

Tulip Tribes Natural Resources Department Report

SNOQUALMIE RIVER JUVENILE SALMON OUT-MIGRATION STUDY PROGRESS REPORT

March – June 2019

by
Ethan Seay
Matthew Pouley

2019



Tulip Natural Resources Division
6406 Marine Dr.
Tulalip, WA 98271



i. Acknowledgements

The 2019 Snoqualmie River Juvenile Salmon Out-Migrant Study was made possible by the following funding sources:

- King County Flood Control District Cooperative Management Grant Funds
- NOAA Pacific Coastal Salmon Recovery Funds

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1. Introduction

In May of 1999, the National Marine Fisheries Service (NMFS) listed the Puget Sound Chinook salmon as threatened under the federal Endangered Species Act (ESA). This listing included Chinook salmon from the Snohomish River Basin (Skykomish and Snoqualmie populations). Similarly, decreases in many runs of Puget Sound Coho salmon have resulted in a designation as a species of concern under ESA. The recovery of these species depends upon improving the effectiveness of habitat, harvest, and hatchery management across the basin. In order to achieve such improved effectiveness, additional information is necessary to fill important data gaps within the Snohomish system, including information on Chinook and Coho salmon abundance, productivity, spatial structure, and diversity (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, provides 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 recovery actions, habitat conditions, and potential ecological trajectories in the basin.

A key project helping to provide information on Snohomish salmon populations has been the operation of two rotary screw traps in the Skykomish and Snoqualmie rivers. Over the last 18 years, these projects involved trapping and enumerating juvenile Chinook and Coho salmon (as well as several un-targeted species) as they emigrate from the Snohomish River Basin 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 (Kubo, Finley, Nelson, 2013).

The Tulalip Tribes (TTT) trapping project has been classified on a multi-agency basis as a project of high priority for monitoring juvenile salmonids in the Snohomish River basin. TTT has worked in close collaboration with the Washington Department of Fish and Wildlife (WDFW), NOAA Fisheries, University of Washington (UW), Long Live the Kings (LLTK), Seattle City Light (SCL), U.S. Geological Survey (USGS), Northwest Indian Fisheries Commission (NWIFC), and other agencies to aid in better co-management of Snohomish basin salmon and steelhead stock assessment monitoring and run forecasting. Cooperative management agreements and in-kind contributions have been made to these agencies regularly from TTT in order to better assist in monitoring the status and trends of Snohomish Basin salmonid stocks.

2. Snoqualmie River Trapping Site Location and Characteristics.

The Snoqualmie trap is located on the Snoqualmie River in Duvall, WA in a straight section of the channel which flows in a northerly direction at river mile 12.2. The Snoqualmie River at this point has a wetted width of ~142 ft., bank full width of ~210 ft, maximum bank full depth of ~23.5 ft, and a summer low-flow level of ~5 ft. Water surface velocity is ~3-4 ft./sec., summer low flow discharge is ~847 cfs, and 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 agriculture with riparian vegetation limited to the banks (e.g. <30 ft.). The riparian zone consists of grass, shrubs, and a few scattered willow and cottonwood trees. At the immediate trap site, the left bank is a steep slope vegetated with mixed deciduous trees and an understory of blackberry and salmonberry (leading to West Snoqualmie Valley Rd NE). The right bank is steeply cut and leads to an active horse and cattle pasture. Riparian vegetation on the right bank is principally blackberry with an occasional alder and cottonwood in addition to Japanese Knotweed surrounding access trail. 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.

3. Summary of activities completed during the sampling season.

On February 27th, 2019, installation of the rotary screw trap began and full trapping operations commenced on March 4th. Trapping operations were initially delayed by heavy snowpack, making roads inaccessible for staff and trap assembly. The season ended on June 13th. The trap operated for approximately 818 hours over 75 business days within a 15-week period from Statistical Week (SW) 10 to 24. Of those 818 hours, 445 of those hours were fished at night representing 54% of total trapping effort. A total of 3 scheduled sampling events were ultimately cancelled due to unfavorable sampling conditions (i.e. high debris and discharge levels). During the sampling season 3,242 salmon and trout were captured, counted and released. Captured unmarked Chinook included 657 sub-yearlings and 24 yearlings. Catch per unit effort of unmarked Chinook (0.80) were significantly lower than the previous two years (2017: 1.04 / 2018: 1.35) while still remaining 33% higher than project average CPUE of 0.61. The number of unmarked sub-yearling Chinook was 19% above the project average (Project average; 530). Captured unmarked Coho included 612 yearlings and 690 sub-yearlings. Catch per unit effort of unmarked Coho (0.75) was 46% lower than project average of 1.39. The number of unmarked Coho yearlings is significantly lower than the previous 3 years and 85% lower than project average of 1136 fish (Table 1.).

