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

North Fork Lewis River – 2022

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

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June 2023

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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 2022. For methods and general descriptions of all programs please refer to the 2022 Bull Trout Annual Operating Plan for the North Fork Lewis River 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 2022 (PacifiCorp, 2021).

2.0 STUDY AREA

Bull trout monitoring activities are performed on the North Fork Lewis River and its tributaries upstream of Merwin Dam beginning 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. 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).

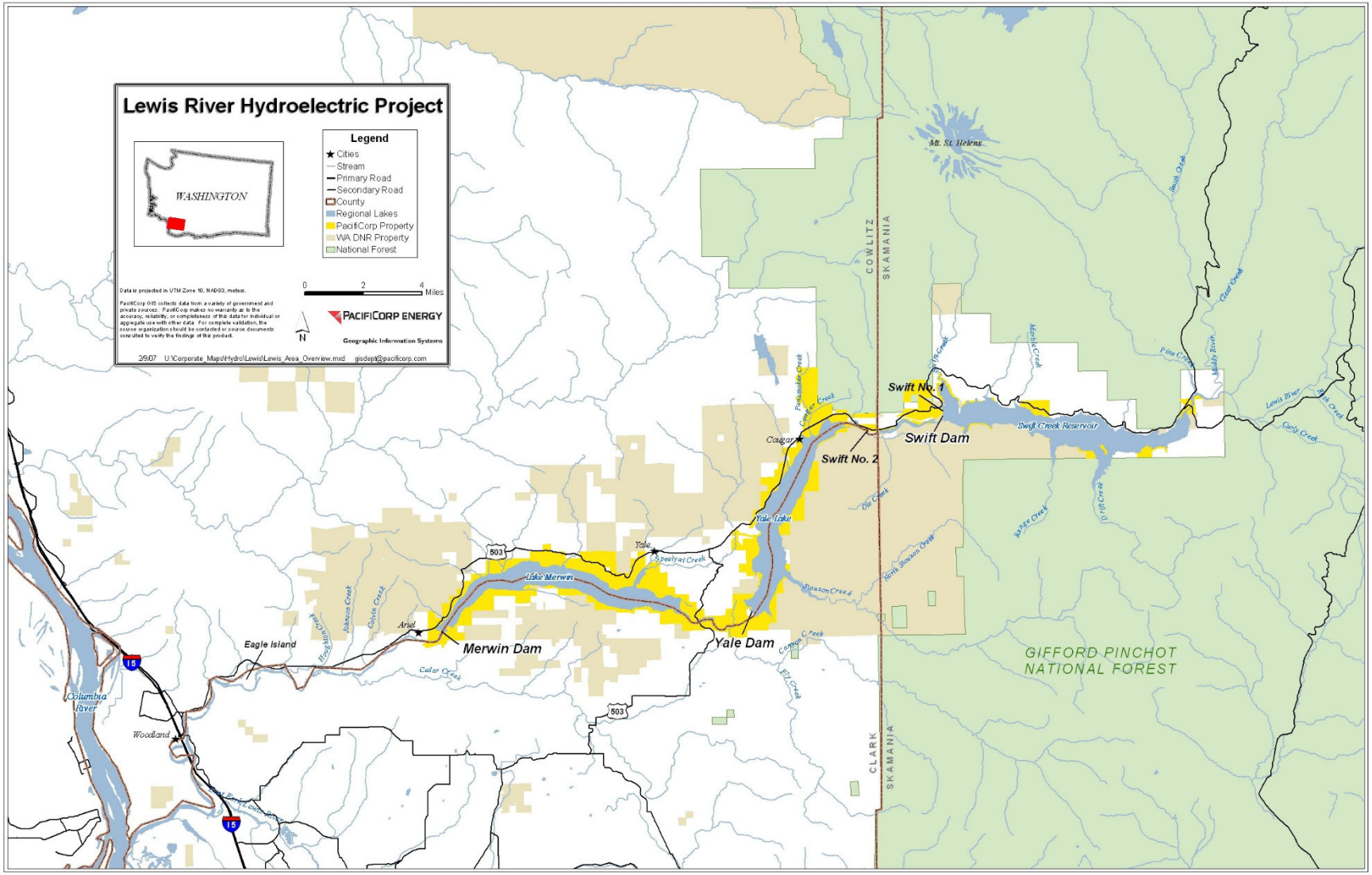

Figure 2.0-1. Map of North Fork Lewis River study area.

3.0 RESULTS FROM 2022 PLANNED ACTIVITIES

During 2022 the Utilities participated in, funded, or initiated seven monitoring programs.

- Collection and tagging of migrant bull trout in and around the Eagle Cliffs area of Swift Reservoir and subsequent Survival (S) estimates.
- Juvenile bull trout sampling from known bull trout spawning streams.
- Full-duplex Passive Integrated Transponder (PIT) tag wagon wheel antennas in Pine Creek, P8, Rush Creek, Rush Pool, Eagle Cliff Pool, and Cougar Creek.
- Yale Tailrace collection and transport.
- Pine, P8, Rush, and Cougar creeks redd surveys, as well as exploratory redd surveys of the Muddy River.
- 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 COLLECTION AND TAGGING ACTIVITIES IN AND AROUND EAGLE CLIFFS AREA OF SWIFT RESERVOIR

Compelling data was presented in 2016 that highlighted the numerous handling opportunities that could befall bull trout within the 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. 2022 marked only the second time active capture and mark activities have taken place since the three-year cycle was implemented.

Eagle Cliffs bull trout capture and marking activities began on May 24 and continued every ten days for a total of five collection events. During this time 43 bull trout were captured, sampled for biodata, marked with a PIT tag, and returned to the point of capture (Figure 3.1.1-1). For a description of sampling methods to capture and tag bull trout at Eagle Cliffs, please refer to Section 2.1 of the Lewis River Bull Trout Annual Operating Plan.

Of the 43 bull trout encountered during Eagle Cliffs collection activities, three were in-season recaptures, seven were recaptures from prior years, and 33 were maiden captures. All maiden captured bull trout were marked with a 24 millimeter (mm) FDX PIT tag in the dorsal sinus. Size distribution of Eagle Cliffs captured bull trout is expressed in Figure 3.1.1-2.

The Swift Floating Surface (FSC) collector, located at the bottom end of Swift Reservoir in the forebay of Swift dam (Figure 3.1.1-1), operates 24/7 from September-July to actively capture and pass juvenile anadromous fish downstream. During normal operations bull trout are inadvertently also caught. Per the direction of USFWS, all captured bull trout at the FSC are returned to Swift Reservoir. Prior to release, fish are sampled for biodata (length, DNA tissue, PIT code), and maiden captures are tagged with a PIT tag in the dorsal sinus. During 2022 operations 16 bull trout were captured by the FSC and released back to Swift Reservoir. Of these 16 captures, one was an in-season recapture, three were prior year recaptures and 12 were maiden captures. Size distribution of FSC captured bull trout is expressed in Figure 3.1.1-2.

47 sub-adult and adult bull trout were newly PIT-tagged in Swift Reservoir in 2022.

Figure 3.1.1-1. Eagle Cliffs and FSC bull trout collection sites within Swift Reservoir.

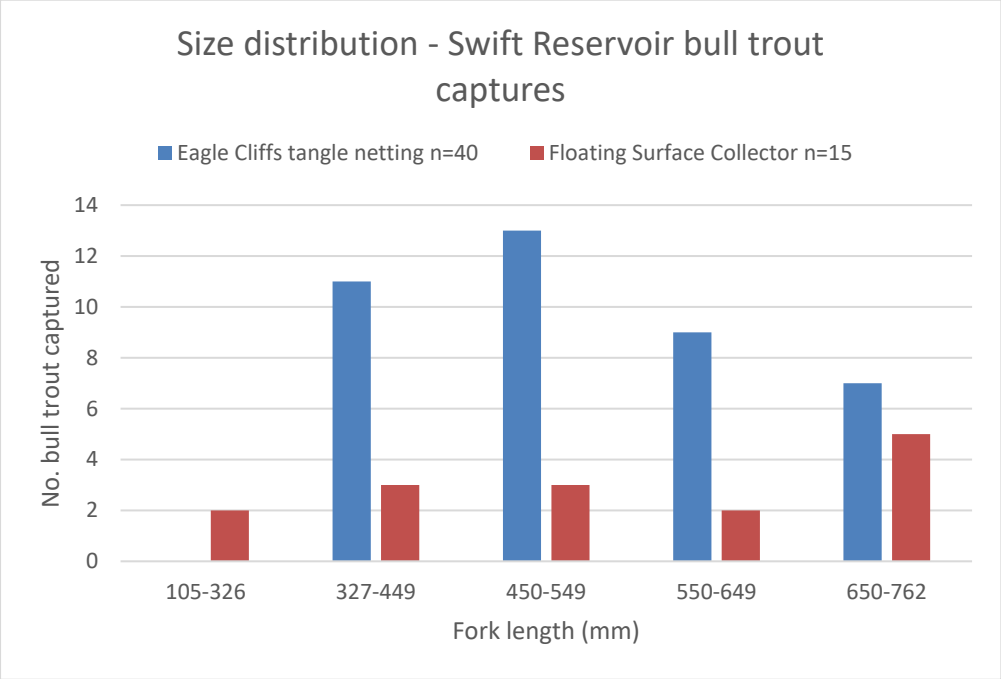

Figure 3.1.1-2. Size distribution of 2022 Swift Reservoir bull trout captures.

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 2022 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—2022 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 (Nb)

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).

In 2022, per the direction of the LRBTRT, no lab analysis of gathered genetic tissue for genetic estimation of spawner abundance for eventual Effective Population estimation was performed. It was decided by the Group to conduct the genetic evaluation piece of this analysis on a three-year cycle. The next lab analysis is slated for 2023. Though no lab analysis was scheduled for 2022, juvenile collection surveys were still conducted in order to assess relative abundance of bull trout and reintroduced anadromous juvenile fish species and their associated interaction. Being fish were in hand, tissue samples were also taken of all captured age 0 bull trout and shelved for possible back calculation analysis of N_b and N_e if ever deemed necessary.

Genetic tissue was gathered and juvenile bull trout from the same cohort (presumably age 0) were enumerated 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). Catch per unit effort (CPEU) values were calculated using time on the electrofisher divided by total catch from that area. CPEU values are expressed as fish captured per minute of electrofisher time.

Areas within Rush Creek were sampled with a backpack electrofishing unit on July 11th and August 4th (Figure 3.1.3-1). In all, 14 juvenile bull trout less than 70 mm fork length and assumed to be of 2021 brood year origin, were captured and sampled for genetic tissue. The length range of the age 0 bull trout was 30 mm – 70 mm, with an average fork length of 39 mm.

