

Tulalip Tribes Natural Resources Department Report

SKYKOMISH RIVER JUVENILE SALMON OUT-MIGRATION STUDY PROGRESS REPORT

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by
Ethan Seay
Matthew Pouley

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



i. Acknowledgements

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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 19 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 Bureau of Indian Affairs (BIA), 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. Skykomish River Trapping Site Location and Characteristics

The Skykomish river trap site is located at river mile 26.5 of the Skykomish River (Figure 1). The wetted width of the Skykomish River at this point is ~325 ft. during the spring out-migration period and the channel's bank full width is ~490 ft. The channel's maximum depth at the site is ~5 ft. at summer low-flow level and approaches ~18.5 ft. at bank full depth. Summer low-flow at this location is ~3,030 cfs and mean annual discharge is ~4,070 cfs. The channel gradient is < 1% and substrate is principally gravel and cobble. When fishing; the trap is positioned in the thalweg of the river, near the center of the channel. Land use adjacent to the project site is principally agriculture; however, riparian vegetation is relatively intact (with some supplemental plantings). Existing riparian vegetation is primarily cottonwood and alder while planted riparian vegetation includes cedar and spruce. At the immediate trapping site, the right-bank is composed of a gravel bar adjacent to a cottonwood stand. The left bank is just downstream of a hardened section (i.e. riprapped) with planted riparian vegetation integrated into a cottonwood stand. Adjacent to the stand is an active farm. (Kubo, Finley, Nelson, 2013).



Figure 1: Aerial photograph of the trap site at river mile 26.5 on the Skykomish River. The red dot indicates the approximate trap fishing position.

3. Summary of activities completed during the sampling season.

On February 28th, 2019 installation of the rotary screw trap began and full trapping operations commenced on March 4th. The 2019 season ended on June 21st. Trapping operations were initially delayed by heavy snowpack, making roads inaccessible for staff and trap assembly. The trap was operated for approximately 985.7 hours over 80 business days within a 16-week period from Statistical Week (SW) 10 to 25. Of those hours, 503.8 were fished at night representing 51% of total trapping effort. A total of 5 sampling events (both schedule cancellations, and unscheduled potential sampling days) were cancelled due to unfavorable sampling conditions. During the sampling season a total of 41,196 salmon and trout were captured, counted, and released. Captured unmarked chinook included 3,979 sub-yearlings and 162 yearlings. The number of Chinook sub-yearlings caught at the Skykomish River trap has varied from year to year, with this years' total approximately twice as high as the project average (2004-2019 average: 2,045). Captured unmarked Coho included 951 sub-yearlings and 1,699 yearlings. The number of unmarked Coho yearlings caught in 2019 was 60% lower than the project average (2004-2019 average: 4,204) (Table 1). During the trapping and handling process a total of 30 salmonid mortalities were reported, of which 13 were unmarked Chinook. Mortality as a percentage of the total sub-yearling Chinook catch was approximately 0.31% (Table 6).

Table 1. Annual sampling effort and catch totals for unmarked sub-yearling Chinook and yearling Coho at the Skykomish River rotary screw trap 2000-2019.

Year	Effort (Hours)	0+ Chinook	1+ Coho	Chinook CPUE	Coho CPUE
2000	308.5	1287	5972	4.17	19.36
2001	900.6	1786	5512	1.98	6.12
2002	671.7	1093	8851	1.63	13.18
2003	992.1	3394	8713	3.42	8.78
2004	1071	951	13949	0.89	13.02
2005	944.3	2411	3082	2.55	3.26
2006	1125.3	2928	6218	2.60	5.53
2007	446.8	1348	3882	3.02	8.69
2009	686.6	1650	1410	2.40	2.05
2010	1045.8	1989	1245	1.90	1.19
2011	666.8	765	1798	1.15	2.70
2012	1015.7	1323	3005	1.30	2.96
2013	1217.77	2446	4443	2.01	3.65
2014	888.2	1354	2625	1.52	2.96
2015	1078.7	1418	1596	1.31	1.48
2016	1031.5	490	2137	0.48	2.07
2017	843.4	3838	2154	4.55	2.55
2018	836	4407	1583	5.27	1.89
2019	985.7	3979	1699	4.04	1.72
<i>Project Average</i>	882	2045	4204	2.43	2.35

Efficiency testing and results.

