Washington Department of Fish and Wildlife
Puget Sound Treaty Indian Tribes

Puget Sound Chinook Comprehensive Harvest Management Plan

Annual Report
The 2019-2020 Fishing Season

October 2020

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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, 2019 and April 30, 2020, and Chinook spawning escapement in 2019. It also includes harvest information relevant to the 2018-2019 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) 2018.

Commercial Chinook catch in Puget Sound pre-terminal fisheries was substantially lower than projected pre-season. Commercial catches in some terminal areas were above expectations, primarily in fisheries targeting higher than anticipated 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 2018-2019 season was estimated at 56,758 and was 36% higher than the pre-season projection of 41,763. Creel survey-based estimates of catch in 2018-2019 mark-selective recreational fisheries in Areas 5, 7, 9, 10, and 11 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 greater than projected.

Coded-wire tag sampling rates for calendar year 2018 commercial fisheries exceeded 20% in most areas except for MCA 10, Hood Canal terminal areas, and Strait of JDF 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 2019 Harvest Biological Opinion (F/WCR-2019-00381) by assessing the performance and effectiveness of treaty and non-treaty commercial fishery management actions adopted for the most recent management year, May 2019 through April 2020. Included in this report are:

- Management objectives for the 2019-2020 management year (May 1, 2019 through April 30, 2020)
- Projected and actual commercial landed catch in Puget Sound and descriptions of fisheries for the 2019-2020 management year
- Projected and actual landed catch for 2019 Puget Sound recreational fisheries where Chinook retention was allowed and creel surveys were conducted as well as for 2018 Puget Sound recreational sport fisheries where Chinook retention was allowed.
- Estimates of total encounters for 2019 summer mark-selective fisheries and non-landed mortality for commercial fisheries with Chinook non-retention where data are available.
- Projected and actual 2019 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 2017 and 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 2018 (January to December, 2018).

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 2019 (Table 1-1). The final pre-season FRAM model run (Chin2719) highlighted the rates that were used as the ceilings for each Management Unit (MU) in 2019, and the projected exploitation rates and escapements for each unit (Table 1-2).

Pre-season fishery planning for 2019-2020 fisheries projected that natural spawning escapement would fall below the Low Abundance Thresholds (LAT) for the Nooksack early, 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. 2019 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%	17% 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	24% Total/13% SUS Max.	8% SUS Max.	1,200 [a]
Snohomish	21%	15% SUS	3,375
Skykomish			2,092
Snoqualmie			1,066
Lake Washington		12% SUS	200
Cedar River	500 Escapement (13% PT SUS)		
Green	2,003 Escapement (13% PTSUS)	12% SUS	805
White River spring	22% SUS	15% SUS	400
Puyallup fall	1,170 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% 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 2019 – 2020 pre-season planning (FRAM Chin2719).

Management Unit	ERC or CERC implemented	Projected ER	Projected Escapement
Nooksack	10.5% SUS	10.5% SUS	242
Skagit summer fall	48%	36.7%	12,504
Skagit spring	37.5%	32.1%	1,616
Stillaguamish	24%Tota/8% SUS	18%Total/ 8% SUS	943 [a]
Snohomish	21% Total/15% SUS	15.8% Total/ 6.5% SUS	3,208
L. Washington (Cedar)	500 Escapement / 13% PT SUS	12.9% PT SUS	1,217
Green	2,003 Escapement / 13% PT SUS	12.9% PT SUS	5,842
White	22% SUS	16.7% SUS	1,834
Puyallup	1,170 Escapement / 13% PT SUS	12.9%	2,695
Nisqually	47% + 2% Exp. Fishery	48.7%	11,467
Skokomish	50%	48.2%	2,667
Mid Hood Canal	12% PT SUS	11.8% PT SUS	286
Dungeness	10% SUS	1.2% SUS	945
Elwha	10% SUS	1.4% SUS	6,662
Western SJDF	10% SUS	2.4% SUS	2,315

[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 2019–20 List of Agreed Fisheries (https://s3.amazonaws.com/nwifc-fisheriesservices/wp/wp-content/uploads/20190826093741/Signed-LOAF-4-23-19.pdf) describes all 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 Chin2719.

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 2019–20 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 catch in waters of the Washington coast and Puget Sound fisheries in 2019.

Fishery	Projected	Actual
Washington ocean non-treaty troll	26,250	23,334
Washington ocean recreational	28,250	10,878
Washington ocean treaty troll	35,000	18,321
Puget Sound pre-terminal net & troll total		
Strait of Juan de Fuca troll	4,262	675
Strait of Juan de Fuca net	469	38
PSC Test Fishery		0
San Juan Islands net [a]	8,405	4,271
Nooksack-Samish terminal net	13,736	6,934
Skagit terminal net	4,496	2,495
Stillaguamish-Snohomish net	12,086	9,950
South Puget Sound terminal net	39,102	41,791
Hood Canal terminal net	45,929	48,035
Strait Tributaries terminal net	1	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 38 and 3,639 Chinook, respectively. Catch in the Strait of Juan de Fuca and San Juan Islands areas occurred mostly during the Fraser pink directed fishery in the summer, primarily in late August 2019.

Non-treaty fisheries targeting Fraser pink in Areas 7 and 7A landed no Chinook. Because purse seines are required to release all Chinook, release mortality estimates are calculated using available data from on-water by-catch monitoring. Post-season analysis estimated 632 Chinook mortalities in the pink fishery.

The PSC Fraser sockeye Test Fishery in Area 5 caught zero chinook during 2019.

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 675 Chinook. Four hundred thirty-one Chinook were caught during the summer SJD troll fishery while 244 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 on 22 days from April 2 to June 28, 2019. Total landed catch was 288 hatchery-origin Chinook with an additional 26 natural-origin Chinook released. Applying the expected release mortality rate of 30% to the 26 early-run NOR encounters results in eight NOR estimated mortalities. The total encounter rate of NORs (n=26) was lower than the pre-season projection of 40 NORs. Genetic results for the released NORs are not currently available to determine population origin.

In 2019, the Lummi Nation initiated 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 5 and June 28, a total of 52 Chinook were implanted with radio tags and released, including 19 of the 26 NORs encountered in the Tangle Net fishery as well as 33 HORs.

In 2019, the Nooksack Tribe conducted a permit only, subsistence fishery from May 6 through June 10, 2019. A total of 143 Chinook were caught in the traditional C&S fisheries and all were sampled. One hundred thirty-five of the 143 chinook were clipped indicating Kendall hatchery origin. Four were non-clipped but with CWT indicating Skookum program origin and four with no ad-clip and no CWT are apparent NORs. Based on timing of catch of the no-mark/no CWT fish during the second half of May, the four apparent NORs are presumed to likely be North/Middle Fork origin. Otolith and genetic results to confirm origin are still pending laboratory processing and analysis.

The Tribes 2019 total NOR mortality is estimated to be 12 early-run NORs, pending additional analysis of remaining biological samples. The pre-season projection was17 NOR mortalities.

Table 2-2. Expected and observed Chinook catches in the Nooksack/Samish terminal area, 2019.

Area	Management Period	Projected	Actual
7B, 7C, 7D, Treaty net[1]	Chinook, coho, chum	7,492	2,767
7B, 7C Non-treaty net	Chinook, coho, chum	4,088	2,206
Nooksack River Treaty net	Early Chinook, May-Jun	1,295	439
	Fall Chinook, Aug-Oct	861	1,522

[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 1st through September 6th and in Samish Bay (7C) from August 1st through September 14th, with a catch of 2,407 Chinook. The coho fishery operated as planned from September 9th through October 19th, with an incidental harvest of 359 Chinook. During the 7A on-reservation Coho fishery from September 8th through October 2nd, one Chinook was incidentally harvested. No Chinook were harvested incidentally during the chum fishery. The total fall Chinook catch of 2,767 for Areas 7B, 7C and 7D was less than the preseason projection of 7,492 (Table 2-2).

The non-treaty fishery in Area 7B and 7C landed 2,198 Chinook from July through September, lower than the pre-season projection of 4,069. Nineteen Chinook were forecasted to be landed during the chum fishery, with eight landed.

Fisheries for fall Chinook, coho, and chum in the Nooksack River occurred as planned from August 1 – September 7, Sept. 8 – October 19, and October 20 – December 11, respectively. The total Chinook catch was 1,522, more than the projected catch of 861 fish; 919 were caught during the Chinook period and 602 during the coho fishery. One Chinook was harvested during the first week of the chum period.

2.3 Skagit Bay/Skagit River Terminal Areas

Skagit Terminal Area Treaty Fisheries – 2019

Spring Chinook Fisheries: Treaty commercial fisheries in the Skagit terminal area directed at hatchery spring Chinook were conducted in 2019 as scheduled preseason, with some adjustments in timing. Incidental catch of spring Chinook also occurred during week 26 of the directed sockeye fishery, as Skagit River sub-areas 78D-2, 78D-3, 78D-4 were still in the spring management period during some or all of that time. A total of 124 wild and 1,130 hatchery spring Chinook were caught in these fisheries, compared to 293 wild and 1,556 hatchery spring Chinook expected pre-season based on Chinook FRAM 2719. An additional 9 hatchery spring Chinook were harvested for ceremonial purposes, compared to 40 wild and 60 hatchery expected.

Summer/Fall Chinook Fisheries: No treaty commercial fisheries directed at summer/fall Chinook were scheduled in the Skagit terminal area for 2019. 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 755 fish, compared to the pre-season expectation of 1,016 based on Chinook FRAM 2719. An additional 243 summer/fall Chinook were harvested for ceremonial purposes, which was less than the pre-season modeled value of 900.

Terminal Area Test Fisheries: A suite of Skagit terminal a rea test fisheries targeting steelhead, Chinook, sockeye, coho, and chum were conducted by the Skagit tribes in 2019. 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 12 wild spring Chinook, 18 hatchery spring Chinook, and 205 summer/fall Chinook mortalities occurred in these fisheries. The pre-season expectation of mortalities in the test fisheries was 39 wild spring Chinook, 42 hatchery spring Chinook, and 523 summer/fall Chinook.

Summary: Overall, a total of 136 wild spring Chinook, 1,156 hatchery spring Chinook, and 1,203 summer/fall Chinook were killed in treaty commercial, C&S, and test fisheries. The preseason expectation based on FRAM Chin2719 was 372 wild springs, 1,658 hatchery springs, and 2,439 summer/falls.

Table 2-3. Skagit terminal area projected and actual Chinook catches for treaty fisheries in 2019. Weekly projections were made by plugging the FRAM Chin2719 run sizes into the Skagit weekly harvest rate model, so totals may differ slightly from FRAM.

