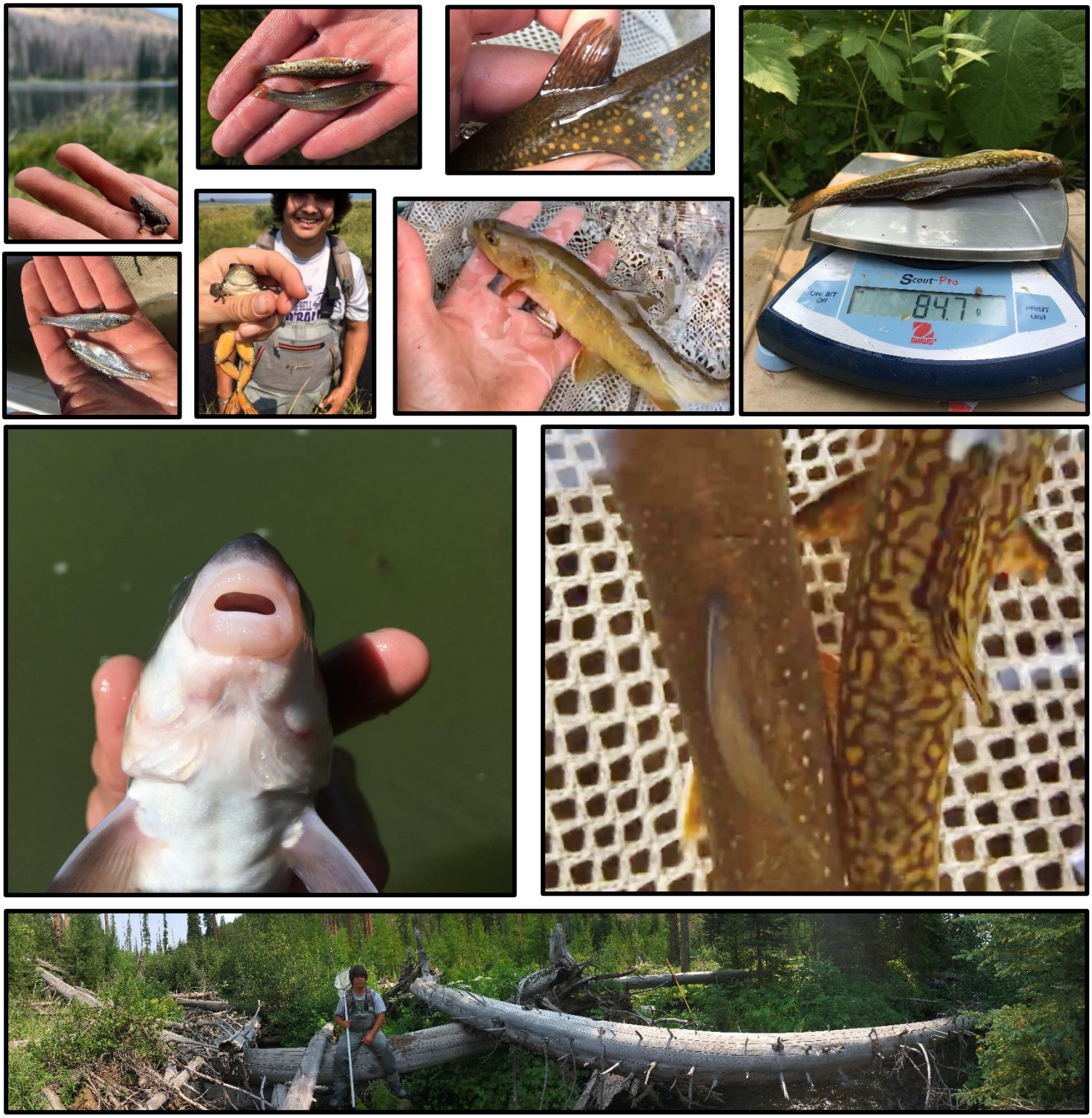
Evaluate the Life History of Salmonids in the Malheur Subbasin

Burns Paiute Tribe Natural Resources Department, Fisheries Program
Burns, Oregon

Project 1997-019-00
Contract #84125



Prepared for Bonneville Power Administration and Northwest Power and Conservation Council

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FY 2021 Annual Report

BPA Project # 199701900

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For work completed January 2021-December 2021

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Background and Context for FY2021 Annual Report

The Bonneville Power Administration (BPA) has supported fisheries research and management conducted by the Burns Paiute Tribe (BPT or, Tribe) Natural Resources Department in the Burns Paiute ancestral homeland since 1997. This report summarizes work completed by the BPT Fisheries Program in 2021. Field work conducted, data collected, objectives accomplished, and management activities fulfilled were approved by the Northwest Power and Conservation Council during the 2019-2020 Categorical Review of Resident Fish and Sturgeon Projects.

Brook trout (Salvelinus fontinalis) suppression

The primary focus of BPT Fisheries in 2021 was to continue mechanical efforts to suppress invasive brook trout. Brook trout (native to eastern United States) were introduced into the Upper Malheur around the 1930's, and brook trout remain the primary limiting factor, as identified by U.S. Fish and Wildlife Service Endangered Species Act recovery plans, to bull trout *(Salvelinus confluentus)* recovery. Until regulatory processes can be completed to allow brook trout eradication via chemical treatment, mechanical suppression will be conducted by BPT Fisheries. In 2021, BPT Fisheries largely electroshocked the same locations (high-density brook trout sites in lower Lake Creek) as 2019 and 2020. BPT electroshocked to remove brook trout from the entire reach of upper Lake Creek and set gillnets in High Lake. BPT led an angling removal event with the Oregon Natural Desert Association (ONDA) Northwest Youth Corps Tribal Stewards (Tribal Stewards) volunteer group. The Tribal Stewards participated in angling to remove brook trout from High Lake, collecting data on any fish caught, and packing fish out for an 'Invasive Fish Fry' at their camp.

Stream temperature monitoring

BPT Fisheries continued monitoring the ten-annual temperature sites on the BPT Logan Valley Wildlife Mitigation Property (LVWMP). 2021 data are missing for the two sites on the LVWMP (both of which experience annual dewatering) because the loggers were not attached to anchors at the end of the field season. BPT also continued monitoring efforts at locations in the Upper Malheur and over in the North Fork of the Malheur. 2021 temperature results support past trends. 1) Lake Creek in Logan Valley continues to have high temperatures which can act as thermal barriers to bull trout. 2) The North Fork Malheur temperature sites and the Upper Malheur sites are consistently cooler than the sites in the LVWMP. BPT expanded the temperature network to include an upstream and downstream location on the Tribe's property on Beech Creek.

Electrofishing surveys in Summit Creek and Crooked Creek, Upper Malheur

BPT fisheries surveyed the same sites on Summit Creek as the previous year 2020 to obtain some baseline fish population data which will be shared with the US Forest Service. BPT electrofished ten, 100-meter sites. Length and weight data were collected on any trout or sucker species caught and other species were counted. All fish were returned to the stream after each survey.

A total of four 100-meter sites were electrofished on Crooked Creek, a tributary to Lake Creek. 2021 was a low water year and Crooked Creek flow was intermittent throughout the stream. BPT obtained some updated data on the summer fish assemblages in these low water conditions. Five species of native fish were encountered and the native redband trout *Oncorhynchus mykiss gairdneri*, occupied one of the sites.

North Fork Malheur

BPT was unable to conduct any surveys (electrofishing/eDNA) in the Little Malheur (a tributary to the North Fork) in 2021 due to the Black Butte Fire as road access to location was restricted during the survey timeframe. This resulted in BPT being unable to further investigate the presence of invasive brook trout in the Little Malheur. However, BPT did update the Malheur Watershed Bull Trout Technical Advisory Committee (TAC) on the evident brook trout presence but difficulty in elucidating abundance in the Little Malheur at a summer meeting in the North Fork. BPT was given suggestions on how to alter sampling methods and timing to potentially assist in more detailed information regarding the presence of brook trout in the Little Malheur.

In 2021, BPT assisted ODFW with North Fork Malheur with an intensive bull trout spawning survey effort. The goals of the ODFW study were to 1) track trends in spawner abundance, 2) narrow down spawning timing, 3) examine duration of red visibility, 4) compare resident and migratory redds, and 5) evaluate redd re-site rates between streams (ODFW, personal comm.). Redd surveys were conducted in the annual streams a total of three times each over the spawning period. Redds were measured, marked, and GPS recorded. Two members from BPT fisheries collaborated on each effort. ODFW reported 96 redds in total in the ~24.3 stream miles surveyed (ODFW, internal data).

Brook Trout eDNA

BPT collected a few eDNA samples from locations in the Upper Malheur. BPT Fisheries used their established protocol to collect samples from McCoy Creek, Meadow Fork Creek, and in Mud Lake. The purpose of this effort was to verify that brook trout were not present in these locations due to suspected natural fish barriers (McCoy Creek) and lack of adequate habitat (Mud Lake). The samples were kept on ice and are currently stored in the BPT Natural Resource freezer at -20° C until sent to a lab for analysis.

Outreach

BPT Fisheries continued to maintain a website www.helpnativefish.com to educate public on local fisheries management and Eastern Oregon native fish species. BPT hosted a 'Help Native Fish' booth at the 2021 Harney County Fair, however the booth was unstaffed due to Covid-19 restrictions. The 2021 BPT Fisheries Staff included: Brandon D. Haslick (Fish Project Manager), Rebecca Fritz (Fish Biologist), and a seasonal technician.

Chapter 1: Selective Removal of Brook Trout (*Salvelinus fontinalis)* in Lake Creek, Upper Malheur River, Oregon

Rebecca J. Fritz and Brandon Haslick
BPT Natural Resource Department, Fisheries Program

Chapter 1:

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

Rebecca J. Fritz and Brandon D. Haslick
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1.1 Introduction

Malheur River Bull Trout (*Salvelinus confluentus)* were listed as threatened under the Endangered Species Act in 1999 (USFWS 2015). The Bull Trout Recovery Plan (USFWS 2015) identifies the key threats to bull trout within geographically broad Recovery Units and their associated local Core Areas. 2021 BPT Fisheries management for bull trout recovery falls within the Upper Snake River Recovery Unit and the Upper Malheur River Core Area. Specifically, this year's management actions were implemented in Lake Creek focusing on the removal of invasive brook trout (*Salvelinus fontinalis).* Brook trout have been determined the primary threat to Upper Malheur Bull Trout recovery (USFWS 2002, 2015).

Invasive Brook Trout in the Upper Malheur

Brook trout occur in abundance in the Upper Malheur Subbasin because of authorized and unauthorized stockings. Around the 1930's brook trout were stocked in Lake Creek's source, High Lake (Bowers et al. 1993). Invasive brook trout in the Upper Malheur Subbasin outcompete (Gunckel et al. 2002) and hybridize with threatened bull trout (Dehaan et al. 2009). The growing competition for resources, along with hybridization, has been directly contributing to bull trout population decline in the Upper Malheur.

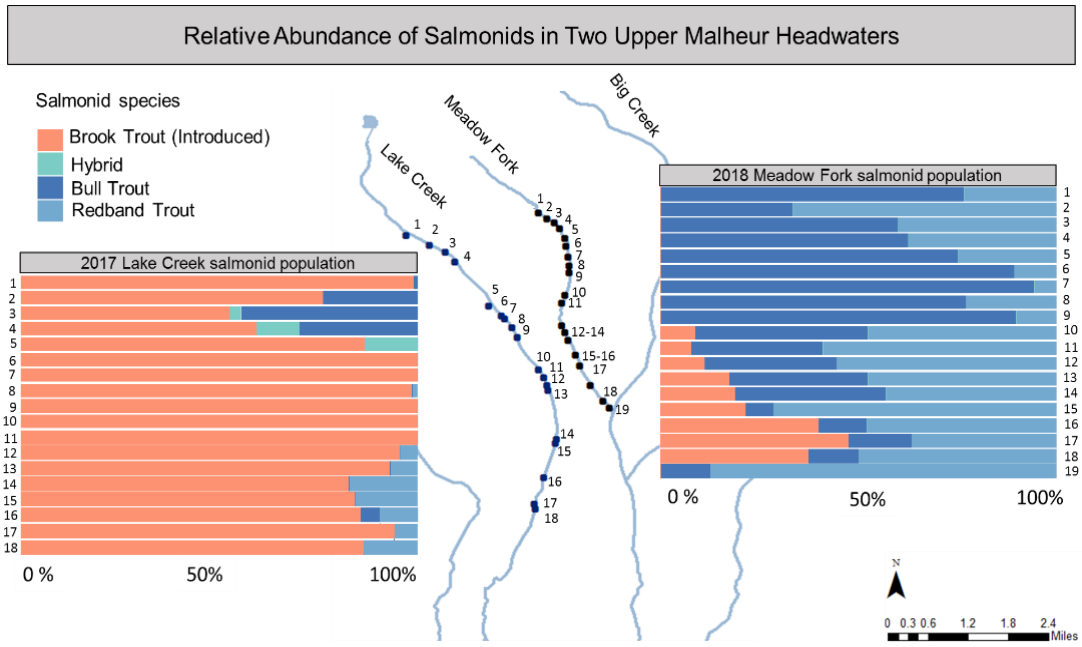

Figure 1.1 Relative abundance of 2017 and 2018 BPT population estimates

The two major tributaries which form the Upper Malheur and are the focus of the BPT's management are Lake Creek and Big Creek. A tributary of Big Creek, Meadow Fork Big Creek, is dominated by native trout species despite the presence of brook trout (Crowley 2018). Neighboring Lake Creek has the opposite trend as brook trout significantly outnumber bull trout (Crowley 2017) (Figure 1.1). Due to a natural fish barrier, the uppermost ~three km of Lake Creek and High Lake contain only invasive brook trout. This allows them to reproduce without competition for resources- thus providing a 'seed source' population to invade downstream bull trout Critical Habitat. Therefore, High Lake and upper Lake Creek are of immediate management concern. The focus of 2021 BPT field work was to continue brook trout suppression efforts in Lake Creek. Brook trout were removed using mechanical methods from multiple sites in the lower reach of Lake Creek and from the entire reach of upper Lake Creek to provide relief to the native salmonids.

