Lewis River Bull Trout (*Salvelinus confluentus*) Annual Operations Report

P8 bull trout - 2020

North Fork Lewis River – 2020

Merwin	*FERC No. 935*
Yale	*FERC No. 2071*
Swift No. 1	*FERC No. 2111*
Swift No. 2	*FERC No. 2213*

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1.0 INTRODUCTION

PacifiCorp and the Public Utility District No. 1 of Cowlitz County, Washington (Cowlitz PUD) (collectively the Utilities) are involved in various bull trout (*Salvelinus confluentus*) and salmonid monitoring programs on the North Fork Lewis River in southwest Washington. These monitoring programs and this Report are designed to meet requirements pursuant to Article 402 in the Utilities' Federal Energy Regulatory Commission (FERC) operating licenses for the Merwin, Yale, Swift No. 1 and Swift No. 2 hydroelectric projects as well as requirements pursuant to sections 4.9, 9.6 and 14.2.6 of the Lewis River Settlement Agreement (SA). This Report and listed monitoring programs also serve to meet requirements contained in the 2006 Biological Opinion issued to PacifiCorp and Cowlitz PUD by the U.S. Fish and Wildlife Service (USFWS, 2006).

All activities are developed in consultation with the USFWS. This Report provides results from programs that are either ongoing or have been completed in 2020. For methods and general descriptions of all programs please refer to the Bull Trout Annual Operating Plan for the North Fork Lewis River 2020 that was submitted to the USFWS, members of the Lewis River Aquatic Coordination Committee (ACC) and FERC within the ACC/TCC Annual Report in April 2020 (PacifiCorp, 2019).

2.0 STUDY AREA

Bull trout monitoring activities are performed on the North Fork Lewis River and its tributaries upstream of Merwin Dam commencing at river mile (RM) 19.5 and ending at Lower Falls, a complete anadromous and resident fish barrier at RM 72.5. The North Fork Lewis River above Merwin Dam is influenced by three reservoirs created by hydroelectric facilities; 4,000 acre Merwin Reservoir, 3,800 acre Yale Reservoir, and the largest and furthest upstream 4,600 acre Swift Reservoir. From Lower Falls downstream, the North Fork Lewis is free-flowing for approximately 12 miles until the river reaches the head of Swift Reservoir at RM 60. A map of the study area for all programs is shown in Figure 2.0-1.

Bull trout are found in all three reservoirs as well as the Swift No. 2 Power Canal, with the bulk of the population residing in Swift Reservoir. Only three known bull trout spawning streams are found in the study area; Rush and Pine Creeks, tributaries to the North Fork Lewis River upstream of Swift Reservoir, and Cougar Creek a tributary to Yale Reservoir. Recent genetic analysis performed in 2011 identified three distinct local populations residing within the basin; Rush, Pine, and Cougar Creek bull trout (Dehaan and Adams 2011).

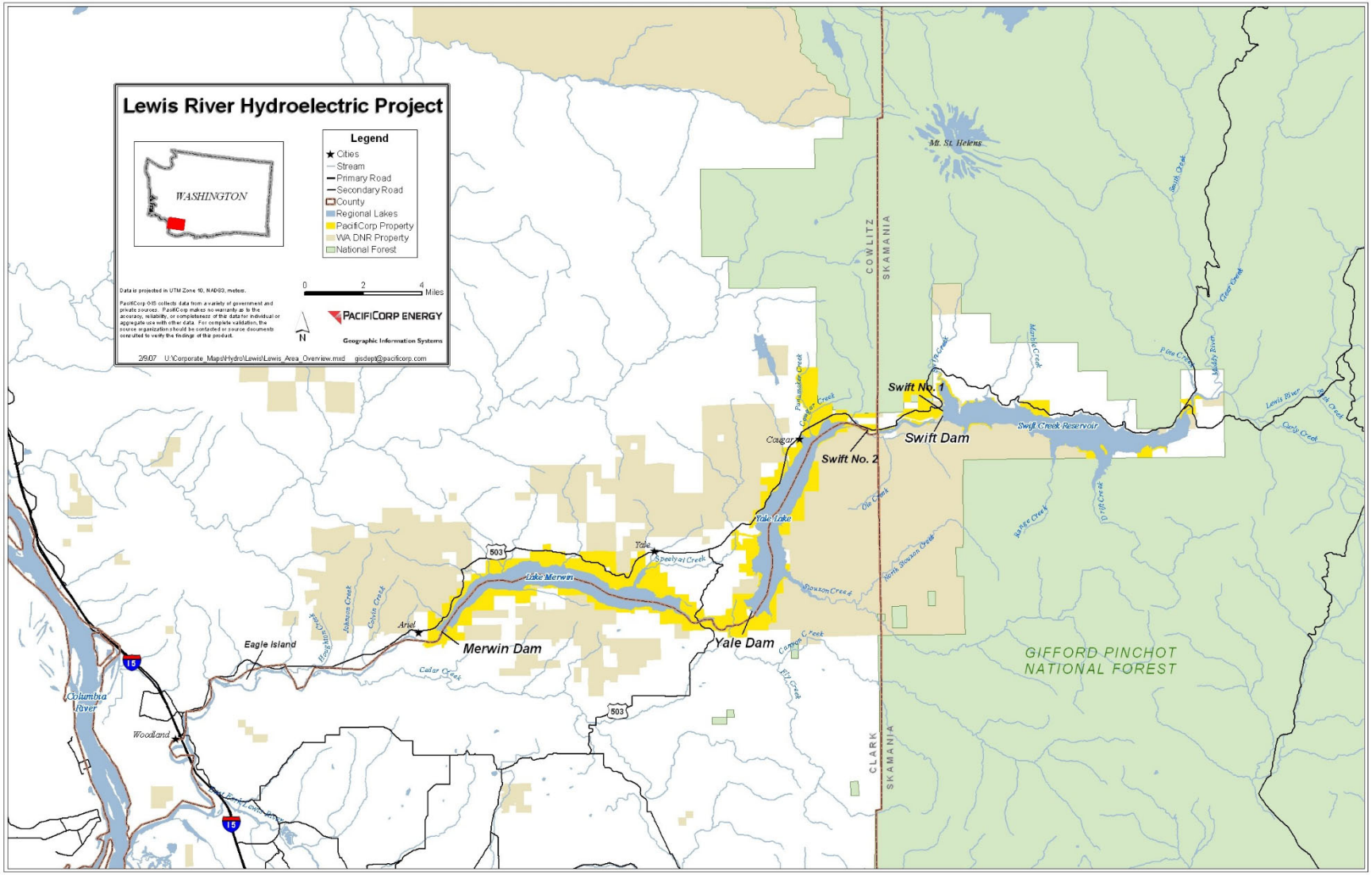

Figure 2.0-1. Map of North Fork Lewis River study area.

3.0 RESULTS FROM 2020 PLANNED ACTIVITIES

During 2020 the Utilities participated in, funded, or initiated six monitoring programs.

- Swift Reservoir Survival (S), bull trout migration, and juvenile bull trout collection (Nb)
- Full-duplex Passive Integrated Transponder (PIT) tag wagon wheel antennas in Pine, P8, Muddy, Rush, Rush Pool, mainstem above Rush, and Cougar creeks
- Yale Tailrace collection and transport
- Pine, P8, Rush, and Cougar creeks redd surveys
- Collection and tagging efforts within the Swift Bypass Reach; underwater video camera in Cougar Creek
- Summer/fall stream temperature monitoring of bull trout pertinent areas upstream of Swift Reservoir

3.1 FERC PROJECT LICENSE ARTICLE 402(B) AND LEWIS RIVER SETTLEMENT AGREEMENT SECTION 9.6 – SWIFT RESERVOIR BULL TROUT POPULATION EVALUATION

3.1.1 ESTIMATE OF THE NUMBER OF STAGING BULL TROUT THAT MIGRATED UP THE NORTH FORK LEWIS RIVER FROM THE HEAD OF SWIFT RESERVOIR

EAGLE CLIFFS BULL TROUT COLLECTION (MARK):

Compelling data was presented in 2016 that highlighted the numerous handling opportunities that could befall bull trout within Swift and Yale Reservoirs and the negative impact this handling is presumed to have on long-term survival (Pers. Comm. Robert Al-Chokhachy, 2016 data analysis). The Utilities in Consultation with the USFWS and the Lewis River Bull Trout Recovery Team (LRBTRT), which is a group comprised of representatives from the Washington Department of Fish and Wildlife (WDFW), United States Department of Agriculture-Forest Service (USDA-FS), United States Geological Survey (USGS) and USFWS, decided in 2016 to place Eagle Cliffs marking activities on a once every three-year cycle. 2019 marked the first year since the three-year cycle was put in place that capture and handling activities were completed at Eagle Cliffs. As such, no marking activities were conducted in 2020 with the next round slated for 2022.

SNORKEL SURVEYS OF THE CONFLUENCE AREAS OF MUDDY RIVER, PINE, AND RUSH CREEKS WITH THE NORTH FORK LEWIS RIVER, AS WELL AS THE NORTH FORK LEWIS RIVER AT HEAD OF SWIFT RESERVOIR:

Snorkel surveys of the three confluence areas and North Fork Lewis River at the head of Swift Reservoir occurred from June 25 to July 24 for a total of four surveys (Table 3.1.1-1). Surveys were slated to continue through the month of August, but poor water clarity after the July 23 survey precluded any additional surveys (Figure 3.1.1-1).

Snorkel surveys of the Muddy, Pine, and Rush confluence areas began upstream of each confluence in the North Fork Lewis and continued downstream until bull trout were no longer observed, usually a distance of approximately 100m. Given the short distance between the mouth of Pine Creek and the Muddy River, this area was also surveyed for bull trout during each confluence survey day. Snorkel surveys of the Eagle Cliffs area of the North Fork Lewis River started from just above the highway bridge to a quarter mile below the bridge (Figure 3.1.1-2).

Figure 3.1.1-1. Poor water conditions at the Rush Creek Pool, July 30, 2020. Poor water clarity persisted for remainder of survey season.

Table 3.1.1-2. 2020 bull trout snorkel survey results for the Muddy River, Rush and Pine Creeks confluence areas as well as Eagle Cliffs area of North Fork Lewis River.

	Rush pool		Muddy pool		Pine pool		Eagle Cliffs area	
	>450 (mm)	<450 (mm)	>450 (mm)	<450 (mm)	>450 (mm)	<450 (mm)	>450 (mm)	<450 (mm)
6/25/2020	0	0	0	6	0	6	0	33
7/8/2020	1	3	1	15	0	2	2	36
7/16/2020	0	8	3	14	0	3	1	19
7/23/2020	2	9	0	6	0	11	0	20

Figure 3.1.1-2. Snorkel sites (for recapture) associated with the Swift Reservoir bull trout migration estimate

3.1.2 EVALUATION OF SURVIVAL (S) OF SWIFT BULL TROUT POPULATIONS THROUGH THE USE OF PIT TAG DETECTIONS

Further analysis of Survival (S) of the 2020 Swift Reservoir bull trout populations can be found in the Memo: Patterns of bull trout *Salvelinus confluentus* demography, life-history and abundance in the North Fork Lewis River—2020 Annual Report, located in Appendix A of this Report.

