Wind River Subbasin Restoration

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5. Executive Summary

The Wind River subbasin in southwest Washington State provides habitat for a population of wild Lower Columbia River steelhead *Oncorhynchus mykiss*, which are listed as threatened under the Endangered Species Act. No hatchery steelhead have been planted in the Wind River subbasin since 1994, and hatchery adults are estimated to be less than one percent of adults in any year (Thomas Buehrens, Washington Department of Fish and Wildlife, personal communication). Numerous restoration actions have been implemented in the subbasin, including the removal of Hemlock Dam on Trout Creek in 2009. We used Passive Integrated Transponder (PIT) tagging and a series of instream PIT-tag interrogation systems (PTIS) to investigate life-histories, populations, and efficacy of habitat restoration actions for these steelhead. Data from our study, and companion work by Washington Department of Fish and Wildlife (WDFW), will contribute to Bonneville Power Administration's (BPA) Research Monitoring and Evaluation (RM&E) Program Strategy of Fish Population Status Monitoring (www.cbfish.org/ProgramStrategy.mvc/ViewProgramStrategySummary/1), specifically the sub-strategies of: 1) Assessing the Status and Trends of Diversity of Natural Origin Fish Populations and to Uncertainties Research regarding differing life histories of a wild steelhead population, 2) Assessing the Status and Trend of Adult Natural Origin Fish Populations, and 3) Monitoring and Evaluating the Effectiveness of Tributary Habitat Actions Relative to Environmental, Physical, or Biological Performance Objectives.

During summer 2014, we PIT-tagged steelhead parr in headwater areas of the Wind River subbasin to investigate life-history diversity, specifically to compare fate of those juvenile steelhead that move downstream prior to smolting with those that remain in their natal areas until smolting. A series of instream PTISs monitored movement of these fish. We added a new multi-antenna PTIS on Trout Creek and made improvements to two of our smaller tributary PTISs during 2014. Detections at the instream PTISs showed trends of parr emigration during summer and fall, in addition to the expected movement of parr and smolts in spring. Long-term monitoring of PIT-tagged fish will provide information on contribution of various life-history

strategies to smolt production and adult returns, as well as helping to identify factors influencing parr movement.

Movements of PIT-tagged adult steelhead were tracked with our instream PTISs. These data will contribute to a better understanding of timing and distribution of spawning by this population of wild steelhead within the Wind River subbasin. Additionally, these data have provided information on timing of adult movements to various parts of the watershed, which is allowing us to assess adult use of tributary watersheds within the Wind River subbasin. These data are contributing to evaluating steelhead response to the removal of Hemlock Dam from Trout Creek. Hemlock Dam, which was located at rkm 2.0 of Trout Creek, was removed in summer 2009 and had contributed to hydrologic impairment of Trout Creek and potentially caused some deterrent to upstream adult steelhead migration.

Evaluating restoration efforts is of interest to many managers and agencies so that funding and time are allocated for best results. The evaluation of various life-histories of Lower Columbia River steelhead within the Wind River subbasin provides information to better track populations, and more effectively direct habitat restoration and water allocation planning. Increasingly detailed Viable Salmonid Population information (Crawford and Rumsey 2009), such as that provided by PIT-tagging and instream PTISs networks like those we build and operate in the Wind River subbasin, provide data to better inform policy and management, as life-history strategies and production bottlenecks are identified and understood.

6. Introduction

This report summarizes work by U.S. Geological Survey's Columbia River Research Laboratory (USGS-CRRL), in the Wind River subbasin, from January 2014 through December 2014. Funding for activities during this time was provided by BPA under contracts 63276 (January 2013 – October 2013) and 66668 (November and December 2014) as part of the Wind River Subbasin project partnership (BPA Project Number 1998-019-00). The Wind River Subbasin project is a collaborative effort to restore, monitor, and research wild Lower Columbia River steelhead in the Wind River, WA. The four partner agencies are the U.S. Forest Service (USFS), WDFW, Underwood Conservation District (UCD), and USGS-CRRL.

This partnership was established in the early 1990s with support from BPA, and has allowed extensive habitat, research, monitoring, and coordination activities across the Wind River subbasin. The project works at multiple levels to identify and characterize key limiting habitat factors in the Wind River; restore degraded habitats and watershed processes; document fish populations, life-histories, and interactions; investigate efficacy of restoration actions; and to share information across agency and non-agency boundaries. Long-term research in the Wind River has focused on assessing steelhead/rainbow trout *Oncorhynchus mykiss* populations and life-history (Connolly and Jezorek 2007; Cochran et al. 2013; Jezorek and Connolly 2014), their relationships with introduced populations of spring Chinook salmon *O. tshawytscha* (Jezorek and Connolly 2015) and brook trout *Salvelinus fontinalis* (Connolly and Jezorek 2007), documenting habitat quality and evaluating habitat restoration efforts (Connolly and Jezorek 2007; Coffin 2011).

There are several goals of the ongoing research presented in this report. These data and efforts will contribute to a greater understanding of the diversity of steelhead life-histories and the factors driving different life-history expressions in a wild steelhead population. Of particular interest are migratory parr and their fates compared to headwater rearing parr that do not migrate until smolting. Factors driving these life-history strategies and the success of them are important considerations for future management and restoration actions. These research efforts are also providing data that will be used to estimate life-stage specific survival and identify potential population bottlenecks. Monitoring of adult steelhead will provide greater resolution to spawn timing and location. Additionally, these data provide a basis to evaluate the effect of the removal of Hemlock Dam from Trout Creek on steelhead populations.

During this reporting, we tagged steelhead parr in headwater sections of the Wind River subbasin with PIT tags (Figure 1) and maintained a network of instream PIT-tag interrogation systems (PTIS; Figure 2). Past monitoring in the Wind River subbasin has suggested a large downstream migration of parr to the lower river (Cochran et al. 2013) that rear for additional time in downstream reaches before smolting. We hope to further document and understand the success and dynamics of this life-history. The PIT-tagged steelhead parr will provide movement and life-history data via recapture events, detections at instream PTIS systems within the Wind River subbasin, and detections at Bonneville Dam as smolts and adults. Monitoring of parr from headwaters through downstream reaches may reveal unknown behaviors and life-history strategies, which could be important knowledge for conservation efforts. All PIT-tag data are

submitted to the PTAGIS database administered by Pacific States Marine Fisheries Commission. These data contribute to the BPA Research Monitoring & Evaluation (RM&E) Program Strategy of Assessing the Status and Trends of Diversity of Natural Origin Fish Populations and to Uncertainties Research by exploring the diversity of life histories of a wild steelhead population (www.cbfish.org/ProgramStrategy.mvc/ViewProgramStrategySummary/1).

Adult steelhead data from the PTISs provide data toward the RM&E Program Strategy of Assessing the Status and Trends of Adult Natural Origin Fish Populations. The PTISs allow estimation of adult steelhead returns to Trout Creek and the Wind River. This is important for evaluating the effects of Hemlock Dam removal from rkm 2.0 of Trout Creek (removed summer 2009; Coffin 2011) on steelhead populations. This habitat restoration assessment is informative to the RM&E Program Strategy of Monitoring and Evaluating the Effectiveness of Tributary Habitat Actions Relative to Environmental, Physical, or Biological Performance Objectives.

We maintained thermologgers to collect water temperature data near the PIT tagging sites. These data will help to provide thermal histories for fish and can be related to growth rates and movement timing. Water temperature data will also continue to be collected and added to a long term database for the Wind River, administered by UCD.

7. Study Area and Methods

The Wind River is a fifth-order tributary of the Columbia River in southwest Washington's Columbia River Gorge. The Wind River subbasin extends north nearly 50 km from the Columbia River. Elevations range from 29 m above sea level at the mouth to 1,190 m on ridge tops in the northern portion of the subbasin. The climate is temperate with most of the average annual precipitation of 280 cm occurring between November and April.

We PIT-tagged age-0 and age-1 *O. mykiss* parr in the Trout Creek and upper Wind River watersheds (Figure 1). All fish were captured by backpack electrofishing. Captured fish were anesthetized with the lightest possible dose of MS-222 before handling. All fish were measured for fork length to the nearest mm, weighed to the nearest 0.1 g, inspected for external signs of disease, and scanned for PIT tags. If they did not have a PIT tag, were at least 70-mm fork length, and were not injured or in poor condition, we PIT-tagged them with a 12-mm 134.2 kHz

tag that was inserted by syringe. In some cases, we PIT-tagged fish between 55 and 70 mm with 9-mm 134.2 kHz tags. The 9-mm tags were inserted into an incision made with a scalpel, which several studies have reported as more effective on small fish than using a syringe (Baras et al. 2000; Archdeacon et al. 2009; Dixon and Mesa 2011). All PIT-tagging sterilization and tag location procedures followed the guidelines outlined by Columbia Basin Fish and Wildlife Authority (1999). After work up, fish were held in fresh ambient-temperature stream water, allowed to recover and regain equilibrium, and released at or near their point of capture.

Our fish-sampling sites were between 300 and 600-m long, which was the length of stream needed achieve our goal of about 150 PIT tags deployed per site. Sample site were spread in tributary streams and mainstem sections of the two watersheds in the Wind River (Trout Creek and upper Wind) that USGS has worked in and which are being researched as part of the monitoring of the Hemlock Dam removal on Trout Creek. We sampled these sites in mid-summer and again in early-fall, which was when we could recapture previously tagged fish and PIT-tag young-of-year fish. All tagging and recapture data followed PTAGIS database protocols and were submitted to the PTAGIS database.

During the period covered by this report, we operated six PTISs (Figure 2) to track PIT-tagged juvenile and adult steelhead. We had previously installed five PTISs (Trout Creek, PTAGIS site code= TRC; upper Wind River, PTAGIS site code = WRU; Paradise Creek, PTAGIS site code = PAD; upper Mine Reach, PTAGIS site code = UMD; and Martha Creek, PTAGIS site code = MAD), and a sixth was installed in September 2014 (Trout Creek at 43 Bridge, PTAGIS site code = TC4). We used three different types of transceivers at the PTIS sites. Multiplexing transceivers were used for larger sites (TRC, WRU, and TC4) because they could power multiple antennas; smaller transceivers were used at the smaller sites: MAD, PAD, and UMD.

The transceivers at TRC, TC4, and WRU were Biomark 1001M units capable of operating six individual antennas. Both used six antennas to span these larger sites (three arrays of two antennas each at TRC, and two arrays of three antennas each at TC4 and WRU; Figures 3 - 5). All of the antennas operated by the MUX transceivers are 6-m long by 0.6-m wide. Because PTISs in streams as large as Trout Creek and the mainstem of the Wind River rarely detect every passing fish (Zydlewski et al. 2006; Achord et al. 2012), an estimate of detection efficiency must be made to estimate run size of PIT-tagged fish. Multiple antenna arrays provided us the

opportunity to generate detection efficiency estimates following the methods outlined in Connolly et al. (2008).

The two transceivers at MAD were Allflex RM310 units. Each operated a single antenna, as described by Bond et al. (2007). The site at Martha Creek had grid power, enabling us to operate two transceivers and antennas (3-m long by 0.6-m wide). Limitations on power at PAD and UMD (both solar supported) allow for operation of only one antenna (3-m long by 0.6-m wide) at each site. During 2014, we changed to Biomark IS1001 transceivers at PAD and UMD. These transceivers were more efficient and have better diagnostics, for optimizing system performance and tracking periods of compromised operation, than the RM310 units. Because of limitations of solar-power charging and access issues due to snowfall, we missed some monitoring time at the PAD and UMD sites during winter conditions. The solar panels at the PAD site are near the road and would be subject to snowplow damage so they were removed during winter.

To investigate parr life histories and movements, we compiled information from recapture events during electrofishing, and from WDFW smolt trapping. The PTISs provided data on parr movement timing from tributaries. All interrogation data from TRC, TC4, and WRU were submitted to the PTAGIS database (file uploads 2 to 4 times per month). Interrogation data from the PTISs MAD, PAD, and UMD are not yet submitted to the PTAGIS database due to interruptions in operations. However, these data have been made available to our project partners and we do plan to submit them to the PTAGIS database.

We operated five thermologgers during the period covered by this report (Table 1). These thermologgers were deployed to provide water temperature data near our parr PIT-tagging locations. All thermologgers were Onset Optic Stowaway units set to record water temperature hourly. The units were downloaded twice per year.

8. Results

Fish sampling -- During summer 2014, we PIT-tagged 1,504 steelhead parr in the headwaters of the Wind River subbasin. In the Trout Creek watershed, we PIT-tagged *O. mykiss* parr in Martha (*n* = 173), Layout (two sites, *n* = 318), and Crater (*n* = 138) creeks, as well as in a mainstem section (rkm 11.0 – 11.3) of Trout Creek (*n* = 155; Figure 1; Table 2). In the upper Wind River watershed, we PIT-tagged *O. mykiss* parr in Trapper (*n* = 244) and Paradise (*n* = 122) creeks, in the Wind River upstream of its confluence with Paradise Creek (*n* = 169), and in a mainstem section of the Wind River (*n* = 185; the Mine Reach) 3 km downstream of the Paradise Creek confluence (Figure 1; Table 2). We PIT tagged 781 *O. mykiss* with 12-mm tags (primarily age-1), and 723 *O. mykiss* with 9-mm tags (age-0). The smaller tags allowed tagging of young-of-year fish between 55 and 70-mm fork length. All sites (Table 2) were sampled twice: summer, then again in early-fall. Length and weight data were collected from all *O. mykiss*, including those we did not PIT tag (Appendix Figures 1 – 9). Length-frequency data were used to determine age-0 and age-1 length breaks for each sample site and date during each year of sampling (Appendix Tables 1 – 8). Increased PIT tagging of age-0 fish will further allow us to validate age breaks as we recapture those fish.

Repeat sampling in fall presented the opportunity to recapture fish that were PIT-tagged during summer, which provided data on late summer growth rates. In addition to the recapture data on fish that were PIT-tagged during the first sampling session, we recaptured PIT-tagged fish from previous years sampling (Tables 3 - 5). We recaptured 246 previously PIT-tagged *O. mykiss* (tagged during 2012, 2013, and 2014) during 2014 electrofishing sampling. Additional re-contacts of PIT-tagged parr during 2014 came from recaptures at Wind River subbasin smolt traps (*n* = 28) , detections at instream PTISs in the Wind River subbasin (see text below), and detections of juveniles in the Columbia River (*n* = 11) at Bonneville Dam or the estuary trawl sampling (Tables 3 - 5). To date, we have not yet detected any returning adult steelhead at Bonneville Dam or in the Wind River from our parr PIT-tagging efforts.

Brook trout, a non-native species, were present in Layout, Crater, and Trout creeks, and length and weight data were collected from those captured. Shorthead sculpin *Cottus confusus* were present in Trapper and Paradise creeks and the mainstem Wind River. No Chinook salmon *O. tshawytscha* juveniles were found at our electrofishing sites during 2014.

Pit Tag Interrogation Systems – Forty-eight PIT-tagged adult steelhead were detected at the TRC PTIS from 7 December 2013 through 10 December 2014 (Figure 6). Adult detection efficiency, derived by the methods of Connolly et al. (2008), of the TRC PTIS was 99.7% (SE =

0.3) over this time period (Table 6). The PTIS installed in Trout Creek at the 43 Road Bridge (TC4; rkm 11.5), which is about 9 km upstream of TRC, detected 18 PIT-tagged adult steelhead during fall of 2014. All 18 of these fish were detected at TRC (rkm 2.0), confirming excellent adult steelhead detection efficiency at TRC. Detections were clustered during fall and spring, but also sporadically throughout the year. Of the 48 adults detected at TRC, 29 were originally tagged as adults at the Shipherd Falls trap in the lower Wind River, 12 were originally tagged as smolts at either Trout Creek or Lower Wind smolt traps, 5 were originally tagged as adults captured in the Wind River by hook and line, and 2 were tagged as adults at Bonneville Dam.

Seven juvenile steelhead (PIT-tagged as parr in the Trout Creek watershed) were detected at the TRC PTIS (rkm 2.0) between 7 December 2013 and 10 December 2014 (Figure 7), two of which (29%) were detected outside of the spring smolt trapping period (one in December and one in August). These seven fish alone are not adequate for calculating detection efficiency. Future efforts at efficiency calculation for this site will incorporate juvenile detection data from steelhead PIT tagged by WDFW at their smolt trap (located upstream of TRC) however, those data are not available at the time of this writing.

Twelve PIT-tagged adult steelhead were detected at the WRU PTIS from 7 December 2013 through 10 December 2014 (Figure 8). Adult detection efficiency, derived by the methods of Connolly et al. (2008), of the WRU PTIS was 72.0% (SE = 19.0%) over this time period (Table 6). Though sample size was relatively small over this time period, there was a cluster of adult detections during fall, similar to the pattern seen at TRC. Of the 12 adults detected at WRU, 7 were originally tagged as adults at the Shipherd Falls trap in the lower Wind River, 4 were originally tagged as smolts at the upper Wind River smolt trap, and 1 was tagged as an adult at Bonneville Dam.

Twenty-five juvenile steelhead (PIT-tagged as parr in the upper Wind River watershed) were detected at WRU from 7 December 2013 to 10 December 2014 (Figure 9). Nine of the 25 juveniles (36%) were detected throughout summer and fall of 2014. Eleven of the juveniles detected were tagged with 9-mm tags as age-0 steelhead.