1.2 Methods

The 2021 BPT Fisheries Program focused efforts on continuing the mechanical removal of brook trout from Lake Creek and High Lake (Figure 1.2). Mechanical methods included: backpack electrofishing efforts in Lake Creek, gill-netting efforts in High Lake, and angling in High Lake. Lake Creek Falls separates upper Lake Creek (inhabited only by brook trout) from lower Lake Creek (habitat to multiple salmonid species: brook trout, bull trout and redband trout (*Oncorhynchus mykiss gairdneri)*). The falls create a division in the Lake Creek fishery as well as in the following brook trout suppression methods.

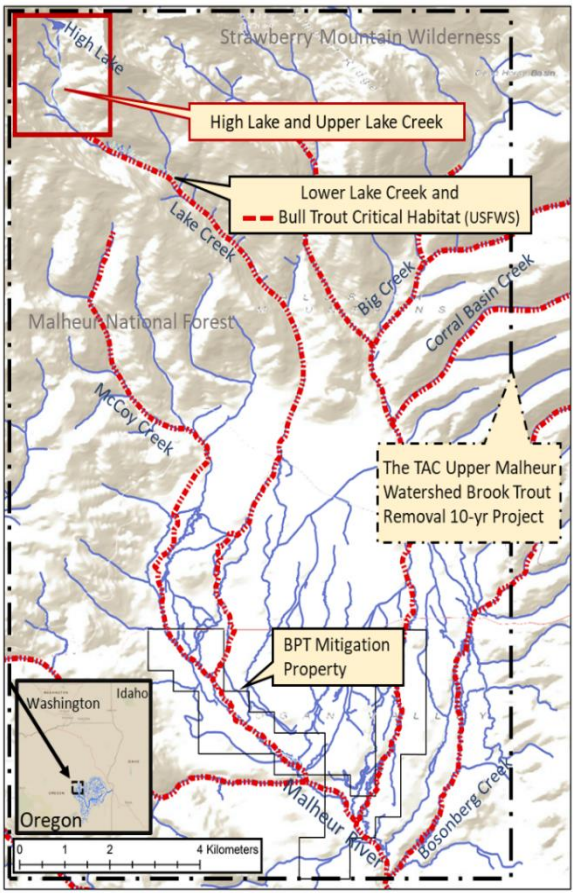

Figure 1.2 The 2021 brook trout removal efforts took place in High Lake/Upper Lake Creek and in Lower Lake Creek with is Critical Bull Trout Habitat (USFWS 2010).

Electrofishing lower Lake Creek

Fisheries used a LR24 Smith-Root backpack electrofisher to mechanically remove brook trout from Lake Creek. Brook trout removal occurred at specific sites below Lake Creek Falls (lower Lake Creek) (Figure 1.3 (A)). The selected sites had been surveyed in previous years and were considered high-density brook trout sites. Lower Lake Creek electrofishing took place beginning the 12th of July and continued through the 22nd of July. At the start of each site a crew of two people performed a single pass survey working upstream. Electrofisher settings were maintained at the lowest possible settings at which fish could be caught (largely, 400 volts, 40 Hz, and at a 40% duty cycle). Brook trout captured were measured for length (fork length) and euthanized. Subsets of brook trout were weighed throughout sampling until weight data had been collected from ~100 individuals. Trout fry (salmonid fry < 50 mm) were not directly targeted for capture in lower Lake Creek.

Non-target species were encountered at sites in lower Lake Creek. Any non-target species captured were taken downstream and revived. These captures were counted but no other data were taken. Captured (brook x bull) hybrids (referred to hereafter as, hybrids) were measured and euthanized. Unless otherwise specified, data on the six individual hybrids removed during sampling season were combined with brook trout data.

Electrofishing upper Lake Creek

Upper Lake Creek was treated as a single site. A crew of two people began upstream of Lake Creek Falls and electroshocked the entire reach until High Lake. Shocking this section involved multiple efforts (a total of six) which took place from mid-July until the end of August. The final section was shocked coinciding with a gill netting effort in High Lake. All captured brook trout fry were counted and euthanized from upper Lake Creek.

Gillnetting and angling in High Lake

2021 suppression efforts ended with a final removal event in High Lake using two ¾ inch gillnets. BPT Fisheries spent a week in August 2021, setting gillnets and angling. Two gill nets were set in High Lake and left to soak for (~) 24 hours. Brook trout were pulled from nets and euthanized. All trout captured were measured (fork length in mm) and a subset of weights was taken (~100 randomly selected fish). Nets were cleaned are deployed again in a different section of High Lake. While nets were soaking BPT crew members angled for brook trout in High Lake and finished electrofishing in Upper Lake Creek.

Additional High Lake Angling

BPT Fisheries organized a brook trout removal event with the 2021 Oregon Natural Desert Association Northwest Youth Corps Tribal Stewards program. A group of twelve spent a day (July 7th) down at High Lake removing brook trout by angling (fly and spinning rods). Captured fish were measured (fork length) and weighed (g). Fish were euthanized and hiked out by volunteers for an 'Invasive Fish Fry' held at their camp (Logan Valley Wildlife Mitigation Property).

Data Analysis

All 2021 data were analyzed using R studio (R version 4.1.2) and maps were created in ArcMap 10.5. Condition factor (K) was calculated for every brook trout that was both measured and weighed in lower Lake Creek. The mean (K) (for 100 individuals randomly selected using R) is reported and was calculated in R studio where W = weight in grams and L= length in mm. $K = \frac{10^5(W)}{(L)^3}$ (Ricker 1975). Data from the hybrids captured were incorporated in with brook trout analysis unless specified otherwise. Reports can be found on www.cbfish.org under project number 1997-01900 and contact brandon.haslick@burnspaiute-nsn.gov with data requests.

1.3 Results

In total, 1,153 brook trout were removed from Lake Creek and High Lake using various mechanical methods (Table 1). Six hybrids were also removed from Lower Lake Creek (1,159 total brook trout + hybrids removed). Fewer brook trout were removed in 2021 compared to previous sampling years (Appendix Figure 1.6). This year BPT Fisheries 1) trained a new technician, 2) electroshocked the same sites as 2019 and 2020 except for site #1 and 3) was unable to entirely shock site #2 due to timing and site complexity and 4) lower catch per unit effort on the High Lake gillnetting sets.

Table 1 *Total brook trout removed in 2021 using mechanical methods*

	Electrofishing	*Gill-netting*	*Angling*
Lower Lake Creek	386	—	—
Upper Lake Creek	164	—	—
High Lake	—	578	31
# Removed / Method	550	578	31
Total # Brook Trout Removed	**1,159**		

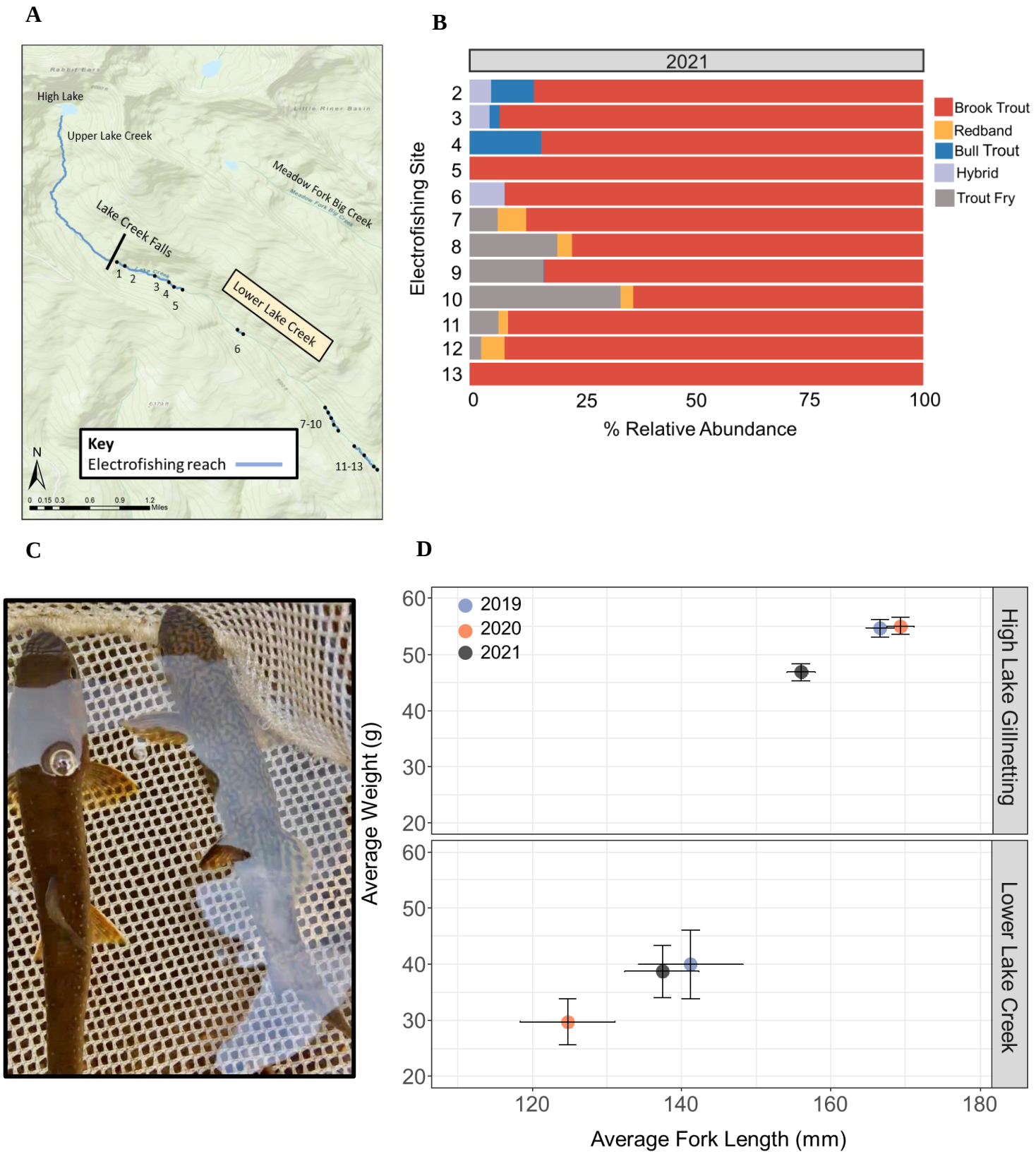

Figure 1.3 (A) Map of Lake Creek 2019-2021 electrofishing sites (#1 was not surveyed in 2021) (B) 2021 relative abundance of salmonids at each electrofishing site in lower Lake Creek (C) Bull trout (left) and brook trout (right) in lower Lake Creek (D) Mean (±95% CI) length and weight of (~100+) brook trout sampled with High Lake gillnetting methods and lower Lake Creek backpack electroshocking

Lower Lake Creek electroshocking

Stream temperatures ranged from 9.0 - 14.5 °C throughout lower Lake Creek shocking sites. Four fish species (brook trout (Table 1), bull trout (ten individuals) (Figure 1.3 C), redband trout (eight individuals), and sculpin *Cottus spp* (149 individuals)) were encountered. Unidentified 'trout fry' (defined as salmonid fry < 50 mm) were counted and released during lower Lake Creek electrofishing surveys. No bull trout or redband trout mortalities resulted from the year's sampling effort.

Brook trout (and hybrids) made up the greatest proportion (~ 89%) of the overall salmonid population captured in the lower Lake Creek Sites (Figure 1.3 (B)). 2021 fork lengths ranged from 58-266 mm and averaged 137.44 mm. (Figure 1.3 (D), Appendix Figure1.4(B)) however the size distributions differed from previous sampling years (Appendix Figure 1.4 A). Combing the length and weight data for (100 randomly selected sampled brook trout) resulted in the average condition factor K= 1.25. This value places the physical body condition of lower Lake Creek brook trout as being considered relatively fair (Appendix Figure 1.5) (Barnham & Baxter, 1998).

Upper Lake Creek and High Lake

Brook trout are the only fish species to occur above Lake Creek Falls and in High Lake. 164 brook trout were removed from upper Lake Creek by electrofishing the entire reach from Lake Creek Falls to High Lake (Figure 1.3 (A)). The final portion of upper Lake Creek was shocked concurrently with the High Lake gillnetting. A total of 578 brook trout were removed from High Lake with two ¾ inch gill nets and angling. High Lake had a lower mean condition factor (K= 1.23), and the average length and weight of the High Lake 2021 trout was smaller when compared to previous years despite the same mesh size.

1.4 Discussion

Mechanical methods unable to effectively eradicate Lake Creek brook trout

The focus of the BPT fishery program is to protect, restore, and enhance native fish assemblages in the Malheur River with an emphasis on ESA-listed bull trout. The unobstructed recruitment of brook trout in upper Lake Creek and High Lake which then populate lower Lake Creek (Critical Bull Trout Habitat) has driven almost a decade of BPT brook trout suppression efforts using mechanical methods (Poole and Harper 2011). BPT Fisheries established a baseline population estimate for Lake Creek brook trout in 2012 and compared it with the estimate resulting from a replicated study conducted in 2017. The intention of this research was to examine the effectiveness of five years of brook trout suppression efforts using mechanical methods (Harper 2013; Crowley 2017) addressing multiple questions. What impact did removal have physically on the brook trout population? Do removal efforts effectively remove a significant proportion of brook trout? Were there lasting impacts?

