State of Utah
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Division of Wildlife Resources

Native Cutthroat Trout (*Oncorhynchus clarkii* ssp.) Conservation Activities in the Northern Region, 2020

Publication Number 21-01

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

Rory Reynolds, Director

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by

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TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

ACKNOWLEDGMENTS

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INTRODUCTION

BONNEVILLE CUTTHROAT TROUT (*Oncorhynchus clarkii utah*)

The Bonneville Cutthroat Trout (BCT) conservation activities by the UDWR Ogden Office in 2020 included population monitoring in the Mill Creek drainage in the Bear River GMU, population monitoring in the Chalk Creek drainage in the Weber River subunit in the Northern Bonneville GMU, collection of samples for genetic analysis, stocking of BCT into Big Creek, and the rotenone treatment of Deadman Creek in Summit County. Activities conducted during 2020 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 2020 included population monitoring in Steel Creek, 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*)

Yellowstone Cutthroat Trout (YCT) conservation work in 2020 was limited to marking YCT downstream of an irrigation diversion slated for modification to allow fish passage. As with the other cutthroat trout subspecies, conservation activities involving YCT 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 125 people days were required to complete the native cutthroat trout fieldwork in the Northern Region during 2020.

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 or Halltech, 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 six personnel were utilized on electrofishing surveys. Electrofishing settings varied depending on stream conductivity. In general, the frequency was set at 60 Hz and the voltage at 250-350V when using a Halltech HT-2000, 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 is

generally 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 2020 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.

Monitoring
Multiple-pass electrofishing was completed on 14 streams/sections during 2020 BCT monitoring efforts (Table 1). Three of the monitored populations appeared to have increased since the previous survey, seven showed a decline, and four remained essentially flat.

Fish species encountered during stream sampling in 2020 included BCT, Brook Trout (BKT; *Salvelinus fontinalis*), Longnose Dace (LND; *Rhinichthys cataractae*), Mountain Sucker (MTS; *Catostomus platyrhynchus*), Northern Leatherside Chub (NLSC; *Lepidomeda copei*), Redside Shiner (RSS; *Richardsonius balteatus*), sculpin (SC; *Cottus* spp.), and Speckled Dace (SPD; *Rhinichthys osculus*). In addition, Northern Leopard Frogs (NLF; *Lithobates pipiens*) were observed during the sampling of Chalk Creek.

Chemical Reclamation
During 2020, the UDWR, in coordination with personnel from Trout Unlimited (TU) and USFS, completed the chemical treatment of the Deadman Creek drainage in Summit County.

Table 1. Results of BCT population monitoring in 2020.

Stream/section	Year	# of ≥age-1 BCT/km	# of ≥age-1 BCT/mile
Bear River GMU, Uinta Mountains/Upper Bear River Subunit			
Mill Creek, upper	2020	131 ± 7	211 ± 11
	2017	173 ± 14	279 ± 23
	2011	10 ± 0	16 ± 0
	2008	300 ± 17	483 ± 28
	2005	157 ± 7	253 ± 11
Deadman Creek	2020	31 ± 0	50 ± 0
	2017	56 ± 20	89 ± 33
	2008	30 ± 31	48 ± 49
	2005	57 ± 0	91 ± 0

Table 1.—cont.

Stream/section	Year	# of ≥age-1 BCT/km	# of ≥age-1 BCT/mile
Gold Hill Creek	2020	376 ± 19	606 ± 30
	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
Northern Bonneville GMU, Ogden River Subunit			
North Fork Ogden River, Section 03	2020	650 ± 54	1046 ± 87
	2016	410 ± 3	660 ± 5
	2011	439 ± 34	868 ± 55
	2006	482 ± 10	779 ± 17
	2000	716 ± 87	1153 ± 140
Northern Bonneville GMU, Weber River Subunit			
Chalk Creek, Section 02 Station 03	2020	63 ± 29	101 ± 46
	2015	160 ± 6	257 ± 10
	1999	174 ± 21	279 ± 33
South Fork Chalk Creek, Station 01	2020	250 ± 4	403 ± 7
	2015	163 ± 15	263 ± 25
	2010	93 ± 33	158 ± 53
	2005	394 ± 34	634 ± 55
	1998	185 ± 91	298 ± 146
South Fork Chalk Creek, Station 02	2020	617 ± 171	993 ± 276
	2015	331 ± 8	533 ± 13
	2010	267 ± 57	430 ± 92
	2005	222 ± 11	358 ± 18
	1999	426 ± 37	685 ± 59
Fish Creek	2020	91 ± 10	147 ± 15
	1998	960 ± 128	1545 ± 206

Table 1.—cont.

Stream/section	Year	# of ≥age-1 BCT/km	# of ≥age-1 BCT/mile
Huff Creek, Station 01	2020	none captured	
	2015	none captured	
	2010	49 ± 0	79 ± 0
	2005	none captured	
	1999	163 ± 15	263 ± 25
Huff Creek, Station 02	2020	11 ± 0	17 ± 0
	2015	none captured	
	2010	350 ± 29	564 ± 46
	2005	10 ± 0	16 ± 0
	1999	418 ± 57	672 ± 92
East Fork Chalk Creek, Station 01	2020	262 ± 10	421 ± 16
	2015	331 ± 8	533 ± 13
	2010	267 ± 57	430 ± 92
	2005	222 ± 11	358 ± 18
	1999	426 ± 37	685 ± 59
East Fork Chalk Creek, Station 02	2020	53 ± 19	86 ± 31
	2015	136 ± 25	219 ± 40
	2010	320 ± 880	515 ± 1416
	2005	46 ± 17	74 ± 27
	1999	310 ± 69	499 ± 112
Middle Fork Chalk Creek	2020	98 ± 10	158 ± 17
	2015	263 ± 79	423 ± 128
	2005	500 ± 42	805 ± 68
	1999	154 ± 21	247 ± 33
Mill Fork	2020	47 ± 79	75 ± 127
	2015	197 ± 15	316 ± 23
	2010	295 ± 6	476 ± 10
	1999	143 ± 43	230 ± 70

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 2020 activities may be found in reports prepared by this field station.

BEAR RIVER GMU
Uinta Mountains/Upper Bear River Subunit

Mill Creek IVAQ230

Monitoring

The monitoring station in the upper drainage near the Mill Creek Guard Station was electrofished on August 7, 2020. The station was 100 m in length. BCT were present in moderately low densities in the station (Table 2), with individuals representing multiple age-classes (Figure 1); this was a slight decline in abundance relative to the 2017 sampling (Table 2). Although BKT were sampled in low abundance in 2005 and 2008, none were sampled in any of the three most recent monitoring events.

Table 2. Population statistics for species sampled in the Mill Creek upper monitoring station, 2005, 2008, 2011, 2017, and 2020.

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	
2020	≥age-1 BCT	13	131 ± 7 (211 ± 11)	49 (44)	192	66-356	101	20-397	1.09
2017	≥age-1 BCT	17	173±14 (279±23)	89 (80)	280	167-371	252	45-525	1.04
2011	≥age-1 BCT	1	16±0 (10±0)		97		10		1.05
2008	≥age-1 BCT	30	300±17 (483±28)	67 (59)	164	73-288	60	4-242	1.03
	≥age-1 BKT	2	20±49 (32±79)	3 (3)	145	103-187	47	14-79	1.24
	SC		sparse						
2005	≥age-1 BCT	15	157±7 (253±11)	42 (37)	164	110-238	54	11-143	0.95
	age-0 BCT	5			42	39-45			
	≥age-1 BKT	1	10±0 (17±0)	2 (2)	155		46		1.24

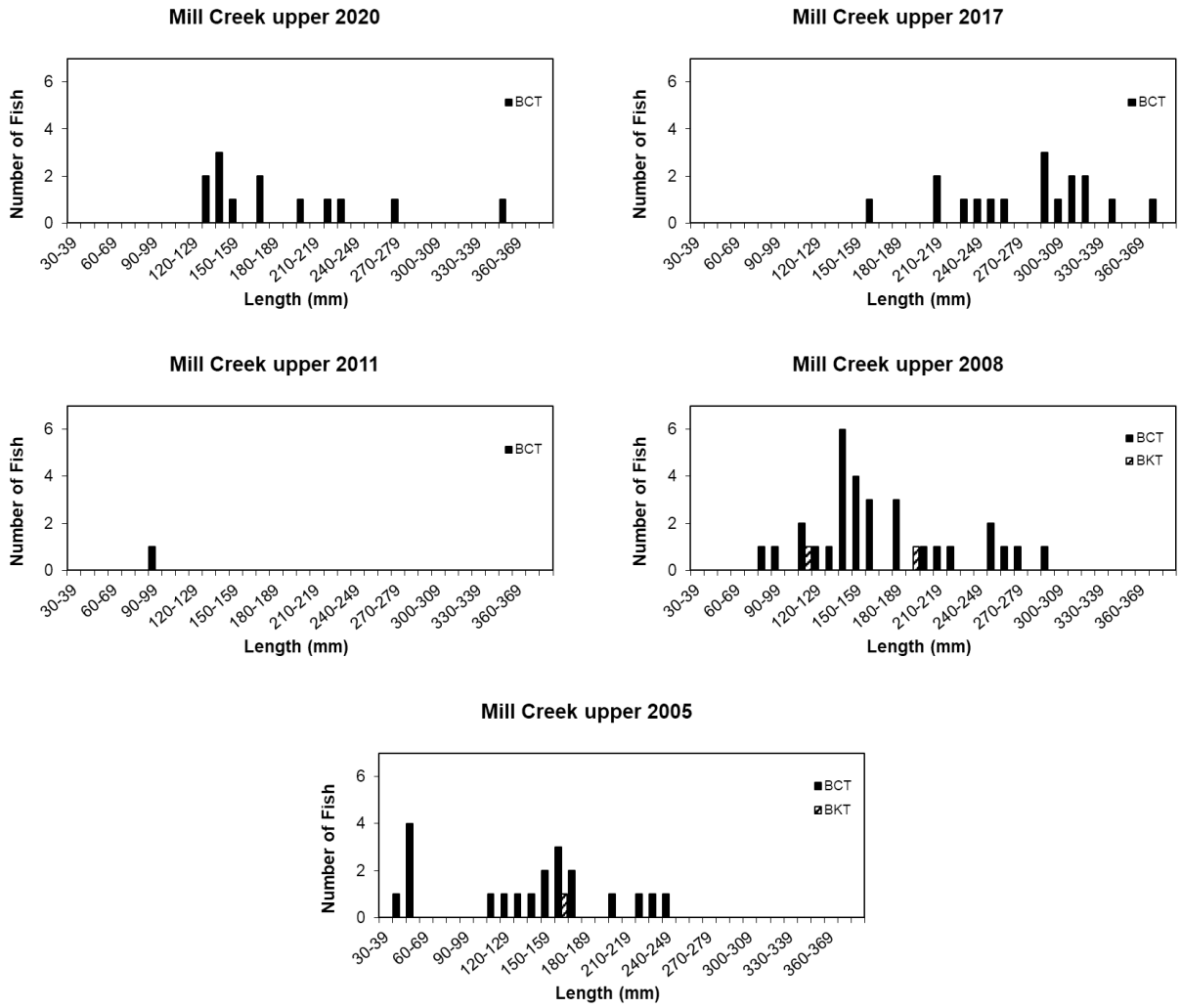

Figure 1. Size distribution of salmonids sampled in the Mill Creek upper monitoring station, 2005, 2008, 2011, 2017, and 2020.

