Tulalip Tribes Natural Resources Department Report

SNOQUALMIE RIVER JUVENILE SALMON OUT-MIGRATION STUDY PROGRESS REPORT

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by
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ACKNOWLEDGEMENTS

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- Snoqualmie Watershed Forum

INTRODUCTION

Due to considerable declines in salmon populations, fisheries managers and stakeholders have been working collaboratively to restore salmon runs in the Snohomish watershed. In 1994, a partnership of 41 organizations formed the Snohomish Basin Salmon Recovery Forum (Forum) in order to implement a watershed scale, scientifically-based, adaptive management strategy to better manage salmon recovery. The Snoqualmie sub-basin is managed by a partnership of local tribes and municipalities called the Snoqualmie Watershed Forum. In1999, the National Marine Fisheries Service listed the Puget Sound Chinook Salmon *Oncorhynchus tshawytscha* as threatened under the federal Endangered Species Act (ESA). This listing included Chinook Salmon from the Snohomish River basin, which includes sub-populations from the Skykomish and Snoqualmie Rivers. Decreases in many runs of Puget Sound Coho Salmon *Oncorhynchus kisutch* have also resulted in a designation as a species of concern under the ESA. This report focuses mostly on Chinook and Coho Salmon because recovery efforts targeted at these species will also help other listed salmonid stocks in the watershed.

In 2005, the Forum adopted the *Snohomish River Basin Salmon Conservation Plan* in order to improve the effectiveness of salmon habitat, harvest, and hatchery management on a watershed scale. In order to inform this decision-making with the best available science, it is necessary to gather and analyze data on Chinook and Coho Salmon abundance, productivity, survival, escapement, spatial structure, and diversity within the Snohomish system (Snohomish Basin Salmonid Recovery Technical Committee, 2005). Information about the trends and inter-annual variability in these population parameters is critical to inform salmon recovery efforts, provide basic information on the productivity and capacity of the system, and can lead to significant improvements in harvest management modeling and run forecasting. Additionally, the monitoring of production and survival along with other physical, chemical, and biological conditions provides a means to evaluate habitat restoration effectiveness, recovery actions, habitat conditions, and potential ecological trajectories in the basin**.**

A key method for monitoring Snohomish salmon populations is the operation of rotary screw traps in the Skykomish and Snoqualmie rivers. Over the last 20 years, these projects have sampled out-migrating juvenile Chinook and Coho Salmon as they emigrate to the Puget Sound. The goals of these trapping efforts are to estimate Chinook and Coho Salmon natural production, migration patterns, and freshwater survival. These goals are accomplished through the direct quantification of juvenile salmon emigrations, evaluation of trap efficiency, and assessment of influential environmental attributes.

The Tulalip Tribes' trapping project has been classified as a project of high priority because it is necessary for stock assessment, monitoring and run forecasting. The Tulalip Tribes have worked in close collaboration with the Washington Department of Fish and Wildlife, NOAA Fisheries, the University of Washington, Long Live the Kings, Seattle City Light, the U.S. Geological Survey, the Northwest Indian Fisheries Commission, and other agencies in an effort to monitor Snohomish basin salmon and steelhead.

SNOQUALMIE RIVER TRAPPING SITE

The Snoqualmie River rotary screw trap is located in Duvall, WA at river mile 12.2 in a section of the channel that flows north (Figure 1). The river at this point has a wetted width of ~142 ft., a bankfull width of ~210 ft., a maximum bankfull depth of ~23.5 ft., and a summer low-flow depth of ~5 ft. The water surface velocity is ~3-4 ft./sec., the summer low flow discharge is ~847 cfs, and the mean annual discharge is ~3,800 cfs. The channel gradient is <1% and the substrate is principally sand and silt with some gravel and cobble on the western side of the channel. The land use adjacent to the trap is principally agriculture with riparian vegetation limited to the banks (e.g. <30 ft.). The riparian zone principally consists of grass, shrubs, and a few scattered willow and cottonwood trees. At the immediate trap site, the left bank is composed of a steep slope vegetated with mixed deciduous trees and an understory of blackberry and salmonberry. The right bank is steeply cut and leads to an active horse and cattle pasture. Riparian vegetation on the right bank is principally blackberry and Japanese Knotweed with an occasional alder and cottonwood. In 2003, the landowner had a fence built around the pasture on the right bank creating a buffer zone of ~50 ft. between the pasture and the river bank. This buffer was planted with an assortment of native riparian vegetation (Kubo, Finley, Nelson, 2013).