We installed a new PTIS in late summer 2014 at the 43 Road Bridge crossing over Trout Creek (TC4), and it immediately began detecting PIT-tagged steelhead. Eighteen PIT-tagged adult steelhead were detected between 15 September and 10 December 2014 (Figure 10). Forty-one juvenile steelhead (PIT tagged as parr in the Trout Creek watershed during 2013 and 2014)

were detected during this same period (Figure 11). Thirty-six of these juveniles had moved upstream from their tagging location at a mainstem Trout Creek sampling site, which is about 200-m downstream of TC4. These upstream movers included 32 fish tagged during 2014, six of which were tagged as age-0 fish.

Additional detections of PIT-tagged fish were recorded at the three tributary interrogation sites (MAD, PAD, and UMD; Figure 2). The UMD site was problematic during 2014. During winter, we experienced some loss of monitoring time due to lack of solar charge (because of limited diagnostics on the transceiver, we do not know exactly how much time). Sometime in March, the antenna cable was worn through, and due to high water, we were not able to replace it until 15 May 2014. At this time, we also replaced the Allflex transceiver with a more robust Biomark IS1001 unit, which required less power with better diagnostics. In September we discovered that our antenna had been broken on one end (likely from someone throwing a rock at it sometime during summer), despite being compromised, the antenna was still functional (continued reading Virtual Tags and actual tags), though read range was reduced. We replaced the antenna on 18 September 2014. The solar controller that we were using with this site was creating significant noise (interfering with read range) and we replaced it on 10 October 2014. On 21 October 2014, we added two solar panels to give us extra charging capacity during winter. Despite the many problems at UMD, we did detect seven steelhead (PIT-tagged as parr during 2013 and 2014 in the Wind River between rkm 41.0 and 41.6) between 1 January 2014 and 10 December 2014 (Figure 12), four of these fish (57%) were detected during summer or fall.

We began operation at PAD on 14 April 2014. This start date was slightly later in spring than intended, but resulted in site improvements as we installed larger solar panels and replaced the Allflex transceiver with a more robust Biomark IS1001 unit. The unit operated well, though at times the solar controller was generating noise. We replaced the solar controller on 10 October 2014. We removed the solar panels and shut down the site on 12 November 2014. We detected fifteen PIT-tagged steelhead (tagged as parr in Paradise Creek during 2012, 2013, and 2014) during 2014 (Figure 13), four of which (27%) were detected during fall. We did not detect any PIT-tagged adult steelhead at either PAD or UMD during 2014. The late start in the spring for PAD, and the cable problem at UMD may have hampered detections since spring is the most likely time for adults to be present in these smaller tributaries. However, the adult escapement for spawn year 2014 was relatively low and we do not know how many adults may have been

present this high in the subbasin. We are hopeful that the improvements to the solar systems and transceivers result in more consistent operation in the future.

The MAD site, which was grid powered, ran consistently during 2014. Sixteen juvenile steelhead (PIT-tagged as parr in Martha Creek during 2012 and 2013) were detected there between 1 January and 10 December 2014 (Figure 14). Fifteen fish were detected during spring and early summer, with only one detection in fall.

Evaluation of restoration -- Data from these PIT-tagging efforts will contribute to evaluation of restoration efforts. Detections of adult steelhead at TRC, TC4, and WRU are providing data that are allowing evaluation of whether the removal of Hemlock Dam has increased adult steelhead populations in Trout Creek. We are working closely with WDFW to use these data to evaluate this restoration action.

Water temperature -- Thermologger data collected during the period covered by this report (Table 1) have been provided to personnel at UCD, who are compiling temperature data from multiple agencies working in the Wind River subbasin. These data and previous USGS temperature data have been provided to the NorWest database. The goal of the NorWest database is to collate stream temperature data to contribute to analyses of climate change scenarios. An initial release of some of the NorWest modeling efforts was distributed during January 2015 (http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html) and includes data from our temperature monitoring.

9. Synthesis of Findings: Discussion/Conclusions

RM&E Program Strategy of Assessing the Status and Trends of Diversity of Natural Origin Fish Populations and Contribute to Uncertainties Research Regarding Differing Life Histories of a Wild Steelhead Population.

Instream PIT-tag interrogation systems have allowed assessment of movements of wild Lower Columbia River steelhead that were PIT-tagged as parr in headwaters of the Wind River, WA. Although smolt traps are excellent for assessing movement timing and migrant populations, they are limited to time periods when river flows allow their operation. In the Wind River subbasin, smolt traps generally operate from April through June.

Smolt trapping in the Wind River has identified downstream movement of steelhead parr during spring. The extent of parr movement outside of the smolt-trapping period (July through March), which some studies have shown to be substantial (Tattam et al. 2013; Martens et al. 2014), is unknown. The yearly population of smolts at the mouth of the Wind River is more than can be accounted for at the three smolt traps located below upstream spawning areas (Trout Creek, upper Wind River, Panther Creek; Cochran et al. 2013). The contribution of migratory parr, which move from upstream spawning areas and rear in portions of the mainstem, to the total Wind River smolt population is unknown. The extent of steelhead spawning downstream of the upper three smolt traps, which is believed minimal (but is currently unknown), also may produce juvenile steelhead that contribute to subbasin smolt totals.

Because instream PIT-tag interrogation systems can operate year-round, they can provide data on juvenile steelhead movement outside of conventional smolt trapping periods (Zydlewski et al. 2006; Connolly 2010). Our network of instream PTISs in the Wind River has proven to be an excellent tool for monitoring parr and adult PIT-tagged steelhead. Our increase in the number of systems and improvements to operation of existing systems has great promise for continued and future monitoring of status and trends of a wild steelhead population.

Data collected to date in the Wind River have shown considerable juvenile steelhead movement outside of the spring migration season. At four of our five PTISs, over 25% of first detections of individual PIT-tagged parr occurred outside of the spring season, with most of those during summer and fall periods. Data collection at instream detectors over a period of years will allow us to address uncertainties about the contribution of migratory parr and the

consistency of downstream movements across years. As our datasets on PIT-tagged fish from each year become more complete (full life cycle of the fish, with recapture and detection data from within the Wind River and the Columbia River), we hope to compare smolt production and escapement to adulthood (smolt-to-adult return, SAR) from the different life-history strategies of juvenile steelhead in the Wind River subbasin.

It is currently unknown if downstream movement of steelhead parr is a result of limited headwater habitat capacity or quality, or if it is a life-history strategy expressed by a consistent percentage of fish regardless of fish abundance or habitat condition. Movement of juveniles into downstream reaches of the mainstem Wind River, or within other Columbia River subbasins, has important implications for habitat and water management and could improve the ability to target restoration actions for highest cost-benefit. To date, we have documented movement of parr, at various ages, from headwater areas and through mid-watershed areas throughout the year (with concentrations in spring and fall). Because of limitations of smolt trapping and Bonneville Dam detections, it is unknown if juvenile steelhead are leaving the Wind River subbasin to the Columbia River as parr or smolts during time periods other than spring.

Recapture data of PIT-tagged juvenile steelhead, through electrofishing and smolt trapping, will provide the opportunity to compare growth rates between different areas and years. These data will help assess what tributary conditions, such as growth rate, influence the extent, timing, and fate of migratory parr steelhead. Recapture data will also contribute to parr life-history research by providing additional location information on individual fish. We have recently completed a compilation of length-at-age data (age-0 and age-1) for each tagging site and date (Appendix Tables 1 - 8), which will allow us to assign an age to each fish at time of tagging, and recaptures of these fish will allow us to validate future age-at-length assignments. This will allow us to stratify by age as patterns of movement and life history are revealed. Our increased tagging of *O. mykiss* at age-0 using 9-mm tags is showing great promise. We began tagging with 9-mm tags in 2013 and increased effort in 2014 with numerous re-contacts of age-0 tagged fish through recaptures and detections.

RM&E Program Strategy of Assessing the Status and Trend of Adult Natural Origin Fish Populations.

The PTISs in the Wind River subbasin are providing an increasing level of detail about adult steelhead populations. Timing of adult movements, spawning locations, and pre-spawn mortality are all being explored. The addition of a second PTIS in the Trout Creek watershed has given us increased confidence in estimates of detection efficiency at the existing downstream site. Additionally, this new site will give greater detail on timing of adult movement to upper Trout Creek and will help assess pre and post-spawn mortality. Preliminary data suggest that some adult steelhead that spawn in Trout Creek migrate upstream during fall and overwinter in Trout Creek. It is unknown to what extent adult steelhead that spawn in the upper Wind River move upstream during fall, though a cluster of adults did pass the WRU site during fall 2014. The ability to determine spawner populations within specific watersheds in the Wind River subbasin will contribute to the calculation of smolt production per adult and smolt-to-adult return rates by specific watershed. Also, data from the PTISs, in conjunction with adult detections at Bonneville Dam, and recaptures within the Wind River subbasin, should help identify spatial and temporal locations where pre-spawn mortality may be occurring.

RM&E Program Strategy of Monitoring and Evaluating the Effectiveness of Tributary Habitat Actions Relative to Environmental, Physical, or Biological Performance Objectives.

Adult steelhead escapement estimates to Trout Creek and the upper Wind watersheds that are generated with data from PTISs are helping evaluate the efficacy of the removal of Hemlock Dam from Trout Creek (removed 2009). This evaluation conforms to a Before After Control Impact design, using the upper Wind River watershed, which has closely tracked Trout Creek populations prior to Hemlock Dam removal, as the control (Cochran et al. 2013). The PTISs are also providing data on juvenile movement outside of the smolt trapping period. These data will inform us of the potential production of juveniles unaccounted for by smolt trapping, thus increasing our ability to evaluate this dam removal restoration action as well as to refine patterns of spawning and rearing by the wild steelhead population in the Wind River subbasin.

Our PTISs are contributing to evaluation of some small-scale restoration projects in the Wind River subbasin. During 2012, the USFS removed a small relic diversion dam on Martha Creek. We PIT-tagged juvenile *O. mykiss* upstream of this dam prior to removal. Detection of four of these fish at the

MAR PTIS suggests either that steelhead do use the area upstream of the former dam, or that non-anadromous *O. mykiss* were moving downstream. In that none of the four have yet been detected in the Columbia River, we do not definitively know if these fish express a steelhead life history. Additionally, we PIT-tagged fish upstream of a culvert on Layout Creek that was then replaced during summer 2014. The culvert was likely a partial barrier to upstream fish movement (Bengt Coffin, Hydrologist, USFS, personal communication). To date, we have not detected any fish PIT-tagged upstream of the culvert at any downstream recapture or detection locations. We will continue to PIT-tag fish from both of these restoration sites and monitor for recaptures and interrogations at downstream locations to gain further insight into their contributions to productivity.

10. Acknowledgements

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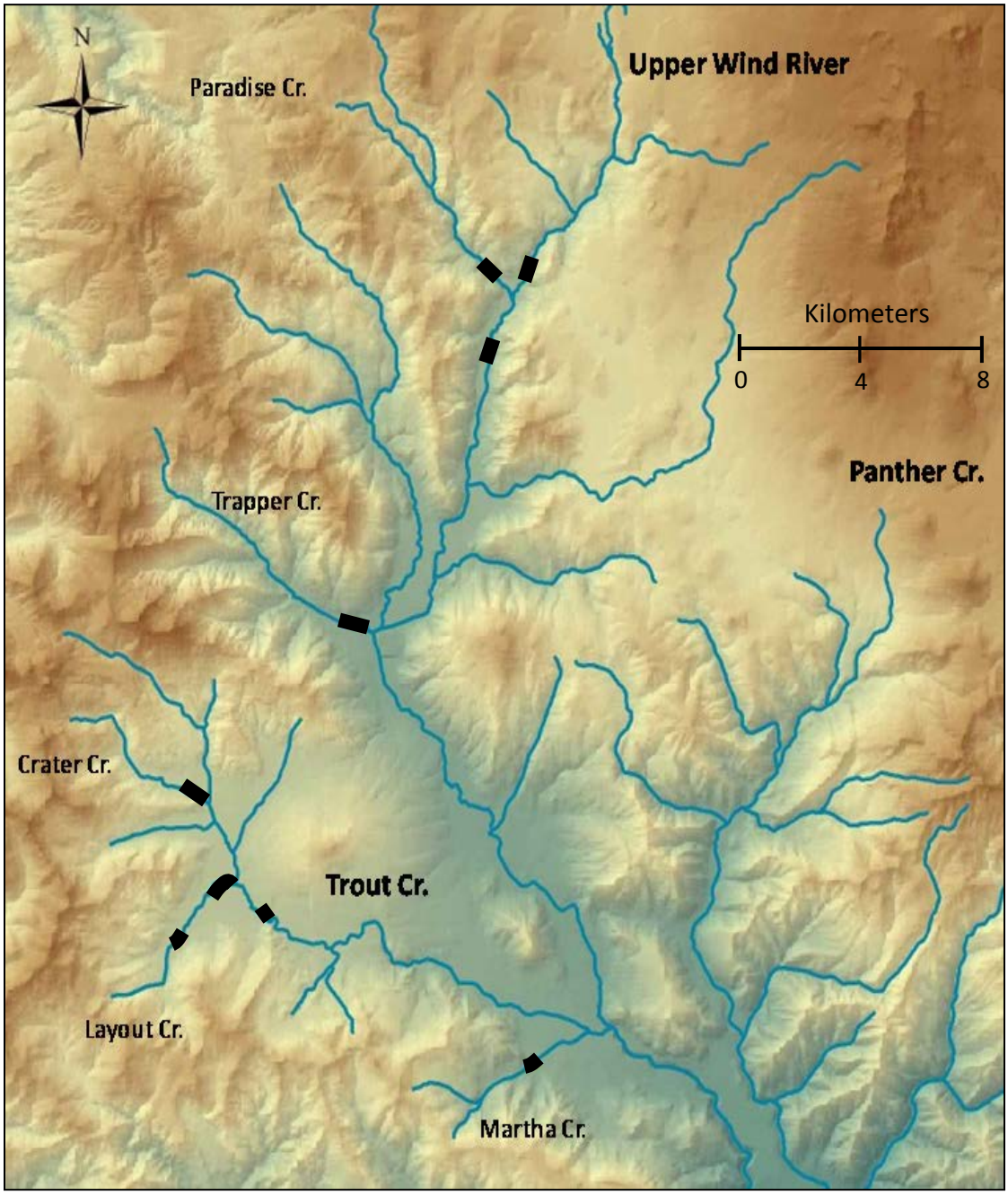


Figure 1. Stream sections (denoted by bold lines) where we tagged juvenile *Oncorhynchus mykiss* with Passive Integrated Transponder tags during summer 2014.

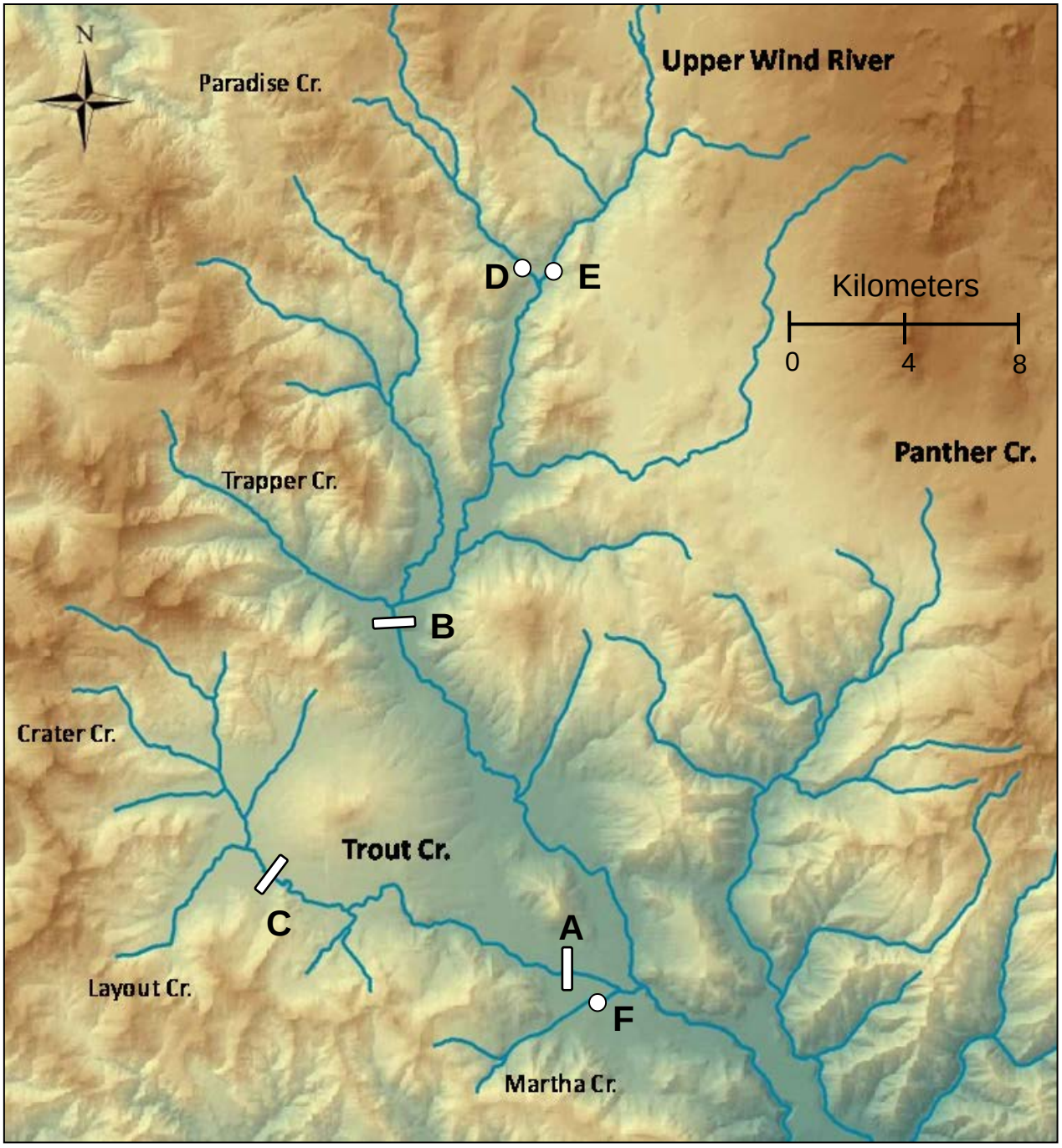


Figure 2. Locations of instream PIT-tag interrogation systems operated in the Wind River subbasin from January 2014 through December 2014. A) Trout Creek (TRC, 1001M Transceiver, 3 arrays of 2 antennas each); B) upper Wind River (WRU, 1001M Transceiver, 2 arrays of 3 antennas each); C) Trout Creek at 43 Bridge (TC4, 1001M Transceiver, 2 arrays of 3 antennas each, installed in September 2014); D) Paradise Creek (PAD, ACN Transceiver, 1 antenna); E) upper Mine Reach (UMD, ACN Transceiver, 1 antenna); F) Martha Creek (MAD, RM310 Transceivers, 2 antennas).