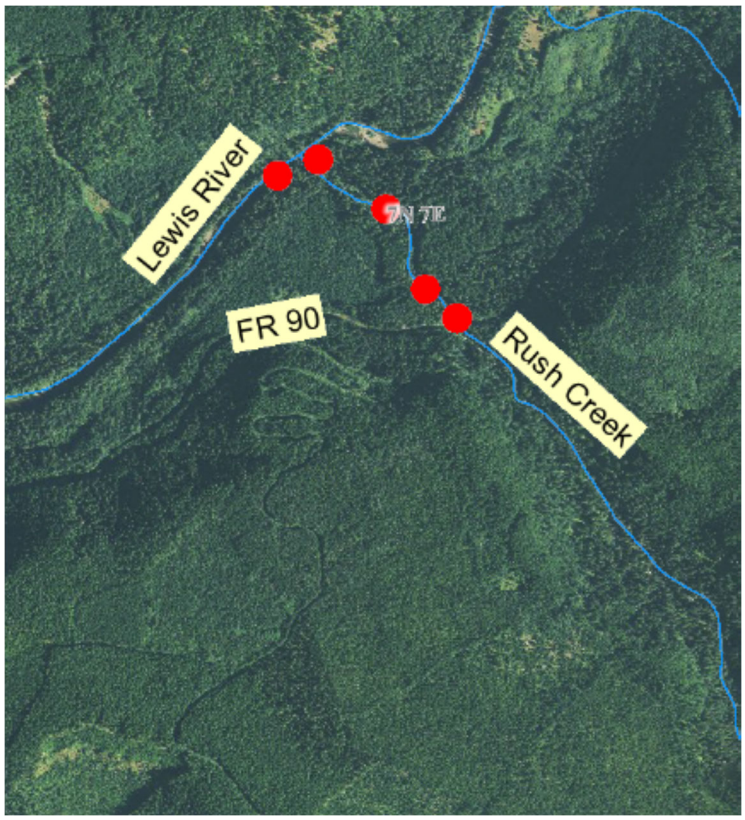

Figure 3.1.3-1. Electrofishing sites within Rush Creek during 2022 juvenile bull trout collection.

Areas within Pine Creek and tributary P8 were sampled for juvenile bull trout with a backpack electrofisher on July 6th and 8th (Figure 3.1.3-2). In all, 28 juvenile bull trout were captured from within P8 ranging from 38 – 62 mm fork length with an average fork length of 52 mm.

33 juvenile bull trout were captured from areas within Pine Creek mainstem ranging in size from 36 – 132 mm fork length, with an average of 57 mm.

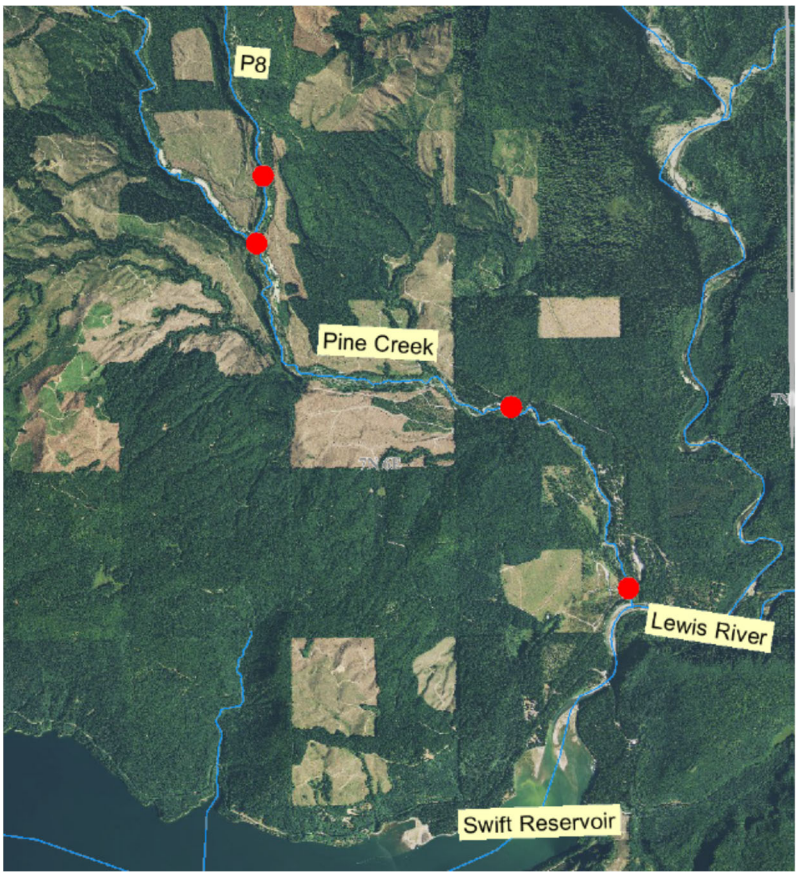

Figure 3.1.3-2. Electrofishing sites within the Pine Creek system during 2022 juvenile bull trout collection.

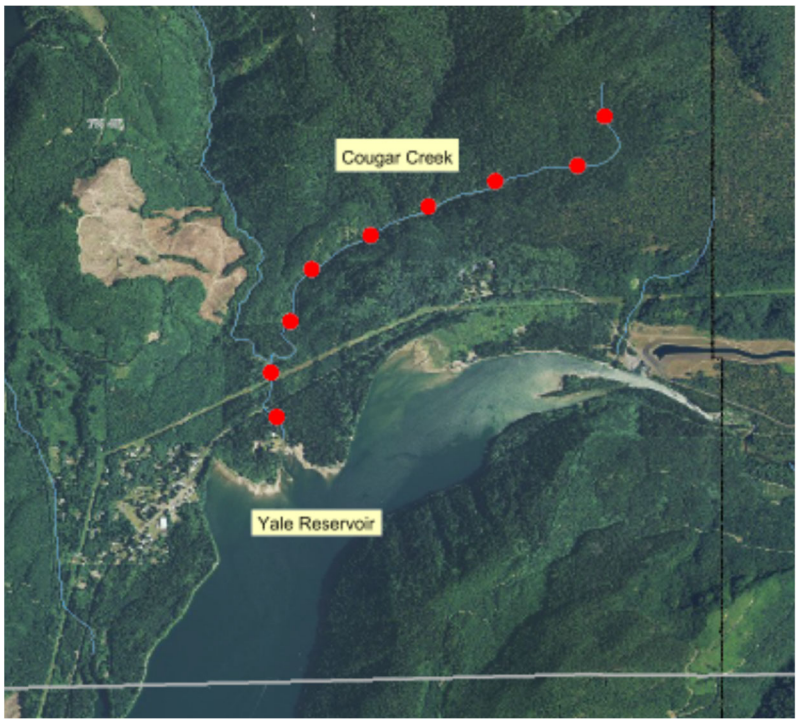

Figure 3.1.3-3. Electrofishing sites within the Cougar Creek system during 2022 juvenile bull trout collection. Picture is simply a representation; sampling sites were not evenly spaced.

Areas within Cougar Creek were sampled with a backpack electrofishing unit on June 13th and July 11th (Figure 3.1.3-3). In all, 17 juvenile bull trout were captured and sampled for genetic tissue. The length range of captured bull trout was 49 – 72 mm, with an average fork length of 62 mm for age 0 bull trout.

Figure 3.1.3-4 and Table 3.1.3-1 compare young of year juvenile bull trout collection by stream and year of sampling.

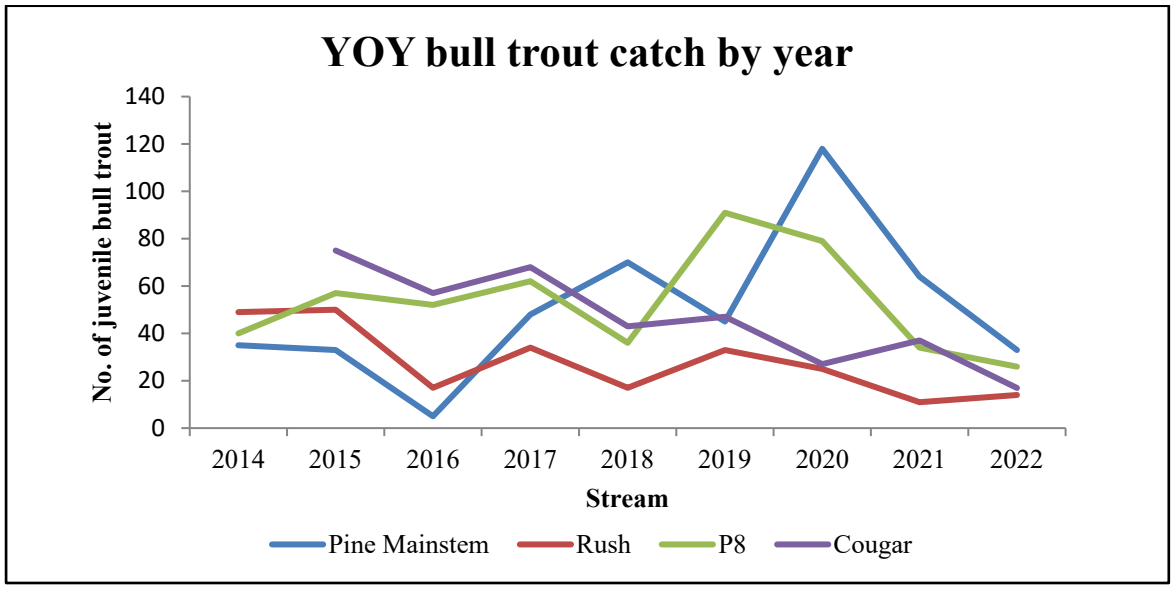

Figure 3.1.3-4. Trend bull trout juvenile catch during stream electrofishing surveys. Cougar Creek was not surveyed in 2014.

Table 3.1.3-1. Tabular representation of juvenile bull trout catch during electrofishing surveys.

Tributary	2014	2015	2016	2017	2018	2019	2020	2021	2022
Pine Mainstem	35	33	5	48	70	45	118	64	33
Rush	49	50	17	34	17	33	25	11	14
P8	40	57	52	62	36	91	79	34	26
Cougar		75	57	68	43	47	27	37	17

Figure 3.1.3-5 compares catch rate of juvenile bull trout by stream of capture in 2021 to catch rates during 2022. Catch per unit of effort is expressed in juvenile bull trout caught per minute of electrofisher on time.

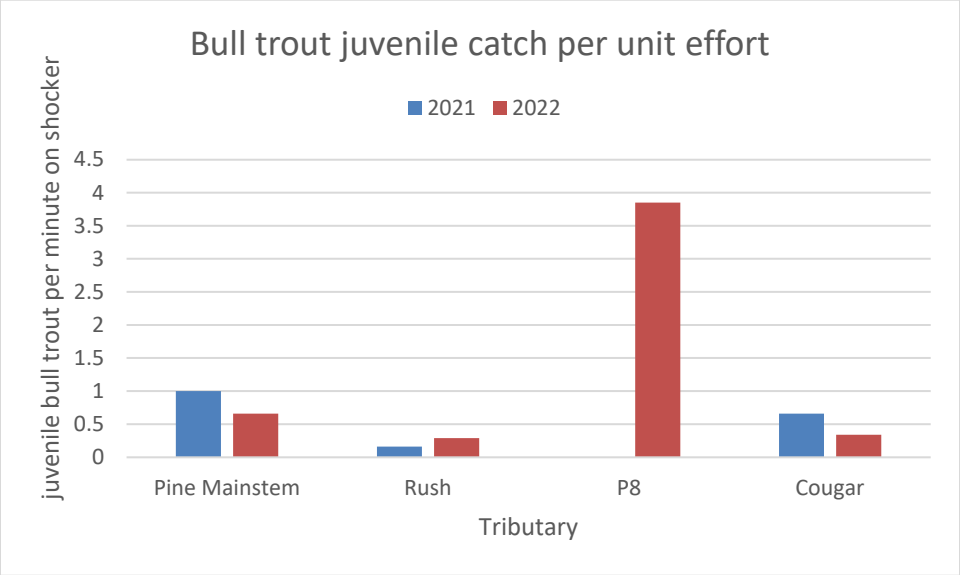

Figure 3.1.3-5. Catch per unit of effort for juvenile bull trout electrofishing surveys in 2021 and 2022. No data was gathered for P8 in 2021.

