Bull Trout Trap and Haul at Bumping, Kachess, Keechelus, and Tieton Dams

2020 Progress Report

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Foreword

Yakima Basin Bull Trout (*Salvelinus confluentus*) are part of the Mid-Columbia River Distinct Population Segment listed as Threatened under the Endangered Species Act (ESA). The Yakima Basin is home to 15 genetically distinct populations of Bull Trout, three of which have been extirpated. There are three generally accepted life history types exhibited by Bull Trout: resident, fluvial, and adfluvial, but in the Yakima Basin, most Bull Trout populations exhibit an adfluvial life history. Adfluvial Bull Trout spawn and juveniles rear in tributary habitats, however, sub-adults and adults forage and reside in lakes and reservoirs. One of the primary threats to Yakima Basin Bull Trout is entrainment at dams and fish not being able to return to their spawning grounds (U.S. Fish and Wildlife Service 2015). Impoundment has fragmented Bull Trout habitat and interim trap and haul measures are needed to move Bull Trout above dams when they are present. Given the prior success of Bull Trout trap and haul operations at Clear Creek Dam on the North Fork Tieton River (Thomas and Monk 2015, 2016; Thomas et al. 2017, 2018), trap and haul operations were expanded to include additional locations in the upper Naches and Yakima rivers. Therefore, in 2019 the US Bureau of Reclamation (USBR) began contracting with the US Fish and Wildlife Service (USFWS), Mid-Columbia Fish and Wildlife Conservation Office (MCFWCO) to: 1) study the feasibility of trap and haul at Bumping, Kachess, Keechelus, and Tieton dams, 2) monitor the movement and viability of transported fish, and 3), monitor water quality for fish health. As a part of our permit, the USFWS Ecological Services requires determination of natal origin of the Bull Trout we collect and transport so that they are released into their natal stream. The spawning tributaries upstream of Kachess Dam (Kachess Reservoir) are the upper Kachess River and Box Canyon Creek. The primary spawning tributary upstream of Keechelus Dam (Keechelus Reservoir) is Gold Creek. The primary spawning areas upstream of Tieton Dam (Rimrock Reservoir) are the South Fork Tieton River and Indian Creek. The primary spawning tributary above Bumping Dam (Bumping Reservoir) is Deep Creek, although a few redds have also been reported in the upper Bumping River (Divens 2019). During 2019 efforts, we collected 15 Bull Trout below Keechelus Dam but none elsewhere (Haskell et al. 2020). Here we report on our second-year trap and haul efforts, adding the Tieton Dam Stilling Basin to our sampling locations. However, due to the COVID-19 pandemic in 2020, field operations were delayed, and hazard protocols limited sampling in some cases.

Goals and Objectives

The ongoing goal of the Bull Trout Transport Project is to increase the viability of Bull Trout populations by maintaining genetic diversity and providing connectivity for fish currently excluded from natal spawning tributaries upstream of Bumping, Kachess, Keechelus, and Tieton dams. Our specific objectives were to: 1) capture adult Bull Trout in the stilling basins directly

below Bumping, Kachess, Keechelus, and Tieton dams, 2) implant Passive Integrated Transponder (PIT) tags in captured Bull Trout and obtain tissue samples for rapid response genetic testing, 3) transport and release tagged fish above the dams into their natal tributaries as determined by rapid response genetic testing, and 4), utilize fixed PIT tag interrogation sites in spawning tributaries to monitor the movement of transported fish.

Methods

Study Area and Monitoring Locations

We conducted Bull Trout trap and haul in two areas of the Yakima River Basin- the upper Yakima River Basin and the upper Nachess River Basin. In the Nachess River Basin we attempted to collect Bull Trout in the Bumping Dam and Tieton Dam stilling basins. Bumping Dam impounds Bumping Reservoir and is located on the Bumping River, a tributary of the Nachess River. The Bumping River flows northeast, joins the American River and then the Little Nachess River, to form the Nachess River. The Bumping and Little Kachess confluence is about 89 km upstream of where the Nachess River enters the Yakima River near Yakima, Washington. Tieton Dam, which impounds Rimrock Reservoir, is located on the Tieton River 35 km upstream of the Tieton and Nachess river confluence near the town of Nachess, Washington. About 1 km upstream of Rimrock Reservoir, Clear Creek Dam impounds the North Fork Tieton River to form Clear Creek Reservoir. Although Clear Creek Dam and the North Fork Tieton River were not monitored for this project, it is feasible that Bull Trout collected below Tieton Dam might have originated in the North Fork Tieton River. Bull Trout originating from Rimrock Reservoir tributaries (Indian Creek, South Fork Tieton River) routinely migrate upstream to Clear Creek Dam but are not transported above the dam to Clear Creek Reservoir (Thomas et al. 2017). In the upper Yakima River Basin, we attempted to collect Bull Trout in the Kachess and Keechelus Dam stilling basins. Keechelus and Kachess dams are located upstream of Easton Dam, which impounds Easton Reservoir near Easton, Washington. The 'Keechelus Arm' of the Yakima River extends upstream from Easton Reservoir about 18 km to Keechelus Dam, while a shorter, 1 km river stretch connects Easton Reservoir to Kachess Dam and Kachess Reservoir via the lower Kachess River (Figure 1).

