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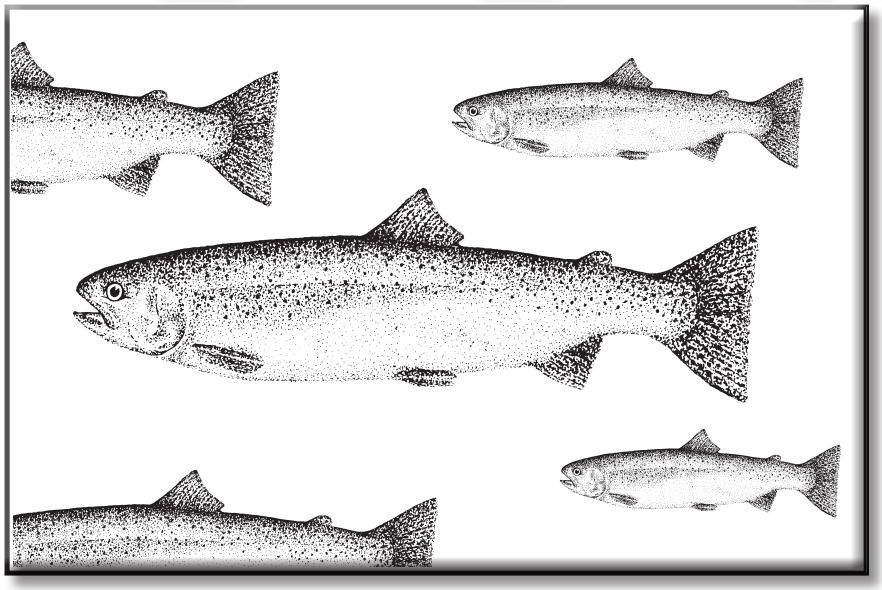
2016 Research and Monitoring of Adult *Oncorhynchus mykiss* in the Puyallup and White Rivers



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Washington Department of
Fish and Wildlife
Fish Program

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2016 RESEARCH AND MONITORING OF ADULT *ONCORHYNCHUS MYKISS* IN THE PUYALLUP AND WHITE RIVERS

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Contents

List of Tables and Figures

Introduction

The Puyallup River flows westward more than 54 miles from the west and north slopes of Mount Rainier to Commencement Bay in South Puget Sound. The Puyallup River watershed encompasses 948 square miles (2,454 km^2) and includes two major tributaries, the Carbon River and White River (Figure 1). The watershed as a whole contains a high proportion of urbanized, degraded habitat, multiple hydropower facilities, and an estuary that serves as one of the most active commercial ports in the world (Port of Tacoma).

Oncorhynchus mykiss (O.mykiss) originating from the Puyallup River watershed represent two distinct populations, Puyallup River steelhead and White River steelhead (Van Doornik et al. 2007) and are part of the Puget Sound Distinct Population Segment (DPS) which was listed as threatened under the Endangered Species Act (ESA) in 2007(NMFS, 2007). *O. mykiss* have been shown to express a variety of life history strategies including anadromous fish that undergo marine migrations and resident fish that complete their life cycle in fresh water (Kendall et al. 2015).

