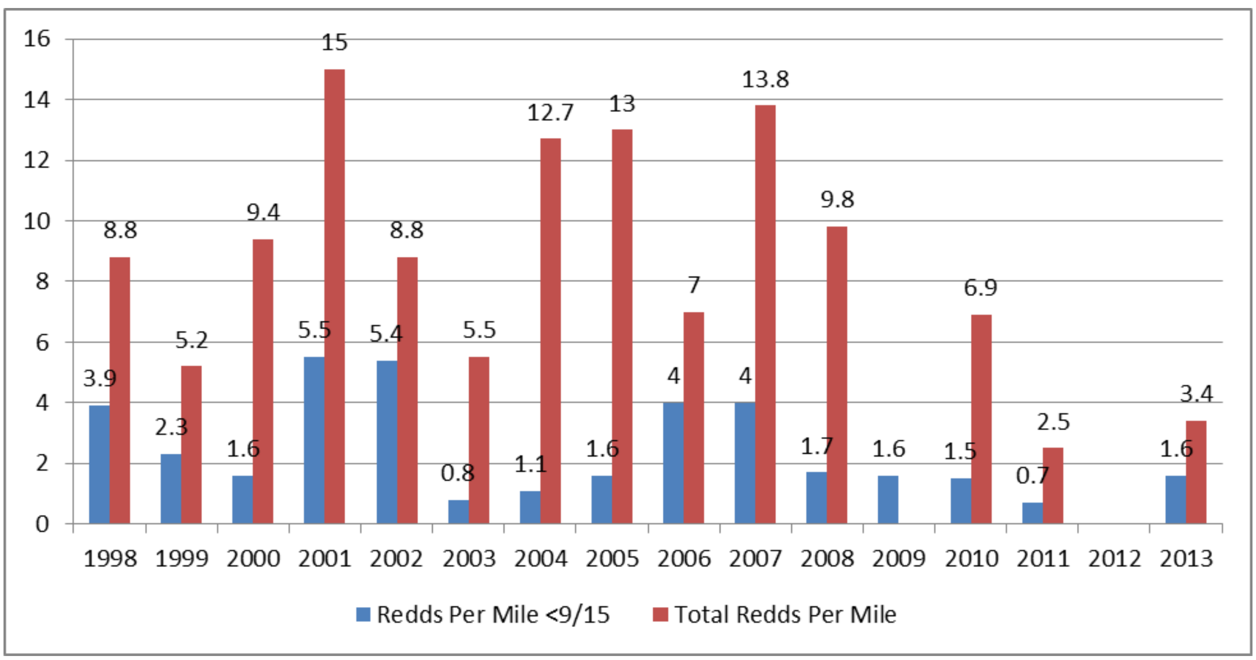

Figure A-4. The number of redds per mile in the upper Malheur River watershed, 1998-2013. Blue bars represent the number redds per mile prior to September 15. Red bars represent the total number of redds per mile.

Chapter 1
2013 Bull Trout Spawning Survey Reports

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Contents

Chapter 2

Selective Removal and Abundance Estimation of Brook Trout *Salvelinus Fontinalis* in Lake Creek, Upper Malheur River, Oregon

Kristopher Crowley
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Selective Removal of Brook Trout (*Salvelinus fontinalis*) in Lake Creek, Upper Malheur River, Oregon

Kristopher Crowley, Fish Biologist
Burns Paiute Tribe Natural Resources Department

2.1 Introduction

Brook trout (*Salvelinus fontinalis*) have been introduced throughout the western United States. Though many of the introductions were originally intended to provide sport fishing opportunities, brook trout have been implicated in declines of native aquatic biota (Adams 1999). Due to the apparent increased dispersal ability in the downstream direction, the stocking of mountain lakes with brook trout can be especially detrimental (Adams 1999; Paul and Post 2001). Though the mechanism(s) through which brook trout affect native species may be variable, resource competition and hybridization are commonly cited factors (Dunham et al. 2002; Gunckel 2001; Ratliff and Howell 1992). In response to the identification of brook trout as a limiting factor to the recovery of ESA-listed bull trout (*S. confluentus*) in the Malheur River basin (USFWS 2002), the Burns Paiute Tribe Natural Resources Department began brook trout suppression efforts in 2010 (Poole and Harper 2011).

Nonnative brook trout exist in high numbers in the Upper Malheur River basin. In the 1930's brook trout were introduced to High Lake (Bowers et al. 1993), a naturally fishless lake which serves as the headwater source of Lake Creek. Brook trout have likely also been introduced through several authorized and unauthorized stockings in the Upper Malheur basin over the last century. The reproductive success of brook trout in High Lake and Upper Malheur River tributaries has led to their dispersal into the majority of suitable habitat. This dispersal has resulted in competition between brook trout and native fish species as well as hybridization between brook and ESA-listed bull trout.

The presence of brook trout can pose serious threats to the bull trout population's long term viability because of its ability to outcompete and hybridize with the native species. Indeed, resource competition and hybridization between the two species is documented in the Upper Malheur (Gunckel 2001; DeHaan et al. 2009). Brook trout threats, along with other environmental and anthropogenic factors, have imperiled bull trout in the Upper Malheur and led to the population being classified as having a "high risk" of extinction (Buchanan et al. 1997). Recovery Criteria for the Malheur Recovery Unit cite stable or increasing abundance trends in bull trout populations and the reestablishment of connectivity between the separated populations of the North Fork and Upper Malheur populations as actions necessary to achieve delisting (USFWS 2002). It has also been deemed necessary to achieve a reduction or elimination of threats from brook trout interaction in the Upper Malheur prior to restoration of passage (USFWS 2002). Full recovery of Malheur River bull trout is therefore contingent upon minimizing the threats posed by brook trout interactions in the basin.

In 2010, Burns Paiute Tribe (BPT) Natural Resources Department began implementation of a mechanical removal project aimed at eliminating brook trout from High Lake and associated headwater portions of its outlet stream, Lake Creek. High Lake and Upper Lake Creek are high elevation sites in the Strawberry Mountains of eastern Oregon. Once naturally devoid of fish, this area now hosts populations of brook trout which may serve as a source population for the Upper Malheur watershed. Suppression efforts continued in 2013 with the purpose of maximizing mechanical removal of invasive brook trout in Lake Creek. This was accomplished through operation of a seasonal weir and a comprehensive stream electrofishing effort above the weirs location. Mechanical brook trout removal in High Lake by gill netting was not achieved in 2013 because of wildfire keeping crews out of the area, but will resume in 2014.

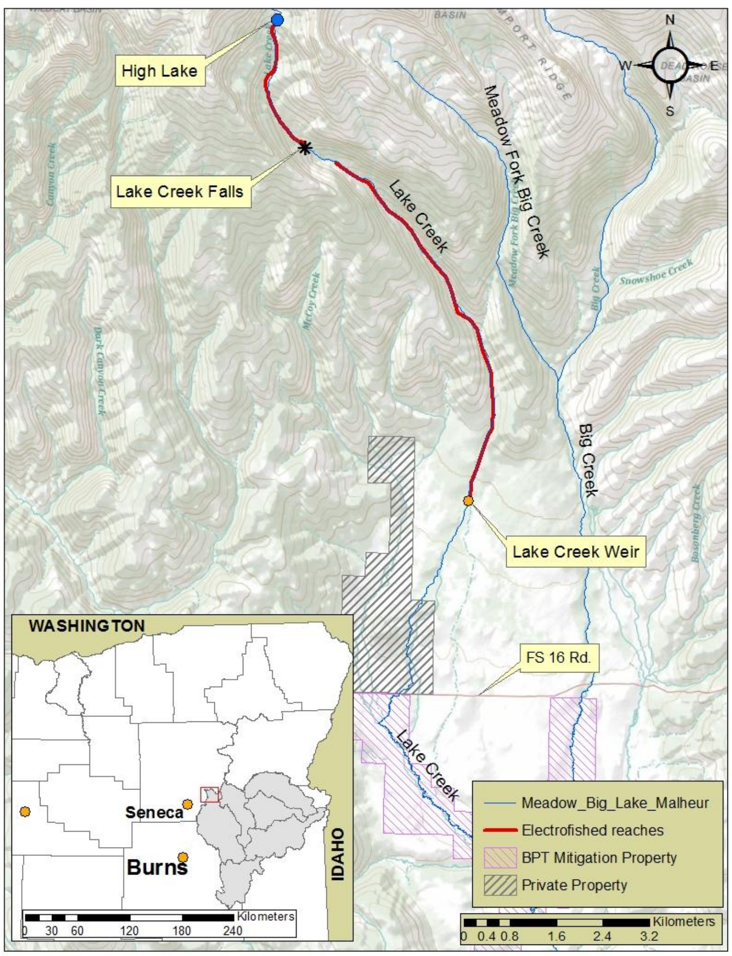

Figure 1. Map showing weir location, property boundaries, and the portion of Lake Creek sampled by electrofishing.

Study Area

The study area is located on the southern flank of the Blue Mountains in eastern Oregon. A major headwater tributary to the Upper Malheur River, Lake Creek flows approximately 20 km from its source at High Lake to its confluence with Big Creek, where the two form the Upper Malheur River (Figure 1). Lake Creek Falls is located near river kilometer (RK) 17 and presents a complete barrier to upstream fish passage. Much of Lake Creek upstream of Lake Creek Falls is characterized by channel widths of 1-2 m and moderate gradients (2-5%) with intermittent steep reaches (15-20%) that may pose as barriers to upstream fish passage. Brook trout are the only fish species present above Lake Creek Falls. Below Lake Creek Falls, Lake Creek is characterized by moderate gradients

(2-5%) and channel widths of 2-5 m. Summer stream temperature regimes in Lake Creek appear suitable for bull trout from Lake Creek Falls down to the weir location (BPT, unpublished data) however, between the weir and Forest Rd. 16 temperatures increase dramatically and often exceed bull trout thermal tolerances (Abel 2010). Fish species present in Lake Creek below Lake Creek Falls include brook trout, bull trout, brook trout/bull trout hybrids, redband trout (*Oncorhynchus mykiss gairdneri*), and sculpin (*Cottus sp.*) (Fenn 2005).

2.2 Methods

Weir

A rigid, picket-style weir with 1.4 cm spacing and fixed with upstream and downstream trap boxes was used to capture fish attempting to pass the weir's location. The weir was checked for fish at least once daily and cleared of debris as necessary. Captured fish were identified to species (except sculpins), measured for fork length (FL; mm), and weighed (g) when a scale was available. The date of capture and trap location (up or downstream) were also recorded. Native species and hybrids were released in the direction of which they were trapped; brook trout were euthanized. Pectoral fin clips were collected from brook trout for future genetics investigations. Bull trout and hybrids larger than 60 mm were anesthetized in 50 mg/L MS-222 (Finquel®) and implanted with a 12 mm x 2.15 mm HDX PIT tag (Texas Instruments®). Fish were tagged ventrally until 23 July when, after guidance from the Bureau of Reclamation, protocol changed to tagging dorsally to reduce tag loss during spawning. Additionally, some downstream migrant brook trout were PIT tagged.[1] Those brook trout were anesthetized using clove oil. Tagged fish were then allowed to recover in freshwater before being released.

Electrofishing

Smith-Root models 12B and LR24 backpack electrofishers were used to conduct electrofishing for removal of brook trout in 2013. A comprehensive sampling approach was taken in which the entire stream was fished successively beginning at the weir (site 1) and moving upstream.

[1] A total of 4 downstream moving brook trout were PIT tagged ventrally from 21 May - 7 June. Prior to the start of the 2013 sampling period in Lake Creek, BPT staff targeted PIT tag implantation of an undefined portion of downstream moving captures. There is currently no evidence that fluvial bull trout use Lake Creek, commonly attributed to unsuitable thermal conditions in lower Lake Creek during the summer months, and few downstream migrant bull trout have been captured at the weir from 2011-2013 (n=8; 0 in 2013). The extent to which these conditions affect brook trout movement is currently unknown. Attempted brook trout movement downstream past the weir location has been observed, but the extent of movements and population level factors triggering these movements is currently unknown. Therefore, implantation of PIT tags on downstream migrant brook trout occurred in hopes of detections at the BPT PIT tag array at the confluence of Big and Lake Creeks. These efforts in 2013 were a continuation of 2012 efforts (n=16) to implant PIT tags in downstream migrant brook trout at the weir location. However, efforts were abandoned early in 2013 due to sporadic operation of the PIT tag array.

Individual sites were 125 m in length and could be adjusted include favorable hydrology and/or structures at reach ends. Crews recorded UTM locations of the top and bottom of each reach using a hand-held GPS unit. The beginning of each new reach was the end of the previous reach with the exception of sites 61-62 which had an area between them that was not sampled.[2] Start and finish times and temperatures were recorded for each site.

Sites sampled through 8 August (1-42) were one pass comprised of a slow, deliberate upstream sweep from a lower block net to the upper block net and a ½-effort sweep back downstream to the lower block net with one electrofishing unit and one to three netters (Harper 2013). Sites sampled beginning 9 August (43-84) were only one upstream pass without a downstream sweep and without block nets (Fenn and Schwab 2003). Change in protocol resulted from time constraints and, more significantly, reducing stress/handling time of bull trout. In each reach, the entire wetted channel and all side channels were sampled. All fish captured via electrofishing were kept in buckets until site completion. Fish were then measured (fork length; FL), enumerated, and identified to species (except sculpins). Native species were measured and released downstream. All brook trout captured were examined for marks/tags and euthanized. Bull trout and hybrids were inspected for PIT tags and/or secondary marks. If perceived stress on bull trout was low (i.e. low holding densities, adequate temperatures) bull trout were retained, measured and some were PIT tagged. Not all bull trout were tagged before release as efforts focused primarily on brook trout removal. If perceived stress on bull trout was high, they were noted and immediately released downstream of the sampling reach without measuring or tagging to limit handling time.

PIT Tagging

Five sites were sampled on 29 July in addition to the above described study with the specific purpose of dorsal PIT tagging of bull trout. Brook trout captured were euthanized, weighed, and measured. Bull trout and hybrids were anesthetized (MS-222), weighed, measured and PIT tagged. Tagged fish were allowed to recover in an in-stream holding tank and released once equilibrium was reestablished and normal behavior ensued. Sites were selected based on high 2012 bull trout densities.

[2] The Parish Cabin wildfire restricted crews from sampling from August 14-26, 2013. When access was granted to the area sampling had to commence above the waterfall barrier as the August 15th deadline to sample where bull trout are present had passed.

2.3 Results

Weir

Species	US	DS
Brook Trout	9	47
Bull Trout	2	0
Bull/Brook Trout Hybrid	1	0
Redband Trout	0	4

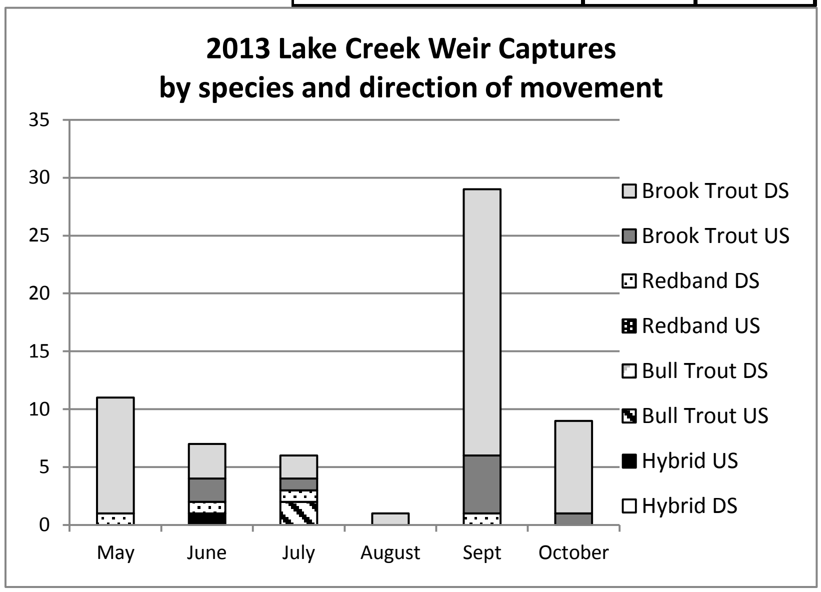

Table 1. Upstream (US) and downstream (DS) weir captures by species (above). Figure 2. Monthly weir captures by species and direction of movement. US=upstream migrants; DS=downstream migrants (below).

In 2013, the temporary weir on Lake Creek was installed on 8 May and removed for the winter season on 30 October. The weir was operational (i.e. trapping) and checked all 175 days it was installed. Four species were captured attempting to pass the weirs location including brook trout (n=56; 52 removed, 4 downstream migrants PIT tagged), bull trout (n=2), brook/bull hybrids (n=1), and redband trout (n=4). The majority of brook trout (84%) and redband trout (100%) were captured moving downstream; while bull trout and hybrids were captured moving exclusively upstream (Table 1).

Length-frequency histograms were created from weir capture data for brook trout and bull trout. Length-frequency histograms from the weir captures are included in Appendix A.

Electrofishing

Electrofishing in Lake Creek began on 17 June and ended on 5 September. Eighty four sites totaling 10,044 meters were sampled with the primary goal of brook trout removal. Forty three sites were sampled in both upstream and downstream directions with block nets. The uppermost 41 sites were sampled using one upstream electrofishing pass without block nets. All sites below the waterfall barrier were visited prior to 15 August to avoid interruption of bull trout spawning.

Five species of fish were captured in the electrofishing effort, including brook trout (n=2640; 2597 ≥ 60mm), bull trout (n=75), bull x brook hybrid (n=58), redband trout (n=178), and sculpin (n=840). All brook trout captured were euthanized; other fish were released. Some trout (n=118) could not be positively identified to species because of undeveloped phenotypic features. Length-frequency histograms are provided for all species (except sculpins; appendix C).

Brook trout was the dominant species below the waterfall barrier (sites 1-61; figure 3; appendix D) and was allopatric above the barrier to High Lake (sites 62-84; appendix B). Brook trout captures outnumbered bull trout (33:1), hybrids (43:1), and redband trout (14:1) below the waterfall barrier. The majority of redband trout were found in the lowest 30 sites (96%). The majority of bull trout and hybrids were captured in sites 30-61 (83%).

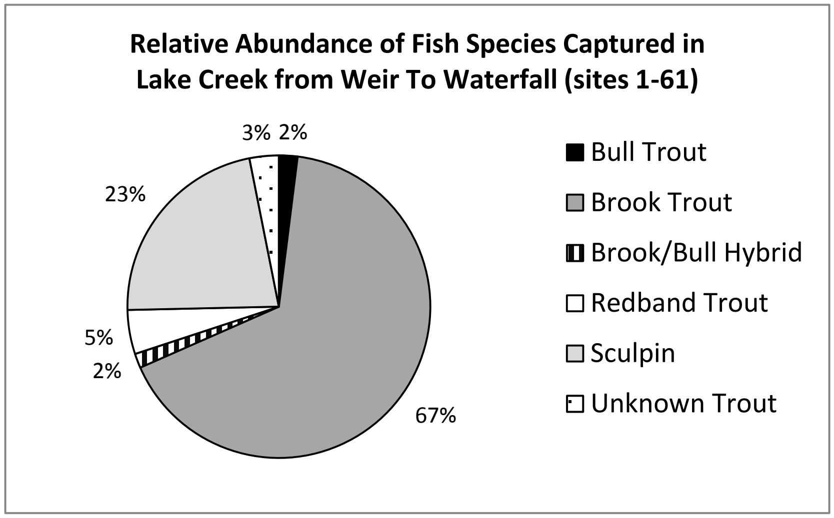

Figure 3. Relative abundance of all electrofishing captures below Lake Creek waterfall barrier. Brook trout were the only species present above the barrier.

PIT Tagging

A total of eleven bull trout, seven brook/bull trout hybrids, and four brook trout were implanted with new PIT tags in 2013. The 29 July sampling for bull trout PIT tagging resulted in tagging of bull trout (n=4) and hybrids (n=5) and the removal of brook trout (n=60). These fish are not included in relative abundance charts or length-frequency histograms for the electrofishing study. Four brook trout, two bull trout, and one hybrid were PIT tagged at the weir in 2013. All brook trout tagged at the weir were downstream migrants; all bull trout and hybrids were upstream migrants. The hybrid tagged at the weir was recaptured 3 days later during the electrofishing effort at site 11 (approximately 1.2 km above the weir) and was further identified to be a bull trout. Nine other recaptures occurred during the electrofishing efforts including bull trout (n=6) and hybrids (n=3). Of these, two bull trout and three hybrids were recaptures from the 29 July tagging effort; other fish were tagged in previous years. Four additional bull trout and two additional hybrids were tagged during the electrofishing effort when time and conditions permitted. Since 2011, BPT has PIT tagged 32 bull trout, 20 brook trout, and 13 brook trout/bull trout hybrids in Lake Creek.

2.4 Discussion

Nonnative brook trout exist in high numbers in the upper Malheur River basin and have dispersed to nearly all suitable habitat within the watershed. This dispersal has resulted in competition between brook trout and native fishes (Gunckel 2001) and is particularly problematic for ESA listed bull trout threatened by hybridization (Dehaan 2009). Brook trout suppression continued in Lake Creek in 2013 through electrofishing and operation of a seasonal weir. In addition to brook trout removal, Lake Creek activities supplement baseline data collection for past and future comparison pertaining to native and exotic fish distributions, interactions, and population dynamics. Comprehensive electrofishing in Lake Creek was accomplished with the exception being the area from the top of site 61 to the waterfall barrier (approximately .5 km). This stream section was not fished because of wildfire keeping crews out of the area. Crews were able to reenter the area 27 August, but the area below the waterfall was left undisturbed so not to disrupt bull trout spawning.