During the trapping and handling process a total of 10 salmonid mortalities were reported. Mortality as a percentage of the total salmonid catch was approximately 0.31%.

Table 1. Annual sampling effort and catch totals for unmarked sub-yearling Chinook and yearling Coho at the Snoqualmie River Rotary screwtrap 2001-2019 (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	1217.93	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	0.75
<i>Project Average</i>	<i>868</i>	<i>530</i>	<i>1136</i>	<i>0.61</i>	<i>1.39</i>

A total of 10 trap efficiency tests (4 with Chinook sub-yearlings, 6 with Coho yearlings) were conducted on a weekly basis throughout the 2019 sampling season (Table 2.). Delays in sampling season and adverse weather conditions for safely transporting fish for releases resulted in less than ideal Chinook releases for 2019. 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 a total of 10 times throughout the sampling season. Releases were conducted until the maximum allowable number of Chinook and Coho available from the hatchery had been reached or the river was unfishable due to flow conditions or other environmental factors. 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 1.10% for Chinook sub-yearlings during the 2019 sampling season (Table 2). The 2019 sub-yearling Chinook efficiency was slightly lower than documented seasonal averages for this trapping location (2001-2018 average: 1.33%). Efficiency trials with yearling Coho indicate an efficiency of approximately 0.29%. This is also slightly below the project efficiency average for yearling Coho at the Snoqualmie (2002-2018 average 0.81%). During the 2019 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 2. Efficiency release dates and re-capture (efficiency) percentages at the Snoqualmie River smolt trap, 2019.

Year	River	Release Date	0+ CK Eff	1+ CO Eff
2019	Snoqualmie	3/13	0.65%	
2019	Snoqualmie	3/20	1.40%	
2019	Snoqualmie	3/26	1.05%	
2019	Snoqualmie	4/3	1.30%	
2019	Snoqualmie	4/23		0.25%
2019	Snoqualmie	5/1		0.15%
2019	Snoqualmie	5/7		0.74%
2019	Snoqualmie	5/15		0.15%
2019	Snoqualmie	5/21		0.37%
2019	Snoqualmie	6/5		0.10%
<i>2019 Avg. Total</i>			1.10%	0.29%

Catch Per Unit of Effort (CPUE) analysis.

After a preliminary review of the data CPUE, unmarked Chinook sub-yearlings showed two distinct peaks in 2019. The timing of the sub-yearling Chinook outmigration has varied from year to year, and does not exhibit the observed single significant peak CPUE consistency documented for yearling Coho in the Snoqualmie. In 2019, sub-yearling Chinook catch increased steadily until it initially peaked around SW 12 when approximately 3 fish per hour were encountered before quickly dropping off to 0.5 fish per hour by SW 13. A secondary and much larger peak was observed in SW 15 when over 5 fish per hour were encountered. Following this peak, sub-yearling Chinook catches began to decline with a slight increase in CPUE during increased outmigration by yearling Coho. The Coho yearling outmigration showed one very clear peak at this time during SW 19 when approximately 5 fish per hour were encountered (Figure 2). 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. Table 4 shows a monthly breakdown of catch numbers for all species and Table 3 shows statistical weeks and the corresponding dates. Figure 3 shows catch per unit effort patterns in previous trapping years.