Figure 1. Aerial photograph of the trap site at river mile 12.2 on the Snoqualmie River in Duvall, WA. The red dot indicates the approximate trap fishing position.

SUMMARY OF SAMPLING OPERATIONS

Sampling dates are stratified by statistical week (SW) in order to more accurately compare results from year to year. Table 1 shows the dates of statistical weeks from the 2021 sampling season. Sampling occurred from March 16th to June 17th (SW12 -25). The trap was fished for approximately 764.4 hours, with 332.7 of those hours fished at night, representing 44% of the total trapping effort. A total of three scheduled sampling events were cancelled due to unfavorable sampling conditions (i.e. high debris and discharge levels).

Table 1. Statistical weeks and corresponding dates for the 2021 sampling season

Statistical Week	From	To
12	3/14/2021	3/20/2021
13	3/21/2021	3/27/2021
14	3/28/2021	4/3/2021
15	4/4/2021	4/10/2021
16	4/11/2021	4/17/2021
17	4/18/2021	4/24/2021
18	4/25/2021	5/1/2021
19	5/2/2021	5/8/2021
20	5/9/2021	5/15/2021
21	5/16/2021	5/22/2021
22	5/23/2021	5/29/2021
23	5/30/2021	6/5/2021
24	6/6/2021	6/12/2021
25	6/13/2021	6/19/2021

During the sampling season 1,722 salmon and trout were captured, counted and released (Appendix A). Captured unmarked Chinook Salmon included 586 sub-yearlings and zero yearlings. The number of unmarked sub-yearling Chinook Salmon caught at the Snoqualmie River trap varies from year to year, with the catch in 2021 being just over the project average of 508 (Table 2). Captured unmarked Coho Salmon included 563 yearlings and 205 sub-yearlings. The number of unmarked yearling Coho Salmon caught was roughly half the project average of 1,165. During the trapping and handling process a total of 11 salmonid mortalities were reported, some of which were killed for toxicology screening. Mortality as a percentage of the total salmonid catch was approximately 0.63% (Appendix A).

Table 2. Annual sampling effort and catch totals for sub-yearling Chinook and yearling Coho Salmon at the Snoqualmie River rotary screw trap 2001-2021 (preliminary data).

Year	Effort (Hours)	0+ Chinook	1+ Coho	Chinook CPUE	Coho CPUE
2001	509	619	553	1.22	1.09
2002	780.3	653	1894	0.84	2.43
2003	945.5	882	1305	0.93	1.38
2004	1056	611	1127	0.58	1.07
2005	1017.8	677	1187	0.67	1.17
2006	992	761	2023	0.77	2.04
2007	509.5	120	615	0.24	1.21
2008	317.9	163	587	0.51	1.85
2009	632.1	259	754	0.41	1.19
2010	1157.8	357	1149	0.31	0.99
2011	500.8	284	1662	0.57	3.32
2012	847.2	377	1384	0.44	1.63
2013	1217.9	615	1718	0.50	1.41
2014	796.8	196	1084	0.25	1.36
2015	1017	82	678	0.08	0.67
2016	1112	44	809	0.04	0.73
2017	1155.4	1200	925	1.04	0.80
2018	1116.8	1508	1517	1.35	1.36
2019	818	657	612	0.80	.75
2020	159.4	13	1	0.08	.01
2021	764.4	586	563	.77	.74
Average	829.7	508	1055	0.59	1.3

