Assessment of Bull Trout, Summer Steelhead and Spring Chinook Salmon Passage during Operation of the Tucannon River Adult Weir/Trap

2021 Annual Progress Report

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On the cover: *Fluvial Bull Trout from the Tucannon River. Photograph by WDFW*

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and authored by

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Assessment of Bull Trout, Summer Steelhead and Spring Chinook Salmon Passage during Operation of the Tucannon River Adult Weir/Trap: 2021 Annual Progress Report

Abstract – Bull Trout are listed across their entire range in the U.S. under the Endangered Species Act (ESA) as a threatened species. Summer steelhead and Spring Chinook salmon are also ESA listed (Snake River steelhead DPS, Snake River spring/summer Chinook ESU). A potential threat to all species is the operation of weirs/traps and the resulting influence on each species' migration. All three species are captured annually at the Washington Department of Fish and Wildlife's (WDFW) Tucannon River adult weir/trap, with all Bull Trout passed upstream following capture, while a portion, or all, of the summer steelhead or spring Chinook salmon are collected for broodstock for the Lower Snake River Compensation Plan (LSRCP) hatchery program. In 2021, a team of biologists investigated whether the operation of the weir/trap impacted Bull Trout, summer steelhead or spring Chinook salmon during their spawning migration. Bull Trout, summer steelhead and spring Chinook salmon tagged with Passive Integrated Transponders (PIT) tags (either as juveniles or adults) were used to monitor migratory behavior at instream PIT arrays in the Tucannon River, and more specifically around the Tucannon River adult weir/trap when in operation.

The percentage of previously PIT tagged Bull Trout (4) that converted through the adult weir/trap in 2021 was estimated to be 100%. Overall, the median time it took Bull Trout to move through the adult weir/trap area was 1.05 days. All four previously tagged Bull Trout detected inside the adult trap were captured, with no detections indicating they escaped the adult trap.

A total of 26 previously PIT tagged summer steelhead were detected near the adult trap in 2021. Of those, 20 (77%) were detected inside the adult trap, and all 20 were captured by hatchery staff. The median time it took summer steelhead to move through the adult weir/trap area was 2.67 days in 2021.

A total of 10 previously PIT tagged spring Chinook salmon were detected near that adult trap in 2021. Of those, nine were detected inside the adult trap and all nine were captured. The median time it took the nine spring Chinook salmon that were first detected at the downstream antennas to capture in the adult trap was 0.99 days.

About 90% of the newly PIT tagged Bull Trout passed upstream remained upstream of the trap. About 75% of the Bull Trout passed upstream were detected at the Panjab PIT tag array in the upper Tucannon River, with less than 10% returning to Panjab Creek. Migration speed from release at the adult trap to the Panjab array ranged from 0.25 to 2.5 river kilometers/day.

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Preface

This report is intended to document annual work and activities associated with Bull Trout, summer steelhead, and spring Chinook salmon passing the Tucannon River adult weir/trap, in the Tucannon River (Washington), which is operated for both the capture, collection and propagation of summer steelhead and spring Chinook salmon by Washington Department of Fish and Wildlife under the Lower Snake River Compensation Plan hatchery mitigation program. This report primarily focuses on activities/monitoring in calendar year 2021.

This report is generally technical in nature and, for context, references and discusses operations and benchmarks that were previously established by co-managers. This report is not a policy document and, while its contents may inform the process, is not for the direct purpose of establishing final policy.

Introduction

Bull Trout (*Salvelinus confluentus*) are listed under the Endangered Species Act (ESA) as a threatened species. Bull Trout were listed across their entire range in the U.S. (coterminously) on November 1, 1999 (see USFWS 2015a). Factors contributing to the listing of Bull Trout included range-wide declines in distribution, abundance and habitat quality. Land and water uses that alter or disrupt the habitat requirements of Bull Trout can be a threat to the persistence of Bull Trout. Commonly considered examples of such threats include dams and timber harvest (USFWS 2015a). A potential threat from the operation of weirs/traps and the resulting influence on Bull Trout migrations has recently received considerable attention (Kelly Ringel 2014). The operation of weirs/traps are prevalent throughout the part of the Columbia River basin that is accessible to anadromous fish and where anadromous fish management occurs.

The Mid-Columbia Recovery Unit (MCRU) is one component of the coterminous Distinct Population Segment (DPS). The MCRU has numerous core areas, one of which is the Tucannon Core Area (Figure 1). Bull Trout still occupy most of their historic range in the Tucannon River watershed, and prior to 2000 the population of the core area was considered relatively large (USFWS 2010). Genetic analyses indicate that there are currently five local populations of Bull Trout, and possibly a sixth, within the core area of the Tucannon River watershed (USFWS 2008; Kassler et al. 2013). Both resident and migratory forms of Bull Trout still occur in the Tucannon River watershed (Martin et al. 1992; WDFW 1997) and recent data indicate that migratory Bull Trout regularly use the mainstem of the Snake River on a seasonal basis (Underwood et al. 1995; WDFW 1997; Faler et al. 2008; Bretz 2010; D. Wills, pers. comm. 2014). Spawning and early rearing for the Tucannon population is focused in the upper Tucannon River (generally considered above its confluence with Panjab Creek [rkm 75], ~16 rkm upstream from the Tucannon adult weir/trap), small tributaries to the upper mainstem, and in Panjab Creek and its tributaries.

Spring Chinook (*Oncorhynchus tshawytscha*) salmon and summer steelhead (*Oncorhynchus mykiss*) are also present in the Tucannon River and include both natural- and hatchery- origin spawners from hatchery programs which began in 1985 for spring Chinook (Bugert et al, 1986) and 2000 for the newly developed summer steelhead program using Tucannon River stock (Bumgarner et al, 2002) under the Lower Snake River Compensation Plan (LSRCP) and has been operated by the Washington Department of Fish and Wildlife (WDFW). The Tucannon spring Chinook salmon population was listed as threatened in 1993 under the ESA and is part of the Snake River spring/summer Chinook ESU, and Tucannon River summer steelhead were listed as threatened in 1997 and is part of the Snake River summer steelhead DPS).

ESA-listed Bull Trout, summer steelhead and spring Chinook salmon are routinely handled during annual operations of the Tucannon adult weir/trap. A “new” fish ladder/trap was constructed in 1998 adjacent to the existing Tucannon FH water intake facility. The water intake

facility uses a sheet pile dam placed in the river as a backwater for the hatchery water supply.

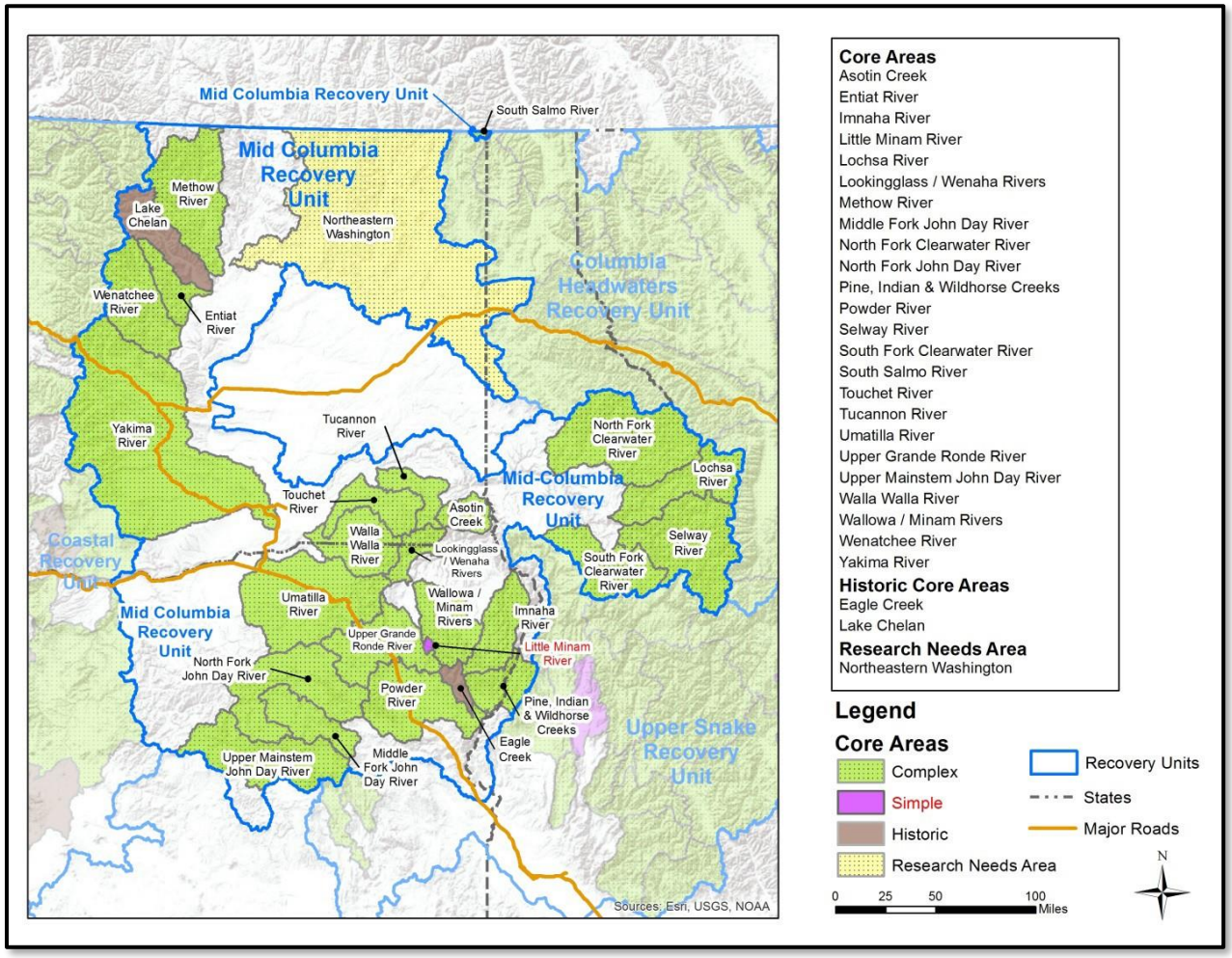

Figure 1. Populations of Bull Trout in the Mid-Columbia Recovery Unit are numerous and provided above. In the Tucannon River Bull Trout can be found primarily in the upper Tucannon River in the mainstem and the following small tributaries: Bear Creek, Cold Creek and Sheep Creek, Panjab Creek, Meadow Creek, Turkey Creek and Turkey Tail Creek. Bull trout are also known to exist in Cummings Creek, a small tributary that enters the Tucannon River mainstem about 1.6 km below Tucannon FH.

The fish ladder and trap allows passage upstream of the sheet pile dam (i.e. now considered or referred to as the "weir") and selective capture of upstream migrants when the trap is operated. The majority of the upstream migration at the adult weir/trap for all species occurs between March and July. Generally, Bull Trout that move from the lower Tucannon River to their spawning area are believed to pass through the entire area where spring Chinook salmon spawn. Overall, the Tucannon adult weir/trap generally operates from late February each year and is generally shut down in early October.

Endangered Species Act Consultation

Starting in 2015, the USFWS-LSRCP and its cooperators initiated consultation with NOAA-Fisheries on continued operation of spring/summer Chinook salmon, steelhead and rainbow trout programs in NE Oregon and SE Washington. In 2016, a Biological Opinion was issued (USFWS 2016) that identified with the following Terms and Conditions (Section 8.4.1c-d) for the Tucannon River spring Chinook salmon program:

c. Upon signature of this Opinion, the LSRCP and WDFW will continue to develop an evaluation of Bull Trout passage and delay at the Tucannon River Hatchery fish ladder/trap during periods of operation; initial discussions have already been initiated. As with the Imnaha study, it is understood that the Tucannon study design will use existing and improved PIT tag arrays and opportunistic PIT tagging efforts for completion. A monitoring group will be established to address Bull Trout passage and delay issues similar to that already described for the Imnaha weir (see T&C 1b of this Opinion and T&Cs in the associated Imnaha Weir Biological Opinion, incorporated here by reference) such that information from both the Tucannon and Imnaha studies may be used to more broadly answer the extent of passage and delay impacts in the action area. Progress reports will be submitted by WDFW and LSRCP after the second full year of data collection, and annual meetings will be convened between the monitoring group, co-managers, and cooperators to review the data and discuss potential operational changes to minimize adverse effects and reduce take associated with Tucannon facility operations. If proposed weir modifications are identified within the study period, those modifications must be implemented within a timeframe agreed to by the Service, LSRCP, and the co-managers in the Tucannon basin; follow-up actions, if needed, will be included in a final report following the study. If study results indicate that passage delays are not significantly impacting Bull Trout migration, co-managers and the Eastern Washington Field Office will determine whether continued PIT tagging and data collection are desired as a means of better understanding Bull Trout life history within the Tucannon River system; continuation of agreed upon aspects of the study will not be the responsibility of the LSRCP.

d. Include the Service (Ecological Services Field Office or Fisheries Office staff) in meetings to deal with weir issues and lessening impacts to Bull Trout.

Starting in late 2016, a monitoring workgroup including program staff from WDFW, Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation and the USFWS was formed, held meetings, analyzed and reviewed existing data for the Tucannon River Bull Trout population. The workgroup developed an initial project goal and project objectives that specifically addressed the Tucannon adult weir/trap facility operations and potential passage and delay issues similar to the operations of the Imnaha River adult weir/trap in NE Oregon. Project implementation was initially attempted in run year 2017 but due to spring flooding events in the Tucannon River was delayed until 2018. This document meets the stated Term and Condition obligation for WDFW and LSRCP to provide an annual report of yearly trapping.

Tucannon River Project Goal

To provide information that can be used to minimize the incidental "take" of ESA-listed Bull Trout, summer steelhead and spring Chinook salmon, and other ESA or sensitive species in the Tucannon River during operation and management of the Tucannon River adult weir/trap for broodstock collections under the LSRCP.

Tucannon River Project Objectives

1. From 2018-2022, assess the passage rate (conversion) of Bull Trout associated with the operation of the Tucannon River adult weir/trap for collection and enumeration of spring Chinook salmon for the hatchery program. Target benchmarks for Bull Trout conversions are an average across the five study years of at least 95%, with no less than 75% in any given year (point estimates). This criterion will be re-examined annually by the workgroup.

