EVALUATION OF JUVENILE SALMONID PASSAGE AND BEHAVIOR AT FOSTER DAM UTILIZNG RADIO TELEMETRY, 2014-2015

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The goal of this study is to provide information on passage of juvenile Chinook salmon and juvenile steelhead (or appropriate surrogate) at Foster Dam (Foster) to support decisions on long-term measures and operations to improve passage conditions. Providing passage data for juvenile salmonids (route of passage, residence times, survival, and passage proportions) will further ensure biological risks to downstream-migrating fish are minimized. Areas of particular interest for this study are passage routes at the spillway, fish weir, turbines, forebay water supply (FWS), hatchery water supply (HWS), and auxiliary water supply (AWS) intakes.

A full-scale radio telemetry evaluation will be conducted under typical levels of forebay elevation and project discharge during 2015. During the field sampling period from fall 2014 through fall 2015, the overall objectives will be to perform a full project assessment at low and high pool (613 ft and 635 ft forebay elevation, respectively) for passage of radio-tagged juvenile Chinook salmon and steelhead to:

I. Estimate diel distribution, behavior, and movements of radio-tagged juvenile fish into and within the forebay of the dam.
II. Estimate the following passage metrics under typical operations (i.e., baseline conditions):
   a) Reservoir and forebay residency times
   b) Route distribution
   c) Dam passage efficiency
   d) Reservoir, project, dam, and route-specific survival
III. Estimate juvenile entrainment rates in the FWS, AWS, and HWS.
IV. Estimate passage metrics under alternative operations; “block/treatment” (on/off) test with spillway operations versus turbines.
V. Estimate detection efficiency of the fish-weir PIT antenna.

Little is known about residence times of out-migrating juvenile Chinook salmon and juvenile steelhead into and through the Foster reservoir. Therefore an optimization task, conducted during the fall of 2014, was performed to assess the adequacy of tag life and determine the detection probabilities of radio telemetry arrays to ensure the study objectives could be met. This work entailed optimally configuring and fine-tuning of the radio telemetry system in preparation for the full-scale evaluation in 2015. *Preliminary results* presented herein are from the optimization task and will be used directly to inform the 2015 spring and fall evaluation.

From October 21-23, 2014, Chinook salmon and steelhead (samples sizes 94 and 97 fish, respectively), provided by the Oregon State University surrogate program, were double tagged

with radio (RT) and Passive Integrated Transponder (PIT) tags and released in the Foster reservoir. Fish were released at mid- and head-of-reservoir (one-half each at 2 km and 4 km upstream of Foster, respectively). Radio tags were evenly distributed across 5 frequencies in a 1 Mhz band (166.500 – 167.495) and burst rates were staggered across all frequencies (4.5 sec-5.2 sec burst rates). Further randomization occurred between release locations, frequencies, codes, and burst rates to minimize the probability of code collision at a telemetry array on the dam-face. Direct-mounted underwater balanced loop-vee radio antennas were deployed at all spill bays and on trash racks of the penstock intakes as well as in possible entrainment locations in the FWS, AWS, and HWS. Balanced loop-vee antennas were chosen because of their nearly spherical reception pattern, which allowed for ease of deployment and consistent detection efficiency in all planes. Downstream arrays consisted of an egress, primary, and secondary array (2.5, 10, and 13 km downstream of Foster Dam).

We have the following findings from the radio telemetry evaluation of juvenile Chinook salmon and steelhead during the fall 2014 optimization task: burst rate and therefore tag life is adequate for a full project assessment in spring and fall 2015; code collision was minimal at the dam-face telemetry array; in general, receiver configuration and system settings (dam face and autonomous arrays) were optimal to ensure the highest detection efficiencies; minimal alterations will be made to array configuration (antenna orientation, sensitivity etc.) before the commencement of the 2015 spring study. Data analysis for the fall optimization study is ongoing and *preliminary results* of fish passage will be presented at the Willamette Science Review.

Research plans for 2015 include tagging and releasing 700 Chinook salmon and 800 steelhead during spring and another 1350 Chinook salmon during fall to address the above objectives. Additionally, a randomized block designed spill test, to evaluate passage at the spillway versus the turbines, is planned for spring 2015. Treatments will be derived from an on/off operation at the spillway and turbines for both low pool (613 ft.) and high pool (635 ft.) evaluations.