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Native Cutthroat Trout (*Oncorhynchus clarkii* ssp.) Conservation Activities in the Northern Region, 2019

Publication Number 20-11

Utah Division of Wildlife Resources
1594 West North Temple
Salt Lake City, Utah 84414

Mike Fowlks, Director

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by

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INTRODUCTION

BONNEVILLE CUTTHROAT TROUT (*Oncorhynchus clarkii utah*)

The Bonneville Cutthroat Trout (BCT) conservation activities by the UDWR Ogden Office in 2019 included population monitoring in the Logan River drainage in the Bear River GMU, population monitoring in the Ogden River drainage in the Weber River subunit in the Northern Bonneville GMU, collection of samples for genetic analysis, stocking of BCT into five Davis County streams, efforts toward developing a Weber River BCT brood source, and the second rotenone treatment of Big Creek in Rich County. Activities conducted during 2019 will help accomplish the objectives for long-term conservation of BCT in Utah (BCT State of Utah Conservation Team 2008) and range-wide (Oplinger and Birdsey 2019).

COLORADO RIVER CUTTHROAT TROUT (*Oncorhynchus clarkii pleuriticus*)

The Colorado River Cutthroat Trout (CRCT) conservation activities conducted in 2019 included population monitoring in the West Fork Smiths Fork drainage, collection of samples for genetic analysis, and planning for future treatment of the West Fork Smiths Fork drainage. The work completed in the Upper Green GMU North Slope subunit will help accomplish the objectives for long-term conservation of CRCT in Utah (Lentsch and Converse 1997).

YELLOWSTONE CUTTHROAT TROUT (*Oncorhynchus clarkii bouvieri*)

The Yellowstone Cutthroat Trout (YCT) conservation activities completed in 2019 were minimal, with population monitoring conducted in the majority of the streams containing YCT in the Raft River drainage during 2017. Activities in 2019 will help accomplish the objectives for long-term conservation of YCT (Range-wide YCT Conservation Team 2009).

METHODS

All stream surveys and monitoring stations were completed at or near base flow conditions. Surveys were completed to determine the extent of the resident cutthroat trout populations in each stream/stream section. When possible, stream survey locations were chosen as closely as possible to previous UDWR or USFS survey locations. Approximately 121 people days were required to complete the native cutthroat trout fieldwork in the Northern Region during 2019.

For surveys on small streams, a 100 m reach, representing habitat conditions throughout the entire stream/section, was identified. For monitoring efforts, the attempt was made to revisit select stations surveyed previously. Stations were measured using a 100 m tape. A natural habitat break (e.g., small waterfall/cascade) was chosen for the upper end of each reach and whenever possible, the lower end. Two or three battery-powered backpack electrofishing units, manufactured by Smith-Root, were utilized side-by-side for surveys on larger streams (e.g., streams >2.5-7 m in width). On the remaining surveys, a single battery-powered backpack electrofishing unit was used. Between two and 11 personnel were utilized on electrofishing surveys. Electrofishing settings varied depending on stream conductivity. In general, the frequency was set at J (70 Hz), the pulse width was set at 3 (2 ms), and the voltage was set at 300V when using a Smith-Root Model 12 POW, and 50 Hz, 25% duty cycle, and 250V when using a Smith-Root LR-20B.

All captured fish were transferred to live cages placed in the stream. Fish collected from the first electrofishing pass were kept separate from fish collected on the second electrofishing pass, and so forth. Fish processing and data collection commenced immediately following electrofishing and fish not collected for genetic analyses or health inspections were returned to

the stream. All fish captured were measured to the nearest millimeter (mm) total length (TL) and weighed to the nearest gram (g). Identification of cutthroat trout x rainbow trout hybrids was based on examination of phenotypic traits, primarily spotting patterns, fin tips and body coloration.

Population estimates were calculated separately for ≥age-1 salmonids and age-0 salmonids because smaller fish are not immobilized as effectively as larger fish while electrofishing (Reynolds 1989) and consequently, population estimates for age-0 fish are usually not as meaningful. In general, cutthroat trout <50-60 mm TL were considered to be age-0.

Population estimates were based on two-pass electrofishing, unless otherwise noted. A modified Zippin multiple pass depletion electrofishing formula was used to calculate the population estimates and ninety-five percent confidence limits for each site surveyed (Zippin 1958). The formulas used to calculate the estimates were:

$$N = C_1^2 / C_1 - C_2$$

$$SE = [C_1 * C_2 / (C_1 - C_2)^2] * (C_1 + C_2)^{½}$$

$$95\%\ C.I. = 2 * SE$$

where,
N = estimated fish population,
C_1 = the number of fish captured from the first pass, and
C_2 = the number of fish captured on the second pass.

Condition factor (K) was calculated using the formula:

$$K = W * 100{,}000/L^3$$

where,
W = weight in g, and
L = TL in mm.

All cutthroat trout tissue samples retained for genetic analyses were collected according to protocol established by Brigham Young University (BYU). These samples were submitted to the Salt Lake Office during the fall of 2019 and will be analyzed with nuclear DNA and mitochondrial DNA techniques.

Population estimates were not attempted for many of the non-game species because these species are difficult to capture. An estimate of abundance was made for these species as follows: >50 individuals per 100 m - abundant, 10-50 individuals per 100 m station - common, and <10 individuals per 100 m station - sparse. Due to the difficulty of differentiating Mottled Sculpin (*Cottus bairdii*) and Piute Sculpin (*C. beldingii*) in the field, no distinction was attempted for this report and these species are simply referred to as sculpin.

Temperature data collection
Temperature loggers were deployed in various streams/sections in an effort to contribute to various programs and projects, including the development of models to assess future climate scenarios, prioritize habitat restoration opportunities (Oplinger and Birdsey 2019), and evaluate suitability of stream temperatures in select streams for cutthroat trout reintroduction potential. Temperature data will be shared with researchers at Utah State University, Trout Unlimited, and the NorWeST Interagency temperature database.

RESULTS AND DISCUSSION

BONNEVILLE CUTTHROAT TROUT

Surveys
Efforts to increase knowledge of the distribution of BCT through inventory of previously un-surveyed streams in the Bonneville Basin are essentially complete. However, sites on the South and Middle Branches of Otter Creek in Rich County were surveyed in 2019 (Table 1).

Monitoring
Multiple-pass electrofishing was completed on eight streams/sections during 2019 BCT monitoring efforts (Table 2). Four of the monitored populations appeared to have increased since the previous survey, two showed a decline, and two remained essentially flat. Where non-native trout are present, their populations were generally up from previous sampling.

Fish species encountered during stream sampling in 2019 included: BCT, Brown Trout (BNT; *Salmo trutta*), cutthroat-rainbow trout hybrid (CTxRB), Fathead Minnow (FHM; *Pimephales promelas*), Mountain Sucker (MTS; *Catostomus platyrhynchus*), Mountain Whitefish (MWF; *Prosopium williamsoni*), Rainbow Trout (RBT; *Oncorhynchus mykiss*), Redside Shiner (RSS; *Richardsonius balteatus*), sculpin (SC; *Cottus* spp.), Speckled Dace (SPD; *Rhinichthys osculus*), Tiger Trout (TGT; Brown Trout x Brook Trout), and Utah Chub (UTC; *Gila atraria*). In addition, Northern Leopard Frogs (NLF; *Lithobates pipiens*) were observed during the sampling of Silver Creek.

Chemical Reclamation
Eight streams, six of which are in drainages of the Bonneville Basin, were identified for chemical reclamation for native cutthroat trout in an Environmental Assessment (EA) completed by the Northern Region of the UDWR. In 2012, the Denver Office of the United States Fish and Wildlife Service (USFWS) approved the EA (USFWS 2012) and issued a Finding of No Significant Impact (FONSI). The Right Hand Fork of Logan River was treated with rotenone in 2012 and 2013 to remove Brown Trout and restocked with BCT in 2013 and 2014. A small treatment to remove Brown Trout from the Right Hand Fork between the two migration barriers was completed in 2015. Otter Creek (Rich County) was treated in 2015 and 2016 to remove Brook Trout and Brown Trout and was restocked with BCT in 2016. Randolph Creek (Rich County), a tributary to Big Creek was treated twice in 2015 to remove Brook Trout and restocked with BCT soon thereafter, but subsequent barrier issues allowed Brook Trout to re-invade the treatment reach and successfully spawn. Big Creek (Rich County), including Randolph Creek, was treated in 2018 and 2019 to remove Brook Trout and Brown Trout. During 2019, the UDWR, in coordination with personnel from Trout Unlimited (TU) and USFS, continued planning for future treatment of the Deadman Creek drainage in Summit County.

Table 1. Streams/sections containing BCT during 2019 surveys.

Stream/section	Approximate # of stream km occupied (# stream miles)	# of ≥age-1 BCT/km (#/mile)
Bear River GMU, Rich County Subunit		
Middle Branch Otter Creek (two stations combined)	7.9 (4.9)	65 (105)

Table 2. Results of BCT population monitoring in 2019.

Stream/section	Year	# of ≥age-1 BCT/km	# of ≥age-1 BCT/mile
Bear River GMU, Uinta Mountains/Upper Bear River Subunit			
West Fork Bear River	2019	20 ± 0	32 ± 0
	2013	476 ± 61	766 ± 98
Gold Hill Creek	2019	449 ± 41	722 ± 66
	2018	1025 ± 65	1650 ± 105
	2017	318 ± 37	511 ± 60
	2016	595 ± 106	958 ± 170
	2015	392 ± 66	631 ± 106
	2014	421 ± 19	677 ± 30
	2013	781 ± 23	1256 ± 38
	2012	564 ± 68	908 ± 109
	2011	342 ± 71	551 ± 114
	2010	210 ± 39	338 ± 63
Bear River GMU, Cache Valley Subunit			
Left Hand Fork Blacksmith Fork, lower	2019	279 ± 9	449 ± 15
	2014	298 ± 15	479 ± 24
	2008	327 ± 0	526 ± 0
	2002	259 ± 46	416 ± 74
Left Hand Fork Blacksmith Fork, upper	2019	151 ± 95	244 ± 153
	2014	31 ± 0	49 ± 0
	2008	70 ± 0	112 ± 0
	2002	68 ± 0	110 ± 0
Rock Creek	2019	221 ± 50	356 ± 80
	2012	282 ± 4	453 ± 7
	2008	134 ± 19	216 ± 31
	2002	75 ± 13	121 ± 21
Curtis Creek	2019	131 ± 7	211 ± 11
	2012	137 ± 20	221 ± 32
	2008	373 ± 52	601 ± 83
	2001	137 ± 20	221 ± 32
Beaver Creek	2019	244 ± 58	392 ± 93
	2014	58 ± 0	93 ± 0
	2008	356 ± 40	574 ± 64
	1999	236 ± 31	380 ± 50

Table 2.—cont.

Stream/section	Year	# of ≥age-1 BCT/km	# of ≥age-1 BCT/mile
Northern Bonneville GMU, Ogden River Subunit			
South Fork Ogden River, Magpie	2019	62 ± 28	99 ± 46
	2014	39 ± 14	63 ± 23
	2009	49 ± 59	79 ± 95
	2004	41 ± 0	66 ± 0
South Fork Ogden River, Memorial Park	2019	109 ± 4	175 ± 6
	2014	42 ± 10	68 ± 16
	2009	544 ± 55	876 ± 89
	2004	767 ± 170	1234 ± 274

BEAR LAKE GMU

Bonneville cutthroat trout work in the Bear Lake GMU was coordinated and completed by personnel at Bear Lake Field Station. Results from 2019 activities can be found in reports prepared by this field station.

BEAR RIVER GMU
Uinta Mountains/Upper Bear River Subunit

West Fork Bear River IVAQ240

Monitoring

The station sampled upstream of Whitney Reservoir in 2013 by the USFS was monitored on August 27, 2019. The station was 100 m in length. Bonneville Cutthroat Trout were present in low densities in the station (Table 3), with the catch comprised of two individuals representing a single, young age-class (Figure 1); this was an apparently sharp decline in abundance relative to the 2013 sampling (Table 3). Sculpin were abundant in the station.

Table 3. Population statistics for species sampled in the West Fork Bear River monitoring station, 2013 and 2019.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
2019	≥age-1 BCT SC	2	20 ± 0 (32 ± 0) abundant	2 (2)	120	119-120	16		0.94
2013	≥age-1 BCT SC	44	476 ± 61 (766 ± 98) abundant	17 (15)	92	69-163	8	3-42	0.93

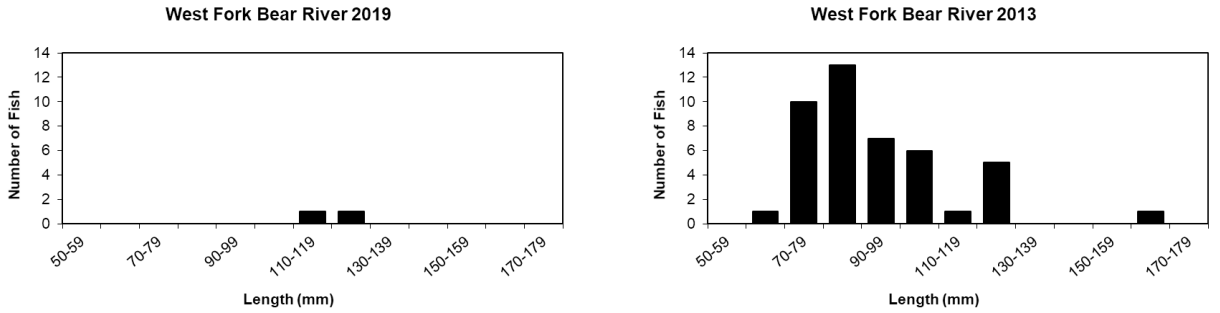

Figure 1. Size distribution of BCT sampled in the West Fork Bear River monitoring station, 2013 and 2019.

Mill City Creek **IVAQ240B**

Genetic Collection

On August 27, 2019, fin clips from 30 BCT were collected from Mill City Creek for genetic analysis. The samples were preserved according to established protocols.

Gold Hill Creek **IVAQ270A**

Monitoring

The 2019 station, 200 m in length, was electrofished on August 15, 2019. This was a NLSC reintroduction site in 2010 and has been sampled annually since then (Table 4 and Figure 2). Based on 10 data points for the Gold Hill monitoring station, the BCT population has experienced fluctuations but has stayed at fairly high densities (Table 4), with 2019 appearing to decrease to approximately half of the 2018 estimate. Recruitment has been documented each year, with relatively strong age-1 cohorts present during most years (Figure 2). NLSC were abundant in the station during 2010, absent in 2011, sparse in 2012-2015, and absent again in 2016-2019 (Table 4).

Table 4. Population statistics for species sampled in Gold Hill Creek, 2010-2019.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
2019	≥age-1 BCT	84	449±41 (722±66)	75 (67)	124	53-250	35	1-137	0.92
2018	≥age-1 BCT	98	1025±65 (1650±105)		90	45-219			
2017	≥age-1 BCT	76	318±37 (511±60)		129	47-236	30	4-124	0.96
2016	≥age-1 BCT	49	595±106 (958±170)	126 (113)	105	50-225	31	1-119	0.88
2015	≥age-1 BCT NLSC	36 1	392±66 (631±106) 10±0 (16±0)	65 (58)	122 95	46-219	36 8	1-125	1.04
2014	≥age-1 BCT NLSC	53 1	421±19 (677±30) 8±0 (13±0)	51 (46)	116 90	49-212	29 8	3-89	0.99
2013	≥age-1 BCT NLSC	153 1	781±23 (1256±38) 5±0 (8±0)	33 (29)	90 72	39-220	12 4	1-100	0.98
2012	≥age-1 BCT NLSC	123 3	564±68 (908±109) 12±0 (20±0)	27 (24)	93 61	46-223 55-66	12 2	1-90 2-3	0.91
2011	≥age-1 BCT	59	342±71 (551±114)	16 (14)	90	42-249	15	1-134	0.92
2010	≥age-1 BCT age-0 BCT NLSC	38 2	210±39 (338±63) 10±0 (16±0) abundant (stocked in 2010)	24 (21)	110 27	62-232 27-27	21	1-124	0.86

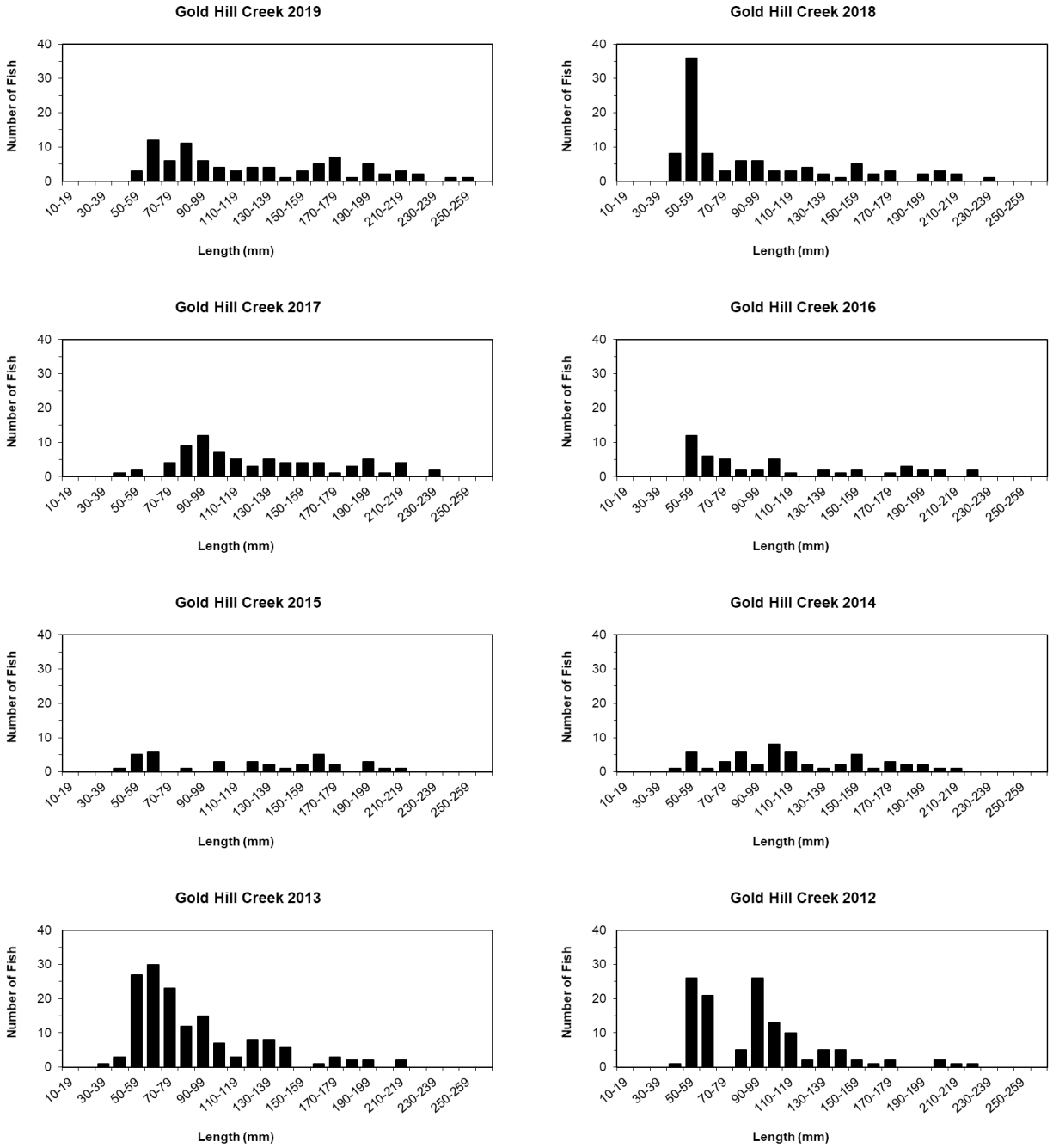

Figure 2. Size distribution of BCT sampled in Gold Hill Creek, 2012-2019.