In 2013, efforts focused solely on brook trout removal[3] resulting in a substantial (223%) increase in brook trout that were dispatched from 2012, with electrofishing accounting for the overwhelming majority (98%) of brook trout removed. Electrofishing captures in the lower reaches (sites 1-42) may be higher in comparison to the upper reaches (sites 43-84) in 2013 relative to other years due to more intensive effort early in the sampling period as a function of mid-season adjustments to the sampling protocol, and do not necessarily indicate higher densities. Despite a considerable increase in capture efficiency when a downstream sweep is included (Harper 2012); protocols shifted to a single upstream sweep to reduce handling stress on bull trout and to maximize the actual linear stream distance covered for brook trout removal. Downstream sweeps were not completed for the upper sites (43-84). Removal of block nets from protocol also potentially enabled some brook trout to escape up or downstream before capture. It is important to consider this change in protocol when comparing data between years, as per site captures were likely lower without including block nets or a downstream sweep to complete a pass.

Upper Lake Creek bull trout are putatively a stream resident population, likely due to unsuitable thermal conditions downstream caused by channel reconfiguration and complex water diversions that prevent fluvial bull trout from accessing historic spawning areas during migration in the Upper Malheur Basin (Abel 2009). This is supported by several years of temperature data collection (BPT unpublished data), spawning surveys (Perkins 2012), and radio telemetry studies (Fenton 2005). This causes bull trout in upper Lake Creek to be highly susceptible to hybridization, particularly in comparison to bull trout in other Malheur River headwater tributaries (Dehaan 2009). While electrofishing to remove brook trout may slow detrimental effects on bull trout, it is unreasonable to assume any lasting reduction in brook trout populations. The 2,752 brook trout removed by all BPT activities in Lake Creek in 2013 still comprised only approximately 23% of the 2012 estimated 11,797 (95% confidence interval; 9,362-14,232) total population in Lake Creek above the weir (Harper 2013). A study in Idaho

[3] 2012 efforts included mark-recapture and depletion sample designs geared toward abundance estimates in addition to removal.

showed that electrofishing removals as high as 88% still did not have long term effects in reducing brook trout or increasing redband or bull trout populations (Meyer et al 2006). High Lake being an upstream seed source of downstream brook trout recruitment further reduces the effectiveness of mechanical removal of brook trout. The high ratio of sexually mature brook trout captured in Lake Creek in 2012 and 2013 (Harper 2013; appendix C) highlight the propensity of the Lake Creek brook trout population to rebound yearly after mechanical removal. Resuming gill-netting in High Lake in future years may help reduce recruitment in Lake Creek, but brook trout densities and the negative consequences on native fish are not expected to be substantially reduced long term by mechanical removal methods. They can, however, be curtailed on a yearly basis until planning is finalized and resources become available for effective eradication.

Increasing understanding of distribution and movements of fish in the Upper Malheur Watershed can be achieved through a functional PIT tag array at the confluence of Big Creek and Lake Creek. An array was installed in 2013, but technical and staffing difficulties resulted in very sporadic periods of operation and no detections. BPT is exploring improvement options and will contract for trouble-shooting array installation and operation for the 2014 season.

The high number of hybrids detected in the upper reaches of Lake Creek intensifies concerns as introgressive hybridization has been observed (Dehaan 2009) and poses further threat of loss to bull trout. As evidenced by some recaptures in 2013, phenotypic overlap between pure bull trout and hybrids makes consistent identification difficult in the field. Hybrids are not currently removed despite their threat to bull trout. This stems from confident identification requiring genetic analysis and a lack of current policy clearly defining thresholds for tolerated levels of hybridization. Until these issues can be resolved, mechanical removal of fish in the Upper Malheur Basin will continue to focus solely on brook trout.

In summary, the goal of removing brook trout in Lake Creek by mechanical means was successful as 2,752 brook trout were dispatched in 2013, with electrofishing being the most efficient method of removal. Despite successful removal efforts, expectations are tempered for any lasting positive effects relying exclusively on mechanical methods. Bull trout in the Upper Malheur, and specifically Lake Creek, are at high risk of extinction because of invasive brook trout and isolation due to habitat loss. BPT recommends piscicide treatment throughout the Upper Malheur Watershed targeting brook trout as the best way to protect existing bull trout populations. Land acquisition for restoration and mitigation of thermal impediments below the weir is integral to restoring fluvial use of Lake Creek. Until eradication of brook trout in the Upper Malheur River, its tributaries, and High Lake is achievable it is recommended that mechanical removal practices continue in order to offset present threats to native salmonids.

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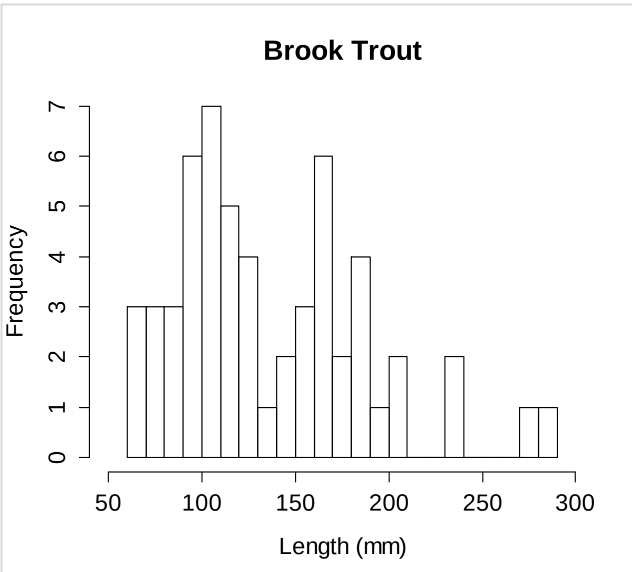
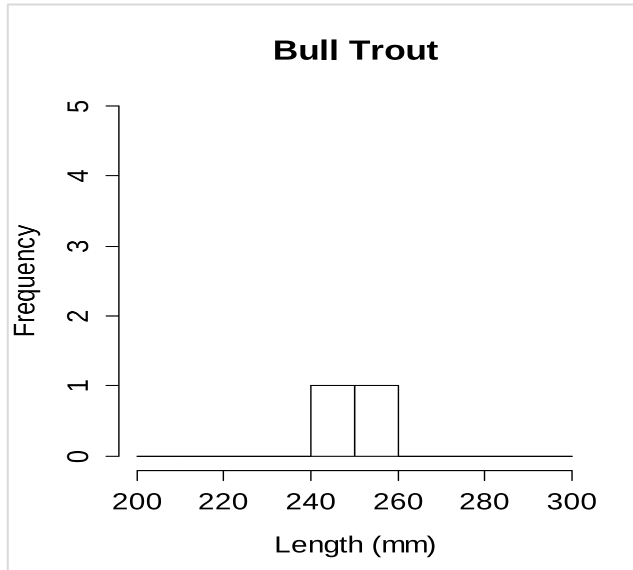
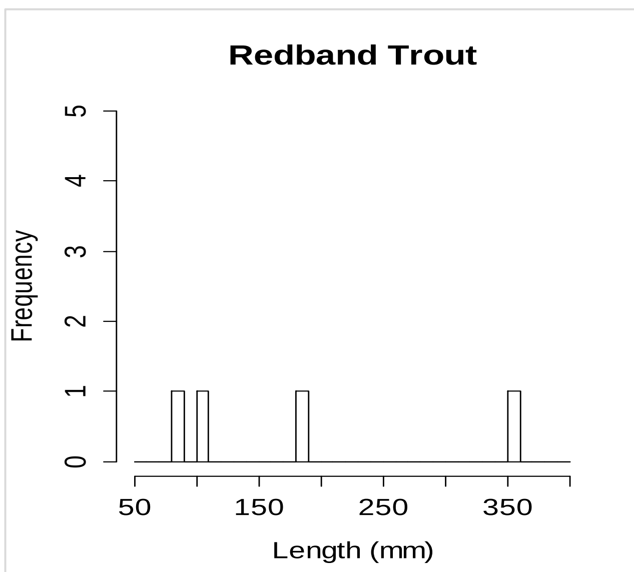
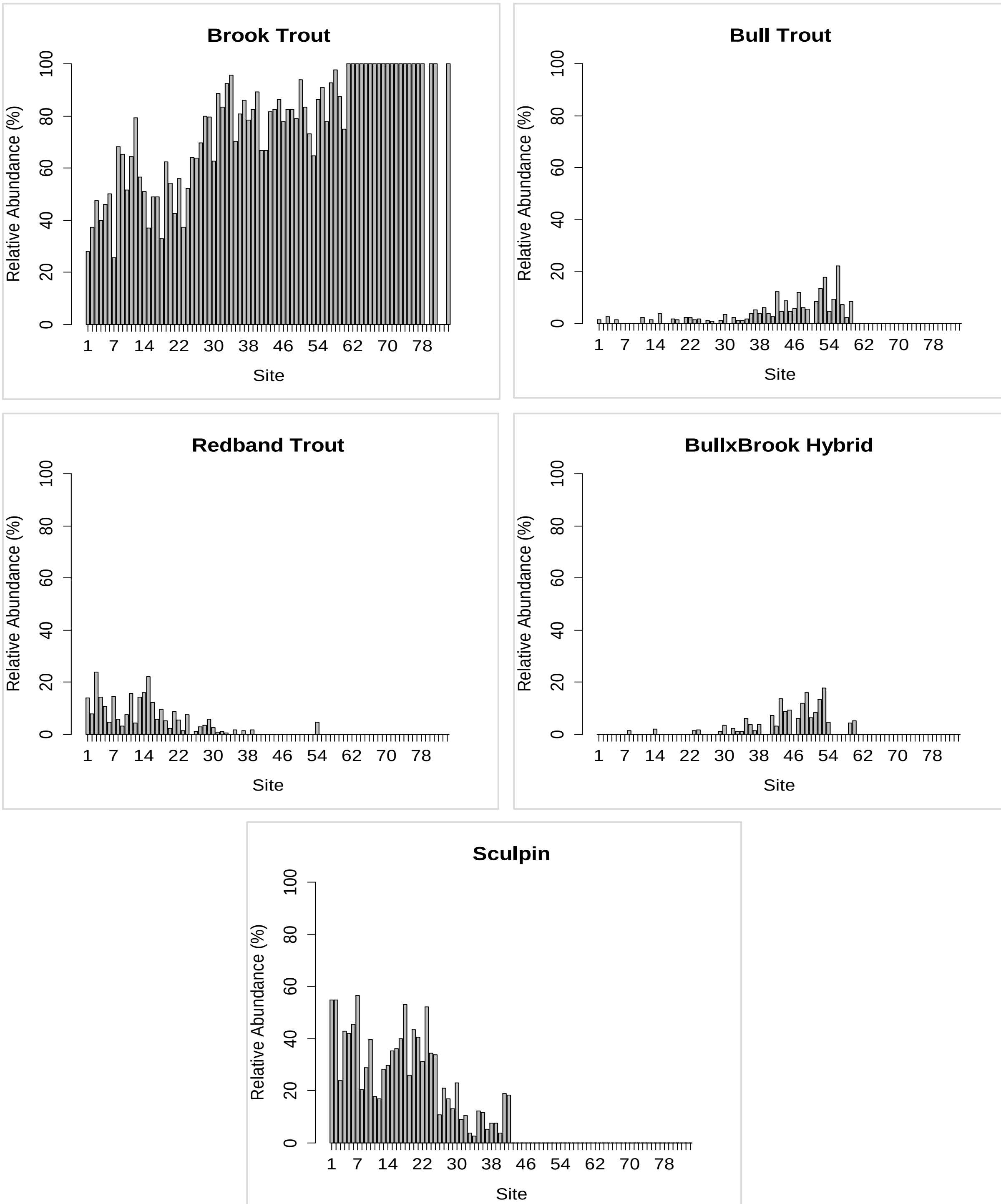
Appendix A. Length-Frequency histograms from weir data.



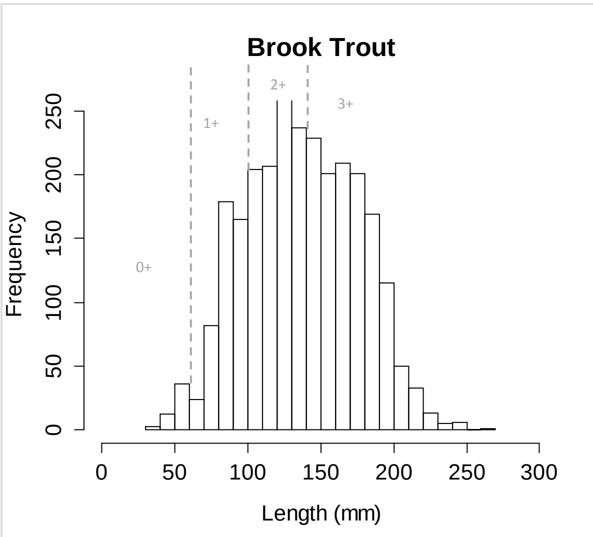


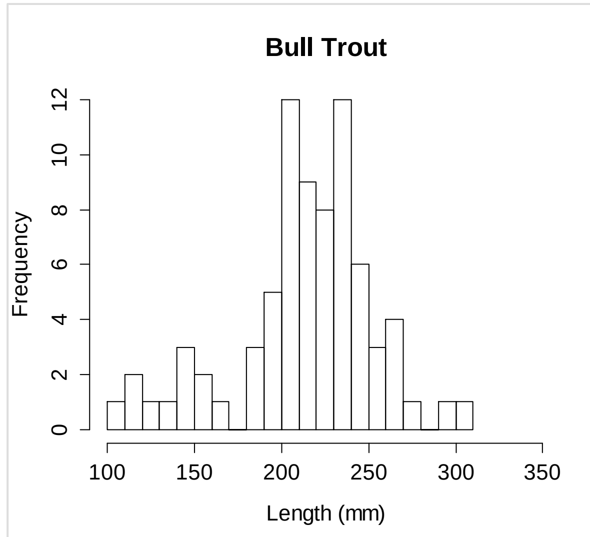


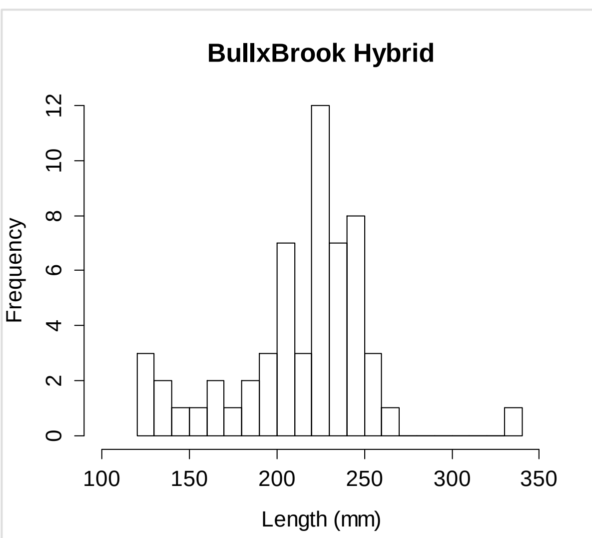
Appendix B. Relative abundance for each species per electrofishing site in Lake Creek (2013). Relative Abundance is expressed as a percent of the total catch of fish per site. Sites 1-61 are below the waterfall barrier; sites 62-84 are above.

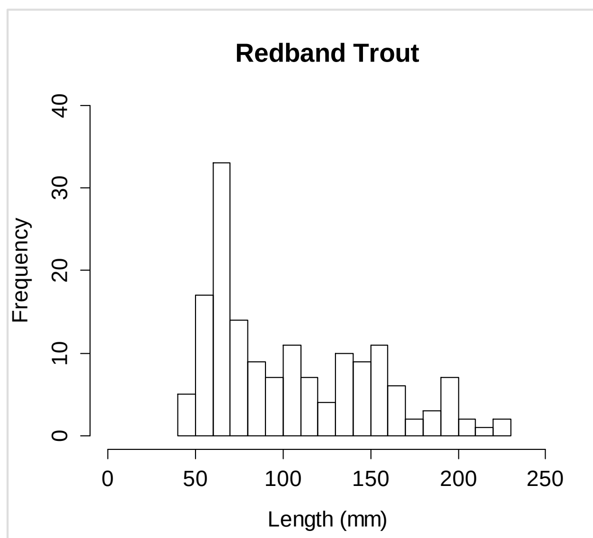


Appendix C. Length-Frequency histograms from electrofishing data. *Note: Brook trout age classes are estimated on that histogram.*

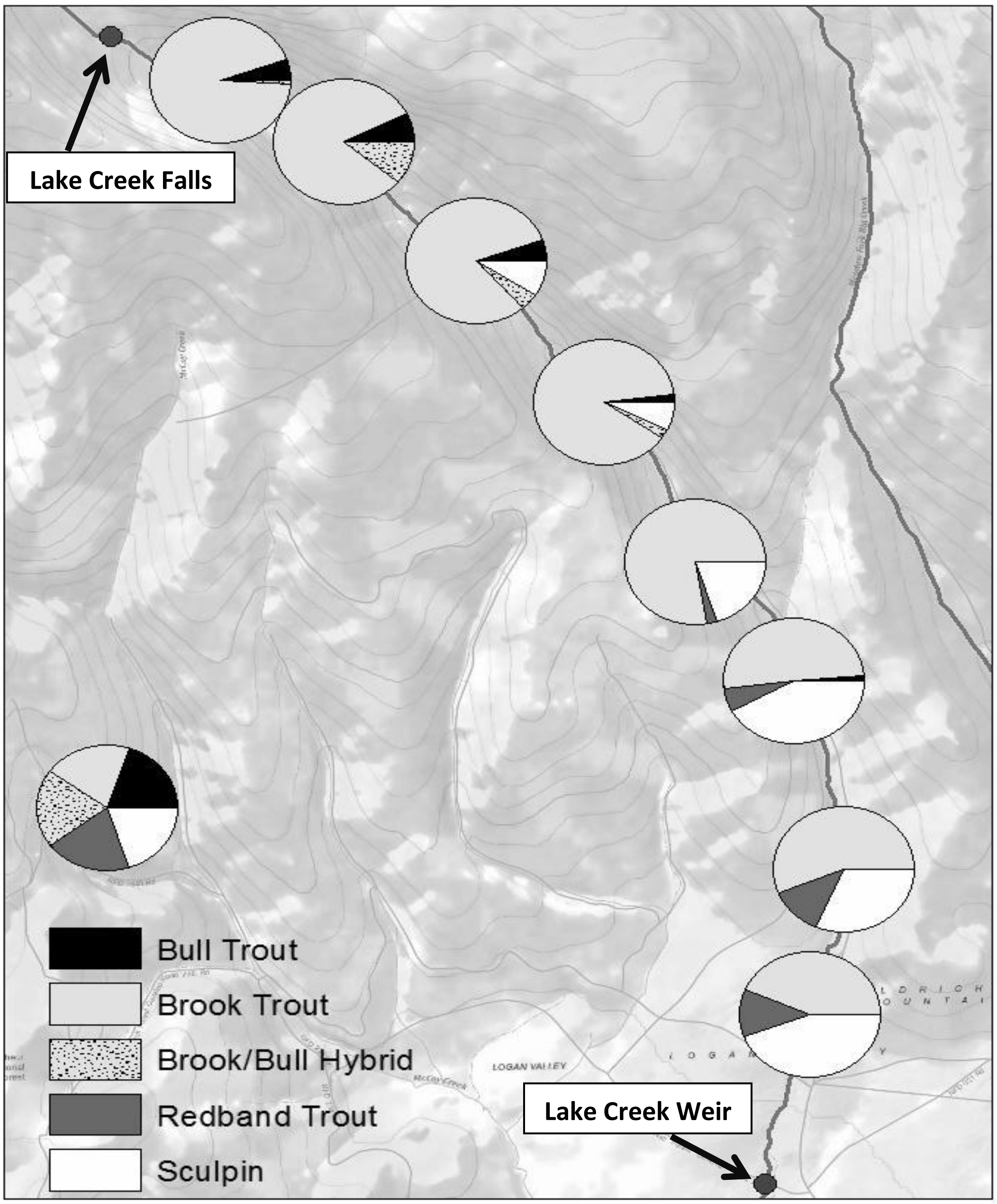








Appendix D. Map of Lake Creek from weir to waterfall with pie charts showing relative abundances of electrofishing captures. Sample area is divided into approximately 1000 meter sections. Trout that were not able to be identified because of undeveloped phenotypic characteristics are not included in charts.



Chapter 3

Selective Removal and Risk Assessment of Brook Trout *Salvelinus faninalis* in Meadow Fork Big Creek, Upper Malheur River, Oregon

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Chapter 4

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Logan Valley Wildlife Mitigation Property, 2013

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Selective Removal and Risk Assessment of Brook Trout *Salvelinus faninalis* in Meadow Fork Big Creek, Upper Malheur River, Oregon

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Burns Paiute Tribe Natural Resources Department

3.1 Introduction:

Brook trout (*Salvelinus fontinalis*) have been introduced throughout the western United States. Though many of the introductions were originally intended to provide sport fishing opportunities, brook trout have been implicated in declines of native aquatic biota (Adams 1999). Due to the apparent increased dispersal ability in the downstream direction, the stocking of mountain lakes with brook trout can be especially detrimental (Adams 1999; Paul and Post 2001). Though the mechanism(s) through which brook trout affect native species may be variable, resource competition and hybridization are commonly cited factors (Dunham et al. 2002; Gunckel 2001; Ratliff and Howell 1992). In response to the identification of brook trout as a limiting factor to the recovery of ESA-listed bull trout (*S. confluentus*) in the Malheur River basin (USFWS 2002), the Burns Paiute Tribe Natural Resources Department began brook trout suppression efforts in 2010 (Poole and Harper 2011).

Nonnative brook trout exist in high numbers in the Upper Malheur River basin. In the 1930's brook trout were introduced to High Lake (Bowers et al. 1993), a naturally fishless lake which serves as the headwater source of Lake Creek. Brook trout have likely also been introduced through several authorized and unauthorized stockings in the Upper Malheur basin over the last century. The reproductive success of brook trout in High Lake and Upper Malheur River tributaries has led to their dispersal into the majority of suitable habitat. This dispersal has resulted in competition between brook trout and native fish species as well as hybridization between brook and ESA-listed bull trout.