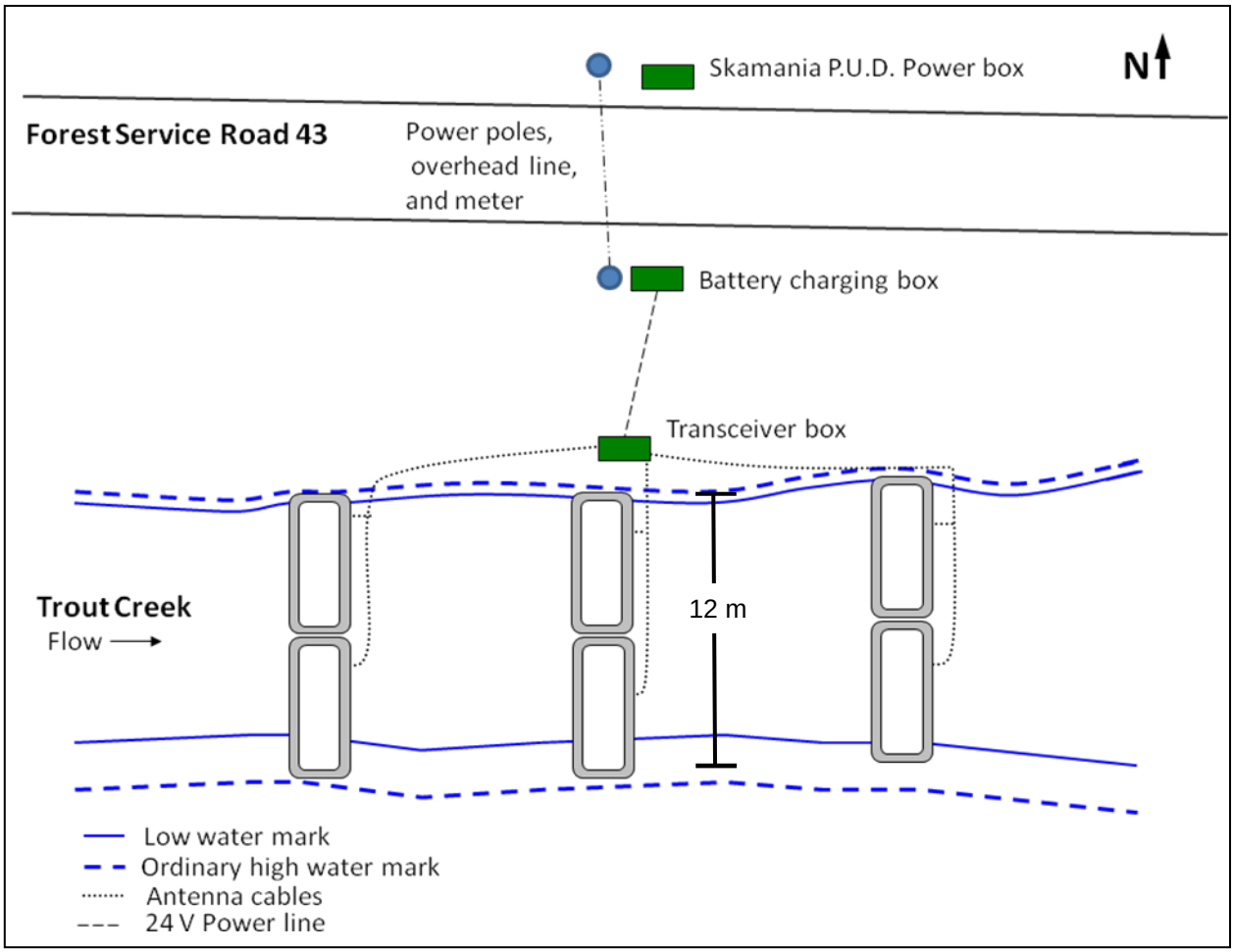


Figure 3. The Trout Creek PIT-tag interrogation system site (located at rkm 2.0 of Trout Creek), showing the three arrays of two antennas each and supporting infrastructure. Data from this site were submitted to the PTAGIS database under site code TRC.

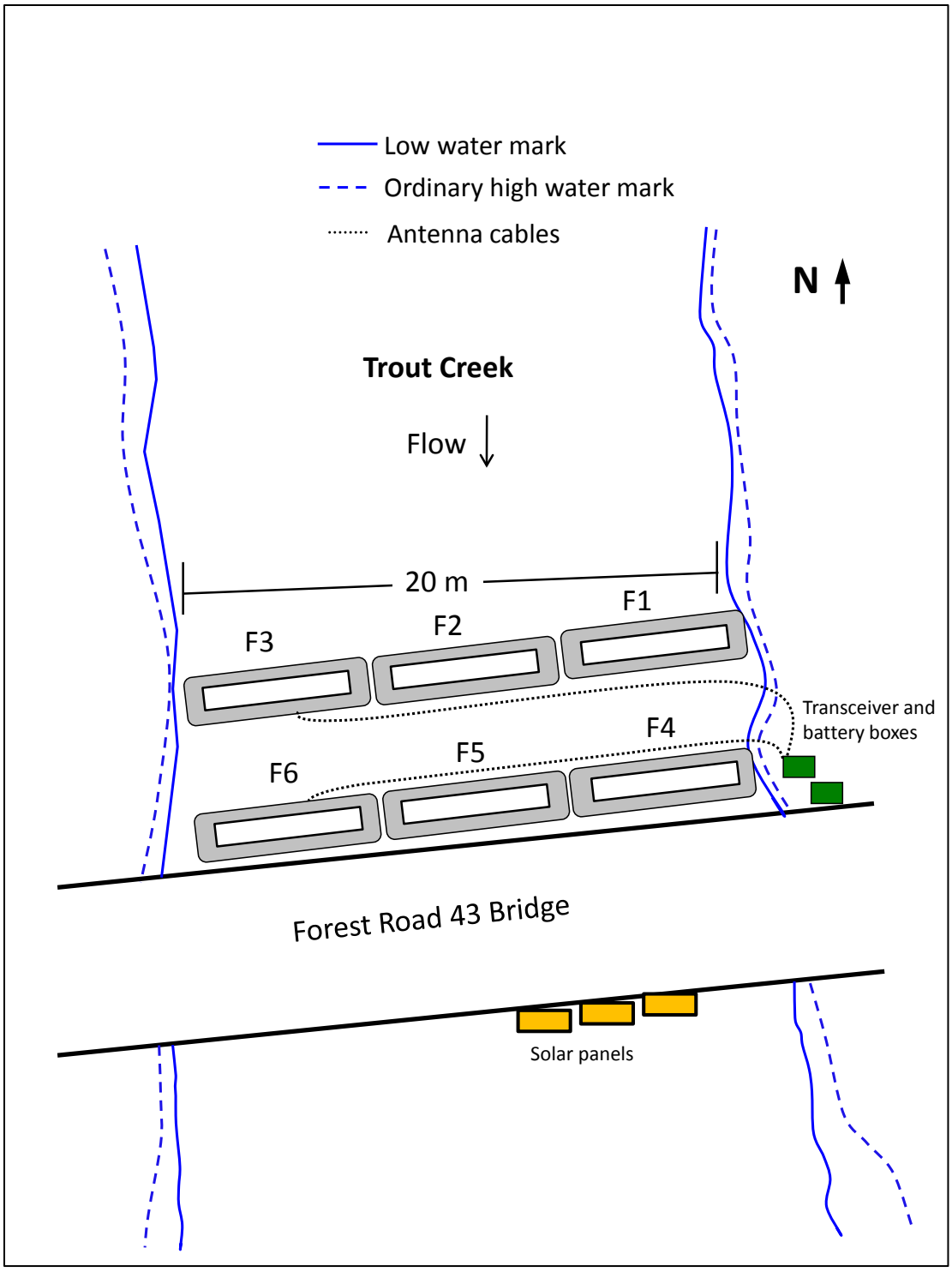


Figure 4. The PIT tag interrogation system in Trout Creek at the 43 Road Bridge (rkm 11.0; installed in September 2014) showing the two arrays of three antennas each and the supporting infrastructure. Data from this site were submitted to the PTAGIS database under site code TC4.

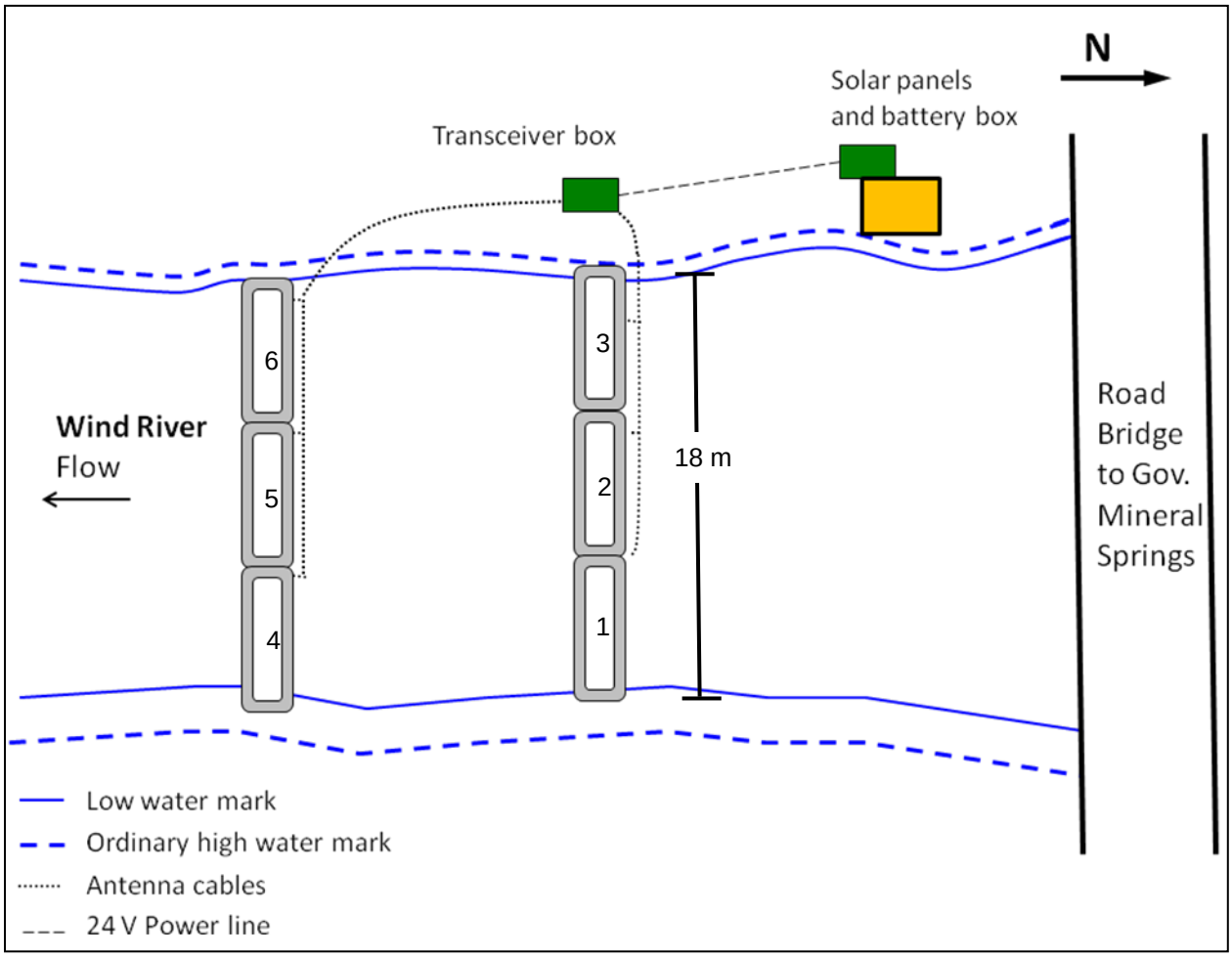


Figure 5. The upper Wind River PIT-tag interrogation site (located at rkm 30.0 of the Wind River) showing the two arrays of three antennas each and the supporting infrastructure. Data from this site were submitted to the PTAGIS database under site code WRU.

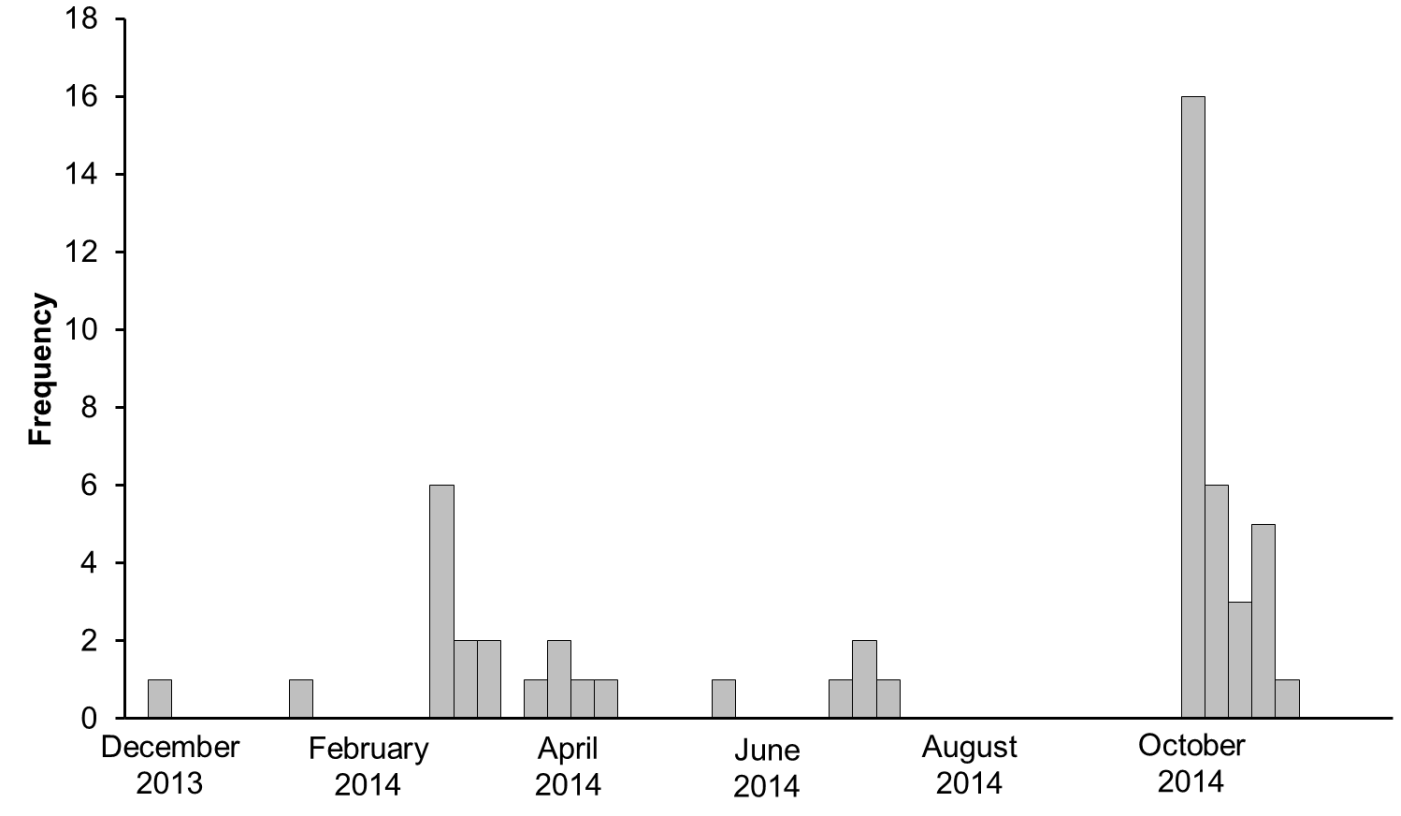


Figure 6. Detections of PIT-tagged adult steelhead *Oncorhynchus mykiss*, by week, at the Trout Creek PIT-tag interrogation system, at rkm 2.0, from 7 December 2013 through 10 December 2014. Shown are dates of first detection. Many fish were detected on multiple days. All detection data were submitted to the PTAGIS database under site code TRC.