We used PIT antennas to monitor the movement of Bull Trout in our study area, except in Deep Creek. Deep Creek is a tributary to Bumping Reservoir where Bull Trout spawn and rear. Annual dewatering of Deep Creek results in flow in either the North or South Channel, but not both. This presents challenges for maintaining PIT antennas in Deep Creek that have not been resolved. In the upper Kachess River, Box Canyon Creek, and upper Gold Creek, we installed antenna 'arrays' consisting of two antennas at a site, while in the lower Gold Creek site, we installed a single antenna. The upper Gold Creek array was located about 4 km upstream from the Gold Creek mouth at Keechelus Reservoir. The lower Gold Creek antenna was located about

0.5 km upstream from its mouth between the eastern span of I-90 and National Forest Road 4832. Yakama Nation installed an antenna array in the upper Kachess River about 1 km upstream of the upper Kachess River mouth at Kachess Reservoir and in lower Box Canyon Creek about 0.2 km upstream of the Box Canyon Creek mouth at Kachess Reservoir. In the upper Nachess Basin, we installed a single antenna in the South Fork Tieton River about 8.5 km upstream of its mouth at Rimrock Reservoir. We also installed an antenna array in lower Indian Creek about 0.9 km upstream of its mouth at Rimrock Reservoir (Figure 1).

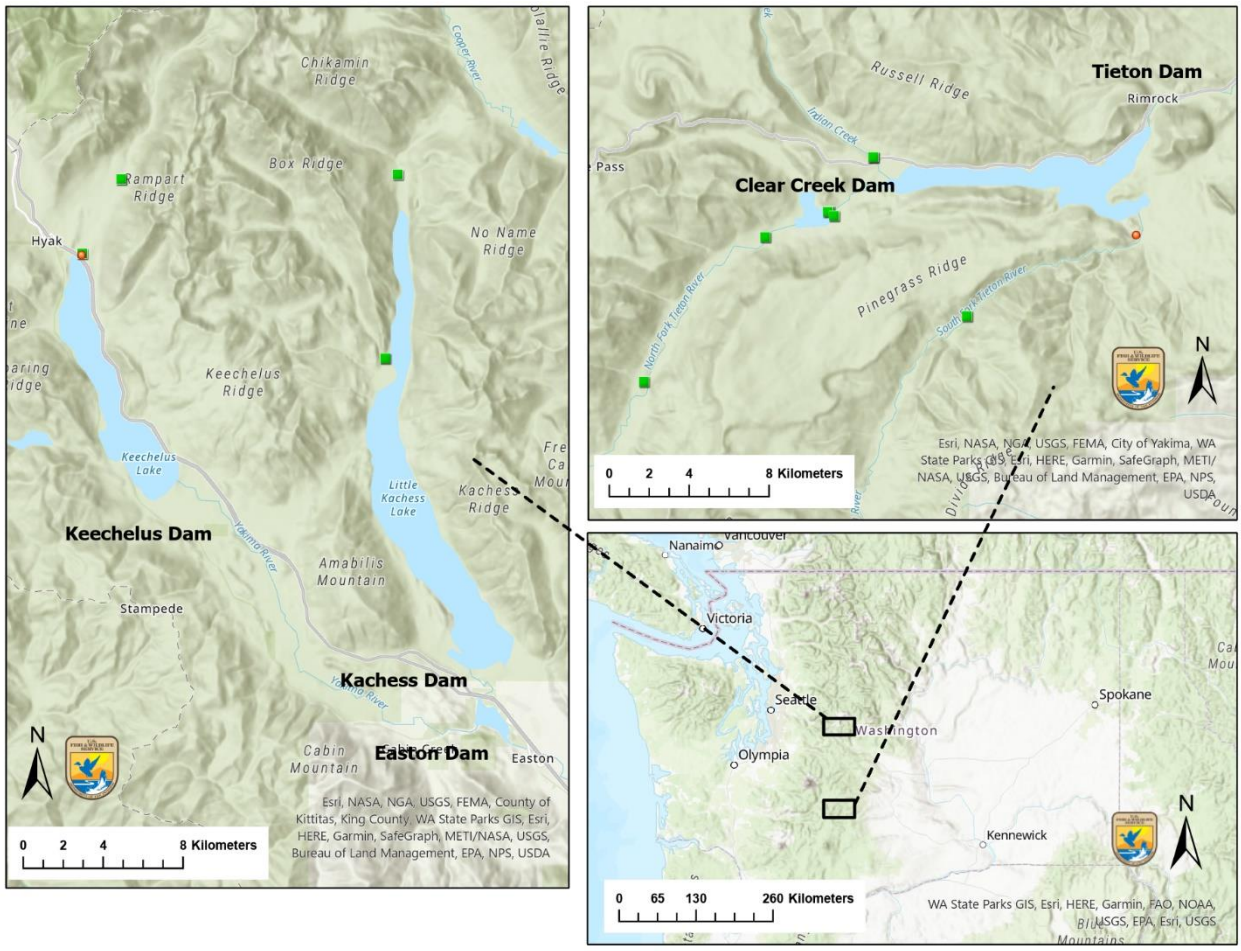

Figure 1. Map of the study site in the Upper Yakima (left map) and Upper Nachess (upper right map) river basins, Washington. The map includes Kachess, Keechelus, Clear Creek and Tieton dams, PIT antenna locations (green squares), and Bull Trout release sites (red dots). Bumping Dam not pictured.

Fish Collection

We conducted snorkeling surveys and fish sampling from June-October 2020 at Bumping, Kachess, and Keechelus dams. Although we sampled at Tieton Dam, we did not snorkel there

because the stilling basin is deep and turbulent. The survey crew consisted of snorkelers and a data collector following Thurow and Schill (1996). We quantified the number of adult Bull Trout present with the survey starting point below each stilling basin as determined by the predominate instream conditions at the time of the survey. Thurow and Schill (1996) found no significant difference between day and night abundances of adult Bull Trout, therefore we conducted our surveys during mid-morning. During 2020 we attempted to snorkel and sample at least three times at each stilling basin provided water temperature was less than 15 °C, water clarity was good enough for snorkeling, and flows were low enough to safely deploy nets and snorkel. In addition to Bull Trout, we also estimated the number of other fishes in our surveys.