Deadman Creek **IVAQ230B**

Monitoring

The Deadman Creek upper monitoring station, 96 m in length, was electrofished on August 7, 2020. Results of the current and previous samplings are shown in Table 3 and Figure 2. The BCT population at the time of monitoring was represented at low density, as in the past (Table 3). The catch was composed of more than 80% BKT in 2008 but only 40% of the sample in 2020 (Table 3).

Chemical Reclamation

On September 15, 2020, the UDWR, with the assistance of personnel from USFS and TU, conducted a rotenone treatment of the Deadman Creek drainage (including all tributaries) upstream of the Uintalands fishing pond. This treatment covered approximately 3.9 km (2.4 mi) of stream in the mainstem and tributaries. Based on observed responses of fish to rotenone exposure, coupled with post-treatment electrofishing, the treatment was considered a success.

Population Restoration

Prior to the treatment, BCT (as well as MTS, NLSC, and SPD) were salvaged from Deadman Creek and held streamside in a large oxygenated holding tank during the treatment. The salvaged fish were released back into Deadman Creek once the stream had cleared of chemical (i.e. sentinel fish placed in cages in the stream remained unstressed for four hours).

Table 3. Population statistics for species sampled in the Deadman Creek upper monitoring station, 2005, 2008, 2017, and 2020.

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	
2020	≥age-1 BCT	3	31 ± 0 (50 ± 0)	10 (9)	127	121-135	20	17-22	0.97
	≥age-1 BKT	2	21 ± 0 (34 ± 0)	12 (11)	141	112-170	36	13-58	1.05
2017	≥age-1 BCT	5	56±20 (89±33)	10 (9)	102	67-154	17	2-43	1.00
	age-0 BCT	1	10±0 (17±0)		32				
	≥age-1 BKT	1	10±0 (17±0)	10 (9)	198		90		1.16
	age-0 BKT	1			67		4		
2008	≥age-1 BCT	3	30±31 (48±49)	4 (3)	96	73-124	9	3-18	0.87
	≥age-1 BKT	14	140±10 (225±16)	60 (53)	140	103-188	31	11-68	0.99
	age-0 BKT	1	10±0 (16±0)		53		1		
2005	≥age-1 BCT	6	57±0 (91±0)	6 (5)	103	91-115	13	9-20	1.14
	≥age-1 BKT	4	38±0 (61±0)		141	129-159	31	23-39	1.11
	age-0 BKT	1	9±0 (15±0)	10 (9)	64		5		

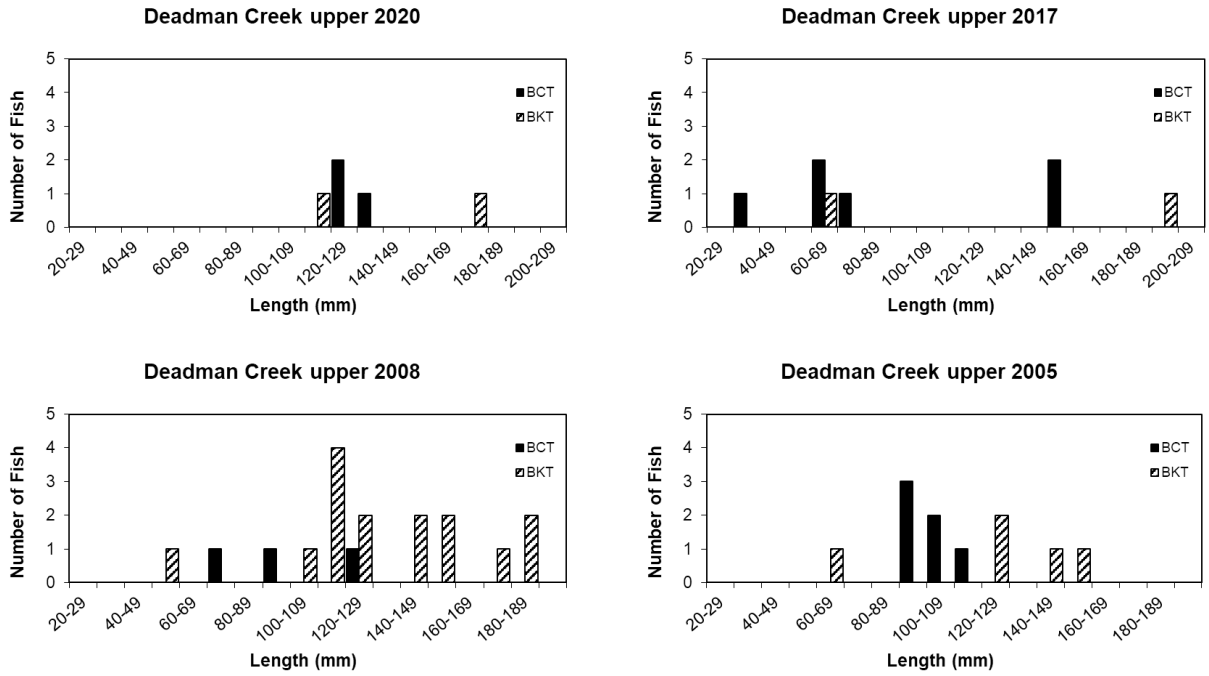

Figure 2. Size distribution of salmonids sampled in the Deadman Creek upper monitoring station, 2005, 2008, 2017, and 2020.

Gold Hill Creek **IVAQ270A**

Monitoring

The 2020 monitoring station, 199 m in length, was electrofished on August 5, 2020. This was a NLSC reintroduction site in 2010 and has been sampled annually since then (Table 4, Figure 3, Figure 4). Based on 11 data points for the Gold Hill monitoring station, the BCT population has experienced fluctuations but maintained fairly high densities (Table 4 and Figure 3), with 2020 showing a slight decline from 2019, following a 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 4). NLSC were abundant in the station during 2010, absent in 2011, sparse in 2012-2015, and absent again in 2016-2020 (Table 4).

Table 4. Population statistics for species sampled in Gold Hill Creek, 2010-2020.

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	
2020	≥age-1 BCT	73	376±19 (606±30)	34 (31)	118	54-237	24	1-126	0.85
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)	24 (21)	110 27	62-232 27-27	21	1-124	0.86

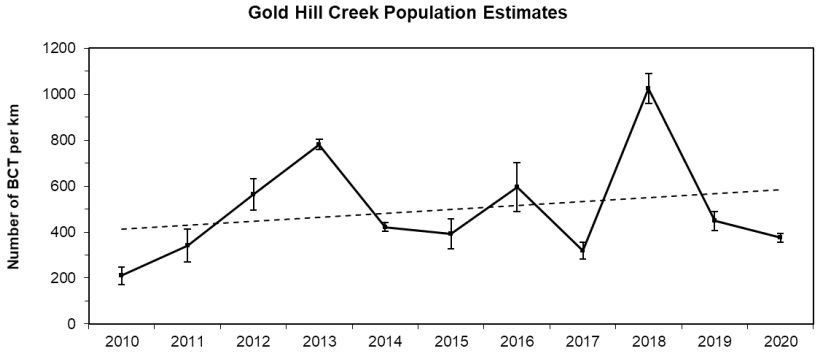

Figure 3. Population estimates for BCT in Gold Hill Creek by year sampled, 2010-2020. Error bars show the 95% confidence interval for each estimate.

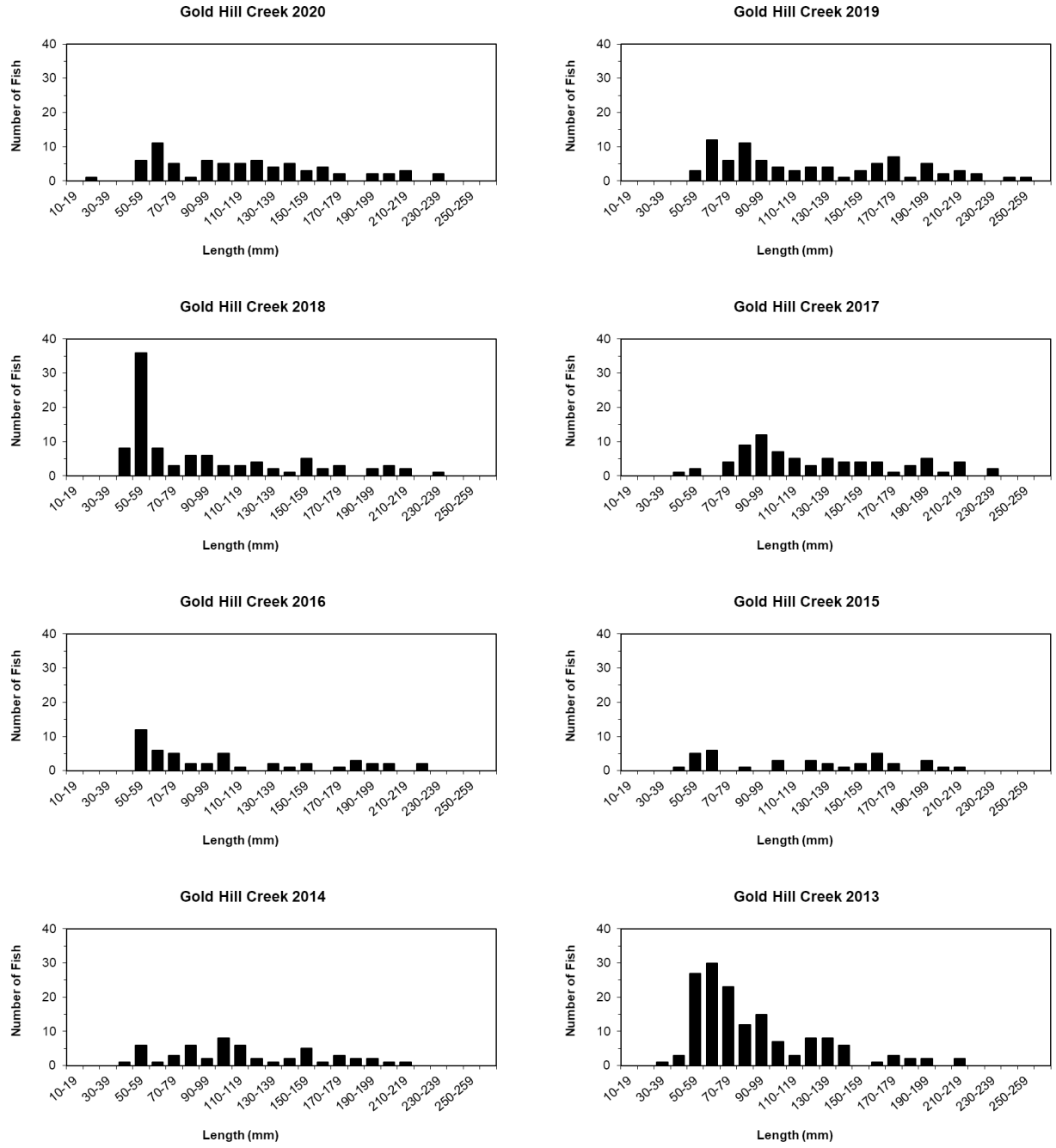

Figure 4. Size distribution of BCT sampled in Gold Hill Creek, 2013-2020.

