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Whooshh Fish Transport System - Buckley Study Report

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adapted from the Buckley test plan by

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Buckley Study Report:
Pilot Study – Pink Salmon Volitional Entry WFTS transport

Study and Site Aspects

In 2015, Whooshh Innovations proposed a pilot test of the fish attraction, collection and volitional entry components downstream of the Whooshh transport tube accelerator entry on the Whooshh Fish Transport System (WFTS) in the rock chute sluiceway located off the Cascade Water Alliance (CWA) diversion canal, just below Buckley Dam on the White River near Buckley, Washington. The rock chute sluiceway is periodically used as needed by CWA to sluice accumulated bedload material out of the canal and back to the White River. The WFTS test at Buckley was performed as part of the development process for experimental fishway technologies, as detailed in Section 16.4 of the National Marine Fisheries Service (NMFS) fishway design manual (NMFS, 2011). This pilot engineering feasibility study, was a preliminary test to evaluate the Whooshh fish attraction/collection equipment design and volitional entry up a false weir technique, to observe operations and to put in place any adjustments and improvements in anticipation of a 2017 WFTS need at this location. The Buckley dam trap has experienced significant fish passage problems (noted: NMFS, 2014) in odd years when pink salmon runs are at their maximum run size. In past odd-numbered years, the pink salmon run created a domino of overcrowding problems including fish crowding injury, delay and rejection of the Buckley fish passage facility thereby creating downstream crowding issues affecting passage of Endangered Species Act (ESA) listed Puget Sound Chinook salmon (PS Chinook) through the Buckley fish passage facility. The Corp of Engineers (COE) have made improvements to the Buckley Dam and fishway to address the challenges, however as a backup, the Puyallup Indian Tribes (PIT) and Whooshh Innovations believed the WFTS could help alleviate fish passage problems by removing some percentage of the pink salmon run before they reached the Buckley Dam fishway. With the successful demonstration of WFTS transport following volitional entry of pink salmon pre-sorted by size exclusion, the WFTS will be a viable augmentation option for capacity management of the 2017 pink salmon run at the upstream Buckley Dam fishway.

The Buckley pilot feasibility study was conducted as part of an adaptive management development approach of the WFTS. It successfully demonstrated proof of concept of attraction, volitional salmonid entry and transport through the WFTS. Pink salmon were encouraged to collect in a fishway constructed in the rock chute sluiceway just downstream of Buckley Dam by providing an attraction flow of ~5 cfs at the bottom of a series of three low wood bypass steps separated by three small, shallow pools. The pink salmon passed through a size exclusion bar rack on their own volition placed within one of the pools. At the last step before entry into the Whooshh transport tube, the fish swam up a small false weir with a flow of <1 cfs and proceeded directly into the Whooshh tube accelerator entry. Within 2-3 seconds the fish transported the length of the 80 ft tube and exit into oxygenated fresh water tanks loaded on a PIT fish transport truck. The trucks hauled the fish upstream to Lower Days park for release back into the river (Whooshh Innovations, 2016).

The study commenced in August 2015. ESA take coverage was provided by the Puyallup Indian Tribes permit, issued for the collection, research and passage of fish at the Buckley site. Protocols and procedures were overseen by PIT members and specifically by Justin Paul the PIT Biologist.

The study was designed to produce no take of endangered PS Chinook, and to transport no species other than pink salmon.

The typical migration timing of PS Steelhead at the Buckley site are such that it was very unlikely that many, if any, PS Steelhead would arrive at the Buckley site during the study. The major concern was the possibility that PS Chinook would be present when the pink salmon run arrived, with the run numbers of pinks forcing abandonment of existing fish sorting measures. Every odd year the pink salmon runs are exceedingly large at the Buckley site and, in the past, have overwhelmed the sorting capacity of the Buckley Dam fishway.