The five-year BPT study looked at the effectiveness of mechanical suppression and resulted in three main conclusions which were further supported by the 2021data. **1)** Mechanical suppression efforts have not resulted in a significant change in brook trout body size or condition. After 2012, BPT saw a higher frequency of captures shifting to a slightly smaller size class but, when combined with a similar condition factor throughout the study, changes were considered minimal (Crowley 2017). The 2021 condition factor followed this trend (Appendix Figure 1.5). **2)** Although by the end of the Lake Creek study BPT reduced the brook trout population by ~30%, there was no increase in native salmonid populations (Crowley 2017) and brook trout still made up the majority of the salmonid population.

Continuing the trend, 2021 brook trout dominated the lower Lake Creek salmonid relative abundance (Figure 1.3 B). **3)** The Lake Creek brook trout population is resilient and rebounds despite the removal efforts.

The Lake Creek brook trout population can almost completely recover to pre-suppression numbers within a year. Wildfires in 2013 and 2015 prevented High Lake removal efforts and the Lake Creek population strongly rebounded (Crowley 2015). BPT has invested considerable time and effort in working to suppress brook trout form even just the upper Lake Creek and High Lake seed source (Table 2). 2021 removal totals were lower than previous years (Figure Appendix 1.6). Regarding High Lake, the gill nets had a lower catch-per-unit-effort than previous years. Net sets were all in locations of previously believed high brook trout densities. However, after the second and third sets resulted in lower numbers of fish gillnetting efforts ended a day earlier than in previous years. BPT will consider alternating net mesh sizes or different net setting methods to widen the range of size selectivity and deter fish avoidance. In total, 2021 mechanical suppression efforts removed over 550 brook trout from Lake Creek, and ~380 of which were directly removed from habitat shared by native salmonids.

Table 2. Estimated Upper Lake Creek and High Lake mechanical removal effort to suppress brook trout between 2003 and 2021 and the Burns Paiute Tribe's investment to execute the projects

Location	**Target Species**	**Treatment**	**Years**	**Investment**
High Lake	Brook Trout	Gillnetting	2011-2021	1,872 staff hours
High Lake	Brook Trout	Angling	2011-2021	28 angling events
Upper Lake Creek	Brook Trout	Backpack Electrofishing	2010-2021	940 staff hours

**Estimates of BPT sampling effort (BPT, internal files)*

Lack of success in eradication efforts using mechanical methods has been demonstrated outside of the BPT's efforts in Lake Creek. Various studies in multiple streams have scrutinized the inability of backpack electrofishing to fully eradicate invasive trout (Thompson & Rahel 1996; Meyer et al. 2006) as well as its higher cost in effort and resources when compared to a piscicide treatment (Buktenica et al. 2013). A collaborative management effort using electrofishing to target brook trout in Idaho streams ended with several conclusions mirroring BPT's own findings. The conclusions: electrofishing removal efforts failed to eradicate 100% of the population, saw a large increase in age-0 abundance after removal efforts, and did not result in a significant increase in native fish populations (Meyer et al. 2006).

Further limitations with using electrofishing to eradicate brook trout are emphasized by outside studies and experienced by BPT. For instance, 1) electrofishing is size selective (Reynolds 1996). A common pattern among projects is the inability to effectively capture all fry (Thompson & Rahel 1996; Meyer et al. 2006). This problem is compounded in the BPT efforts in lower Lake Creek. Due to the desire to protect struggling populations of native salmonids, BPT does not target, capture, or remove unidentified fry in lower Lake Creek. 2) Complete eradication using mechanical methods may be an effective option for small streams and/or simple habitat. Habitat complexity (log jams, pools, beaver dams) limits the ability to completely capture all targeted trout during electrofishing. Lake Creek has complex habitat throughout the entire reach. Log jams, pools, subterranean flow, marshes, side springs, pools are all examples of locations where BPT removal efforts likely fail to remove all brook trout. 2021 electrofishing crews noticed an increase in beaver activity/added complexity in two lower Lake Creek sites compared to previous sampling years. The ineffectiveness of mechanical methods to completely eradicate brook trout is supported by outside studies, and further restricted by Lake Creek's complex habitat as well as a limited field season.

1.5 Recommendations

Throughout removal efforts, BPT has formulated a plan to fully eradicate brook trout from Lake Creek using rotenone. While BPT works with agency partners to implement such a treatment, suppression efforts aim

to continue in Lake Creek and High Lake to provide relief to native salmonids. Since 2015, BPT has removed more than 11,000 brook trout from the Lake Creek Drainage (Figure Appendix 1.6). In 2021, BPT had continued collaboration with the Malheur River Bull Trout Technical Advisory Committee (TAC) which formed and created the Upper Malheur Watershed Bull Trout Conservation Strategy in 2017 (TAC 2017). BPT will continue mechanical suppression in Lake Creek until the implementation of an anticipated, large scale, interagency rotenone treatment in the Upper Malheur.

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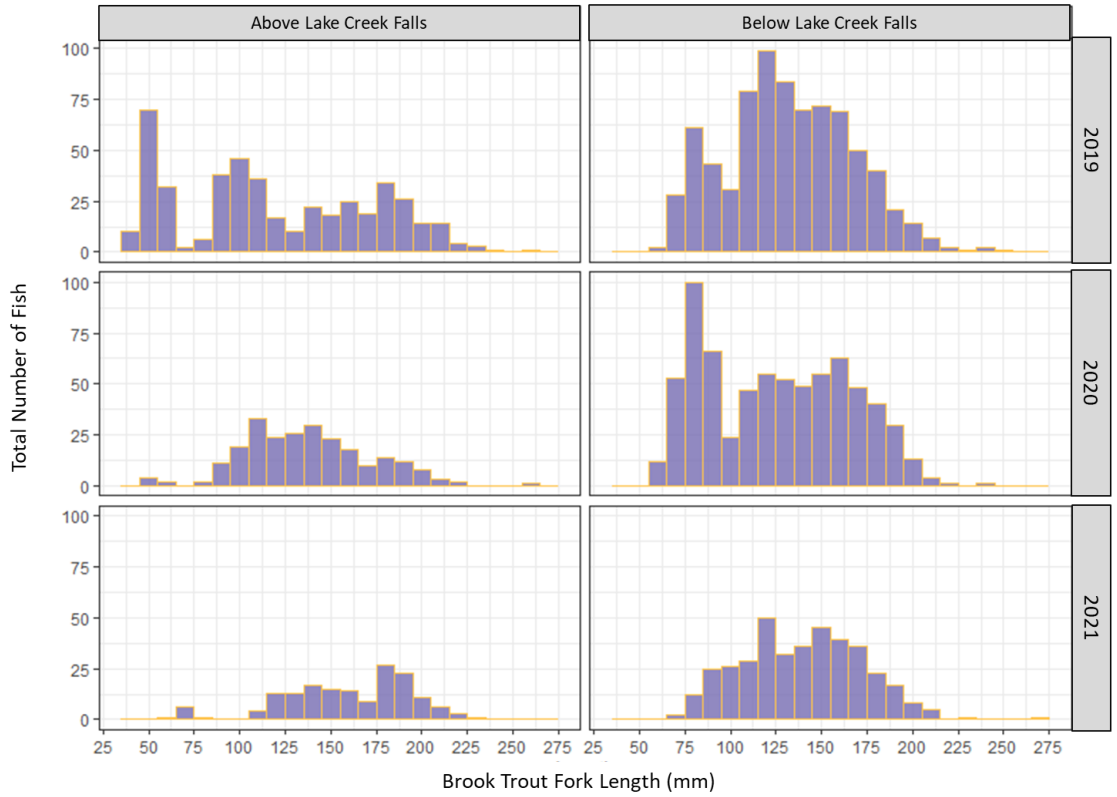
Appendices

A



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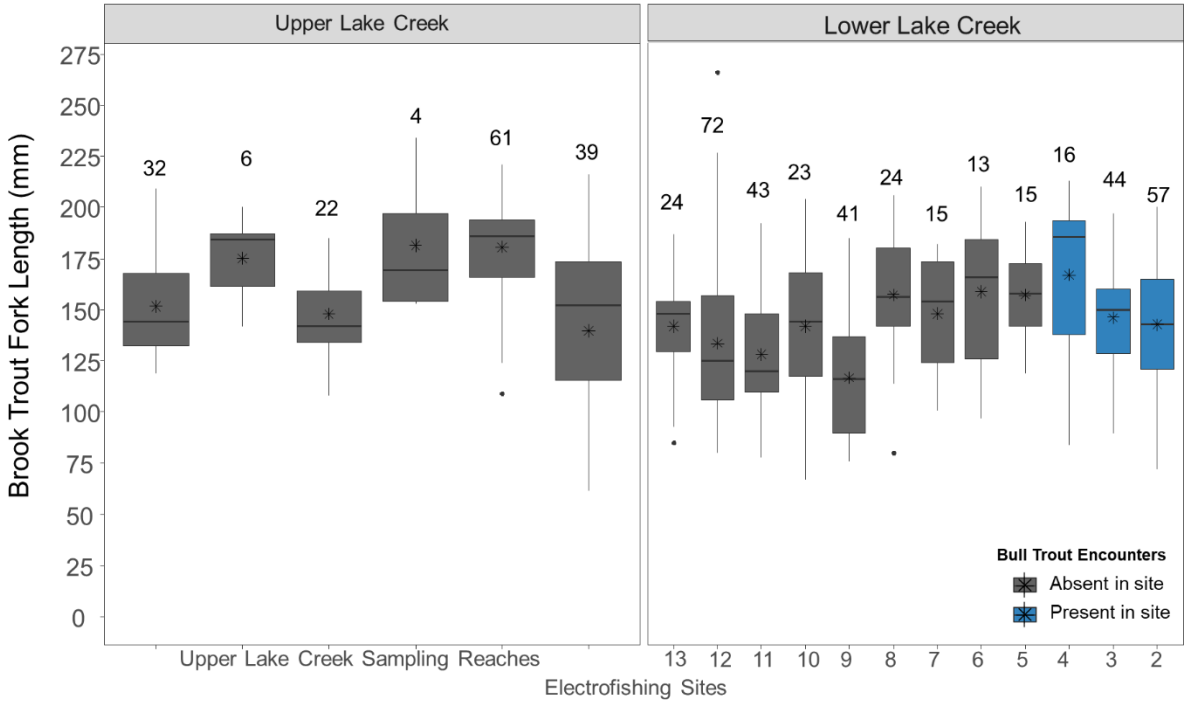
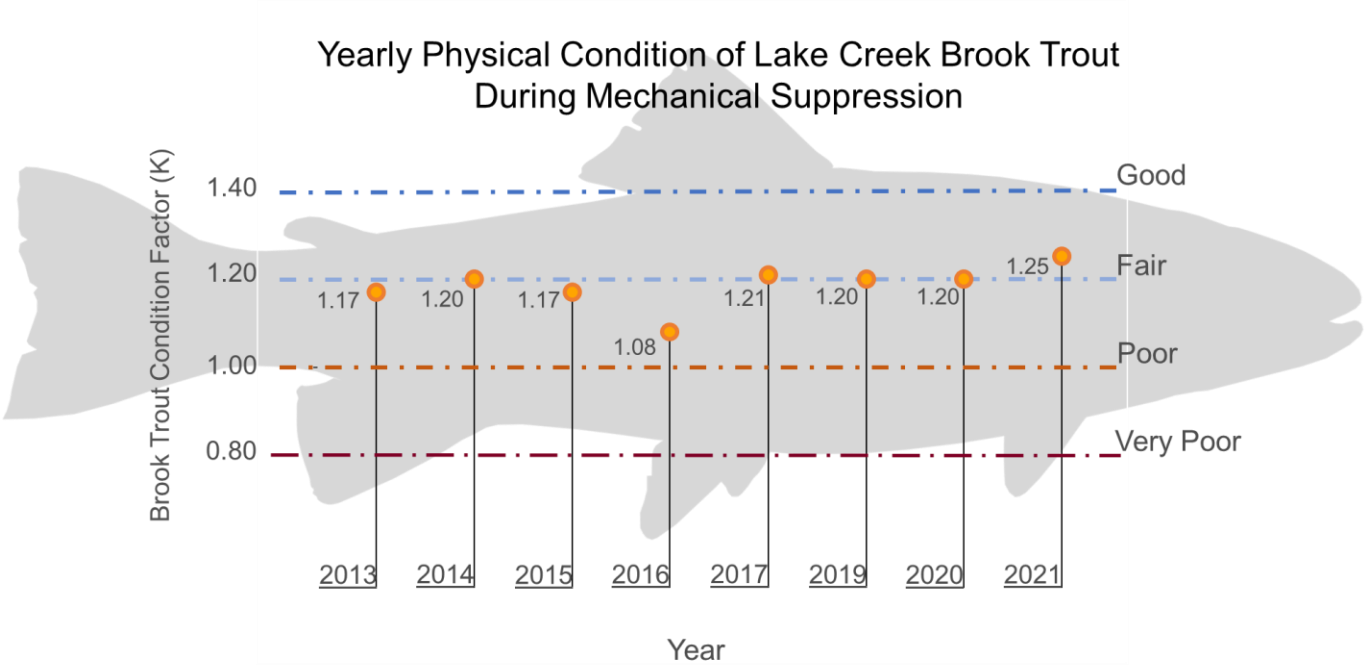
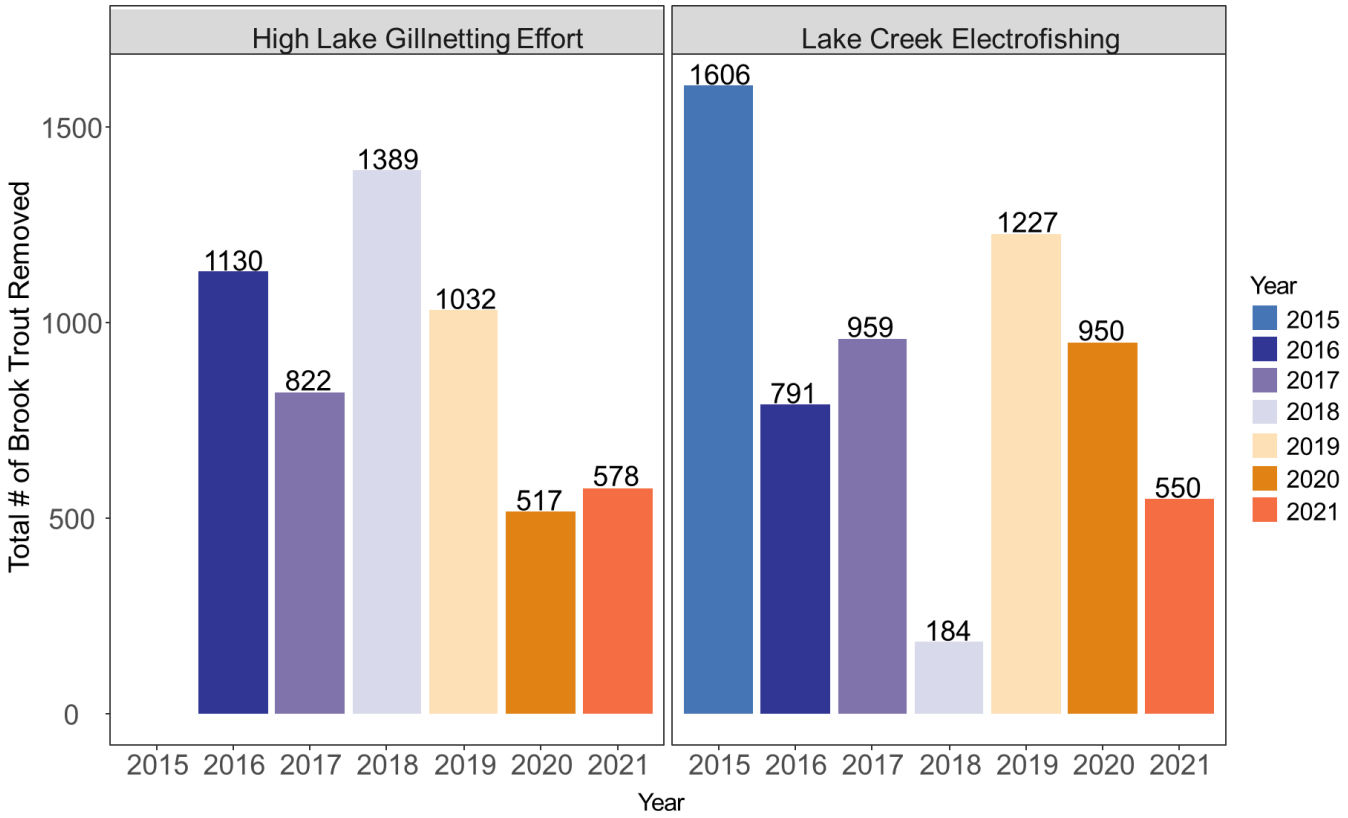