Rich County Subunit

Big Creek — IVAQ190

Chemical Reclamation

During the second treatment of Big Creek in 2019, a few dozen small BKT were observed in a 3.9 km (2.4 mi) reach of the stream, indicating the 2018 treatment did not result in a complete removal of BKT. The best habitat (1.5 km [0.9 mi]) in the reach, found within a BLM riparian exclosure where the majority of the BKT were observed during the treatment, was electrofished on October 4, 2019; no BKT were found during that effort. However, electrofishing on July 2, 2020, in 1.8 km (1.1 mi) of stream further upstream near a complex of springs where BKT had been found during the treatment resulted in the capture and removal of three BKT (207 mm mean TL); only the largest, a 243 mm male, appeared to be sexually mature.

Population Restoration

Cutthroat trout produced from the Bear Lake brood source at Mantua Hatchery were stocked into Big Creek on two occasions during 2020: on July 20, approximately 300 with a mean TL of 340 mm, and approximately 500 with a mean TL of 250 mm on August 3.

NORTHERN BONNEVILLE GMU
Ogden River Subunit

North Fork Ogden River — IVAP030D

Monitoring

The monitoring station in the North Fork section 03 was electrofished on August 6, 2020. The station was 100 m in length. Results of this and the previous surveys are shown in Table 5 and Figure 5. Based on five data points, the BCT population is maintaining at moderately high densities, increasing slightly since 2016 (Table 5). Two noticeable changes in the population are a decrease in estimated biomass and apparent truncation of the age (size) structure exhibited by fewer larger individuals and increased recruitment among the age-1 cohort (Figure 5). One obvious habitat change in the station, which likely accounts for the lack of large individuals in the sample, was the disappearance of a beaver dam and its associated pool habitat between 2016 and 2020. Sculpin were again abundant in the sampled reach.

Table 5. Population statistics for species sampled in North Fork Ogden River section 03, 2000, 2006, 2011, 2016, and 2020.

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	
2020	≥age-1 BCT age-0 BCT SC	62 5 140	650±54 (1046±87) present abundant	47 (42)	118 43	73-195 42-44	19 1	4-70	0.97
2016	≥age-1 BCT age-0 BCT SC	41 4 95	410±3 (660±5) present abundant	83 (74)	179 36	80-266 30-39	69	6-219	0.99
2011	≥age-1 BCT age-0 BCT SC	55 13	539±34 (868±55) 128±18 (206±29) common	74 (66)	162 59	88-300 47-67	54 2	6-278 1-3	0.95 0.76

Table 5.—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	
2006	≥age-1 BCT age-0 BCT SC	48	482±10 (776±17) present common	74 (66)	172	75-391	73	4-478	1.03
2000	≥age-1 BCT age-0 BCT SC	45 18	716±87 (1153±140) 358±248 (576±399) abundant	81 (73)	147 43	60-275 36-49	45 1	2-222 1-2	0.99 1.36

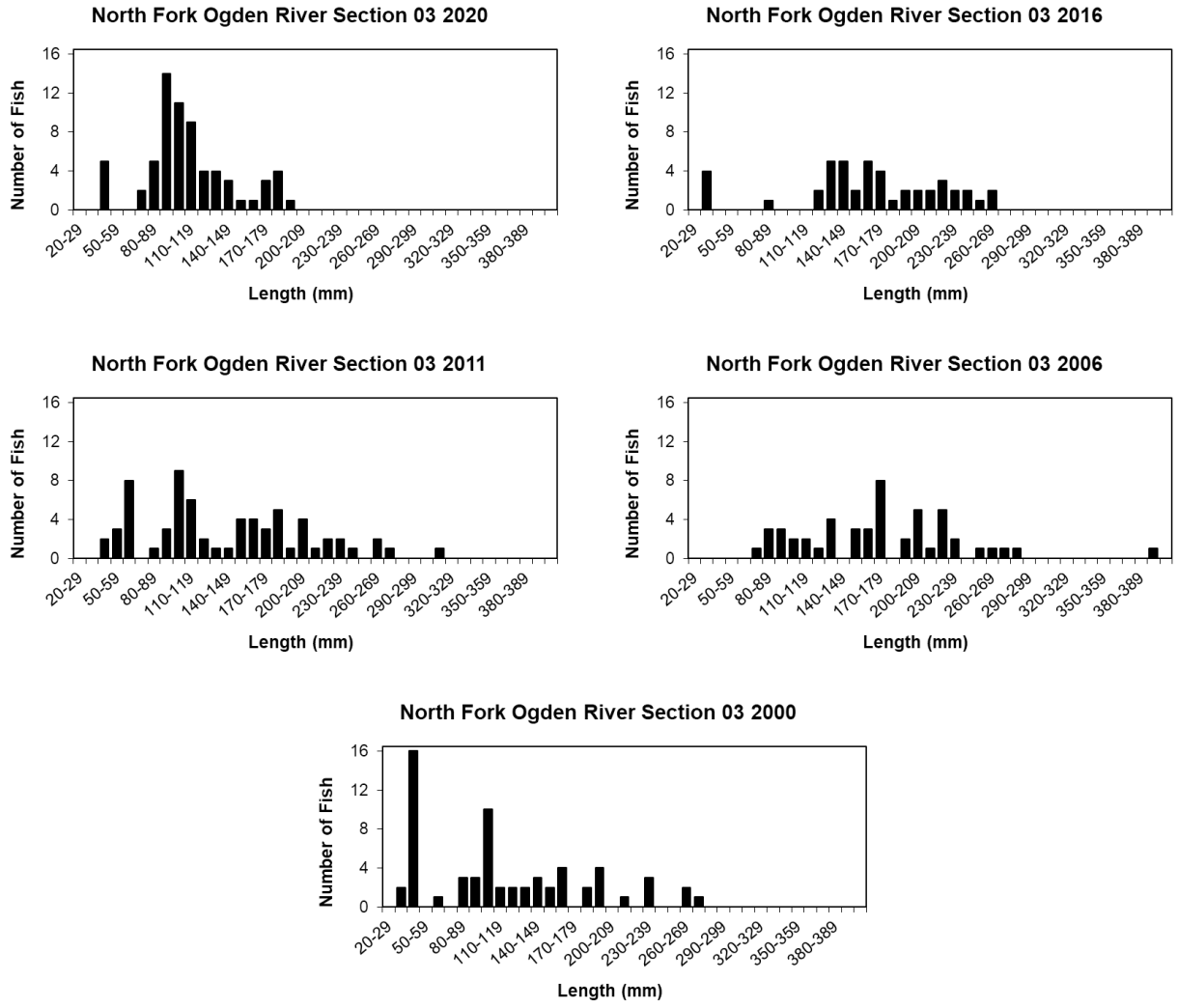

Figure 5. Size distribution of salmonid species sampled in the North Fork Ogden River Section 03 monitoring station, 2000, 2006, 2011, 2016, and 2020.

Weber River Subunit

Chalk Creek IVAP230

Monitoring

The upper monitoring station (Station 03) in Chalk Creek section 02 was electrofished on July 23, 2020. The station was 144 m in length. Results of this and the previous surveys are shown in Table 6 and Figure 6. Based on three data points, the BCT population has experienced a decrease in density at this site, declining by 60% since 2015 (Table 6). The estimated biomass also appears to have declined by the same proportion (Table 6), while the same range of size-classes was represented (Figure 6), albeit by fewer individuals. The numbers of each of the nongame species also generally decreased between 2015 and 2020 (Table 6).

Table 6. Population statistics for species sampled in Chalk Creek Section 02 Station 03, 1999, 2015, and 2020.

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	
2020	≥age-1 BCT	8	63±29 (101±46)	13 (12)	213	107-327	141	12-332	1.05
	LND	205							
	MTS	37							
	RSS	24							
	SPD	59							
	SC	117							
2015	≥age-1 BCT	26	160±6 (257±10)	33 (30)	224	114-335	127	15-374	0.91
	LND	335							
	MTS	65							
	RSS	27							
	SPD	48							
	UTS	1							
	SC	170							
1999	≥age-1 BCT	33	174±21 (279±33)	31 (27)	234	114-364	154	16-463	0.98
	LND	6							
	MTS	26							
	SPD	1							
	SC	63							

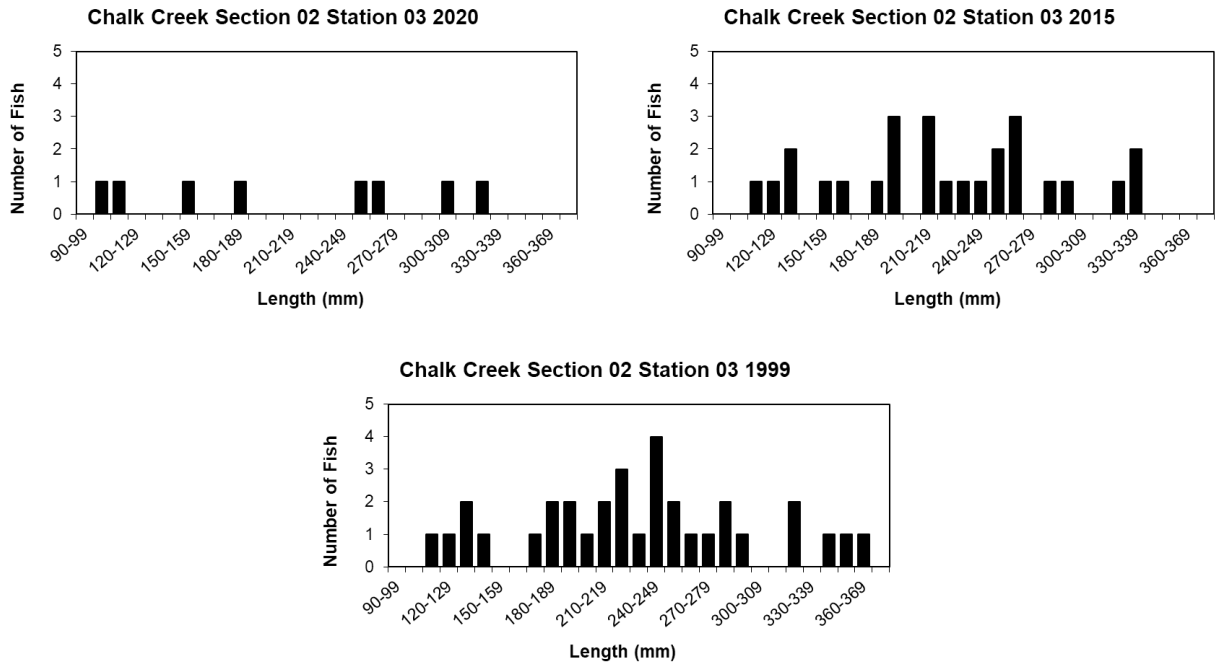

Figure 6. Size distribution of BCT sampled in the Chalk Creek Section 02 Station 03 monitoring station, 1999, 2015, and 2020.