	Preseason Projected			Post-season Observed/Estimated			Difference	
Fishery	Schedule	Encounters	Mortality	Schedule	Encounters	Mortality	Encounters	Mortality
Test:								
Chinook	1 site, wks 19-35	162	162	No week 25	129	129	-33	-33
Sockeye	2 sites: Area 3 wks 23-30, Blakes wks 24-29	81	81	Area 3 Same; No Blakes wks 27-29	37	37	-44	-44
Coho	3 sites: Blakes wks 38 - 42, Area 3 wks 34-42, Spudhouse wks 35-44	359	359	Blakes same; Area 3 no wks 34-36 or 41-42; Spudhouse no wks 35,37,44	68	68	-291	-291
Chum	3 sites, wks 44-45	0	0	No Bay wk 44; No Blakes wks 44-45	0	0	0	0
Steelhead	2 sites, wks 5-17	10	2	No wk 5-7 or 9	1	1	-9	-1
Area 8/78C Spring Chinook Fishery Swinomish Tribe:								
Week 19	5 days	194	194	Same	255	255	61	61
Week 20	5 days	307	307	Same	115	115	-192	-192
Week 21	5 days	193	193	Same	145	145	-48	-48
Week 22	5 days	165	165	Same	16	16	-149	-149
Area 78C Spring Chinook Fishery Sauk-Suiattle Tribe:								
Week 19	3 days	25	25	None	0	0	-25	-25
Week 20	3 days	38	38	None	0	0	-38	-38
Week 21	3 days	33	33	None	0	0	-33	-33
Area 78C/78D Spring Chinook Fishery Upper Skagit Tribe:								
Week 19	1 day	256	256	1.25 day	284	284	28	28
Week 20	1 day	309	309	1.25 day	247	247	-62	-62
Week 21	0.833 day	216	216	0.708 day	123	123	-93	-93
Week 21	0.167 day	60	60	None	0	0	-60	-60
Area 8/78C/78D Chinook C&S Fishery Swinomish, Sauk-Suiattle, Upper Skagit Tribes:								
Sum/Fall-Spring Chin.	As needed	1,000	1,000	As needed	252	252	-748	-748
Areas 8/78C Sockeye Fishery Swinomish Tribe:								
Week 25	None	0	0	3 days	8	8	8	8
Week 26	3 days	26	26	3.5 days	38	38	12	12
Week 27	5 days	47	47	5 days	108	108	61	61

Week 28	5 days	74	74	5 days	137	137	63	63
Week 29	5 days	227	227	3.5 days	115	115	-112	-112
Area 78D/78O Sockeye Fishery Swinomish Tribe:								
Week 29	1 day	4	4	None	0	0	-4	-4
Areas 78C Sockeye Fishery Sauk-Suiattle Tribe:								
Week 26	3 days	13	13	None	0	0	-13	-13
Week 27	5 days	22	22	None	0	0	-22	-22
Week 28	5 days	13	13	None	0	0	-13	-13
Week 29	5 days	15	15	None	0	0	-15	-15
Areas 78C/78D/78O Sockeye Fishery Upper Skagit Tribe:								
Week 26	0.5 days	90	90	1.208 days	52	52	-38	-38
Week 27	0.625 days	27	27	1.354 days	39	39	12	12
Week 28	0.625 days	36	36	1 day	40	40	4	4
Week 29	0.208 days	14	14	None	0	0	-14	-14
Areas 8/78C Coho Fishery Swinomish Tribe:								
Week 38	1 day	60	60	Same	72	72	12	12
Week 39	2 days	45	45	Same	43	43	-2	-2
Week 40	2 days	17	17	Same	9	9	-8	-8
Week 41	1 day	2	2	Same	0	0	-2	-2
Areas 78C Coho Fishery Sauk-Suiattle Tribe:								
Week 38	1 day	14	14	None	0	0	-14	-14
Week 39	2 days	2	2	None	0	0	-2	-2
Week 40	2 days	0	0	None	0	0	0	0
Week 41	1 day	0	0	None	0	0	0	0
Areas 78C/78D Coho Fishery Upper Skagit Tribe:								
Week 39	0.458 days	78	78	None	0	0	-78	-78
Week 40	0.667 days	136	136	None	0	0	-136	-136
Week 41	1 days	76	76	1.167 days	108	108	32	32
Week 42	0.333 days	23	23	1.417 days	54	54	31	31
Week 43	0.167 days	9	9	None	0	0	-9	-9
Areas 8/78C Chum Fishery Swinomish and Sauk-Suiattle Tribes:								
None	None	0	0	None	0	0	0	0
Total Skagit Terminal Area:		**4,478**	**4,470**		**2,495**	**2,495**	**-1,983**	**-1,974**

2.4 Stillaguamish/Snohomish Terminal Area

The tribal net fishery in Area 8A was open for the 2019/2020 fishing season for C&S fishing, a one-week pink fishery, and a six-week commercial coho fishery. Forty-one Chinook salmon were anticipated to be caught during the coho fishery, and 47 Chinook were harvested in the first two weeks of the fishery. Sixteen Chinook, of the 100 set aside, were harvested for C&S purposes (Table 2-4). Fifty-one Chinook were expected during the pink salmon fishery, with one landed. Non-treaty commercial fishing in Area 8A was closed for the 2019-2020 season.

Tribal Chinook catch in Area 8D occurred from May through late-September, with most of the catch occurring during July. Total 8D catch was 9,766, including 115 for ceremonial or subsistence purposes (Table 2-4). Tribal Chinook catch was less than projected in area 8D.

Non-treaty Chinook catch in Area 8D was zero Chinook during the Coho fishery.

The Stillaguamish Tribe harvested five Chinook for ceremonial purposes from the Stillaguamish River in 2019 (Table 2-4). There was no Tribal fishing effort during the pink salmon directed fishery and no Chinook harvested incidentally during the coho directed fishery.

Table 2-4. Projected (FRAM Chin2719) and actual Chinook net fishery harvest in the Stillaguamish - Snohomish terminal area in 2019.

Area		Projected	Actual
8A Commercial	Treaty	92	48
	Treaty C&S	Up to 100	16
	Ntrty	0	0
8A Test		0	0
8D Commercial	Treaty	11,871	9,766
	Treaty C&S		115
	Ntrty	2	0
Stillaguamish R. Net	C&S/Pink/Coho	22	5

2.5 South Puget Sound Terminal Areas

Table 2-5. Projected and actual Chinook catch in 2019 South Puget Sound net fisheries.

Area	Management Period	Projected	Actual
Area 9/10/11	Coho (A10 - Test)	21	0
	Chum (A9 - Test)	226	7
	A9 (Trty. C&S + chum)	501	0
	Trty coho/chum (A10/11)	12	0
	NT chum (A10/11)	169 [a]	0[a]
Area 10E	Treaty Chinook/coho/chum	5,040	10,653
Area 10A	Chinook (test/C&S/Comm)	595	450
	Pink/Coho/chum	979	19
Duwamish River	Chinook/Coho/Pink/Chum	8,282	2,885
	Coho (Test/C&S)		0
L Washington/Ship Canal	Sockeye/coho/ C&S	553	252
	Test/Research	N/A	--
Lake Sammamish	Chinook/Coho	0	0
Puyallup River	Spring/Fall C&S	606	424[b]
	Chinook/Coho	4,797	9,496
White River	Spring C&S	-- [c]	230
	Coho		240
Areas 13, 13D-K	Chinook/Coho/Chum	5,427	1,732
Area 13A	Chinook/Coho/Chum	3,073	6,843
Areas 13C/Chambers	Chinook	345	0
Nisqually River	Chinook/coho	5,817	6,420[b]
McCallister Cr.	Chinook	2,971	2,140

[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 2019. The chum test fishery at Apple Cove Point (Area 9) incidentally caught a total of seven Chinook (Table 2-5), well below the estimated 226.

The non-treaty chum-directed fishery in Area 10 and 11 incidentally harvested zero Chinook. The treaty coho fishery in Area 10 harvested zero Chinook, while harvesting zero Chinook during the chum fishery. Fisheries directed at Chinook and coho in Area 10E harvested 10,653 Chinook (Table 2-5). No Chinook were harvested during the chum fishery in area 10E.

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

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. Neither the Suquamish Tribe nor the Muckleshoot Tribe conducted any C&S fisheries in the Lake Ship Canal in 2019. Incidental Chinook catch during the coho fishery in Lake Union, and the upper and lower Ship Canal harvested 213 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 39 Chinook. There were no coho directed fisheries in Lake Sammamish.

The Lake Washington warm water test fishery, technically occurring in Lake Sammamish, conducted by the Muckleshoot Tribe landed seven sub-adult HOR Chinook salmon (blackmouth) during the 2019 portion of the fishery (May-June 2019).

Elliott Bay/Duwamish River

The Suquamish Tribe harvested 27 Chinook for C&S purposes in Elliot Bay in 2019. The Chinook test fishery in Area 10A harvested 212 Chinook in 2019. A Chinook-directed commercial fishery occurred in Area 10A and the Duwamish River, harvesting 211 and 2,404 Chinook salmon, respectively. In 10A, there were 19 Chinook caught in September during the coho directed fishery. In the Duwamish River, zero Chinook were caught during the coho test fishery to determine Chinook clearance. During the coho directed fishery in the Duwamish River, 481 Chinook were caught incidentally.

Puyallup River and White Rivers

Ceremonial and subsistence fisheries in the Puyallup River caught 349 adult Chinook salmon along with six estimated jacks during management weeks 20–28. Based on fisheries sampling data, approximately 86 of the adults are assumed to be fall-run based on ad-clip marks. The Muckleshoot Tribe had an additional C&S fishery in the White River which caught 230 spring Chinook. The Puyallup Tribe also harvested 75 fall Chinook were taken for C&S in the Puyallup River. The pre-season projected C&S catch was 606.

Fall Chinook catch was 5,040 during the Chinook directed fishery. The coho fishery in the Puyallup River occurred from management week 36 (September 1st) to management week 42 (October 13th) and incidentally harvested 4,456 Chinook salmon, mostly during early September. During the Coho directed fishery in the White River, scheduled to occur from September 1 through October 13, harvested 240 Chinook during the first half of September (Table 2-5).

Marine area 13 & sub areas (Deep South Sound)

The Chinook fishery in Carr Inlet (13A) caught 6,794 Chinook (Table 2-5), in August and early September (weeks 32 – 36). Pre-season projected catch was 3,037. This fishery targets Minter Creek Hatchery Chinook returns where no natural origin fish are returning to spawn. The coho fishery in 13A incidentally harvested 49 Chinook in late-September, with a preseason expectation of 36.

The Chinook fishery at Chambers Bay (13C) occurred between July 28 through October 12 with zero Chinook harvested (Table 2-5). The preseason catch projection was 345.

Chinook directed fisheries in 13D and Budd Inlet (13F) occurred from mid-July through early-September; total catch was 1,436. Chinook caught incidentally during the coho fishery in (Week 37-44) 13D totaled 296 fish. Zero Chinook were caught during the Fox Island (Area 13) coho fishery. The total preseason catch projection for both areas was 5,427.

Nisqually River

The treaty commercial fishery in the Nisqually River harvested an estimated 6,420 Chinook, excluding jacks, but including fish for Ceremonial and Subsistence purposes, with a pre-season projected commercial catch, excluding jacks, of 5,817 (Table 2-5).

The selective net gear evaluation study in the Nisqually River encountered and released 22 ad-clipped Chinook salmon during 2019.

2.6 Hood Canal

Tribal Chinook directed fishing in 12C occurred as planned from July 21 through August 31 with a catch of 5,645. One Chinook was landed in 12C in early-October during the Coho directed fishery. In marine catch area 12B, one Chinook was harvested during the tribal Coho directed fishery while 14 were landed in marine catch area 12 during the Coho directed fishery.

Tribal Chinook harvest in the Hoodsport Hatchery Zone (12H) was 25,446 and occurred as planned from July 9 through September 13. Catch was more than the preseason expectation of 20,924.

Chinook harvest in the Skokomish River occurred as planned from August 5 through August 29 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 6 through August 3 landing 2,489 fish.

In Port Gamble (Area 9A), 12 Chinook were harvested, primarily in mid-August to mid-September during Coho fisheries.

Non-treaty commercial fisheries in the Hoodsport Zone (12C) harvested 7,303 Chinook salmon (Table 2-6). There were no Chinook landed in other non-treaty fisheries in Hood Canal in 2019 (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 2019.