2. From 2018-2022, assess the migration delay (delay) of Bull Trout associated with the operation of the Tucannon River adult weir/trap for collection and enumeration of spring Chinook salmon for the hatchery program. Target benchmarks for delay are median passage times from first detection downstream of the trap to either capture in the adult trap, or detection immediately upstream of the trap/weir of no longer than 8 days for May, 6 days for June, 4 days for July and 2 days for August and September, with no individual taking longer than 8 days in any month.

3. From 2018-2022, assess the passage rate (conversion) of spring Chinook salmon during broodstock collection and enumeration of the spring Chinook salmon run in the Tucannon River. Target conversion benchmarks for spring Chinook salmon have not been set.

4. From 2018-2022, assess the migration delay (delay) of spring Chinook salmon during standard broodstock collection and enumeration of the spring Chinook salmon run in the Tucannon River. Target migration delay benchmarks for spring Chinook salmon have also not been set at this time.

5. For 2021, assess the passage rate and delay of summer steelhead during standard broodstock collection of summer steelhead at the trap.

6. For all three species in 2021, assess their ability to escape the adult trap.

7. Minimize and standardize impacts to Bull Trout and spring Chinook salmon during operation of the Tucannon River adult weir/trap through adaptive management during planned monitoring activities of passage and delay. This will be done through ongoing and continued discussions and coordination between the USFWS, NOAA-Fisheries, co-managers, and cooperators, and may involve revising benchmarks, implementing operational changes or modification of structures.

In addition to the above objectives, a summary has been included in this report to describe the fallback/reascension of newly PIT tagged Bull Trout at the adult trap from 2019-2021. Also, a summary has been provided to describe the conversion rate and migration speed of Bull Trout to the upper basin in 2021 based on detections at the Panjab PIT tag array.

Study Area and Adult Weir/Trap Operation

The Tucannon River adult weir/trap is located at approximately rkm 59. The facility is located on WDFW property within the W.T. Wooten Wildlife Area and serves as the adult collection facility for the Tucannon River spring Chinook salmon and summer steelhead hatchery programs under the USFWS-LSRCP Program. From 1985 to 1996, a floating weir attached to a sheet pile dam adjacent to the Tucannon FH (rkm 58) was installed for broodstock collection with a target installation period in late-April or early-May. After major floods destroyed this adult weir/trap location in 1996, a new fish ladder and trap was placed around the current Tucannon FH water intake facility and sheet pile dam (Photo 1). The original water intake sheet pile dam had a center 3-step ladder section which allowed unimpeded fish passage through the dam. In 1998, when the new facility was completed, the 3-step ladder section had to be closed off for broodstock collections. Hanging vinyl picket panels (first installed in 2008) are installed manually prior to the summer steelhead return each year and kept in place throughout the spring Chinook salmon run. The objective of the vinyl panels are to prevent or lessen the number of fish that could jump over the dam (Photo 1), which during certain flow conditions many fish can pass unimpeded.

The adult weir/trap is operated by WDFW, with spawning, incubation and early rearing for the spring Chinook salmon and summer steelhead hatchery programs occurring at Lyons Ferry FH, also operated by WDFW. Lead management entities identified in the current 2018 – 2027 *U.S. v. Oregon Management Agreement* include WDFW, the Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation.

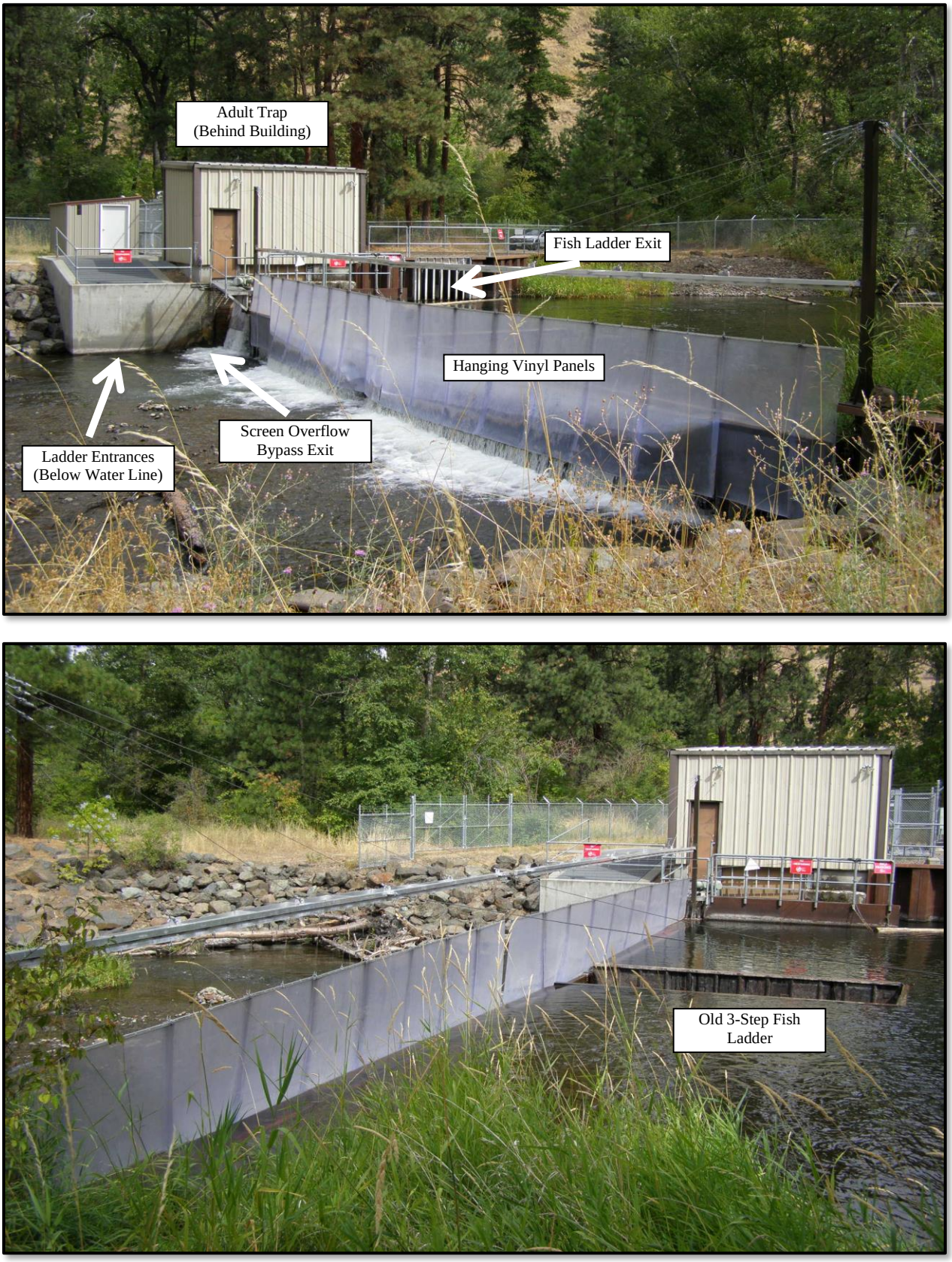

Photo 1. Photos of the Tucannon River adult weir/trap. Photos by WDFW hatchery evaluation staff.

Methods

Per the USFWS Biological Opinion (2016), and as part of ongoing investigations by co-managers and cooperating agencies, Bull Trout have been PIT-tagged annually at the Tucannon River adult weir/trap for several years. Upon capture and determining a Bull Trout doesn't contain a PIT tag, a new PIT tag is inserted into the dorsal sinus (anterior edge of the dorsal fin) per Bouwens and Jakubowski (2015). Bull Trout which have been previously PIT tagged in other monitoring efforts within or outside the Tucannon River are opportunistically included in the analysis if they are detected in the Tucannon River and attempt passage at the adult weir/trap. In addition, summer steelhead and spring Chinook salmon adults/jacks returning with PIT tags, either from juvenile tagging in the Tucannon River (hatchery or natural origin), or from adult tagging efforts at Bonneville or Lower Granite dams, were also used to address similar objectives for summer steelhead and spring Chinook salmon. Information of all three of these species with PIT tags that move throughout the entire Tucannon River is possible through a series of instream PIT tag detection arrays (Figure 2) in the Tucannon River. Detection data can be queried from these PIT-detection arrays through the PIT tag information system (www.ptagis.org).

For 2021, our analyses consisted of PIT tag detections from the PIT antennas located just downstream (TC1), in the fish ladder (TC2), and in the adult trap (TC3) (Photo 2). In addition to the standard instream PIT tag antennas that have been in place around the adult weir/trap since 2017, an additional temporary PIT antenna was operated on the floor of the adult trap (Photo 3). The additional antenna was added to determine if fish were escaping the adult trap area after entering, further delaying the passage of fish. There used to be additional antennas upstream of the weir/adult trap (TC4), but a major flood in 2020 swept those antennas away, and re-shaped the river channel enough that replacement antennas have not been added upstream yet. Additional resources (cabling and antennas) will be required to make the site fully functional again. However, since this study is nearing its completion, the cost to add these antennas back to the site may not be worth the expense for the limited data obtained.

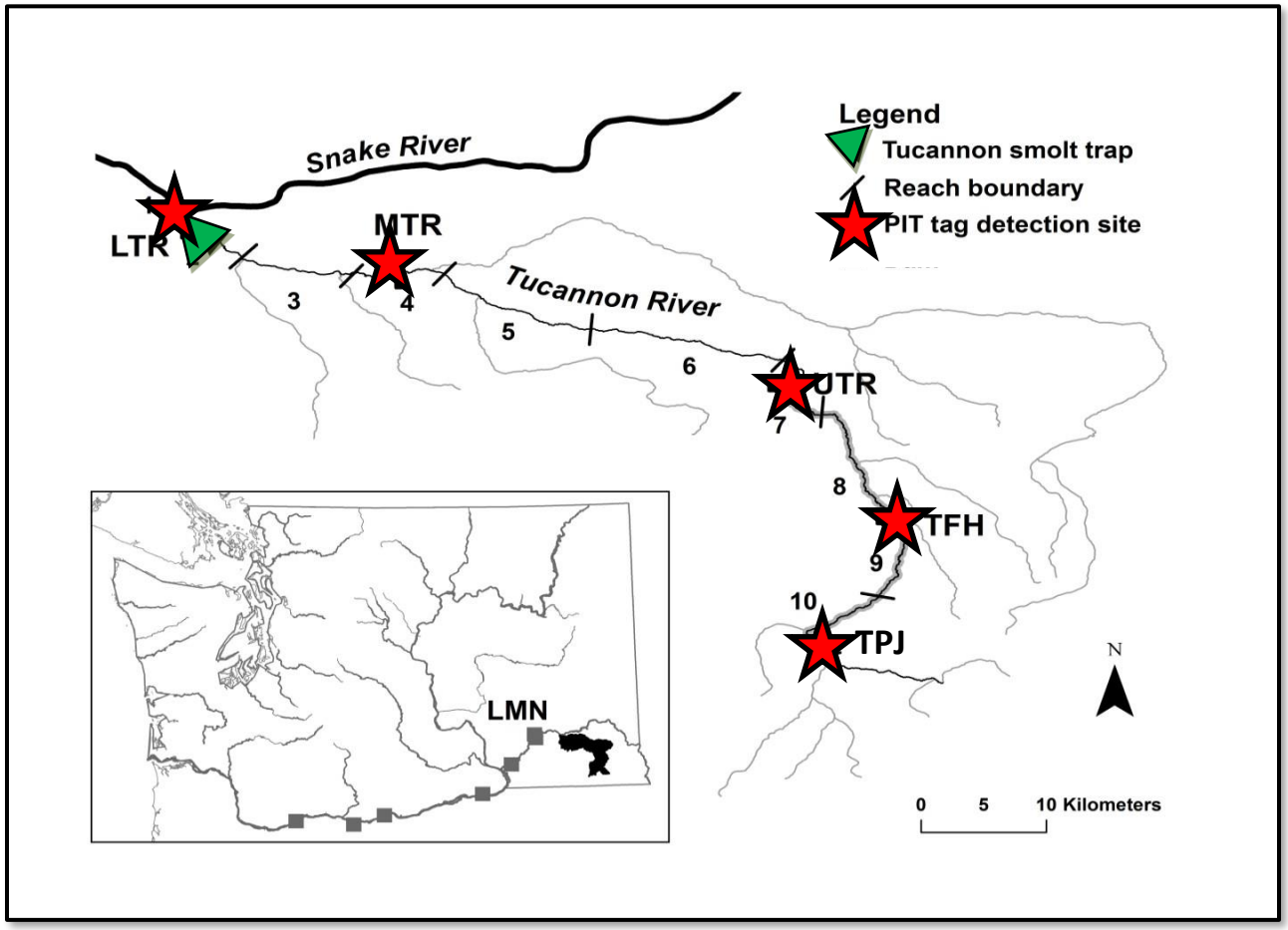

Figure 2. Tucannon River Basin and location of the adult trap/weir, PIT Tag Arrays, and smolt trap. Lower Monunmental Dam (LMN), 2nd of the lower four Snake River Dams, is identified in the inset of Washington. LTR - Lower Tucannon River Array, MTR – Middle Tucannon River Array, UTR – Upper Tucannon River Array, TFH – Tucannon Fish Hatchery Array, TPJ – Tucannon Panjab Array.