Appendix Figure 1.4 (A) 2020-2021 electrofishing results: length frequency histogram detailing brook trout fork lengths (mm), bins = 25 **(B)** 2021 Lengths (fork length) of lower and upper Lake Creek brook trout and the six hybrids. N= 550. (*) denotes the mean for the site



Appendix Figure 1.5 Mean condition factor (K) calculated for the lower Lake Creek brook trout throughout BPT suppression efforts



Appendix Figure 1.6 The total number of brook trout removed from High Lake and upper Lake Creek in the past seven sampling years.

Chapter 2: Stream Temperature Monitoring in the Upper Malheur Subbasin, the *Logan Valley Wildlife Mitigation Property,* and the North Fork of the Malheur Subbasin

Burns Paiute Tribe Natural Resources Department, Burns OR 97720

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Chapter 2

Stream Temperature Monitoring in the Upper Malheur Subbasin, the Logan Valley Wildlife Mitigation Property, and in the North Fork of the Malheur Subbasin

Rebecca J. Fritz and Brandon D. Haslick
Burns Paiute Tribe Natural Resources Department, Burns OR 97720

2.1 Introduction

Stream temperatures directly impact native fish populations. Three of the native Malheur River Salmonids (bull trout, redband trout, and (reintroduced for a put-and-take fishery) Chinook Salmon (*Oncorhynchus tshawytscha)*) are considered vulnerable to climate change (Halofsky and Peterson 2017). Of these three, bull trout are a current management focus for the BPT Fisheries Program and are considered the most sensitive to high stream temperatures (Buchanan and Gregory 1997; Haas 2001; Selong et al. 2001; Dunham et al. 2003). Stream temperatures are an important component in understanding habitat quality and fish distribution, particularly in respect to bull trout populations. High stream temperatures create thermal barriers, threaten spawning success/early-stage survival, and decrease resiliency to wildfire or environmental disturbances (Rieman et al. 2007; Halofsky and Peterson, 2017).

The Burns Paiute Tribe began monitoring stream temperatures in the Upper Malheur Subbasin after the purchase of the Logan Valley Wildlife Mitigation Property (LVWMP) in the spring of 2000. This property includes the confluence of the headwater tributaries which form the Upper Malheur River (also referred to as the Middle Fork Malheur). A series of ten stream temperature sites have been monitored annually to track the effects of habitat improvement projects on the property (Figure 2.1 A). Since the establishment of the annual sites, BPT's stream temperature monitoring has expanded to include various sites in the Upper Malheur, the North Fork of the Malheur, and as of 2021 two sites in Beech Creek (a tributary to the John Day River).

The BPT temperature monitoring program has grown since it started in 2000, and currently incorporates multiple objectives. 1) BPT continues to monitor thermal barriers to bull trout on the LVWMP. 2) BPT monitors the temperatures of the Upper Malheur headwaters to inform future bull trout management efforts. 3) BPT monitors temperatures throughout bull trout habitat in the North Fork of the Malheur and 4) collaborates with partner agencies to place loggers in locations which will contribute to the interagency monitoring effort as well as potentially provide temperature data for significant temperature modeling efforts.

2.2 Methods

Study Area

The Burns Paiute Tribe Fisheries Program monitors temperatures in the Malheur River Watershed in Eastern Oregon. Most sites selected for temperature monitoring fall into two subbasins: Upper Malheur and North Fork of the Malheur. However, in 2021, two loggers were placed on the Tribe's property in Beech Creek which drains into the John Day River. BPT temperature sites in the Upper Malheur are further grouped by 1) the ten annual sites located on the BPT Logan Valley Mitigation Property and 2) sites on major Upper Malheur tributaries.

Table 2.1 Burns Paiute Tribe ten annual temperature sites on the Logan Valley Wildlife Mitigation Property. (*) denotes the loggers exposed to air temperature during the 2021 monitoring period. Site #6 logger was collected by the USFS and will be returned to BPT in 2022 for data retrieval.

Site #	Location	Year Initiated	2021 Hobo Retrieved	Year Initiated Reference
1	Lake Creek below McCoy Creek	2000	Yes *	Namitz 2000
2	Lake Creek below Crooked Creek	2000	Yes	Namitz 2000
3	Malheur River below Big/Lake Creek	2000	Yes	Namitz 2000
4	Big Creek 1-mile south FS-16 Road	2000	Yes	Namitz 2000
5	Big Creek below FS-16 Road	2000	Yes	Namitz 2000
6	Lake Creek below FS-16 Road	2007	Pending	Schwabe 2007
7	McCoy Creek above Lake Creek	2007	Yes	Schwabe 2007
8	Lake Creek at Cabin Bridge	2008	No	Abel 2008
9	McCoy Creek below FS-16 Road	2009	Yes	Abel 2009
10	Lake Creek Ditch below FS-16 Road	2009	Yes	Abel 2009

Logan Valley Mitigation Property

The Logan Valley Wildlife Mitigation Property is located south of the Strawberry Mountains, located in the Strawberry Mountain Wilderness in eastern Oregon. This property spans 1,760 acres and includes the confluence of McCoy Creek, Lake Creek, and Big Creek which form the Malheur River (or Middle Fork of the Malheur). These headwater tributaries come together approximately 200 river miles upstream from where the Malheur joins the Snake River. In 2000, the Tribe began collecting seasonal (spring-fall) data on stream temperatures at five sites of the LVWMP. These sites have been maintained in the same locations and five more have been added within the property boundaries over time (Table 2.1) (Namitz 2000; Schwabe 2001, 2002, 2003, 2004, 2007; Fenton and Schwabe 2005, 2007; Fenton 2006; Abel 2008, 2009; Brown 2010, 2011, 2012; Haslick 2014, 2015, 2016, 2017, 2018, Fritz and Haslick 2019, Fritz and Haslick 2020).

Upper Malheur River

The ten annual stream temperature sites in Logan Valley are the overarching focus of the BPT monitoring effort. However, the tribe has expanded the program to include loggers upstream (North) of the LVMP. These sites are on Lake Creek (including the High Lake outlet), Big Creek, Meadow Fork of Big Creek, and McCoy Creek (seven sites to date in 2021) (Figure Appendix 2.5).

North Fork of the Malheur River

BPT has also expanded the temperature monitoring effort to include tributaries in the neighboring North Fork Subbasin. This involves nine monitoring sites on the North Fork of the Malheur and its tributaries (Figure Appendix 2.5). These locations are on streams in USFS managed forests. As of 2021, these loggers will contribute to a larger North Fork Malheur interagency temperature array. Oregon Department of Fish and Game (ODFW) and the USFS Prairie City District also have loggers monitoring temperatures in the North Fork to better understand habitat quality for bull trout.

Beech Creek

In 2021, BPT deployed two loggers on Beech Creek, the John Day Watershed. Both loggers were set in the ~6 miles of Beech Creek that runs through Burns Paiute Tribal Property. A logger was placed at the upstream end of the reach and a logger was placed downstream at the lower property boundary. In total, for the 2021 field year BPT fisheries was actively monitoring stream temperatures in both Grant and Baker County-Eastern Oregon.

Field Techniques

Pre/Post Deployment:

All stream temperatures were monitored using Tidbit v2 Temperature Loggers (hereafter referred to as, loggers) which are a product of the Onset Computer Corporation. Prior to stream deployment, the battery life and memory storage were checked, and all loggers were set to take a temperature reading at the start of every hour. Once collected from the field, all loggers must pass a post-deployment test to check each logger for accuracy.

Field Deployment:

All temperature loggers at the Logan Valley Mitigation Property were set in the field by the middle of May/end of May. Most Upper Malheur loggers and North Fork loggers were also set within this time frame. The 2021 upper McCoy Creek logger (#15) (Figure Appendix Figure 2.4) was moved ~100 meters upstream (same location as 2020). At the stream site, each logger was directly attached to an eight-pound anchor and placed in the thalweg of the stream. Anchors were secured by cable and tied off on a tree or staked into the bank. Loggers were collected within October. Once gathered from the field, loggers were required to pass post-deployment accuracy tests.

Data Analysis

The BPT monitors temperatures starting in late spring through late fall. Due to the yearly differences in logger deployment, BPT reports temperatures from June 1st – September 30th. This establishes a standard 122-day monitoring period for most loggers (road access and snow level can alter individual deployment dates).

Data are analyzed using the same methodology as previous years summarizing temperature data using mean weekly maximum temperature (MWMT) in °C (as summarized in Haslick 2018). MWMT (the average of a rolling 7-day temperature maximum) is used due to its accuracy as a biological parameter describing stream temperatures. Specific temperature benchmarks are recognized as standard parameters and used in this report. The first two Stream Temperature Standards established through the Department of Environmental Quality (DEQ) are 12 °C MWMT (optimal temperature for rearing juvenile bull trout and considered the maximum temperature for bull trout migration) and 16 °C is the ideal temperature for core salmonid rearing areas (OAR 340-04102004). The final temperature standard highlighted in this report is the Incipient Lethal Temperature (ILT) in which stream temperatures ≥ 20.9 °C are harmful to ESA listed bull trout (Selong et al. 2001). One of the LVMP Loggers (Lake Creek Annual #1) was exposed to air in 2021. The point of air exposure is identified, and further temperature data are excluded. 2021 data were analyzed using R Studio and maps of were created using ArcMap 10.5. Raw data can be obtained by contacting Brandon Haslick (brandon.haslick@burnspaiute-nsn.gov) or Rebecca Fritz rebecca.fritz@burnspaiute-nsn.gov.

Oregon Department of Fish and Wildlife (ODFW) defines the critical period for high stream temperatures in the Malheur watershed as, the summer timeframe which falls within the dates, July 15th thru

August 15th (Perkins 1999). Peak high stream temperatures occur within or near this critical period (Figure 2.2 A) and the critical periods has been used as a base index for comparing yearly stream temperatures in the Upper Malheur (Namitz 2000; Schwabe 2001, 2002, 2003, 2004, 2007; Fenton and Schwabe 2005, 2007; Fenton 2006; Abel 2008, 2009; Brown 2010, 2011, 2012; Haslick 2013, 2014, 2015, 2016, 2018; Fritz and Haslick 2019, 2020).