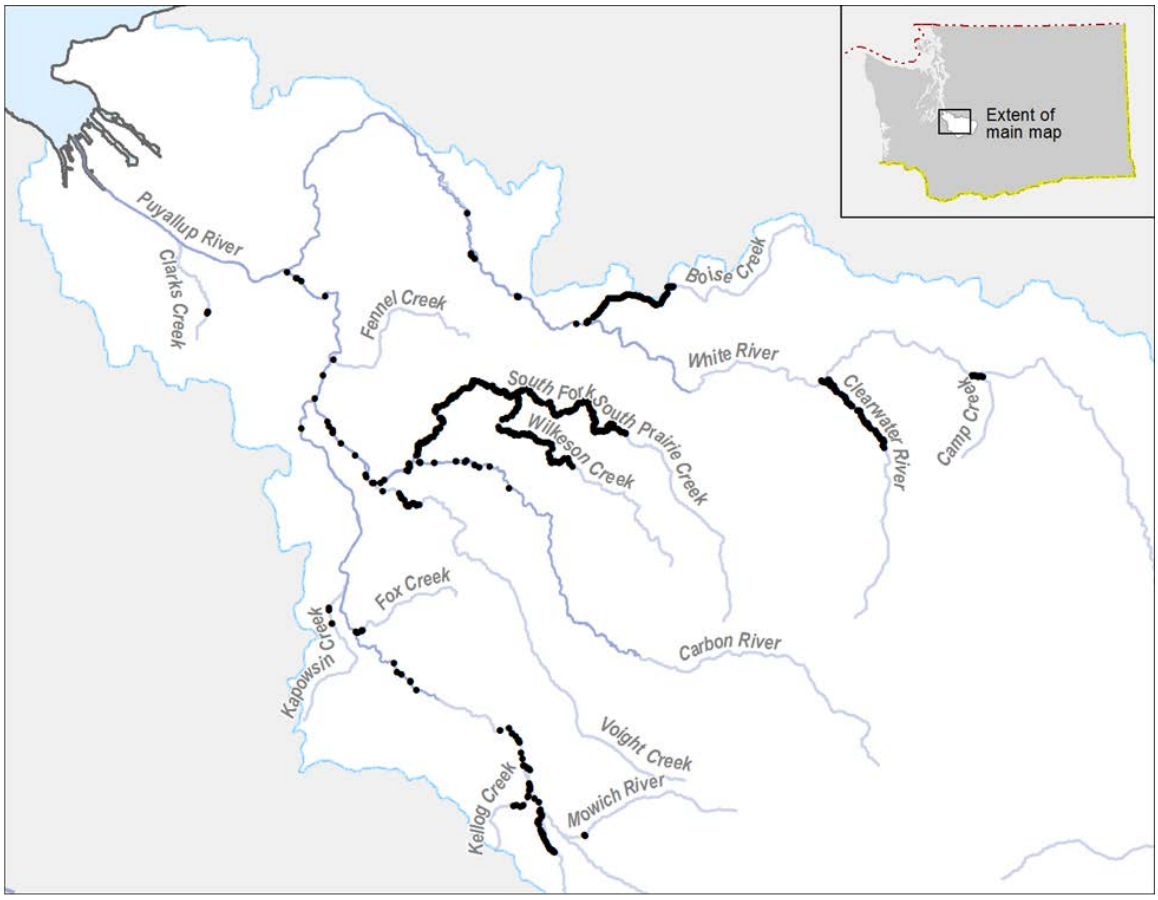

Figure 1. 2016 steelhead reeds observed in Puyallup Basin, Pierce County, WA.

The Puyallup steelhead population is made up of natural spawners who utilize the Puyallup and Carbon mainstems but the majority of spawning occurs in the many tributaries. An accurate estimate of the total number of spawners utilizing the mainstem Puyallup River is unknown due to low visibility caused by glacial flour. Surveying effort throughout the watershed suggests that South Prairie Creek, a non-glacial Carbon River tributary, supports a high proportion of the total steelhead spawners.

While the majority of spawning on the White River occurs naturally above Mud Mountain Dam (rkm 47.6) a proportion of steelhead returning to the White River originate from a wild broodstock hatchery program that was started in 2006. The juveniles are reared and released from acclimation ponds located in the upper White River. These individuals are distinguishable from naturally produced fish through electronic detection of a blank coded wire tag.

Management Practices

Historically, management has been focused on the anadromous population of *O.mykiss* until 2008 when the Washington Department of Fish and Wildlife's Statewide Steelhead Management Plan (WDFW 2008) was published. This document highlighted the importance of resident fish as one component of the *O.mykiss* life history complex. Specifically this management plan called for a better understanding of the relationship resident *O.mykiss* have to their anadromous counterpart through the development of tools to evaluate the status of resident and anadromous life histories.

The purpose of this document is to summarize stock assessment, monitoring and research activities conducted by WDFW and the Puyallup Tribal Fisheries (PTF) in 2016 associated with adult *O.mykiss* in the Puyallup River Watershed.