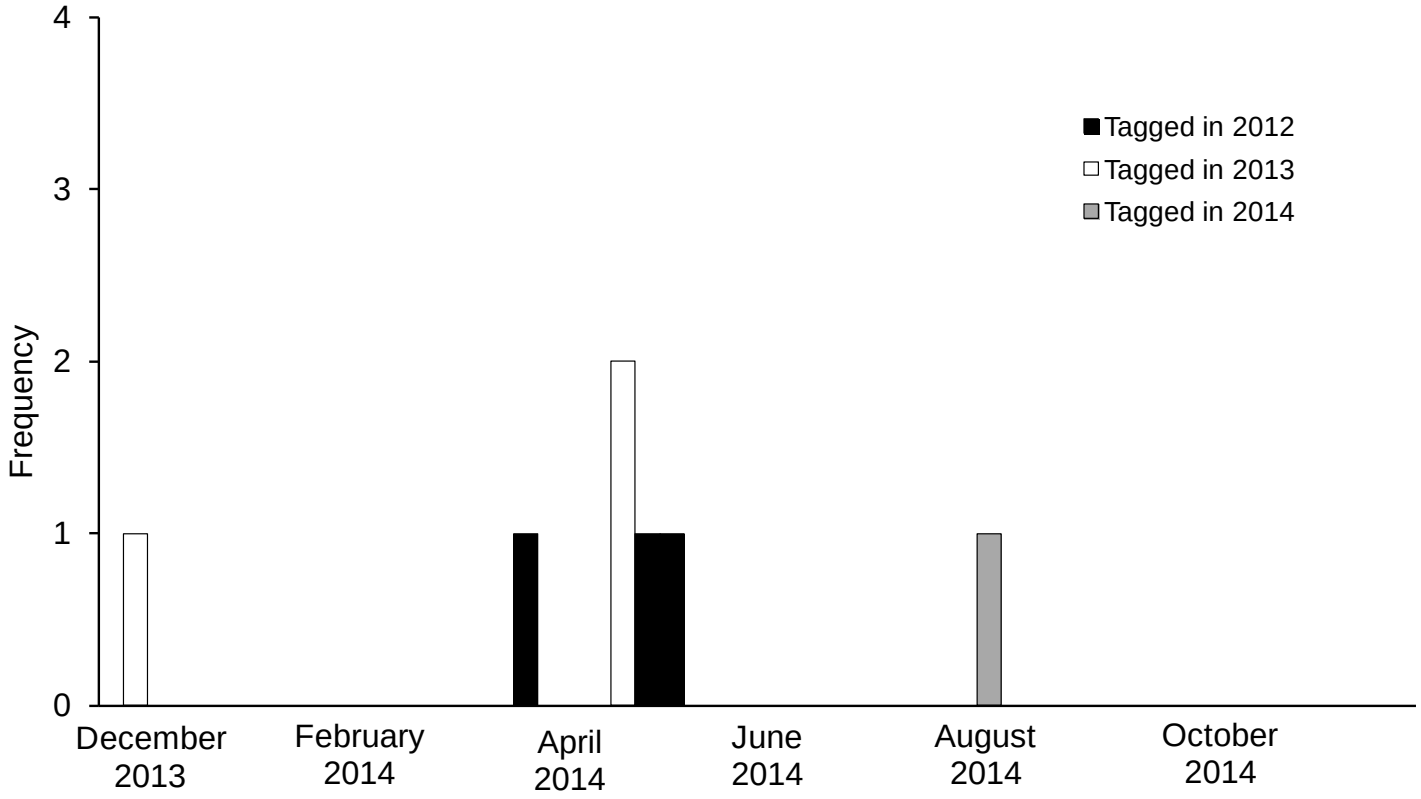


Figure 7. Detections of juvenile steelhead *Oncorhynchus mykiss*, by month, at the Trout Creek PIT-tag interrogation system, at rkm 2.0, from 7 December 2013 through 10 December 2014. The fish were tagged in the Trout Creek watershed during August or September 2012, 2013, and 2014 at least 8 rkm upstream of the site. Shown are first detection dates. Some fish were detected on multiple days. All detection data were submitted to the PTAGIS database under site code TRC.

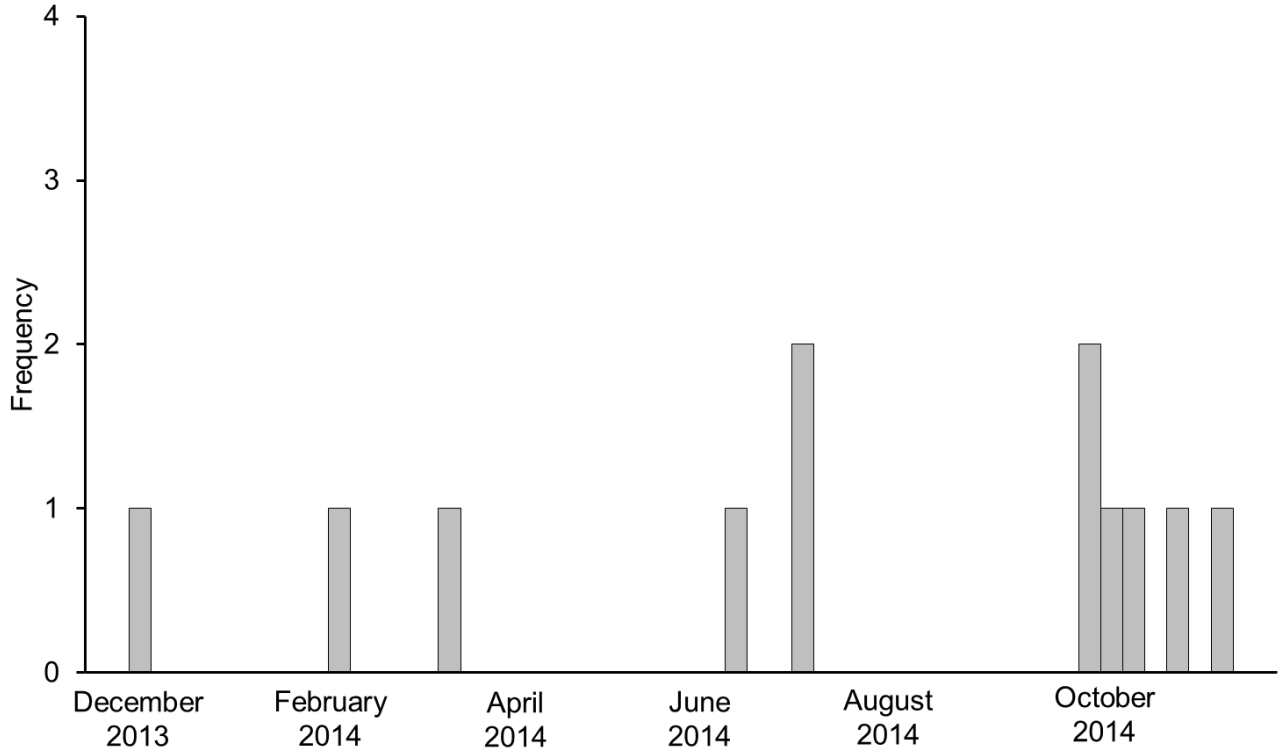


Figure 8. Detections of PIT-tagged adult steelhead *Oncorhynchus mykiss*, by week, at the upper Wind River PIT-tag interrogation system from 7 December 2013 through 10 December 2014. The site was located at rkm 30.0 of the Wind River. Shown are first detection dates for these fish. Many fish were detected on multiple days. All detection data were submitted to the PTAGIS database under site code WRU.

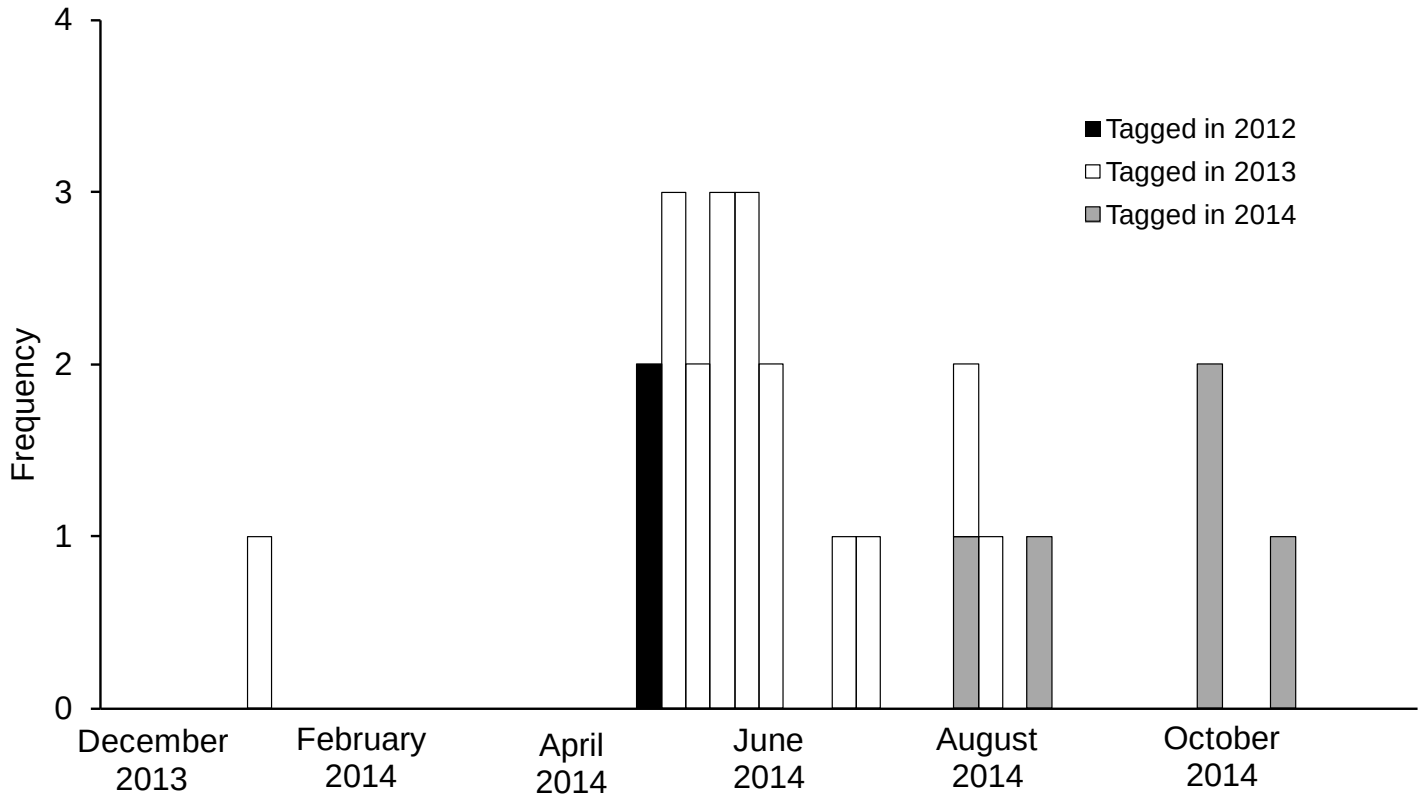


Figure 9. Detections of juvenile steelhead *Oncorhynchus mykiss* (PIT-tagged as parr in the upper Wind River watershed during August and September 2012, 2013, and 2014), by week, at the upper Wind River PIT-tag interrogation system from 7 December 2013 through 10 December 2014. The site was located at rkm 30.0 of the Wind River. Shown are first detection dates, many fish were detected on multiple days. All detection data were submitted to the PTAGIS database under site code WRU.

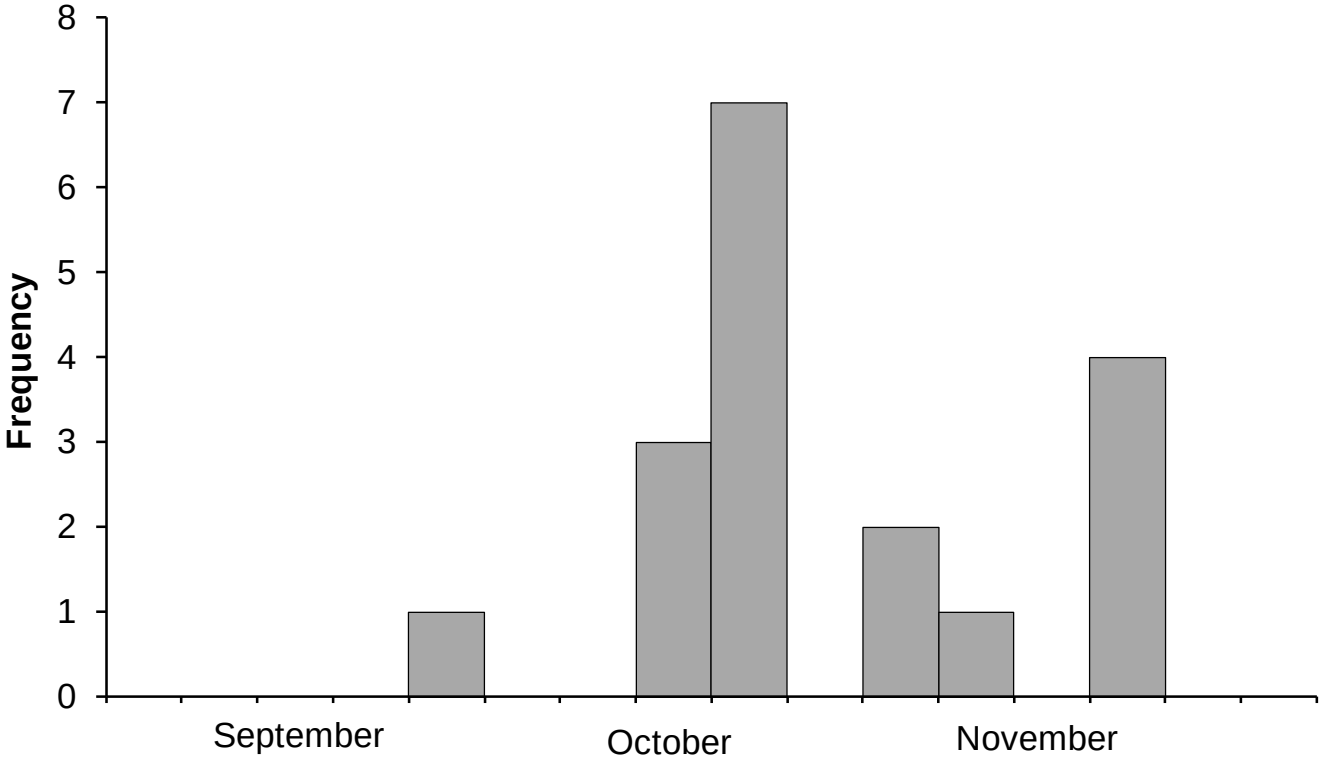


Figure 10. Detections of PIT-tagged adult steelhead *Oncorhynchus mykiss*, by week, at the Trout Creek at 43 Road PIT-tag interrogation system from 15 September 2014 through 10 December 2014. The site was located at rkm 11.5 of Trout Creek. Shown are first detection dates for these fish. Many fish were detected on multiple days. All detection data were submitted to the PTAGIS database under site code TC4.

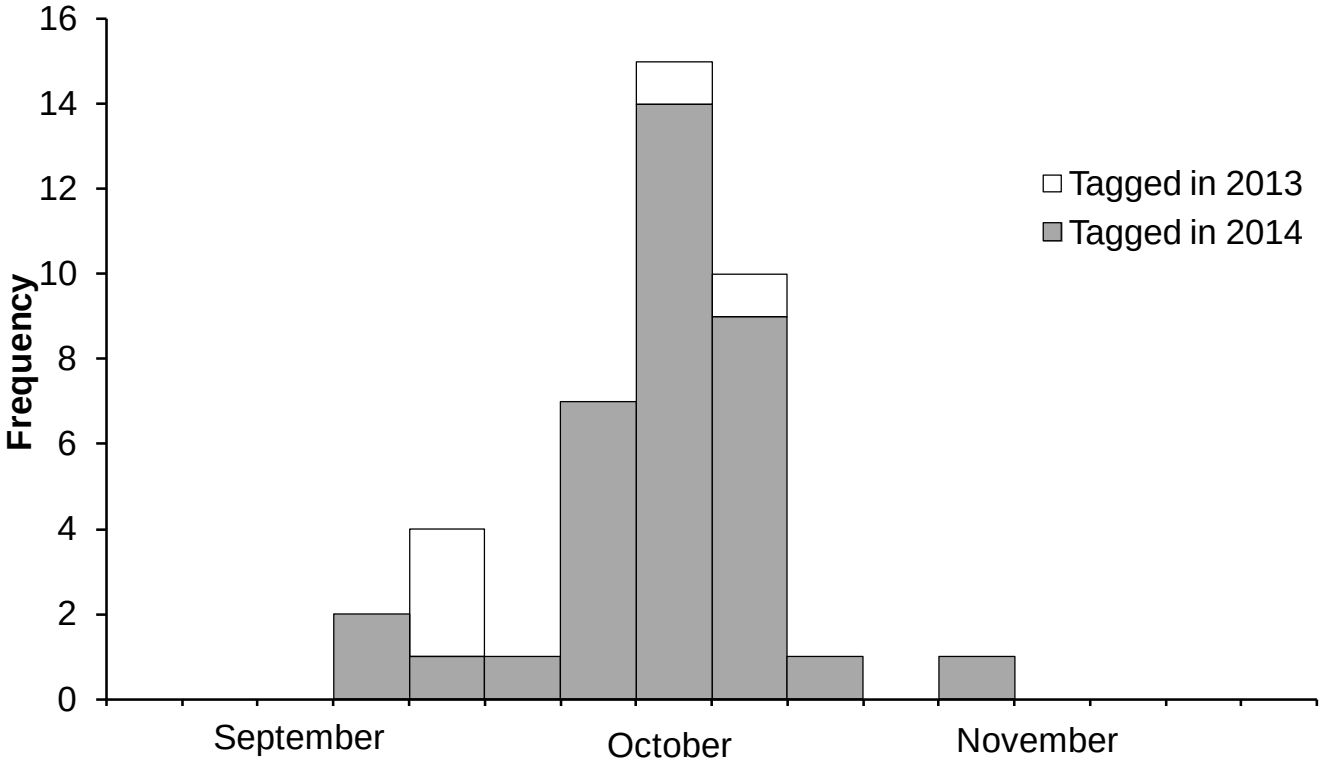


Figure 11. Detections of juvenile steelhead *Oncorhynchus mykiss* (PIT-tagged as parr in the Trout Creek watershed during August and September 2013, and 2014), by week, at the Trout Creek at 43 Bridge PIT-tag interrogation system from 15 September 2014 through 10 December 2014. The site was located at rkm 11.5 of Trout Creek. Shown are first detection dates, many fish were detected on multiple days. Thirty-six of the 41 juveniles detected had moved upstream from their tagging location, which was about 200-m downstream of this site. All detection data were submitted to the PTAGIS database under site code TC4.