A total of 11 trap efficiency tests (6 with Chinook sub-yearlings, and 4 with Coho yearlings) were conducted on 11 different days throughout the 2019 sampling season. During these tests, groups of hatchery origin juvenile salmon were collected from Wallace River Hatchery, marked with biological dye, and released approximately one mile upstream of the trap site. These releases were conducted weekly throughout the duration of the sampling season until the maximum allowable number of Chinook and Coho available from the hatchery had been reached unless the river was deemed unfishable due to flow conditions. 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, but preliminary calculations suggest that the trap was operating at an efficiency rate of 2.02% for Chinook sub-yearlings and 0.88% for Coho yearlings during the 2019 sampling season (Table 2). Due to the later than average start timing for trap operations, fewer Chinook releases were conducted in 2019 than is typical for the Skykomish Trap. Chinook sub-yearling efficiency rates in 2019 were higher than documented seasonal 2001-2018 averages of 1.30%; Coho yearling efficiency rates were slightly below seasonal averages of 1.10% (Table 2). 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. A limited number of Chinook releases were conducted due to limited number of fish available for releases; during Coho 1+ releases, fish were exposed to warm spring temperatures, resulting in variable release numbers.

Table 2. Efficiency Release dates, species, and capture percentages for the Skykomish River smolt trap, 2019.

Year	River	Release Date	0+ CK Eff	1+ CO Eff
2019	Skykomish	3/12	1.01%	
2019	Skykomish	3/19	1.59%	
2019	Skykomish	3/27	2.95%	
2019	Skykomish	4/2	2.53%	
2019	Skykomish	4/24		1.55%
2019	Skykomish	4/30		0.85%
2019	Skykomish	5/8		0.61%
2019	Skykomish	5/14		0.90%
2019	Skykomish	5/22		0.91%
2019	Skykomish	5/29		0.45%
2019	Skykomish	6/4		0.85%
		2019 Avg.	2.02%	0.88%

In 2015 Snohomish County Public Utility District (PUD) began conducting similar efficiency releases at their smolt trap on the Sultan River. The Sultan trap site is approximately 7.8 river miles upstream from the Skykomish trap and is located on the Sultan River approximately 0.2 river miles upstream from the confluence of the Sultan and Skykomish.

	Summed 2019 Sultan Efficiency	
	Chinook 0+ UM	Chum 0+
<i>Total Rel. 2019</i>	1967	20767
<i>Total Recap. 2019</i>	7	91
Efficiency %	0.36%	0.44%

Catch Per Unit of Effort (CPUE) analysis.

A preliminary review of the data reveals that CPUE for 0+ Chinook demonstrated two distinct peaks in SW 12 and 14, with the peak in SW 12 being slightly higher at approximately 17 fish per hour encountered. Following the CPUE peak for 0+ Chinook in SW 14, catches dropped off before a much smaller secondary peak was seen in week 19 (Figure 3). The 2019 peak outmigration timing for sub-yearling Chinook was consistent with observed seasonal norms occurring between SW11 and SW17 for all recorded years. The sub-yearling Chinook outmigration occurred over a relatively extended period, while migration for unmarked Coho yearlings was more abbreviated, taking place over a 8 week period from SW16 to 23. The peak for Coho yearlings occurred during SW19 when approximately 11 fish per hour were captured. The timing of the yearling Coho outmigration is very consistent from year to year, and the 2019 data is consistent with monitoring trends observed since the beginning of trap operations in 2001. In all years the peak outmigration of Coho occurred between SW18 and SW22, as was observed in the 2019 sampling season. Table 6 shows a monthly breakdown of catch numbers for all species and Table 5 shows calendar weeks and the corresponding dates.