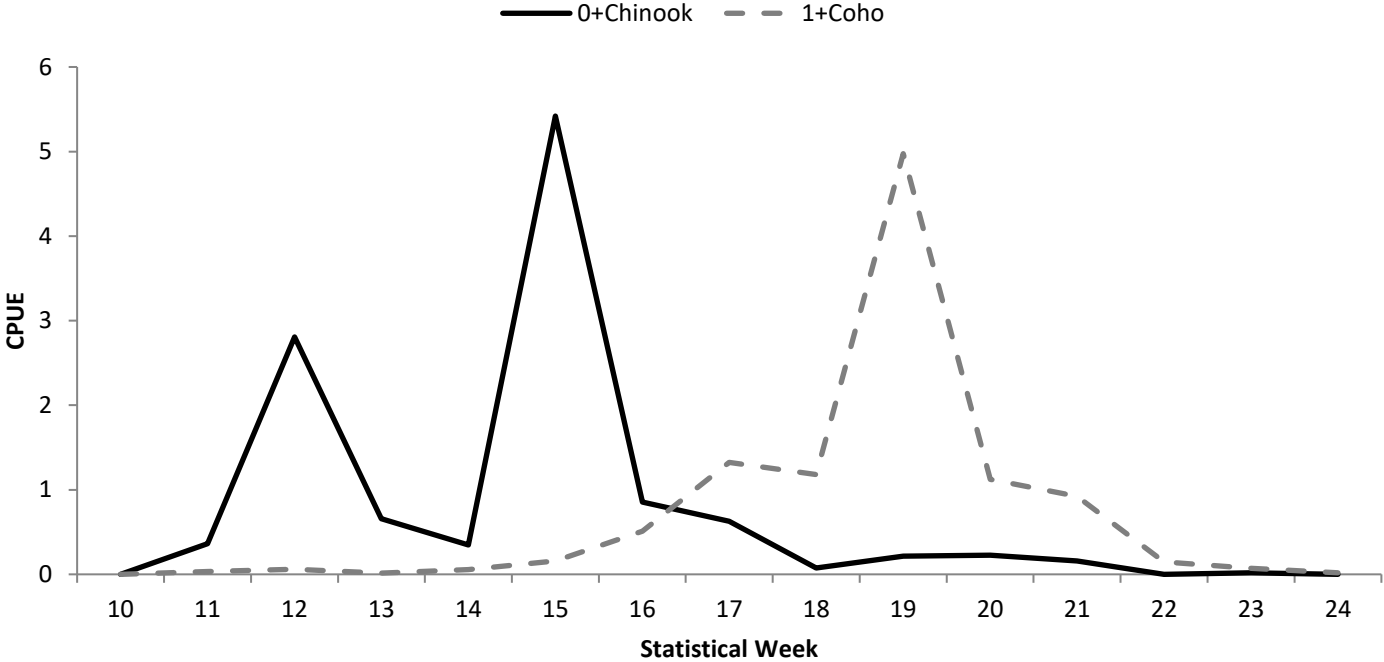


Figure 2. Average catch per hour of Chinook sub-yearling (age 0+) and Coho yearling (age 1+) during 2019 at the Snoqualmie River trap, river mile 12.2 (preliminary data).

