NF TIETON BULL TROUT TRANSPORT PROJECT

2016 PROGRESS REPORT

U.S. Fish and Wildlife Service
Mid-Columbia Fish and Wildlife Conservation Office
Yakima Sub-Office
1917 Marsh Road
Yakima, WA 98901

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Authors:

Jeff A. Thomas, Patrick Monk

and Robert Randall

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FOREWORD

A comprehensive assessment of fish passage conditions at Clear Creek Dam was completed in 2015 (Thomas and Monk 2016). The study spanned four years and was conducted by the Yakima Sub-Office of the USFWS Mid-Columbia Fish and Wildlife Conservation Office (MCFWCO). The focal species of the investigation was Bull Trout (Salvelinus confluentus) which were listed as threatened under the ESA in 1998. A population of Bull Trout spawns in the North Fork (NF) Tieton River above Clear Creek Dam. The NF Tieton River is designated Critical Habitat for Bull Trout (69 Fed. Reg. 60070; October 6, 2004).

The NF Tieton Bull Trout Transport Project is a follow-up to the Clear Creek Dam Fish Passage Assessment (CCDFPA) and is based on the findings of that study.

PROJECT LOCATION AND INFRASTRUCTURE

Clear Creek Dam, owned and operated by the U.S. Bureau of Reclamation, impounds Clear Lake, a small reservoir (4,400 acre-feet) on the NF Tieton River in Yakima County, Washington. The concrete structure, 82 feet tall, was built in 1914 without fish passage. During reconstruction work conducted in 1992 two fish ladders were installed in the adjacent spillway channel, the only potential migration route past the dam. This bedrock channel is approximately 540 feet long with three distinct segments based on gradient. The lower segment is approximately 240 feet long with an average gradient of 15 percent. The upper segment is 140 feet long and steeper with an average gradient of 21 percent, but this is somewhat deceiving because the gradient in the lower 70 feet of the segment is 35 percent. In between these two segments is a section of 8 percent gradient approximately 160 feet long.

A fish ladder located in the lower segment on the right bank is actually a series of four denil ladders interspaced with resting pools. The slopes of the four ladder sections range from 12.5 to 45 percent. A pool-and-weir ladder is located in the upper segment of the spillway on the left bank. It contains 11 weirs with a two-foot hydraulic drop from weir to weir. The pool-and-weir ladder, while not built to current criteria, is functional but this is not the case for the denil ladder. It is considered too steep and does not meet accepted criteria so it may have never passed fish with much success (USBR 2004). It most certainly does not now as it has not been maintained for over a decade and is completely clogged with gravel.

Under normal reservoir operations the spillway channel always contains flowing water which originates as surface spill over a concrete weir combined with water coming down the upper ladder. Dam releases into the adjacent outlet channel are made through two gates located 32 and 49 feet below the surface of Clear Lake. Water exits into a deep stilling basin directly below the dam. This water is much cooler in the summer and fall than spillway flow. The two channels are hundreds of feet apart, merging about 300 feet below the lower terminus of the spillway (Figure 1).

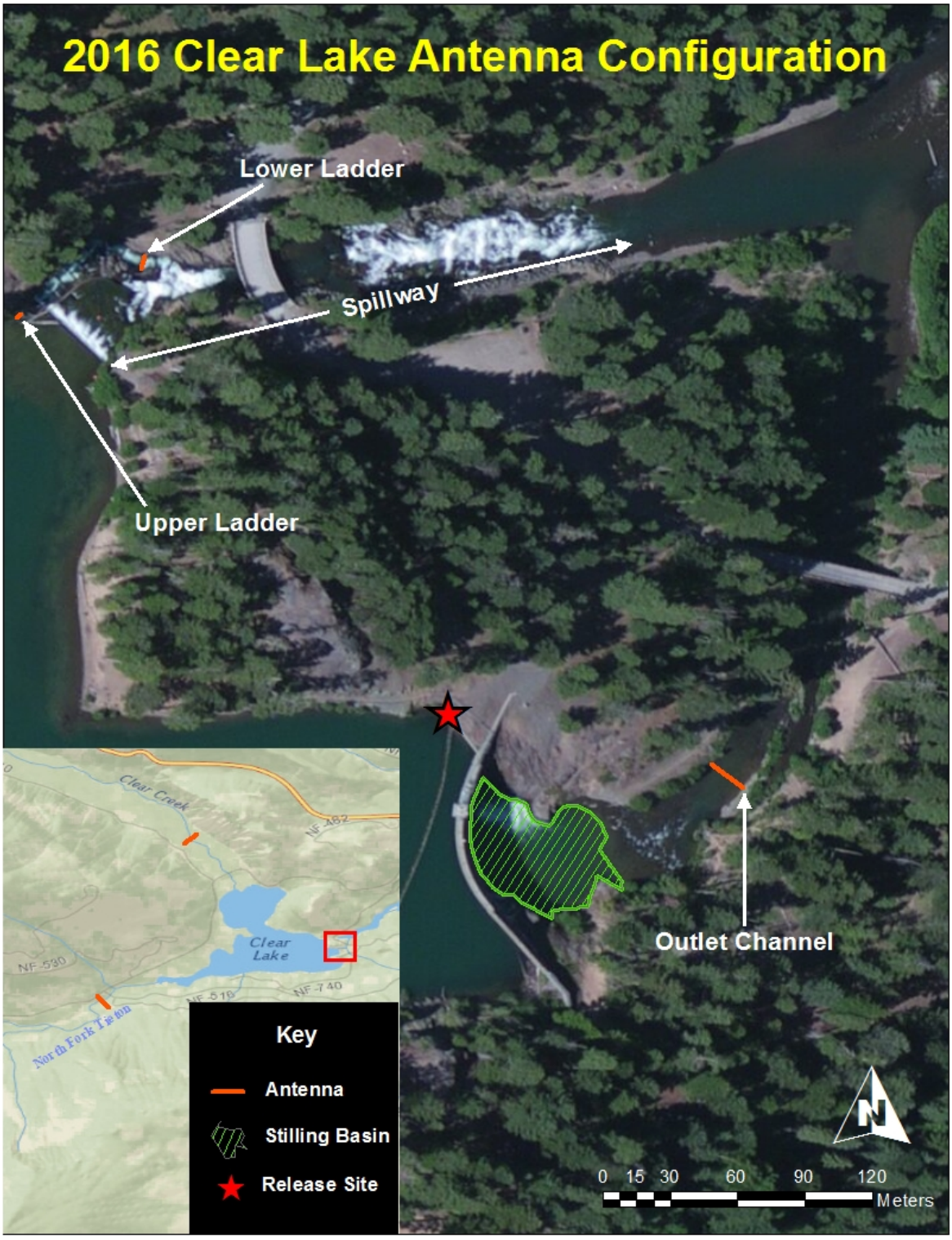

Figure 1. The area around Clear Creek Dam on the NF Tieton River, Yakima County, WA