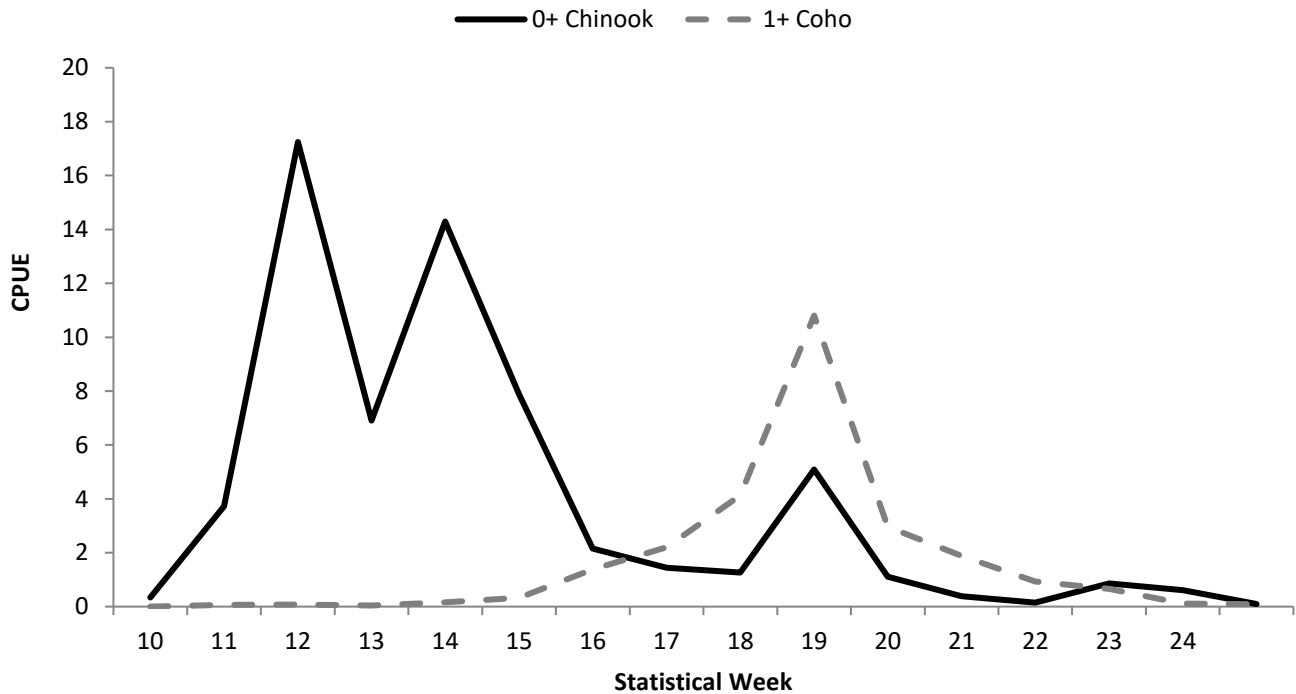


Figure 3. Chinook sub-yearling (age 0+) and Coho (1+) migration patterns observed at the Skykomish River trap, March 4th – June 14th, 2019.