After snorkeling, Bull Trout were collected using gill nets with 7.5-cm stretch mesh and 3.5-kg (8-lb test) monofilament. Nets were fished using one of two methods, either by placing them across stream reaches where snorkelers directed fish towards nets, or by letting them fish passively without snorkelers. In both cases, nets were constantly monitored, and fish were immediately removed from gill nets using standard dip nets. Net meshes were cut as needed to minimize fish injury during removal. Captured Bull Trout were placed in a holding pen prior to processing. The holding pen was constructed of perforated stainless steel with lockable latches and submerged in the river where there was generally good flow (Figure 2).

Figure 2. Stainless steel pen (0.9 m x 1.2 m x 1.8 m) used for holding Bull Trout after collection and before rapid response genetic testing and transport.

After collecting Bull Trout, we prepared an anesthetic solution of MS-222 at 50 mg/L using river water and a 75.7-liter (80-quart) cooler. Since MS-222 is acidic, a buffer ($NaHCO_3$; i.e., baking soda) was added to raise the pH, which was measured using a Eutech Instruments pHTestr20

(Cole-Parmer, Vernon Hills, Illinois). Individual Bull Trout were removed from the pen using a dip net and placed in the cooler where the fish were anesthetized until sedation (3-5 min). After sedation, we recorded total length (mm), collected a small tissue sample from the anal fin using sterilized surgical scissors, and inserted a PIT tag into the base of the dorsal fin (dorsal sinus) using a sterilized hollow needle.). Tissue samples were placed in vials with ethanol. PIT tags were full duplex (FDX-B), measured 12.5 x 2.1 mm, and operated at a frequency of 134.2 kHz (APT-12, Biomark, Boise, Idaho). Processing generally took less than 2 min.

After processing, Bull Trout were placed in a perforated PVC recovery tube (1-m length, 15-cm diameter) with adequate flow to allow fish to recover and regain equilibrium before returning them to the holding pen. Tagged and processed fish were separated from unprocessed fish in the holding pen until all fish were processed. Vials were shipped to the USFWS Abernathy Fish Technology Center (AFTC) for rapid response genetic assessment to determine population origin.

Rapid Response, Genetic Testing, and Transport

To meet the USFWS requirements of natal origin and hybrid (Brook Trout x Bull Trout) identification prior to transport, we used a real-time genotyping and analysis method, hereafter referred to as rapid response (DeHaan et al. 2011). The field identification of hybrids can be difficult; therefore, we euthanized hybrids based solely on the results from rapid response. Upon arrival in the laboratory, genomic DNA was extracted twice from each individual fin clip to ensure consistency using a modified chelex extraction protocol (Miller and Kapuscinski 1996) with incubation at 55°C for 15 min, and then at 103°C for 8 min. Individuals were genotyped at the following 16 microsatellite loci: *Omm1128, Omm1130* (Rexroad et al. 2001), *Sco102, Sco105, Sco106, Sco107, Sco109*, (WDFW unpublished), *Sco200, Sco202, Sco212, Sco215, Sco216, Sco218, Sco220* (Dehaan and Ardren 2005), *Sfo18* (Angers et al. 1995) and *Smm22* (Crane et al. 2004). Allele calling at each of these loci was previously standardized between our laboratory and WDFW Molecular Genetics Laboratory using a protocol similar to the one described by Stephenson (2009) to facilitate data sharing. Several Bull Trout and Brook Trout loci have diagnostically different allele sizes and can be used to identify species and individuals with hybrid ancestry.

We used the baseline genotypes described by Small et al. (2016) to assign fish to population groups and evaluated the power of the baseline to accurately assign individuals using a simulation approach. The probability of an individual originating from each baseline population was estimated following Rannala and Mountain (1997) as implemented in the computer program ONCOR (Steven Kalinowski; available: http://www.montana.edu/kalinowski/software/oncor.html). Preliminary leave-one-out simulations suggested a high probability (95 % - 100 %) of correct assignment to the twelve populations in the baseline (Table 1). Based on these results, we decided that the baseline had

enough power to assign individual Bull Trout to one of twelve populations. Each of the Bull Trout captured in 2020 were thus assigned to one of these populations.

The next day, Bull Trout were transported to their natal stream based on rapid response results. Bull Trout were loaded by hand into a transport vehicle outfitted with a large holding tank. The tank was 1,230 L, had an O_2 bottle with air stones, and a 4-in (10-cm) gate valve. We hand loaded and removed fish using a hand dip net. Water temperature was measured before fish were loaded into the tank and within the creek where fish were released.

Table 1. Results of simulations used to assess the accuracy with which the genetic baseline could be used to assign Bull Trout to 13 reporting groups. The left column indicates the true origin, and subsequent columns indicate numbers of fish assigned to each reporting group. Bold values indicate correct assignments.