FISH PASSAGE ASSESSMENT FINDINGS

A total of 28 fish were captured by hook-and-line in the stilling basin below Clear Creek Dam in 2014 and 2015 during two sampling occasions totaling about seven hours (Thomas and Monk 2016). Twenty-five of these were genetically pure Bull Trout which keyed to the NF Tieton River population. Two keyed to one of the other populations which inhabit Rimrock Reservoir downstream of the dam; only one fish captured was a hybrid (Bull Trout x Brook Trout) which was surprising given that 21 percent of the fish captured in the NF Tieton River above the dam during the course of the assessment were hybrids. Twenty-two fish, all NF Tieton Bull Trout, were PIT tagged. These, combined with four tagged in the NF Tieton River which had migrated down the spillway after spawning, brought the known number of PIT tagged NF Tieton Bull Trout present below the dam to 26. None of these fish were subsequently detected completing a migration up the spillway channel although many tried. The assessment concluded that adult Bull Trout could not ascend the lower segment of the channel. A combination of factors contributed to this. Extreme hydraulic conditions occur in the channel over a wide range of flows (Figures 1 and 2) and water temperatures exceeded those considered limiting for Bull Trout distribution (>15°C) from late-spring through early September, the primary migration period. Bypassing the spillway channel, Bull Trout congregated in the stilling basin below Clear Creek Dam where water temperatures were much cooler (Figure 4).

Figure 2. Lower spillway fish passage conditions at high flow.

Figure 3. Lower spillway fish passage conditions at a median flow.

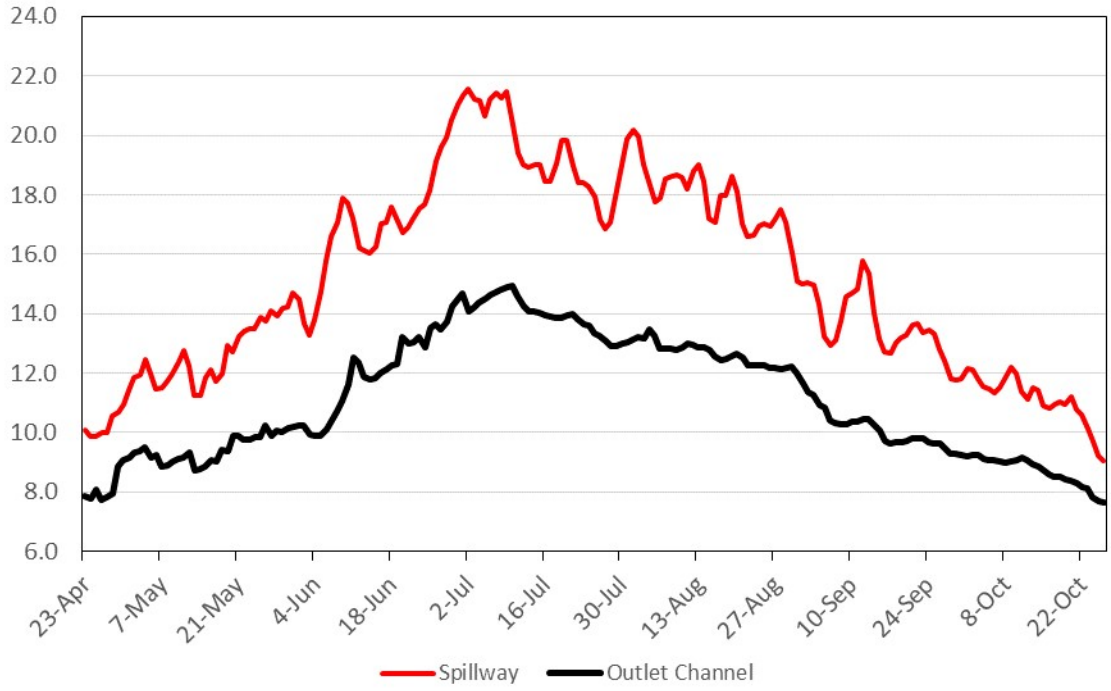

Figure 4. Mean daily water temperatures (°C) from April 23 through the end of October 2015 in the spillway and outlet channels of Clear Creek Dam.

The CCDFPA found that the NF Tieton Bull Trout population is split between two segments which are genetically identical. One segment spawns in the river above Clear Creek Dam and appears to reside in Clear Lake when not migrating to spawn; only four fish were detected migrating downstream via the spillway during four years of study. The other segment resides in Rimrock Reservoir, unable to migrate past Clear Creek Dam to access natal spawning habitat in the NF Tieton River.

The number of NF Tieton Bull Trout which were present in the stilling basin below Clear Creek Dam was significant. Consider that 25 were captured at the site in just seven hours of hook-and-line sampling in 2014 and 2015 compared to 29 captured in a picket-weir box trap deployed in the NF Tieton River upstream of Clear Lake for a total of 58 days in the fall of 2012 to 2014. An estimate of the size of the populations, which was based upon mark-recapture methods, was derived for the spawning population (i.e., fish tagged upstream of Clear Lake) and the segment of the population found below the dam. Using three years of capture data (2012-2014), the maximum likelihood estimate for the size of the spawning population was 59 individuals with a 95% confidence interval of 37-135 (Schnabel, 1938). Using the Chapman method and tagging data from 2014 and 2015, the size of the population found in the stilling basin below the dam was estimated at 71 individuals with a 95% confidence interval of 41-95. Thus, it appears that size of the population segment that resides downstream of Clear Creek Dam is roughly equivalent to the one above.

