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WIND RIVER WATERSHED RESTORATION

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Wind River Watershed Restoration

Annual Report

November 2011 through October 2012

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Introduction

This report summarizes work by U.S. Geological Survey's Columbia River Research Laboratory (USGS-CRRL) in the Wind River subbasin, from November 2011 through October 2012. Funding was provided by Bonneville Power Administration (BPA) under contract 55275. The primary focus of USGS activities during this time was tagging of parr steelhead *Oncorhynchus mykiss* with Passive Integrated Transponder (PIT) tags, and establishing a network of instream PIT tag interrogation systems (PTIS). The PIT-tagged parr steelhead will provide movement and life history data through recapture events and detections at instream PTIS systems, will contribute to estimates of adult steelhead returning to the Wind River, and aid in the evaluation of the removal of Hemlock Dam on Trout Creek steelhead populations.

The Wind River Watershed project (BPA Project Number 1998-019-00) is a collaborative effort to restore wild steelhead in the Wind River, WA. The four partner agencies are the U.S. Forest Service (USFS), Washington Department of Fish and Wildlife (WDFW), USGS-CRRL, and Underwood Conservation District (UCD). This partnership was established in the early 1990s with support from BPA, and has continued to conduct extensive habitat, research, monitoring, and coordination activities across the 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 assessments of steelhead/rainbow trout populations, relationships with introduced populations of spring Chinook salmon *O. tshawytscha* and brook trout *Salvelinus fontinalis*, and effects of habitat variables and habitat restoration on fish productivity.

During the period covered by this report, we PIT tagged steelhead parr in headwater sections of the subbasin (Figure 1), maintained a PTIS in Trout Creek, installed a PTIS in the Wind River, and installed smaller scale PTISs in Trapper Creek, Paradise Creek, and the Wind River upstream of Paradise Creek (Figure 2). Additionally we maintained thermologgers to collect water temperature data near the PIT tagging sites.

A statement of work (SOW) was submitted to BPA in October 2011 that outlined work to be performed by USGS-CRRL. The SOW was organized by Work Element (WE), with each describing a research task. This report summarizes the progress completed under each WE.

Work Elements

A: 185. Produce Pisces Status Report

Title: Periodic Status Reports for BPA

Description: The Contractor shall report on the status of milestones and deliverables in Pisces. Reports shall be completed either monthly or quarterly as determined by the BPA contracting officer (COTR). Additionally, when indicating a deliverable milestone as COMPLETE, the contractor shall provide metrics and the final location (latitude and longitude) prior to submitting the report to the BPA COTR.

Progress:

Status reports were provided to BPA on a quarterly basis.

B: 165. Produce Environmental Compliance (EC) Documentation

Title: Document that all EC has been completed.

Description: Environmental compliance work has already been completed for this work. Confirmation of this will be provided by BPA EC representative. If any other documentation is needed, this will be supplied.

Progress:

Permitting for PTIS activities (Trout Creek site relocation, deployment of sites in the Wind River upstream of Carson National Fish Hatchery, in Paradise Creek, in Trapper Creek, and in the Wind River upstream of the confluence with Paradise Creek) was completed on 5 September 2012, after receipt of our Special Use Permit from the Gifford Pinchot National Forest. The PTIS activities were permitted through Washington State Hydraulic Permit Approvals 123868-1, 123870-1, and 126165-1, and U.S. Forest Service Special Use Permit MTA

235. Permitting for fish sampling and tagging was under Washington Department of Fish and Wildlife Permit 11-387 and ESA Section 10 Permit 1135-7R.

C: 132. Produce (Annual) Progress Report

Title: Submit Annual Report for the period November 2010 through October 2011

Description: The annual report summarizes the project goal, objectives, activities, problems encountered, and lessons learned. Date range of November 2010 through October 2011 will be agreed upon by the COTR and the contractor. This may or may not coincide with the contract period. For an ongoing project, an annual report covering a contract period may be submitted under the subsequent contract, if approved by the COTR.

Progress:

An Annual Report was submitted to BPA on 30 March 2012.

D: 119. Manage and Administer Projects

Title: Manage and administer project

Description: Development of next year's SOW, Budget, and Property Inventory. Tracking of budget expenditures and accomplishments.

Progress:

Documents for FY13 were submitted and accepted.

E: 191. Watershed Coordination

Title: Share project activity and progress with partner agencies

Description: Share project activities and progress with the partner agencies for the Wind River (WDFW, UCD, USFS) to promote better understanding of data being collected and its implications, reduce redundancy in habitat and monitoring work, improve feedback loop between habitat work and assessment/evaluation work, maintain strong relationship between agencies and partners working in

the same watershed for parallel purposes, maintain a unified, coordinated project.

Progress:

Personnel from USGS-CRRL attended quarterly meetings with partner agencies to communicate project activity and share data.

F: 157. Collect/Generate/Validate Field and Lab Data

Title: Maintain and download thermologgers.

Description: USGS will download at least six thermologgers deployed in tributaries of the Wind River subbasin where juvenile steelhead have been PIT tagged and instream readers are to be located. Coordination of thermologger placement with UCD and USFS will be done during quarterly project meetings to insure no duplication of effort and maximum coverage throughout the watershed and that stored data is accessible. As in the past, the thermologger data will be archived at CRRL and will be available to partner agencies or other interested parties. Underwood Conservation District is coordinating an effort to put Wind River partner's water temperature data into a publicly accessible database, and we will continue to contribute data to that effort.

Progress:

During the summer of 2012, we downloaded the thermologgers (Table 1), brought them back to CRRL for testing, and redeployed them. The thermologger in Martha Creek had been lost during winter and it was replaced with a spare. The thermologger in Paradise Creek failed and it was replaced with the unit from Trapper Creek after this site was identified as redundant with a UCD site. Electronic data have been added to the database of water temperatures in the Wind River subbasin and stored at CRRL.

G: 70. Install Fish Monitoring Equipment

Title: Build and install a PIT tag interrogation system for Stabler, or Panther Creek

Description: Build a 6-antenna multiplexing PIT tag interrogation system to be deployed in the Stabler area of the Wind River, or in Panther Creek, dependent upon landowner willingness/permitting and site availability. USGS will submit data to PTAGIS.

Progress:

Not applicable. This WE was replaced by WE N in the final contract. Due to delays procuring our Forest Service Special Use Permit, we were not able to install the upper Wind River PTIS during 2011 as planned. Time and personnel constraints prevented us from installing two large systems in 2012. The upper Wind site was deemed more critical to the habitat and parr life-history evaluations already under way, so it was installed during 2012 in lieu of either a Stabler or Panther Creek site.

H: 157. Collect/Generate/Validate Field and Lab Data

Title: Maintain the upper Wind PIT tag interrogation system and ensure data collection.

Description: Maintain the upper Wind PIT tag interrogation system. This may include tuning of the transceiver, wiring of solar panels, and replacement of lost or malfunctioning antennas. Assure that the data are collected in a timely manner. USGS will submit data to PTAGIS.

Progress:

We maintained the upper Wind PTIS after it was installed in October 2012. The site was registered with PTAGIS (site code WRU) and data were submitted beginning on 12 October 2012.

I: 157. Collect/Generate/Validate Field and Lab Data

Title: Maintain the Trout Creek PIT tag interrogation system and assure data collection.

Description: Assist with maintaining the Trout Creek PIT tag interrogation system in cooperation with WDFW. This may include tuning of the transceiver, wiring of solar panels, and replacement of lost or malfunctioning antennas. Assure that the data are collected in a timely manner. Pending additional BPA funds during FY2012, and Forest Service permits, the Trout Creek PIT tag interrogation system may be relocated downstream and connected to grid power. WDFW will submit data to PTAGIS.

Progress:

We maintained the Trout Creek PTIS while at its original location, then relocated it during October 2012 and maintained it at the new site (see WE L).

J: 70. Install Fish Monitoring Equipment

Title: Install Allflex PIT tag interrogators in Trapper Creek, Paradise Creek, and the Wind River upstream of Paradise Creek.

Description: Install Allflex PIT tag interrogation systems in Trapper Creek, Paradise Creek, and the Wind River upstream of Paradise Creek to provide data on life-history aspects of steelhead parr PIT tagged in the Wind River subbasin. These units will provide data on migration timing and survival of steelhead parr. The units will be paired to provide data on direction of movement. USGS will submit these data to PTAGIS.

Progress:

We installed Allflex PTISs in Trapper Creek, Paradise Creek, and the Wind River upstream of Paradise Creek (Upper Mine Reach; Figure 2). The units were installed after receiving our Special Use Permit from the Forest Service on 5 September 2012. The Trapper Creek site was installed on 14 September 2012, the Paradise Creek site on 18 September 2012, and the Upper Mine Reach site on 20 September 2012. Each site had two instream antennas each paired with an Allflex RM310 transceiver board as described by Bond et al. (2007). The antennas were about 4-m long by 0.7-m wide, housed in 7.6-cm diameter Schedule 80 PVC pipe. At each site the antennas were placed in the thalweg with one upstream of the other, separated by about 10 m.

We experienced some initial problems with loss of power to the antennas at Trapper Creek and the Upper Mine Reach sites. The antennas worked initially, but after a short period of operation, antenna amperage dropped, even when powered with a fully charged battery. One antenna from the Upper Mine Reach site was brought back to CRRL for testing. The deployed antennas may have been too large for the Allflex transceivers to power for extended periods. Further lab testing should help determine the problem and identify if the antennas need to be replaced or modified. Additionally, the solar charging at the sites was inadequate to keep batteries charged for more than a couple of days. Additional solar panels were added to each site to boost charging capacity. Because of these initial operations difficulties, the sites were not registered with PTAGIS. We plan to register them as soon as a steady state of operation is reached. Despite these startup difficulties, PIT-tagged *O. mykiss* were detected at both the Paradise Creek and Trapper Creek sites right away.

K: 158. Mark/Tag Animals

Title: PIT tag a total of 1,500 steelhead parr in the headwaters of the Wind River subbasin.

Description: PIT tag 1,500 steelhead parr in headwater areas of the Wind River subbasin to contribute to life-history studies and population monitoring. Parr will be captured by electrofishing. These efforts will occur in Martha, Layout, and Crater creeks in the Trout Creek watershed, and Trapper and Paradise creeks, and the Wind River upstream of Paradise Creek in the upper Wind River watershed. Additionally, parr will be tagged in the upper areas of both the mainstem of Trout Creek and the Wind River. About 150 fish will be targeted for tagging at each site.

Progress:

We PIT tagged 1,251 *O. mykiss* parr in the Trout Creek and upper Wind River watersheds (Figure 1; Table 2). 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 (Appendix Figures 1 – 11), 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. All PIT tagging followed the procedures and guidelines outlined by Columbia Basin Fish and Wildlife Authority (1999). The PIT tags we used were 134.2 kHz and 12-mm long. 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.

In the Trout Creek watershed, we PIT tagged *O. mykiss* parr in Martha, Layout, and Crater creeks, as well as a mainstem section of Trout Creek (Figure 1; Table 2). In the upper Wind River watershed, we tagged *O. mykiss* parr in Trapper and Paradise creeks, in the Wind River upstream of its confluence with Paradise Creek, and in a mainstem section 3 km downstream of the Paradise Creek confluence (Figure 1; Table 2). Most sites were sampled in late summer, then again in fall. Repeat sampling presented the opportunity to recapture previously PIT-tagged fish for growth data (Table 2). All PIT-tagging and recapture data from 2012 were proofed and submitted to the PTAGIS database.

In addition to the recapture data of fish that were PIT tagged during the first sampling session, we recaptured fish that were PIT tagged during 2011 sampling (Table 3). These data will provide insights into growth and life-history patterns of *O. mykiss* in headwater areas of the Wind River subbasin. Additional re-contacts of PIT-tagged parr will come from recaptures at Wind River subbasin smolt traps, detections at instream PTISs in the Wind River subbasin, and detections of juveniles and adults at Bonneville Dam.

Length and weight data were collected at each site from *O. mykiss* fry that were too small to PIT tag (< 70 mm). Brook trout were present in Layout, Crater, and Trout creeks and length and weight data were also collected from them. Shorthead sculpin *Cottus confusus* were present in Trapper and Paradise creeks and the Wind River. No Chinook salmon *O. tshawytscha* parr were found at our sample sites during 2012.

