

**Washington Department of Fish and Wildlife
Puget Sound Treaty Indian Tribes**

Puget Sound Chinook Comprehensive Harvest Management Plan

Annual Report
The 2020-2021 Fishing Season

October 2021

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Executive Summary

This annual report on the Puget Sound Chinook Comprehensive Harvest Management Plan summarizes harvest information about commercial salmon fisheries occurring between May 1, 2020 and April 31, 2021, and Chinook spawning escapement in 2020. It also includes harvest information relevant to the 2019-2020 non-treaty sport fishing seasons where Chinook retention was allowed and a review of the coded wire tag sampling rates in marine sport salmon fisheries during calendar year (January-December) 2019.

Commercial Chinook catch in Puget Sound pre-terminal and terminal fisheries was substantially lower than projected pre-season, even in terminal areas targeting terminal hatchery runs (i.e. Gorst Creek, Minter Creek, and Hoodsport Hatcheries).

Marine and freshwater landed recreational Chinook catch in fisheries where Chinook retention was allowed, based on catch record cards, in the 2019-2020 season was estimated at 31,959 compared to the pre-season projection of 43,329. Creel survey-based estimates of catch in 2020-2021 summer mark-selective recreational fisheries in Areas 5, 7, 9, 10, and 11 and winter MSF in Area 10 as well as the North Fork Nooksack recreation spring Chinook MSF are included in this report. Total encounter estimates for intensively monitored 2019-20 summer marine area selective fisheries are presented and compared to pre-season projections for these areas.

Escapement for summer/fall management units was generally lower than projected while most spring management unit escapement were generally greater than projected.

Coded-wire tag sampling rates for calendar year 2019 commercial fisheries exceeded 20% in most areas except for MCA 13D-F, Hood Canal marine areas, and Strait of JDF net and troll fishery. Sampling rates for marine recreational fisheries exceeded the 10% objectives in all areas except marine area 12.

1 Introduction

The Puget Sound Chinook Harvest Management Plan mandates annual reporting of the performance of Chinook harvest management relative to the standards and guidelines of the plan (PSIT and WDFW 2010). This report partially fulfills that requirement and that of the Terms and Conditions in the 2020 Harvest Biological Opinion (F/WCR-2020-00690) by assessing the performance and effectiveness of treaty and non-treaty commercial fishery management actions adopted for the most recent management year, May 2020 through April 2021. Included in this report are:

- Management objectives for the 2020-2021 management year (May 1, 2020 through April 30, 2021)
- Projected and actual commercial landed catch in Puget Sound and descriptions of fisheries for the 2020-2021 management year
- Projected and actual landed catch for 2020 Puget Sound recreational fisheries where Chinook retention was allowed, and creel surveys were conducted as well as for 2019 Puget Sound recreational sport fisheries where Chinook retention was allowed.
- Estimates of total encounters for 2020 summer mark-selective fisheries and non-landed mortality for commercial fisheries with Chinook non-retention where data are available.
- Projected and actual 2020 spawning escapements for nearly all, except Nooksack spring Chinook, Puget Sound Chinook populations with details on estimation methods and surveys. For Nooksack Spring Chinook escapement estimates, details are provided for 2018 escapement.
- Summaries of biological sampling of spawning escapement and estimates of contributions of hatchery- and natural-origin spawners where available.
- Coded-wire tag sampling rates for commercial and recreational fisheries in calendar year 2019 (January to December 2019).

1.1 Management Objectives

General management objectives for Puget Sound Chinook populations, including Exploitation Rate Ceilings (ERCs), Critical Exploitation Rate Ceilings (CERC's), Upper Management Thresholds (UMTs), and Low Abundance Thresholds (LATs) were implemented in 2020 (Table 1-1). The final pre-season FRAM model run (Chin3120) highlighted the rates that were used as the ceilings for each Management Unit (MU) in 2020, and the projected exploitation rates and escapements for each unit (Table 1-2).

Pre-season fishery planning for 2020-2021 fisheries projected that natural spawning escapement would fall below the Low Abundance Thresholds (LAT) for the Nooksack early, Skagit springs, Stillaguamish summer/fall, Snohomish summer/fall, and Mid-Hood Canal MUs, so CERC's were implemented for those units. Escapement projections for other MUs exceeded their LAT's.

Table 1-1. 2020 Puget Sound Chinook Harvest Management Objectives.

Management Unit	ER Ceiling	Critical ER Ceiling	Low Abundance Threshold
Nooksack			
North Fork		10.5% SUS	400
South Fork			200
Skagit summer / fall	48%	15% SUS	9,100
Upper Skagit summer			2,200
Sauk summer			400
Lower Skagit fall			900
Skagit spring	37.5%	10.3% SUS	823
Upper Sauk			130
Cascade			170
Suiattle			170
Stillaguamish	22% Total/13% SUS Max.	8% SUS Max.	1,200 ^a
Snohomish	9% SUS	8% SUS	3,375
Skykomish			2,092
Snoqualmie			1,066
Lake Washington	500	12% SUS	200
Cedar River	Escapement (13% PT SUS)		
	2,003		
Green	Escapement (13% PTSUS)	12% SUS	805
White River spring	22% SUS	15% SUS	400
	1,170		
Puyallup fall	Escapement (13% PT SUS)	15% SUS	468
Nisqually	47% + 2% Exp. Fishery	50% Reduction of SUS ER	7,000
Skokomish	50%	12% PTSUS	1,300 aggregate; 800 natural
Mid-Hood Canal	15% PTSUS	12.2% PTSUS	400
Dungeness	10% SUS	6% SUS	500
Elwha	10% SUS	6% SUS	1,500
Western SJDF	10% SUS	6% SUS	500

^a Stillaguamish LAT is terminal runsize and does not account for terminal fishery impacts.

Table 1-2. Management guidelines implemented and projected exploitation rates and escapements for Puget Sound Chinook Management Units for 2020 – 2021 pre-season planning (FRAM Chin3120).

Management Unit	ERC or CERC implemented	Projected ER	Projected Escapement
Nooksack	10.5% SUS	10.5% SUS	371
Skagit summer fall	48%	48.0%	9,560
Skagit spring	10.3% SUS	9.0% SUS	1,508
Stillaguamish	22%Total/8% SUS	18.4%Total/7.2% SUS	990 ^a
Snohomish	8% SUS	7.7% SUS	2,989
L. Washington (Cedar)	500 Escapement / 13% PT SUS	10.5% PT SUS	855
Green	2,003 Escapement / 13% PT SUS	10.5% PT SUS	4,001
White	22% SUS	15.7% SUS	2,125
Puyallup	1,170 Escapement / 13% PT SUS	10.5%	2,633
Nisqually	47% + 2% Exp. Fishery	48.8%	9,423
Skokomish	50%	48.3%	2,749
Mid Hood Canal	12.2% PT SUS	12.2% PT SUS	39
Dungeness	10% SUS	3.4% SUS	793
Elwha	10% SUS	3.3% SUS	3,319
Western SJDF	10% SUS	2.3% SUS	2,170

^a Stillaguamish LAT is forecasted terminal runsize and does not account for terminal fishery impacts.

2 Commercial Harvest

This chapter provides post-season estimates of Chinook catch for Puget Sound commercial fisheries, catch from tribal ceremonial and subsistence (C&S) fisheries, and test or research fisheries. Catch is projected pre-season through modeling of the fishery regime, which is developed and agreed upon in the Pacific Fisheries Management Council (PFMC) and North of Cape Falcon (NOF) forums, using the Fishery Regulation Assessment Model (FRAM). The 2020–21 List of Agreed Fisheries (<https://nwifc-fisheriesservices.s3.amazonaws.com/wp/wp-content/uploads/20210310103824/LOAF-2020-2021-Final-with-signatures.pdf>) describes salmon fisheries for all areas of Puget Sound and ocean fisheries off the Washington coast. The final pre-season projections of catch under this regime were made in FRAM run number Chin3120.

Commercial, ceremonial and subsistence, and test fishery catch is accounted for on fish tickets, i.e., receipts from transactions between fishers and buyers. Fish ticket data are stored in joint databases maintained by WDFW and the Puget Sound Tribes. In some commercial fisheries with Chinook non-retention, particularly non-treaty purse seine fisheries, estimates of non-landed mortality are also available for comparison to pre-season expectations (Table 2-8 and Table 2-9). WDFW conducts on-the-water observations of by-catch in commercial fisheries, concentrating on areas and gears where Chinook retention is not allowed.

Non-treaty troll, treaty troll, and recreational catches in Washington coastal fisheries north of Cape Falcon were less than their expected quotas (Table 2-1). Comparisons of projected and actual Puget Sound catch are provided for two pre-terminal areas (Strait of Juan de Fuca and San Juan Islands), and six regional terminal fisheries (Nooksack/Samish, Skagit, Stillaguamish/Snohomish, South Puget Sound, Hood Canal,

and Strait of Juan de Fuca). General information is presented for the 2020–21 fisheries, including in-season management actions that deviated from the pre-season plan, and explanations for differences in projected and actual catch.

Table 2-1. Projected and actual Chinook net and troll catch, including release mortalities from selective net fisheries, in waters of the Washington coast and Puget Sound fisheries in 2020.

Fishery	Projected	Actual
Washington ocean non-treaty troll	27,640	12,500
Washington ocean recreational	26,360	7,659
Washington ocean treaty troll	35,000	2,437
Puget Sound pre-terminal net & troll total		
Strait of Juan de Fuca troll	3,728	313
Strait of Juan de Fuca net	312	8
PSC Test Fishery		0
San Juan Islands net ^a	8,260	63
Nooksack-Samish terminal net	11,742	7,542
Skagit terminal net	4,647	2,234
Stillaguamish-Snohomish net	6,148	3,458
South Puget Sound terminal net	42,076	22,641
Hood Canal terminal net	50,138	19,231
Strait Tributaries terminal net	3	0

^a includes non-retention mortality in NT purse seine fishery.

2.1 Strait of Juan de Fuca and San Juan Islands

Treaty net fisheries in the Strait of Juan de Fuca and the San Juan Islands caught 8 and 31 Chinook, respectively. Catch in the San Juan Islands areas occurred during the Fraser chum directed fishery in October 2020.

Non-treaty fisheries targeting Fraser chum in Areas 7 and 7A landed no Chinook. Because non-tribal purse seines are required to release all Chinook, release mortality estimates are calculated using available data from on-water by-catch monitoring. An estimated 32 Chinook release mortalities occurred during the chum directed non-tribal purse seine fishery in Area 7A.

There was no PSC Fraser sockeye Test Fishery in Area 5 during 2020.

The Treaty troll fishery in the Strait of Juan de Fuca (SJD), exclusive of catch in Area 4B when it was managed under PFMC quotas, caught 313 Chinook. Two hundred thirteen Chinook were caught during the summer SJD troll fishery while 100 were caught during the winter SJD troll fishery.

2.2 Nooksack/Samish Terminal Area

Treaty Spring Chinook Ceremonial and Subsistence Fishery

The Lummi Nation conducted fishing with tangle-net gear from April 6 to June 2, 2020. Total landed catch was 337 hatchery-origin Chinook and 11 natural-origin Chinook with an additional 56 natural-origin Chinook and 74 CWT-only fish encountered and released. Applying the expected release mortality rate of 30% to the 56 early-run NOR encounters results in 17 NOR estimated mortalities. The total encounter of NORs (n=67, including released and retained fish) was lower than the pre-season projection of 90 NORs. Genetic results for the released NORs are not currently available to determine population origin.

In 2020, the Lummi Nation implemented a radio-telemetry study to better understand migration timing, habitat utilization, and inform release mortality for fish encountered in the tangle-net fishery. Between April 28 and July 24, a total of 89 Chinook were implanted with radio tags and released. Thirty-five of the 56 NORs and 54 of 74 HORs encountered in the Tangle Net fishery were used in the study.

In 2020, the Nooksack Tribe conducted a permit only, subsistence fishery from May 7 through June 15, 2020. A total of 147 Chinook were caught in the traditional C&S fisheries and all were sampled. One hundred twenty-nine of the 147 chinook were clipped indicating Kendall hatchery origin. Eleven were non-clipped but with CWT indicating Skookum program origin and seven with no ad-clip and no CWT are apparent NORs. Otolith and genetic results to confirm origin are still pending laboratory processing and analysis.

The Tribes 2020 total NOR mortality is estimated to be 35 early-run NORs, pending additional analysis of remaining biological samples. The pre-season projection was 35 NOR mortalities.

Table 2-2. Expected and observed Chinook catches in the Nooksack/Samish terminal area, 2020.

Area	Management Period	Projected	Actual
7B, 7C, 7D, Treaty net ¹	Chinook, coho, chum	5,795	5,285
7B, 7C Non-treaty net	Chinook, coho, chum	3,276	1,203
Nooksack River Treaty net	Early Chinook, May-Jun	1,844	534
	Fall Chinook, Aug-Oct	827	520

¹ Includes 7A on-reservation catch during coho management.

Fall Chinook, Coho, and Chum Fisheries

The tribal fall Chinook fishery in Bellingham Bay (Area 7B) and Lummi Bay (7D) operated as planned from August 2nd through September 4th and in Samish Bay (7C) from August 2nd through September 11th, with a catch of 4,923 Chinook. The coho fishery operated as planned from September 6th through October 17th, with an incidental harvest of 356 Chinook. During the 7A on-reservation Coho fishery from September 8th through October 2nd, six Chinook were incidentally harvested. No Chinook were harvested incidentally during the chum fishery. The total fall Chinook catch of 5,279 for Areas 7B, 7C, and 7D was less than the preseason projection of 5,795 (Table 2-2).

The non-treaty fishery in Area 7B and 7C landed 1,197 Chinook from July through September, lower than the pre-season projection of 3,261. Fifteen Chinook were forecasted to be landed during the chum fishery, with six landed.

Fisheries for fall Chinook, coho, and chum in the Nooksack River occurred as planned from August 2 – September 5, September 6 – October 17, and October 18 – December 11, respectively. The total Chinook catch was 520, less than the projected catch of 827 fish; 292 were caught during the Chinook period and 227 during the coho fishery. One Chinook was harvested during the chum period.

2.3 Skagit Bay/Skagit River Terminal Areas

Skagit Terminal Area Treaty Fisheries

Spring Chinook Fisheries: Treaty commercial fisheries in the Skagit terminal area directed at hatchery spring Chinook were conducted in 2020 as scheduled preseason, although with some adjustments in timing. The Upper Skagit tribe's sockeye fishery started later than planned, outside the spring chinook management period. A total of 68 wild and 514 hatchery spring Chinook were encountered in these fisheries. Two of the wild chinook were released, which resulted in an estimated 67 wild and 514 hatchery spring Chinook mortalities (assuming a 52.4% release mortality rate on the 2 release fish), compared to 66 wild and 727 commercial hatchery spring Chinook mortalities expected pre-season based on Chinook FRAM 3120. No directed hatchery spring chinook ceremonial fisheries occurred, compared to 30 wild and 45 hatchery C&S expected.

Summer/Fall Chinook Fisheries: No treaty commercial fisheries directed at summer/fall Chinook were scheduled in the Skagit terminal area for 2020. However, as anticipated, incidental catch of summer/fall Chinook occurred in the sockeye and coho fisheries. The sockeye and coho fisheries were adjusted from the preseason schedule as noted in Table 2-3 due to in-season management needs and intertribal sharing agreements. Total summer/fall Chinook mortality in these fisheries was 1,174 fish, compared to the pre-season expectation of 816 based on Chinook FRAM 3120. No summer/fall Chinook were harvested for ceremonial purposes; the pre-season modeled value was 2,534.

Terminal Area Test Fisheries: A suite of Skagit terminal area test fisheries targeting steelhead, Chinook, sockeye, coho, and chum were conducted by the Skagit tribes in 2020. Some weeks of these fisheries were adjusted or cancelled, as noted in Table 2-3, in response to weather, flow concerns, or staffing issues. A total of 20 wild spring Chinook, 26 hatchery spring Chinook, and 433 summer/fall Chinook mortalities occurred in these fisheries. The pre-season expectation of mortalities in the test fisheries was 27 wild spring Chinook, 37 hatchery spring Chinook, and 442 summer/fall Chinook.

Summary: Overall, a total of 87 wild spring Chinook, 540 hatchery spring Chinook, and 1,607 summer/fall Chinook were killed in treaty commercial, C&S, and test fisheries. The preseason expectation based on Chinook FRAM 3120 was 123 wild springs, 809 hatchery springs, and 3,717 summer/falls.

Table 2-3. Skagit terminal area projected and actual Chinook catches for treaty fisheries in 2020. Weekly projections were made by plugging the FRAM Chin3120 run sizes into the Skagit weekly harvest rate model, so totals may differ slightly from FRAM.

Fishery	Preseason Projected			Post-season Observed/Estimated			Difference	
	Schedule	Encounters	Mortality	Schedule	Encounters	Mortality	Encounters	Mortality
Test:								
Chinook	1 site, wks 19-35	134	134	No week 19, 25-27	155	155	21	21
Sockeye	2 sites: Area 3 wks 23-30, Blakes wks 24-29	69	69	Area 3 no wk 23, 27, 28; Blakes no wks 24-25,27,29	38	38	-31	-31
Coho	3 sites: Blakes wks 38 - 42, Area 3 wks 34-42, Spudhouse wks 35-44	299	299	Blakes no week 42; Area 3 no wk 42 added wk 43; Spudhouse no wks 35,37,44	286	286	-13	-13
Chum	3 sites, wks 44-45	0	0	No Bay wk 44-45; No Jetty Week 45; No Blakes wks 44-45	0	0	0	0
Steelhead	2 sites, wks 5-17	8	4	Only wks 8-12	0	0	-8	-4
Area 8/78C Spring Chinook Fishery Swinomish Tribe:								
Week 18	3 days	118	118	Same	99	99	-19	-19
Week 19	3.5 days	137	137	2.667 days	73	73	-64	-64
Week 20	1 day	56	56	1.833 days	87	87	31	31
Week 21	None	0	0	Same	0	0	0	0
Area 78P Spring Chinook Fishery Sauk-Suiattle Tribes:								
Wk 23-31	3 days/week	154	150	Same	5	4	-149	-146
Area 78C/78D Spring Chinook Fishery Upper Skagit Tribe:								
Week 18	0.25 days	72	72	None	0	0	-72	-72
Week 19	0.625 days	179	179	1.375 days	144	144	-35	-35
Week 20	0.25 days	77	77	1.208 days	174	174	97	97
Week 21	None	0	0	None	0	0	0	0
Area 8/78C/78D Chinook C&S Fishery Swinomish, Sauk-Suiattle, Upper Skagit Tribes:								
Sum/Fall-Spring Chin.	As needed	2,534	2,534	As needed	0	0	-2,534	-2,534
Areas 8/78C Sockeye Fishery Swinomish Tribe:								
Week 25	None	0	0	None	0	0	0	0
Week 26	None	0	0	None	0	0	0	0
Week 27	2.292 days	22	22	2.5 days	35	35	13	13

Week 28	2.292 days	32	32	None	0	0	-32	-32
Week 29	None	0	0	0.667 days	3	3	3	3
Week 30	None	0	0	1.333 days	126	126	126	126
Area 78D/78O Sockeye Fishery Swinomish Tribe:								
Week 28	1 day	3	3	None	0	0	-3	-3
Week 29	1 day	3	3	None	0	0	-3	-3
Week 30	None	0	0	1.115 days	5	5	5	5
Areas 78C/78D/78O Sockeye Fishery Upper Skagit Tribe:								
Week 26	None	0	0	None	0	0	0	0
Week 27	0.167 days	6	6	None	0	0	-6	-6
Week 28	0.167 days	7	7	0.188 days	20	20	13	13
Week 29	0.167 days	8	8	None	0	0	-8	-8
Week 30	0.167 days	10	10	1.5 days	185	185	175	175
Areas 8/78C Coho Fishery Swinomish Tribe:								
Week 38	None	0	0	None	0	0	0	0
Week 39	2 days	40	40	2 days	85	85	45	45
Week 40	2 days	14	14	None	0	0	-14	-14
Week 41	None	0	0	5.5 days	21	21	21	21
Areas 78C Coho Fishery Sauk-Suiattle Tribe:								
Wk 40-46	3 days/week	400	400	Same	1	1	-399	-399
Areas 78C/78D Coho Fishery Upper Skagit Tribe:								
Week 39	0.583 days	88	88	1.25 days	460	460	372	372
Week 40	0.5 days	90	90	None	0	0	-90	-90
Week 41	0.5 days	36	36	1.167 days	174	174	138	138
Week 42	0.5 days	30	30	1.417 days	59	59	29	29
Week 43	0.5 days	30	30	None	0	0	-30	-30
Areas 8/78C Chum Fishery Swinomish and Sauk-Suiattle Tribes:								
None	None	0	0	None	0	0	0	0
Total Skagit Terminal Area:		4,657	4,649		2,235	2,234	-2,422	-2,415

2.4 Stillaguamish/Snohomish Terminal Area

The tribal net fishery in Area 8A was open for the 2019/2020 fishing season for Ceremonial Chinook and a five-week commercial coho fishery. No commercial or ceremonial Chinook were harvested in Area 8A during 2020 (Table 2-4). Non-treaty commercial fishing in Area 8A was closed for the 2020-2021 season.

Tribal Chinook catch in Area 8D occurred from May through late-September, with most of the catch occurring during June. Total 8D catch was 3,614, including 448 for ceremonial or subsistence purposes (Table 2-4). Tribal Chinook catch was less than projected in area 8D.

Non-treaty commercial fishing in Area 8D was closed for the 2020-2021 season.

The Stillaguamish Tribe harvested 21 Chinook for ceremonial purposes from the Stillaguamish River in 2020 (Table 2-4). Four Chinook were harvested incidentally during the coho directed fishery.

Table 2-4. Projected (FRAM Chin3120) and actual Chinook net fishery harvest in the Stillaguamish - Snohomish terminal area in 2020.

Area		Projected	Actual
8A Commercial	Treaty	1	0
	Treaty C&S	Up to 100	0
	Ntrty	0	0
8A Test		0	0
8D Commercial	Treaty	6,012	3,166
	Treaty C&S		448
	Ntrty	3	0
Stillaguamish R. Net	C&S/Coho	32	25

2.5 South Puget Sound Terminal Areas

Table 2-5. Projected and actual Chinook catch in 2020 South Puget Sound net fisheries.