In response to these findings the MCFWCO (Yakima Sub-Office) decided that efforts were warranted to capture NF Tieton Bull Trout trapped below Clear Creek Dam and transport them above the structure. While a permanent upstream passage solution is in the planning stages as part of the Yakima Basin Integrated Water Management Plan, the construction of these facilities is likely years in the future. Given the relatively small size of the current active spawning population and questions concerning its viability, the North Fork Tieton Bull Trout Transport Project was initiated in the spring of 2016. It is our intention to continue this project into subsequent years until permanent passage facilities are provided or, more likely, a point of diminishing returns is reached.

GOALS AND OBJECTIVES

The ultimate goal of this project is to maintain the genetic diversity and increase the viability of the NF Tieton Bull Trout population by providing passage for fish currently excluded from natal spawning habitat near the headwaters of the NF Tieton River upstream of Clear Creek Dam. To achieve this goal the following objectives were developed:

- Capture adult Bull Trout by hook-and-line in the stilling basin directly below Clear Creek Dam
- Surgically implant Half-Duplex (HDX) PIT tags in captured Bull Trout and obtain tissue samples for later genetic analysis
- Transport tagged fish above the dam and release them

- Utilize fixed PIT tag interrogation sites established in the NF Tieton watershed, and around the dam and spillway, to monitor the movements of tagged fish
- Assess the spawning success of transported fish (future)

METHODS

Capture, Tagging, and Transport

Fish were captured by hook-and-line using large lures or flies with single barbless hooks. Heavy fishing line was used to ensure that fish were landed quickly without a protracted struggle. Captured Bull Trout were scanned to determine if they had been PIT tagged in previous years. If so, those confirmed to be pure NF Tieton Bull Trout were ready for transport (see below). Fish visually identified as possible hybrids were PIT tagged and released just downstream of the stilling basin (if recaptured in a subsequent year genetic data will be available to confirm their status). Untagged fish were placed in an 80-quart cooler and anesthetized. The anesthesia used was tricaine-s (i.e., MS-222) mixed at a 50mg/L concentration with river water. Since MS-222 is acidic, buffer ($NaHCO_3$, i.e., baking soda) was added to the solution to raise the pH back to the baseline level of the river. The pH was measured using a Eutech Instruments pHTestr20®. To ensure the consistency and safety of the solution the cooler was pre-marked to hold 25 liters of water and the amounts of MS-222 (1.25 grams) was premeasured and kept in individual bottles.

The fish were measured, photographed, sexed, and a small tissue sample was taken from the pectoral fin which was preserved in 100% ethanol. A scalpel was used to make a one-half inch vertical incision just posterior and ventral to the pectoral musculature near the end of the pectoral fin. This incision penetrated only the epidermal layer under which an HDX PIT tag was horizontally inserted. We used 23 mm x 3.65 mm tags (manufactured by Texas Instruments, Inc.) operating on the 134.2 kHz radio frequency identification standard for animal tagging. The tag was gently pushed in between muscle and skin towards the tail of the fish until barely visible, at which point a straw was used to implant it about one inch further. This surgical procedure was simple and did not require any sutures. After being placed in the anesthetic solution, full anesthetization usually occurred within 7-10 minutes. The time required to work each fish was between 5-7 minutes. Fish were transported in a large cooler filled with fresh cold water secured in the back of a pickup truck. They were transported two or three at a time with each transport run taking less than 10 minutes. The fish were released in deep water adjacent to Clear Creek Dam (Figures 5 and 6).

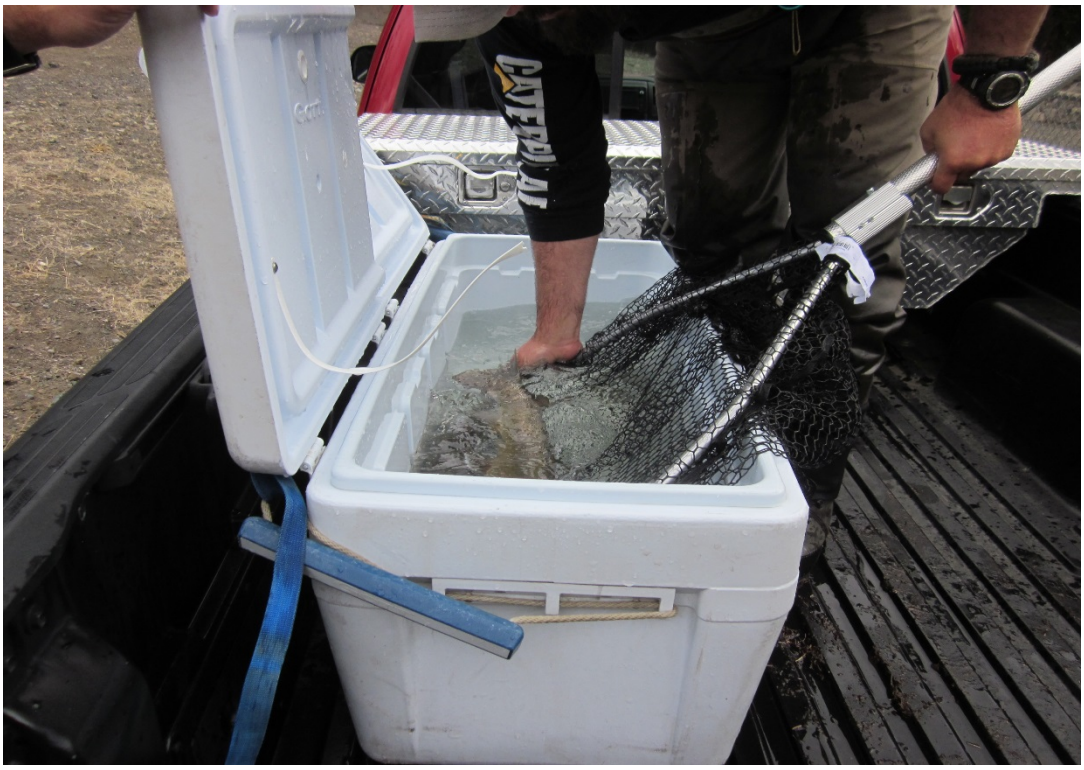

Figure 5. Transport of adult Bull Trout to Clear Lake above Clear Creek Dam.