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 2022. This single 2.4 m diameter cone screw trap was operated from March - August in 2022. Emigrating bull trout juveniles were inadvertently captured during screw trap operations, data analysis of bull trout capture is provided in Table 3.1.3-2 and catch by year in Figure 3.1.3-6.

Table 3.1.3-2. 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
2021	Eagle Cliff	3/15-8/10	3/24-7/27	49	127	54	136	26	430
2022	Eagle Cliff	3/20-7/31	3/29-6/16	30	145	26	147	110	220

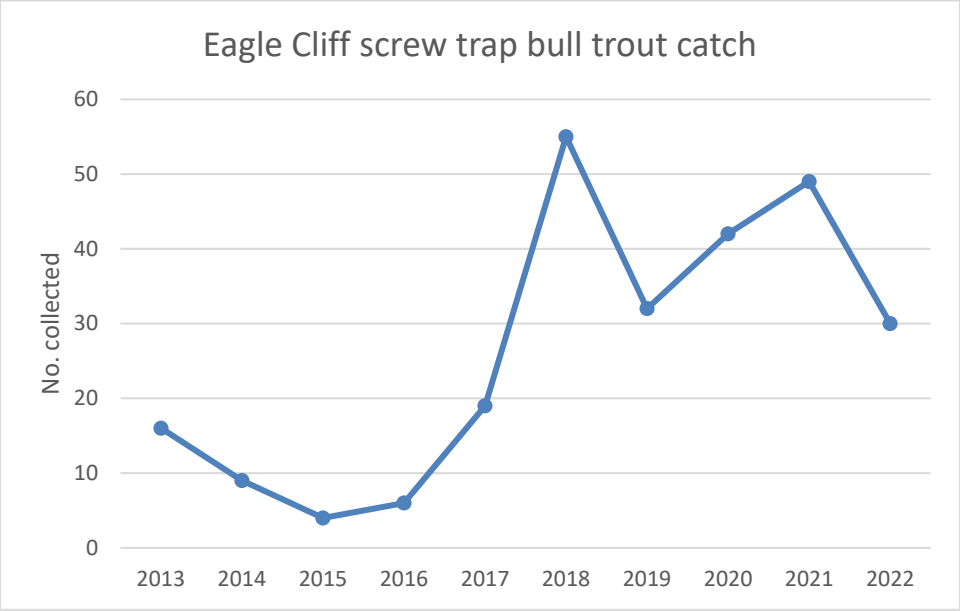

Figure 3.1.3-5. Eagle Cliff screw trap bull trout catch by year.

Monitoring and Evaluation (M&E) 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. Captured 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.

As in prior years, coho YOY dominated the catch in areas electrofished within the mainstem of Pine Creek, while Pine Creek tributary P8 and Rush Creek saw far fewer coho encountered than in past surveys; no coho was encountered within Cougar Creek in 2022. Pine Creek mainstem had a total coho catch of 213; P8 a catch of 19 and Rush a total coho catch of 12. 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 33 and a difference in overall collected of 72 percent more YOY coho. The P8 coho catch corresponds to a YOY bull trout catch of 26 and a difference in overall collected of 14 percent more YOY bull trout. The Rush Creek coho catch corresponds to a YOY bull trout catch of 14 and a difference in overall collected of 12 percent more bull trout (Figure 3.1.3-7).

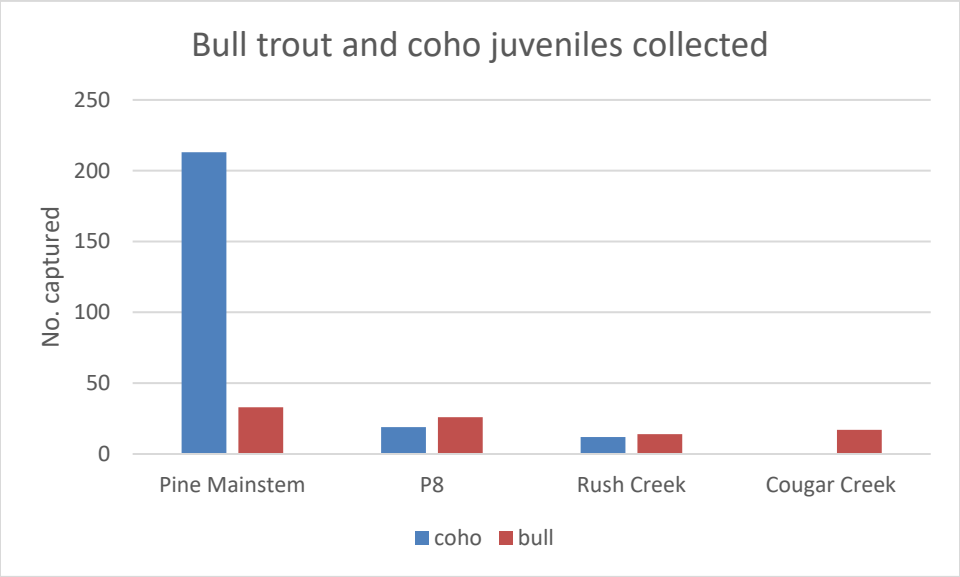

Figure 3.1.3-7. Coho and bull trout juvenile capture numbers by stream of capture in 2022.

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 the same size on average as bull trout YOY in tributary P8, while bull trout in Pine Creek mainstem

were marginally larger than encountered coho. Coho YOY in Rush Creek were marginally larger than encountered bull trout YOY (Figure 3.1.3-8).

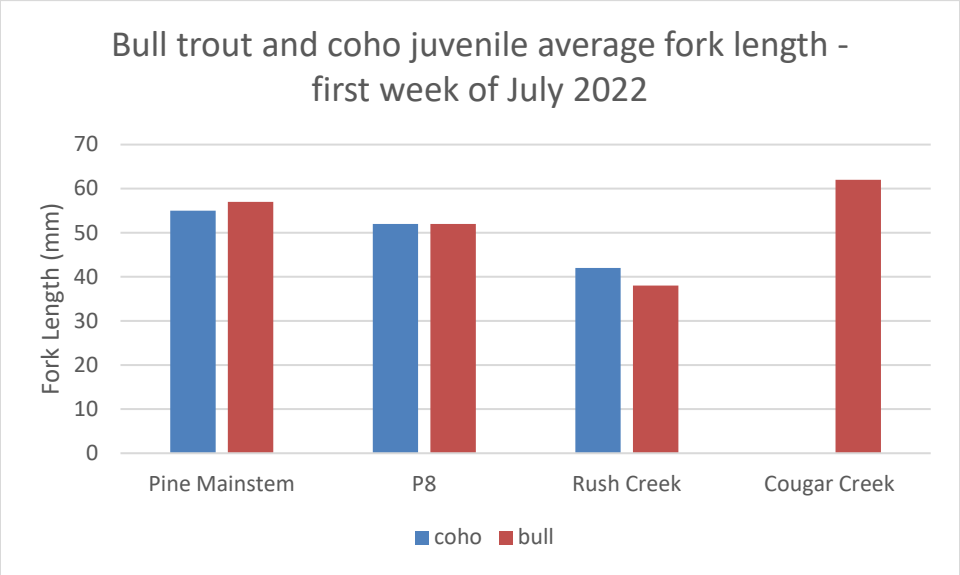

Figure 3.1.3-8. Juvenile coho and bull trout captures average fork length observed in 2022.

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 Rush pool, Eagle Cliff pool, and Rush, P8, Pine and Cougar creeks

2 meter diameter wagon-wheel PIT tag antennas manufactured from Biomark® were placed in the Rush pool, Eagle Cliff pool, 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. Six in Cougar Creek, two in Pine Creek, one in P8, two in Rush Creek, one in Rush pool, and one in Eagle Cliff 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 into the stream bottom, except for the antenna in Rush and Eagle Cliff pools, which were 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, 2022.

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 all that was needed if only two antennas were at a location, with five foot spacing needed between each antenna if three or more antennas 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 – 2022.

Figure 3.2.1-3. Wagon wheel PIT tag antenna locations in Cougar Creek within the Yale Reservoir Basin – 2022.

360 discrete PIT codes were detected swimming past a PIT antenna in 2022. Of these, 65 were known to be bull trout. The other 295 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 bull trout detections by stream, as well as timing and spawning frequency is as follows:

Cougar Creek

The six wagon wheel PIT antennas near the mouth of Cougar Creek were in operation from August 5 – November 1. No power loss was recorded during the period of operation. During the operational period 14 discrete bull trout detections were recorded (Figure 3.2.1-5). Of note at this PIT antenna site was the use of the six PIT antennas to evaluate delay at the Cougar Creek weir. Four antennas were located below the weir, and two were located upstream of the weir (Figure 3.2.1-3). Evaluation of PIT tag detections at these six sites are further analyzed in the 2022 Operation of the Cougar Creek Weir Report, located in Appendix C of this Report.

Pine Creek

The two wagon wheel PIT antennas at the mouth of Pine Creek were in operation from August 2 to October 31, no power loss was experienced during the period of operation. The two 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. 32 discrete PIT codes were cumulatively detected by the two antennas. Of these, 11 were found to be individual bull trout, while the other 21 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 3.2.1-5. Of the 11 bull trout that were detected moving past these antennae in 2022, seven were correspondingly also detected upstream at the PIT antenna in tributary P8. Of the four bull trout that were only detected at the Pine Creek mouth PIT antennas, 75 percent showed evidence of consecutive year migrations, and 25 percent were maiden detections (Figure 3.2-4).

Pine Creek Tributary P8

The PIT antenna at the mouth of Pine Creek tributary P8 was in operation from August 2 to November 1 (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 21 discrete tag codes. Of the 21 interrogated bull trout, 14 were detected only at the P8 antenna, whereas the other seven discrete detects were detected at both the Pine Creek mouth and P8 antennas. Of the 14 bull trout that were only detected at the P8 PIT antenna, 86 percent showed evidence of consecutive year migrations, and 14 percent were maiden detections (Figure 3.2-4). Historical discrete detections at the P8 site are expressed in Figure 3.2.1-5.

Rush Creek

The confluence of Rush Creek with the North Fork Lewis River has been in constant flux since a 2015 winter high flow event. The mouth of Rush Creek currently is comprised of numerous braided channels that all eventually meet up with the mainstem Rush approximately 500 meters upstream. PIT antennas were positioned in the two main braided channels just downstream where they come together to form the Rush mainstem channel. These PIT antennas were in operation from August 11 – October 31. No power loss was experienced during the period of operation. Five discrete tag codes were recorded during this time, resulting in five discrete bull trout tags. Historical discrete detections at this site are expressed in Figure 3.2.1-5. Of the five bull trout detected at the Rush Creek antenna location in 2022, 60 percent showed evidence of consecutive year migrations, and 40 percent were maiden detections.