Area	Management Period	Projected	Actual
Area 9/10/11	Coho (A10 - Test)	0	0
	Chum (A9 - Test)	225	32
	A9 (Trty. C&S + chum)	511	10
	Trty coho/chum (A10/11)	12	14
	NT chum (A10/11)	174 ^a	0 ^a
Area 10E	Treaty Chinook/coho/chum	6,793	4,651
Area 10A	Chinook (test/C&S/Comm)	1,169	795
	Coho/chum	1	43
Duwamish River	Chinook/Coho/Chum	7,749	7,108
	Coho (Test/C&S)		57
L Washington/Ship Canal	Sockeye/coho/ C&S	636	190
	Test/Research	N/A	--
Lake Sammamish	Chinook/Coho	0	0
Puyallup River	Spring/Fall C&S	592	175 ^b
	Chinook/Coho	3,742	4,485
White River	Spring C&S	-- ^c	108
	Coho		600
Areas 13, 13D-K	Chinook/Coho/Chum	4,670	706
Area 13A	Chinook/Coho/Chum	3,282	1,164
Areas 13C/Chambers	Chinook	557	227
Nisqually River	Chinook/coho	5,990	2,009 ^b
McCallister Cr.	Chinook	6,283	267

^a Values include landed catch and release mortalities

^b Adult (Age 3+) catch only, does not include jacks.

^c White River C&S Projected harvest is incorporated in the Puyallup River Spring/Fall C&S catch of 606 fish.

Marine Areas 9, 10 & 11

The coho test fishery in area 10 was not implemented in 2020. The chum test fishery at Apple Cove Point (Area 9) incidentally caught a total of 32 Chinook (Table 2-5), well below the estimated 225.

The non-treaty chum-directed fishery in Area 10 and 11 did not open in 2020. The treaty coho fishery in Area 10 harvested 14 Chinook, while harvesting five Chinook during the chum fishery. Fisheries directed at Chinook and coho in Area 10E harvested 4,651 Chinook (Table 2-5). No Chinook were harvested during the chum fishery in area 10E.

Ten Chinook were harvested in Area 9 for C&S purposes, while no Chinook were harvested during the chum fishery.

Lake Washington

There were no Chinook directed fisheries in Lake Washington, the Ship Canal, or North Lake Washington. Sockeye returns to Lake Washington were insufficient to allow any directed fisheries. The Muckleshoot Tribe conducted a C&S fisheries in the Lake Washington Ship Canal in 2020 which harvested 60 Chinook. Incidental Chinook catch during the coho fishery in Lake Union, and the upper and lower Ship Canal harvested 25 Chinook, which was less than expected. The Muckleshoot Tribe conducted a coho directed commercial fishery in North Lake Washington with a total by-catch of 105 Chinook. There were no coho directed fisheries in Lake Sammamish.

The Lake Washington ship canal abundance and diet study of piscivorous fish that was planned to be conducted by WDFW in 2020 did not occur due to limitations associated with the COVID-19 pandemic.

The Lake Washington warm water test fishery, conducted by the Muckleshoot Tribe was not prosecuted in spring (May-June) of 2020 due to Covid-19 limitations. During March-April of 2021, four marked Chinook and 1 un-marked Chinook were encountered.

Elliott Bay/Duwamish River

The Suquamish Tribe harvested 124 Chinook during the Chinook directed fishery and 28 incidental Chinook in Elliot Bay during the coho directed fishery in 2020. The Chinook test fishery in Area 10A harvested 215 Chinook in 2020. A Chinook-directed commercial fishery occurred in Area 10A and the Duwamish River, with Muckleshoot Indian Tribe harvesting 456 and 6,672 Chinook salmon, respectively. In 10A, there were 15 Chinook caught in September during the coho directed fishery by Muckleshoot Indian Tribe. In the Duwamish River, 57 Chinook were caught during the coho test fishery to determine Chinook clearance. During the coho directed fishery in the Duwamish River, 436 Chinook were caught incidentally.

Puyallup River and White Rivers

Ceremonial and subsistence fisheries in the Puyallup River caught 136 adult spring Chinook salmon along with six estimated jacks during management weeks 21–28. Based on fisheries sampling data, an additional 39 adults presumed to be fall-run Chinook, based on ad-clip marks, were taken during the spring C&S fishery. The Muckleshoot Tribe had an additional spring Chinook C&S fishery in the White River which caught 178 spring Chinook and 20 presumed fall Chinook based on ad-clip marks. Besides the 59 fall Chinook taken during the spring C&S, no other fall Chinook C&S fisheries occurred. The pre-season projected C&S catch was 592.

Fall Chinook catch was 3,384 during the Chinook directed fishery. The coho fishery in the Puyallup River occurred from management week 37 (September 6th) to management week 42 (October 13th) and incidentally harvested 1,097 Chinook salmon, mostly during early September. During the Coho directed fishery in the White River, scheduled to occur from August 30th through October 13th, harvested 600 Chinook during the second half of September (Table 2-5).

Marine area 13 & sub areas (Deep South Sound)

The Chinook fishery in Carr Inlet (13A) caught 1,164 Chinook (Table 2-5), in August and early September (weeks 32 – 36). Pre-season projected catch was 3,282. This fishery targets Minter Creek Hatchery Chinook returns where no natural origin fish are returning to spawn. The coho fishery in 13A incidentally harvested zero Chinook, with a preseason expectation of 36.

The Chinook fishery at Chambers Bay (13C) occurred between July 26 through October 10 with 227 Chinook harvested (Table 2-5). The preseason catch projection was 557.

Chinook directed fisheries in 13D and Budd Inlet (13F) occurred from mid-July through early-September; total catch was 588 all in 13F. Chinook caught incidentally during the coho fishery (Week 37-40) in 13D totaled 118 fish. Zero Chinook were caught during the Fox Island (Area 13) coho fishery. The total preseason catch projection for both areas was 4,670.

Nisqually River

The treaty commercial fishery in the Nisqually River harvested an estimated 2,009 Chinook, excluding jacks, but including fish for Ceremonial and Subsistence purposes, with a pre-season projected commercial catch, excluding jacks, of 5,990 (Table 2-5).

The selective net gear evaluation study in the Nisqually River encountered and released 21 ad-clipped Chinook salmon during 2020.

2.6 Hood Canal

Tribal Chinook directed fishing in 12C occurred as planned from July 19 through August 31 with a catch of 2,774. No Chinook were landed in 12C during the Coho directed fishery. In marine catch areas 12 and 12B, zero Chinook were harvested during the tribal Coho directed fishery.

Tribal Chinook harvest in the Hoodspout Hatchery Zone (12H) was 6,931 and occurred as planned from July 12 through September 12. Catch was less than the preseason expectation of 24,226.

Chinook harvest in the Skokomish River occurred as planned from August 3 (wb 8/2) through August 27 (wb 8/23) landing 9,608 fish. Chinook harvest also occurred in Purdy Creek (tributary of Skokomish River that feeds the George Adams Hatchery) to access Chinook returning to George Adams Hatchery each Saturday from July 18 through August 8 landing 163 fish.

In Port Gamble (Area 9A), 54 Chinook were harvested, primarily in mid-August to mid-September during Coho fisheries.

Non-treaty commercial fisheries in the Hoodspout Zone (12C) harvested 8,043 Chinook salmon (Table 2-6). There were no Chinook landed in other non-treaty fisheries in Hood Canal in 2020 (Table 2-6 and Table 2-9).

Table 2-6. Pre-season projected and observed catch of Chinook in Hood Canal terminal area net fisheries in 2020.

Area	Target Species	Projected	Actual
(12, 12B-12D, 9A) (T)	Chin, coho, chum	6,313	2,828
(12-12C, 9A) (NT)	chum, coho	79	0 ^a
12A Net (T)	Coho	76	0
12H Net (T)	Chinook, chum	24,226	6,931
12C Hoodspout Zone Net (NT)	Chinook, chum	10,000	8,043
Skokomish River (82G) (T)	Chin, coho, chum	9,443	1,429
(82J) (T)	Chinook		163
Total		50,138	19,231

^a Values reported are release mortalities.

^b Total does not include catch from area 82J.

2.7 Strait of Juan de Fuca

Due to the continued depressed status of Chinook populations, terminal fisheries in the Elwha River and Dungeness River were closed or provided very limited fishing opportunity, with no Chinook harvested in either terminal area in 2020.

Table 2-7. Projected and actual catches of Chinook in Strait of Juan de Fuca terminal net fisheries in 2020.

Terminal Area	Projected	Actual
Area 6D & Dungeness River Treaty	0	0
Area 6D Non-Treaty	3	0
Elwha River Treaty (C&S)	0	0
Hoko River Treaty	0	0

^a NT fisheries were non-retention for Chinook and values are reported as release mortalities.

2.8 Non-Treaty Commercial Monitoring and Total Mortality

Because non-treaty vessels are required to release non-target species in many fisheries, WDFW conducts on-water monitoring to provide data on encounters of non-target species. Summaries of observer data for 2020 are presented in Table 2-8. Expanded estimates of total mortality, where available, were presented above in the summaries for individual fisheries, and are summarized and compared to pre-season expectations below in Table 2-9.

Table 2-8. Commercial fishery observation data for 2020 Puget Sound non-treaty salmon net fisheries.

Area	Gear type	# sets observed	Chinook	Coho	Sockeye	Pink	Chum	Steelhead
7	PS	14	0	283	0	0	563	0
7A	PS	12	5	153	0	0	707	0
8A	PS	CLOSED						
10	PS	CLOSED						
11	PS	CLOSED						
12	PS	18	0	11	0	0	837	0
12B	PS	9	0	11	0	0	494	0
7	GN	0	0	0	0	0	0	0
7A	GN	10	0	18	0	0	71	0
12	GN							
12B	GN							

Table 2-9. Total pre-season projected and post-season estimated Chinook mortality (landed + released) in Puget Sound non-treaty commercial salmon fisheries in 2020.

Area	Total Mortality	
	Projected	Actual
6D	3	0
7/7A	3,560	32
7B/7C	3,276	1,203
8	N/A	Closed
8A	N/A	Closed
8D	3	Closed
10/11	174	Closed
12-12C/9A	79	0
12C Hoodsport	10,000	7,303

3 Recreational Harvest

This chapter summarizes expected recreational catch in Puget Sound marine waters and freshwater tributaries for the 2020-2021 management year and presents catch estimates available from Chinook MSF that were intensively monitored using creel during that period. Due to the cycle of recovery and analysis of Catch Record Cards (CRCs) used by recreational anglers, complete catch estimates for all areas where Chinook retention was allowed are not yet available. Since complete Chinook MSF and NS catch estimates were not available for all areas in the annual report covering the previous management cycle, projected and actual recreational Chinook MSF and NS catches for the 2019-2020 management year are also included here, except for winter MSFs in marine catch areas 5, 11, 12, and 13, which only account for catch through March 31, 2020.

3.1 2019-2020 Recreational Chinook MSF and NS Catch

Mark-selective and non-selective Recreational Chinook harvest in 2019-2020, estimated from preliminary Catch Record Card (CRC) data through March 31, 2020 and creel estimates where available, was 31,959, compared to a preseason projection of 43,329. The CRC estimates are preliminary and subject to revision. Projected and actual catches for individual fisheries are shown in Table 3-1. Estimates of total mortality in mark-selective fisheries, for those fisheries where estimates are available, are presented in reports available by searching for “mark-selective” at <https://wdfw.wa.gov/publications>.

Table 3-1. Projected (FRAM 2719) and actual (preliminary, where available) Chinook catches in Puget Sound Chinook MSF and NS recreational fisheries during the 2019-2020 season.

Area/Fishery	Projected	Actual
Area 5-6		
Area 5 Summer MSF	4,666	4,568
Area 5 Winter MSF	554	26*
Area 6 Summer MSF	4,392	3,802
Area 6 Winter MSF	1,454	449
Other		
Strait Tributaries		
Area 7		
Summer (July MSF)	1,467	3,026
Winter MSF	3,277	1,760
Nooksack/Samish FW	4,904	4,382
Area 8-1 & 8-2		
Winter MSF	804	406
Skagit River		
Spring MSF	875	259
Area 8D SAF	304	596
Stillaguamish River	0	0
Snohomish River		
Skykomish MSF	713	207
Area 9		
Summer MSF	3,501	3,451
Winter MSF	1,282	577
Area 10		
Summer MSF	3,079	3,284
Winter MSF	230	55
Area 11		
Summer MSF	2,818	2,618
Winter MSF	466	36*
Area 10E SAF	206	253
Lake Sammamish	1	0
Area 10A SAF	432	519
Green River	356	424
Puyallup River		
Carbon R MSF	459	1,033
Puyallup R MSF	1,232	1,499
Area 13		
Summer MSF	2,562	1,942
Winter MSF	99	127*
Chambers Cr	5	11
Nisqually	1,801	2,027
Deschutes	7	0
Area 12		
Summer MSF	943	1,041
Winter MSF	441	164*
Skokomish River	Closed	

* All CRC estimates of catch through 3/31/2020

3.2 2020-2021 Recreational Chinook MSF Catch

Projected Chinook catches for 2020-2021 recreational Chinook MSF fisheries are listed in Table 3-2. The recreational fishing regime included Chinook mark selective fisheries (MSF) for portions of the year in Marine Areas 5 through 13 and in several rivers. WDFW conducted intensive sampling and monitoring of Chinook summer MSFs in Marine Areas 5, 7, 9, 10 and 11 as well as the winter Chinook MSF in Marine Area 10, which provided the estimates in Table 3-2. Brief summaries of Chinook catch and encounters resulting from summer sampling programs are included below. The analysis of 2020-2021 winter fisheries is still in draft form, and reports summarizing the information have not been created, although preliminary estimates of catch are provided. When complete, this analysis will be made available on the WDFW publications website at <https://wdfw.wa.gov/publications>. Searching for “mark-selective” on that page will return links to individual reports.

For Chinook mark-selective fisheries without intensive sampling and/or creel data available, catch will be estimated using CRC data and data from baseline dockside sampling of marine fisheries. Baseline sampling provides data on catch per unit effort (CPUE), species composition, as well as CWT and biological sampling data. For freshwater fisheries, catch estimates are made using CRC data, unless creel studies were conducted, and harvest estimates are available. For marine fisheries, species-specific catch estimates are made using CRC estimates of total catch, combined with species composition data obtained from the baseline sampling program. These estimates will be included in the 2021 annual report.

Table 3-2. Projected (FRAM 3120) and actual (preliminary, where available) Chinook MSF catches in Puget Sound recreational fisheries during the 2020-2021 season.

Area/Fishery	Projected	Actual
Area 5-6		
Area 5 Summer MSF	3,999	3,649
Area 5 Winter MSF	527	
Area 6 Summer MSF	4,798	
Area 6 Winter MSF	Closed	
Other		
Strait Tributaries		
Area 7		
Summer MSF	1,562	1,556
Winter MSF	Closed	
Nooksack/Samish FW	4,155	
NF Nooksack Spring Chinook	485	72
Area 8-1 & 8-2		
Winter MSF	Closed	
Skagit River		
Spring MSF	504	
Area 8D SAF	377	
Stillaguamish River	0	1 ^a
Snohomish River		
Skykomish MSF	691	
Area 9		
Summer MSF	6,542	3,786
Winter MSF	Closed	
Area 10		
Summer MSF	4,158	1,543
Winter MSF	378	234
Area 11		
Summer MSF	4,196	2,128
Winter MSF	Closed	
Area 10E SAF	200	
Lake Sammamish	1	
Area 10A SAF	502	
Green River	513	
Puyallup River		
Carbon R MSF	583	
Puyallup R MSF	1,034	
Area 13		
Summer MSF	2,578	
Winter MSF	91	
Chambers Cr	5	
Nisqually	1,965	
Deschutes	7	
Area 12		
Summer MSF	1,112	
Winter MSF	Closed	
Skokomish River	Closed	

^a Represents illegally retained Chinook recovered by WDFW Law Enforcement

^b Preliminary MSF catch estimate.

3.2.1 Marine Area 5 Summer MSF

2020 was the 18th year of summer mark-selective Chinook fishing in Marine Area 5. The 2020 fishery was open for a set season, from July 1 through August 15.

WDFW conducted comprehensive fishery monitoring activities during the Area 5 MSF. Sampling activities included dockside creel sampling and intensive efforts to distribute and collect voluntary trip reports (VTRs) from the angling public. An enhanced Salmon Trip Report (STR) program was used to obtain estimates of Chinook encounter rates by size class (legal or sub-legal) and mark status (ad-marked or unmarked), similar to the approach used successfully during summer 2009. Detailed descriptions of the sampling program and results are available in WDFW (2021).

For Area 5, WDFW estimates that 3,649 Chinook were landed, compared to preseason projections of 3,999 (Table 3-3).

Table 3-3. Comparison of modeled (FRAM 3120) and estimated total Chinook encounters for the 2020 Area 5 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	9,537	2,464	7,073	25
	AD	13,588	4,568	9,020	3,974
	Total	23,125	7,032	16,093	3,999
	% Marked	59	65	56	99
Estimated (Creel) Encounters	UM	7,066	3,381	3,686	31
	AD	8,700	3,965	4,736	3,618
	Total	15,767	7,346	8,421	3,649
	% Marked	55	54	56	99

3.2.2 Marine Area 7 Summer MSF

2020 was the 5th year of summer mark-selective Chinook fishing in Marine Area 7. The 2020 fishery was planned to be open from July 1 through July 31, 2020 and again from August 16 through August 31, 2020. Due to the number of Chinook salmon encounters in July, the reopening of the fishery was delayed by six days until August 22, 2020.

WDFW conducted comprehensive fishery monitoring activities during the Area 7 MSF. Sampling activities included intensive dockside creel sampling, on-the-water effort surveys, test fishing and collection of voluntary trip reports (VTRs) from the angling public. Detailed descriptions of the sampling program and results are available in WDFW (2021).

For Area 7, WDFW estimates that 1,556 Chinook were landed, compared to preseason projections of 1,562 (Table 3-4).

Table 3-4. Comparison of modeled (FRAM 3120) and estimated total Chinook encounters for the 2020 Area 7 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	3,224	2,140	1,084	21
	AD	3,267	1,771	1,496	1,541
	Total	6,491	3,911	2,580	1,562
	% Marked	50	45	58	99
Estimated (Creel) Encounters	UM	1,742	1,061	682	7
	AD	3,203	1,760	1,443	1,549
	Total	4,945	2,821	2,124	1,556
	% Marked	65	62	68	100

3.2.3 Marine Area 9 Summer MSF

In 2020, a recreational MSF occurred for the 14th consecutive summer in Marine Area 9. The fishery was open from July 16 through August 15, 2020. As in previous years, WDFW's Puget Sound Sampling Unit (PSSU) implemented an intensive monitoring program in Area 9 during the summer season to collect the data needed to provide in-season catch estimates and to estimate key parameters characterizing the fishery and its impacts on unmarked salmon. Detailed descriptions of the sampling program and results are available in WDFW (2021).

An estimated 3,786 Chinook were landed in Area 9, compared to a preseason projection of 6,542 (Table 3-5).

Table 3-5. Comparison of modeled (FRAM 3120) and estimated Chinook encounters for the 2020 Area 9 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	1,957	1,279	678	13
	AD	13,654	7,505	6,149	6,529
	Total	15,611	8,784	6,827	6,542
	% Marked	87	85	90	100
Estimated (Creel) Encounters	UM	4,235	1,289	2,946	0
	AD	14,729	4,235	10,495	3,786
	Total	18,964	5,523	13,440	3,786
	% Marked	78	77	78	100

3.2.4 Marine Area 10 Summer MSF

In 2020, a summer recreational MSF was implemented in Area 10 for the 13th year, running from July 16 through August 31, 2020. WDFW's Puget Sound Sampling Unit (PSSU) implemented an intensive monitoring program in Area 10 throughout the season in order to collect the data needed to estimate key parameters characterizing the fishery and its impacts on

unmarked salmon. An estimated total of 1,543 Chinook were landed during this fishery, compared to the pre-season projection of 4,158 (Table 3-6).

Table 3-6. Comparison of modeled (FRAM 3120) and estimated Chinook encounters for the 2020 Area 10 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	2,110	944	1,166	9
	AD	9,462	4,769	4,693	4,149
	Total	11,572	5,713	5,859	4,158
	% Marked	82	83	80	100
Estimated (Creel) Encounters	UM	3,235	1,129	2,107	33
	AD	5,794	1,580	4,214	1,510
	Total	9,029	2,709	6,320	1,543
	% Marked	64	58	67	98

3.2.5 Marine Area 11 Summer MSF

In 2020, a summer recreational MSF was implemented in Area 11 for the fourteenth consecutive year, running from July 1 through September 30, 2020 for five days a week. The fishery was closed on Thursdays and Fridays. The fishery closed early on September 6 when the number of unmarked legal encounters was estimated to be approaching the 718 encounters projected preseason. WDFW's Puget Sound Sampling Unit (PSSU) implemented an intensive monitoring program in Area 11 to collect the data needed to provide in-season catch estimates and to estimate key parameters characterizing the fishery and its impacts on unmarked salmon. An estimated total of 2,128 Chinook were landed during this fishery, compared to the pre-season projection of 4,196 (Table 3-7).

Table 3-7. Comparison of modeled (FRAM 3120) and estimated Chinook encounters for the 2020 Area 11 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	1,750	718	1,032	14
	AD	9,159	4,806	4,353	4,182
	Total	10,909	5,524	5,385	4,196
	% Marked	84	87	81	100
Estimated (Creel) Encounters	UM	936	702	234	25
	AD	4,252	2,302	1,951	2,102
	Total	5,189	3,004	2,185	2,128
	% Marked	82	77	89	99

3.2.6 North Fork Nooksack Spring Chinook MSF

In 2020, a recreational spring Chinook MSF was prosecuted in the North Fork Nooksack River from June 1st through June 30th. An estimated 72 ad-clipped adult chinook were harvested during the fishery of a projected 485 (Table 3-8).

Table 3-8. Comparison of modeled (FRAM 3120) and estimated Chinook encounters for the 2020 North Fork Nooksack spring Chinook MSF.

Data Source	Group	Total Adult Encounters	Landed Adults Only
FRAM/TAMM Adult Encounters	UM	22	0
	AD	497	485
	Total	519	485
	% Marked	96	100
Estimated (Creel) Adult Encounters	UM	8	0
	AD	79	72
	Total	87	72
	% Marked	91	100

4 Spawning escapement

This section compares natural Chinook escapement estimates for 2020 with pre-season escapement projections, and management thresholds.