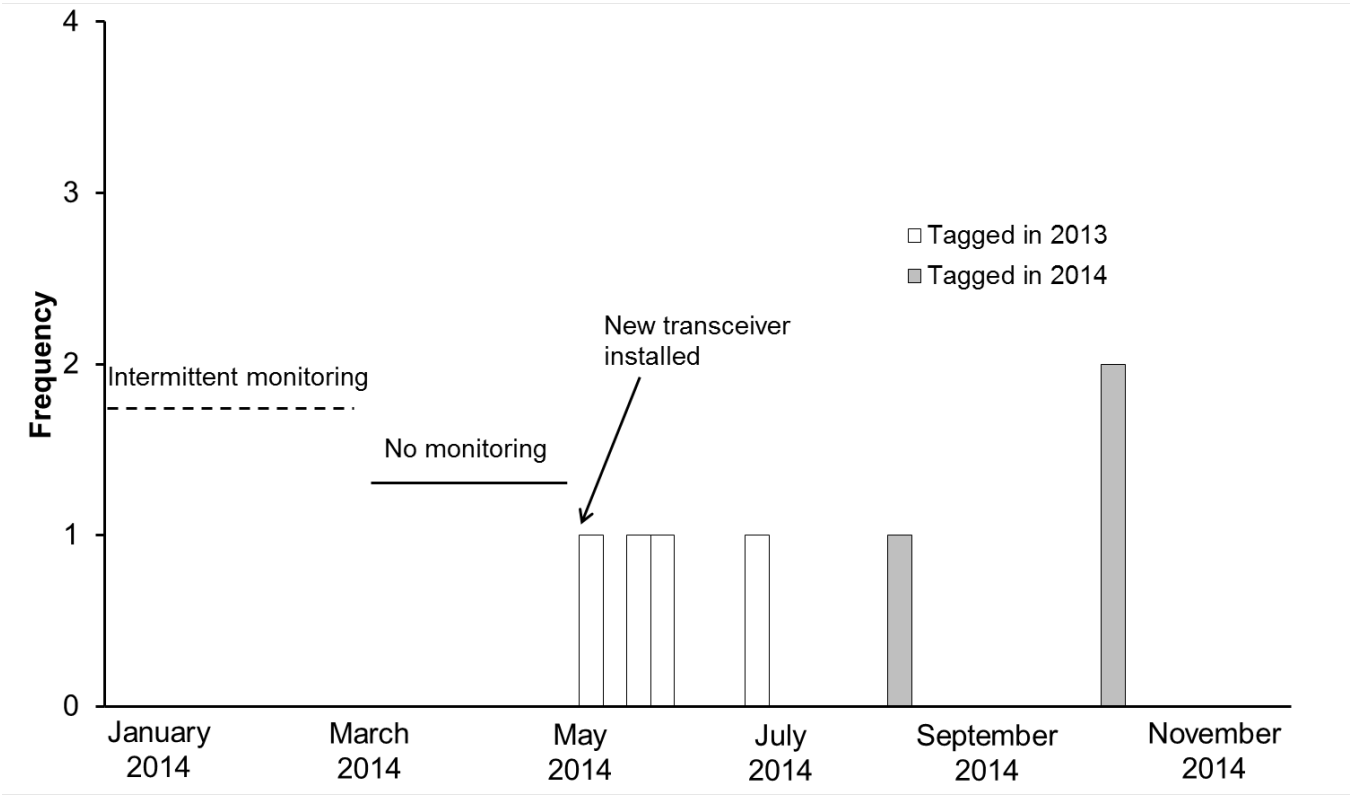


Figure 12. Detections of juvenile steelhead *Oncorhynchus mykiss*, by week, at the upper Mine PIT-tag interrogation system (UMD) from 1 January 2014 to 10 December 2014. The fish were PIT-tagged as parr in the Wind River between rkm 41.0 and 41.6 during August and September 2013 and 2014. The system was located at rkm 40.5 of the Wind River. Shown are first detection dates for these fish. Some fish were detected over multiple days. During winter, lack of solar charging ability resulted in intermittent operation. During a portion of spring, the cable to the antenna was severed rendering the antenna non-functional. A new transceiver (Biomark ACN) was installed on 15 April.

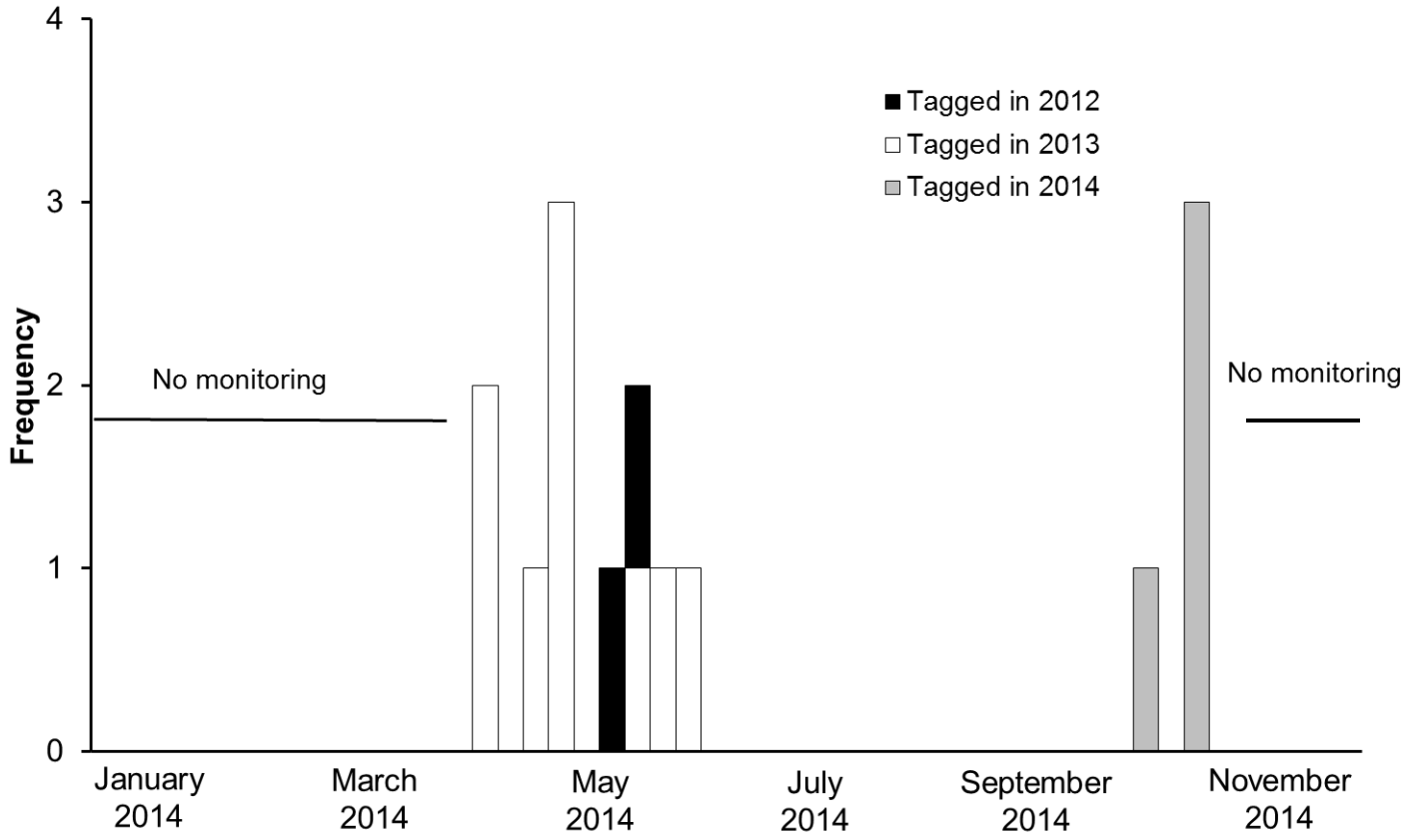


Figure 13. Detections of juvenile steelhead *Oncorhynchus mykiss*, by week, at the Paradise Creek PIT-tag interrogation system (PAD) from 14 April 2014 to 12 November 2014. The fish were PIT-tagged as parr in Paradise Creek during August and September 2012, 2013, and 2014. The site was located at rkm 0.5 of Paradise Creek. Shown are first detection dates. Some fish were detected on multiple days. Due to snowfall and access issues, the site was not operated during winter periods.

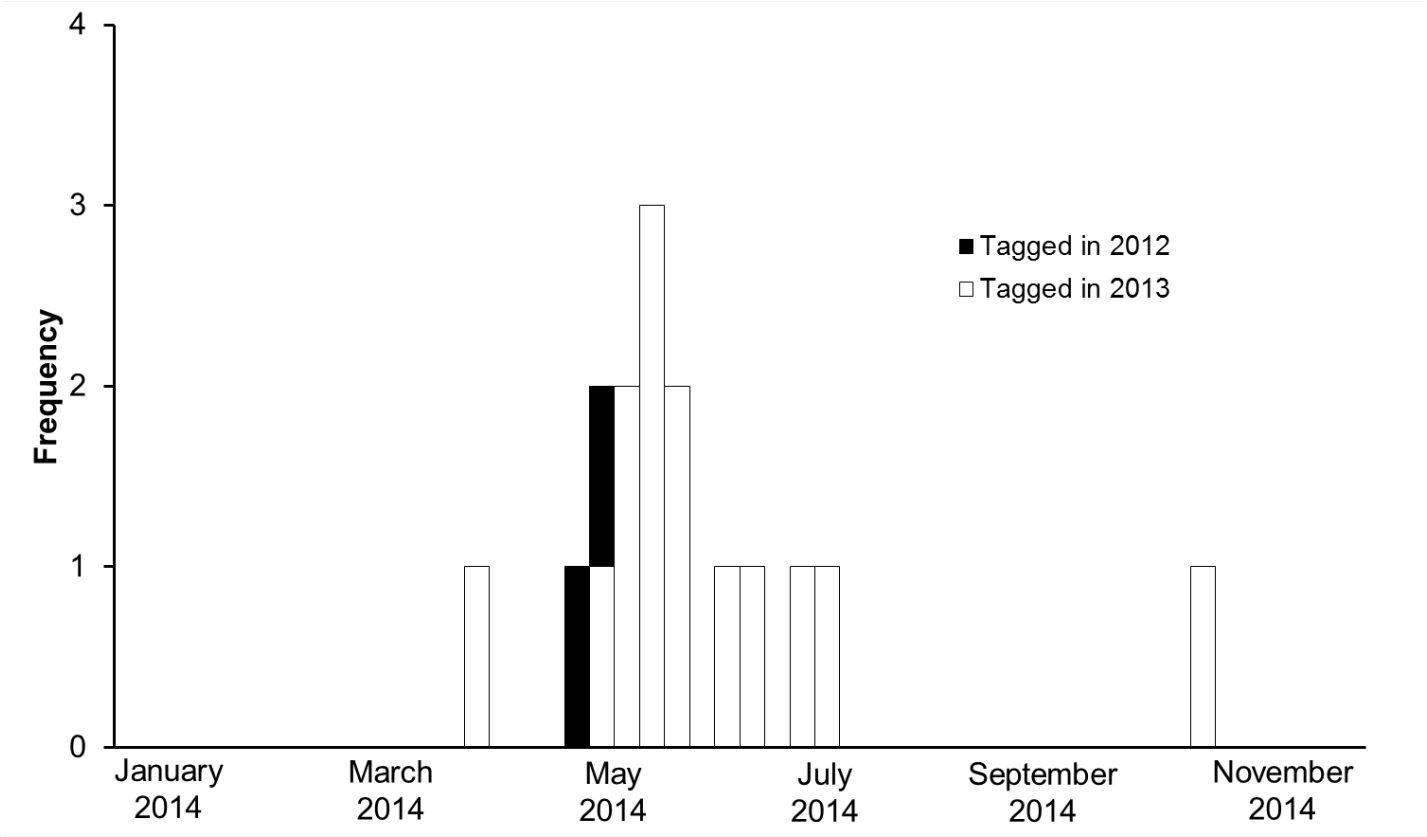


Figure 14. Detections of juvenile steelhead *Oncorhynchus mykiss* (PIT-tagged as parr in Martha Creek between rkm 1.3 and 2.6 during August and September 2012 and 2013), by week, at the Martha Creek PIT-tag interrogation system (MAD) from 1 January 2014 to 10 December 2014. The site was located at rkm 1.0 of Martha Creek. Shown are first detection dates for these fish, some fish were detected on multiple days.

Table 1. Locations of thermologgers in the Wind River subbasin maintained by U.S. Geological Survey's Columbia River Research Laboratory. Sites are listed from upstream to downstream within a watershed. Coordinates were obtained from Google Earth using World Geodetic System 1984.

Watershed / Subwatershed	Coordinates North	Coordinates West	Elevation (m)	Distance upstream from mouth (km)	Date start (mm/yy)	Date end (mm/yy)
Trout Creek						
Crater Cr.	45º 50.761'	122º 02.083'	587	0.1	10/11	present
Layout Cr.	45º 49.451	122º 01.334'	559	0.7	08/14	present
Martha Cr.	45º 47.576'	121º 55.659'	344	1.5	07/12	present
Upper Wind River						
Wind R.	45º 56.985'	121º 55.897'	472	41.0	07/14	present
Paradise Cr.	45º 56.939'	121º 56.218'	469	0.4	07/12	present

Table 2. Total number of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* that were captured and PIT-tagged in two watersheds in the Wind River subbasin during 2014. Also shown are number of fish recaptured, some of which were tagged in prior years. Tags used were 12-mm and 9-mm 134.2 kHz.

Watershed Stream	Dates sampled (month/day)	Rkm sampled, from stream mouth	Number of fish tagged	Number of recaptured tagged fish
Trout Creek				
Martha	8/08	1.3 - 1.9	91	15
	9/17	1.3 - 1.9	82	42
Layout	8/07	0.0 - 0.5	92	0
	9/22	0.0 - 0.5	73	10
	7/31	2.5 - 3.0	82	5
	9/8	2.5 - 3.0	71	21
Trout	8/20	11.0 - 11.3	94	3
	10/08	11.0 - 11.3	61	16
Crater	7/30	0.0 - 0.4	58	3
	9/09	0.0 - 0.5	80	18
Wind River				
Trapper	8/06	0.1 - 0.5	107	3
	10/01	0.1 - 0.5	137	30
Paradise	8/11	0.5 - 1.0	92	5
	9/19	0.5 - 1.0	30	42
Wind River	8/14	37.0 - 37.4	145	4
	9/26	37.0 - 37.4	40	19
	8/12	41.0 - 41.4	64	2
	9/25	41.0 - 41.5	105	8
Total			**1,504**	**246**

Table 3. Re-contacts, through November 2014, of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* that were PIT-tagged as parr during August and September 2011 in headwater areas of two watersheds in the Wind River subbasin.

		Recapture and detection events through November 2014					
Watershed	Number Tagged in 2011	Instream	Trout Creek smolt trap	Upper Wind smolt trap	Lower Wind smolt trap	Detected at a PTIS[a]	Detected in Columbia River[b]
Trout Creek	494[c]	53	7	0	0	5	4
Upper Wind	497	60	0	0	0	3[d]	9

[a] PTIS = PIT-tag interrogation systems (PTIS) in mainstem Trout Creek and Wind River. The Trout Creek PTIS is at rkm 2.0 of Trout Creek, the Upper Wind PTIS is located at rkm 30.0 of the Wind River.
[b] Bonneville Dam, estuary trawl, or avian-mortality sampling.
[c] Includes 127 fish tagged in Martha Creek, which is downstream of the Trout Creek PTIS.
[d] The upper Wind PTIS began operation in October 2012.

Table 4. Re-contacts, through November 2014, of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* that were PIT-tagged as parr during August and September 2012 in headwater areas of two watersheds in the Wind River subbasin.

		Recapture and detection events through November 2014					
Watershed	Number tagged in 2012	Instream	Trout Creek smolt trap	Upper Wind smolt trap	Lower Wind smolt trap	Detected at a PTIS[a]	Detected in Columbia River[b]
Trout Creek	628[c]	83	14	0	1	20	10
Upper Wind	623	93	0	7	2	25[d]	8

[a] PTIS = PIT-tag interrogation systems (PTIS) in mainstem Trout Creek and Wind River. The Trout Creek PTIS is at rkm 2.0 of Trout Creek, the Upper Wind PTIS is located at rkm 30.0 of the Wind River.
[b] Bonneville Dam, estuary trawl, or avian-mortality sampling.
[c] Includes 121 fish tagged in Martha Creek, which is downstream of the Trout Creek PTIS.
[d] The upper Wind PTIS began operation in October 2012.

