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

Swift Bypass Reach captures - 2021

***North Fork Lewis River – 2021***

| | |
|---|---|
| *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 2021. For methods and general descriptions of all programs please refer to the 2021 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 2021 (PacifiCorp, 2020).

# 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. 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).

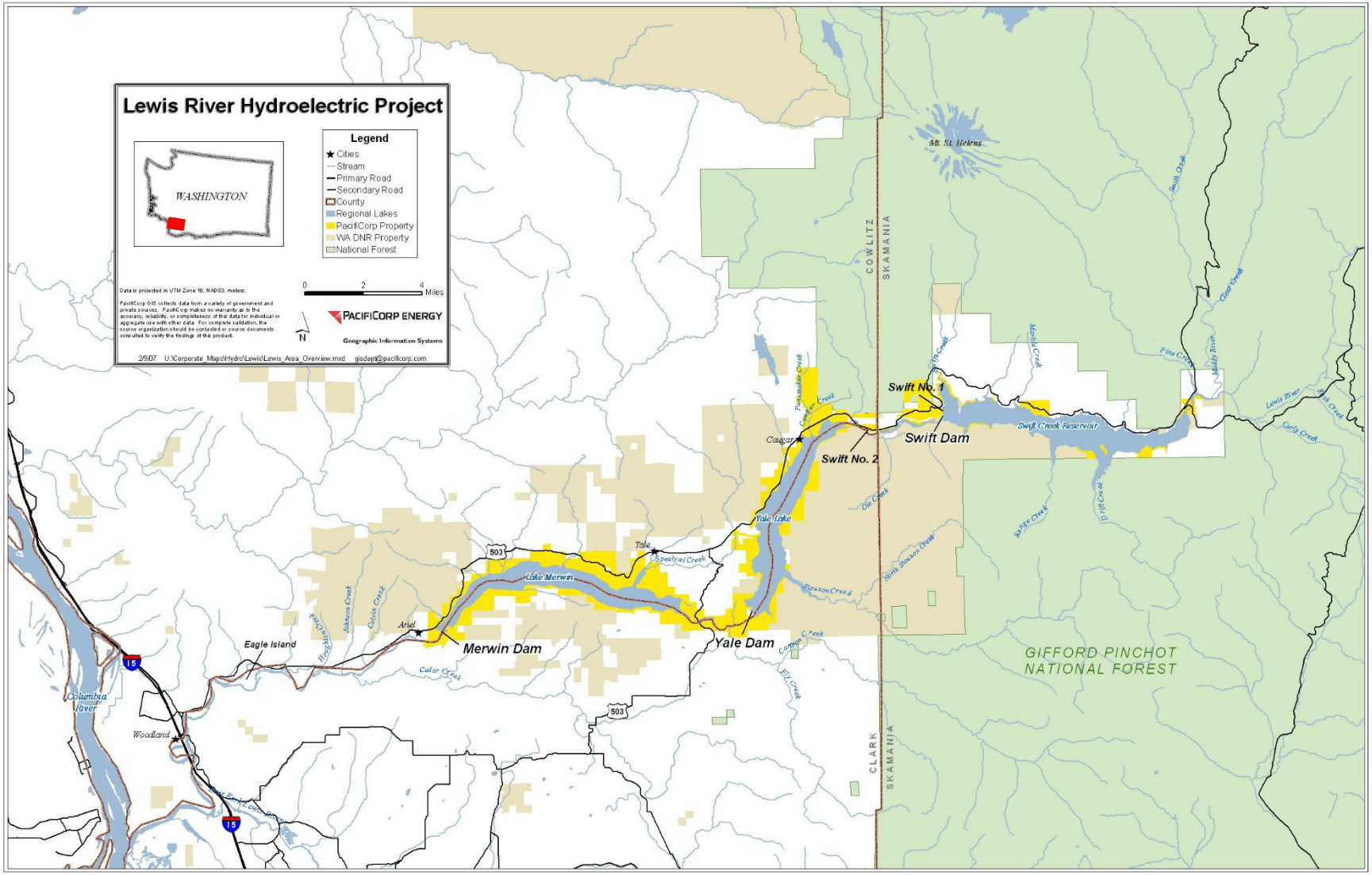


**Figure 2.0-1. Map of North Fork Lewis River study area.**

## 3.0 RESULTS FROM 2021 PLANNED ACTIVITIES

During 2021 the Utilities participated in, funded, or initiated six monitoring programs.

- Swift Reservoir Survival (S) and juvenile bull trout collection.
- 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 upper North Fork Lewis 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 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) AND 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 (RECAPTURE):

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 or snorkeling activities were conducted in 2021 with the next round slated for 2022.

### 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 2021 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—2021 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).

In 2021, 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 2021, 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).

Areas within Rush Creek were sampled with a backpack electrofishing unit on July 6$^{th}$ and 16$^{th}$ (Figure 3.1.3-1). In all, 11 juvenile bull trout were captured and sampled for genetic tissue. Eight of the captures were less than 70 mm fork length and assumed to be of 2020 brood year origin.

The length range of the age 0 bull trout was 32 mm – 55 mm, with an average fork length of 43 mm.

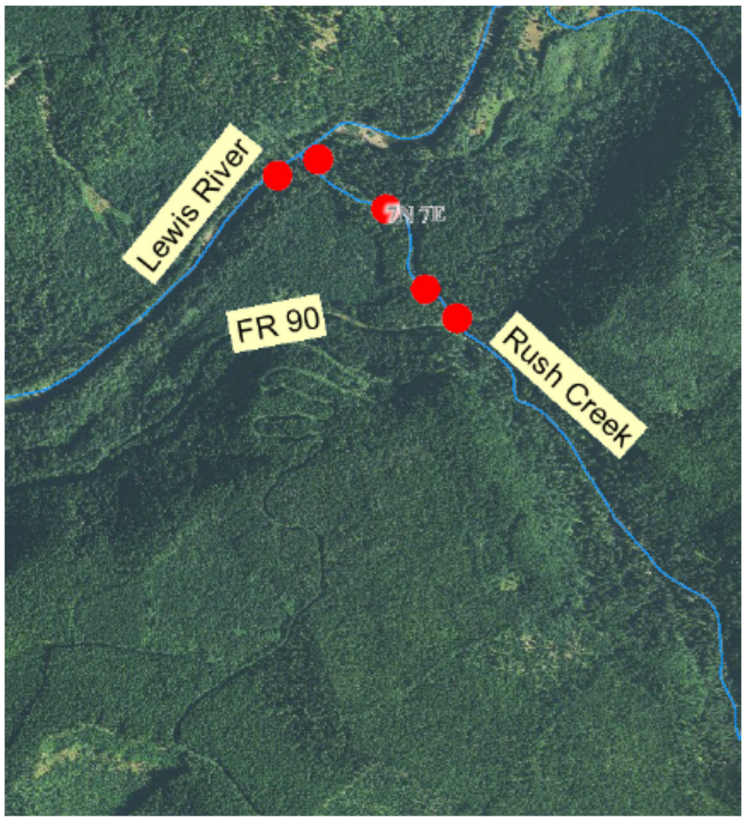


**Figure 3.1.3-1. Electrofishing sites within Rush Creek during 2021 juvenile bull trout collection.**

Areas within Pine Creek and tributary P8 were sampled for juvenile bull trout with a backpack electrofisher on June 14th, 16th and 17th, and June 14th (Figure 3.1.3-2). In all, 34 juvenile bull trout were captured from within P8 ranging from 40 – 120 mm fork length with an average fork length of 49 mm. 64 juvenile bull trout were captured from within areas of Pine Creek mainstem ranging in size from 44 – 190 mm fork length with an average of 57 mm.