Data from these PIT-tagging efforts will also contribute to evaluation of efficacy of restoration efforts. During 2012, we PIT tagged *O. mykiss* parr at a site in Martha Creek where a small diversion dam was planned for removal by the USFS (rkm 2.3; Figure 1; Table 2). Additionally, on Layout Creek we PIT tagged *O. mykiss* parr above a road culvert (rkm 4.0; Figure 1; Table 2) that may be removed and replaced with a bridge that meets fish passage requirements.

L: 70. Install Fish Monitoring Equipment

Title: Relocate the Trout Creek PIT tag interrogation system

Description: Relocate the Trout Creek PIT tag interrogation system to a point downstream with better winter access and grid power.

Progress:

The Trout Creek PTIS (PTAGIS site code TRC) was relocated during the week of 1 October 2012, after receiving our Special Use Permit from the Forest Service on 5 September 2012. The new location is about 2.0 km downstream of the previous site, and just upstream of the Hemlock Recreation Site (Figure 2). The site antenna configuration was three arrays of two 6-m long antennas each (3x2; Figure 3). The antennas were anchored with a combination of rock bolts and MANTA RAY® MR-4 earth anchors, which were set with a jackhammer. During October 2012, site power was provided by batteries, which required weekly changing because no charging system was yet in place. Grid power will be installed at the site during fall 2012.

M: 162. Analyze/Interpret Data

Title: Analyze adult steelhead passage data at the Trout Creek interrogation site for detection efficiency

Description: Report on adult steelhead detections at the Trout Creek PIT tag interrogation site and determine detections efficiencies by methods described in Connolly et al. (2008).

Progress:

Operation of the Trout Creek PTIS (TRC) began in fall of 2007. The objective of establishing this site was to contribute data to aid in estimating returns of adult steelhead to the Trout Creek watershed following the removal of Hemlock Dam on Trout Creek. Hemlock Dam had a fish ladder with a trap that provided a yearly count of the number of adult steelhead returning (Rawding and Cochran 2010). The TRC site was located at rkm 4.0 of Trout Creek (Figure 2). The detection system consisted of a FS1001M multiplexing transceiver, three arrays of two 6-m long antennas (3x2), and solar panels to provide battery charging. Trout Creek was about 13 – 14 m wide at the site and the antennas were deployed in a run with depth from 0.1 –

1.2 m at base flow levels. Substrate was primarily large boulder and bedrock. Because PTISs in streams as large as Trout Creek rarely detect every passing fish (Zydlewski et al. 2006; Achord et al. 2012), some estimate of detection efficiency must be generated to estimate run size of PIT-tagged fish.

We used the methods outlined in Connolly et al. (2008) to derive detection efficiency estimates for adult steelhead at TRC. From 21 September 2007 through 31 May 2012, 163 PIT-tagged adult steelhead were detected at the site (Figures 4 – 6; Table 4), and we used the array-detection histories of these fish to calculate efficiency estimates. No detection data from juvenile PIT-tagged steelhead were included in the efficiency estimate calculations.

We calculated detection efficiencies for two periods of monitoring time. From 1 January 2010 to 9 February 2012, a degraded transceiver component caused interference (noise) at the transceiver. This noise caused a reduction in reading ability of the antennas, which could be expected to reduce detection efficiencies. We produced separate estimates of detection efficiency during this noisy period and the rest of the monitoring time: the quiet period. Detection efficiency estimates for adult steelhead were 0.96 (SE = 0.01) during the quiet period and 0.81 (SE 0.06) during the noisy period (Table 4). These estimates of detection efficiency will assist WDFW in estimating yearly adult steelhead escapement to Trout Creek. These estimates apply to periods when the site was operating; some fish may have passed during times when there were equipment problems.

Throughout the TRC monitoring period, we experienced times when power loss or equipment malfunction resulted in system down time (Figures 4 – 6; Appendix Table 1). The remote nature of the site restricted winter access due to heavy snow and road blockage from downed trees. This resulted in many weeks during winter when we could not access the site. Though the batteries were supported by a solar charging system, winter charging capacity was limited due to snowfall, cloudy weather, and the location in a river canyon with little solar exposure even on sunny winter days. Further data analysis is planned by WDFW and USGS to determine how best to account for possible adult steelhead passage during down periods prior to final adult escapement estimates being generated. Because of the difficulties of winter maintenance and power supply, a plan was established to relocate the system to a downstream site where access to grid power will be available (see WE L), and which provides year round access.

N: 70. Install Fish Monitoring Equipment

Title: Install the upper Wind River PIT tag interrogation system

Description: Install the upper Wind River PIT tag interrogation system at the Government Mineral Springs Bridge on the Wind River.

Progress:

The upper Wind River PTIS was installed during the week of 9 October 2012, after receiving our Special Use Permit from the Forest Service on 5 September 2012. The system consisted of two arrays of three 6-m long antennas each (Figure 7), operated with a Destron Fearing FS1001M multiplexing transceiver. The antennas were anchored with a combination of rock bolts anchors and MANTA RAY® MR-4 earth anchors driven with a jackhammer. Power to the site was provided by three 180W 24V solar panels. The site was registered with the PTAGIS database as WRU. Data from the site were submitted to the PTAGIS database beginning on 12 October 2012.

O: 98. Other

Title: Purchase a Multiplexing Transceiver for use in Panther Creek

Description: Purchase a Multiplexing Transceiver to be used at the Panther Creek instream site (planned install in FY13), or as a backup unit for the Trout Creek and upper Wind River systems.

Progress:

An FS1001M multiplexing transceiver was purchased from Biomark. The unit is currently serving as a backup in case of transceiver failure at the Trout Creek or upper Wind PTIS sites. It is also used to tune antennas in the shop when performing repairs or constructing replacements.

Acknowledgements

A number of people helped with this work. Mary Todd Haight was our BPA COTR. Joe Benjamin, Bingham Giamalva, Pete Kofoot, Brad Liedtke, Kyle Martens, Carrie Munz, and Joe Warren were fellow USGS-CRRL employees who helped in the field and office. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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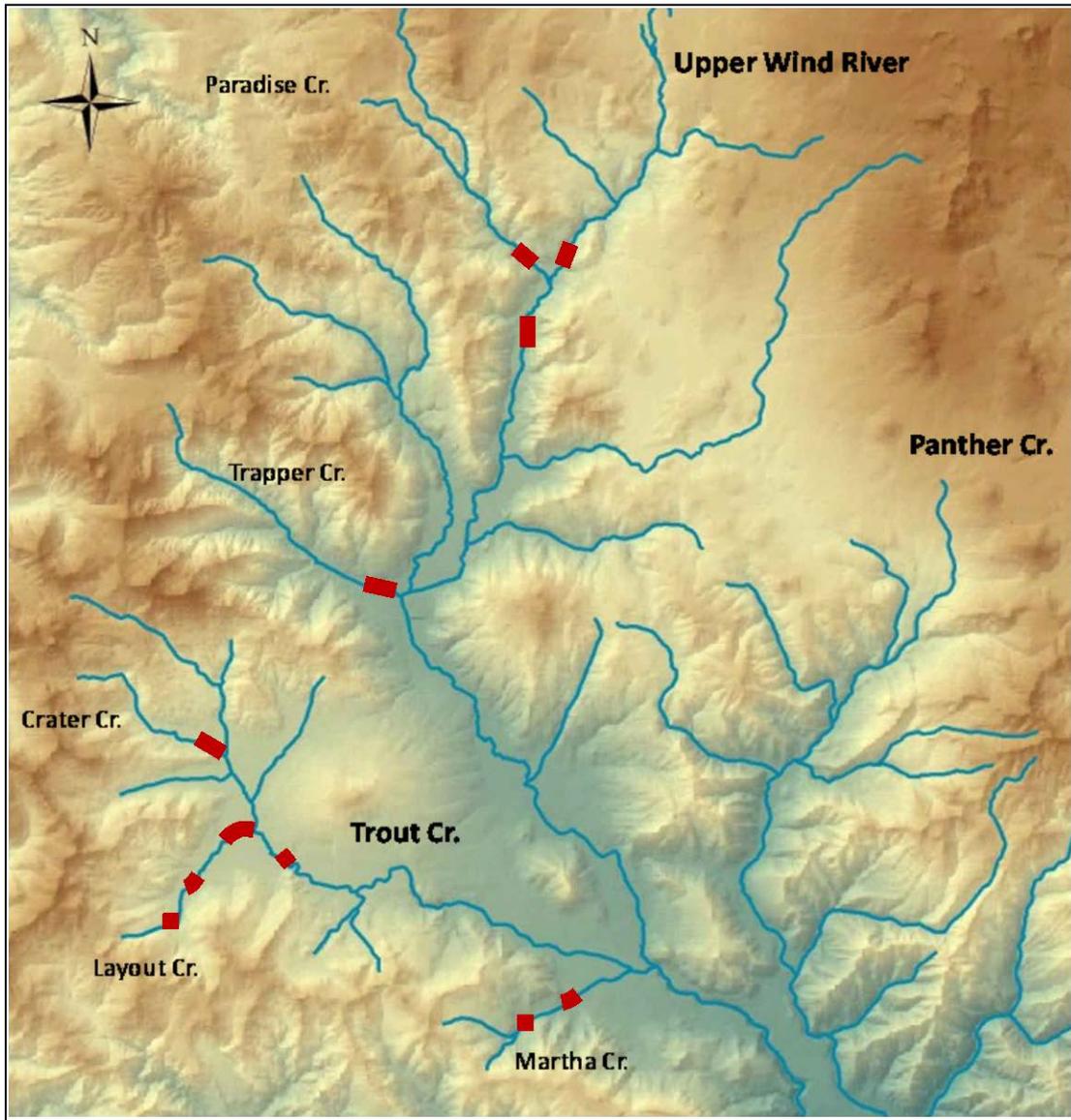


Figure 1. Stream sections (denoted by red bold lines) where we tagged parr steelhead *Oncorhynchus mykiss* with Passive Integrated Transponder tags during summer 2012.

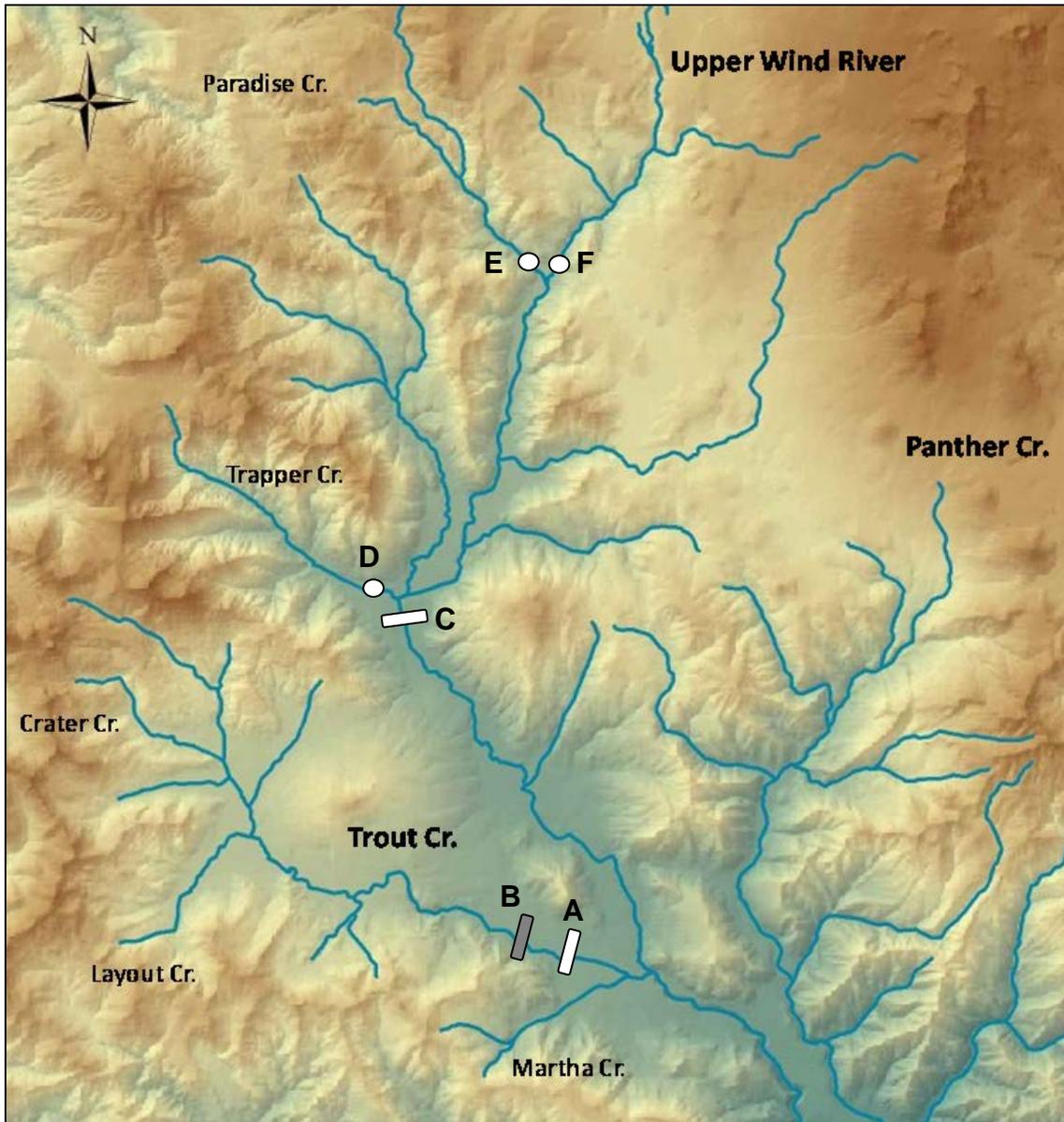


Figure 2. Instream Passive Integrated Transponder tag interrogation sites established in the Wind River subbasin: A) Trout Creek multiplexing site, established in October 2012, about 2 km downstream of its original location. B) Location of the original Trout Creek multiplexing site. C) Upper Wind River multiplexor site, installed during October 2012. D) Trapper Creek Allflex site, installed during September 2012. E) Paradise Creek Allflex site. This site was installed during September 2012. F) Upper mine reach Allflex site, installed during September 2012.