A total of nine trap efficiency tests (three with sub-yearling Chinook Salmon, six with yearling Coho Salmon) were conducted throughout the 2021 sampling season (Table 3). During these tests, groups of hatchery-origin juvenile salmon were collected from Wallace River Hatchery, marked with biological dye, and released over a mile upstream of the trap site. These releases were conducted weekly throughout the duration of the sampling season while hatchery Chinook and Coho Salmon were available. Following each release, the trap was operated continuously (except during debris removal) for a minimum of 36 hours. Efficiency calculations are expressed as the percentage of captured dyed fish in relation to the total number of dyed fish released. The results of these tests are still being evaluated; however, preliminary calculations suggest that the trap was operating at an efficiency rate of .86% for Chinook Salmon sub-yearlings during the 2021 sampling season (Table 3). This efficiency estimate was lower than the average for this trapping location (2001-2021 average: 1.14%). Efficiency trials with yearling Coho Salmon indicate an efficiency of approximately 0.69%. This is slightly above the project efficiency average for yearling Coho Salmon at the Snoqulamie (2002-2021 average 0.64%). During the 2021 season, trapping equipment was inspected and monitored frequently and the trap was found to be in fully operational condition with no escape paths detected and no major equipment malfunctions.

Table 3. Efficiency release dates and re-capture percentages at the Snoqualmie trap site; 2021.

Species	Date	Released	Captured	Efficiency
Chinook	4/7/2021	1992	18	0.90%
Chinook	4/20/2021	2001	23	1.15%
Chinook	4/28/2021	1913	10	0.52%
Coho	5/5/2021	2014	17	0.84%
Coho	5/12/2021	2031	7	0.34%
Coho	5/18/2021	1998	18	0.90%
Coho	5/25/2021	2002	9	0.45%
Coho	6/2/2021	2007	19	0.95%
Coho	6/8/2021	2037	14	0.69%
	2021 Average Chinook Efficiency			0.86%
	2021 Average Coho Efficiency			0.69%

Catch Per Unit of Effort (CPUE) analysis

After a preliminary review of the data, catch per unit effort (CPUE) for unmarked Chinook Salmon sub-yearlings showed two distinct peaks in 2021 at SW 13 and SW 23 (Figure 2). The timing of the sub-yearling Chinook Salmon out-migration has varied from year to year, and does not exhibit the observed consistency documented for yearling Coho Salmon in the Snoqualmie. The yearling Coho Salmon out-migration showed one very clear peak during SW 18-20 when approximately 5-6 fish per hour were encountered. The timing of this peak is consistent with the timing observed in all other years of the trapping project which generally occurs during SW 18-20. Appendix A shows a monthly breakdown of catch numbers for all species.

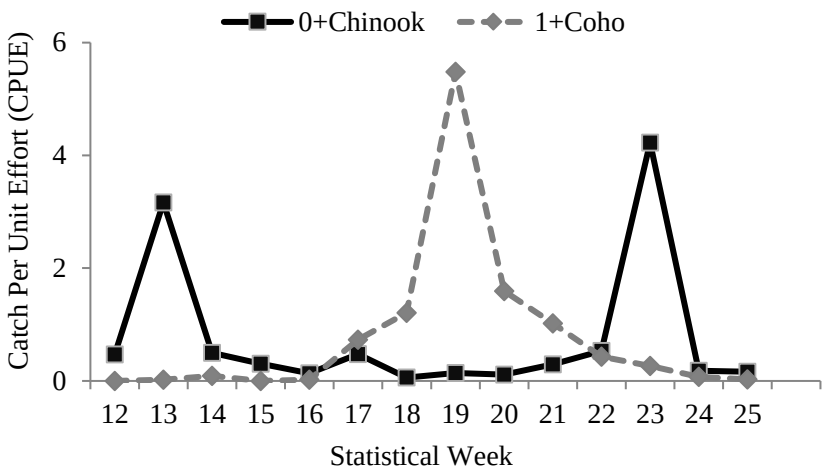

Figure 2. Sub-yearling (age 0+) Chinook Salmon and yearling (age 1+) Coho Salmon migration patterns observed in 2021 at the Snoqualmie River trap, river mile 12.2 (preliminary data).