Area	Target Species	Projected	Actual
(12, 12B-12D, 9A) (T)	Chin, coho, chum	5,473	5,673
(12-12C, 9A) (NT)	chum, coho	60	5[a]
12A Net (T)	Coho	82	0
12H Net (T)	Chinook, chum	20,924	25,446
12C Hoodsport Zone Net (NT)	Chinook, chum	10,000	7,303
Skokomish River (82G) (T)	Chin, coho, chum	9,390	9,608
(82J) (T)	*Chinook*		*2,489*
	Total	43,929	48,035[b]

[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 2019.

Table 2-7. Projected and actual catches of Chinook in Strait of Juan de Fuca terminal net fisheries in 2019.

Terminal Area	Projected	Actual
Area 6D & Dungeness River Treaty	0	0
Area 6D Non-Treaty	1	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 2019 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 2019 Puget Sound non-treaty salmon net fisheries. No onboard observation data was collected on gillnet vessels in 2019.

Area	Gear type	# sets observed	Chinook	Coho	Sockeye	Pink	Chum	Steelhead
7	PS	9	358	1	27	7902	0	0
7A	PS	0	0	0	0	0	0	0
8A	PS	CLOSED						
10	PS	27	0	5	0	0	991	0
11	PS	20	0	4	0	0	463	0
12	PS	81	2	52	0	0	3,611	0
12B	PS	51	0	63	0	0	2,181	0
7	GN							
7A	GN							
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 2019.

	Total Mortality	
Area	Projected	Actual
6D	1	0
7/7A	2,083	632
8	N/A	Closed
8A	N/A	Closed
10/11	275	0
12/12B	60	5
12C Hoodsport	10,000	7,303
9A/12A	8	0

3 Recreational Harvest

This chapter summarizes expected recreational catch in Puget Sound marine waters and freshwater tributaries for the 2019-2020 management year, and presents catch estimates available from Chinook MSF that were intensively creeled 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 2018-2019 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, 2019.

3.1 2018-2019 Recreational Chinook MSF and NS Catch

Mark-selective and non-selective Recreational Chinook harvest in 2018-2019, estimated from preliminary Catch Record Card (CRC) data through March 31, 2019 and creel estimates where available, was 56,758, compared to a preseason projection of 41,763. 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 3218) and actual (preliminary, where available) Chinook catches in Puget Sound Chinook MSF and NS recreational fisheries during the 2018-2019 season.

Area/Fishery	Projected	Actual
Area 5-6		
Area 5 Summer MSF	3,527	3,839
Area 5 Winter MSF	568	408*
Area 6 Summer MSF	4,241	7,871
Area 6 Winter MSF	2,003	2,046
Other		
Strait Tributaries		
Area 7		
Summer MSF	1,727	2,295
Non-Selective	2,155	2,600
MSF (December-April)	3,739	3,776
Nooksack/Samish FW	4,572	6,449
Area 8-1 & 8-2		
Winter MSF	975	1,680
Skagit River		
Spring MSF	456	297
Area 8D SAF	256	558
Stillaguamish River	0	0
Snohomish River		
Skyokomish MSF	757	368
Area 9		
Summer MSF	5,587	6,031
Winter MSF	2,090	3,753
Area 10		
Summer MSF	4,743	4,886
Winter MSF	227	792
Area 11		
Summer MSF	5,344	5,673
Winter MSF	552	702*
Area 10E SAF	135	165
Lake Sammamish	1	0
Area 10A SAF	0	0
Green River	386	397
Puyallup River		
Carbon R MSF	500	1,190
Puyallup R MSF	1,831	873
Area 13		
Summer MSF	1,269	2824
Winter MSF	83	41*
Chambers Cr	34	0
Nisqually	3,218	3,709
Deschutes	6	0
Area 12		
Summer MSF	1,127	2,511
Winter MSF	390	628*
Skokomish River		

* All CRC estimates of catch through 3/31/2019

3.2 2019-2020 Recreational Chinook MSF Catch

Projected Chinook catches for 2019-2020 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 a number of rivers. WDFW conducted intensive sampling and monitoring of Chinook summer MSFs in Marine Areas 5, 7, 9, 10 and 11 as well as Chinook winter MSFs in Marine Areas 6, 7, 8-1, 8-2, 9, and 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 2019-2020 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 2020 annual report.

Table 3-2. Projected (FRAM 2719) and actual (preliminary, where available) Chinook MSF catches in Puget Sound recreational fisheries during the 2019-2020 season.

Area/Fishery	Projected	Actual
Area 5-6		
Area 5 Summer MSF	4,666	4,567
Area 5 Winter MSF	554	
Area 6 Summer MSF	4,392	
Area 6 Winter MSF	1,453	466
Other		
Strait Tributaries		
Area 7		
Summer (July MSF)	1,467	3,026
Winter MSF	3,277	1,760
Nooksack/Samish FW	4,904	
Area 8-1 & 8-2		
Winter MSF	803	405
Skagit River		
Spring MSF	875	
Area 8D SAF	304	
Stillaguamish River	0	
Snohomish River		
Skyokomish MSF	713	
Area 9		
Summer MSF	3,501	3,451
Winter MSF	1,281	578
Area 10		
Summer MSF	3,079	3,284
Winter MSF	229	60
Area 11		
Summer MSF	2,818	2,618
Winter MSF	466	
Area 10E SAF	206	
Lake Sammamish	1	
Area 10A SAF	432	
Green River	356	
Puyallup River		
Carbon R MSF	459	
Puyallup R MSF	1,232	
Area 13		
Summer MSF	2,562	
Winter MSF	99	
Chambers Cr	5	
Nisqually	1,801	
Deschutes	7	
Area 12		
Summer MSF	943	
Winter MSF	441	
Skokomish River		

*Preliminary MSF catch estimate.

3.2.1 Marine Area 5 Summer MSF

2019 was the 17th year of summer mark-selective Chinook fishing in Marine Area 5. The 2019 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 (2020).

For Area 5, WDFW estimates that 4,567 Chinook were landed, compared to preseason projections of 4,666(Table 3-3).

Table 3-3. Comparison of modeled (FRAM 2719) and estimated total Chinook encounters for the 2019 Area 5 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	9,583	2,965	6,618	30
	AD	17,865	5,329	12,536	4,636
	Total	27,448	8,294	19,154	4,666
	% Marked	65	64	65	99
Estimated (Creel) Encounters	UM	6,383	3,131	3,252	8
	AD	9,514	5,058	4,456	4,558
	Total	15,897	8,189	7,708	4,567
	% Marked	60	62	58	100

3.2.2 Marine Area 7 Summer MSF

2019 was the fourth year of summer mark-selective Chinook fishing in Marine Area 7. The 2019 fishery was open from July 1 through July 31, 2019.

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 (2020).

For Area 7, WDFW estimates that 3,026 Chinook were landed, compared to preseason projections of 1,467 (Table 3-4).

Table 3-4. Comparison of modeled (FRAM 2719) and estimated total Chinook encounters for the 2019 Area 7 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	3,325	1,959	1,366	20
	AD	3,558	1,663	1,895	1,447
	Total	6,883	3,622	3,261	1,467
	% Marked	52	46	58	99
Estimated (Creel) Encounters	UM	1,756	1,380	376	10
	AD	4,015	3,388	627	3,015
	Total	5,771	4,768	1,004	3,026
	% Marked	70	71	63	100

3.2.3 Marine Area 9 Summer MSF

In 2019, a recreational MSF occurred for the thirteenth consecutive summer in Marine Area 9. This fishery was scheduled to open from July 25 through August 15, 2019, but due to the expectation of achieving the harvest quota early, in-season actions were taken. The fishery was closed from July 28, 2019 – July 30, 2019 and reopened July 31, 2018 to August 4, 2019. It was closed again on August 5, 2019, opened on August 6, 2019 through August 9, 2019 and eventually closed to MSF from August 10, 2019 – August 15, 2019. 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 (2020).

An estimated 3,451 Chinook were landed in Area 9, compared to preseason projections of 3,501 (Table 3-5).

Table 3-5. Comparison of modeled (FRAM 2719) and estimated Chinook encounters for the 2019 Area 9 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	1,403	959	444	10
	AD	7,932	4,013	3,919	3,491
	Total	9,335	4,972	4,363	3,501
	% Marked	85	81	90	100
Estimated (Creel) Encounters	UM	731	585	146	5
	AD	4,532	3,947	585	3,446
	Total	5,263	4,532	731	3,451
	% Marked	86	87	80	100

3.2.4 Marine Area 10 Summer MSF

In 2019, a summer recreational MSF was implemented in Area 10 for the twelfth year, running from July 25 through August 31, 2019. The fishery closed early on August 16, 2019 to avoid exceeding the preseason modeled expected catch of 3,079. 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 3,284 Chinook were landed during this fishery, compared to the pre-season projection of 3,079 (Table 3-6).

Table 3-6. Comparison of modeled (FRAM 2719) and estimated Chinook encounters for the 2019 Area 10 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	2,890	1,097	1,793	22
	AD	7,052	3,513	3,539	3,057
	Total	9,942	4,610	5,332	3,079
	% Marked	71	76	66	99
Estimated (Creel) Encounters	UM	1,380	1,035	345	17
	AD	4,141	3,681	460	3,266
	Total	5,521	4,716	805	3,284
	% Marked	75	78	57	99

3.2.5 Marine Area 11 Summer MSF

In 2019, a summer recreational MSF was implemented in Area 11 for the thirteenth consecutive year, running from July 1 through September 30. Due to in-season action, the fishery was closed on August, 25 2019 when the quota was reached. 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 2,618 Chinook were landed during this fishery, compared to the pre-season projection of 2,818 (Table 3-7). Unmarked legal and sublegal encounters were greater than pre-season projections.

Table 3-7. Comparison of modeled (FRAM 2719) and estimated Chinook encounters for the 2019 Area 11 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	1,878	673	1,205	13
	AD	7,169	3,224	3,945	2,805
	Total	9,047	3,897	5,150	2,818
	% Marked	79	83	77	100
Estimated (Creel) Encounters	UM	1,707	1,186	520	12
	AD	4,256	2,959	1,298	2,606
	Total	5,963	4,145	1,818	2,618
	% Marked	71	71	71	100

4 Spawning escapement

This section compares natural Chinook escapement estimates for 2019 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.

For summer/fall populations, escapement were less than projected for all management units, except the preliminary Elwha River escapement is greater than forecasted abundance.

Table 4-1. Preseason projections and estimates of Puget Sound Chinook natural spawning escapement in 2019.