South Fork Chalk Creek **IVAP230D**

Monitoring

Two stations in South Fork Chalk Creek were monitored in 2020, one just downstream of Fish Creek (Station 01) and the other below the ponds in the upper reaches (Station 02). Both stations were 100 m in length; Station 01 was electrofished on August 27, and Station 02 was electrofished on July 27, 2020. Both stations were monitored previously in 2005, 2010, and 2015 (McKell 2016).

Station 01

The fish community in this station was comprised of a moderate population of BCT and five species of native nongame fish (Table 7). The BCT population exhibited greater density numerically but slightly lower biomass relative to the 2015 and 2010 surveys (Table 7). The length-frequency histograms for all sampling events show multiple size-classes of BCT, with fewer size-classes represented in 2020; however, 2020 had strong age-0 and age-1 cohorts (Figure 7). Presence of age-0 BCT in 2020 but not in previous samples is the result of sampling later in 2020.

Station 02

The fish community was comprised of a large population of BCT and sculpin (Table 7). The BCT population exhibited its highest density of any sampling of the South Fork, while the biomass estimate was among the lowest observed for this station (Table 7). The length-frequency histograms for all prior sampling events at this station show a similar range of size-classes of Bonneville Cutthroat Trout and a well-represented age-1 cohort, and while the range of size-classes decreased in 2020, the age-1 cohort was stronger than ever (Figure 8).

Table 7. Population statistics for species sampled in South Fork Chalk Creek, 1998, 1999, 2005, 2010, 2015, and 2020.

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	
Station 01									
2020	≥age-1 BCT	25	250±4 (403±7)	20 (18)	140	112-178	24	11-47	0.82
	age-0 BCT	24	242±11 (389±17)		58	45-68	2	1-3	
	LND	29	common						
	MTS	17	common						
	RSS	7	sparse						
	SC	350	abundant						
	SPD	141	abundant						
2015	≥age-1 BCT	16	163±15 (263±25)	23 (21)	168	122-310	46	16-247	0.80
	LND	83	abundant						
	MTS	14	common						
	SC	240	abundant						
	SPD	33	common						
2010	≥age-1 BCT	9	98±33 (158±53)	27 (24)	229	119-313	125	18-246	0.89
	LND		sparse						
	MTS		sparse						
	SC		abundant						
	SPD		sparse						
2005	≥age-1 BCT	38	394±34 (634±55)	57 (51)	165	102-282	53	10-240	0.96
	MTS		sparse						
	SC		abundant						
	SPD		sparse						
1998	≥age-1 BCT	14	185±91 (298±146)	12 (10)	152	87-210	42	6-81	1.07
	LND		sparse						
	MTS		sparse						
	SC		common						
	SPD		sparse						
Station 02									
2020	≥age-1 BCT	51	617±171 (993±276)	34 (30)	112	78-208	16	4-101	0.97
	SC	22	common						
2015	≥age-1 BCT	33	331±8 (533±13)	47 (42)	150	95-234	43	7-130	0.97
	age-0 BCT	1	10±0 (16±0)		41				
	SC	2	sparse						
2010	≥age-1 BCT	26	267±57 (430±92)	31 (27)	136	51-283	47	1-228	1.05
	SC		abundant						
2005	≥age-1 BCT	22	222±11 (358±18)	35 (31)	176	86-262	70	8-194	1.05
	SC		sparse						
1999	≥age-1 BCT	43	426±37 (685±59)	61 (55)	154	76-290	58	5-209	1.16
	SC		sparse						

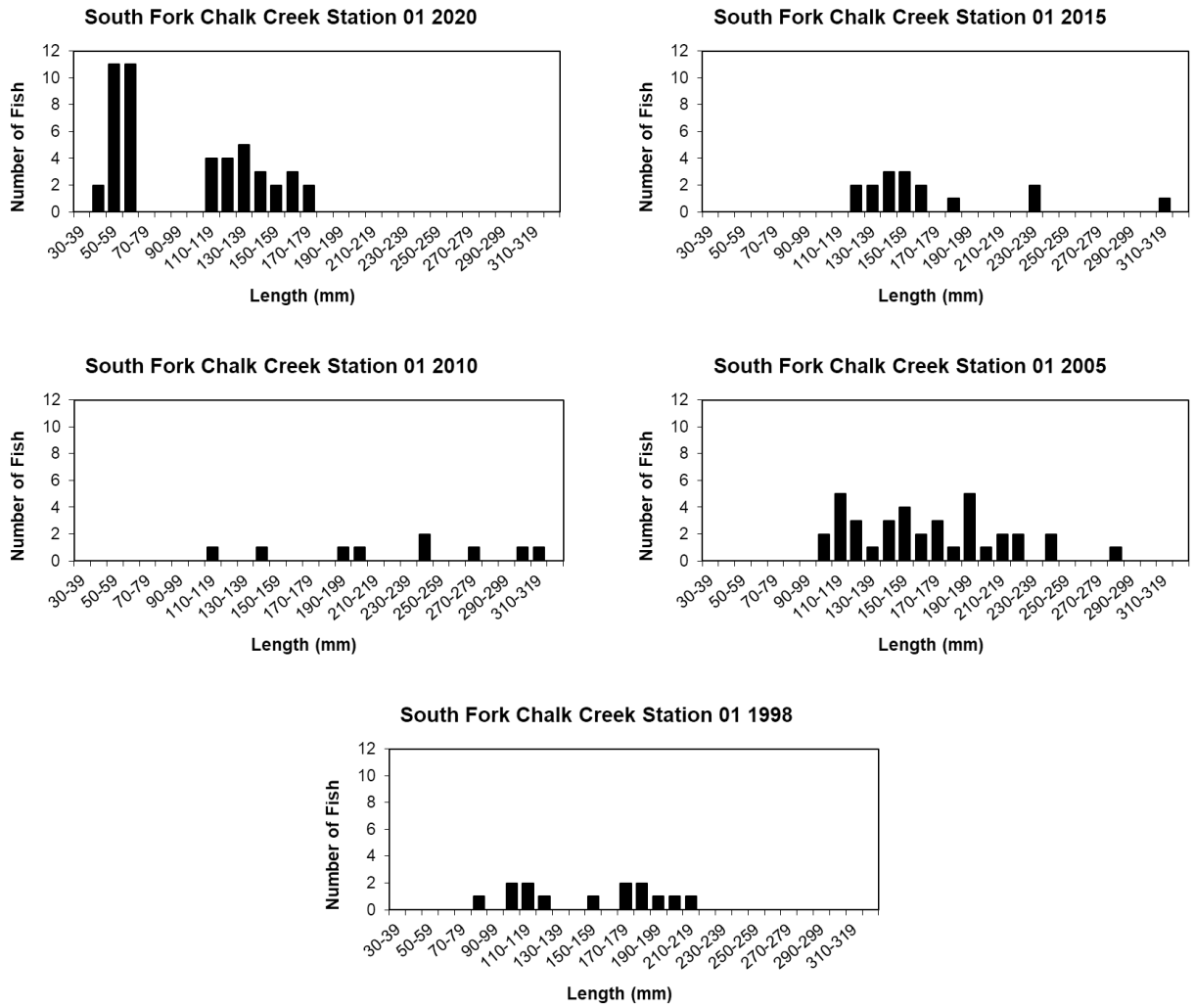

Figure 7. Size distribution of BCT sampled in the South Fork Chalk Creek Station 01 monitoring station, 1998, 2005, 2010, 2015, and 2020.

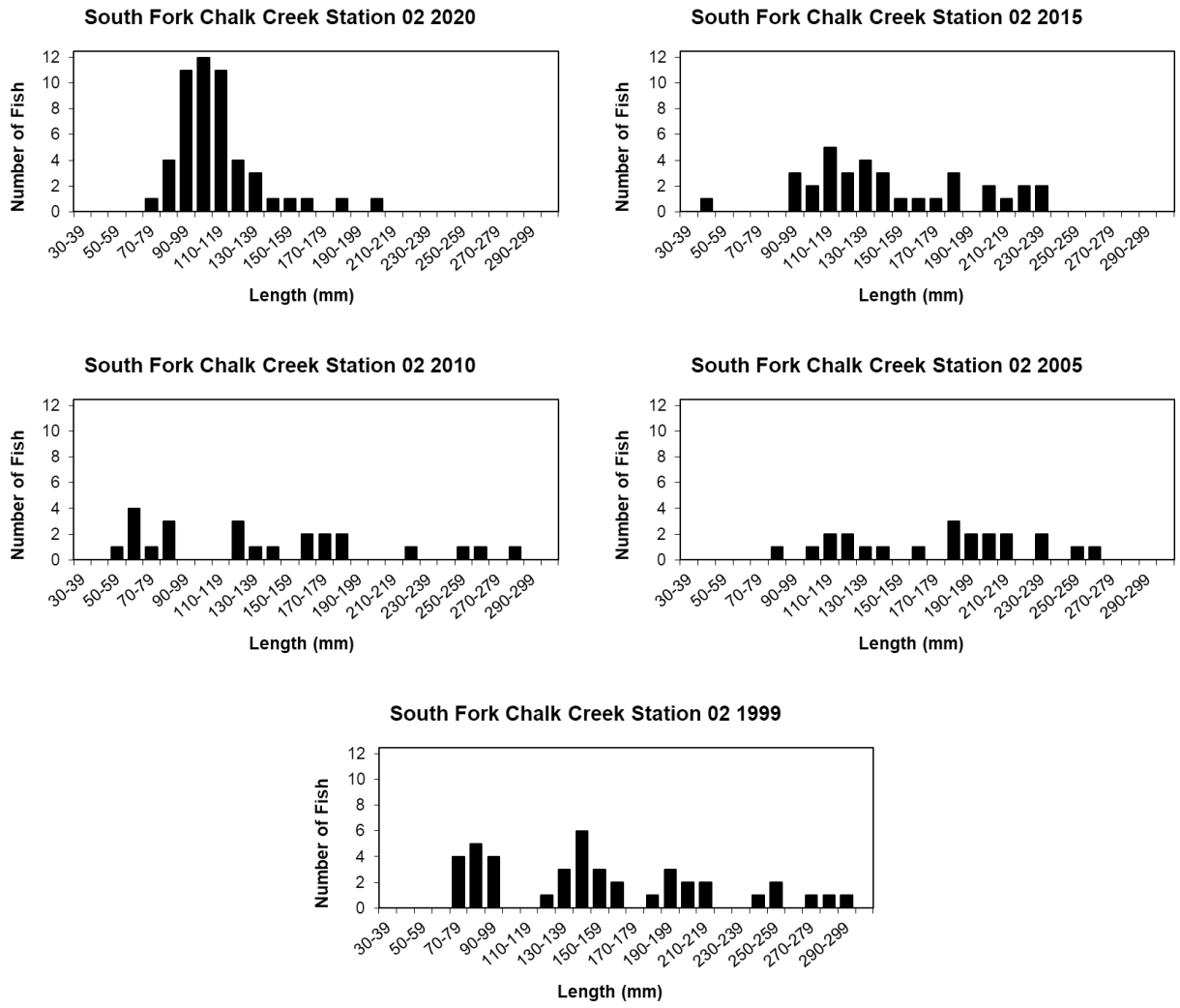

Figure 8. Size distribution of BCT sampled in the South Fork Chalk Creek Station 02 monitoring station, 1999, 2005, 2010, 2015, and 2020.