In general, salmonid catch rates on the Snoqualmie trap have exhibited seasonal variability throughout the duration of the project primarily due to fluctuating sampling conditions and the strength of a given year's out-migrant cohort. Analysis of seasonal CPUE averages for sub-yearling Chinook and yearling Coho Salmon in 2021 indicate a slightly above average incidence of encounter for sub-yearling Chinook Salmon and a below average incidence of encounter for yearling Coho Salmon (Table 2, Figure 3).

The overall CPUE for sub-yearling Chinook Salmon in the Snoqualmie River was alarmingly low in both 2015 and 2016 at approximately .08 and .04 fish per hour of effort, respectively, representing the lowest annual encounter rates in project history (Figure 3). Since 2017, however the sub-yearling Chinook Salmon CPUE has been trending well above the project average of 0.59 fish per hour. This above-average incidence of encounter for sub-yearling Chinook Salmon likely directly corresponds to a very strong sub-yearling Chinook Salmon emigration from the Snoqualmie basin since 2017.

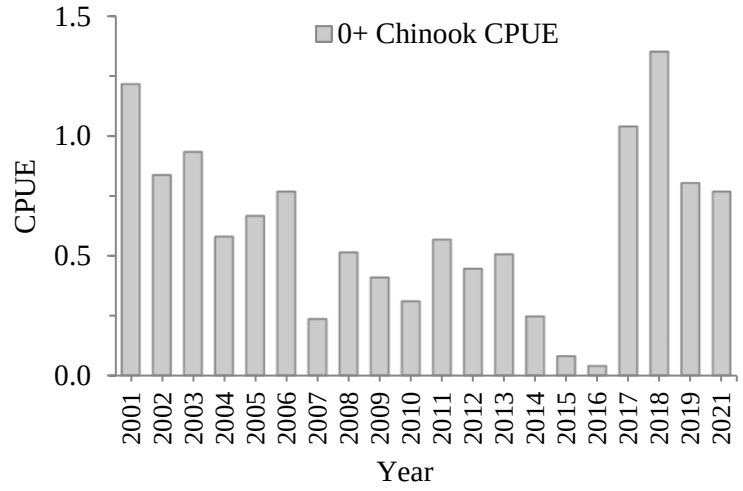

Figure 3. Sub-yearling Chinook Salmon average CPUE at the Snoqualmie trap; 2001-2021.

Yearling Coho Salmon catch rates have in general remained fairly consistent throughout the project duration with some observed seasonal variability dependent upon river conditions and the size of a given year's out-migrant cohort (Figure 4). In 2021, the average yearling Coho Salmon CPUE (.74) was much lower than the project average of 1.3 yearling Coho Salmon per hour sampled. The total number of yearling Coho Salmon

encountered was far below project averages to date at 563 individuals encountered (Project average; 1,055). Yearling Coho Salmon total annual catch, and CPUE averages show a slight decreasing trend at the Snoqualmie trap and display some seasonal variability due to environmental factors and the size of a given years emigrating class (Figure 4).