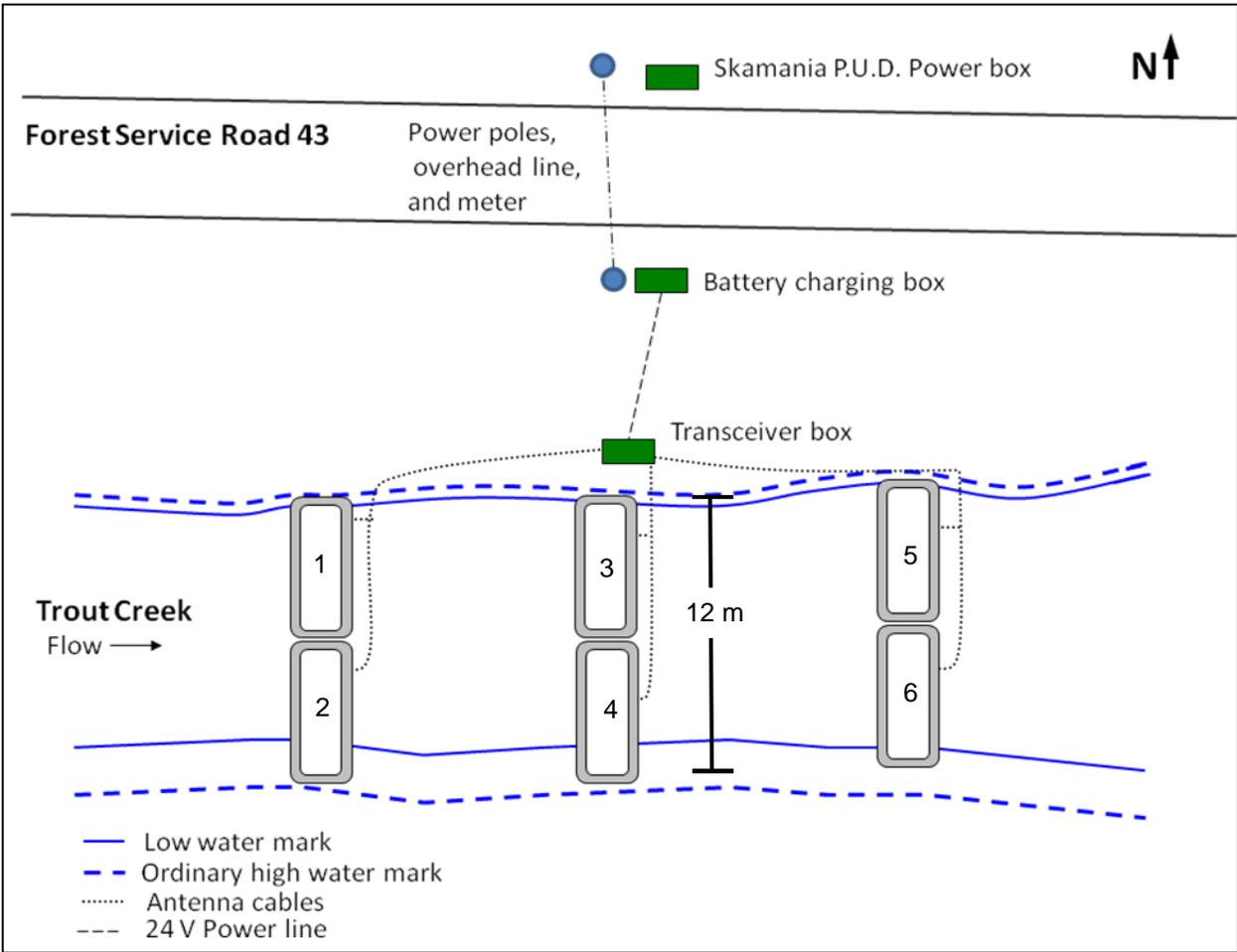


Figure 3. The new Trout Creek PIT tag interrogation system site (relocated in October 2012), showing the three arrays of two antennas each, and supporting infrastructure, including the planned installation of a line to provide grid power to the battery box. This site is about 2 km downstream of the initial site (operated from September 2007 through September 2012). Data from both site locations were submitted to PTAGIS under site code TRC.

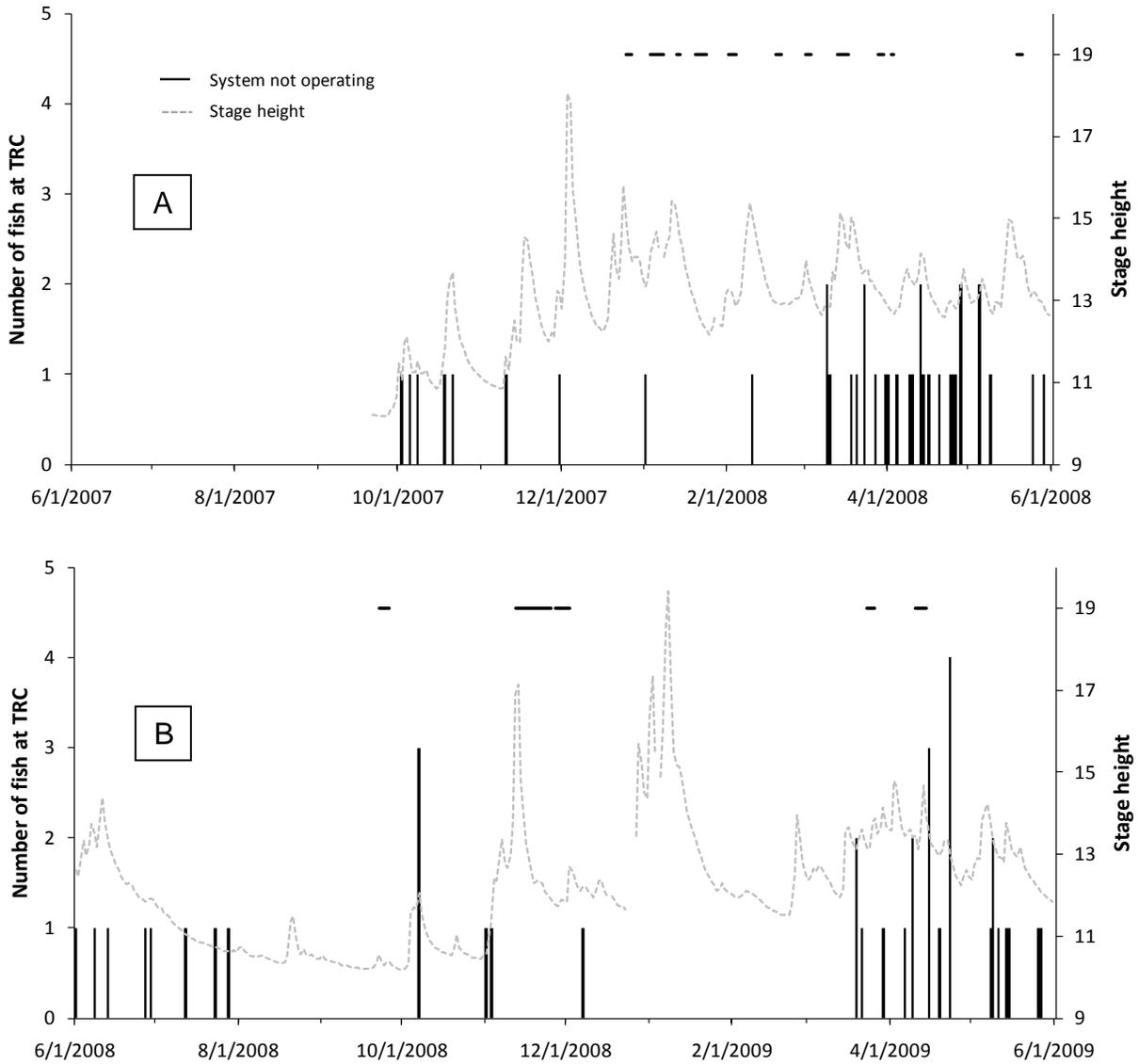


Figure 4. Detections of adult steelhead *Oncorhynchus mykiss* at the Trout Creek PIT tag interrogation system from 21 September 2007 through 31 May 2008 (n = 37; graph A) and 1 June 2008 through 31 May 2009 (n = 37; graph B). The system began recording data in the last week of September 2007. Vertical bars show the daily detections of adult steelhead (first detection event only, many individuals were detected on multiple days). Also shown are times when the system was not operating due to power loss, and stage height (in feet) recorded at the East Fork Lewis River (USGS Gage 14222500), which closely tracks the general pattern of flow in Trout Creek.