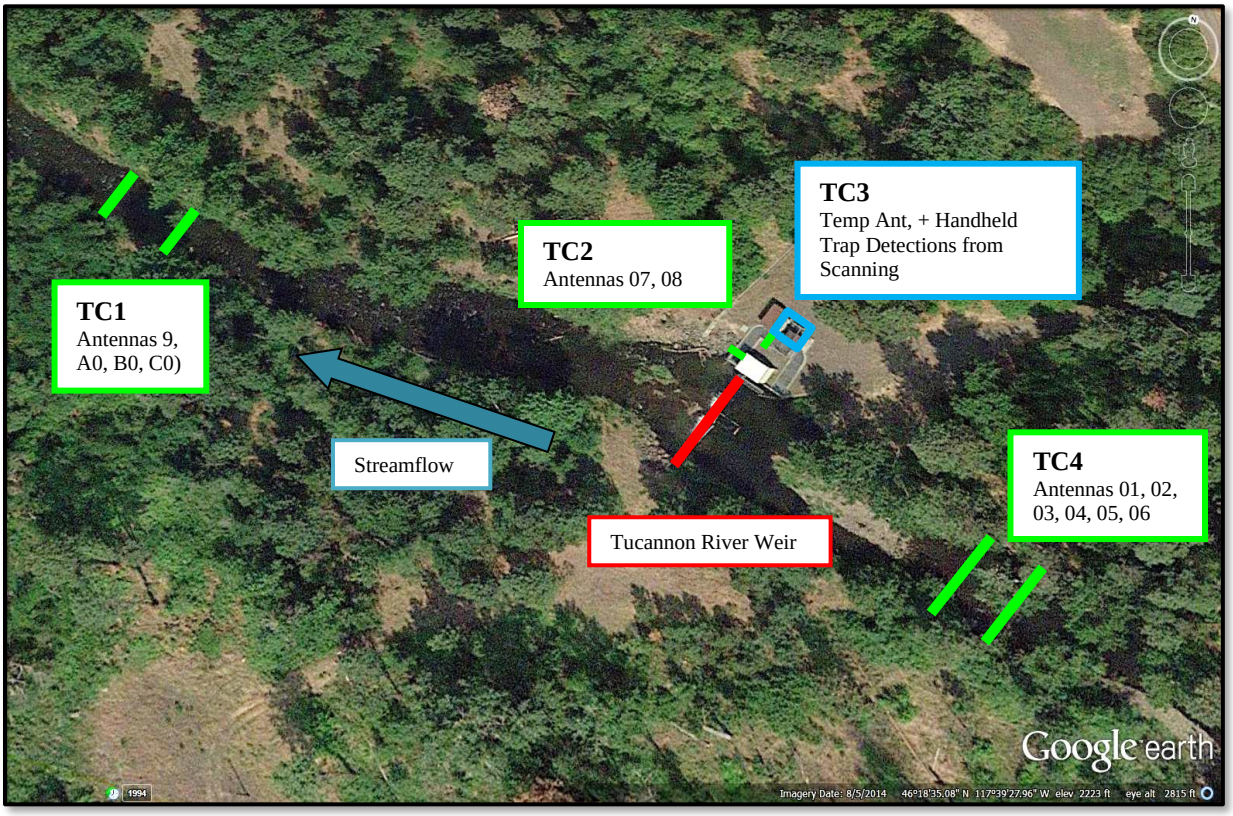

Photo 2. Location of the Passive Integrated Transponder (PIT) tag detection arrays around the Tucannon River adult weir/trap site. The TC1 (4 antennas) and TC4 (6 antennas) are within the bankfull area of the Tucannon River, while TC2 (2 permanent antennas) are in the fish ladder. In 2021, one additional temporary antenna was operated on the floor of the trap (included in TC3), and no antennas were operational at TC4. All locations are approximations.

Photo 3. Photo of the temporary trap antenna operated in 2021. Note: the antenna location is the same, but the photo shows the old fyke entrance. The photo to the right shows the new fyke as installed in 2020.

Detection histories for the PIT- tagged Bull Trout, summer steelhead and spring Chinook salmon were compiled to determine whether they exhibited a pattern reflective of the behavior of interest, specifically:

1) Detections occurred during adult weir/trap operation, not pre- or post-operation

2) Detections moving upstream rather than only downstream.

3) Detections tagged prior to year of capture at the adult weir/trap.

Objectives 1, 3 and 5. *Assess the passage rate (conversion) of Bull Trout, summer steelhead and spring Chinook salmon that is associated with the operation of the Tucannon River adult weir/trap for broodstock collection*.

In 2021, adult weir/trap operations were similar to previous years and detections of PIT-tagged Bull Trout, summer steelhead and spring Chinook salmon were summarized and analyzed as outlined in the Methods section except regarding TC4. All antennas at TC4 (upstream of the adult weir/trap) were inoperable in 2021 due to damage from a flood in February 2020 and have not been replaced at this time. As such, calculations to assess passage rate (conversion) were modified for 2021, where detection/capture in the adult trap was the upper most detection location at the adult weir/trap, but also added in detections at the Panjab Array (TPJ) site in the upper Tucannon River if needed. Annually, but depending on stream flows, a small percentage of Bull Trout, summer steelhead and spring Chinook salmon can jump over the sheet pile dam under certain flow conditions, even with the hanging vinyl panels in place. The addition of the Panjab PIT Array detections provided some detection data upstream of the weir that was lost with TC4 antennas inoperable for the 2021 season.

Relative to Objectives 1, 3 and 5, the *observed percent* of Bull Trout, summer steelhead and spring Chinook salmon that passed the adult weir/trap in 2021 was calculated as:

$$(TC3 + TPJ)/TC1 \times 100$$

Where:

TC1 = the number of PIT-tagged Bull Trout, summer steelhead or spring Chinook salmon that were detected at the set of antennas below the trap,

TC3 = the number of PIT-tagged Bull Trout, summer steelhead or spring Chinook salmon that were captured/handled in the adult trap (with confirmation from the temporary trap antenna if possible),

TPJ = the number of PIT-tagged Bull Trout, summer steelhead or spring Chinook salmon that were detected at the Panjab Array, but weren't captured in the adult trap. For 2021, no additional fish were detected at the TPJ Array that weren't also detected/captured in the adult trap.

Objectives 2, 4 and 5. *Assess the migration delay (delay) of Bull Trout, summer steelhead and spring Chinook salmon associated with the operation of the Tucannon River adult weir/trap for broodstock collection.*

As in Objectives 1, 3 and 5, only previously PIT-tagged fish detected at the lower array (TC1), and the capture date in the adult trap (TC3) were used to calculate migration delay. Target days of delay benchmarks for Bull Trout used in this evaluation are identical to those developed for the Imnaha River (as data to inform benchmarks for the Tucannon River was lacking). Relative to Objective 2, 4 and 5, the time (in days) for an individual Bull Trout, summer steelhead or spring Chinook salmon to pass the adult weir/trap site was calculated by either:

Capture/release date [TC3] – 1st detection date [TC1]

Where:

1st detection date[TC1] = the date and time a PIT-tagged Bull Trout, summer steelhead or spring Chinook salmon was first detected at the row of antennas immediately below the adult trap;

Capture date[TC3] = the date and time a PIT-tagged Bull Trout or spring Chinook salmon was captured/released in the adult trap by hatchery staff.

Results and Discussion

Infrastructure and Specific Adult Weir/Trap Operations in 2021

In 2021, adult weir/trap operations were identical to prior years but as previously discussed, no antennas were operational at TC4, but a temporary antenna was installed inside the trap area for determining if fish were escaping the trap. All previously PIT-tagged Bull Trout, summer steelhead and spring Chinook salmon arriving below the adult weir/trap in 2021 were included in this evaluation. In 2021, 4 Bull Trout, 26 summer steelhead, and 10 spring Chinook salmon were detected moving upstream at TC1 based on detection history (Appendix A).

Conversion Rates and Delay (Objectives 1 - 5)

Objective 1, 3 and 5 – Conversion Rates

For the 2021 migration period, conversion rates of all three species were high (Figure 3). Not all fish detected downstream of the fish ladder converted upstream to be captured, but 82.5% of the fish (all species) that entered the fish ladder were captured and passed upstream or collected for broodstock needs. The conversion rate benchmark for Bull Trout was set at 95%. The running average conversion rate for Bull Trout based on data from 2015-2016, and 2018-2021 is 97.0% (See Bumgarner and Engle 2019, and Bumgarner 2021 for prior year specific conversion rates).

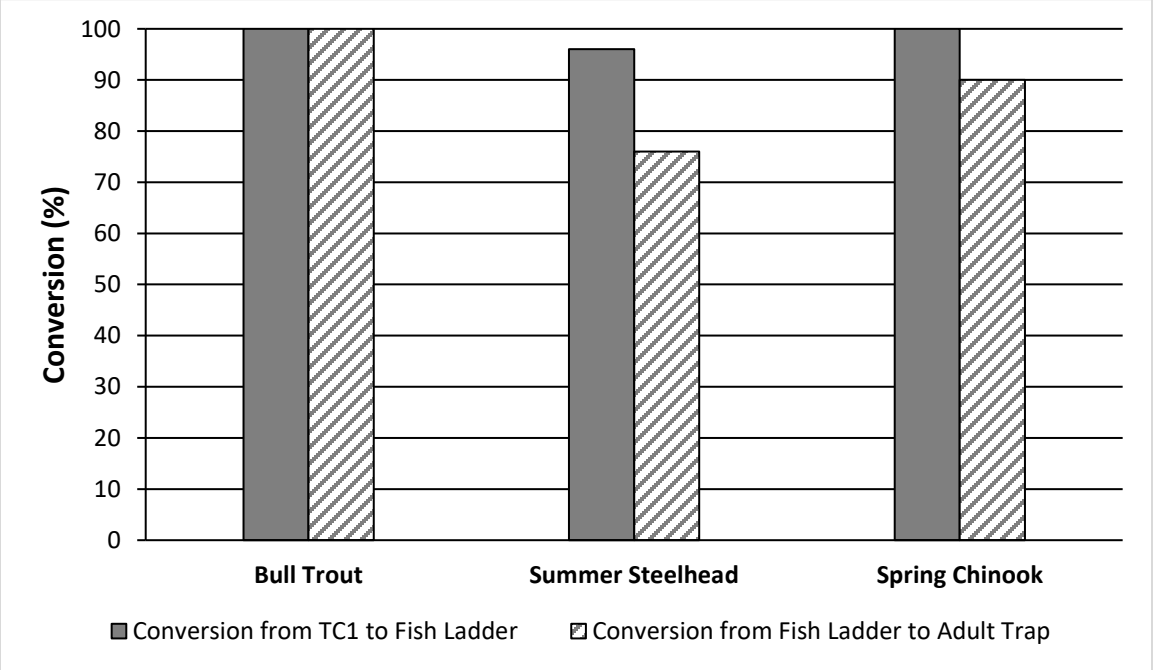

Figure 3. Conversion through the Tucannon adult weir/trap for Bull Trout, summer steelhead and spring Chinook salmon in 2021.

Objective 2, 4 and 5. Delay

For the 2021 migration period, days of delay of all three species were low (Figure 4), especially compared to previous years (Bull Trout and spring Chinook median days of delay has generally been 3-4 days). Days of delay for steelhead were not calculated in prior years due to springtime flow events which often disabled antennas in the river making an assessment incomplete, in addition to it not being a focal point of this study in the past. Median days of delay for Bull Trout, spring Chinook and summer steelhead were 1.05, 0.99. and 2.67 days, respectively.

For Bull Trout delays by month, in May (based on 1 Bull Trout) the delay was 1.6 days, with no fish delayed more than 8 days. Delay in June (based on 3 Bull Trout) ranged from 0.5-1.6 days with a median of 0.5 days, with no fish delayed more than 6 days. No previously PIT tagged Bull Trout arrived below the adult trap after June 6th. The benchmarks for median days of delay in May and June (8 and 6 days, respectively) were met for both months. Maximum days of delay in May (1.6 days) and June (1.6 days) were well below the benchmark for maximum days of delay (8 days) for both months.

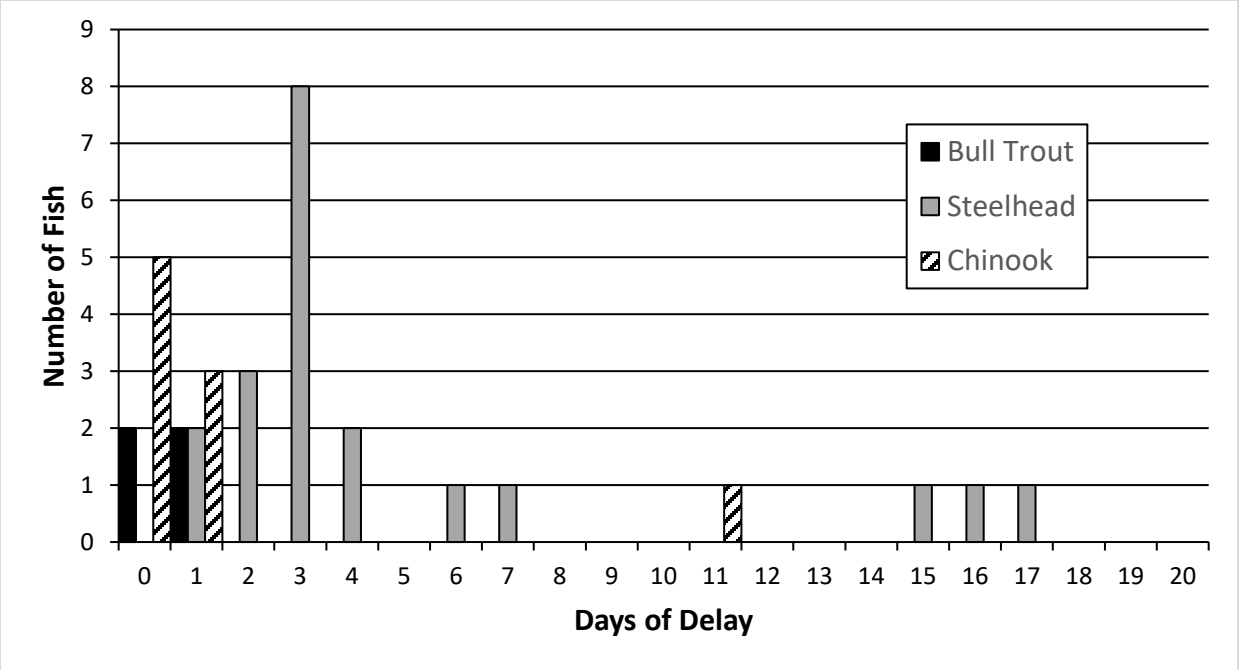

Figure 4. The number of days in 2021 it took Bull Trout, summer steelhead or spring Chinook to move from TC1 to TC3 (adult trap detection/passage by hatchery staff).