Figure 6. Release of adult Bull Trout into Clear Lake adjacent to the Clear Creek Dam.

MONITORING MOVEMENTS OF TRANSPORTED BULL TROUT

Five PIT tag detection arrays were operated in 2016 (Figure 1). Three were antennas that were used during the fish passage assessment and all had to be rebuilt after being destroyed by flood flows in early December, 2015. Two were located in the pool-and-weir ladder, one at the exit into Clear Lake (Upper ladder) and one seven weirs below the top (Lower ladder). The third was in the NF Tieton River (0.75 mi. above Clear Lake). New arrays were established in the outlet channel of the dam approximately 70 meters below the stilling basin and in Clear Creek (another tributary to Clear Lake) about a half-mile up from the mouth. The construction materials and electronic components, installation methods, and power supply details for all of these antennas were similar (if not identical) and were described in the final report for the CCDFPA (Thomas and Monk 2016).

All detection arrays were established and operational as soon as flow conditions would allow and prior to the time they were needed to accomplish the objectives of the project. The antennas were shut down when the power supply became consistently inadequate (i.e., reliable solar charging of the batteries became impossible due to low light conditions). This varied between sites. The operational windows for all of these antennas appears below:

Upper Ladder	May 10-December 2
Lower Ladder	May 10-October 24
Outlet Channel	May 24-October 25
NF Tieton	June 1-October 24
Clear Creek	June 29-October 5

The detection arrays were powered by six-volt batteries recharged with solar panels. They were susceptible to short-term power outages on successive cloudy days and from both topographical and forest canopy shading. Solar panels were placed such that maximum solar exposure could be achieved but it was not possible to avoid occasional power outages, particularly in the hours just before dawn. The most challenging site was on Clear Creek which was located in dense forest. Still, this site had sufficient power for PIT tag detection 80% of the time from July 7, the date when the first transported Bull Trout were released above the dam, to the date when the site was shut down on October 5. The operational efficiencies of the other detection sites from July 7 to site decommissioning was as follows: Upper ladder (100%); Lower ladder (89%); Outlet channel (100%); and NF Tieton River (92%).

Assessing Spawning Success of Transported Bull Trout

The accomplishment of this objective will be difficult. It will require considerable manpower and will be logistically complex. For those reasons it exists as a proposal at this time. Since it requires genetic sampling of the offspring of transported Bull Trout the effort cannot commence until sufficient progeny are produced. In our estimation this could occur by 2018 at the earliest.

The migration of translocated Bull Trout into, and out of, the NF Tieton River will be monitored. These data will provide some indication of their intent to spawn but not of their success. Bull Trout spawning surveys have been conducted in the river annually since 2007 and this practice will continue. These surveys provide a measure of spawning population abundance and it should be expected that an increase in the number of redds observed annually would occur if significant numbers of transported fish are entering the spawning population. However, complete redd surveys are often difficult to conduct on the NF Tieton River. Survey conditions can change rapidly with glacial runoff and precipitation events influencing visibility and access.

For these reasons neither redd count trends, nor PIT tag data, provide direct evidence of successful spawning by transported individuals (Dehaan and Bernall 2013). We propose to use genetic parentage analysis to document spawning success of adult Bull Trout in the NF Tieton River. These data will also provide information on the reproductive contribution of fish that are transported and for making preliminary inferences about spawning behavior of transported adults.

Juvenile Bull Trout may rear in the NF Tieton for 1-4 years before migrating downstream while some fish may remain as permanent residents although this has not been confirmed. In order to evaluate spawning success, electrofishing and/or snorkel surveys will be conducted to collect genetic samples (fin clips) from juvenile fish. The samples will be preserved in 100% ethanol for subsequent analysis by the WDFW Molecular Genetics Laboratory in Olympia, Washington. Samples will be collected annually, possibly beginning in 2018.

RESULTS

Capture, Tagging, and Transport

Thirty-two Bull Trout[1] were captured below the dam by hook-and-line in 2016 over the course of five sampling dates spaced a week apart and beginning on July 7. The first sampling date produced the most captures (14). The next four dates each produced 4-5 captures. On the first four sampling dates (July 7, 13, 20 and 27) capture efforts began around 9:00 AM and continued for 4-5 hours; all ended when no additional fish were caught for an extended period (about an hour). The last sampling on August 3 was conducted beginning at dusk. The effort was curtailed after three hours with just four fish caught. Other species captured included three Rainbow Trout (*Oncorhynchus mykiss*), one Brook Trout (*S. fontinalis*), and one West Slope Cutthroat Trout (*O. clarki lewsii*).

Just two of the fish captured in 2016 were recaptures of Bull Trout previously tagged below the dam, both females tagged in 2015; the other 30 were new encounters. The total lengths (TL) of these fish ranged from 32.5 to 70 centimeters. From visual inspection, it appeared that twelve

[1] Without genetic analysis, which would occur later, it was not possible to determine if the fish was a pure Bull Trout or a hybrid (Brook T**o**ut x Bull Trout) at the time of capture

were females and eight were males (we were unsure of the sex of ten fish). Thirty fish were transported above the dam and released into Clear Lake. Two fish, while tagged, were not transported. Suspicious markings (Figure 7) led us to believe these fish might be hybrids (Brook Trout x Bull Trout). Since this could not be confirmed at the time and we did not want to transport a hybrid fish, they were released downstream. A list of all fish captured below Clear Creek Dam in 2016 is presented in Table 1.