Rich County Subunit

South Branch Otter Creek — IVAQ170A

Monitoring

The 2019 station, 100 m in length, was electrofished on July 3, 2019. This station was surveyed in 2015 to estimate trout population densities prior to rotenone treatments in 2015 and 2016 to remove Brown Trout and Brook Trout from the Otter Creek drainage. Two age-classes of BCT were stocked in the South Branch in October 2016 (McKell 2017), but no fish were sampled in the station in 2019. Although electrofishing was not conducted upstream or downstream of the station in 2019, it is likely that BCT are present in low densities.

Table 5. Population statistics for species sampled in South Branch Otter Creek, 2015-2019.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
2019	No fish sampled								
2016	BCT stocked post-treatment								
2015	≥age-1 BKT	1	9±0 (14±0)	2 (2)	168	44-66	46	20-503	0.97
	age-0 BKT	11	present	122 (109)	51	126-361	114		0.99
	≥age-1 BNT	23	206±4 (331±7)		203	35-45			
	age-0 BNT	15	154±61 (248±98)		40	44-90			
	SC	554	abundant		60				

Middle Branch Otter Creek — IVAQ170A01

Monitoring

In an effort to monitor the restoration of BCT in the Otter Creek drainage, two stations in the Middle Branch were sampled in 2019, replicating sites sampled on BLM land in 2015 to evaluate pre-treatment fish densities (McKell 2016). The two sites, both upstream of the Pole Line Road, were electrofished on July 3, 2019. The lower of the two stations was within a BLM riparian exclosure and the other directly upstream and outside of the exclosure.

Lower Station

The only fish species sampled in this 101 m station was BCT, the catch comprised of probably three age-classes (Figure 3). The biomass estimate for BCT was good and is expected to increase as the BCT population becomes more well-established in the reach. Consequently, the brown trout biomass estimate for this station was very high in 2015 (Table 6).

Upper Station

This 100 m station contained only BCT (Figure 3 and Table 6), represented by two adult individuals.

Based on abundance and biomass estimates for the two stations, which were spatially contiguous and separated only by a barbed-wire fence, the fish habitat within the BLM riparian exclosure is more suitable than the habitat immediately upstream of the exclosure fence. This is evidenced by the five-fold difference in both abundance and biomass between stations (Table 6). This was also apparent in the 2015 brown trout population and biomass estimates, the lower station exhibiting double and quadruple, respectively, those of the upper station (Table 6).

Table 6. Population statistics for species sampled in Middle Branch Otter Creek, 2003, 2015, and 2019.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
Lower Station									
2019	≥age-1 BCT	11	110±8 (177±13)	72 (64)	213	126-297	107	17-245	0.90
2015	≥age-1 BNT age-0 BNT SC	38 4 118	359±3 (577±5) present abundant	283 (253)	215 48	118-332 43-51	126	18-358	1.04
2003	≥age-1 BKT age-0 BKT SC	19 21 226	193±13 (310±21) 216±22 (348±35) abundant	168 (150) 6 (5)	267 85	173-372 61-105	222 7	62-512 3-13	1.12
Upper Station									
2019	≥age-1 BCT	2	20±0 (32±0)	14 (12)	224	203-245	97	82-112	0.87
2015	≥age-1 BNT age-0 BNT SC	18 5 19	198±47 (319±76) present common	71 (64)	155 44	110-270 40-52	48	14-198	1.03

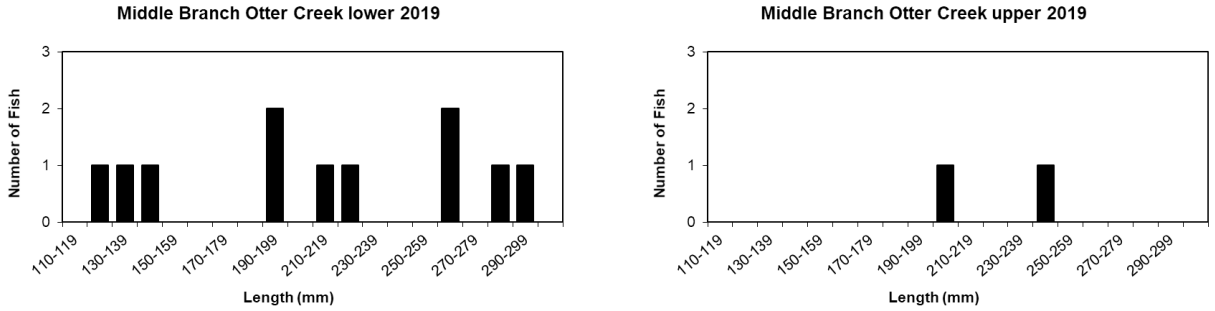

Figure 3. Size distribution of BCT sampled in Middle Branch Otter Creek lower (left panel) and upper (right) monitoring stations, 2019.

Big Creek **IVAQ190**

Chemical Reclamation

On September 17-18, 2019, the UDWR, with the assistance of personnel from BLM and USFS, conducted a rotenone treatment of the entire Big Creek drainage (including Randolph Creek IVAQ190A, Spring Canyon [unnumbered], and other tributaries) upstream of the 2018 fish migration barrier. This was the second treatment of Big Creek, covering approximately 35.7 km (22.2 mi) of stream in the mainstem and tributaries. Based on observations of sentinel fish responses to rotenone exposure, coupled with the supposition of thorough coverage during rotenone application, the treatment was considered a success; however, a few dozen small, presumed to be age-1, Brook Trout were observed (mortalities) in a 3.9 km (2.4 mi) reach during the treatment, indicating the 2018 treatment did not result in a complete eradication of Brook Trout. The best habitat (1.5 km [0.9 mi]) in the reach, found within a BLM riparian exclosure where the majority of the Brook Trout were observed during the treatment, was electrofished on October 4; no Brook Trout were found during electrofishing.

Population Restoration
Prior to the treatment, fish were salvaged from Big and Randolph creeks and held streamside in a large oxygenated holding tank during the treatment. The salvaged fish, 35 BCT and two sculpin, were released into Randolph Creek at the upstream end of the upper BLM exclosure on September 19, once the stream had cleared of chemical (i.e. sentinel fish placed in cages in the stream remained unstressed for four hours).

Cache Valley Subunit

Left Hand Fork Blacksmith Fork — IVAQ040A03A

Monitoring
Two stations in the Left Hand Fork were monitored in 2019, one just upstream of the Forest Service boundary (lower) and the other near the headwaters (upper). Both stations were electrofished on July 25, 2019, the upper by a USFS crew; both stations were also monitored previously in 2014 (McKell 2015).

Lower Station
The fish community in this 101 m station was comprised of a moderate population of BCT, a large population of Brown Trout, and a very large population of Sculpin (Table 7). Based on four data points for this station, the size of the BCT population appears to have remained roughly stable since 2002 (Table 7), while the Brown Trout population nearly doubled in size since 2014. Comparison of the biomass estimates suggests the current population is about one-third of the 2014 estimate, which was equivalent to the 2002 and 2008 estimates (Table 7). Multiple size-classes during each sampling event indicates recruitment is consistent (Figure 4).

Upper Station
This 107 m station contained a moderate abundance of BCT, which exhibited a five-fold increase since 2014 (Table 7); while the Brown Trout population showed a decrease, they still outnumber, by triple, the BCT population in the station. The BCT population was represented by multiple size-classes but dominated by the age-1 cohort, and the Brown Trout population during each sampling event has composed predominantly of larger adults (Figure 4). Sculpin density appears to have decreased at this site since 2014 (Table 7).

Table 7. Population statistics for species sampled in Left Hand Fork Blacksmith Fork, 2002, 2008, 2014, and 2019.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
Lower Station									
2019	≥age-1 BCT	28	279±9 (449±15)	21 (18)	191	96-300	54	12-134	0.98
	age-0 BCT	55	545±6 (878±9)		34	22-46			
	≥age-1 BNT	62	617±12 (993±20)	103 (92)	232	116-392	121	17-453	1.01
	age-0 BNT	34	338±8 (544±13)		66	49-82	4	3-6	
	SC		abundant						
2014	≥age-1 BCT	30	298±15 (479±24)	66 (58)	214	91-364	125	8-406	0.97
	≥age-1 BNT	35	343±4 (553±6)	133 (119)	269	144-391	221	33-603	1.02
	age-0 BNT	5	49±0 (79±0)		58	48-66	2	1-3	
	SC		abundant					1-44	

Table 7.—cont.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
2008	≥age-1 BCT	33	327±0 (526±0)	64 (57)	195	111-351	93	12-429	0.98
	age-0 BCT		present						
	≥age-1 CTxRT	3	30±0 (48±0)	2 (2)	146	136-151	29	23-34	0.94
	≥age-1 BNT	28	285±25 (459±40)	105 (94)	232	148-386	175	31-560	1.03
	age-0 BNT	4			63	60-68	2	1-3	
	SC		abundant						
2002	≥age-1 BCT	28	259±46 (416±74)	65 (58)	211	94-315	130	10-313	1.03
	≥age-1 BNT	52	455±26 (733±42)	131 (116)	222	108-392	148	14-539	1.11
	age-0 BNT	1	9±0 (14±0)	12 (11)	60				
	MWF	1	9±0 (14±0)		402		721		1.11
	SC		abundant						
Upper Station									
2019	≥age-1 BCT	13	151±95 (244±153)	37 (33)	191	103-302	97	11-256	1.03
	≥age-1 BNT	46	466±66 (750±106)	177 (158)	230	129-356	150	22-426	1.02
	age-0 BNT	1	9±0 (15±0)		58		2		
	SC		common						
2014	≥age-1 BCT	3	31±0 (49±0)	6 (6)	172	109-292	97	13-262	1.01
	≥age-1 BNT	75	761±18 (1225±29)	206 (184)	219	126-310	123	23-296	1.02
	age-0 BNT	4	41±0 (66±0)		57	52-60	2		
	SC		abundant						
2008	≥age-1 BCT	6	70±0 (112±0)	21 (19)	217	133-286	125	33-235	1.18
	age-0 BCT	3			33				
	≥age-1 BNT	28	326±0 (524±0)	90 (81)	215	127-285	116	29-212	1.09
	age-0 BNT	2			63	62-64			
	SC		abundant						

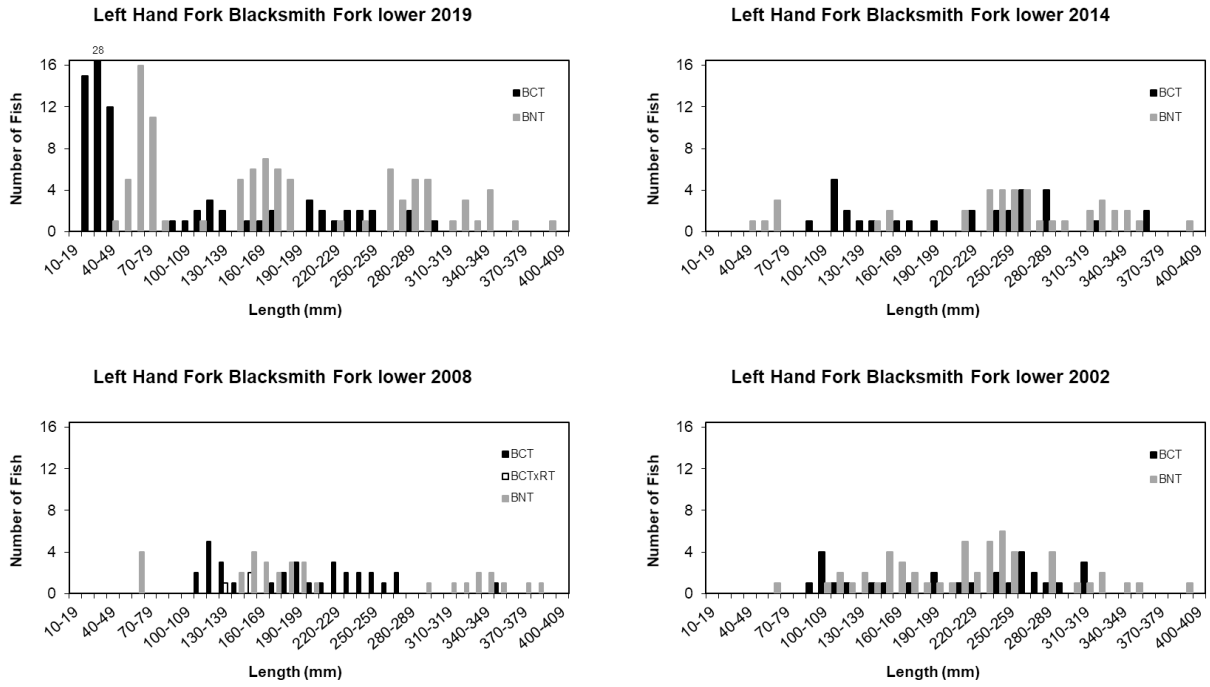

Figure 4. Size distribution of salmonid species sampled in the Left Hand Fork Blacksmith Fork lower monitoring station, 2002, 2008, 2014, and 2019.

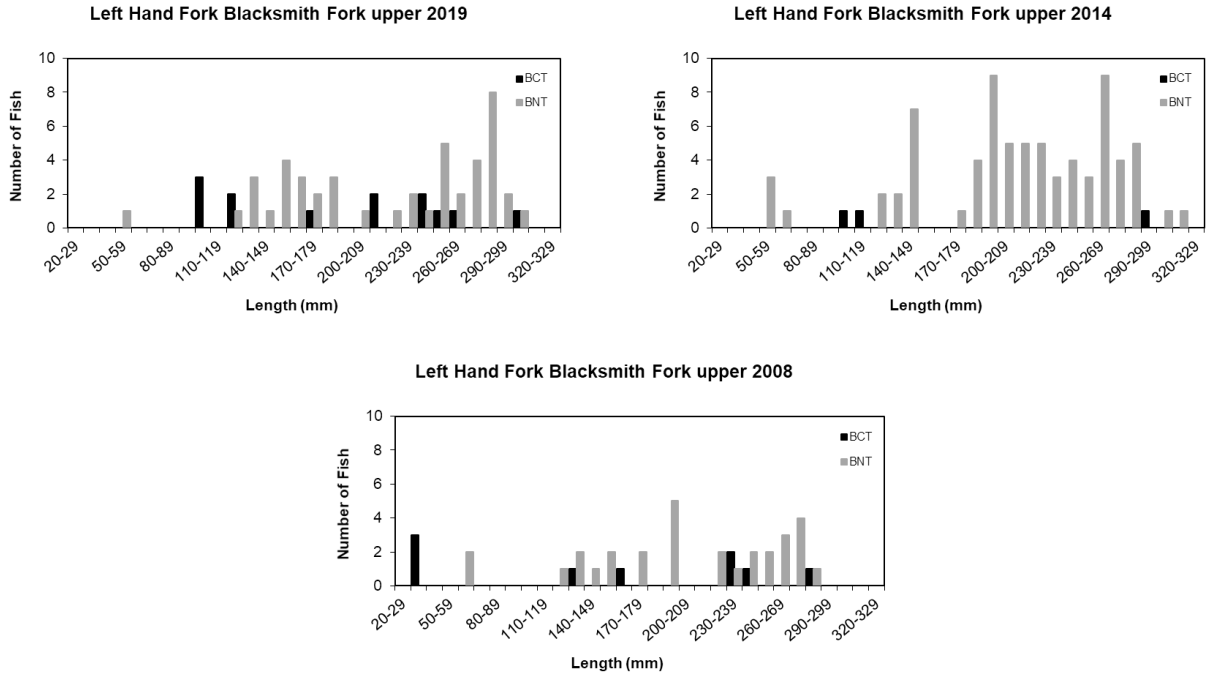

Figure 5. Size distribution of salmonid species sampled in the Left Hand Fork Blacksmith Fork upper monitoring station, 2008, 2014, and 2019.

Rock Creek **IVAQ040A03B**

Monitoring

The 2019 station, 109 m in length, was electrofished on July 25, 2019. Results of this and the previous surveys are shown in Table 8 and Figure 6. Based on four data points for Rock Creek, the trout population in the stream has experienced a marked increase since the previous sampling event, likely due to continued habitat improvement resulting from the 2009 installation of exclosure fencing intended to protect the stream from further degradation that had at that time injured the stream extensively. The BCT population appeared to decline slightly between 2012 and 2019, while the Brown Trout population exploded during that period (Table 8). The presence of multiple age-classes of BCT during all surveys indicates recruitment is consistent, though apparently limited (Figure 6). Similar to the BCT length-frequency distribution, a variety of sizes of Brown Trout was also found during each survey, including an extremely large group of younger (likely age-1 and age-2) individuals (Figure 6). Sculpin and Mountain Sucker were abundant in the station and both species increased 2012 compared with previous sampling (Table 2).