Table 5. Re-contacts, through November 2014, of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* that were PIT-tagged as parr during August and September 2013 in headwater areas of two watersheds in the Wind River subbasin.

		Recapture and detection events through November 2014					
Watershed	Number tagged in 2013	Instream	Trout Creek smolt trap	Upper Wind smolt trap	Lower Wind smolt trap	Detected at a PTIS[a]	Detected in Columbia River[b]
Trout Creek	813[c]	129	10	0	0	10	5
Upper Wind	644	69	0	9	0	20	3

[a] PTIS = Instream PIT-tag interrogation systems (PTIS) in mainstem Trout Creek and Wind River. Trout Creek has a PTIS at rkm 2.0 and a new PTIS (installed September 2014) at rkm 11.0, the Upper Wind PTIS is located at rkm 30.0 of the Wind River.
[b] Bonneville Dam, estuary trawl, or avian-mortality sampling.
[c] Includes 384 fish tagged in Martha Creek, which is downstream of the Trout Creek PTIS.

Table 6. Detection efficiency estimate, for PIT-tagged adult steelhead *Oncorhynchus mykiss*, at the Trout Creek PIT-tag interrogation site (TRC; rkm 2.0) and the upper Wind River PIT-tag interrogation site (WRU; rkm 30.0), by the methods of Connolly et al. (2008).

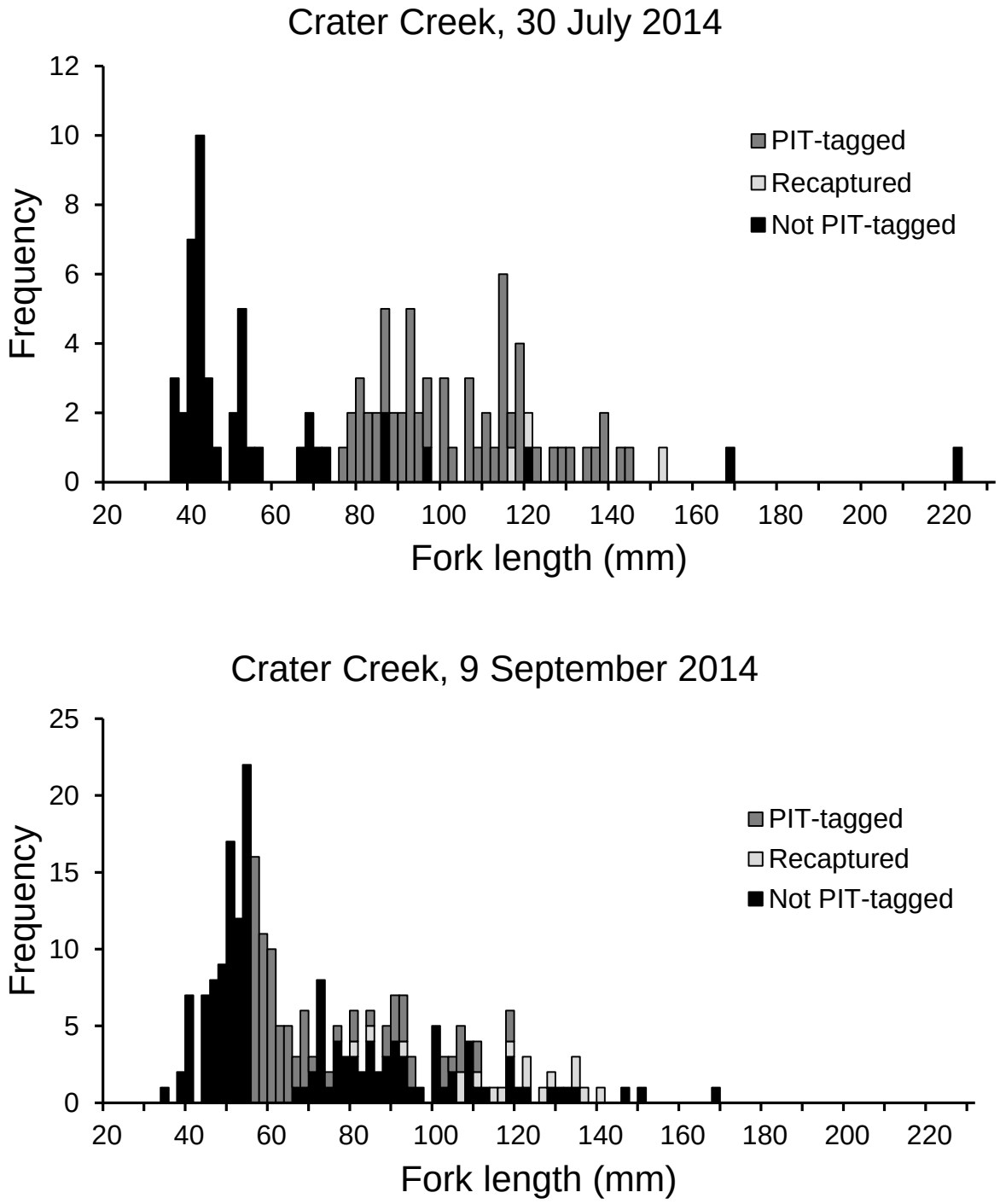
Site	Detection Period	Number of fish detected	Efficiency estimate %	SE	Lower 95% CI	Upper 95% CI
TRC	01/01/14 – 12/10/14	56	99.7	0.3	98.6	100.0
WRU	01/01/14 – 12/10/14	12	72.0	19.0	28.8	95.4

Appendix A: Use of Data & Products

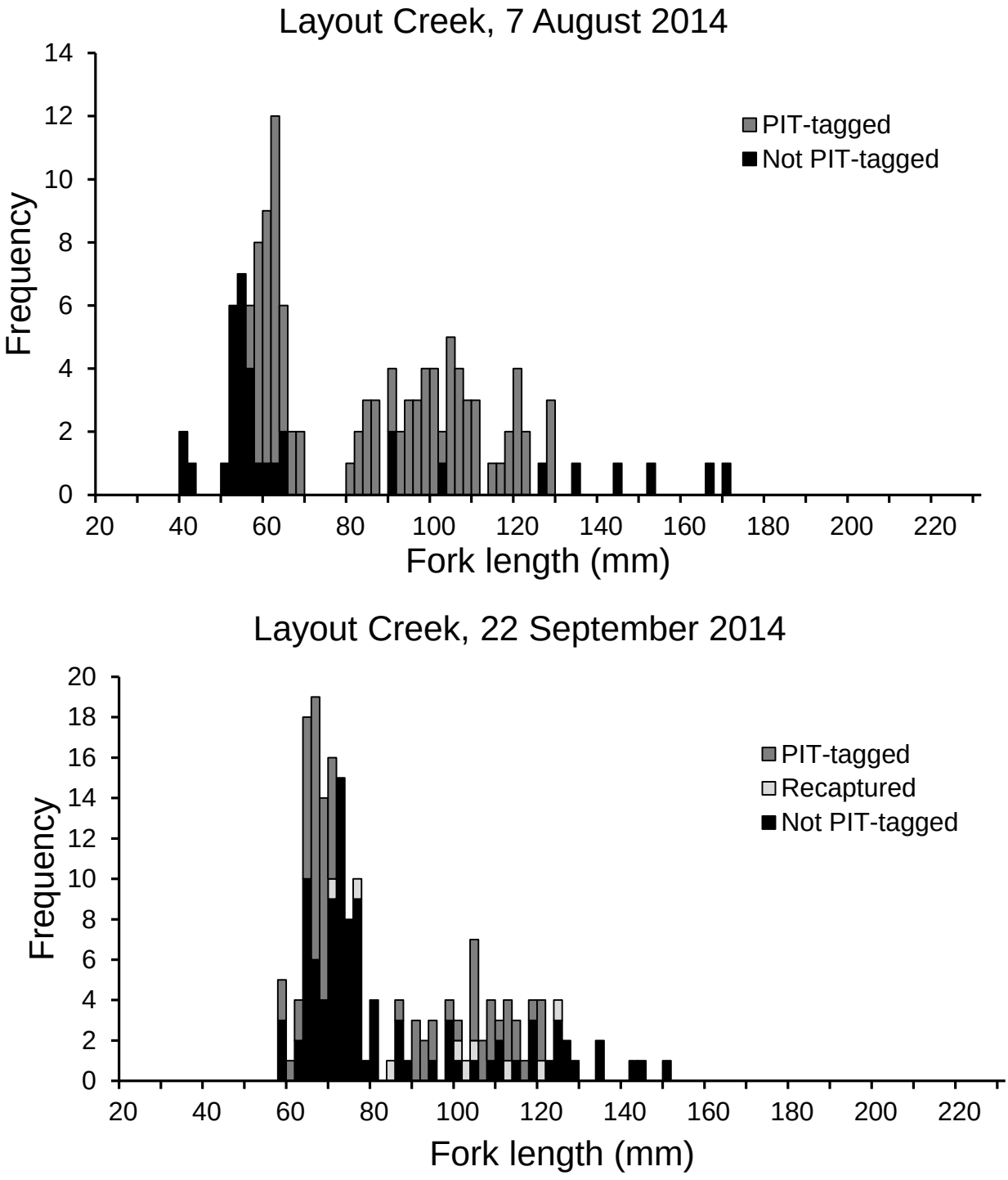
We have submitted PIT tagging data to the PTAGIS database.
http://ptagis.org/

We have submitted water temperature data to the NorWest database.
http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html

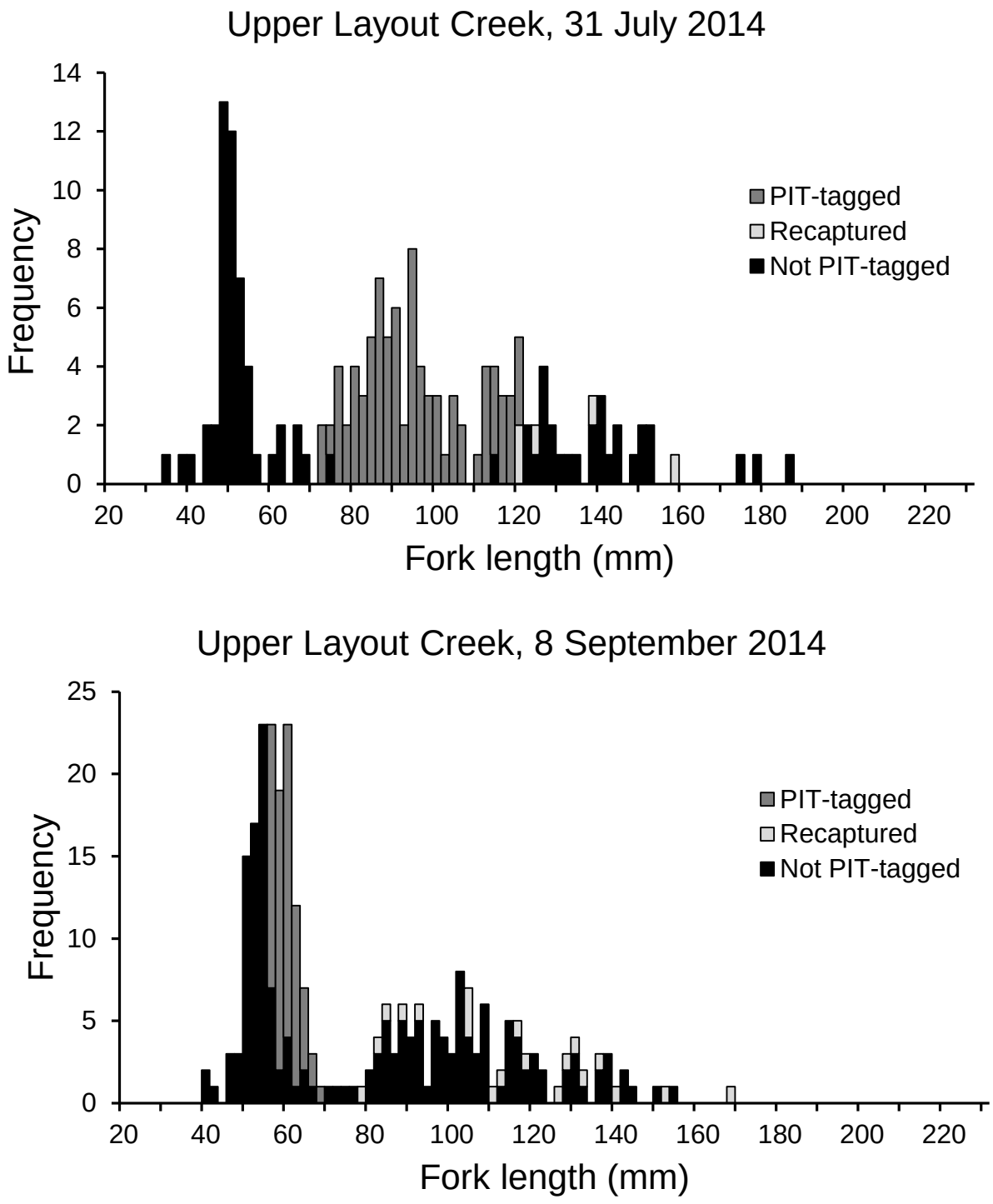
Appendix B: Detailed Results – Length frequency histograms



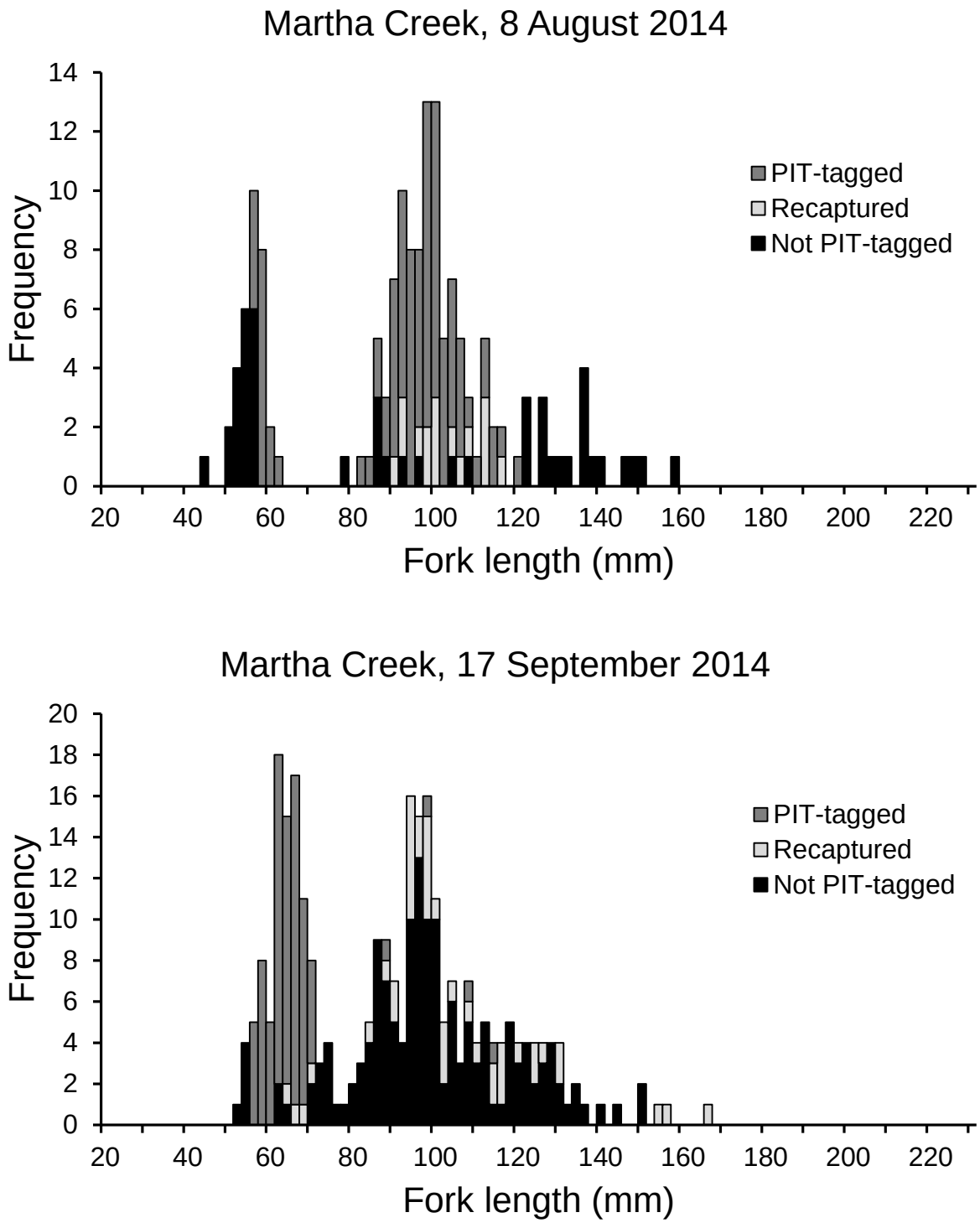
Appendix Figure 1. Length frequencies of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* in Crater Creek (rkm 0 – 0.5), sampled by electrofishing during 2014. Some fish were tagged with Passive Integrated Transponder (PIT) tags and some were recaptures of fish previously PIT-tagged.