Harvest

Harvest of anadromous *O.mykiss* in 2015-16 was consistent with previous years and was limited to incidental encounters during sport and tribal fisheries. No wild steelhead were harvested by the Puyallup Indian Tribe, Muckleshoot Indian Tribe or non-treaty sport fishermen during 2015/16 fisheries targeting chum, coho and Chinook salmon.

Harvest of wild, resident *O.mykiss* is unknown however opportunity did exist in the Puyallup River during the 2015-16 fall fisheries. Regulations are designed to protect juvenile steelhead and resident rainbow trout by prohibiting fishing during the smolt migration period and/or through the use of minimum fish size, gear restrictions and bag limits (WDFW 2008).

Estimate of Escapement

Anadromous *O.mykiss* (steelhead)

Methodology

Escapement of wild winter steelhead on the Puyallup and White rivers was estimated from the total number of redds observed by float, foot and aerial index surveys conducted by WDFW and PTF during spawning ground surveys, as well as adult counts at the Buckley Diversion Dam Trap-and-Haul facility (Buckley Trap). Redds observed during spawning ground surveys were expanded to number of fish based on the assumption that one redd represents 1.62 fish (Mayer et al. 2005).

Index areas were chosen based on the availability of suitable spawning habitat and have remained relatively unchanged since 1983. While the relationship between index areas and the total number of spawners is unknown, areas surveyed provide a relative estimate of steelhead spawning in the Puyallup and White rivers. Index areas were surveyed every seven to ten days depending on flow, clarity and staff available. New redds were recorded and marked with a flag labeled with the date and surveyors initials. Previously marked redds were recorded to estimate redd life. Live and dead fish were enumerated and carcasses were sampled for gender, length, fin marks, scales, DNA, otoliths and coded wire tags.

These escapement estimates should not be considered an estimate of the total number of steelhead in the Puyallup watershed as all known spawning areas were not surveyed. The methodology used to produce the 2016 steelhead estimate represents a conservative estimate of relative abundance for this time period.

2016 steelhead escapement, length and age data

Low flows this survey season allowed for excellent coverage of index areas and an estimate of relative steelhead abundance for the Puyallup watershed including both the Puyallup and White River populations. Together, the 2015-16 Puyallup Basin wild winter steelhead escapement estimate is 2,391and is summarized in Table 1 and the text below. Figure 1 summarizes steelhead redd observations during the time period.

Table 1. 2016 Puyallup Basin Steelhead escapement estimate.

Puyallup River Population	rkm	Escapement
Mainstem	58.9	66
Puyallup R. Tributaries (Niesson, Ledout, Kellogg, Fennel, Canyonfalls, Fox, Kapowsin, Clarks, Swan, Clear)	22.2	131
Carbon River Mainstem	18.2	95
Carbon River Tributaries (South Prairie, Wilkeson, Voights)	40.1	1,271
White River Population		
Lower White River including Boise Cr.	40.7	295
Buckely Trap counts (including wild Broodstock)		533
Total Basin Wide Escapement		2,391

Puyallup River steelhead

The wild winter steelhead escapement estimate for steelhead spawning in the mainstem of the Puyallup River is 197 fish. An estimated 1,366 steelhead spawned in the Carbon River in 2016. This estimate includes fish spawning in the mainstem of the Carbon River, South Prairie, Wilkeson, and Voight's creeks.

White River steelhead

Estimates of steelhead spawning below Mud Mountain Dam via redd surveys (295 fish) were combined with the number of fish transported upstream at Buckley trap (533 fish) for an estimated 828 White River steelhead returning. Of these fish, 34 originated from the wild brood program and 23 natural origin steelhead were used for broodstock at White River hatchery. The progeny of these fish will be marked with blank wire tag and reared in acclimation ponds in the upper White River consistent with previous years.

Fluvial/Resident *O.mykiss* (rainbow trout)

Methodology

Sampling of resident *O.mykiss* in 2016 served as a pilot project to develop a long term approach to monitor size, age, gender and abundance of resident *O.mykiss* in the Puyallup River watershed. Resident *O. mykiss* were sampled at two locations in the Puyallup system: 1) at the Buckley Trap below Mud Mountain Dam on the White River and 2) in S. Prairie Creek using hook and line and snorkel surveys.