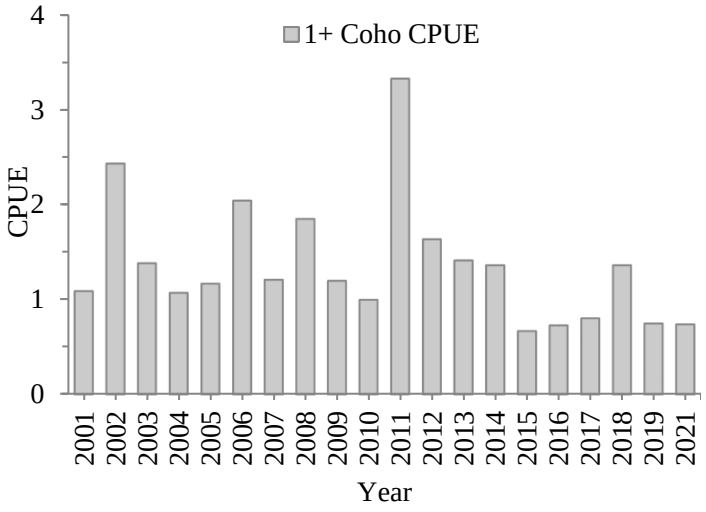

Figure 4. Yearling Coho Salmon average CPUE at the Snoqualmie trap; 2001-2021.

ADDITIONAL STUDIES

Genetic Mark Recapture Parentage Assignment - WDFW

In 2012, the Tulalip Tribes began assisting WDFW in a basin-wide genetic mark and recapture (GMR) study. This was funded under a cooperative management agreement with WDFW. DNA samples are collected at the Snoqualmie trap site for genetic parentage-assignment analyses of juvenile Chinook salmon in an attempt to further evaluate stock-specific production estimates and abundance. Under WDFW GMR project protocol all unmarked (adipose intact) Chinook Salmon (both 0+ and 1+ size classes) caught in the trap are clipped for DNA sampling. During the 2021 monitoring season 586 upper-caudal DNA samples were taken from a mix of sub-yearling and yearling unmarked Chinook Salmon juveniles. Unmarked and untagged sub-yearling Chinook Salmon are presumed to be of natural-origin given that all regional hatchery Chinook Salmon production is marked through a combination of adipose fin clips and CWTs, less a very small proportion that end up not being marked due to clip and tag loss (Seamons, et. al, 2015). To date over 4,600 DNA samples have been collected from emigrating Chinook Salmon sub-yearling and yearling smolts at the Snoqualmie trap site.

DISCUSSION

The 2021 trapping season went generally well. Although sampling was not impacted by weather or hydrologic conditions, the sample scheduling was heavily impacted by Covid-19 hiring limitations. Our two traps were staffed by about half as many employees as usual, but after the Skykomish trap was shut down mid-season, our full effort was focused on the Snoqualmie trap. Normally the traps are run five nights a week and two days, but this year the Snoqualmie trap was generally only run for three nights and three days per week. It is likely that sampling more during the day stratum lowered the CPUE. Only three scheduled sampling events were canceled during the 2021 season due to employee sickness and quarantine protocol. These three cancellations account for approximately 40 hours of effort that was potentially missed. As a function of total

trapping effort these 40 hours represent approximately 5% of the total 764.4 hours that the Snoqualmie trap was fished in 2021.

We were able to trap through a high flow event during SW 23, which allowed us to run an additional efficiency test and capture a lot of emigrant fish that would have been missed had we cancelled. Although this gave us better estimates during an emigration event, the trap had to be moved out of the thalweg to minimize debris, which generally lowers trap efficiency. Interestingly, the efficiency trial conducted during this high flow event resulted in the highest Coho recapture efficiency rate (.95%), despite the trap being moved out of the thalweg (Table 3).

Aside from the aforementioned scheduling difficulties, all trapping equipment including the trap itself, the boat, and all associated supplies were in full working order and operated as expected throughout the duration of the 2021 season with no down-time associated directly with equipment failure.

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APPENDIX A: SUMMARY OF 2021 TRAP CATCH AND MORTALITIES

March

	Chinook Salmon		Coho Salmon		Chum Salmon	Pink Salmon	steelhead		Resident Rainbow	Cut./Rain. Trout Fry/Parr	Total Salmonid Catch	Lamprey	Sunfish	Sculpin spp.	Stickle-back
	0+	1+	0+	1+	0+	0+	Unm Smolts	Mark Smolts							
Day	(27.8 hours of effort)														
Catch	4	0	0	0	22	0	0	0	0	0	26	0	0	0	0
Morts.	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
Night	(50.0 hours of effort)														
Catch	156	0	37	3	128	0	0	0	0	0	324	40	1	2	0
Morts.	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Monthly Totals	(77.8 hours of effort)														
Catch	160	0	37	3	150	0	0	0	0	0	350	40	1	2	0
Morts.	1	0	0	0	1	0	0	0	0	0	2	0	0	0	0