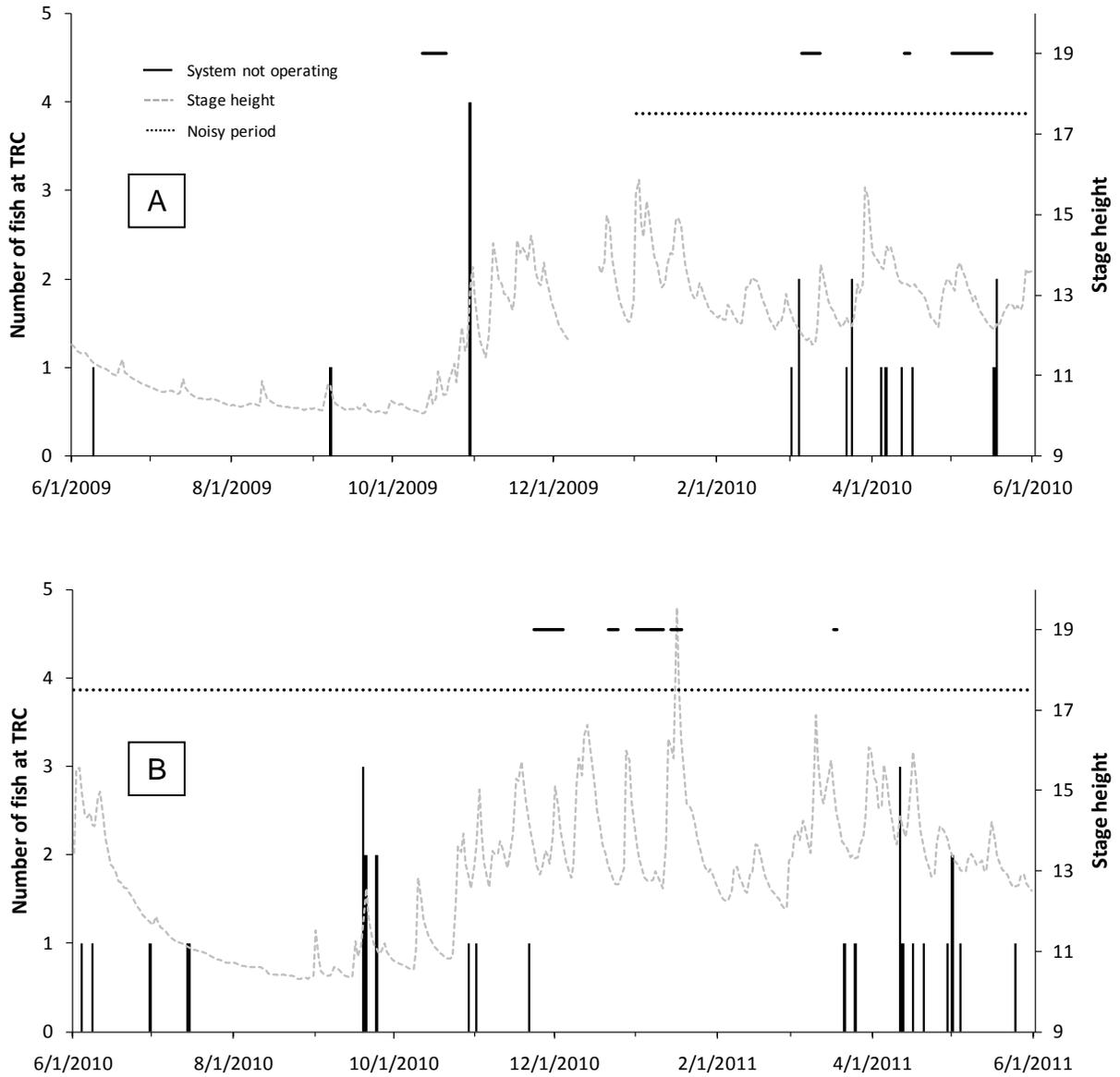


Figure 5. Detections of adult steelhead *Oncorhynchus mykiss* at the Trout Creek PIT tag interrogation system from 1 June 2009 through 31 May 2010 (n = 19; graph A) and 1 June 2010 through 31 May 2011 (n = 28; graph B). Vertical bars show the daily detections of adult steelhead (first detection event only, many individuals were detected on multiple days). Also shown are times when the system was not operating due to power loss, the extent of the noisy period, and stage height (in feet) recorded at the East Fork Lewis River (USGS Gage 14222500), which closely tracks the general pattern of flow in Trout Creek.

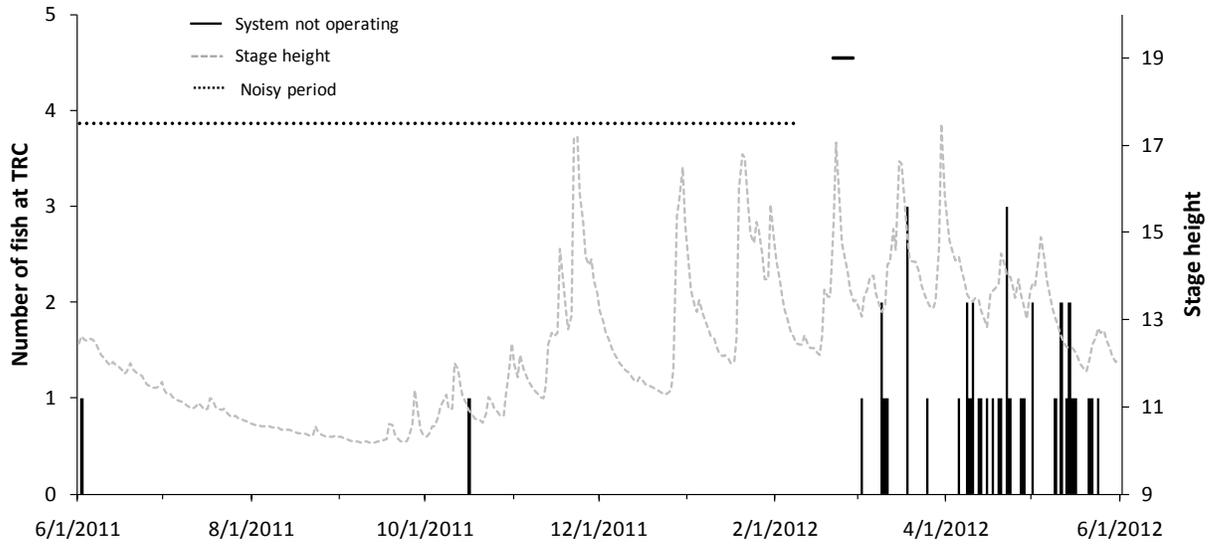


Figure 6. Detections of adult steelhead *Oncorhynchus mykiss* at the Trout Creek PIT tag interrogation system from 1 June 2011 through 31 May 2012 (n = 42). Vertical bars show the daily detections of adult steelhead (first detection event only, many individuals were detected on multiple days). Also shown are times when the system was not operating due to power loss, the extent of the noisy period, and stage height (in feet) recorded at the East Fork Lewis River (USGS Gage 14222500), which closely tracks the general pattern of flow in Trout Creek.

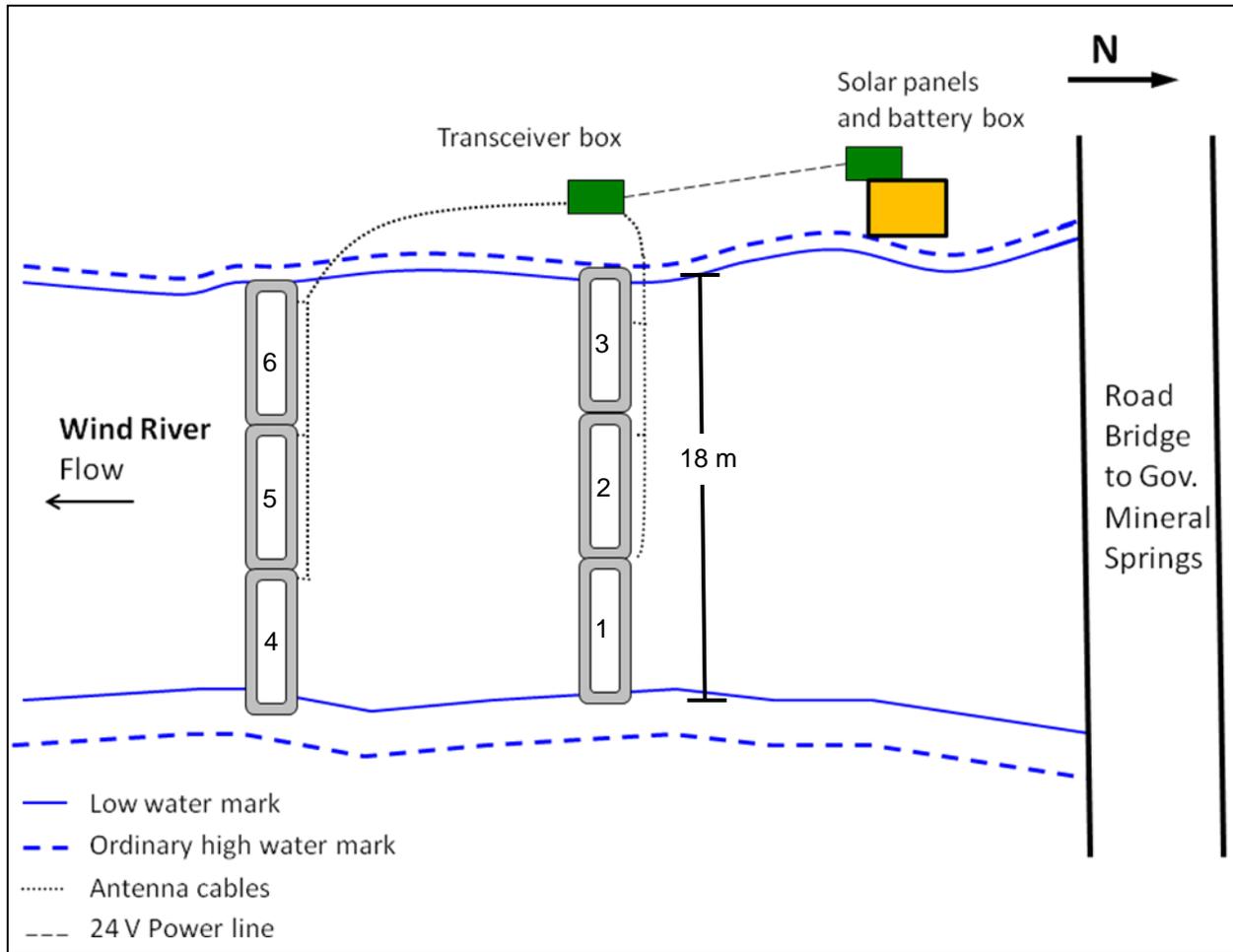


Figure 7. The upper Wind River Passive Integrated Transponder tag interrogation site showing the two arrays of three antennas each and the supporting infrastructure that was installed in October 2012. The site was registered with PTAGIS (site code WRU) and data submitted started on 12 October 2012.

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		Elevation (m)	Distance upstream from mouth (km)	Date start (mm/yy)	Date end (mm/yy)
	North	West				
Trout Creek						
Crater Cr.	45° 50.761'	122° 02.083'	587	0.1	10/11	present
Layout Cr.	45° 49.451	122° 01.334'	559	0.7	09/11	present
Martha Cr.	45° 47.576'	121° 55.659'	344	1.5	07/12 ^a	present
Upper Wind River						
Wind R.	45° 56.985'	121° 55.897'	472	41.0	10/11	present
Paradise Cr.	45° 56.939'	121° 56.218'	469	0.4	07/12 ^b	present
Trapper Cr.	45° 52.771'	121° 58.890'	344	0.1	10/11	06/12 ^c

^a The Martha Creek thermologger was lost to high flow during winter 2011/2012. It was replaced in July 2012.

^b The Paradise Creek thermologger failed in spring 2012, it was replaced in July 2012 with the unit from Trapper Creek.

^c The Trapper Creek thermologger was identified as a duplication of a Underwood Conservation District site and was removed to replace the failed Paradise Creek unit.

Table 2. Total number of juvenile steelhead/rainbow trout *Oncorhynchus mykiss* that were captured and tagged with Passive Integrated Transponder (PIT) tags in two watersheds in the Wind River subbasin during 2012.

Watershed Stream	Dates sampled (month/day)	Rkm sampled, from stream mouth	Number of fish PIT tagged	Number of recaptured PIT- tagged fish
Trout Creek				
Martha	8/7	1.3 - 1.8	64	5
	9/6	1.3 - 1.8	54	29
	8/8	2.3 - 2.6	53	- ^a
Layout	8/2	0.0 - 0.6	63	0
	8/6	2.5 - 3.0	87	3
	8/28	4.0 - 4.5	79	-
Trout	8/21	11.0 - 11.3	71	0
Crater	8/9	0.0 - 0.5	92	4
	9/4	0.0 - 0.6	65	12
Wind River				
Trapper	8/13	0.1 - 0.6	135	2
	9/27	0.1 - 0.6	117	23
Paradise	8/14	0.5 - 1.0	91	1
	9/28	0.5 - 1.0	46	19
Wind River	8/22	37.0 - 37.4	83	-
	8/16	41.0 - 41.5	89	6
	9/25	41.0 - 41.6	62	12
Total			1,251	116

^a “ - “ denotes that this was this first PIT tagging effort in this section and no recaptures would have been expected.

Table 3. Re-contacts, through October 2012, of steelhead/rainbow trout *Oncorhynchus mykiss* that were PIT tagged as parr during 2011 in headwater areas of two watersheds in the Wind River subbasin.

Watershed	Number of fish tagged in 2011	Re-contacted from Nov. 2011 through Oct. 2012			
		Smolt trap	Instream recapture	Detected at a PTIS	Detected in Columbia R.
Trout Creek	494	6 ^a	22	2	2
Upper Wind	497	0 ^b	23	5	4

^a Trap located at rkm 2 of Trout Creek.

^b Trap located at rkm 31 of the Wind River.

Table 4. Detection efficiency estimates for adult steelhead *Oncorhynchus mykiss* at the Trout Creek Passive Integrated Transponder tag interrogation site during September 2007 through May 2012 operations. The noisy period was from 1 January 2010 through 9 February 2012, when a degraded transceiver component caused interference that reduced antenna read ranges.