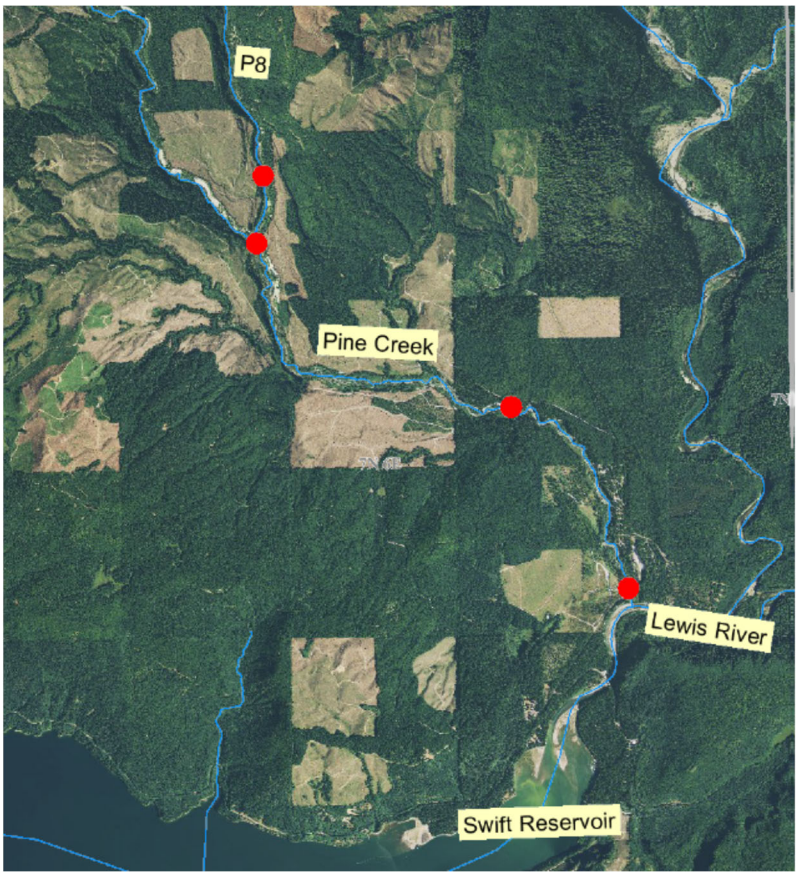


**Figure 3.1.3-2. Electrofishing sites within the Pine Creek system during 2021 juvenile bull trout collection.**

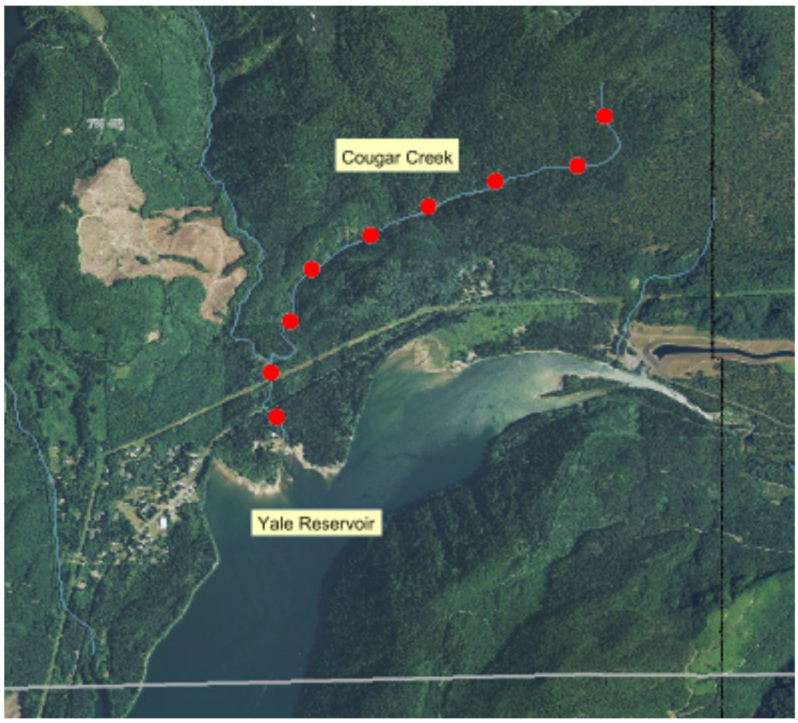


**Figure 3.1.3-3. Electrofishing sites within the Cougar Creek system during 2021 juvenile bull trout collection.**

Areas within Cougar Creek were sampled with a backpack electrofishing unit on June 29th (Figure 3.1.3-3). In all, 37 juvenile bull trout were captured and sampled for genetic tissue. The length range of captured bull trout was 44 – 124 mm, with an average fork length of 55 mm for age 0 bull trout (Figure 3.1.3-4).

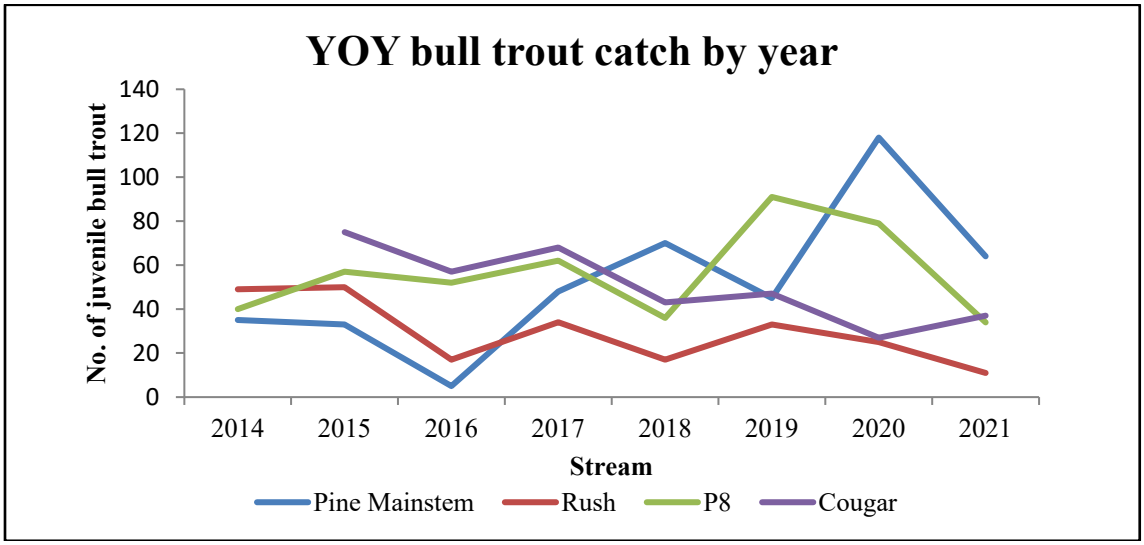


**Figure 3.1.3-4. Trend bull trout juvenile catch during stream electrofishing surveys. Cougar Creek was not surveyed in 2014.**

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 2021. This single 2.4 m diameter cone screw trap was operated from March 15 – August 10 in 2021. 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 |
| 2021 | Eagle Cliff | 3/15-8/10 | 3/24-7/27 | 49 | 127 | 54 | 136 | 26 | 430 |

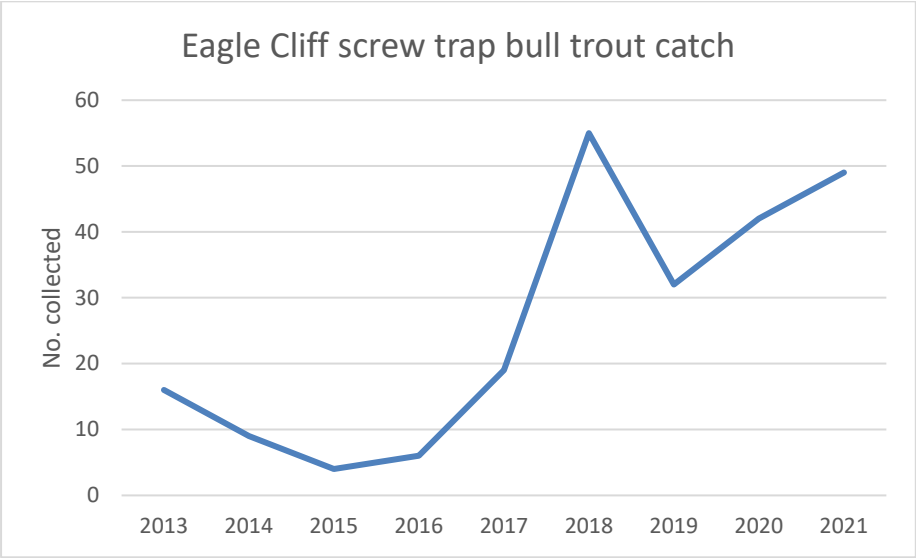


**Figure 3.1.3-5. Eagle Cliff screw trap bull trout catch by year.**

**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, as well as within Rush Creek; one coho was encountered within Cougar Creek in 2021. Pine Creek mainstem had a total coho catch of 240; P8 a catch of 183 and Rush a total coho catch of 28. 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 64 and a difference in overall collected of 58 percent more YOY coho. The P8 coho catch corresponds to a YOY bull trout catch of 34 and a difference in overall collected of 68 percent more YOY coho. The Rush Creek coho catch corresponds to a YOY bull trout catch of 11 and a difference in overall collected of 66 percent. As stated above, only one coho juvenile was encountered within Cougar Creek in 2021 (Figure 3.1.3-6).