3.1.3 EVALUATION OF THE GENETIC ESTIMATION OF BREEDER POPULATION FOR SWIFT RESERVOIR BULL TROUT (N_B)

Estimates of breeder population size through means of genetic markers (N_b) is the precursor to an eventual estimate of effective population size (N_e). Estimation of Effective Population can provide information on the level of genetic variation within a population and how fast genetic variation may be lost through genetic drift (Luikart et al. 2010). The effective population size represents the size of an ideal population that would have the same rate of loss of genetic variation as the observed population (Wright 1931). Although general guidelines for minimum effective population sizes have been suggested (e.g., the 50/500 rule; Franklin 1980), evaluating temporal trends in estimates of N_e are often more useful than determining whether a population meets some minimum threshold number. For example, a population that shows a large decrease in N_e over the course of one or two generations could be experiencing a genetic bottleneck or decline in abundance. Alternatively, an increase in effective size following implementation of new management actions could be one indication that the population is responding positively (Pers. Comm. Pat DeHaan, USFWS).

Activities pursuant to the assessment of a genetic estimate of breeder population size (N_b) for bull trout within Swift Reservoir were performed in 2020. N_b is performed as part of the bull trout demographic characteristics evaluation objective within Section 17 of the Monitoring and Evaluation Plan. In 2020, per the direction of the LRBTRT, lab analysis of gathered genetic tissue for genetic estimation of spawner abundance for eventual Effective Population estimation was performed. Juvenile surveys were also conducted in order to assess relative abundance of bull trout and reintroduced anadromous juvenile fish species and their associated interaction. Tissue samples were taken of all captured age 0 bull trout for N_b analysis.

To evaluate N_b, genetic tissue from juvenile bull trout from the same cohort (presumably age 0) was attained from utilized spawning tributaries (Rush, Pine, and Cougar Creeks, Figures 3.1.3-1 to 3.1.3-3). In order to get maximum genetic representation, fish captures were spatially balanced as much as practical along the length of usable habitat within each stream. Surveys were timed such to ensure capture of prior year's brood fish, with less than 70 mm fork length the cut-off used to determine age 0 bull trout (Fraley/Shepard 1989).

Areas within Rush Creek were sampled with a backpack electrofishing unit on July 9th, 13th, and 25th (Figure 3.1.3-1). In all, 33 juvenile bull trout were captured and sampled for genetic tissue. 26 of the captures were less than 70 mm fork length and assumed to be of 2019 brood year origin.

The length range of the age 0 bull trout was 27 mm – 50 mm, with an average fork length of 40 mm.

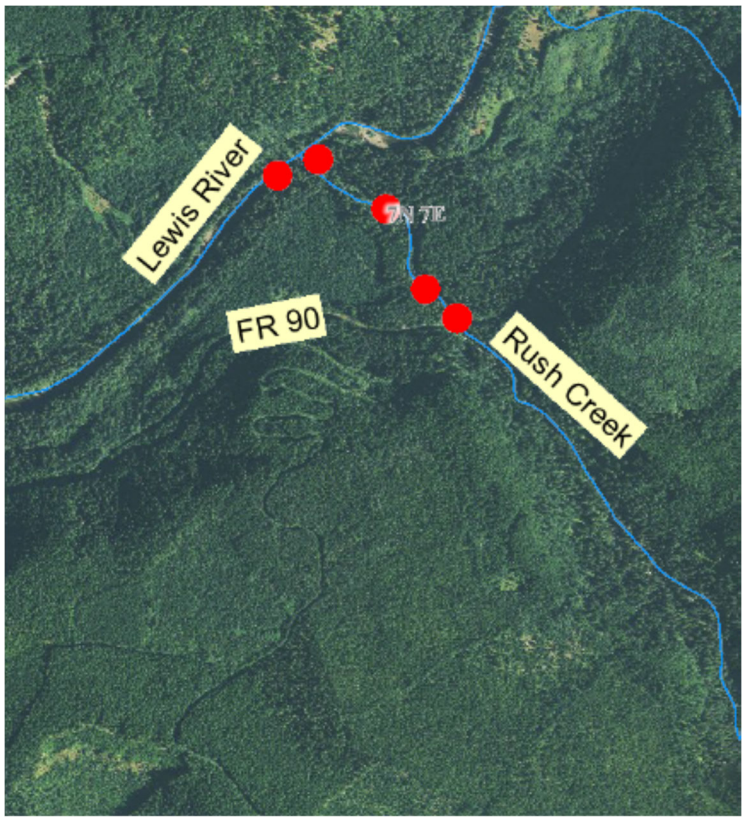

Figure 3.1.3-1. Electrofishing sites within Rush Creek during 2020 juvenile bull trout collection.

Areas within Pine Creek and tributary P8 were sampled for juvenile bull trout with a backpack electrofisher on June 24th and 30th, and July 7th (Figure 3.1.3-2). In all, 79 juvenile bull trout were captured from within P8 ranging from 40 – 64 mm fork length with an average fork length of 57 mm. 118 juvenile bull trout were captured from within areas of Pine Creek mainstem ranging in size from 48 – 70 mm fork length with an average of 59 mm.

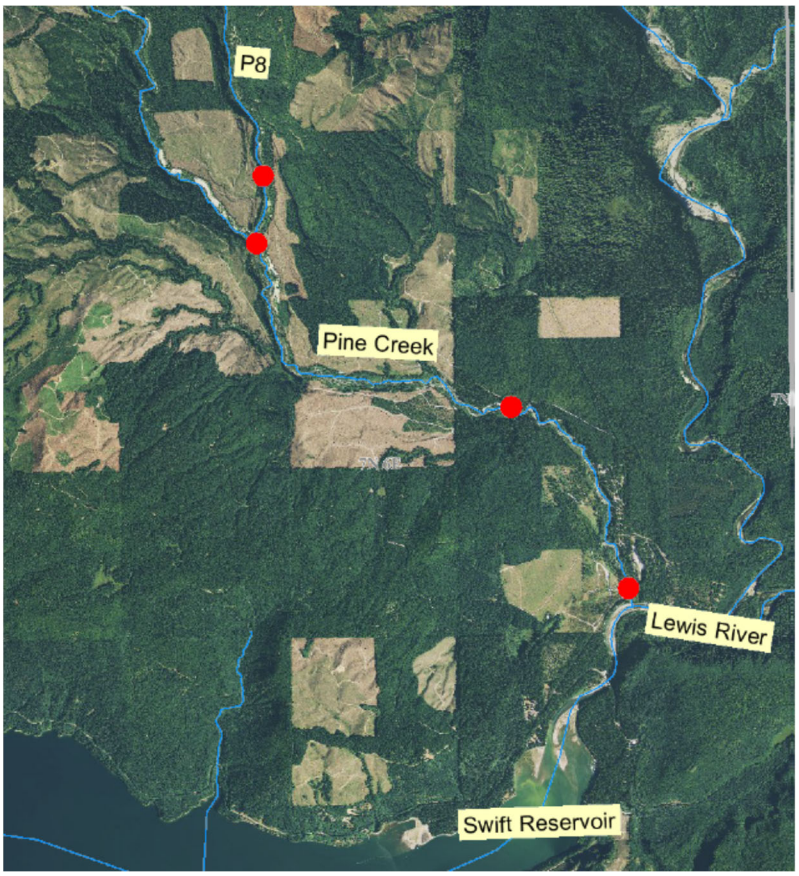

Figure 3.1.3-2. Electrofishing sites within the Pine Creek system during 2020 juvenile bull trout collection.

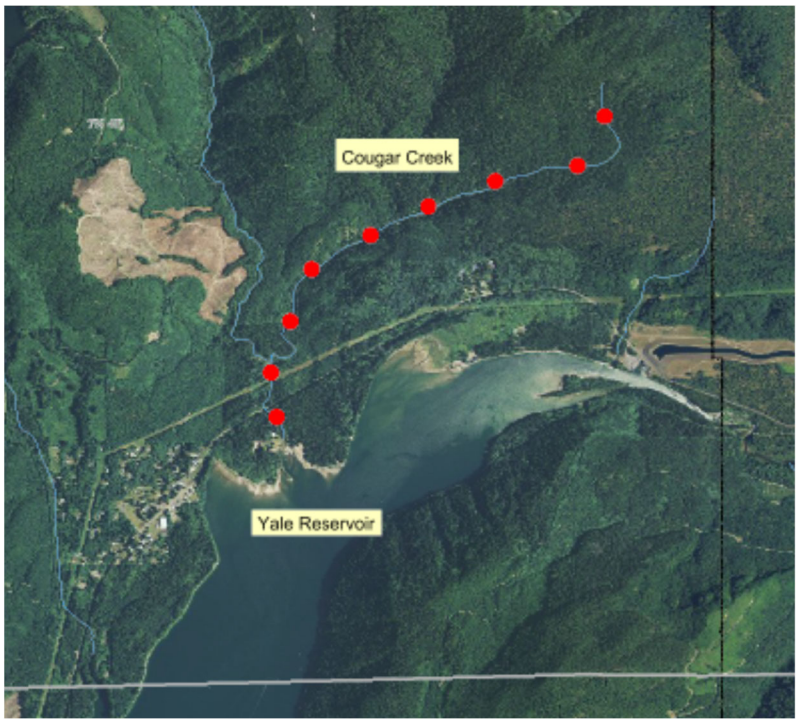

Figure 3.1.3-3. Electrofishing sites within the Cougar Creek system during 2020 juvenile bull trout collection.

Areas within Cougar Creek were sampled with a backpack electrofishing unit on June 23rd and August 12th (Figure 3.1.3-3). In all, 27 juvenile bull trout were captured and sampled for genetic tissue. The length range of captured age 0 bull trout was 43 – 87 mm, with an average fork length of 67 mm (Figure 3.1.3-4).