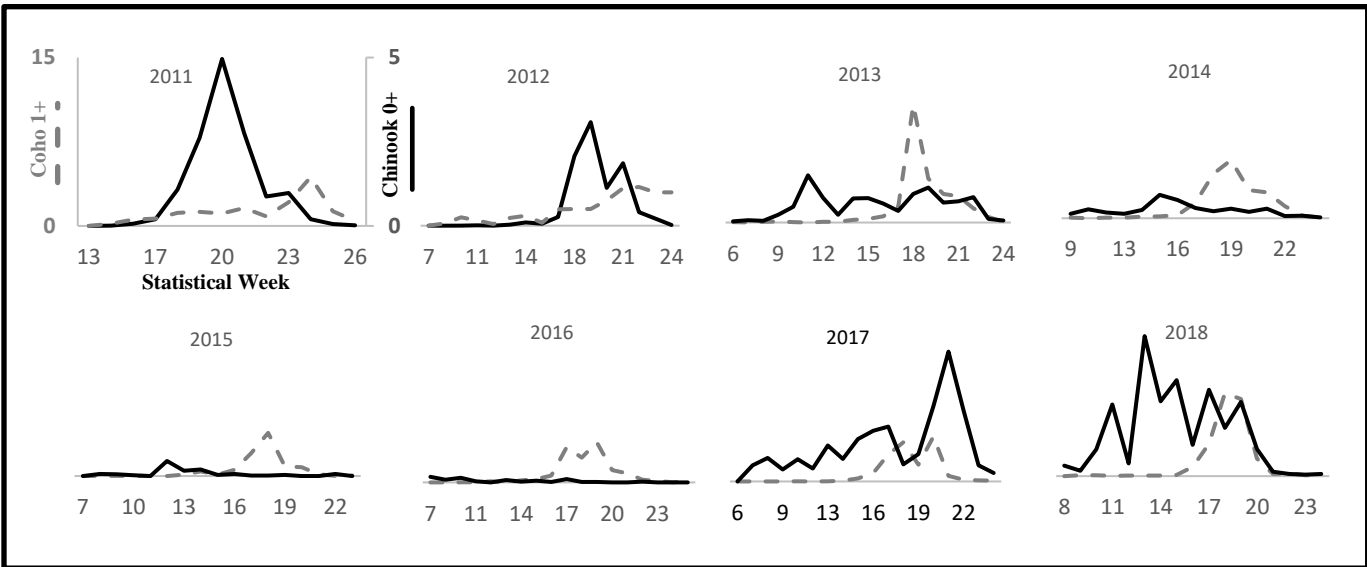


Figure 3. 2011- 2018 Chinook sub-yearling and Coho CPUE

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 years outmigrant cohort. Analysis of seasonal CPUE averages for sub-yearling Chinook and yearling Coho in 2019 indicate slightly above average incidence of encounter for sub-yearling Chinook (2019: 0.80; Average: 0.61) and a below average incidence of encounter for yearling Coho (2019: 0.75; Average: 1.39) (Table 1, Figure 4).

The overall CPUE for sub-yearling Chinook 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 (2001-2019). The 2017 and 2018 CPUE, however are significantly above project averages for sub-yearling Chinook (Average; 0.61 fish per hour). 2017 sub-yearling Chinook catch rates were the second highest ever documented at the Snoqualmie trap site, and 2018's catch rates set an all-time project record high catch of 1508. Following these record years, the total number of sub-yearling Chinook in 2019 dropped significantly however catches were still slightly above project averages. .

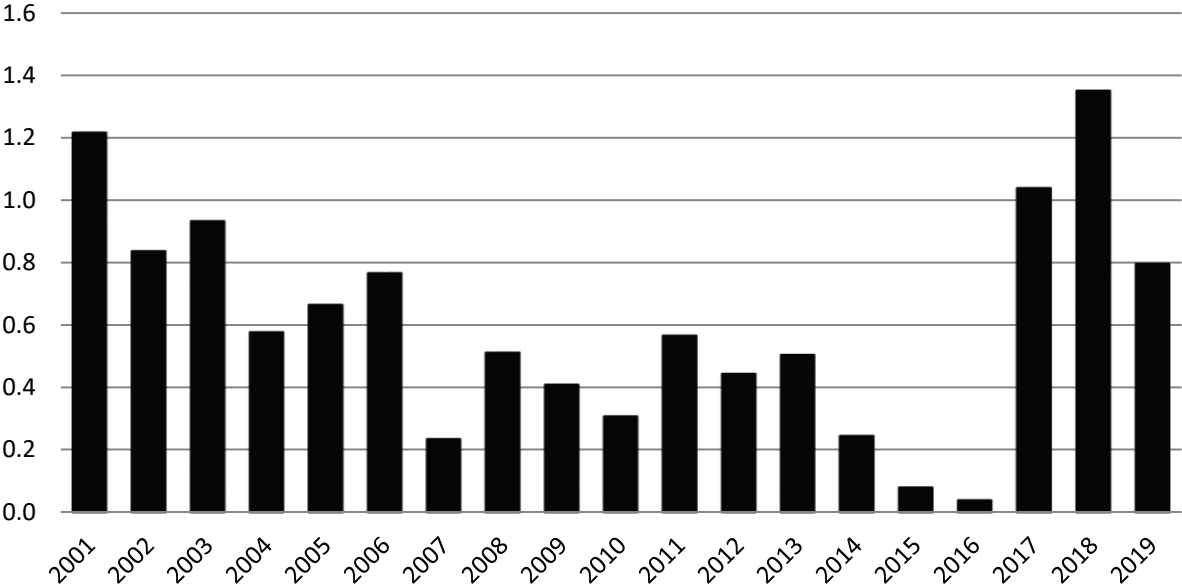


Figure 4. Sub-yearling Chinook average CPUE at the Snoqualmie trap; 2001-2019.