Fallback and Reascension of Bull Trout at the Adult Trap

For a few years, local biologists surmised that some of the Bull Trout arriving at the adult trap are not necessarily destined to continue their migration to the upper watershed, and that some may even remain in the vicinity of the adult trap (upstream or downstream) throughout the summer.

Since all newly arriving Bull Trout are PIT tagged, detection histories post-tagging allow an assessment of Bull Trout falling back below the weir and/or their reascension through the adult trap. Based on the last three years of detections, on average about 90% of the newly arriving Bull Trout would appear to be destined to areas upstream of the adult trap. Graphs of the detection histories of newly tagged Bull Trout that fell back below the weir in 2021 are provided in Appendix B.

Table 1. Fallback and reascension rates of newly PIT tagged Bull Trout, and the estimated overall proportions that were both upstream and downstream of the adult trap, 2019-2021.

	2019	**2020**	**2021**	**Total**
Total Newly Tagged Bull Trout	**31**	**72**	**94**	**197**
Total Fallback	3 (9.7%)	16 (22.2%)	19 (20.2%)	38 (19.3%)
Fallback - reascend upstream	2 (6.5%)	8 (11.1%)	6 (6.4%)	16 (8.1%)
Fallback – reascend then fallback, stay downstream	0 (0.0%)	5 (6.9%)	2 (2.1%)	7 (3.6%)
Fallback – stayed downstream	1 (3.2%)	3 (4.2%)	11 (11.7%)	15 (7.6%)
Upstream of Trap	93.5%	88.9%	86.2%	88.8%
Downstream of Trap	6.5%	11.1%	13.8%	11.2%

Migration and Conversion of Bull Trout into the Upper Tucannon River

As described previously, an additional instream PIT tag array was installed by WDFW and the U.S. Forest Service at the confluence of Panjab Creek and the mainstem Tucannon River in the late fall of 2018. Panjab Creek is about 15.1 river kilometers upstream of the Tucannon FH adult trap. The array consists of five antennas, with two downstream of the confluence of Panjab Creek and the Tucannon River, one antenna within Panjab Creek (~10 m upstream), and two antennas upstream of the confluence in the Tucannon River (Photo 4). The primary purpose of this array was to gain additional information primarily from Bull Trout (but could include other species as well) on their migration timing and migration speed (rkm/day) into the upper basin, but also to determine the proportion of Bull Trout entering each of these drainages.

In 2021, four previously PIT tagged, and 94 newly PIT tagged Bull Trout were passed upstream of the adult weir/trap (Appendix F). Of those, three (75%) of the previously PIT tagged, and 71 (75.6%) of the newly PIT tagged Bull Trout were detected on the Panjab PIT Array. Of the 74 total, 69 (93%) appeared to have continued up the mainstem Tucannon River, and 5 (7%) went up Panjab Creek.

Timing of the 74 PIT tagged Bull Trout to the upper watershed at the Panjab Array was variable, with the majority of fish arriving at the array between 15 June and 15 July (Figure 5). Migration speed doesn't appear to depend on size (Figure 6) or when they were passed at the adult trap/weir (Figure 7). WDFW plans to continue the operation of the Panjab PIT Array through the duration of this study.

Photo 4. Configuration of the Panjab Creek PIT Tag Array Site (TPJ).

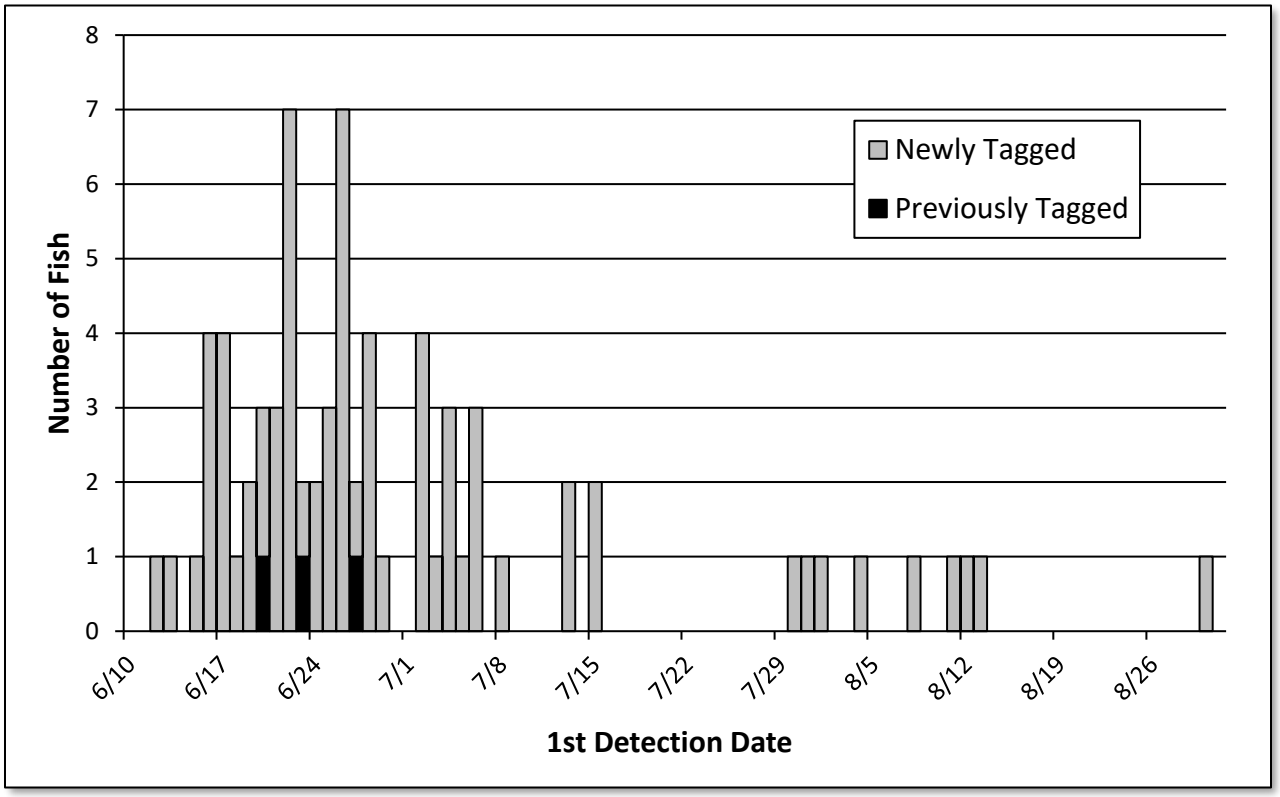

Figure 5. Timing of PIT tagged Bull Trout to the Panjab PIT Array, 2021

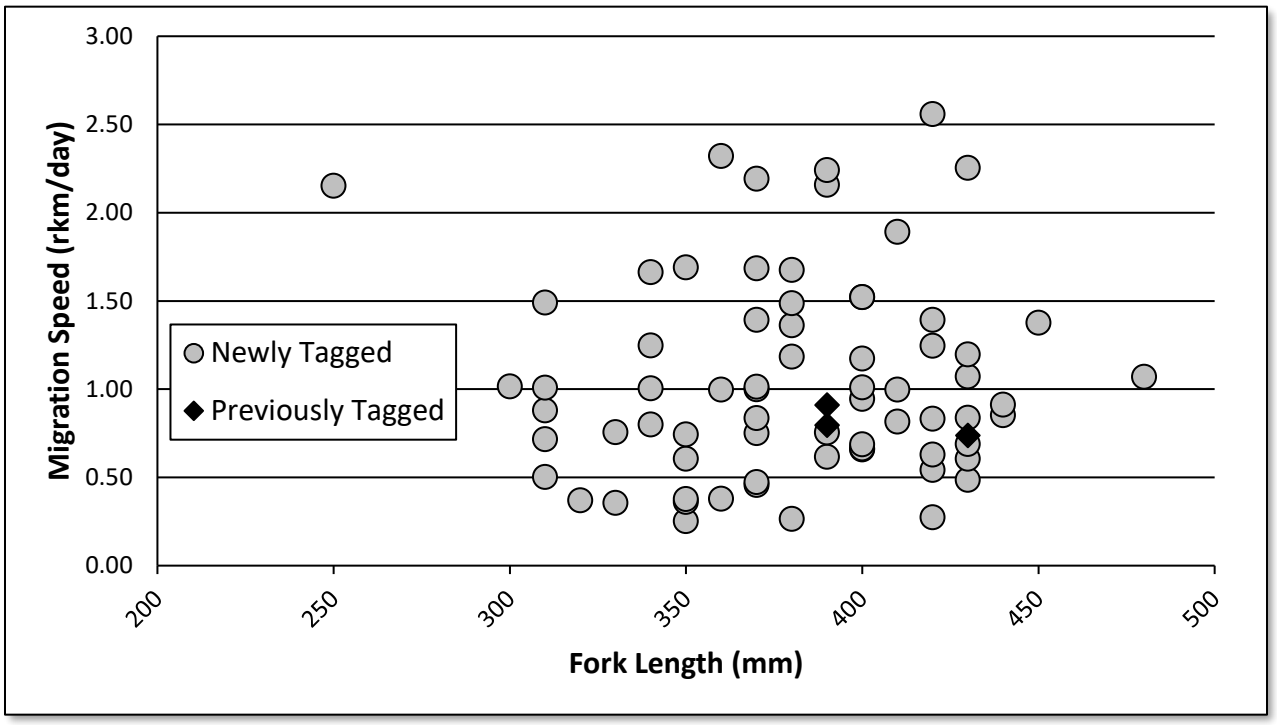

Figure 6. Migration speed of PIT Tagged Bull Trout following release at the adult weir/trap to the Panjab PIT Array by fork length, 2021.

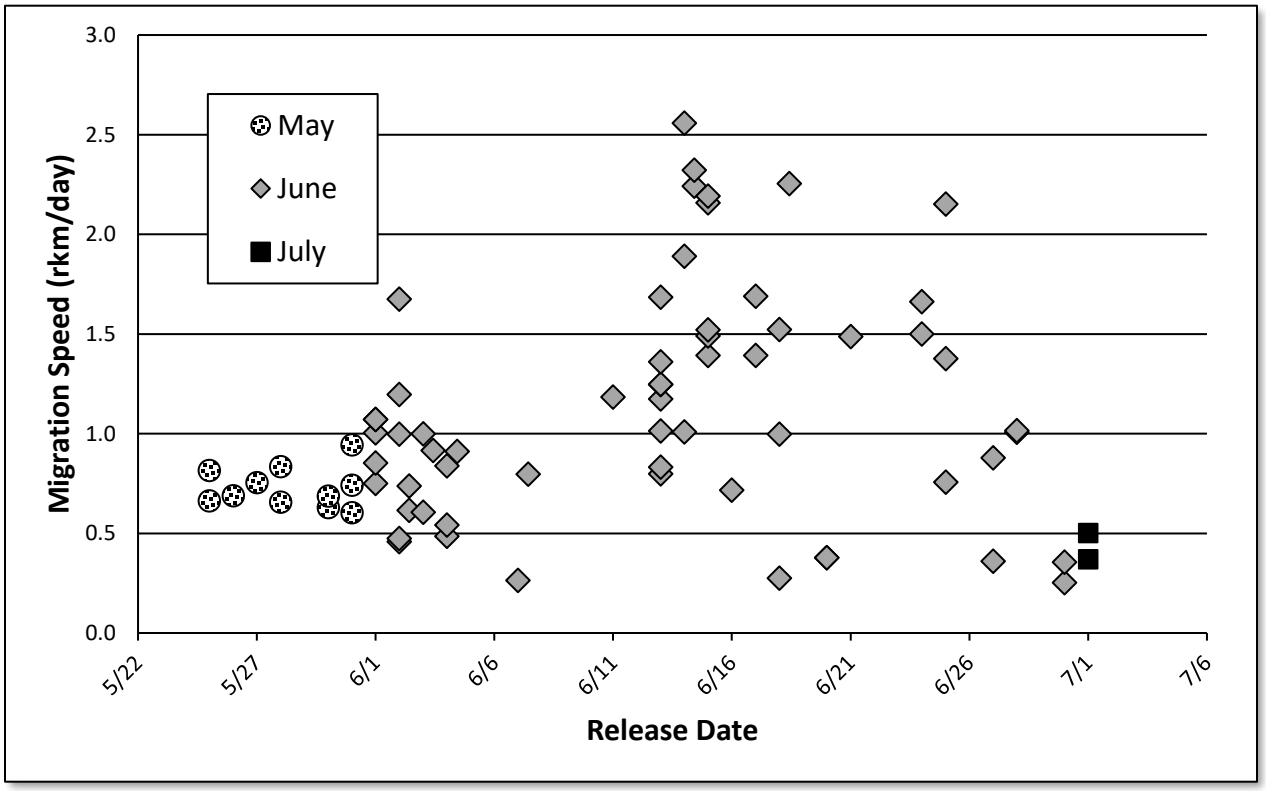

Figure 7. Migration speed of PIT Tagged Bull Trout following release at the adult weir/trap to the Panjab PIT Array by month, 2021.

Conclusions and Future Actions

This is the third report of a multi-year effort into the effects of the adult weir/trap operated for the LSRCP Tucannon River spring Chinook salmon program and its potential impacts to Bull Trout migration and delay. While not the main focus of the study, passage conversion and delay for spring Chinook salmon and summer steelhead have also been summarized, along with escapement rates from the adult trap for all three species. This progress report presents specific findings for the 2021 migration year, but prior year's information has been included where useful to better describe what has been observed for both Bull Trout fallback and reascension at the adult trap, and their conversion into the upper Tucannon River.

In 2021, the Bull Trout conversion rate was 100% (benchmark >95%) through the weir/trap area, but based only on four fish that were previously tagged. For spring Chinook salmon, conversion through the trap area was 90%, and was based on 10 previously tagged spring Chinook. For summer steelhead, conversion rate through the trap area was 77%, based on 26 previously tagged fish. Median days of delay for Bull Trout and spring Chinook salmon have been reduced compared to what has been reported in previous years. This reduction in delay appears to be the result of the new trap fyke, and operational improvements made to the fyke between the 2020 and 2021 trapping seasons. Based on detection histories in 2021, no previously tagged Bull Trout, spring Chinook or summer steelhead that entered that adult trap were able to escape, leading to a shorter overall time in which these fish could eventually be passed upstream. Median days of delay for Bull Trout and spring Chinook in 2021 were 1.05 and 0.99 days, respectively, compared to 3.5 and 3.8 days in 2018, and 3.9 and 4.0 days in 2019.