Table 8. Population statistics for species sampled in Rock Creek, 2002, 2008, 2012, and 2019.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
2019	≥age-1 BCT	22	221±50 (356±80)	30 (27)	179	104-275	72	14-226	1.01
	≥age-1 BNT	165	1599±90 (2574±146)	249 (223)	183	116-425	82	16-850	1.03
	MTS		abundant						
	SC		abundant						
2012	≥age-1 BCT	27	282±4 (453±7)	99 (88)	199	89-331	92	8-273	0.95
	≥age-1 BNT	15	160±17 (258±27)	77 (69)	217	98-334	128	10-320	1.08
	age-0 BNT	37	present		58	45-73			
	MTS		sparse						
	SC		common						
2008	≥age-1 BCT	13	134±19 (216±31)	30 (26)	161	99-236	53	9-132	1.06
	≥age-1 BNT	41	410±3 (660±5)	122 (109)	180	127-285	71	21-233	1.08
	SC		abundant		60	43-94			
2002	≥age-1 BCT	7	75±13 (121±21)	25 (22)	209	138-285	94	20-164	0.98
	≥age-1 BNT	41	432±18 (695±29)	194 (173)	218	116-321	128	17-388	1.04
	age-0 BNT	5		2 (1)	93	81-98	8	7-10	
	SC		abundant						

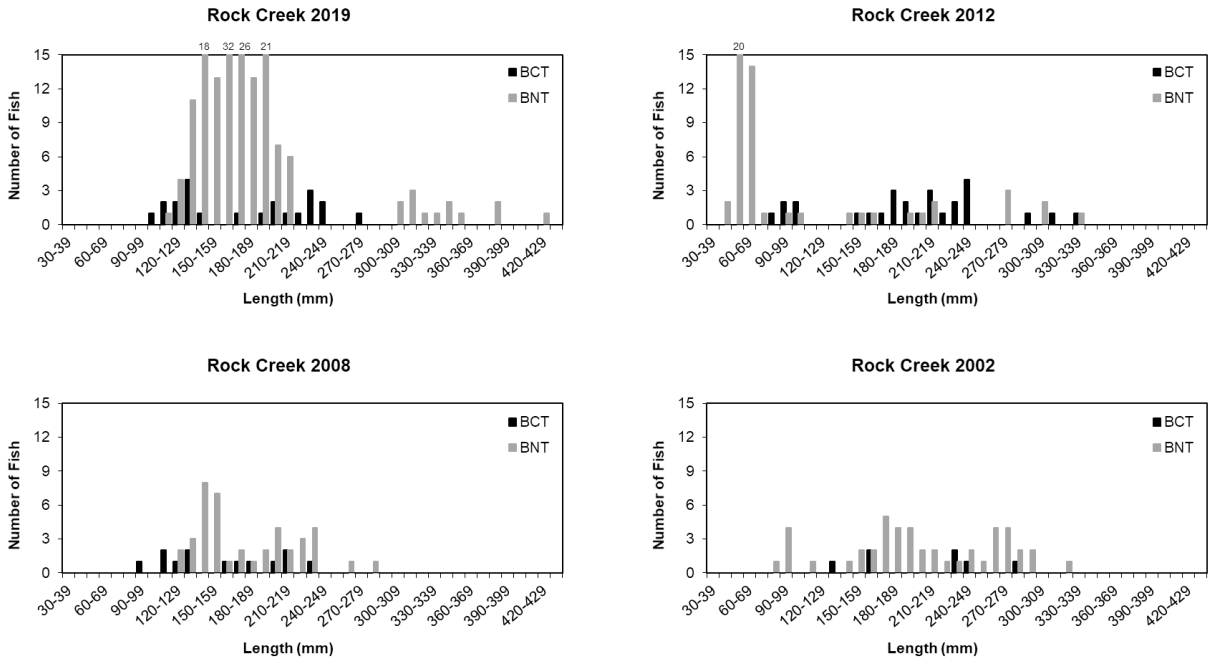

Figure 6. Size distribution of salmonid species sampled in Rock Creek, 2002, 2008, 2012, and 2019.

Curtis Creek **IVAQ040A03C**

Monitoring

The 2019 station, 100 m in length, was electrofished on July 30, 2019. Results of this and the previous surveys are shown in Table 9 and Figure 7. Based on four data points for Curtis Creek, the fish community in the station in 2019 was similar to the previous sampling event (Table 9). The BCT population appeared stable between 2012 and 2019, while the Brown Trout population may have declined slightly during that period (Table 9). The presence of multiple age-classes of BCT during all surveys indicates recruitment is consistent, though limited (Figure 7). Similar to the BCT length-frequency distribution, a variety of sizes of Brown Trout was also found during each survey (Figure 7). Sculpin were common in the station and showed an increase in abundance compared with all previous samplings (Table 9).

Table 9. Population statistics for species sampled in Curtis Creek, 2001, 2008, 2012, and 2019.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
2019	≥age-1 BCT	13	131±7 (211±11)	33 (30)	196	53-310	101	1-309	0.98
	≥age-1 BNT	5	no depletion		218	133-306	101	3-295	0.76
	age-0 BNT	4	present		55	47-60	2	1-2	
	SC		common		74				
2012	≥age-1 BCT	13	137±20 (221±32)	52 (47)	232	77-335	154	5-320	0.98
	≥age-1 BNT	10	103±9 (166±14)	32 (29)	219	103-342	126	10-318	1.03
	age-0 BNT	9	present		44	40-50			
	SC		sparse						
2008	≥age-1 BCT	35	373±52 (601±83)	56 (50)	166	77-321	69	5-320	1.04
	≥age-1 BCTxRT	6	60±0 (97±0)	11 (10)	180	91-300	91	10-280	1.08
	≥age-1 BNT	1	10±0 (16±0)	7 (6)	311		316		1.05
	SC		sparse						
2001	≥age-1 BCT	20	193±21 (310±34)	35 (31)	179	106-251	72	10-193	0.98
	age-0 BCT	81	1798±2194 (2893±3530)	9 (8)	52	37-71	2	1-4	
	≥age-1 BCTxRT	2	19±0 (30±0)	4 (4)	239	221-256	87	77-97	0.68
	≥age-1 BNT	5	47±0 (75±0)	6 (5)	175	146-200	51	7-84	0.96
	age-0 BNT	83	1279±754 (2059±1214)	20 (18)	82	70-100	6	2-12	
	SC		sparse						

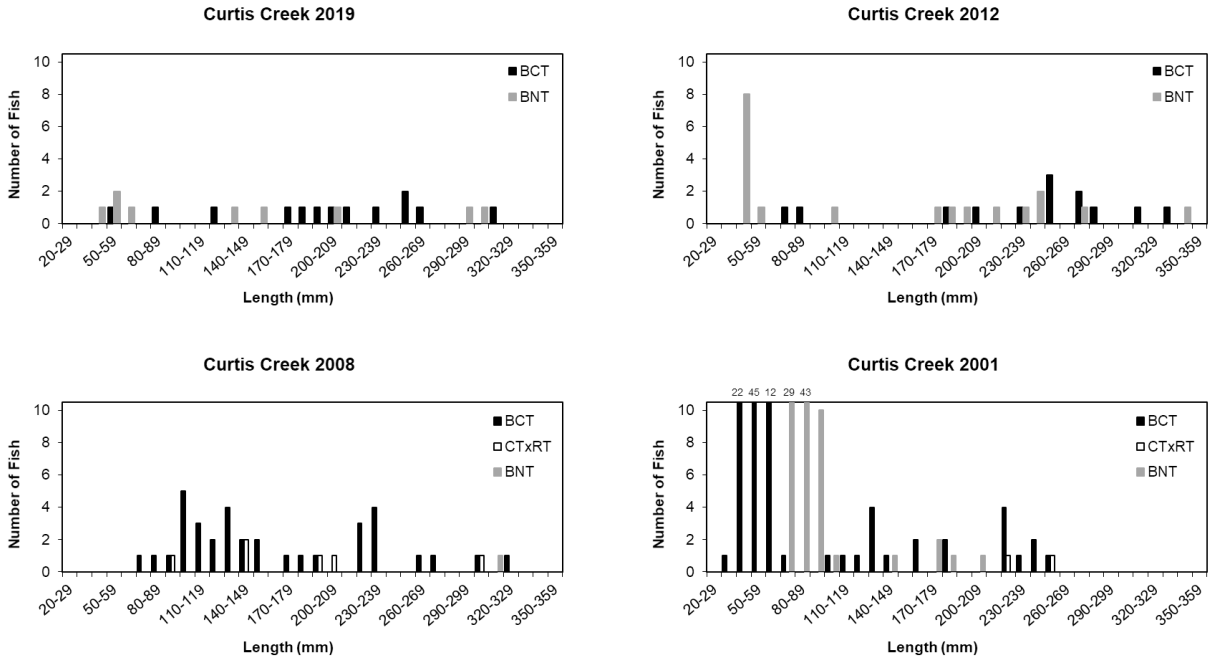

Figure 7. Size distribution of salmonid species sampled in Curtis Creek, 2001, 2008, 2012, and 2019.

Beaver Creek **IVAQ040A16**

Monitoring

The 2019 station, 114 m in length, was electrofished by a USFS crew on August 19, 2019. Results of this and the previous surveys are shown in Table 10 and Figure 8. Based on four data points for Beaver Creek, the BCT population experienced a decline between 2008 and 2014 but was back up to a moderate level in 2019 (Table 10). The presence of multiple age-classes of BCT during most surveys indicates recruitment is consistent, though evidently limited in some years (Figure 8).

Table 10. Population statistics for BCT sampled in Beaver Creek, 1999, 2008, 2014, and 2019.

Year	Species	Total Catch	**#/km** ± 95% C.I. **(#/mi** ± 95% C.I.**)**	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
2019	≥age-1 BCT	25	244±58 (392±93)	32 (28)	158	94-258	56	8-193	1.11
2014	≥age-1 BCT	6	58±0 (93±0)	7 (7)	177	141-228	74	34-140	1.23
2008	≥age-1 BCT	34	356±40 (574±64)	15 (13)	118	70-241	28	4-148	1.16
1999	≥age-1 BCT	23	236±31 (380±50)	68 (60)	190	59-309	100	2-318	1.18

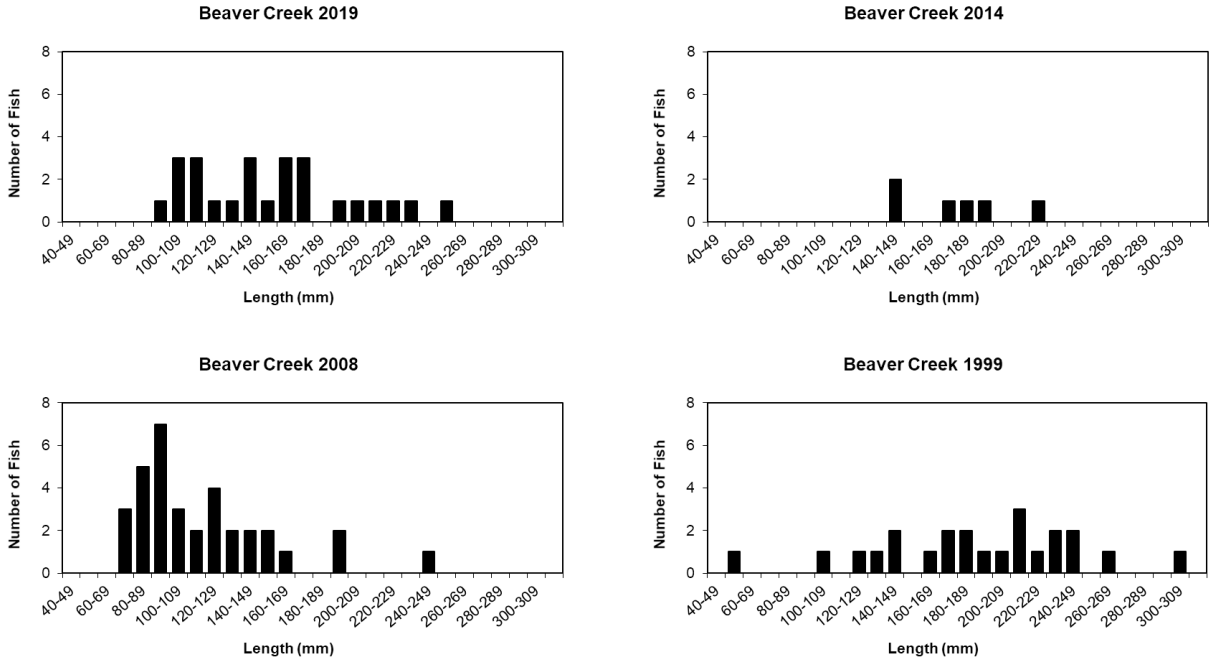

Figure 8. Size distribution of salmonid species sampled in Curtis Creek, 1999, 2008, 2014, and 2019.

NORTHERN BONNEVILLE GMU
Ogden River Subunit

South Fork Ogden River **IVAP030B**

Monitoring

Two stations in the South Fork were monitored in 2019, one adjacent to Magpie Campground (lower) and the other upstream near Memorial Park (upper). Both stations were electrofished on October 17, 2019; both stations were also monitored previously in 2014 (McKell 2015).

Lower Station

The Magpie Campground station was 146 m in length. Results of this and the previous surveys are shown in Table 11 and Figure 9. Based on four data points, the BCT population appears to be fairly stable in terms of both density and biomass (Table 11). For the first time there were age-0 BCT among the sample at this station, even though all sampling events have occurred during the same time of year (i.e. early to mid-October). The presence of very few individuals among the older age-classes represented during all sampling events (Figure 9) indicates very little BCT recruitment in this reach of the river. Conversely, brown trout recruitment appears to be both successful and consistent from year to year (Figure 9). Abundance of Brown Trout in 2019 was about 40% less than 2014, and the lowest of all four surveys (Table 11). Sculpin remain abundant in the sampled reach.

Upper Station

The Memorial Park station was 157 m in length. Results of this and the previous surveys are shown in Table 11 and Figure 10. Based on four data points, the BCT population appears to be hanging on, increasing slightly since 2014 (Table 11). Recent reproduction, indicated by the age-0 cohort, appears similar to that of 2004, both well below the levels encountered in 2009 and 2014 (Figure 10). The Brown Trout population appears to have declined by nearly half since 2014, but is still much larger than the BCT population (Table 11). Sculpin remain abundant in the sampled reach.

Table 11. Population statistics for species sampled in South Fork Ogden River, 2004, 2009, 2014, and 2019.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
Lower Station									
2019	≥age-1 BCT	8	62±28 (99±46)	9 (8)	233	153-317	146	28-311	0.92
	age-0 BCT	15	118±47 (191±75)		77	62-88	5	1-7	
	≥age-1 BNT	52	384±49 (618±78)	68 (61)	244	157-422	187	43-759	1.03
	age-0 BNT	5	34±0 (55±0)		87	81-97	6	5-7	
	SC		abundant						
2014	≥age-1 BCT	5	39±14 (63±23)	6 (5)	251	185-340	166	55-365	0.88
	≥age-1 BNT	93	680±5 (1094±8)	144 (128)	259	172-425	225	66-582	1.03
	age-0 BNT	11	no depletion		104	90-123			
	SC		abundant						
2009	≥age-1 BCT	6	49±59 (79±95)	7 (7)	259	204-311	172	83-279	0.92
	≥age-1 BNT	98	625±36 (1006±58)	189 (168)	299	159-446	343	22-935	1.07
	age-0 BNT	7	51±35 (82±57)	1 (1)	107	91-127	16	10-27	
	≥age-1 RBT	1	6±0 (10±0)	2 (1)	314		292		0.94
	≥age-1 CTxRT	1	6±0 (10±0)	1 (1)	272		194		0.96
	≥age-1 MWF	1	6±0 (10±0)		156		35		0.92
	SC		abundant						

Table 11.—cont.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
2004	≥age-1 BCT	5	41±0 (66±0)	10 (9)	309	267-339	272	180-356	0.91
	≥age-1 BNT	96	793±17 (1277±28)	160 (143)	262	175-444	221	48-842	1.06
	age-0 BNT	25	219±36 (352±57)	2 (2)	105	77-130	12	2-25	
	≥age-1 RBT	1	8±0 (13±0)	2 (1)	262		202		1.12
	SC		abundant						
				Upper Station					
2019	≥age-1 BCT	17	109±4 (175±6)	26 (23)	257	138-396	218	22-660	1.03
	age-0 BCT	80	642±171 (1034±275)	2 (2)	72	55-97	3	1-9	
	≥age-1 BNT	42	296±53 (477±86)	130 (116)	307	160-521	406	47-1414	1.06
	age-0 BNT	22	153±35 (247±56)	1 (1)	93	65-109	8	2-12	
	≥age-1 RBT	3	19±0 (31±0)	3 (3)	243	201-280	167	89-247	1.11
	≥age-1 CTxRT	2	no depletion		244	235-253	158	135-180	
	≥age-1 MWF	2	13±0 (21±0)		141	140-141	25		0.90
	SC		abundant						
2014	≥age-1 BCT	6	42±10 (68±16)	9 (8)	259	155-370	215	31-462	0.92
	age-0 BCT	40	295±48 (475±78)		75	58-92	4	1-9	
	≥age-1 BNT	89	605±10 (973±17)	220 (197)	265	150-410	349	73-690	1.10
	age-0 BNT	31	348±343 (561±552)		93	70-118			
	≥age-1 TGT	4	30±20 (49±32)	2 (2)	188	168-225	69	52-104	1.01
	≥age-1 MWF	12	82±5 (132±8)	8 (7	166	130-430	95	15-861	0.89
	SC		abundant						
2009	≥age-1 BCT	48	283±19 (455±31)	48 (43)	238	121-415	170	9-704	0.95
	age-0 BCT	40	280±93 (451±150)	1 (1)	77	56-105	4	1-9	
	≥age-1 BNT	67	406±38 (654±62)	110 (98)	279	165-429	271	44-788	1.04
	age-0 BNT	39	432±525 (695±845)	3 (3)	89	52-116	8	1-15	
	≥age-1 CTxRT	6	34±0 (55±0)	7 (6)	255	214-320	191	75-352	0.95
	≥age-1 TGT	1	6±0 (9±0)	2 (2)	342		320		0.80
	≥age-1 MWF	1	6±0 (9±0)	3 (3)	377		541		1.01
	SC		abundant						
2004	≥age-1 BCT	33	195±2 (315±4)	49 (44)	287	134-451	299	19-1042	1.04
	age-0 BCT	71	1052±1496 (1693±2408)	3 (3)	73	57-88	4	2-6	
	≥age-1 BNT	56	335±10 (538±17)	91 (81)	294	151-499	323	60-1323	1.03
	age-0 BNT	59	590±436 (949±702)	4 (4)	95	66-126	8	2-18	
	≥age-1 RBT	3	18±0 (29±0)	4 (3)	288	274-307	258	191-336	1.06
	≥age-1 CTxRT	4	24±0 (38±0)	5 (5)	287	216-356	254	94-424	0.99
	≥age-1 TGT	1	6±0 (10±0)		132		20		0.87
	≥age-1 MWF	20	118±0 (190±0)	43 (39)	326	152-432	437	29-730	1.22
	MTS		common						
	SC		abundant						