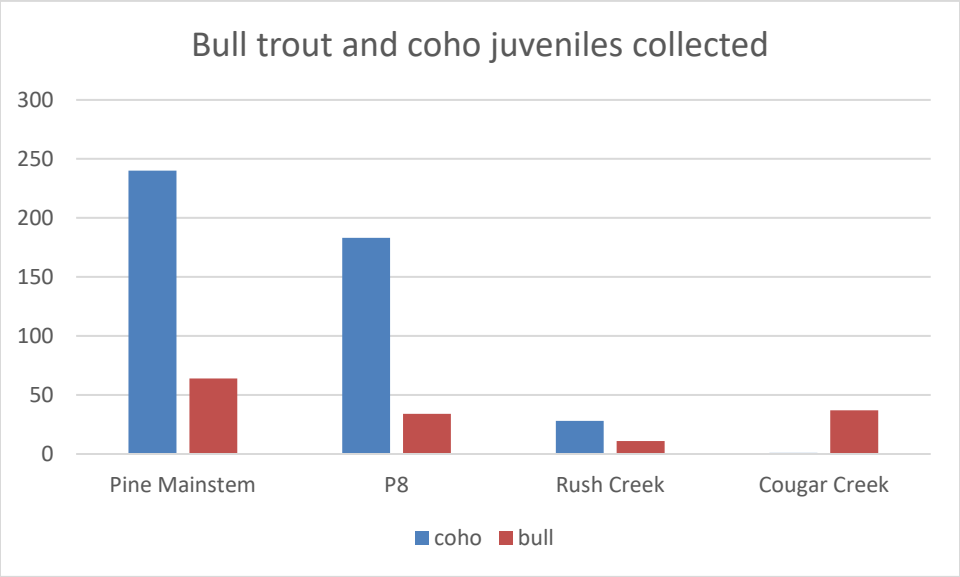


**Figure 3.1.3-6. Coho and bull trout juvenile capture numbers by stream of capture in 2021.**

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 almost 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 substantially larger than encountered bull trout YOY (Figure 3.1.3-7).

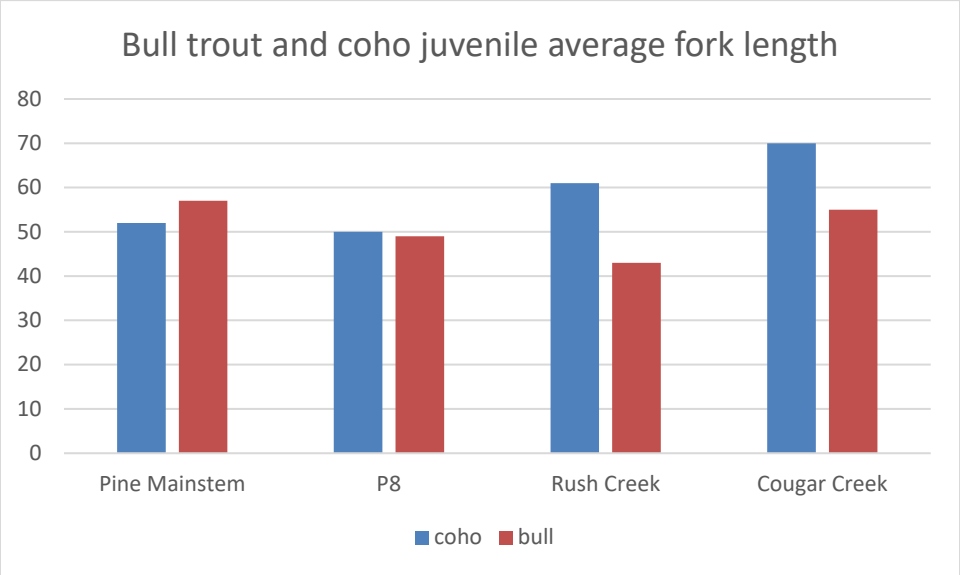


**Figure 3.1.3-7. Juvenile coho and bull trout captures average fork length observed in 2021.**

## 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

6' 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. Five in Cougar Creek, two in Pine Creek, one in P8, two in Rush Creek, one in Rush pool, and two 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 in 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, 2021.**

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 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 – 2021.**

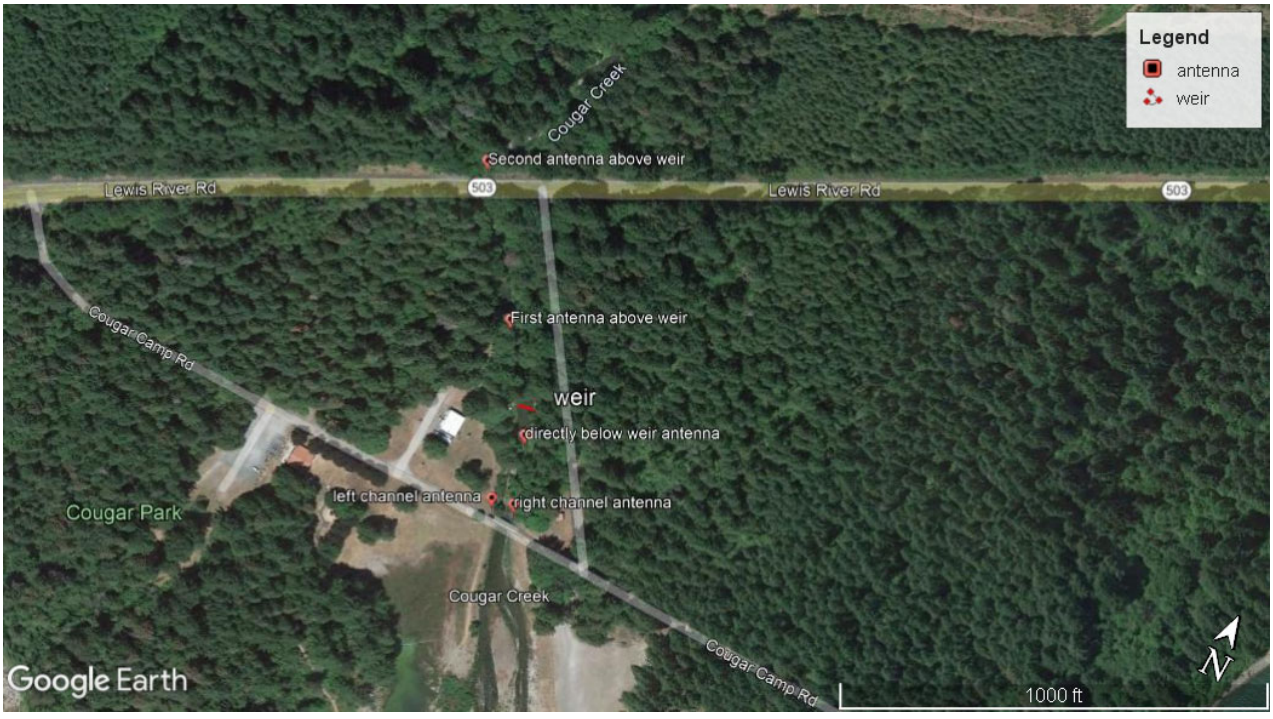


**Figure 3.2.1-3. Wagon wheel PIT tag antenna locations in the Yale Reservoir Basin – 2021.**

234 discrete PIT codes were detected swimming past a PIT antenna in 2021. Of these, 64 were known to be bull trout. The other 170 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 five wagon wheel PIT antennas near the mouth of Cougar Creek were in operation from July 27 – October 29. No power loss was recorded during the period of operation. During the operational period eight discrete bull trout detections were recorded (Figure 3.2.1-6). Of note at this PIT antenna site was the use of the five PIT antennas to evaluate delay at the Cougar Creek weir. Three 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 five sites are further analyzed in the 2021 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 July 28 to October 27, 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. 58 discrete PIT codes were cumulatively detected by the two antennas. Of these, 25 were found to be individual bull trout, while the other 33 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 3.2.1-6. Of the 25 bull trout that were detected moving past these antennae in 2021, ten were correspondingly also detected upstream at the PIT antenna in tributary P8. Of the 15 bull trout that were only detected at the Pine Creek mouth PIT antennas, 80 percent showed evidence of consecutive year migrations (2, 3, 4, 5, 6, 7, or 8 year consecutive), and 20 percent were maiden detections (Figure 3.2-5).