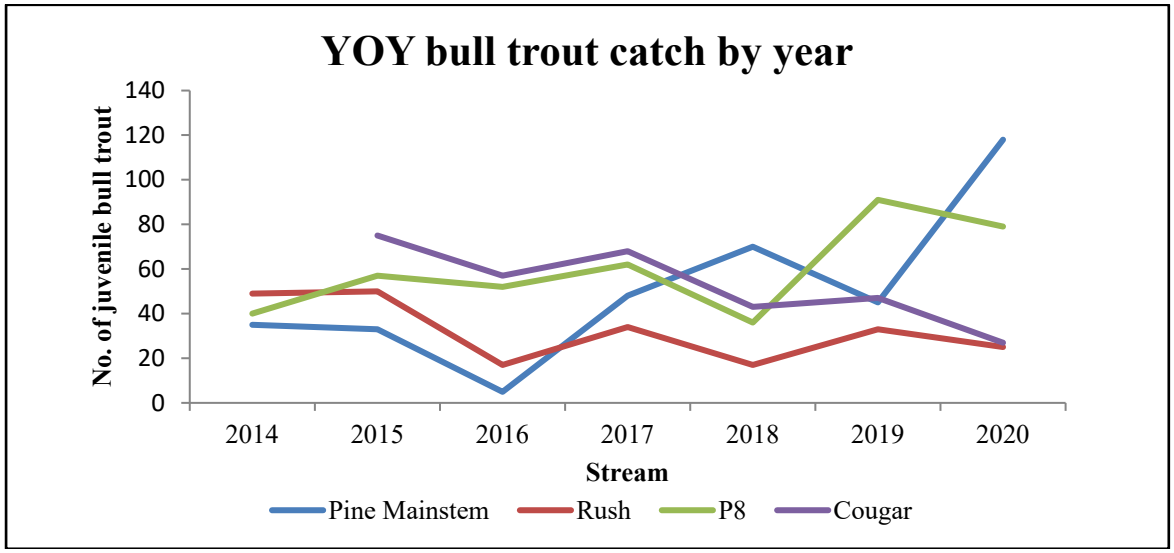

Figure 3.1.3-4. Trend bull trout juvenile catch during stream electrofishing surveys. Cougar Creek was not surveyed in 2014.

As part of monitoring and evaluation of anadromous salmon and steelhead reintroduction efforts, a rotary cone screw trap was also operated at the head of Swift Reservoir in the area of the Eagle Cliff pool in 2020. This single 2.4 m diameter cone screw trap was operated from March 13 – June 30 in 2020. Emigrating bull trout juveniles were inadvertently captured during screw trap operations, data analysis of bull trout capture is provided in Table 3.1.3-1 and catch by year in Figure 3.1.3-5.

Table 3.1.3-1. Historical Eagle Cliff screw trap bull trout captures and data analysis.

					Length (mm)				
Year	**Location**	**Trap operation dates**	**Range of capture dates**	**Number captured**	**Median**	**SD**	**Mean**	**Min**	**Max**
2013	Eagle Cliff	3/28-6/30	3/29-6/21	16	137	24	126	98	220
2014	Eagle Cliff	3/18-7/2	3/26-6/4	9	131	46	121	77	265
2015	Eagle Cliff	3/25-6/1	4/12-5/11	4	139	30	120	103	180
2016	Eagle Cliff	3/24-6/30	4/4-6/16	6	160	18	141	115	157
2017	Eagle Cliff	4/20-7/30	5/10 - 6/27	19	120	26	157	130	200
2018	Eagle Cliff	3/13-6/30	3/20-6/24	55	125	37	106	45	149
2019	Eagle Cliff	3/15-7/19	3/15-7/13	32	136	58	110	25	217
2020	Eagle Cliff	3/15-7/15	3/30-7/8	42	125	16	123	87	180

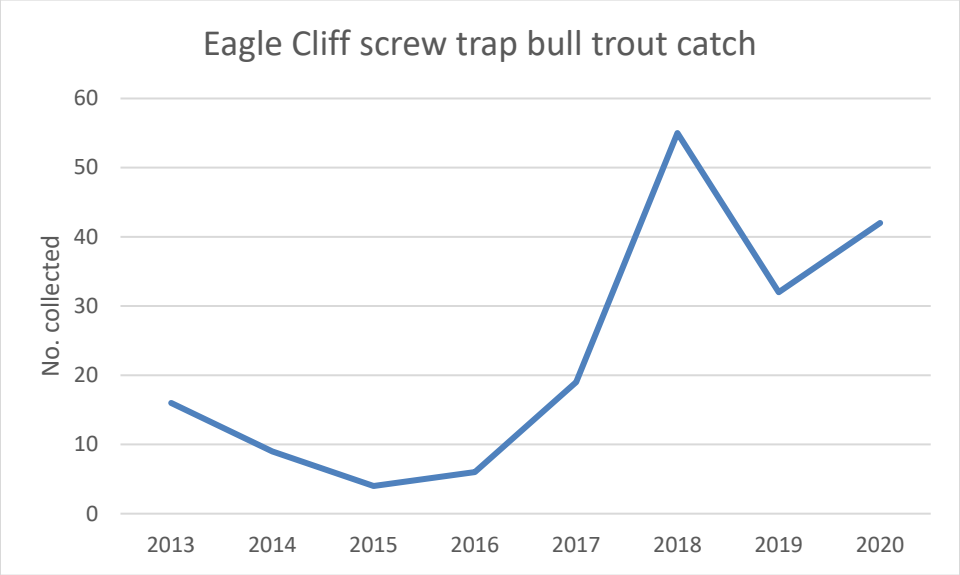

Figure 3.1.3-5. Eagle Cliff screw trap bull trout catch by year.

Monitoring and Evaluation Plan Objective 18; juvenile bull trout/coho interactions

Numerous young of the year (YOY) coho were also found to be occupying the same habitat as YOY bull trout in the Rush and Pine creek systems above Swift Reservoir and as such were inadvertently captured during electrofishing surveys. These coho were quantified and measured to their caudal fork as part of activities pursuant to Objective 18 within the M&E Plan, evaluation of resident/anadromous fish interactions. Juvenile coho captured within the Rush and Pine creek drainages were progeny of adults released above Swift Reservoir as part of the ongoing anadromous reintroduction program.

Coho YOY dominated the catch in all areas electrofished within the mainstem of Pine Creek and tributary P8; few coho were encountered within Rush Creek, and no coho were encountered or observed within Cougar Creek in 2020. Pine Creek mainstem had a total coho catch of 225; P8 a catch of 85 and Rush a total coho catch of 8. There was a paucity of other species encountered, with the occasional steelhead (*Oncorhynchus mykiss*) or coastal cutthroat trout (*Oncorhynchus clarkii*).

The Pine Creek mainstem coho catch corresponds to a YOY bull trout catch of 118 and a difference in overall collected of 48 percent more YOY coho. The P8 coho catch corresponds to a YOY bull trout catch of 79 and a difference in overall collected of 8 percent more YOY coho. Far fewer coho YOY were encountered in Rush Creek, where the coho catch represented only 20 percent of the total (Figure 3.1.3-6).

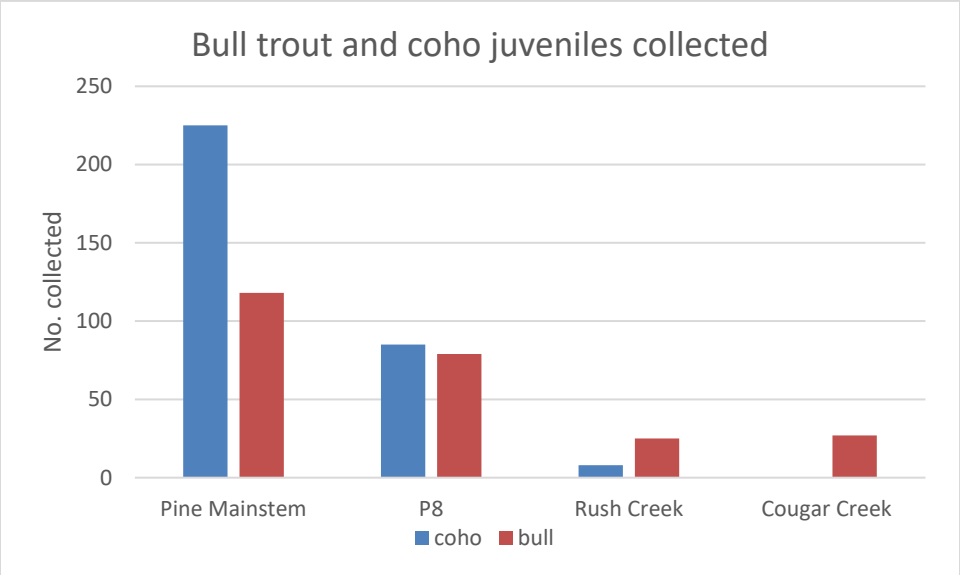

Figure 3.1.3-6. Coho and bull trout juvenile capture numbers by stream of capture in 2020.

Size of coho YOY in terms of average fork length was also assessed and compared to that of YOY bull trout occupying the same habitat within the Pine and Rush creek systems. Coho YOY were marginally larger than bull trout YOY in Pine Creek mainstem and tributary P8, while coho YOY in Rush Creek were substantially larger than encountered bull trout YOY (Figure 3.1.3-7).

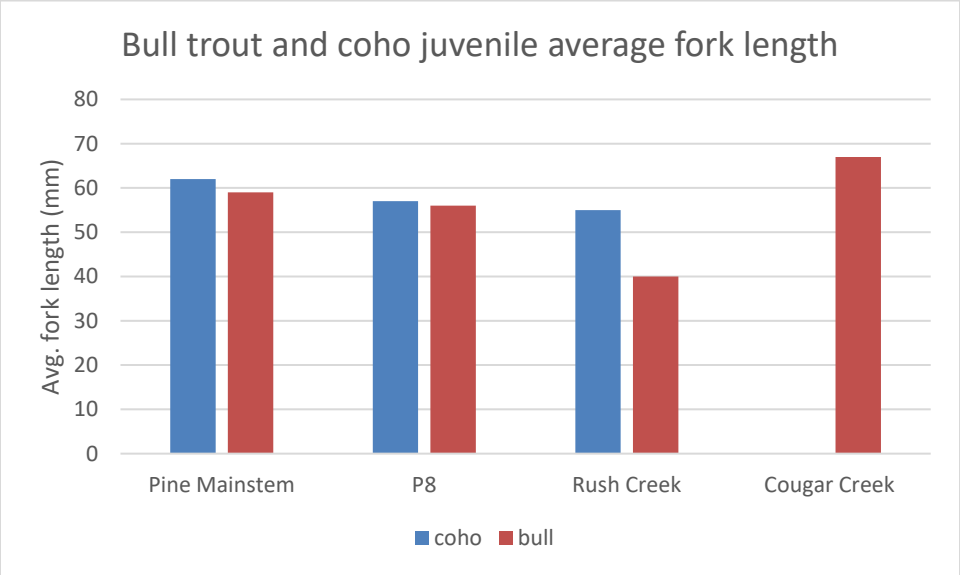

Figure 3.1.3-6. Juvenile coho and bull trout captures average fork length observed in 2020.

3.2 LEWIS RIVER PASSIVE INTEGRATED TRANSPONDER TAG ANTENNA ARRAYS

3.2.1 EVALUATION OF SWIFT AND YALE RESERVOIR BULL TROUT THROUGH THE USE OF SIX FOOT DIAMETER WAGON WHEEL FULL-DUPLEX PASSIVE INTEGRATED TRANSPONDER ANTENNAS IN MUDDY RIVER, RUSH POOL, LEWIS RIVER ABOVE RUSH, RUSH, P8, PINE AND COUGAR CREEKS

6' diameter wagon-wheel PIT tag antennas manufactured from Biomark® were placed in the Muddy River, Rush pool, North Fork Lewis River above Rush, Pine, P8, Rush, and Cougar creeks in the late summer through fall time period (Figures 3.2.1-2 and 3.2.1-3). 13 wagon wheel antennas in total were installed at stream sites. Three in Cougar Creek, three in Pine Creek, one in P8, two in the Muddy River, two in Rush Creek, one in Rush pool, and one in the mainstem Lewis River above Rush pool. All wagon wheel antennas were secured to the stream bottom by means of a wire tether attached from the antenna to a vertically driven piece of rebar in the stream bottom, except for the antenna in Rush pool, which was fixed to the stream bottom by means of an attached anchor. All antennas had long wire leashes attached to the downstream end of the antenna and run to an anchor point, usually a large tree, above the high water mark. In the unlikely event the antenna broke free from the anchoring rebar or anchor, the long leash would ensure the antenna was not lost (Figure 3.2.1-1).