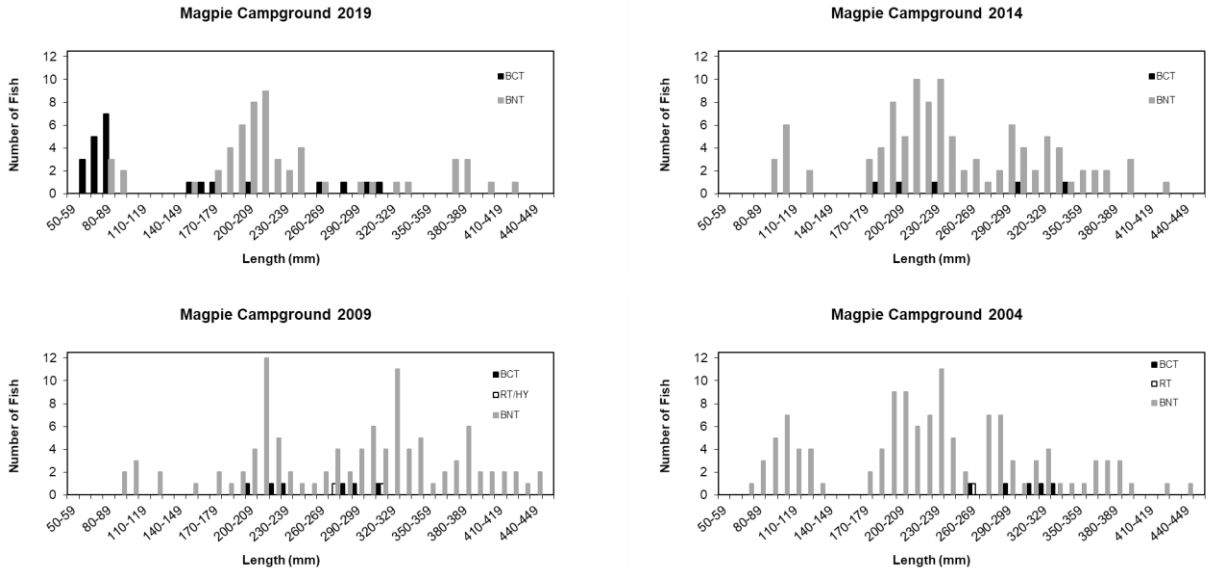

Figure 9. Size distribution of salmonid species sampled in the South Fork Ogden River lower monitoring station, 2004, 2009, 2014, and 2019.

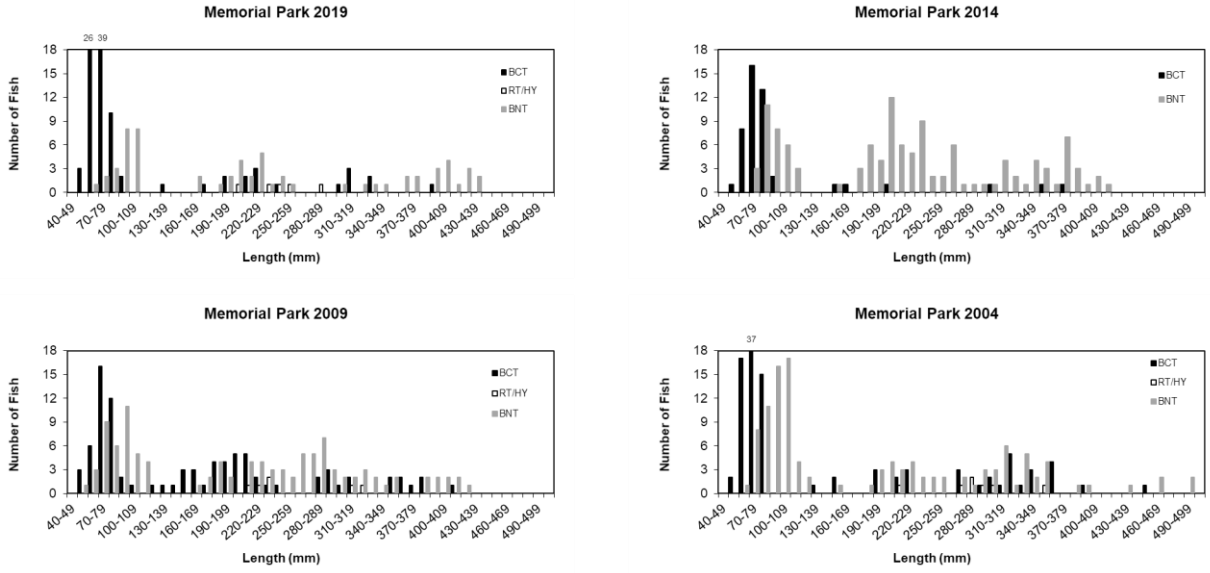

Figure 10. Size distribution of salmonid species sampled in the South Fork Ogden River upper monitoring station, 2004, 2009, 2014, and 2019.

Weber River Subunit

Mill Creek **IVAC**

Population Expansion

On October 2, 2019, approximately 1,000 fingerling BCT, mean TL 65 mm, produced from the Little Dell brood source were stocked into Mill Creek above Bountiful.

Stone Creek **IVAE**

Population Expansion

On October 2, 2019, approximately 2,000 fingerling BCT, mean TL 65 mm, produced from the Little Dell brood source were stocked into Stone Creek above Bountiful.

Barnard Creek **IVAH**

Population Expansion

On October 3, 2019, approximately 1,000 fingerling BCT, mean TL 65 mm, produced from the Little Dell brood source were stocked into Barnard Creek above Centerville.

Ricks Creek **IVAI**

Population Expansion

On October 3, 2019, approximately 1,000 fingerling BCT, mean TL 65 mm, produced from the Little Dell brood source were stocked into Ricks Creek above Centerville.

Holmes Creek **IVAN**

Population Expansion

On October 3, 2019, approximately 1,000 fingerling BCT, mean TL 65 mm, produced from the Little Dell brood source were stocked into Holmes Creek above Kaysville.

Burch Creek **IVAP050**

Temperature Monitoring

A HOBO Pendant Temperature Data Logger (Model # UA-001-64) was deployed in Burch Creek upstream of Ridgedale Drive from June 14, 2019, until October 17, 2019. Water temperatures during the deployment period varied from a maximum of 16.7°C (62.1°F) on August 5 and 6 to a minimum of 1.9°C (35.4°F) on October 11; the highest daily mean was 15.3°C (59.5°F) on August 5 and 6, while the mean daily mean for the entire period was 11.5°C (52.7°F) (Figure 11).

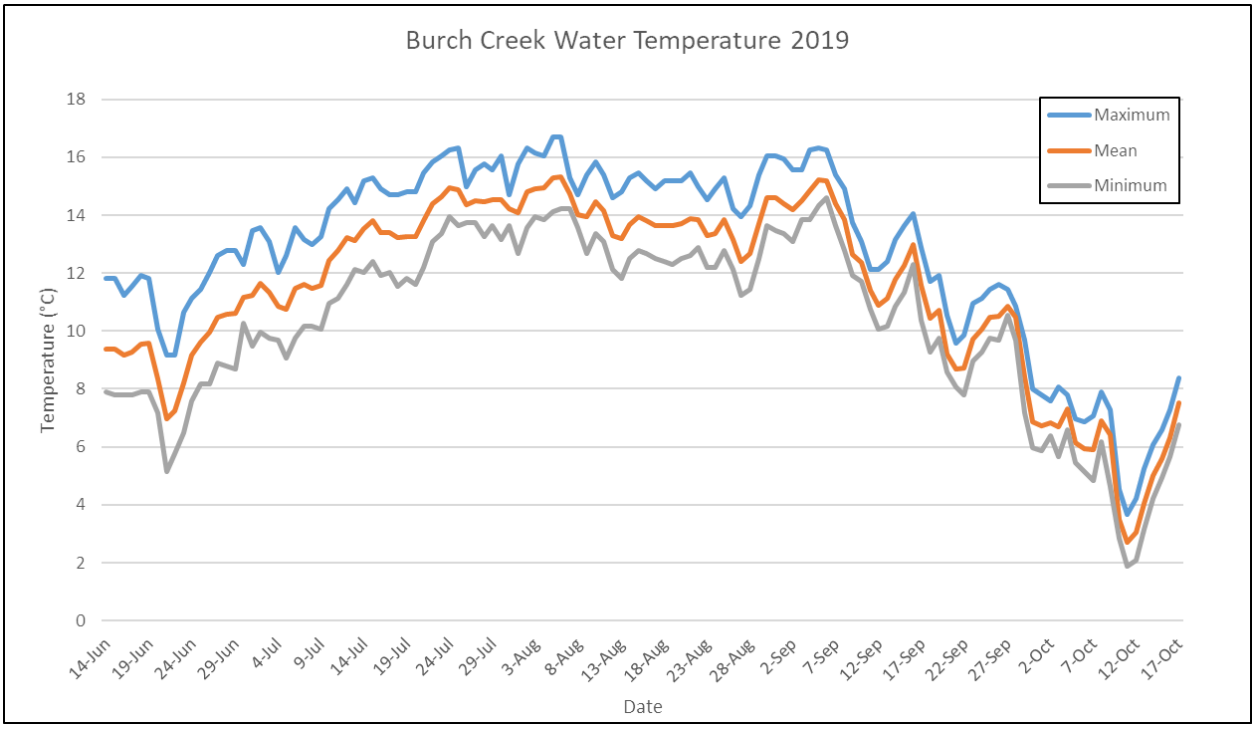

Figure 11. Water temperature data for Burch Creek, June 14-October 17, 2019.

Beus Creek **IVAP050A**

Temperature Monitoring

A HOBO Pendant Temperature Data Logger (Model # UA-001-64) was deployed in Beus Creek upstream of the USFS facility on 1900 East from June 14, 2019, until October 17, 2019. Water temperatures during the deployment period varied from a maximum of 16.1°C (61.0°F) on August 6 to a minimum of 2.0°C (35.6°F) on October 11; the highest daily mean was 14.5°C (58.1°F) on August 5 and 6, while the mean daily mean for the entire period was 11.3°C (52.3°F) (Figure 12).

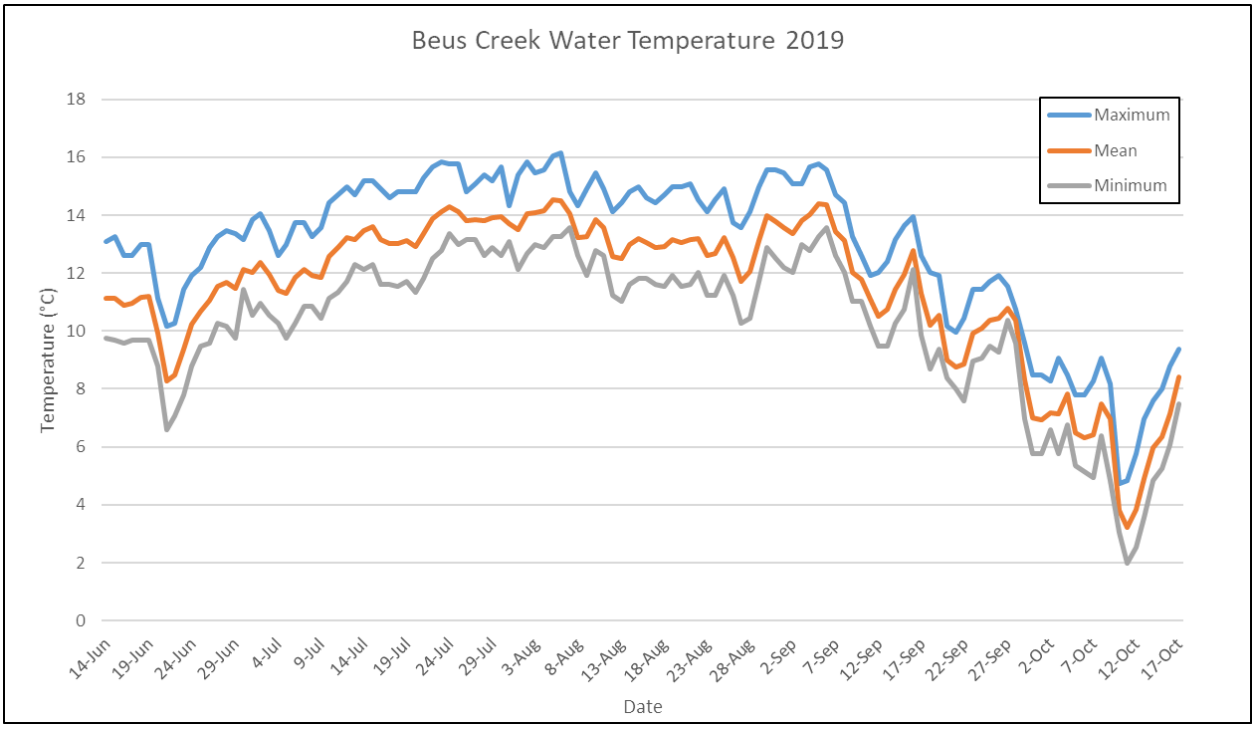

Figure 12. Water temperature data for Beus Creek, June 14-October 17, 2019.

Jacobs Creek **IVAP065**

Temperature Monitoring

A HOBO Pendant Temperature Data Logger (Model # UA-001-64) was deployed in Jacobs Creek just below the step-pool reach downstream of the upper culvert from June 8, 2019, until October 17, 2019. Water temperatures during the deployment period varied from a maximum of 22.8°C (73.0°F) on July 25 and August 5 to a minimum of 1.4°C (34.5°F) on October 11; the highest daily mean was 18.5°C (65.3°F) on July 24, while the mean daily mean for the entire period was 12.5°C (35.6°F) (Figure 13).

This logger was a repeat of the logger deployed in 2018 (see McKell 2019) just upstream of this location that recorded air temperatures when stream flows dropped and exposed the logger during the summer.

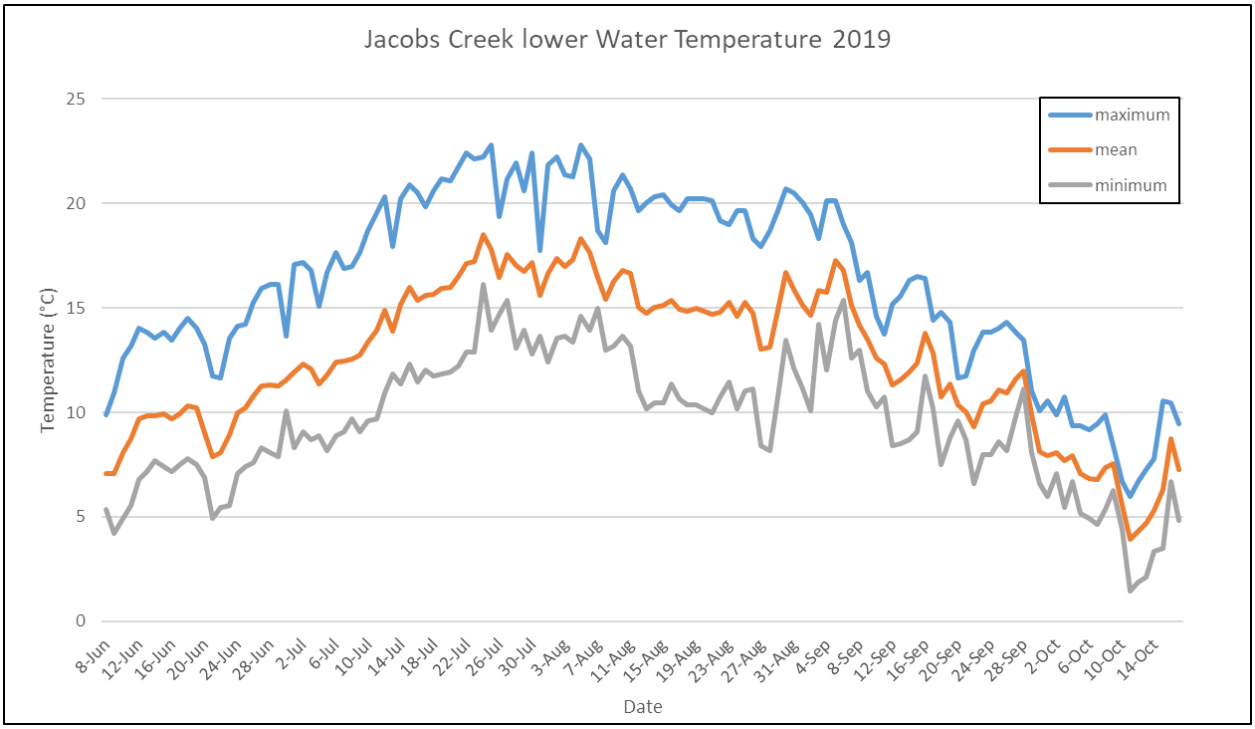

Figure 13. Water temperature data for Jacobs Creek, June 8-October 17, 2019.

Echo Creek **IVAP210**

Temperature Monitoring

A HOBO Pendant Temperature Data Logger (Model # UA-001-64) was deployed in Echo Creek from June 20, 2019, until October 10, 2019, at the same location as the 2018 logger. Water temperatures during the 2019 deployment period varied from a maximum of 24.5°C (76.1°F) on July 22 to a minimum of 3.0°C (37.4°F) on October 10; the highest daily mean was 20.1°C (68.2°F) on July 24, while the mean daily mean for the entire period was 15.4°C (59.7°F) (Figure 14). A comparison of summary data by year is given in Table 12. Two-sample t-tests detected significant differences ($P<.05$) between daily maximum, daily minimum, and daily mean temperatures for 2018 and 2019, demonstrating that water temperatures in 2018 in Echo Creek were significantly warmer than in 2019.