In general, FRAM projects natural escapement of unmarked adult (age-3 to age-5) Chinook. For some MUs where hatchery-origin adults contribute to natural spawning, the FRAM projections of escapement include adult natural-origin recruits (NOR) and adult hatchery-origin recruits (HOR) that spawn naturally. This includes projections for the Stillaguamish, Cedar, Green, Puyallup, Nisqually, Skokomish, Mid-Hood Canal, Dungeness, and Elwha. For the White MU, the projection includes adult fish of natural origin and adult fish originating from the acclimation pond program. Natural-origin adults that are used for hatchery broodstock may be included in the projections of natural escapement.

FRAM projects adult natural-origin escapement for the Nooksack, Skagit spring, Skagit fall, and Snohomish populations, so hatchery-origin fish must be subtracted from total escapement and the number of natural-origin fish used for broodstock added, to obtain an estimate comparable to the FRAM projections.

Escapements for available spring-run Chinook management units were all above projected estimates, except for White River spring-run Chinook salmon.

For summer/fall populations, escapement were less than projected for all management units, except the Skagit River summer/falls and Green River fall-run escapements were greater than forecasted abundance.

Table 4-1. Preseason projections and estimates of Puget Sound Chinook natural spawning escapement in 2020.

Management Unit		NOR	HOR	Total	Projected (FRAM 3120)
Nooksack	NF			N/A	138 ¹
	SF			N/A	232 ¹
Skagit spring	Suiattle	396		396	469 ¹
	Cascade	115		115	168 ¹
	Sauk	938		938	871 ¹
	Total spring	1,449	285	1,734	1,508 ¹
Skagit summer/fall	Sauk summer	341		341	445 ¹
	Upper Skagit summer	9,599		9,599	7,051 ¹
	Lower Skagit fall	869		869	1,717 ¹
	Total summer/fall	10,809		10,809	9,214 ²
Stillaguamish	Total	382	605	987 ³	990
Snohomish	Skykomish	1,975	747	2,721	1,766 ¹
	Snoqualmie	804	407	1,211	1,223 ¹
	Total	2,779	1,154	3,932	2,989 ¹
Lake Washington	Cedar	277	236	513	855
Green		1,967	2,333	4,300	4,001
Puyallup		542	1,208	1,750	2,633
White		633	1,296	1,929 ⁴	2,125 ⁴
Nisqually		481	104	4,483 ⁵	9,423
Skokomish		69	2,052	2,061	2,749
Mid Hood Canal	Dosewallips	0	0	0	
	Duckabush	2	0	2	
	Hamma Hamma	2	1	3	
	Total	4	1	5	39
Dungeness		323	510	833 ⁶	793
Elwha				3,250 ⁷	3,319
Hoko		433	1,689	2,122 ⁸	2,170

1. Natural-origin only.

2. Skagit Su/Fa projection total includes NOR and HOR escapement to the spawning grounds.

3. Includes NORs and HORs collected for broodstock from the North Fork which are part of the FRAM Projection.

4. Includes NORs, HORs, and 1,173 vent-clipped acclimation pond fish trucked and released upstream of Mud Mountain.

Actual spawning escapement is unknown but likely lower due pre-spawn mortalities from trap and haul and other environmental effects

5. Includes 585 (481 NOR and 104 HOR) volitional spawners, as well as 3,898 hatchery rack return. From in-river fishery performance it was determined that there were not enough hatchery fish to truck and make hatchery rack, therefore zero hatchery rack return Chinook were trucked upstream in 2020. Change-in-ratio (CIR) estimate of volitional spawners will be revised with sport-catch data when available.

6. Includes 100 fish (74 HORs and 26 NORs) removed from the river for use as broodstock.

7. TRS estimate includes 1,289 fish collected for broodstock. Estimate does not include jacks.

8. TRS estimate includes 283 fish spawned at hatchery.

4.1 Nooksack River Early Chinook

North/Middle Fork early (spring) Chinook

The North and Middle Forks of the Nooksack River originate from Mount Baker glaciers and are typically turbid with moderate or lower flows during summer due to glacial melt. Nooksack Basin co-managers have modified escapement methodologies as needed to most accurately expand data to reflect the conditions during the season. The most recent two years of completed spawning ground escapement estimates (return years 2017 and 2018) for both native Nooksack Chinook populations (North/Middle Fork and South Fork spring Chinook) are presented in tables 4-2 and 4-3 respectively; the 2019 and 2020 spawning ground escapement estimates are not available at this time.

Due to the unpredictability of redd viewing conditions in the North and Middle Forks of the Nooksack River during spring Chinook spawning seasons (mid-July through late-September), a carcass-based methodology is the norm instead of a redd based methodology. The North Fork/Middle Fork (NFMF) spring Chinook spawning ground escapement estimate is the number of naturally spawning natural origin and Kendall Creek Hatchery origin Chinook in the North and Middle Forks and their tributaries; beginning with return year 2016, the Nooksack Basin co-managers agreed that the NFMF Chinook population escapement estimate should include NFMF population Chinook that were estimated to have spawned in the South Fork Nooksack. Traditionally, this estimate was derived by expanding the total number of enumerated carcasses from the two watersheds by a 3.48 expansion factor. This methodology was developed from five years of surveys with good visibility that enabled cumulative redd counts. Redd counts are multiplied by 2.5 fish to estimate total population abundances. The total carcass counts in each of these five years was expanded to match the respective redd based total population abundance estimates. The averaged expansion needed in these five years was 3.48 carcasses per carcass enumerated to match the redd based estimates.

Beginning in 2005, an alternative method was developed in the Middle Fork. From 2005 through 2008, lower water flows and good viewing conditions enabled the spawning ground surveyors to enumerate a high percentage of total redds in the river. As a result, Nooksack Basin co-managers shifted to a redd based methodology for these years, expanding total enumerated redds by 2.5 adults per redd for the Middle Fork; the 3.48 expansion factor was applied only to the North Fork carcass counts.

In 2009, higher than normal water flows and limited visibility in the Middle Fork during the early Chinook spawning season reduced the ability to identify and enumerate redds. As a result, co-managers adjusted the Middle Fork escapement methodology to account for these less than optimal viewing conditions. The following methodology was agreed to by the Nooksack Basin co-managers for the 2009 through 2018 early Chinook returns. A carcass expansion factor of 1.91 was calculated in a method similar to the North Fork's 3.48, expanding carcass counts using the 2005 through 2008 years with good viewing conditions. The total number of redds multiplied by 2.5 fish per redd to estimate total spawners was divided by the number of carcasses observed to calculate a 1.91 average expansion factor. This expansion factor was used to calculate the 2009 through 2012 Middle Fork escapements.

From 2013-2018, the carcass expansion factor of 1.91 continued to be used for Middle Fork mainstem and side channel surveys due to more limited redd visibility. Peat Bog Creek and, to an extent, Bear Creek also began to have much higher carcass counts than years prior to 2013. In these years, carcass counts from tributaries to the Middle Fork were enumerated but not expanded. Middle Fork tributary surveys were frequent and unexpanded tributary carcass counts were considered to more accurately reflect total Chinook in these low flow and clear water tributaries.

Beginning in 2010 and continuing through 2018, there was another significant change in methodology in the North Fork early returning Chinook spawning ground escapement estimate. The carcasses observed in Kendall Creek and Kendall Slough were not expanded due to high carcass recovery rates in those areas, and instead were considered the total counts. Unexpanded counts were considered to more accurately reflect total abundance in this area. The prior assumption was that the Kendall Creek and Slough carcass enumerations should be expanded by 3.48, like all other North Fork carcasses. High densities in this limited area and frequent surveys resulted in co-managers no longer expanding these near-hatchery spawners. We continue to use the (3.48) expansion for the rest of the North Fork carcass recoveries.

Table 4-2. Early timed Chinook spawning escapements for 2017 and 2018 return years within the North Fork and Middle Fork Nooksack basins. South Fork early Chinook NOR and HOR spawning escapement in the North/Middle Fork basins are additional to those within the South Fork basin.

Year	<u>North./Middle Fork Nooksack Basins</u>					
	NF/ MF NORs	Kendall HORs	SF NORs	SF HORs	Fall NORS	Fall HORs
2017	88	1,811	41	39	6	23
2018	53	1,622	39	24	0	6

South Fork Nooksack early (spring/summer) Chinook

The South Fork Nooksack is non-glacial, therefore the summer low flow visibility is much better than in the other forks. The escapement methodology in this fork is redd-based instead of carcass-based. Escapement estimates are calculated by multiplying the total number of redds by 2.5 adults per redd.

Beginning in 2017, the methodology made the following assumptions:

- 1) All redds are accurately counted in all geographic spawning areas utilized
- 2) No spawning Chinook after October 8 are early returning Chinook
- 3) Chinook that spawn through October 8 die within 1 week (by October 15)

Prior to 2017, assumption #3 only included the redds that were built through September 30 and carcass recoveries through October 7. However, new coded wire tag (CWT) recoveries and genetic results have indicated that spawning occurred later than was previously understood when the escapement estimates were much smaller, Nooksack Basin co-managers agreed to amend the assumption based on the new information.

Tissue samples are collected from all carcasses to determine stock assignments to one of the three Nooksack genetic baseline stocks using probability estimates. The genetic baseline stocks are: South Fork early returning Chinook, North/Middle Fork early returning Chinook, and Samish/Nooksack fall Chinook. Hatchery origin (HOR) fish were identified based on adipose fin clip marks, otolith marks, and/or CWT presence and subsequently assigned to their respective hatchery stock origin.

These data are used to estimate respective hatchery contributions. The genetic results from the natural-(NOR) and hatchery-origin carcass are proportionally applied to the total estimate of chinook as determined by total redd counts multiplied by 2.5 adults per redd.

In 2017 and 2018, WDFW Molecular Genetics Lab staff also used parentage-based tagging identification for field sampled carcasses that assigned to the South Fork baseline but did not have indicators recorded that identified them as hatchery-origin fish (primarily CWTs). As the Lab has genotyped the broodstock for the Skookum Hatchery Chinook program, they were able to identify individuals that had single parent assignments and both parent assignments, of hatchery Chinook. The Lab recommended that Nooksack co-managers consider as South Fork HORs, the individuals that assigned as offspring of two hatchery broodstock parents if spawning records were consistent or at least were spawned on the same date. These individuals are included as South Fork HORs instead of South Fork NORs. The Skookum hatchery program now otolith marks the South Fork releases (beginning with Brood Year 2017). It is assumed that beginning with return year 2022, all returning HORs will be otolith marked and there will no longer be the need to assess genetic parentage assignments for natural escapement estimates.

Naturally spawning HOR South Fork chinook and NOR chinook are included in the population escapement estimates. Unlike 2013 and 2015, when the South Fork chinook estimates are considered minimum estimates due to pink salmon redd superimposition, 2017 was a more modest pink salmon return, and the 2017 estimate is not a minimum estimate.

Table 4-3. Early timed Chinook spawning escapements for 2017 and 2018 return years in the South Fork Nooksack basin. North Fork/Middle Fork Nooksack early NOR and Kendall Creek HOR spawning escapement in the South Fork basin are in addition to those spawning within the North/Middle Fork basins.

Year	South Fork Nooksack Basin					
	SF Native NOR	SF HOR	NF/MF Early NOR	Kendall. HOR	Fall NOR	Fall/ other HOR
2017	145 (4)	697 (55)	43 (4)	62 (8)	100 (4)	65 (4)
2018	369 (5)	896 (8)	49 (0)	65 (2)	50 (1)	97 (1)

Note: Numbers in parentheses represent additional pre-spawn mortalities encountered.

4.2 Skagit River

Background

Six recognized Chinook populations spawn in the tributaries and mainstems of the Skagit River watershed. The Sauk River, Suiattle River, Baker River, and the Cascade River are major tributaries to the Skagit River, but there are also numerous smaller, anadromous fish bearing tributaries flowing both into the major tributaries and also into the Skagit River directly. Five hydroelectric projects are in the basin, two on the Baker River at river miles (RM) 1.6 and 9.3, and three on the Skagit River at RM 96.6, 100.9, and 105.1.

Escapements were calculated using various methodologies dependent on population and based on either total new redd counts, total visible redd counts, linear regression predictions, or a combination of methods. During spawning ground surveys, Chinook carcasses were sampled for fork length, sex, scales, and presence or absence of a hatchery mark. We also electronically sampled Chinook carcasses for coded wire tags (CWT) and collected CWT present snouts.

Surveys were performed on foot, by pontoon boat, jet boat, or by helicopter. Escapement estimates for Skagit hatchery spring Chinook, Upper Cascade spring Chinook, and Suiattle spring Chinook were calculated by multiplying total redd counts by 2.5 fish per redd. Upper Sauk spring Chinook, Skagit summer and Skagit fall Chinook, and Sauk River summer Chinook spawning escapement estimates were calculated by summing

total redds observed during ground based surveys with area under the curve (AUC) calculated redds from aerial surveys, and multiplying the sum by 2.5 fish per redd.

Additional personnel from the Skagit Fisheries Enhancement Group (SFEG), Skagit River System Cooperative (SRSC, the management body for the Sauk-Suiattle and Swinomish Indian tribes), the Upper Skagit Indian Tribe (USIT), Seattle City Light, and Puget Sound Energy, also performed work and contributed data necessary to complete the escapement estimates and predictions for the Skagit River Basin Chinook salmon runs.

Methods and Results

Suiattle River Spring Chinook

Suiattle River spring Chinook spawn in the clear, large tributaries draining into the turbid mainstem of the Suiattle River. Some redds are found at tributary confluences with the mainstem and within the tributary's clear water lens in the mainstem created by unmixed tributary and mainstem water. Redds found within the tributary lenses are included in the tributary counts. Historically, limited spawning activity has been documented in the glacially influenced, high turbidity mainstem with the exception of spawning in the tributary clear water lenses. The only recorded exception to date was in 2011, when an unusual combination of environmental variables reduced turbidity in the mainstem and resulted in conditions the Chinook apparently deemed suitable for spawning.

Surveys were conducted from August 5 through October 4. Surveys of tributary indexes were attempted weekly to ensure all redds were enumerated. The indexes included all known spawning habitat for each tributary and the survey was performed on foot and wading the stream. The log-jam that had been a passage barrier on Buck Creek in previous years (approximately RM 1.2) remained in 2020. The logjam continues to be a total passage barrier with no live Chinook or Chinook redds observed upstream of the logjam. A large wildfire swept through several spawning tributaries during the first week of September. Surveys were halted in Circle, Lime, Downey, Sulphur, and Milk Creeks after September 1st. A total of 130 redds were observed before the fire. An expansion using the previous five years of spawning data was calculated to estimate the amount of spawning occurring in these tributaries (Table 30a). Three methods were averaged together to predict 28 redds during the missed survey time frame for a total of 158 redds in 2020.

A total of 6 Suiattle spring Chinook carcasses were observed and 5 were collected and sampled; all 5 were wild unmarked with no CWT. The season total redd count was 130 (Table 4-4).

Table 4-4. Suiattle River spring Chinook 2020 spawning ground survey redd counts. This table includes only observed redds.

Stream	WRIA	Survey method	Reach (RM)	Location ¹	Redds
Big Creek	3.0723	Foot	0.0-0.6	7.8	12
Tenas Creek	3.0761	Foot	0.0-0.5	9.6	13
Straight Creek	3.0797	Foot	0.0-0.1	15.1	7
Buck Creek	3.0813	Foot	0.0-1.7	18.1	5
Circle Creek	3.0892	Foot	0.0-0.2	18.4	0
Lime Creek	3.0897	Foot	0.0-0.5	20.8	0
Downey Creek	3.0919	Foot	0.0-2.1	24.4	78
Sulfur Creek	3.0973	Foot	0.0-0.9	26.3	15
Milk Creek	3.1022	Foot	0.0-0.1	28.6	0
Total redds					130

¹Location refers to river mile location of tributary mouth on a mainstem, or lower river mile terminus of a mainstem index.

The preliminary 2020 Suiattle River Spring Chinook escapement estimate was 396 fish (rounded). All data and estimates of escapement were preliminary at the time of reporting and remain subject to further review and agreement by the Skagit co-managers.

Upper Cascade River Spring Chinook

Cascade River spring Chinook spawn in the mainstem Cascade River and accessible tributaries from river mile 8.1 (just upstream of a high gradient canyon) up to and including the forks at RM 18.6. Spawning has been documented in the North and South Fork Cascade Rivers, from the mouth of each fork upstream at varying distances (less than one river mile) dependent upon stream flow and available spawning habitat.

Surveys of all known habitat occurred from August 13 through October 4. Mainstem surveys were conducted by foot or pontoon boat depending on the stream features of the index. Beginning in 2016, with help from USIT, the interval goal was shortened from 10 to 14 days, to weekly surveys with the goal of collecting more carcasses. This weekly goal was met in 2020.

Carcasses are notoriously difficult to find from this upper Cascade population. No carcasses were observed and sampled in the upper Cascade spring Chinook area in 2020.

Forty-six redds were identified in 2020 (Table 4-5). The 2020 upper Cascade River spring Chinook spawning escapement estimate was 115 fish. All data and estimates of escapement were preliminary at the time of reporting and remained subject to further review and agreement by the Skagit co-managers.

Table 4-5. 2020 Cascade River spring Chinook redd counts.

Stream	WRIA	Survey method	Reach (RM)	Location ¹	Redds
Cascade River	3.1411	Foot	8.1-9.0	8.1	3
Marble Creek	3.1451	Foot	0.0-0.3	8.6	0
Cascade River	3.1411	Foot/Raft	9.0-12.4	9.0	13
Cascade River	3.1411	Foot	12.4-15.8	12.4	17
Cascade River	3.1411	Foot	15.8-18.6	15.8	13
Kindy Creek	3.1528	Foot	0.0-0.5	16.2	0
North Fork Cascade River	3.1605	Foot	0.0-0.1	18.6	0
South Fork Cascade River	3.1411	Foot	0.0-0.5	18.6	0
Total redds:					46

¹Location refers to river mile location of tributary mouth on mainstem, or lower river mile terminus of a mainstem index.

Upper Sauk River Spring Chinook

This population spawns in the mainstem Sauk River and in the North and South Fork Sauk Rivers. Mainstem spawning has been documented between RM 31.0 to the forks at RM 31.9. A high gradient section of the Sauk River beginning 0.9 river miles downstream of the White Chuck River is an assumed barrier to Sauk *summer* Chinook and the beginning and lowest point of spawning of Upper Sauk River *spring* Chinook. Spawning in the North Fork Sauk occurs from the forks to an impassable falls 1.6 RM upstream. Spawning in the South Fork Sauk has been documented from the forks upstream to approximately RM 5.0, upstream of the area known as Monte Cristo Lake. However, spawning in the South Fork River upstream of RM 2.9 has only been documented once and was after a substantial flow increase from rain.

WDFW surveyed upper Sauk River spring Chinook spawning areas from August 9 through October 4. The survey interval goal was to survey all indexes upstream of the White Chuck River weekly by foot or pontoon boat. The index below the White Chuck River was surveyed by helicopter with a goal of a survey every two weeks; this reach is too treacherous to raft or walk. A total of 100 Sauk River spring Chinook carcasses were observed and 79 were recovered and sampled. All carcasses sampled were wild unmarked and untagged fish. There were 371 redds located upstream of the White Chuck River by ground based surveys, and 4 AUC estimated redd downstream of the White Chuck River in the section surveyed by helicopter (Table 4-6).

The 2020 upper Sauk River spring Chinook preliminary escapement estimate was 938 fish; all data and estimates of escapement are preliminary at the time of reporting and are subject to further review and agreement by the Skagit co-managers.

Table 4-6. Upper Sauk River spring Chinook redd counts from 2020 spawning ground surveys.

Stream	WRIA	Survey method	Reach (RM)	Location ¹	Redds
Sauk River	3.0673	Flight	31.0-31.9	31.0	4
Sauk River	3.0673	Foot/Float	31.9-34.5	31.9	101
Sauk River	3.0673	Foot/Float	34.5-37.8	34.5	209
Falls Creek	3.1182	Foot	0.0-0.2	34.9	1
Sauk River	3.0673	Foot/Float	37.8-39.7	37.8	7
South Fork Sauk River	3.1204	Foot	0.0-2.9	0.0	22
North Fork Sauk River	3.0673	Foot	39.7-40.1	39.7	11
North Fork Sauk River	3.0673	Foot	40.1-41.3	40.1	20
Total redds (rounded):					375

¹Location refers to river mile location of tributary mouth on mainstem, or lower river mile terminus of a mainstem index.

Skagit Summer Chinook

Skagit River summer Chinook spawn in the mainstem of the Skagit River from the mouth of the Sauk River at RM 67.2 to the Seattle City Light Powerhouse at Newhalem at RM 94.3. Spawning also occurs in tributary streams with suitable flow and spawning habitat. Tributaries were surveyed by foot or pontoon boat at an interval of every seven days to ensure all redds were enumerated before redd life expired.

Tributary surveys covered most of the known spawning area except for some limited spawning known to occur above the tributary index areas in years of high abundance, and in some other tributaries which have infrequent spawning activity. Skagit summer Chinook tributary spawning surveys occurred regularly from September 8 through November 2 (Table 4-7).

Carcass recovery and sampling occurred incidentally during tributary surveys, and actively during mainstem carcass recovery surveys conducted on jet boats. Mainstem carcass surveys of approximately 22.3 river miles were attempted weekly. Recovered carcasses were sampled for scales, measured for fork length, and checked for presence of tags and marks. Not all carcasses encountered could be sampled; carcasses were often observed in deep pools beyond the reach of gaff hooks or were badly decomposed and disintegrated upon disturbance. All new redds located during tributary surveys were counted and marked with survey flagging. The mainstem of the Skagit River was surveyed by helicopter. The protocol for mainstem aerial redd surveys was to count all visible redds including redds that were recognizable from previous flight surveys.

A total of 527 Skagit summer Chinook carcasses were observed, and 518 carcasses were recoverable and sampled; 483 carcasses were unmarked and untagged wild Skagit summer Chinook, 12 carcasses were adipose clipped only (no cwt), 20 carcasses were adipose clipped and CWT present, 1 carcasses were CWT only, 1 carcasses was not clipped but the CWT status could not be determined, and 1 carcass was unknown adiposeclipped and no CWT present.

We observed 414 Skagit summer Chinook redds in the tributaries. Using AUC, we estimated 3,426 mainstem redds from five aerial mainstem surveys.

The 2020 escapement estimate of Skagit River summer Chinook was 9,599 fish (rounded). All data and estimates of escapement were preliminary at the time of reporting and remained subject to further review and agreement by the Skagit co-managers.

Table 4-7. Skagit summer Chinook redd counts from 2020 spawning ground surveys.