Experience suggested that pink salmon readily enter shallow, three-inch target, channels with ~5cfs flow conditions whereas Chinook prefer deeper passage conditions. To reduce or exclude attraction of Chinook into the rock chute sluiceway such an attraction flow was engineered at the end of the rock chute sluiceway, which was just a few inches deep. Historical remarks by Biologists at Buckley indicated no observed occurrences of Chinook in the rock chute sluiceway. To further exclude PS Chinook from the rock chute sluiceway, a bar rack was placed in a pool of the fishway, allowing segregation via size and therefore separation of Chinook from the smaller pinks. The bar rack was constructed such that the spacing could be altered to accommodate pink size and body shape which vary from fish to fish and from year to year. The initial spacing used in the rock chute sluiceway pool was 1.5 inches.

To safe-guard against the possibility that a PS Chinook that was of the same size as a pink salmon traveled up the rock chute sluiceway and passed through the exclusion bar rack, a dedicated technician was put in place to visually inspect the fish at the entry pool below the false weir for presence of PS Chinook salmon. The Whooshh daily onsite technician was Mike Jaca. No Chinook were observed at the false weir during the study.

Previous WFTS studies evaluating adult survival, productive spawning, egg viability and overall adult condition, injury assessment and well-being after Whooshh tube transport have revealed that Whooshh transported fish fared as well or better than control transported fish. These initial studies transported Chinook salmon: spring/summer Chinook at Roza to the Cle Elum hatchery by the Yakama Tribe (Yakama Nations, 2014, 2014b & 2016) and fall Chinook at Priest Rapids hatchery by the Pacific Northwest National Laboratories (PNNL) (Geist, 2016). Although pink salmon, as a species, is a considerably smaller fish than the Chinook, it was expected that the favorable survival and injury results demonstrated for Chinook WFTS transport would translate to safe and effective passage of pink salmon.

Design Aspects

The rock chute sluiceway was modified to reflect a simple pool and weir fishway operated with about 5 cfs fishway flow. The basic modifications to the Buckley rock chute involved wood constructed stop log guides spot welded to the sides of the rock chute sluiceway to receive fishway weirs to be used as observation pools to detected the unlikely presence of PS Chinook (Whooshh Innovations, 2016). The design addressed the following concepts:

1. provided a shallow apron depth at the sluiceway terminus in the river, replicating hydraulic conditions to be attractive mostly to pink salmon;

2. provided a 6" jump height per fishway weir;
3. provided about 12" water depth over each fishway weir;
4. provided a weir length design taking sluiceway flow and current channel length in consideration;
5. provided a pool depth comparable or greater than 1.5 of the average pink salmon body lengths below the false weir, to allow pink salmon to stage and jump, swim up, the false weir into the WTFS;
6. provided a supply pool to create consistent hydraulic conditions in the fishway, and particularly for the false weir water supply;
7. provided swim through pool velocity of less than 3 feet per second
8. provided a non-convoluted flow path from the supply pool to the false weir, to eliminate the chance of injury to downstream migrants.

Typically, water was provided to create the attraction flow before daylight and fish were allowed to accumulate in the fishway for several hours. The entrance to the false weir was obstructed until sufficient number of fish had collected. The WFTS was prepared by running pre-wet sponges through and starting the mister, water for the mister having been collected from the river into a large tank wherein the silt was allowed to settle out before pumping out the clarified water. The obstructive barrier was removed and the fish swam their way up and into the WFTS tube. The tube exited into a 500-gallon water tank on the transport truck which was filled just prior to use and oxygenated. Pink salmon counts were recorded daily for fish transported via WFTS as data to inform the adaptive management process of the WFTS design. When fish were present they entered the WFTS at an observed rate which appeared to have a maximum rate approximately one every 2-3 seconds with the duration of the transport through the tube lasting just 2-3 seconds. Thus, one and possibly two fish may have been transporting through the tube at any given time. The transport truck was then driven to a site at Lower Days park, upstream of Mud Mountain Dam, and the pink salmon released to continue their migration upstream. At the end of each day the water coming through the sluiceway was drawn down to deter attraction when the WFTS was not manned and operational. Since the pilot test was intended to be just a demonstration of volitional entry proof of concept, no data was recorded with respect to individual pink salmon. No Chinook were observed in the rock chute sluiceway nor transported via the WFTS.