Table 12. Summary of water temperature data for Echo Creek, 2018 and 2019.

Year	Dates	Maximum Temp		Minimum Temp		Max Daily Mean		Mean Daily
		°C (°F)	Date	°C (°F)	Date	°C (°F)	Date	Mean
2019	Jun 20-Oct 10	24.5 (76.1)	Jul 22	3.0 (37.4)	Oct 10	20.1 (68.2)	Jul 24	15.4 (59.7)
2018	Jun 20-Oct 10	26.1 (79.0)	Jul 9	5.2 (41.4)	Oct 10	21.5 (70.7)	Jul 10	16.4 (61.5)

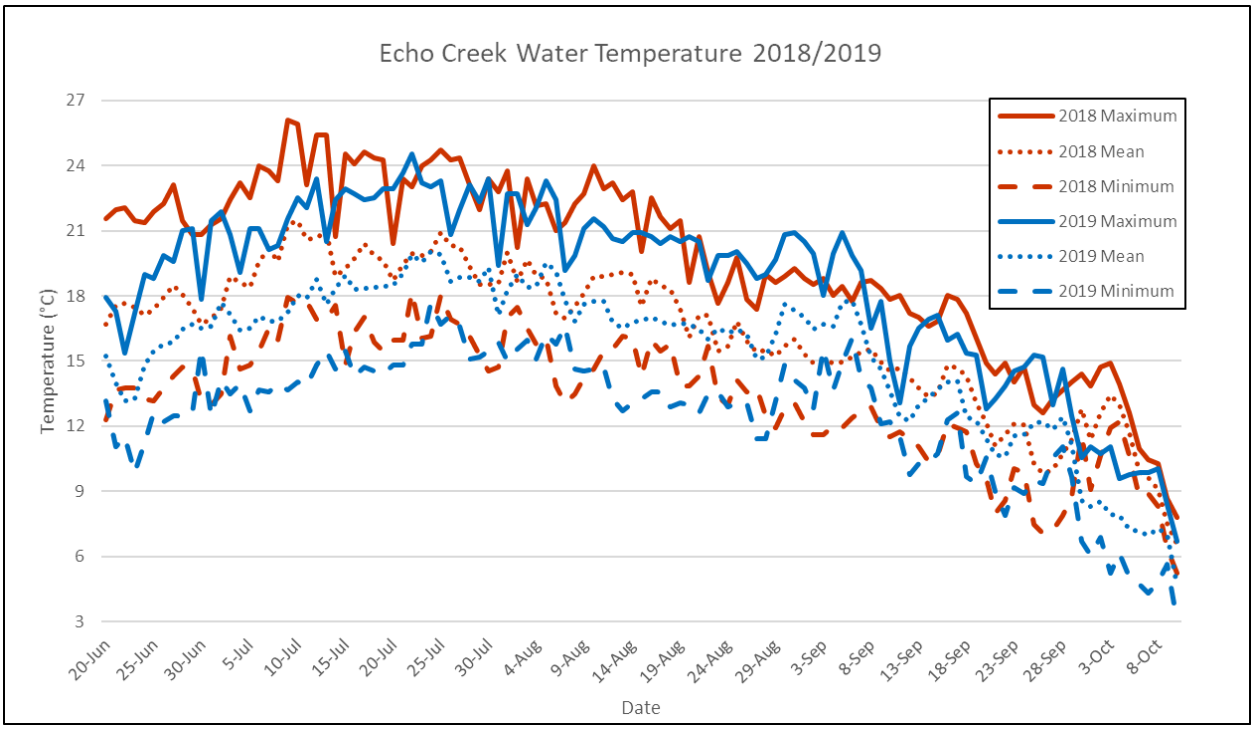

Figure 14. Water temperature data for Echo Creek, June 20-October 10, 2018 and 2019.

Four additional temperature loggers were deployed upstream of the 2018/2019 logger to assess potential longitudinal differences in temperature along a 20.8 km reach of Echo Creek (Figure 15). Data for each site are summarized in Table 13; daily maximum temperatures for each of the five sites are shown in Figure 16. Interestingly, temperatures were highest at the two upstream-most sites (Sites 1 and 2), and were lowest at Site 4 (Figure 16). Anecdotally, the higher temperatures at Sites 1 and 2 are likely attributed to a lack of riparian cover, while the lower temperatures at Site 4 are likely associated with the stream flowing through a 500 m culvert under Interstate-80, emerging just 1.0 km upstream of the logger location. Temperatures at Site 3 are likely influenced by the inflow of Heiner Creek a short distance upstream, and the reach between Sites 4 and 5 has a mix of exposed channel and riparian cover.

Table 13. Summary of water temperature data collected at five sites in Echo Creek, June 20-October 10, 2019.

Site No.	Location	Maximum Temp °C (°F)	Maximum Temp Date	Minimum Temp °C (°F)	Minimum Temp Date	Max Daily Mean °C (°F)	Max Daily Mean Date	Mean Daily Mean
1	Point of Entry	26.9 (80.4)	Jul 22	2.2 (36.0)	Oct 10	19.7 (67.5)	Jul 22	15.0 (59.0)
2	Emory	27.3 (81.1)	Jul 22	1.0 (33.8)	Oct 10	21.0 (69.8)	Jul 24	15.2 (59.4)
3	Heiner Cyn	24.1 (75.4)	Jul 22	2.3 (36.1)	Oct 10	19.1 (66.4)	Jul 24	14.6 (58.3)
4	Rest Stop	21.9 (71.4)	Jul 22	4.0 (39.2)	Oct 10	19.2 (66.6)	Jul 24	14.8 (58.6)
5	Rail Trail	24.5 (76.1)	Jul 22	3.0 (37.4)	Oct 10	20.1 (68.2)	Jul 24	15.4 (59.7)

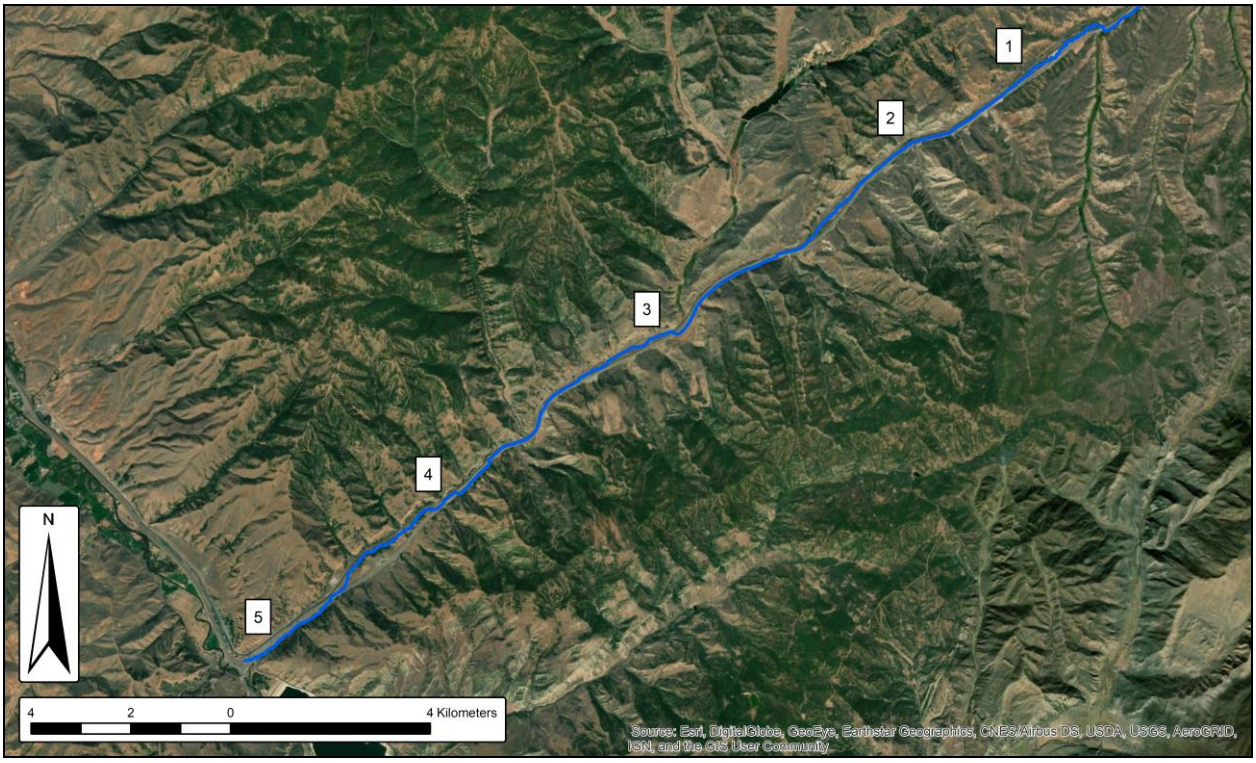

Figure 15. Map of temperature logger locations in Echo Creek, 2019.

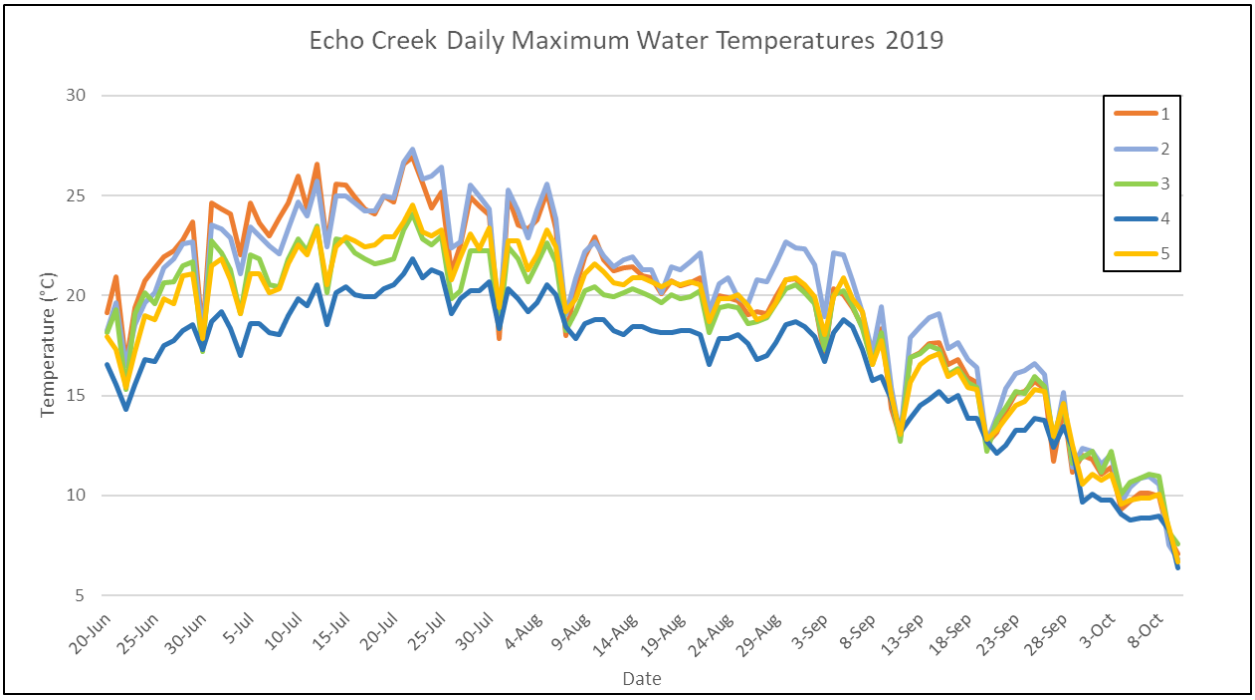

Figure 16. Daily maximum temperatures for Echo Creek Sites 1-5, June 20-October 10, 2019.

Huff Creek **IVAP230H**

Temperature Monitoring

Six HOBO Pendant Temperature Data Loggers (Model # UA-001-64) were deployed in Huff Creek from June 8, 2019, until October 7, 2019, to assess potential longitudinal differences in temperature along a 14.5 km reach of Huff Creek (Figure 17). Data for each site are summarized in Table 14; daily maximum temperatures for each of the six sites are shown in Figure 18. Interestingly, temperatures were highest at the two upstream-most sites (Sites 1 and 2), and were lowest at Site 6 (Figure 18). Anecdotally, the temperatures at Site 2 are likely attributed to a lack of riparian cover, while the temperatures at Site 6 are likely associated with riparian cover and a deep, narrow channel in the reach upstream. Temperatures at Site 4 are influenced by the irrigation reservoir just upstream.

Table 14. Summary of water temperature data collected at six sites in Huff Creek, June 8-October 7, 2019.

Site	Location	Maximum Temp		Minimum Temp		Max Daily Mean		Mean Daily
No.		°C (°F)	Date	°C (°F)	Date	°C (°F)	Date	Mean
1	Oil well	24.9 (76.8)	Jul 22	2.7 (36.9)	Oct 5	18.5 (65.3)	Aug 5	14.5 (58.1)
2	Road crossing	26.4 (79.5)	Jul 22	2.2 (36.0)	Oct 5	19.6 (67.3)	Jul 22	15.0 (59.0)
3	Below diversion	24.3 (75.7)	Jul 12	4.0 (39.2)	Oct 7	20.0 (68.0)	Jul 24	15.3 (59.5)
4	Below reservoir	25.0 (77.0)	Sep 5	1.7 (35.1)	Oct 7	22.3 (72.1)	Jul 25	16.7 (62.1)
5	Flat rock	25.5 (77.9)	Jul 22	2.9 (37.2)	Oct 7	21.3 (70.3)	Jul 22	16.2 (61.1)
6	Chalk Cr road	19.0 (66.2)	Jun 14	4.4 (39.9)	Oct 7	16.1 (61.0)	Jul 24	13.3 (55.9)

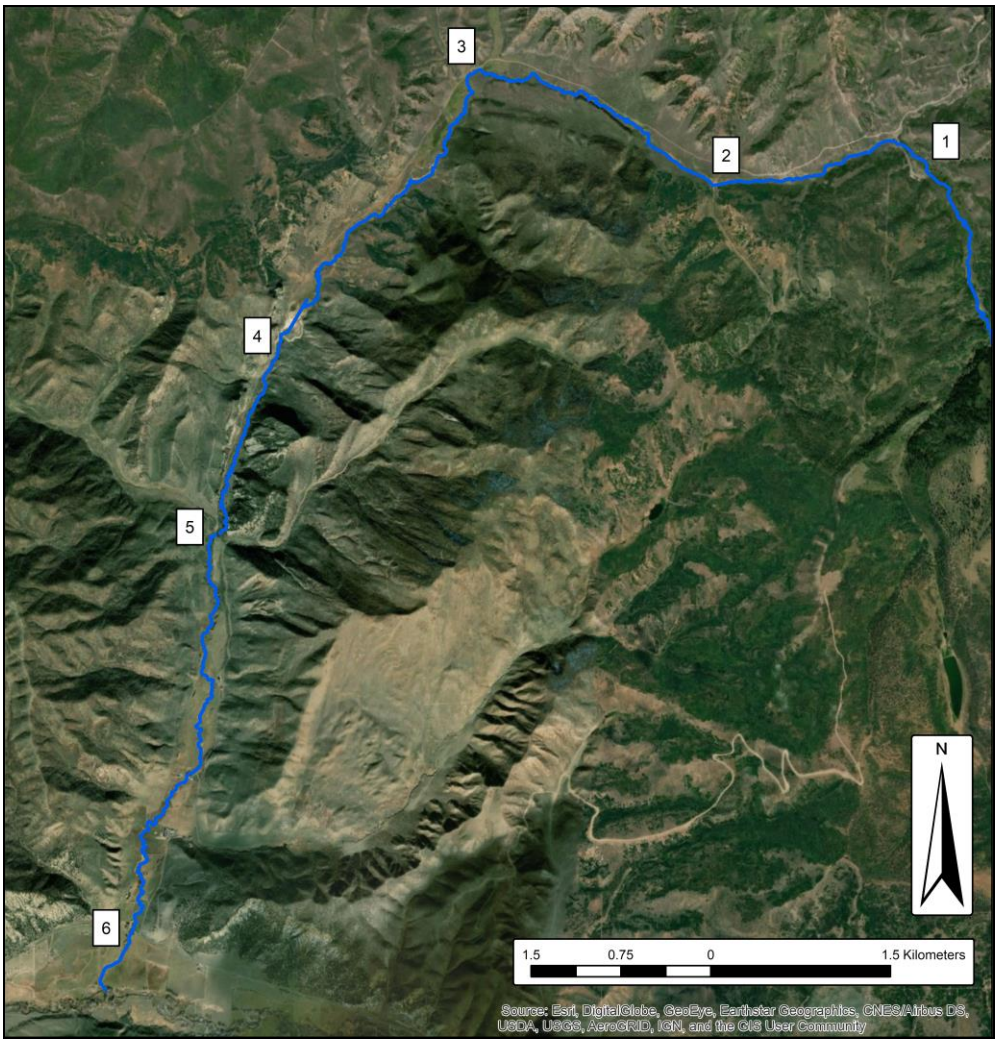

Figure 17. Map of temperature logger locations in Huff Creek, 2019.