Stream	WRIA	Survey method	Reach (RM)	Location ¹	Redds
Goodell Creek	3.1867	Foot	0.0-1.3	92.9	14
Falls Creek ³	3.1780	Foot	0.0-0.4	4.0	0
Bacon Creek	3.1774	Foot	0.0-4.2	82.9	56
Diobsud Creek	3.1750	Foot	0.0-1.3	80.7	48
Cascade River	3.1411	Foot/Float	0.0-4.2	78.1	150
Illabot Creek	3.1346	Foot	0.0-2.6	71.6	146
Skagit River	3.0176	Helicopter	85.9-94.3	85.9	1,601
Skagit River	3.0176	Helicopter	78.1-85.2	78.1	1,274
Skagit River	3.0176	Helicopter	67.2-78.1	67.2	786
Total redds:					3,840

¹Location refers to river mile location of tributary mouth on mainstem, or lower river mile terminus of a mainstem index.

²Falls Creek WRIA 03.1780 is a tributary of Bacon Creek. The mouth is located at river mile 4.0 of Bacon Creek on the right bank.

Lower Sauk River Summer Chinook

These fish spawn from the mouth of the Sauk River to approximately RM 31.0 (0.9 RM downstream of the White Chuck River). The only documented tributary spawning has occurred in Dan Creek (WRIA 3.1079) but due to frequent low flows this has been intermittent. Spawning is surveyed on the mainstem by helicopter flights; the lower Sauk River is too wide, too braided, and spawning is too sparsely distributed to be effectively surveyed by foot or pontoon boat. Surveys of Dan Creek began September 15 and continued through November 10, with 24 Sauk summer Chinook redds and four carcasses observed for the spawn year (Table 4-8). All carcasses sampled in Dan Creek were wild (unmarked and no CWT present). A single Chinook redd was located in Hilt Creek in 2020, but no carcasses were observed.

Mainstem Sauk summer Chinook spawning is often difficult to monitor due to turbidity inputs from the Suiattle River and the White Chuck River, but conditions were favorable this year. From five mainstem flights the AUC method estimated 137 Sauk summer Chinook redds in the indexes, and the 2020 escapement estimate of lower Sauk River summer Chinook was 341 fish (rounded). All data and estimates of escapement were preliminary at the time of reporting and remained subject to further review and agreement by the Skagit co-managers.

Table 4-8. Lower Sauk River summer Chinook redd counts from 2020.

Stream	WRIA	Survey method	Reach (RM)	Location ¹	Redds by method		
					Foot surveys	AUC	Linear regression
					Actual	Estimated	Predicted
Sauk River	3.0673	Flight	0.0-13.2	0.0	14		N/A
Sauk River	3.0673	Flight	13.2-21.1	13.2		109	
Dan Creek	3.1079	Foot	0.0-0.8	16.8	24		
Hilt Creek	3.0678	Foot	0.0-0.5	0.6	1		
Sauk River	3.0673	Flight	21.1-31.0	21.1		14	
Grand total redds from all methods (rounded):					162		

¹Location refers to river mile location of tributary mouth on mainstem, or lower river mile terminus of a mainstem index.

Lower Skagit River Fall Chinook

Skagit fall Chinook spawn in the mainstem Skagit River from the vicinity of RM 24.5 to the mouth of the Sauk River (RM 67.2). They have also been documented spawning in a number of large and small tributary streams depending on flow conditions. Tributary surveys were conducted by foot every seven to fourteen days. Encountered carcasses were sampled for scales, measured for fork length, and checked for coded wire tags. Tributary redds were counted and marked with flagging to prevent repeated counting.

Skagit fall Chinook spawning surveys began September 15 and continued through November 24 (Table 4-9). Six helicopter flight redd surveys were conducted and tributary surveys were conducted by foot every seven to fourteen days. A total of 141 carcasses were observed and sampled. All Chinook sampled were wild (unmarked and no CWT present). Tributary surveys identified 79 redds, and these were summed with 269 AUC estimated mainstem redds from the six aerial surveys. Redd counts were multiplied by 2.5 fish per redd to calculate escapement.

The 2020 escapement estimate of Skagit River fall Chinook was 869 fish (rounded). All data and estimates of escapement were preliminary at the time of reporting and remained subject to further review and agreement by the Skagit co-managers.

Table 4-9. Lower Skagit River fall Chinook redd counts from 2020 spawning ground surveys.

Stream	WRIA	Survey method	Reach (RM)	Redds
Skagit River	3.0176	Flight	24.5-56.5	92
Skagit River	3.0176	Flight	56.5-67.2	177
Hansen Creek	3.0265	Foot	3.0-4.5	0
Day Creek	3.0299	Foot	0.0-2.2	14
Jones Creek	3.0332	Foot	0.0-1.3	1
Grandy Creek	3.0337	Foot	0.0-1.4	14
Alder Creek	3.0359	Foot	0.0-1.6	0
O'Toole Creek	3.0365	Foot	0.0-0.2	2
Pressentin Creek	3.0385	Foot	0.0-0.4	3
Finney Creek	3.0392	Foot	0.0-7.0	25
Jackman Creek	3.0626	Foot	0.0-0.7	16
EF Nookachamps Creek	3.0230	Foot	3.5-5.1	3
Mundt Creek	3.0235	Foot	0.0-0.9	1
Total Redds				348

4.3 Stillaguamish River

The Stillaguamish River basin has two populations of Chinook distinguished by genetic characteristics: summers and falls. These two populations overlap in spawn timing and distribution with both populations spawning in both forks of the Stillaguamish River. The summer stock is a composite of natural and hatchery-origin supplemental production with the majority of spawning occurring in the North Fork Stillaguamish and its major tributaries, including Boulder River and Deer, Grant, French, and Squire Creeks. The fall stock is a composite of natural and hatchery-origin supplemental production with the majority of

spawning primarily in the mainstem and South Fork Stillaguamish Rivers, in Pilchuck, Jim, and Canyon Creeks, and in the North Fork Stillaguamish River. Escapement is currently estimated for North Fork and South Fork Stillaguamish Rivers rather than summer and fall populations of Chinook.

Escapement estimates for Stillaguamish Chinook were calculated by multiplying the cumulative redd count by 2.5 and by the genetic mark recapture (GMR) correction factor. This is an annual provisional estimate. The GMR correction factor is a multiplier resulting from regression analysis of redd-based escapements compared to GMR-based escapement estimate results from the years 2008 through 2016. GMR based escapement estimates are considered more accurate than redd-based estimates and can be produced with statistical confidence intervals (whereas redd-based estimates cannot) but are not available until the following year. GMR escapement estimates require genetic sampling of adult fish in the fall and juvenile fish the following spring. When the final GMR escapement estimate is completed, it then replaces the initial redd-based GMR corrected (provisional) result. Since 2008, Chinook redds found in the North and South Forks have been individually counted during periodic foot or raft surveys using the marked redd census method. Previous to 2008, redd counts in the North and South Forks were estimated using area under the curve methodology based on aerial surveys of North and South Fork mainstem reaches as well as ground-based surveys of tributary streams. Aerial surveys continue to provide redd count data for the Lower Mainstem and upper South Fork. Since 2008, the Stillaguamish Tribe Department of Natural Resources has provided ground coverage of the North Fork Stillaguamish River from its mouth to river mile (RM) 30.0. WDFW staff surveyed the remaining known Chinook spawning areas in the Stillaguamish basin.

Surveys were conducted from mid-August to mid-November to encompass the spawn timing of both stocks. All known spawning habitat was surveyed either by foot or raft on a seven to fourteen-day cycle, or by helicopter every fourteen to twenty-one days. All ground-counted redds were flagged, enumerated, and recorded with a GPS waypoint. Helicopter surveys counted total visible redds during each flight and total redds were estimated using area-under-the-curve methods. Carcasses encountered were sampled for scales, DNA, CWT, and adipose fin mark status.

North Fork Stillaguamish summer and fall Chinook

North Fork Stillaguamish Chinook spawning surveys covered the entire known distribution. Surveyed areas were the North Fork from RM 0.0 to 34.4 and North Fork tributaries including Squire, Segelson, French, Brooks, and Grant creeks, and Boulder River. Escapement was estimated using expansion of cumulative redd counts (2.5 fish per redd) from raft and foot surveys and then multiplying by the GMR correction factor. Survey conditions for counting Chinook in the North Fork Stillaguamish were generally good during the spawning period. The first redds were detected August 24th in the North Fork, and last one was detected November 3 in the North Fork. A total of 256 Chinook redds were counted on the North Fork of the Stillaguamish in 2020 (Table 4-10). The redd-based escapement estimate was 641 fish (Table 4-10). The GMR adjusted provisional escapement estimate is 776 fish (304 NOR, 472 HOR). An additional 137 fish (49 NOR, 88 HOR) were taken for hatchery brood stock and were not included in the GMR adjusted provisional escapement estimate but are included in agreed to total watershed spawner escapement. Total NOR North Fork Stillaguamish River escapement (natural spawning + broodstock collection) was 382 Chinook.

Table 4-10. North Fork Stillaguamish summer and fall Chinook redd counts in 2020.

Stream	WRIA	Method	Reach (RM)	Redds	Escapement
North Fork	5.0135	Foot/Float	0.0-14.3	26	65
North Fork	5.0135	Foot/Float	14.3-30.0	182	455
North Fork	5.0135	Foot/Float	30.0-34.4	31	78
Grant Creek	5.0156	Foot	0.0-0.4	1	3
Deer Creek	5.0173	Foot	0.0-6.0	0	0
Brooks Creek	5.0215	Foot	0.0-0.1	0	0
Boulder River	5.0229	Foot	0.0-2.9	2	5
French Creek	5.0246	Foot	0.0-3.0	4	10
Squire Creek	5.026	Foot	0.0-4.0	10	25
Brown Creek	5.0265	Foot	0.0-1.0	0	0
Total Redds				256	
Redd-based Escapement Estimate					641
GMR adjusted EE (provisional)					776

South Fork and Mainstem Stillaguamish summer and fall Chinook

South Fork and Mainstem Stillaguamish summer and fall Chinook escapement in 2020 was estimated using expansion of cumulative redd counts (2.5 fish per redd) from aerial, foot, and raft surveys. Areas surveyed were the Mainstem between the juvenile trap (near the town of Sylvana and the confluence at Arlington (river miles 6.0 to 17.8), the South Fork from the confluence to Granite Falls (river miles 17.8 to 34.7), and Canyon, Jim, Siberia, and Pilchuck Creeks. River mile 34.7 to 55.1 include Granite Falls and Robe Canyon and are neither surveyable nor good Chinook spawning habitat.

The mainstem aerial index reach, from the juvenile trap (RM 6.0) to the forks (RM 17.8) was flown three times in 2020, September 14 and October 7 and November 2.

A total of 24 Chinook redds were found in the Mainstem Stillaguamish and South Fork Stillaguamish River and tributaries in 2020 (Table 4-11). The redd-based escapement estimate was 61 adult fish, which expanded to 74 adult fish with the application of the GMR correction factor (Table 4-121).

Table 4-11. South Fork and Mainstem Stillaguamish summer and fall Chinook redd counts in 2020.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Mainstem	5.0001	Flight	6.0-17.8	4	10
South Fork	5.0001	Foot/Float	17.8-34.7	11	28
South Fork (upper)	5.0001	Foot	34.7-65.0	0	0
Pilchuck Creek	5.0062	Foot/Float	0.0-6.2	2	5
Jim Creek	5.0322	Foot/Float	0.0-4.1	6	15
Siberia Creek	5.0324	Foot	0.0-0.4	0	0
Canyon Creek	5.0359	Foot	0.0-0.5	1	3
Total Redds				24	
Redd-based Escapement Estimate					61
GMR adjusted EE (provisional)					74

Carcass sampling and escapement composition

WDFW and Stillaguamish Tribe Natural Resources staff conducted spawning ground survey work and carcass sampling in the North and South Forks of the Stillaguamish River and their tributaries. Stillaguamish Tribal staff also sample the broodstock collected from the spawning grounds for hatchery production. Tribal staff focused their Chinook carcass sampling efforts in the North Fork between the mouth and Swede Heaven Bridge (RM 0.0 to 30.0) and WDFW staff focused on the remaining spawning grounds. In total, 239 complete carcasses (status of both adipose fin and CWT was determined) were sampled in the Stillaguamish River; 137 in broodstock collection, 102 combined in the North Fork and South Fork reaches (Table 4-12). The sampling rates of Chinook carcasses, not including those with unknown mark dispositions, were 12.0% for the spawning grounds and 100% for the broodstock. These rates were calculated by dividing the number of carcasses sampled by the escapement estimate for each sampling location.

Escapement of Chinook by origin (hatchery or natural) was determined in a two step method, first by taking the ratio of hatchery origin carcasses to natural origin carcasses and applying to the spawning ground GMR adjusted escapement. For 2020, 62 of 102 samples were determined to be of hatchery origin, which estimates 62% of the provisional GMR adjusted escapement is 517 adults. Then the number of hatchery origin adults known in the broodstock (88) are added to the estimated spawning ground hatchery adults (517), for a watershed escapement hatchery proportion of 61%. This methodology is used due to the reduced sampled sizes on the spawning grounds and differences in timing of broodstocking that can in some years cause the broodstock samples to weight the total proportion in a magnitude not reflective of the returning population (Table 4-12).

Table 4-12. Stillaguamish Chinook sample proportions and HOR:NOR composition in 2020.

	Sampled	Sampled Hatchery	Sampled Natural	% Hatchery	% Natural	GMR Esc EST	% Sampled
GMR Adjusted EE1	102	62	40	60.7%	39.3%	850	12.0%
Broodstock (NF)	137	88	849	64.2%	35.8%	137	100.0%
Stillaguamish Totals				61.29%	37.2%	987	

4.4 Snohomish River

There are two populations of Chinook in the Snohomish River basin: Skykomish summer/fall Chinook and Snoqualmie fall Chinook. The Skykomish stock spawns in the mainstem of the Skykomish River and its tributaries, including the Wallace and Sultan Rivers, Bridal Veil Creek, the South Fork Skykomish River (between RM 49.6 and RM 51.1 and above Sunset Falls) and the North Fork Skykomish River (occasionally above Bear Falls at RM 13.1). The Snoqualmie stock spawns in the Snoqualmie River and its tributaries, including the Tolt and Raging Rivers, and Tokul Creek.

Escapement estimates of naturally spawning Chinook salmon returning to the Snohomish watershed are calculated from cumulative redd counts made from physical surveys of their spawning grounds, and from counts of adult fish passed at Sunset Falls. Additionally, redd estimates for non-surveyed reaches on Raging River, North Fork Tolt River and Cherry Creek were expanded based on redds per mile of adjacent surveyed reaches. Survey methods included ground-based walking and float surveys, as well as aerial surveys conducted from a helicopter. Ground counted redds were monitored using marked-redd-census methodology.

Ground surveys were done at a frequency of seven to ten days, to not miss new redds. Redds in ground-surveyed reaches were enumerated, marked with a GPS waypoint, and flagged to prevent re-counting on subsequent surveys. Aerial surveys were conducted on the Snohomish, Skykomish and North Fork Skykomish Rivers at target intervals of two weeks. Aerial surveys provided total visible redd counts per survey flight and were plotted against survey date for the area-under-curve (AUC) method yielding total redd days. Total redd days were then divided by the assumed standard 21-day redd life to yield the estimated cumulative redds from aerial surveyed reaches. The cumulative redd count was then expanded by 2.5 (fish per redd) to estimate escapement. Additionally, a count of Chinook passed above the trap at Sunset Falls on the South Fork of the Skykomish was made. Carcasses encountered were sampled for scales, DNA, CWT, adipose fin mark status, and otoliths.

Skykomish summer/fall Chinook

Spawning ground surveys were conducted throughout the known spawning distribution of Skykomish summer/fall Chinook. Survey reaches were the mainstem Snohomish and Skykomish Rivers, Pilchuck, Sultan, and Wallace Rivers, Woods, Elwell, Bridal Veil, Olney, and Proctor Creeks, and in the North and South forks of the Skykomish River.

Survey conditions were good for most of the spawning season. Normal Fall rains came in October that briefly interrupted survey coverage, but frequency and number of surveys was acceptable. For the most part, survey intervals were kept at seven to ten days. An important piece of equipment for conducting surveys on larger rivers, the jet sled, was out of service during the entire monitoring period. But survey coverage, albeit less efficient, was completed using a drift boat. The absence of a jet sled for mainstem surveys likely reduced the overall number of carcasses that otherwise would have been sampled. Four aerial surveys were flown on the Mainstem Snohomish, Skykomish and North and South Fork Skykomish Rivers at two-week intervals between mid-September and mid-November.

A total of 917 Chinook redds were found in the Skykomish River and its tributaries, and Pilchuck River in 2020 (Table 4-13). The spawning escapement estimate (including Sunset Falls trap counts) was 2,721 adult fish (1,975 NOR, 747 HOR; Table 4-15). An additional 5,318 adult hatchery origin fish (including 1,284 jacks) and 389 adult and 14 jack natural origin fish recruited to Wallace Hatchery and were not included in this escapement estimate. Total adult NOR Skykomish escapement (natural spawning + broodstock collection) was 2,364 Chinook.

Table 4-13. Skykomish summer/fall Chinook redd counts and escapement, 2020.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Snoh-Sky (Mainstems)	7.0012	Float/Flight	13.2-51.5	360	900
NF Skykomish	7.0982	Foot/Flight	0.0-13.5	87	218
SF Sky (Sunset Falls)	7.0012	Trap/Haul	51.5-up		
Pilchuck River	7.0125	Foot/Float	2.0-26.5	39	98
Woods Creek	7.0826	Foot/Float	0.0-3.5	3	8
Elwell Creek	7.0865	Foot	0.0-1.0	13	33
Sultan River	7.0881	Foot/Float	0.0-9.7	277	692
Wallace River (lower)	7.094	Foot/Float	0.0-4.4	95	238
Wallace River(upper)	7.094	Foot/Float	4.4-7.3	2	5
Olney Creek	7.0946	Foot	0.0-0.6	0	0
Proctor Creek	7.097	Foot	0.0-0.4	12	30
Bridal Veil Creek	7.1248	Foot	0.0-0.4	29	73
Total Redds				917	
Escapement					2,721

Snoqualmie summer/fall Chinook

The escapement estimates for Snoqualmie summer/fall Chinook were made using cumulative redd counts from boat, foot, and aerial surveys of known spawning habitat. Surveyed reaches were the Snoqualmie River and its tributaries, including the Tolt and Raging Rivers, and Cherry and Tokul Creeks. Chinook redds were observed from mid-September to early November.

Survey conditions were good for monitoring Chinook spawning until mid-October when Fall rainstorms significantly increased stream flows, delaying or preventing some surveys.

In 2020, 1,211 Chinook are estimated to have escaped to the Snoqualmie Basin, based on a total count of 483.5 redds (Table 4-14). Based on carcass sampling results, the escapement estimate is composed of 804 NORs and 407 HORs (Table 4-15).

Table 4-14. Snoqualmie fall Chinook redd counts and escapement by reach, 2020.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Snoqualmie River (Lower)	7.0219	Float	20.5-24.9	43	108
Snoqualmie River (Upper)	7.0219	Float	32.9-39.6	82	205
Cherry Creek	7.0240	Foot	1.8-3.5	1	3
Tolt River (Lower)	7.0291	Foot/Float	0.0-6.0	40	100
Tolt River (Upper)	7.0291	Foot/Float	6.0-8.9	22	55
NF Tolt River	7.0291	Foot	8.9-11.3	18	45
SF Tolt River	7.0302	Foot	0.0-2.3	14	35
Raging River	7.0384	Foot	0.0-4.6	129	323
Raging River (Upper)	7.0384	Foot	4.6-13.2	116.5	291
Tokul Creek (Lower)	7.044	Foot	0.0-0.3	15	38
Tokul Creek (Upper)	7.044	Foot	0.3-0.6	3	8
Total Redds				483.5	
Escapement Estimate					1,211

Sampling and HOR:NOR summary

Field staff sampled 480 complete Chinook carcasses (status of CWT, otolith mark, and adipose fin mark are known) within the Snohomish basin. Additionally, adipose fin and CWT status was determined for 76 live Chinook passed at Sunset Falls. In total, the Chinook carcass sampling rate on the spawning grounds and at Sunset Falls was 12.2% (Table 4-15). This was calculated by dividing the number of carcasses and live fish sampled by the escapement estimate.

Escapement of Chinook by origin (hatchery or natural) was determined by applying ratios of hatchery marked carcasses and unmarked carcasses (and live fish sampled at Sunset Falls) to the escapement estimate by reach groupings (Table 4-15). Grouping reaches into subsets of the populations allows the calculation of hatchery origin recruits (HOR) and natural origin recruits (NOR) for escapement reaches where sample sizes were small or no sampling occurred.

Table 4-15. Snohomish Chinook carcass sampling and escapement composition in 2020, preliminary.

Stratum	Escapement	No. Hatchery	No. Natural	% Hatchery	% Natural	Number Sampled	Percent Sampled
Skykomish	971	262	709	26.94%	73.06%	27	2.8%
Bridal Veil	291	105	186	35.96%	64.04%	89	30.6%
SF Sky *	426	95	331	22.37%	77.63%	76	17.8%
Pilchuck River	98	28	71	28.06%	71.94%	3	3.1%
Sultan River	692	117	575	16.88%	83.12%	77	11.1%
Wallace River	243	140	103	57.69%	42.31%	52	21.4%
Skykomish Population	2,721	747	1,975	27.43%	72.57%	324	11.9%
Snoqualmie	1,165	381	784	32.73%	67.27%	110	9.4%
Tokul	46	26	20	56.52%	43.48%	46	100.0%
Snoqualmie Population	1,211	407	804	33.61%	66.39%	156	12.9%
Snohomish Total	3,932	1,154	2,779	29.34%	70.66%	480	12.2%

*Sunset Falls sample: A sub-sample of Chinook passed upstream were sampled for cwt wire and adipose mark.