**Pine Creek Tributary P8**

The PIT antenna at the mouth of Pine Creek tributary P8 was in operation from July 29 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 31 discrete tag codes. Of these 31 discrete detects, 30 were previously handled bull trout and one was an unknown orphan tag. Of the 30 interrogated bull trout, 20 were detected only at the P8 antenna, whereas the other ten discrete detects were detected at both the Pine Creek mouth and P8 antennas. Of the 20 bull trout that were only detected at the P8 PIT antenna, 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 3.2-5). Historical discrete detections at the P8 site are expressed in Figure 3.2.1-6.

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 fourth week of September and second week of October. This peak is two weeks later to what was observed during the prior year.

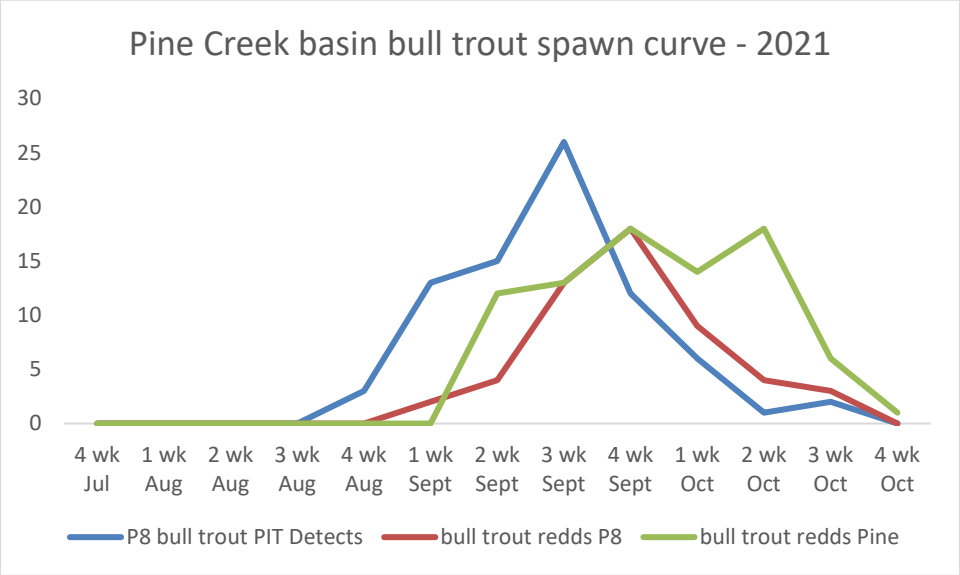


**Figure 3.2.1-4. Pine Creek system spawn timing observed in 2021.**

## 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 19 – November 1. 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 3.2.1-6. Of the five bull trout detected at the Rush Creek antenna location in 2021, 80 percent showed evidence of consecutive year migrations, and 20 percent were maiden detections.

## Rush Creek Pool

The PIT antenna located in Rush Creek pool was in operation from August 9 - October 25. No power loss was experienced during the period of operation. 11 discrete tag codes were recorded during the period of operation, resulting in seven discrete bull trout tags and four coho juvenile/adult tags. Historical discrete detections at this site are expressed in Figure 3.2.1-6. Of the seven bull trout detected at the Rush Creek pool antenna location in 2021, 80 percent showed evidence of consecutive year migrations, and 20 percent were maiden detections. All five bull trout detected migrating upstream past antennae in Rush Creek were also previously detected at

the Rush Creek Pool antenna. Of the two bull trout detected in Rush Creek Pool that were not subsequently also detected within Rush Creek; one was detected migrating upstream Pine Creek and the other was not detected at any other antenna site.

**Eagle Cliff Pool**

The two wagon wheel PIT antennas located within Eagle Cliff Pool were in operation from August 9 – November 1, no power loss was experienced. During this time, 154 discrete PIT tag codes were recorded. Of these, 20 were found to be bull trout with the other 134 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 20 bull trout detected at this location, 15 were subsequently detected moving past PIT antenna in the Pine Creek basin, while the other five were not detected at any other PIT antenna site.

**All Detection Analysis**

Spawning frequency for the last seven years from all detections at all streams combined was analyzed and is expressed in Figure 3.2.1-5. It is noted that a shift from maiden detection to multiple year detection is observed from 2015 to 2021, this shift is expected to become more pronounced as additional data is collected and individual fish are followed through their lifecycle.