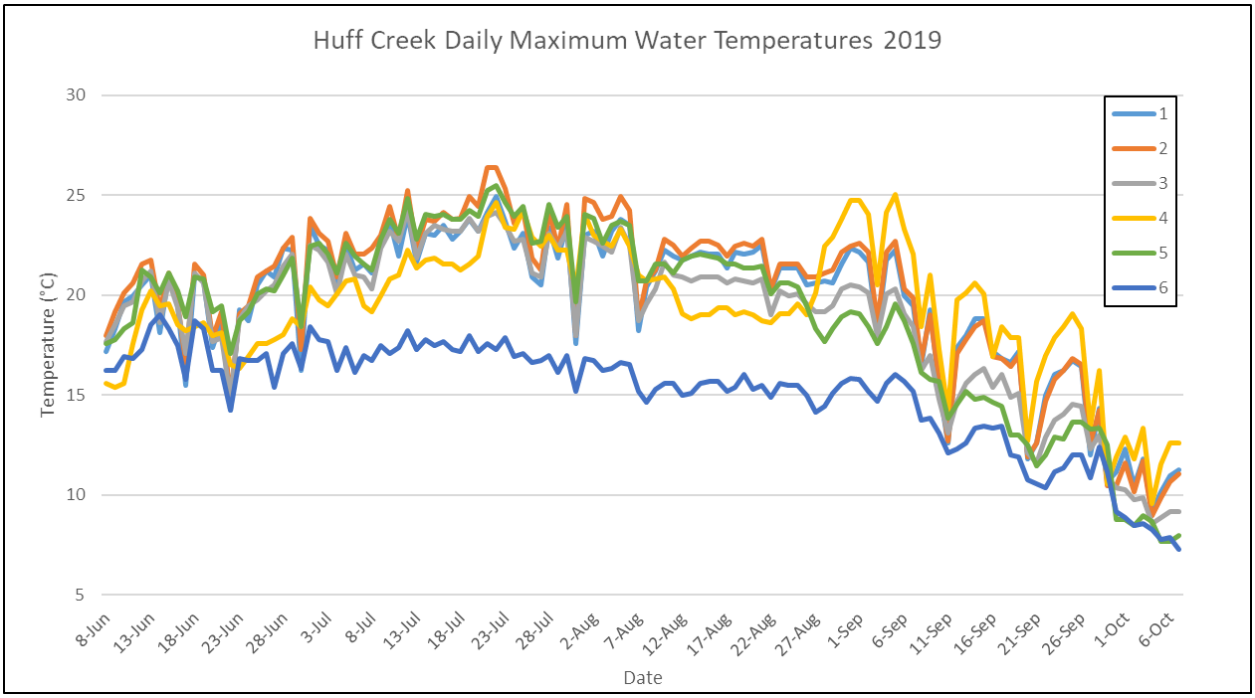

Figure 18. Daily maximum temperatures for Huff Creek Sites 1-6, June 8-October 7, 2019.

East Fork Chalk Creek **IVAP230M**

Brood Development

In an effort to develop a BCT brood population to represent the Weber River, portions of the East Fork Chalk Creek drainage were spot electrofished during late spring and early summer to search for spawning BCT. Several short reaches of the East Fork were electrofished on June 6, 2019, with only a few small (fingerling) BCT found. Portions of the Middle Fork and lower Mill Fork were electrofished on June 11, including a sizeable gravel bed; the entire effort produced only three adult females and four males, none of which were ripe. The same Middle and Mill Fork reaches were repeated on June 26, plus an additional stretch of Mill Fork, with similar results: two pre-spawn females and two males. Lower Mill Fork again, on July 2, was electrofished and produced four females: two spent, one pre-spawn, and one likely immature, plus two males. Consequently, no BCT gametes were collected during these efforts.

Silver Creek **IVAP280**

Survey

A qualitative electrofishing survey of much of Silver Creek from I-80 near Silver Creek Junction to Prospector Park in Park City, was completed July 15-16, 2019, by personnel from the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Utah Department of Environmental Quality, and UDWR. The survey was conducted to assess fish distribution in the Richardson Flat area and guide restoration efforts in the area, which is heavily laden with tailings produced from upstream mining operations during the 1800s.

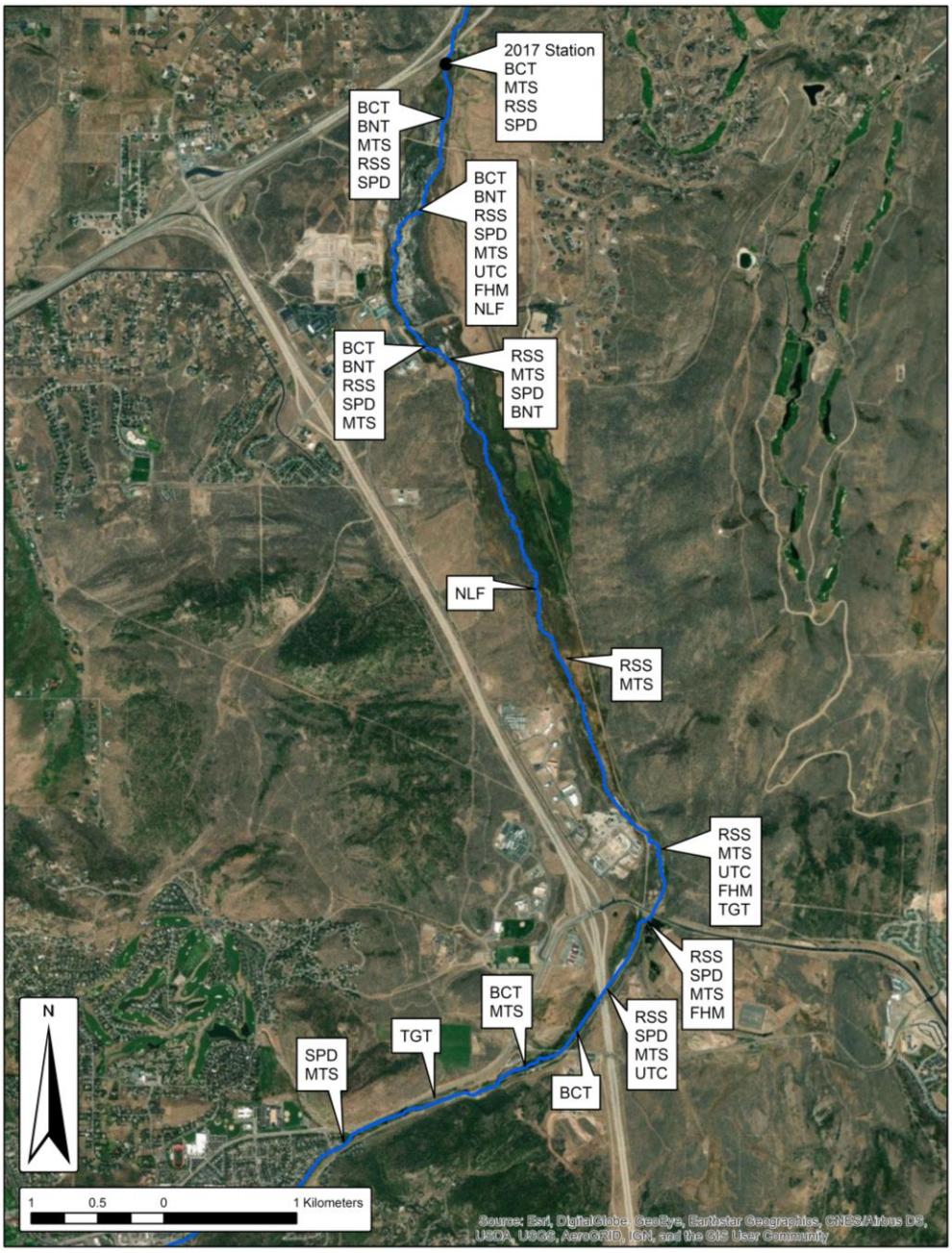

Figure 19. Distribution of aquatic species sampled in Silver Creek, July 15-16, 2019.

Temperature Monitoring

Four HOBO Pendant Temperature Data Loggers (Model # UA-001-64) were deployed in Silver Creek from June 22, 2019, until October 21, 2019, to assess potential longitudinal differences in temperature along a 16.4 km reach of Silver Creek (Figure 20). However, the logger deployed at Site 1 was no longer at the deployment location at the time of retrieval and was consequently not recovered. Data for each of the other three sites are summarized in Table 15; daily maximum temperatures for each of the three sites are shown in Figure 21. Interestingly, maximum daily temperatures were highest at Sites 2 and 4, and were lowest at Site 3 (Figure

21). Temperatures at Site 4 fluctuated more widely on a daily basis than the other sites, likely a result of conditions in the canyon, while Site 3 temperatures are undoubtedly influenced by discharge from the Silver Creek Water Reclamation Facility just upstream of the logger location.

In addition, Site 3 temperature measurements (collected every half hour) were plotted with corresponding discharge measurements recorded at the USGS Gage just upstream. The plotted data illustrate the correlation between changes in flow and changes in temperature (Figure 22), particularly the low flow point on August 27 and its effect on temperature (i.e. a large positive spike), as well as an upward spike in flow on September 12 and the corresponding drop in temperature.

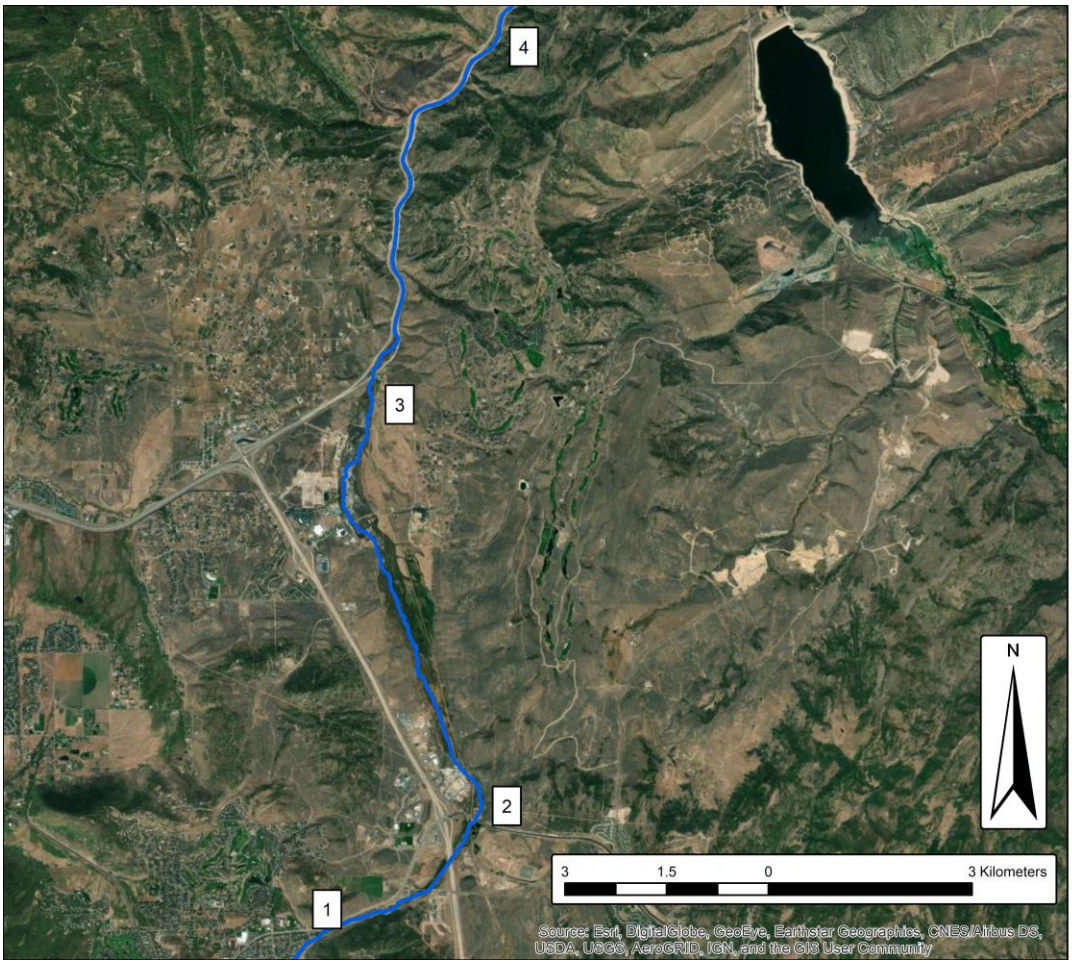

Figure 20. Map of temperature logger locations in Silver Creek, 2019.

Table 15. Summary of water temperature data collected at sites in Silver Creek, June 22-October 21, 2019.

Site No.	Location	Maximum Temp °C (°F)	Date	Minimum Temp °C (°F)	Date	Max Daily Mean °C (°F)	Date	Mean Daily Mean
1	Prospector Park	no data – logger not recovered						
2	Abv SR-248	24.4 (75.9)	Jul 22	1.7 (35.1)	Oct 20	20.9 (69.6)	Jul 24	15.4 (59.7)
3	Blw USGS Gage	23.4 (74.1)	Aug 27	3.5 (38.3)	Oct 19	20.0 (68.0)	Aug 6	15.3 (59.5)
4	Blw Tollgate Cyn	24.7 (76.5)	Jul 22	1.5 (34.7)	Oct 11	20.1 (68.2)	Aug 5	14.8 (58.6)

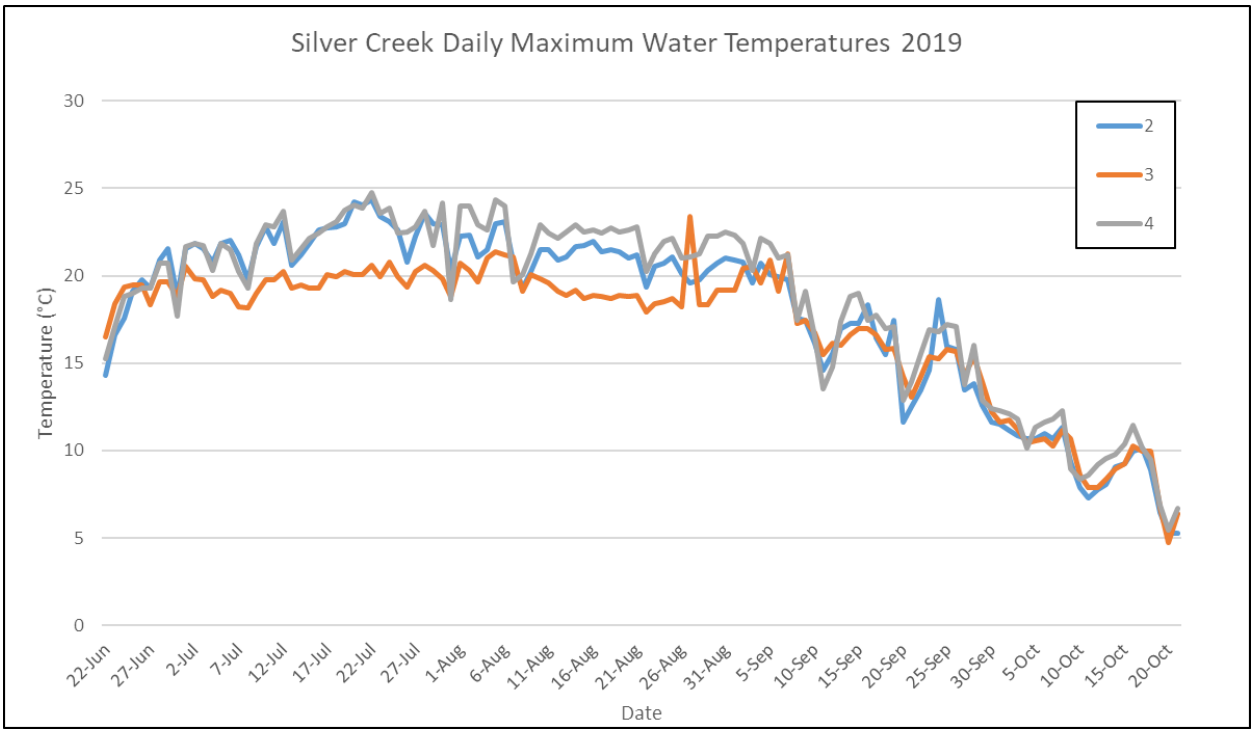

Figure 21. Daily maximum temperatures for Silver Creek Sites 2-4, June 22-October 21, 2019.

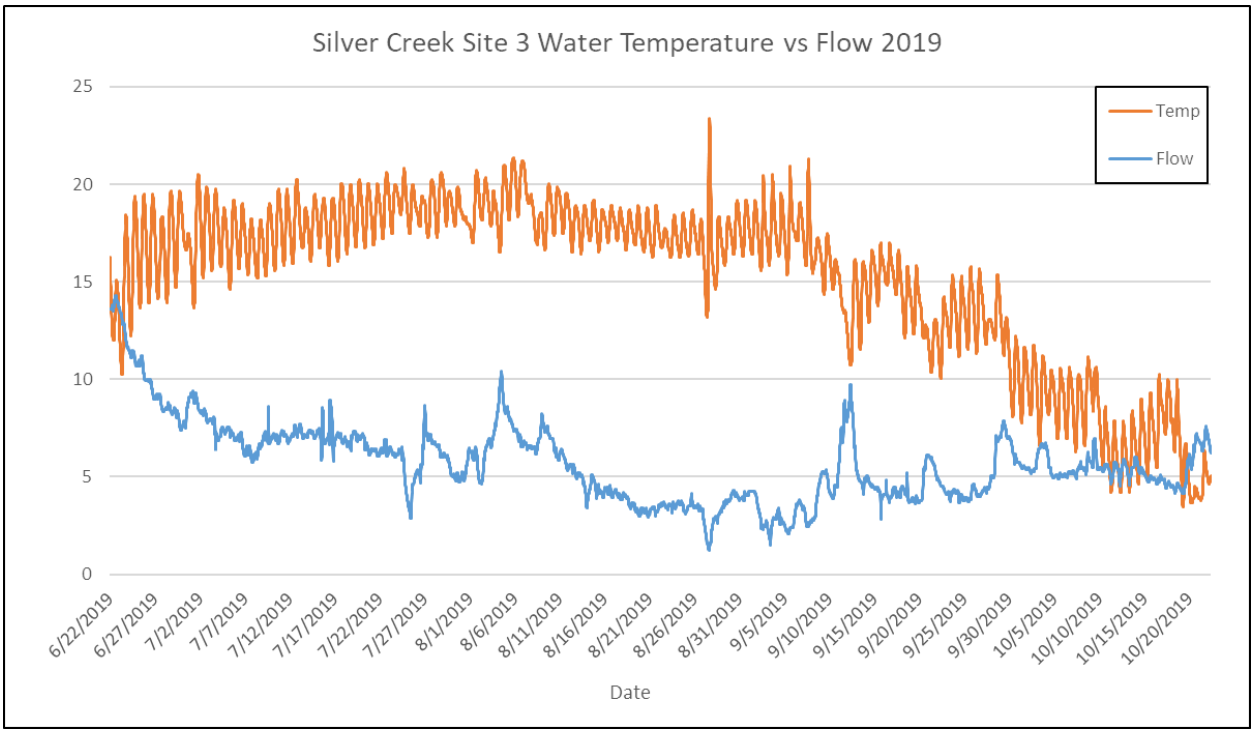

Figure 22. Water temperatures for Silver Creek Site 3 and discharge measurements at the USGS Streamflow Gage, June 22-October 21, 2019.