Figure 3.2.1-1. Wagon wheel PIT antenna in operation at Pine Creek tributary P8, 2020.

Each wagon wheel submersible antenna was fully self-contained with no power leads or wires connected to the stream bank. Each antenna consisted of rigid polyvinylchloride construction, were powered by lithium-ion batteries which allowed for one month of continuous deployment, and each were run by a Biomark® ISO-1001 tag reader that read both full and half-duplex PIT tags. Per the manufacturer, submersible antennas could be placed in relatively close proximity without fear of interference. One foot spacing was that was needed if only two antennas were at a location, with five foot spacing needed between each antenna if three or more antennae were in close proximity (Pers Comm. Matt Brower, Biomark®, 2020)

Figure 3.2.1-2. Wagon wheel PIT tag antenna locations in the Upper Lewis River Basin – 2020.

Figure 3.2.1-3. Wagon wheel PIT tag antenna locations in the Yale Reservoir Basin – 2020.

128 discrete PIT codes were detected swimming past a PIT antenna in 2020. Of these, 72 were known to be bull trout. The other 56 discrete PIT codes were juvenile or adult steelhead, spring Chinook, coho, and cutthroat, tagged at either the Swift Floating Surface Collector (FSC), Eagle Cliffs screw trap or Merwin adult trap. The breakdown of detections by stream, as well as timing and spawning frequency is as follows:

Cougar Creek

The three wagon wheel PIT antennas near the mouth of Cougar Creek were in operation from July 21 – November 5. No power loss was recorded during the period of operation. During the operational period thirteen discrete bull trout detections were recorded (Figure 3.2.1-9). Of note at this PIT antenna site, was the detection in 2020 of a bull trout first captured and tagged in Yale within the Swift Bypass Reach in 2012 with a fork length of 526 mm. This same fish was again captured within the Swift Bypass Reach in 2016, this time with a fork length of 684 mm. Since 2012 this bull trout has been detected moving past a PIT antenna in Cougar Creek every year except 2014 and 2019.

Pine Creek

The three wagon wheel PIT antennas at the mouth of Pine Creek were in operation from July 21 to October 27, no power loss was experienced during the period of operation. The three antennas were spaced apart across the width of the stream in the same general location, with at least a five foot space in between each antenna. 48 discrete PIT codes were cumulatively detected by the three antennas. Of these, 29 were found to be individual bull trout, while the other 19 were juvenile or adult steelhead, coho, or cutthroat tagged at either the Swift FSC, Eagle Cliffs screw trap, or Merwin adult fish facility.

Historical discrete detects at the Pine Creek site is expressed in Figure 3.2.1-9. Of the 29 bull trout that were detected moving past these antennae in 2020, 17 were correspondingly also detected upstream at the PIT antenna in tributary P8. Of the 12 bull trout that were only detected at the Pine Creek mouth PIT antennas, 75 percent showed evidence of consecutive year migrations (2, 3, 4, 5, 6, 7, or 8 year consecutive), and 25 percent were maiden detections (Figure 3.2-8).

Pine Creek Tributary P8

The PIT antenna at the mouth of Pine Creek tributary P8 was in operation from July 24 to October 26 (Figure 3.2.1-1). No power loss was experienced during the period of operation. Thousands of detections were recorded during the period of operation resulting in 35 discrete tag codes. Of these 35 discrete detects, 34 were previously handled bull trout and one was an unknown orphan tag. Of the 34 interrogated bull trout, 17 were detected only at the P8 antenna, whereas the other 17 discrete detects were detected at both the Pine Creek mouth and P8 antennas.

Temporal spawning migration for the Pine Creek system is expressed in Figure 3.2.1-4. Based on observed redds in Pine Creek mainstem and P8, as well as PIT antenna interrogations, peak spawn

for this system occurred during the third and fourth weeks of September. This peak is similar to what has been observed during prior years.

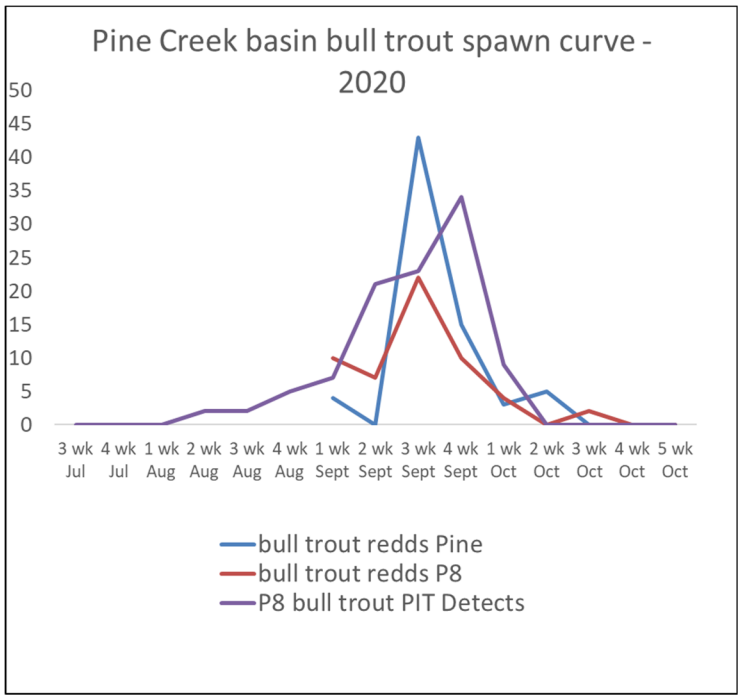

Figure 3.2.1-4. Pine Creek system spawn timing observed in 2020.

Historical discrete detections at the P8 site are expressed in Figure 3.2.1-9. Of the 17 bull trout detected only at the P8 antenna in 2020, 77 percent showed evidence of consecutive year migrations to this site, while 23 percent were maiden detections.

Rush Creek

The PIT antenna near the mouth of Rush Creek was in operation from August 19 - October 22 (Figure 3.2.1-5). No power loss was experienced during the period of operation. Five discrete tag codes were recorded during the period of operation, resulting in four discrete bull trout tags and one coho juvenile tagged during 2020 Eagle Cliff screw trap operations. Historical discrete detections at this site are expressed in Figure 3.2.1-9. Of the four bull trout detected at the Rush Creek antenna location in 2020, 50 percent showed evidence of consecutive year migrations, and 50 percent were maiden detections.

Figure 3.2.1-5. Wagon wheel PIT antennas in Rush Creek, 2020.

Rush Creek Pool

The PIT antenna located in Rush Creek pool was in operation from August 22 - October 22. No power loss was experienced during the period of operation. 17 discrete tag codes were recorded during the period of operation, resulting in ten discrete bull trout tags and seven coho juvenile/adult tags. Historical discrete detections at this site are expressed in Figure 3.2.1-9. Of the ten bull trout detected at the Rush Creek pool antenna location in 2020, 40 percent showed evidence of consecutive year migrations, and 60 percent were maiden detections.

Lewis River mainstem above Rush Creek Pool

The wagon wheel PIT antenna located in the Lewis River mainstem above the Rush Creek pool was in operation from August 22 - October 15, at which time a high flow event tore the antenna from the stream bottom (Figure 3.2.1-6). The antenna was later retrieved by means of the wire rope safety lead that was run from the antenna to an anchor tree on the stream bank. No power loss was experienced during the period of operation. 13 discrete tag codes were recorded during the period of operation, resulting in five discrete bull trout tags and eight coho juvenile/adult tags. All tags detected at the antenna in the Lewis River mainstem above Rush Creek pool were also detected downstream at the Rush Creek pool antenna. Historical discrete detections at this site are expressed in Figure 3.2.1-9.

Figure 3.2.1-6. Wagon wheel PIT antenna in mainstem Lewis River above Rush Creek pool, 2020.

Muddy River

Two wagon wheel PIT antennas were operated upstream of the mouth of the Muddy River in 2020 from August 28 - October 26 (Figure 3.2.1-7). No power loss was experienced during the period of operation. This was the first operation of PIT antennas in the Muddy River since 2015. During the period of operation 38 discrete tag codes were recorded, resulting in three bull trout and 35 coho, spring Chinook, or steelhead juveniles and or adults. Coho represented the bulk of the detections, comprising 26. Historical discrete detections at this site are expressed in Figure 3.2.1-9.

Of the three bull trout detected at the Muddy River antenna location in 2020, two were captured during Eagle Cliffs marking activities in 2019 and at the time of handling were less than 500mm. The other 2020 interrogated bull trout was captured in 2019 by the Eagle Cliffs screw trap and at the time of handling measured 210mm.

Figure 3.2.1-7. Wagon wheel PIT antennas in Muddy River, 2020.

All Detection Analysis

Spawning frequency for the last six years from all detections at all streams combined was analyzed and is expressed in Figure 3.2.1-8. It is noted that a shift from maiden detection to multiple year detection is observed from 2015 to 2020, this shift is expected to become more pronounced as additional data is collected and individual fish are followed through their lifecycle. It should be noted that 2020 marked the first year bull trout in the Lewis basin (1) had been observed (interrogated by a PIT antenna) intermittently over a nine-year timespan.

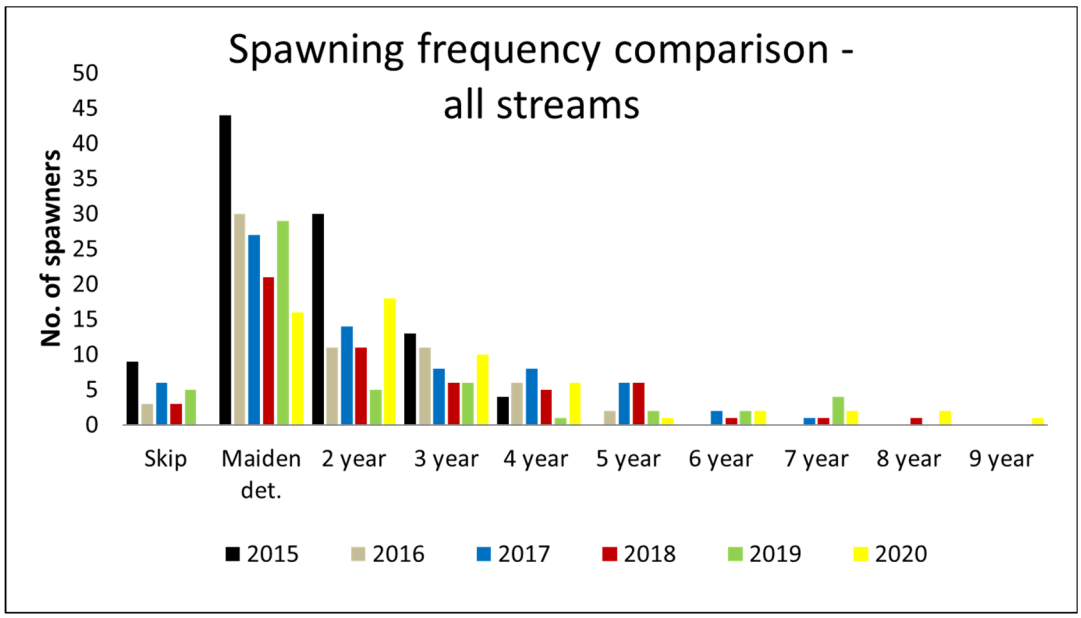

Figure 3.2.1-8. Spawning frequency of all detections for the years 2015-2020.