Fish Creek **IVAP230D05**

Monitoring

This station was monitored in 2020 for the first time since its initial survey in 1998. The station was 100 m in length and was electrofished on July 27, 2020. The fish community was comprised of a small population of BCT and sculpin (Table 8). The BCT population estimate in 1998 was an order of magnitude greater than the estimate for 2020 (Table 8). The length-frequency histogram for 2020 suggests there were up to three age-classes, all of them limited in abundance (Figure 9), while in 1998 there were likely four or more age-classes represented, including an age-0 cohort, although sampling that year occurred in late September.

Table 8. Population statistics for species sampled in South Fork Chalk Creek, 1998 and 2020.

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	
2020	≥age-1 BCT	9	91±10 (147±15)	14 (12)	142	85-217	39	7-91	1.02
	SC	27	common						
1998	≥age-1 BCT		960±128 (1545±206)	128	156 56		42 1		0.87
	age-0 BCT	67	973±459 (1566±738)						
	SC	17	common						

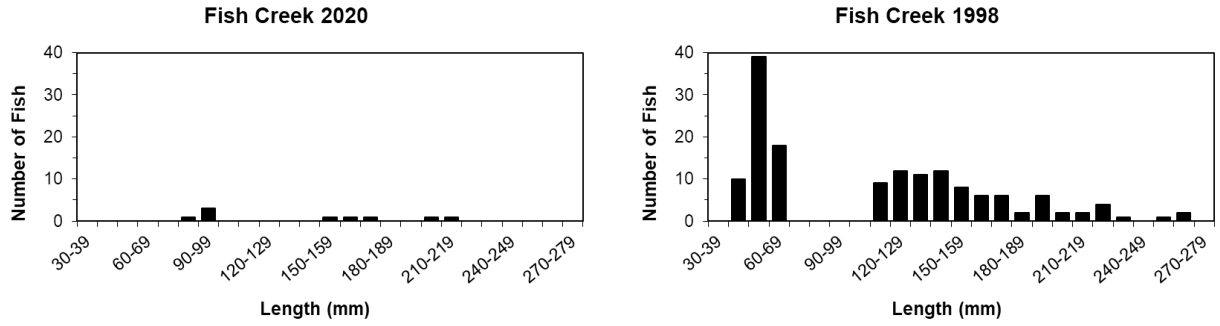

Figure 9. Size distribution of BCT sampled in the Fish Creek monitoring station, 1998 and 2020.

Huff Creek **IVAP230H**

Monitoring

Two stations in Huff Creek were monitored in 2020, one in the lower half of the drainage (Station 01) and the other in the upper reaches (Station 02). Both stations were electrofished on July 23, 2020, and both were monitored previously in 2005, 2010, and 2015 (McKell 2016).

Station 01

The fish community in this station was comprised of four species of native non-game fish (Table 9). The reach in which this station lies is just downstream of a portion of Huff Creek that exhibits conditions less suited to cutthroat trout than non-game native fishes. Although BCT were observed during the 2010 and 1999 sampling events, they appear to be transient occupants in the reach, or may occur in small, localized pockets where habitat conditions are adequate.

Station 02

This station was 92 m in length. The fish community experienced an abrupt change after 2015, with a sharp increase in MTS abundance, although other segments of the community appear to be suppressed in the reach, with only a single BCT and two SPD observed in 2020 (Table 9). The single BCT individual sampled in 2020 was likely a sub-adult (Figure 10). The BCT population exhibited a sharp decline after 2010, and no BCT were sampled in 2015 (Table 9). Spot electrofishing upstream and downstream of the station in 2015 verified BCT were still present but in very low numbers (McKell 2016). The reasons for the decline, as noted in the

previous report, are most likely related to changes in habitat and flow patterns associated with extensive beaver activity in the vicinity and a resulting loss of spawning habitat. These habitat conditions were also noted in 2020.

Table 9. Population statistics for species sampled in Huff Creek, 1999, 2005, 2010, 2015, and 2020.

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	
Station 01									
2020	MTS RSS SC SPD	9 155 3 51	sparse abundant sparse abundant						
2015	MTS RSS SPD	27 335 105	common abundant abundant						
2010	≥age-1 BCT MTS SPD	6	49±0 (79±0) common sparse	5 (4)	190	132-322	112	30-345	1.28
2005	MTS		abundant						
1999	≥age-1 BCT MTS SC	16	163±15 (263±25) sparse common	7 (6)	190	122-308	94	35-253	1.42
Station 02									
2020	≥age-1 BCT MTS SPD	1 141 2	11±0 (17±0) abundant sparse	1 (1)	143		21		0.72
2015	SPD	1	sparse						
2010	≥age-1 BCT	43	438±22 (704±36)	96 (86)	154	67-289	52	5-235	1.08
2005	≥age-1 BCT MTS	1	10±0 (16±0) common	1 (1)	135		28		1.14
1999	≥age-1 BCT MTS	39	418±57 (672±92) common	128 (114)	170	89-259	80	11-210	1.11

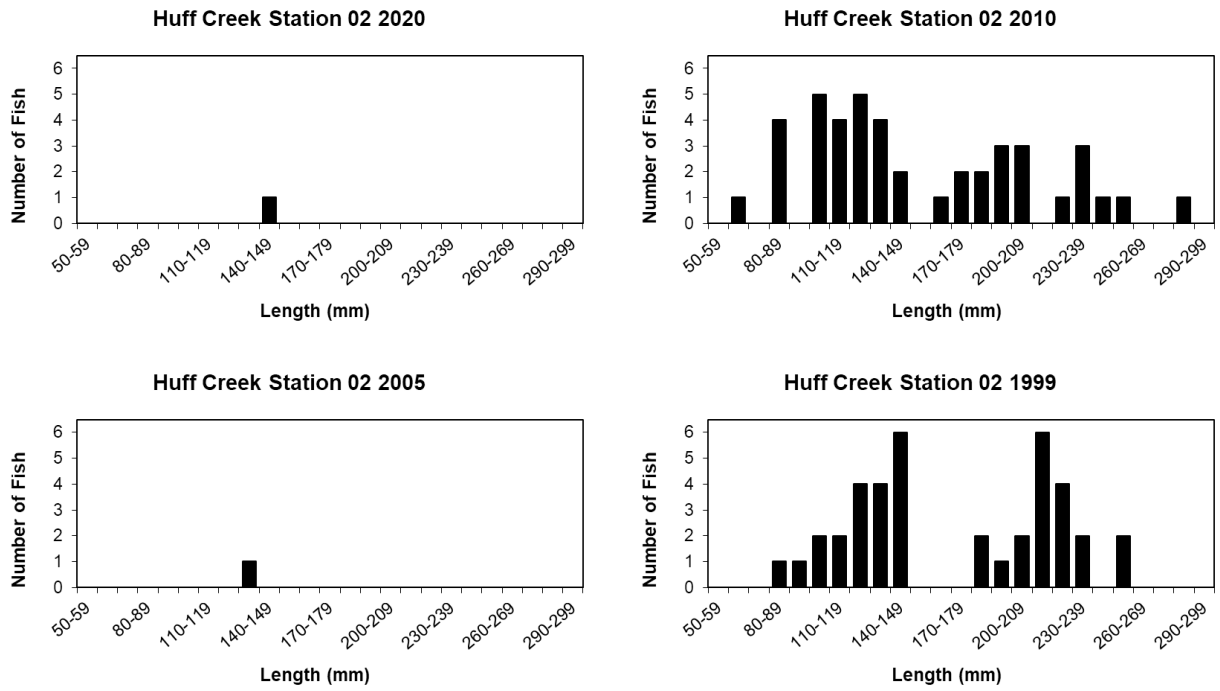

Figure 10. Size distribution of BCT sampled in Huff Creek Station 02, 1999, 2005, 2010, and 2020.

East Fork Chalk Creek **IVAP230M**

Monitoring

Two stations in East Fork Chalk Creek were monitored in 2020, one just upstream of Middle Fork (Station 01) and the other in the upper reaches (Station 02). Both stations were 100 m in length and were electrofished on July 29, 2020. Both stations were monitored previously in 2005, 2010, and 2015 (McKell 2016).

Station 01

The fish community in this station was comprised of a moderate population of BCT, abundant sculpin, and small numbers of MTS and SPD (Table 10). The BCT population estimate for 2020 was larger numerically with a roughly equivalent estimated biomass relative to the 2010 and 2015 estimates (Table 10). The length-frequency histograms for all sampling events show a similar range of size-classes of BCT for all years, except 2020, which appears to represent a single but strong age-1 cohort (Figure 11). Sculpin were again abundant, MTS were among the sample after an absence in 2015, and SPD were not sampled here prior to 2020 (Table 10).

Station 02

This station contained a reduced population of BCT, which was estimated to be less than half the density and biomass found in 2015 (Table 10). Incidentally, the 2015 estimates were less than half the 2010 estimates for both metrics (Table 10). The length-frequency histograms for this station show a varying distribution of size-classes of BCT, with the 2020 plot most similar to 2005 (Figure 12), each comprised of up to three age-classes.

Table 10. Population statistics for species sampled in East Fork Chalk Creek, 1998, 1999, 2005, 2010, 2015, and 2020.