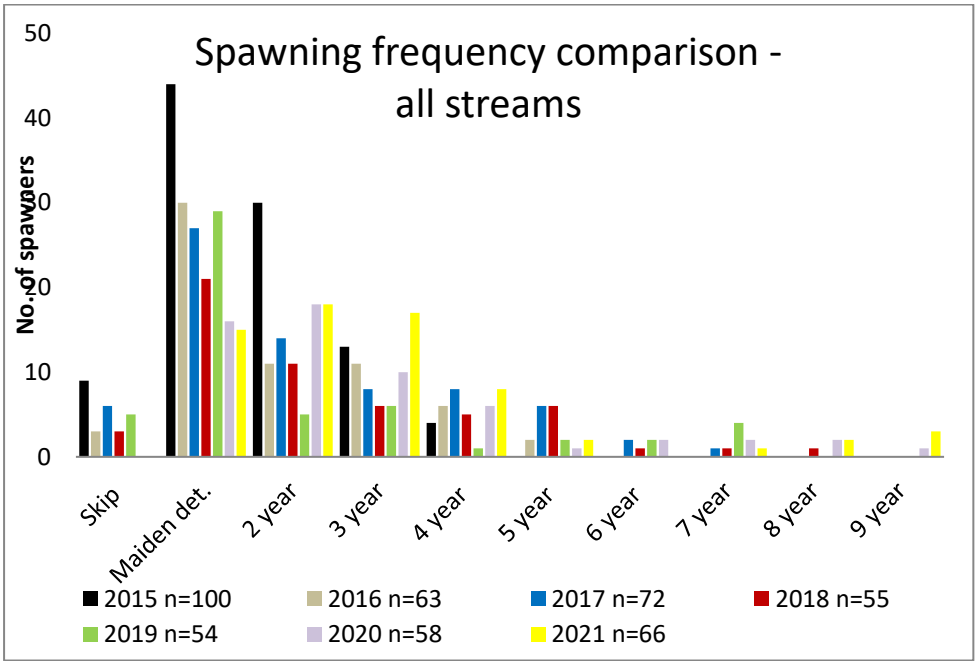


**Figure 3.2.1-5. Spawning frequency of all detections for the years 2015-2021.**

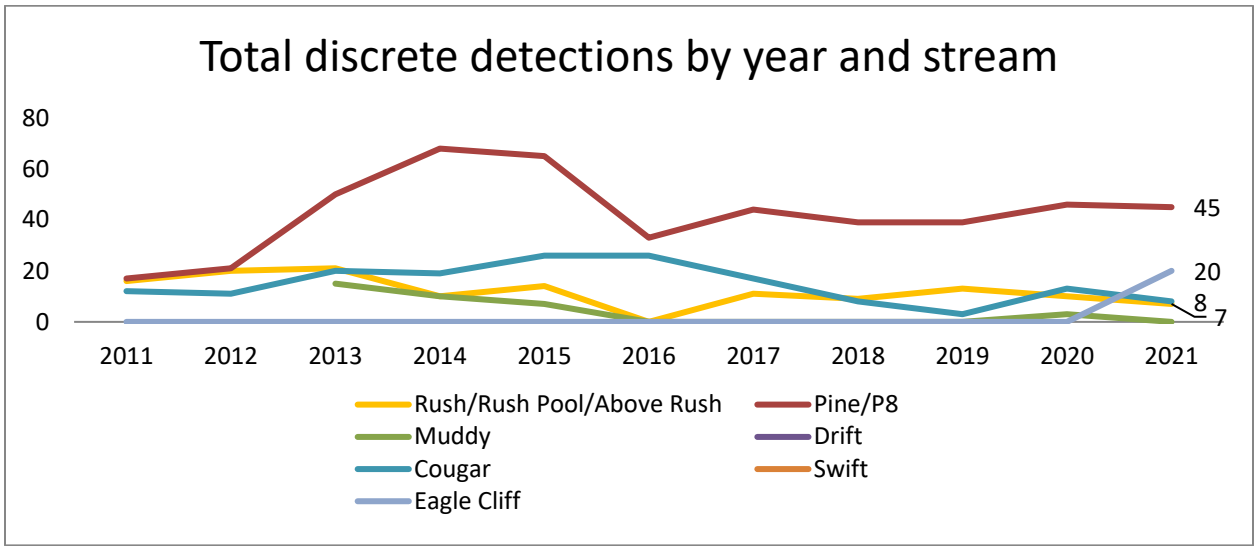


**Figure 3.2.1-6. Total detections by year from all sites for years 2011-2021.**

## 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, 2021.**

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.

2021 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. 2021 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 2021 simply consisted of collecting biological data from each capture, and PIT tagging all encountered maiden captures 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 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 four collection events a total of three bull trout were captured (Table 3.3.1-1). Of these, two were prior year recaptures and one a maiden capture. Two of the three 2021 captures were later interrogated at a PIT antenna in Cougar Creek. 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.

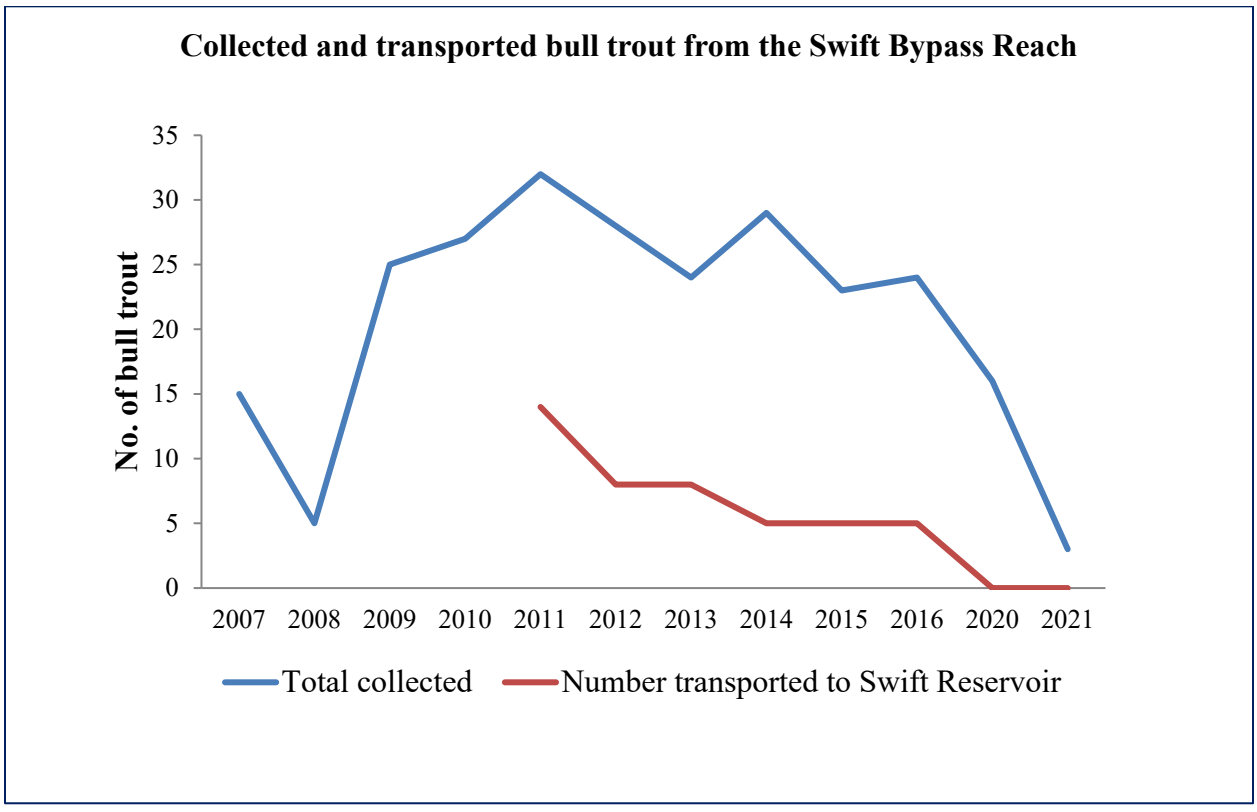


**Figure 3.3.1-2. Historical Swift Bypass Reach capture and transport numbers. No collection activities were conducted 2017-2019.**

### 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) 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 2021, 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 2021, three capture attempts were completed; June 10, July 12, and August 15, yielding no bull trout captures. This is the fourth year in a row of zero bull trout captures in the Yale Tailrace, with 2017 being the last time a bull trout was handled in this area.

**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 – 2021.**

| 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 |
| **TOTAL** | **162** | **122** | **2** | **21** | **14** |

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

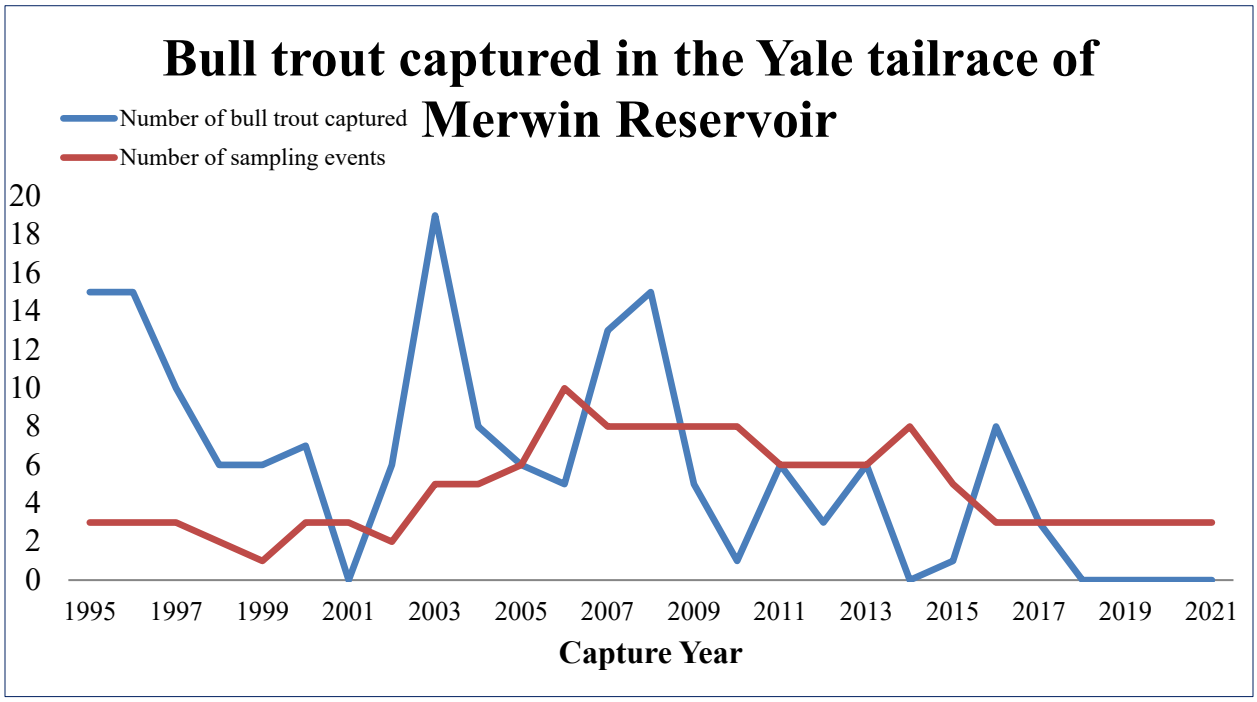


**Figure 3.3.2-1. Historical catch and associated effort within the Yale Tailrace (1995-2021).**

## 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 2021.

## 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 2021, the Utilities conducted five Cougar Creek bull trout redd surveys from September 14 to October 20. Two additional surveys were attempted on October 29 and November 2, but due to a high flow event which resulted in unsafe survey conditions, they were not completed. Surveys begin at the mouth of the creek and end at the creek's spring source, a distance of approximately 2100 m.