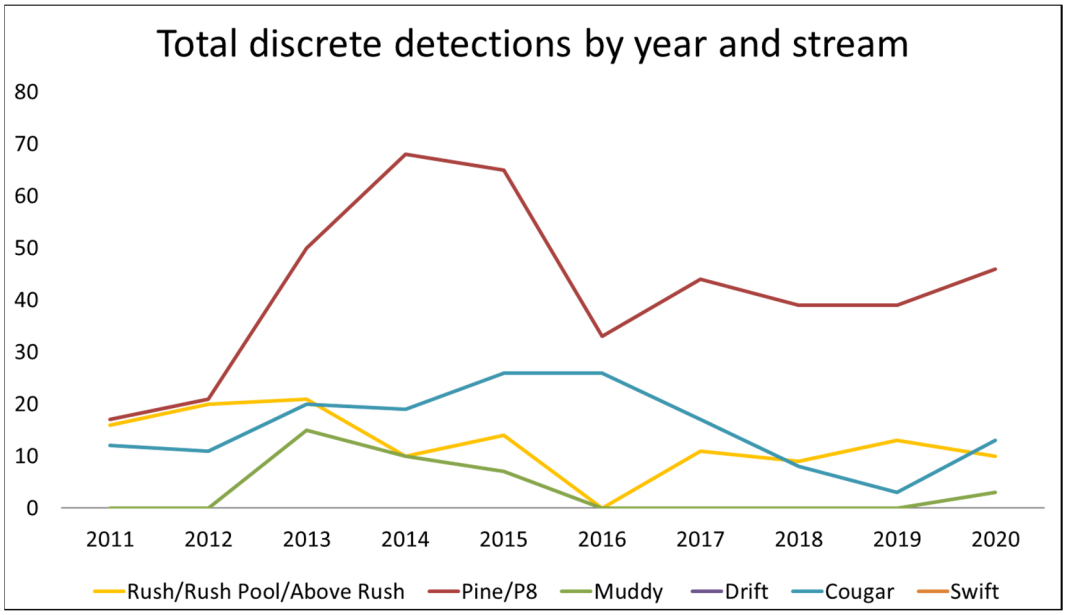

Figure 3.2.1-9. Total detections by year from all sites for years 2011-2020.

3.3 Lewis River Bull Trout Capture and Transport Activities

3.3.1 FERC Project License Article 402(a) and Lewis River Settlement Agreement Sections 4.9.1 & 4.9.2 - Swift Bypass Reach Capture and Transport Activities

The Swift Bypass Reach is the former Lewis River channel between the Swift No. 1 and Swift No. 2 hydroelectric projects. Since 2010, a minimum flow of 65 cubic feet per second (cfs) has flowed in the Bypass Reach through what the SA termed the "Upper Release Point" and the "Canal Drain". The Upper Release Point flows from the Swift No. 2 Power Canal directly upstream from the Swift No. 1 spill plunge pool and provides 51 – 76 cfs of water depending on the time of year. The Canal Drain flows from the Swift No. 2 Power Canal into an approximately 350 m long reach (termed the Constructed Channel) that is relatively unaffected by Swift No. 1 spill events and provides a continual 14 cfs of water flow. This Constructed Channel then joins the main channel Bypass Reach. Along with Ole Creek, these two water release points provide most of the flow into the Bypass Reach.

In 1999, The Utilities began netting the Swift No. 2 powerhouse tailrace as part of requirements contained in amendments to Article 51 of the former Merwin license. The tailrace was not netted from 2001 to 2005 because of the Swift No. 2 canal failure in 2001 and subsequent reconstruction. Capture efforts were then restarted in 2006 pursuant to sections 4.9.1 and 4.9.2 of the Lewis River Settlement Agreement and in 2008 pursuant to Article 402(a) of the new FERC licenses for Swift No. 1 and No. 2.

At the 2007 annual bull trout coordination meeting (attended by USFWS, WDFW, and PacifiCorp), the Utilities proposed to discontinue netting the Swift No. 2 tailrace (since only two fish had been captured since 1999) and move the collection site to an area near the International Paper (IP) Bridge within the Swift Bypass Reach (Figure 3.3.1-1). As noticed in past Swift Bypass Reach snorkel surveys, this area was found to contain adult bull trout between the months of June thru October. The USFWS and those in attendance at the 2007 coordination meeting approved this recommendation.

Figure 3.3.1-1. Bull trout capture sites within the Swift Bypass Reach, 2020.

Then in 2016, in light of compelling data that highlighted the numerous handling opportunities that could befall bull trout within Swift and Yale Reservoirs and the negative impact this handling is presumed to have on long-term survival, capture activities in this location were put on hold. The Utilities in Consultation with the USFWS and the LRBTRT decided in 2016 to place a two year research handling moratorium on all bull trout activities in Swift and Yale Reservoirs. This moratorium was lifted for 2019 in the Eagle Cliff area of Swift Reservoir, while it was kept in place in Yale Reservoir. The group decided to continue the moratorium within the Swift Bypass Reach of Yale Reservoir for 2019.

2020 again saw bull trout collected within the Swift Bypass Reach. In order to help refine, calibrate, and identify individual bull trout at the Cougar Weir and Underwater Video Project, capture and tagging activities were performed from May-July. 2020 handling activities deviated from prior year collection efforts in that no bull trout were analyzed for genetic stock assignment and subsequently transported to a location upstream of Swift dam. Collection effort goals in 2020 simply consisted of collecting biological data from each capture, and PIT tagging all encountered un-tagged bull trout for hopeful interrogation later at the Cougar Creek PIT antennas.

To capture bull trout from within the Swift Bypass Reach, monofilament mesh tangle nets (typically 40 m long, 2 m deep, and consisting of 6.5 cm stretch mesh), and hook and line techniques are used. Nets are deployed, stretched, and allowed to sink to the bottom in areas of high bull trout concentration using a powerboat. Depending on conditions or capture rate, the nets are either held by hand on one end or allowed to fish unattended. The maximum time nets are allowed to fish is 10 minutes.

Upon capture of a bull trout, it was immediately freed of the net (usually by cutting the net material) and placed in a live well. Captured fish were measured to their caudal fork, weighed with a hand-held scale to the nearest gram, and if a maiden capture inserted with a uniquely coded HDX or FDX PIT tag (size dependent). All fish were scanned with a hand-held PIT tag detector to check for previous tags prior to inserting a PIT tag.

During six collection events a total of 19 bull trout were captured (Table 3.3.1-1). Of these, three were in-year recaptures, one a prior year recapture, and 15 maiden captures. Nine of the 16 maiden 2020 captures were later interrogated at a PIT antenna in Cougar Creek. Of note during these activities was the capture of a bull trout initially captured and tagged at Eagle Cliffs in Swift Reservoir in 2011 with a fork length of 385 mm. This same fish was recaptured this year, downstream, in the Swift Bypass Reach in Yale Reservoir with a fork length of 788 mm. This bull trout has never been detected moving past a PIT antenna in either the Swift or Yale systems. Figure 3.3.1-2 graphically illustrates historical bull trout catch within the Swift Bypass Reach, and subsequent transport of eligible fish.

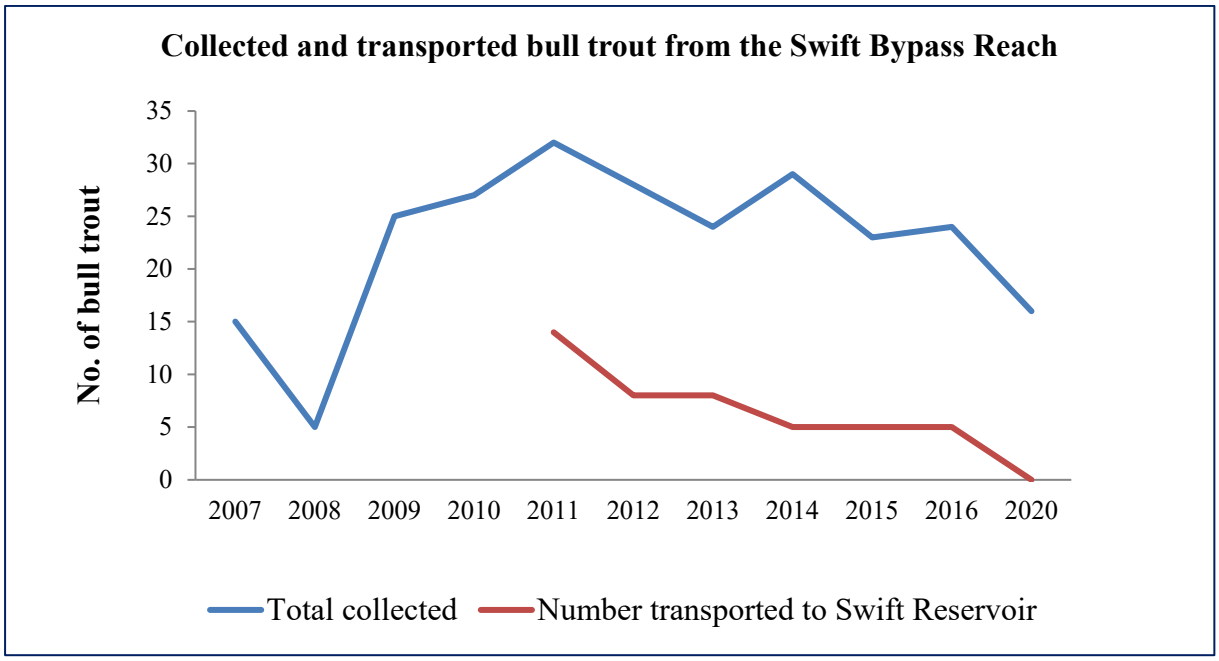

Figure 3.3.1-2. Historical Swift Bypass Reach capture and transport numbers.

Table 3.3.1-1. 2020 Swift Bypass Reach bull trout catch.