Key for Grouped Stratum and Populations:

Skykomish Population:

Bridal Veil: Bridal Veil Creek, NF Skykomish River, SF Sky (Sunset Falls)

Sultan: Sultan River

Skykomish: Snoh-Sky (Mainstems), Elwell Creek, Olney Creek, Woods Creek, Proctor Creek

Pilchuck: Pilchuck River

Wallace: Wallace River (Upper and Lower)

Snoqualmie Population:

Snoqualmie: Snoqualmie River (Lower and Upper), Raging River, Tolt River (Lower and Upper), SF

Tokul: Tokul Creek (Lower), Tokul Creek (Upper)

4.5 Cedar River

Prior to 1999, live counts and Area Under the Curve (AUC) methods were used to estimate Chinook spawning abundance in the Cedar River. Since 1999, Chinook redds have been enumerated and mapped in the Cedar River via floating surveys, and escapement estimated by expanding the redd count by 2.5. Cedar River redd surveys are considered to be a complete census of the mainstem river, where every Chinook redd in the Cedar system is counted. Redd surveys are conducted between RM 4.2 and RM 21.8 (Landsburg Dam) 2-3 times per week for the duration of the Chinook spawning period. The portion of the river upstream from the Landsburg Dam to the Cedar Falls powerhouse (RM 34.5), and the lower 4.2 miles of the Cedar mainstem are each surveyed once per week. Due to the overlap with sockeye spawning timing, Chinook redds are only included in the count if a female Chinook is present and actively attending to a redd.

In 2020, a total of 205 Chinook redds were observed in the Cedar River during the spawning season (including the surveyed area upstream from Landsburg Dam and including two small tributaries below Landsburg, Rock and Taylor). Of the Chinook redds, 201 were observed in the Cedar River mainstem (153 below Landsburg Dam and 48 above), and 4 were observed in the small tributaries to the Cedar River. Expansion by 2.5 Chinook per redd resulted in the estimated escapement of 513 (Table 4-1). Carcass surveys in the Cedar River indicated that

55% of the naturally spawning adult Chinook were natural origin (unclipped) and 45% were hatchery origin (clipped).

4.6 Sammamish River/North Lake Washington Tributaries

The Sammamish Chinook population is composed of naturally spawning Chinook in the Big Bear/Cottage Lake Creek watershed and in the Issaquah Creek watershed downstream of Issaquah Hatchery. Chinook natural escapement to the Sammamish River/ North Lake Washington tributaries in 2020 was estimated at 1706.

Big Bear/Cottage Lake Creeks

Escapement estimation to Big Bear Creek and Cottage Lake Creek involves weekly surveys of all known Chinook spawning areas to enumerate live Chinook. Total spawning escapement is estimated using the area under the curve (AUC) method, where live Chinook counts and a 10-day stream life estimate are used to calculate escapement.

The Bear Creek/Cottage Creek area was surveyed weekly during the 2020 spawning season. The escapement estimate was 219 Chinook. Of these, 41 were estimated in the Bear Creek mainstem, and 178 were estimated in Upper and Lower Cottage Creek. Carcass surveys in the Big Bear/Cottage Lake system indicated that 22% of the naturally spawning adult Chinook were natural origin and 78% were hatchery origin.

Issaquah Creek System

Issaquah Creek is surveyed weekly from the Issaquah Hatchery (located at river mile 3.0), downstream to its confluence with Lake Sammamish to count Chinook carcasses. All Chinook carcasses are assumed to have spawned, and the cumulative carcass count is used as the escapement estimate for this reach of Issaquah Creek. East Fork Issaquah Creek is also surveyed weekly from its confluence with the Issaquah Creek mainstem, upstream to the High Point Trail crossing at approximately RM 3.0. Similar to the Issaquah Creek mainstem, the cumulative carcass count is used as the escapement estimate for the East Fork.

The Issaquah Creek system was surveyed weekly during the 2020 spawning season, and total escapement was estimated at 1487 Chinook. This estimate includes 1404 in the mainstem below the hatchery, and 83 from the East Fork. Carcass surveys in the Issaquah Creek system indicated that 4% of the naturally spawning adult Chinook were natural origin and 96% were hatchery origin.

Chinook escapement to Issaquah Hatchery in 2020 was 2,352 (2,303 adults and 49 jacks); of which 54 adults were intentionally released upstream to spawn in upper Issaquah Creek.

4.7 Green River

Beginning in 2009, Muckleshoot (MIT) and WDFW Biologists agreed to attempt weekly counts of new Chinook redds in all survey-able reaches of the Green River and Newaukum Creek during Chinook spawning ground surveys, reasoning that so few redds were being dug, it was possible to count all redds in all reaches. This estimation methodology uses season total redd counts, without adjustment, in four of the six sections of the mainstem Green River. At the conclusion of the spawning season, the observed number of redds in these sections of the river is known with zero assumed variance. There may be observational error in these sections or spawning outside these sections. However, these factors operate in all sampling programs and are not included in any variance estimates.

New Chinook redds were counted weekly over three days by boat and twice during the season from an aerial survey in the mainstem river between River Mile (RM) 25.4 to 48.5 (Lower River (counted every other week), Middle River, and Lower Gorge) and 59.2 to 61.0 (Headworks). Using two, one-man pontoon boats or two, two-man boats, crews worked in tandem to count redds left and right of the center of the river. Foot surveys of Chinook naturally spawning in Newaukum Creek were conducted weekly by WDFW crews from the creek mouth to river mile 3.9. Redds in the Metzler Side Channel (MSC) were counted opportunistically when adequate water filled the side channel, in a similar manner. Only those redds that could reasonably be presumed to be Chinook redds were counted, based on the presence of a female observed digging or guarding the redd, or when redd size and substrate size were unambiguous.

A rigorous surveying schedule began on September 9 and continued through November 12. Surveys were limited during the week of September 13 due to poor air quality and suspended during the week of October 18 when high flows prohibited safe conduct of surveys. Redd counts from MSC were conducted on September 29, October 14, and October 30. These counts were added to the weekly counts for the Middle River. The weekly number of redds counted in each section, was summed, without adjustment, to produce the season total redd count by section.

On October 6 and November 1, a count of visible redds in each reach was made by helicopter in all 6 sections, encompassing the entire "spawnable area" of the mainstem river between RM 25.4 and approximately RM 60.4. Pending amenable weather conditions, flights were timed to coincide with the historical peak of natural Chinook spawning activity which typically occurs the first or second week in October. Flight scheduling was limited by availability of the helicopter and weather and river conditions.

Escapement was calculated for the sections of the river not surveyed by boat: "Gorge", RM 48.5 to 56.2 and "Hwy 167 to Transfer Shack", RM 25.4 to 26.7, the lowermost reach in the Lower River. The season total redd count from the section just below the Gorge; Lower Gorge section: RM 44.3 to 48.5, was divided by the number of redds in the Lower Gorge section counted on the flight, resulting in the "Ground to Air Ratio" (G/A). The G/A was then applied to the number of redds observed in the Gorge on the day of the flight. For the Lower River (104 redds) and Hwy 167 to Transfer Shack (4 redds) reaches, the sum of redds observed during four floats (Lower River) and an estimate of redds extrapolated from one aerial survey (Hwy 167 to Transfer Shack) was used to estimate a combined season total of 108 redds.

Season total redd counts from boat and foot surveys of the mainstem Green River and Newaukum Creek and calculated values from the aerial sections of the Green River, were multiplied by 2.5 Chinook per redd to estimate total Chinook spawning naturally in the Green River basin. This multiplier is intended to account for the number of males and females and is derived from an assumed sex ratio of 1.5 males for every female.

Post season analysis of the season totals indicates that peak spawning activity varied by section, and was generally highest during either the last week of September or the first week of October (Table 4-16 and Table 4-17). By the end of surveys the week of October 11, 93.6% of the redds (1425 of 1522) observed during boat and foot spawning ground surveys were complete.

Table 4-16. Chinook redd counts from foot and boat surveys of the Green River in 2020.

Section	Week ¹									8-Nov	Total
	6-Sep	13-Sep	20-Sep	27-Sep	4-Oct	11-Oct	18-Oct	25-Oct	1-Nov		
Headworks	1	4	72	194	163	79	-	15	-	-	528
Lower Gorge	-	1	8	37	73	26	-	4	0	-	149
Middle River	-	-	63	137	199	139	-	50	16	0	604
Lower River ¹	-	10	-	54	-	30	-	10	-	-	104
Newaukum Creek	0	1	19	58	34	23	2	-	-	-	137
Total	1	16	162	480	469	297	2	79	16	0	1522

¹Aerial surveys on October 4 were used to estimate 3 redds in the Hwy 167 to transfer shack reach.

Table 4-17. Aerial survey counts of Chinook redds in the Green River, 2020.

Section	Week ¹									Total
	6-Sep	13-Sep	20-Sep	27-Sep	4-Oct	11-Oct	18-Oct	25-Oct	1-Nov ²	
Headworks	-	-	-	-	151	-	-	-	18	169
Gorge	-	-	-	-	107	-	-	-	29	136
Lower Gorge	-	-	-	-	82	-	-	-	19	101
Middle River	-	-	-	-	261	-	-	-	71	332
Lower River	-	-	-	-	82	-	-	-	24	106
Hwy 167- Transfer Shack	-	-	-	-	3	-	-	-	0	3
Total	-	-	-	-	686	-	-	-	161	847

¹Aerial counts can include redds still visible from prior weeks and thus exceed boat counts for the same week.

²The second aerial survey was conducted on Nov 1 but represented counts for the week of Oct 25-31.

The season total redds from the Middle River was 570 redds plus 34 from MSC, 149 from the Lower Gorge, 528 from the Headworks, and 104 in the Lower River plus 4 in the Hwy 167-Transfer Shack reach. The G/A ratio for the Lower Gorge was 1.82 (149/82) resulting in a calculated 194 redds for the “Gorge”. A total of 1,583 redds were counted or calculated in the mainstem Green River, including MSC, by census. In Newaukum Creek, the season total redds for the section “400th to Whitney Hill Bridge” was 86 and for the section “Whitney Hill Bridge” to mouth” was 51, totaling 137 redds in Newaukum Creek.

Applying the constant 2.5 Chinook/redd (1.5 males:1.0 female), an estimate of 4,300 naturally spawning Chinook was generated for the Green River Basin (Table 4-1).

Although in recent years some Chinook that returned to the Soos Creek and Keta Creek hatcheries were tagged by the Muckleshoot Indian Tribe, hauled upstream, and released in the mainstem, no Chinook were outplanted from the hatcheries in 2020.

River flows during the 2020 Chinook spawning season were moderate through the peak of spawning and then increased through the end of the season (Table 4-18). This resulted in surveys being suspended during the week of October 18 followed by reduced visibility through the final week.

Table 4-18. Average weekly discharge (cfs) at three locations on the Green River (Palmer USGS Gage 12106700, Auburn USGS Gage 12113000, and Newaukum Creek USGS Gage 12108500) in 2020. Weekly discharges are 7-day averages of mean daily discharge beginning with the day listed.

USGS Gauge	Week									
	6-Sep	13-Sep	20-Sep	27-Sep	4-Oct	11-Oct	18-Oct	25-Oct	1-Nov	8-Nov
Palmer	231	242	351	377	369	711	2086	1666	1848	1341
Auburn	359	390	542	577	553	921	2266	1930	2124	1714
Newaukum Creek	9	10	26	20	18	34	23	21	59	47

Carcass sampling

Naturally spawning Chinook carcasses (clipped and unclipped) were sampled opportunistically during spawning ground surveys in the mainstem and Newaukum Creek. Biological data were collected from these carcasses, and a “Percent Egg Retention” variable was determined. The “Percent Egg Retention” variable was determined by inspection of the gonads of all female carcasses. The proportion of eggs estimated to have been retained was noted for carcasses where eggs remained in the body cavity. A carcass noted as having 25% egg retention was estimated to have expelled 75% of her total eggs. In years where surplus Chinook are transferred from a hatchery to the spawning ground, tags from those releases are noted for all sampled carcasses.

A total of 694 carcasses were sampled for standard biological data by Green River crews in 2020; 409 (1 DIT+ 20 CWT&AD + 203 AD + 185 thermal marked with no adipose fin and no CWT) or 59.8% were of hatchery origin as indicated by the presence of an adipose fin, CWT tag, or hatchery thermal mark (Table 4-19).

Table 4-19. Summary of Chinook biological sampling in the Green River, 2020.

Section	Biological Samples	Adipose Clipped	Thermal Marks	MIT Tags ¹	CWT ³ & Ad-Clipped	DIT ³
Headworks	368	112	136	0	2	0
Lower Gorge	36	8	8	0	4	0
Middle River	166	43	17	0	4	0
Lower River	8	6	0	0	1	0
Metzler Side Channel	0	0	0	0	0	0
SubTotal: River	578	169	161	0	11	0
Newaukum: 400th to Whitney Hill Br	71	34	18	0	6	1
Newaukum: Whitney Hill Br to Mouth	45	20	6	0	3	0
SubTotal: Newaukum	116	54	24	0	9	1
Grand Total:	694	223	185	0	20	1

¹“MIT tags”; the number of sampled Chinook with MIT tags, or those otherwise identified as hatchery re-release. No Chinook were re-released in 2020.

² CWT: Coded wire tag present (unconfirmed) DIT = (Double Index Tag) Adipose fin present, coded wire tag present.

Table 4-20. Coded wire tag sampling, thermal mark analysis of otoliths¹, and origin of natural Chinook spawners² in the Green River, 2020.

	Sampled						NM with no Thermal Mark		AD or NM with Thermal Mark		Unknown Origin ³	
	Number	NOS	HOS	Unknown Origin ³	CWT	No CWT	DIT	No CWT	CWT	No CWT	CWT	No CWT
Green River	578	241	330	7	11	567	0	241	11	319	0	7
Newaukum Creek	116	34	79	3	10	106	1	33	9	70	0	3
Green River Basin Total	694	275	409	10	21	673	1	274	20	389	0	10

¹Since 2014, Chinook released from the Palmer Hatchery have been thermal marked but not adipose fin clipped.

²NOS= Natural origin spawner; HOS= Hatchery origin spawner; NM = Adipose fin present; AD = Adipose fin clipped; CWT = Coded wire tag present (unconfirmed); DIT = Double Index Tag; Adipose fin present, coded wire tag present; TM = Thermal Marked.

³Unknown origin = otoliths not analyzed for thermal mark or adipose fin presence unknown

4.8 White River

The escapement estimate for White River Spring Chinook is derived from trap counts at the Army Corps of Engineers' Buckley Diversion Dam fish trap (Buckley Trap) and hatchery returns to the White River Hatchery (WRH). The WRH and Buckley Trap are on opposite sides of a diversion dam on the White River. Off-site propagation of White River Spring Chinook also occurs at the Minter Creek/Hupp Springs Hatchery, and returns to that facility are recorded separately. Under ideal conditions, the Buckley Trap allows sampling and enumeration of all fish transported to the upper White River watershed. During odd years when pink salmon return and during years of relatively high Coho returns (2003-2012), sampling at the Buckley trap is limited, particularly during the latter part of the Chinook run. Consequently, the proportions of hatchery and natural-origin spring and fall Chinook transported above the dam are uncertain. Records of trap and haul operations conducted in the absence of state or tribal fisheries managers are a subject of ongoing concern. In 2020, complete sampling occurred through August 28th, but 908 Chinook (345 adults and 563 jacks) of unknown origin were transported upstream after this date.

The number of adult fish sampled at the WRH and at the Buckley Trap prior to the termination of sampling was 2,321. Of these, 1,718 were natural-origin (NOR) and acclimation pond (AP) recruits. NORs are assumed to be primarily spring Chinook although based on DNA analysis, fall-run Chinook and potential hybrids have been passed. NORs made up 29% and APs made up 45% of the sampled adult Chinook. At the Buckley Trap, the ratios of coded wire tagged, non-coded wire tagged, and vent clipped fish among sampled adults and jacks, were applied to un-sampled adults and jacks passed upstream after the termination of sampling. In addition, 87 of the adult NORs were collected at, or taken to, the White River Hatchery for use as broodstock.

Table 4-21. Estimated number NOR and Acclimation Pond Chinook salmon hauled upstream of Mud Mountain Dam in 2020. Results are a combination of returns sampled White River Hatchery and sampled and un-sampled fish at Buckley Trap.

Origin	Adults	Jacks	Totals
Wild (NOR)	643	1,094	1,727
Acclimation Pond	1,173	2,083	3,256
Totals	1,806	3,177	4,983

There are two hatchery programs for White River spring Chinook: Minter Creek/Hupp Springs program and the White River Hatchery. The Minter Creek/Hupp Springs program was initiated in the mid-1970's in response to steep declines in population abundance. The spring Chinook program was subsequently expanded following completion of the Muckleshoot Tribe's White River Hatchery in 1989. In 2020, escapement to the Minter Creek/Hupp Springs hatchery was 2,348 adults and 361 jacks. None of these fish nor their gametes were taken to the White River Hatchery. Escapement to the White River Hatchery in 2020 was 702 adults and 75 jacks. These fish were either collected at the Buckley fish trap on the south side of the diversion dam or volunteered to the WRH trap on the north side of the diversion dam. An additional 123 adult and 1,517 jacks were passed above Mud Mountain Dam that originated from the White River Hatchery program. These fish were identified through CWT sampling.

4.9 Puyallup River

The Puyallup Tribal Fisheries (PTF) and WDFW staff used a redd count based methodology to estimate Chinook escapement in the Puyallup River basin during even years. The escapement estimate includes fall-timed Chinook spawning in the lower White River downstream of the Buckley diversion dam trap. These fish have been enumerated by PTF biologists through spawning ground surveys since 2002 but were not accounted for in escapement estimates prior to 2009.

South Prairie Creek

Survey coverage of the South Prairie system was very good in 2020. The cumulative redd count of 293 in South Prairie Creek, expanded by 2.5, yielded an escapement estimate of 733 spawners. In Wilkeson Creek, the cumulative redd count of 24, expanded by 2.5, yielded an escapement estimate of 60 spawners. The South Prairie Creek (SPC) sub-basin total spawning escapement estimate for 2020 is 793. Based on mark-sampling of carcasses observed, about 65% of these fish were marked, so the escapement was made up of 268 NORs and 525 HORs.

Carbon River

Because conditions in the Carbon River seldom allow accurate Chinook escapement surveys, estimates are based on the relationship between SPC and Carbon River escapement in 1999, when there was an accurate redd count for the Carbon River. Carbon River reaches with complete data tracked the SPC spawn timing remarkably well. Therefore, reaches with incomplete data were expanded using the SPC spawn timing curve with a high degree of confidence. The 2020 SPC escapement, including Wilkeson Creek, utilized in the Carbon River escapement expansion is an adjusted area under the curve (AUC) escapement estimate accounting for the average even-year (1994-2020) ratio of redd-based escapement and live fish AUC estimate exclusively in SPC multiplied by the 2020 AUC live fish estimate for SPC sub-basin.

Survey conditions were not suitable on the Carbon River during the 2020 spawning period. Consistent with the last ten years, the 2020/1999 SPC AUC escapement ratio ($1178 / 1422 = 0.9775$) was applied to the 1999 Carbon River escapement (250) to estimate the 2020 value. This method estimated 207 Chinook spawning in the Carbon during 2020 ($250 * 0.8284 = 207$). Based on mark sampling ratios observed in South Prairie Creek, the escapement was made up of 73 NORs and 134 HORs.

Puyallup River Tributaries

Aggregate escapement to Puyallup River tributaries in 2020 was estimated at 233 (Table 4-22). Based on mark sampling in these tributaries, excluding Clark's Creek, 20 of these fish are NORs and 213 HORs.

Table 4-22. Chinook escapement estimates for Puyallup River tributaries, 2020.

Tributary	Escapement
Fennel Creek (WRIA 10.0406)	15
Canyon Falls Creek (10.0410)	0
Kapowsin Creek (10.0600)	38
Clear Creek (10.0022)	180
Clarks Creek (10.0027)	0
Tributary total	233

Mainstem Puyallup River

Chinook spawning escapement to the mainstem Puyallup River was estimated to be 149. This escapement comprised 31 NOR and 118 HOR Chinook, based on mark sampling ratios observed in mainstem tributaries.

As with the Carbon River, surveys of Puyallup River were not possible in 2020. WDFW and PTF staff believe that mainstem spawning escapement is closely related to the tributaries (Fennel, Canyon Falls, Clear, Kapowsin, and Clarks creeks). Therefore, the 2020/1999 Puyallup tributary AUC ratio ($86/113 = 0.7628$) was applied to the estimated 1999 Puyallup mainstem escapement (195) to estimate 2020 escapement of 149 Chinook ($195 * 0.7628 = 149$). The same even year (1994-2020) average AUC adjustment used for the Carbon River was applied to the Puyallup tributary AUC live-fish estimate to develop the 2020 Puyallup tributary AUC estimate for this analysis.

Lower White River

The fall component of Chinook spawning in the lower White River and its tributaries, downstream of the Buckley trap, are included in the 2020 Puyallup River basin fall Chinook escapement estimate. Spawning ground surveys indicate that, in some years, a sizeable number of Chinook spawn in these areas.

Spring and fall Chinook spawn in the White River. The fall component in the lower White River and tributaries was identified by mark sampling during spawning ground surveys and the genetic analysis conducted by Ford et al. (2004). Carcass sampling during spawning ground surveys provides a ratio of hatchery-origin fall Chinook (i.e. fish with a clipped adipose fin), to unmarked fish. Based on previous genetic analysis of samples collected in Boise Creek (Ford et al 2004), 60% of the unmarked fish are assumed to be fall Chinook.

Fall Chinook spawning escapement into the lower mainstem White River and its tributaries in 2020 was estimated to be 368 fish. This escapement is made up of 150 NORs and 218 HORs based on mark sampling ratios observed during spawning ground surveys.

Total Puyallup Escapement

The estimated total number of naturally spawning fall Chinook in the Puyallup basin in 2020 was 1,750. Based on carcass sampling, we estimated that 542 were NORs, and 1,208 were HORs. The estimate of NORs assumes the proportions of hatchery and natural origin spawners is the same in Puyallup River tributaries, the Puyallup River mainstem, South Prairie Creek, and the Carbon River.

4.10 Nisqually River

Natural escapement to the Nisqually River in 2020 was estimated using a change in ratio methodology (Seber 1982). This method uses (1) the proportion of marked fish entering the river (as estimated by sampling tribal gillnet catch), (2) the total removals below the video counting slot in the Yelm Diversion dam and proportion of those removals marked, and (3) the proportion of marked fish passing above the Yelm Diversion Dam video counting slot to estimate the total return to the river.

Total escapement to the spawning grounds and the hatcheries in the Nisqually River was estimated to be 4,483 adult Chinook salmon (Table 4-1) with a preliminary natural spawning escapement of 585. The spawning escapement was composed of 481 natural-origin and 104 hatchery-origin adult fish volitionally escaping to the spawning grounds. Hatchery-origin adults were not trucked to the spawning grounds in 2020 due to the low runsize of adult Chinook that returned to the Nisqually River.

4.11 Hood Canal

Natural Chinook escapement to the Skokomish River and Mid-Hood Canal rivers in 2020 were 2,754 and 5, respectively (Table 4-23).