WEST DESERT GMU

Pine Creek **IVAR010B**

Temperature Monitoring

A HOBO Pendant Temperature Data Logger (Model # UA-001-64) was deployed in Pine Creek from June 27, 2018, until October 23, 2019, to assess the suitability of Pine Creek for BCT stocking. Water temperatures (maximum, minimum, and mean) during the overlapping period for both years are shown in Figure 23 and summarized in Table 16. Two-sample t-tests detected significant differences ($P<.05$) between daily maximum, daily minimum, and daily mean temperatures for 2018 and 2019, indicating that water temperatures in 2018 in Pine Creek were significantly warmer than in 2019. During both years, water temperatures were well below lethal levels for BCT (Schrank et al 2003), thereby suggesting that BCT could be stocked into Pine Creek, assuming other habitat requirements are satisfied.

Table 16. Summary of water temperature data for Pine Creek, 2018 and 2019.

Year	Dates	Maximum Temp		Minimum Temp		Max Daily Mean		Mean Daily
		°C (°F)	Date	°C (°F)	Date	°C (°F)	Date	Mean
2019	Jun 27-Oct 23	18.1 (64.6)	Jul 22	2.7 (36.9)	Oct 12	15.0 (59.0)	Aug 6	11.5 (52.7)
2018	Jun 27-Oct 23	21.7 (71.1)	Jul 11	3.9 (39.0)	Oct 15	16.3 (61.3)	Jul 9	12.7 (54.9)

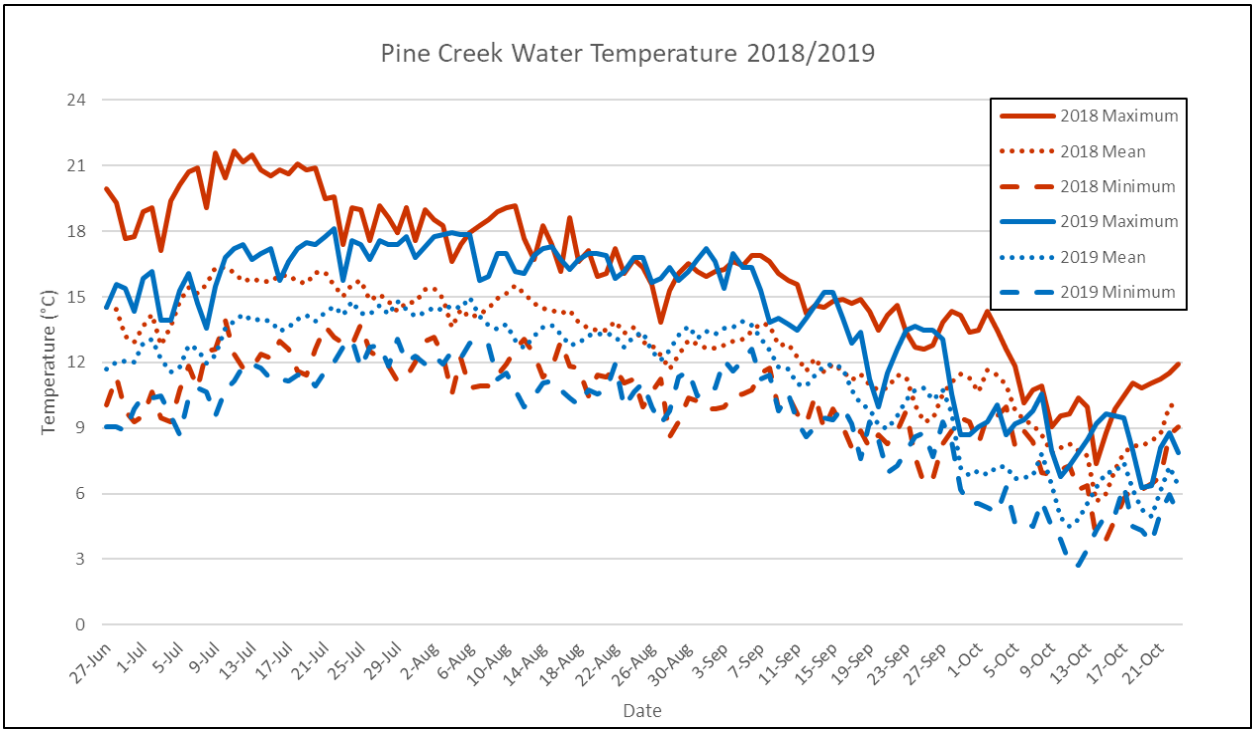

Figure 23. Water temperature data for Pine Creek, June 27-October 23, 2018 and 2019.

COLORADO RIVER CUTTHROAT TROUT

Monitoring
Multiple-pass electrofishing was completed on four streams/sections during 2019 CRCT monitoring efforts (Table 17). One of the monitored CRCT populations appeared to have declined since the previous sampling and three remained essentially flat.

The following fish species were encountered during stream sampling in 2019: Colorado River Cutthroat Trout, Mountain Sucker, Speckled Dace, and sculpin.

Table 17. Results of CRCT population monitoring in 2019.

Stream/section	Year	# of ≥age-1 CRCT/km	# of ≥age-1 CRCT/mi
West Fork of Smiths Fork UT/WY border	2019	160 ± 34	257 ± 54
	2014	111 ± 0	179 ± 0
	2005	173 ± 68	278 ± 110
West Fork of Smiths Fork North Slope Road	2019	169 ± 31	272 ± 49
	2014	215 ± 65	347 ± 105
	2009	227 ± 4	366 ± 6
	2005	111 ± 8	179 ± 13
	1999	519 ± 40	835 ± 65
West Fork of Smiths Fork Wilderness Boundary	2019	197 ± 24	317 ± 39
	2014	568 ± 130	914 ± 210
	2005	560 ± 56	902 ± 91
	1999	631 ± 24	1015 ± 39
Archie Creek	2019	40 ± 0	64 ± 0
	2014	30 ± 0	48 ± 0
	2009	144 ± 8	232 ± 12
	2004	100 ± 0	161 ± 0

UPPER GREEN GMU
North Slope of the Uinta Mountains subunit

West Fork of Smiths Fork IICK020B

Monitoring
Three stations in the West Fork of Smiths Fork were monitored in 2019, one just upstream of the Wyoming state line (lower), one just upstream of the North Slope Road (middle), and one near the wilderness boundary (upper). The lower and middle stations were electrofished on August 16, 2019, and the upper was electrofished on August 15, 2019. All three stations were also monitored in 2014 (McKell 2015).

Lower Station
The fish community in this 100 m station was comprised of a small to moderate population of CRCT (Table 18). Based on three data points, the population has experienced a slight increase in number from the 2014 estimate but a large increase (by triple) in biomass (Table 18), and the

length-frequency histogram shows multiple size-classes (Figure-8 23), although none of them very abundant. Mountain Sucker were common, Speckled Dace were sparse, and sculpin were abundant in the station (Table 18).

Middle Station

This 100 m station contained a small to moderate population of CRCT (Table 18), slightly less in number than the 2014 and 2009 population estimates. The length-frequency distribution for this station showed a similar range of size-classes of CRCT during each sampling event (Figure 25). Sculpin remain abundant in the reach (Table 18).

Upper Station

The CRCT population at this location has experienced a sharp decline in both abundance and biomass since 2014 (Table 18), with both estimates lower than observed during any previous sampling event. Until 2019, the length-frequency distribution for this station showed a wide range of size-classes of CRCT during each sampling event, as well as good representation from many size-classes (Figure 26); however, the length-frequency distribution for 2019 indicates a vast reduction in the number of older CRCT and also fewer representatives of younger age-classes. Sculpin were abundant in this reach (Table 18).

Genetic Collection

On August 15, 2019, fin clips from 26 CRCT were collected from a headwater meadow of West Fork Smiths Fork for genetic analysis. The samples were preserved according to established protocols.

Table 18. Population statistics for species sampled in West Fork Smiths Fork, 1999, 2005, 2009, 2014, and 2019.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
Lower Station									
2019	≥age-1 CRCT MTS SPD SC	15	160±34 (257±54) common sparse abundant	22 (20)	166	95-255	58	9-169	0.99
2014	≥age-1 CRCT MTS SC	12	111±0 (179±0) common abundant	7 (6)	150	88-259	41	6-158	0.89
2005	≥age-1 CRCT MTS SC	15	173±68 (278±110) common abundant	11 (9)	139	93-231	36	10-138	1.13
Middle Station									
2019	≥age-1 CRCT SC	16	169±31 (272±49) abundant	8 (7)	131	89-214	25	7-87	0.96
2014	≥age-1 CRCT SC	23	215±65 (347±105) abundant	12 (10)	126	64-247	28	2-153	0.89
2009	≥age-1 CRCT SC	27	227±4 (366±6) abundant	20 (18)	156	73-248	44	3-136	0.95
2005	≥age-1 CRCT MTS SC	11	111±8 (179±13) sparse abundant	7 (6)	135	74-214	31	4-116	1.01

Table 18.—cont.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
Upper Station									
2019	≥age-1 CRCT SC	16	197±24 (317±39) abundant	9 (8)	115	68-222	20	3-109	0.95
2014	≥age-1 CRCT MTS SC	48	568±130 (914±210) sparse abundant	48 (42)	145	65-295	40	2-234	0.92
2005	≥age-1 CRCT SC	53	560±56 (902±91) abundant	32 (28)	118	63-258	27	2-172	0.82
1999	≥age-1 CRCT age-0 CRCT MTS SC	64 8	631±24 (1015±39) present sparse abundant	81 (72)	142 31	66-246 25-35	38	1-139	0.95

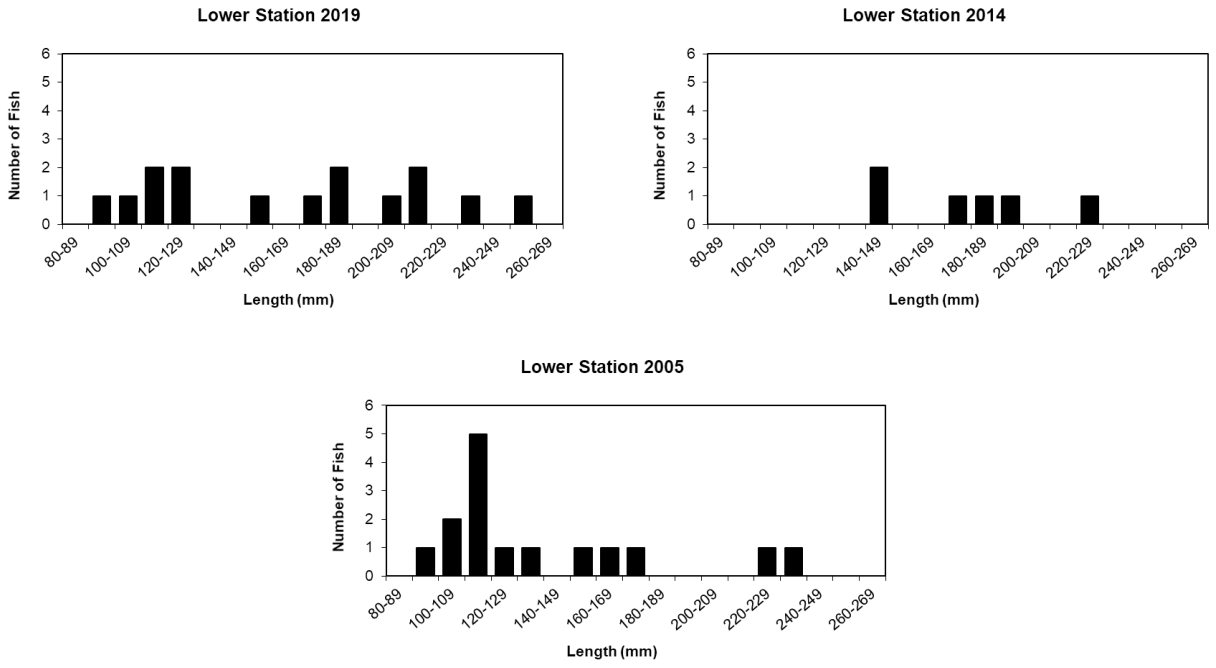

Figure 24. Size distribution of CRCT sampled in the West Fork Smiths Fork lower monitoring station, 2005, 2014, and 2019.

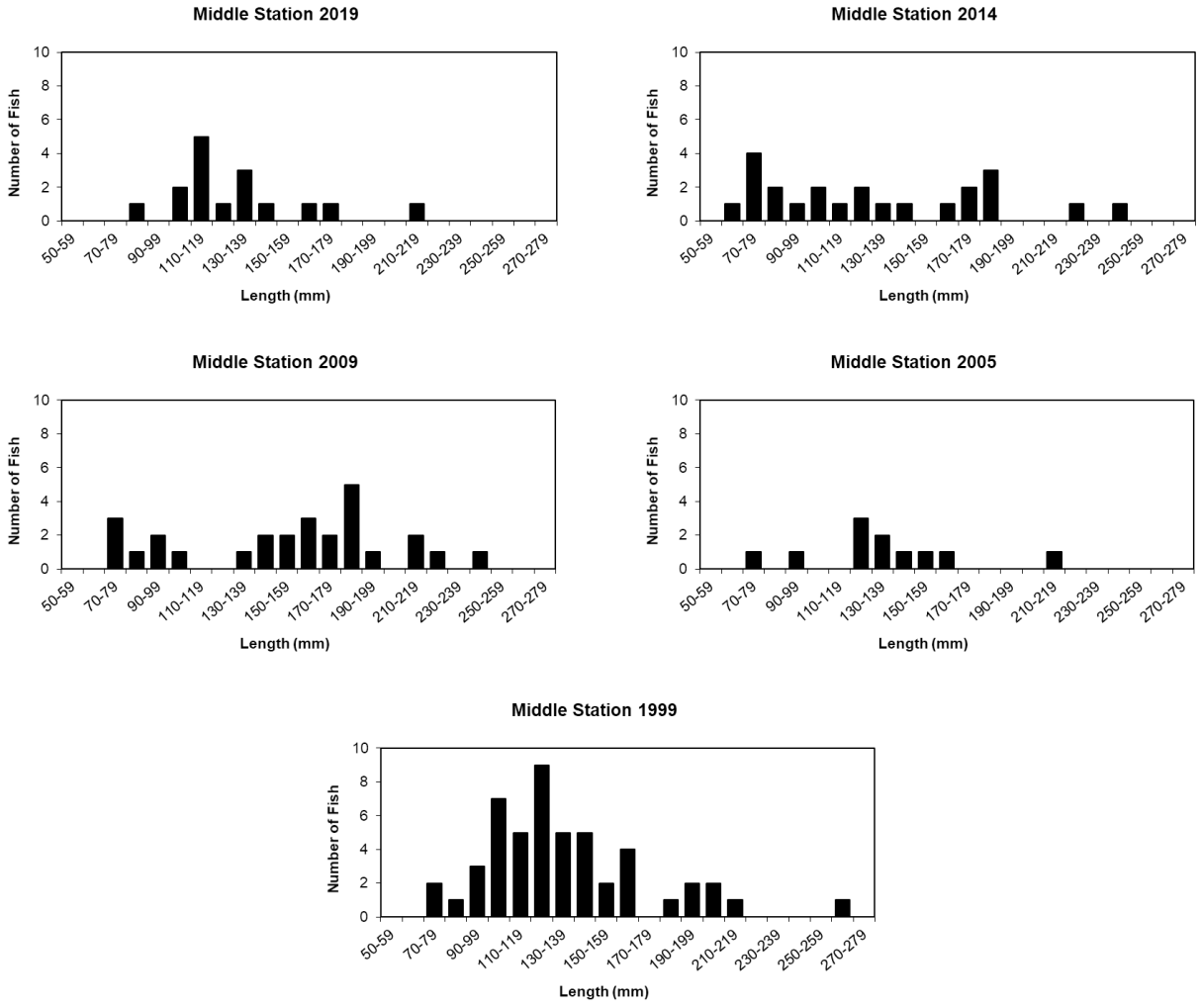

Figure 25. Size distribution of CRCT sampled in the West Fork Smiths Fork middle monitoring station, 1999, 2005, 2009, 2014, and 2019.

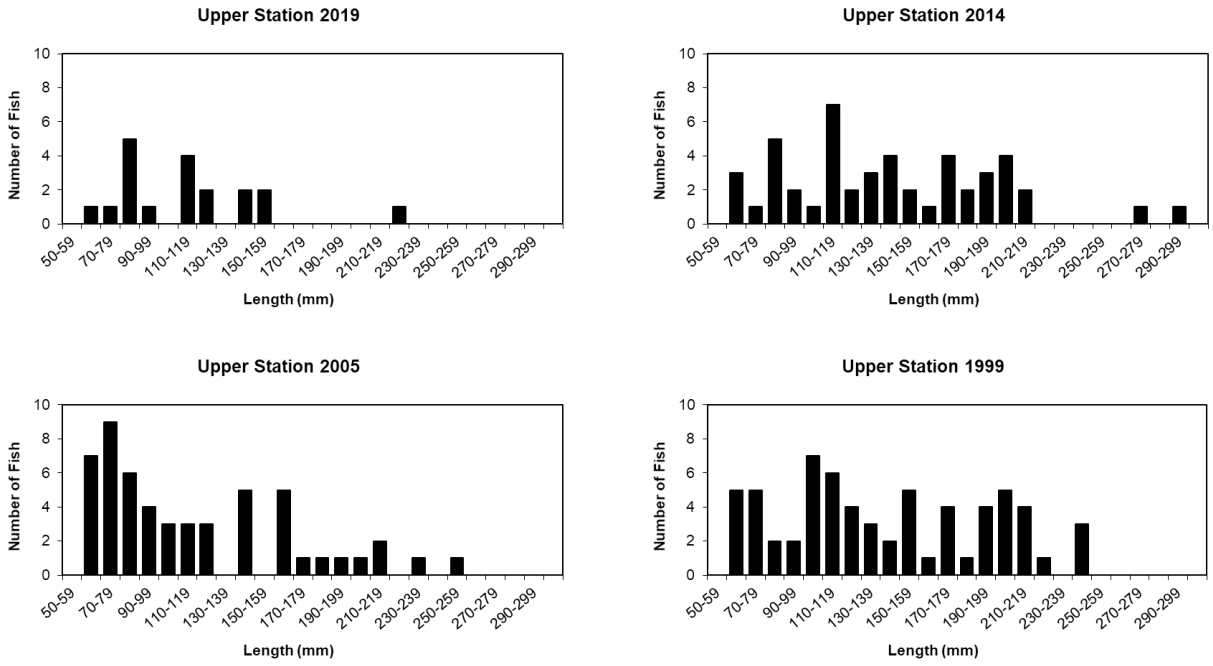

Figure 26. Size distribution of CRCT sampled in the West Fork Smiths Fork upper monitoring station, 1999, 2005, 2014, and 2019.