At this time, no further actions are being proposed to alter operations or equipment at the weir/adult trap. Based on the detection data gathered in 2021, it would appear that fish can no longer escape the trap with the new fyke in place. WDFW will continue to monitor PIT tag detections in 2022 to determine if further actions can be taken to increase conversion, or reduce delays times through the adult trap area.

Acknowledgements

Thanks to the Lower Snake River Compensation Plan Office for funding the analysis of this work. Thanks to all of those who improved this report through their review of earlier drafts. Special thanks to the Tucannon FH staff (Doug Maxey, Daniel Pounds, Chris Highley, and Daniel Byington) for the daily operation of the adult trap, scanning and PIT tagging the Bull Trout, summer steelhead and Spring Chinook salmon captured in the trap. Thanks to the co-managers (the Nez Perce Tribe and the Confederated Tribes of the Umatilla Indian Reservation) for their support of and participation in this work as well as the U.S. Fish and Wildlife staff contributions to the Tucannon River workgroup.

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Underwood, K. D., S. W. Martin, M. A. Schuck, and A. T. Scholz. 1995. Investigations of Bull Trout (Salvelinus confluentus), steelhead trout (Oncorhynchus mykiss), and spring Chinook salmon (O. tshawytscha) interactions in southeast Washington streams. 1992 Annual Report. Project No 90-053, Contract No. De B179-91BP17758, US Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. 206 pages.

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Appendix A

Previously PIT-tagged Bull Trout, summer steelhead and Spring Chinook salmon used in the 2021 run year analysis.

Bull Trout			
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3DD.003D365AAE	3DD.003D493CD3	3DD.00779D854C	3DD.0077D90479
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Spring Chinook			
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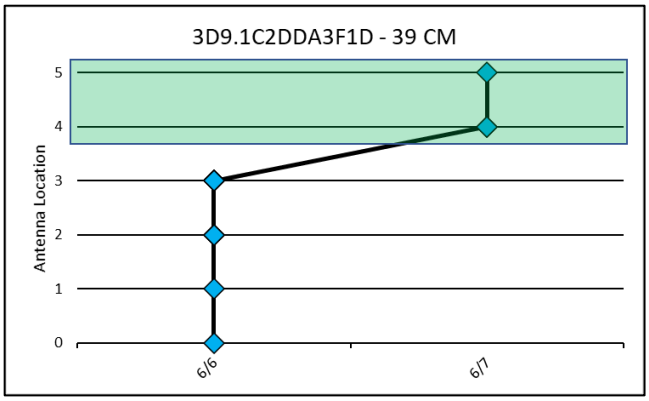
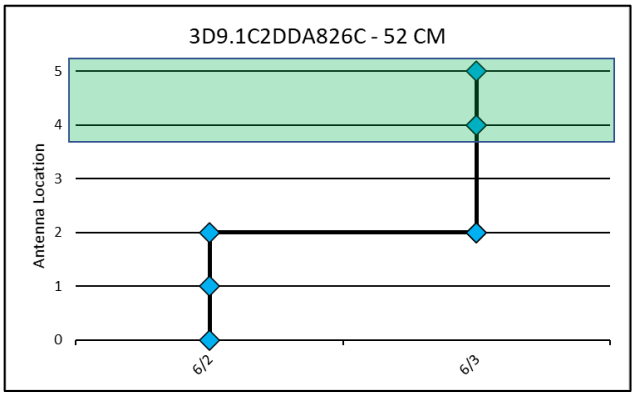
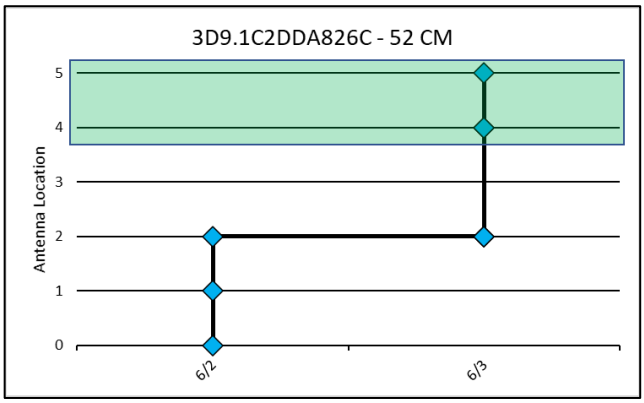
3DD.003D493972	3DD.003D492FF1		

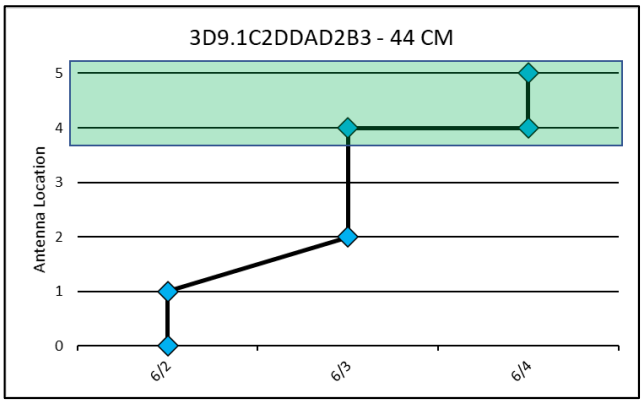
Appendix B

Movement histories of previously PIT tagged Bull Trout at the Tucannon River adult weir/trap, ***2021***. Location Key: 0 – Antennas below adult weir/trap (bottom row); 1 – Antennas below adult weir/trap (top row); 2 – Bottom antenna in the fish ladder; 3 – Top antenna in the fish ladder; 4 – Temporary antenna in adult trap box; 5 – Adult trap capture. Green shaded box indicates fish were inside the trap and/or captured.

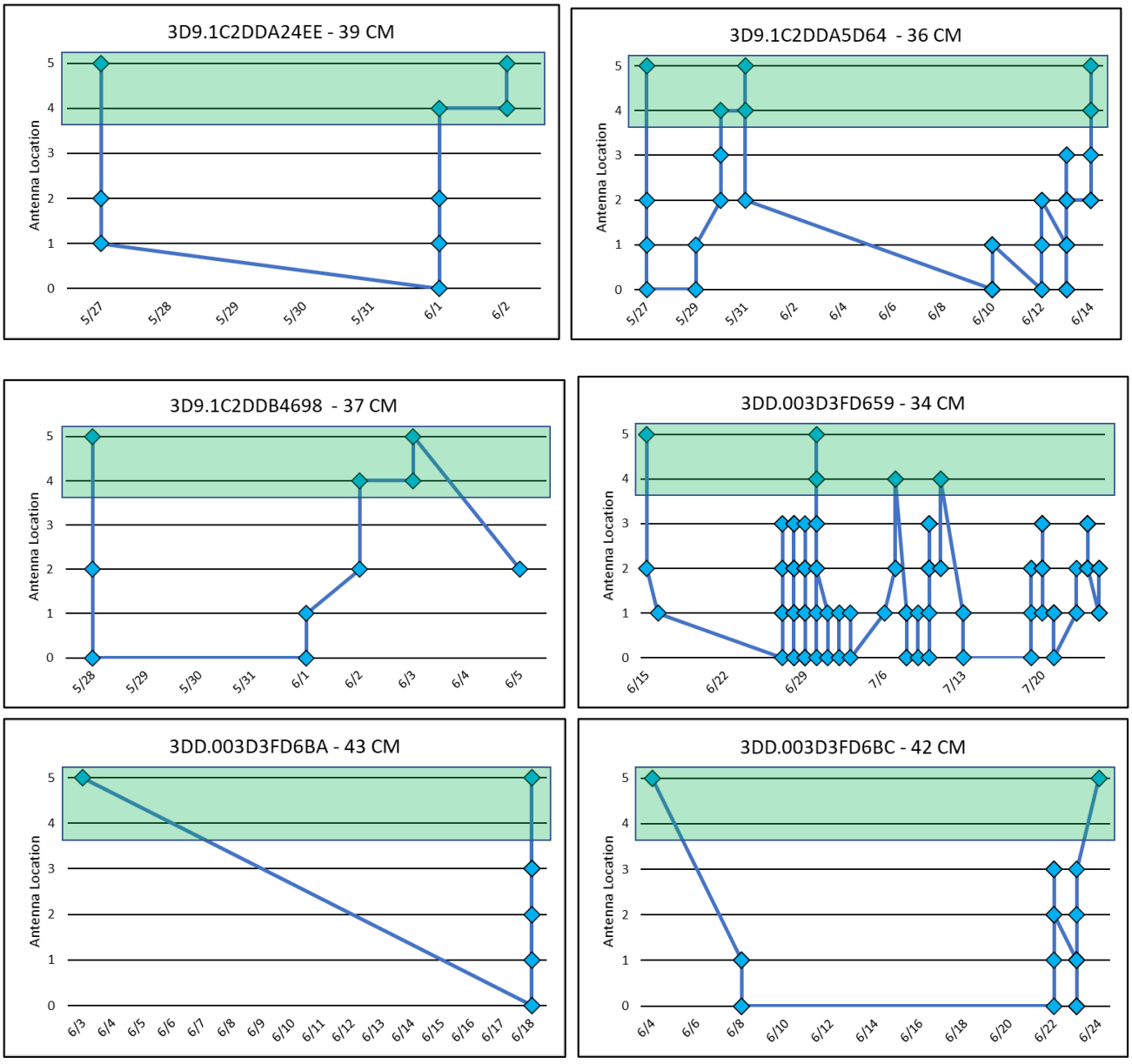


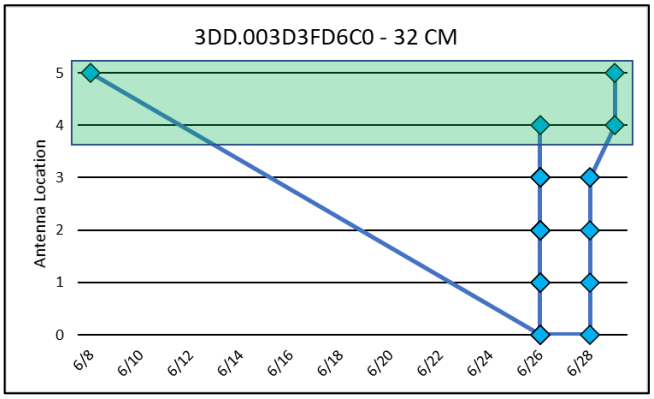






Movement histories of ***newly*** PIT tagged Bull Trout at the Tucannon River adult weir/trap, ***2021, that fell below the weir after tagging and reascended into the trap or remained downstream***. Location Key: 0 – Antennas below adult weir/trap (bottom row); 1 – Antennas below adult weir/trap (top row); 2 – Bottom antenna in the fish ladder; 3 – Top antenna in the fish ladder; 4 – Temporary antenna in adult trap box; 5 – Adult trap capture. Green shaded box indicates fish were inside the trap and/or captured. Note: Two fish were detected by the trap antenna, but were not captured. It's unclear if these were truly in the trap, or were detected by the trap antenna before they physically entered the trap.