Fork Length (mm)	Initial Tag Year	Detected in Cougar Creek 2020
788	2011	no
780	2020	yes
696	2020	yes
687	2020	yes
675	2020	yes
672	2020	yes
671	2020	yes
671	2020	yes
615	2020	yes
610	2020	yes
570	2020	no
443	2020	no
440	2020	no
414	2020	no
380	2020	no
310	2020	no

3.3.2 FERC Project License Article 402(a) and Lewis River Settlement Agreement Sections 4.9.1 & 4.9.2 - Yale Tailrace Capture and Transport Activities

Per Article 402(a) in the FERC licenses and the Lewis River SA section 4.9.1, PacifiCorp annually captures bull trout from the Yale powerhouse tailrace (upper Merwin Reservoir). All bull trout captures are transported to and held at Merwin Hatchery while rapid response genetic analysis is performed following methods outlined in Section 3.3.2 of this Report. Depending on the outcome of the analysis, bull trout are either transported for release into Yale or Swift reservoirs. A total of

162 bull trout have been captured from the Yale tailrace since the program began in 1995 (Table 3.3.2-1). Figure 3.3.2-1 also illustrates historical catch and associated effort.

To capture bull trout from the Yale Tailwaters, monofilament mesh tangle nets are used (typically 40 m long, 2 m deep, and consisting of 6.5 cm stretch mesh). Depending on catch rates, netting occurs for the most part on a monthly basis beginning in June and ending mid-August. Netting usually occurs between the hours of 0900 and 1200. During this time, the powerhouse generators are taken off-line to facilitate deployment and handling of the nets. Nets are tied to the powerhouse wall and then stretched across the tailrace area using a powerboat. The nets are then allowed to sink to the bottom. Depending on conditions or capture rate, the nets are either held by hand on one end or allowed to fish unattended. The maximum time nets are allowed to fish is 10 minutes.

Upon capture of a bull trout, it is immediately freed of the net (usually by cutting the net material) and placed in a live well. Captured fish are measured to their caudal fork, weighed with a hand-held scale to the nearest gram, and if a maiden capture inserted with a uniquely coded HDX or FDX PIT tag (size dependent). All fish are scanned with a hand-held PIT tag detector to check for previous tags prior to inserting a PIT tag.

Use of Alternative Capture Methods

PacifiCorp continues to consider more effective and less intrusive methods to collect bull trout from the Yale tailrace. Past alternative methods investigated include; beach seines, purse seines, drifting tangle nets when the powerhouse is online, and angling.

In 2020, tangle nets and angling were the only methods used. To date, tangle nets remain the most effective. PacifiCorp continues research on possible alternative methods of effective capture and transport. However, upon investigation of each concept or pilot test conducted at other Northwestern dams, PacifiCorp has not been successful in finding a better alternative than the current method.

Yale Netting Results

At the Yale powerhouse tailrace in 2020, three capture attempts were completed; June 16, July 15, and August 14, yielding no bull trout captures.

Table 3.3.2-1. Number of bull trout collected from Yale tailrace (Merwin Reservoir) and transferred to the mouth of Cougar Creek (Yale tributary) or Swift Reservoir: 1995 – 2020.

YEAR	No. captured at the Yale tailrace	No. transferred to mouth of Cougar Creek	No. transferred to Swift Reservoir	No. released back into Merwin Reservoir	MORTALITIES
1995	15	9	0	6	0
1996	15	13	0	2	0
1997	10	10	0	0	0
1998	6	6	0	0	0
1999	6	0	0	6	0
2000	7	7	0	0	0
2001	0	0	0	0	0
2002	6	5	0	1	0
2003	19	8	0	1	10^
2004	8	3	0	5	0
2005	5	5	0	0	0
2006	5	5	0	0	0
2007	13	13	0	0	0
2008	15	15	0	0	0
2009	5	5	0	0	0
2010	1	0	0	0	1
2011	6	5	0	0	1
2012	3	3	0	0	0
2013	6	4	2	0	0
2014	0	0	0	0	0
2015	1	0	0	0	1
2016	8	7	0	0	1
2017	3	3	0	0	0
2018	0	0	0	0	0
2019	0	0	0	0	0
2020	0	0	0	0	0
TOTAL	**162**	**122**	**2**	**21**	**14**

^Please refer to the 2003 PacifiCorp Threatened and Endangered Species Monitoring Report for a description of mortalities

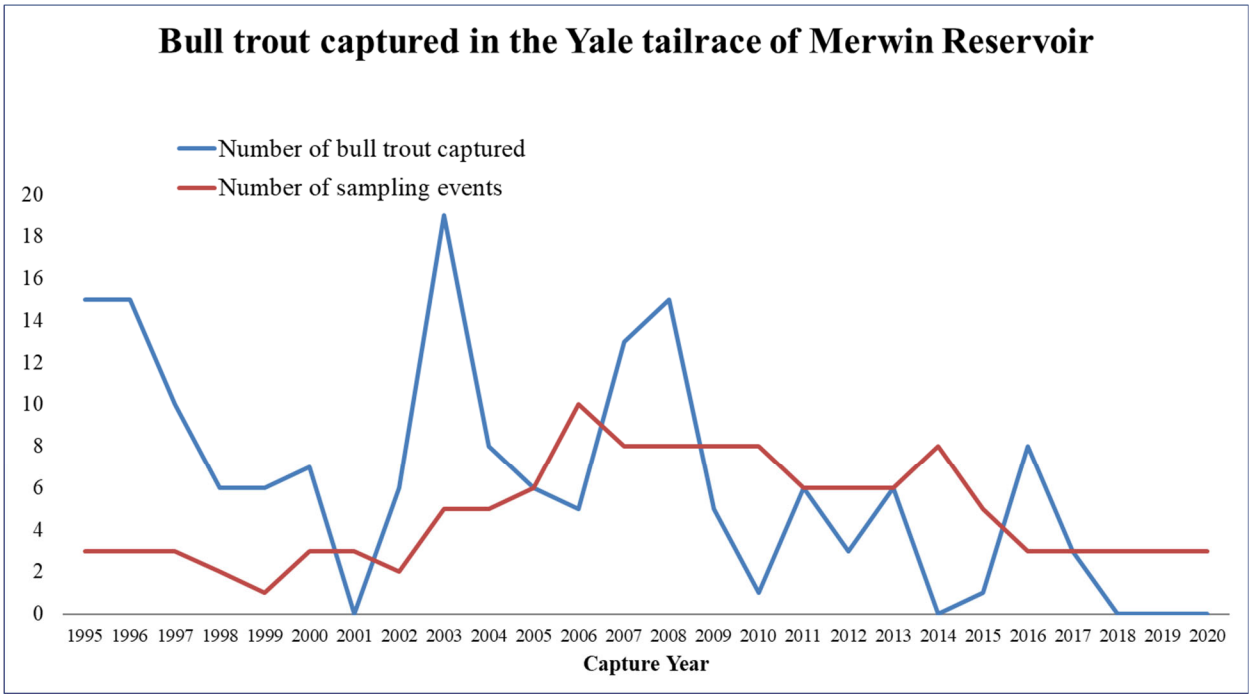

Figure 3.3.2-1. Historical catch and associated effort within the Yale Tailrace (1995-2020).

3.4 UNDERWATER VIDEO CAMERA OPERATION IN COUGAR CREEK

Please see the memo located in Appendix C of this Report for information, data, and analysis from the operation of an underwater video camera by the United States Fish and Wildlife Service within Cougar Creek in 2020.

3.5 LEWIS RIVER BULL TROUT SPAWNING SURVEYS

3.5.1 FERC PROJECT LICENSE ARTICLE 402(B) AND LEWIS RIVER SETTLEMENT AGREEMENT SECTION 9.6 - COUGAR CREEK SPAWNING ESTIMATE

Since 1979, PacifiCorp biologists, along with various state and federal agencies, have conducted annual surveys to estimate spawning escapement of kokanee in Cougar Creek. Along with the kokanee, surveyors also count the number of bull trout and bull trout redds observed within the creek. In 2020, the Utilities conducted six Cougar Creek bull trout redd surveys from September 15 to November 5. Surveys begin at the mouth of the creek and end at the creek's spring source, a distance of approximately 2100 m.

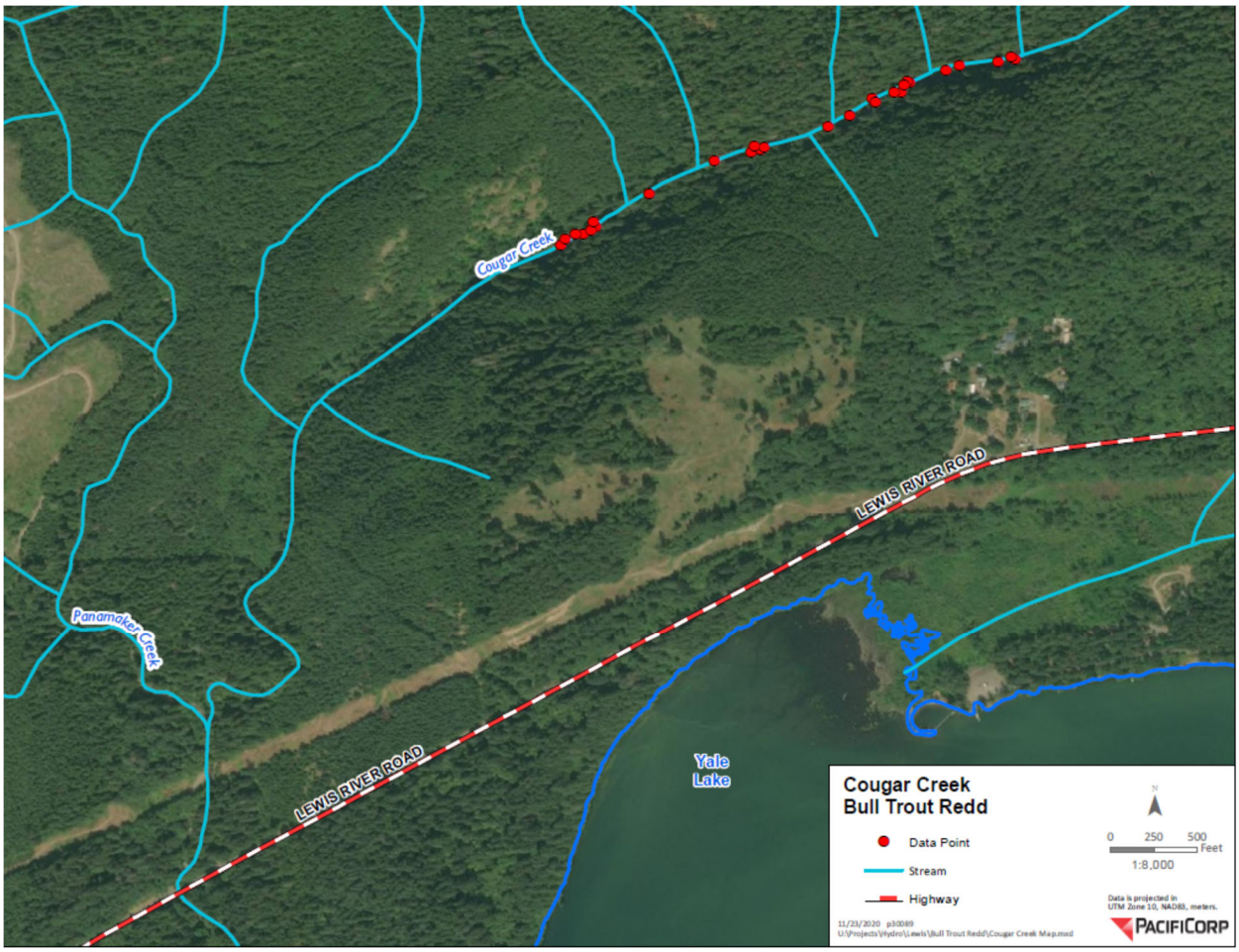

Figure 3.5.1-1. GPS locations of bull trout redds in Cougar Creek in 2020. Each red dot represents an individual bull trout redd (n=27).