2.3 Results

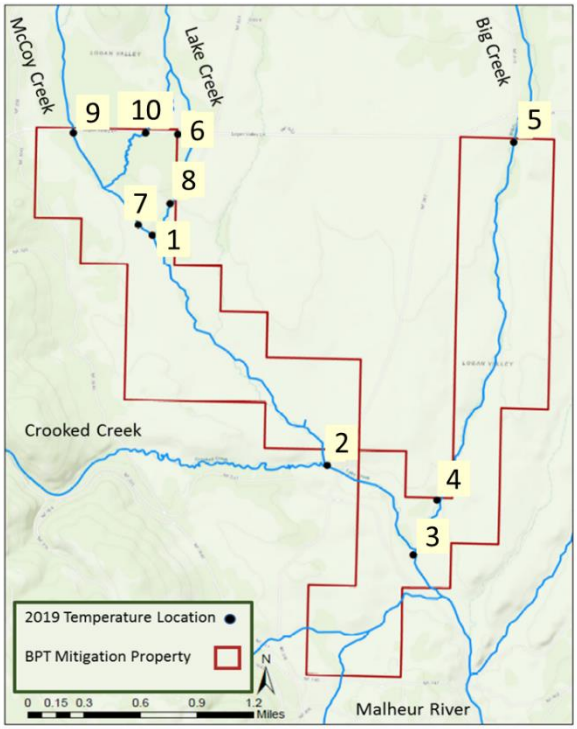
Logan Valley Mitigation Property ten annual sites

The 2021 BPT Logan Valley temperature sites (Figure 2.1 A) had MWMT temperatures peaked early starting in the end of June (Figure 2.2 B) before the defined critical period (July 15-Aug 15). When comparing only the complete datasets, all but one of the sites on Big Creek had an MWMT that exceeded the ILT threshold for bull trout (20.9 C) (Selong et al. 2001) (Table 2.2), 2021 had earlier and warmer peak temperatures than past years (Figure 2.2 A), and McCoy Creek (site #9 in Figure 2.1 A) has repeatedly had the warmest temperatures on the LVWMP (Figure 2.2. B). The loggers for site LVWMP site #6 and #8 not recovered. The logger was exposed to air during peak summer at site 1 on Lake Creek so data are reported (2.1 B) but will not be analyzed. All loggers passed post deployment checks.

Table 2.2 The total number of days (and % of the sampling season) for the last three seasons in which MWMT exceeded specified temperature benchmarks at the LVWMP. Sites 1,6 and 8 excluded due to air exposure.

		DEQ: Bull Trout > 12 ℃			***DEQ: Salmonids Trout >16 ℃***			***ILT: Bull Trout >20.9 ℃***		
BPT Logan Valley Mitigation Property Site		**2019**	**2020**	**2021**	**2019**	**2020**	**2021**	**2019**	**2020**	**2021**
	2	120 days (98%)	122 days (100%)	122 days (100%)	95 days (78%)	95 days (78%)	109 days (89%)	44 days (36%)	50 days (41%)	65 days (53%)
	3	112 days (91%)	122 days (100%)	122 days (100%)	75 days (61%)	81 days (66%)	92 days (75%)	0	8 days (7%)	30 days (25%)
	4	111 days (91%)	122 days (100%)	119 days (97.5%)	67 days (55%)	77 days (63%)	86 days (70%)	0	0	13 days (11%)
	5	89 days (73%)	87 days (71%)	109 days (89%)	14 days (11%)	32 days (26%)	61 days (50%)	0	0	0
	7	No data	122 days (100%)	122 days (100%)	No data	89 days (73%)	108 days (88.5%)	No data	37 days (30%)	63 days (52%)
	9	122 days (100%)	122 days (100%)	122 days (100%)	104 days (85%)	108 days (89%)	110 days (90%)	54 days (44%)	60 days (49%)	73 days (60%)
	10	105 days (86 %)	114 days (93%)	122 days (100%)	68 days (56%)	77 days (63%)	93 days (76%)	4 days (3%)	22 days (18%)	57 days (47%)

A



B

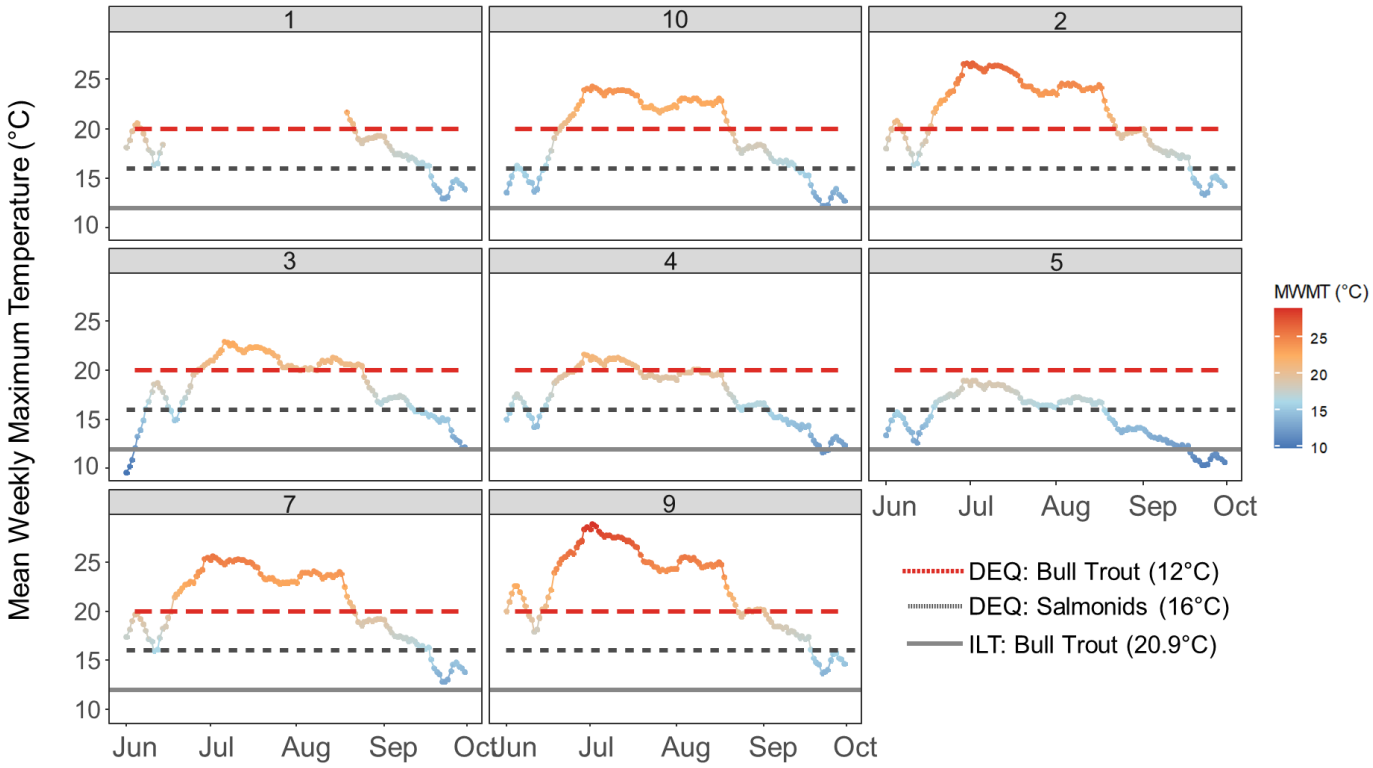


Figure 2.1 (A) BPT ten annual temperatures sites on the LVWMP (B) BPT 2021 MWMT (°C) values for 8 of the ten 2021 annual sites. July 15th-Aug 15th is the 'critical time' for bull trout. Site 6 and 8 are not included due to missing loggers. Site 1 has an incomplete dataset due to air exposure.

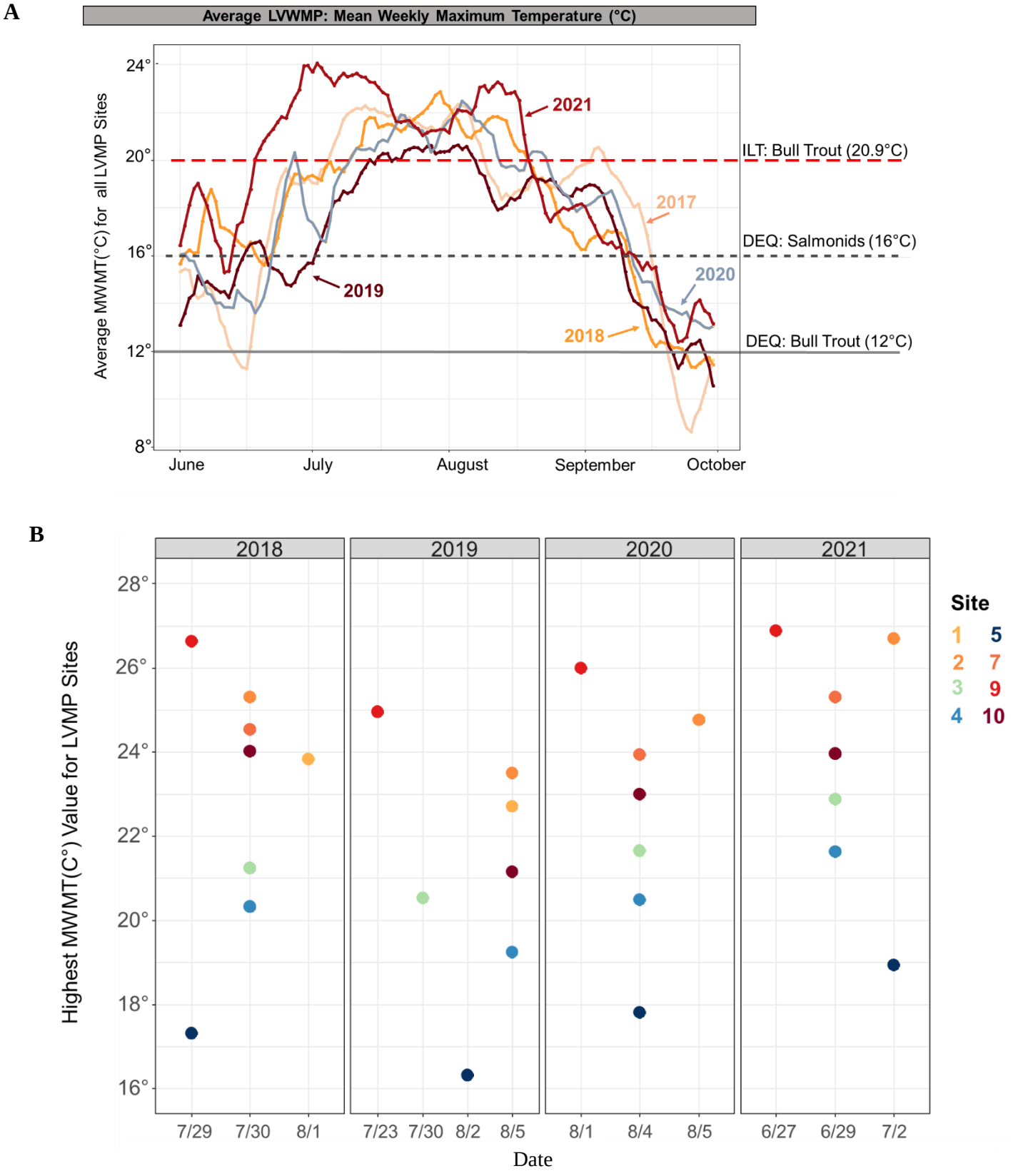


Figure 2.2 (A) Average MWMT (°C) for the BPT LVWMP ten annual temperature sites. Temperatures are recorded for the BPT monitoring period: June 1st- September 30th. **(B)** The highest MWMT(°C) recorded for each site (excluding sites 1, 6 and 8) for the BPT LVWMP from 2018-2021 (data found in Appendix Table 2.3)

Upper Malheur and North Fork Locations

BPT temperature monitoring has expanded to encompass multiple locations upstream of the LVWMP in the Upper Malheur tributaries as well as throughout the neighboring North Fork Malheur (Figure Appendix 2.5). The North Fork Malheur provides valuable habitat to a distinct population of bull trout (MW Council 2004). Comparatively, North Fork tributaries have temperatures which remain cooler throughout the summer critical period for bull trout (Figure Appendix 2.5). Of the BPT monitoring locations, the ten annual sites (sites 1-10) in Logan Valley result in consistent thermal barriers to bull trout (Figure 2.3).