Management Unit		NOR	HOR	Total	Projected (FRAM 3218)
Nooksack	NF			N/A	167 [1]
	SF			N/A	75 [1]
Skagit spring	Suiattle			400	478 [1]
	Cascade			180	182 [1]
	Sauk			551	957 [1]
	Total spring			1,131	1,616 [1]
Skagit summer/fall	Sauk summer			319	587 [1]
	Upper Skagit summer			10,155	9,274 [1]
	Lower Skagit fall			1,336	2,363 [1]
	Total summer/fall			11,810	12,504 [2]
Stillaguamish	Total	132	502	634 [3]	878
Snohomish	Skykomish	569	397	966	2,414 [1]
	Snoqualmie	445	233	678	794 [1]
	Total	1,014	630	1,644	3,208 [1]
Lake Washington	Cedar	599	256	855	1,217
Green		1,344	1,632	2,976	5,842
Puyallup		291	1,397	1,688	2,695
White		342	2,601	2,943 [4]	1,834 [4]
Nisqually		436	130	8,654 [5]	11,467
Skokomish		260	2,005	2,265	2,667
Mid Hood Canal	Dosewallips	0	0	0	
	Duckabush	2	1	3	
	Hamma Hamma	13	5	18	
	Total	15	6	21	286
Dungeness		214	719	936 [6]	945
Elwha				7,500 [7]	6,662
Hoko				1,815 [8]	2,315

1. Natural-origin only.
2. Skagit Su/Fa projection total includes NOR and HOR escapement to the spawning grounds.
3. Includes additional 28 NORs and 103 HORs collected for broodstock from the North Fork which are part of the FRAM Projection.
4. Includes NORs, HORs, and 2,013 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 436 NOR and 130 HOR volitional spawners, as well as 8,088 hatchery rack return of which 1,862 HORs from Clear Creek Hatchery were trucked, released upstream, and remained on the spawning grounds. Change-in-ratio (CIR) estimate will be revised with final sport-catch data when available. Total is adult (Age 3-5) escapement. Total fish on the spawning grounds 2,428.
6. Includes 95 fish (21 NORs and 74 HORs) removed from the river for use as broodstock.
7. Estimate does not include jacks.
8. TRS estimate includes 264 fish spawned at hatchery.

4.1 Nooksack River Early Chinook

North/Middle Fork early (spring) Chinook

The Nooksack River North and Middle Forks originate from Mount Baker glaciers and are typically turbid with moderate or lower flows during summer due to glacial melt. As co-managers, we have modified our escapement methods as needed to most accurately expand data to reflect the conditions during the season. The 2017 and 2018 escapement estimates for both populations (North/Middle Fork and South Fork) are presented (Table 4-2 and Table 4-3, respectively); 2019 estimates are not yet available.

Because of the unpredictability of redd viewing conditions during spring Chinook spawning seasons (mid-July through late-September), a carcass-based methodology is the norm instead of a redd based methodology. The 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. 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 surveys to enumerate a high percentage of total redds in the river. As a result, co-managers shifted to a redd based methodology for these years, expanding total enumerated redds by 2.5 adults per redd. The 3.48 expansion factor was applied only to the North Fork carcass counts in those years.

In 2009, higher than normal water flows and associated limited visibility in the Middle Fork limited redd visibility during the early Chinook spawning season. 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 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 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 prior to 2013. In these years, carcass counts from tributaries to the Middle Fork were enumerated but not expanded. 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 escapement estimate. The carcasses observed in Kendall Creek and Kendall Slough were not expanded, 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 Basins. South Fork early NOR and HOR spawning escapement in the North/Middle Fork basins are additional to those within the South Fork basin.

	North./Middle Fork					
Year	NF 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 watershed is non-glacial, so 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 for early returning Chinook to the South Fork from 2006 through 2018 are shown in Table 2. 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 DNA results indicated spawning occurred later than was understood when the escapement estimates were much smaller, and Nooksack co-managers agreed to amend the assumption.

DNA is collected from all carcasses to determine stock assignments to one of the three Nooksack baseline stocks using probability estimates: South Fork early returning Chinook, North/Middle Fork early returning Chinook, or 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 DNA 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 BY2017) and by 2022 when all returning HORs are otolith marked, we will no longer assess genetic parentage assignments for natural escapement purposes.

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 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.

			South Fork			
Year	SF Native NOR	SF HOR	N. Fk Early NOR	Kendall Cr. 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 9. 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 2019. The logjam continues to be a total passage barrier with no live Chinook or Chinook redds observed upstream of the logjam.

A total of 45 Suiattle spring Chinook carcasses were observed and 38 were collected and sampled; 37 were wild unmarked with no CWT, and one carcass was adipose clipped and CWT present. The season total redd count was 160 (
Table 4-4).

Table 4-4. Suiattle River spring Chinook 2019 spawning ground survey redd counts.

Stream	WRIA	Survey method	Reach (RM)	Location[*1]	Redds
Big Creek	3.0723	Foot	0.0-0.6	7.8	4
Tenas Creek	3.0761	Foot	0.0-0.5	9.6	3
Straight Creek	3.0797	Foot	0.0-0.1	15.1	3
Buck Creek	3.0813	Foot	0.0-1.7	18.1	17
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	125
Sulfur Creek	3.0973	Foot	0.0-0.9	26.3	5
Milk Creek	3.1022	Foot	0.0-0.1	28.6	3
				Total redds	160

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

The preliminary 2019 Suiattle River Spring Chinook escapement estimate was 400 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 8 through October 2. 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 2019.

Carcasses are notoriously difficult to find from this upper Cascade population. A total of three carcasses were observed and sampled in the upper Cascade spring Chinook area in 2019. Two of the carcasses were adipose clipped and CWT present, and one of the carcasses was unmarked and no CWT.

Seventy-two redds were identified in 2019 (Table 4-5). The 2019 upper Cascade River spring Chinook spawning escapement estimate was 180 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. 2019 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	5
Marble Creek	3.1451	Foot	0.0-0.3	8.6	0
Cascade River	3.1411	Foot/Raft	9.0-12.4	9.0	35
Cascade River	3.1411	Foot	12.4-15.8	12.4	23
Cascade River	3.1411	Foot	15.8-18.6	15.8	8
Kindy Creek	3.1528	Foot	0.0-0.5	16.2	1
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:	**72**

[*1]Location 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 15 through October 14. 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 65 Sauk River spring Chinook carcasses were observed and 52 were recovered and sampled; of these sampled carcasses, 49 were wild unmarked and untagged fish. One carcass was adipose-present, but the head had been scavenged (no CWT scan), and one carcass was no CWT, but adipose area was scavenged so clip status could not be determined. Additionally, one carcass was adipose clipped and no CWT. There were 219

redds located upstream of the White Chuck River by ground based surveys, and 1 AUC estimated redd downstream of the White Chuck River in the section surveyed by helicopter (Table 4-6). The 2019 upper Sauk River spring Chinook preliminary escapement estimate was 551 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 2019 spawning ground surveys.

Stream	WRIA	Survey method	Reach (RM)	Location[*1]	Redds
Sauk River	3.0673	Flight	31.0-31.9	31.0	1
Sauk River	3.0673	Foot/Float	31.9-34.5	31.9	79
Sauk River	3.0673	Foot/Float	34.5-37.8	34.5	90
Falls Creek	3.1182	Foot	0.0-0.2	34.9	0
Sauk River	3.0673	Foot/Float	37.8-39.7	37.8	5
South Fork Sauk River	3.1204	Foot	0.0-2.9	0.0	24
North Fork Sauk River	3.0673	Foot	39.7-40.1	39.7	7
North Fork Sauk River	3.0673	Foot	40.1-41.3	40.1	14
				Total redds (rounded):	**220**

[*1]Location 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 October 29 (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 1,319 Skagit summer Chinook carcasses were observed, and 1,287 carcasses were recoverable and sampled; 1,180 carcasses were unmarked and untagged wild Skagit summer Chinook, 15 carcasses were adipose clipped only (no cwt), 82 carcasses were adipose clipped and CWT present, 5 carcasses were CWT only, 4 carcasses were not clipped but the CWT status could not be determined, and 1 carcass was unknown adipose

clip and no CWT present.

We observed 332 Skagit summer Chinook redds in the tributaries and 1 redd in the Skagit mainstem upstream of the Newhalem powerhouse that was unable to be observed from the air; using AUC, we estimated 3,729 mainstem redds from five aerial mainstem surveys.

The 2019 escapement estimate of Skagit River summer Chinook was 10,155 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 2019 spawning ground surveys.

Stream	WRIA	Survey method	Reach (RM)	Location[*1]	Redds
Goodell Creek	3.1867	Foot	0.0-1.3	92.9	4
Falls Creek[*3]	3.1780	Foot	0.0-0.4	4.0	1
Bacon Creek	3.1774	Foot	0.0-4.2	82.9	127
Diobsud Creek	3.1750	Foot	0.0-1.3	80.7	12
Cascade River	3.1411	Foot/Float	0.0-4.2	78.1	154
Illabot Creek	3.1346	Foot	0.0-2.6	71.6	34
Skagit River	3.0176	Helicopter	85.9-94.3	85.9	1,460
Skagit River	3.0176	Helicopter	78.1-85.2	78.1	1,483
Skagit River	3.0176	Helicopter	67.2-78.1	67.2	786
				Total redds:	4,062

[*1]Location refers to river mile location of tributary mouth on mainstem, or lower river mile terminus of a mainstem index.
[*2]Falls 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 3 and continued through November 5, with one Sauk summer Chinook redd and no carcasses observed for the spawn year (
Table 4-8).

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 127 Sauk summer Chinook redds in the indexes, and the 2019 escapement estimate of lower Sauk River summer Chinook was 319 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 2019.

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		6	N/A
Sauk River	3.0673	Flight	13.2-21.1	13.2		81	
Dan Creek	3.1079	Foot	0.0-0.8	16.8	1		
Sauk River	3.0673	Flight	21.1-31.0	21.1		40	
Grand total redds from all methods (rounded):						128	

[1]Location 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 variable 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 August 28 and continued through November 21 (Table 4-9). Five helicopter flight redd surveys were conducted and tributary surveys were conducted by foot every seven to fourteen days. A total of 41 carcasses were observed and 39 were recoverable and sampled; 30 were wild (unmarked and untagged) fish, 1 was adipose clipped only, 3 were adipose clipped and CWT present, 4 were CWT present only, and 1 was adipose present but unknown CWT status. Tributary surveys identified 89 redds, and these were summed with 445 AUC estimated mainstem redds from the four aerial surveys.

The 2019 escapement estimate of Skagit River fall Chinook was 1,336 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 2019 spawning ground surveys. The Upper Skagit Indian Tribe surveyed the Grandy Creek and upper Finney Creek indexes. The East Fork Nookachamps Creek index was not surveyed in 2018 due to a landowner access issue. Hansen Creek was not surveyed due to a miscommunication.

Stream	WRIA	Survey method	Reach (RM)	Redds
Skagit River	3.0176	Flight	24.5-56.5	215
Skagit River	3.0176	Flight	56.5-67.2	230
Hansen Creek	3.0265	Foot	3.0-4.3	DNS
Day Creek	3.0299	Foot	0.0-2.2	18
Jones Creek	3.0332	Foot	0.0-1.3	4

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 in 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 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 27th in the North Fork, and last one was detected November 13 in the North Fork. A total of 157 Chinook redds were counted on the North Fork of the Stillaguamish in 2019 (Table 4-10). The redd-based escapement estimate was 395 fish (Table

4-10 and Table 4-12). The GMR adjusted provisional escapement estimate is 452 fish (100 NOR, 352 HOR). An additional 131 fish (28 NOR, 103 HOR) were taken for hatchery brood stock and were not included in the escapement estimate. Total NOR North Fork Stillaguamish River escapement (natural spawning + broodstock collection) was 128 Chinook.

Table 4-10. North Fork Stillaguamish summer and fall Chinook redd counts in 2019.

Stream	WRIA	Method	Reach (RM)	Redds	Escapement
North Fork	5.0135	Foot/Float	0.0-14.3	5	13
North Fork	5.0135	Foot/Float	14.3-30.0	111	278
North Fork	5.0135	Foot/Float	30.0-34.4	13	33
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	14	35
French Creek	5.0246	Foot	0.0-3.0	3	8
Squire Creek	5.026	Foot	0.0-4.0	10	25
Brown Creek	5.0265	Foot	0.0-1.0	0	0
			Total Redds	**157**	
	Redd-based Escapement Estimate				**395**
	GMR adjusted EE (provisional)				**452**

South Fork and Mainstem Stillaguamish summer and fall Chinook

South Fork and Mainstem Stillaguamish summer and fall Chinook escapement in 2019 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 2019, September 12 and October 3 and 14. Rain generated flow pulses in late October and November reduced visibility and precluded further survey efforts.