Rush Creek Pool

The PIT antenna located in Rush Creek pool was in operation from August 4 - October 11. No power loss was experienced during the period of operation. 10 discrete tag codes were recorded during the period of operation, resulting in eight discrete bull trout tags and two coho juvenile/adult tags. Historical discrete detections at this site are expressed in Figure 3.2.1-5. Of the eight bull trout detected at the Rush Creek pool antenna location in 2022, 50 percent showed evidence of consecutive year migrations, and 50 percent were maiden detections. All five bull trout detected migrating upstream past antennas in Rush Creek were also previously detected at the Rush Creek Pool antenna. Of the three bull trout detected in Rush Creek Pool that were not subsequently also detected within Rush Creek, all were small (<500) and maiden captures at Eagle Cliff in 2022.

Eagle Cliff Pool

The one PIT antenna located within Eagle Cliff Pool was in operation from July 20 – October 31, no power loss was experienced. During this time, 125 discrete PIT tag codes were recorded. Of these, 25 were found to be bull trout with the other 100 codes coming from juvenile or adult steelhead, coho, or cutthroat tagged at either the Swift FSC, Eagle Cliffs screw trap, or Merwin adult fish facility. Of the 25 bull trout detected at this location, three were subsequently detected moving past PIT antenna in the Pine Creek basin, and one in Rush Pool. The other 21 Eagle Cliff bull trout detects were not detected at any other PIT antenna site in 2022.

All Detection Analysis

Spawning frequency for the last five years from all detections at all streams combined was analyzed and is expressed in Figure 3.2.1-4. It is noted that a shift from maiden detection to multiple year detection is observed from 2018 to 2022, this shift is expected to become more pronounced as additional data is collected and individual fish are followed through their lifecycle.

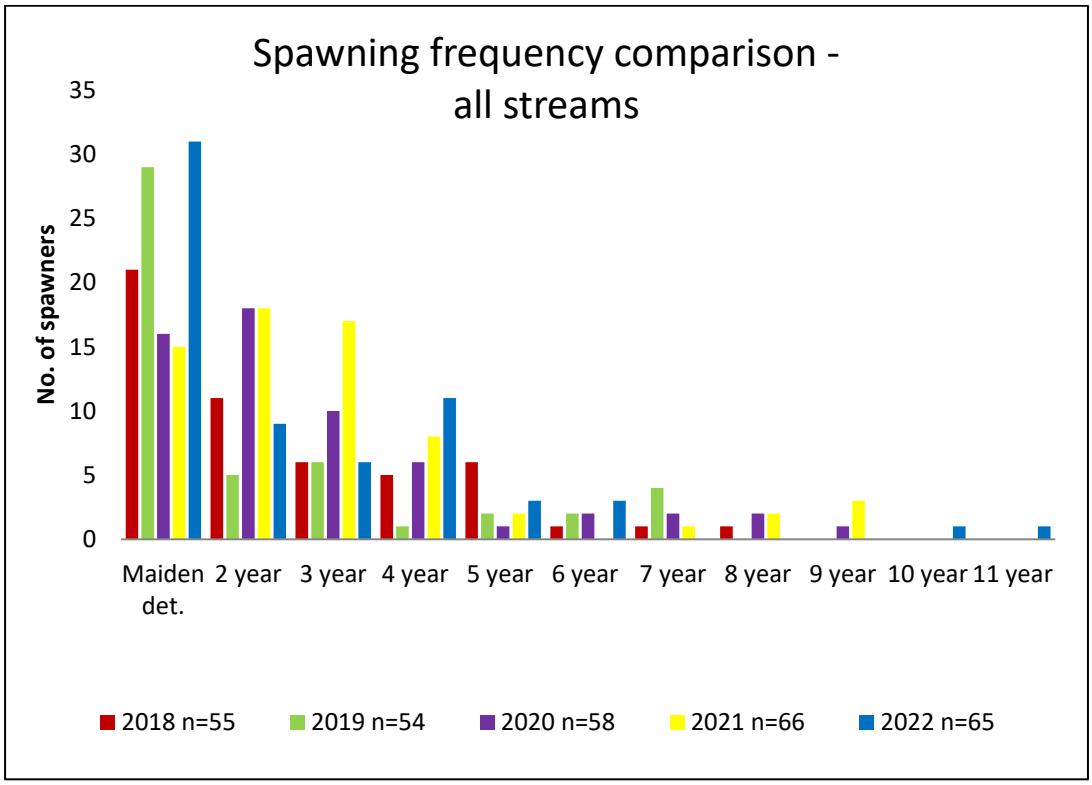

Figure 3.2.1-4. Spawning frequency (annual consecutive detects) of all detections for the years 2018-2022.

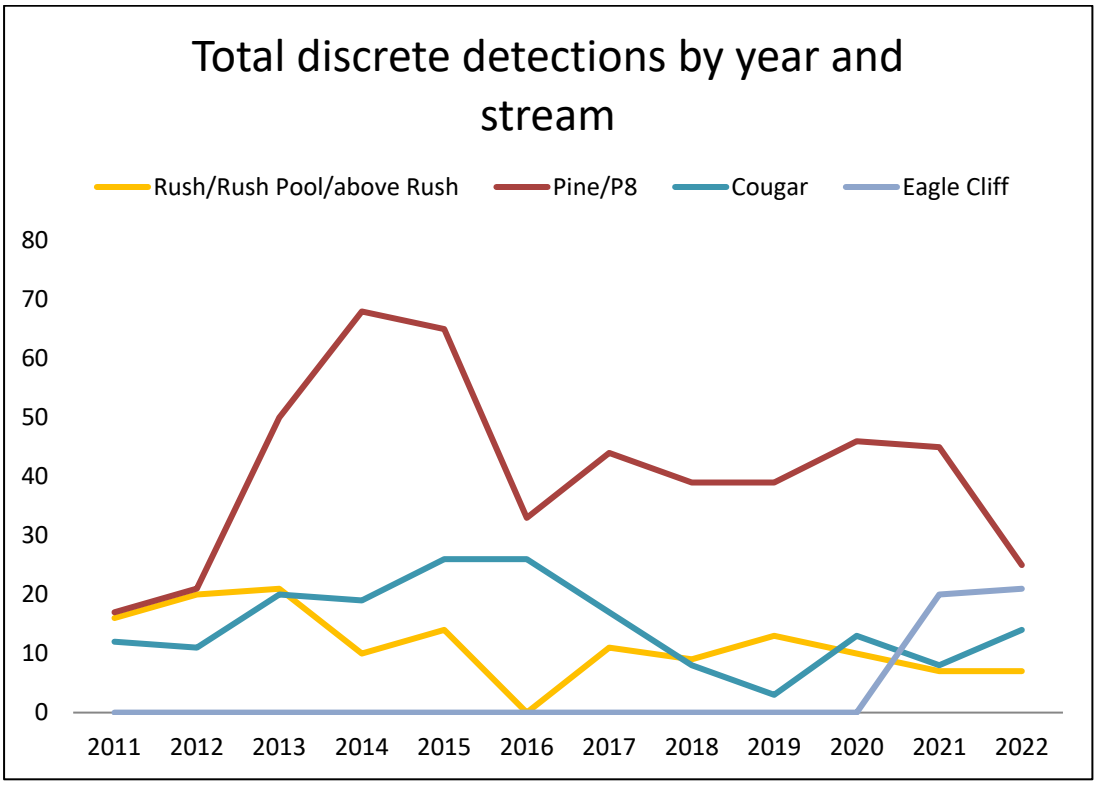

Figure 3.2.1-5. Total detections by year from all sites for years 2011-2022.

Assessment of Long-Lived Individuals through PIT Detection Histories on the Lewis River

PIT tags have been utilized to mark all maiden captured and handled bull trout of sufficient size in the Lewis River basin since 2002. Since that time, passive PIT antennas have also been deployed during the spawn migration time period in strategically identified streams. Of note in 2022, was the detection at passive antenna sites of unusually long-lived individual bull trout.

On August 17, 2022, the wagon wheel antenna located in the Eagle Cliff hole detected PIT tag codes A0F6575 and 3D600053FD8F4. These tag codes belonged to a double pit-tagged bull trout that was originally captured and tagged during tangle netting activities at the Eagle Cliff hole in June of 2010. At initial capture this fish measured 423 mm and was presumed to be four-plus years of age. Handling and detection history of fish A0F6575 is shown in Figure 3.2.1-6.

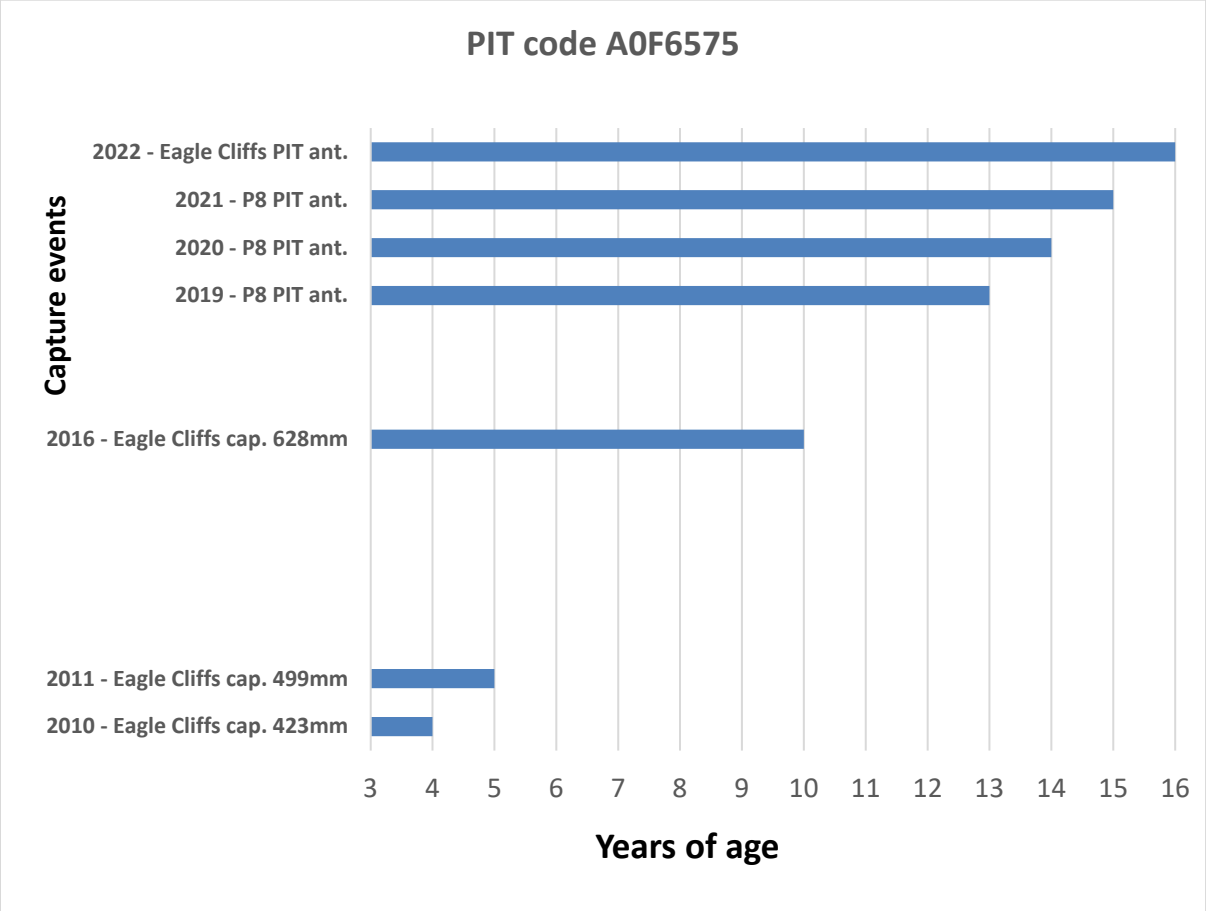

Figure 3.2.1-6. Timeline of handling and PIT detection events for bull trout A0F6575.