The presence of brook trout can pose serious threats to the bull trout population's long term viability because of its ability to outcompete and hybridize with the native. Indeed, resource competition and hybridization between the two species is documented in the Upper Malheur (Gunckel 2001; DeHaan et al. 2009). Brook trout threats, along with other environmental and anthropogenic factors, have imperiled bull trout in the Upper Malheur and led to the population being classified as having a "high risk" of extinction (Buchanan et al. 1997). Recovery Criteria for the Malheur Recovery Unit cite stable or increasing abundance trends in bull trout populations and the reestablishment of connectivity between the separated populations of the North Fork and Upper Malheur populations as actions necessary to achieve delisting (USFWS

2002). It has also been deemed necessary to achieve a reduction or elimination of threats from brook trout interaction in the Upper Malheur prior to restoration of passage (USFWS 2002). Full recovery of Malheur River bull trout is therefore contingent upon minimizing the threats posed by brook trout interactions in the basin.

Past redd surveys (Perkins 2002) and electrofishing studies (Fenn and Schwabe 2004) have identified Meadow Fork Big Creek (Meadow Fork) as one of the strongholds for bull trout in the upper Malheur River basin. The upper reaches of Meadow Fork have been found to contain exclusively bull trout (Fenn and Schwabe 2003). Similarly to Lake Creek, Meadow Fork has a waterfall barrier defining the upper limits of bull trout. However, unlike Lake Creek, there is no source of brook trout recruitment from above the barrier.

Brook trout have often been observed as the dominant species only in high elevation headwater stream reaches when competition exists from brook trout (Paul and Post 2001). The reason for this tendency is complex as brook trout are capable of outcompeting bull trout across a wide range of temperatures (McMahon 2007). However, despite retaining a competitive advantage over bull trout even at lower temperatures, this advantage may be magnified in thermal conditions more desirable to brook trout. Stream temperatures have been monitored in Meadow Fork by BPT since 2011, and the Oregon Department of Fish and Wildlife (ODFW; unpublished data) since 1999. In addition to weir installation, stream temperatures may lend understanding concerning movements and migrations of stream resident and fluvial bull trout populations inhabiting Meadow Fork.

Study Area

The study area is located approximately 320 river kilometers (RK) upstream from the Snake River on the southern flank of the Blue Mountains in eastern Oregon. Major headwater tributaries are Lake Creek and Big Creek which merge in Logan Valley to form the Upper Malheur River (figure 1). The source of Lake Creek is High Lake and a variety of springs. Big Creek is fed by Snowshoe Creek, Coral Basin Creek, and Meadow Fork. The source of Meadow Fork is Mud Lake and Little Mud Lake; both are naturally fishless. There is an impassible waterfall barrier 5.4 km from the mouth of Meadow Fork. Above the barrier is naturally fishless. Meadow Fork contains critical bull trout spawning areas (Perkins 2002). Habitat consists of pool riffle sequences with large amounts of woody debris. Upper Malheur River flows typically peak in late spring and early summer and are primarily attributed to snowmelt. Flows decline to base levels in mid-summer. As flows decline and stream water temperatures rise, bull trout migrate upstream into smaller tributaries such as Meadow Fork seeking suitable temperatures and spawning areas (Fenton 2006).

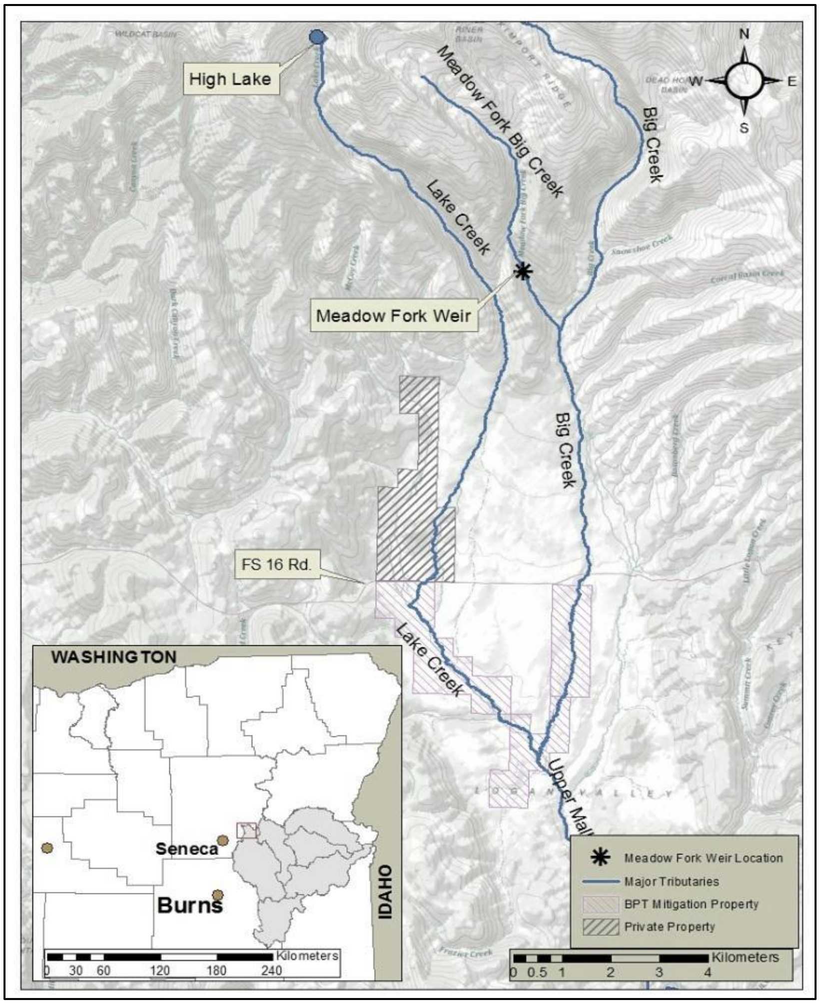

Figure 1. Map showing major tributaries and features in the study area including the weir in Meadow Fork Big Creek.

In 2013 a weir was placed in Meadow Fork and was monitored by BPT with the purpose of removal of invasive brook trout. It helped determine the use of critical spawning habitat above the weir by bull trout, brook trout, and bull trout/brook trout hybrids (hybrids). Results will aid in future management decisions regarding brook trout suppression and proposed chemical treatment of the Upper Malheur Watershed.

3.2 Methods:

Weir

A rigid picket style weir with 1.4 cm spacing was placed in Meadow Fork. The weir was fitted to reach just beyond the wetted width and was equipped with upstream and downstream trap boxes in order to capture fish attempting to pass the weir's location. Bull trout and bull trout/brook trout hybrids (hybrids) caught in traps were scanned for existing marks/tags. If tagged the fish was noted and released in consideration of the direction of capture. If not marked or tagged, fish were anesthetized (50mg/L MS-222(Finquel®)), measured (fork length in millimeters; weight in grams) PIT tagged subcutaneously in the dorsal sinus (12mm x 2.15 mm HDX passive integrated transponder (Texas Instruments)), and released in consideration of the direction of capture after recovering in fresh water. Smaller fish were noted and released without tagging.

Periodic night checks were also performed in order to account for 'trap-shy' behavior. During these checks a spotlight was utilized to detect fish in the pools upstream and downstream of the weir. Fish found with the spotlight were then captured if possible using dip nets or by herding into trap boxes. When fish were captured outside of the weir trap boxes directionality was not speculated and the fish were released on the same side of the weir as capture occurred.

Temperature:

In 2013, one Tidbit v2 Temperature Logger (hobo) manufactured by Onset Computer Corporation was deployed in Meadow Fork. Past BPT hobo locations were just upstream of the mouth of Meadow Fork (2011-12). In 2013 the hobo unit was moved to the weir site and was deployed on 10 July. Hobos were subjected to accuracy checks prior to deployment using methods recommended by the Oregon Water Quality Monitoring Technical Guidebook (2001). Standards dictate that hobo readings cannot vary ±0.5°C from readings by a thermometer certified by the National Institute of Standards and Technology (NIST). Eight pound anchors were used to secure hobos in stream. Timing of deployment has varied slightly from year to year, usually as a result of seasonal weather conditions or staff availability. Having hobos deployed in Logan Valley by 1 May was the objective in 2013 and may continue to serve as the target date for deployment in the years ahead.

The rolling daily maximum temperature averaged over a seven day period is referred to as mean weekly maximum temperature (MWMT). This unit of measurement is also known as Seven Day Average Maximum or 7DADM, and is synonymous with maximum rolling temperature calculations utilized in previous reports by BPT. The Department of Environmental Quality (DEQ) Stream Temperature Standard is 12 °C MWMT for bull trout migration and juvenile rearing and is 16 °C MWMT for salmonid core rearing areas (i.e. an area of moderate to high density use generally in a basin's middle to upper reaches)(OAR 2004). In past reports BPT has used these rolling temperature benchmarks in determining suitable thermal conditions for bull trout. MWMT graphs are provided in this report for comparative purposes, but daily temperature ranges provide a more detailed examination of water quality as it pertains to bull trout survival, growth and interactions with brook trout. Selong et al (2001) describes maximum-growth temperature as the temperature where the growth rate of fish fed to satiation is maximized and the incipient lethal temperature (ILT) as the temperature at which 50% of individuals will die in a defined amount of time. Bull trout maximum-growth temperature is 13.2°C and ILT is 20.9°C in 60 days (23.5°C in 7 days)(Selong 2001). Brook trout exhibit a higher maximum-growth temperature of 16°C (Dwyer et al. 1983 as cited in Selong 2001) and ILT of 24.5°C in 7 days (McCormick et al. 1972 as cited in Selong et al 2001). . The temperatures listed above are thus important monitoring benchmarks and are utilized for comparative analysis throughout this report.

The timeframe 15 July-15 August was outlined as the critical stream temperature period in the Malheur by Perkins (1999) and has been used in previous BPT reports as an index for interpreting stream temperature data. Temporal occurrence of highest stream temperatures was identified to see if dates fell within the 32 day critical stream temperature period.

3.3 Results:

Weir

The weir on Meadow Fork was installed on 25 June, 2013. The weir remained until 30 October, 2013. The weir was operational and checked 126 of the 127 days it was installed[1]. Two species of fish were captured during the period of operation, including bull trout (n=17) and putative bull/brook trout hybrids (n=3). Bull trout ranged in length from 197-345mm. Hybrids ranged from 335-385mm. Length-frequency histograms were created from weir capture data for bull trout and hybrids. 40% of fish (n=8) were captured in the upstream trap, 50% (n=10) in the downstream trap, and 10% (n=2) were netted outside of the weir during night checks (table 1). One fish was initially captured during a night check upstream of the weir; the fish was tagged and released upstream of the weir and was recaptured in the downstream trap two days later. Because the fish eventually passed the weir it is included with downstream captures. Excluding the two fish that never passed the weir, most fish (80%) showed upstream movement from weir installation through September 6th. September 7th through October 30th all fish were captured in the downstream direction. No PIT tagged fish initially captured in upstream or

Direction	US	DS	NM
Bull Trout	5	10	2
Brook Trout	0	0	0
Bull/Brook Trout Hybrid	3	0	0

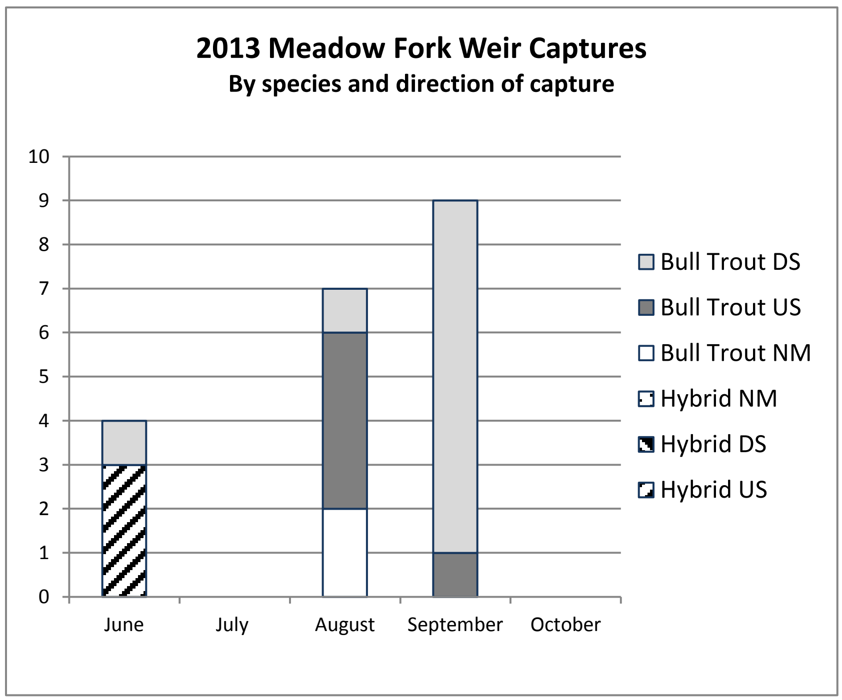

Table 1. Upstream (US), downstream (DS), or no movement (NM) for direction of captures at weir by species (above). Figure 2. Monthly weir captures by species and direction. NM= No directional movement across weir; US= upstream migrants; DS= downstream migrants (below).

[1] The Parish Cabin Fire kept crews from accessing the weir on 13 August. No fish were trapped when the weir was checked the next day.

downstream trap boxes were recaptured at the weir for the duration of the season. Peaks for downstream bull trout movement were observed in August and September, although not to the extent expected. All hybrids were captured in June heading upstream.

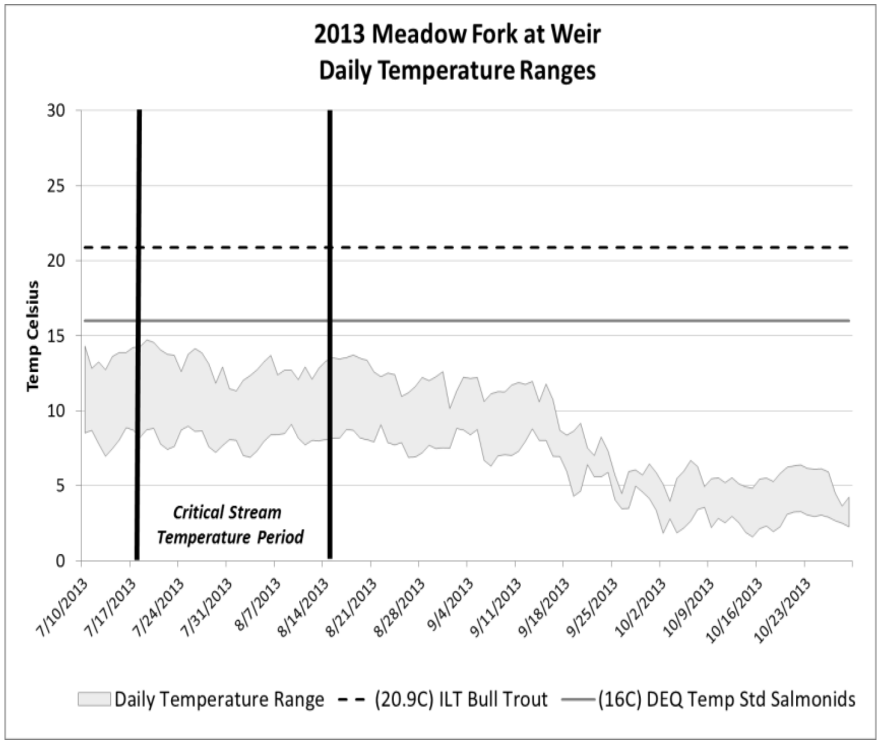

Figure 3. Daily temperature ranges at the Meadow Fork weir in 2013 (Critical stream temperature period 15 July-15 August).

Temperature

In 2013, Meadow Fork daily temperature ranges never encompassed the ILT of 20.9°C or the 16°C benchmark for salmonid core rearing areas, decline of bull trout feeding, and brook trout maximum-growth temperature (figure 3). Daily temperature ranges often encompassed bull trout maximum growth temperatures throughout the critical stream temperature period. Temperatures in Meadow Fork reached highs during the week of 13 July through 20 July.

3.4 Discussion:

Since initial introduction, potentially during the 1930s or prior, brook trout exist in high numbers and have either dispersed or have been introduced to nearly all suitable habitat within the Upper Malheur River Watershed. This has resulted in competition between brook trout and native fishes as well as hybridization between brook and ESA-listed bull trout. Hybridization poses a significant threat to bull trout at the population level (Dehaan 2009). In addition, competition with brook trout has direct negative effects on bull trout densities (Nakano et al 1998). Efforts for suppressing brook trout and assessing their risk on bull trout were expanded in 2013 with a weir being placed in Meadow Fork, a bull trout dominated tributary in the upper Malheur River (Fenn and Schwabe 2004). However, despite a high ratio of bull trout to brook trout, populations have shown susceptibility to stochastic natural events such as wild fire and flash flooding (Fenton 2005) and the population remains sensitive due to threats from invasive brook trout throughout other streams in the watershed. Although this was the first year installing a Meadow Fork weir, implementation was based on similar studies in Lake Creek in previous years. The weir operation in Meadow Fork provided establishment of some data for comparison with future and past efforts while providing insights about brook trout use in the upper reaches of the stream.

Peak bull trout capture in August and September in Meadow Fork differs from observations in Lake Creek in 2012 and 2013 where bull trout captures did not show a defined peak, but were observed only in June and July (Harper, 2013; BPT unpublished data). This is most likely due to a small sample size in Lake Creek in 2012 (n=9) and 2013 (n=2) and in Meadow Fork in 2013 (n=17), but may also be attributed to varying habitats and thermal conditions between the two streams. Spawning activity was observed in 2013 by adult sized bull trout (BPT unpublished data).

The data collected in Meadow Fork supported previous radio telemetry studies (Schwabe 2000; Schwab and Fenton 2001; Fenton 2005; Fenton 2006) suggesting that bull trout move out of the Malheur River and into its smaller tributaries until late August and spawn in early September before beginning downstream migration during the fall and winter months. Given a small sample size, it is worth noting the upstream migration of all hybrids captured in the study occurred in June and no hybrids were captured in the downstream trap box for the duration of the weir being operational. It is also important to note that these hybrids are putative and no genetic confirmation was completed. As Dehaan (2009) demonstrated, phenotypic identification of hybrids reflect genetic identity 89% of the time. This is evident by some recaptures in 2013 (Lake Creek; BPT unpublished data) demonstrating phenotypic overlap between pure bull trout and hybrids makes consistent identification difficult in the field. As introgressive hybridization has been observed in the Upper Malheur (Dehaan 2009); actual hybrids above the weir would pose further threat of loss to bull trout in Meadow Fork. Hybrids are not currently removed from the upper Malheur watershed despite their threat to bull trout. This stems from lack of confirmatory genetic identification in the field and a lack of current policy clearly defining thresholds for tolerated levels of hybridization. Until these issues can be resolved, mechanical removal of fish in the Upper Malheur basin will continue to focus solely on brook trout. It is inconclusive whether the putative hybrids were utilizing Meadow Fork for spawning purposes in 2013; however, their presence above the weir suggests the possibility. Past mechanical efforts of brook trout removal in the upper Malheur may have slowed, but not eliminated this threat. A more effective approach to invasive brook trout removal is a comprehensive piscicide eradication effort for the entire watershed. Through piscicide treatment, eradication has been achieved in other watersheds in the Western United States (Buktenica et al 2013; Anderson 2011). In order to preserve the genetic purity of bull trout populations in the Upper Malheur Subbasin it is critical that eradication efforts commence as soon as possible.

No fish initially captured and tagged were recaptured to indicate a completed migration/spawning cycle. This suggests that downstream migration out of headwater streams like Meadow Fork to the Malheur River either began later than in previous years (Fenn and Schwabe, 2002) or that migration as a whole was impeded. Homel (2008) suggests that temperature cues may play a role in migration timing, but other biotic and abiotic factors present from season to season may also have influence. Stream temperatures dropping steeply in mid-September (figure 3) suggest the possibility that thermal conditions affected migration timing in 2013.

The fish captured during night checks shows that trap-shy behavior may be a factor in these types of trapping efforts in Meadow Fork. It is unclear whether bull trout captures by spotlight resulted from fish that were hesitant to migrate because of the weir, or due to the use of the backwater pool habitat at the weir location. It is possible that weir operation hindered migratory bull trout seeking spawning grounds. Night spotlight checks were in place to reduce trap-shy behavior, and/or decide whether observations warranted premature weir removal. It is unclear whether night checks were sufficient to account for negative effects of the weir to movement as two of the three fish captured outside of the weir trap boxes never passed the weir after capture. Redd counts in Meadow Fork have been relatively low in recent years (Perkins 2012) and showed no departure from this pattern in 2013 (ODFW unpublished data). Any impediment to movement could be detrimental to the population if persistent for subsequent years.

The purpose of the weir in Meadow Fork was to remove brook trout attempting to utilize known bull trout spawning areas, to determine the timing and extent of this movement, and to assess risk to bull trout relative to baseline data (Fenn and Schwabe 2004). No brook trout were captured in 2013 supporting previous electrofishing surveys that found no brook trout in the upper reaches of Meadow Fork (Fenn and Schwabe 2004). Since trap-shy behavior may have occurred, bull trout captures were low, and no brook trout were captured either moving upstream or downstream of the weir location, it is recommended that weir operation cease in Meadow Fork in 2014 to take a highly cautionary approach to avoid any possible negative effects on bull trout reproduction. In order to expedite relief from known threats (i.e. hybrids in critical spawning areas), resources may be better utilized on base line data collection in preparation for piscicide treatment in the Upper Malheur.

Temperature studies in Upper Malheur streams in the last decade indicate that during the critical stream temperature period conditions are largely unsuitable for bull trout (>16°C). In 2013, an exception continued to be Meadow Fork where bull trout have been found to be the dominant species, and where brook trout have not been found in headwater areas. Documented thermal conditions in Meadow Fork, and lack of an upstream seed source for brook trout downstream recruitment, may continue to create suitable conditions for bull trout. Temperatures which remain constantly below 16°C (appendix B) prevent bull trout exposure to detrimental summertime conditions for growth, juvenile rearing, and migration. The area above the weir may be a priority area for piscicide treatment and salvage efforts, as conditions remain suitable for bull trout. The weirs location may also be considered for a velocity barrier during piscicide treatments to definitively prevent brook trout and hybrid movement upstream. Until piscicide treatment begins in the Upper Malheur it is recommended that efforts focus on preparatory baseline data collection and mechanical removal of brook trout to reduce effects on bull trout in areas of sympatry.