2.4 Discussion

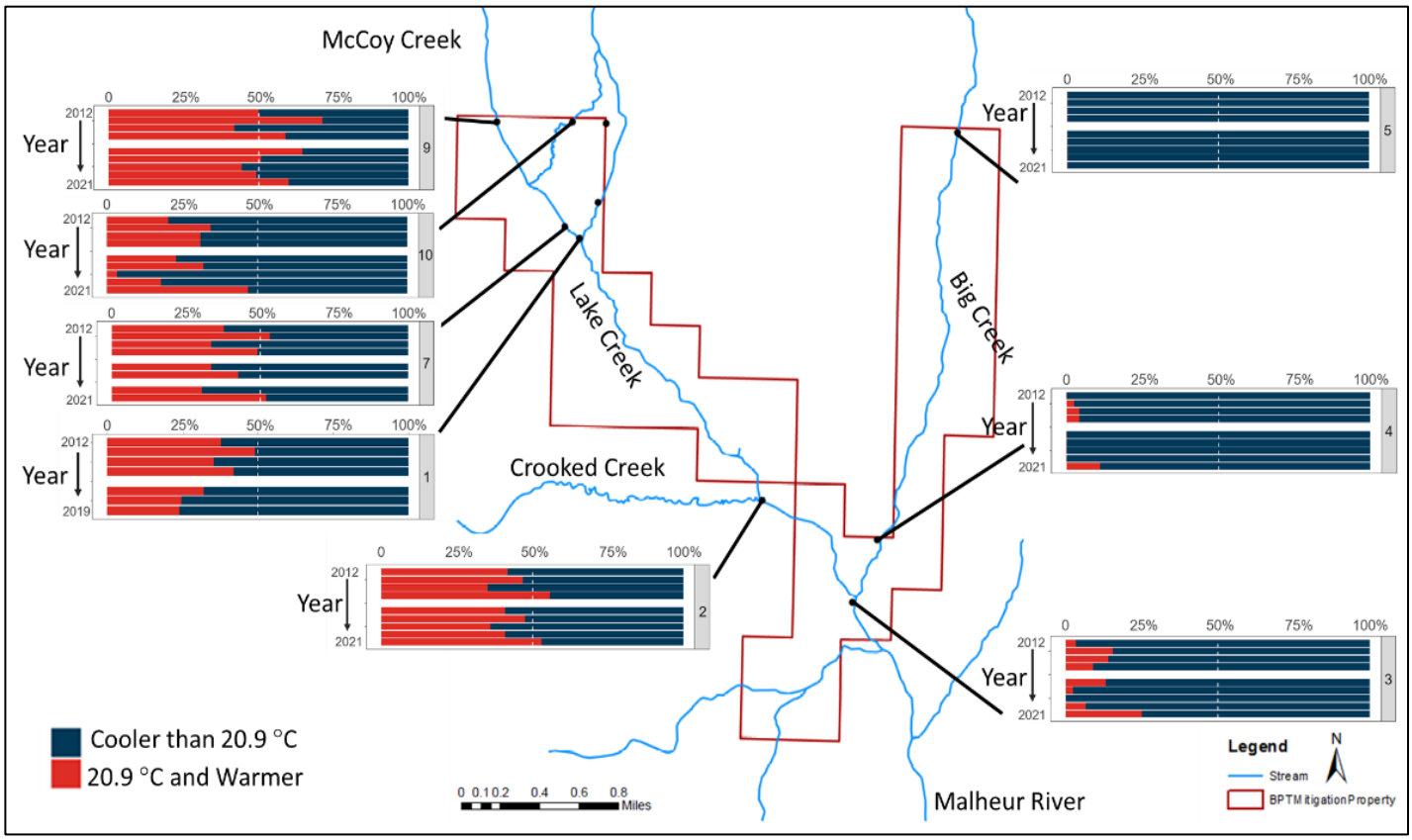


Figure 2.3 Percent of the days during the summer monitoring season (June 1st- September 30th) in which temperatures reach or exceed ILT at ten annual sites. (%) calculated out of a 122-day monitoring season. No data available for 2016 or sites 6 and 8 (dewatered annually).

The Burns Paiute Tribe Fisheries Program entered a cooperative effort with the USDA Forest Service and ODFW to document stream temperature trends in the Upper Malheur (Namitz 2000). The BPT has been actively monitoring some temperatures in Logan Valley for nearly two decades (Namitz 2000) and this effort has grown to include over twenty locations in two different subbasins of the Malheur Watershed (the Upper Malheur and the North Fork of the Malheur) which flow into the Malheur River (Haslick 2018). The purpose of collecting temperature data is to monitor stream habitat suitability for ESA listed bull trout. 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 the most thermally sensitive fish species; requiring cold water 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 presence (Haas 2001; Dunham et al. 2003). The ten annual monitoring sites in Logan Valley occur in U.S. Fish and Wildlife Service designated bull trout Critical Habitat (75 FR 63897 2010).

Logan Valley Mitigation Property sites consistently reveal thermal barriers to bull trout

Upstream of the BPT Logan Valley property, the tributaries forming the Upper Malheur run through forested National Forest and designated wilderness. Groundwater inputs create cool water temperatures in these headwaters, making them valuable bull trout habitat (Figure Appendix 2.5). The daily average temperatures of these tributaries rise as they enter Logan Valley becoming restrictive to bull trout at most sites throughout the summer months (Figure Appendix 2.4). Several trends have been observed over time regarding temperatures on the LVWMP. 1) Big Creek lowers the temperature of the Malheur River (site 3). 2) McCoy Creek (sites 7 and 9) is a driver of the hot stream temperatures in Lake Creek. 3) Finally, lack of continuous flow throughout the summer (sites 6 and 8) presents barriers to migrating fish and could potentially lead to entrainment (Haslick 2018). Continual monitoring of the LVWMP annual temperature sites has provided, and will continue to provide, important information regarding land use practices thought Logan Valley. The ten LVWMP loggers will provide valuable information regarding the status of present and future restoration efforts.

BPT monitors temperatures upstream of the LVWMP on the Upper Malheur headwaters to inform current and future bull trout recovery efforts. Loggers located on Lake Creek provide temperature data in habitat where bull trout populations are facing competition and hybridization from invasive brook trout. Invasive brook trout are identified as the primary threat to Upper Malheur bull trout recovery, and monitoring stream temperatures in the headwater streams informs future management actions. Tracking temperature trends will provide important habitat information for planned brook trout eradication efforts. For instance, Lake Creek, particularly upper Lake Creek/High Lake, are the first locations for proposed rotenone efforts. BPT Fisheries has plans of placing more loggers to capture temperatures at a more refined scale on Lake Creek in 2022.

When compared to the Upper Malheur sites (namely, LVWMP), the upper North Fork Malheur has experienced fewer lasting effects of anthropogenic pressures (logging and livestock grazing) (Haslick 2016). North Fork stream temperatures maintain a pattern of being relatively cooler when compared to Upper Malheur Logan Valley Temperatures (Figure Appendix 2.5). North Fork logger locations are in reaches with active bull trout spawning, rearing, and migration (Perkins 2009, Haslick 2016) and therefore are providing data on valuable bull trout habitat. BPT collaborates with agency partners on logger locations and data are made available to provide a large picture of temperatures in the North Fork system.

BPT Fisheries will continue monitoring temperatures in the locations reported for the foreseeable future. Stream temperature data collected in the Upper Malheur and the North Fork Malheur by the BPT helps guide understanding regarding future climate impacts on bull trout. Using temperature data from watersheds throughout the Columbia Basin, scientists are effectively modeling future climate change scenarios. These models provide guidance for habitat restoration, bull trout recovery, and focused management efforts. BPT collaborates with USFS and the U.S. Geological Survey NorWeST to provide stream temperature data which can further develop and fine tune models (Haslick, 2018). BPT, ODFW, and USFS partnered to place temperature loggers and form a detailed temperature array in the North Fork Malheur in 2021. Although, BPT did not add or move the location of the North Fork Loggers, the 2021 monitoring locations were reported to inform partners where place new loggers to avoid data gaps in an array. BPT will continue future collaboration with partner agencies to collect important temperature data throughout the Upper Malheur and the North Fork Malheur.

2021 challenges and changes

2021 temperature monitoring experienced some challenges. Two of the Logan Valley annual temperature loggers were not collected. One logger was not attached to the anchor upon fall retrieval, and another was collected by a forest service crew (logger will be retrieved for data readout from USFS in 2022).

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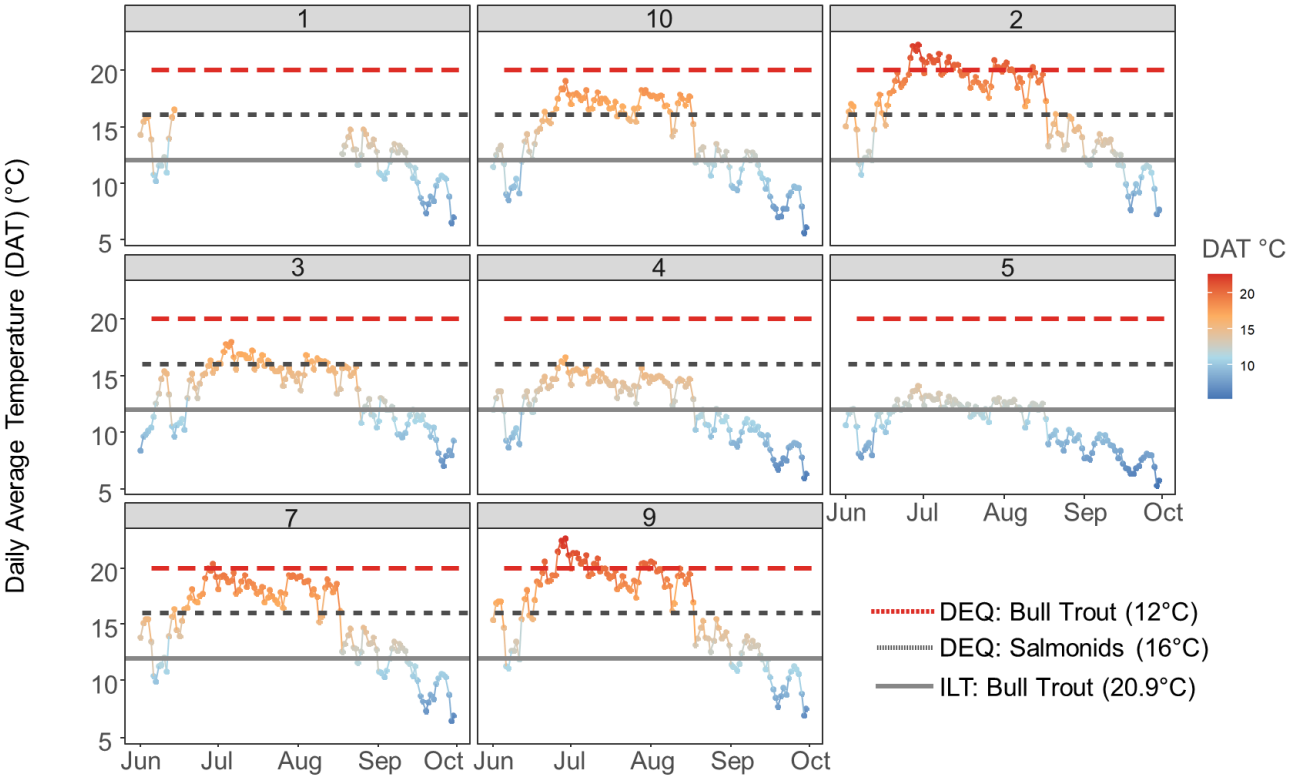
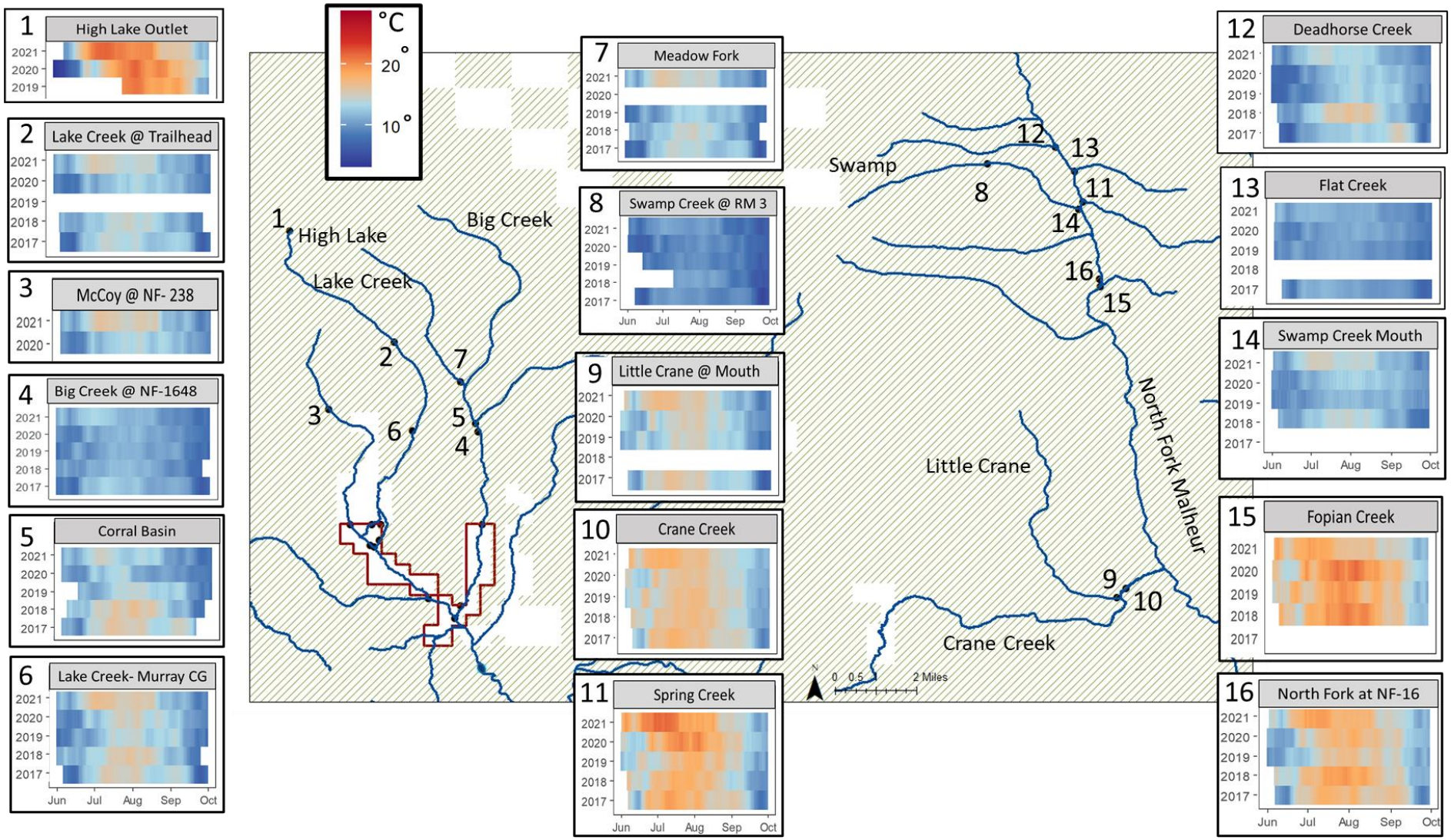
Appendices