Based on detection histories at wagon wheel antennas located within Cougar Creek in 2022, another unusually old bull trout was identified within the Cougar Creek local population. On October 18, 2022, PIT code AC35639 was interrogated moving upstream past a wagon wheel antenna. This tag code belonged to a bull trout that was originally captured and tagged within the Swift Bypass Reach in June of 2012. At initial capture this fish measured 526 mm and was presumed to be five-plus years of age. Handling and PIT detection history of bull trout AC35639 is shown in Figure 3.2.1-7. This bull trout washed up deceased on the Cougar Creek weir on October 21. Cause of death was not assessed. After further investigation bull trout AC35639 was found to be female, and mortality occurred post-spawn. The otoliths were taken from the carcass and sent to the USGS lab for ageing analysis.

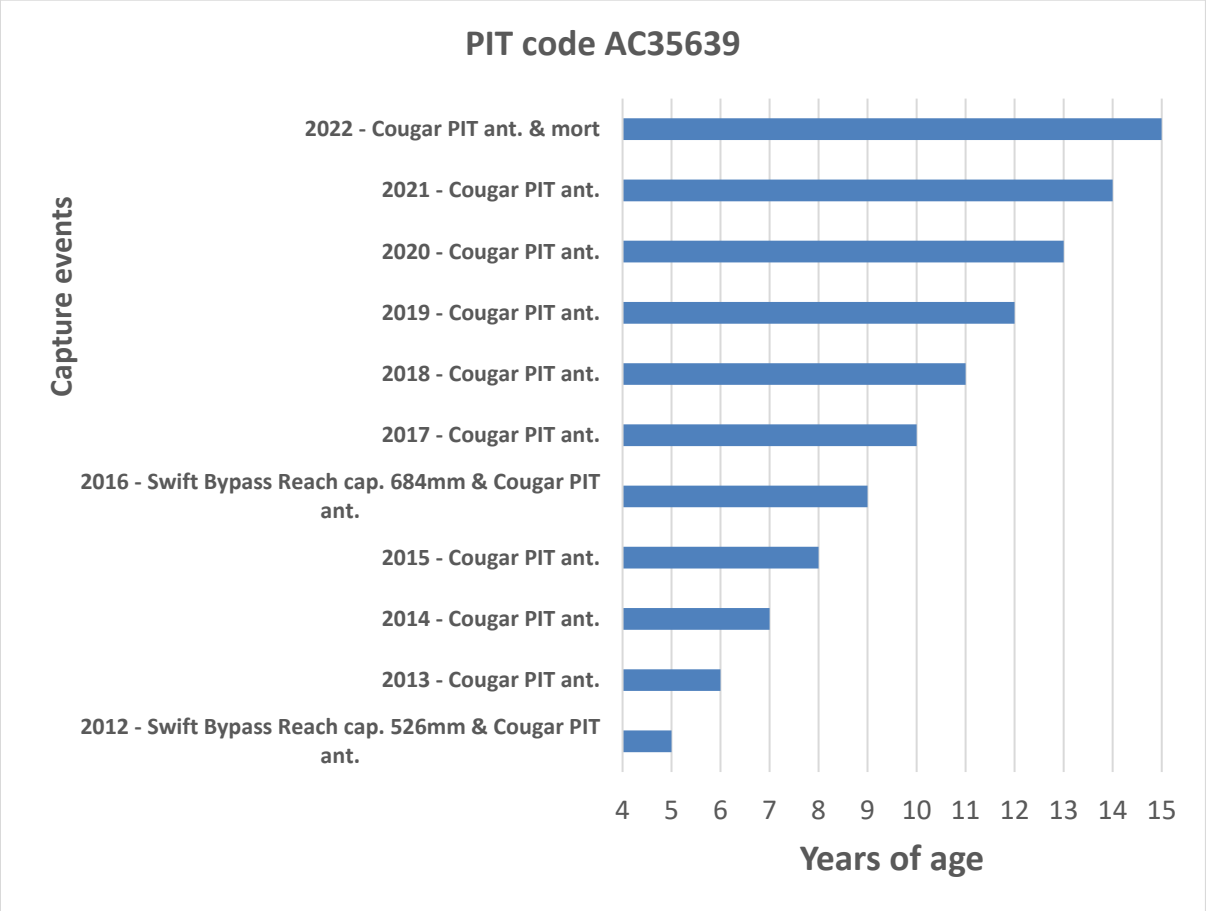

Figure 3.2.1-7. Timeline of handling and PIT detection events for bull trout AC35639.

Length at age for the Lewis River bull trout populations was assessed via right pectoral fin-ray analysis in 2016. For reference, Figure 3.2.1-8 graphically expresses average length at age that was observed in 2016.

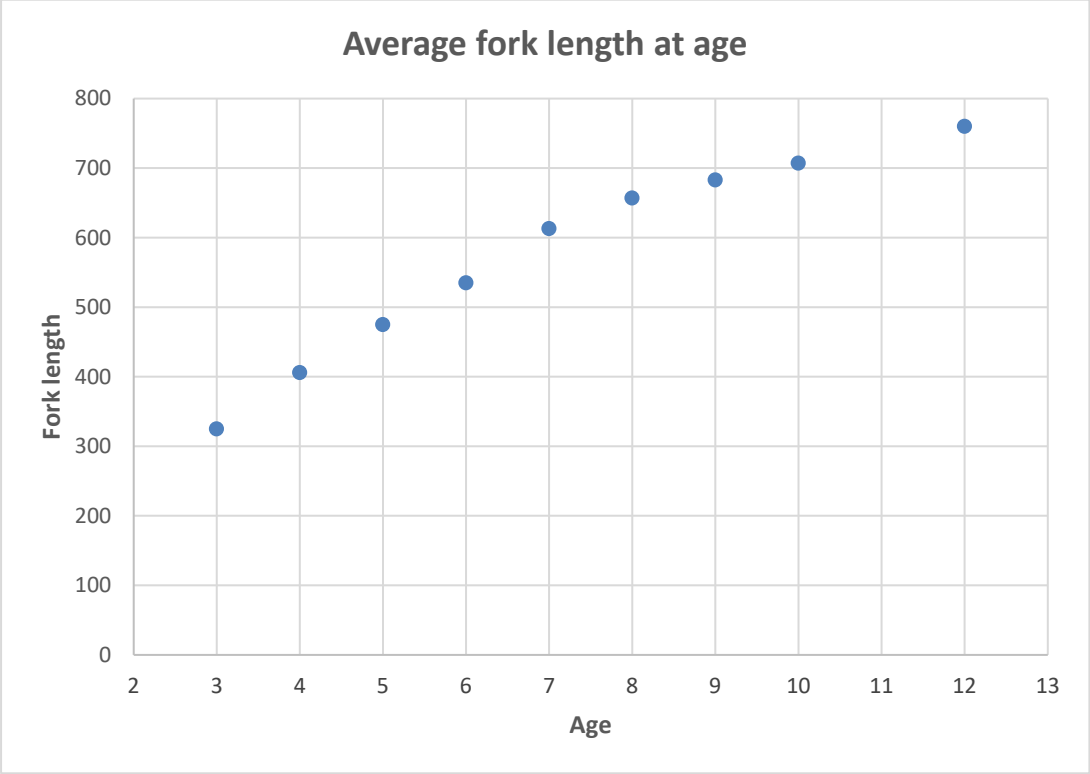

Figure 3.2.1-8. Average length at age for 38 bull trout aged by pectoral fin-ray analysis in 2016. Bull trout in the sample were a mixture of the three local populations found in the Lewis River basin.

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, 2022.

Then in 2016, in light of compelling data that highlighted the numerous handling opportunities that could befall bull trout within the 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.

For the second consecutive year running, 2022 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. Similar to last year, 2022 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 2022 simply consisted of collecting biological data from each capture, and PIT tagging all encountered maiden captures for potential 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 were used. Nets were 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 were either held by hand on one end or allowed to fish unattended. The maximum time nets were allowed to fish was 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 three collection events a total of one bull trout was captured. Figure 3.3.1-2 graphically illustrates historical bull trout catch within the Swift Bypass Reach, and subsequent transport of eligible fish during times of fish transport activities.

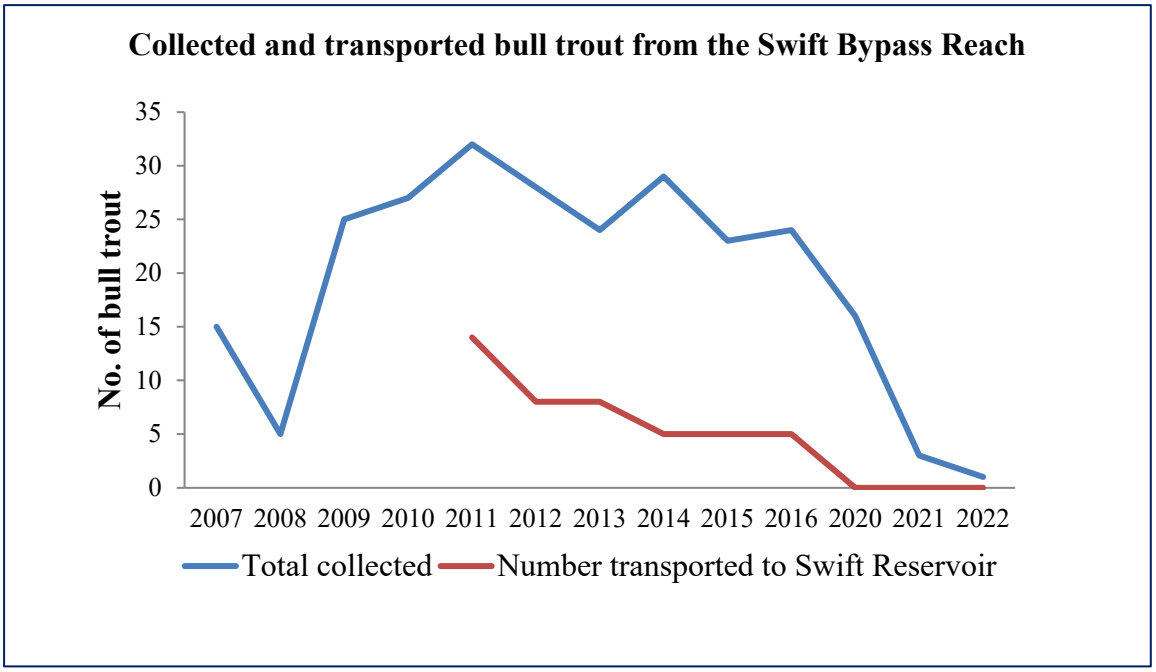

Figure 3.3.1-2. Historical Swift Bypass Reach capture and transport numbers. No collection activities were conducted 2017-2019.