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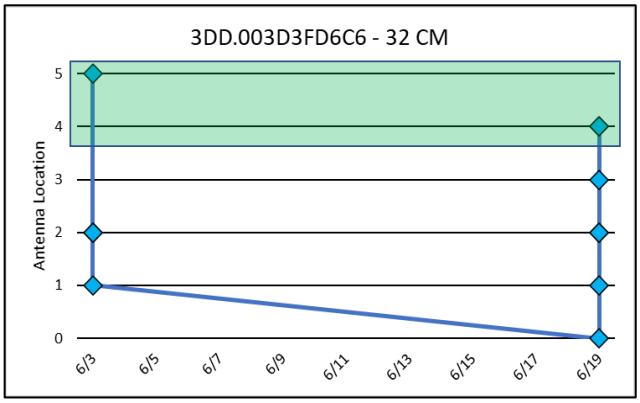
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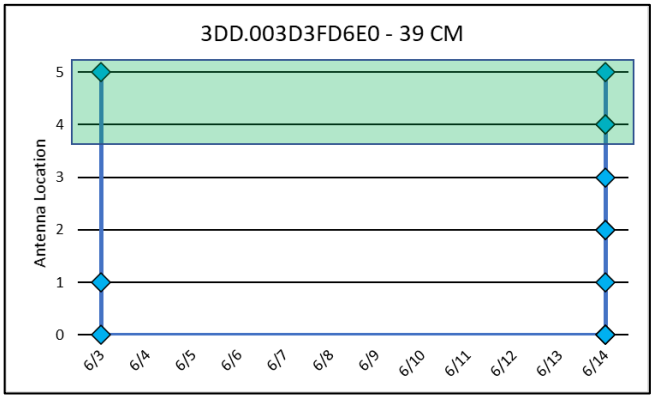
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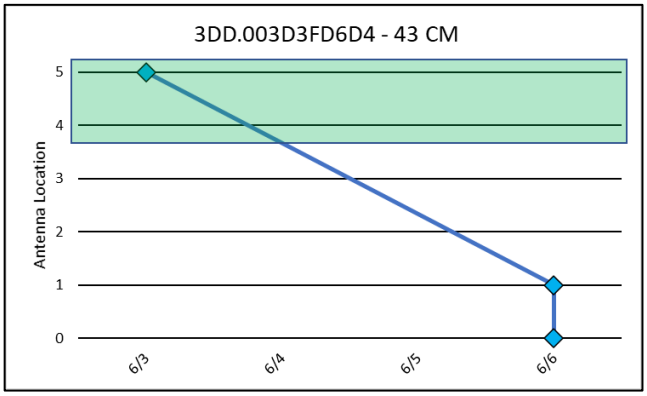
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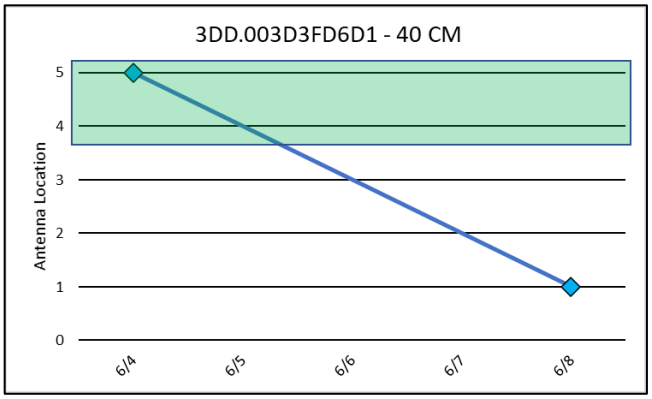
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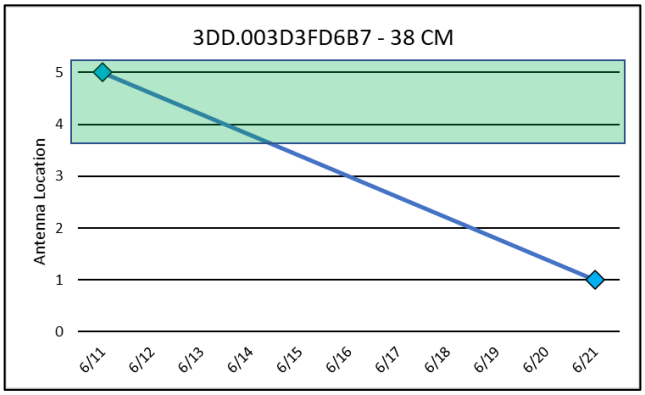
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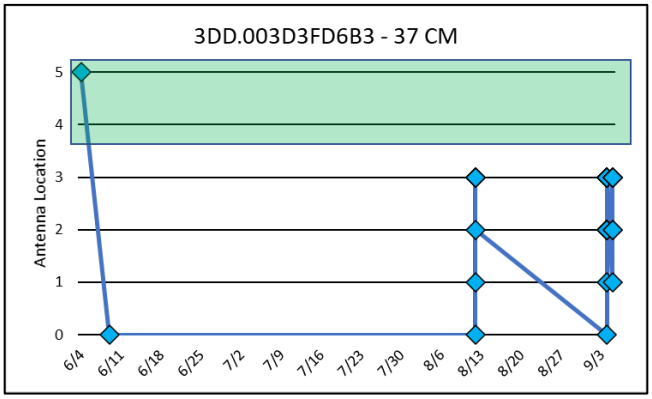
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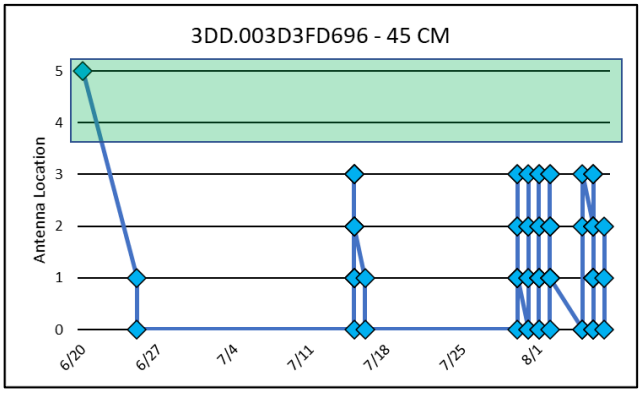
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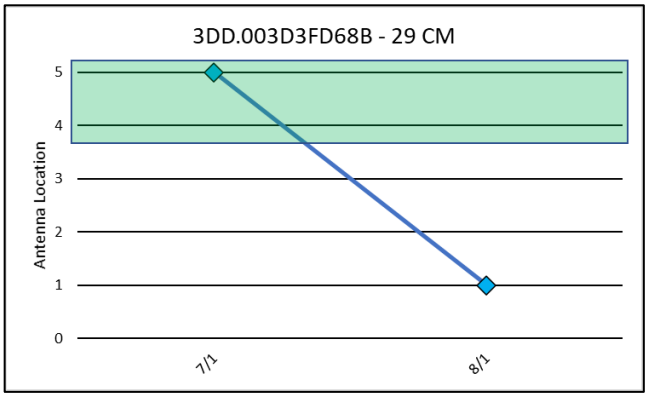
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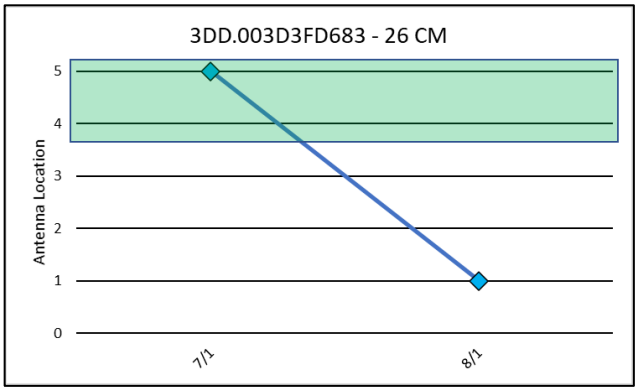
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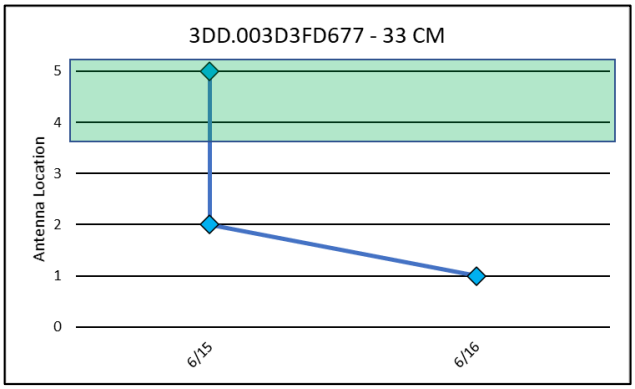
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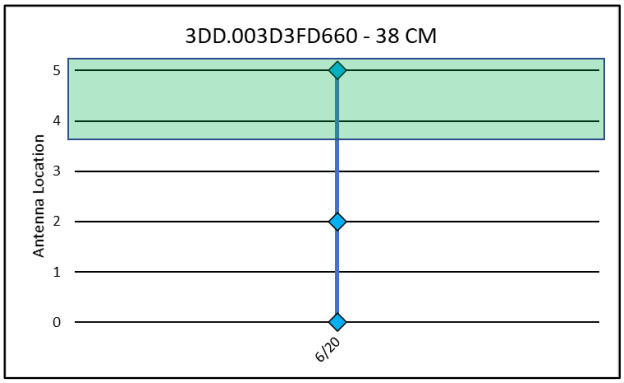
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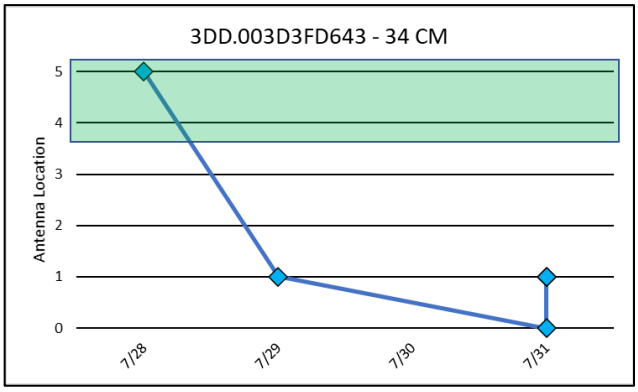
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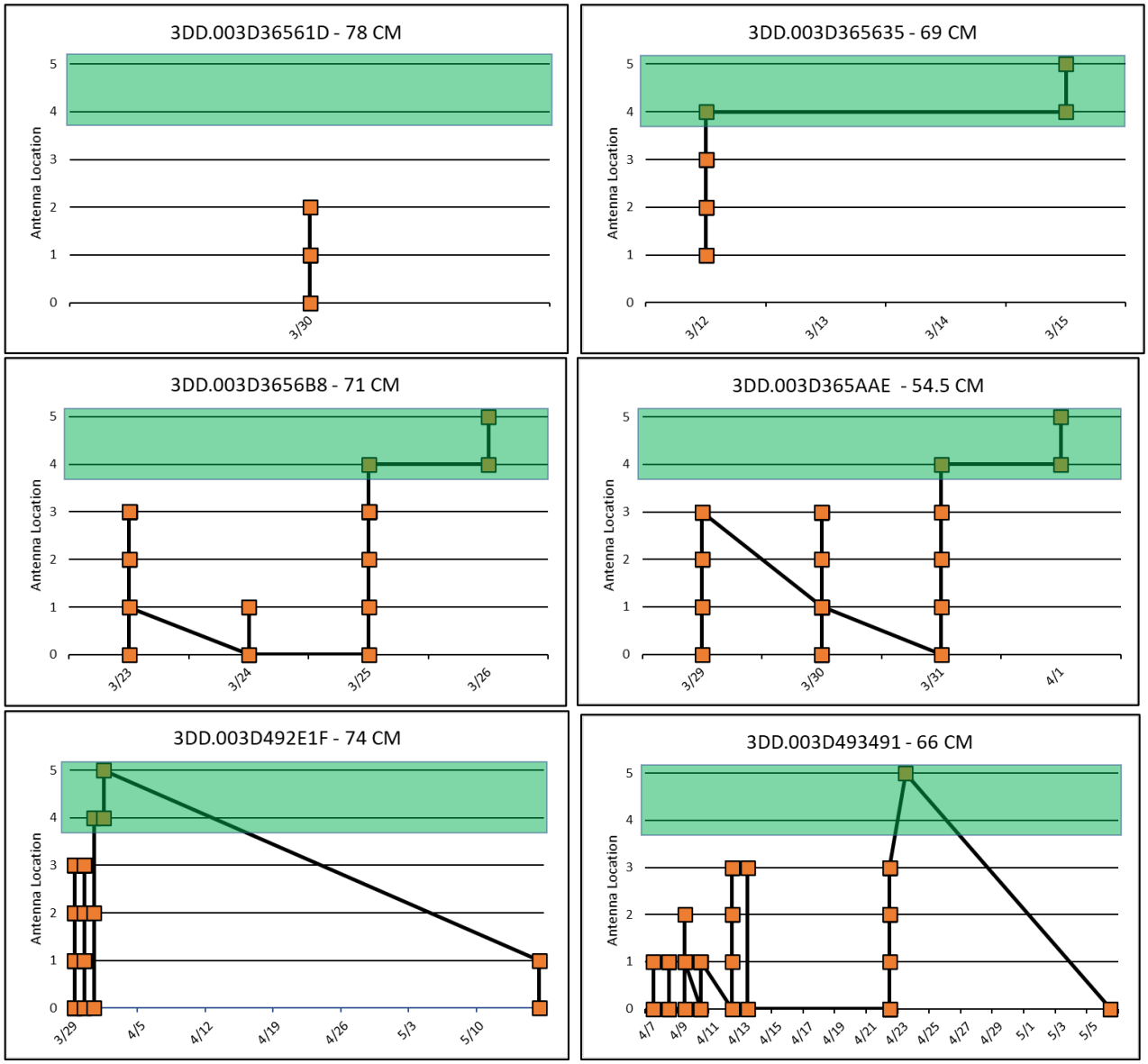
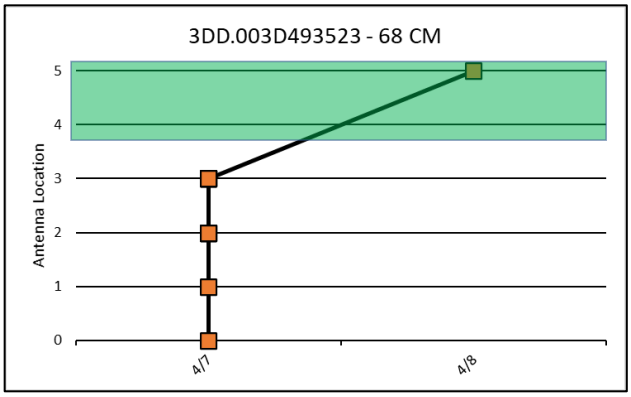
Appendix C

Movement histories of previously PIT tagged summer steelhead at the Tucannon River adult weir/trap, ***2021***. Location Key: 0 – Antennas below adult weir/trap (bottom row); 1 – Antennas below adult weir/trap (top row); 2 – Bottom antenna in the fish ladder; 3 – Top antenna in the fish ladder; 4 – Temporary antenna in adult trap box; 5 – Adult trap capture. Green shaded box indicates fish were inside the trap and/or captured.