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	
Station 01									
2020	≥age-1 BCT MTS SC SPD	26 3 187 1	262±10 (421±16) sparse abundant sparse	8 (7)	100	84-126	10	5-22	0.95
2015	≥age-1 BCT SC	15	154±16 (247±26) common	7 (7)	115	87-180	17	7-53	0.96
2010	≥age-1 BCT MTS RSS SC	9	120±118 (193±189) sparse sparse abundant	9 (8)	138	83-200	32	5-80	1.01
2005	≥age-1 BCT age-0 BCT MTS SC	30	307±23 (495±37) present common abundant	14 (12)	117	87-246	20	5-144	0.97
1998	≥age-1 BCT MTS SC	18	183±14 (294±22) common common	11 (10)	126	84-262	27	4-157	0.80
Station 02									
2020	≥age-1 BCT	5	53±19 (86±31)	5 (4)	137	63-177	34	2-66	0.98
2015	≥age-1 BCT	16	136±25 (219±40)	14 (13)	153	122-181	38	21-72	1.01
2010	≥age-1 BCT MTS	14	320±880 (515±1416) abundant	34 (30)	133	90-195	32	8-85	1.13
2005	≥age-1 BCT	5	46±17 (74±27)	6 (6)	138	67-212	46	4-122	1.09
1999	≥age-1 BCT	29	310±69 (499±112)	29 (26)	135	51-221	37	1-123	1.09

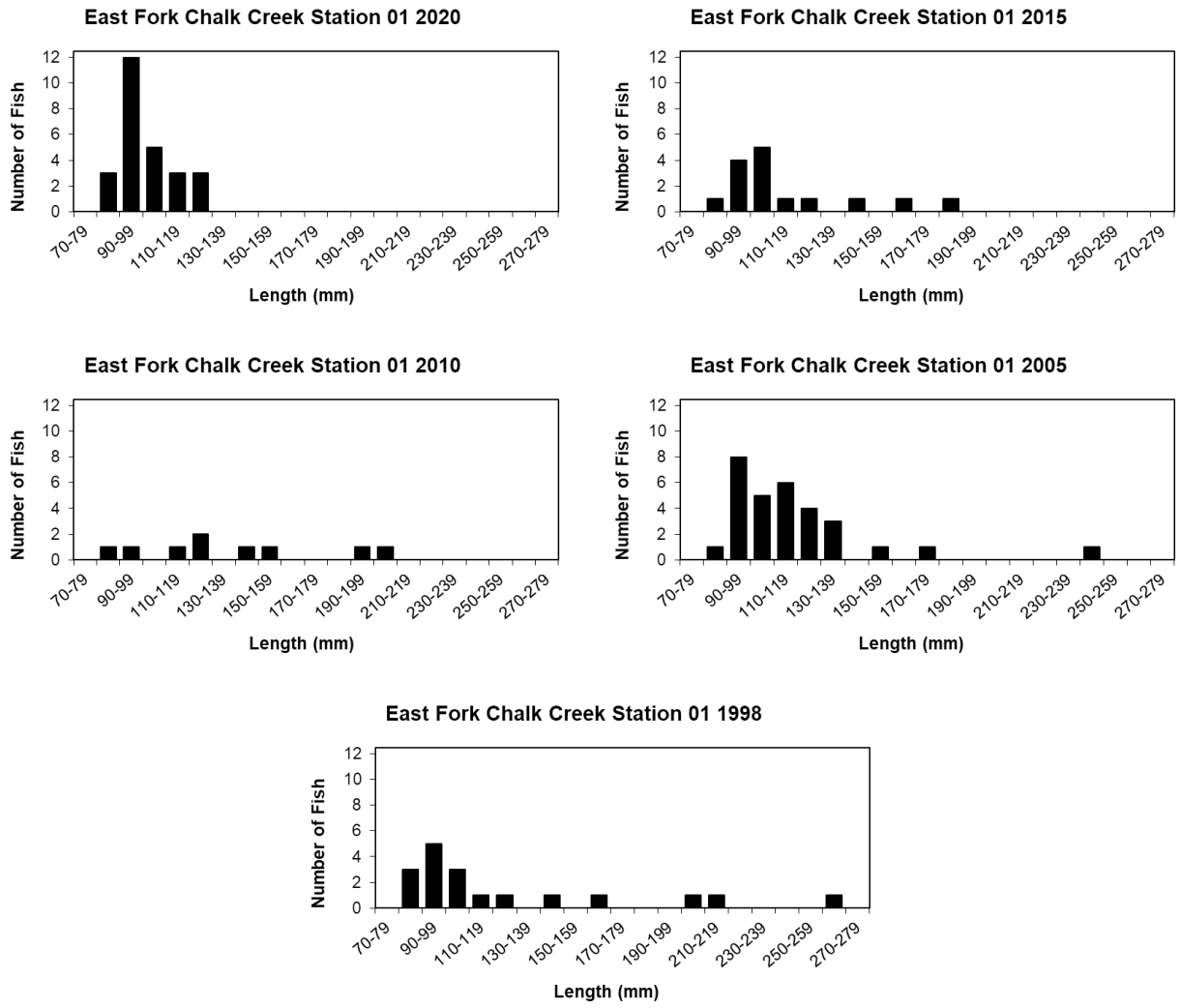

Figure 11. Size distribution of BCT sampled in the East Fork Chalk Creek Station 01 monitoring station, 1998, 2005, 2010, 2015, and 2020.

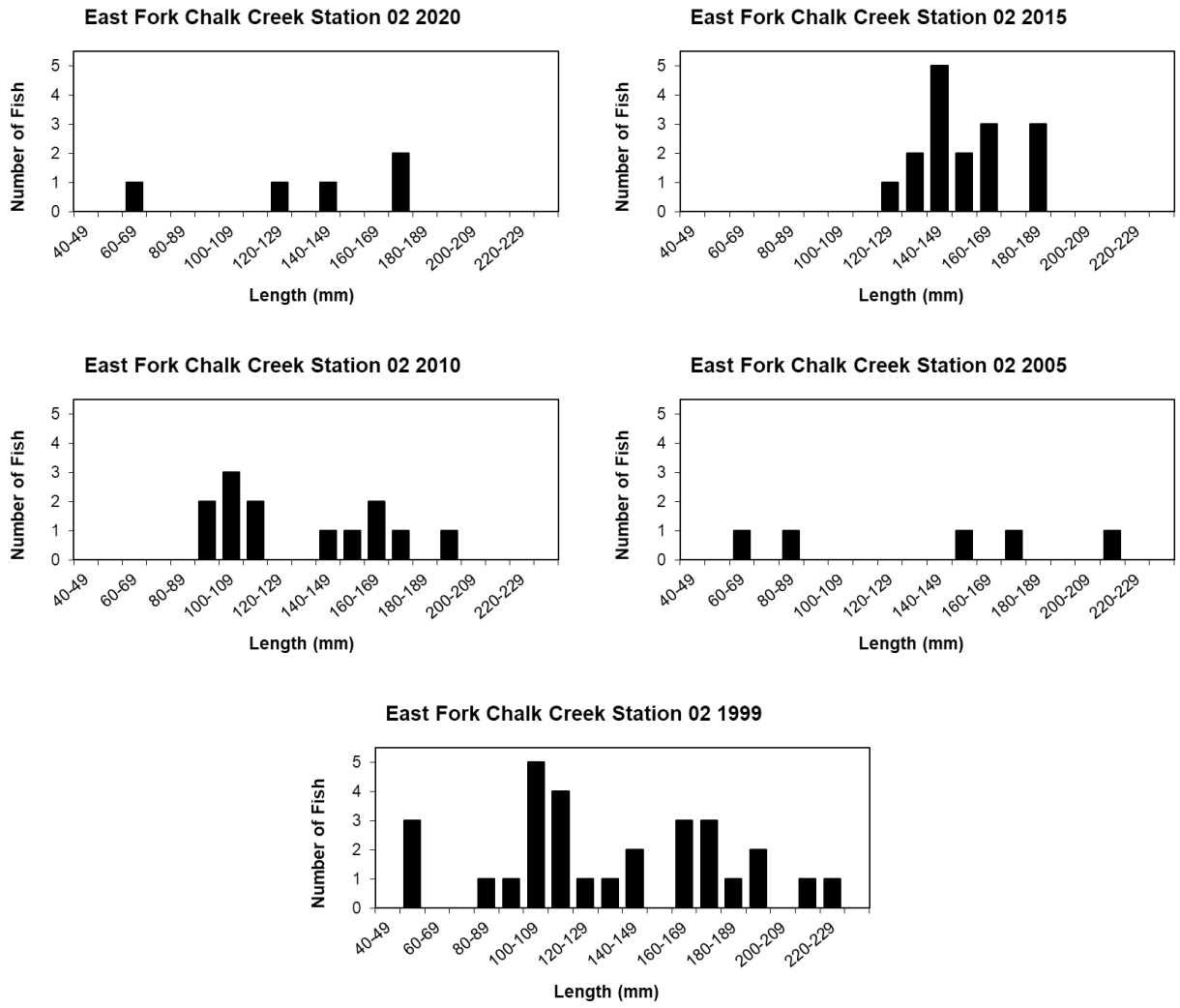

Figure 12. Size distribution of BCT sampled in the East Fork Chalk Creek Station 02 monitoring station, 1999, 2005, 2010, 2015, and 2020.

Middle Fork Chalk Creek **IVAP230M01**

Monitoring

The Middle Fork monitoring station was electrofished on July 28, 2020. The length of the station was 93 m. This station was sampled previously in 1999, 2005, and 2015 (McKell 2016). Based on the four data points, the BCT population has experienced a substantial decline, exhibiting its lowest density in 2020 (Table 11), in not only number but also, and more dramatically, in estimated biomass. The length-frequency histogram for 2020 demonstrates the severe truncation of the population in the number of both individuals and size-classes in the population (Figure 13). Sculpin were again represented in the sample at a moderately low density (Table 11).

Table 11. Population statistics for species sampled in Middle Fork Chalk Creek, 1999, 2005, 2015, and 2020.