In 2016, age, gender and length (fork length) data was collected from all individuals captured in S. Prairie Creek and White river. Scale analysis was conducted as described by Peven et al. (1994). To determine gender we relied on morphology and the expression of milt.

To evaluate interannual variability in abundance of the resident *O.mykiss* population in the White River we enumerated adult *O.mykiss* passed upstream at Buckley Trap. Scale analysis was used to estimate the proportion of fish sampled that exhibited no marine entry check (fluvial/resident life history). We then expanded this estimate based on the proportion of steelhead sampled at the trap. Scale data from 2016 had not been analyzed at the time of this report and will be reported in 2017. For the Puyallup River *O.mykiss* population we used hook and line data in S. Prairie Creek to serve as an index of relative abundance. We conducted a one-day test fishery on June 15th using artificial, un-baited lures (flys, spoons, spinners) with barbless hooks. Two anglers walked S. Prairie Creek from rkm 20.2 to the mouth at the confluence with the Carbon River. We divided this area into 4 "subareas". From these data we calculated catch per unit effort (CPUE, fish/hour) and made comparisons between subareas.

Numerous studies have documented sampling bias associated with hook and line methods (Hetrick and Bromaghin 2006; Losee and Phillips 2016) where larger rainbow trout are disproportionately captured relative to what is present in the population. In an effort to evaluate sampling bias associated with hook and line methods in S. Prairie Creek and strengthen estimates of relative abundance we compared the size of fish captured using hook and line vs. those observed snorkeling. Snorkel surveys were conducted one week prior to hook and line sampling using standard snorkel survey methodologies (Torgersen et al. 2006).

Resident O.*mykiss* age, size, gender and abundance

In 2016, a large proportion of rainbow trout from S. Prairie Creek that were successfully aged were 4 and 5 year olds (87.5%, N=7/8, Figure 2) however sample size was low and the majority (52.9%, N=9/17, Figure 2) of scale samples collected in S. Prairie Creek were regenerated and therefore unreadable. Similarly, 4 and 5 year olds were the dominant age class of resident *O.mykiss* sampled at the Buckley Trap in 2015 (N=2, Figure 3). This is in contrast to 2012-2014 where age 3 fish were common.

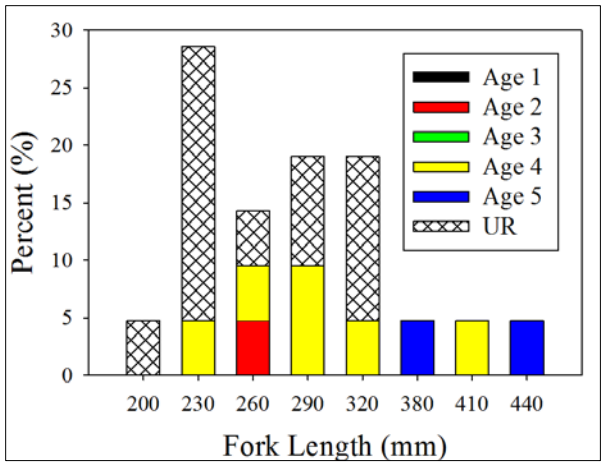

Figure 2. Length frequency distribution and age composition of resident O. *mykiss* captured in South Prairie Creek, Pierce County, WA in 2016. "UR' signifies fish who's scales were unreadable.