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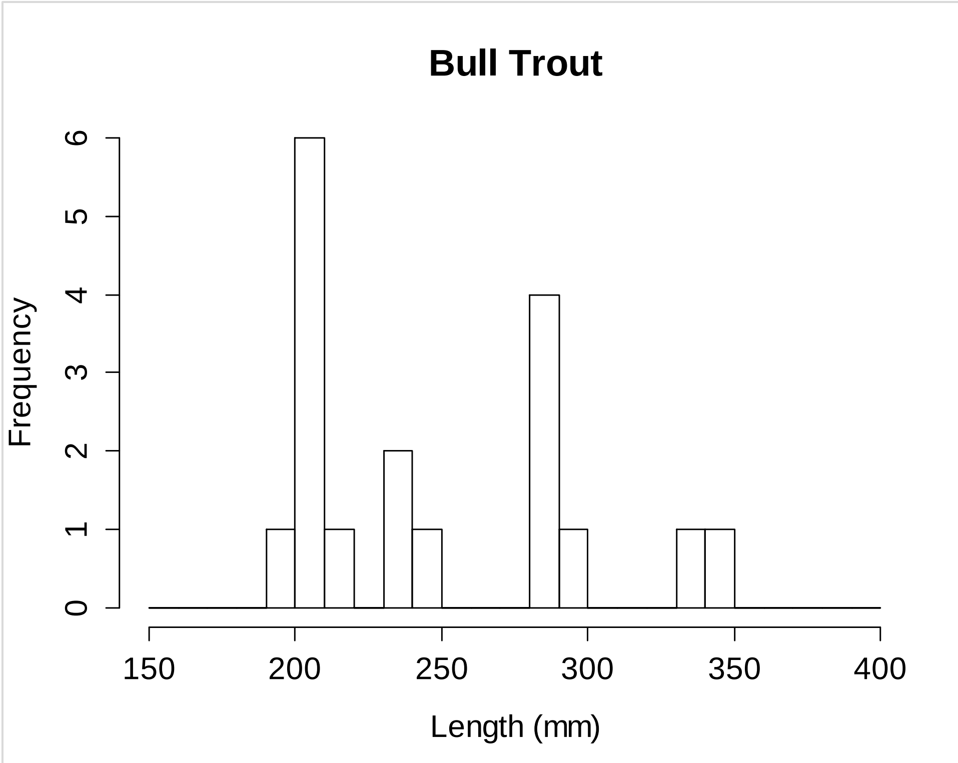
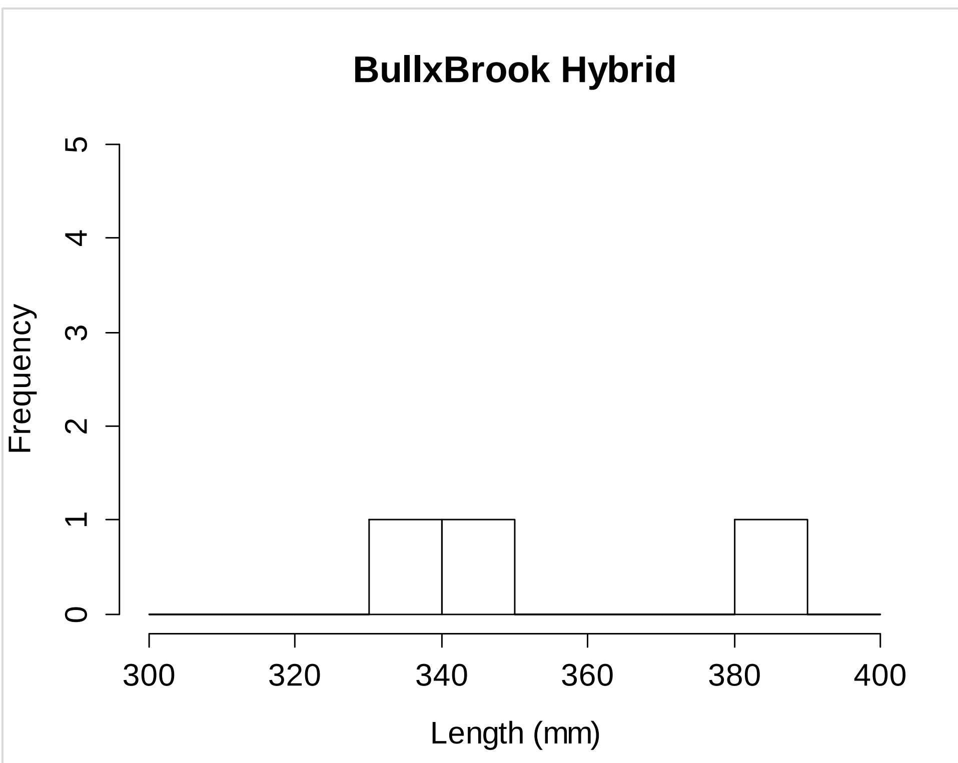
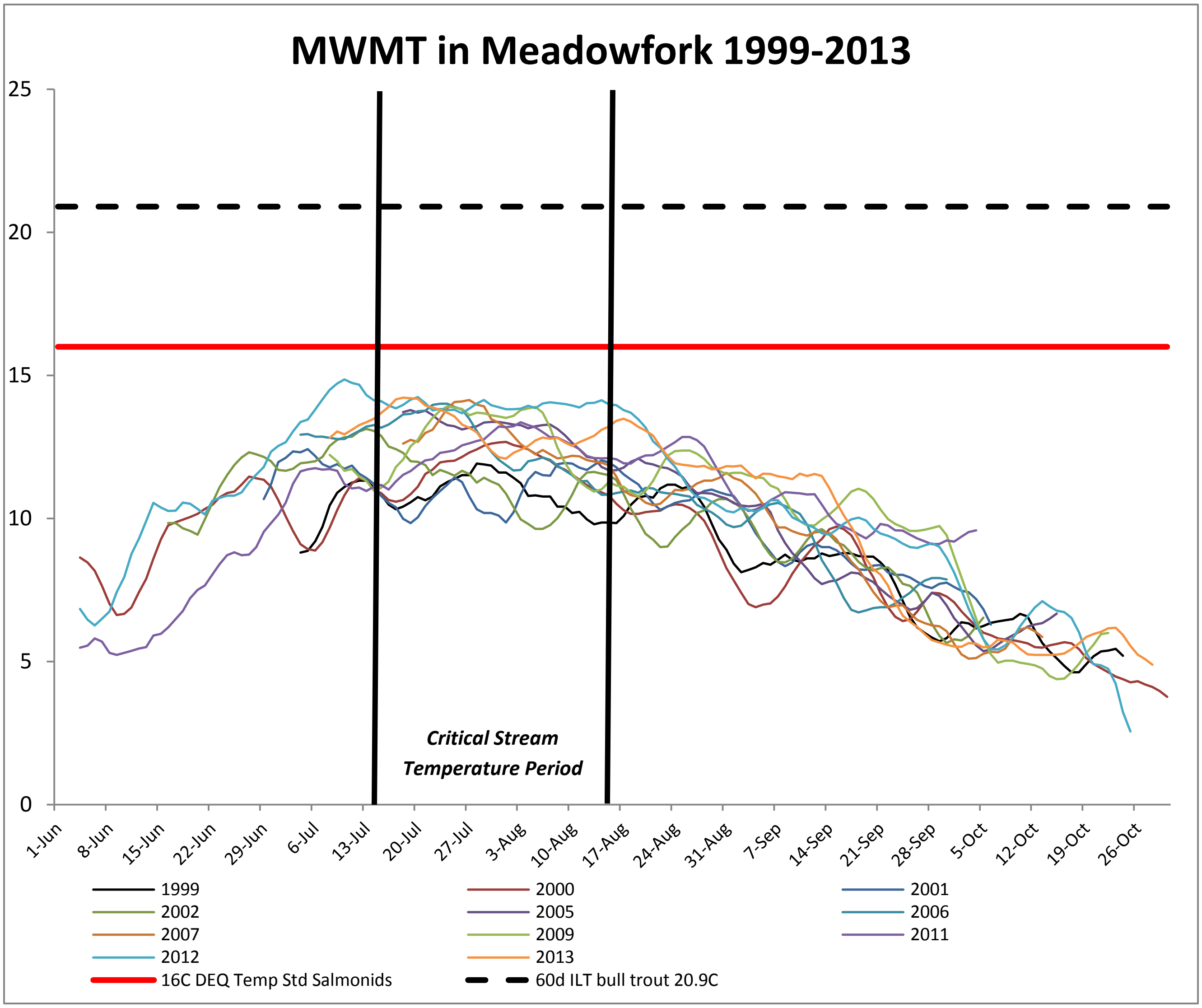
Appendix A. Length Frequency histograms for weir data.





Appendix B. Mean weekly maximum temperatures in Meadow Fork since 1999. Critical stream temperature period 15 July- 15 August. *Notes: Data was not collected in 2003-04 or 2010. 2011-12 temperature data was collected at the mouth of Meadow Fork. All other years were collected upstream near the weirs location.*



2013 Stream Temperature Monitoring in the Upper Malheur
Logan Valley Wildlife Mitigation Property

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Burns Paiute Tribe Natural Resources Department, Fisheries Program

4.1 Introduction

The Burns Paiute Tribe Natural Resources Dept (BPT) has been monitoring stream temperatures in the headwaters of the Upper Malheur since acquiring the Logan Valley Wildlife Mitigation Property in April 2000. BPT collects stream temperature data on the property in order to evaluate long-term effectiveness of aquatic habitat improvement projects, such as ongoing riparian plantings and fencing. In select years, BPT has also collected stream temperature data elsewhere to evaluate suitability of various habitat types to life history stages of both extant and extirpated native fish species, and to identify areas that may benefit from restorative or protective measures. With the ongoing regional efforts to model climate change scenarios based on local empirical datasets, BPT continues to collect stream temperature data to aid in the improvement of these models. Long-term datasets may function to refine model predictions over time and provide understanding of habitat change and loss due to climate change.

4.2 Methods
4.2.1 Study Area

The Logan Valley Wildlife Mitigation Property is located south of the Strawberry Mountain Wilderness in Grant County, OR. The parcel consists of 1760 deeded acres in which Lake Creek, Big Creek, Crooked Creek and McCoy Creek combine to form the Upper Malheur River. BPT has maintained five temperature sites on the Upper Malheur since acquiring the property in April 2000 (Namitz 2000; Schwabe 2001; Schwabe 2002; Schwabe 2003; Schwabe 2004; Fenton and Schwabe 2005; Fenton 2006; Schwabe 2007; Abel 2008; Abel 2009; Brown 2010; Brown 2011; Brown 2012). Of these five original sites, two are stationed on Lake Creek (one below the confluence with McCoy Creek and the other below the confluence with Crooked Creek), two on Big Creek, and one where Big and Lake Creeks join to form the middle fork of the Malheur River. In 2007 two more sites, with a focus on the Lake Creek drainage, were selected for monitoring (Schwabe 2007). Another site, near the tribe’s cabin bridge, was added to Lake Creek in 2008 (Abel 2008). For the 2009 field season, two additional monitoring sites were added, one on McCoy Creek and the other on a branch of Lake Creek (Abel 2009). Site locations are mapped in Figure 1 and described in Table 1.

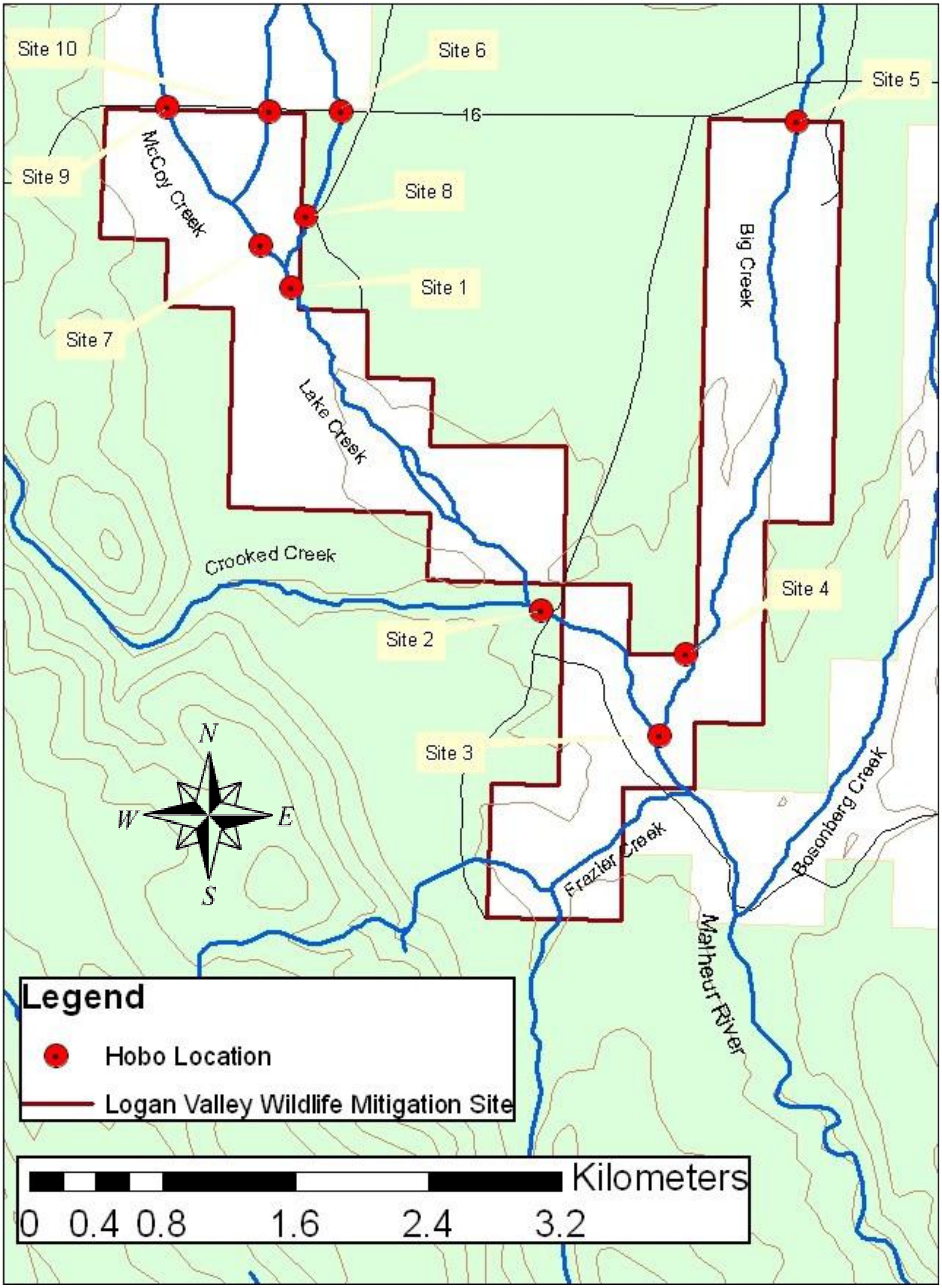


Figure 1: BPT Annual Stream Temperature Monitoring Site Locations in Logan Valley

Table 1: BPT Logan Valley Annual Stream Temperature Monitoring Site Descriptions

Site	Location	Year Initiated
1	Lake Creek below McCoy Creek	2000
2	Lake Creek below Crooked Creek	2000
3	Malheur River below Big and Lake Creek	2000
4	Big Creek one mile below Forest Service 16 Road	2000
5	Big Creek below Forest Service 16 Road	2000
6	Lake Creek below Forest Service 16 Road	2007
7	McCoy Creek above Lake Creek	2007
8	Lake Creek at Cabin Bridge	2008
9	McCoy Creek below Forest Service 16 Road	2009
10	Lake Creek Ditch below Forest Service 16 Road	2009

4.2.2 Field Techniques

In 2013, Tidbit v2 Temperature Loggers (hobos) manufactured by Onset Computer Corporation were deployed between the 20th-31st of May and retrieved between the 2nd-8th of October. Hobos were subjected to accuracy checks post-deployment using methods recommended by the Oregon Water Quality Monitoring Technical Guidebook (OPSW v2.0 2001). Standards dictate that hobo readings cannot vary from actual by more than ±0.5 °C. All hobos deployed in the 2013 field season were within accuracy parameters.

Eight pound anchors were used to secure the hobos near the bottom of streams. In order to account for as many physical variables as possible, hobo sets were standardized in the deep and swift water of the thalweg and shaded from the sun when possible under vegetation and undercut banks. Timing of deployment has varied slightly from year to year, usually as a result of seasonal weather conditions and access to sites. Hobo deployment in Logan Valley by the 31st of May was the objective in 2013 and will likely continue to serve as the target date for future deployment.

4.2.3 Data Analysis

Temperature data is summarized by the rolling daily maximum temperature averaged over a seven day period. This is referred to as the Mean Weekly Maximum Temperature (MWMT). This unit of measurement is also known as the Seven Day Average Daily Maximum or 7DADM, and is synonymous with the maximum rolling temperature calculations utilized in previous reports by BPT. Figures 1-10A in Appendix A plot the 2013 MWMT at each monitoring site against DEQ stream temperature standards. Figures 6A and 8A illustrate the periods that the respective streambeds were dewatered, necessitating the exclusion of data from those sites during that time.

The DEQ Stream Temperature Standard is 12 °C MWMT for bull trout migration and juvenile rearing and 16 °C MWMT for salmonid core rearing areas (i.e., an area of moderate to high density use) (OAR 340-041-0028 2004). Sixteen centigrade has been cited as an important benchmark in relation to the thermal tolerance of bull trout as well. Research conducted in a controlled setting indicates that bull trout food consumption declined significantly at temperatures greater than 16 °C (Selong et al. 2001). The same study identified 20.9 °C as the Incipient Lethal Temperature (ILT) for bull trout. Temperatures listed above are thus important monitoring benchmarks utilized for comparative analysis throughout this report.

Daily Average Temperature (DAT) at each site in 2013 was calculated and charted in Appendix B (Figures 1-10B). Temperature data was compared to data on the movements of radio-tagged bull trout in 2000 and 2001 in Appendix C (Figures 1-5C). The peak of bull trout migration through the property both years was mid-June.

4.3 Results

The timeframe July 15th-August 15th was outlined by the Oregon Department of Fish and Wildlife (ODFW) as the critical period for high stream temperatures in the Malheur watershed (Perkins 1999). This timeframe has been used in previous BPT reports as an index for comparing stream temperature data between years (Namitz 2000; Schwabe 2001; Schwabe 2002; Schwabe 2003; Schwabe 2004; Fenton and Schwabe 2005; Fenton 2006; Schwabe 2007; Abel 2008; Abel 2009; Brown 2010; Brown 2011; Brown 2012). Highest stream temperatures for each site were identified to determine whether dates occurred within the 32-day critical period (Table 2). Table 3 represents the number of days and percent total days in 2013 that MWMT eclipsed cited temperature benchmarks during the monitoring period.

In 2013, the dates of absolute maximum stream temperatures occurred during the critical stream temperature period (July 15th-August 15th) at only one of the nine sites where this could be determined (Table 2). Instead, absolute maximums were obtained the last two days of June or the first two days of July at every location except Lake Creek Ditch site 10. All sites except McCoy Creek site 7 and site 10 reached their highest MWMT on July 3rd or 4th.

As Table 3 illustrates, in the summer of 2013 Logan Valley streams regularly exceeded average weekly temperature maximums based on DEQ standards for bull trout migration and juvenile rearing habitat (12 °C), as well as standards for salmonid core rearing habitat (16 °C; OAR 340-041-0028 2004). Each site with a complete data set on the Lake Creek drainage spent the vast majority (over 85%) of the summer period with MWMT exceeding 12 °C. Five of the eight sites (Lake Creek sites 1 and 2, Malheur River site 3, and sites 7 and 9) spent over 90 days of the 116 in which MWMT can be calculated in excess of 16 °C. In the cooler water of Big Creek, site 4 MWMT exceeded 16 °C for 85 days, and site 5 (upstream) exceeded that threshold for 38 days. The ILT for bull trout was surpassed at all sites except site 5 in 2013. MWMT was

Table 2: Summary of Temperature Maximums at BPT Monitoring Sites, Summer 2013

2013 Monitoring Period: June 1st-September 30th					
Stream Name	Site Number	Highest MWMT (°C)	Date of Occurrence	Absolute Maximum (°C)	Date of Occurrence
Lake Creek	1	24.75	7/4/13	26.18	7/2/13
Lake Creek	2	25.49	7/4/13	27.06	7/2/13
Malheur River	3	22.92	7/3/13	24.00	6/30/13
Big Creek	4	21.30	7/3/13	22.32	6/30/13
Big Creek	5	18.80	7/3/13	19.63	7/2/13
Lake Creek	6	30.17*	7/3/13*	31.00*	6/29/2013*
McCoy Creek	7	24.74	8/20/13	25.87	7/2/13
Lake Creek	8**	-	-	-	-
McCoy Creek	9	28.26	7/3/13	29.44	7/1/13
Lake Ditch	10	22.92	7/23/13	24.05	7/19/13

*Data set incomplete (dewatered twice in September)
**Dewatered for a substantial portion of the summer season rendering data unusable

Table 3: Number of Days and Percent Total Days at Stations MWMT Exceeded Temperature Benchmarks, Summer 2013

Site Name and Number	Days > 12 °C	Days > 16 °C	Days > 20.9 °C
#1 Lake Creek below McCoy Creek	111 (96%)	98 (84%)	60 (52%)
#2 Lake Creek below Crooked Creek	111 (96%)	99 (85%)	57 (49%)
#3 Malheur River below Big and Lake Creek	108 (93%)	93 (80%)	19 (16%)
#4 Big Creek one mile below NF-16 Road	106 (91%)	85 (73%)	3 (3%)
#5 Big Creek below NF-16 Road	101 (87%)	38 (33%)	0 (0%)
#6 Lake Creek below NF-16 Road*	-	-	-
#7 McCoy Creek above Lake Creek	111 (96%)	98 (84%)	65 (56%)
#8 Lake Creek at Cabin Bridge*	-	-	-
#9 McCoy Creek below NF-16 Road	112 (97%)	105 (91%)	87 (75%)
#10 Lake Creek Ditch below NF-16 Road	109 (94%)	86 (74%)	42 (36%)

*Incomplete data (dewatered a portion of the monitoring season)

above 20.9 °C at site 9 for 75% of the total days monitored, approximately 50% at sites 1, 2, and 7, 36% at site 10, and 16% at site 3. Site 4 exceeded the ILT of 20.9 °C for three days in 2013, the implications of which will be discussed below. All sites on average spent 38% of the summer period above the Incipient Lethal Temperature for bull trout.