A total of 17 Chinook redds were found in the Mainstem Stillaguamish and South Fork Stillaguamish River and tributaries in 2019 (Table 4-11). The redd-based escapement estimate was 45 adult fish, which expanded to 51 adult fish with the application of the GMR correction factor (Table 4-12).

Table 4-11. South Fork and Mainstem Stillaguamish summer and fall Chinook redd counts in 2019.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Mainstem	5.0001	Flight	6.0-17.8	3	8
South Fork	5.0001	Foot/Float	17.8-34.7	1	3
South Fork (upper)	5.0001	Foot	34.7-65.0	0	0
Pilchuck Creek	5.0062	Foot/Float	0.0-6.2	1	3
Jim Creek	5.0322	Foot/Float	0.0-4.1	11	28
Siberia Creek	5.0324	Foot	0.0-0.4	1	3
Canyon Creek	5.0359	Foot	0.0-0.5	0	0
		Total Redds		**17**	
		Redd-based Escapement Estimate			**45**
		GMR adusted EE (provisional)			**51**

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. 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, 140 complete carcasses (status of both adipose fin and CWT was determined) were sampled in the Stillaguamish River; 132 in the North Fork reaches and eight in the South Fork reaches (Table 4-12). The sampling rates of Chinook carcasses, not including those with unknown mark dispositions, were 29.2% for North Fork reaches, and 15.0% for South Fork reaches. These rates were calculated by dividing the number of carcasses sampled by the escapement estimate for each population.

Escapement of Chinook by origin (hatchery or natural) was determined by applying ratios of hatchery marked carcasses and unmarked carcasses and marked and unmarked live fish collected for broodstock to the total escapement estimate (Table 4-13).

Table 4-12. Stillaguamish Chinook sample proportions and HOR:NOR composition in 2019

	Sampled	Sampled Hatchery	Sampled Natural	% Hatchery	% Natural	GMR Esc EST	% Sampled
North Fork and Tributaries	132	103	29	78.0%	22.0%	452	29.2%
South Fork and Tributaries	8	8	0	100.0%	0.0%	51	15.6%
Broodstock (NF)	131	103	28	78.6%	21.4%	131	100%
Stillaguamish Totals	**271**	**214**	**57**	**79.0%**	**21.0%**		

Table 4-13. Stillaguamish Chinook escapement estimate (GMR provisional) HOR:NOR composition, 2019.

	GMR Escapement Est.	% Hatchery	% Natural	Esc Est. HOR	Esc. Est. NOR
North Fork and Tributaries	452	79.0%	21.0%	352	100
South Fork and Tributaries	51	79.3%	20.7%	41	10
Stillaguamish Totals	**503**			**393**	**110**

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 unsurveyed 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, raft, and jet sled 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 so as 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. High flows late-October made survey conditions difficult. Survey intervals were kept to seven to ten days except for when rain-fed flow pulses in mid-October caused survey delays. Five 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 276.4 Chinook redds were found in the Skykomish River and its tributaries, and Pilchuck River in 2019 (Table 4-14). The spawning escapement estimate (including Sunset Falls trap counts) was 966 adult fish (569 NOR, 397 HOR; Table 4-16). An additional 4,954 adult hatchery origin fish (including 256 jacks) and 238 adult and five jack natural origin fish recruited to Wallace Hatchery and were not included in this escapement estimate. Total adultNOR Skykomish escapement (natural spawning + broodstock collection) was 807 Chinook.

Table 4-14. Skykomish summer/fall Chinook redd counts and escapement, 2019.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Snoh-Sky (Mainstems)	7.0012	Float/Flight	20.5-51.5	108	270
NF Skykomish	7.0982	Foot/Flight	0.0-13.5	42	105
SF Sky (Sunset Falls)	7.0012	Trap/Haul	51.5-up	*	273
Pilchuck River	7.0125	Foot/Float	2.0-26.5	20	50
Woods Creek	7.0826	Foot/Float	0.0-3.5	5	13
Elwell Creek	7.0865	Foot	0.0-1.0	3	8
Sultan River	7.0881	Foot/Float	0.0-9.7	34	85
Wallace River (lower)	7.094	Foot/Float	0.0-4.4	34	85
Wallace River(upper)	7.094	Foot/Float	4.4-7.3	20	50
Olney Creek	7.0946	Foot	0.0-0.6	1	3
Proctor Creek	7.097	Foot	0.0-0.4	9	23
Bridal Veil Creek	7.1248	Foot	0.0-0.4	0.4	1
			Total Redds	276.4	
			Escapement		966

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 early September to mid-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 2019, 678 Chinook are estimated to have escaped to the Snoqualmie Basin, based on a total count of 263.5 redds (Table 4-15). Based on carcass sampling results, the escapement estimate is composed of 445 NORs and 233 HORs (Table 4-16).

Table 4-15. Snoqualmie fall Chinook redd counts and escapement by reach, 2019.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Snoqualmie River (Lower)	7.0219	Float	20.5-24.9	20	50
Snoqualmie River (Upper)	7.0219	Float	32.9-39.6	41	103
Cherry Creek	7.0240	Foot	1.8-3.5	1	3
Tolt River (Lower)	7.0291	Foot/Float	0.0-6.0	46	115
Tolt River (Upper)	7.0291	Foot/Float	6.0-8.9	12	30
NF Tolt River	7.0291	Foot	8.9-11.3	10	25
SF Tolt River	7.0302	Foot	0.0-2.3	5	15
Raging River	7.0384	Foot	0.0-4.6	58	145
Raging River (Upper)	7.0384	Foot	4.6-13.2	52.5	131
Tokul Creek (Lower)	7.044	Foot	0.0-0.3	13	48
Tokul Creek (Upper)	7.044	Foot	0.3-0.6	5	13
		Total Redds		**263.5**	
		Escapement Estimate			**678**

Sampling and HOR:NOR summary

Field staff sampled 364 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 25 live Chinook passed at Sunset Falls. In total, the Chinook carcass sampling rate on the spawning grounds and at Sunset Falls was 22.1% (Table 4-16). 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 4-16). 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 carcasses were sampled.

These escapement by origin (hatchery origin and natural origin) numbers are preliminary pending co-manager agreement.

Table 4-16. Snohomish Chinook carcass sampling and escapement composition in 2019, preliminary.

Stratum	Escapement	No. Hatchery	No. Natural	% Hatchery	% Natural	Number Sampled	Percent Sampled
Skykomish	317	98	219	31.03%	68.97%	58	18.3%
Bridal Veil	106	50	56	47.06%	52.94%	17	16.0%
SF Sky *	273	95	178	34.88%	65.12%	25	9.2%
Pilchuck River	50	18	32	36.36%	63.64%	11	22.0%
Sultan River	85	25	60	29.51%	70.49%	3	3.5%
Wallace River	135	111	24	82.26%	17.74%	62	45.9%
Skykomish Population	966	397	569	41.10%	58.90%	176	18.2%
Snoqualmie	617	192	425	31.16%	68.84%	138	22.4%
Tokul	61	41	20	68.00%	32.00%	50	82.0%
Snoqualmie Population	678	233	445	34.37%	65.63%	188	27.7%
Snohomish Total	1,644	630	1,014	38.32%	61.68%	364	22.1%

*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:

Snoqalmie: 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 2019, a total of 342 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, all 342 were observed in the Cedar River mainstem (312 below Landsburg Dam and 30 above), and zero were observed in the small tributaries to the Cedar River. Expansion by 2.5 fish per redd resulted in the estimated escapement of 855 Chinook (Table 4-1). Carcass surveys in the Cedar River indicated that 70% of the naturally spawning adult Chinook were natural origin fish (unclipped) and 30% were hatchery origin (clipped) fish.

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 2019 was estimated at 365 fish.

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 fish counts and a 10-day stream life estimate are used to calculate escapement.

The Bear Creek/Cottage Creek area was surveyed weekly during the 2019 spawning season. The escapement estimate was 147 fish. Of these, 87 fish were estimated in the Bear Creek mainstem, and 60 fish were estimated i Upper and Lower Cottage Creek . Carcass surveys in the Big Bear/Cottage Lake system indicated that 58% of the naturally spawning adult Chinook were natural origin and 42% 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 2019 spawning season, and total escapement was estimated at 218. This estimate includes 206 fish in the mainstem below the hatchery, and 12 fish from the East Fork. Carcass surveys in the Issaquah Creek system indicated that 7% of the naturally spawning adult Chinook were natural origin and 93% were hatchery origin.

Chinook escapement to Issaquah Hatchery in 2019 was 2,183 (2,076 adults and 107 jacks); of which 70 adults and 1 jack 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, and the variance is zero. 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 once 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 4 and continued through November 1. Surveys were suspended during the week of October 20 when high flows prohibited safe conduct of surveys. Redd counts from Metzler Side Channel were conducted on September 24, October 9, and October 31. 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 4, 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 (41 redds) and Hwy 167 to Transfer Shack (3 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 44 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 fish 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 the sex ratio of 1.5 males for every female.

Post season analysis of the season totals indicates that peak spawning activity varied by section, but was generally highest during the second week of October for all but the Headworks section that peaked in late September (Table 4-17 and Table 4-18). By the end of surveys the week of October 13, 96.2% of the redds (917 of 953) observed during boat and foot spawning ground surveys were complete.

Table 4-17. Chinook redd counts from foot and boat surveys of the Green River in 2019.

Section	Week[1] 1-Sep	8-Sep	15-Sep	22-Sep	29-Sep	6-Oct	13-Oct	20-Oct	27-Oct	Total
Headworks	0	0	26	120	73	61	44	-	6	330
Lower Gorge	-	0	0	2	25	30	26	-	1	84
Middle River	-	0	2	47	54	153	106	-	14	376
Lower River [1]	-	0	-	8	-	33	-	-	0	41
Newaukum Creek	-	0	4	27	29	37	10	-	15	122
Total	0	0	32	204	181	314	186	-	36	953

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

Table 4-18. Aerial survey counts of Chinook redds in the Green River, 2019.

Section	Week[1] 1-Sep	8-Sep	15-Sep	22-Sep	29-Sep	6-Oct	13-Oct	20-Oct	27-Oct	Total
Headworks	-	78	-	-	78	-	-	-	-	78
Gorge	-	67	-	-	67	-	-	-	-	67
Lower Gorge	-	24	-	-	24	-	-	-	-	24
Middle River	-	104	-	-	104	-	-	-	-	104
Lower River	-	40	-	-	40	-	-	-	-	40
Hwy 167-Transfer Shack	-	2	-	-	2	-	-	-	-	2
Total	-	315	-	-	315	-	-	-	-	315

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

The season total redds from the Middle River was 369 redds plus 7 from MSC, 84 from the Lower Gorge, 330 from the Headworks, and 41 in the Lower River plus 3 in the Hwy 167-Transfer Shack reach. The G/A ratio for the Lower Gorge was 3.50 (84/24) resulting in a calculated 235 redds for the "Gorge". A total of 1,069 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 26 and for the section "Whitney Hill Bridge" to mouth" was 96, totaling 122 redds in Newaukum Creek.