Reporting Groups	Brook	Gold Creek	Box Canyon	Kachess River	NF Teanaway	Deep	American/ Union	Rattlesnake	Crow	NF Tieton	Indian	SF Tieton	Ahtanum	Percent Correct
Brook	**25**	0	0	0	0	0	0	0	0	0	0	0	0	100%
Gold Creek	0	**46**	0	0	0	0	0	0	0	0	0	0	0	100%
Box Canyon	0	0	**18**	1	0	0	0	0	0	0	0	0	0	95%
Kachess	0	0	0	**28**	0	0	0	0	0	0	0	0	0	100%
NF Teanaway	0	0	0	0	**10**	0	0	0	0	0	0	0	0	100%
Deep	0	0	0	0	0	**57**	0	0	0	0	0	0	0	100%
American Union	0	0	0	0	0	0	**56**	0	0	0	0	0	0	100%
Rattlesnake	0	0	0	0	0	0	1	**36**	0	0	0	0	0	97%
Crow	0	0	0	0	0	0	0	0	**24**	0	0	0	0	100%
NF Tieton	0	0	0	0	0	0	0	0	0	**46**	1	0	0	98%
Indian	0	0	0	0	0	0	0	0	0	1	**108**	3	0	96%
SF Tieton	0	0	0	0	0	0	0	0	0	0	1	**75**	0	99%
Ahtanum	0	0	0	0	0	0	0	0	0	0	0	0	**54**	100%

Fish Monitoring and Water Quality

At each antenna site we deployed either a single PIT antenna or a two-antenna 'array'. Arrays consisted of two antennas placed about 20 m apart along the course of the stream bed. Each antenna consisted of an IS1001, 24V antenna control node (Biomark Inc., Boise, Idaho) housed within a waterproof case (Pelican Products, Inc., Torrance, California). External power cords and antenna wires were attached to the control board within the case. Power was supplied to the control board using DC power from four, 6V batteries wired together in a 24V configuration. Batteries were charged by 300W/24V solar panels (Grape Solar, Eugene, Oregon) mounted to a wooden frame that faced 120° - 150° (Southeast). The output of the solar panels was regulated by a solar controller (ProStar PS-15, Morningstar Inc., Newtown, Pennsylvania). The batteries and solar controller were housed in a steel storage chest (Ridge Tool Company, Elyria, Ohio). In Box Canyon Creek, the array was powered by a thermoelectric generator (TEG; Global Power Technologies, Calgary, Alberta, Canada). Propane from a 25-gal (94.6-L) tank powered the TEG, which supplied 24 V of continuous DC power to the array. Antenna coils consisted of 12-gauge copper 'Litz' wire housed within polyethylene piping. The piping was connected to a waterproof case via a 2-in (5.1-cm) PVC 'T' fitting, which contained both ends of the coil, a hydrovolt cable (AK Industries, Rancho Domingo, California), and the appropriate capacitor based on the inductance of the antenna coil.

We employed two antenna configurations for antenna coils at our interrogation sites. Antenna coils were installed in either a 'pass-through' or flat-plate ('pass-by') configuration. Generally, 'pass-through' antennas are better for detecting fish across a range of water levels but are more susceptible to damage during high water events, whereas flat-plate antennas are less susceptible to being displaced by high water events and associated debris. The upper Kachess River (KR1, KR2) Indian Creek (IND1, IND2), and Gold Creek (UGC1, UGC2, G90) antennas were setup in a rectangular 'pass-through' configuration and measured about 10 x 2 m depending on stream width. An antenna support cable was affixed from one bank to the other with each end attached to a 10-ft (3.1-m) T-post. Zip ties or straps were used to affix the antenna to the support cable. The Box Canyon Creek (BOX1, BOX2), and South Fork Tieton River (SFT) antennas were setup in a flat-plate configuration, lying flat on the creek bed in a rectangular shape about 11 x 1 m (Figure 3). For both configurations, piping was affixed to the stream bed with 5/16-in (0.8-cm) barbed rebar anchors with 1-in (2.5-cm) thread-less eye nuts welded near the top of the rebar. The anchors were driven into the stream bed using a gas-powered post driver (Titan, Nevada, Missouri), and antenna piping was secured to the anchors with nylon straps (NRS Inc., Moscow, Idaho).

Figure 3. Example of a flat-plate antenna design to monitor the movement of PIT-tagged Bull Trout.

PIT antennas were installed during summer when flows were low enough to allow in-river work and sun declination was high enough to power equipment. Antenna installation and startup was delayed in 2020 due to the COVID pandemic. For example, repair and activation of the South Fork Tieton River antenna was delayed until July 22. In upper Gold Creek, our downstream antenna (UGC2) operated continuously until November 24 while the upstream antenna (UGC1) operated until October 14. In lower Gold Creek (G90), our antenna operated nearly continuously until December 1. In the upper Kachess River the downstream antenna (KR2) operated continuously from June 7 - October 10, while the upstream antenna (KR1) operated continuously from September 9 - October 10, but both antennas operated intermittently afterwards and were turned off on October 27. In Box Canyon Creek, the upstream antenna (BOX1) operated from July 6 - November 19, while the downstream antenna operated from July 20 - November 19. Both Box Canyon Creek antennas had short operational gaps from August 1 - 6 and August 20 - 27. In the upper Nachess River Basin, our Indian Creek antennas generally operated from June 1 - October 20, but our upstream antenna (IND1) had small operational gaps from July 23 - 27 and August 6 - 18. In the South Fork Tieton River, our antenna (SFT) operated continuously from July 28 - October 20. In Indian Creek, the lack of solar exposure limited antenna operations in September and October and we deactivated the array on October 20 (Figure 4). We also deployed water temperature loggers at Indian Creek,

South Fork Tieton River, and Gold Creek to continuously log water temperature every 15 min (Onset, Bourne, Massachusetts).