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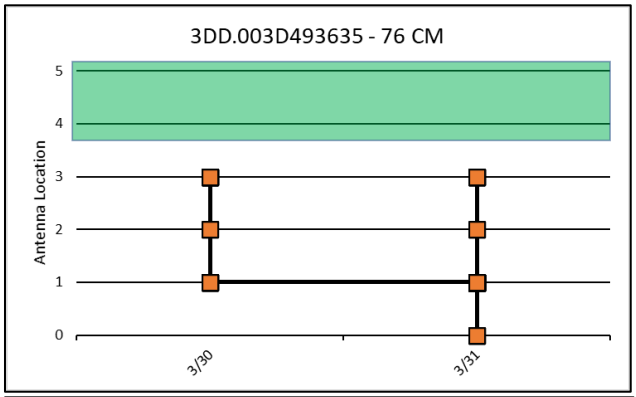
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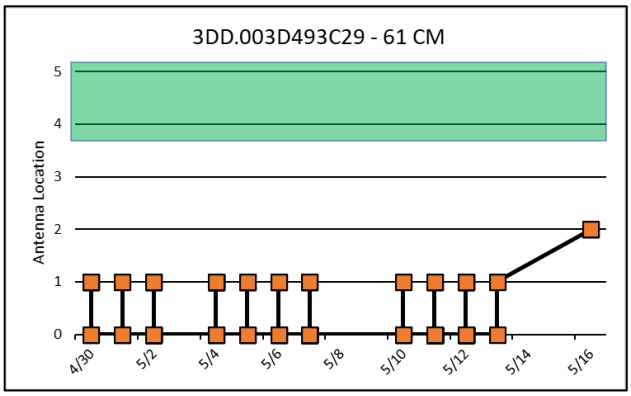
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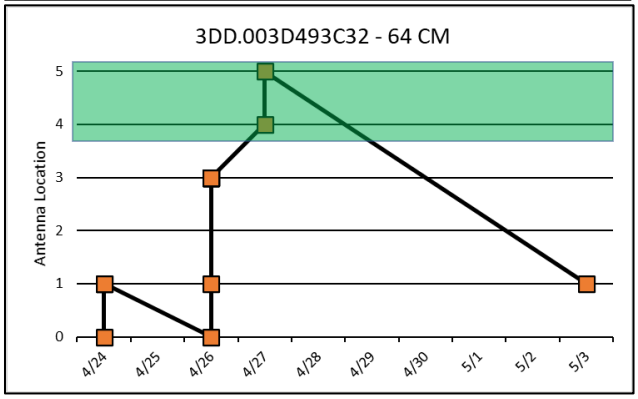
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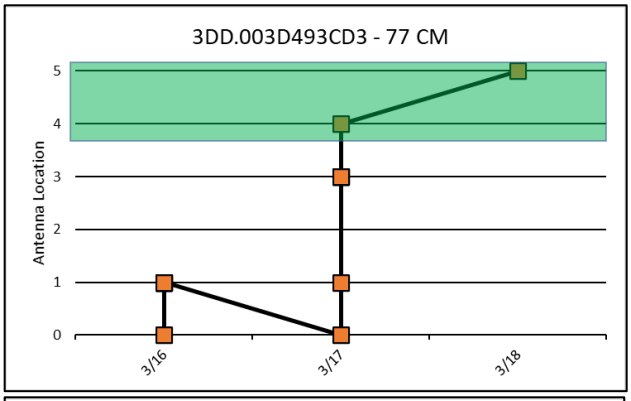
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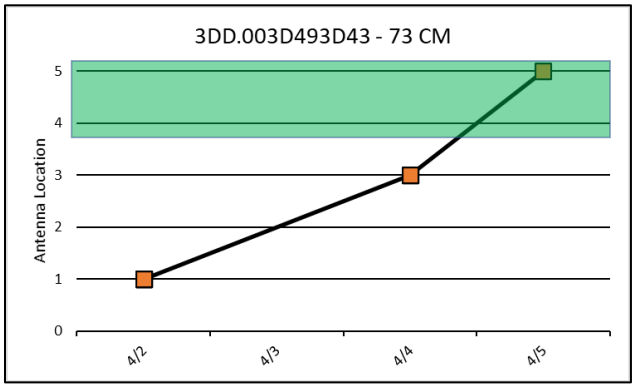
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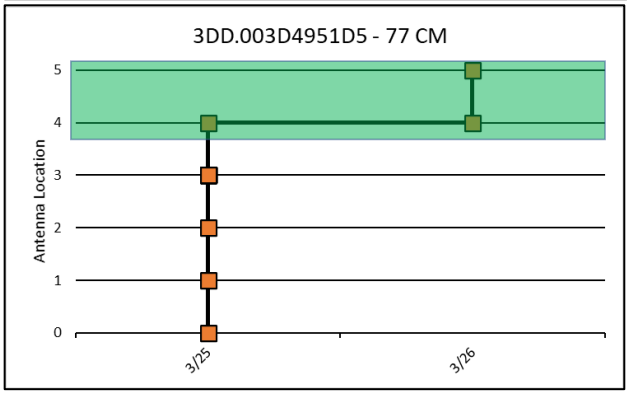
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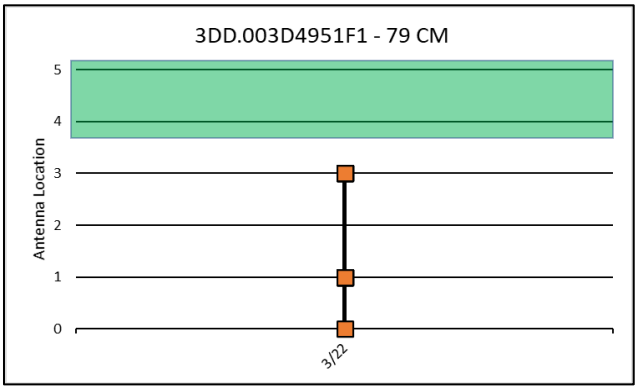
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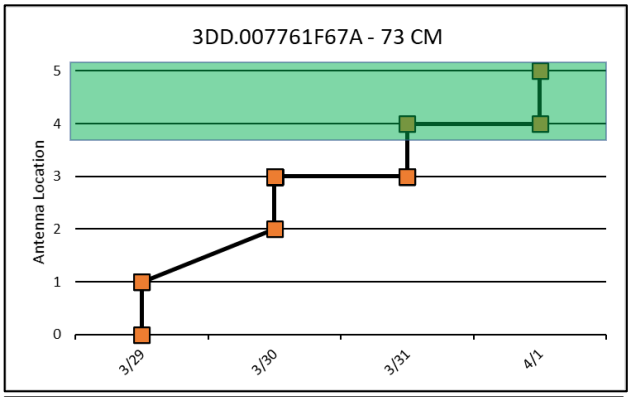
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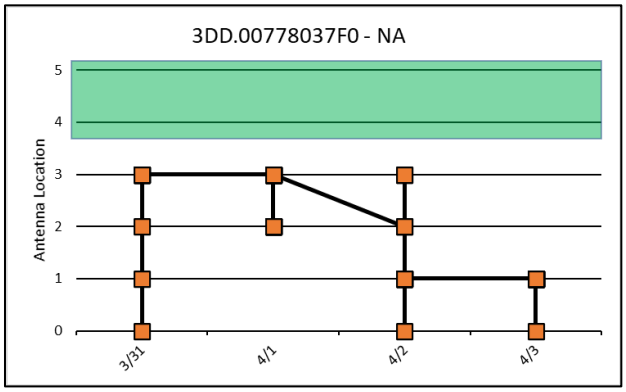
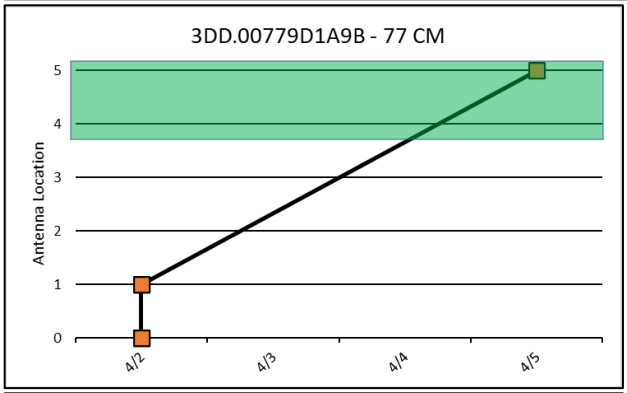
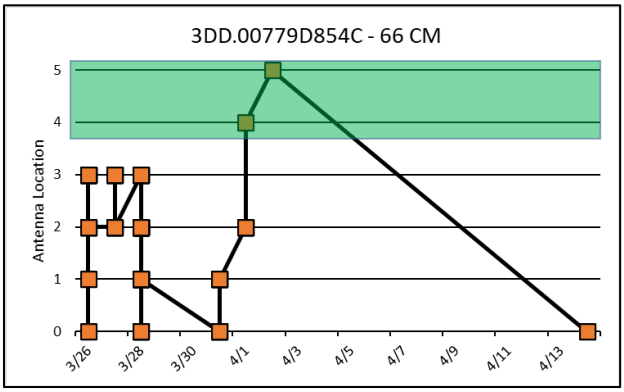
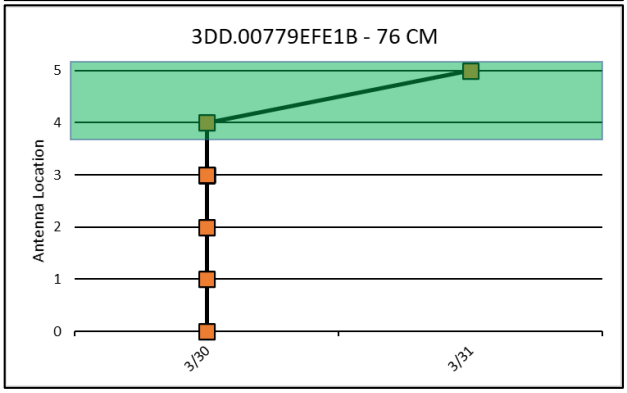
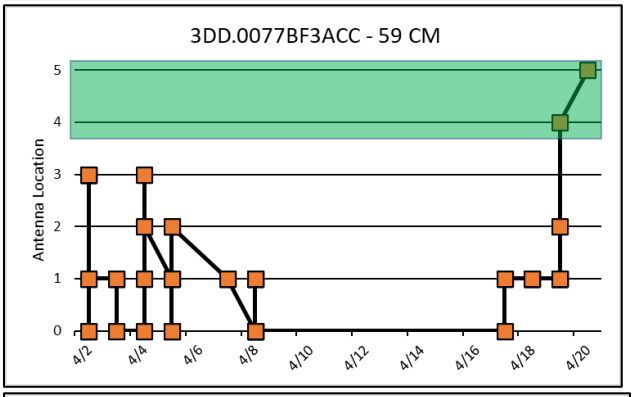
4/1

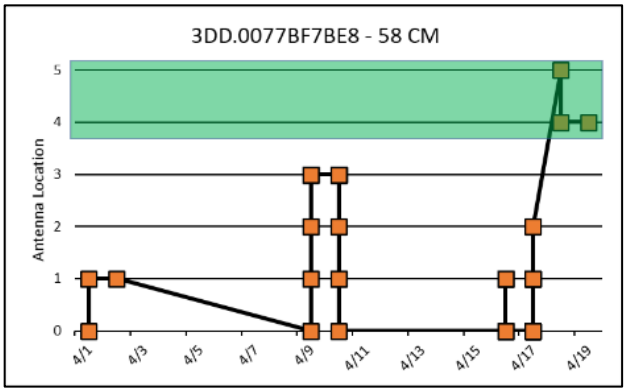

3DD.00778037F0 - NA
Antenna Location
0
1
2
3
4
5
3/31
4/1
4/2
4/3

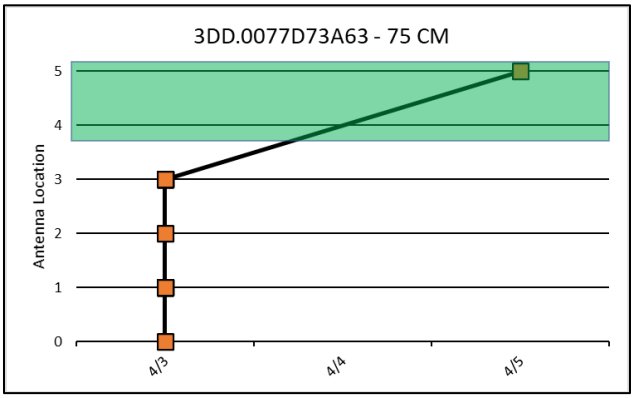

3DD.00779D1A9B - 77 CM
Antenna Location
0
1
2
3
4
5
4/2
4/3
4/4
4/5

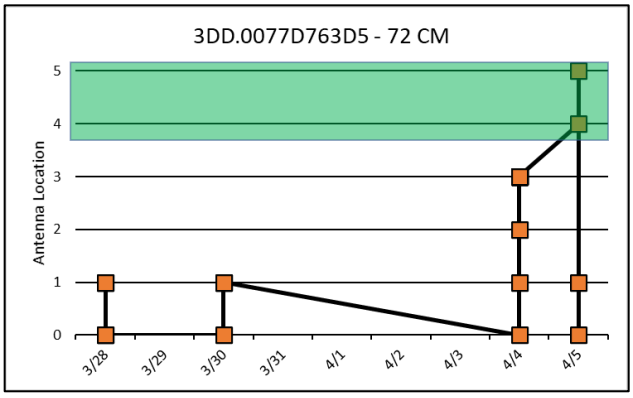

3DD.00779D854C - 66 CM
Antenna Location
0
1
2
3
4
5
3/26
3/28
3/30
4/1
4/3
4/5
4/7
4/9
4/11
4/13

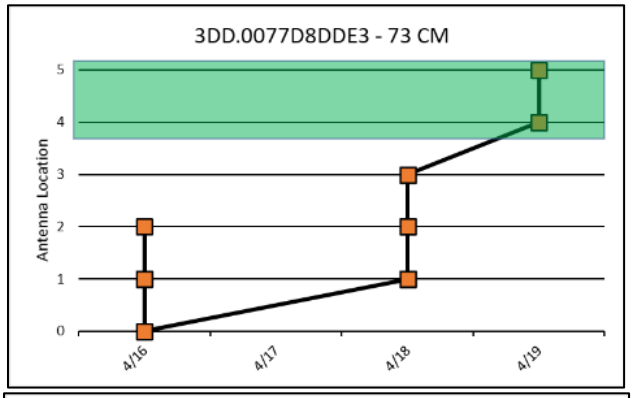

3DD.00779EFE1B - 76 CM
Antenna Location
0
1
2
3
4
5
3/30
3/31

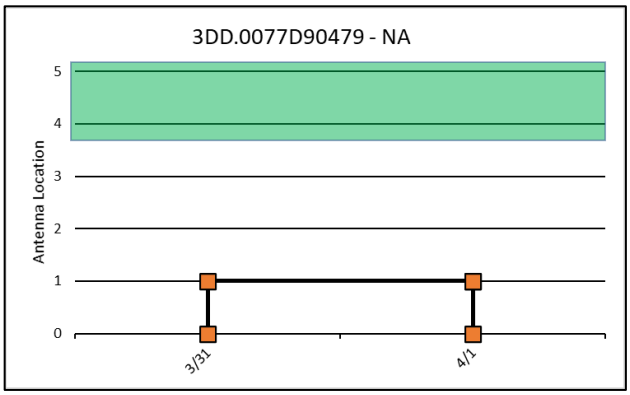

3DD.0077BF3ACC - 59 CM
Antenna Location
0
1
2
3
4
5
4/2
4/4
4/6
4/8
4/10
4/12
4/14
4/16
4/18
4/20