The construction of the fishway within the rock chute sluiceway was scheduled to be conducted mid-July 2015 over the course of about a week when the sluiceway was dry, eliminating the potential of construction debris affecting the river environment. The WFTS itself is a portable, mobile unit containing an ~80 ft T123 tube and required only an electrical connection, hose water access and less than an hour for installation. The goal had been to commence the pilot study during the early portion of the pink run.

Outcomes and Observations

The COE had made some significant modifications to the Buckley Dam and fishway at and below the dam in anticipation of the salmon runs. Overall the improvements were positive for fish passage past the dam, however the modifications significantly impacted the flow stream patterns downstream of the dam. With respect to the WFTS pilot study, the altered flow pattern resulted in the fish tending to swim up the opposite side of the river from the rock chute

sluiceway channel outflow, thereby missing the attraction flow point and entry. In stream rock placement modifications made by PIT on 8/24/2015 helped to open up access to the rock chute sluiceway channel although the vast majority of pink salmon still elected to take the left passage upstream to the Buckley dam.

Although the goal was to commence sampling during the early portion of the run, the pink salmon run came early and the COE construction project upstream impacted the start date as their construction was not complete when we expected to begin the project and water was blocked from entering the diversion canal which feeds the rock chute sluiceway such that there was no water, the rock chute sluiceway was dry. The altered White River flow pattern was also not anticipated and therefore the flow issue affecting attraction to the rock chute sluiceway was not resolved immediately, therefore a significant portion of the pink salmon run had passed before the rock chute sluiceway/WFTS option was allowed to operate and the pilot test commenced. Approximately 500 fish were transported over a ~2.5-week period of limited sampling.

It was observed that pink salmon, once recognizing the attraction flow at the rock chute sluiceway, readily passed up the wood bypass steps, entered the short false weir singly, traversed the incline and entered the Whooshh tube. There were no transport issues noted; once the fish had entered the tube all fish were successfully transported to the holding tank. The pilot test for volitional entry was successful. The safe and effective transport of an additional species, pink salmon, was successful.

It was observed that the WFTS exit to tank was a loose fit and a little rough for the fish with limited deceleration prior to exit into a relatively small vessel. Regardless, the pinks recovered quickly from the directed exit and behaved normally once in the tank, exhibiting no ill effects of the WFTS transport. After hauling to Lower Days park and releasing the pinks, there were no noted observations of injury or mortality.

Whether it was due to the COE Buckley Dam and fishway modifications or is typical of the White River, the high silt content in the river water, glacial silt, resulted in substantial accumulations in the pools of the fishway weirs as noted when the attraction flow water was drawn down daily. Daily cleaning of the tube by way of running through pre-wetted sponges served to both wet the tube and push any accumulated silt deposits out.

PIT biologist provided the protocol and oversight on tank preparations for the pink salmon. The water for use in the tanks, temperature range, oxygen infusion rate and so forth. It was suggested by one observer that the oxygenations rate may be slightly high, however, no apparent ill effects were observed. Ideally a larger hatchery-type haul truck with refrigeration, oxygenation and capability to accommodate several hundred fish would be ideal to maximize the WFTS transport and hauling.

It was observed that some pinks, especially large males appeared to have difficulty jumping from the wood bypass step at the entry point of the sluiceway. The observer suggested that it may have been too shallow for those larger fish to maneuver and jump. In light of the fact that the ESA PS Chinook are considerably larger than the typical pink salmon and that the goal was to

design a system to prevent their entry, the observation, all be it the observation was of large pinks, was informative and meaningful in supporting the collection technique and shallow design option that was chosen to facilitate sorting prior to volitional entry of the correct species and fish size for transport through the T123 tube of the WFTS.

Conclusions

The pilot study demonstrated efficacious WFTS volitional entry and transport. Pink salmon entered the WFTS volitionally. They were transported safely, timely, efficiently, and effectively via the WFTS. This study increased the number of species that have been successfully transported by the WFTS to include pink salmon and furthers the engineering development process of WFTS volitional entry options.

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