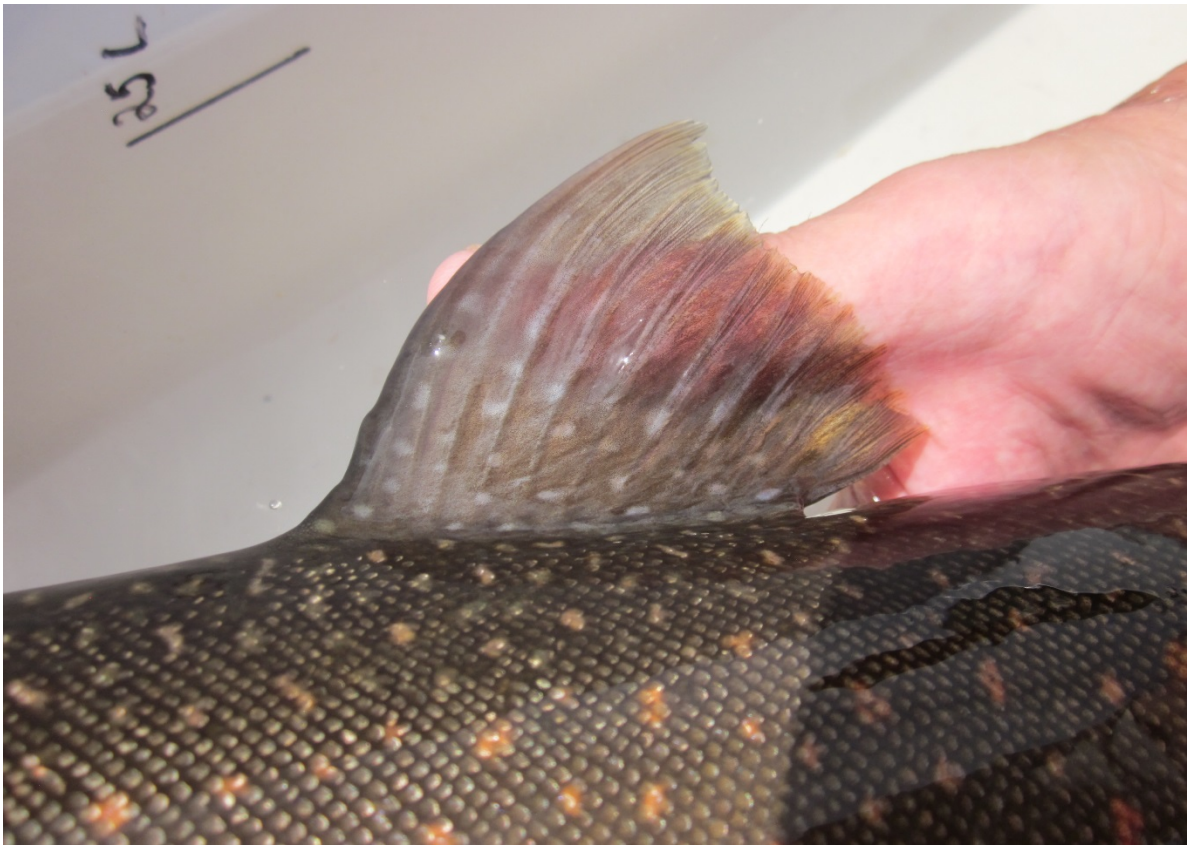

Figure 7. Dorsal fin of a Bull Trout captured below Clear Creek Dam on July 27, 2016 which was suspected to be a hybrid (Brook Trout x Bull Trout). Pure Bull Trout normally have clear fins. This fish was not transported above Clear Creek Dam.

Genetics

The genetic analyses of 30 tissue samples acquired from Bull Trout tagged below Clear Creek Dam in 2016 was conducted by WDFW's Molecular Genetics Lab with a final report issued in December, 2016 (Small et al. 2016). The results were surprising. Thirteen of the thirty belonged to one of the other genetically distinct populations inhabiting Rimrock Reservoir (five from the SF Tieton River and eight from Indian Creek). All but one of these fish were transported, it being the suspected hybrid pictured above which was actually a pure Indian Creek Bull Trout. The other suspected hybrid which was not transported turned out to be a pure NF Tieton Bull Trout. In fact, only one hybrid (Brook x Bull Trout) was captured in 2016. It was not visually detected at the time of capture and was thus tagged and transported.

Table 1. Bull Trout captured in the NF Tieton River downstream of Clear Creek Dam, 2016. The red shading denotes suspected hybrids which were not transported. The fish identified with blue shading was the only hybrid captured.

No.	Date	Sex	TL (cm)	Genetic Origin	Notes
1	7-July	Female	53.0	NF Tieton	Transported
2	7-July	Female	52.5	NF Tieton	Transported
3	7-July	Unknown	43.5	NF Tieton	Transported
4	7-July	Female	54.0	NF Tieton	Transported
5	7-July	Unknown	35.5	SF Tieton	Transported
6	7-July	Unknown	32.5	NF Tieton	Transported
7	7-July	Female	61.0	NF Tieton	Transported
8	7-July	Female	44.0	NF Tieton	Transported
9	7-July	Male	70.0	NF Tieton	Transported
10	7-July	Unknown	45.5	NF Tieton	Transported
11	7-July	Female	47.0	NF Tieton	Released downstream
12	7-July	Female	60.0	Hybrid	Transported
13	7-July	Male	56.0	NF Tieton	Transported
14	7-July	Male	39.0	SF Tieton	Transported
15	13-July	Unknown	35.0	SF Tieton	Transported
16	13-July	Unknown	38.0	NF Tieton	Transported
17	13-July	Female	47.0	Indian Creek	Transported
18	13-July	Unknown	38.0	SF Tieton	Transported
19	20-July	Unknown	45.5	Indian Creek	Transported
20	20-July	Male	48.5	NF Tieton	Transported
21	20-July	Female	54.0	NF Tieton	Transported
22	20-July	Female	61.0	NF Tieton	Transported

No.	Date	Sex	TL (cm)	Genetic Origin	Notes
23	20-July	Female	58.0	NF Tieton	2015 recap, Transported
24	27-July	Unknown	41.0	Indian Creek	Transported
25	27-July	Unknown	46.0	SF Tieton	Transported
26	27-July	Male	62.0	Indian Creek	Released downstream
27	27-July	Male	47.5	Indian Creek	Transported
28	27-July	Male	48.0	Indian Creek	Transported
29	3-Aug	Male	53.5	Indian Creek	Transported
30	3-Aug	Female	45.0	Indian Creek	Transported
31	3-Aug	Female	68.5	NF Tieton	Transported
32	3-Aug	Female	53.0	NF Tieton	2015 recap, Transported

Water Temperatures

In 2016, water temperatures were recorded every two hours in the spillway and outlet channels as well in the NF Tieton River and Clear Creek. As was the case during previous years, water temperatures in the spillway channel were much warmer than those in the outlet channel (Figure 8). Data were not available after August 25 for the spillway due to an undetected malfunction of the temperature logger but it is reasonable to assume that a similar temperature difference existed between the two channels as that which was observed in 2015 (see Figure 4). By August 25 there was just a 0.4°C difference in the mean daily water temperature in the spillway channel between 2015 and 2016 while the average difference in the outlet channel was 0.1°C from August 26 through the end of October. During the period when capture and transport efforts were underway (July 2-August 3) mean daily water temperatures averaged nearly five degrees cooler in the outlet channel (11.5 versus 16.3°C).