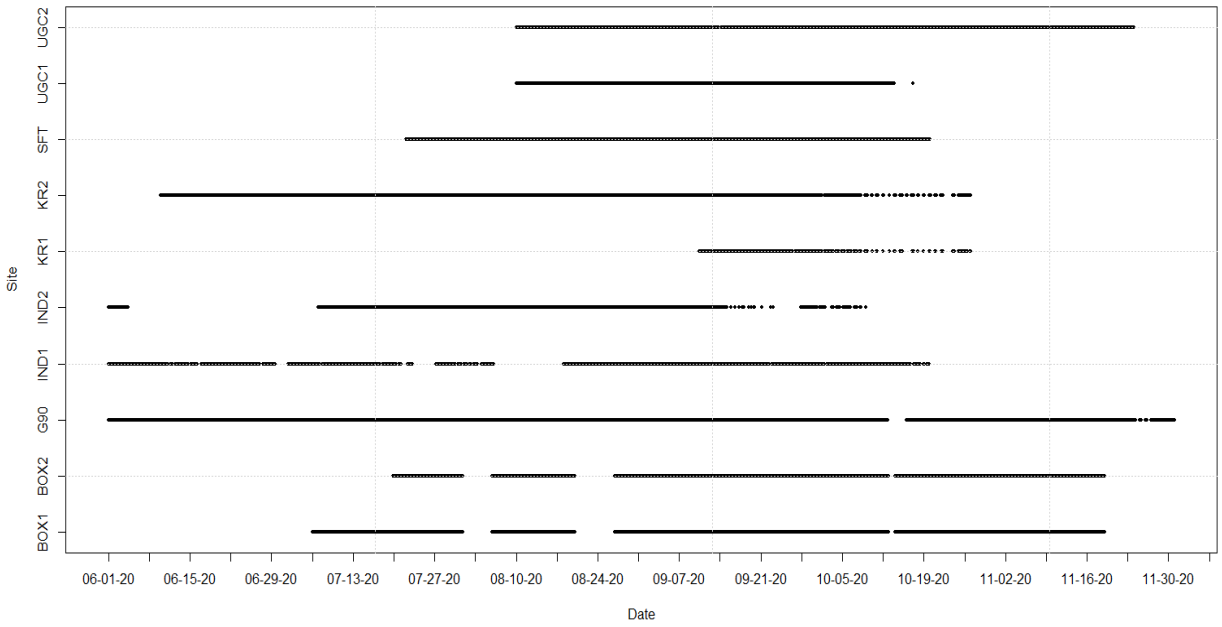

Figure 4. Antenna operations during the 2020 field season. Each 'dot' represents an hour in which the antenna was operational (BOX1= Box Canyon Creek upstream antenna, BOX2 = Box Canyon Creek downstream antenna, G90 = lower Gold Creek antenna, IND1= Indian Creek downstream antenna, IND2= Indian Creek upstream antenna, KR1= upper Kachess River upstream antenna, KR2 = upper Kachess River downstream antenna, SFT = South Fork Tieton River antenna, UGC1 = upper Gold Creek upstream antenna, and UGC2 = upper Gold Creek downstream antenna).

Results

Fish Collection

The MCFWCO sampled on two days at the Bumping Dam Stilling Basin, three days at the Kachess Dam Stilling Basin, three days at the Keechelus Dam Stilling Basin, and three days at the Tieton Dam Stilling Basin. Overall, we collected one adult Bull Trout at Bumping Dam, one at Keechelus Dam, two at Tieton Dam, and none at Kachess Dam (Table 2). At Keechelus Dam, we observed three Bull Trout, but were only able to collect one. No Brook Trout x Bull Trout hybrids were collected during our trap and haul efforts in 2020.

Table 2. Stilling basin, survey date, number of Bull Trout observed, and the number of Bull Trout collected during trap and haul efforts in 2020.

Stilling Basin	Survey Date	Bull Trout Observed	Bull Trout Collected
Bumping Dam	8/14/2020	1	1
Bumping Dam	9/30/2020	0	0
Kachess Dam	6/8/2020	0	0
Kachess Dam	7/29/2020	0	0
Kachess Dam	10/19/2020	0	0
Keechelus Dam	9/14/2020	2	1
Keechelus Dam	10/5/2020	1	0
Keechelus Dam	10/19/2020	0	0
Tieton Dam	6/22/2020	0	0
Tieton Dam	7/13/2020	2	2
Tieton Dam	8/5/2020	0	0

In addition to observing Bull Trout during snorkeling, we also observed Chinook Salmon, Cutthroat Trout, Mountain Whitefish, Rainbow Trout, as well as unidentified Dace and Sculpin. Overall, we observed relatively large numbers of Mountain Whitefish, moderate numbers of juvenile Chinook Salmon and unidentified Dace, and small numbers of adult Chinook Salmon, Cutthroat Trout, Rainbow Trout, and unidentified Sculpin (Table 3).

Table 3. Common and scientific names of fish observed while snorkeling in the stilling basins of Bumping, Kachess, Keechelus, and Tieton dams during trap and haul efforts in 2020. Numbers observed from the Tieton Dam Stilling Basin are from fish collected during hook-and-line sampling.