Applying the constant 2.5 fish/redd (1.5 males:1.0 female), an estimate of 2,976 naturally spawning Chinook was generated for the Green River Basin (Table 4-1).

During the season, 598 adults and 150 jacks that returned to the Soos Creek and Keta Creek hatcheries were tagged by the Muckleshoot Indian Tribe, hauled upstream, and released in the mainstem. Although duration of survival and spawning success of these fish may be variable, any redds created by these fish would have been counted during surveys, meaning that they are included in the natural spawning escapement estimate.

River flows during the 2019 Chinook spawning season remained moderate until the final two weeks (Table 4-19). This resulted in surveys being suspended during the week of October 20 followed by reduced visibility in the final week.

Table 4-19. 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 2019. Weekly discharges are 7-day averages of mean daily discharge beginning with the day listed.

	Week								
USGS Gauge	1-Sep	8-Sep	15-Sep	22-Sep	29-Sep	6-Oct	13-Oct	20-Oct	27-Oct
Palmer	214	229	303	428	469	446	512	2216	1213
Auburn	313	348	449	555	597	562	668	2469	1500
Newaukum Creek	11	13	17	13	12	10	19	44	28

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. Additionally, tagged fish from re-released hatchery returns were noted for all sampled carcasses.

A total of 493 carcasses were sampled for standard biological data by Green River crews in 2019; 280 (4 DIT+ 62 CWT&AD + 90 AD + 124 thermal marked with no adipose fin and no CWT) or 56.8% were of hatchery origin as indicated by the presence of an adipose fin, CWT tag, or hatchery thermal mark (Table 4-20).

Table 4-20. Summary of Chinook biological sampling in the Green River, 2019.

Section	Biological Samples	Adipose Clipped	Thermal Marks	MIT Tags[1]	Acoustic MIT Tags[2]	CWT[3] & Ad-Clipped	DIT[3]
Headworks	223	26	93	0	5	8	1
Lower Gorge	18	7	3	0	1	6	0
Middle River	67	26	3	2	0	5	0
Lower River	5	3	0	0	0	0	1
Metzler Side Channel	1	0	1	0	0	0	0
SubTotal: River	**314**	**62**	**100**	**2**	**6**	**19**	**2**
Newaukum: 400th to Whitney Hill Br	42	17	7	1	0	7	0
Newaukum: Whitney Hill Br to Mouth	137	73	17	10	0	36	2
SubTotal: Newaukum	**179**	**90**	**24**	**11**	**0**	**43**	**2**
Grand Total:	***493***	***152***	***124***	***13***	***6***	***62***	***4***

[1]"MIT tags"; the number of sampled fish with MIT tags, or those otherwise identified as hatchery re-release.

[2]Accoustic MIT Tags: the number of carcasses retrieved with MIT acoustic tags (MIT supplemental study)

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

Table 4-21. Coded wire tag sampling, thermal mark analysis of otoliths[1], and origin of natural Chinook spawners[2] in the Green River, 2019.

	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	314	147	164	3	21	293	2	147	19	143	0	3
Newaukum Creek	179	57	116	6	45	134	2	57	43	71	0	6
Green River Basin Total	493	204	280	9	66	427	4	204	62	214	0	9

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

[2]NOS= Natural origin spawner; HOS= Hatchery origin spanwer; 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.

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

4.8 White River

By definition, 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. As a consequence, 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 2019, complete sampling occurred through August 16th, but 4,643 Chinook (1,237 adults and 3,406 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 2,690. Of these, 1,311 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 11% and APs made up 38% 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, 57 of the adult NORs were collected at, or taken to, the White River Hatchery for use as broodstock.

Table 4-22. Estimated number NOR and Acclimation Pond Chinook salmon hauled upstream of Mud Mountain Dam in 2019. 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)	342	458	800
Acclimation Pond	2,013	3,498	5,511
Totals	**2,355**	**3,956**	**6,311**

There are two hatchery programs for White River spring Chinook: the 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 2019, escapement to the Minter Creek/Hupp Springs hatchery was 1,195 adults and 212 jacks. None of these fish nor their gametes were taken to the White River Hatchery. Escapement to the White River Hatchery in 2019 was 970 adults and 39 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 588 adult and 900 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 Washington Department of Fish and Wildlife (WDFW) staff agree that the ability to quantify fall Chinook escapement in the Puyallup River during odd years is difficult due to abundant pink salmon spawning in the system simultaneously. Due to these challenges, the co-managers agreed to use an adjusted AUC-based methodology to estimate escapement for Chinook in the Puyallup River basin during odd years.

South Prairie Creek

Odd-year estimates for SPC are based on live count AUC adjusted by the mean South Prairie redd-based estimate/AUC-based estimate ratio. This adjustment is necessary because pink returns in odd years often preclude objective Chinook redd accounting and historic live count-based estimates have been very conservative when compared to redd-based estimates in this system. The South Prairie Creek (SPC) sub-basin spawning escapement estimate for 2019 is 738 spawners. This escapement is made up of 117 NORs and 621 HORs. The 2019 SPC redd estimate/AUC estimate ratio was 1.86, based on even-year data from 1994 to 2018. The 2019 AUC spawner curve yielded an escapement estimate of 397 spawners for SPC. Expanding the SPC AUC-based escapement (397x1.86) yielded a South Prairie escapement of 738. Wilkeson Creek contributed an additional 83 Chinook (all HORs) to the escapement estimate.

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 2019 SPC escapement, including Wilkeson Creek, utilized in the Carbon River escapement expansion is an adjusted area under the cure (AUC) escapement estimate accounting for the average even-year (1994-2018) ratio of redd-based escapement and live fish AUC estimate exclusively in SPC multiplied by the 2019 AUC live fish estimate for SPC sub-basin.

Survey conditions were not suitable on the Carbon River during the 2019 spawning period. Consistent with the last ten years, the 2019/1999 SPC AUC escapement ratio (943 / 1422 = 0.6628) was applied to the 1999 Carbon River escapement (250) to estimate the 2019 value.

This method estimated 166 Chinook spawning in the Carbon during 2019 (250 * 0.6628 = 166). Based on mark sampling ratios observed in South Prairie Creek, the escapement was made up of 26 NORs and 140 HORs.

Puyallup River Tributaries

Aggregate escapement to Puyallup River tributaries in 2019 was estimated at 198 (Table 4-23). Based on mark sampling in these tributaries, excluding Clark's Creek, 30 of these fish are NORs and 168 HORs.

Table 4-23. Chinook escapement estimates for Puyallup River tributaries, 2019.

Tributary	Escapement
Fennel Creek (WRIA 10.0406)	3
Canyon Falls Creek (10.0410)	3
Kapowsin Creek (10.0600)	34
Clear Creek (10.0022)	158
Clarks Creek (10.0027)	0
Tributary total	198

Mainstem Puyallup River

Chinook spawning escapement to the mainstem Puyallup River was estimated to be 165. This escapement comprised 25 NOR and 140 HOR Chinook, based on mark sampling ratios observed in mainstem tributaries.

As with the Carbon River, surveys of Puyallup River were not possible in 2019. 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 2019/1999 Puyallup tributary AUC ratio (96/113 = 0.8487) was applied to the estimated 1999 Puyallup mainstem escapement (195) to estimate 2019 escapement of 165 Chinook (195 * 0.8487 = 165). The same even year (1994-2018) average AUC adjustment used for the Carbon River was applied to the Puyallup tributary AUC live-fish estimate to develop the 2019 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 2019 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 2019 was estimated to be 338 fish. This escapement is made up of 93 NORs and 245 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 2019 was 1,688. Based on carcass sampling, we estimated that 291 were NORs, and 1,397 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 2019 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 8,654 adult Chinook salmon (Table 4-1) with a preliminary natural spawning escapement of 2,428. This includes 436 natural-origin and 130 hatchery-origin adult fish volitionally escaping to the spawning grounds, as well as an additional 1,862 adult HOR's out of 8,088 adults HORs, which originally returned to Clear Creek and Kalama Creek Hatcheries and were trucked, released, and remained upstream to spawn naturally. The goal of this effort is to supplement natural spawning and increase the number of juvenile outmigrants and corresponding adult returns, which is outlined in the Nisqually Fall Chinook Recovery Plan.

4.11 Hood Canal

Natural Chinook escapement to the Skokomish River and Mid-Hood Canal rivers in 2019 were 2,265 and 21, respectively (Table 4-24).

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 21 adults: zero, three, and 18 Chinook in Dosewallips, Duckabush, and Hamma Hamma rivers, respectively (Table 4-24). During 2019, 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, few very 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 2019. 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 3 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 is 18 which is the AUC 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 mainstem surveys. No Chinook were collected for broodstock. The FRAM preseason escapement projection was 286 for the Mid-Hood Canal (FRAM 2719) while the estimated escapement is 21 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 and raft 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 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 2019, however, Chinook had limited access the South Fork Skokomish after a brief period of increased flow in early September.

The total estimated spawner escapement to the Skokomish River is 2,265 (Table 4-24). This total includes 1,297 in the mainstem Skokomish, 740 Chinook in the North Fork, and 228 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 2,667 (FRAM 2719).

Table 4-24. Summary of Chinook escapement to Hood Canal streams during 2019.

Area	Stream	Escapement	Comments
82 G/J	Skokomish R.	1,297	AUC based on live fish (MS+NF), apportioned using redd-based esc for NF and SF due to superimposition and large pink and summer chum return in MS
	N.F. Skokomish R.	740	
	S.F. Skokomish R.	228	
	Total	**2,265**	
12A	Little Quilcene R.	0	No Chinook observed
	Big Quilcene R.	2	Peak Live/Dead
	Total	2	
12B	Dosewallips R.	0	No Chinook observed during foot surveys
	Duckabush R.	3	AUC based on live fish
	Hamma Hamma R.	18	AUC Hamma
	Total	**21**	
12C	Dewatto R.	20	AUC
	Eagle Cr	45	AUC
	Lilliwaup Cr.	4	AUC
	Total	**69**	
12D	Tahuya R.	0	No Chinook observed
	Union R.	52	Trap
	Total	**52**	
Hood Canal total		**2,409**	

a/ Hamma natural escapement =18, 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. In 2017, the Skokomish, Dosewallips, Duckabush, and Hamma Hamma rivers were targeted for enhanced mark and CWT sampling and WDFW also sampled Chinook carcasses for marks and CWTs on the Dewatto, Tahuya, and Lilliwaup rivers.

Of the 419 Chinook sampled in Hood Canal rivers during 2019, 340 Chinook were adipose-clipped and, of these, 15 had CWTs. 31 unmarked Chinook were coded-wire tagged. We sampled 16.2% of the Chinook spawning escapement in the Skokomish River, 0% of the Mid-Hood Canal Chinook escapement (in the Hamma Hamma, Duckabush, and Dosewallips rivers), with an overall sampling rate of 17.5% in all Hood Canal rivers combined (Table 4-25).

Jacks are not included in Chinook spawning escapement estimates in Hood Canal, but few jacks were sampled during 2019.

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 2014 (age-5), BY 2015 (age-4), and BY 2016 (age-3).

In 2019 there was close agreement in the two aforementioned methods, with mark sampling-based pHOS estimated as 96% and expanded clip pHOS of 95.9% in the Skokomish River system (Table 4-25 and Table 4-26). 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 260 Chinook sampled, 229 were adipose-marked (88.6%). Spawning escapement in the Skokomish River was comprised of about 96% hatchery-origin Chinook and 4% natural-origin Chinook, with a higher proportion of NOR returns to the North Fork where they accounted for 23% (Table 4-25). These estimates may be further refined as CWT data becomes available next fall.