Due to the wide range use of redd counts to quantify bull trout spawner abundance, multiple research studies have been performed in an effort to gauge the precision of this methodology and also to question the efficacy of redd counts as a population estimator (Dunham et al. 2001, Muhlfeld et al. 2006). Most often, redd surveys are conducted in large river systems with multiple different observers. The large systems necessitate the need for index areas mainly due to time and logistical constraints. The use of indices has been questioned based on their reliance of fish coming back to the same area at the same time every year to spawn. In addition, the use of multiple observer teams and a variety of observers on the same project, is considered to cause inaccuracies based on the variability between observers' experience with identifying redds.

The redd count methodology employed within Cougar Creek differs from most large-scale redd surveys in that the stream is small enough to feasibly cover the entire length during each survey, and currently is the only known bull trout spawning stream in Yale Reservoir. Cougar Creek also lends itself nicely to these types of surveys in that the water is extremely clear and has stable flow for most of the survey period. Also, redd life, the amount of time a redd remains visible, has an exceptionally long duration. Most, if not all, observed redds remain visible during the entire time-

frame of the surveys.

In 2020, biologists walked the entire 2100 m of Cougar Creek during each redd survey. Surveys are completed over an extended period of time to address potential error associated with spawn-timing. To alleviate inter-observer variability, all surveys in 2020 were performed by the same experienced biologists. Dunham et al. (2001) specified that a sampling effort should not rely on indices and should use the same surveyors as effective ways of improving the reliability of bull trout redd counts.

The real challenge of using bull trout redds to quantify the bull trout spawning population size lies in determining the relationship between redd counts and actual numbers of fish (Budy et al. 2003). Much past and present research has been conducted that attempts to correlate the number of spawning adult bull trout per redd. These numbers range widely by basin (1.2 to 4.3 fish per redd) and it seems the number of bull trout per redd is most likely basin or watershed specific. Work is currently underway in this watershed to get a better grasp on fish per redd numbers. The Underwater Video Camera Project (Appendix C) will hopefully allow a better understanding of actual bull trout per redd in Cougar Creek.

During each 2020 redd survey, new redds were flagged and identified by Global Positioning Satellite (GPS) coordinates. The date, location of redd in relation to the flag, and GPS coordinates were all written on the flagging (Figure 3.5.1-1). Subsequent surveys inspected each redd to see if they were still visible. If a redd was still visible, that information was written on the flagging with the date, until the redd was no longer visible, at which time this was noted on the flagging. Biologists also counted any bull trout observed within the vicinity of each redd.

27 individual bull trout redds were observed in Cougar Creek in 2020 (figure 3.5.1-2). As in past years, all bull trout redds were observed in the upper half of the creek upstream of a log jam that in most years is impassable to kokanee (Figure 3.5.1-1).

A continued concern within Cougar Creek, first observed in 2008, are bull trout redds found to be superimposed over one another. During redd counts in 2020, no bull trout redds were observed superimposed or partially superimposed over a previously excavated bull trout redd.

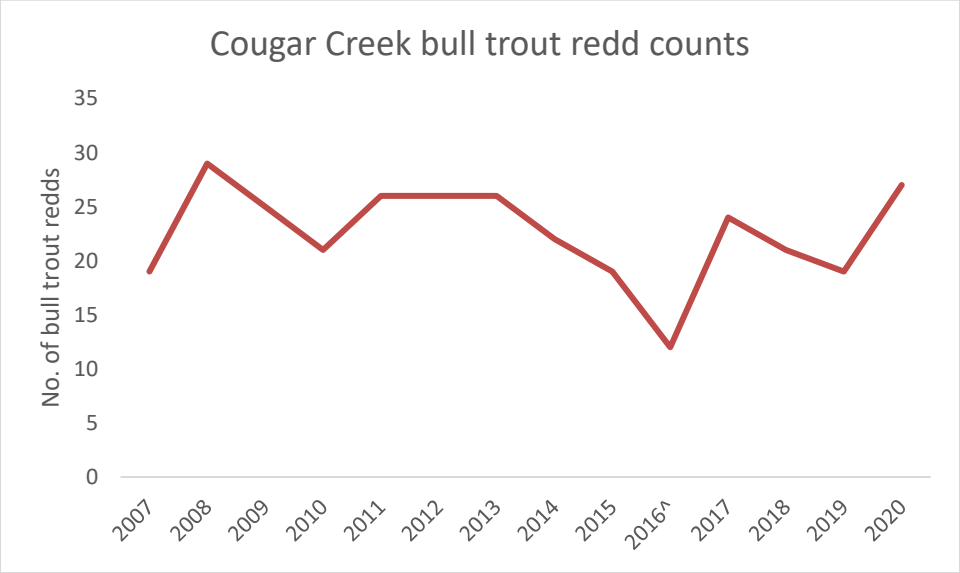

Figure 3.5.1-2. Annual Cougar Creek bull trout cumulative redd counts, 2007-2020. ^truncated survey year.

3.5.2 Bull Trout Redd Surveys of Pine Creek, Pine Creek Tributary P8, and Rush Creek

P8

Tributaries to Pine Creek are counted from the mouth of Pine Creek upstream. P8 (Figure 3.5.2-1) is the eighth and largest of these tributaries. Based on surveys performed in 1999 and 2000 to document the extent of available anadromous fish habitat within the North Fork Lewis River basin, P8 contains approximately 6400 m of accessible anadromous fish habitat and has relatively low gradient for the first 1600 m. P8 is a relatively small stream, with an average wetted width of 3.5 m, but it contains abundant annual flow and cold water (PacifiCorp and Cowlitz PUD 2004).

Redd surveys (consistent with methodology utilized on Cougar Creek) were performed on Pine Creek tributary P8 seven times from September 2 – October 26 during the 2020 bull trout spawning season. In all, GPS coordinates were collected from 54 bull trout redds during the survey period, the highest on record (2008-2020). Redds were observed and counted from the mouth of P8 to 2100 m upstream (Figure 3.5.2-1 and 3.5.2-2). Interspecies redd superimposition was not observed within P8 during the 2020 survey period.

Spawning coho had been observed within P8 during the 2014 and 2015 bull trout spawning season. A cluster of four coho redds were observed within P8 on November 25, 2020. Per previously hung flagging in the area for bull trout redds, these coho redds were not observed to be superimposed over previously dug bull trout redds.

Pine Creek

Redd surveys completed on a weekly rotation were performed of all available spawning habitat within Pine Creek mainstem during the months of September and October in 2020 (river mile 0 to

river mile 8). In all, seven surveys were completed and 70 redds were recorded and GPS'd (Figures 3.5.2-1 and 3.5.2-2). Due to heavy smoke from forest fires in the area, no survey was performed during the fourth week of September.

16 percent of redds were recorded in the lower quarter of available spawning habitat (11 redds from river mile 0 to river mile 2.1), 44 percent of redds were recorded in the lower middle quarter of available habitat (31 redds from river mile 2.1 to river mile 4.1), 20 percent of bull trout redds were recorded and observed in the upper middle quarter of available habitat (14 redds from river mile 4.1 to river mile 6.1), while 19 percent of observed bull trout redds in Pine Creek in 2020 were observed in the upper quarter of available habitat (13 redds from river mile 6.1 to river mile 8). One bull trout redd was observed within tributary P10 in 2020 (Figure 3.5.2-1).

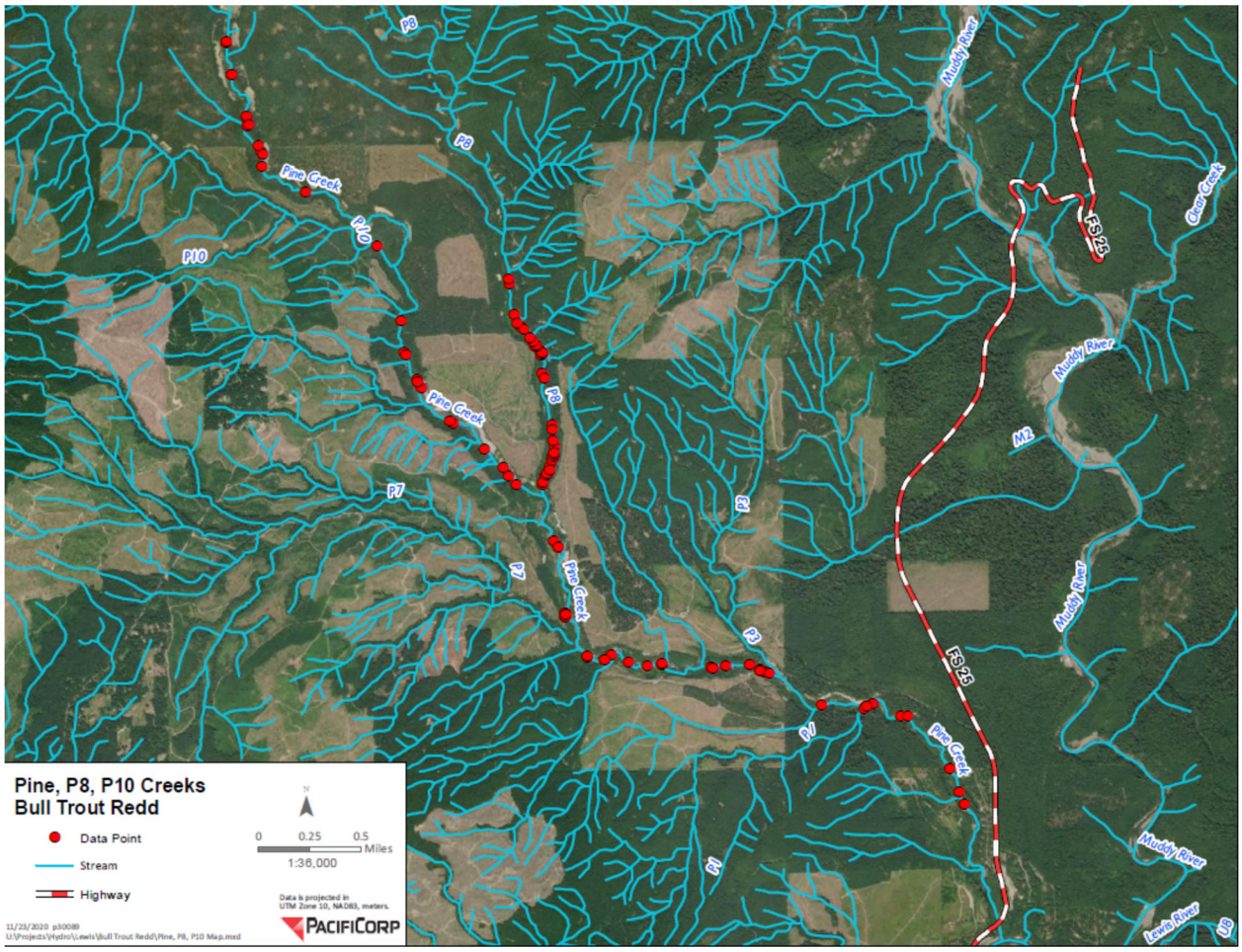

Figure 3.5.2-1. GPS locations of bull trout redds in Pine Creek, tributary P8, and tributary P10 in 2020. Each red dot represents an individual bull trout redd (n=124).