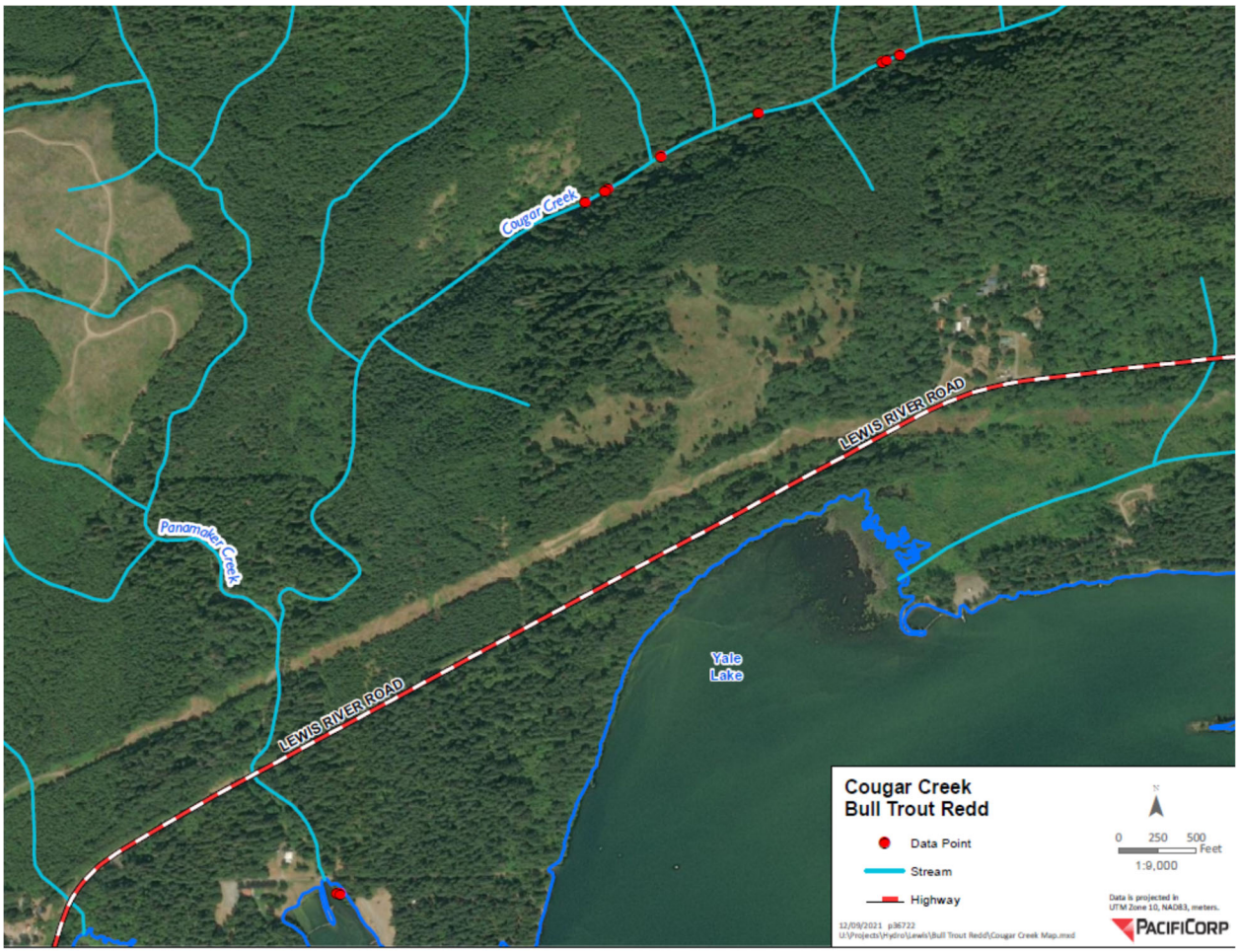


**Figure 3.5.1-1. GPS locations of bull trout redds in Cougar Creek in 2021. Each red dot represents an individual bull trout redd (n=11).**

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 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.

In 2021, biologists walked the entire 2100 m of Cougar Creek during each completed redd survey. Surveys are performed over an extended period of time to address potential error associated with spawn-timing. To alleviate inter-observer variability, all surveys in 2021 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 B) will hopefully allow a better understanding of actual bull trout per redd in Cougar Creek.

During each 2021 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 the flagging was taken down. Biologists also counted any bull trout observed within the vicinity of each redd.

11 individual bull trout redds were observed in Cougar Creek in 2021 (figure 3.5.1-4). As in past years, most 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). For the first time since systematic redd surveys commenced in this watershed, bull trout redds (2) were observed downstream of the 503 highway crossing, near the creek confluence with the reservoir (Figure 3.5.1-1).

A high flow event occurred within the basin during the last week of October, precluding completion of the final two scheduled redd surveys (Figure 3.5.1-2 and 3.5.1-3). Though surveys were attempted, this high flow event resulted in unsafe survey conditions and the surveys were ultimately called off prior to completion. Due to the truncated survey season, the observed 11 bull trout redds are considered the minimum number of bull trout redds constructed in Cougar Creek in 2021.