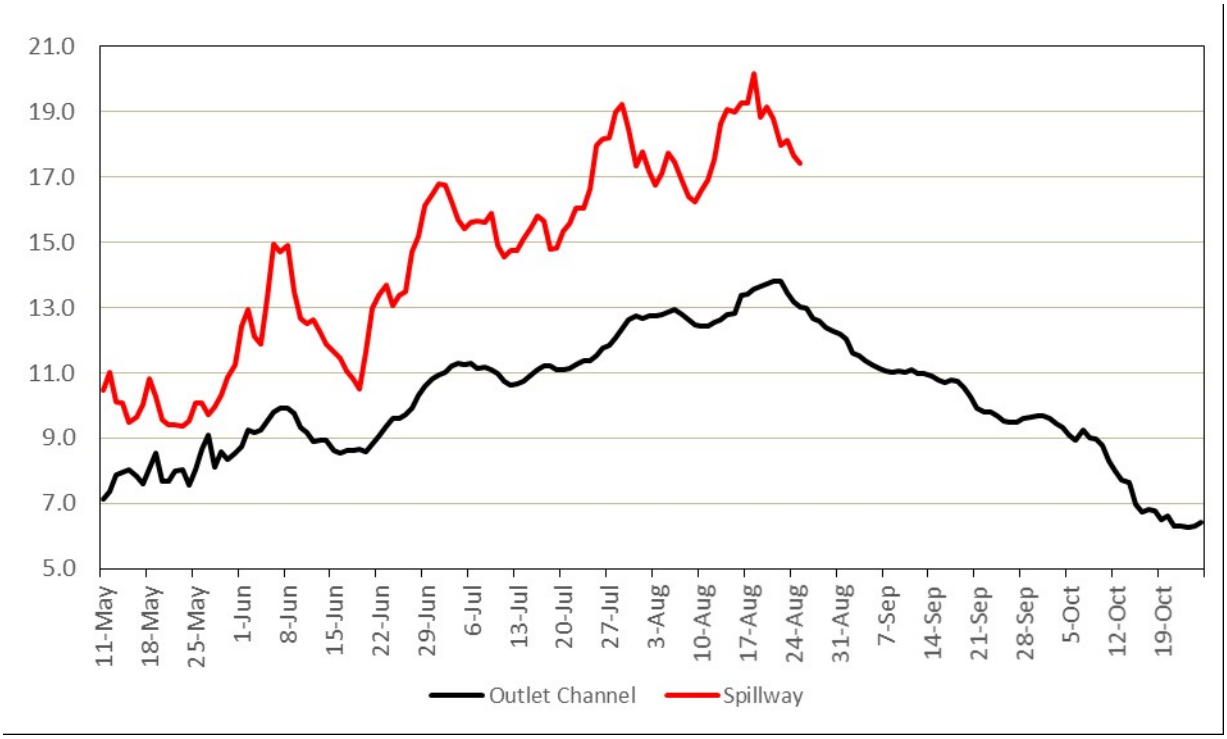

Figure 8. Mean daily water temperatures (°C) from May 11 through the end of October 25, 2016 in the spillway and outlet channels of Clear Creek Dam. An undetected malfunction of the temperature logger precluded data collection after August 25 in the spillway channel.

Although Bull Trout had never been observed in Clear Creek, we postulated that transported fish might enter the creek if water temperatures were suitable. A logger was deployed in Clear Creek on July 2 which recorded water temperatures for three months. The data show that excessively warm temperatures would not be a concern for Bull Trout. Mean daily water temperatures were 3.7°C less on average than those recorded in the NF Tieton River over the period with minimal variability (Figure 9). If anything, Clear Creek might be too frigid to support adequate growth (~10-12°C) for juvenile Bull Trout. Water temperatures in the NF Tieton River, as was the case during the fish passage assessment, were suitable for Bull Trout.