Mid-Hood Canal

The Mid-Hood Canal population is comprised of Chinook produced in the Dosewallips, Duckabush, and Hamma Hamma watersheds.

In the Dosewallips and Duckabush rivers, the lower reaches surveyed are spawning and transit areas. Upper reaches of the Dosewallips and Duckabush rivers have also been regularly surveyed since 1998, but few adults have been observed. Current escapement estimates are derived from combinations of live Chinook adult counts and Chinook redd expansions, depending on flow conditions and fish distributions.

In the Hamma Hamma River, most of the Chinook spawning area is currently being surveyed. A cooperative supplementation program was initiated in 1995 to rebuild Chinook abundance. Prior to 1998, escapement had been estimated from counts of cumulative new redds and/or from live Chinook using the area-under-the curve (AUC) method. However, since returns increased as the result of supplementation, the AUC method has been employed as the primary method of escapement estimation.

Summer chum salmon and pink salmon (in odd years) spawn at the same time as Chinook in the lower reaches of these three streams. Consequently, it can be difficult to distinguish Chinook redds from summer chum or pink redds unless Chinook are actively spawning and observed on redds. Pink salmon spawn predominately downstream of RM 6.7 on the Dosewallips, downstream of RM 2.6 on the Duckabush and throughout the reaches surveyed on the Hamma Hamma. Summer chum salmon spawn predominately downstream of RM 3.6

on the Dosewallips, downstream of RM 2.6 on the Duckabush and throughout the reaches surveyed on the Hamma Hamma. It has been possible to count Chinook redds in the upper Dosewallips and Duckabush River reaches (especially in years without pink salmon).

The WDFW conducted spawner surveys on the Dosewallips, Duckabush, and Hamma Hamma rivers every 7 to 10 days from late August or early September through October. The escapement estimate to all three systems combined was 5 adults: zero, two, and three Chinook in Dosewallips, Duckabush, and Hamma Hamma rivers, respectively (Table 4-23). During 2020, it is possible that some Chinook redds were not identifiable on the Dosewallips and Duckabush rivers in areas with summer chum spawning. However, based on the number of Chinook redds and adults observed during surveys and carcasses recovered during intensive weekly surveys, very few Chinook were present and the escapement estimates for Dosewallips and Duckabush rivers are considered in line with the actual order of magnitude for very low numbers.

The Dosewallips River was surveyed from RM 0 to RM 2.3, RM 3.6 to RM 6.7, but not RM 7 to RM 11; Rockybrook Creek, a tributary, was surveyed from RM 0 to RM 0.3. No Chinook redds were identified and no live fish were observed in the Dosewallips River during 2020. The Duckabush River was surveyed from RM 0 to RM 2.6, RM 4.8 to RM 6. Although no Chinook redds were conclusively identified, an AUC estimate of two individual live adults was made based on observations made in September and October. The Hamma Hamma River was surveyed from RM 0.3 to RM 1.8; John Creek, a tributary, was also accessible to Chinook and was surveyed from RM 0 to RM 1.6. The estimated total escapement to the Hamma Hamma River is three which is the peak/live dead estimate of natural spawners in the mainstem. Flows were low in John Creek late into the season that the fish counted there had been previously accounted for in several Hamma Hamma River mainstem surveys. No Chinook were collected for broodstock. The FRAM preseason escapement projection was 39 for the Mid-Hood Canal (FRAM 3120) while the estimated escapement is 5 Chinook. Escapements to the Dosewallips River and Duckabush River were low as anticipated.

Skokomish River

Chinook spawning takes place in the mainstem Skokomish River up to the confluence with the South and North Forks at RM 9, in the South Fork (primarily up to RM 5.5), and in the North Fork from RM 9 to 15.7 (where Little Falls once blocked further access). Natural escapement estimates have historically been based on counts of Chinook redds in the principal spawning habitat in the mainstem Skokomish (RM 2.2 to 9.0), North Fork (R.M. 9.0 to 15.6), and South Fork (R.M. 0 to 2.2). Since 2008, surveys have been conducted from RM 0 to RM 5.5 in the South Fork and included in the total escapement estimate. In addition, escapement estimates are made for Vance Creek and Hunter Creek. However, dramatically increasing numbers of summer chum spawning in the mainstem Skokomish since 2014 led the co-managers to re-evaluate the redd-based spawning methodology, and ultimately shift to a modified Area under the Curve (AUC) methodology applied elsewhere in Hood Canal. This change was necessary because summer chum spawning has become so prolific and Chinook spawning has become increasingly concentrated in preferred habitat. These conditions lead to widespread superimposition and difficulties in individual redd detection.

Live and dead adults, along with visible redds, were counted in Skokomish River index areas during foot, raft and snorkel surveys (e.g., see Smith and Castle 1994). Surveys are conducted every seven to ten days. Historically, the fall Chinook survey season extended from late August through October, but with the first returns of North Fork spring Chinook, there is no break between steelhead survey season and Chinook season, now running from May through October or November if flows allow. Weekly instantaneous live fish counts for the entire mainstem, South Fork and North Fork are used to calculate fish days, which are then divided by

a stream life value of 21 days (the average difference between peak average live counts and peak average redd deposition) to estimate total Chinook escapement. In 2020, Chinook escapement estimates were further reduced by subtracting the George Adams Hatchery rack escapement total from the AUC estimates calculated for the Mainstem, Hunter Creek, North and South Fork. In addition, foot surveys are made in Hunter and Vance creeks. Escapements to these tributaries are estimated based on redd counts and/or live Chinook observed.

In recent years, low flows at the mouth of the South Fork have prevented Chinook from accessing the lower South Fork early in the season. In 2020, Chinook had limited access to the South Fork Skokomish as the channel remained dry from August 12 through September 18 when increased flow again allowed passage.

The total estimated spawner escapement to the Skokomish River is 2,754 (Table 4-23). This total includes 1,771 in the mainstem Skokomish, 393 Chinook in Hunter Creek, 575 Chinook in the North Fork, and 15 Chinook in the lower (RM 0 to RM 5.5) South Fork Skokomish. These numbers were apportioned based on calculating a redd-based escapement estimate for the north and south forks where summer chum spawning was limited, then using those numbers to apportion the total AUC estimate. The preseason escapement prediction was 2,749 (FRAM 3120).

Table 4-23. Summary of Chinook escapement to Hood Canal streams during 2020.

Area	Stream	Escapement	Comments
82 G/J	Skokomish R.	1,771	
	Hunter Cr.	393	AUC (MS+HC+NF+SF – Hatchery Rack), apportioned by subtracting redd-based escapement for NF and SF and AUC HC.
	N.F. Skokomish R.	575	
	S.F. Skokomish R.	15	
Total	2,754		
12A	Little Quilcene R.	0	No Chinook observed
	Big Quilcene R.	2	Chinook observed + on completed redd
	Total	2	
12B	Dosewallips R.	0	No Chinook observed during foot surveys
	Duckabush R.	2	Based on live fish obs.
	Hamma Hamma R.	3	Peak live/dead
	Total	5	
12C	Dewatto R.	0	No Chinook observed
	Eagle Cr	2	Peak live/dead
	Lilliwaup Cr.	0	No Chinook observed
	Total	2	
12D	Tahuya R.	0	No Chinook observed
	Union R.	14	Trap
	Total	14	
Hood Canal total		2,777	

a/ Hamma natural escapement =3, broodstock = 0, John Ck = 0 (John Creek fish previously counted in Hamma AUC due to late access)

Mark Sampling

Mass marking has been implemented for releases from George Adams Hatchery, Hoodsport Hatchery, and Endicott Ponds. Double index tag (DIT) groups have been released from George Adams Hatchery since 1998. The proportion of all Hood Canal hatchery Chinook that were either tagged and/or marked has incrementally increased since brood year 2003. In addition, all of the Chinook released from the Hamma Hamma supplementation program were tagged and/or marked. Coded-wire tag (CWT), age, and sex composition data have been routinely collected from Chinook returning to George Adams Hatchery since 1988.

There has been more intensive sampling of Chinook on the spawning grounds since 1998. Since 2017, the Skokomish, Dosewallips, Duckabush, and Hamma Hamma rivers continue to be targeted for enhanced mark and CWT sampling, with WDFW also sampling Chinook carcasses for marks and CWTs on the Dewatto, Tahuya, and Lilliwaup rivers.

Of the 197 Chinook sampled in Hood Canal rivers during 2020, 165 Chinook were adipose-clipped and, of these, 9 had CWTs. 23 unmarked Chinook were coded-wire tagged. We sampled 6.8% of the Chinook spawning escapement in the Skokomish River. In the Mid-Hood Canal rivers Chinook escapement, only three fish were live sampled in the Hamma Hamma River through snorkeling, and no carcasses were present in the Duckabush and Dosewallips Rivers. Overall the sampling rate was 7.1% for all Hood Canal rivers combined (Table 4-24).

Jacks are not included in Chinook spawning escapement estimates in Hood Canal, but few jacks were sampled during 2020.

Conservative estimates of hatchery contribution to natural the spawning escapement were made based on the total number of CWT tags and marks recovered (CWT's + adipose-clips + otoliths). However, these estimates are subject to correction for clip error and tag detection rates for the returning brood years. Thus, the proportion of hatchery fish on the spawning escapement is estimated by expanding adipose-clipped fish based on proportions of clipped fish released from each brood year, based on co-manager agreement. Age composition in the escapement, carcass sampling rate, and the proportion of hatchery production releases that were marked and/or tagged from BY 2015 (age-5), BY 2016 (age-4), and BY 2017 (age-3).

In 2020 there was close agreement in the two aforementioned methods, with mark sampling-based pHOS weighted estimated as 97.8% and expanded clip pHOS of 98.5% in the Skokomish River system (Table 4-24 and Table 4-25). Clip rate expansion estimate, the preferred method of the co-managers, does not include Purdy Creek samples because of the likely bias associated with hatchery mortality. However, a total of 66 Chinook sampled, 61 were adipose-marked (98.5%). Spawning escapement in the Skokomish River was comprised of about 98% hatchery-origin Chinook and 2% natural-origin Chinook, with a higher proportion of NOR returns to the Mainstem where they accounted for 96% (Table 4-24). Also, the commercial sampling of the tribal gillnet fishery in the mainstem was similar in composition with 97.7% hatchery-origin Chinook and 2.3% natural-origin Chinook. These estimates may be further refined as CWT data becomes available next fall. The low carcass recovery sample size along with the extremely low escapement, highlight the uncertainty in the 2020 Skokomish River HOR/NOR estimates.

Hatchery releases into the Hamma Hamma River for the purposes of supplementation were 100% CWT and otolith marked, with the exception of BY 2013, when all broodstock were collected directly from the Hamma Hamma River and therefore only otolith marked. The 2013 BY was 100% tagged but not otolith marked since the purpose of otolith marking has been primarily to assess differences in the survival of Hamma Hamma origin supplementation fish versus George Adams origin supplementation fish. The last brood year release was 2014

making 2018 the last year Age 4 adults returned to the Hamma from the supplementation program, and Age-5 Chinook from the last supplementation release would have returned in 2019. Since supplementation origin fish are no longer returning, otoliths are no longer collected. Any Chinook carcasses encountered will continue to be 100% sampled for sex, length, scales, mark status, and coded wire tag. However, no carcasses were recovered, due the low numbers of Chinook and scavenging and predation. Thus, snorkeling is now being employed to monitor for ad-clipped fish.

Because no carcasses were recovered from the Duckabush and Dosewallips rivers, a long term HOR average for the Hamma Hamma (15%) was applied to the 2020 escapements (Table 4-24). The low carcass recovery sample size along with the extremely low escapement, highlight the uncertainty in the 2020 Mid Hood Canal HOR/NOR estimates.

Table 4-24. Chinook salmon spawner escapement origin based on carcasses sampled for marks and coded-wire tags (CWTs) in Hood Canal rivers, 2020.

Management Unit	Escapement	Chinook Sampled		Tagged ^{1/}			Untagged ^{1/}			Unknown Tagged ^{2/}			Totals		Rate	Escapement		
		No.	%	AD	NM	Unk	AD	NM	Unk	AD	NM	Unk	CWT's Recovered	Ad-clips observed		HOR	NOR	
Skokomish																		
Mainstem River	1,771	34	1.6%	0	1	0	27	1	1	3	0	1	1	30	0.97	1,716	55	
Hunter Creek	393	142	36.1%	7	19	0	115	1	0	0	0	0	26	122	0.99	390	3	
North Fk.	575	11	1.9%	2	3	0	6	0	0	0	0	0	5	8	1.00	575	0	
South Fk.	15	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.99	15	0	
Skokomish River Total	2,754	187	6.0%	9	23	0	148	2	1	3	0	1	32	160	0.99	2,696	58	
12A																		
Big Quilcene R.	2	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	NA			
Little Quilcene R.	0	0	0%	0	0	0	0	0	0	0	0	0	0	0	NA			
12B																		
Hamma Hamma R. ^{3/}	3	3	100.0%	0	0	0	0	0	0	1	2	0	0	1	0.33	1	2	
Duckabush R. ^{4/}	2	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.15	0	2	
Dosewallips R. ^{4/}	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.15	0	0	
Mid-Hood Canal Total	5	3	60.0%	0	0	0	0	0	0	1	2	0	0	0	0.26	1	4	
12C																		
Dewatto R.	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	
Eagle Creek	2	2	100.0%	0	0	0	2	0	0	0	0	0	0	2	1.00	2	0	
Lilliwaup R.	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	
12D																		
Tahuya R.	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	
Union R. ^{2/}	14	5	35.7%	0	0	0	2	3	0	0	0	0	0	2	0.40	6	8	
Hood Canal Total	2,775	197	7.1%	9	23	0	152	5	1	4	2	1	32	165	0.97	2,706	70	

^{1/} AD = Adipose fin-clipped; NM = No Mark; Unk = Unknown

^{2/} Visual detection only life fish at the trap

^{3/} Supplementation Origin Fish calculated from otolith recoveries

^{4/} SOR for Hamma applied due to low sample size

^{5/} Estimates based on mark sampling data only, not yet corrected for clip error or cwt detection rates, resulting in conservative, provisional estimates

Table 4-25. Chinook salmon spawner escapement origin based on carcasses sampled for marks and coded-wire tags (CWTs) in Hood Canal rivers, 2020.

	Age				Total
	2.1	3.1	4.1	5.1	
Mark rate	0.871	0.868	0.860	0.867	
ADB	0	2	5	0	
ADNB	8	50	52	0	
ADNH	5	1	1	0	
Total ad-clipped	13	53	58	0	111
expanded	15	61	67	0	128
UMB	1	7	9	1	
UMNB	0	1	1	0	
UMNH	0	0	0	0	
Total no clip	1	8	10	1	
Total mark status known	14	61	68	1	130
Proportion Hatchery Origin Spawners (pHOS)					0.985

*Excluding fish < 49cm in sample
 AD = Adipose-clipped (marked)
 UM = Unmarked
 NB = no CWT detected
 B = CWT detected
 NH = No head

4.12 Dungeness

Since 1986, surveys by foot have been conducted throughout the spawning season from RM 0.0 to 18.7 in the mainstem Dungeness River, and from RM 0 to 5.1 in the mainstem Gray Wolf River, to generate a cumulative redd count for the season. The total redd count is multiplied by 2.5 to estimate the total number of adults. In 2020, 279 Chinook redds were counted in the Dungeness River and 14 redds were counted in the Gray Wolf River (Table 4-26). The estimated number of natural spawners in the rivers were 698 in the Dungeness River and 35 adults in Gray Wolf River. There were an additional 100 adults either trapped or netted from the Dungeness River for the hatchery broodstock program including five pond mortalities. The total estimated return to the river was 833.

Table 4-26. The distribution of Chinook redds in the Dungeness Rivers system, 2020.

Season summary				New redds	Proportion	Est. adults
Upper River						
	WRIA	Lower RM	Upper RM			
Gold Cr (18.0121)	18.0121	RM 0.0	RM 0.3	0	0.0000	0
Dungeness R (18.0018)	18.0018	RM 17.5	RM 18.7	3	0.0102	7.5
Dungeness R (18.0018)	18.0018	RM 15.8	RM 17.5	20	0.0683	50
Dungeness R (18.0018)	18.0018	RM 13.8	RM 15.8	18	0.0614	45
Dungeness R (18.0018)	18.0018	RM 10.8	RM 13.8	21	0.0717	52.5
Gray Wolf R (18.0048)	18.0048	RM 0.0	RM 1.0	11	0.0375	27.5
Gray Wolf R (18.0048)	18.0048	RM 1.0	RM 2.5	3	0.0102	7.5
Gray Wolf R (18.0048)	18.0048	RM 2.5	RM 4.0	0	0.0000	0
Gray Wolf R (18.0048)	18.0048	RM 4.0	RM 5.1	0	0.0000	0
				76	0.2594	190
Lower River						
Canyon Cr (18.0038)	18.0038	RM 0.0	RM 0.2	0	0.0000	0
Dungeness R (18.0018)	18.0018	RM 9.2	RM 10.8	34	0.1160	85
Dungeness R (18.0018)	18.0018	RM 6.4	RM 9.2	84	0.2867	210
Dungeness R (18.0018)	18.0018	RM 3.3	RM 6.4	65	0.2218	162.5
Dungeness R (18.0018)	18.0018	RM 0.5	RM 3.3	34	0.1160	85
					0.7406	542.5
Grand total					1.0000	733

Since 1986, the Dungeness River Chinook total returns have ranged from 50 in 1997 to 1,543 in 2006. The decreases in escapement of Dungeness spring Chinook relative to recent years and relative to forecast are partially due to the termination of the captive brood program after the 2002 brood, and resulting decrease in numbers of hatchery juveniles released.

CWT Recoveries

Each carcass observed on the spawning ground and those collected and used for broodstock were sampled. Information, such as, fork length, post orbital hypural (POH) length, gender, mark status (adipose fin present or absent), scales, otoliths, DNA, gill condition, and tag presence were collected. If a CWT was detected, the snout was removed and a label was attached for identification.

We sampled 217 carcasses (n=100 broodstock collection and mortalities and 117 from natural spawners in the river). Of the total number of carcasses sampled, 117 of 217 (53.9%) were tagged (Table 4-27).

Table 4-27. The number of CWT recoveries from Dungeness River Chinook salmon collected from broodstock collections and on spawning ground surveys (SGS) in the Dungeness and Gray Wolf rivers in 2020.

Recovery type	Carcass sample size	# carcasses with CWT	Prop. Snouts detected with CWT	No. carcasses with no tag detected	Prop. no tag detected
Broodstock collection and mortalities	100	65	0.6500	35	0.3500
Spawning Ground Surveys (SGS)	117	52 ¹	0.4444	65	0.5556
Total sample size	217	117 ¹	0.5392	100	0.4608

¹ One tag was lost

Based on the CWT results and scale samples analyzed, the preliminary NOR/HOR composition for Return Year (RY) 2020 is 323 (38.8%) NOR and 509 (61.2%) HOR. The ages of the NOR Chinook for RY2020 consisted of 0.0% age-2, 15.8% age-3, 75.2% age-4, 9.0% age-5, and 0.0% age-6. The ages of the HOR Chinook for RY2020 consisted of 0.0% age-2, 24.0% age-3, 71.3% age-4, 4.7% age-5, and 0.0% age-6. The ages of all Chinook for RY2020 combined were 0.0% age-2, 20.8% age-3, 72.8% age-4, 6.4% age-5, and 0.0% age-6 (Table 4-28).

Table 4-28. Total number and percentages of age-2, age-3, age-4, age-5, and age-6 HOR and NOR Chinook returns in 2020.

	NOR	Percentage	HOR	Percentage	Total	Percentage
Age-2	0	0.0%	0	0.0%	0	0.0%
Age-3	51	15.8%	122	24.0%	173	20.8%
Age-4	243	75.2%	363	71.3%	606	72.8%
Age-5	29	9.0%	24	4.7%	53	6.4%
Age-6	0	0.0%	0	0.0%	0	0.0%
Total	323	100.0%	509	100.0%	833	100.0%

From 2006 to 2020, the total Dungeness River Chinook NOR plus HOR returns ranged from 204 to 1,543 (Table 4-29). The number of NOR Chinook returns ranged from 43 to 339 and the number of HOR returns ranged from 90 to 1,204. The fifteen year average is 163.7 (27.6%) NOR and 430.1 (72.4%) HOR, respectively.

Table 4-29. Total number of NOR and HOR natural spawners and broodstock in the Dungeness River for return years 2006-2020.

Return year	Natural spawners NOR ¹	Natural spawners HOR ¹	Natural spawners NOR+HOR	Broodstock collection NOR ²	Broodstock collection HOR ²	Broodstock collection NOR+HOR	Natural spawners + Broodstock NOR	Natural spawners + Broodstock HOR	Total returns NOR+HOR
2006	293	1,112	1,405	46	92	138	339	1,204	1,543
2007	146	159	305	47	51	98	193	210	403
2008	86	54	140	53	36	89	139	90	229
2009	71	57	128	42	50	92	113	107	220
2010	76	269	345	18	94	112	94	363	457
2011	83	452	535	21	109	130	104	561	665
2012	212	296	508	38	68	106	250	364	614
2013	46	122	168	31	79	110	77	201	278
2014	21	87	108	22	74	96	43	161	204
2015	65	200	265	37	105	142	102	305	407
2016	135	273	408	30	77	107	165	350	515
2017	149	456	605	26	74	100	175	530	705
2018	127	661	788	20	97	117	147	758	905
2019	173	665	838	19	73	92	192	738	930
2020	294	439	733	27	70+3Unk	100	321	512	833
Avg.	132	354	485	32	77	109	164	430	577

¹ Natural spawners: Chinook that spawned naturally in the river. Natural spawner estimate based on redd surveys.

² Broodstock collection: Chinook that were collected in the river or returned to the hatchery and used for broodstock. Total includes pre-spawn mortalities.

³ NORs and HORs determined by CWT detection, otolith marks, scales, or visible marks (adipose clips) from broodstock and river carcasses sampled.

4.13 Elwha River

The Elwha Dam removal project began in September 2011 and was completed by March 2012. The natural river flow was restored through the former Lake Aldwell. Prior to September 2012, Chinook spawning in the Elwha River was limited to the 4.8 miles below the dam with most natural spawning concentrated between RM 2.8 and 4.4. In August 2014, the Glines Canyon Dam was removed. Before dam removal, Chinook surveys were conducted by raft and foot surveys. SONAR technology is being used in the Elwha River as a method to improve enumeration of Chinook passage during the entire run from June through September. This technology will improve Chinook escapement estimates due to the difficulty of observing redds and fish in turbid water conditions caused by the removal of the two dams. Denton et. al. (2020) used an ARIS 1800 and a DIDSON LR (long-range) multi-beam sonar system to enumerate Chinook salmon in the Elwha River on a daily basis from June 3rd to September 21, 2020. For RY 2020, the total return estimate for non-jack Chinook salmon was 3,250 fish with a calculated 95% CI (3,015-3,487) with a CV of 3.7%.