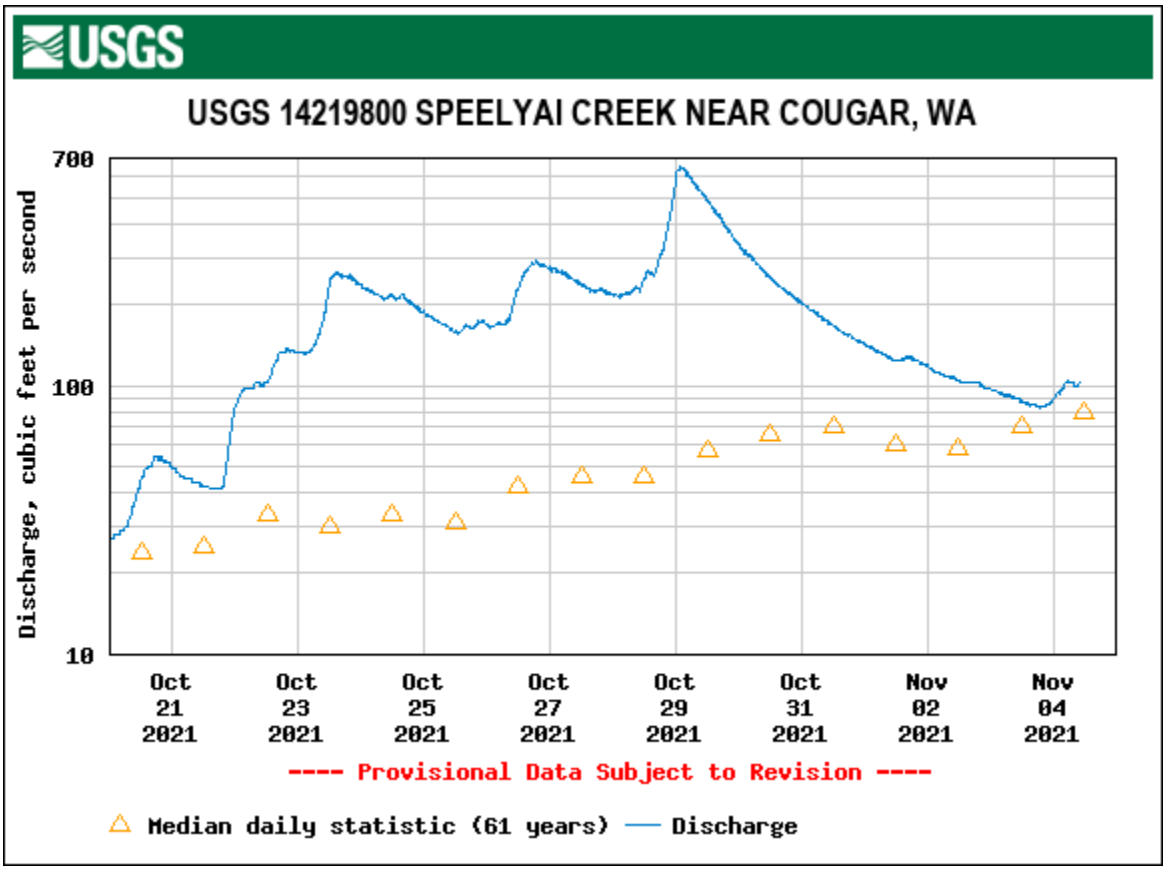


**Figure 3.5.1-2. Hydrograph from Speelyai Creek during the October high flow event. Cougar Creek currently does not have a United States Geological Survey gage associated with its outflow, Speelyai Creek is in close vicinity to Cougar Creek.**

**Figure 3.5.1-3. Cougar Creek weir during the October high flow event.**

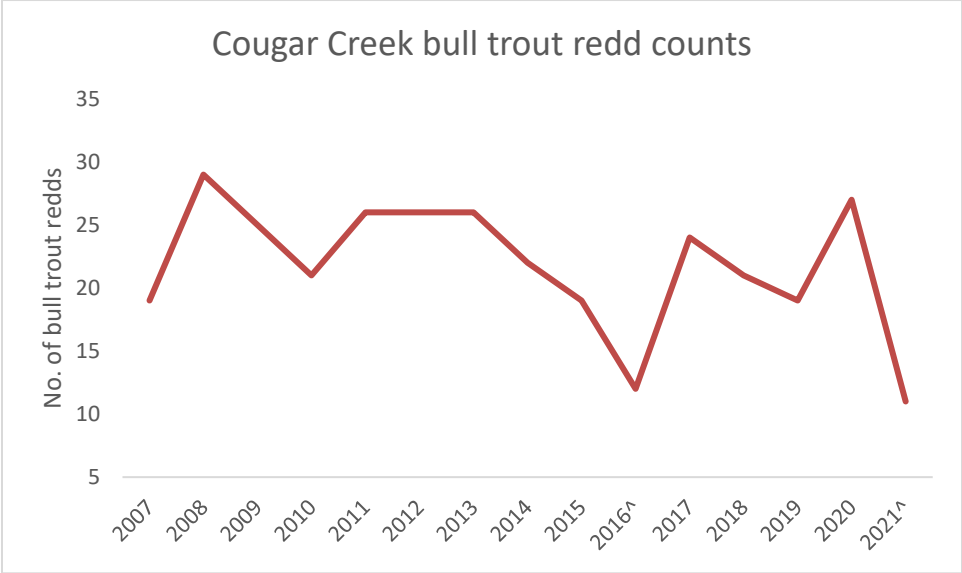


**Figure 3.5.1-4. Annual Cougar Creek bull trout cumulative redd counts, 2007-2021. ^truncated survey year due to high water flow.**

## 3.5.2 Bull Trout Redd Surveys of Pine Creek, Pine Creek Tributary P8, Rush Creek, and upper mainstem North Fork Lewis 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 7 – November 1 during the 2021 bull trout spawning season. In all, GPS coordinates were collected from 53 bull trout redds during the survey period (2008-2021). Redds were observed and counted from the mouth of P8 to 2100 m upstream (Figure 3.5.2-1 and 3.5.2-2). Intrapecies redd superimposition was observed on one occasion within P8 during the 2021 survey period.

Spawning coho had been observed within P8 during the 2014, 2015, and 2020 bull trout spawning season. During 2021 bull trout spawning surveys, spawning coho were observed during a survey on October 18 and November 1. Two coho redds were identified during each survey. A coho redd was observed fully superimposed over one previously dug bull trout redd during each of these two surveys. 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 2021 (river mile 0 to river mile 8). In all, seven surveys were completed and 82 redds were recorded and GPS'd (Figures 3.5.2-1 and 3.5.2-2). Due to a high flow event the last week of October, not all areas of the stream were surveyed based on unsafe conditions.

49 percent of redds were recorded in the lower half of available spawning habitat below the confluence of tributary P8 (40 redds from river mile 0 to river mile 4), 51 percent of redds were recorded in the upper half of available habitat just upstream of the confluence with tributary P8 (42 redds from river mile 4 to river mile 8). During the 2021 bull trout spawning season, bull trout redds were observed in upper Pine Creek just meters below where Pine Creek comes out of the ground to establish surficial flow.

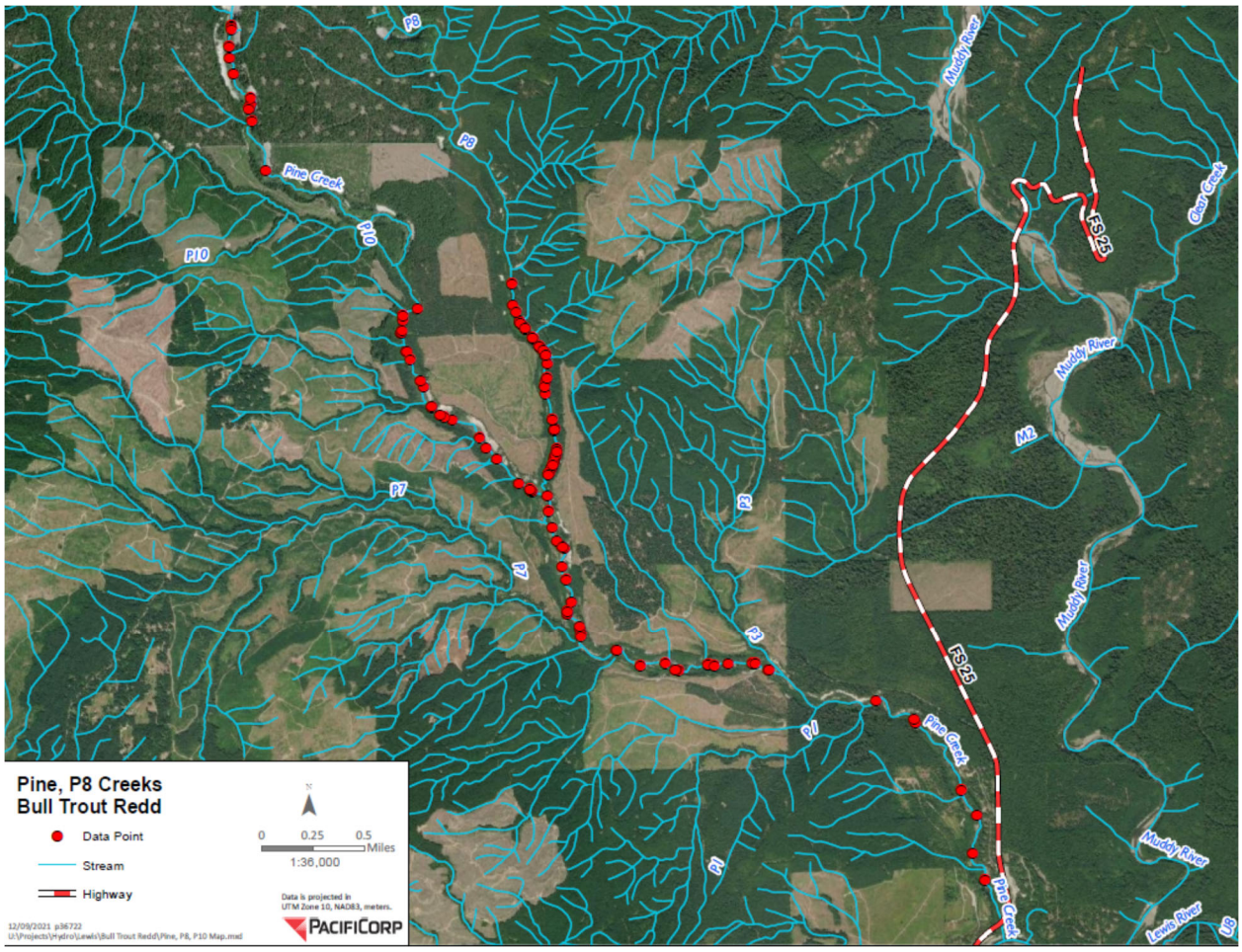


**Figure 3.5.2-1. GPS locations of bull trout redds in Pine Creek and tributary P8 in 2021. Each red dot represents an individual bull trout redd (n=135).**