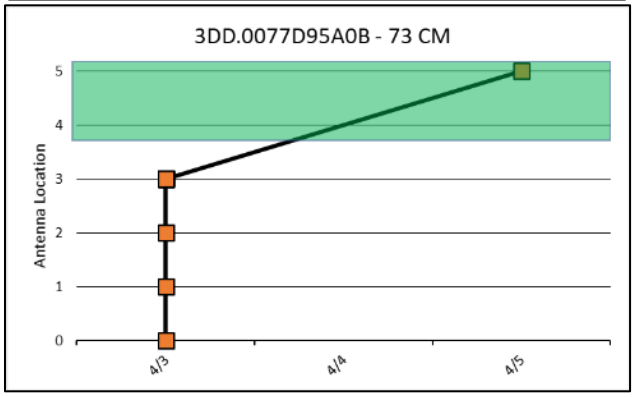

3DD.0077BF7BE8 - 58 CM
Antenna Location
0
1
2
3
4
5
4/1
4/3
4/5
4/7
4/9
4/11
4/13
4/15
4/17
4/19


3DD.0077D73A63 - 75 CM
Antenna Location
0
1
2
3
4
5
4/3
4/4
4/5


3DD.0077D763D5 - 72 CM
Antenna Location
5
4
3
2
1
0
3/28
3/29
3/30
3/31
4/1
4/2
4/3
4/4
4/5

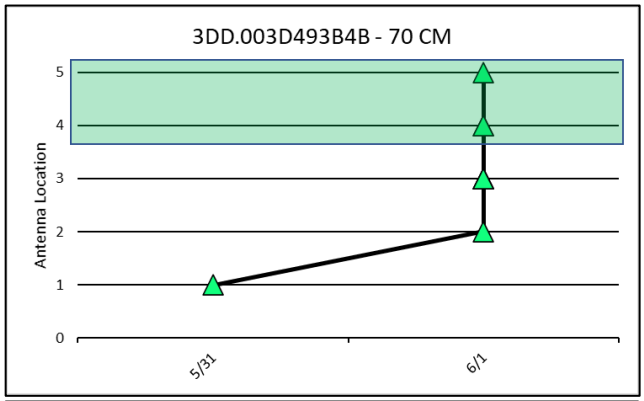

3DD.0077D8DDE3 - 73 CM
Antenna Location
5
4
3
2
1
0
4/16
4/17
4/18
4/19

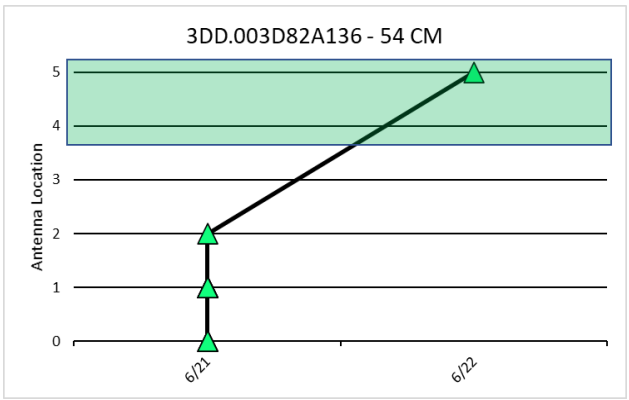

3DD.0077D90479 - NA
Antenna Location
5
4
3
2
1
0
3/31
4/1

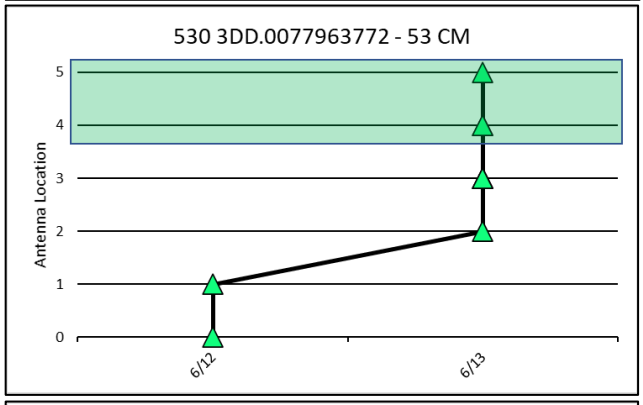

3DD.0077D95A0B - 73 CM
Antenna Location
5
4
3
2
1
0
4/3
4/4
4/5

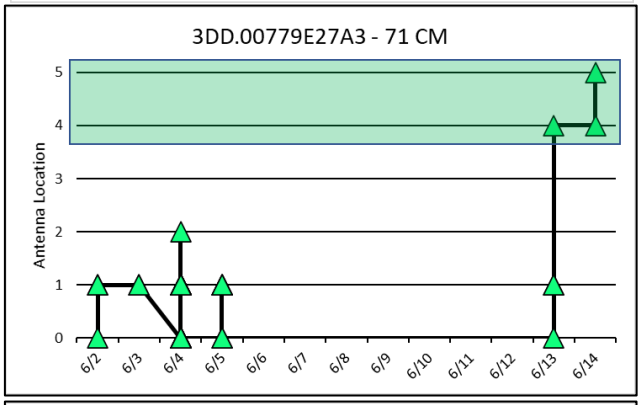
Appendix D

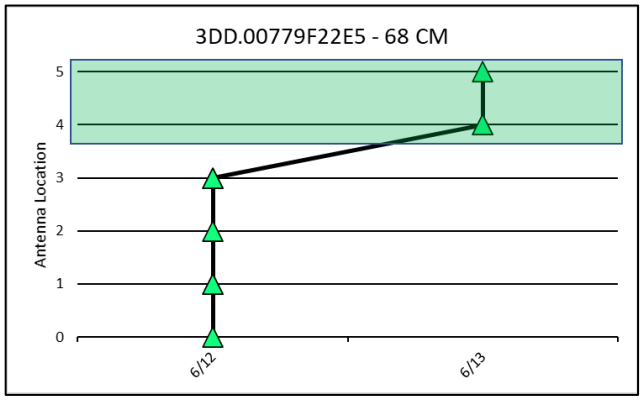
Movement histories of previously PIT tagged spring Chinook salmon at the Tucannon River adult weir/trap, ***2021***. Location Key: 0 – Antennas below adult weir/trap (bottom row); 1 – Antennas below adult weir/trap (top row); 2 – Bottom antenna in the fish ladder; 3 – Top antenna in the fish ladder; 4 – Temporary antenna in adult trap box; 5 – Adult trap capture. Green shaded box indicates fish were inside the trap and/or captured.

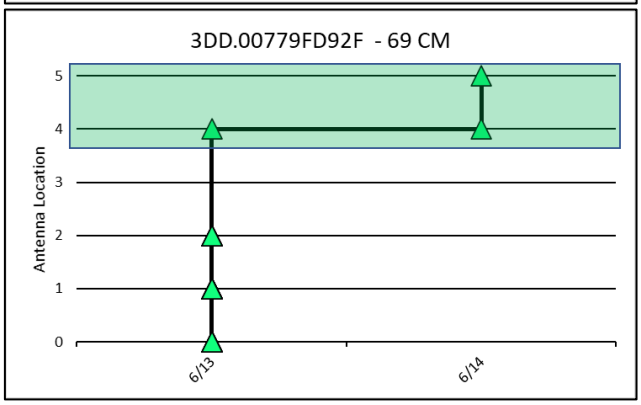


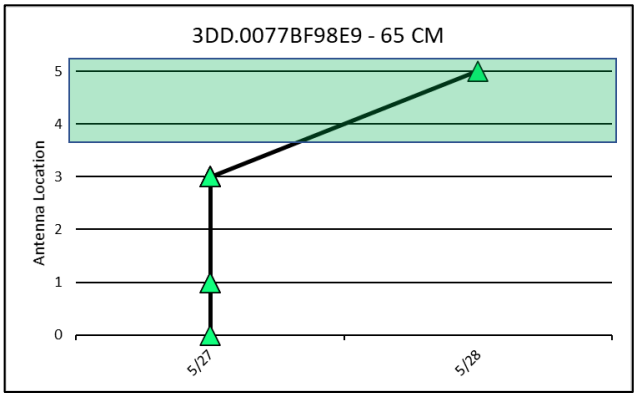


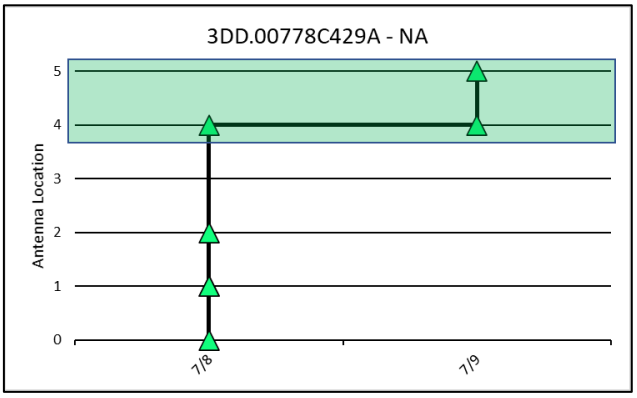


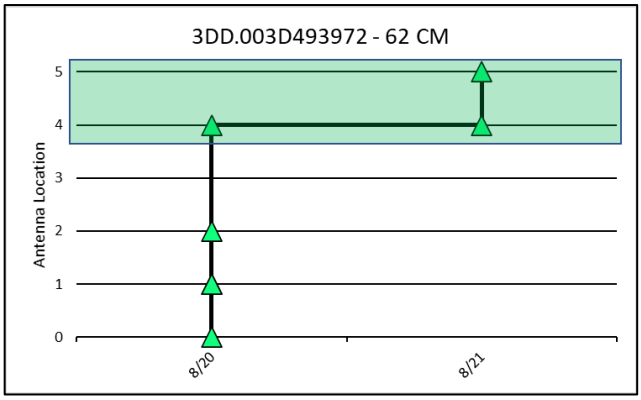


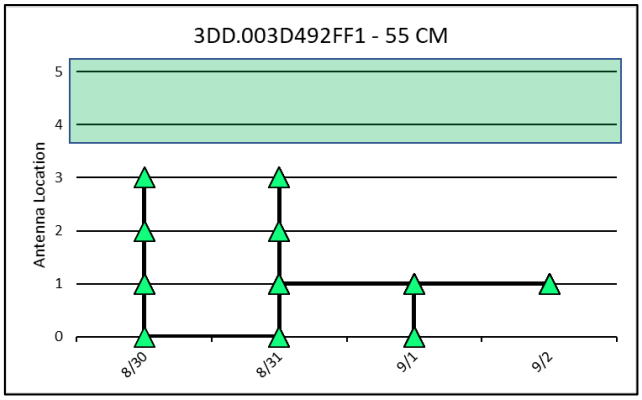





3DD.0077BF98E9 - 65 CM
Antenna Location
5
4
3
2
1
0
5/27
5/28


3DD.00778C429A - NA
Antenna Location
5
4
3
2
1
0
7/8
7/9


3DD.003D493972 - 62 CM
Antenna Location
5
4
3
2
1
0
8/20
8/21


3DD.003D492FF1 - 55 CM
Antenna Location
5
4
3
2
1
0
8/30
8/31
9/1
9/2

Appendix E

Newly PIT-tagged Bull Trout tagged at the Tucannon adult weir/trap in ***2021*** used to summarize movements/conversions into the upper watershed at the TPJ array.

3D9.1C2DDA24EE	3DD.003D3FD653	3DD.003D3FD683	3DD.003D3FD6B3	3DD.003D3FD6E0
3D9.1C2DDA5D64	3DD.003D3FD654	3DD.003D3FD685	3DD.003D3FD6B6	3DD.003D3FD6E1
3D9.1C2DDA7608	3DD.003D3FD655	3DD.003D3FD689	3DD.003D3FD6B7	3DD.003D3FD6E2
3D9.1C2DDAA5BA	3DD.003D3FD659	3DD.003D3FD68A	3DD.003D3FD6BA	3DD.003D3FD6E3
3D9.1C2DDAB27B	3DD.003D3FD65E	3DD.003D3FD68B	3DD.003D3FD6BC	3DD.003D3FD6E8
3D9.1C2DDABA2F	3DD.003D3FD660	3DD.003D3FD68D	3DD.003D3FD6C0	3DD.003D3FD6EA
3D9.1C2DDAD5E2	3DD.003D3FD662	3DD.003D3FD692	3DD.003D3FD6C6	3DD.003D3FD6EC
3D9.1C2DDAEAEF	3DD.003D3FD663	3DD.003D3FD696	3DD.003D3FD6C8	3DD.003D3FD6EE
3D9.1C2DDB4698	3DD.003D3FD666	3DD.003D3FD697	3DD.003D3FD6CA	3DD.003D3FD6F0
3DD.003D3FD63B	3DD.003D3FD669	3DD.003D3FD698	3DD.003D3FD6CC	3DD.003D3FD6F3
3DD.003D3FD63D	3DD.003D3FD66A	3DD.003D3FD69A	3DD.003D3FD6CD	3DD.003D3FD6F4
3DD.003D3FD63E	3DD.003D3FD66C	3DD.003D3FD69B	3DD.003D3FD6CF	3DD.003D3FD6F8
3DD.003D3FD63F	3DD.003D3FD66E	3DD.003D3FD69D	3DD.003D3FD6D1	3DD.003D3FD6FB
3DD.003D3FD642	3DD.003D3FD671	3DD.003D3FD6A0	3DD.003D3FD6D3	3DD.003D3FD6FD
3DD.003D3FD643	3DD.003D3FD672	3DD.003D3FD6A5	3DD.003D3FD6D4	
3DD.003D3FD646	3DD.003D3FD673	3DD.003D3FD6A6	3DD.003D3FD6D5	
3DD.003D3FD64A	3DD.003D3FD675	3DD.003D3FD6A7	3DD.003D3FD6DA	
3DD.003D3FD64C	3DD.003D3FD676	3DD.003D3FD6A8	3DD.003D3FD6DB	
3DD.003D3FD64E	3DD.003D3FD677	3DD.003D3FD6A9	3DD.003D3FD6DC	
3DD.003D3FD650	3DD.003D3FD679	3DD.003D3FD6B1	3DD.003D3FD6DE	

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