Hatchery releases into the Hamma Hamma River for the purposes of supplementation are 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. No Chinook carcasses were sampled for CWT and otoliths during 2019. Only Age-5 Chinook from the last supplementation release would have returned in 2019. However, no carcasses were recovered, due the low numbers of Chinook and scavenging and predation. Thus, snorkeling in now being employed to monitor for ad-clipped fish.

Because no carcasses were recovered from the Duckabush and Dosewallips rivers, a long term pHOS average (33%) was applied to the 2019 escapements (Table 4-25). The low carcass recovery sample size along with the extremely low escapement, highlight the uncertainty in the 2019 Mid Hood Canal HOR/NOR estimates.

Table 4-25. Chinook salmon spawner escapement origin based on carcasses sampled for marks and coded-wire tags (CWTs) in Hood Canal rivers, 2019.

		Chinook Sampled		Tagged [1/]			Untagged [1/]			Unknown Tagged [2/]			Totals			Escapement	
Management Unit	Escapement	No.	%	AD	NM	Unk	AD	NM	Unk	AD	NM	Unk	CWT's Recovered	Ad-clips observed	Rate	HOR	NOR
Skokomish																	
Mainstem River	1,297	323	24.9%	10	23	0	278	9	1	2	0	0	33	290	0.97	1261	36
North Fk. River	740	31	4.2%	5	4	0	15	7	0	0	0	0	9	20	0.77	573	167
South Fk. River	228	12	5.3%	0	4	0	4	3	0	1	0	0	4	5	0.75	171	57
Skokomish River Total	2,265	366	16.2%	15	31	0	297	19	1	3	0	0	46	315	0.96	2,005	260
12A																	
Biq 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/]	18	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.26	5	13
Duckabush R.	3	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.33	1	2
Dosewallips R.	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	na	0	0
Mid-Hood Canal Total	21	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.27	6	15
12C																	
Dewattor R.	20	1	5.0%	0	0	0	1	0	0	0	0	0	0	1	1.00	20	0
Eagle Creek	4	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.00	0	4
Lilliwaup R.																	
12D	0	0	#DIV/0!	0	0	0	0	0	0	0	0	0	0	0	na		
Tahuya R.	52	52	100.0 %	0	0	0	24	28	0	0	0	0	0	24	0.46	24	28
Union R.																	
Hood Canal Total	2,362	419	17.7%	15	31	0	322	47	1	3	0	0	46	340	0.87	2,054	308

[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, provisionary estimates

Table 4-26. Chinook salmon spawner escapement origin based on carcasses sampled for marks and coded-wire tags (CWTs) in Hood Canal rivers, 2019.

	Age				
	2.1	3.1	4.1	5.1	Total
Mark rate	0.891	0.876	0.867	0.896	
ADB	0	3	6	0	
ADNB	1	119	94	0	
ADNH	0	0	4	0	
Total ad-clipped	1	122	104	0	227
expanded	1	139	120	0	260
UMB	0	17	8	1	
UMNB	0	10	7	1	
UMNH	0	0	0	0	
Total no clip	0	27	15	2	
Total mark status known	1	149	119	2	271
Proportion Hatchery Origin Spawners (pHOS)					**0.959**

*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 2019, 317 Chinook redds were counted in the Dungeness River and 18 redds were counted in the Gray Wolf River (Table 4-27). The estimated number of natural spawners in the rivers were 793 in the Dungeness River and 45adults in Gray Wolf River. There were an additional 92 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 930.

Table 4-27. The distribution of Chinook redds in the Dungeness Rivers system, 2019.

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	7	0.0209	17.5
Dungeness R (18.0018)	18.0018	RM 15.8	RM 17.5	18	0.0537	45
Dungeness R (18.0018)	18.0018	RM 13.8	RM 15.8	20	0.0597	50
Dungeness R (18.0018)	18.0018	RM 10.8	RM 13.8	17	0.5074	42.5
Gray Wolf R (18.0048)	18.0048	RM 0.0	RM 1.0	10	0.0299	25
Gray Wolf R (18.0048)	18.0048	RM 1.0	RM 2.5	8	0.0239	20
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
				80	**0.2388**	**200**
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	62	0.2431	155
Dungeness R (18.0018)	18.0018	RM 6.4	RM 9.2	28	0.1098	70
Dungeness R (18.0018)	18.0018	RM 3.3	RM 6.4	106	0.4157	265
Dungeness R (18.0018)	18.0018	RM 0.5	RM 3.3	59	0.2314	147.5
				255	**0.7612**	**638**
			Grand total	**335**	**1.0000**	**838**

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 362 carcasses (n=94 broodstock collection and mortalities and 268 from natural spawners in the river). Of the total number of carcasses sampled, 281 of 362 (77.6%) were tagged (Table 4-28). Three Chinook carcasses with CWT were strays originating from the Elwha Hatchery.

Table 4-28. 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 2019.

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	94	73	0.7766	21	0.2234
Spawning Ground Surveys (SGS)	268	208[1]	0.7761	60	0.2239
Total sample size	362	281[1]	0.7762	81	0.2238

[1] One tag was lost

Of the 280 tagged fish decoded and excluding one tag that was lost, no age-2 fish were sampled, 78 (27.8%) age-3, 199 (71.1%) age-4, and 3 (1.1%) were age-5. Three Elwha Hatchery origin Chinook had strayed into the Dungeness River. Based on the CWT results and scale samples analyzed, the preliminary NOR/HOR composition for Return Year (RY) 2019 is 192 (20.6%) NOR and 738 (79.4%) HOR. The ages of the NOR Chinook for RY2019 consisted of 0.0% age-2, 33.8% age-3, 56.3% age-4, 9.9% age-5, and 0.0% age-6. The ages of the HOR Chinook for RY2019 consisted of 0.0% age-2, 27.2% age-3, 71.7% age-4, 1.1% age-5, and 0.0% age-6. The ages of all Chinook for RY2019 combined were 0.0% age-2, 28.6%% age-3, 68.5% age-4, 2.9% age-5, and 0.0% age-6 (
Table 4-29).

Table 4-29. Total number and percentages of age-2, age-3, age-4, age-5, and age-6 HOR and NOR Chinook returns in 2019...

	NOR	Percentage	HOR	Percentage	Total	Percentage
Age-2	0	0.0%	0	0.0%	0	0.0%
Age-3	65	33.8%	201	27.2%	266	28.6%
Age-4	108	56.3%	529	71.7%	637	68.5%
Age-5	19	9.9%	8	1.1%	27	2.9%
Age-6	0	0.0%	0	0.0%	0	0.0%
Total	192	100.0%	738	100.0%	930	100.0%

From 2006 to 2019, the total Dungeness River Chinook NOR plus HOR returns ranged from 204 to 1,543 (Table 4-30). The number of NOR Chinook returns ranged from 43 to

339 and the number of HOR returns ranged from 90 to 1,204. The fourteen year average is 152.4 (26.4%) NOR and 424.3 (73.6%) HOR, respectively.

Table 4-30. Total number of NOR and HOR natural spawners and broodstock in the Dungeness River for return years 2006-2019.

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
Avg.	120.2	347.4	467.6	32.1	77.1	109.2	152.4	424.3	576.7

[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. (2019) 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 May 28th to September 17, 2019. For RY 2019, the total return estimate for non-jack Chinook salmon was 7,600 fish with a calculated 95% CI (7,085-8,115) with a CV of 3.5%. (Denton et al. 2019)

The 2019 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 2019.

Peak Spawning Ground Surveys and Redd Distribution

To determine the 2019 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 1,672 redds observed, 103 (6.2%) redds were detected in the Upper Elwha RIver, 1,099 (65.7%) in the Middle Elwha River, and 470 (28.1%) in the Lower Elwha River. In addition to recording the number of redds, surveyors recorded the number of live and dead Chinook (Table 4-31, McHenry et al. 2019).

Table 4-31. 2019 Elwha River Chinook salmon spawners from Upper Watershed Dam to the mouth (McHenry et al. 2019).

Survey Reach	Rkm midpoint	Redds	Redds/km	Live Chinook	Dead Chinook	Jacks
Upper Elwha						
Upper Watershed	43.8	0	0.0	2	0	0
Long Creek						
Geyser Valley	28.8	5	0.8	8	2	0
Cat Creek		9	6.0	3	8	0
Boulder Creek		22	44	8	39	1
Mills	23.4	67	14.5	73	25	1
UE Subtotal		**103**		**94**	**74**	**2**
		6.2%				
Middle Elwha						
Glines Power.	20.6	46	41.8	51	164	0
Altaire Bridge	19.5	34	34.0	23	16	0
Griff Creek	18.5	34	34.0	176	125	0
Rabbit Hole (Hughes)	17.3	133	88.7	175	125	0
Fisherman's Cr.	16.1	67	83.7	17	0	0
ONP Boundary	14.7	42	21.0	29	0	0
McDonald Br.	12.9	14	8.7	17	0	0
Little River	12.2	124	65.3	30	91	0
Indian Creek	12.1	215	113.2	48	159	0
Aldwell South	11	259	112.6	33	60	0
Aldwell North	8.8	131	68.9	8	69	0
ME Subtotal		**1,099**		**421**	**684**	**0**
		65.7%				
Lower Elwha						
Elwha Dam	7.3	36	45.0			
Hwy 112 Bridge	6.1	248	145.9			
County Bridge	3.8	120	66.7	400	398	0
East Channel	1.4	42	18.3	11	45	-
Hunt Rd. Chan.	2	24	16.0	11	12	0
LE Subtotal		**470**		**422**	**455**	
		28.1%				
TOTAL		**1,602**		**937**	**1,213**	**2**

1/Long Creek was not surveyed in 2019

2/Live/Dead counts aggregated for Hughes/Griff survey reaches

3/ Live/Dead Counts aggregated for Dam/112 bridge/County Bridge reaches

Source: McHenry et al. 2019.

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. Hatchery personnel collected 1,289 Chinook (800 males, 1,103 females, jacks) from the traps and river for broodstock for the hatchery program. Due to an excess of males and females, 204 males, 410 females and 7 jacks, hatchery staff trucked the fish upstream and released them into the river to spawn naturally. The number of males, females, and jacks used for broodstock were 528, 521, and 10, respectively. In addition, seventeen females were spawned but eggs were non-viable. The terminal run size to the river was based on the SONAR estimate of 7,600 Chinook. Excluding jacks, the total number of

Chinook that spawned naturally in the Elwha River and its tributaries was 6,311 adults. This number was calculated by subtracting the number of Chinook that were collected for broodstock from the SONAR estimate (Table 4-32).

Table 4-32. Chinook broodstock collection, estimated total adult return, and estimated number of natural spawning fish Elwha River in 2019.

Capture method	No. Males	No. Females	Total adults	No. Jacks	Total adults incl jacks
Gaff-Hook and line	0	0	**0**	0	266260
Seining-Gill netting	436	545	**981**	0	981
Elwha Hatchery Trap Volunteers	364	558	**922**	0	922
Lower Elwha Hatchery transfers	0	0	**0**	0	0
Total broodstock collection	800	1,103	**1,903**	0	1,903
Minus Elwha Hatchery Trap Volunteers Returned back to the river to spawn naturally	204	410	**614**	7	621
Total broodstock collection	596	693	**1,289**	0	1,289
Mortalities in raceways	68	155	**223**	2	225
SONAR adult estimate			**7,600**		
Estimated natural spawners in river			**6,311**		

Natural spawners = SONAR estimate of 7,600 minus adult broodstock collection of 1,289 = 6,311 natural escapements.
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. Three hundred ninety-eight carcasses were sampled in the river and 240 broodstock carcasses were sampled at the WDFW Elwha Hatchery adult raceways for a total of 638. All broodstock and carcass survey results in this report are preliminary until all age, mark, otolith and CWT results are verified.