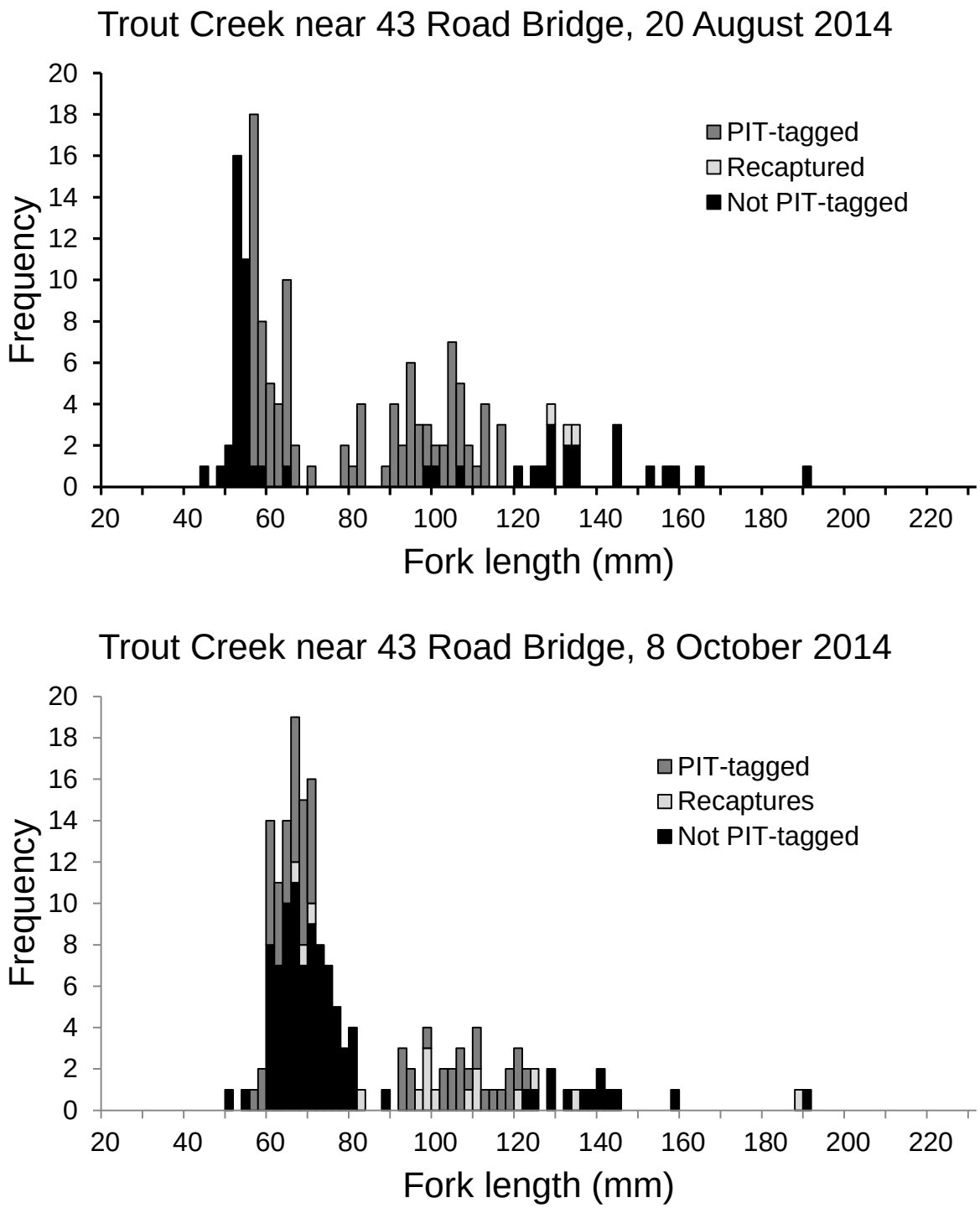
Appendix Figure 2. Length frequencies of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* in Layout Creek (rkm 0 – 0.5), sampled by electrofishing during 2014. Some fish were tagged with Passive Integrated Transponder (PIT) tags and some were recaptures of fish previously PIT-tagged.



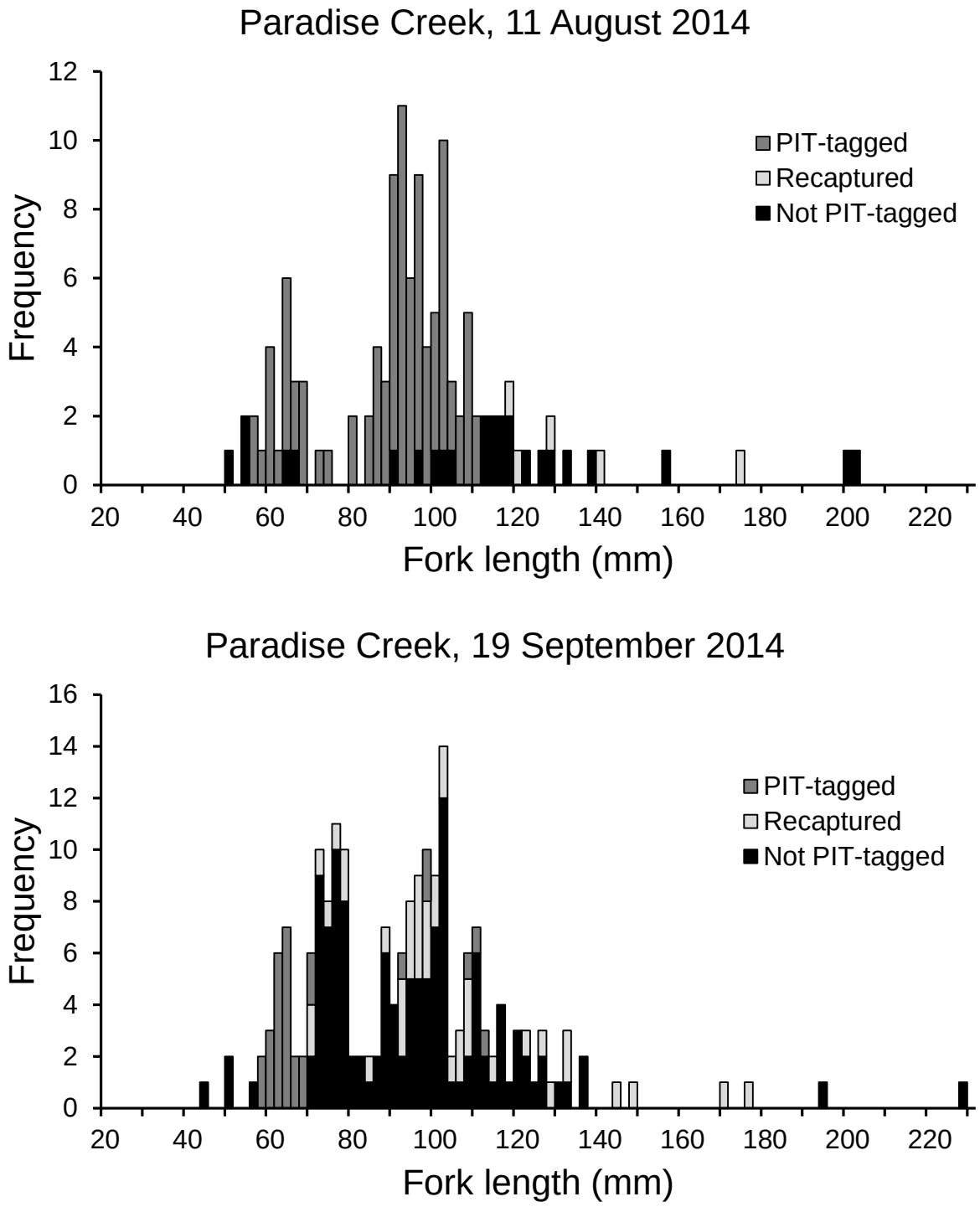
Appendix Figure 3. Length frequencies of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* in Upper Layout Creek (rkm 2.5 – 3.0), sampled by electrofishing during 2014. Some fish were tagged with Passive Integrated Transponder (PIT) tags and some were recaptures of fish previously PIT-tagged.



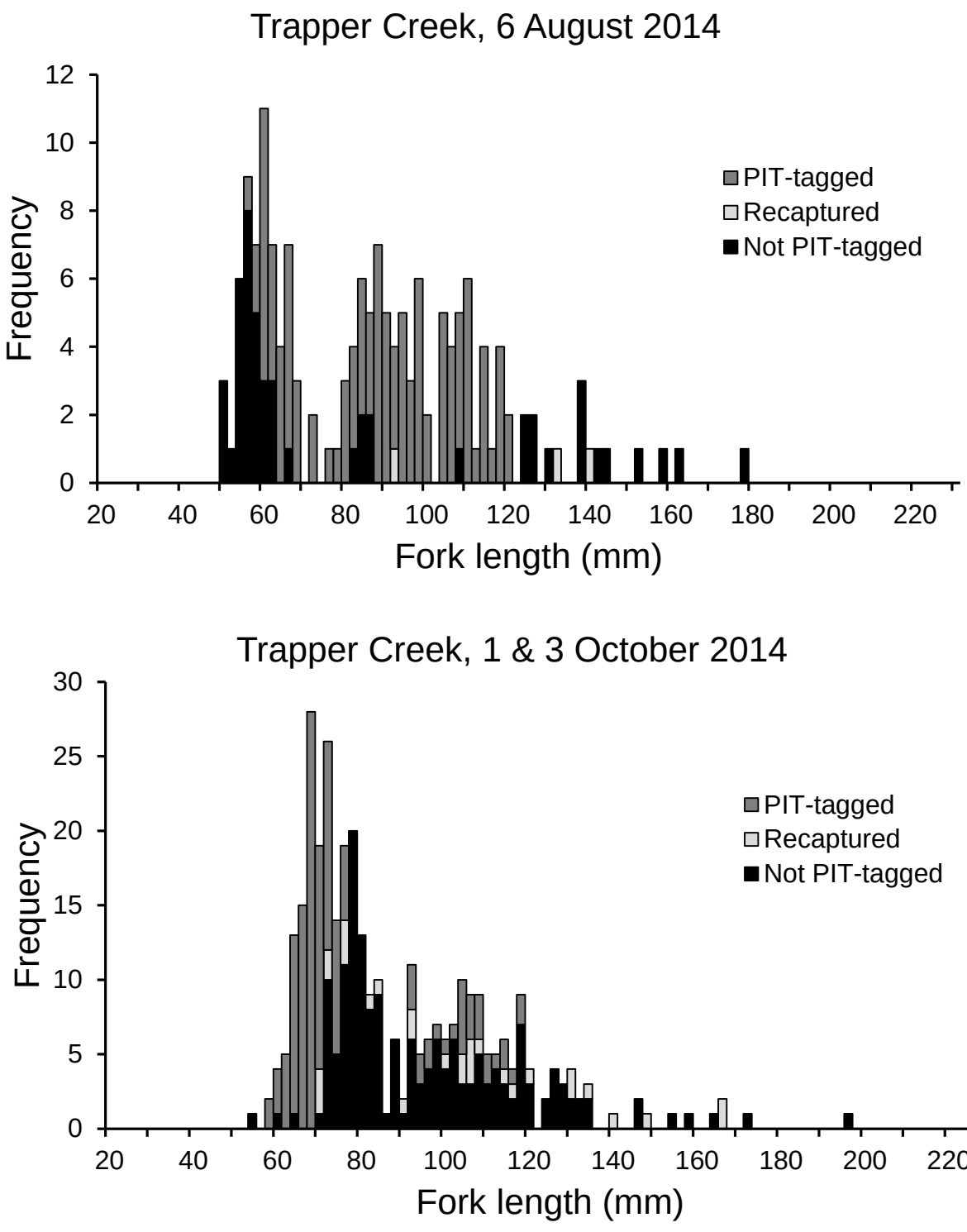
Appendix Figure 4. Length frequencies of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* in Martha Creek (rkm 1.3 – 1.9), sampled by electrofishing during 2014. Some fish were tagged with Passive Integrated Transponder (PIT) tags and some were recaptures of fish previously PIT-tagged.



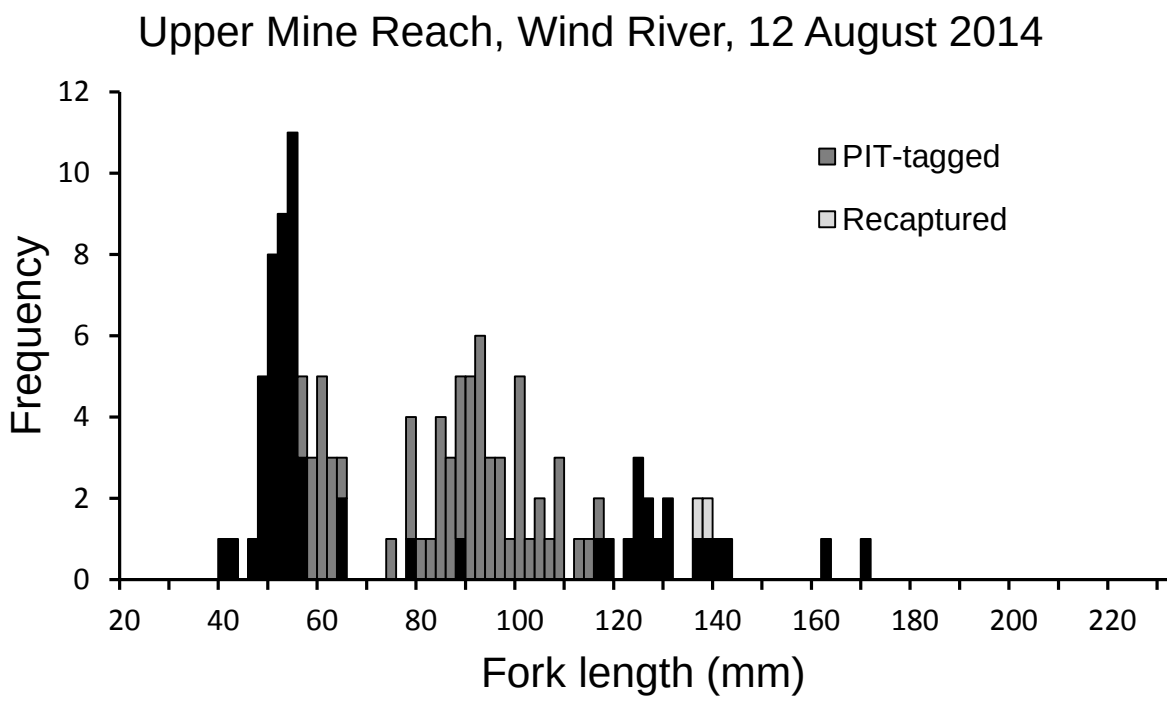
Appendix Figure 5. Length frequencies of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* in Trout Creek (rkm 11.0 – 11.3), sampled by electrofishing during 2014. Some fish were tagged with Passive Integrated Transponder (PIT) tags and some were recaptures of fish previously PIT-tagged.

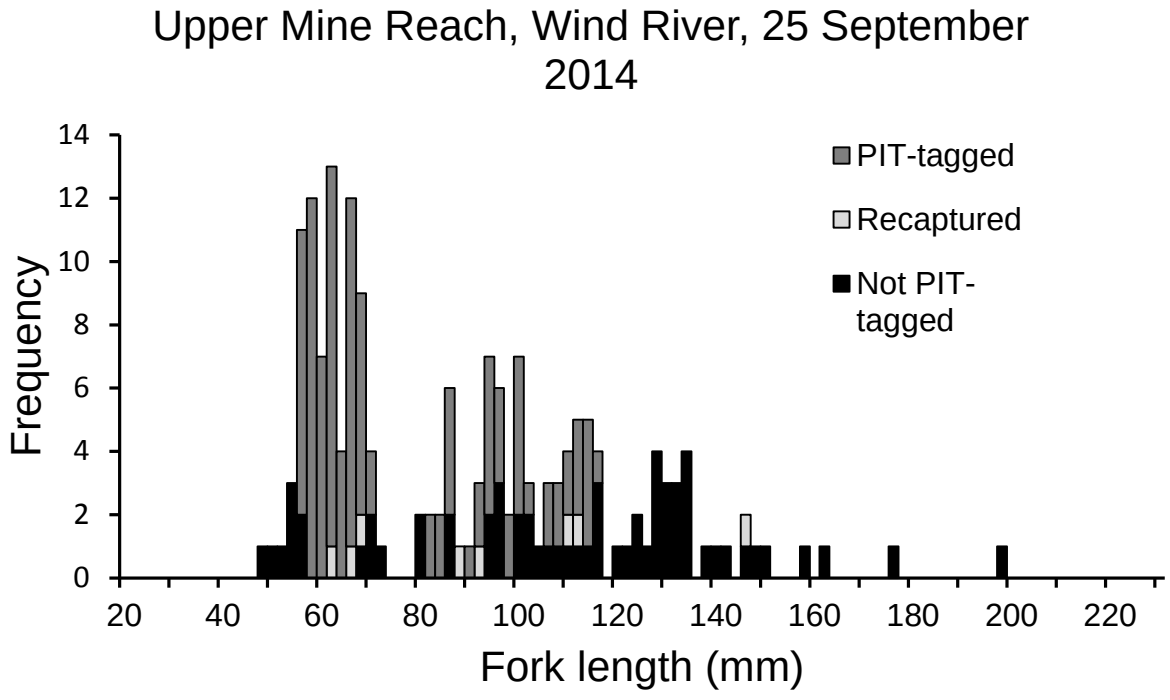


Appendix Figure 6. Length frequencies of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* in Paradise Creek (rkm 0.5 – 1.0), sampled by electrofishing during 2014. Some fish were tagged with Passive Integrated Transponder (PIT) tags and some were recaptures of fish previously PIT-tagged.