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) of the project FERC licenses and 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 upstream to Yale Reservoir for release at Saddle Dam boat launch. A total of 163 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 2022, passive set tangle nets and angling were the only methods used. To date, passive set 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 2022, three capture attempts were completed; June 15, July 19, and August 12, yielding one bull trout capture (Table 3.3.2-1).

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 – 2022.

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
2021	0	0	0	0	0
2022	1	1	0	0	0
TOTAL	**163**	**123**	**2**	**21**	**14**

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

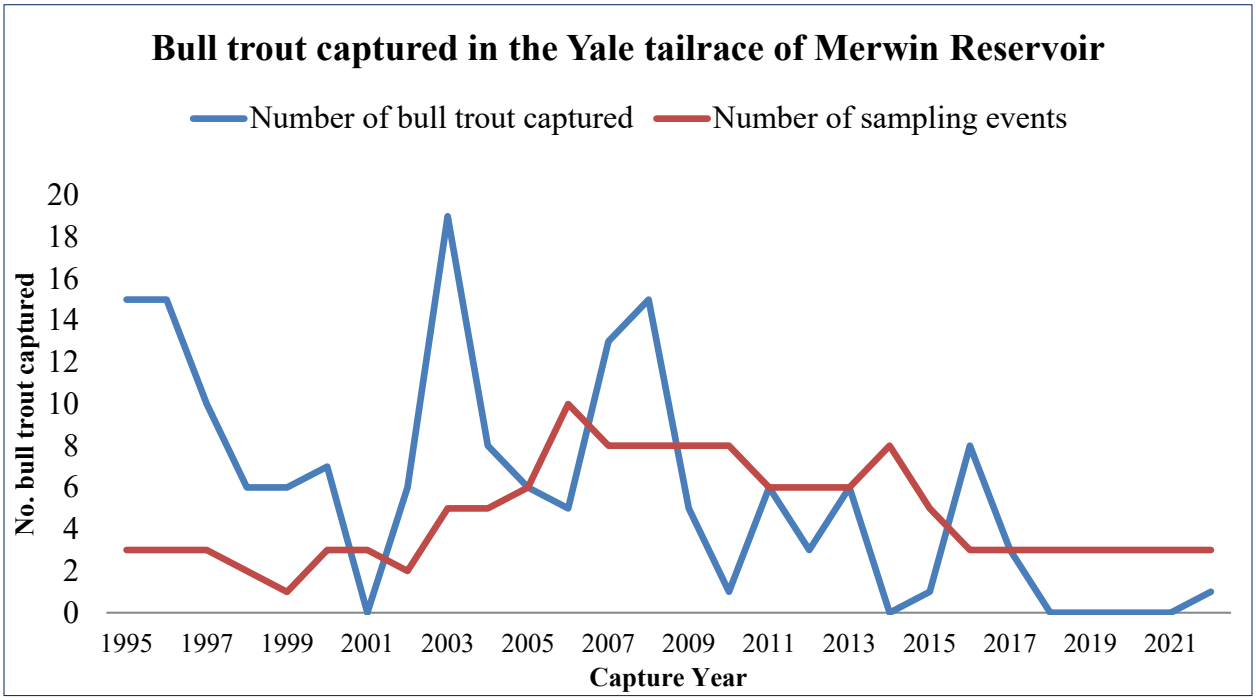

Figure 3.3.2-1. Historical catch and associated effort within the Yale Tailrace (1995-2022).

3.4 UNDERWATER VIDEO CAMERA OPERATION IN COUGAR CREEK

Please see the memo located in Appendix B 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 2022.

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

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 (Dunham et al. 2001). 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 (Muhlfeld et al. 2006).

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 typically 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.

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 2022, the Utilities conducted twelve Cougar Creek redd surveys from the first week of September to the last week of November. Weather and water flow were stable throughout the spawning season, with ideal survey conditions. Surveys begin at the mouth of the creek and end at the creek's spring source, a distance of approximately 2100 m.

New in Yale Reservoir and Cougar Creek in 2022, was the release of 1,800 early-run coho. Starting in September, early-run coho were released over the course of the return at either Saddle Dam or Yale Park in Yale Reservoir. These releases were part of the Lewis River Settlement Agreement directed Habitat Preparation Plan, with the intent of kick-starting the anadromous fish habitat prior to full anadromous fish reintroduction slated for this watershed in 2026. As part of these releases, it was anticipated that coho would utilize Cougar Creek for spawning habitat. Surveys were temporally extended in 2022 to account for the later spawning coho. Bull trout redd surveys typically cease the last week of October; surveys in 2022 continued weekly to the last week of November.

In 2022, biologists walked the entire 2100 m of Cougar Creek during each completed redd survey. To alleviate inter-observer variability, all surveys in 2022 were performed by the same experienced biologists. Dunham et al. (2001) specified that a sampling effort should not rely on indices and use the same surveyors as effective means 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 attempting 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 (Budy et al. 2003)), 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 B), when completed and all data analyzed from the data collection period 2019 – 2022, should allow a better understanding of actual bull trout per redd in Cougar Creek.

During each 2022 redd survey, new bull trout and coho 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. 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 the flagging was taken down. Biologists also counted any live or dead bull trout or coho observed within the vicinity of each marked redd.

In order to document possible spawning spatial interactions (superimposition) that could occur between newly released adult coho and bull trout in 2022, all bull trout redds were also visually marked within the stream similar to the picture in Figure 3.5.1-1. A long piece of flagging was tied to a 12 ounce weight (Figure 3.5.1-2), and the egg pocket of each redd was demarcated at its width within the stream. To our knowledge, this methodology to assess redd superimposition had never been tried before. The thought was if a fish came and constructed a new redd over a previously flagged redd, then the underwater flagging would become disturbed (moved or buried) and would aid in surveyors' ability to quantify. Success for this methodology prior to implementation was considered high given Cougar Creek's groundwater source and its penchant for flows to remain fairly stable even in the midst of persistent storms.

Figure 3.5.1-1. Underwater flagging demarcated bull trout redd egg pocket in Cougar Creek – 2022.

Figure 3.5.1-2. Lead weight and loop that vinyl survey flagging was attached to in 2022 in order to mark bull trout redd egg pockets in the stream in Cougar Creek.

23 individual bull trout redds were observed, GPS'd, and flagged within the stream in Cougar Creek in 2022 (figure 3.5.1-3). Additionally, 75 coho redds were also observed and GPS'd in Cougar Creek in 2022. The spawn timing of bull trout is compared to that of released early-run coho in Figure 3.5.1-4. Given releases of coho were controlled and known for the 2022 spawning run, this curve is also presented in Figure 3.5.1-4. From other watersheds in the Lewis basin, it is documented from direct observation that coho and bull trout prefer the same space to spawn within stream habitats, thus it is interesting to note the later overlap of the early-run coho spawn curve and how this temporal difference has the possibility to pose risk to the earlier spawning bull trout. Figure 3.5.1-5 expresses historical trend counts of bull trout redds in Cougar Creek since redd surveys began in this watershed in 2007.

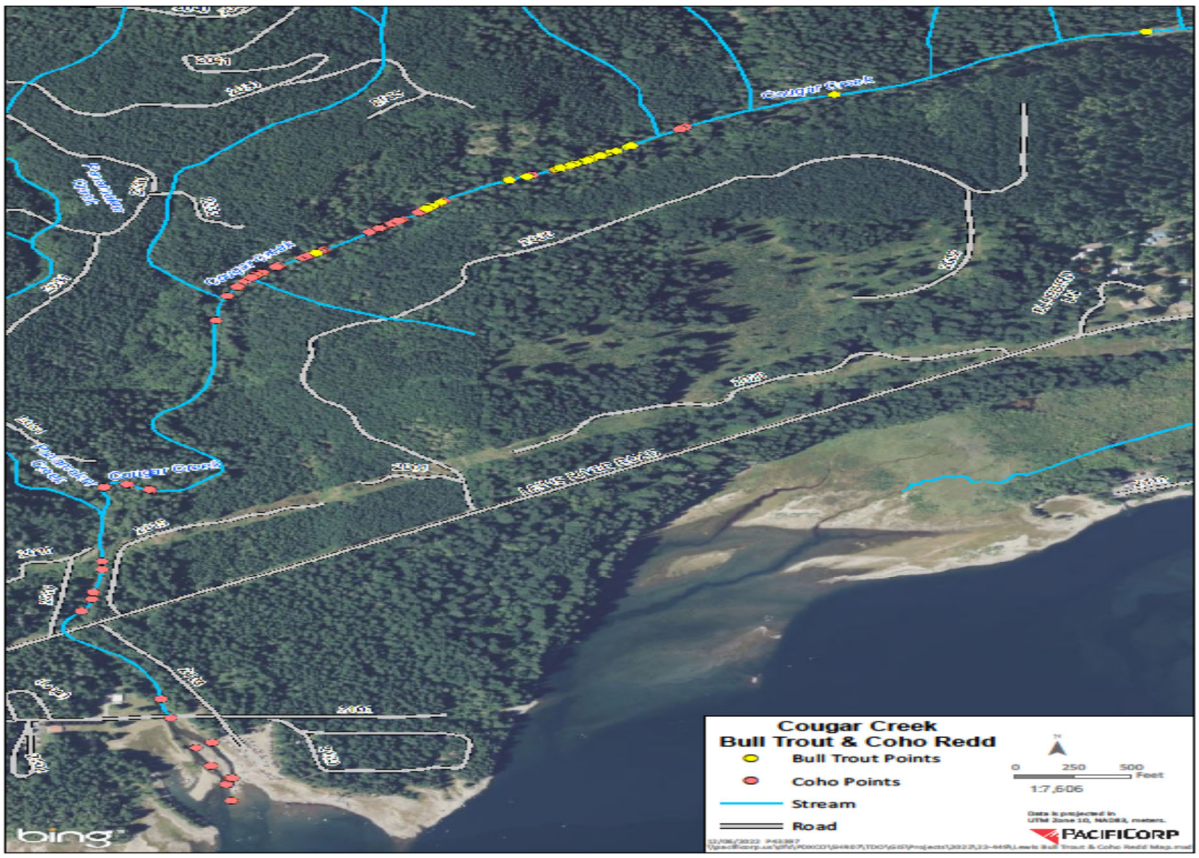

Figure 3.5.1-3. GPS locations of bull trout and coho redds in Cougar Creek in 2022. Each red dot represents an individual bull trout redd (n=23), while each yellow dot represents an individual coho redd (n=75).

