

STUDY CODE: - TBD

TITLE: Improved Monitoring at Willamette Falls

MANAGEMENT PURPOSE:

Willamette Falls is a critical monitoring site in the migration corridor for nearly all ESA-listed spring Chinook and winter steelhead in the Upper Willamette River (UWR). It is a site where tagged outmigrating smolts can be readily detected, and a subset can be collected and tagged when exiting the UWR prior to estuary residence and ocean entry. Willamette Falls provides a natural bottleneck with adult fish ladders where all returning salmon and steelhead can be observed, counted, and detected. Additional data from this site can greatly improve our understanding of the overall survival of spring Chinook and winter steelhead. The importance of improving these estimates is referenced in both NMFS Willamette Biological Opinion (2008) and the Upper Willamette River (UWR) Recovery Plan (ODFW and NMFS 2011).

Existing PIT arrays at Willamette Falls have failed, taking away valuable data from many releases upstream that are ongoing. We propose replacing the existing PIT arrays, conducting an active tag study to quantify passage routes, and installing new PIT arrays in additional locations. These improvements will greatly increase detections and allow for robust survival estimates, similar to those from other monitoring sites in the Columbia River. Survival estimates will support many phases of planning for population recovery and water management.

The WATER RM&E Team considers monitoring at Willamette Falls a high priority for all research and monitoring in the UWR. We are seeking administrative support to work with various partners at this site and to pursue funding for these improvements. We hope to begin these improvements as soon as possible to avoid losing additional data.

FISH PROGRAM FEATURE: Monitoring and Research

BIOLOGICAL OPINION ACTION: RPA measures; 2.8, 2.10, 4.11, 6.2.4, 9.3

BACKGROUND:

Salmon have been monitored at Willamette Falls since 1885 when the first fish ladder was built. In recent years, monitoring has been done primarily at two sites; a counting station for adult salmon and a hydroelectric power plant on the west side of the river.

The adult counting station is near the middle of the river where the three fish ladders come together and exit above Willamette Falls. UWR adult Chinook salmon and steelhead listed under the Endangered Species Act swim through this facility to ascend Willamette Falls (other than those returning to the Clackamas River), as do other species of interest. This facility is owned and operated by the Oregon Department of Fish and Wildlife (ODFW). Accurate counts of adult salmon and steelhead have been taken at this site since 1950. Currently, video data are collected continuously with daily counts posted on a website. While this provides the total count of each species, and a subtotal of hatchery origin fish, it cannot provide tributary-specific data. The 4 orifices where the fish ladders come together have existing PIT antennae around them. These are single wire antennae in a housing made of plastic. Because of the configuration and past data, we can assume 100% detection of all PIT tagged adult

salmon returning to Willamette Falls through the lower Willamette River from the Columbia River estuary and the Pacific Ocean.

The second monitoring site is the Sullivan Plant, a hydroelectric facility owned and operated by Portland General Electric (PGE). Currently, the Sullivan Plant has 13 turbines in line upstream to downstream, with Turbine 13 the last turbine downstream. PGE has completed many improvements for fish passage at the Sullivan Plant and current survival of smolts that enter the plant is estimated as 99%. The primary passage route for smolts through the Sullivan Plant is the North Fish Bypass (NFB), with guidance screens and a ramp back to the river. The NFB has one large, single loop PIT antenna around the middle of the bypass ramp. The NFB is used by about 90% of the juvenile salmonids going through the power plant. The second passage route through the plant is Turbine 13. It has an Eicher screen and bypass pipe to divert fish, the pipe has a single PIT antenna in it. This route is used by the remaining 10% of juvenile salmonids going through the power plant. In addition, the plant has an evaluator and sampling station that uses screens on the channel from Turbine 13 to divert fish into a holding basin. This evaluator was used to catch, sample, and tag juvenile salmonids until it failed in 2018. The evaluator was used initially to produce survival estimates for fish going through the Sullivan Plant. Also, it's been used to sample juvenile Chinook before they enter the Columbia River Estuary for studies by ODFW and OSU.

The original PIT arrays have many limitations, and their designs are outdated. Each array only has a single PIT antenna at a given location and the current antennas are not shielded from electronic noise. Big changes in detection efficiency are unknown without a second antenna in series. New arrays typically have two PIT antennas close together in the same housing, where one antenna can detect fish that the other missed. This allows for estimates of real-time detection efficiency, which in turn greatly improves survival estimate from detections. This is especially important in locations with high water velocity, such as the juvenile bypasses.

All PIT arrays at Willamette Falls were taken offline in 2019 after various components failed due to their age. Fiber-optic cables for data communication have failed at all the existing arrays. Modems need to be replaced as well. The readers may still be functional, although the readers and detection fields from the antennas likely need to be tuned. Without communication, we don't know when the arrays go offline or for how long. The anchors and cleaning system for the evaluator have completely failed due to severe corrosion. No other options are currently available to sample smolts at Willamette Falls.