Yearling Coho catch rates have remained fairly consistent throughout the project duration with some observed seasonal variability dependent upon river conditions and the size of a given years outmigrant cohort (Figure 4). In 2019 the average yearling Coho CPUE was significantly lower than documented averages at 0.75 yearling Coho per hour sampled (Project average: 1.39 fish per hour). The total number of yearling Coho encountered was well below project averages to date at 612 individuals encountered (Project average: 1136). While yearling Coho total annual catch, and CPUE averages showed a decrease this year, preliminary analysis does not allow for a clear trend of decreasing catch to be established without further research in seasonal variability, dependence upon environmental factors and the size of a given years emigrating class (Figure 4).

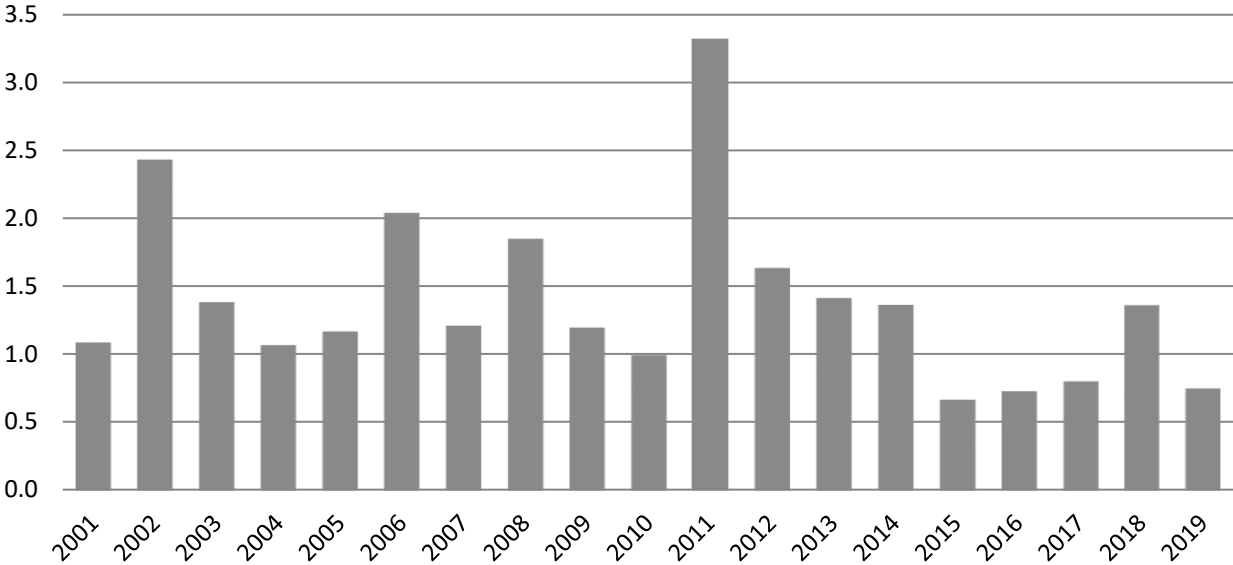


Figure 5. Yearling Coho average CPUE at the Snoqualmie trap; 2001-2019.

4. Project status and difficulties.

The 2019 smolt trap season was successful in maintaining average effort (Average: 869 hours, Observed: 818) and experienced minimal interruption once underway. Heavy snowpack on access roads, staffing, and logistical difficulties led to a later start date for this season. Usually, trapping begins mid-February or around SW 7; in 2019, fishing efforts commenced on SW 10. From SW 10 through SW 16, the smolt trap was generally fishing a continuous 72 hours each week, usually Tuesday morning through Friday morning due to limited staff available. In SW 16, we were effectively staffed and fishing efforts were shifted to focus on 5 night sampling events with day sampling events coordinated with efficiency releases. Throughout the entire season, 2 night shifts and 2 day shifts were cancelled; these totaled 50 hours of missed effort or 6% of total effort. Two day shifts (March 12th and April 3rd) were missed due to limited staffing. One night shift (April 11th) was cancelled due to high flow conditions and heavy debris making it difficult to properly sample in an effective manner. The last night shift (May 3rd) was missed following limited staffing and prioritizing efforts on the Skykomish river smolt trap as outmigration slowed down on the Snoqualmie.