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	
2020	≥age-1 BCT SC	9 37	98±10 (158±17) common	4 (4)	111	88-163	17	6-53	1.07
2015	≥age-1 BCT RSS SC	23	263±79 (423±128) sparse common	25 (22)	145	75-275	43	4-183	0.96
2005	≥age-1 BCT age-0 BCT SC	48	500±42 (805±68) present sparse	28 (25)	129	85-322	36	6-348	1.00
1999	≥age-1 BCT SC	15	154±16 (247±26) sparse	18 (17)	156	83-345	63	6-389	1.08

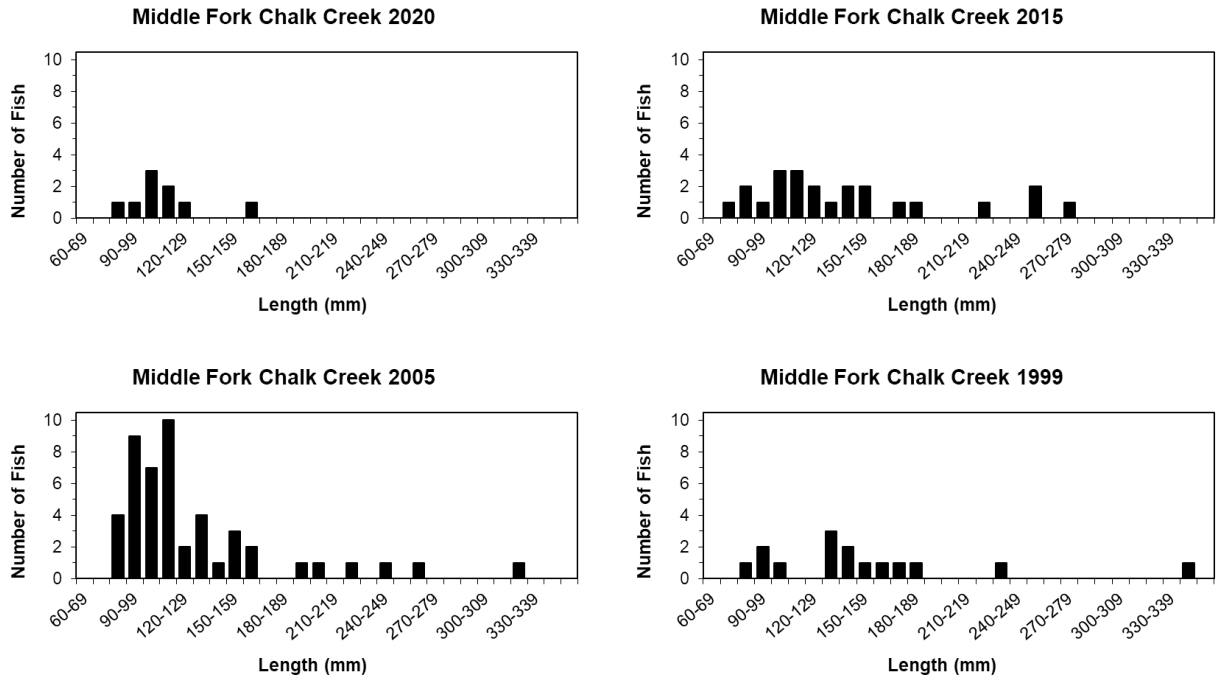

Figure 13. Size distribution of BCT sampled in the Middle Fork Chalk Creek monitoring station, 1999, 2005, 2015, and 2020.

Mill Fork **IVAP230M01B**

Monitoring

The Mill Fork monitoring station was electrofished on July 28, 2020. The station was 86 m in length. Previous sampling at this site occurred in 1999, 2010, and 2015 (McKell 2016). Based on the four data points, the BCT population has experienced a substantial decline, exhibiting its lowest density in 2020 (Table 12), in not only number but also in estimated biomass. The length-frequency histogram for 2020 demonstrates the severe reduction in the population in the number individuals and the range of size-classes present (Figure 14).

Table 12. Population statistics for species sampled in Mill Fork, 1999, 2010, 2015, and 2020.

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	
2020	≥age-1 BCT	3	47±79 (75±127)	5 (4)	134	100-172	29	11-54	1.07
2015	≥age-1 BCT	18	197±15 (316±23)	17 (15)	131	102-178	26	10-63	1.01
2010	≥age-1 BCT	23	295±6 (476±10)	87 (78)	223	93-332	133	8-385	1.01
1999	≥age-1 BCT	13	143±43 (230±70)	20 (18)	142	44-274	53	1-226	1.15

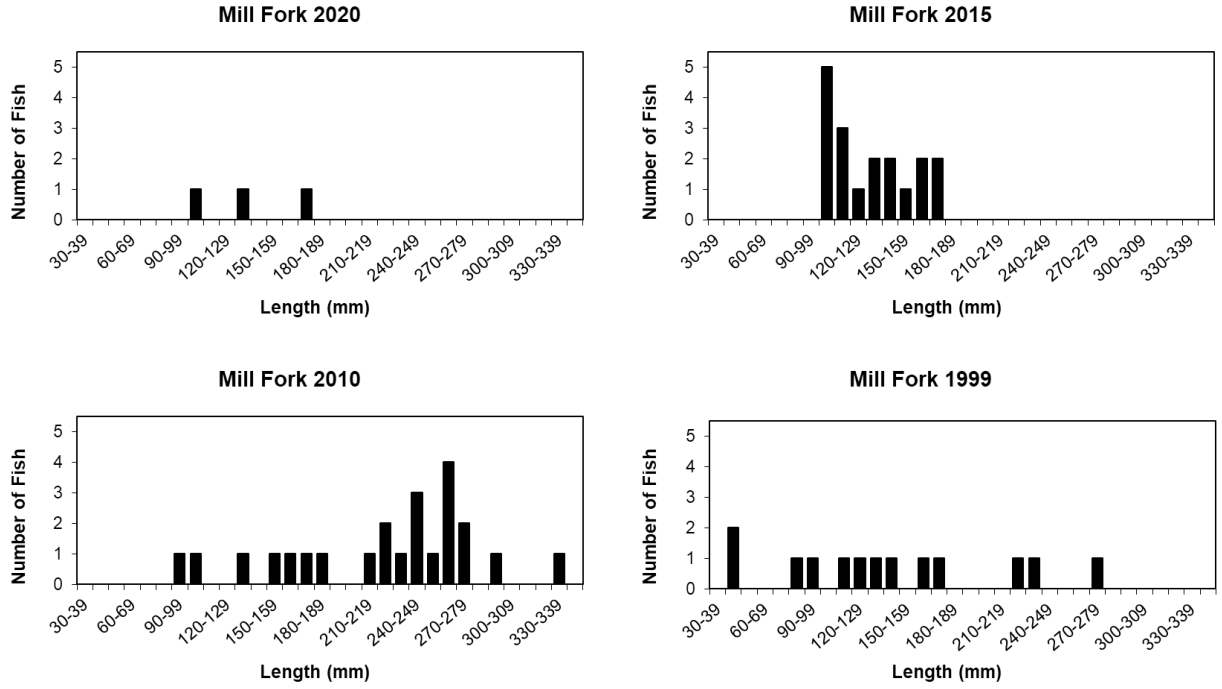

Figure 14. Size distribution of BCT sampled in the Mill Fork monitoring station, 1999, 2010, 2015, and 2020.

COLORADO RIVER CUTTHROAT TROUT

Monitoring

Multiple-pass electrofishing was completed on two streams during 2020 (Table 13). Both of the monitored populations appeared to have decreased since the previous surveys. Brook Trout abundance was down at the only site they were present.

Fish species encountered during stream sampling in 2020 included CRCT, Brook Trout (BKT; *Salvelinus fontinalis*), Mountain Whitefish (MWF; *Prosopium williamsoni*), and sculpin (SC; *Cottus* spp.).

Chemical Reclamation

During 2020, the UDWR continued planning for the future chemical treatment of the West Fork Smiths Fork drainage in Summit County.

Table 13. Results of CRCT population monitoring in 2020.

Stream/section	Year	# of ≥age-1 CRCT/km	# of ≥age-1 CRCT/mile
Upper Green GMU, North Slope of the Uinta Mountains Subunit			
Steel Creek	2020	30 ± 0	48 ± 0
	2014	275 ± 33	442 ± 53
	2009	451 ± 7	726 ± 11
	2005	494 ± 34	796 ± 54
	1999	470 ± 54	757 ± 87
Middle Fork Blacks Fork	2020	19 ± 0	30 ± 0
	2005	90 ± 42	145 ± 67
	1994	82 ± 11	131 ± 17

UPPER GREEN GMU
North Slope of the Uinta Mountains subunit

West Fork of Smiths Fork — IICK020B

Chemical Reclamation

Planning for the future chemical treatment of the West Fork Smiths Fork continued in 2020. Treatment is tentatively set for implementation during the 2021 field season.

Steel Creek — IICK020B02

Monitoring

This 100 m station was electrofished on July 8, 2020. The CRCT population in this station has experienced a severe reduction since 2014 (Table 14). The length-frequency distribution shows a shift in 2020 to an apparently entirely adult demographic (Figure 15), and loss of the historically strong age-1 cohort present in each of the previous sampling events. This suggests recruitment failure from at least the 2019 spawn. Sculpin continue to be abundant in this station.

Table 14. Population statistics for species sampled in Steel Creek, 1999, 2005, 2009, 2014, and 2020.

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	
2020	≥age-1 CRCT SC	3	30±0 (48±0) abundant	11 (10)	191	179-210	70	59-89	0.99
2014	≥age-1 CRCT SC	24	275±33 (442±53) abundant	25 (22)	117 88	81-225 41-122	19	3-110	0.83
2009	≥age-1 CRCT age-0 CRCT SC	45 2	451±7 (726±11) 20±0 (32±0) abundant	91 (81)	152 40 76	77-241 37-42 23-141	41	4-127	0.92
2005	≥age-1 CRCT SC	48	494±34 (796±54) abundant	51 (45)	126 96	76-233 52-146	23	2-118	0.80
1999	≥age-1 CRCT SC	46	470±54 (757±87) abundant	91 (81)	120 91	74-250 56-138	19	2-116	0.76