Appendix Figure 2.4 2021 Daily Average Temperature (DAT) for eight of the ten annual Logan Valley Wildlife Mitigation sites. *Site 1 incomplete dataset due to air exposure



Appendix Figure 2.5: Heatmap of BPT Upper Malheur and North Fork Malheur Stream Temperatures

Appendix Table 2.3: Summary of Temperature Maximums at annual Logan Valley Wildlife Mitigation Property BPT Temperature Sites. Dewatered sites (6 & 8) not included. Temperature Monitoring Period: June 1st- September 30th

Site	Year	Highest MWMT (°C)	MWMT Date	Absolute Maximum(°C)	Maximum Date
1	2018	23.84	8/1/2018	24.68	7/29/2018
	2019	22.72	8/5/2019	24.07	7/12/2019
	2020	*No data- logger was exposed to air during this time.			
	2021	*No data- logger was exposed to air during this time.			
2	2018	25.3	7/30/2018	26.11	7/25/2018
	2019	23.5	8/5/2019	24.41	8/3/2019
	2020	24.76	8/5/2020	25.6	7/31/2020
	2021	26.7	7/2/2021	28.44	6/29/2021
3	2018	21.24	7/30/2018	21.7	7/25/2018
	2019	20.52	7/30/2019	21.44	7/12/2019
	2020	21.65	8/4/2020	22.66	7/30/2020
	2021	22.88	6/29/2021	24.22	6/29/2021
4	2018	20.33	7/30/2018	20.91	7/14/2018
	2019	19.24	8/5/2019	20.27	7/12/2019
	2020	20.49	8/4/2020	21.37	7/30/2020
	2021	21.64	6/29/2021	23.06	6/29/2021
5	2018	17.31	7/29/2018	17.75	7/24/2018
	2019	16.32	8/2/2019	17.2	7/22/2019
	2020	17.8	8/4/2020	18.58	7/30/2020
	2021	18.93	7/2/2021	20.46	6/29/2021
7	2018	24.53	7/30/2018	25.43	7/25/2018
	2020	23.94	8/4/2020	24.77	7/30,7/31/2020
	2021	25.3	6/29/2021	27.35	6/29/2021
9	2018	26.64	7/29/2018	28.2	/24/2018
	2019	24.95	7/23/2019	26.4	7/12/2019
	2020	25.99	8/1/2020	26.92	7/20/2020
	2021	26.89	6/27/2021	30.42	6/27/2021
10	2018	24.01	7/30/2018	24.63	7/25/2018
	2019	21.16	8/5/2019	21.51	7/31/2019
	2020	23.0	8/4/2020	24.05	7/31/2020
	2021	23.96	6/29/2021	25.93	6/29/2021

Chapter 3: Investigating Fish Populations in Summit Creek and Crooked Creek; Two Upper Malheur Tributaries

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BPT Natural Resource Department, Fisheries Program

Contents

Chapter 3

Investigating Fish Populations in Summit Creek and Crooked Creek; Two Upper Malheur Tributaries

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Introduction

BPT fisheries conducted electrofishing surveys in two Upper Malheur Tributaries for the 2021 field season. The two tributaries, Summit Creek and Crooked Creek (Figure 3.1) are both classified by the USFWS as Critical Habitat for ESA Threatened Bull Trout (USFWS 2010). However, the information regarding bull trout presence and current native/non-native fish population data at these locations is outdated.

The Malheur River Bull Trout Technical Advisory Committee (TAC) is an interagency organization in which the partners[1] collaborate to effectively manage the Upper Malheur Subbasin and benefit native fish species, with a focus on bull trout. The TAC provides an avenue for agencies like BPT and USFS to collaborate on riparian restoration activities, like the USFS led Stage-0 restoration plan for Summit Creek. The TAC also meets at least once annually to discuss future restoration and recovery goals. TAC meetings in Spring 2021 reveled some gaps in current data/understanding about both Crooked Creek and Summit Creek. BPT last surveyed Crooked Creek in 2010 and Summit Creek in 2011 (Appendix Figure 3.5, BPT internal files). The overall interest in updating the data gap in current fish populations drove the 2021 BPT effort to continue to collect baseline data in Summit Creek and survey Crooked Creek.

Summit Creek: Summit Creek is considered to once have supported bull trout populations however, bull trout have not been observed since 2000 (USFWS 2010) despite multiple BPT electrofishing surveys (Appendix Figure 3.5, BPT internal files). Restoration on Summit Creek may allow for the eventual bull trout expansion into the habitat (USFWS 2010). The US Forest Service is currently planning a large scale, future Stage-0 restoration. A Stage-0 treatment is proposed for a segment, hereafter referred to as Upper Summit (Figure 3.2). The study reach, Middle Summit, will serve as a control reach as no restoration activities are planned for this segment and a second Stage-0 Treatment is proposed for the reach, Lower Summit (Figure 3.2). 2021 BPT electrofishing survey sites and methods on Summit Creek are intended to replicate surveys conducted the previous year. In 2020, the BPT began gathering baseline biological data on Summit Creek to assist USFS in the restoration planning.

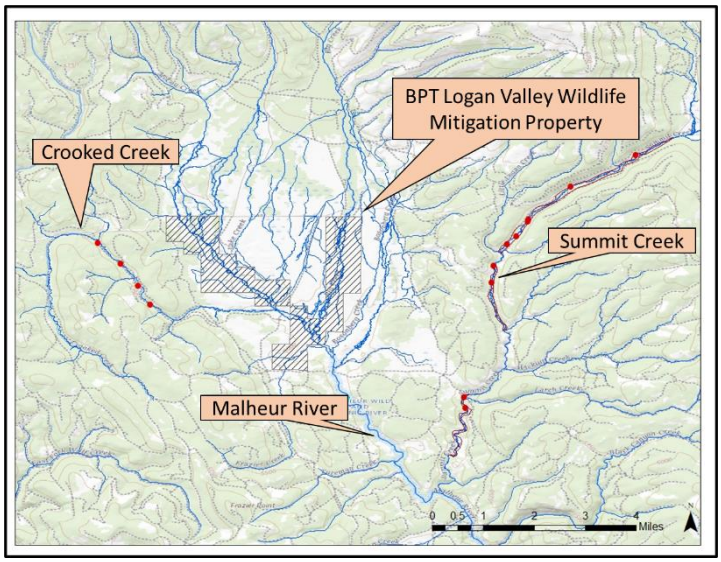


Figure 3.1 Map showing location of both of Summit Creek electrofishing sites and Crooked Creek electrofishing sites in the Upper Malheur Subbasin.

Crooked Creek: Crooked Creek, considered historic Spawning/Rearing habitat (USFWS 2010) and historic Feeding/Migratory habitat (ODFW), is

[1] Partner agencies in the TAC: Oregon Department of Fish and Wildlife (ODFW), United States Forest Service (USFS), United States Fish and Wildlife Service (USFWS), Burns Paiute Tribe (BPT), and Bureau of Reclamation (BOR)

currently known to be unoccupied by bull trout. The last bull trout encounters occurred in 1995 and 1998 (USFWS 2010). Crooked Creek can have intermittent flow during low water years and may be a location for future TAC restoration efforts. The TAC expressed interest in obtaining more recent survey data on the species present in Crooked Creek. BPT Fisheries conducted four (100 meter) electrofishing surveys in Crooked Creek during the 2021 summer field season. BPT also walked Crooked Creek multiple times in the summer to investigate whether flow was continuous.

Methods

Study Area

BPT fisheries conducted electrofishing surveys in two different tributaries within the Upper Malheur Subbasin. These tributaries largely flow through the Malheur National Forest as well as some privately-owned land. Summit Creek is a 23 km long Upper Malheur River tributary which joins the Malheur River upstream of Malheur Ford Campground. Crooked Creek is a 13 km long tributary upstream of Summit Creek which flows into Lake Creek on the BPT Logan Valley Wildlife Mitigation Property (LVWMP) (Figure 3.1).

Fish sampling: Summit Creek

July 26th-Aug 5th, Fisheries electroshocked the same ten sites that were established in 2020 on Summit Creek (Figure 3.2) using a single-pass, upstream survey. Ten, 100-meter long, sites were randomly selected in 2020 among the Lower, Middle, and Upper Summit treatment reaches. Two sites were sampled in Lower Summit, two sites in Middle Summit, and six sites were sampled in Upper Summit Creek. Once at the site location, BPT measured 100-meters using a tape.

Fisheries used a LR24 Smith-Root backpack electrofisher to survey the fish at each site. Electrofisher settings were maintained as the lowest levels as which fish could be caught and no electrofishing was conducted if stream temperatures had exceeded 18° C. Trout fry (salmonid/unidentified fry < 50 mm) were counted and released during the survey. Redside shiner (*Richardsonius balteatus batlteatus)* and dace spp. were also counted and immediately released to avoid mortalities. Other species, salmonids (redband trout and brook trout) and suckers (*Catostomus columbianus*) were collected in an aerated bucket, identified to species, measured (fork length), weighed, and released back into stream. 2021 methods differed from 2020 in that dace were identified to species. Freshwater mussel/crayfish/and amphibian presence were all recorded.

Fish sampling: Crooked Creek

BPT crews surveyed a total of four sites on Crooked Creek (Figure 3.4 A). Site locations were randomly selected however crews may have shifted the start and stop location to ensure 100-meters of shockable habitat. A LR24 Smith-Root backpack electrofisher was used for a single-pass, upstream survey at each site and settings were maintained as the lowest levels as which fish could be caught. No electrofishing was conducted if stream temperatures were expected to exceed 18° C. Due to concerns regarding water temperatures, all fish were identified, counted, and immediately revived/released downstream.

Data Analysis

All 2021 data were analyzed using R studio (R version 4.1.2) and maps were created in ArcMap 10.5. Reports can be found on www.cbfish.org under project number 1997-01900. Data can be requested by contacting BPT Fisheries- Brandon Haslick, Fisheries Program Manager, brandon.haslick@burnspaiute-nsn.gov.

Results and Discussion

Summit Creek Fish Distributions

BPT fisheries encountered a total of six fish species in Summit Creek. Five of the species, speckled dace *Rhinichthys osculus, l*ongnose dace *Rhinichthys cataractae, r*edside shiner, bridgelip sucker, and redband trout are native to the Malheur River. Brook trout, invasive to the Malheur, were also present, and had a higher relative abundance than the native redband trout (Figure 3.3). In total, over 1,800 fish were captured and identified (Table 3.1).

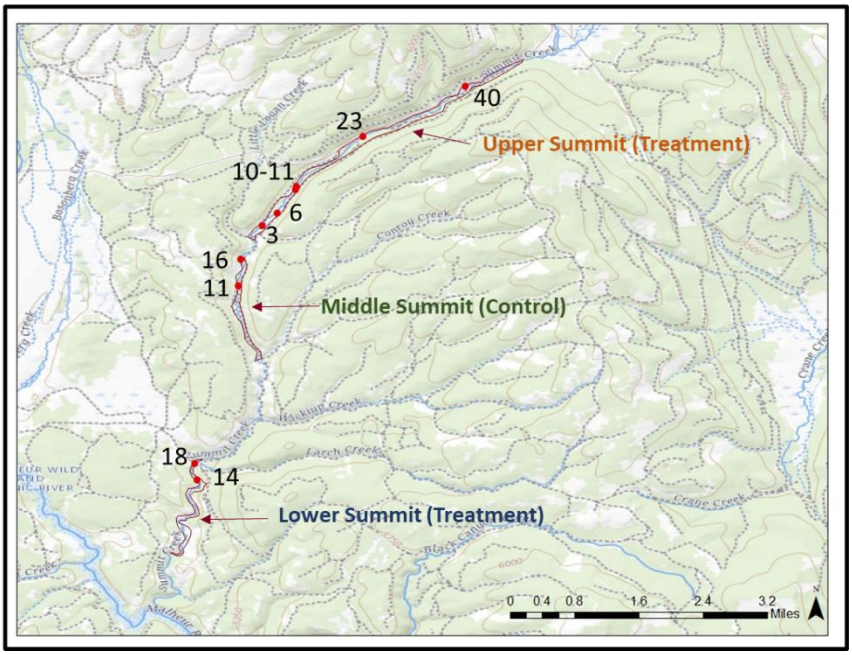
Table 3.1 2021 electrofishing results in two Upper Malheur Tributaries

	Summit Creek		**Crooked Creek**	
	Total # Fish Captured	% Abundance	Total # Fish Captured	% Abundance
Specked Dace	1052	57%	253	58%
Longnose Dace	52	2%	0	0%
Brook Trout	179	10%	0	0%
Redside Shiner	142	8%	133	30%
Unidentified Fry	224	12%	9	2%
Bridgelip Sucker	153	8%	40	9%
Redband Trout	57	3%	5	1%
Total fish captured	**1859**		**440**	

Although the overall survey size was relatively small (10 electrofishing sites), data show that 1) Summit Creek provides habitat for multiple species of native fish, 2) electrofishing sites were dominated by dace species (largely, speckled dace) (Table 3.1), and 3) sites with a higher density of brook trout show lower abundance of some native species. Excluding the unidentified fry, native fish made up 90% of the overall Summit Creek fish population. Speckled dace were present in all ten survey sites, and largely the most abundant fish in each survey, with the exception of an Upper Summit survey (Figure 3.3). Like 2020, brook trout were more abundant (Figure 3.3) and increased in density in the Upper Summit locations (Figure 3.2 B).