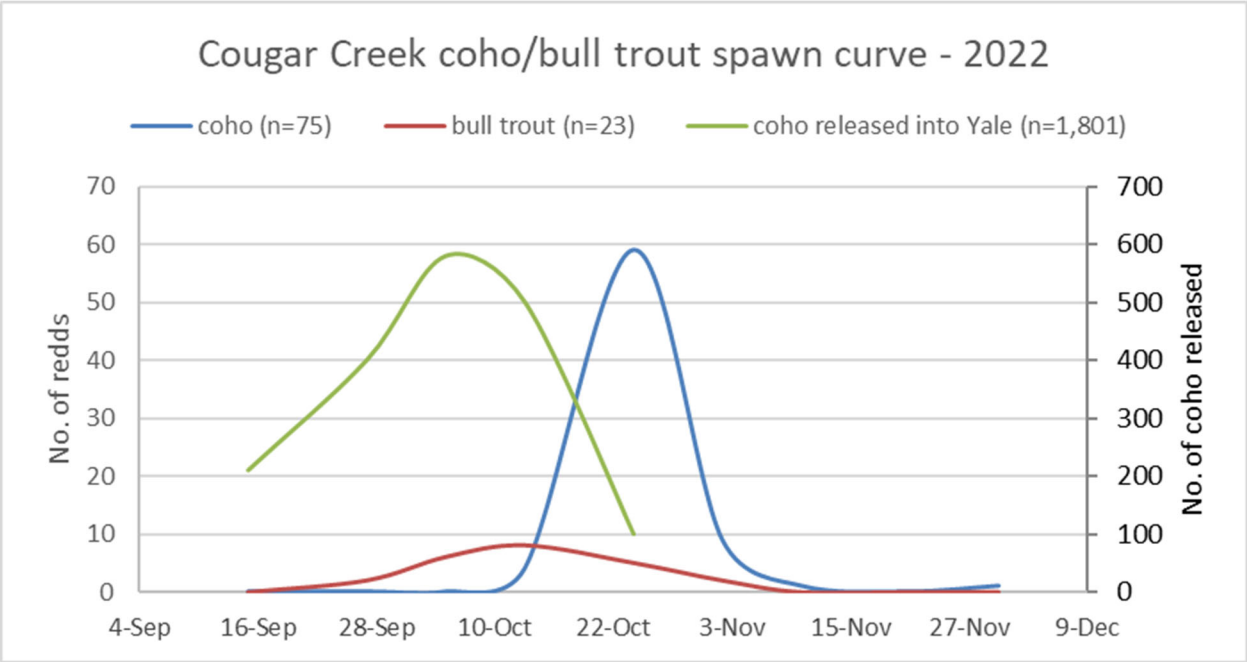

Figure 3.5.1-4. Release curve for coho into Yale Reservoir, and spawn curves for both coho and bull trout in Cougar Creek in 2022.

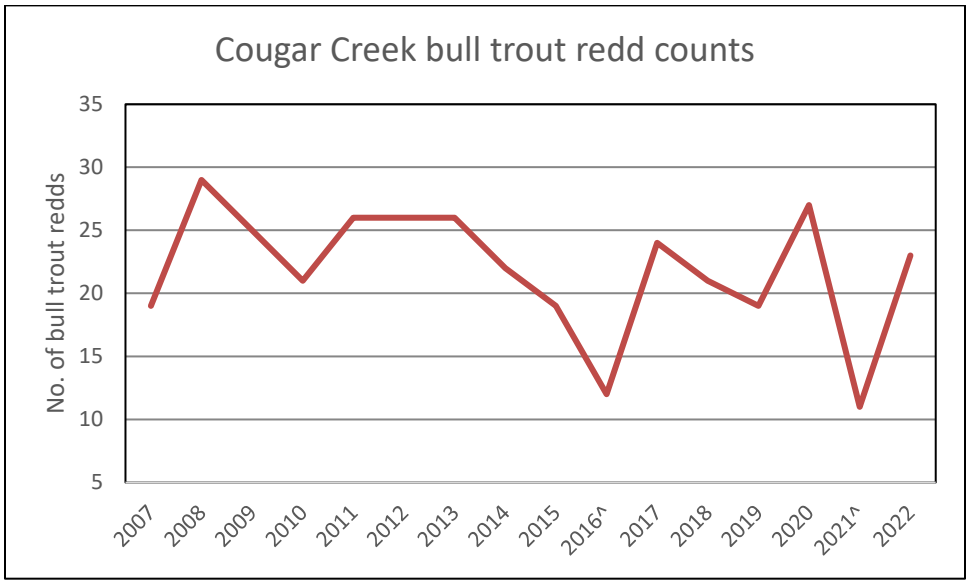

Figure 3.5.1-5. Annual Cougar Creek bull trout cumulative redd counts, 2007-2022. ^truncated survey year due to high stream flow.

Redd Superimposition in Cougar Creek

As documented above, care was taken in 2022 to document any instances of bull trout redd superimposition. Through the use of instream redd egg pocket flagging, it was observed that four of the 23 marked bull trout redds in 2022 were partially or fully disturbed. Of these four superimposed redds, after analysis of timing of the new redd over the old redd, linear location in

the stream, and size of the two redds in question, it was decided that two bull trout redds were superimposed by later spawning coho, and two bull trout redds were superimposed by other later spawning bull trout. Superimposition of bull trout redds on other previously dug bull trout redds is not uncommon in the Lewis basin and is observed on an annual basis in both Cougar Creek and tributary P8 in the Pine Creek basin. Figures 3.5.1-6 – 3.5.1-9 visually compare a bull trout redd superimposed by another bull trout redd, and a bull trout redd superimposed by that of a coho redd.

Figure 3.5.1-6. Bull trout redd marked on October 5 in the upper portion of Cougar Creek.

Figure 3.5.1-7. Same bull trout redd as above revisited on October 24, notice how flagged redd pocket on October 5 is now the redd "pit" of the newly constructed redd observed on October 24.

Figure 3.5.1-8. Bull trout redd observed and marked on September 27.

Figure 3.5.1-9. Same redd site as picture above revisited on October 24 and now superimposed by a coho. Notice the flagging weights have become displaced and are further downstream and not in originally placed location.

3.5.2 Bull Trout Redd Surveys of Pine Creek, Pine Creek Tributary P8, Rush Creek, and exploratory redd surveys of the Muddy River

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 six times from September 2 – November 1 during the 2022 bull trout spawning season. In all, GPS coordinates were collected from 50 bull trout redds during the survey period. Figure 3.5.2-2 expresses historical redd survey trend for this watershed (2008-2022). Redds were observed and counted from the mouth of P8 to 2100 m upstream.

Spawning coho had been observed within P8 during the 2014, 2015, and 2020 bull trout spawning season. During 2022 bull trout spawning surveys, spawning coho were observed during a survey on October 18 and November 1. Twenty coho redds in total were identified during the two survey. For the first time since anadromous reintroduction began in 2012, spawning spring Chinook were also observed in P8 during bull trout spawning surveys.

Seven coho redds were observed fully superimposed over previously dug bull trout redds during the October 18 and November 1 surveys. One bull trout redd was also observed superimposed over a previously dug bull trout redd during a survey on October 4. Previously dug bull trout redd locations were identified via flagging demarcating their spatial location within the stream, as well as field notes taken during the initial bull trout redd survey at the time of first observance of the superimposed bull trout redd. The coho redds were identified as coho due to the presence of live coho on the redd actively constructing.

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 2022 (river mile 0 to river mile 8). In all, eight surveys were completed and 80 redds were recorded and GPS'd (Figures 3.5.2-1 and 3.5.2-2). During the 2022 bull trout spawning season, bull trout redds were observed in upper Pine Creek just meters (appr. 5) below where Pine Creek comes out of the ground to establish surficial flow.

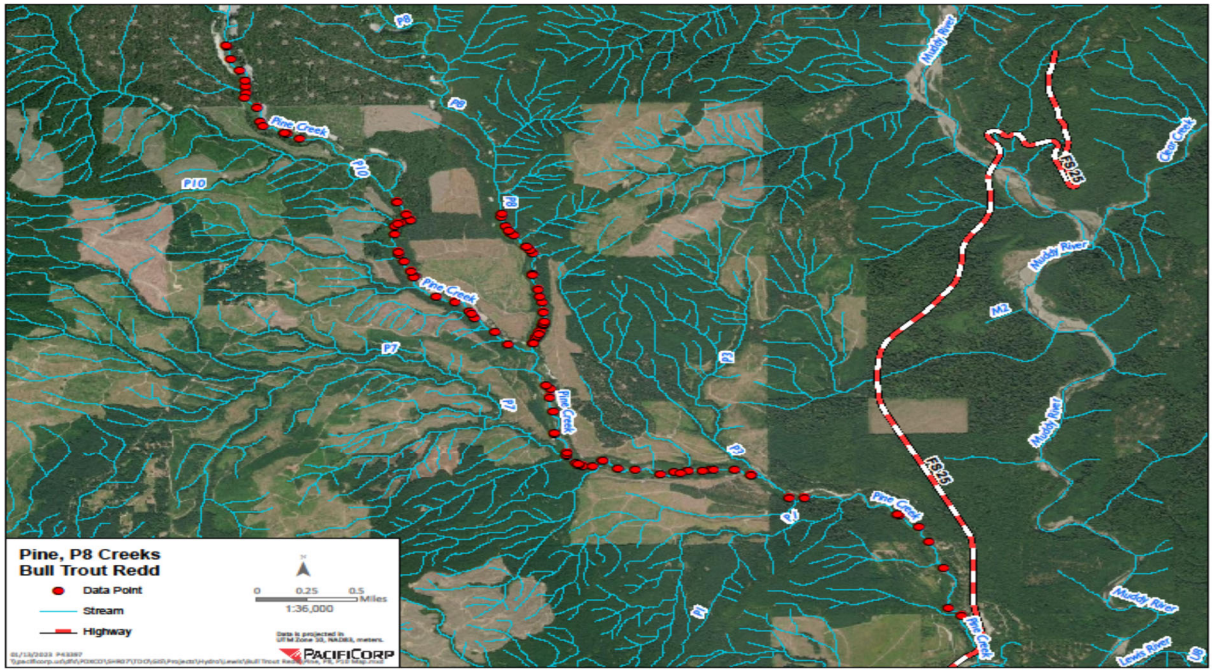

Figure 3.5.2-1. GPS locations of bull trout redds in Pine Creek and tributary P8 in 2022. Each red dot represents an individual bull trout redd (n=130).

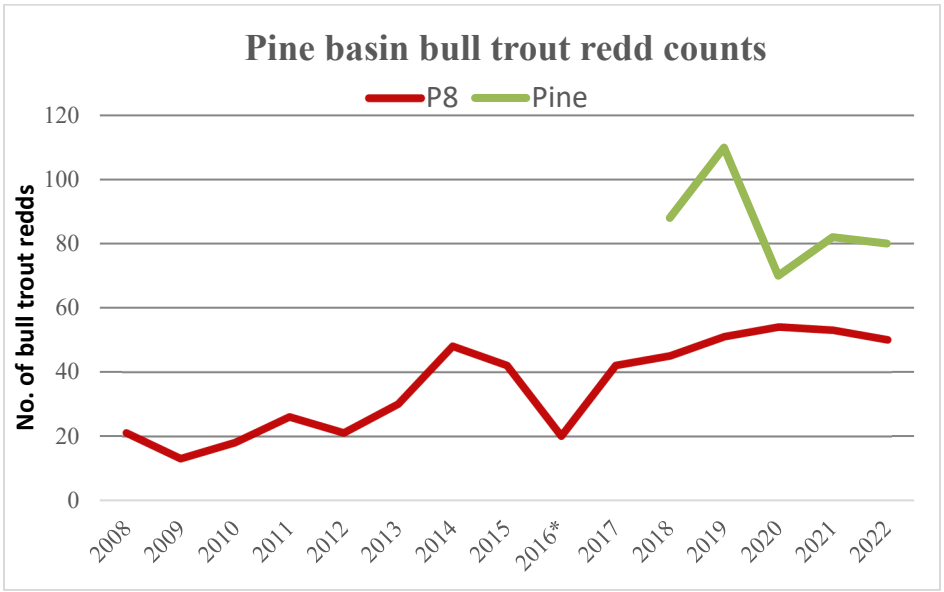

Figure 3.5.2-2. Pine Creek and tributary P8 historical bull trout redd counts. *Truncated survey year due to high flows.