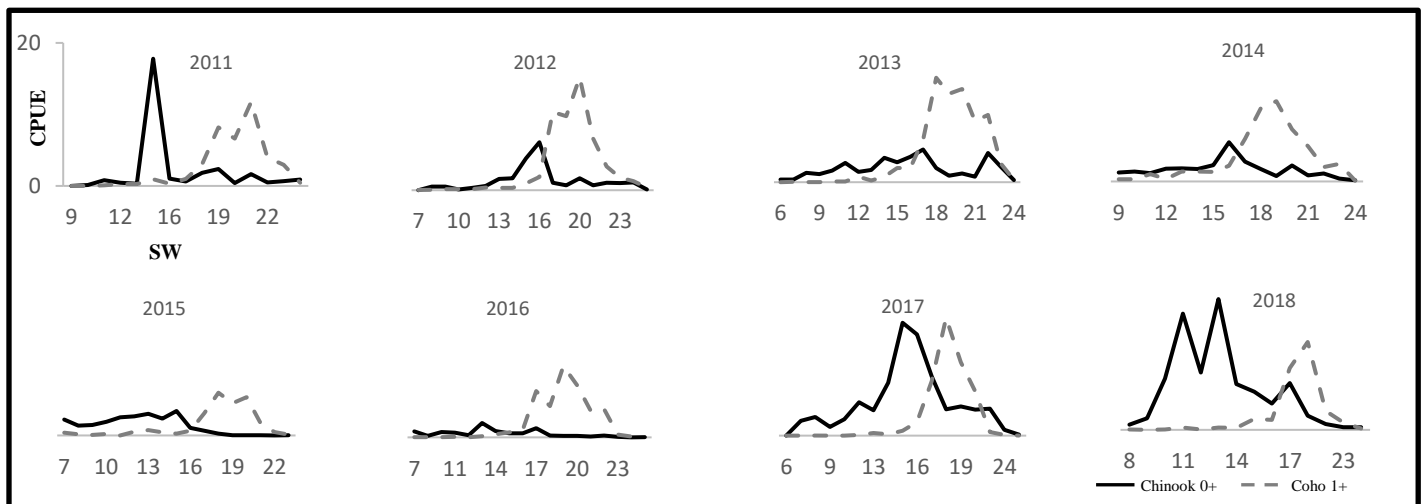


Figure 4. 2011- 2018 Chinook sub-yearling and Coho CPUE

In general, average salmonid CPUE and total catch on the Skykomish trap have exhibited seasonal variability throughout the duration of the project due to fluctuating sampling conditions and the strength of a given years outmigrant cohort. Analysis of seasonal CPUE averages for sub-yearling Chinook indicate that the catch rates in 2019 exceeded the project average (2019 CPUE; 4.04, Project Average CPUE; 2.43). Taking into account seasonal variability and sampling conditions, the total annual catch and CPUE for sub-yearling Chinook seem to display annual variability, with a higher than project average catches for the last three years (2017-2019). In 2007 the trap was moved upstream from River mile (RM) 23 to its current location at RM 26.5. This relocation excluded the Woods creek drainage from the sample, likely causing a catch decline for both species following 2007 due to decreasing drainage area sampled. For the last three years (2017-2019), average Chinook CPUE has rose dramatically, while average Coho CPUE remains consistent with trends following river mile relocation.

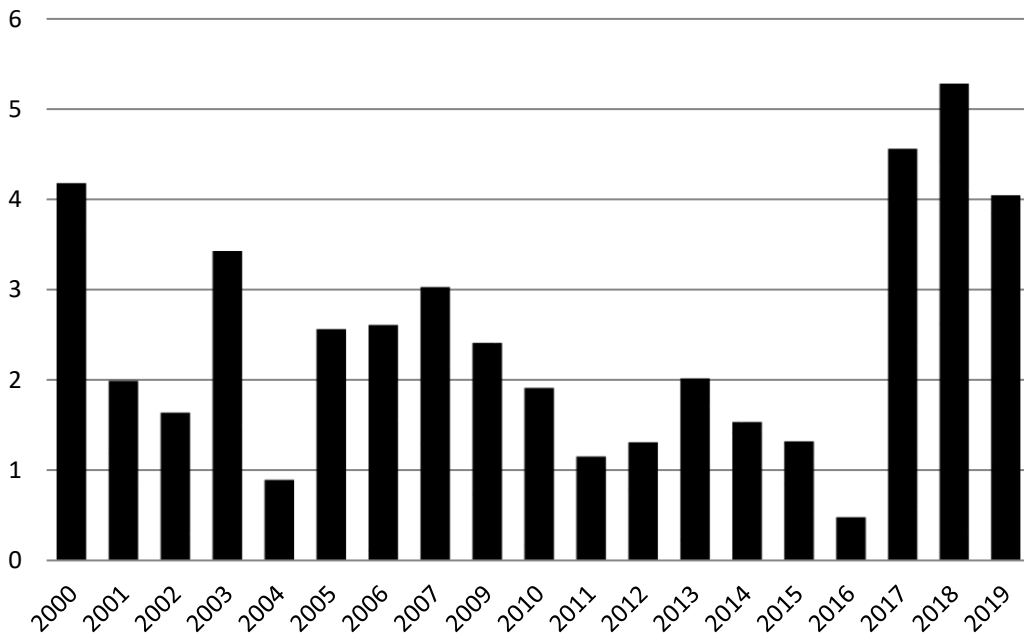


Figure 5. Sub-yearling Chinook average CPUE at the Skykomish trap; 2001-2019.