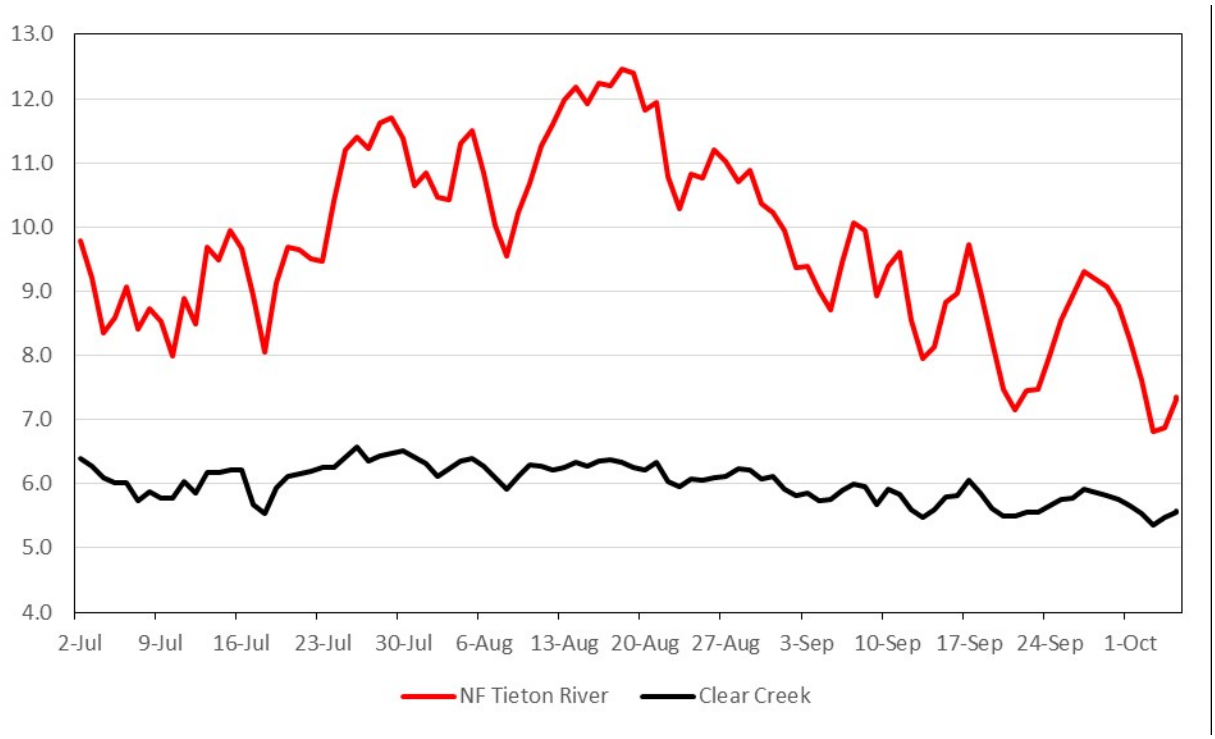

Figure 9. Mean daily water temperatures (°C) from July 2 through October 5, 2016 in the NF Tieton River and Clear Creek.

Movements of Transported Bull Trout

Eight of the 30 fish transported in 2016 were not subsequently detected at any of our PIT tag interrogation sites. These included the two recaptures from 2015, both confirmed to be pure NF Tieton Bull Trout. Also among the no-shows were three of the five SF Tieton Bull Trout and two of the seven Indian Creek fish. The last of the undetected Bull Trout was a NF Tieton fish tagged on July 7.

Of the 22 fish that were later detected, 21 were detected up the NF Tieton River. Ten of these were NF Tieton Bull Trout which were up the river within four days of their release into Clear Lake, seven making the one-mile journey by the next day. Also making a rapid migration (less than four days) was the lone hybrid transported (of NF Tieton origin) and surprisingly, one SF Tieton Bull Trout and one from Indian Creek.

Of the remaining eight Bull Trout detected up the river, four were NF Tieton Bull Trout which showed up about a week after release, another SF Tieton fish a bit later, and three Indian Creek Bull Trout that were later still. These three Indian Creek fish were also detected in Clear Creek, all having gone back and forth between the streams multiple times. Only one of the 22 fish transported and subsequently detected did not migrate up the NF Tieton River. It was an Indian Creek Bull Trout detected in Clear Creek just once (September 16). All four Bull Trout detected in Clear Creek were Indian Creek fish. An accounting of the PIT tag detections of the 22 Bull Trout detected after transport is presented in Table 2.

Table 2. PIT tag detections of 22 Bull Trout tagged and transported above Clear Creek Dam in 2016. Red tag numbers are fish which genetically keyed to the SF Tieton River and blue tag numbers represent Indian Creek fish. The grey shaded number was a hybrid (Brook x Bull Trout).

Tag	Date	NF Tieton	Clear Creek	Upper	Lower Ladder
224	7-Jul	8-Jul, 14-Sep			
270	7-Jul	8-Jul, 1-Oct			
273	7-Jul	8-Jul			
315	7-Jul	11-Jul, 2-Oct			
330	7-Jul	15-Jul, 14-Sep		17-Sep	19-Sep, 25-Sep,
343	7-Jul	8-Jul			
384	7-Jul	13-Jul, 1-Oct			
403	7-Jul	13-Jul, 20-Sep		18-Oct	18-Oct
455	7-Jul	9-Jul			
459	7-Jul	8-Jul			
196	13-Jul	29-Jul, 4-Oct			
200	13-Jul	22-Jul, 5-Oct			
322	13-Jul	18-Jul, 26-Jul, 5-Aug,	7-Aug, 8-Aug, 16- Sep	24-Sep	24-Sep
222	20-Jul		16-Sep		
226	20-Jul	20-Jul, 1-Oct			
235	20-Jul	21-Jul, 2-Oct			
261	20-Jul	23-Jul, 30-Sep			
230	27-Jul	2-Oct	5-Aug, 10-Sep, 12-Sep,	18-Oct,	
256	27-Jul	29-Jul			
386	27-Jul	31-Jul, 23-Sep			
259	3-Aug	21-Sep	30-Aug, 4-Sep, 5-Sep,		
378	3-Aug	4-Aug, 2-Oct			

Emigration

Four of the transported Bull Trout detected up the NF Tieton, appear to have emigrated back to Rimrock after the spawning period. Of these, two were Indian Creek fish and two were NF Tieton Bull Trout. Three were detected at both the upper and lower ladder PIT tag detection arrays with the lower ladder being the last. The fourth fish was detected at the upper ladder site on October 18 and 30 but we could not confirm movement downstream because we had decommissioned the lower ladder antenna on October 26. That we confirmed three Bull Trout had emigrated downstream (with a fourth possible migrant) in 2016 was noteworthy; during the previous four years of tracking Bull Trout for the fish passage assessment only four were confirmed to have emigrated downstream of Clear Creek Dam. All of those post-spawn Bull Trout had been PIT tagged nearly seven miles up the NF Tieton River.

Fish Kill

On a visit to the PIT tag interrogation site in the outlet channel on September 20 it was obvious that a fish kill had occurred. Hundreds of dead and dying Kokanee Salmon (*O. nerka)* were found. Observing dead Kokanee in this location was not unusual as the species spawns in the outlet channel during that time of year and dies afterward. However, the number observed was surprising. Further, three fresh adult Bull Trout carcasses were found, one in the stilling basin and two others about 0.5 mile downstream. Tissue samples acquired from these fish and genetically analyzed confirmed them to be Indian Creek Bull Trout (Small et al. 2016). The water in the basin, usually very clear, was off-color and opaque but did not have an unusual odor.

