Willamette Valley Screw Trap Monitoring

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Cramer Fish Sciences (CFS) monitored juvenile fish passage through the Willamette Valley Project (WVP) for the U.S. Army Corps of Engineers (USACE) during March-August 2021 using rotary screw traps (RSTs). The purpose of this fish passage monitoring through the WVP is to understand the biological effects on downstream passage of ESA-listed emigrating juvenile Chinook salmon and steelhead implemented as part of:

- The National Marine Fisheries Service 2008 Biological Opinion Reasonable and Prudent Alternative measures (2008 BiOp RPA).
- A suite of interim measures implemented through August 2021, in addition to the measures in the 2008 BiOp RPA, to benefit ESA-listed salmonids in the Willamette River basin. Broadly, the interim measures were intended to improve water quality and downstream passage of juvenile salmonids.

To understand the effects of these BiOp RPA and interim measures, rotary screw traps (RSTs) were used to monitor downstream outmigration of juvenile salmonids and other fishes with the following primary objectives: 1) enumerate catch of out-migrating native ESA-listed juvenile Chinook salmon, ESA-listed Winter steelhead and other non-target fish; 2) describe the out-migration timing patterns, sizes, and life histories of naturally produced juvenile ESA-listed Chinook salmon and ESA-listed winter steelhead leaving WVP reservoirs; and 3) assess condition, injury, and mortality of juvenile Chinook salmon after passage through the WVP. Monitoring periods in 2021 were initially established based on the periods necessary to evaluate 'interim measures' (through 31 August 2021).

The following methods and analyses were conducted at each trapping location to achieve objectives:

Objective 1. Juvenile Chinook salmon and non-target abundance.

1. Juvenile salmon, steelhead and non-target fish were captured using RSTs and enumerated.
2. Efficiency trials were conducted and when trap efficiency was sufficient, juvenile Chinook salmon abundance was estimated.

Objective 2. Juvenile Chinook out-migration timing, sizes, and age-class.

1. Assess Outmigration timing.
2. Fork lengths and weights were measured, and age classes were assigned using length frequency histograms.

Objective 3. Fish condition, injury, and mortality.

1. Juvenile Chinook were examined for injuries (mechanical injuries, barotrauma, etc.), presence/quantity of parasitic copepods (*Salmincola californiensis*), and mortality.

Objective 1.

A total of eight RSTs were operated at locations downstream of Big Cliff, Lookout Point and Cougar dams and upstream of Fall Creek Reservoir. Traps were operated between March and August and checked a minimum of once per day. Juvenile Chinook salmon caught were enumerated, measured for fork length (FL), weighed, and their condition was assessed using injury codes. Non-target species were enumerated and released. In addition to biological data, environmental data (temperature, gage height/discharge and weather) and trapping metrics (fishing time and trap revolutions) were collected. Trap efficiency was monitored at each site by releasing groups of marked juvenile Chinook salmon upstream of the RSTs including both hatchery fish and run-of-river fish. Subsequent recaptures were pooled by week and used to calculate weekly efficiency estimates. For locations with sufficient recaptures (trap capture efficiency), estimates of juvenile Chinook salmon abundance were calculated by expanding trap catches using the equations of Romer et al. (2012 - 2017).

- The Fall Creek (above reservoir) trap was operated for a total of 83 days and captured a total of 424 juvenile Chinook salmon. Abundance at this location was not calculated due to insufficient recaptures.
- The Lookout Point traps were operated for 121.75 days and captured a total 18 juvenile Chinook salmon. Abundance at this location was not calculated due to insufficient recaptures.
- The three traps at the Cougar location were operated for 160 days, capturing 264 juvenile Chinook salmon. Abundance at this location was not calculated due to insufficient recaptures.
- The Big Cliff trap was operated for 100 days, capturing 447 juvenile Chinook salmon. Trap efficiency was sufficient to estimate juvenile Chinook salmon abundance at 4,066 (95% CI: 2,489-8,507) fish during the period of 7/4/2021 - 8/8/2021.
- Most abundant non-target captures at Fall Creek were *Oncorhynchus mykiss* (rainbow trout), bluegill at Lookout Point, large-scale sucker at Cougar, and pumpkinseed sunfish at Big Cliff.

Objective 2.

We evaluated the migration timing of naturally produced juvenile Chinook salmon using catch data. Fish were assigned to ages and migratory life histories based on size at capture and evaluation of length frequency histograms.

- Juvenile Chinook salmon catch at Fall Creek (above the reservoir) peaked during the second week of March (**Figure 1**) and the catch was predominately composed

of fry (n = 402; mean 34.7 mm), however comparisons to historical catches (Keefer et al. 2012, 2013) suggests the trap was installed at least a month after typical peak migration.