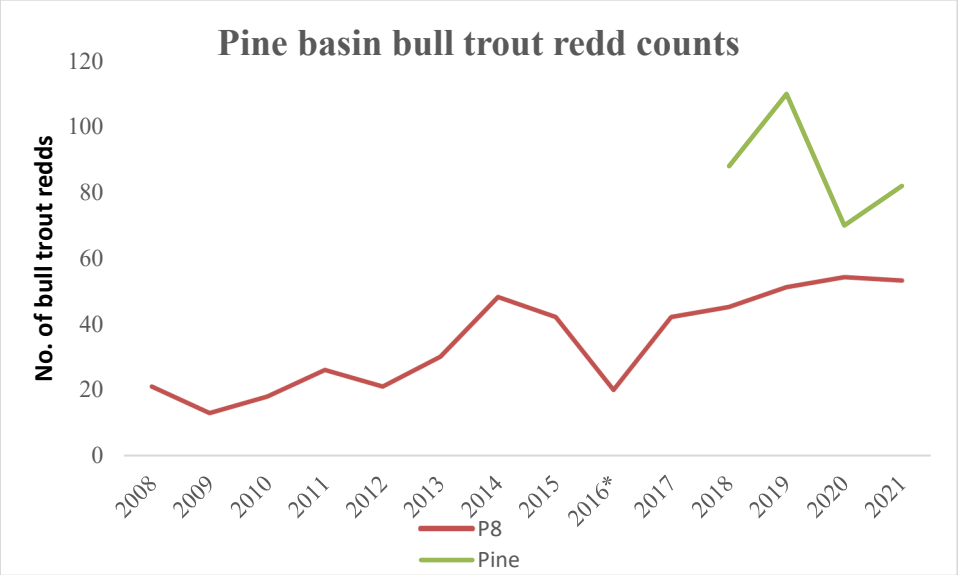


**Figure 3.5.2-2. Pine Creek and tributary P8 historical bull trout redd counts (2008 and 2009 data courtesy of WDFW). *truncated survey year due to high flows.**

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

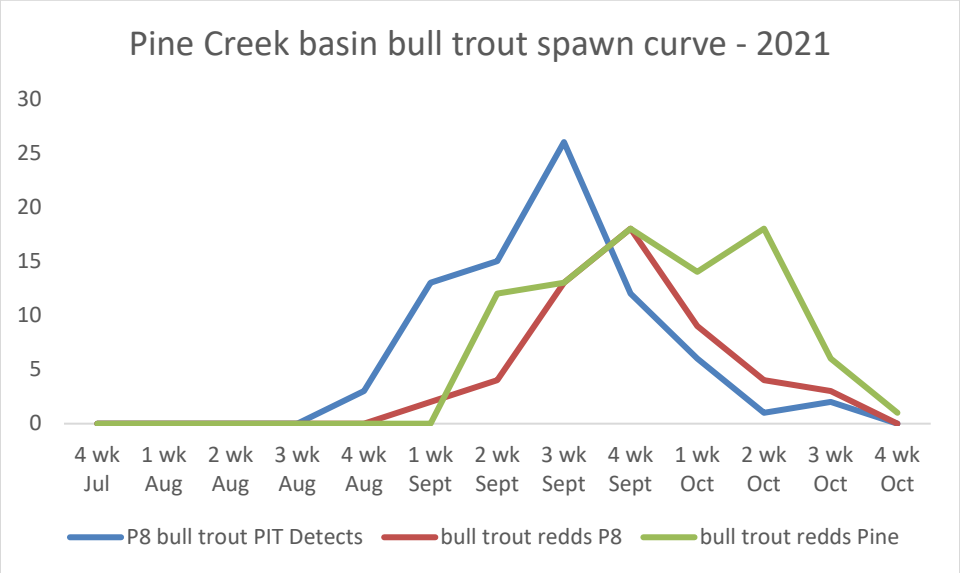


**Figure 3.5.2-3. Temporal evaluation of the Pine Creek bull trout spawn migration in 2021.**

## Rush Creek

Rush Creek was surveyed on four occasions between September 15 and October 12, 2021. An additional fifth survey was attempted on October 21, but due to high flows and unsafe survey conditions it was not completed. From October 21 forward, high river flow conditions persisted for the remainder of the survey season, resulting in an incomplete redd abundance dataset for 2021. In all, 7 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 2021. Each red dot represents an individual bull trout redd (n=7).**

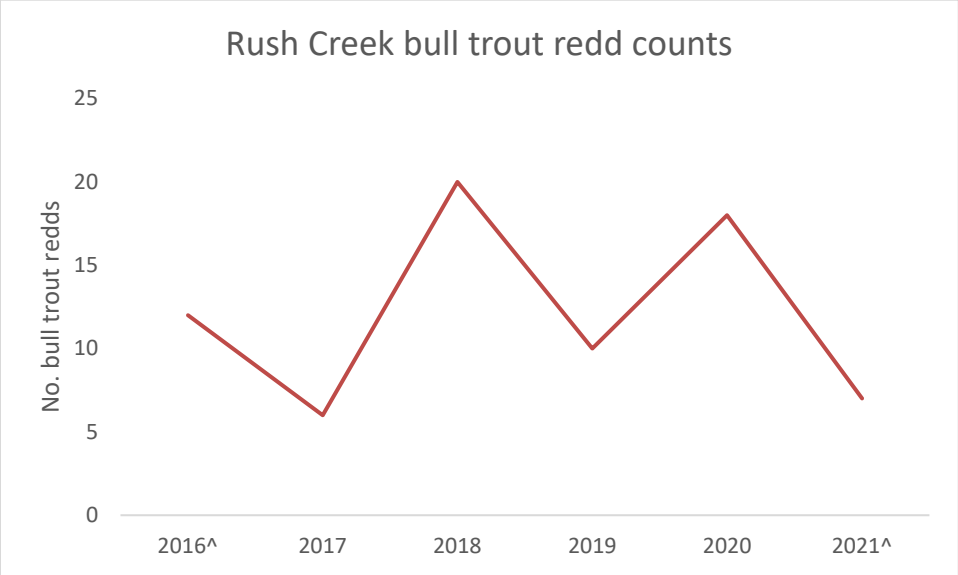


**Figure 3.5.2-5. Rush Creek historical bull trout redd counts. ^truncated survey year due to high flows.**

### Upper North Fork Lewis

The upper North Fork Lewis River mainstem was surveyed for bull trout redds from Lower Falls just upstream of Crab Creek to Eagle Cliffs (a distance of approximately 14 miles), on September 13 and October 15 in 2021. During these two surveys, two surveyors kayaked and walked, one on each side of the river. No bull trout redds were identified during either survey.

## 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 2021. 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 2021 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

# 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, 2021 Report. (This Report was not available at the time of submittal. This data will be included within the 2022 Annual Report when it becomes available)

APPENDIX B

MEMO BY MARSHALL BARROWS, UNITED STATES FISH AND WILDLIFE SERVICE: Operation of Cougar Creek Weir and Underwater Video, 2021 Report. (This Report was not available at the time of submittal. This data will be included within the 2022 Annual Report when it becomes available.)