Yearling Coho catch rates dropped off significantly starting in 2009, and in 2010 the lowest documented average CPUE of 1.19 occurred (Figure 5). The overall decline in Coho catch rates is likely primarily due to the relocation of the trap site to RM 26.5 in 2007 below the Woods Creek drainage. In 2008, unforeseen complications halted Skykomish trap operations. Following relocation in 2007, catch rates have remained fairly consistent both in total catch and CPUE. In 2019, the average yearling Coho CPUE of 1.72 yearlings per hour was slightly lower, however fairly consistent with project average of 2.29 since the relocation of the site in 2007. Yearling Coho annual catch and CPUE seem to display annual variability, but no clear positive or negative trend. CPUE's have been fairly consistent year over year since the traps relocation in 2007 with 2010 being the lowest recorded year (1.19 yearlings per hour) and 2013 being the highest (3.65). These fluctuations are likely influenced by year to year variance in sampling season, effort distribution, hydrologic conditions and the size of a given years emigrating class.

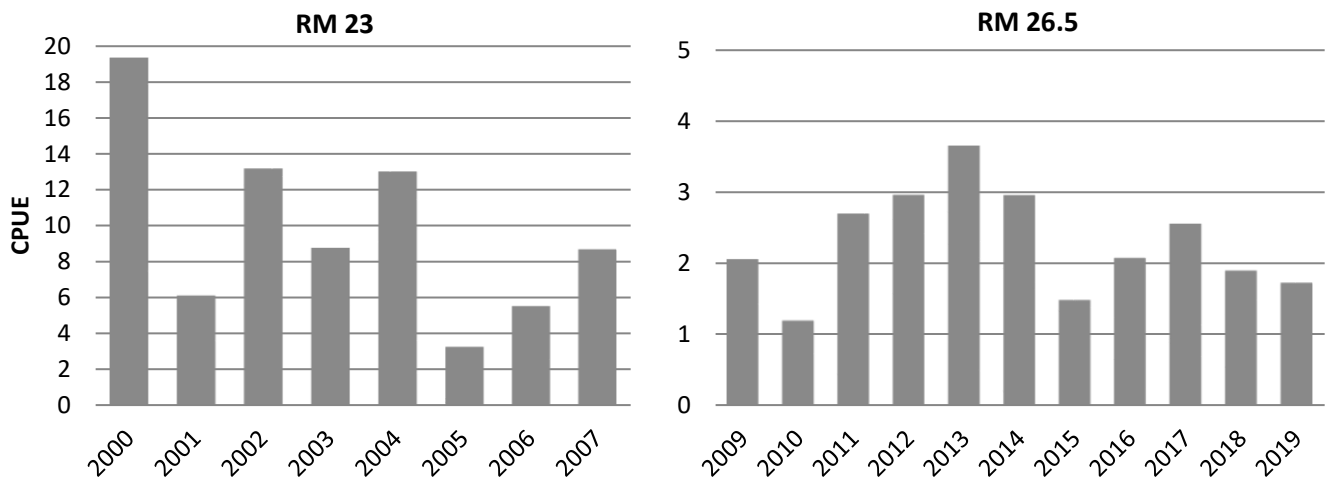


Figure 6. Yearling Coho average CPUE at the Skykomish trap by year; River mile 23: 2000-2007; River mile 26.5: 2009-2019.

4. Project status and difficulties.

The 2019 smolt trap season experienced an above average fishing effort (Average: 882 hours, Observed: 986) and experienced minimal interruption once underway. Heavy snowpack on access roads, staffing, and logistical difficulties led to a later start date for this season. Trapping usually begins mid-February or around SW 7; in 2019, fishing efforts commenced in 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 through SW 25, 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, 1 day shift and 4 night shifts were cancelled; these totaled 72 hours of missed effort or 7% of total effort.