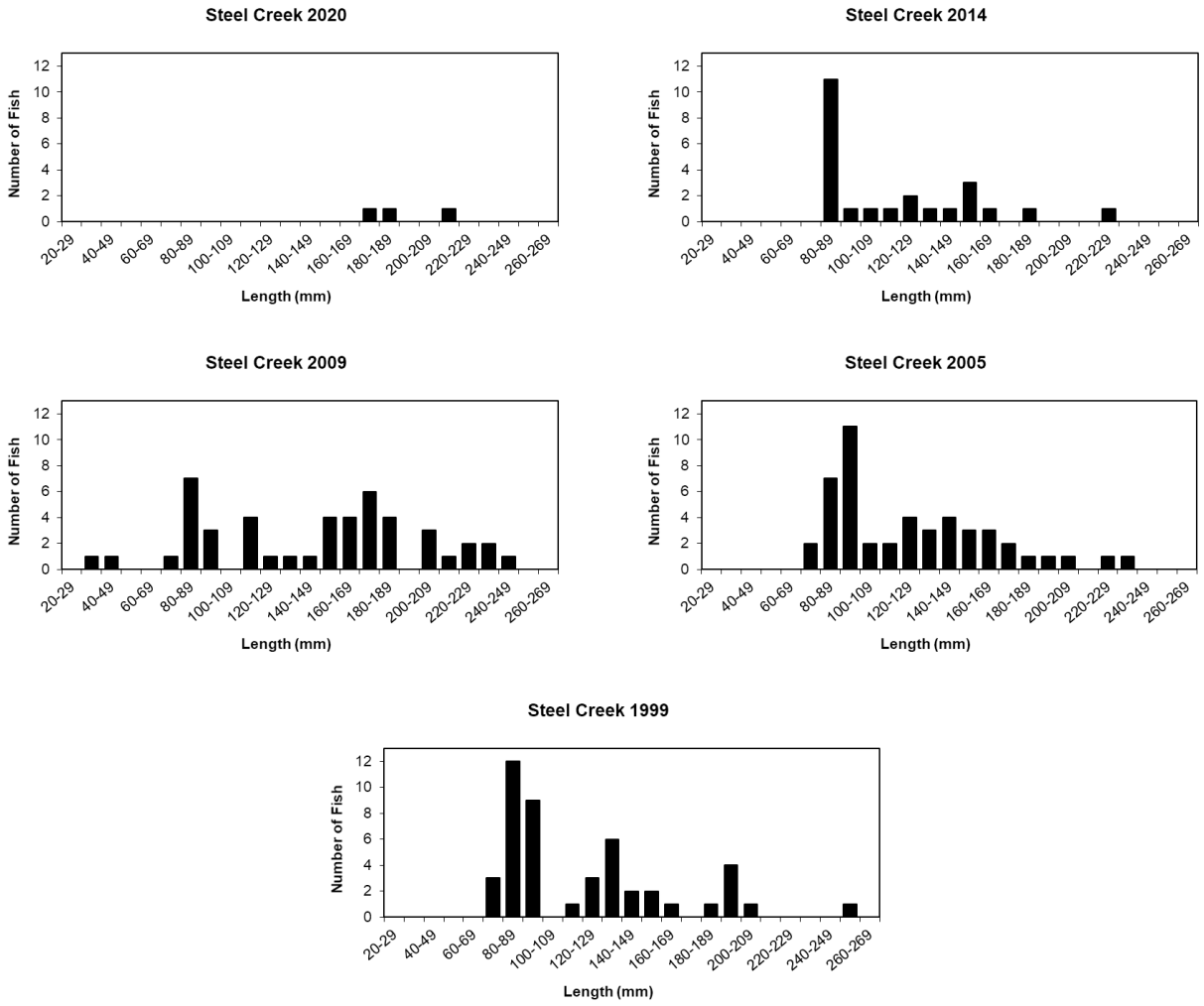

Figure 15. Size distribution of CRCT sampled in the Steel Creek monitoring station, 1999, 2005, 2009, 2014, and 2020.

Middle Fork Blacks Fork **IICK050A**

Monitoring

This 108 m station was electrofished on July 7, 2020. The CRCT population in this station has experienced a marked reduction since 2005 (Table 15), as has the BKT population. The catch, as illustrated in the length-frequency distribution, in 2020 consisted of a large adult cutthroat, the largest fish ever sampled at this site, and one age-1 individual (Figure 16). This suggests recruitment failure from at least the 2019 spawn. Sculpin continue to be common in this station.

Table 15. Population statistics for species sampled in Middle Fork Blacks Fork, 1994, 2005, and 2020.

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	
2020	≥age-1 CRCT	2	19±0 (30±0)		200	87-313			
	≥age-1 BKT	17	174±48 (280±77)		138	69-205	no scale		
	≥age-1 MWF	1	9±0 (15±0)		217				
	SC		common						
2005	≥age-1 CRCT	8	90±42 (145±67)	8 (7)	161	101-239	54	10-150	1.05
	≥age-1 BKT	39	403±33 (649±54)	44 (39)	172	86-240	65	4-162	1.09
	≥age-1 MWF	1	present		215		112		1.13
	SC		common						
1994	≥age-1 CRCT	8	82±11 (131±17)	7 (6)	157	120-220	46	15-115	0.93
	age-0 CRCT	7	present		36	28-44			
	≥age-1 BKT	4	45±29 (72±47)	3 (2)	134	111-177	31	15-75	1.07
	SC		common						

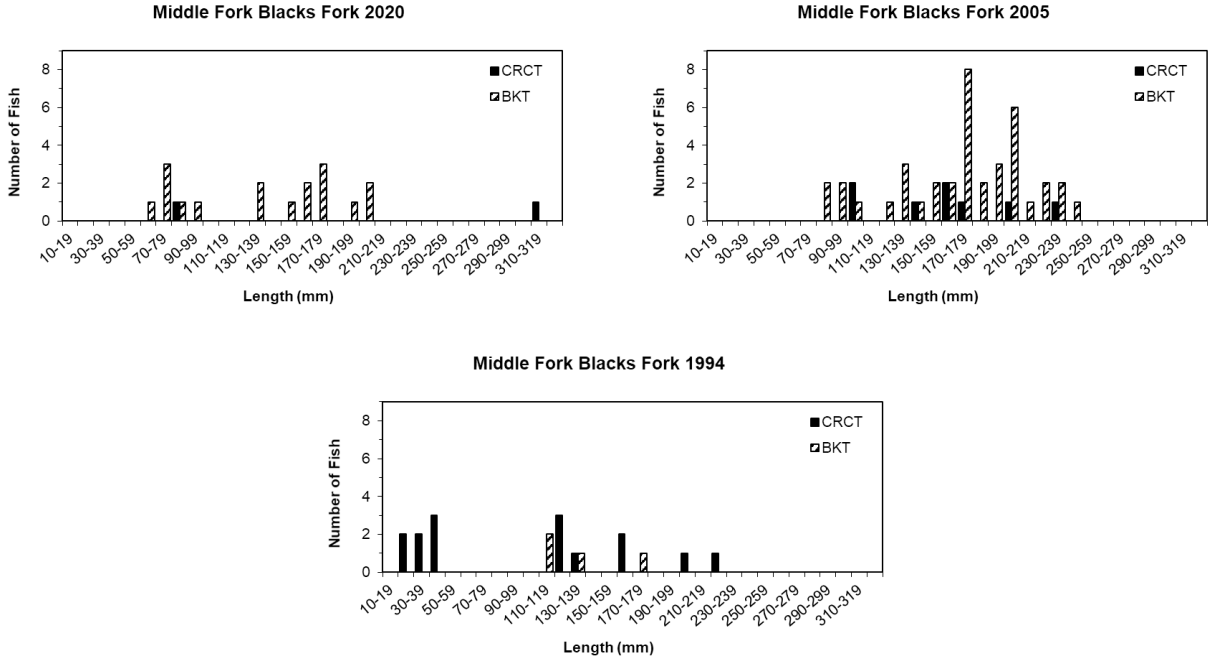

Figure 16. Size distribution of salmonids sampled in the Middle Fork Blacks Fork monitoring station, 1994, 2005, and 2020.

Unnamed tributary to Middle Fork Blacks Fork **No ID**

Survey

A short reach of an unnamed tributary to the Middle Fork Blacks Fork was electrofished on July 7, 2020. Although water and habitat appeared sufficient to support fish, none were found in approximately 70 m of thoroughly sampled stream.

YELLOWSTONE CUTTHROAT TROUT

LOWER SNAKE GMU
North Slope Raft River Mountains

Basin Creek **IIIAA06011**

Habitat Assessment

In anticipation of reconstruction of an irrigation diversion on Basin Creek, a day of effort was expended on June 30, 2020, to mark as many YCT downstream of the diversion as possible. Marking consisted of clipping adipose fins of 111 YCT of varying sizes collected via electrofishing from approximately 1.5 km of Basin Creek below the diversion. Sculpin, SPD, and Bluehead Sucker were also observed during electrofishing but were not marked. Passage of the reconstructed structure by YCT will be assessed by inspecting the adipose area of YCT captured during future electrofishing efforts upstream of the diversion.

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 2020 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 in most populations 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 2021, monitoring is planned for streams in Rich County, streams in the Ogden 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. The chemical treatment of Deadman Creek in the upper Bear River drainage was conducted in 2020. With the Deadman Creek treatment concluded, the Northern Region will be decreasing efforts to restore BCT and increasing focus on population monitoring.

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.

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 CRCT distribution within them.

Monitoring
Populations monitored in 2020 showed declines in abundance since the previous sampling, one from 2014 and one from 2005. The monitoring of CRCT populations should follow the timeline established by the UDWR and USFS, and should remain a high priority. Monitoring is scheduled for the Little West Fork Blacks Fork in 2021.

Restoration
Opportunities for CRCT expansion and enhancement in North Slope drainages should continue to be explored. Planning for the chemical treatment of the West Fork Smiths Fork drainage in 2021 continued in 2020; successful treatment would restore approximately 35 km of stream to CRCT.

YELLOWSTONE CUTTHROAT TROUT

Habitat Assessment
The marking of YCT in 2020 below the diversion in Basin Creek will allow assessment of whether passage and reconnection of fragmented portions of the drainage would be achieved through reconstruction of the diversion.

Monitoring
Although no YCT populations were monitored in 2020, monitoring will continue to be a priority in the future. The next round of population monitoring is slated for 2022.

Restoration
Opportunities for YCT restoration and enhancement in Raft River tributaries should continue to be explored, particularly for the population in the headwaters of George Creek.

LITERATURE CITED

BCT State of Utah Conservation Team. 2008. Conservation agreement for Bonneville cutthroat trout (*Oncorhynchus clarkii utah*) in the State of Utah. Utah Division of Wildlife Resources, Salt Lake City, Utah.

Lentsch, L. and Y. Converse. 1997. Conservation agreement and strategy for Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) in the State of Utah. Publication Number 97-20. Utah Department of Natural Resources, Division of Wildlife Resources, Salt Lake City, Utah.

McKell, M. 2016. Native cutthroat trout (*Oncorhynchus clarkii* ssp.) conservation activities in the Northern Region, 2015. Publication Number 16-03. Utah Department of Natural Resources, Division of Wildlife Resources, Salt Lake City, Utah.

McKell, M. D. and P. Thompson. 2009. Native cutthroat trout (*Oncorhynchus clarkii* ssp.) conservation activities in the Northern Region, 2008. Publication Number 09-10. Utah Department of Natural Resources, Division of Wildlife Resources, Salt Lake City, Utah.

Oplinger, R. and P. Birdsey. 2019. Bonneville cutthroat trout range-wide conservation agreement and strategy. Publication Number 18-11. Utah Department of Natural Resources, Division of Wildlife Resources, Salt Lake City, Utah.

Range-wide YCT Conservation Team. 2009. Conservation agreement for Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*) in the States of Idaho, Montana, Nevada, Utah and Wyoming. Montana Fish, Wildlife & Parks.

Reynolds, J. B. 1989. Electrofishing. Pages 147-163 in L. A. Nielsen and D. L. Johnson, editors. Fisheries Techniques. American Fisheries Society, Bethesda, Maryland.

USFWS (United States Fish and Wildlife Service). 2012. Final Environmental Assessment for Native Fish Restoration and Enhancement Projects in Northern Utah. Prepared by Utah Division of Wildlife Resources (Ogden, Utah) and U.S. Fish and Wildlife Service (Denver, Colorado) in cooperation with Bureau of Land Management (Salt Lake City, Utah).

Zippin, C. 1958. The removal method of population estimation. Journal of Wildlife Management 22:82-90.