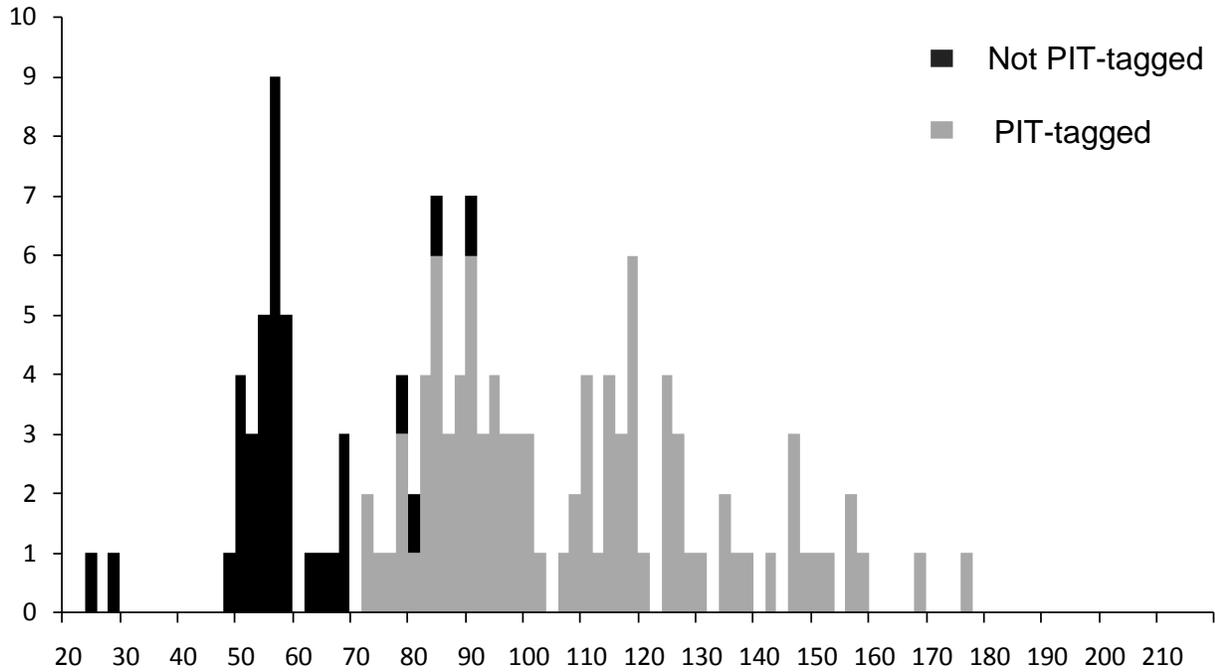
Detection period	Number of fish detected	Efficiency estimate	SE	Lower 95% CI	Upper 95% CI
Quiet	120	0.96	0.01	0.93	0.98
Noisy	43	0.81	0.06	0.68	0.91

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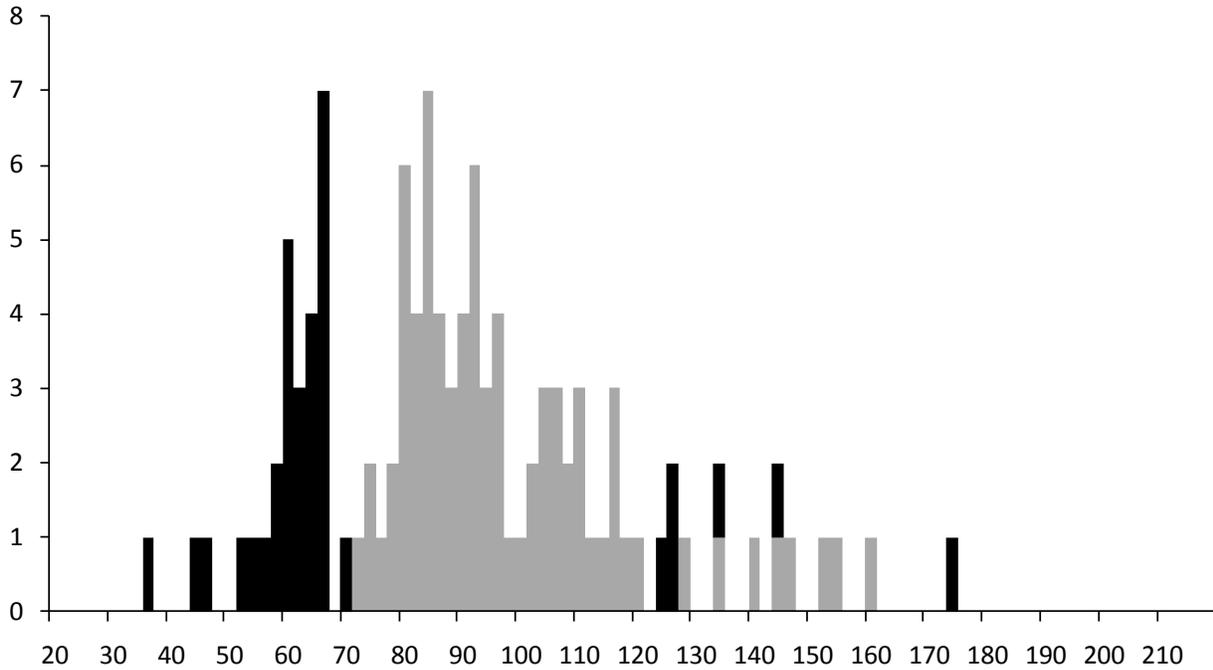
Appendix Table 1. Number of days and the dates when the Trout Creek PIT tag interrogation system experienced operational problems (due to power loss or equipment malfunction) during each calendar year from 21 September 2007 through 31 May 2012.

Year	Number of days	Dates (MM/DD) when the system experienced operational problems
2007	4	12/04, 12/25 – 12/27
2008	60	01/03 - 01/07, 01/13, 01/14, 01/20 – 01/24, 02/01 - 02/04, 02/14, 02/19 – 02/21, 03/01 – 03/03, 03/13 – 03/17, 03/28 – 03/30, 04/02, 04/03, 05/19 – 05/21, 09/22 - 09/26, 11/12 – 11/25, 11/27 – 12/02
2009	20	02/04, 03/23 – 03/26, 04/10 – 04/14, 10/12 – 10/21
2010	45	03/05 – 03/12, 04/13 – 04/15, 05/01 – 05/16, 11/23 – 12/04, 12/21 – 12/25
2011	19	01/01 – 01/11, 01/14 – 01/18, 03/17, 03/18, 10/05
2012	7	02/21 – 02/28

Crater Creek, 9 August 2012

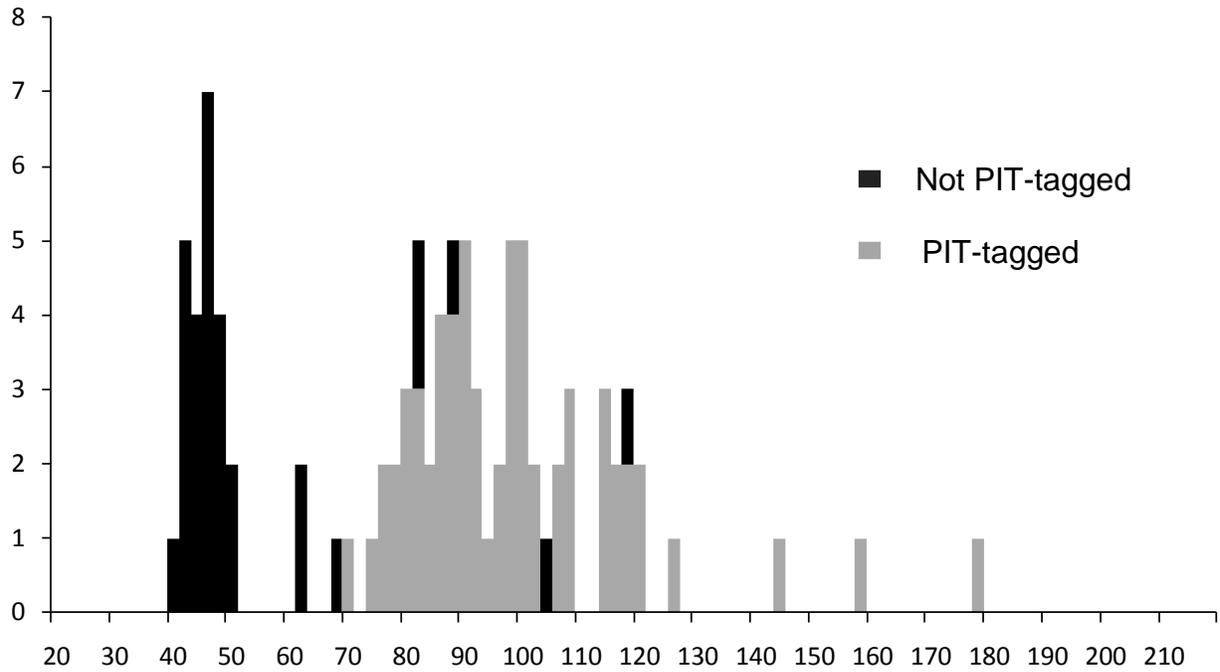


Crater Creek, 4 September 2012



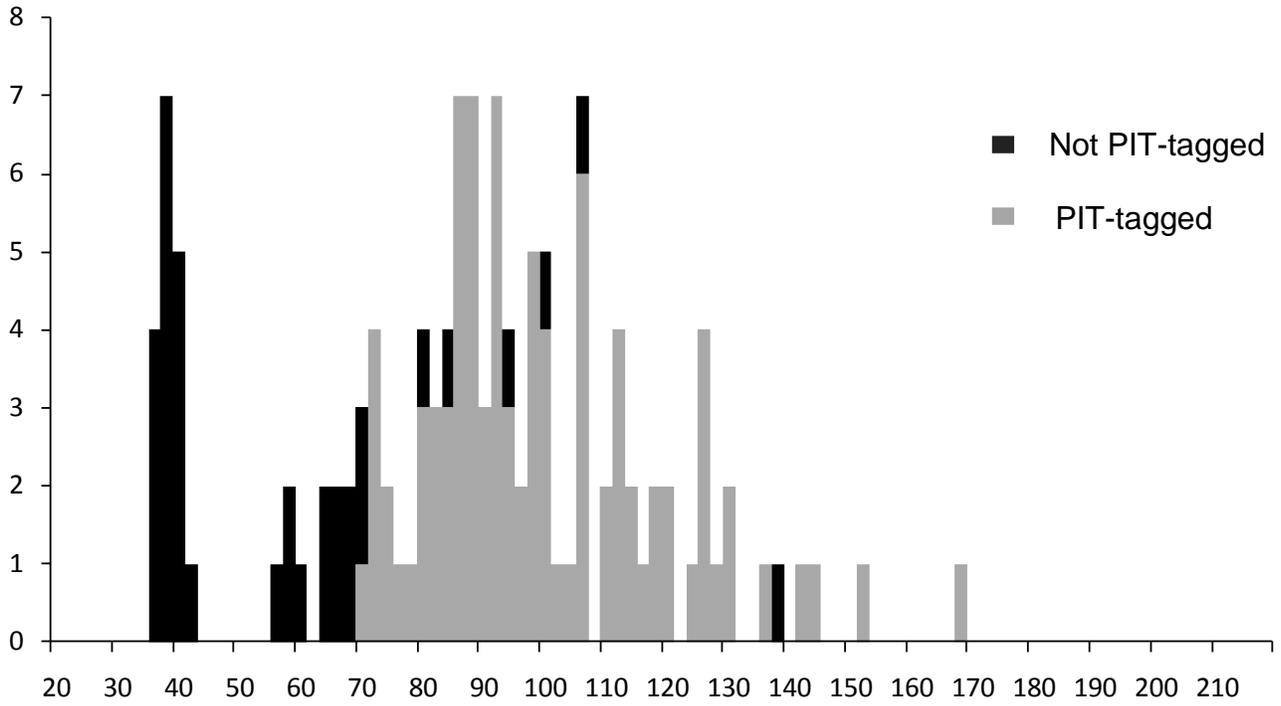
Appendix Figure 1. Length frequencies of juvenile steelhead *Oncorhynchus mykiss* in Crater Creek, sampled by electrofishing during August and September 2012 between rkm 0.0 and 0.6.