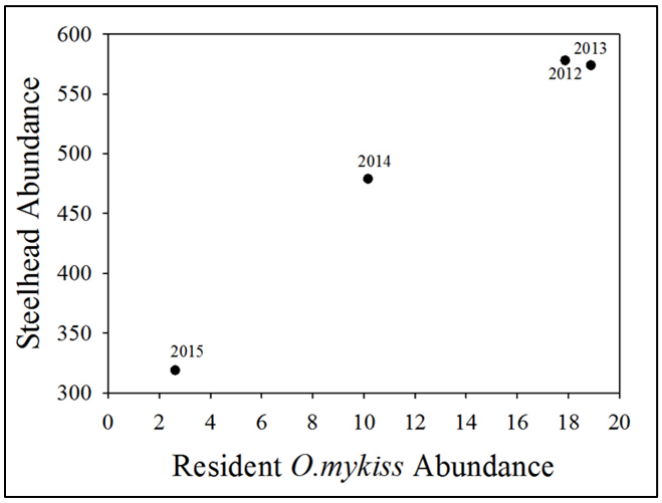

Figure 3. Number of Resident O. *mykiss* vs. steelhead at the Buckley Trap, Pierce County, WA, 2012-2015.

Size of resident *O.mykiss* caught in S. Prairie Creek ranged from 220 mm to 440mm (mean: 300.6 mm ± S.D. 64.4, N=17, Figure 2). In 2016, gender was determined for only 4 of the fish sampled (2 males: 2 females) due to the lack of milt expression or clear morphological characteristics. Previous work in the Nisqually and Puyallup Rivers suggests that the ability to determine gender is driven in large part by the time of sampling (Madel and Losee 2016). Peak spawn timing of steelhead in the Puyallup River takes place between April 15th and May 1st. Sampling of resident rainbow in the current study occurred in June, well outside the peak spawning period of anadromous *O.mykiss*.

In 2016, CPUE of *O. mykiss* in S. Prairie Creek was 0.47 fish/hour. This was the first year to assess relative abundance therefore no comparisons were made to other years. In the White River the number of resident *O.mykiss* enumerated has decreased since 2012. In 2015 only 2 residents

were encountered at Buckley Trap. Based on 4 years of data, interannual variability in abundance of resident *O.mykiss* is positively related to abundance of anadromous *O.mykiss* in the White River (P<0.05, R=.986, Pearson Correlation, Figure 3).

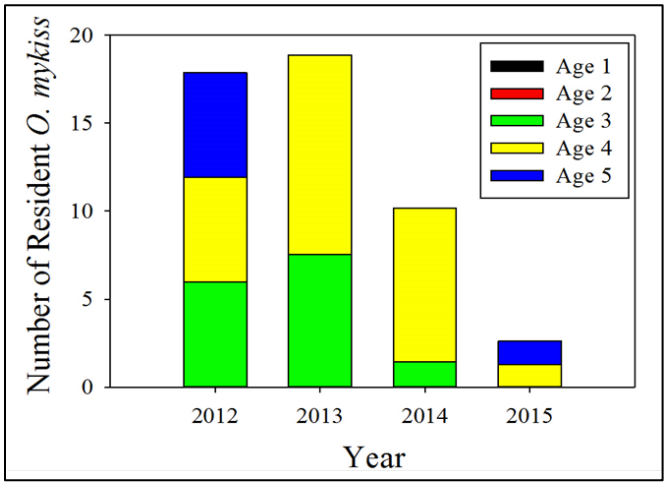

Figure 4. Number and age composition of resident O. *mykiss* passed upstream at Buckley Trap, White River, Pierce County, WA, 2012-2015.

We observed no significant difference between fork length from snorkel observations vs. hook and line, suggesting (p>0.05, chi-square, Figure 5) that hook and line provides a representative sample of the population. Sampling in subsequent years will confirm these observations.