		Stilling Basin			
Common Name	Scientific Name	Bumping	Kachess	Keechelus	Tieton
Chinook Salmon	*Oncorhynchus tshawytscha*				
Adults		2	-	-	-
Juveniles		*	**	-	-
Cutthroat Trout	*Oncorhynchus clarkii*	1	-	-	-
Mountain Whitefish	*Prosopium williamsoni*	***	**	***	-
Rainbow Trout	*Oncorhynchus mykiss*	1	4	1	2
Unidentified Dace	*Rhinichthys* spp.	**	**	-	-
Unidentified Sculpin	*Cottus* spp.	1	-	-	-

*estimated less than 10

**estimated between 10 and 100

***estimated more than 100

Fish Release and Movements

We released Bull Trout in different locations based on the results of our rapid response. The two Bull Trout collected on July 13, 2020 below Tieton Dam were identified as South Fork Tieton River origin and were released into the South Fork Tieton River 1 km upstream of Rimrock Reservoir. The single Bull Trout collected below Bumping Dam was identified as originating from Deep Creek but was released into Bumping Reservoir because Deep Creek water temperature exceeded 15 ˚C and was nearly dewatered (Table 4). The single Bull Trout collected below Keechelus Dam was sampled for genetic origin, but the sample delivery to AFTC was delayed. Therefore, not wanting to hold the fish longer than 48 hours, we released the fish into lower Gold Creek (National Forest Road 4832 bridge) after contacting USFWS Ecological Services (Gregg Kurz, USFWS, personal communication). The fish in question was later identified as a Gold Creek fish. In 2019, 93% (14/15) of the fish collected below Keechelus Dam were identified as Gold Creek fish with a single fish originating in the Kachess River.

Table 4. Capture location, date, length (mm), PIT tag, and genetic population assignment of fish collected through MCFWCO trap and haul in 2020.

Capture Location	Collection Date	Total Length (mm)	PIT tag ID	Population ID
Tieton Dam	7/13/2020	660	3D9.1C2E05CA4A	SF Tieton River
Tieton Dam	7/13/2020	525	3D9.1C2E05D1B3	SF Tieton River
Bumping Dam	7/15/2020	435	3D9.1C2E064E24	Deep Creek
Keechelus Dam	9/14/2020	550	3D9.1C2DFE717E	Gold Creek

At our PIT antenna sites in Gold Creek, we detected the single Bull Trout collected below Keechelus Dam in 2020 and three Bull Trout collected below Keechelus Dam in 2019. The fish we released in 2020 was first detected two days after release at our nearby lower Gold Creek antenna and then again 18 days later at the same location, however, we did not detect it at our upper Gold Creek antenna array. We also detected three Bull Trout that we released into Gold Creek in 2019. The first (3D9.1C2DFE98DE) was a single detection at our lower Gold Creek antenna on June 19. We also detected this fish at our upper Gold Creek antenna array in 2019. The second (3D9.1C2E05F357) we first detected on August 7 at 0127 hours and then for the last time, later that day, at 21:46 hours. The third (3D9.1C2DFE5673), we detected at our lower Gold Creek antenna on September 9, at our upper Gold Creek antenna array on September 25, and then finally on our lower Gold Creek antenna on October 11 (Table 5).

We detected one of the two Bull Trout released into the lower South Fork Tieton River at our South Fork Tieton River antenna. This Bull Trout was detected nine days after release on July 23 (travel rate = 0.8 km/d), and then again on September 18 (Table 5). We have no PIT antennas in Deep Creek (or other Bumping Reservoir tributaries) and therefore did not detect the single Bull Trout released into Bumping Reservoir.

Table 5. PIT tag ID, release location, release date, first and last detections at PIT antenna locations, and water temperature range experienced by Bull Trout between first and last detections in 2020.

PIT tag ID	Release Location	Release Date	Antenna Location	First 2020 Detection Date	Last 2020 Detection Date	Water Temp Range (°C)
3D9.1C2E05D1B3	Lower SF Tieton River	7/14/2020	Upper SF Tieton River	7/23/2020	9/18/2020	7.0 - 16.8[1]
3D9.1C2DFE717E	Lower Gold Creek	9/16/2020	Lower Gold Creek (I-90)	9/18/2020	10/6/2020	9.3 - 14.5
3D9.1C2DFE98DE	Lower Gold Creek	10/1/2019*	Lower Gold Creek (I-90)	6/19/2020	6/19/2020	-
3D9.1C2E05F357	Lower Gold Creek	10/1/2019*	Lower Gold Creek (I-90)	8/7/2020	8/7/2020	-
3D9.1C2DFE5673	Lower Gold Creek	10/1/2019*	Lower Gold Creek (I-90)	9/25/2020	10/11/2020	7.9 - 12.4
			Upper Gold Creek	9/25/2020	10/10/2020	7.6 - 10.9

* - Fish tagged and released in 2019 trap and haul

1 - Temperature range is before first detection from 7/14 - 7/22/2020

Water Temperature

Water temperatures at our antenna sites were generally lowest in February and highest in mid to late summer, however we had some data gaps because we were unable to deploy and download data loggers during the COVID-19 pandemic. At our lower Gold Creek antenna, water temperatures fluctuated daily but generally decreased from 14.5 °C in mid-September to 7.9 °C in late October during the time when Bull Trout were present. During this time frame, mean daily water temperatures decreased from 13.3 °C to 5.3 °C (Figure 5).