Key Uncertainties:

- Smolt-to-Adult-Return rates (SARs) for spring Chinook and winter steelhead
- Survival through reaches upstream of Willamette Falls, both in the mainstem and in tributaries
- Delayed mortality after passage through dams upstream
- Flow changes affecting survival and passage timing
- Proportions of smolts using different passage routes through Willamette Falls
- Locations for additional PIT antennas

Key Management Needs:

- Better detection data from the thousands of smolts tagged annually for passage studies
- Consistent detections of all PIT tagged adult salmonids returning to Willamette Falls
- Estimates of the percentages of smolts using different routes through Willamette Falls
- Tributary-specific data of adults returning to lower river, when not counted upstream

- Tributary-specific juvenile migration timing and potential survival data
- Long-term SARs to compare years and groups of migrants

OBJECTIVES:

1. Replace existing PIT arrays

- a. Adult ladders
- b. Sullivan Plant (NFB and Turbine 13)

This will prevent the further loss of data and allow for detections of tagged fish from many studies taking place upstream. Previous data from these arrays can be compared to help build survival estimates. Detections of adult salmon are especially important given the number of PIT tag releases over the last 2 years.

2. Replace the evaluator in the Sullivan Plant

The ability to sample and tag juvenile salmonids at Willamette Falls will greatly improve survival estimates because of detections from sites downstream in the Columbia River. Smolts at Willamette Falls will be detected in the adult ladders when they return, providing survival data. The evaluator can support many different studies.

3. Conduct an active tag study to determine passage routes through Willamette Falls

Active tags will determine different passage routes and the proportions of smolts using them. This will show the need additional PIT antennas and where to locate them. passage routes can improve survival estimates at different river levels. Additional antennas and detections will support robust survival estimates.

4. Add new PIT antennas

- a. Log-booms just upstream of the Sullivan Plant
- b. Other sites as determined by the active tag study

Additional PIT antennas and detections will improve survival estimates overall. The log-booms have already been identified as they are in line with Sullivan Plant and will add multiple detections of fish on this side of the river. Other locations may be identified by the active tag study.

5. We recommend completing these improvements comprehensively as they are all of equal importance and all contribute data needed to plan population recovery.

IMPROVEMENTS AND COSTS:

Replace the PIT antenna on the NFB - \$70,000

- Install 2 shielded antennas in the same housing, a new reader, cables, and modem.
- Will increase detection efficiency and survival estimates.
- Permission needed from PGE to proceed.

Replace PIT antenna in Turbine 13 - \$35,000

- Install 2 shielded antennas in the same housing, a new reader, and cables.
- While a secondary passage route, higher detection efficiency overall at this site will further improve survival estimates.
- Permission needed from PGE to proceed.

Replace PIT antennas in the adult ladders - \$50,000

- Install 4 cord antennas, new readers, cables and modem.
- Will detect 100% of PIT tagged adult salmonids migrating through Willamette Falls.
- Will consistently record data, year-round.
- Will provide adult return data for SARs estimates.

Replace the Evaluator - \$230,000

- Completely redesign and rebuild metal screens, automated cleaning system, holding basin and outlet canal.
- Cost estimated by PGE in 2019, may now be higher.
- Permission needed from PGE to proceed.

New antennas upstream of the Sullivan Plant – \$82,000

- Install 6 cord antennas below the log-booms, with solar panels, batteries, reader and modem.
- Will provide additional detections to improve survival estimates.
- Permission needed from PGE to proceed.

New antennas in the upper NFB – \$35,000

- Install 2 shielded antennas in the same housing, new reader and cables.
- Will increase detections in an area with lower water velocity than lower in the NFB.
- Permission needed from PGE to proceed.

Active tag study - \$200,000

- JSAT tags, acoustic receivers, staff time for deploying receivers, tagging and analysis.
- 4 runs at different river flow levels of 50 JSAT tags each (200 tags total).
- Close receiver spacing to identify passage routes.
- Summary of results and percentages of smolts using each passage route.

Annual maintenance of PIT Arrays and tagging by ODFW - \$125,000

- Full-time, year-round technician to maintain electronics, catch and tag juvenile salmonids, and process data and upload data.
- Support from PIT antennae expert for repairs and troubleshooting.
- Administrative support would be provided by an existing ODFW project under this scenario.

- Alternatively for cost savings, maintenance of the PIT systems at Willamette Falls can be combined with work at nearby sites on the Columbia River by another agency. Tagging can be done as needed by other cooperating agencies.

TOTAL ESTIMATED COST TO REPLACE EXISTING IFASTRUCTURE: \$385,000

TOTAL ESTIMATED COST OF NEW ARRAYS AND ACTIVE TAG STUDY: \$317,000

GRAND TOTAL: \$702,000

ANNUAL PERSONNEL COSTS: \$125,000

We thank Dan Cramer at PGE, Derrek Faber at ODFW, Gordon Axle at NMFS, and Dr. Tobias Kock at USGS for their input and technical expertise.