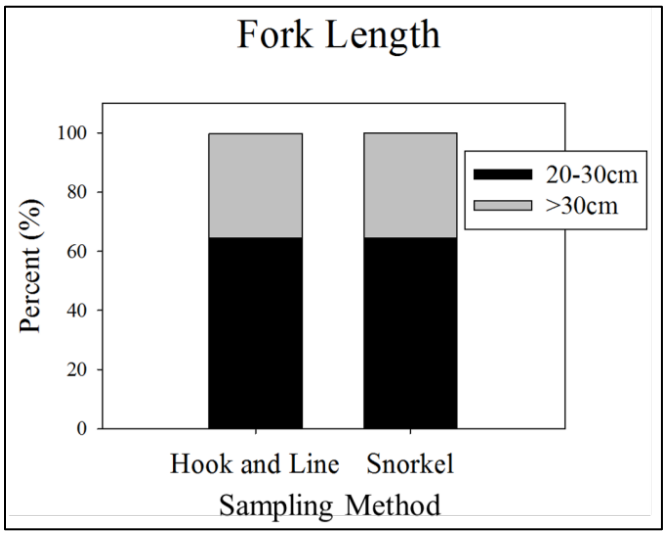

Figure 5. Fork length (cm) of adult resident O. *mykiss* sampled via hook and line (N=29) vs. estimated lengths observed during snorkel surveys (N=79) in South Prairie Creek, Pierce County, WA (river kilometer 0.0-20.2), 2016.

Discussion and Future Work

The 2015-16 steelhead escapement estimate (2,391 spawners) represents the highest number of steelhead estimated in over two decades (Figure 6). While factors controlling adult returns of steelhead in the Puyallup river are complex and not well-understood, early marine survival of juvenile steelhead during outmigration has been identified as a critical period, where survival is low relative to other life stages (Moore et al. 2015). In addition, environmental conditions during freshwater rearing have been shown to have a significant effect on survival rates of juvenile steelhead (Petrosky and Schaller 2010). In order to fully understand factors that affect variability in abundance of anadromous *O.mykiss* in the Puyallup River additional work needs to be done to compare survival at various life stages. In line with these efforts, PTF began operating a smolt trap on the lower White River (rkm 9.6) in 2016. These data will be used in conjunction with smolt trap data that has been collected in the Puyallup River (rkm 17.4) since 2000 and adult data presented here for future work.

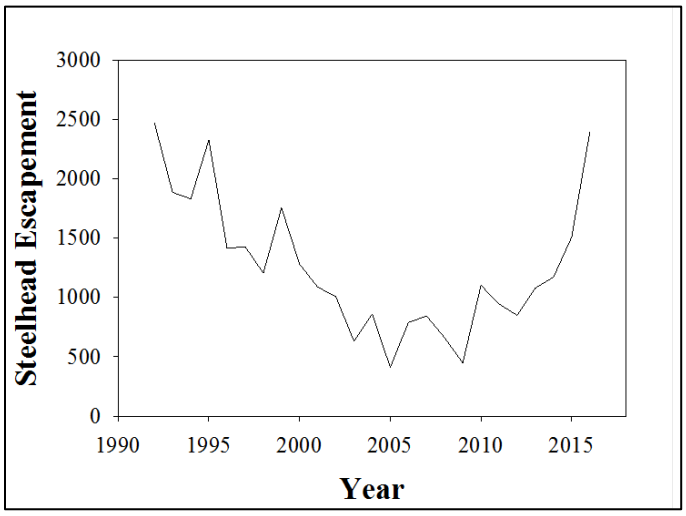

Figure 6. Puyallup River steelhead Escapement estimate, Pierce County, WA, 1992 to current.

In 2016 WDFW personnel took the first steps toward developing a monitoring approach for resident *O. mykiss* in the Puyallup River Drainage. Work completed in 2016 should be viewed as a pilot project to build a foundation for collecting metrics to monitor the resident life history of this species. In order to evaluate interannual variability associated with length, age, and abundance and maximize identification of gender, sampling efforts should be concentrated at the beginning of the spawning period (first two weeks of April) and new technology should be investigated to better understand the gender of those fish that do not express milt during the spawning period (ultrasound, genetics etc.).

In addition, species identification through snorkel surveys proved to be challenging in reaches where cutthroat trout were abundant. Discussions on how to improve methods in these areas are ongoing with one option being to focus effort on upper reaches where cutthroat trout are less abundant. Finally, with over 50% of the scales that were taken being unreadable due to regeneration, procedures to take additional samples from multiple locations on the fish should improve the probability of obtaining readable scales in the future. While valuable data was collected associated with both anadromous and resident *O. mykiss* in 2016, the strength in this research will result from long term, consistent, monitoring of *O. mykiss* as it relates to the overall *O. mykiss* complex in the Puyallup River Basin.

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