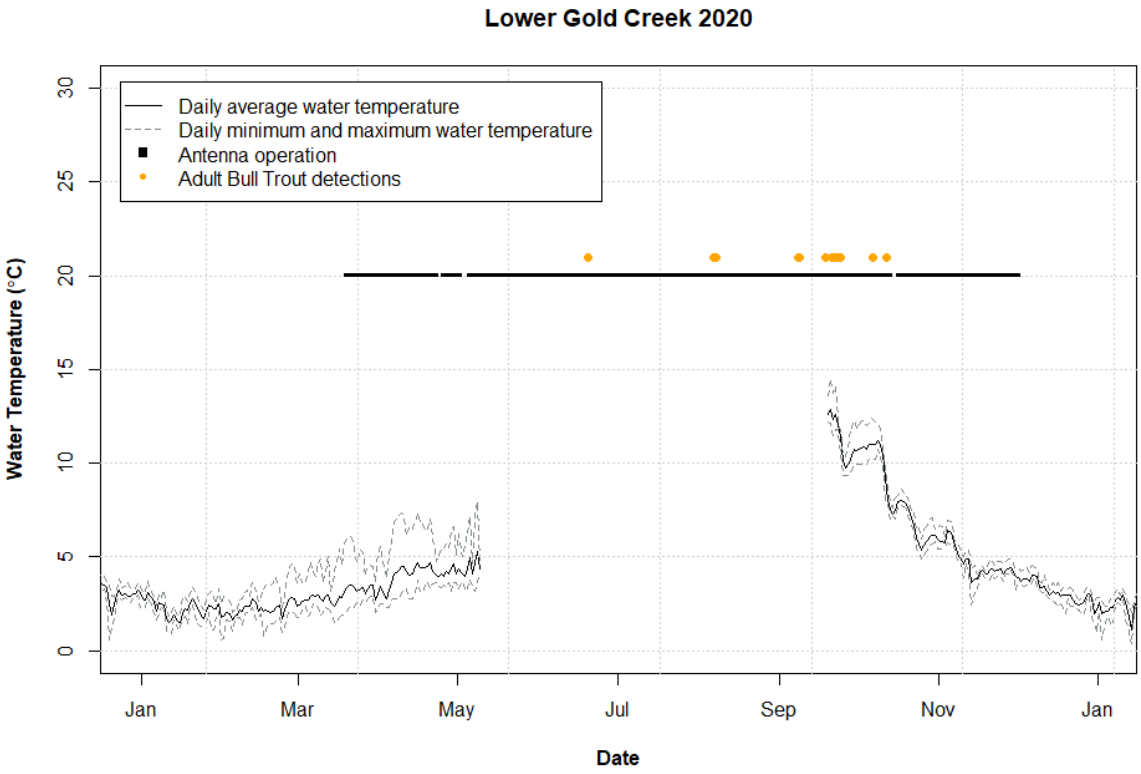

Figure 5. Seasonal change in water temperature, antenna operation, and detections of PIT-tagged adult Bull Trout at the lower Gold Creek antenna (G90) during 2020.

At our upper Gold Creek antenna, water temperature fluctuated daily but decreased while Bull Trout were present from 10.9°C to 7.6 °C. Overall, mean daily water temperatures ranged from a high of 11.4 °C in late August to 1.5 °C in mid-November (Figure 6).

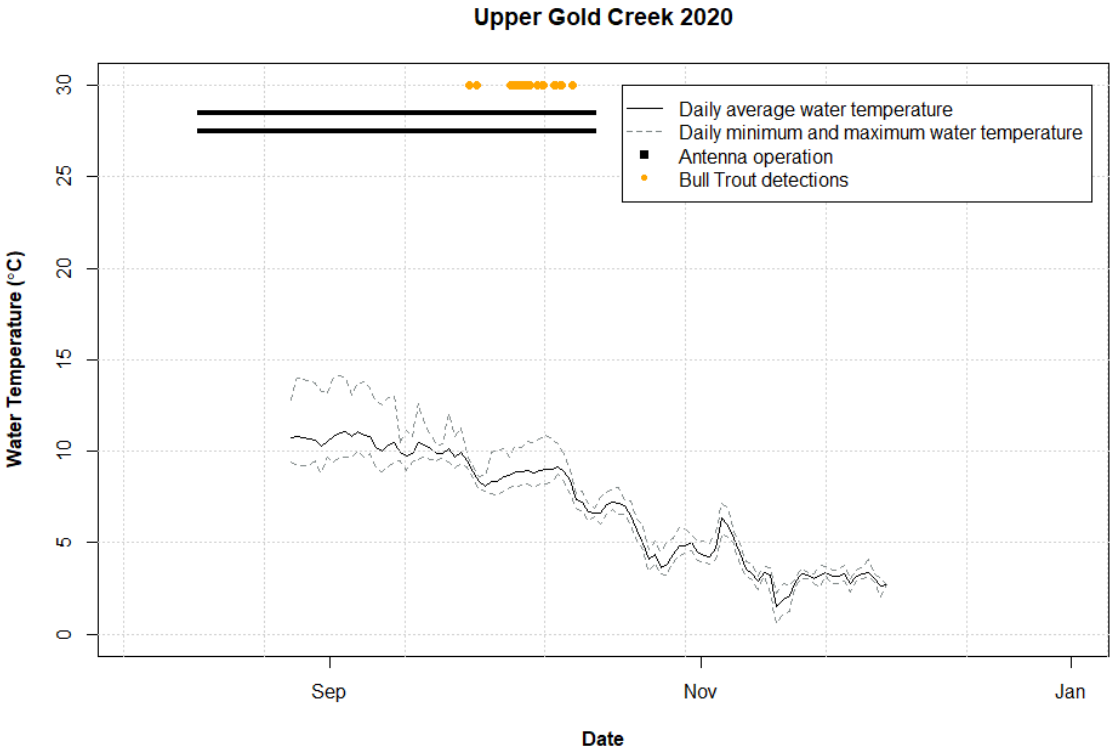

Figure 6. Seasonal change in water temperature, antenna operation, and detections of PIT-tagged adult Bull Trout at the upper Gold Creek antennas (UGC1, UGC2) from August 24 – December 1, 2020.