Layout Creek, 2 August 2012



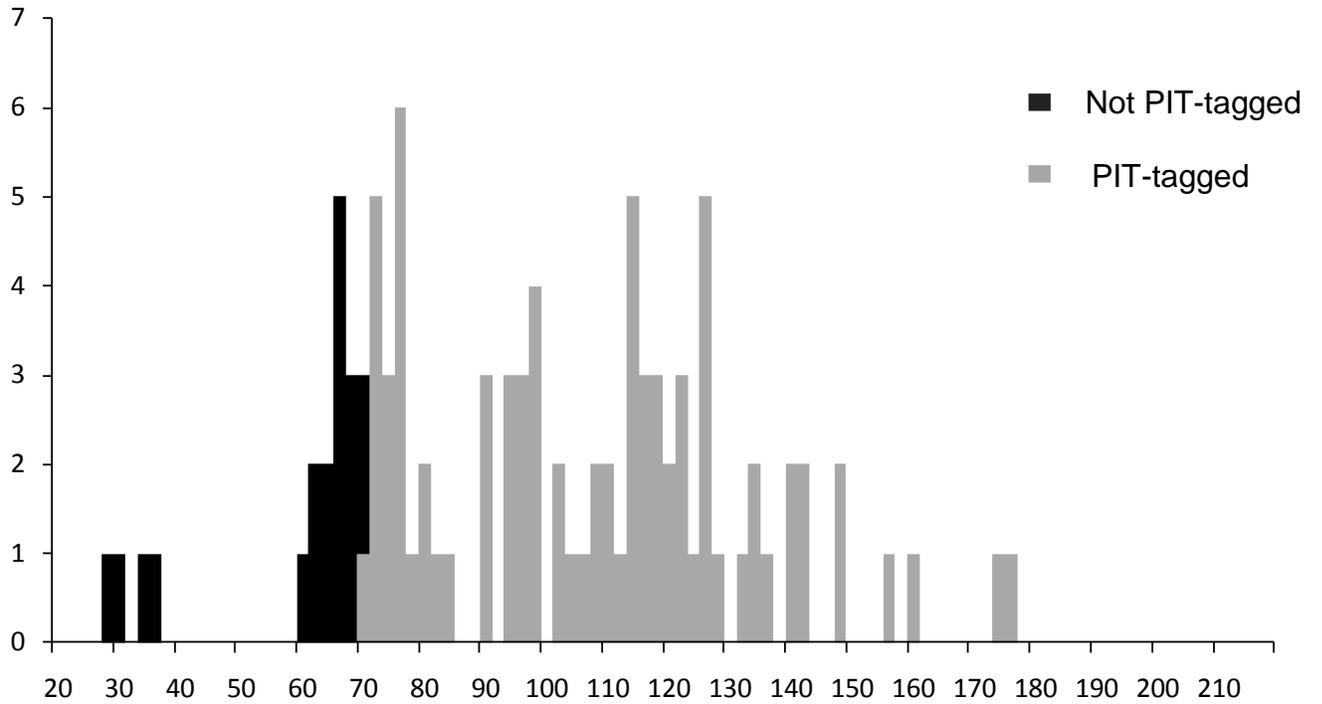
Appendix Figure 2. Length frequencies of juvenile steelhead *Oncorhynchus mykiss* in Layout Creek, sampled by electrofishing during August 2012 between rkm 0.0 and 0.6.

Upper Layout Creek 6 August 2012



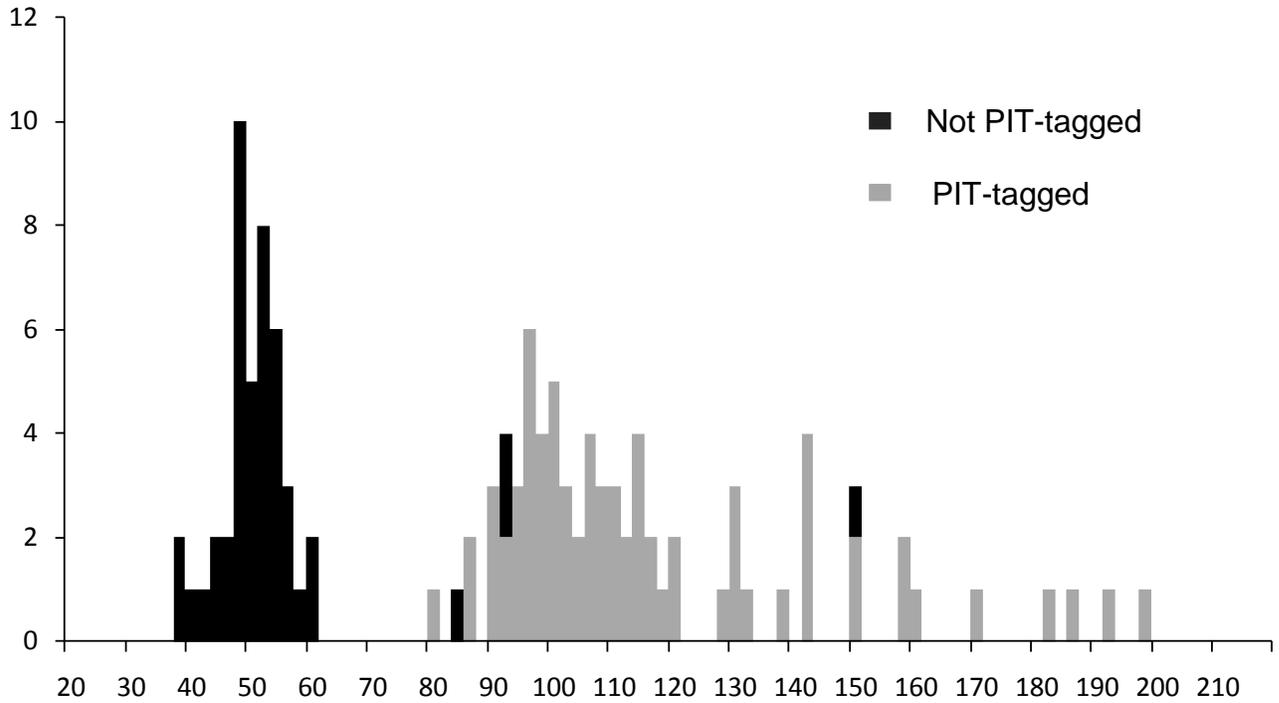
Appendix Figure 3. Length frequencies of juvenile steelhead *Oncorhynchus mykiss* in upper Layout Creek, sampled by electrofishing during August 2012 between rkm 2.5 and 3.0.

Way Upper Layout Creek, 28 August 2012

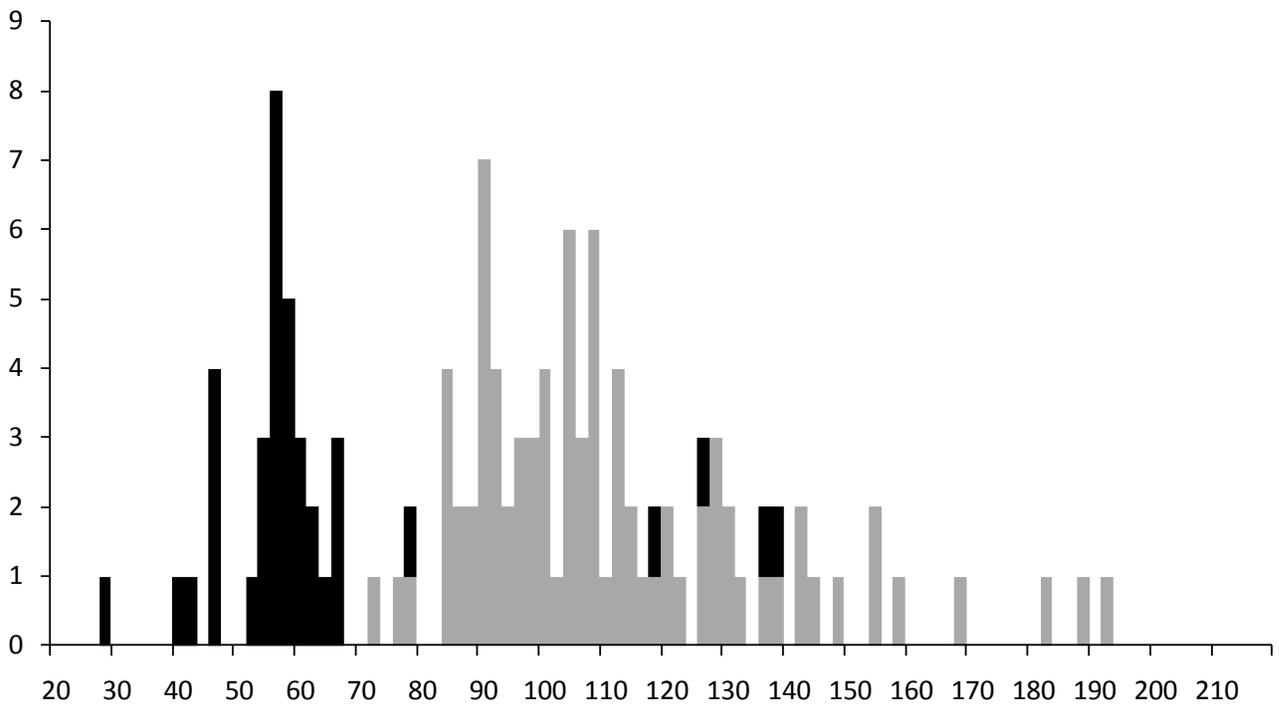


Appendix Figure 4. Length frequencies of juvenile steelhead *Oncorhynchus mykiss* in way upper Layout Creek (upstream of the 43 Road crossing), sampled by electrofishing during August 2012 between rkm 4.0 and 4.5.