The warm water temperature measurements of 2013 are not aberrations. Since BPT began stream temperature monitoring in Logan Valley, water temperatures have consistently surpassed the DEQ Bull Trout Temperature Standard of 12 °C MWMT for a majority of the summer period at all monitoring sites where data was collected. Taking into account the occasional inability to retrieve hobos due to loss, the original five strategically placed sites initiated in 2000 are associated with the longest datasets, thus permitting more extensive detailed comparisons. Lake Creek sites 1 and 2 have exceeded the 16 °C threshold on the very first day MWMT can be calculated (June 7th) for the years 2000-09. The MWMT of these same sites has consistently exceeded the Incipient Lethal Temperature for bull trout, on average in late June/early July for the years 2000-08; later in the season the four subsequent years.[1] At Malheur River site 3, the beginning of the summer monitoring season is typically when the MWMT has exceeded 12 °C. As displayed in Table 4, the mean date for the years 2000-08 when the MWMT of site 3 surpassed 16 °C was June 16th (later in June the four subsequent years). The ILT for bull trout based on MWMT has on average been obtained at site 3 in July, but this location never achieved such high temperatures in 2010 or 2011. Big Creek sites 4 and 5 typically obtain the 12 °C and 16 °C temperature thresholds later in the season. Site 5 maximum weekly average failed to reach the salmonid temperature threshold of 16 °C only once in recent years (2011). For the years 2000-12, Big Creek sites did not eclipse the ILT based on MWMT during the summer monitoring period (Namitz 2000; Schwabe 2001; Schwabe 2002; Schwabe 2003; Schwabe 2004; Fenton and Schwabe 2005; Fenton 2006; Schwabe 2007; Abel 2008; Abel 2009, Brown 2010; Brown 2011; Brown 2012).

2013 temperature readings differ from the baseline of Table 4 in several key areas. All sites began the summer monitoring period with MWMT above or near 16 °C (as opposed to only sites 1 and 2 in 2012), but decreased below 16 °C later in June. Sites 4 and 5 actually dropped below 12 °C in late June before spiking, similar to all the other sites, into July. The 16 °C MWMT temperature threshold was bettered more than nine days earlier at site 3 and more than twelve days earlier at site 4 (MWMT was already surpassing the threshold at point of hobo insertion). Site 5 broke the 16 °C mark a full 25 days earlier in 2013. ILT based on MWMT was obtained at sites 1-3 in early July, but more notable was site 4 recording readings above 20.9 °C for the first time in BPT monitoring history. Site 5 once again never achieved such highs (Table 4).

[1]Site 1 experienced one outlier year in 2010 in which it never obtained the ILT for bull trout (Brown 2010).

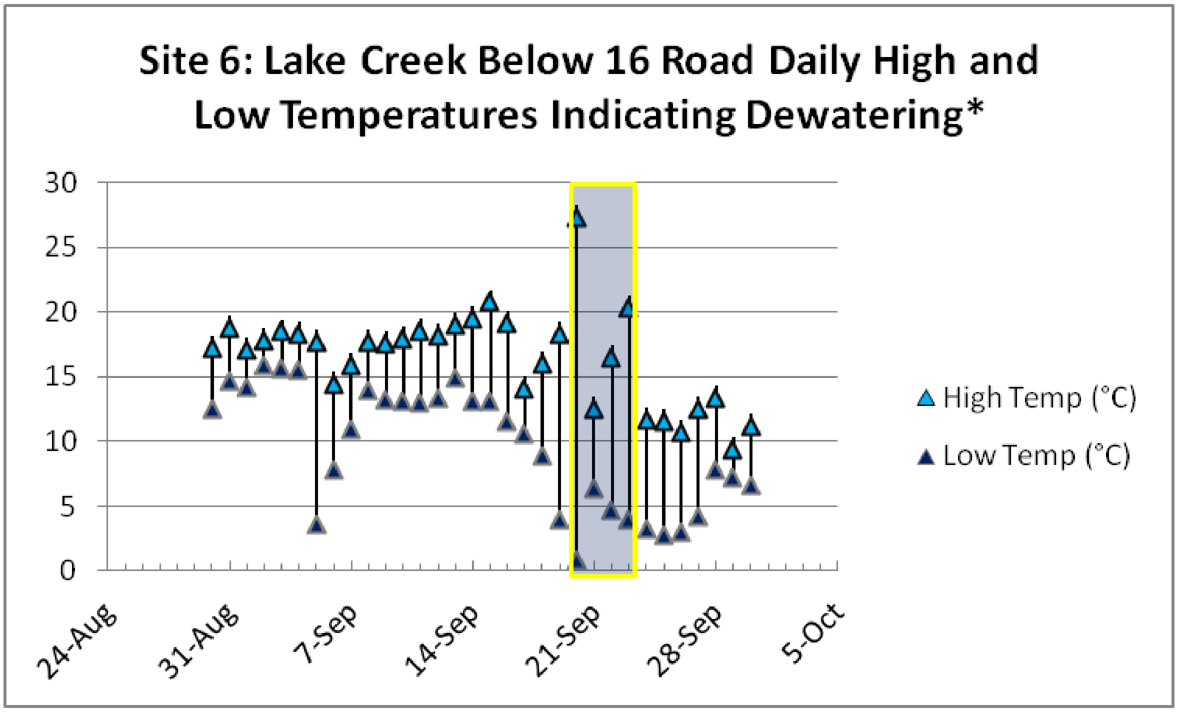
Table 4: Average Date of First Recorded MWMT over Cited Benchmarks for the Summer Monitoring Interval June 7th-August 2000-08 Compared with 2013

		Site 1 Lake Creek	Site 2 Lake Creek	Site 3 Malheur River	Site 4 Big Creek	Site 5 Big Creek
2000-08	> 12 °C	no readings < 16 °C	no readings < 16 °C	June 7th	June 7th	June 14th
	> 16 °C	June 7th	June 7th	June 16th	June 19th	July 4th
	> 20.9 °C	July 2nd	June 28th	July 13th	no readings > 20.9 °C	no readings > 20.9 °C
2013	> 12 °C	June 7th	June 7th	June 7th	June 7th	June 7th
	> 16 °C	June 7th	June 7th	June 7th	June 7th	June 9th
	> 20.9 °C	July 1st	July 1st	July 2nd	July 3rd	no readings > 20.9 °C

In addition to the differences between 2013 and the baseline illustrated in Table 4, general temperature trends for all sites in 2013 showed variation when compared with the prior year as well. Falling temperatures were evident in June at the beginning of the monitoring season in 2013, the opposite of 2012. Record air temperatures in late June and early July helped drive an earlier and hotter summer peak in 2013 than in 2012. Highest temperatures from this year's data were greater than 2012 for all sites except McCoy Creek site 9.

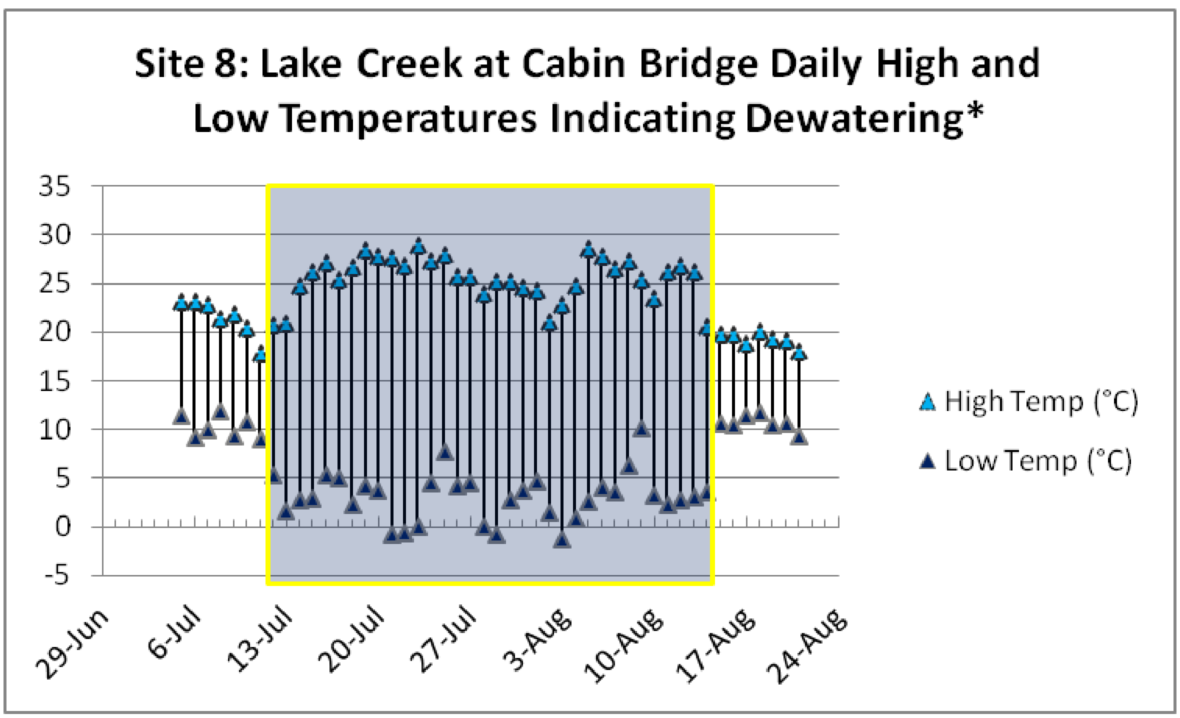
In 2013, as in previous years, Lake Creek sites 6 and 8 were dewatered to the point of hobo exposure to air. This occurred late in the season on September 5th and again from September 20th-23rd for site 6 (Figure 2). This minimal dewatering contrasts with the substantial portion of the summer monitoring period during which Lake Creek site 8 was dewatered (Figure 3). Dates with data indicating hobo exposure to air have been excluded from temperature analysis.

Figure 2: Evidence of Site 6 Hobo Air Exposure



*Dates in shaded box experienced hobo exposure to air; September 5th was also dewatered.

Figure 3: Evidence of Site 8 Hobo Air Exposure



*Dates in shaded box experienced hobo exposure to air.

4.4 Discussion

In 2000, the Burns Paiute Tribe entered into a cooperative effort with the USDA Forest Service and the Oregon Department of Fish and Wildlife to document stream temperature trends in the Upper Malheur (Namitz 2000). The primary purpose of the monitoring effort was to utilize stream temperature data as an indicator of habitat suitability for the federally threatened bull trout (Namitz 2000). Bull trout are stenothermal, requiring a narrow range of cold water temperature conditions to rear and reproduce (Buchanan and Gregory 1997). In western North America, the bull trout is believed to be among the most thermally sensitive species in coldwater habitats (Buchanan and Gregory 1997; Haas 2001; Selong et al. 2001; Dunham et al. 2003), and maximum temperature has consistently been suggested as likely the most critical variable determining bull trout health and presence (Haas 2001). All monitoring sites in this report occur in U.S. Fish and Wildlife Service designated bull trout Critical Habitat (75 FR 63897 2010).

MWMT data plotted against temperature benchmarks in Figures 1-10A (Appendix A) coupled with site location from Figure 1 2013 weather trends yield several observations: 1) Lake Creek sites reached much higher maximum temperatures and sustained bull trout ILT for longer durations than Big Creek sites. 2) Lake Creek sites 6 and 8 follow somewhat different temperature patterns than all other sites. 3) Big Creek lowers the temperature of the Malheur River (site 3). 4) McCoy Creek (sites 7 and 9) is a major driver to high stream temperatures noted in Lake Creek. 5) Stream temperatures at most sites peaked early this year in the record heat of late June/early July and then trended down, even through the mid-summer critical stream temperature period of generally hot summer air temperatures and clear skies. 6) A relatively low water year (E.M. Maltz, personal communication) contributed to higher temperature readings. 7) All sites ended the monitoring season below the 12 °C MWMT threshold.

The patterns and observations evident in 2013, with particular emphasis on the essential bull trout corridors of Lake and Big Creeks and general trend of sites exceeding temperature thresholds, have important implications for these stenothermic fish. Given that cooler water temperatures are important surrogates for bull trout habitat utilization, the clear differences in recordings between Big and Lake Creek are concerning. However, bull trout are migratory and rates of movement have been found to correlate with rising daily maximum water temperatures (Swanberg 1997). Thus, migratory patterns could be theorized to stay ahead of the curve of rising temperatures and trump summer temperature extremes. Appendix C displays supporting evidence from early to mid-summer migrations in 2000 and 2001, with a concentration of activity in Big Creek and avoidance of Lake. Maps show locations from radio-tagged bull trout and suggest that, at least for fluvial bull trout populations, migration through the Logan Valley property occurs before the critical stream temperature period generally associated with annual temperature maximums (Schwabe 2000; Fenton and Schwabe 2001). In 2000, all radio tagged bull trout except one individual were above the Upper Malheur weir by June 29^{th} (Figure 1C) and had successfully migrated upstream of the property by July 6^{th} (Figure 2C). Similar movement patterns occurred in 2001 when all live individuals were above the weir by June 29^{th} (Figure 4C), and all putative spawning participants were upstream of the property by July 13^{th} (Figure 5C). It is important to note, however, that in both those years stream temperatures at all monitoring sites did not peak until late July/early August. In 2013, temperatures peaked an entire month earlier, forcing bull trout to adjust migratory patterns accordingly.

Assuming bull trout are migrating ahead of lethally warm summer water temperatures, they are still likely subjected to temperatures in excess of the DEQ standard of 16 °C (Figures 4A and 5A). Thus, exploring ways to lessen exposure and maintain adequate stream temperatures to allow a longer suitable migration window could prove beneficial to success of the breeding population, especially in regard to Lake Creek. Because stream temperatures in Lake Creek during the primary migration period (June 1^{st}-July 14^{th}) reach critical thresholds sooner than in Big Creek (Tables 4 and 5), the result is a potential thermal barrier that prevents upstream movements of fluvial bull trout. A thermal barrier early in the primary migration period might explain why no radio-tagged bull trout were observed using the Lake Creek corridor to access upstream spawning grounds in either 2000 or 2001. In 2001, bull trout 151224 attempted migration up Lake Creek (Figure 3C) but had retreated by June 29^{th} to join Big Creek migrants (Figure 4C). Stream temperatures in Lake Creek had already surpassed bull trout ILT in 2001 when 151224 had attempted the Lake Creek migration (Fenton and Schwabe 2001).

Current redd counts in the upper reaches of Lake Creek are about average for periods of drought, but redd count data is muddled by difficulty distinguishing between bull and invasive brook trout redds (Brown 2012). In 2013, 17 bull trout redds were observed at Lake Creek spawning grounds (ODFW, unpublished data). Based on current temperature data and past tracking efforts, it is likely that the Lake Creek breeding population is comprised of an isolated resident, non-migratory population. The current status of the entire Upper Malheur bull trout metapopulation is considered to be at a high risk of extinction (Buchanan et al. 1997, USFWS 2002). If the small Lake Creek subpopulation truly is isolated, depensatory factors and hybridization may contribute to risk status.

It is worth discussing Lake Creek sites 6 and 8 in detail, given the unique thermograph charts produced there in 2013 (Figures 6A and 8A) . Both stations lie in the historic Lake Creek main channel, a stream course that has largely been diverted and rerouted just above NF-16 (16 Road) for many years for grazing and irrigation purposes on private land. After supplying irrigation, the remaining water flows into another Lake Creek channel, referred to by BPT as Lake Creek Ditch (the location of site 10). As a consequence of this diversion, hobos at both sites 6 and 8 experienced exposure to air in 2013, although site 6 for a much shorter period of time and later in the season than previous years. Site 6 sits upstream of site 8 in full sunlight and often shallow, slow-moving water; site 8 is located underneath BPT's cabin bridge in water that can also be quite shallow. The sun exposure, depth, and velocity at site 6 are partially responsible for the higher temperatures experienced there in June. However, site 6 has good connection to groundwater inputs from springs and seeps. This, along with beaver activity supplying sustained flows and increasing inputs from a reduction in diverted water upstream for cattle (K.A. Heinrick and E.M. Maltz, personal communication), seems to have helped this site cool to a greater degree than many other sites in Logan Valley in July. These inputs were not enough to prevent site 8 downstream from dewatering in the first half of July, but this is a typical occurrence. Cooler water from site 6 and late summer rains eventually supplied enough water to flood site 8 in the middle of August.

The consequences of water management on Lake Creek upstream of site 6 include reductions in flow, increased water temperatures, and a disjointed historic channel unsuitable for bull trout migration. Any resident fish attempting to use this channel instead of Lake Creek Ditch for migration between overwintering areas before or after spawning are exposed to temperature stress, the risk of stranding, and potential lethal take. The BPT Natural Resources Department has been in contact with the landowner to seek a solution.

Based on the challenges and difficulties comparing and analyzing temperature data, the following recommendations, if implemented, should permit more efficient and accurate temperature data collection. Hobos should always be accuracy checked both prior to deployment and after retrieval. Hobos that are malfunctioning, low on battery, or not within the accuracy brackets for proper recording should be replaced. If accidentally used, an entire season of temperature data could be compromised for that location. Additionally, hobo depths and station flows should be taken at a minimum upon deployment and retrieval if staff time allows. This would facilitate a greater understanding of temperature in the context of site-specific depth and discharge. Ideally, at least one air temperature station should be installed in Logan Valley to facilitate comparisons between air and water temperature. When analyzing temperature data after the field season has transpired, it's not always clear when a hobo has been exposed to air and is no longer providing water temperature readings. Water temperatures do not fluctuate to the daily magnitude of air temperatures but the temperature of shallow, slow-moving water can act similar to that of air, especially in direct sunlight. Graphing and charting air temperatures for the nearest weather station and comparing them to hobo readings to ascertain hobo status is a time-consuming and challenging endeavor. Considering the nearest weather station is a substantial distance away, local variations in air temperature would be expected and difficult to account for as well. Operating a local weather station would streamline this process and lend itself to better accuracy of stream temperature reporting.

Water temperatures at BPT's Logan Valley Wildlife Mitigation Property monitoring sites were higher in 2013 than in years past; land managers should focus on strategies they can control to address this concern and its impacts to threatened bull trout. As discussed above, bull trout are a highly temperature sensitive coldwater species (Buchanan and Gregory 1997; Haas 2001; Selong et al. 2001; Dunham et al. 2003). In addition, they have also been shown to be positively correlated with deep pools, undercut banks, large substrate, and riparian habitat dominated by trees and shrubs (Watson and Hillman 1997). Recommendations to create better habitat should focus on water withdrawals, pool creation, riparian restoration, and potentially substrate alteration. Most of these activities, discussed below, would likely lower water temperature as well.

With the exception of Big Creek, stream channels through the mitigation property exist in largely open environments, a result of prior land management activities. Historically, riparian willow and sedge coverage was estimated at 40 percent and 60 percent, respectively (K.A. Heinrick, personal communication). Changes in composition and density of riparian vegetation have been shown to produce corresponding changes in water temperature (Rosgen 1996). In 2009, a large scale native revegetation project was undertaken on the Logan Valley Wildlife Mitigation parcel in the riparian corridors of Lake, McCoy, and lower Big Creek. 100,000 willows were planted with only an estimated 18 percent survival rate due to subcontractor quality control issues. An additional 2,000 willows are planted annually to supplement the original mass planting (K.A. Heinrick, personal communication). Although it is too soon for the surviving willows to have any impact on reducing stream temperature, it is expected that the current level of willow restoration will begin to have an effect in twenty years time. Establishing riparian zones that create shade is a practical and effective way to cool stream temperatures to create more suitable bull trout habitat. Therefore, it is imperative that the willow restoration in Logan Valley be continued and if possible, substantiated.

Other avenues to pursue might be bank stabilization, large woody debris placement in stream corridors, or encouraging beaver activity in Logan Valley. The principle goal of these activities would be to slow water velocity enough to create deep backwaters, supplying cool water refugia to potential bull trout migrants. At the same time, large wood would increase available cover for bull trout and bank stabilization has the potential to lessen total dissolved solids, improving both water quality and fines deposition rates.

Finally, negotiations with private landowners upstream of BPT’s property should continue. Grazing and water withdrawals just north of the mitigation lands have substantial negative effects on stream temperatures and quality and quantity of water downstream. Alleviating those negative impacts through property acquisition or some other means would likely lower stream temperatures and create more suitable bull trout habitat.

4.5 Acknowledgements

The Burns Paiute Tribe thanks Bonneville Power Administration for their continued financial support of this project.