At our South Fork Tieton River antenna, water temperatures fluctuated from 0.0 to 16.8 °C during 2020. Mean daily water temperatures ranged from a low of 0.0 °C in mid-February to 13.1 °C in late July (Figure 7). The single Bull Trout that we collected and released, migrated up the lower South Fork Tieton to our antenna when the water temperature ranged from 7.0 °C to 16.8 °C at our antenna site, however, we collected no water temperature data during the time period when the fish was upstream of our antenna- presumably to spawn.

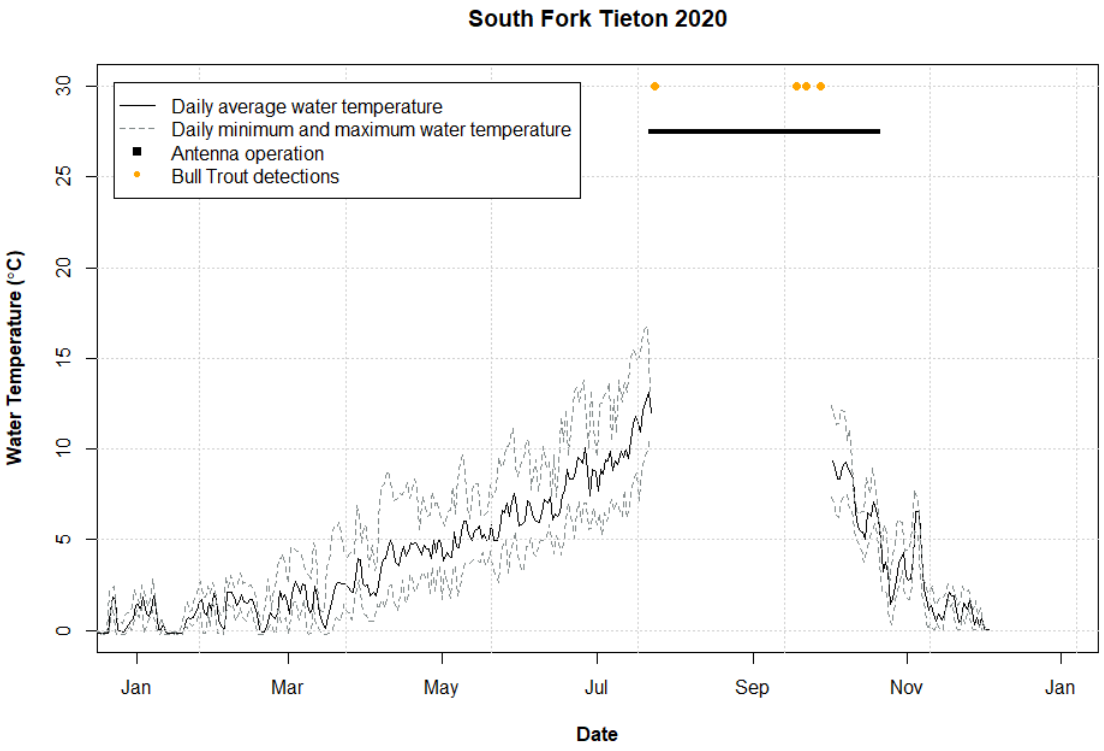

Figure 7. Seasonal change in water temperature, antenna operation, and detections of PIT-tagged adult Bull Trout at the lower South Fork Tieton antenna (SFT) during 2020.

Discussion

Our 2020 data continue to indicate that some Bull Trout originating in tributaries of Kachess, Keechelus, Bumping, and Rimrock reservoirs pass downstream of dams and then attempt to return upstream, presumably to spawn. We collected two Bull Trout below Tieton Dam, one Bull Trout below Keechelus Dam, and one Bull Trout below Bumping Dam. For the second year in a row, we observed no Bull Trout below Kachess Dam, however the fact that a single Bull Trout collected below Keechelus Dam in 2019 was identified as Kachess River origin, indicates that Bull Trout pass Kachess Dam as well. In 2019 we collected fifteen Bull Trout below Keechelus Dam, but during 2020 we only collected one, though we observed two others. Unlike many of the Bull Trout we collected below Keechelus in 2019, the single Bull Trout we collected there in 2020 did not exhibit injuries to the caudal peduncle, maxillaries, and opercles; injuries that we previously associated with rubbing against concrete surfaces.

Of the four Bull Trout that we detected at our lower Gold Creek antenna, only one appears to have migrated upstream past our upper Gold Creek antenna and presumably spawned in upper Gold Creek in 2020. The stretch of Gold Creek between our upper and lower antennas routinely

dewaters in late summer and could have prevented upstream migration to spawning grounds. However, we detected one Bull Trout on June 19. Another of the three was detected eight times on August 7 over the course of about 20 hours and then no more. The last was detected on September 18 and then for the last time on October 6. Therefore, of the three Bull Trout detected on our lower, but not upper, Gold Creek antennas, it appears that one (3D9.1C2DFE717E, first detected on September 18) could have been prevented from migrating upstream due to dewatering as Gold Creek was dewatered between our antennas from at least as early as September 15 until it rained and the creek rewatered on September 23 (Figure 5).

In 2021 we will continue our efforts to collect Bull Trout below Reclamation Dams at the four stilling basins we outlined here. We will continue to look for operational opportunities at these dams to sample when reduced flows outside the typical low flow periods allow us to do so. We are hopeful to complete fabrication and begin operation of a mobile steep pass to collect Bull Trout passively in addition to the netting and hook-and-line sampling outlined here. The steep pass would operate from a double-axle trailer equipped with a generator, pump, false weir, and 10 ft (3.1-m) fishway sections. Depending on initial results, the mobile steep pass could be used at Tieton Dam and if warranted, at Kachess Narrows to collect Bull Trout concurrent with implementation of the Kachess Drought Relief Pumping Plant.

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