Archie Creek **IICK020B01**

Monitoring

This 100 m station was electrofished on August 14, 2019. The CRCT population in this station is small and continues to be suppressed (Table 19), as indicated by the 2014 data. The length-frequency distribution shows a shift in 2019 to an apparently entirely sub-adult demographic (Figure 27), suggesting this reach may be used only seasonally and may be unable to support a permanent, long-term population. Sculpin continue to be abundant in this station.

Genetic Collection

On August 14, 2019, fin clips from 30 CRCT were collected from Archie Creek for genetic analysis. Extensive spot electrofishing was conducted upstream and downstream of the monitoring station in order to obtain the fin samples, which were preserved according to established protocols.

Table 19. Population statistics for species sampled in Archie Creek, 2004, 2009, 2014, and 2019.

Year	Species	Total Catch	#/km ± 95% C.I. (#/mi ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
2019	≥age-1 CRCT SC	4	40±0 (64±0) abundant		105	77-124			
2014	≥age-1 CRCT SC	3	30±0 (48±0) abundant	6 (5)	154 75	117-191 44-101	43	14-77	1.01
2009	≥age-1 CRCT SC	13	144±8 (232±12) abundant	24 (21)	143	74-220	35	3-93	0.87
2004	≥age-1 CRCT age-0 CRCT SC	10 2	100±0 (161±0) 20±0 (32±0) abundant	12 (11)	165 33	122-210	41	16-84	0.85

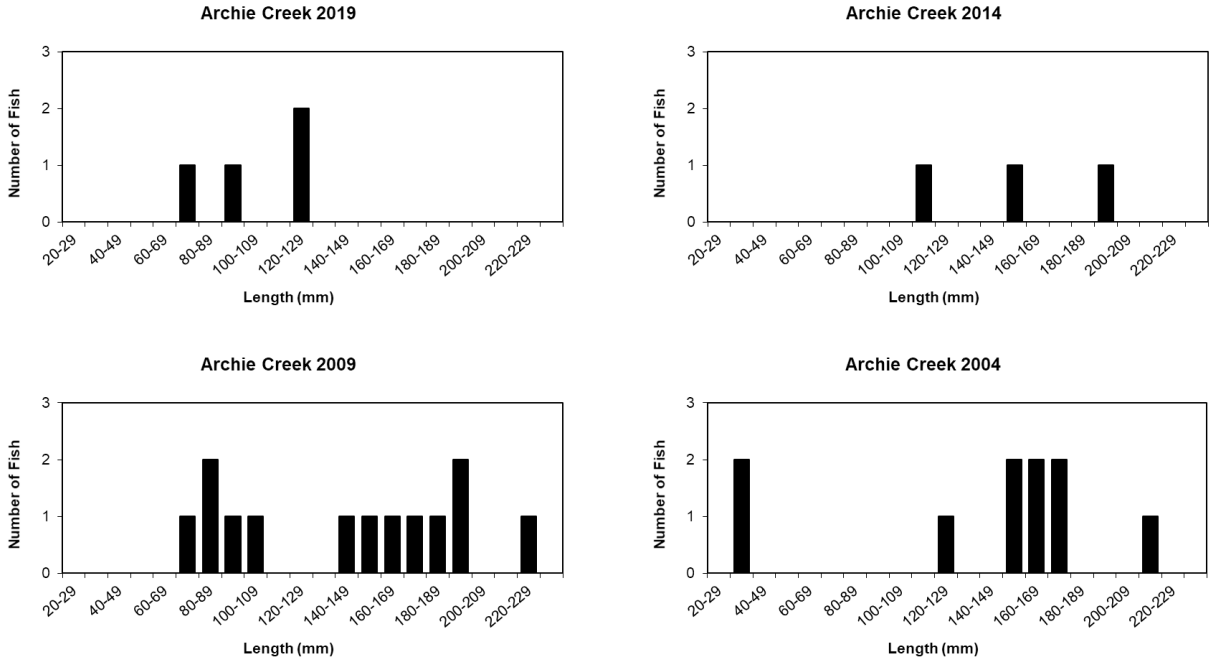

Figure 27. Size distribution of CRCT sampled in the Archie Creek monitoring station, 2004, 2009, 2014, and 2019.

YELLOWSTONE CUTTHROAT TROUT

North Slope Raft River Mountains

Raft River **IIIAA**

Temperature Monitoring

A HOBO Pendant Temperature Data Logger (Model # UA-001-64) was deployed in the Raft River from June 26, 2018, until October 23, 2019, to assess the differences in summertime temperatures between years. Water temperatures (maximum, minimum, and mean) during the overlapping period for both years are shown in Figure 28 and summarized in Table 20. Two-sample t-tests detected no significant difference (*P*>.05) between daily maximum, daily minimum, or daily mean temperatures for 2018 and 2019, suggesting that water temperatures in 2018 in the Raft River were not dissimilar to 2019. Further, a two-sample t-test performed on the twice-hourly measurements (n=5,760) for the sampling period was also unable to detect any significant difference between 2018 and 2019. During 2018, daytime temperatures peaked above the temperature (24.2°C) demonstrated to cause stress in BCT (Schrank et al 2003); however, those temperatures were not sustained longer than a few hours, even on the warmest day, rather during nighttime periods temperatures decreased to more suitable levels.

Table 20. Summary of water temperature data for the Raft River, 2018 and 2019.

Year	Dates	Maximum Temp		Minimum Temp		Max Daily Mean		Mean Daily
		°C (°F)	Date	°C (°F)	Date	°C (°F)	Date	Mean
2019	Jun 27-Oct 23	22.5 (72.5)	Jul 22	2.9 (37.3)	Oct 20	19.6 (67.3)	Aug 6	15.0 (59.0)
2018	Jun 27-Oct 23	25.1 (77.2)	Jul 10	2.5 (36.5)	Oct 15	22.1 (71.7)	Jul 10	15.5 (59.9)

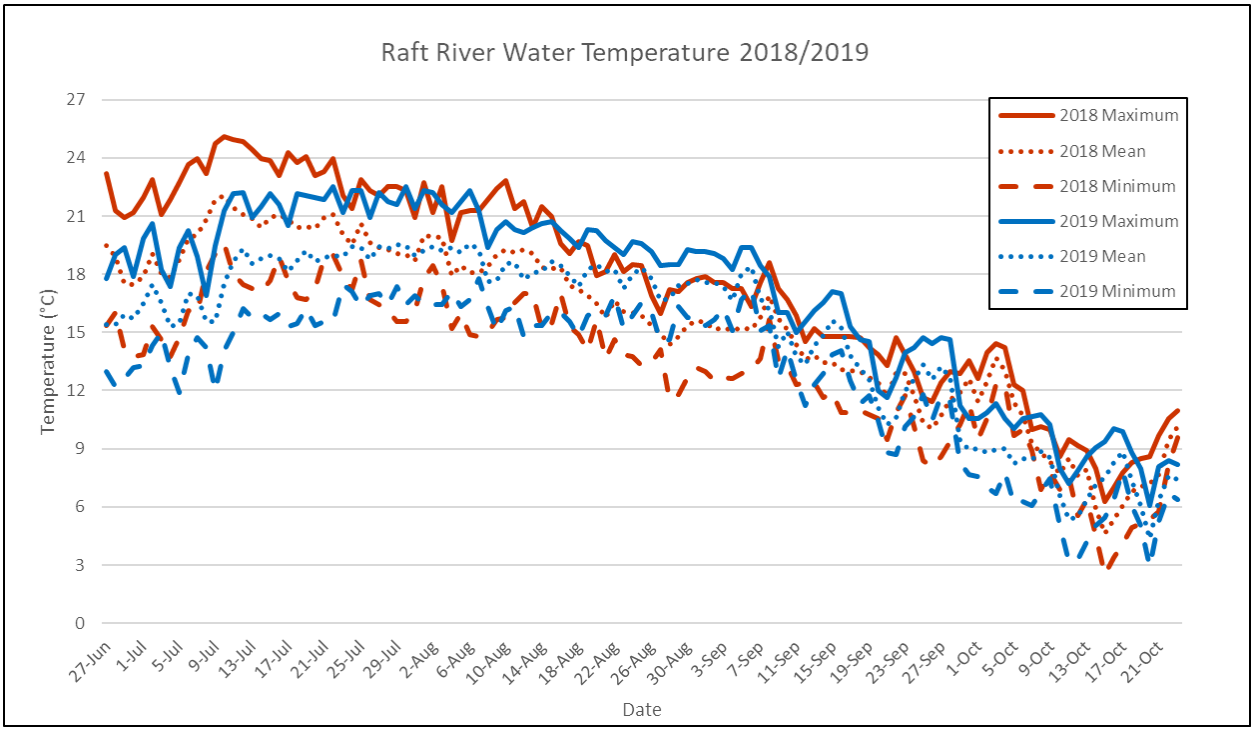

Figure 28. Water temperature data for the Raft River, June 27-October 23, 2018 and 2019.

Johnson Creek **IIIAA030A**

Monitoring

This station, 100 m in length, was electrofished on August 8, 2019, in an effort to assess the status of the YCT population. Results of this and previous samplings are shown in Table 21 and Figure 29. In 2012, this monitoring station contained an extraordinarily high density of BKT and very few YCT (Table 21). In 2013 and 2014, Johnson Creek was treated with rotenone to remove BKT from the drainage. The monitoring station contained no YCT in 2016 and only one in 2017 (Table 21). However, the YCT population in this reach shows evidence of becoming established (Table 21), with multiple age-classes occupying the station (Figure 29).

Table 21. Population statistics for species sampled in Johnson Creek, 2001, 2006, 2012, 2016, 2017, and 2019.

Year	Species	Total Catch	**#/km** ± 95% C.I. (**#/mi** ± 95% C.I.)	kg/ha (lb/ac)	TL (mm)		WT (g)		Mean K
					Mean	Range	Mean	Range	
2019	≥age-1 YCT	31	317±22 (510±36)	49 (44)	129	78-289	30	5-286	0.94
	SC		abundant						
2017	≥age-1 YCT	1	10±0 (16±0)	10 (9)	282		253		1.13
	SC		sparse						
2016	BHS		sparse						
	SC		sparse						
2012	≥age-1 YCT	4	38±0 (61±0)	34 (31)	254	200-289	161	74-254	0.93
	≥age-1 BKT	137	1322±32 (2127±51)	470 (420)	147	67-318	63	3-307	1.02
	age-0 BKT	63	653±83 (1051±134)	8 (7)	58	37-66	2	1-3	
	SC		abundant						
2006	≥age-1 BKT	26	280±28 (451±46)	128 (114)	195	106-301	96	10-321	1.22
	SC		common						
2001	≥age-1 YCT	7	68±0 (109±0)	13 (12)	145	90-200	40	8-83	1.10
	≥age-1 BKT	74	557±19 (899±31)	111 (99)	145	65-256	40	1-196	1.06
	age-0 BKT	5			43	40-47			

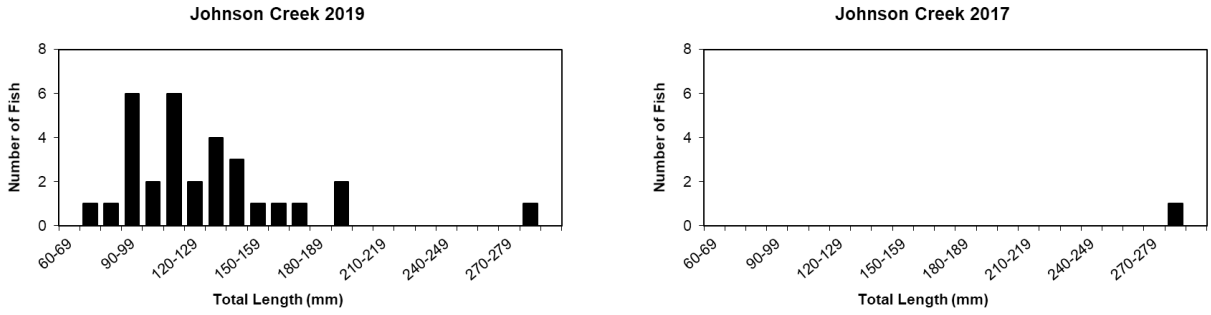

Figure 29. Size distribution of Yellowstone Cutthroat Trout sampled in Johnson Creek, 2017 and 2019.

RECOMMENDATIONS

BONNEVILLE CUTTHROAT TROUT

Surveys
The majority of surveys to determine BCT distribution in the Northern Region have been completed. Small, un-surveyed streams/stream reaches may be discovered and additional work would be required to determine BCT distribution within them.

Monitoring
Overall, BCT populations monitored in 2019 showed some variation in numbers compared to previous surveys, some populations up in number, some down, and some flat. Overall, populations appeared to be stable, with consistent recruitment indicated by multiple age-classes in most of the samples.

As noted for some streams surveyed twice during 2008 (see McKell and Thompson 2009), timing of surveys or monitoring may produce varying results—results that may not accurately characterize the long-term status of a population. Unless monitoring is conducted during the same month in the field season as the previous survey, the results may reflect seasonal variation instead of actual trends. Tracking trends is ultimately the purpose of monitoring, which is an important part of efforts to conserve native trout. Monitoring should continue as populations of BCT representative of each GMU/subunit are revisited on an approximate five-year cycle. Specifically for 2020, monitoring is planned for Chalk Creek and its tributaries, Mill Creek in the upper Bear River drainage, and tributaries of Causey Reservoir.

Efforts toward increasing our understanding of the fluvial BCT population in the lower Weber River and tributaries should continue, including additional electrofishing and PIT-tagging, and antenna deployment in select tributaries where passage is being restored.

Restoration
Opportunities for BCT expansion and enhancement, including barrier construction and chemical treatments, will continue to be explored on an opportunistic basis. Finalization of the EA in August 2012 (USFWS 2012) signaled the commencement of treatment project implementation in 2012 in the Right Hand Fork of Logan River, continued with the second chemical treatment of the Right Hand Fork in September 2013 and stocking of BCT fingerling (produced from Temple Fork gametes) in October 2013 and September 2014, and the small-scale chemical treatment between the barriers in 2015. The chemical treatment of the Otter Creek drainage in Rich County was initiated with the first treatment in September 2015, continued with the second treatment in October 2016, and reintroduction of BCT in October 2016. The first treatment of Big Creek was conducted in September 2018 and the second in September 2019; salvaged BCT were restocked in its primary tributary Randolph Creek following the treatment. The chemical treatment of Deadman Creek in the upper Bear River drainage is anticipated for 2020.

Identifying opportunities to repatriate fishless streams along the Wasatch Front should continue to be a priority. This will add to cutthroat trout reintroduction efforts for Holmes and Willard creeks in 2011 and 2012, Mill and Steed creeks in 2013 and 2014, upper Willard Creek and Stone Creek in 2015, upper Stone Creek in 2016, Ricks, Barnard, and Stone creeks in 2017, North Fork Kays Creek in 2018, and Mill, Stone, Barnard, Ricks, and Holmes creeks in 2019. Opportunities that should be explored further include the headwater portions of Barnard, Ricks, and Parrish creeks in Davis County, and Waterfall and Beus canyons in Weber County.

Brood Development
The priority for BCT brood development in Northern Utah is for the Weber River Drainage. An opportunity may yet be available in Heiners Canyon and should be explored further in 2020. Although water quality (DO) appears questionable in Pond #3 for parts of the winter, there are likely features of the pond (e.g., subsurface spring inputs) that make it habitable for trout, since rainbow trout stocked in the pond survive from year to year. Water temperatures were sufficient to support trout. A streamside spawn in Chalk Creek was attempted in the spring of 2019 but was unsuccessful due to low numbers of spawning BCT. An alternate source needs to identified and pursued, with progeny from successful spawning efforts subsequently stocked into Heiners Pond #3, followed by evaluation of growth and survival.

In the absence of a brood population, selection of an appropriate source of fish or eggs for specific projects in the Northern Region will be determined on a case-by-case basis. This process was successfully followed for the Otter Creek project in 2016.

COLORADO RIVER CUTTHROAT TROUT

Surveys
Colorado River cutthroat trout surveys have essentially been completed in the Northern Region. However, small, un-surveyed streams/stream reaches may be discovered and would require additional surveys to determine Colorado River cutthroat trout distribution within them.

Monitoring
Populations monitored in the West Fork Smiths Fork in 2019 showed some variation in abundance since 2014, two populations decreasing, one increasing, and one remaining flat. The monitoring of CRCT populations should follow the timeline established by the UDWR and USFS. Monitoring should remain a high priority. No monitoring is scheduled for 2020.

Restoration
Opportunities for CRCT expansion and enhancement, including the tentative 2021 chemical treatment of the West Fork Smiths Fork drainage, should continue to be explored in 2020.

YELLOWSTONE CUTTHROAT TROUT

Surveys
Surveys to determine YCT distribution in the Northern Region have been completed. However, small, un-surveyed streams/stream reaches may be discovered and would require additional surveys to determine YCT distribution within them.

Monitoring
Monitoring of YCT and other fish populations in the Raft River drainage was completed in 2019 in Johnson Creek only. The estimated size of the YCT population was much higher than the 2017 estimate, indicating that the lower portions of Johnson Creek are being recolonized by YCT upstream. Monitoring of YCT in Utah remains a high priority.

Restoration Evaluation
In conjunction with YCT monitoring, the three stations in the Johnson Creek drainage were evaluated in the light of restoration efforts completed in August 2014. Numbers in lower Johnson Creek appear to be building, as stated above.

Additional opportunities for YCT expansion and enhancement, including the potential chemical treatment of George Creek, will be explored where appropriate.

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