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APPENDIX A

STREAM TEMPERATURES EXPRESSED BY MWMT

FIGURE 1A: LAKE CREEK BELOW MCCOY CREEK (SITE 1)

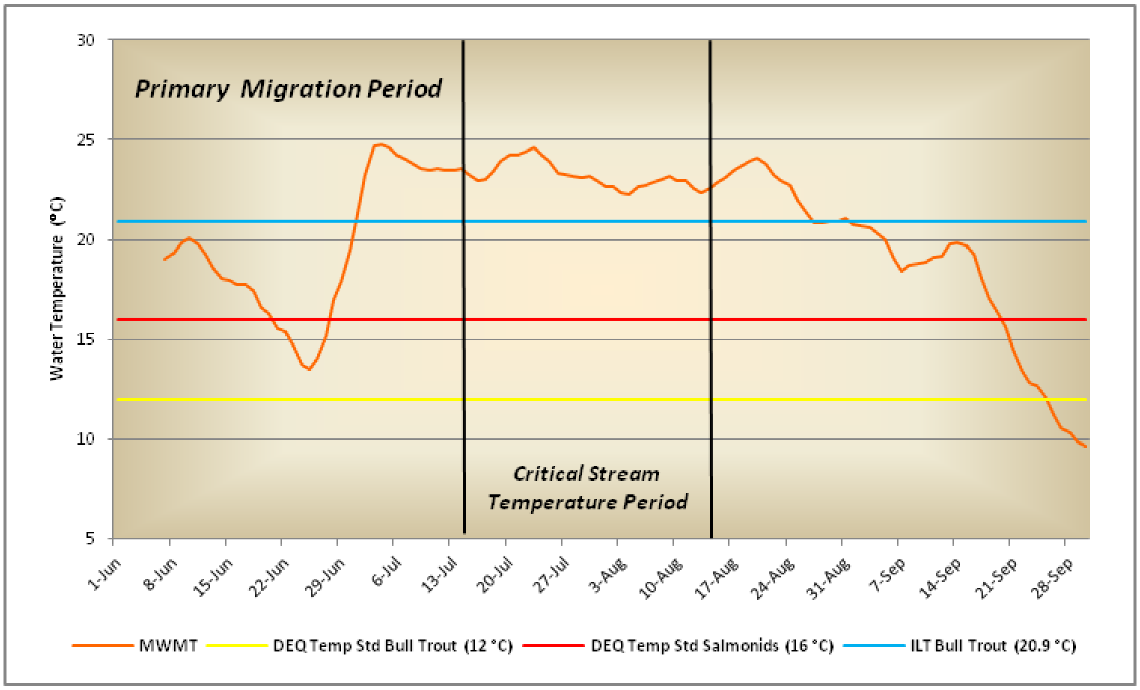


FIGURE 2A: LAKE CREEK BELOW CROOKED CREEK (SITE 2)

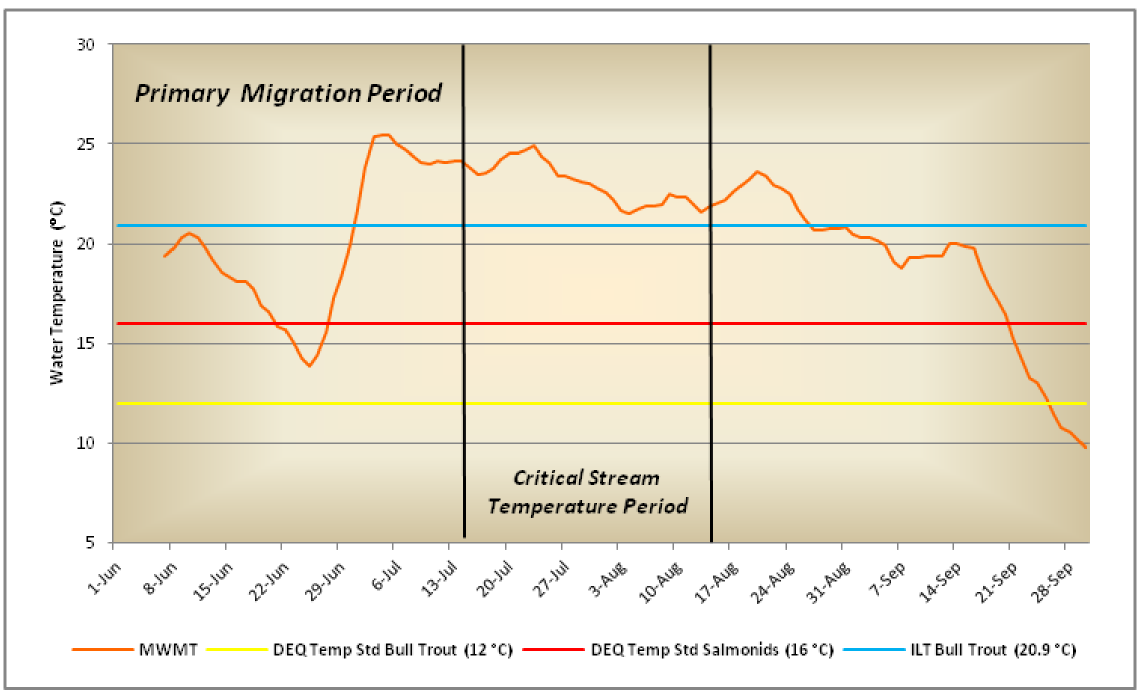


FIGURE 3A: MALHEUR RIVER BELOW BIG AND LAKE CREEK (SITE 3)

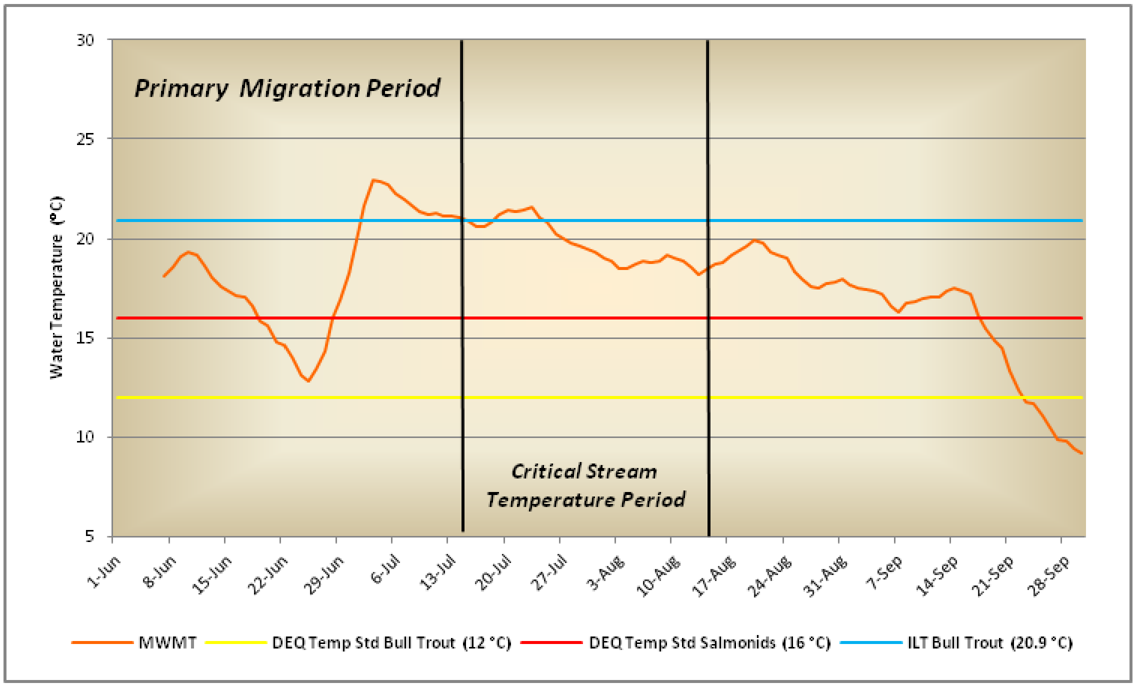


FIGURE 4A: BIG CREEK ONE MILE BELOW NF-16 ROAD (SITE 4)

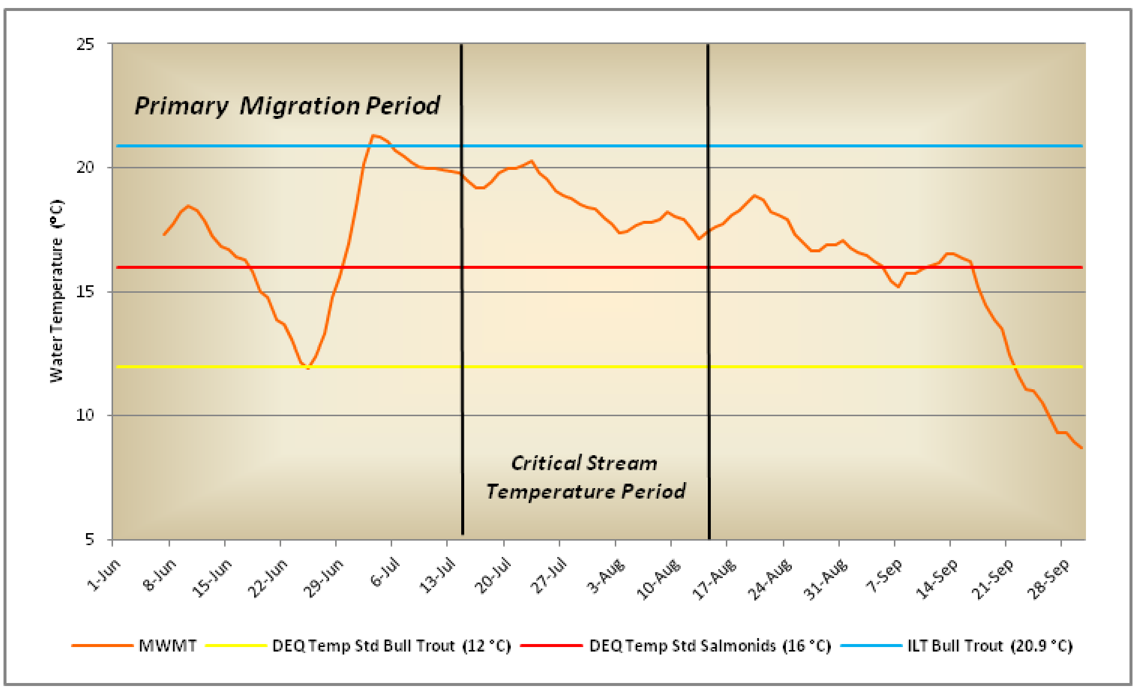


FIGURE 5A: BIG CREEK BELOW NF-16 ROAD (SITE 5)

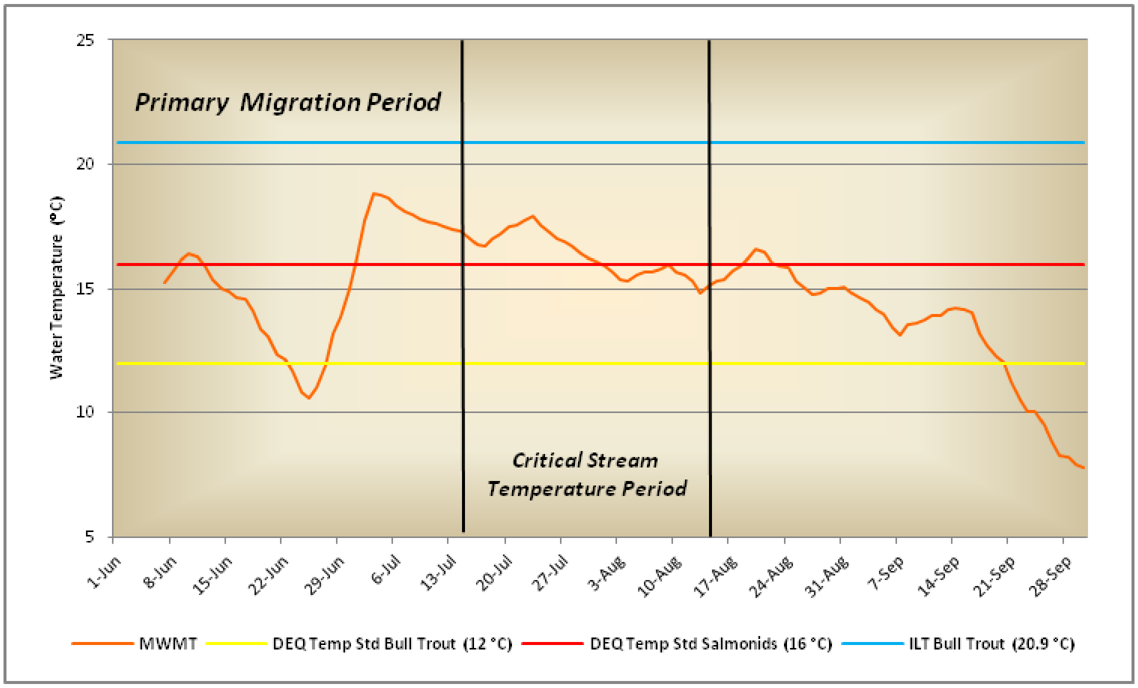
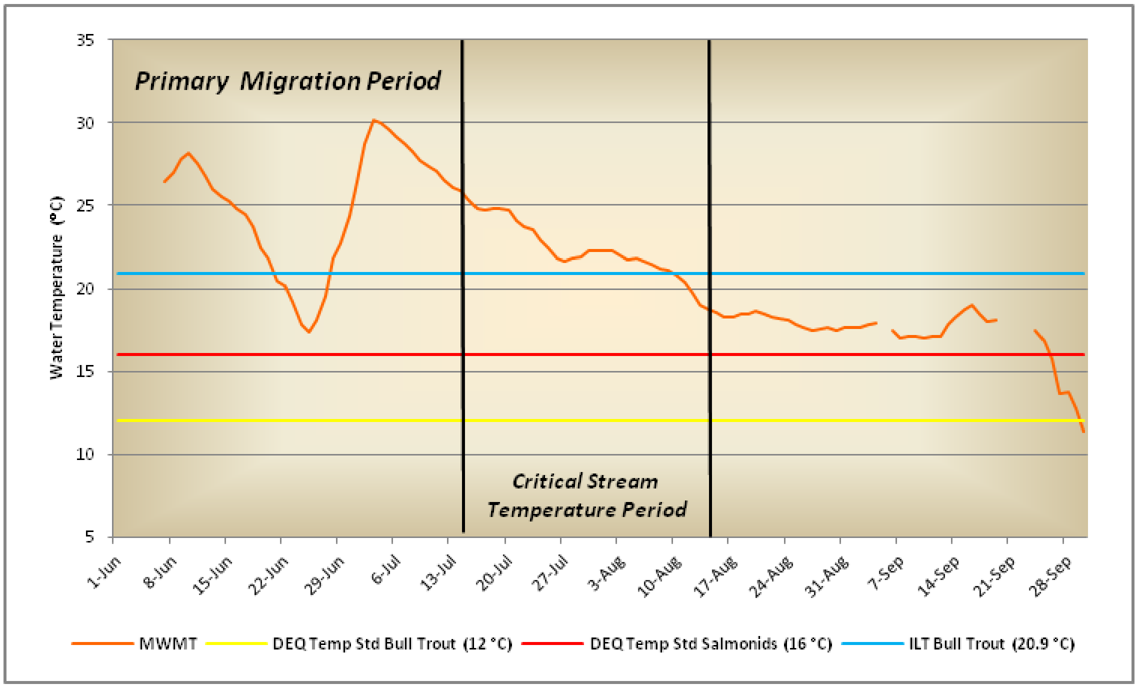


FIGURE 6A: LAKE CREEK BELOW NF-16 ROAD (SITE 6)*



*Late season breaks in MWMT indicate dewatering

FIGURE 7A: MCCOY CREEK ABOVE LAKE CREEK (SITE 7)

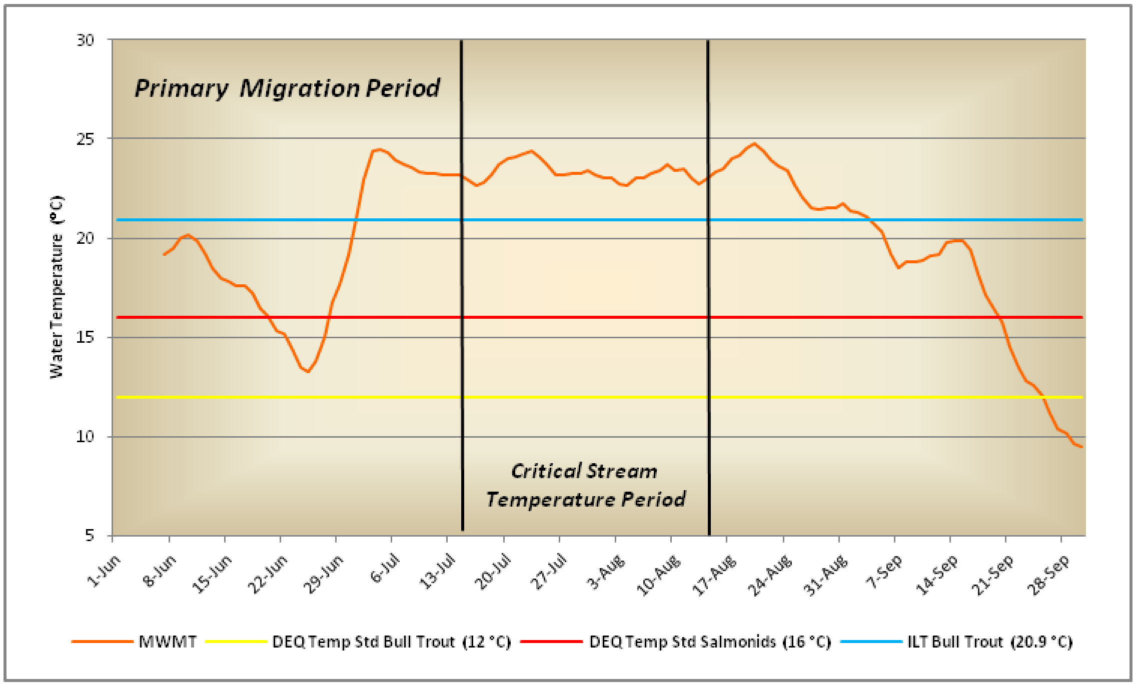
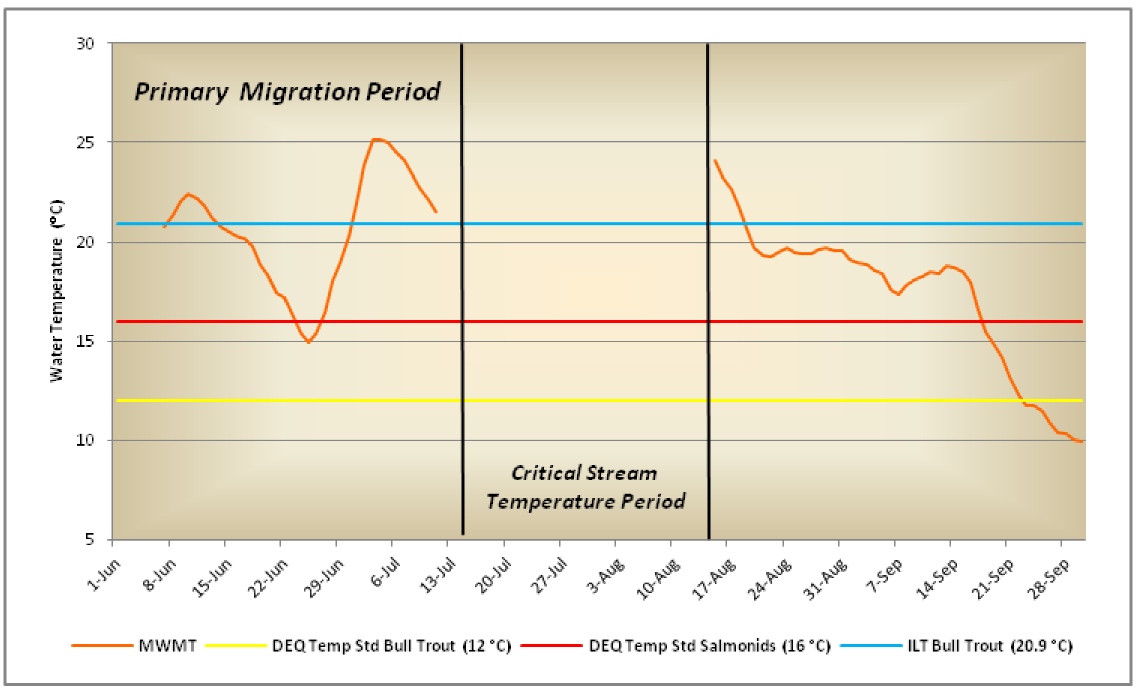


FIGURE 8A: LAKE CREEK AT CABIN BRIDGE (SITE 8)*



*Mid-season break in MWMT indicates dewatering

FIGURE 9A: MCCOY CREEK BELOW NF-16 ROAD (SITE 9)