The cause of the kill has not been determined but evidence points to oxygen deprivation. Campers who had been in the area for several days confirmed that dying fish had been floating past their campsite for two days. They described fish with flared gills that seemed to be struggling to breathe, a condition we had also observed. We postulated that Clear Lake may have turned over resulting in anoxic conditions in the depths of Clear Lake where water released through the gates of the dam originates. This hypothesis gained some credibility because no dead fish were found in the spillway channel. However, it is not backed up by water temperature data which would be expected to show an increase in temperatures in the outlet channel if the lake had turned over. This increase did not occur (see Figure 8). Considering contaminants, there were no reported spills and even the possibility that one might have occurred is more than unlikely as only forest roads, and no rail lines, are in the vicinity. In addition, a fish kill was not observed in Clear Lake.

An event such as this had not been observed over the course of the four-year fish CCDFPA although one of very limited duration might have gone unnoticed. Hoping 2016 was an anomaly, water quality conditions will be monitored going forward to determine the cause should it happen again.

DISCUSSION

Overall, the 2016 NF Tieton Bull Trout Transport Project was a success. This success was measured not only in the number of NF Tieton Bull Trout transported above an impassable dam but also in the lessons learned to improve the effort going forward. Our goal was to transport at least 30 genetically pure fish so that they could join the active spawning population above the dam. While we did transport 30 fish we missed that goal by 13. Yet supplementing a Bull Trout population of apparently limited size with an additional 17 potential spawners was significant. In the six years when since 2007 when it was possible to conduct complete redd surveys in the NF Tieton River an average of 23.5 redds were observed.

During the tagging below the dam in 2014 and 2015 a combined total of 28 fish were captured and only one was a Brook Trout/Bull Trout hybrid. This pattern was repeated in 2016 with just one of 32 captured being a hybrid. However, the large number of Bull Trout captured from one of the other two populations present in Rimrock Reservoir was not expected. While only two "foreigners" had been caught the previous two years, 13 were in 2016 (all but one were transported). While these Bull Trout could return to Rimrock (two did) and there would be no harm if they spawned with the NF Tieton population, we still find this unacceptable. This is based, in part, on the fact that redd counts for the Indian Creek population have significantly declined over the last couple of years and we do not want to limit the chances of reversing this trend. Therefore, we have contracted with the USFWS Abernathy Fish Technical Center in Longview, Washington to conduct a rapid genetic assay of fish we capture in 2017. The assay will require that captured fish be held for a couple of days to determine their genetic origin but will ensure that only pure NF Tieton Bull Trout are transported.

To meet a goal of transporting at least 30 NF Tieton fish, and considering that a significant number we capture may be from another population, it is obvious that the number caught must increase. This was already becoming evident in 2016 when our catch per unit effort decreased markedly after the first sampling date. It is quite possible that despite their aggressive predatory reputation, Bull Trout learn from past experience and display some avoidance to lures used in angling for them. Consider that of the 22 fish tagged below the dam in 2014 and 2015 only two were recaptured in 2016; eight others were detected in the outlet channel but were not subsequently caught. This suggests that many Bull Trout are not inclined to attack artificial prey (i.e. lures) after they have seen them multiple times or have some recollection of what happened the last time they did. In order to increase our capture numbers in 2017 we will employ the use of small mesh tangle-nets.

In 2016, the average size of the fish PIT tagged was 7 cm (TL) less than those tagged in 2014 and 2015 (49 cm vs. 56 cm) and the minimum size nearly 8 cm less (32.5 cm vs. 44 cm). In 2015 a 38.5 cm fish was deemed too small to tag (HDX PIT tags are just over 2 cm long). In 2016 we elected to tag five fish smaller than that (avg. 35.8 cm). Three of them were detected up the NF Tieton River in both July and September indicating they may have stayed to spawn. Somewhat uncertain before, we are now confident that smaller Bull Trout can be successfully tagged. We will however adhere to a 30 cm minimum length going forward.

The ultimate goal of this project is to maintain the genetic diversity and increase the viability of the NF Tieton Bull Trout population by providing passage for currently excluded members to natal spawning habitat in the NF Tieton River upstream of Clear Creek Dam. A key objective is to determine the reproductive contribution (i.e. spawning success) of transported Bull Trout. As was previously mentioned in this report, a future endeavor will be to conduct a genetic parentage analysis from genetic samples acquired from juvenile Bull Trout collected in the river. This being the first year that fish were transported, such an analysis will only be possible when the progeny of transported fish are present in meaningful numbers.

So what level of analysis might be possible in the interim? Given the inherent annual variability of redd counts for any Bull Trout population, which is certainly evident for those in the Yakima Basin, looking for a short-term increase in the number of redds observed is not the answer. This is particularly true for the NF Tieton River where redd surveys are complicated by the remoteness of the spawning area and the dynamic nature of the river. It is common to reach the spawning area in the Goat Rocks Wilderness and find the main channel from the previous year abandoned and a new one located a significant distance across the valley floor. Side channels appear and disappear on an annual basis. Complicating matters further, it is often impossible to conduct complete surveys due to the rivers “flashy” hydrology and turbidity issues (the river derives from glaciers in the Goat Rocks and is often clouded with glacial flour). In short, it is a very difficult place to conduct redd surveys. What local biologists consider complete surveys have been conducted in six of the last ten years. Redd counts have ranged from a high of 37 in 2007 to 11 in 2011 (average 23.5). Twenty-one redds were found in 2016, down from 27 the year before. However, an small unnamed tributary which had produced over half of the 2015 redds had none in 2016; it had been rendered inaccessible after flood flows the previous winter saw the creek abandon a well-defined channel to follow several flow paths that were shallow and undefined. Bull Trout seeking to return to that creek in 2016 could have easily spawned in undetected areas elsewhere as the entire channel pattern in the mainstem had changed as well. So while the 2016 count was technically considered complete there were definite qualifications to that designation.

Transported Bull Trout which were detected at out PIT tag detection array in the NF Tieton River provided some indication of an intent to spawn but considering the detection site was just 0.75 mile up the river (over eight miles downstream of the primary spawning area) it does not indicate they actually spawned. However, 11 of the 14 NF Tieton Bull Trout detected at the site showed up shortly after their release into Clear Lake and were detected again, on average, 72 days later (range: 59-85 days). None were detected between the time of their presumed migration upstream and subsequent migration downstream. This duration of stay in the river, while not definitive, provides reason to believe that these fish were there to spawn.

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