Following a record high year (2018 CPUE: 5.27) of sub-yearling Chinook catch per unit effort, 2019 still had an above average CPUE (Average: 2.43, Observed: 4.04). For Coho, CPUE was still below average, yet fairly consistent with previous years' catch per unit effort (Average: 2.29, Observed: 1.72). 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. Delays early on in the season could have resulted in missing proportions of outmigrating salmon in mid to late February which may affect production estimates during these missed weeks.

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 5. 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

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Table 6

March																					
	<i>Chinook</i>				<i>Coho</i>			<i>Chum</i>	<i>Pink</i>	<i>Sockeye</i>	<i>Steelhead</i>			<i>Rain. Trout</i>	<i>Trout Fry</i>	<i>Dolly/Bull Trout</i>	<i>Total Salmonid Catch</i>	<i>Juv. Lamp.</i>	<i>Dace spp.</i>	<i>Sculpin spp.</i>	<i>Stickle-back</i>
	<i>Unm 1+</i>	<i>Mark 1+</i>	<i>Unm 0+</i>	<i>Mark 0+</i>	<i>0+</i>	<i>Unm 1+</i>	<i>Mark 1+</i>				<i>Unm Smolts</i>	<i>Mark Smolts</i>	<i>Cut. Trout</i>								
<i>Day</i> (112.0 hours of effort)																					
Catch	0	0	361	0	1	0	0	1591	0	0	0	0	0	0	0	0	1953	0	0	0	0
Morts.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Night</i> (98.1 hours of effort)																					
Catch	0	0	1296	0	34	11	1	17683	11	0	0	0	1	3	0	0	19040	13	29	20	2
Morts.	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0
Monthly Totals (210.1 hours of effort)																					
Catch	0	0	1657	0	35	11	1	19274	11	0	0	0	1	3	0	0	20993	13	29	20	2
Morts.	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3	0	0	0	0
April																					
	<i>Chinook</i>				<i>Coho</i>			<i>Chum</i>	<i>Pink</i>	<i>Sockeye</i>	<i>Steelhead</i>			<i>Rain. Trout</i>	<i>Trout Fry</i>	<i>Dolly/Bull Trout</i>	<i>Total Salmonid Catch</i>	<i>Juv. Lamp.</i>	<i>Dace spp.</i>	<i>Sculpin spp.</i>	<i>Stickle-back</i>
	<i>Unm 1+</i>	<i>Mark 1+</i>	<i>Unm 0+</i>	<i>Mark 0+</i>	<i>0+</i>	<i>Unm 1+</i>	<i>Mark 1+</i>				<i>Unm Smolts</i>	<i>Mark Smolts</i>	<i>Cut. Trout</i>								
<i>Day</i> (125.8 hours of effort)																					
Catch	4	73	631	2	88	10	1	2688	0	0	1	3	0	0	0	0	3501	0	0	2	0
Morts.	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0
<i>Night</i> (139.7 hours of effort)																					
Catch	7	840	1082	79	285	310	174	8175	2	0	6	251	2	0	1	1	11215	9	33	23	1
Morts.	0	0	1	0	2	0	0	1	0	0	0	0	0	0	0	0	4	0	0	0	0
Monthly Totals (265.5 hours of effort)																					

Catch	11	913	1713	81	373	320	175	10863	2	0	7	254	2	0	1	1	14716	9	33	25	1
Morts.	0	1	1	0	2	0	0	2	0	0	0	0	0	0	0	0	6	0	0	0	0