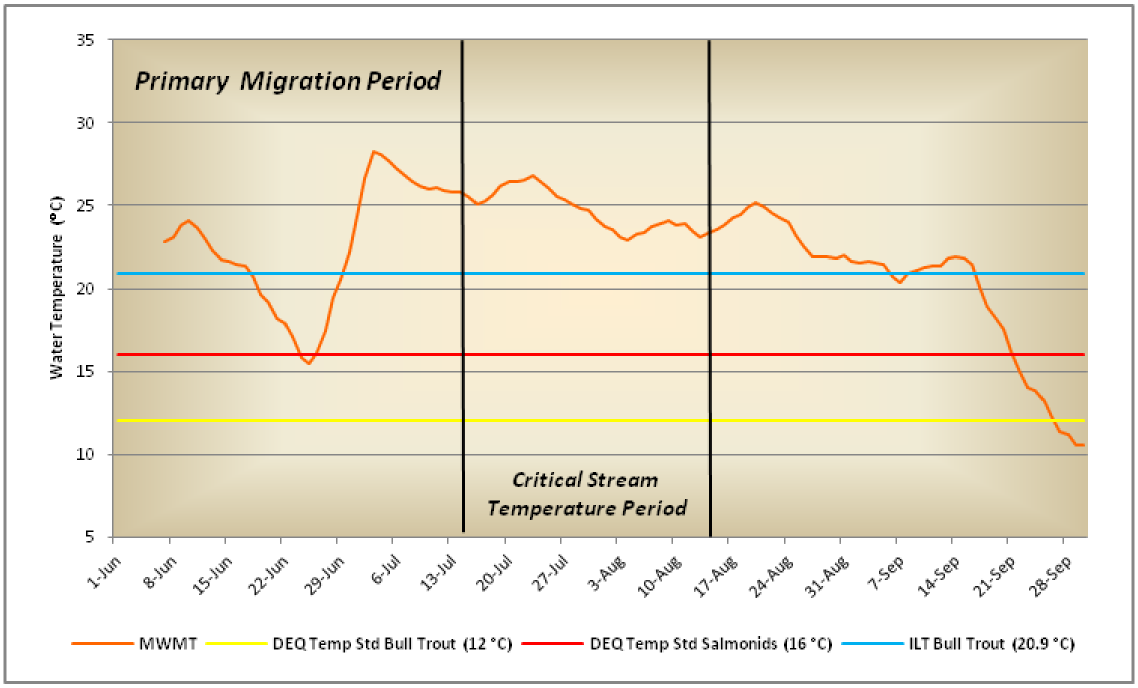
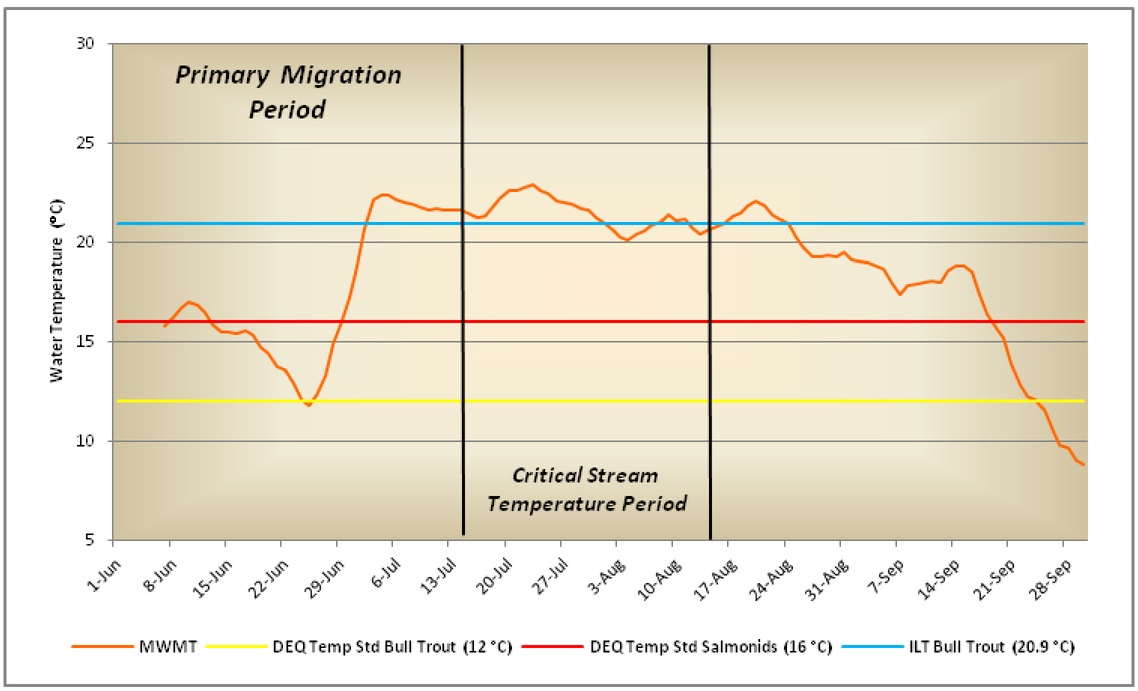


FIGURE 10A: LAKE CREEK DITCH BELOW NF-16 ROAD (SITE 10)



APPENDIX B

DAILY AVERAGE STREAM TEMPERATURES

FIGURE 1B

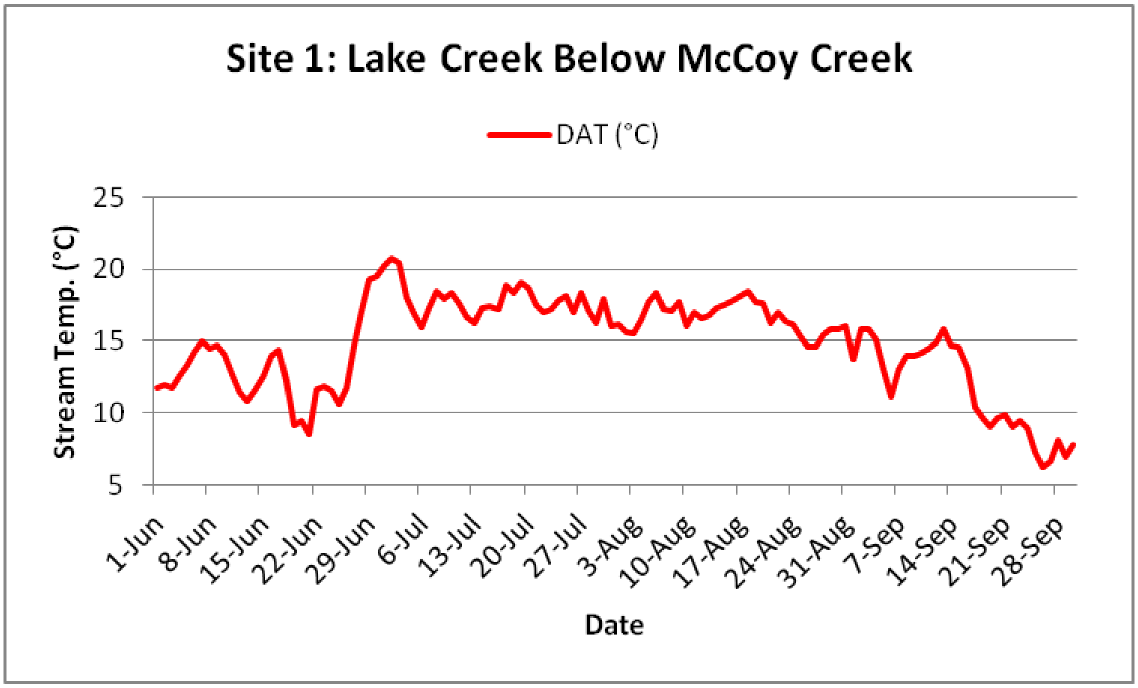


FIGURE 2B

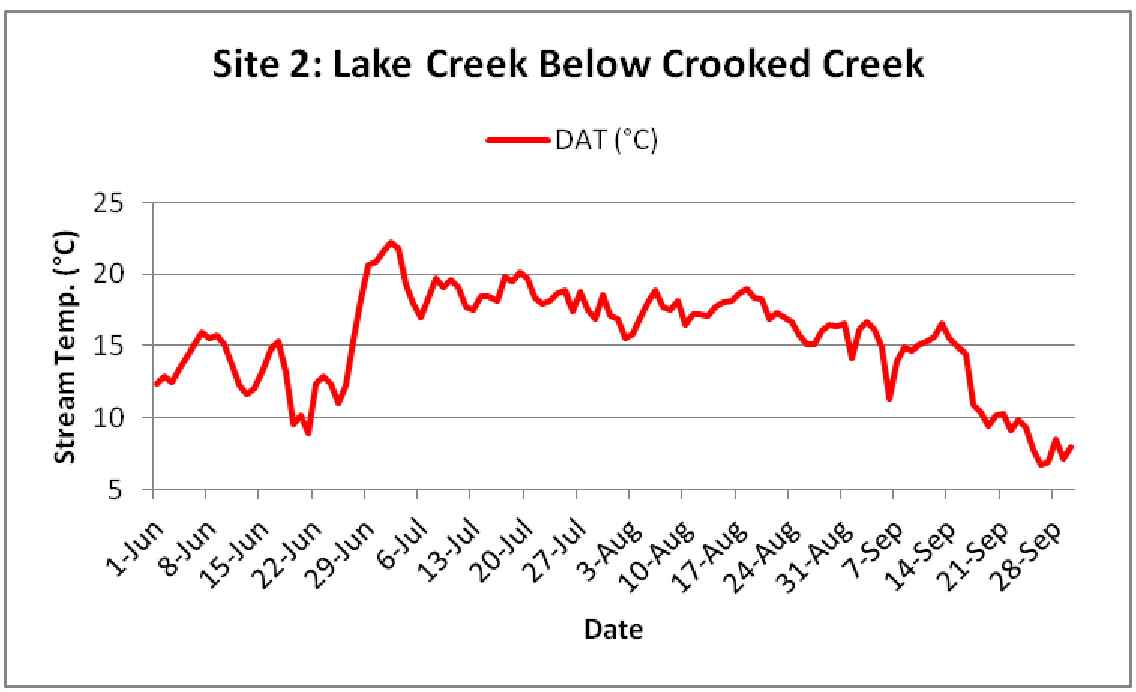


FIGURE 3B

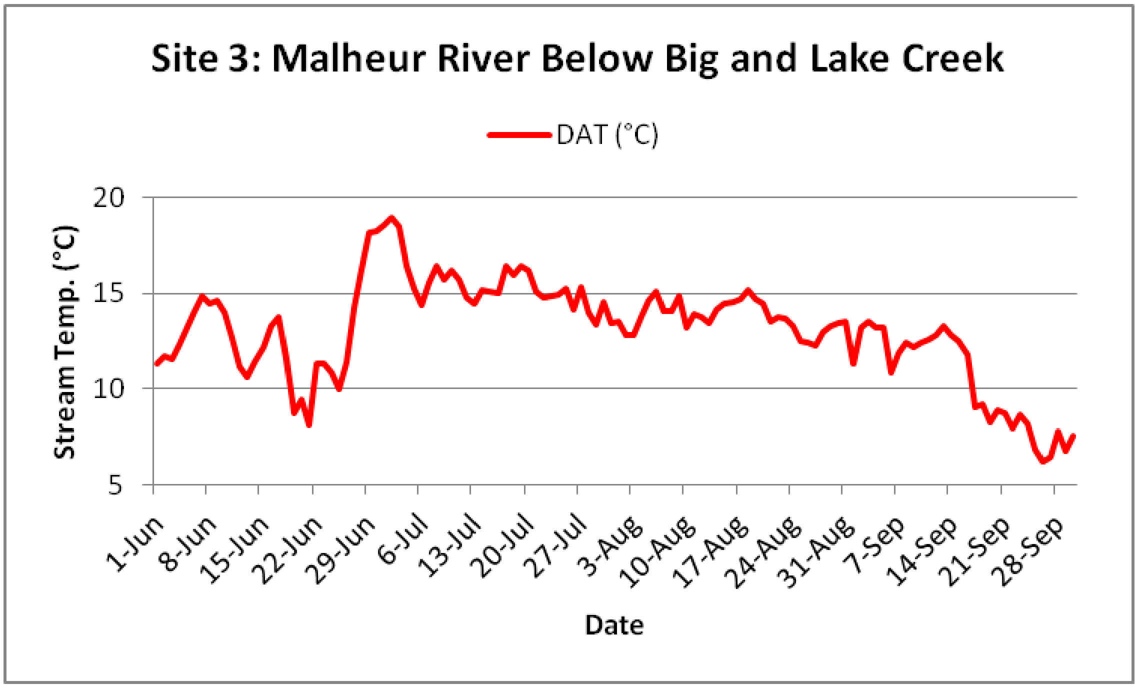


FIGURE 4B

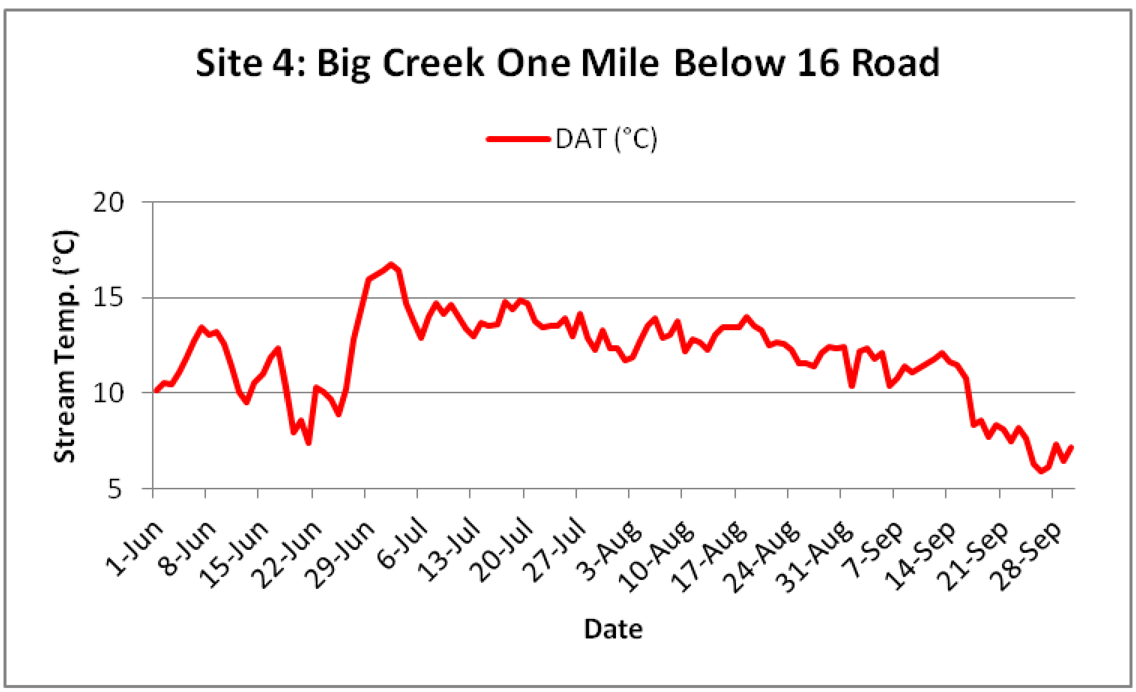


FIGURE 5B

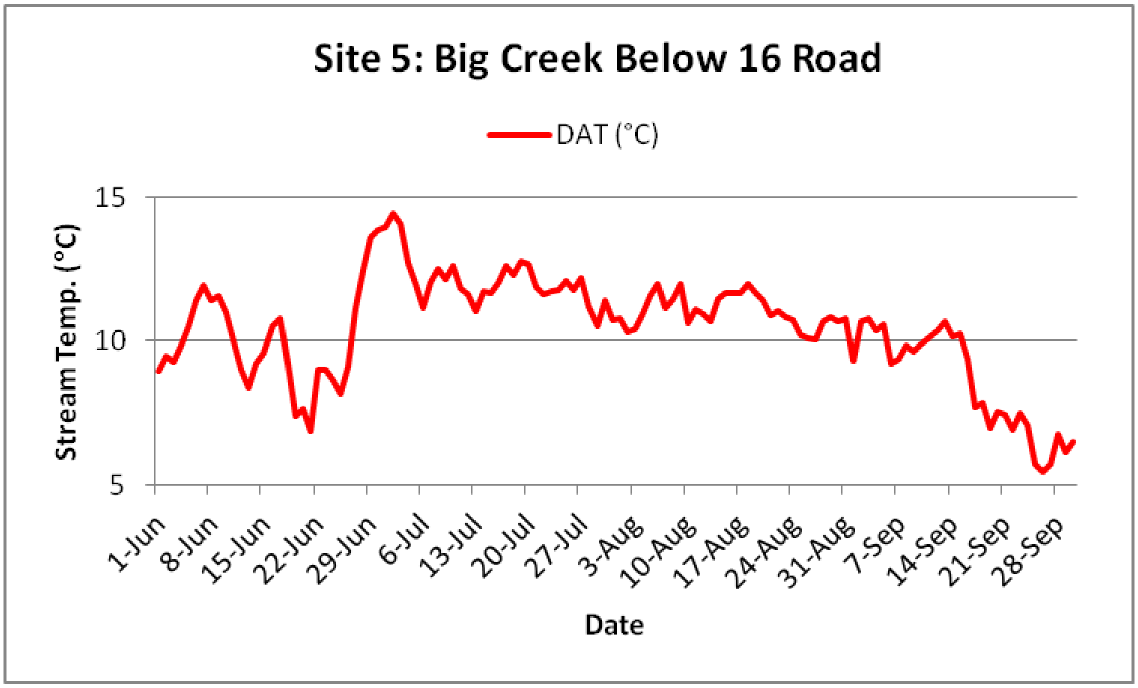
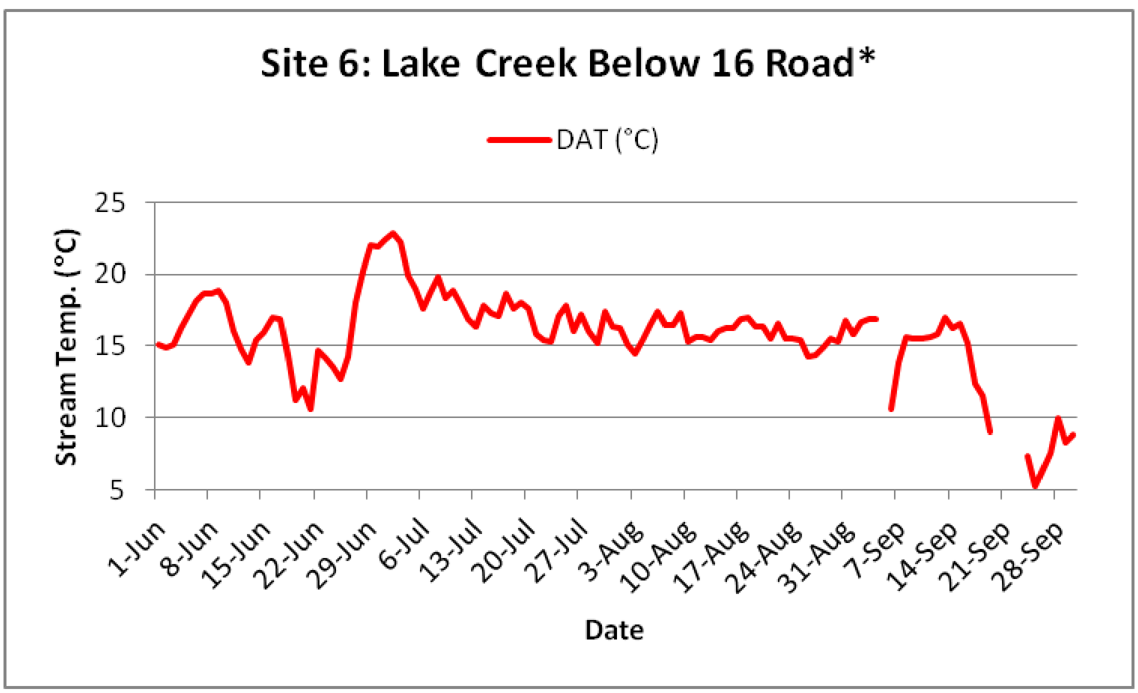


FIGURE 6B



*Late season breaks in DAT indicate dewatering

FIGURE 7B

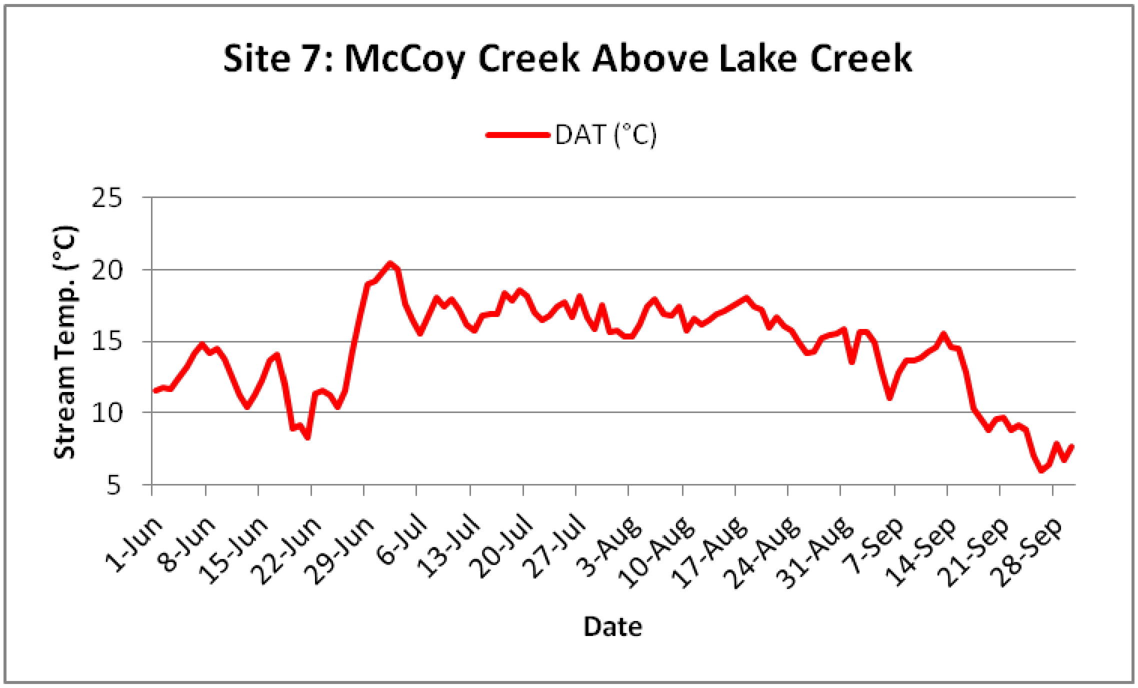
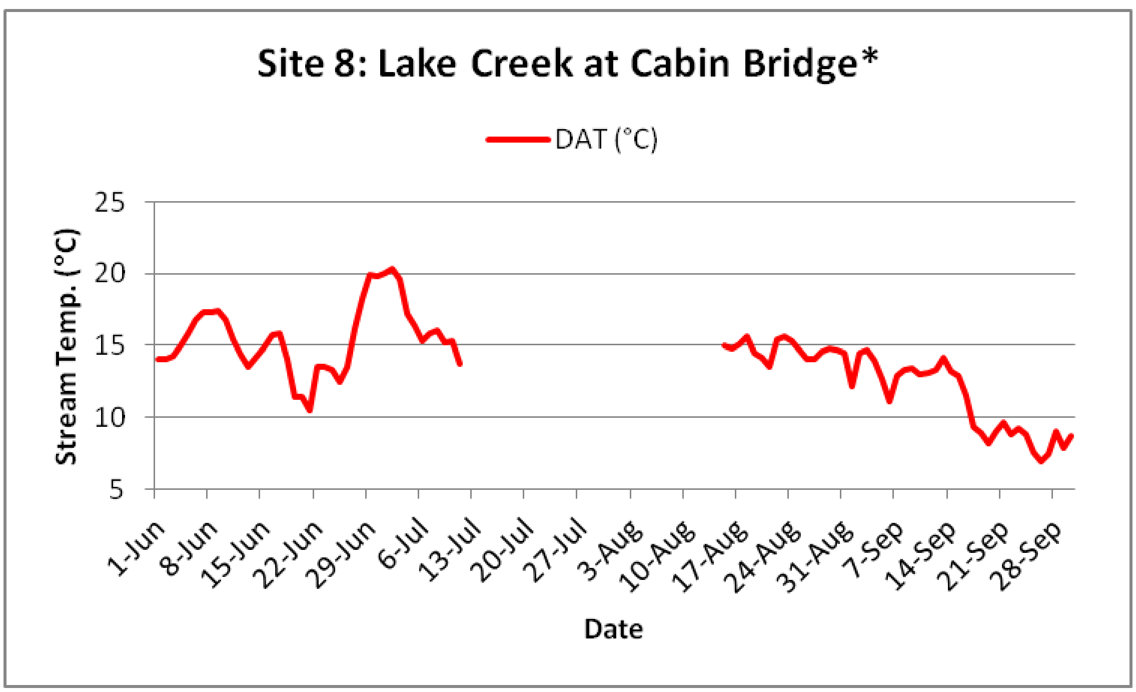