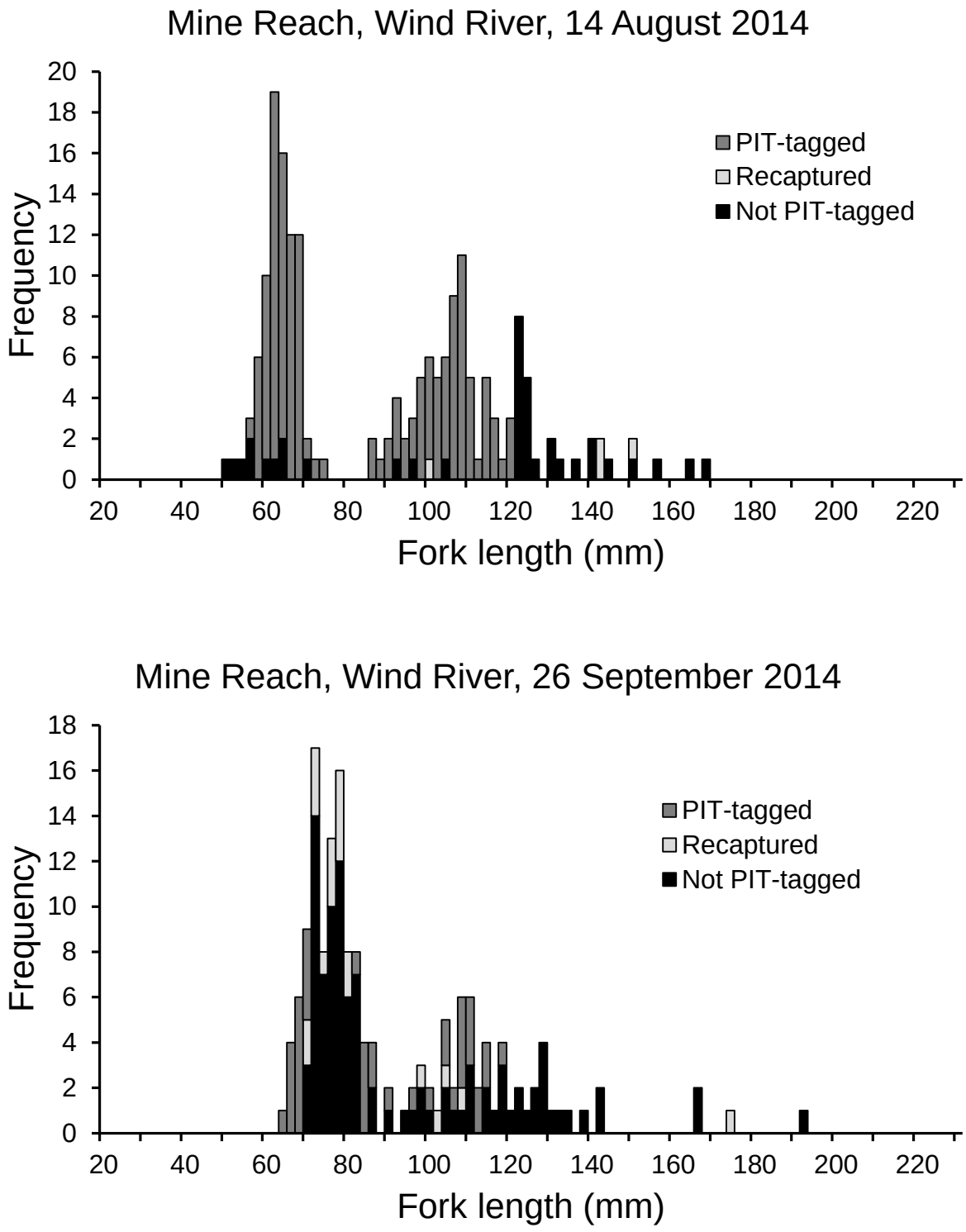


Appendix Figure 7. Length frequencies of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* in Trapper Creek (rkm 0.1 – 0.6), sampled by electrofishing during 2014. Some fish were tagged with Passive Integrated Transponder (PIT) tags and some were recaptures of fish previously PIT-tagged.





Appendix Figure 8. Length frequencies of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* in the Wind River upstream of the confluence with Paradise Creek (rkm 41.0 – 41.5), sampled by electrofishing during 2014. Some fish were tagged with Passive Integrated Transponder (PIT) tags and some were recaptures of fish previously PIT-tagged.



Appendix Figure 9. Length frequencies of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* in the Wind River (rkm 37.0 – 37.4), sampled by electrofishing during 2014. Some fish were tagged with Passive Integrated Transponder (PIT) tags and some were recaptures of fish previously PIT-tagged.

Appendix C: Detailed Results – Fork-length at age data

Appendix Table 1. Summary fork-length data (mm) for age-0 steelhead *Oncorhynchus mykiss* parr sampled in the Wind River subbasin during 2011.

Stream	Date sampled	Site rkm from mouth	n	Range	Median	Mean	SD
Martha	8/08	1.3 – 1.8	36	35 – 62	49	51	9.7
	8/31	1.3 – 1.9	61	43 – 72	59	59	5.7
Layout	8/02 & 8/10	0.0 – 0.9	21	32 – 49	43	42	4.5
	9/13 & 9/14	0.0 – 1.0	43	41 - 76	56	57	7.4
	8/29	3.0 – 3.5	7	38 - 41	39	39	1.1
	9/29	2.5 – 3.0	31	41 - 64	56	55	5.4
Trout	8/01	12.0 – 12.6	30	31 - 49	41	40	5.5
	10/6	11.0 – 11.2	38	56 - 73	64	64	4.1
Crater	8/03 & 8/04	0.0 – 0.7	-	-	-	-	-
	9/08	0.0 – 0.3	21	36 - 55	46	46	4.3
Trapper	8/18 & 8/22	0.1 – 0.7	59	36 - 72	51	52	8.1
	9/16	0.1 – 0.4	75	43 - 78	64	64	6.5
Paradise	8/11 & 8/16	0.5 – 1.2	57	33 - 56	45	45	5.7
	9/15	0.5 – 1.1	46	45 - 68	57	57	6.1
Wind R.	8/24	41.0 – 41.6	16	41 - 57	48	47	4.7
	10/04	41.0 – 41.6	33	44 - 67	56	57	5.3

Appendix Table 2. Summary fork-length data for age-1 steelhead *Oncorhynchus mykiss* parr sampled in the Wind River subbasin during 2011.

Stream	Date sampled	Site rkm from mouth	N	Range	Median	Mean	SD
Martha	8/08	1.3 – 1.8	49	85 - 126	108	108	10.5
	8/31	1.3 – 1.9	45	93 - 139	114	117	13.2
Layout	8/02 & 8/10	0.0 – 0.9	41	79 - 134	104	107	13.0
	9/13 & 9/14	0.0 – 1.0	23	89 - 134	111	113	12.0
	8/29	3.0 – 3.5	16	68 - 129	103	103	19.4
	9/29	2.5 – 3.0	76	77 - 138	98	101	13.1
Trout	8/01	12.0 – 12.6	21	81 - 138	111	108	18.7
	10/6	11.0 – 11.2	45	83 - 143	117	115	15.8
Crater	8/03 & 8/04	0.0 – 0.7	56	62 - 95	80	80	8.5
	9/08	0.0 – 0.3	26	70 - 109	88	88	10.5
Trapper	8/18 & 8/22	0.1 – 0.7	85	75 - 119	97	98	11.7
	9/16	0.1 – 0.4	38	81 - 125	105	104	11.4
Paradise	8/11 & 8/16	0.5 – 1.2	90	64 - 105	83	84	8.7
	9/15	0.5 – 1.1	45	80 - 115	95	95	9.0
Wind R.	8/24	41.0 – 41.6	74	72 - 112	90	91	9.2
	10/04	41.0 – 41.6	63	72 - 134	100	103	16.2

Appendix Table 3. Summary fork-length data for age-0 steelhead *Oncorhynchus mykiss* parr sampled in the Wind River subbasin during 2012.

Stream	Date sampled	Site rkm from mouth	n	Range	Median	Mean	SD
Martha	8/07	1.3 – 1.8	43	38 - 59	50	50	5.0
	9/06	1.3 – 1.8	33	28 - 66	56	54	8.2
	8/08	2.3 – 2.6	53	32 - 52	44	43	3.9
Layout	8/02	0.0 – 0.6	23	39 - 50	45	45	2.8
	8/06	2.5 – 3.0	17	35 - 41	38	38	1.7
	8/28	4.0 – 4.5	4	28 - 35	31	31	3.3
Trout	8/21	11.0 – 11.3	23	46 - 60	53	53	4.7
Crater	8/09	0.0 – 0.5	29	23 - 58	54	52	7.9
	9/04	0.0 – 0.6	27	36 - 66	61	59	7.6
Trapper	8/13	0.1 – 0.6	57	42 - 72	57	57	6.2
	9/27	0.1 – 0.6	64	54 - 78	68	68	5.5
Paradise	8/14	0.5 – 1.0	29	42 - 54	48	48	2.8
	9/28	0.5 – 1.0	28	46 - 69	60	61	5.1
Wind R.	8/22	37.0 – 37.4	43	44 - 65	59	57	5.2
	8/16	41.0 – 41.5	28	38 - 61	47	48	6.2
	9/25	41.0 – 41.6	38	48 - 70	58	59	5.7

Appendix Table 4. Summary fork-length data for age-1 steelhead *Oncorhynchus mykiss* parr sampled in the Wind River subbasin during 2012.

Stream	Date sampled	Site rkm from mouth	n	Range	Median	Mean	SD
Martha	8/07	1.3 – 1.8	54	83 - 120	100	101	9.4
	9/06	1.3 – 1.8	73	72 - 132	103	102	14.7
	8/08	2.3 – 2.6	38	68 - 114	88	88	11.2
Layout	8/02	0.0 – 0.6	57	61 - 108	89	89	11.2
	8/06	2.5 – 3.0	94	56 - 120	90	89	15.7
	8/28	4.0 – 4.5	35	60 - 83	71	71	5.8
Trout	8/21	11.0 – 11.3	50	79 - 126	101	102	13.4
Crater	8/09	0.0 – 0.5	58	62 - 101	85	85	9.9
	9/04	0.0 – 0.6	70	69 - 119	91	92	12.7
Trapper	8/13	0.1 – 0.6	124	75 - 133	97	99	14.3
	9/27	0.1 – 0.6	95	80 - 127	100	102	12.0
Paradise	8/14	0.5 – 1.0	85	67 - 115	87	88	9.9
	9/28	0.5 – 1.0	57	73 - 124	94	96	12.7
Wind R.	8/22	37.0 – 37.4	68	69 -111	92	91	10.5
	8/16	41.0 – 41.5	69	69 - 105	86	87	9.0
	9/25	41.0 – 41.6	62	71 - 109	89	89	9.2

Appendix Table 5. Summary fork-length data for age-0 steelhead *Oncorhynchus mykiss* parr sampled in the Wind River subbasin during 2013.

Stream	Date sampled	Site rkm from mouth	n	Range	Median	Mean	SD
Martha	8/06	1.3 – 1.8	38	43 - 58	51	51	4.4
	9/12 & 9/13	1.3 – 2.0	205	46 - 74	60	61	4.9
	8/07	2.3 – 2.6	31	33 - 62	49	47	7.3
Layout	8/08	0.0 – 0.6	53	38 - 68	49	49	7.5
	9/16	0.0 – 0.6	41	44 - 80	58	59	9.2
	8/02	2.5 – 3.0	18	38 - 49	45	45	2.5
	8/16	4.0 – 4.5	1	22	-	-	-
Trout	8/20	11.0 – 11.3	35	47 - 63	54	53	4.0
	9/25	11.0 – 11.3	46	55 - 77	66	66	5.6
Crater	7/30	0.0 – 0.5	31	36 - 51	44	44	3.5
	9/09	0.0 – 0.6	48	29 - 62	49	47	9.1
Trapper	8/15	0.1 – 0.6	67	38 - 79	63	62	9.0
	9/24	0.1 - 0.6	212	40 - 82	64	64	7.3
Paradise	8/13	0.5 – 1.0	57	41 - 68	57	56	6.2
	9/18	0.5 – 1.0	51	50 - 78	65	64	6.9
Wind R.	8/19	37.0 – 37.4	46	45 - 74	55	56	6.6
	9/26	37.0 – 37.4	93	53 - 88	68	68	7.2
	8/14	41.0 – 41.5	48	41 - 59	51	51	4.2
	9/19	41.0 – 41.5	34	47 - 67	59	59	5.5

Appendix Table 6. Summary fork-length data for age-1 steelhead *Oncorhynchus mykiss* parr sampled in the Wind River subbasin during 2013.

Stream	Date sampled	Site rkm from mouth	n	Range	Median	Mean	SD
Martha	8/06	1.3 – 1.8	152	68 - 130	98	99	13.6
	9/12 & 9/13	1.3 – 2.0	134	77 - 128	99	100	13.1
	8/07	2.3 – 2.6	72	72 - 102	89	89	7.3
Layout	8/08	0.0 – 0.6	67	73 - 130	112	110	13.6
	9/16	0.0 – 0.6	28	88 - 142	118	116	15.8
	8/02	2.5 – 3.0	121	59 - 130	89	93	18.3
	8/16	4.0 – 4.5	24	61 - 84	71	72	6.6
Trout	8/20	11.0 – 11.3	48	72 - 133	101	102	16.5
	9/25	11.0 – 11.3	37	81 - 140	109	109	18.4
Crater	7/30	0.0 – 0.5	50	58 - 96	80	81	9.7
	9/09	0.0 – 0.6	73	65 - 121	89	90	16.7
Trapper	8/15	0.1 – 0.6	76	82 - 137	108	110	15.0
	9/24	0.1 - 0.6	61	85 - 146	112	114	18.2
Paradise	8/13	0.5 – 1.0	62	75 - 125	97	99	12.2
	9/18	0.5 – 1.0	55	82 - 132	107	108	12.8
Wind R.	8/19	37.0 – 37.4	89	79 - 135	110	109	13.2
	9/26	37.0 – 37.4	34	100 - 156	119	123	14.9
	8/14	41.0 – 41.5	53	73 - 115	95	96	11.1
	9/19	41.0 – 41.5	59	72 - 125	95	96	14.1

Appendix Table 7. Summary fork-length data for age-0 steelhead *Oncorhynchus mykiss* parr sampled in the Wind River subbasin during 2014.

Stream	Date sampled	Site rkm from mouth	n	Range	Median	Mean	SD
Martha	8/08	1.3 – 1.9	34	44 - 61	55	55	3.4
	9/17	1.3 – 1.9	100	52 - 76	64	63	5.0
Layout	8/07	0.0 – 0.5	62	39 - 68	59	58	5.9
	9/22	0.0 – 0.5	115	57 - 79	68	68	5.0
	7/31	2.5 – 3.0	44	33 - 55	49	48	4.1
	9/08	2.5 – 3.0	154	39 - 71	55	56	5.3
Trout	8/20	11.0 - 11.3	79	44 - 70	55	56	4.8
	10/08	11.0 -11.3	122	49 - 82	66	67	6.0
Crater	7/30	0.0 – 0.4	35	35 - 56	41	43	5.7
	9/09	0.0 – 0.5	154	34 - 73	54	54	8.6
Trapper	8/06	0.1 – 0.5	60	49 - 71	59	59	5.0
	10/01	0.1 - 0.5	198	54 - 84	71	72	6.3
Paradise	8/11	0.5 – 1.0	25	50 - 74	63	62	5.8
	9/19	0.5 – 1.0	75	44 - 81	72	69	7.9
Wind R.	8/14	37.0 – 37.4	85	50 - 73	63	63	4.1
	9/26	37.0 – 37.4	100	64 - 90	75	75	5.5
	8/12	41.0 – 41.4	55	40 - 64	53	53	5.2
	9/25	41.0 – 41.5	79	47 - 71	61	61	5.3

Appendix Table 8. Summary fork-length data for age-1 steelhead *Oncorhynchus mykiss* parr sampled in the Wind River subbasin during 2014.

Stream	Date Sampled	Site rkm from mouth	n	Range	Median	Mean	SD
Martha	8/08	1.3 – 1.9	104	78 - 121	97	98	8.9
	9/17	1.3 – 1.9	170	78 - 135	98	102	13.8
Layout	8/07	0.0 – 0.5	56	80 - 122	100	101	11.6
	9/22	0.0 – 0.5	62	83 - 127	106	106	12.1
	7/31	2.5 – 3.0	72	60 - 105	87	86	10.8
	9/08	2.5 – 3.0	92	74 - 122	100	99	12.5
Trout	8/20	11.0 - 11.3	53	77 - 120	99	98	10.7
	10/08	11.0 - 11.3	47	87 - 143	110	113	15.3
Crater	7/30	0.0 – 0.4	41	66 - 105	87	87	10.4
	9/09	0.0 – 0.5	73	75 - 113	91	92	11.0
Trapper	8/06	0.1 – 0.5	88	76 - 125	96	98	13.0
	10/01	0.1 - 0.5	130	86 - 134	105	107	12.4
Paradise	8/11	0.5 – 1.0	87	79 - 119	96	98	9.2
	9/19	0.5 – 1.0	116	84 - 135	101	103	12.3
Wind R.	8/14	37.0 – 37.4	87	85 - 124	106	106	10.2
	9/26	37.0 – 37.4	55	93 - 142	110	113	12.1
	8/12	41.0 – 41.4	54	74 - 117	91	93	10.7
	9/25	41.0 – 41.5	86	79 - 133	105	106	15.4