The 2020 hatchery component of the Elwha Chinook Forecast terminal run size employed the return per spawner rates, with 4, 5, and 6 year old rates adjusted by the brood's previous performance. The adjustment is a multiplier consisting of the previous year's return rate divided by the mean return for that age. The wild (natural origin) return was estimated from 3 years of breakouts using otoliths and CWTs. The wild component of the returns has been rather consistent at 5.5% of the total but otoliths have not been analyzed for 2020.

Peak Spawning Ground Surveys and Redd Distribution

To determine the 2020 spatial distribution and density of Chinook redds in the Elwha River after dam removal, the Lower Elwha Klallam Tribe (LEKT), Washington Department of Fish and Wildlife (WDFW), and Olympic National Park (ONP) personnel conducted extensive surveys during the peak spawning period (September 19-27) in the upper, middle, and lower watersheds. The Upper Elwha River section is from Mills at Rkm 23.4 to Rkm 43.8, the Middle Elwha River from Glines Power (Rkm 20.6) to Aldwell North (Rm 8.8), and the Lower Elwha River from Lower Dam (Rkm 7.3) to Hunt Channel (Rkm 2.0). Of 625 redds observed, 106 (16.9%) redds were detected in the Upper Elwha River, 329 (57.6%) in the Middle Elwha River, and 190 (30.4%) in the Lower Elwha River. In addition to recording the number of redds, surveyors recorded the number of live and dead Chinook (Table 4-30, McHenry et al. 2020).

Table 4-30. 2020 Elwha River Chinook salmon spawners from Upper Watershed Dam to the mouth (McHenry et al. 2020).

Survey Reach	Rkm midpoint	Redds	Redds/km	Live Chinook	Dead Chinook	Jacks
Upper Elwha						
Upper Watershed	43.8	0	0	0	0	0
Long Creek	--	--	--	--	--	--
Geyser Valley	28.8	0	0.0	0	0	0
Cat Creek		6	4.0	0	1	0
Boulder Creek		18	36.0	1	1	0
Mills	23.4	82	17.8	67	32	2
UE Subtotal		106		68	34	2
		16.9%				
Middle Elwha						
Glines Power.	20.6	41	37.3	30	15	0
Altaire Bridge	19.5	19	19.0	18	1	0
Griff Creek	18.5	15	15.0	27	2	0
Rabbit Hole (Hughes)	17.3	26	17.3	11	2	0
Fisherman's Cr.	16.1	20	25.0	15	4	0
ONP Boundary	14.7	12	6.0	14	7	0
McDonald Br.	12.9	21	13.1	25	9	0
Little River	12.2	6	3.2	9	0	0
Indian Creek	12.1	76	33.0	60	33	0
Aldwell South	11.0	52	22.6	37	30	0
Aldwell North	8.8	41	21.6	27	12	0
ME Subtotal		329		268	115	0
		57.6%				
Lower Elwha						
Elwha Dam	7.3	19	23.7			
Hwy 112 Bridge	6.1	109	64.2			
County Bridge	3.8	26	14.4	65	95	0
East Channel	1.4	36	15.6	43	12	-
Hunt Rd. Chan.	2.0	0	0.0	0	0	0
LE Subtotal		190		108	107	
		30.4%				
TOTAL		625		444	256	2

1/Long Creek was not surveyed in 2020

In addition to SONAR enumeration and peak spawning ground surveys, adult Chinook were collected from the lower river by various methods for broodstock purposes. WDFW hatchery staff collected salmon for broodstock by net, seine, gaff, and trap methods. 624 adult Chinook and 36 jacks were utilized in broodstock efforts in 2020. Hatchery personnel collected 490 Chinook (306 males, 145 females, 39 jacks) as volunteers to the two hatcheries and as fish netted from the river and brought to the hatchery. Of these 433 were spawned, (266 males, 134 females and 31 jacks, an additional 2 were non-viable females) and 38 fish were not needed for broodstock and returned to the river, (35 males and 3 jacks). An additional 208 fish were gaffed and spawned on the river (21 males, 87 females, and 100 non-viable females). The terminal run size to the river was based on the SONAR estimate of 3,250 Chinook. Excluding jacks, the total number of Chinook that spawned naturally in the Elwha River and its tributaries was 2,626 adults. This number was calculated by subtracting the number of Chinook that were collected for broodstock (including the 100 non-viable) from the SONAR estimate (Table 4-31).

Table 4-31. Chinook broodstock collection, estimated total adult return, and estimated number of natural spawning fish Elwha River in 2020.

Capture method	No. Males	No. Females	Total adults	No. Jacks	Total adults incl jacks
Gaff-Hook and line	21	87	108 ^{/1}	0	108
Seining-Gill netting	72	74	146	0	146
Elwha Hatchery Trap Volunteers	189	44	233	34	267
Lower Elwha Hatchery transfers	45	27	72	5	77
Total broodstock collection	327	232	559	39	598
<u>Minus</u> Elwha Hatchery Trap Volunteers Returned back to the river to spawn naturally	35	0	35	3	38
Total broodstock collection	292	232	524 ^{/1}	36	550
Mortalities in raceways	5	9	14	5	19
SONAR adult estimate			3,250		
Estimated natural spawners in river			2,626		

^{/1} Another 100 fish were gaffed but were determined to be non-viable.

Natural spawners = SONAR estimate of 3,250 minus adult broodstock collection of 624 (524 plus 100 non-viable gaff-hooked) = 2,626 natural escapement.

Data source: Hatchery broodstock collection numbers from Troy Tisdale, WDFW Hatchery Manager.

Sampling Collection

WDFW personnel sampled carcasses using the methods described in Weinheimer et al (2018). Carcasses were sampled in the mainstem river (CS) and from broodstock collected by WDFW hatchery staff using seines and nets (Net) and fish returning to the Lower Elwha Klallam tribal hatchery (LEKT) and WDFW Elwha Rearing Channel (Volunteers). WDFW staff sampled carcasses for fork length (cm), post-orbital hypural length (POH), sex, scales, otoliths, presence of CWT tag, checked for clipped adipose fin, and a DNA fin clip if fish gills showed a coloration of better than 50%. During each sampling day and after all samples were collected (sampled group), personnel would tally the remaining spawned fish for sex, marks, and tags (non-sampled group). No scales, otoliths, or DNA were collected from this group. If a tag was detected in a fish, then the snout was removed, labeled, and bagged. Summaries of the sampled and non-sampled groups were given to the hatchery manager for their records. One-hundred seventy-four

carcasses were sampled in the river and 247 broodstock carcasses were sampled at the WDFW Elwha Hatchery adult raceways for a total of 421 fish sampled. All broodstock and carcass survey results in this report are preliminary until all age, mark, otolith and CWT results are verified. See table Table 4-35.

Evaluating hatchery mark rates

The primary hatchery marking strategy for brood years of Elwha Chinook salmon expected to return in 2020 was a thermal otolith mark. Avoidance of the adipose clip was intended to reduce vulnerability to mark selective fisheries. Most hatchery Chinook salmon are released into the Elwha River as sub-yearlings, but there is also a smaller yearling release group (Table 4-32).

In some years, equipment malfunctions limited the capacity to induce thermal otolith marks. Thermal otolith marks require sequentially altering water temperature during embryonic development in a prescribed protocol over the course of approximately 1-3 weeks, and specialized chillers are required to accomplish this task.

Table 4-32. Releases of hatchery Chinook in the Elwha River Basin, brood years 2014-2019.

Brood Year	Type	Thermal Otolith	Thermal Otolith + CWT	CWT	AD + CWT + Thermal Otolith	Total
2014	Sub-yearling	2,423,097	0	0	249,920	2,673,017
	Yearling	0	158,985	0	0	157,985
2015	Sub-yearling	2,397,694	0	0	248,747	2,646,441
	Yearling	0	176,100	0	0	176,100
2016	Sub-yearling	585,431	0	0	249,206	834,637
	Yearling	0	154,760	0	0	154,760
2017	Sub-yearling	1,259,103	0	0	246,533	1,505,636
	Yearling	0	193,664	0	0	193,664
2018	Sub-yearling	2,967,400	0	0	248,525	3,215,925
	Yearling	0	182,324	0	0	182,324
2019	Sub-yearling	2,423,500	0	0	246,500	2,670,000
	Yearling	0	188,997	0	0	188,997

River Carcass Recoveries

WDFW, LEKT, and ONP biologists and technicians sampled carcasses of fish that spawned naturally in the river. Chinook carcasses were sampled between September 9 and September 24, 2020. Based on redd numbers from previous spawning seasons, the period between September 23 and September 25 provided the best opportunity for the peak redd count and for sampling carcasses.

172 Chinook carcasses were sampled in the river (80 females, 90 males, and two sex not determined). Female age classes consisted of 1.3% age 2, 10.3% age 3, 44.9% age 4, and 43.6% age 5. Male age classes consisted of 2.4% age 2, 50.6% age 3, 38.8% age 4, and 8.1% age 5. Overall, 1.8% were age 2; 31.3% age 3; 41.7% age 4; and 25.2% age 5. The male to female ratio in the sample was 1.123 to 1.000

Of the 172 fish sampled, 21 (12.2%) were adipose clipped with a tag, 6 (3.5%) were adipose clipped and not tagged, 1 (0.6%) was unidentified mark and tagged, 7 (4.1%) were unmarked and tagged, 136 (79.1%) were unmarked and tagged, 1 (0.60%) were unmarked with unknown tag presence. (Table 4-33).

Table 4-33. Ages, marks, and tags observed in 80 female and 91 male Chinook carcasses sampled in the Elwha River during 2020.

2020 Elwha Chinook River Carcass (Natural Spawners) Samples

Female + Unk	ADB	ADNB	UDB	UMB	UMNB	UMUNK	Grand Total	Age Prop.
Age 2	0	0	0	0	1	0	1	0.013
Sex Unknown Age 3	0	0	0	0	0	1	1	omit
Age 3	2	0	0	0	6	0	8	0.103
Age 4	6	1	0	1	27	0	35	0.449
Age 5	5	0	0	0	29	0	34	0.436
Age UNK	0	0	0	0	2	0	2	omit
Female Totals	13	1	0	1	65	1	81	1.000
Male + Unk	ADB	ADNB	UDB	UMB	UMNB	UMUNK	Grand Total	Age Prop.
Age 2	0	1	0	0	1	0	2	0.024
Age 3	4	2	1	4	32	0	43	0.506
Age 4	4	2	0	0	27	0	33	0.388
Age 5	0	0	0	1	6	0	7	0.081
Sex Unknown Age 5	0	0	0	0	1	0	1	omit
Age UNK	0	0	0	1	4	0	5	omit
Male Totals	8	5	1	6	71	0	91	0.999
Female + Male + Unk	ADB	ADNB	UDB	UMB	UMNB	UMUNK	Grand Total	Age Prop.
Age 2	0	1	0	0	2	0	3	0.018
Sex Unknown Age 3	0	0	0	0	0	1	1	omit
Age 3	6	2	1	4	38	0	51	0.313
Age 4	10	3	0	1	54	0	68	0.417
Age 5	5	0	0	1	35	0	41	0.252
Sex Unknown Age 5	0	0	0	0	1	0	1	omit
Age UNK	0	0	0	1	6	0	7	omit
F+M Totals	21	6	1	7	136	1	172	1.000
Mark-Tag Prop.	0.122	0.035	0.006	0.041	0.791	0.006	1.000	

1\ Two fish with sex unknown counts were omitted in female and male age proportion calculations.

Broodstock Collection:

Biologists and technicians sampled broodstock (BS) carcasses on four different spawning days. The following dates, September 9, 16, 23, and 30, provided an excellent opportunity to collect scale, otolith, DNA, and to check for marked and tagged fish during the prime spawning period (Table 4-34).

Table 4-34. 2020 Elwha Chinook broodstock carcass sampling dates.

2020 Elwha Chinook Broodstock				
Date	Female	Male	Total	Method
9/9/2020	2	0	2	LEKT
9/9/2020	25	20	45	NET
9/9/2020	6	11	17	Vol.
Total	33	31	64	
Date	Female	Male	Total	Method
9/16/2020	11	14	25	LEKT
9/16/2020	22	12	34	NET
9/16/2020	6	22	28	Vol.
Total	39	48	87	87
Date	Female	Male	Total	Method
9/23/2020	13	12	25	LEKT
9/23/2020	12	14	26	NET
9/23/2020	4	12	16	Vol.
Total	29	38	67	67
Date	Female	Male	Total	Method
9/30/2020	0	7	7	LEKT
9/30/2020	2	15	17	NET
9/30/2020	2	3	5	Vol.
Total	4	25	29	29
Date	Female	Male	Total	Method
Season Totals	26	33	59	LEKT
Season Totals	61	61	122	NET
Season Totals	18	48	66	Vol.
Total	105	142	247	

Of the 247 broodstock carcasses sampled, 105 were females and 142 were males. Female age classes consisted of 4.8% age 3, 49.0% age 4, and 46.2% age 5. Male age classes consisted of 0.50% age 2, 62.9% age 3, 27.9% age 4, 4.3% age 5 and 2 unmarked fish were unknown ages. For mark and tag results, 52 (21.1%) were adipose clipped with a CWT, 4 (1.6%) were adipose clipped and not tagged, 8 (3.2%) were unmarked with a CWT, 183 (74.1%) were unmarked with no CWT (Table 4-35).

Table 4-35. Ages, marks, and tags observed in Chinook 105 male and 142 female Chinook Broodstock carcasses sampled at the WDFW Elwha Rearing Channel in 2020.

2020 Elwha River Chinook Net, Volunteer, and LEKT Broodstock Samples

Female		ADB	ADNB	UDB	UMB	UMNB	UMUNK	Grand Total	Age Prop.
Age 2		0	0	0	0	0	0	0	0.000
Age 3		2	0	0	0	3	0	5	0.048
Age 4		14	0	0	0	37	0	51	0.490
Age 5		1	1	0	2	44	0	48	0.462
Age UNK		0	0	0	0	1	0	1	omit
Female Totals		17	1	0	2	85	0	105	1.000
Male		ADB	ADNB	UDB	UMB	UMNB	UMUNK	Grand Total	Age Prop.
Age 2		2	0	0	0	5	0	7	0.050
Age 3		18	3	0	5	62	0	88	0.629
Age 4		15	0	0	1	23	0	39	0.279
Age 5		0	0	0	0	6	0	6	0.043
Age UNK		0	0	0	0	2	0	2	omit
Male Totals		35	3	0	6	98	0	142	1.000
Female + Male		ADB	ADNB	UDB	UMB	UMNB	UMUNK	Grand Total	Age Prop.
Age 2		2	0	0	0	5	0	7	0.029
Age 3		20	3	0	5	65	0	93	0.381
Age 4		29	0	0	1	60	0	90	0.369
Age 5		1	1	0	2	50	0	54	0.221
Age UNK		0	0	0	0	3	0	3	omit
F+M Totals		52	4	0	8	183	0	247	1.000
Mark-Tag Prop.		0.211	0.016	0.000	0.032	0.741	0.000	1.000	

1/ UMNB = Unmarked + No Beep (No CWT detected); ADB = adipose clipped + Beep (CWT detected); ADNB = adipose clipped + No Beep (no CWT detected); UMB = Unmarked + Beep (CWT detected); UDB= Undetermined Mark+ Beep (CWT detected).

Hatchery Origin Returns (HOR) and Natural Origin Returns (NOR) were determined by otolith marks, adipose clipped fins, tags, and scales. For the 2020 season, 174 river carcasses (CS), 59 strays to Lower Elwha Klallam Tribe (LEKT) Hatchery and 122 Chinook netted (NET) from the Elwha River were transferred to WDFW Elwha River Channel, and 66 Chinook returned to the WDFW Elwha River Channel (Volunteers). The number and percentage of females, males, and undetermined sex sampled from all collection methods were females 187 (44.4%), males 232 (55.1%), and undetermined 2 (0.50%). Fish identified as Unknown origin were omitted for calculating HOR and NOR percentages. For all samples combined (421), HOR and NOR percentages were 93.3% and 6.7%, respectively. Chinook collected for broodstock were 99.4% HOR and 0.6% NOR. Carcasses from naturally spawning Chinook in the river consisted of 84.9% HOR and 15.1% NOR. The percentages for the broodstock and river carcasses would change slightly if the Unknown origin fish could be positively identified (Table 4-36).

Table 4-36. Estimated number and proportion of Hatchery-Origin Return (HOR), Unknown Origin, and Natural-Origin Return Chinook sampled in the Elwha River watershed in 2020.

2020 Elwha Chinook Samples by Method and Origin	Female	Male	Undetermined	Grand Total	Prop. of Total	
Carcass Survey (Natural Spawners)	82	90	2	174	0.4133	H:W Prop.
Hatchery-Origin	66	74	1	141	0.3349	0.849
Unknown Origin	5	3	0	8	0.0190	omit
Natural-Origin	11	13	1	25	0.0594	0.151
LEKT-Broodstock	26	33	0	59	0.1401	H:W Prop.
Hatchery-Origin	25	31	0	56	0.1330	1.000
Unknown Origin	1	2	0	3	0.0071	omit
Natural-Origin	0	0	0	0	0.0000	0.000
Net-Broodstock	61	61	0	122	0.2898	H:W Prop.
Hatchery-Origin	57	58	0	115	0.2732	0.983
Unknown Origin	4	1	0	5	0.0119	omit
Natural-Origin	0	2	0	2	0.0048	0.017
Volunteer-Broodstock	18	48	0	66	0.1568	H:W Prop.
Hatchery-Origin	17	46	0	63	0.1496	1.000
Unknown Origin	1	2	0	3	0.0071	omit
Natural-Origin	0	0	0	0	0.0000	0.000
Carcass Survey and Broodstock Collections	Female	Male	Undetermined	Grand Total	Prop.	H:W Prop.
Hatchery-Origin	165	209	1	375	0.8907	0.933
Unknown Origin	11	8	0	19	0.0451	omit
Natural-Origin	11	15	1	27	0.0641	0.067
Grand Total	187	232	2	421	1.0000	1.000
Proportion Females:Males:Undetermined Sex	0.444	0.551	0.005	1.000		

1/ One Sockeye male sampled in river is not included in table.

2/ Origin derived from scale, marks, tag returns, and otolith marks.

CWT Data

The number of decoded tags recovered from river carcass surveys (CS) and from the Elwha Hatchery (HAT) were 11 and 59, respectively for a total of 70 tags recovered. Of the 70 tags, 34 Elwha tags and 3 Dungeness tags were from BY 2017, 25 Elwha tags were from BY 2016, 5 Elwha tags and 1 Dungeness tag were from BY 2015, and 2 Elwha tags were from BY 2018 (66 Elwha and 4 Dungeness tags recovered). Five of the 66 (7.58%) Elwha tags recovered were from yearling releases and 64 of the 66 Elwha fish were adipose (ADP) clipped. Four Chinook strayed from the Dungeness River releases and were Unmarked (3 sub-yearlings and 1 yearling; Table 4-37).

Table 4-37. Number of decoded tags recovered in 2020 from sampling carcasses in the Elwha River (CS) and the Elwha Hatchery (HAT), mark status, release locations and origin, number released, and brood year.

Carcass Survey (CS), Hatchery (HAT)	Decoded Tag No.	Number of tags recovered	Mark Status (ADP or Unmarked)	Release Location and Origin	Age at Release Sub-yearling or Yearlings	WRIA No.	Release No.	Brood year
CS	211228	1	Unmarked	Dungeness	Sub-yearling	18.0018	51,796	2017
CS	211257	1	Unmarked	Dungeness	Sub-yearling	18.0018	49,107	2017
CS	636963	2	ADP	Elwha R.	Sub-yearling	18.0272	248,748	2015
CS	637163	3	ADP	Elwha R.	Sub-yearling	18.0272	201,434	2016
CS	636956	1	ADP	Elwha R.	Yearling	18.0272	176,100	2015
CS	637377	3	ADP	Elwha R.	Sub-yearling	18.0272	246,534	2017
HAT	211111	1	Unmarked	Dungeness	Yearling	18.0018	46,785	2015
HAT	637120	7	ADP	Elwha R.	Sub-yearling	18.0272	47,774	2017
HAT	637243	2	Unmarked	Elwha R.	Yearling	18.0272	193,663	2017
HAT	211257	1	Unmarked	Dungeness	Sub-yearling	18.0018	49,107	2017
HAT	637377	22	ADP	Elwha R.	Sub-yearling	18.0272	246,534	2017
HAT	636956	2	ADP	Elwha R.	Yearling	18.0272	176,100	2015
HAT	637163	22	ADP	Elwha R.	Sub-yearling	18.0272	201,434	2016
HAT	637526	2	ADP	Elwha R.	Sub-yearling	18.0272	248,527	2018

DNA Collection

DNA fin clips were collected from broodstock and in-river carcasses. These samples are stored for future analysis at the WDFW Molecular Genetics Laboratory.

4.14 Hoko

WDFW and Makah Fisheries Management staff conducted foot surveys to count live and dead Chinook and Chinook redds in the mainstem Hoko River between river miles 3.4 and 21.7 and in tributaries which represent all Chinook spawning area in the Hoko basin. There are ten mainstem and 13 tributary reaches which include the Little Hoko River, a tributary to the lower mainstem, and Browne's, Herman, North Fork Herman, Ellis, Bear, and Cub Creeks, which are tributaries to the upper mainstem. WDFW conducted surveys from RM 3.4 to 10.1 during the 2020 return year and observed 274 redds (Table 4-38 and Table 4-39) and Makah Fisheries Management (MFM) counted 55 redds (Table 4-40).

Table 4-38. Chinook redd surveys in mainstem Hoko River from RM 3.4 - RM 10. by WDFW 2020.