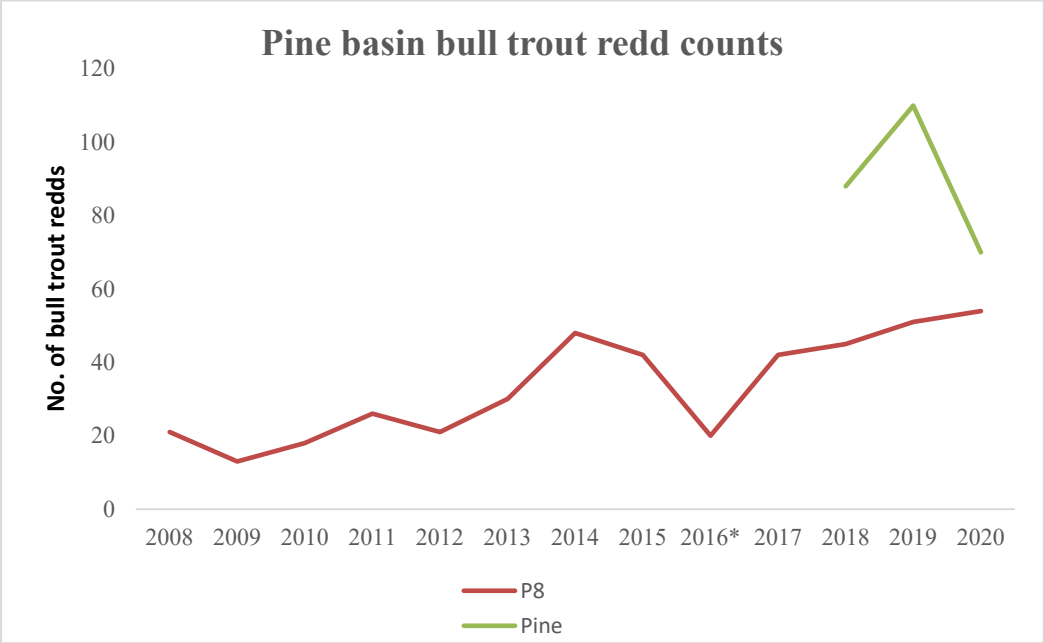

Figure 3.5.2-2. Pine Creek and tributary P8 historical bull trout redd counts (2008 and 2009 data courtesy of WDFW). *truncated survey year due to high flows.

Figure 3.5.2-3 further illustrates the spawn curve within the Pine Creek basin by evaluating by week, snorkel observations at the mouth of Pine Creek, P8 fixed PIT antenna detections, and redd counts within Pine Creek and tributary P8.

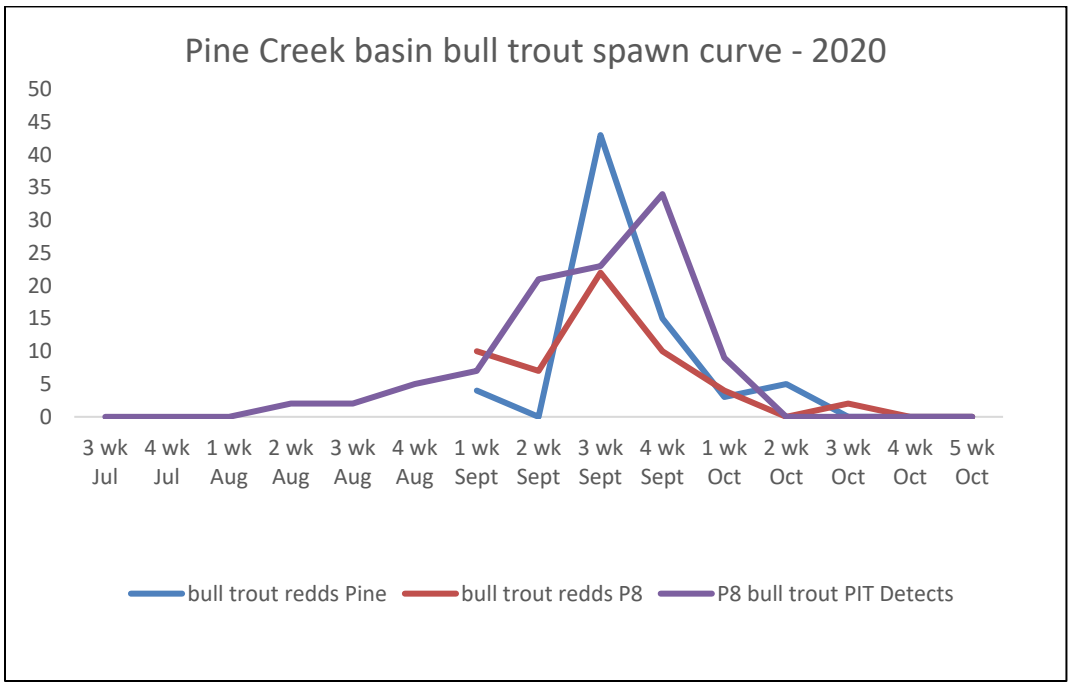

Figure 3.5.2-3. Evaluation of the Pine Creek bull trout spawn migration in 2020.

Rush Creek

Rush Creek was surveyed on four occasions between September 16 and October 22, 2020. In all, 18 redds were observed and marked by flagging and GPS (Figure 3.5.2-4). Redd surveys were completed from the stream mouth upstream to the Forest Road 90 bridge, a distance of approximately 1,600 m. Historical redd counts are expressed in Figure 3.5.2-5.

Figure 3.5.2-4. GPS locations of bull trout redds in Rush Creek in 2020. Each red dot represents an individual bull trout redd (n=18).

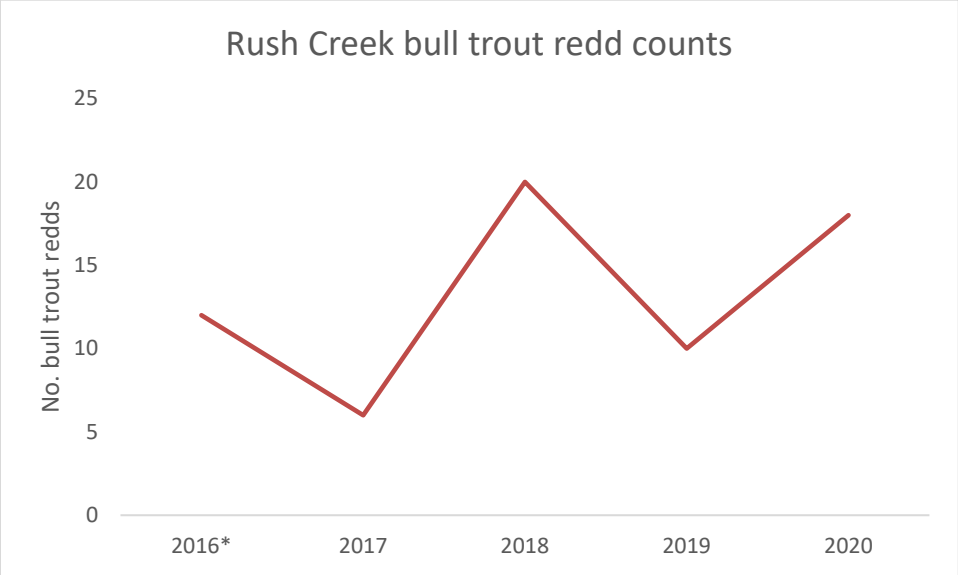

Figure 3.5.2-5. Rush Creek historical bull trout redd counts. *truncated survey year due to high flows.

3.6 SUMMER AND FALL STREAM TEMPERATURE MONITORING OF BULL TROUT PERTINENT SITES UPSTREAM OF EAGLE CLIFF

In order to better understand bull trout spawn migration timing and how it correlates to stream temperature, Onset Tidbit® temperature data loggers were remotely deployed on June 15 in Pine, P8, P10, and Rush creeks and in the mainstem Lewis River at Eagle Cliffs and just upstream from Rush Creek in 2020. Thermographs were quality assured/quality controlled by the manufacturer prior to deployment and were set to record continuous hourly temperature readings at each identified location. Thermographs operated until October 31 at which time they were recovered and taken out of each stream location. All sites experienced continuous data collection at each location during the stipulated time-frame. The 2020 dataset was added to the 2019 dataset and this data collection will continue to be added to in the future to better assess long-term thermal changes of bull trout spawning streams in the upper Lewis River basin.

4.0 ACKNOWLEDGEMENTS

The Utilities would like to thank Dr. Robert Al-Chokhachy from USGS for his analysis of bull trout PIT tag data and subsequent Survival and abundance estimates, as well as Brice Adams from USFWS for his analysis of Genetic Estimation of Lewis River Breeder Abundance (Nb). The Utilities would also like to thank Marshall Barrows from USFWS for operation of the Cougar Creek weir and video and analysis of video data.

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APPENDIX A

MEMO BY DR. ROBERT AL-CHOKHACHY, UNITED STATES GEOLOGICAL SURVEY: Lewis River Bull Trout Demographic Update, 2020 Report. *Analysis of 2020 data was still in process at submission of this Report. This data analysis will be included within the 2021 Annual Report.

APPENDIX B

MEMO BY BRICE ADAMS, UNITED STATES FISH AND WILDLIFE SERVICE: Genetic Estimation of Lewis River Bull Trout Spawner Abundance, 2020 Report. *Analysis of 2020 data was still in process at submission of this Report. This data analysis will be included within the 2021 Annual Report.

APPENDIX C

MEMO BY MARSHALL BARROWS, UNITED STATES FISH AND WILDLIFE SERVICE: Operation of Cougar Creek Weir and Underwater Video, 2020 Report. *Analysis of 2020 data was still in process at submission of this Report. This data analysis will be included within the 2021 Annual Report.