April

	Chinook Salmon		Coho Salmon		Chum Salmon	Pink Salmon	steelhead		Resident Rainbow	Cut./Rain. Trout Fry/Parr	Total Salmonid Catch	Lamprey	Sunfish	Sculpin spp.	Stickle-back
	0+	1+	0+	1+	0+	0+	Unm Smolts	Mark Smolts							
Day	(127.2 hours of effort)														
Catch	14	0	23	10	65	0	0	1	0	0	113	1	1	1	1
Morts.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Night	(119.6 hours of effort)														
Catch	47	0	47	121	130	0	3	2	0	0	350	38	12	2	11
Morts.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monthly Totals	(246.8 hours of effort)														
Catch	61	0	70	131	195	0	3	3	0	0	463	39	13	3	12
Morts.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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May

	Chinook Salmon		Coho Salmon		Chum Salmon	Pink Salmon	steelhead		Resident Rainbow	Cut./Rain. Trout Fry/Parr	Total Salmonid Catch	Lamprey	Sunfish	Sculpin spp.	Stickle-back
	0+	1+	0+	1+	0+	0+	Unm Smolts	Mark Smolts							
Day	(147.0 hours of effort)														
Catch	14	0	13	38	4	0	0	2	0	0	71	4	2	0	6
Morts.	1	0	1	0	0	0	0	0	0	0	2	0	0	0	0
Night	(93.5 hours of effort)														
Catch	55	0	35	367	1	0	4	1	0	1	464	72	9	0	5
Morts.	7	0	0	0	0	0	0	0	0	0	7	0	0	0	0
Monthly Totals	(240.5 hours of effort)														
Catch	69	0	48	405	5	0	4	3	0	1	535	76	11	0	11
Morts.	8	0	1	0	0	0	0	0	0	0	9	0	0	0	0

June

	Chinook Salmon		Coho Salmon		Chum Salmon	Pink Salmon	steelhead		Resident Rainbow	Cut./Rain. Trout Fry/Parr	Total Salmonid Catch	Lamprey	Sunfish	Sculpin spp.	Stickle-back
	0+	1+	0+	1+	0+	0+	Unm Smolts	Mark Smolts							
Day	(129.8 hours of effort)														
Catch	116	0	6	6	0	0	1	0	0	0	129	10	6	0	3
Morts.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Night	(69.6 hours of effort)														
Catch	180	0	44	18	0	0	1	1	0	0	245	52	20	0	6
Morts.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monthly Totals	(199.4 hours of effort)														
Catch	296	0	50	24	0	0	2	1	0	0	374	62	26	0	9
Morts.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX A: SUMMARY OF 2021 TRAP CATCH AND MORTALITIES

Totals (764.4 total hours of effort)

	Chinook Salmon		*Coho Salmon*		*Chum Salmon*	*Pink Salmon*	*steelhead*		*Resident Rainbow*	*Cut./Rain. Trout Fry/Parr*	*Total Salmonid Catch*	*Lamprey*	*Sunfish*	*Sculpin spp.*	*Stickle-back*
	0+	*1+*	*0+*	*1+*	*0+*	*0+*	*Unm Smolts*	*Mark Smolts*							
Catch	586	0	205	563	350	0	9	7	0	1	1722	217	51	5	32
Morts.	9	0	1	0	1	0	0	0	0	0	11	0	0	0	0
Mortality Rate	1.54%	0.00%	0.49%	0.00%	0.29%	0.00%	0.00%	0.00%	0.00%	0.00%	0.63%				
% of Total Catch	28.7%	0.0%	10.0%	27.6%	17.2%	0.0%	0.4%	0.3%	0.0%	0.0%	84.4%	10.6%	2.5%	0.2%	1.6%