Stream Name	Survey Date	End River Mile	Start River Mile	Total Live	Total Dead	New Redds
Hoko R (19.0148)	2020-09-30	RM 9.80	RM 10.10	1	0	16
Hoko R (19.0148)	2020-09-30	RM 7.50	RM 8.70	0	0	4
Hoko R (19.0148)	2020-09-30	RM 5.60	RM 7.50	0	0	2
Hoko R (19.0148)	2020-09-30	RM 4.40	RM 5.60	4	0	2
Hoko R (19.0148)	2020-09-30	RM 3.40	RM 4.40	6	0	0
Weekly Redd Total						24
Hoko R (19.0148)	2020-10-06	RM 9.80	RM 10.10	18	0	27
Hoko R (19.0148)	2020-10-06	RM 7.50	RM 8.70	15	0	6
Hoko R (19.0148)	2020-10-06	RM 5.60	RM 7.50	0	0	6
Hoko R (19.0148)	2020-10-07	RM 4.40	RM 5.60	0	0	1
Hoko R (19.0148)	2020-10-07	RM 3.40	RM 4.40	15	0	1
Weekly Redd Total						41
Hoko R (19.0148)	2020-10-27	RM 9.80	RM 10.10	43	0	76
Hoko R (19.0148)	2020-10-27	RM 7.50	RM 8.70	10	19	62
Hoko R (19.0148)	2020-10-27	RM 5.60	RM 7.50	14	7	52
Hoko R (19.0148)	2020-10-27	RM 4.40	RM 5.60	1	3	9
Hoko R (19.0148)	2020-10-27	RM 3.40	RM 4.40	0	0	7
Hoko R (19.0148)	2020-10-27	RM 2.80	RM 3.40	0	0	3
Weekly Redd Total						209
Redd Grand Total from RM 3.4 - RM10.1						274

Table 4-39. Chinook redd surveys in the upper mainstem Hoko River from (RM 20.4-Rm 22.5) and in Bear Creek (RM0.0-RM1.7) and Cub Creek (RM0.0-RM1.1) by WDFW 2020.

Stream Name	Survey Date	End River Mile	Start River Mile	Total Live	Total Dead	New Redds
Bear Cr (19.0196)	2020-11-09	RM 0.00: Mouth	RM 0.70: Bridge	0	0	0
Bear Cr (19.0196)	2020-11-24	RM 0.00: Mouth	RM 0.70: Bridge	0	0	0
Bear Cr (19.0196)	2020-12-04	RM 0.00: Mouth	RM 0.70: Bridge	0	0	0
Bear Cr (19.0196)	2020-12-14	RM 0.00: Mouth	RM 0.70: Bridge	0	0	0
Bear Cr (19.0196)	2020-12-29	RM 0.00: Mouth	RM 0.70: Bridge	0	0	0
Bear Cr (19.0196)	2020-11-09	RM 0.70: Bridge	RM 1.30: Marker	0	0	0
Bear Cr (19.0196)	2020-11-24	RM 0.70: Bridge	RM 1.30: Marker	0	0	0
Bear Cr (19.0196)	2020-12-04	RM 0.70: Bridge	RM 1.30: Marker	0	0	0
Bear Cr (19.0196)	2020-12-14	RM 0.70: Bridge	RM 1.30: Marker	0	0	0
Bear Cr (19.0196)	2020-12-29	RM 0.70: Bridge	RM 1.30: Marker	0	0	0
Bear Cr (19.0196)	2020-11-09	RM 1.30: Marker	RM 1.70: Falls	0	0	0
Bear Cr (19.0196)	2020-11-24	RM 1.30: Marker	RM 1.70: Falls	0	0	0
Bear Cr (19.0196)	2020-12-04	RM 1.30: Marker	RM 1.70: Falls	0	0	0
Bear Cr (19.0196)	2020-12-14	RM 1.30: Marker	RM 1.70: Falls	0	0	0
Bear Cr (19.0196)	2020-12-29	RM 1.30: Marker	RM 1.70: Falls	0	0	0
Cub Cr (19.0197)	2020-11-09	RM 0.00: Mouth	RM 0.40: Bridge	0	0	0
Cub Cr (19.0197)	2020-11-24	RM 0.00: Mouth	RM 0.40: Bridge	0	0	0
Cub Cr (19.0197)	2020-12-04	RM 0.00: Mouth	RM 0.40: Bridge	0	0	0
Cub Cr (19.0197)	2020-12-14	RM 0.00: Mouth	RM 0.40: Bridge	0	0	0
Cub Cr (19.0197)	2020-12-29	RM 0.00: Mouth	RM 0.40: Bridge	0	0	0
Cub Cr (19.0197)	2020-11-09	RM 0.40: Bridge	RM 0.80: Marker	0	0	0
Cub Cr (19.0197)	2020-11-24	RM 0.40: Bridge	RM 0.80: Marker	0	0	0
Cub Cr (19.0197)	2020-12-04	RM 0.40: Bridge	RM 0.80: Marker	0	0	0
Cub Cr (19.0197)	2020-12-14	RM 0.40: Bridge	RM 0.80: Marker	0	0	0
Cub Cr (19.0197)	2020-12-29	RM 0.40: Bridge	RM 0.80: Marker	0	0	0
Cub Cr (19.0197)	2020-11-09	RM 0.80: Marker	RM 1.10: Log Jam	0	0	0
Cub Cr (19.0197)	2020-11-24	RM 0.80: Marker	RM 1.10: Log Jam	0	0	0
Cub Cr (19.0197)	2020-12-04	RM 0.80: Marker	RM 1.10: Log Jam	0	0	0
Cub Cr (19.0197)	2020-12-14	RM 0.80: Marker	RM 1.10: Log Jam	0	0	0
Cub Cr (19.0197)	2020-12-29	RM 0.80: Marker	RM 1.10: Log Jam	0	0	0
Hoko R (19.0148)	2020-11-09	RM 20.40	RM 20.80	0	0	0
Hoko R (19.0148)	2020-11-24	RM 20.40	RM 20.80	0	0	0
Hoko R (19.0148)	2020-12-04	RM 20.40	RM 20.80	0	0	0
Hoko R (19.0148)	2020-12-14	RM 20.40	RM 20.80	0	0	0
Hoko R (19.0148)	2020-12-29	RM 20.40	RM 20.80	0	0	0

Table 4-40. Summary of Hoko River Chinook surveys by Makah Fisheries Management staffin 2020.

River	Date	Upper RM	Lower RM	Live	Dead	Redd
Bear Cr	10/9/2020	0.66	0.00	0	0	0
Bear Cr	10/29/2020	0.66	0.00	3	1	1
Brown's Cr	9/28/2020	0.59	0.00	2	0	0
Brown's Cr	10/8/2020	0.59	0.00	0	0	0
Brown's Cr	10/8/2020	0.97	0.59	0	0	0
Brown's Cr	10/14/2020	0.59	0.00	200	5	4
Brown's Cr	10/14/2020	0.97	0.59	27	1	0
Brown's Cr	10/22/2020	1.30	0.97	0	0	0
Brown's Cr	10/22/2020	0.97	0.59	13	0	9
Brown's Cr	10/22/2020	0.59	0.00	232	4	157
Cub Cr	10/9/2020	0.37	0.00	0	0	0
Cub Cr	10/29/2020	0.37	0.00	0	4	0
Ellis Cr	10/6/2020	0.45	0.00	0	0	0
Ellis Cr	10/21/2020	0.45	0.00	0	0	0
Herman's Cr (Main)	10/5/2020	2.00	0.00	2	0	0
Herman's Cr (Main)	10/27/2020	2.00	0.00	5	1	2
Herman's Cr (NF)	10/5/2020	0.37	0.00	0	0	0
Herman's Cr (NF)	10/27/2020	0.37	0.00	0	0	0
Hoko River	9/29/2020	11.00	10.00	1	1	0
Hoko River	10/5/2020	15.50	13.00	3	5	0
Hoko River	10/7/2020	18.30	15.50	23	5	0
Hoko River	10/7/2020	20.40	18.30	0	2	0
Hoko River	10/26/2020	15.50	13.00	2	0	1
Hoko River	10/26/2020	18.30	15.50	10	3	7
Hoko River	10/29/2020	20.40	18.30	0	5	1
Hoko River	10/29/2020	21.70	20.40	0	2	0
Little Hoko R	9/30/2020	2.00	0.00	0	0	0
Little Hoko R	10/8/2020	2.00	0.00	0	0	0
	10/15/202					
Little Hoko R	0	2.00	0.00	3	0	0
	10/27/202					
Little Hoko R	0	2.00	0.00	0	2	0
Rights Creek	10/28/2020	0.30	0.00	0	2	0

Hoko Broodstock Collection

For the 2020 Hoko Chinook broodstock season, 368 females, 459 males, and 17 jacks returned to the Hoko Falls Hatchery pond facility. Of the 844 total fish that returned to the pond, 120 females, 133 males and 12 jacks were lethally spawned. Fifteen fish died in the pond prior to spawning and three additional females were lethally spawned but their eggs were non-viable. The remaining 255 females, 333 males, and 9 jacks were released back to the river to spawn naturally (Table 4-41).

Table 4-41. Number of female, male, and jack Chinook that returned to the Hoko Falls Hatchery in 2020 that were spawned, released back to the river to spawn naturally, culled, surplused, or died before spawning.

Sex	Rack count	Pond Mortality	Surplused	Lethal spawned (Viable)	Non-Viable Spawned	Returned to stream
Female	368	7	0	120	3	255
Male	459	8	0	133	N/A	333
Total adults	827	15	0	253	3	588
Jack	17	0	0	12	N/A	9
Total fish	844	15	0	268	3	591

Source: Joe Hinton, Hoko Falls Hatchery Manager-Makah Tribe.

The 2020 adult escapement estimate for Hoko Chinook is 1,242 spawning in the river (natural origin and hatchery origin combined) and 283 returning to and remaining at the hatchery, plus an additional 597 released back into the river for a total adult terminal runs size (TRS) of 2,122. The following methods were used to calculate the final TRS:

- 1) Hoko Falls Hatchery return retained for broodstock purposes (includes jacks, pond mortalities and non-viable females) 283 (130 females, 141 males and 12 jacks).
- 2) Number of adult Chinook broodstock spawned at hatchery: 120 females and 133 males spawned = 253 adults. Three females were lethally spawned, but their eggs were non-viable, while 15 adults died before spawning. An additional 12 jacks were spawned bringing the total broodstock count to 283.
- 3) Two hundred fifty-five females, 333 males at the hatchery were released back to the river. The majority of fish (559) were released on October 15th and the remaining 32 were released in early November. The 559 fish chinook released on October 15th were all floy tagged prior to release, however the 32 released in November were not marked.
- 4) During the 2020 spawning season, WDFW staff counted 274 redds (274 redds x 2.5 adults per redd = 685 fish). The 2.5 adults per redd is equal to one female and 1.5 males per redd.
- 5) During the 2020 spawning season, the MFM staff utilized a combination of live counts and redd estimations. This totaled 557 fish for the season.
- 6) The Terminal Run Size (TRS) is estimated at 2,122 adults when the 283 adult broodstock spawned at the hatchery (includes 15 pond mortalities and 3 non-viable females) are added to the natural escapement of 1,242.

The estimated age and number of hatchery origin (HOR) and natural origin (NOR) Chinook which returned to the Makah Hoko Falls Hatchery and the Hoko River equals 1,689 HOR adults and 433 NOR adults (Table 4-42). The age composition of HOR total spawners consisted of 16 age-2 (0.9%), 412 age-3 (24.3%), 1,067 age-4 (63.2%), and 194 age-5 (11.4%). The age

composition of NOR total spawners consisted of 3 age 2 (0.6%), 85 age 3 (19.6%), 327 age 4 (75.5%), and 17 age 5 (3.9%). The proportion of HOR spawners by age group were: age 2 (0.82), age 3 (0.83), age 4 (0.77) and age 5 (0.92).

Table 4-42. Age and origin of broodstock and natural Chinook spawners in the Hoko River in 2020.

Hatchery Broodstock				In-River Spawners				Total Spawners				
by Origin				by Origin				by Origin				
Age	HOR	NOR	Totals	Age	HOR	NOR	Totals	Age	HOR	NOR	Dbl-chk	HOR Proportion
2	10	3	13	2	6	0	6	2	16	3	19	0.82
3	44	15	59	3	368	71	438	3	412	85	497	0.83
4	155	36	191	4	912	290	1,202	4	1,067	327	1,393	0.77
5	17	3	20	5	177	14	192	5	194	17	212	0.92
6	0	0	0	6	0	0	0	6	0	0	0	0
7				7				7	0	0	0	0
Totals	226	57	283	Totals	1,463	376	1,839	Totals	1,689	433	2,122	0.80

Data Source: Aged scale cards collected by Makah Fisheries Management and WDFW.

Data source: Hap Leon and Tiffany Petersen, Makah Fisheries Management.

5 Coded-wire Tag Sampling

Commercial and recreational catch is sampled to recover coded-wire tagged Chinook and Coho. General objectives are to sample 20% of commercial catch in each area and week, and 10% of marine recreational catch in each area and month. Sampling rates for calendar year (January-December) 2018 are summarized below, and were based on catches reported by local biologists, and sample sizes queried from the RMIS database. Sampling rates of commercial fisheries in 2018 generally exceeded the 20% sampling objective although North Hood Canal (9A, 12, 12A, 12B), 12C, 13D-F, and Strait of Juan de Fuca Troll were below 20% (Table 5-1). Marine area recreational fisheries were sampled at rates between 12.4%% and 38.2% for the year (Table 5-2). Note that these data were updated just prior to completion of this report and will be validated and corrected as needed prior to submission to update the RMIS (Regional Mark Information System) database.

Table 5-1. Chinook coded-wire tag sampling rates for commercial fisheries in 2019 (calendar year).

Catch Area/River	Catch	# Sampled	Sample Rate
7-7A	3,659	2,630	72%
7B-7C-7D-Nooksack River	6,935	3,513	51%
Skagit River/Bay	2,505	892	36%
8A	26	16	62%
8D	9,371	1,986	21%
Stillaguamish River	5	0	0%
10	0	0	0%
10E	10,692	4,277	40%
10F	83	0	0%
10G	--	--	--
10A	222	206	93%
Duwamish River	2,867	1,761	61%
Puyallup/White rivers	11,529	5,600	49%
Nisqually River	6,410	3,518	55%
13A	6,848	2,593	38%
13C	--	--	--
13D-F	1,815	284	16%
9	--	--	--
9A-12-12A-12B	27	1	4%
12C	12,990	5,710	44%
12H	25,450	5,618	22%
Skokomish River	9,848	1,912	44%
Purdy Creek	2,600	1,149	19%
Strait of JDF 4B-5-6 (Net)	22	0	0%
Strait of JDF 4B-5-6C (Troll) ^a	364	0	0%

^a Includes 4B Summer Troll catch for 2017.

Table 5-2. Chinook coded-wire tag sampling rates for marine recreational fisheries in 2019.

Catch Area	Catch	# Sampled	Sample Rate
MARINE SPORT AREA 5	8,813	1,824	20.7%
MARINE SPORT AREA 6	5,717	1,832	32.0%
MARINE SPORT AREA 7	7,939	1,503	18.9%
MARINE SPORT PCA 8.1	288	76	26.4%
MARINE SPORT PCA 8.2	1,556	594	38.2%
MARINE SPORT AREA 9	8,515	2,202	25.9%
MARINE SPORT AREA 10	4,864	1,587	32.6%
MARINE SPORT AREA 11	3,908	1,151	29.5%
MARINE SPORT AREA 13	2,066	357	17.3%
MARINE SPORT AREA 12	1,833	227	12.4%

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7 9-Year (2011-2019) Spawning Escapements

Nooksack Early Management Unit.

Early timed Chinook spawning escapements for 2011 through 2019 return years within the North Fork and Middle Fork Basins. South Fork early NOR and HOR spawning escapement in the North/Middle Fork basins are additional to those within the South Fork basin.

Year	North./Middle Fork					
	NF NORs	Kendall HORs	SF NORs	SF HORs	Fall NORs	Fall HORs
2011	99	766	N/A	N/A	N/A	N/A
2012	281	477	N/A	N/A	N/A	N/A
2013	100	1,247	N/A	N/A	N/A	N/A
2014	91	1,307	N/A	N/A	N/A	N/A
2015	401	1,316	N/A	N/A	N/A	N/A
2016	187	735	15	7	5	15
2017	88	1,811	41	39	6	23
2018	53	1,622	39	24	0	6

Early timed Chinook spawning escapements for 2011 through 2019 return years in the South Fork basin. North Fork early NOR and Kendall Creek HOR spawning escapement in the South Fork basin are in addition to those spawning within the North/Middle Fork basins.

Year	South Fork					
	SF Native NOR	SF HOR	N. Fk Early NOR	Kendall Cr. HOR	Fall NOR	Fall/other HOR
2011	90 (3)	0	61 (1)	176 (0)	96 (1)	48 (8)
2012	116 (1)	0	172 (1)	79 (17)	93 (2)	42 (0)
2013	10 (1)	0	39 (0)	162 (39)	16 (2)	15 (2)
2014	22 (1)	10 (0)	56 (1)	99 (2)	11 (0)	10 (0)
2015	7 (0)	11 (0)	39 (0)	9 (0)	32 (0)	37 (0)
2016	319 (4)	302 (7)	179 (3)	32 (5)	86 (1)	39 (0)
2017	145 (4)	697 (55)	43 (4)	62 (8)	100 (4)	65 (4)
2018	369 (5)	896 (8)	49 (0)	65 (2)	50 (1)	97 (1)

Note: Numbers in parentheses represent additional pre-spawn mortalities encountered.

Skagit Springs Management Unit.

Year	Upper Sauk	Suiattle	Upper Cascade
2010	768	263	330
2012	1,826	460	488
2013	1,080	620	310
2014	923	460	225
2015	743	478	188
2016	1,502	648	295
2017	1,630	898	323
2018	1,603	645	128
2019	551	400	180

Skagit Summer/Falls Management Unit.

Year	Upper Skagit	Lower Sauk	Lower Skagit
2011	4,480	210	820
2012	9,808	715	3,295
2013	8,801	530	1,551
2014	8,308	364	1,785
2015	10,705	406	2,203
2016	15,423	1,044	2,921
2017	7,792	1,001	3,638
2018	8,602	378	1,923
2019	10,155	319	1,336

Stillaguamish Management Unit. Stillaguamish River escapement estimates for both summer and fall Chinook populations proportioned by HOR/NOR adult returns. Numbers in parentheses represent additional fish (both HOR and NOR) collected for brood-stock (BS) utilization.

Year	MU Total	
	NOR (BS)	HOR (BS)
2011	560(45)	1,077 (128)
2012	934(109)	853(70)
2013	620 (73)	377 (59)
2014	140 (57)	279 (87)
2015	482 (61)	227(68)
2016	702 (76)	351 (65)
2017	548 (76)	522 (65)
2018	199 (44)	767 (102)
2019	196 (28)	748 (103)

Snohomish Management Unit.

Year	Skykomish		Snoqualmie	
	NOR	HOR	NOR	HOR
2011	876	305	477	225
2012	2,462	1,283	891	488
2013	1,860	495	770	119
2014	1,654	1,409	698	140
2015	1,585	1,449	694	135
2016	2,363	1,422	1,013	355
2017	2,790	1,584	1,409	336
2018	2,259	789	823	339
2019	569	397	443	233

Lake Washington Management Unit.

Year	Cedar River		Sammamish River	
	NOR	HOR	NOR	HOR
2011	648	162	25	708
2012	899	184	60	1,974
2013	1,590	260	96	2,237
2014	303	277	20	462
2015	1,177	631	52	936
2016	609	436	102	1,145
2017	1,557	491	153	1,371
2018	671	142	84	575
2019	599	256	101	264

Green River Management Unit.

Year	NOR	HOR
2011	459	534
2012	1,638	1,452
2013	524	1,517
2014	756	1,974
2015	864	3,223
2016	2,566	7,497
2017	2,031	6,326
2018	2,177	4,714
2019	1,360	1,616

Puyallup River Fall Management Unit.

Year	NOR	HOR
2011	447	818
2012	642	395
2013	203	406
2014	468	793
2015	831	729
2016	713	1,822
2017	637	849
2018	486	1,833
2019	291	1,397

White River Spring Management Unit.

Year	NOR	HOR	APP
2011	455	368	983
2012	825	204	1,120
2013	803	873	2,734
2014	221	105	637
2015	360	472	736
2016	657	501	2,851
2017	686	2,953	2,749
2018	326	1,520	1,837
2019	344	588	2,013

Nisqually River Management Unit. HOR's on the spawning grounds include trucked fish in 2017, 2018, and 2019.

Year	NOR	HOR
2011	302	1,962
2012	617	1,850
2013	738	933
2014	528	512
2015	715	790
2016	796	168
2017	1,445	2,039
2018	435	1,850
2019	343	1,957

Skokomish River Management Unit.

Year	NOR	HOR	Total
2011	54	1,267	1,321
2012	142	1,391	1,533
2013	171	1,551	1,722
2014	109	740	849
2015	117	315	432
2016	179	1,163	1,342
2017			8,058
2018	103	2,356	2,459
2019	260	2,005	2,265

Mid-Hood Canal Management Unit.

Year	Hamma Hamma	Duckabush	Dosewallips
2011	294	5	11
2012	425	6	7
2013	707	7	4
2014	117	13	11
2015	236	20	3
2016	268	15	8
2017	365	2	7
2018	58	4	1
2019	18	3	0

Dungeness River Management Unit.

Return year	Natural Spawners ^{1/}			Broodstock Collection ^{2/}			Total Returns (Natural Spawners + Broodstock)		
	NOR	HOR	Total	NOR	HOR	Total	NOR	HOR	Total
2011	83	452	535	21	109	130	104	561	665
2012	212	296	508	38	68	106	250	364	614
2013	46	122	168	31	79	110	77	201	278
2014	21	87	108	22	74	96	43	161	204
2015	65	200	265	37	105	142	102	305	407
2016	135	273	408	30	77	115	165	350	515
2017	149	456	605	26	74	100	175	530	705
2018	127	661	788	20	97	117	147	758	905
2019	173	665	838	19	73	92	192	738	930

1/ Natural spawners: Chinook that spawned naturally in the river. Natural spawner estimate based on redd surveys.

2/ Broodstock collection: Chinook that were collected in the river or returned to the hatchery and used for broodstock. Includes pre-spawned mortalities as well.

3/ NORs and HORs determined by CWT, otolith, scales, or visible marks from broodstock and river carcasses sampled.

Elwha River Management Unit.

Year	HOR/NOR
2011	1,862
2012	2,638
2013	4,243
2014	4,360
2015	4,112
2016	2,628
2017	3,100
2018	7,107
2019	7,500

Hoko River Management Unit.

Year	HOR/NOR
2011	1,504
2012	663
2013	1,406
2014	1,760
2015	2,877
2016	1,324
2017	1,225
2018	1,943
2019	1,815