Following a record high year of sub-yearling Chinook catch per unit effort, 2019 still experienced above average CPUE (Average: 0.61, Observed: 0.80). This drop in CPUE was also shown in yearling Coho in which we saw below average numbers this season (Average: 1.39, Observed: 0.75). Despite a later start to the season and early scheduling difficulties, fishing efforts were successful in exposing typical bimodal trends of Chinook and Coho salmon outmigration.

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 2019 season with no down-time associated directly with equipment failure.

Table 3. Statistical weeks and corresponding dates for 2019 sampling season.

2019 Trap Sampling Season				
Year	StatWeek	BegWeek	MidWeek	EndWeek
2019	10	3/3	3/6	3/9
2019	11	3/10	3/13	3/16
2019	12	3/17	3/20	3/23
2019	13	3/24	3/27	3/30
2019	14	3/31	4/3	4/6
2019	15	4/7	4/10	4/13
2019	16	4/14	4/17	4/20
2019	17	4/21	4/24	4/27
2019	18	4/28	5/1	5/4
2019	19	5/5	5/8	5/11
2019	20	5/12	5/15	5/18
2019	21	5/19	5/22	5/25
2019	22	5/26	5/29	6/1
2019	23	6/2	6/5	6/8
2019	24	6/9	6/12	6/15
2019	25	6/16	6/19	6/22

5. References

- Kubo, J., Finley, K., Nelson K. 2013. 2000-2012 Skykomish and Snoqualmie Rivers Chinook and Coho Salmon Out-Migration Study. Tulalip Tribes Natural Resource Division, Tulalip WA.
- Seamons, T., Crewson, M., Whitney, J., Verhey, P. 2015 Progress Report: Genetic-based abundance estimates for Snohomish River Chinook Salmon. Washington Department of Fish and Wildlife. Olympia, WA; Tulalip Tribes, Tulalip WA.
- Snohomish Basin Salmonid Recovery Technical Committee. 2005. Snohomish River Basin ecological analysis for salmonid conservation. Snohomish County Public Works, Surface Water Management, Everett, WA.

Prepared by:

Ethan Seay, Field Biologist

The Tulalip Tribes, Cultural & Natural Resources Department

November, 2019.

Table 4.

March															
	<i>Chinook</i>		<i>Coho</i>		<i>Chum</i>	<i>Pink</i>	<i>Steelhead</i>		<i>Resident Rainbow</i>	<i>Cut./Rain. Trout Fry/Parr</i>	<i>Total Salmonid Catch</i>	<i>Lamp</i>	<i>Sunfish</i>	<i>Sculpin spp.</i>	<i>Stickle-back</i>
	<i>0+</i>	<i>1+</i>	<i>0+</i>	<i>1+</i>	<i>0+</i>	<i>0+</i>	<i>Unm Smolts</i>	<i>Mark Smolts</i>							
<i>Day</i>	(109.7 hours of effort)														
Catch	65	0	0	0	130	0	0	0	0	0	195	0	0	0	0
Morts.	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Night</i>	(102.7 hours of effort)														
Catch	193	0	7	7	363	0	0	0	0	0	549	34	0	6	0
Morts.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monthly Totals	(212.4 hours of effort)														
Catch	258	0	7	7	493	0	0	0	0	0	744		0	6	0
Morts.	1	0	0	0	0	0	0	0	0	0	10		0	0	0
April															
	<i>Chinook</i>		<i>Coho</i>		<i>Chum</i>	<i>Pink</i>	<i>Steelhead</i>		<i>Resident Rainbow</i>	<i>Cut./Rain. Trout Fry/Parr</i>	<i>Total Salmonid Catch</i>	<i>Lamp</i>	<i>Sunfish</i>	<i>Sculpin spp.</i>	<i>Stickle-back</i>
	<i>0+</i>	<i>1+</i>	<i>0+</i>	<i>1+</i>	<i>0+</i>	<i>0+</i>	<i>Unm Smolts</i>	<i>Mark Smolts</i>							
<i>Day</i>	(112.5 hours of effort)														
Catch	52	3	63	0	346	0	0	0	0	0	434	7	2	0	0
Morts.	0	0	1	0	2	0	0	0	0	0	3	0	0	0	0
<i>Night</i>	(146.1 hours of effort)														
Catch	304	11	418	143	317	0	6	31	0	0	1272	111	12	4	1
Morts.	3	1	0	0	2	0	0	0	0	0	6	0	0	0	0
Monthly Totals	(258.5 hours of effort)														
Catch	356	14	481	143	663	0	6	31	0	0	1706		14	4	1
Morts.	3	1	1	0	4	0	0	0	0	0	9		0	0	0