- Catches at Lookout Point indicated approximate equal proportions of sub-yearling (n = 9; mean 106 mm) and yearling migrants (n = 8; mean 143 mm). Most yearlings were captured in April, and sub-yearlings in June.
- At Cougar, fry and yearling migrants were captured in spring (April - June) and sub-yearlings were captured throughout the summer (June - August). Sub-yearlings (n = 116; mean 95 mm) were the most abundant age-class captured, followed by yearlings (n = 75; mean 137 mm), and fry (n = 73; mean 42 mm).
- Catch below Big Cliff peaked in July, coinciding with the spill gates being opened. Sub-yearlings (n = 361; mean 122 mm) were the dominant age class followed by yearlings (n = 84; mean 165 mm) and fry (n = 2, mean 50 mm).

Objective 3.

All juvenile Chinook salmon captured were assessed for body condition, external injuries, and mortality.

- At Fall Creek (above reservoir), 2.1% of the total catch of juvenile Chinook salmon exhibited at least one adverse external condition.
- 33% of the total catch at Lookout Point exhibited at least one adverse external condition, and 17% of the catch were mortalities.
- At Cougar, 36% of the total catch of juvenile Chinook salmon exhibited at least one adverse external condition. The most prevalent conditions were copepod infections (33% of catch), and 1% of the catch were mortalities.
- At Big Cliff, 89% of the total catch exhibited at least one adverse external condition, with the most common condition being copepod infection (82% of catch), followed by descaling (11% of catch). Mortality during the sampling season was 4% of the catch and was highest for the yearling age class.

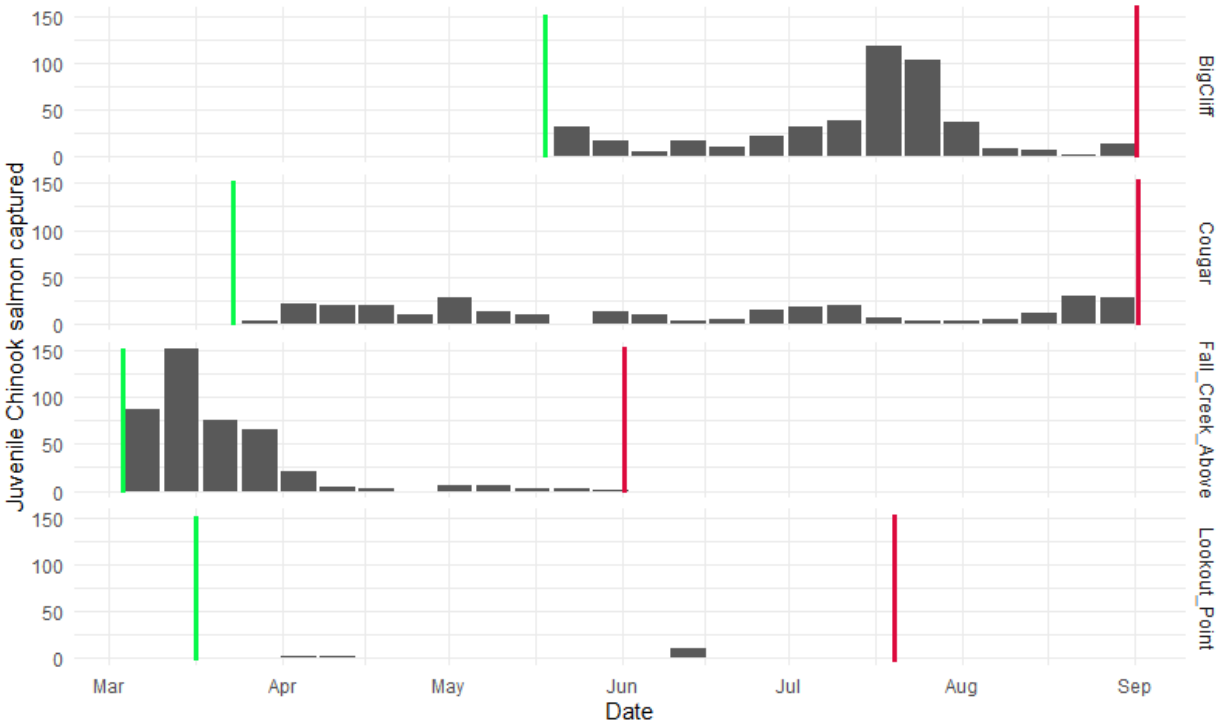

Figure 1. Number of juvenile Chinook salmon captured by week for each sampling location during 2021 RST monitoring. The Big Cliff trap was operated 5/23/2021 - 8/31/2021, Cougar traps (3) were operated 3/24/2021 - 8/31/2021, the Fall Creek trap was operated 3/10/2021 - 6/1/2021, and the Lookout Point traps (3) were operated 3/15/2021 - 7/19/2021. Green and red vertical lines represent the beginning and end of the sampling period at each site.