Martha Creek, 7 August 2012

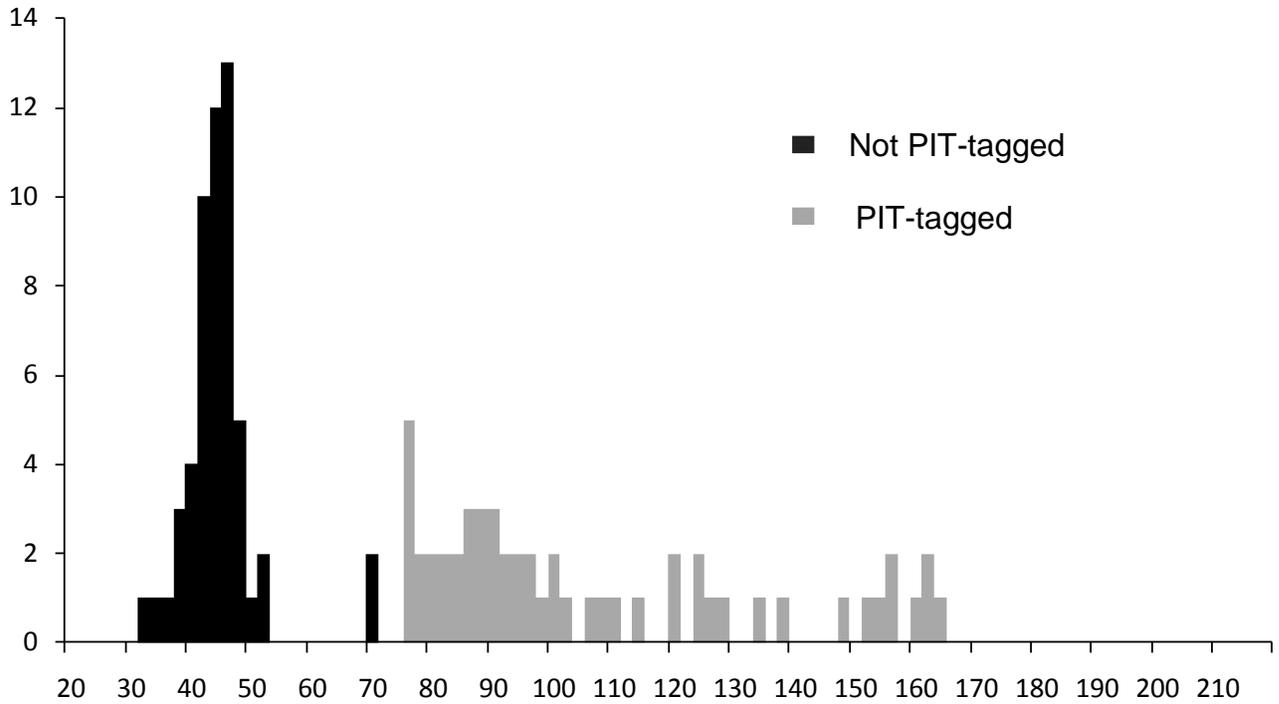


Martha Creek, 6 September 2012



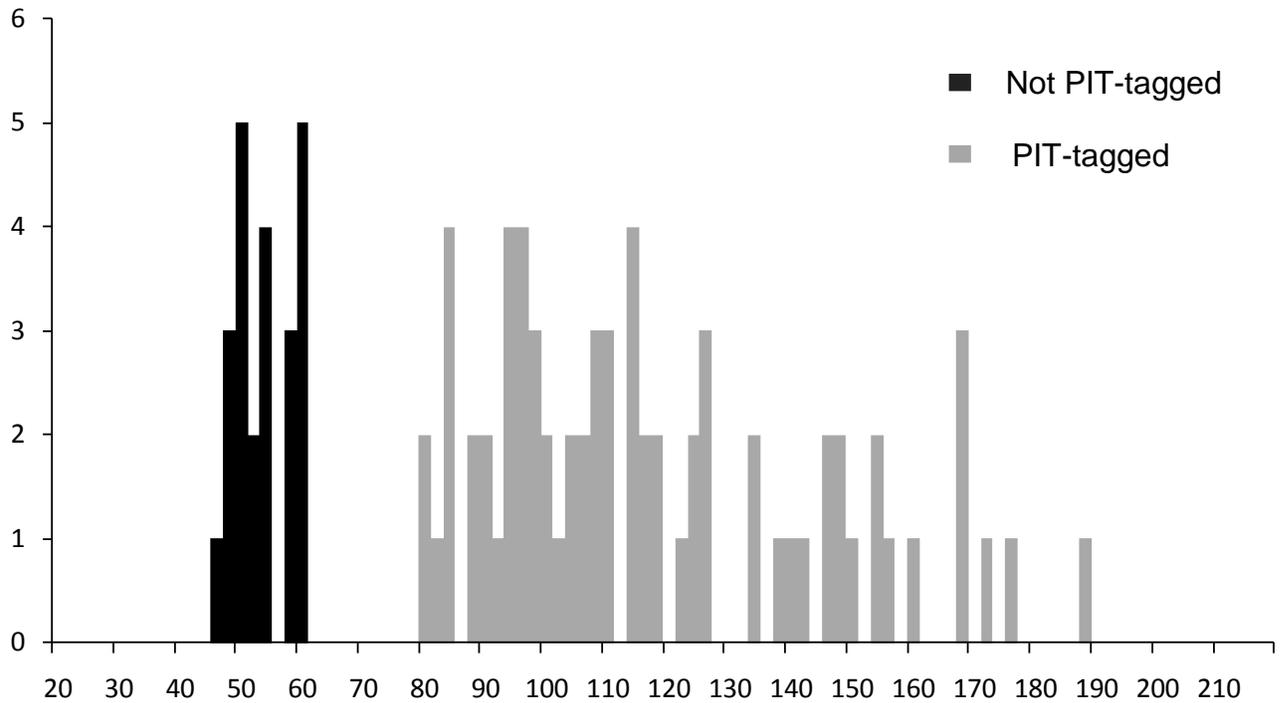
Appendix Figure 5. Length frequencies of juvenile steelhead *Oncorhynchus mykiss* in Martha Creek, sampled by electrofishing during August and September 2012 between rkm 1.3 and 1.8.

Upper Martha, Dam Site, 7 August 2012



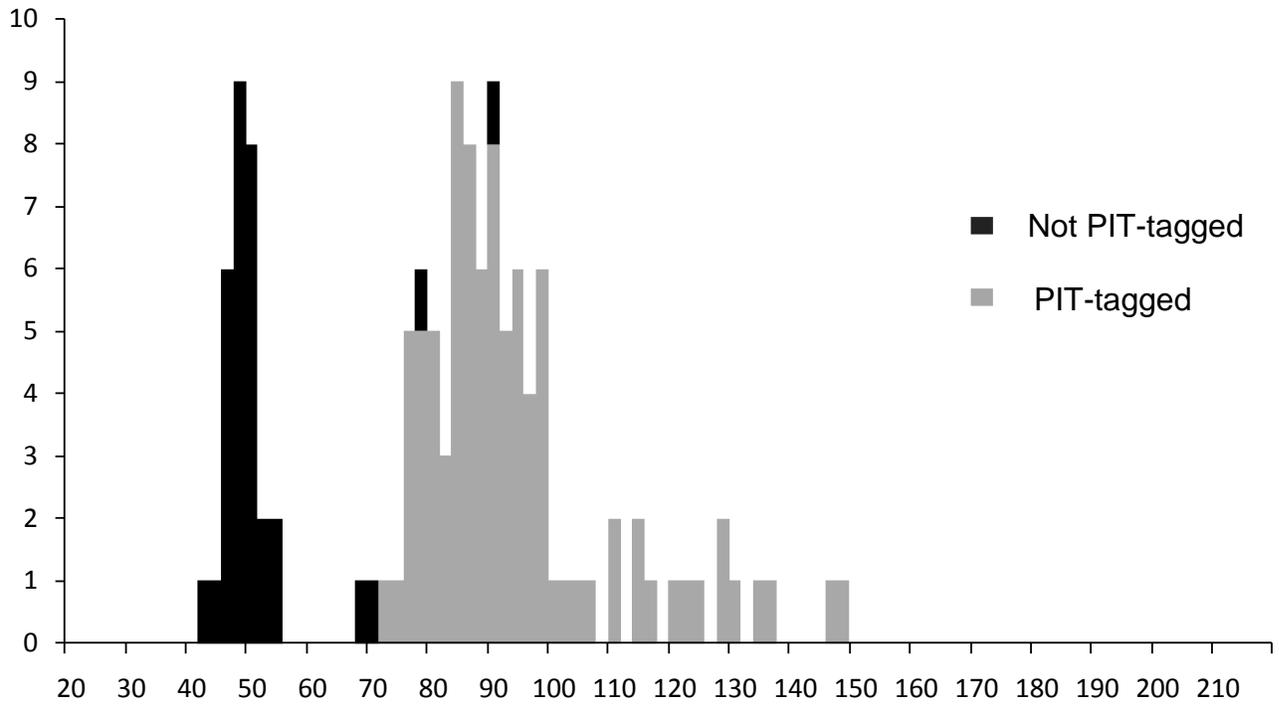
Appendix Figure 6. Length frequencies of juvenile steelhead *Oncorhynchus mykiss* in upper Martha Creek (site of a small diversion dam that was demolished by the U.S. Forest Service during late August 2012), sampled by electrofishing during August 2012 between rkm 2.3 and 2.6.

Trout Creek near 43 Road Bridge, 21 August 2012

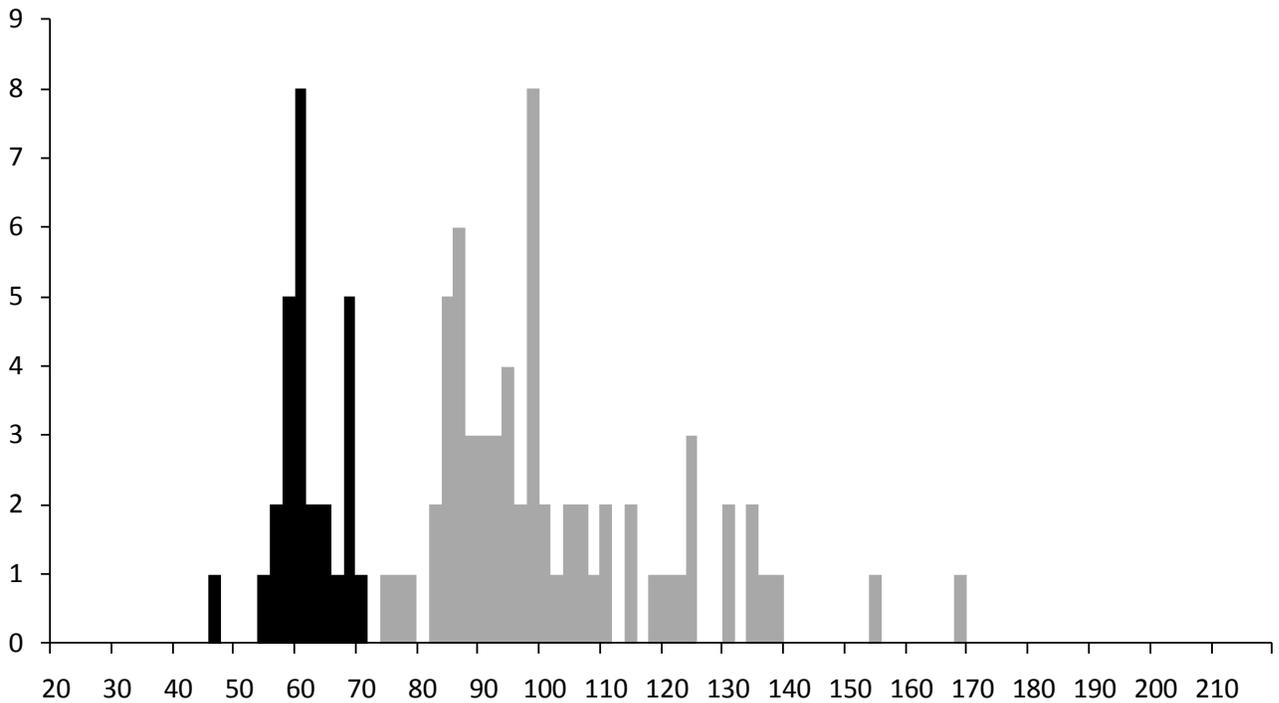


Appendix Figure 7. Length frequencies of juvenile steelhead *Oncorhynchus mykiss* in Trout Creek (just downstream of the 43 Road bridge), sampled by electrofishing during August 2012 between rkm 11.0 and 11.3.