May															
	<i>Chinook</i>		<i>Coho</i>		<i>Chum</i>	<i>Pink</i>	<i>Steelhead</i>		<i>Resident Rainbow</i>	<i>Cut./Rain. Trout Fry/Parr</i>	<i>Total Salmonid Catch</i>	<i>Lamp</i>	<i>Sunfish</i>	<i>Sculpin spp.</i>	<i>Stickle-back</i>
	<i>0+</i>	<i>1+</i>	<i>0+</i>	<i>1+</i>	<i>0+</i>	<i>0+</i>	<i>Unm Smolts</i>	<i>Mark Smolts</i>							
<i>Day</i>	(105.9 hours of effort)														
Catch	4	0	3	4	3	0	0	0	0	0	14	5	0	0	1
Morts.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>Night</i>	(130.9 hours of effort)														
Catch	38	6	123	453	40	0	6	21	0	0	690	166	4	6	15
Morts.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monthly Totals	(236.8 hours of effort)														
Catch	42	6	126	457	43	0	6	21	0	0	704		4	6	16
Morts.	0	0	0	0	0	0	0	0	0	0	0		0	0	1

June															
	<i>Chinook</i>		<i>Coho</i>		<i>Chum</i>	<i>Pink</i>	<i>Steelhead</i>		<i>Resident Rainbow</i>	<i>Cut./Rain. Trout Fry/Parr</i>	<i>Total Salmonid Catch</i>	<i>Lamp</i>	<i>Sunfish</i>	<i>Sculpin spp.</i>	<i>Stickle-back</i>
	<i>0+</i>	<i>1+</i>	<i>0+</i>	<i>1+</i>	<i>0+</i>	<i>0+</i>	<i>Unm Smolts</i>	<i>Mark Smolts</i>							
<i>Day</i>	(45.2 hours of effort)														
Catch	0	0	8	1	0	0	0	0	0	0	9	3	2	1	0
Morts.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Night</i>	(65.1 hours of effort)														
Catch	1	4	68	4	2	0	0	0	0	0	79	54	3	4	6
Morts.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monthly Totals	(110.3 hours of effort)														
Catch	1	4	76	5	2	0	0	0	0	0	88		5	5	6
Morts.	0	0	0	0	0	0	0	0	0	0	0		0	0	0

Totals															
	<i>Chinook</i>		<i>Coho</i>		<i>Chum</i>	<i>Pink</i>	<i>Steelhead</i>		<i>Resident Rainbow</i>	<i>Cut./Rain. Trout Fry/Parr</i>	<i>Total Salmonid Catch</i>	<i>Lamp</i>	<i>Sunfish</i>	<i>Sculpin spp.</i>	<i>Stickle-back</i>
	<i>0+</i>	<i>1+</i>	<i>0+</i>	<i>1+</i>	<i>0+</i>	<i>0+</i>	<i>Unm Smolts</i>	<i>Mark Smolts</i>							
Catch	657	24	690	612	1201	0	12	52	0	0	3242	380	23	21	23
Morts.	4	1	1	0	4	0	0	0	0	0	10	1	0	0	1
Mortality Rate (%)	0.61	4.17	0.14	0	0.33	0	0	0	0	0	0.31	0.003	0	6	0
% of Total Catch	17.8	0.6	18.7	16.6	32.5	0	0.3	1.4	0	0	87.8	10.3	0.6	0	0.6