FIGURE 8B



*Mid-season break in DAT indicates dewatering

FIGURE 9B

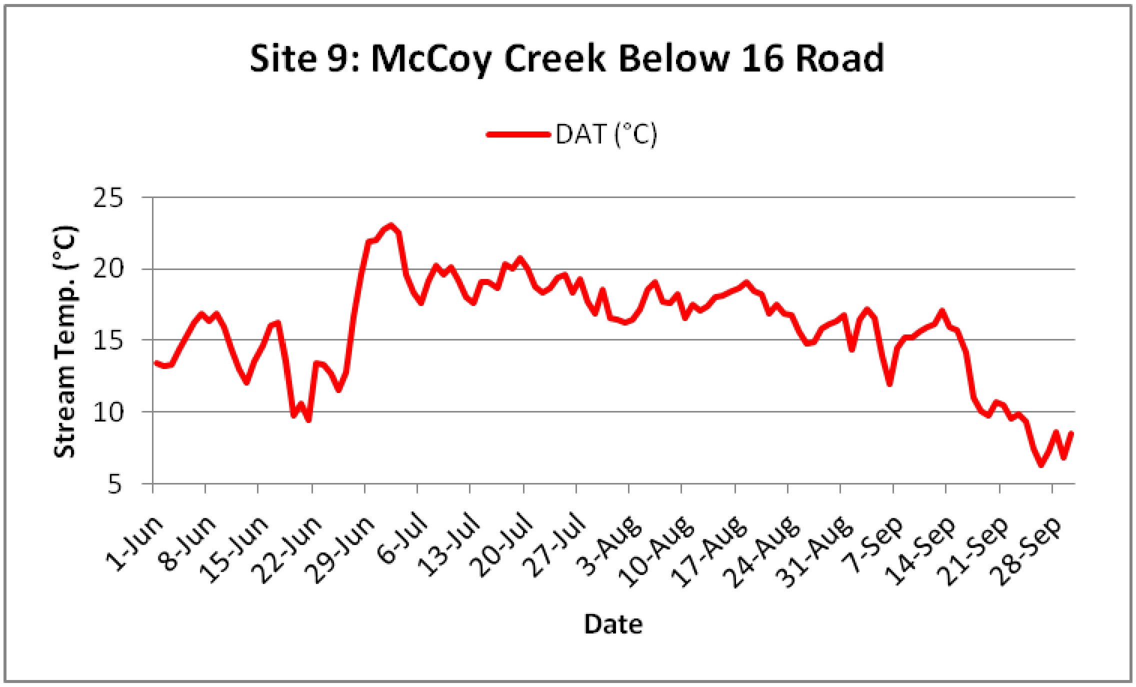
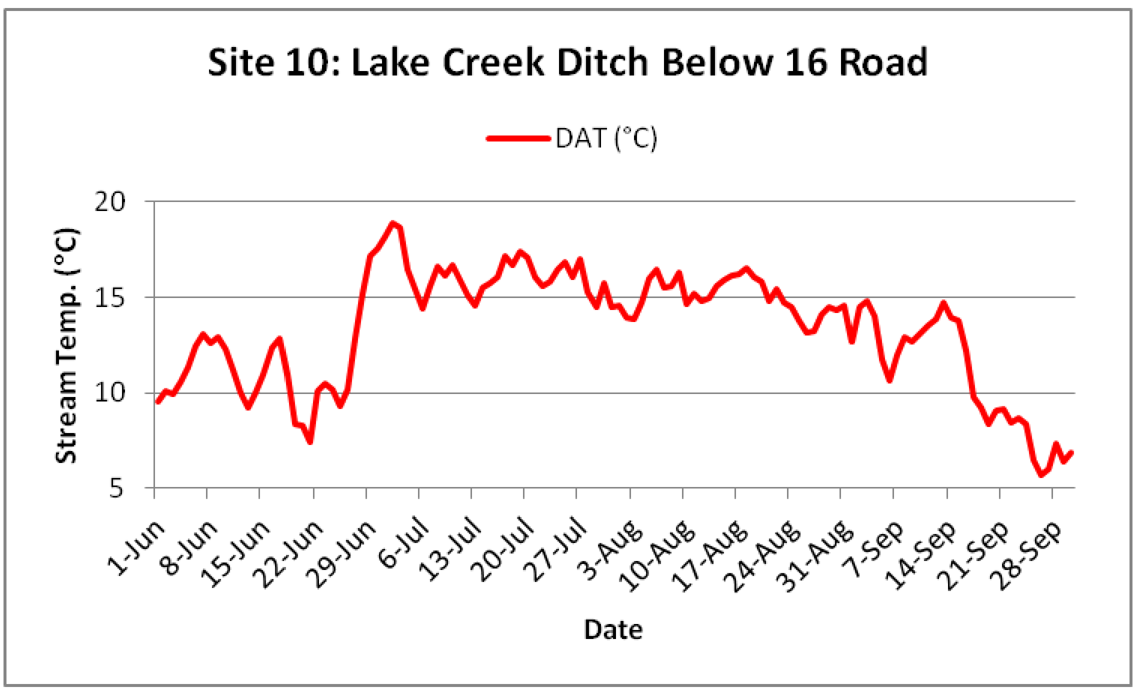


FIGURE 10B



APPENDIX C

BULL TROUT MOVEMENT IN THE UPPER MALHEUR (2000-01)

FIGURE 1C: JUNE 23RD-29TH, 2000

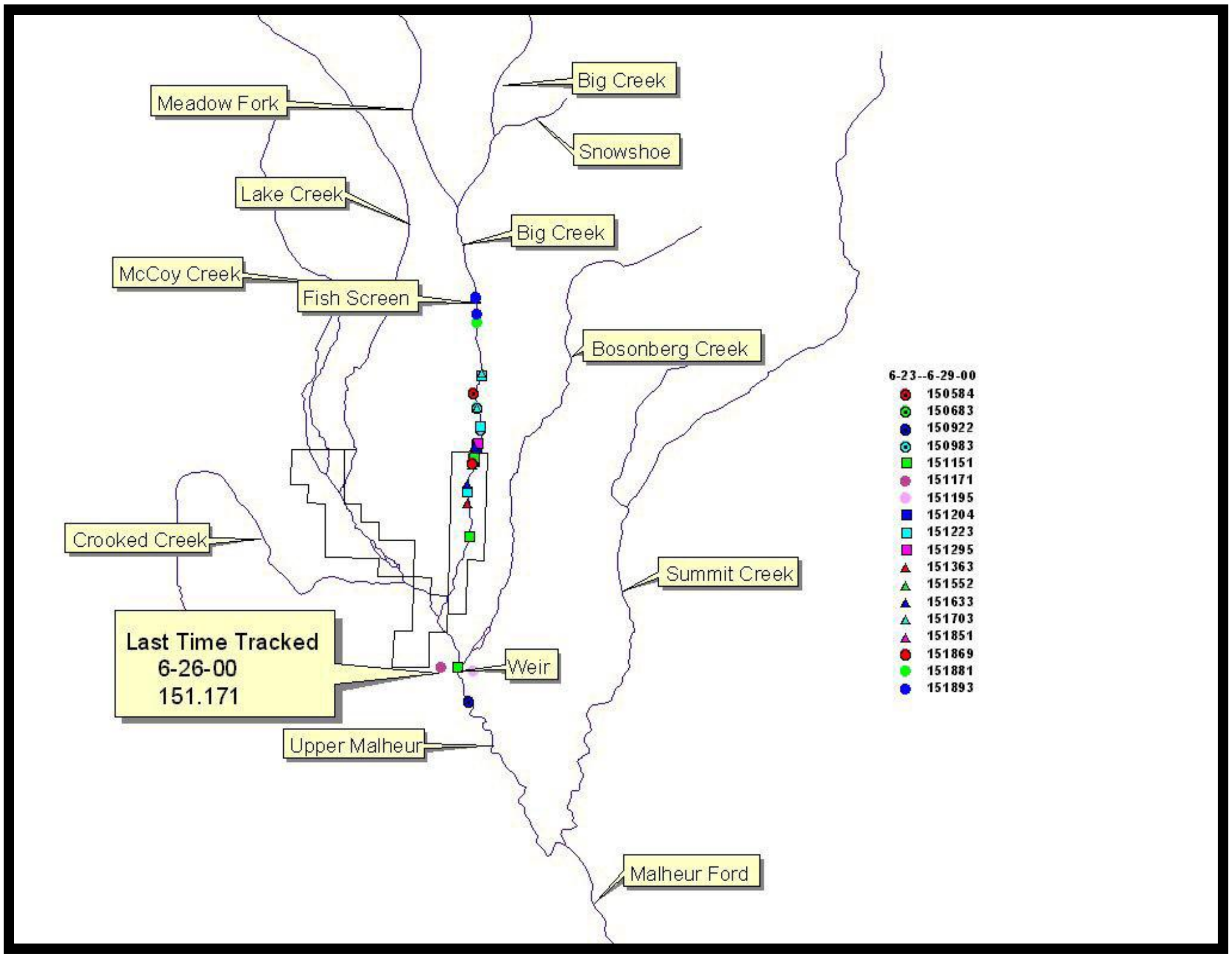


FIGURE 2C: JUNE 30TH-JULY 6TH, 2000

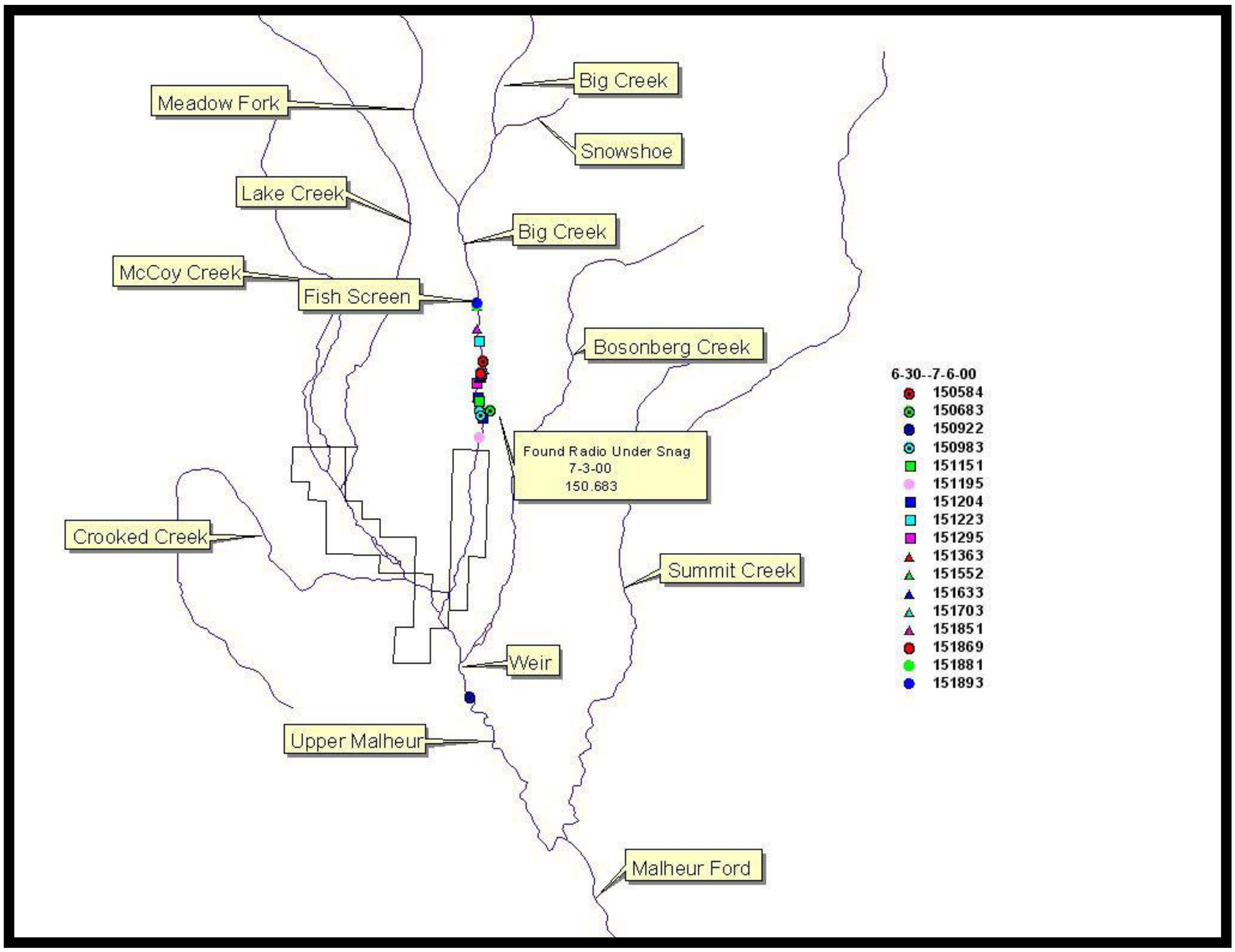


FIGURE 3C: JUNE 16TH-22ND, 2001

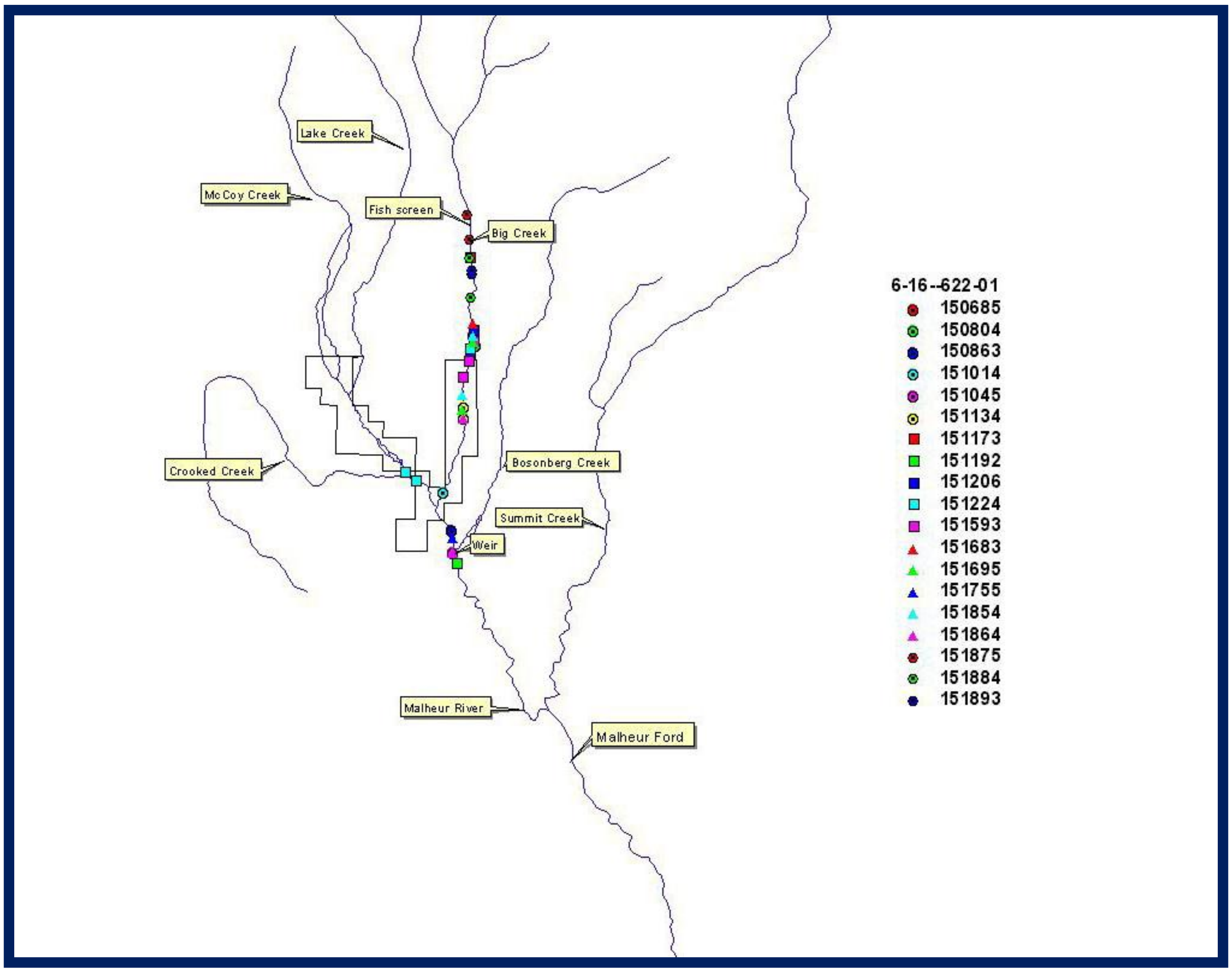


FIGURE 4C: JUNE 23RD-29TH, 2001

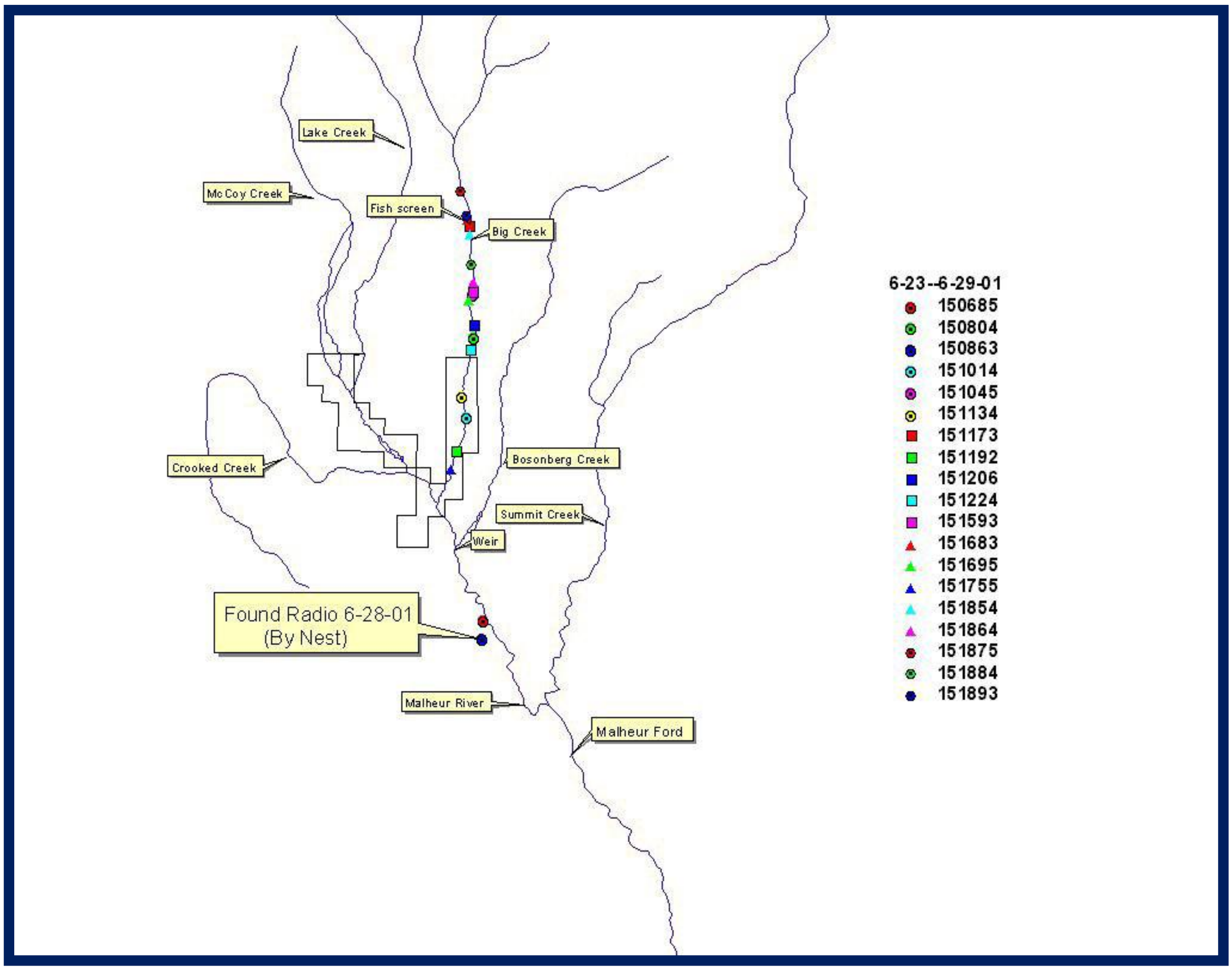


FIGURE 5C: JULY 7TH-13TH, 2001