Figure 3.5.2-3 further illustrates the spawn curves of bull trout in the Lewis basin by evaluating redd counts within Pine Creek, tributary P8, Rush Creek, and Cougar Creek.

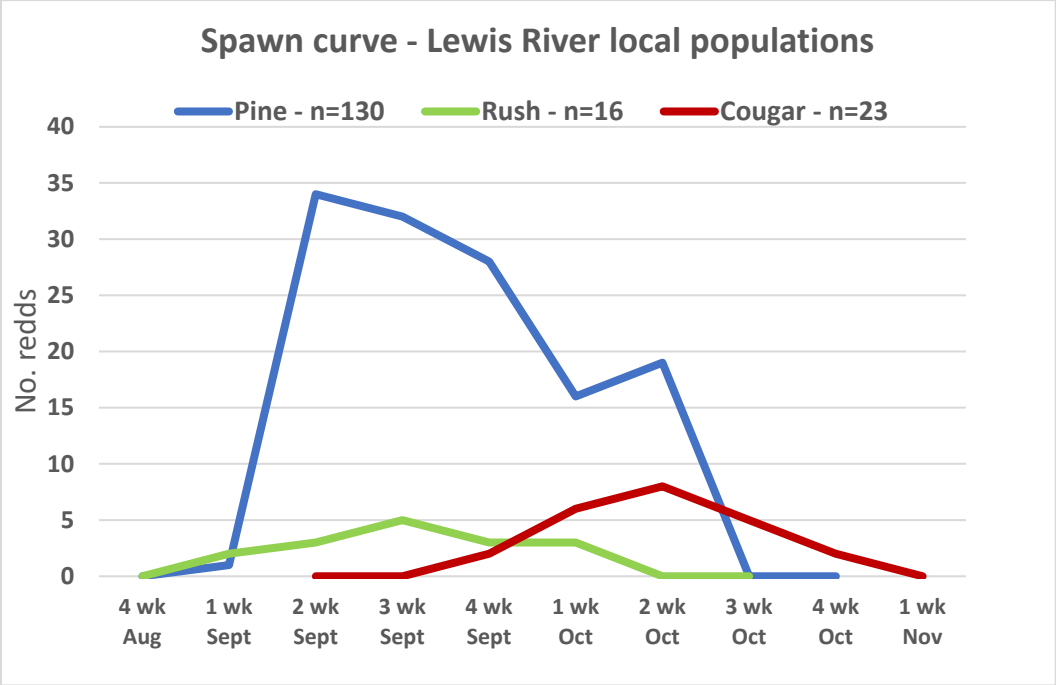

Figure 3.5.2-3. Spawn curve for bull trout upstream of Swift Reservoir as compared to bull trout in Yale.

Rush Creek

Rush Creek was surveyed on five occasions between September 7 and October 20, 2022. In all, 16 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.

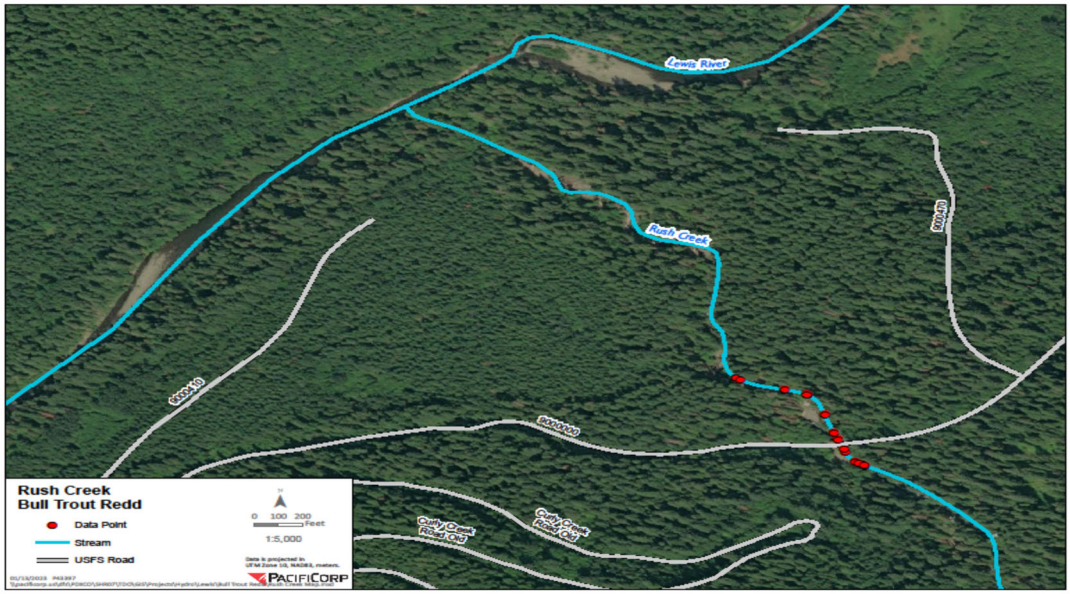

Figure 3.5.2-4. GPS locations of bull trout redds in Rush Creek in 2022. Each red dot represents an individual bull trout redd (n=16).

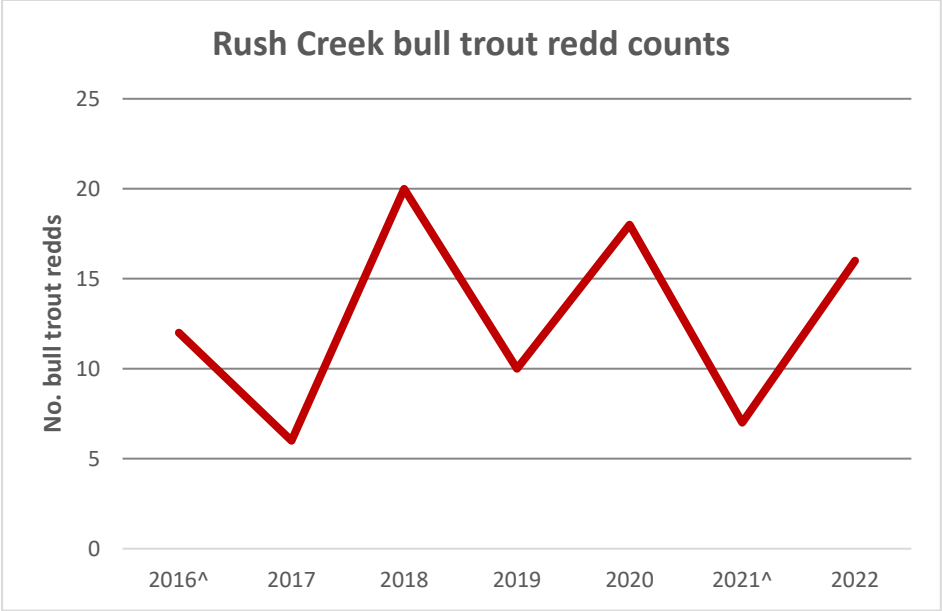

Figure 3.5.2-5. Rush Creek historical bull trout redd counts. ^truncated survey year due to high flows.

Exploratory Bull Trout Redd Surveys of the Muddy River

The Muddy River was surveyed in an exploratory capacity for bull trout redds from Smith Creek downstream to the Muddy's confluence with the North Fork Lewis River on September 8-9 and September 28-29 in 2022. During these two surveys, two surveyors kayaked and walked, one on

each side of the river. No bull trout lives or redds were identified during either of the two surveys.

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 2022 (Figure 3.6-1). 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 timeframe. Figure 3.6-2 visually exhibits recorded temperatures at Pine, P8, Rush, Eagle Cliff, and mainstem Lewis River upstream of Rush Creek in 2022. The thermograph in P10 was not retrieved due to snow and high flow and remained deployed for the entirety of the year.

Figure 3.6-1. Thermograph placement in the upper basin above Swift Reservoir in 2022.

The 2022 dataset 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. Raw hourly data collected since 2019 is substantial in its size, all data is available upon request

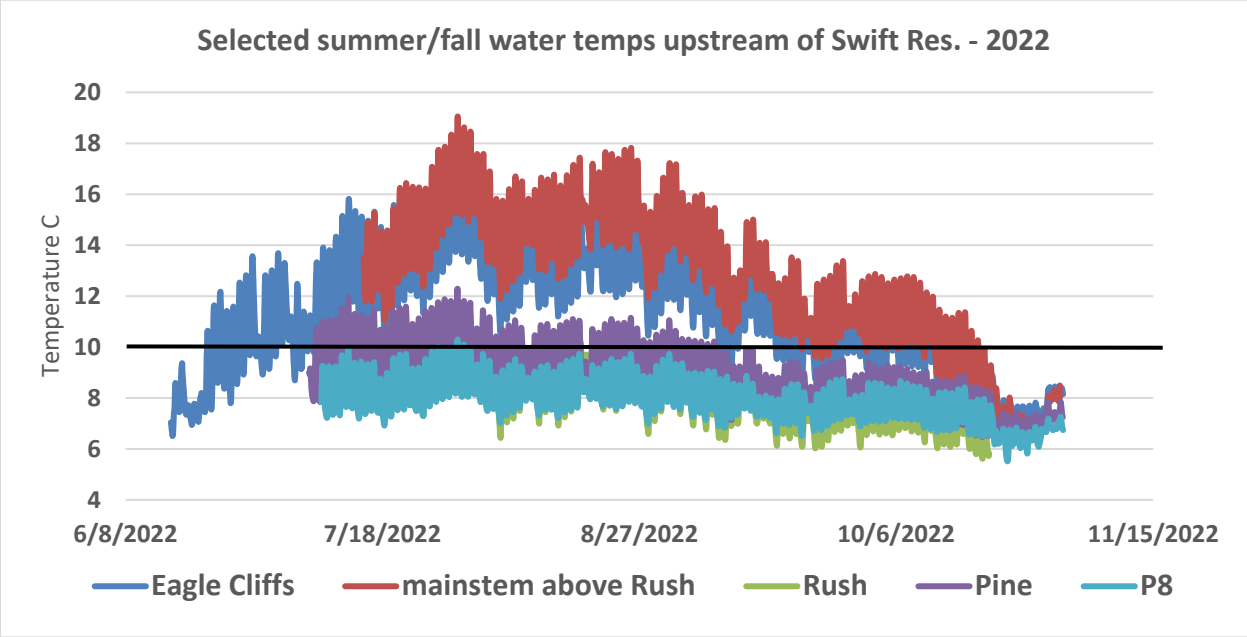

Figure 3.6-2. Recorded temperatures from tributaries upstream of Swift Reservoir in 2022.

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 Marshall Barrows from USFWS for operation of the Cougar Creek weir and video chute 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, 2022 Report. (This Report was not available at the time of submittal. This data will be included within the 2023 Annual Report as it becomes available)

APPENDIX B

MEMO BY MARSHALL BARROWS, UNITED STATES FISH AND WILDLIFE SERVICE: Operation of Cougar Creek Weir and Underwater Video, 2022 Report. (This Report was not available at the time of submittal. This data will be included within the 2023 Annual Report as it becomes available.)