Brook trout increased in abundance in Upper Summit Creek, however some native fish species, bridgelip suckers and speckled dace, decreased in relative abundance at these upstream locations (Figure 3.3). Redside shiner were not encountered in the uppermost upstream sites (Figure 3.2 B). These differences in species composition among lower and upper Summit Creek may be due to differences in habitat or due to the increase of a nonnative predator (brook trout). It may be a future management concern that Brook Trout occur at great densities than the native salmonid, redband trout. The increasing numbers of brook trout will be monitored by the TAC as future restoration efforts for bull trout and native fish recovery are implemented.

A



B

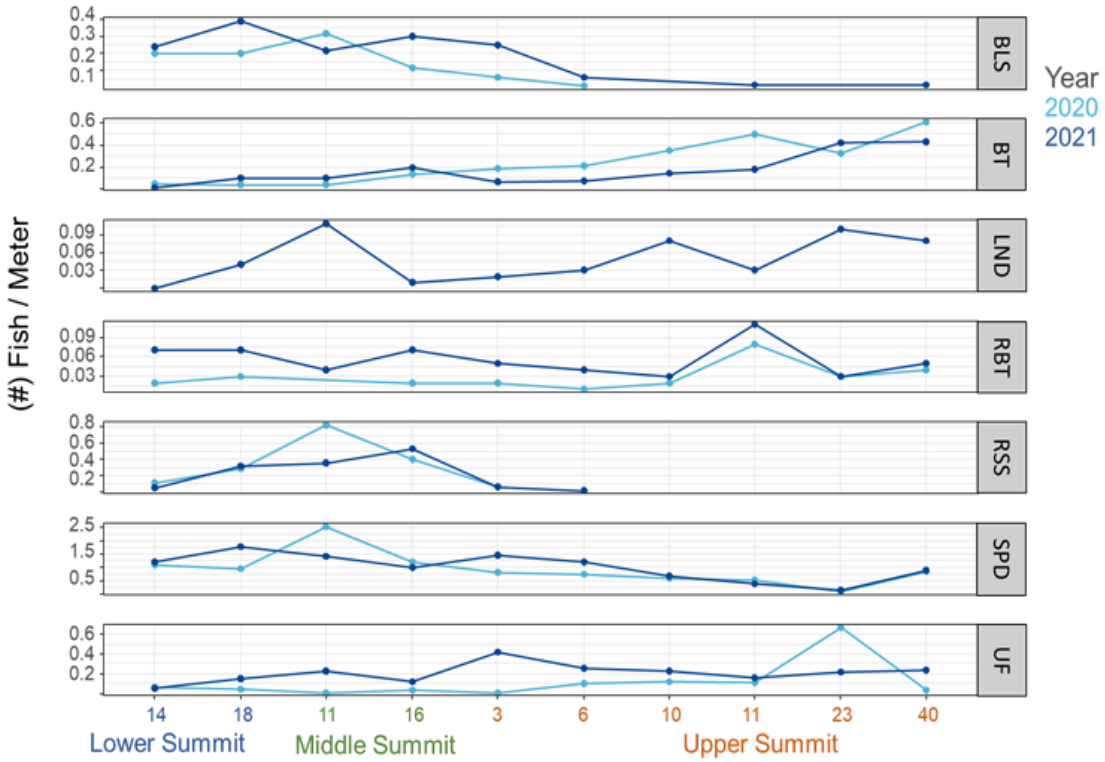


Figure 3. 2 (A) Map displaying the 2020/21 Summit Creek electrofish survey sites within the USFS restoration project. Survey sites were randomly selected to fall within the three USFS restoration (treatment/control) sites. **(B)** Calculated Summit Creek fish density (#fish/meter) for each electrofishing reach.

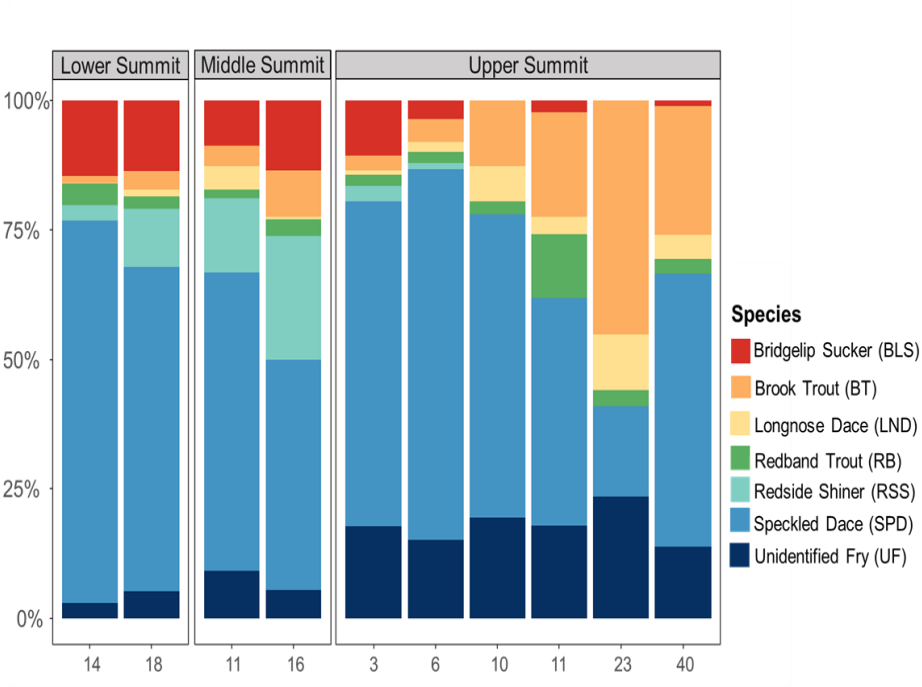


Figure 3.3. Fish species composition found in the ten electrofishing surveys distributed along the three future restoration treatments.

Crooked Creek Fish Distribution

Pre and post the electrofishing efforts, BPT Fisheries walked a large portion of Crooked Creek to examine stream flow and habitat. Walking upstream from the confluence with Lake Creek to the NF-1643 road, Crooked flow was intermittent. BPT noted pools of entrained fish throughout this reach.

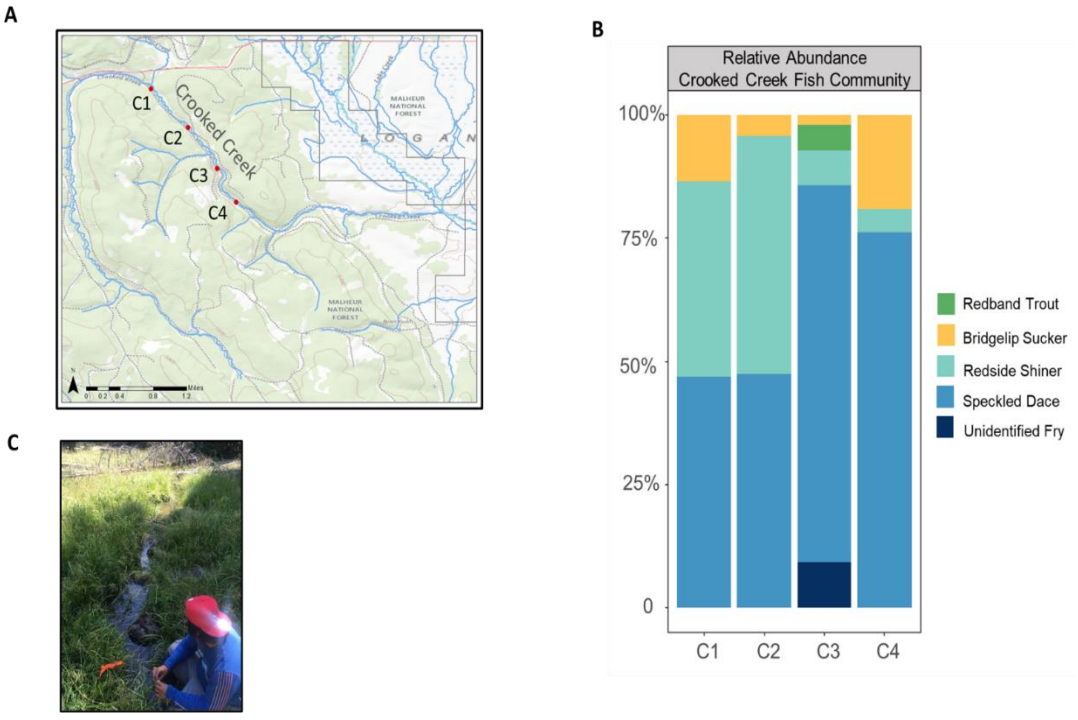
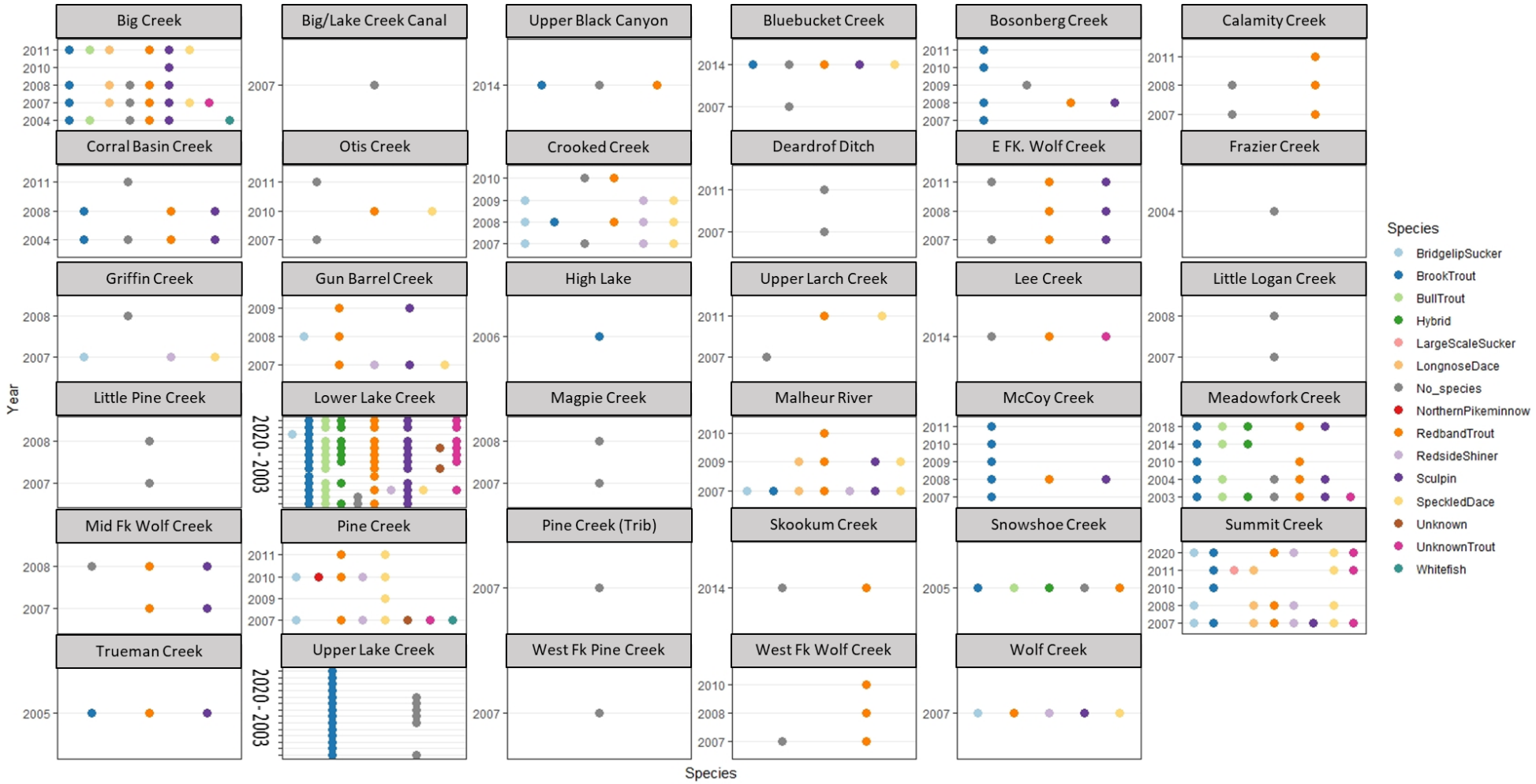


Figure 3.4 (A) Map of the four electrofishing sites on Crooked Creek. **(B)** BPT electrofishing results display the species composition **(C)** Photo at the end of an electrofishing site on Crooked Creek (downstream looking up)

BPT Fisheries electrofishing efforts lasted 2,846 seconds and resulted in 440 individual fish (five different species) being encountered for the 2021 survey efforts (Table 3.1). Speckled dace made up the greatest proportion of the fish assemblage in Crooked (Figure 3.4 B).

2021 was a low water year and Crooked Creek was largely intermittent. Locating more than four 100-meter sites to survey was difficult. Survey site locations were moved upstream or downstream to find a location in which there would be 100 meters of shockable habitat. All the sites were heavily vegetated (dominated with grasses) and had small channel widths (Figure 3.4 C). Although Crooked Creek is currently not habitat for bull trout, it does provide habitat for native species which serve as a prey base even during low flow years. Crooked Creek also falls within the Upper Action Area regarding proposed TAC future brook trout removal efforts making updated population information critical to any future recovery efforts.



Appendix Figure 3.5 Archived BPT electrofishing survey data since 2003 reveals effort at Upper Malheur Streams and species encountered by staff Biologists. (Obtained from BPT Access database)