Paradise Creek, 14 August 2012

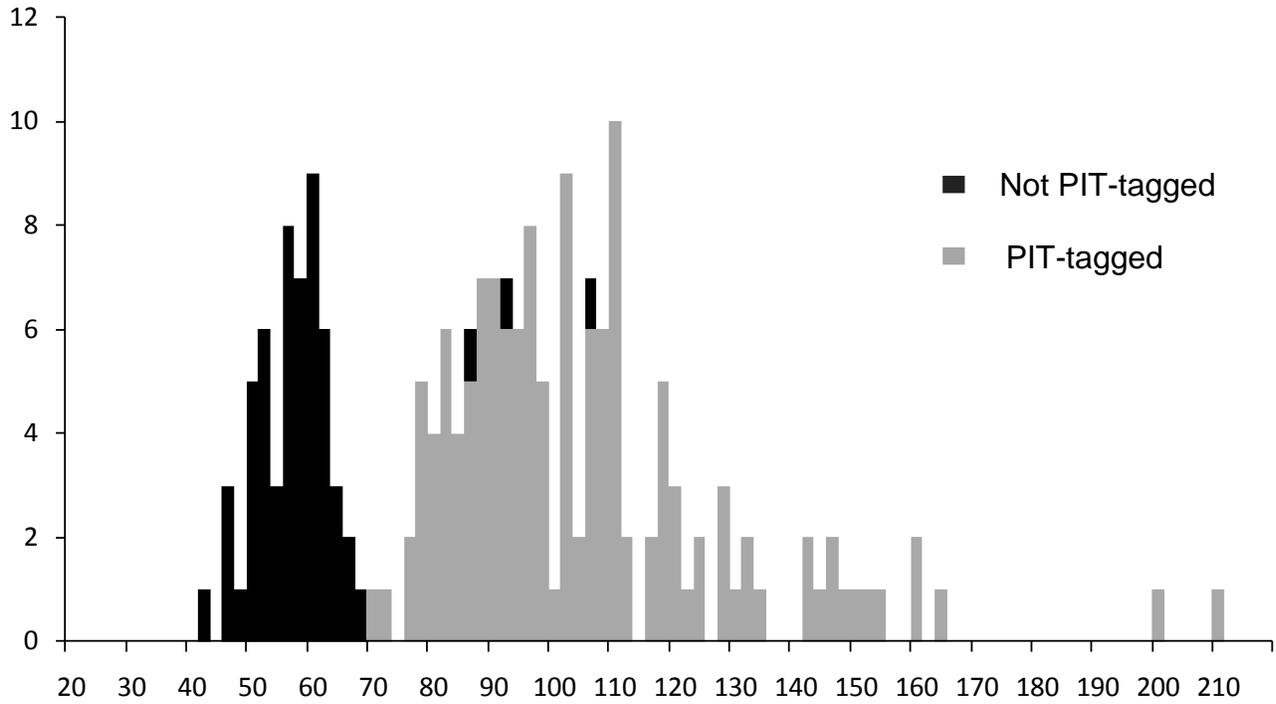


Paradise Creek, 28 September 2012

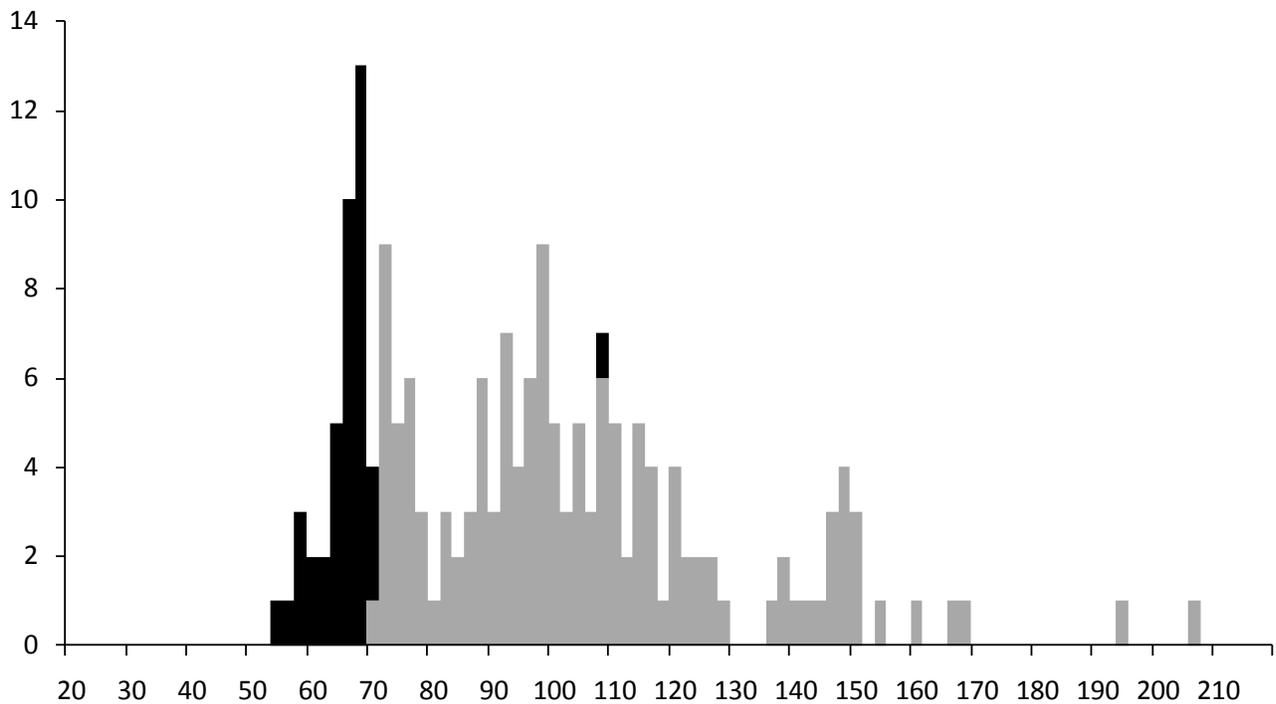


Appendix Figure 8. Length frequencies of juvenile steelhead *Oncorhynchus mykiss* in Paradise Creek, sampled by electrofishing during August and September 2012 between rkm 0.5 and 1.0.

Trapper Creek, 13 August 2012

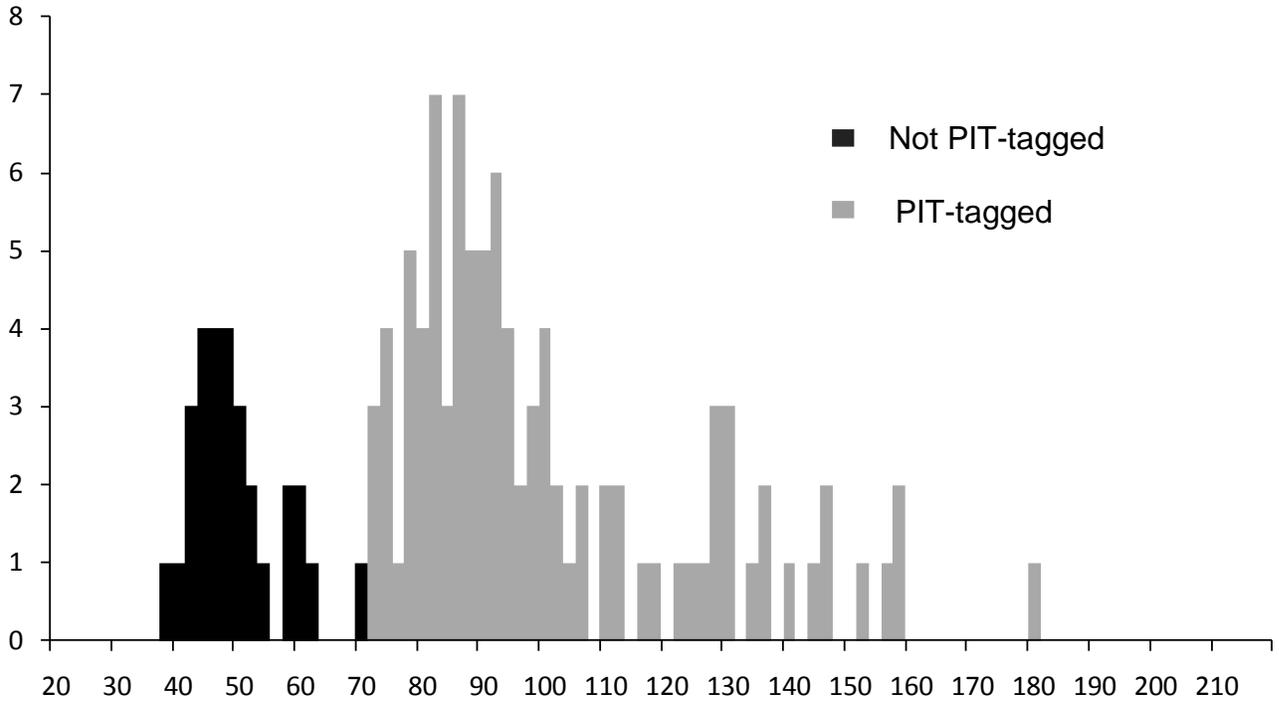


Trapper Creek, 27 September 2012

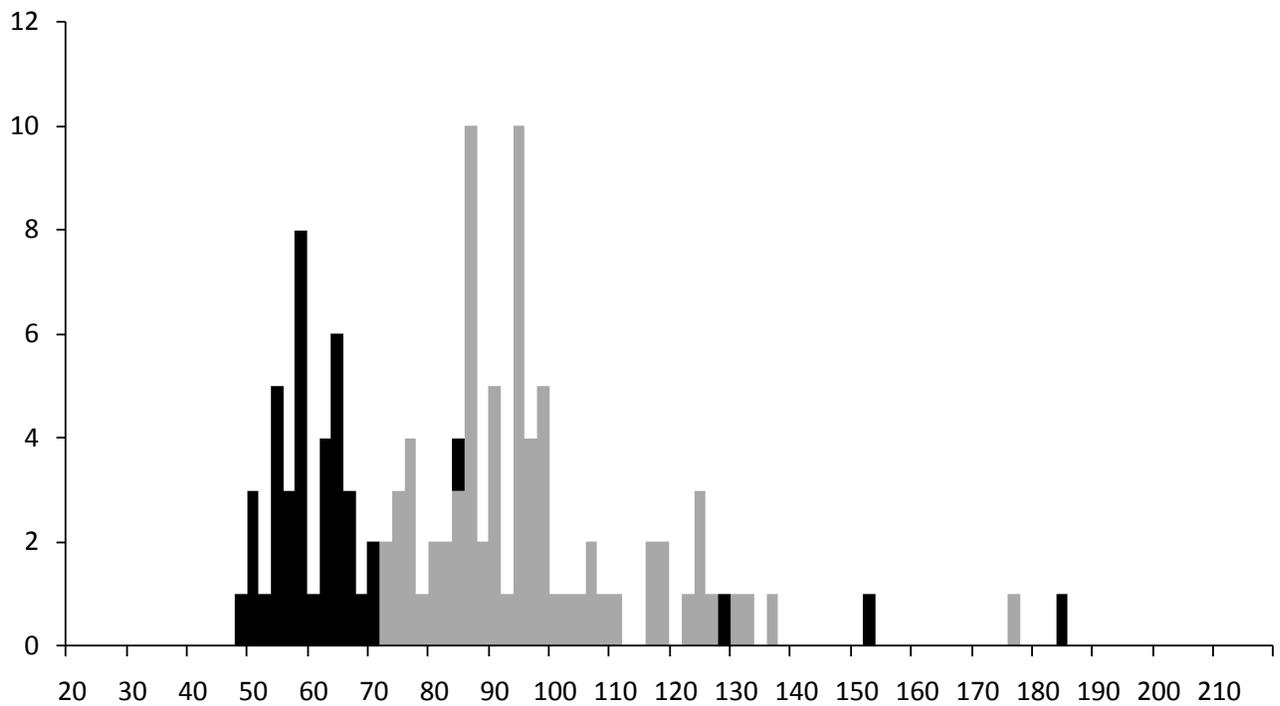


Appendix Figure 9. Length frequencies of juvenile steelhead *Oncorhynchus mykiss* in Trapper Creek, sampled by electrofishing during August and September 2012 between rkm 0.1 and 0.6.

Wind River, Upper Mine Site, 16 August 2012

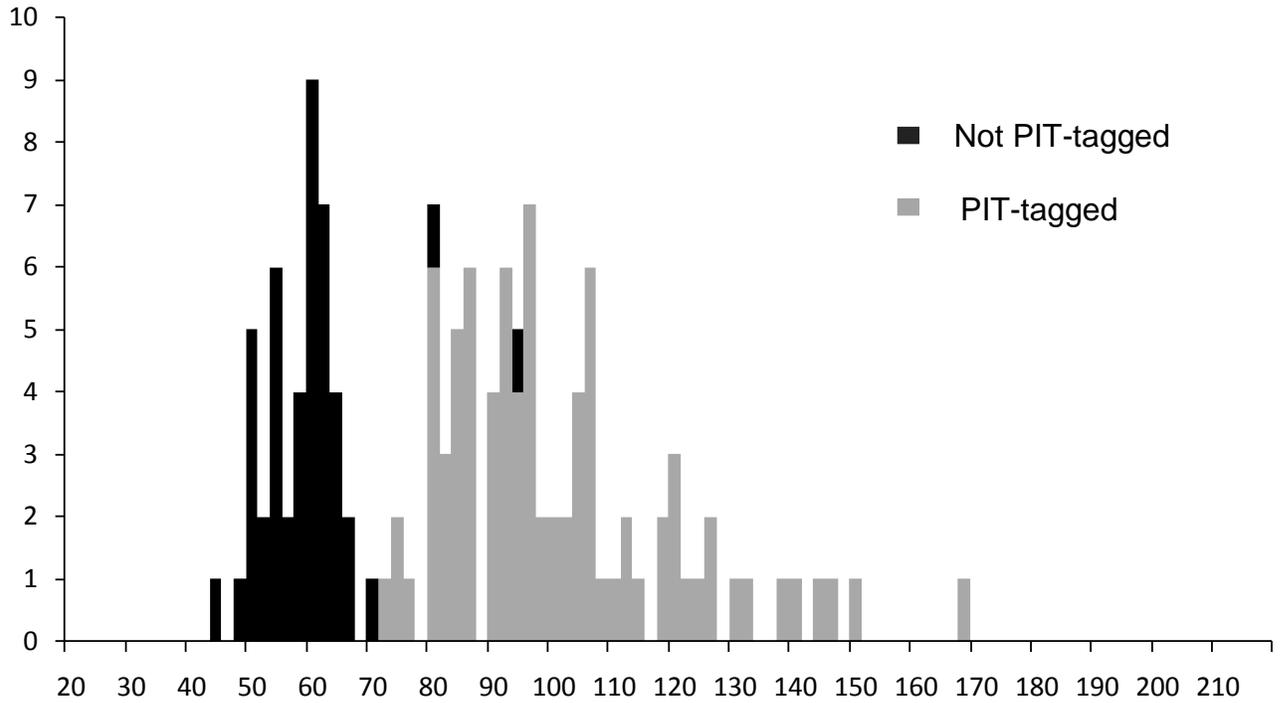


Wind River, Upper Mine Site, 25 September 2012



Appendix Figure 10. Length frequencies of juvenile steelhead *Oncorhynchus mykiss* in the Wind River upstream of its confluence with Paradise Creek, sampled by electrofishing during August and September 2012 between rkm 41.0 and 41.6.

Wind River, Mine Reach Site, 22 August 2012



Appendix Figure 11. Length frequencies of juvenile steelhead *Oncorhynchus mykiss* in the Wind River, sampled by electrofishing during August between rkm 37.0 and 37.4.