May

	<i>Chinook</i>				<i>Coho</i>			<i>Chum</i>	<i>Pink</i>	<i>Sockeye</i>	<i>Steelhead</i>		<i>Cut. Trout</i>	<i>Rain. Trout</i>	<i>Trout Fry</i>	<i>Dolly/Bull Trout</i>	<i>Total Salmonid Catch</i>	<i>Juv. Lamp.</i>	<i>Dace spp.</i>	<i>Sculpin spp.</i>	<i>Stickle-back</i>
	<i>Unm I+</i>	<i>Mark I+</i>	<i>Unm 0+</i>	<i>Mark 0+</i>	<i>0+</i>	<i>Unm I+</i>	<i>Mark I+</i>				<i>Unm Smolts</i>	<i>Mark Smolts</i>									
<i>Day</i>	<i>(135.4 hours of effort)</i>																				
Catch	12	10	79	27	31	13	20	45	0	0	2	2	0	0	0	0	241	0	0	3	1
Morts.	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0
<i>Night</i>	<i>(162.6 hours of effort)</i>																				
Catch	26	712	437	863	404	1310	149	598	0	0	31	52	8	0	4	0	4594	12	52	13	0
Morts.	1	0	11	0	3	0	0	0	0	0	0	0	1	0	0	0	16	0	0	0	0
Monthly Totals	<i>(298.0 hours of effort)</i>																				
Catch	38	722	516	890	435	1323	169	643	0	0	33	54	8	0	4	0	4835	12	52	16	1
Morts.	1	0	11	0	4	0	0	1	0	0	0	0	1	0	0	0	18	0	0	0	0

June

	<i>Chinook</i>				<i>Coho</i>			<i>Chum</i>	<i>Pink</i>	<i>Sockeye</i>	<i>Steelhead</i>		<i>Cut. Trout</i>	<i>Rain. Trout</i>	<i>Trout Fry</i>	<i>Dolly/Bull Trout</i>	<i>Total Salmonid Catch</i>	<i>Juv. Lamp.</i>	<i>Dace spp.</i>	<i>Sculpin spp.</i>	<i>Stickle-back</i>
	<i>Unm I+</i>	<i>Mark I+</i>	<i>Unm 0+</i>	<i>Mark 0+</i>	<i>0+</i>	<i>Unm I+</i>	<i>Mark I+</i>				<i>Unm Smolts</i>	<i>Mark Smolts</i>									
<i>Day</i>	<i>(108.7 hours of effort)</i>																				
Catch	0	0	4	0	5	1	0	0	0	0	0	0	0	0	0	0	10	1	0	1	0
Morts.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
<i>Night</i>	<i>(103.5 hours of effort)</i>																				
Catch	89	0	89	288	103	44	21	1	1	0	4	0	0	0	0	0	640	13	18	2	0
Morts.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0

Monthly Totals

(212.2 hours of effort)

Catch	89	0	93	288	108	45	21	1	1	0	4	0	0	0	0	0	650	14	18	3	0
Morts.	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0

Totals

(985.7 total hours of effort)

	<i>Chinook</i>				<i>Coho</i>			<i>Chum</i>	<i>Pink</i>	<i>Sockeye</i>	<i>Steel head</i>			<i>Rain. Trout</i>	<i>Trout Fry</i>	<i>Dolly/Bull Trout</i>	<i>Total Salmonid Catch</i>	<i>Juv. Lamp.</i>	<i>Dace spp.</i>	<i>Sculpin spp.</i>	<i>Stickle-back</i>
	<i>Unm I+</i>	<i>Mark I+</i>	<i>Unm 0+</i>	<i>Mark 0+</i>	<i>Unm 0+</i>	<i>Mark I+</i>	<i>Unm I+</i>				<i>Unm Smolts</i>	<i>Mark Smolts</i>	<i>Cut. Trout</i>								
Catch	138	1635	3979	1249	951	1699	366	30781	14	0	44	308	11	3	5	1	41196	48	132	64	4
Morts.	1	1	12	2	7	0	0	6	0	0	0	0	1	0	0	0	30	0	0	1	0
% Mort	0.72%	0.06%	0.30%	0.17%	0.74%	0.00%	0.00%	0.02%	0.00%	#Num!	0.00%	0.00%	9.09%	0.00%	0.00%	0.00%	0.07%				
% of Total Catch	0.3%	3.9%	9.6%	2.8%	2.3%	4.1%	0.9%	74.3%	0.0%	0.0%	0.1%	0.7%	0.0%	0.0%	0.0%	0.0%	99.4%	0.1%	0.3%	0.2%	0.0%