Evaluating hatchery mark rates

The primary hatchery marking strategy for brood years of Elwha Chinook salmon expected to return in 2019 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 4-33).

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 4-33. Releases of hatchery Chinook in the Elwha River Basin, brood years 2013-2017.

Brood Year	Type	Thermal Otolith	Thermal Otolith + CWT	CWT	AD + CWT + Thermal Otolith	Total
2013	Subyearling	2,388,947	0	0	251,024	2,639,971
	Yearling	0	177,945	0	0	177,269
2014	Subyearling	2,429,097	0	0	250,295	2,679,392
	Yearling	0	158,799	0	0	158,799
2015	Subyearling	2,429,097	0	0	250,072	2,646,442
	Yearling	0	155,400	0	0	158,400
2016	Subyearling	585,431	0	0	249,206	834,637
	Yearling	0	154,760	0	0	154,760
2017	Subyearling	585,431	0	0	249,206	834,637
	Yearling	0	154,760	0	0	154,760

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 11 and October 2, 2019. 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 sampling carcasses.

Biologist and technicians sampled 398 Chinook river carcasses throughout the spawning season. Of this total, 255 (64.1%) had readable scales. The highest number of river carcass samples collected in a one-week period occurred during the week of Sept 23-27,. percent of the carcasses were sampled after September 27 as spawning declined significantly. Of the 255 carcasses that were successfully aged, 33 (12.9%) were age-3, 214 (83.9%) were age-4, and 8 (3.1%) were age-5 (Table 4-34). No age-2 were collected.

Table 4-34. Ages of male and female Chinook carcasses sampled during Elwha River surveys in 2019.

Age	Male	female	Total	Proportion
2_1	0	0	0	0.000
3_1	29	4	33	0.129
4_1	89	124	213	0.835
4_2	0	1	1	0.004
5_1	2	6	8	0.031
6_2	0	0	0	0.000
Total	120	135	255	1.000
Proportion	0.471	0.529	1.000	

Broodstock Collection:

We sampled 175 netted fish that were transported from the river to the WDFW Hatchery and 65 volunteers to the WDFW Hatchery for a total of 240 (Table 4-35).

Biologists and technicians sampled broodstock (BS) carcasses on three different spawning days. The following dates, September 10, 17, and 24, provided an excellent opportunity to collect scale, otolith, DNA, and to check for marked and tagged fish during the prime spawning period. For the three spawning days, 240 of 1,289 or 18.6% of the fish were sampled. Of the total sampled and non-sampled fish, 118 of 596 males (19.8%) and 122 of 693 females (17.6%) were sampled.

Of the 240 carcasses sampled, 203 (84.6%) were unmarked with no CWT, 33 (13.8%) were adipose clipped with a CWT, two (0.8%) were adipose clipped and not tagged, one was unknown mark status and no CWT (0.40%), and one (0.4%) was unmarked with a CWT (Table 4-35).

Table 4-35. Total number of males and females from sampled groups spawned on September 10, 17, and 24, 2019..

Broodstock	Net Female	Net Male	Net Total	Vol Female	Vol Male	Vol Vol Total	Net +Vol Female	Net +Vol Male	Net +Vol Vol Total
10-Sep	**28**	**27**	**55**	**13**	**12**	**25**	**41**	**39**	**80**
ADB	4	1	5	2		2	6	1	7
ADNB	0				1	1	0	1	1
UMNB	24	26	50	11	11	22	35	37	72
17-Sep	**30**	**30**	**60**	**10**	**10**	**20**	**40**	**40**	**80**
ADB	5	6	11		1	1	**5**	**7**	12
UMNB	25	24	49	10	9	19	**35**	**33**	68
24-Sep	**31**	**29**	**60**	**10**	**10**	**20**	**41**	**39**	**80**
ADB	9	4	13	1		1	10	4	14
ADNB		1	1				0	1	1
UMB		1	1				0	1	1
UMNB	21	23	44	9	10	19	30	33	63
UNKNB	1		1				1	0	1
Grand Total	**89**	**86**	**175**	**33**	**32**	**65**	**122**	**118**	**240**

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). All broodstock and carcass survey results in this report are preliminary until all age, mark, otolith and CWT results are verified

Of the 240 fish sampled, 205 (94 males and 111 females) could be aged by scales and CWT. Overall, 1.5% were age-2; 6.8% were ag- 3; 86.4% age-4; 4.9% age-5; 0.00%

were age-6. Males represented 85.7% of the age-3 group and females were 57.6% of the age-4 group (Table 4-36)

Table 4-36. Ages of male and female Chinook broodstock sampled at Elwha Rearing Channel in 2019.

Age	Male	female	Total	Proportion
2.1	3	0	3	0.015
3.1	12	2	14	0.068
4.1	74	102	176	0.859
4.2	1	0	1	0.005
5.1	4	6	10	0.049
6.2	0	1	1	0.005
Total	94	111	205	1.000
Proportion	0.459	0.541	1.000	

Of the 638 total carcasses sampled, 460 (214 males and 246 females) could be aged by scales. Overall, 0.7% were age-2, 10.2% were age-3, 85.0% age-4, 3.9% age-5, and 0.20% were age-6. Males represented 87.2% of the age-3 group and females were 58.1% of the age-4 group (Table 4-37).

Table 4-37. Ages of all male and female Elwha Chinook broodstock and natural spawners in the rivers sampled in 2019.

Age	Male	Female	Total	Proportion
2_1	3	0	3	0.007
3_1	41	6	47	0.102
4_1	163	226	389	0.846
4_2	1	1	2	0.004
5_1	6	12	18	0.039
6_2	0	1	1	0.002
Total	214	246	460	1.000
Proportion	0.465	0.535	1.000	

Hatchery mark rates

Of the 237 hatchery broodstock samples, 99, 6% were marked (otolith, adipose, CWT). The 388 river carcasses sampled were 94.8% marked (otolith, adipose, CWT;Table 4-38).

Table 4-38. Percentage of hatchery Chinook broodstock and river carcass samples that had marks-tags present in 2019.

Elwha River Chinook -2019	**Hatchery**	**samples**	**River survey**	**samples**	**Total**	
Type Marks/Tag-Present	N	% marked	N	% marked	N	% marked
All hatchery marks (otolith, adipose, CWT)	237	99.60%	388	94.80%	625	96.60%

CWT Data

We collected CWTs from 56 fish in the Elwha River watershed during fall 2019. In addition, three snouts were submitted to the CWT Lab which did not have a tag. Twenty-three of the CWTs were recovered from river carcasses and the remaining 33 from Chinook

broodstock (Table 4-39). The majority of the CWTs originated from releases in the Elwha River and one stray from the Dungeness River was sampled. Of the 56 CWTs recovered, 52 were from adipose clipped fish originating from Elwha releases and three were from unmarked releases. Of the 52 marked fish, one was from brood year 2014, 47 from brood year 2015, and four from brood year 2016. The ages of the 55 Elwha River tagged releases were 7.3% age-3, 87.3% age-4, 3.6% age-5 and 1.8% age-6 (Table 4-39).

Table 4-39. Number of decoded tags recovered from sampling carcasses in the Elwha River (CS) and the Elwha Hatchery (HAT), mark status, releases location and origin, number released, and brood year.

Collection method	Decoded Tag no.	No. of CWTs recovered	Mark Status (ADP or Unmarked)	Release Location and Origin	WRIA No.	Release No.	Brood year
CS	211172	1	ADP?	Dungeness R.	18.0018	47,500	2015
CS	636763	1	Unmarked	Elwha R.	18.0272	38,715	2014
CS	636963	18	ADP	Elwha R.	18.0272	248,748	2015
CS	637120	1	ADP	Elwha R.	18.0272	47,774	2016
CS	637163	2	ADP	Elwha R.	18.0272	201,434	2016
HAT	636963	28	ADP	Elwha R.	18.0272	248,748	2015
HAT	636833	2	ADP	Elwha R.	18.0272	249,920	2014
HAT	636956	1	Unmarked	Elwha R.	18.0272	176,100	2015
HAT	637163	1	ADP	Elwha R.	18.0272	201,434	2016
HAT	636671	1	Unmarked	Elwha R	18.0272	176,269	2013

DNA Collection

We collected 240 DNA fin clips from the broodstock collection. 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 2019 return year and observed 343 redds (Table 4-40Table 4-40 and Table 4-41) and Makah Fisheries Management (MFM) counted 24 redds (Table 4-42).

Table 4-40. Chinook redd surveys in mainstem Hoko River from RM 3.4 - RM 10. by DFW 2019.

Stream Name	Survey Date	End River Mile	Start River Mile	Total Live	Total Dead	New Redds
Hoko R (19.0148)	2019-10-02	RM 3.40	RM 4.40	1	0	1
Hoko R (19.0148)	2019-10-02	RM 4.40	RM 5.60	1	0	8
Hoko R (19.0148)	2019-10-02	RM 5.60	RM 7.50	1	0	19
Hoko R (19.0148)	2019-10-02	RM 7.50	RM 8.70	13	0	28
Hoko R (19.0148)	2019-10-02	RM 9.80	RM 10.10	11	0	47
Weekly Redd Total						103
Hoko R (19.0148)	2019-10-11	RM 3.40	RM 4.40			
Hoko R (19.0148)	2019-10-11	RM 4.40	RM 5.60			
Hoko R (19.0148)	2019-10-11	RM 5.60	RM 7.50	42	6	56
Hoko R (19.0148)	2019-10-11	RM 7.50	RM 8.70	74	4	86
Hoko R (19.0148)	2019-10-10	RM 9.80	RM 10.10	186	13	87
Weekly Redd Total						229
Hoko R (19.0148)	2019-10-15	RM 3.40	RM 4.40	1	0	3
Hoko R (19.0148)	2019-10-15	RM 4.40	RM 5.60	3	2	6
Hoko R (19.0148)	2019-10-11	RM 5.60	RM 7.50			
Hoko R (19.0148)	2019-10-11	RM 7.50	RM 8.70			
Hoko R (19.0148)	2019-10-10	RM 9.80	RM 10.10			
Weekly Redd Total						9
Hoko R (19.0148)	2019-10-31	RM 3.40	RM 4.40	0	0	0
Hoko R (19.0148)	2019-10-31	RM 4.40	RM 5.60	0	0	1
Hoko R (19.0148)	2019-10-31	RM 5.60	RM 7.50	0	0	0
Hoko R (19.0148)	2019-10-31	RM 7.50	RM 8.40	0	0	1
Hoko R (19.0148)	2019-10-31	RM 9.80	RM 10.10	1	0	0
Weekly Redd Total						2
Redd Grand Total from RM 3.4 - RM10.1						343

Table 4-41. 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 DFW 2019.

Stream Name	Survey Date	End River Mile	Start River Mile	Total Live	Total Dead	New Redds
Bear Cr (19.0196)	2019-11-01	RM 0.00: Mouth	RM 0.70: Bridge	0	0	0
Bear Cr (19.0196)	2019-11-13	RM 0.00: Mouth	RM 0.70: Bridge	0	0	0
Bear Cr (19.0196)	2019-11-20	RM 0.00: Mouth	RM 0.70: Bridge	0	0	0
Bear Cr (19.0196)	2019-12-04	RM 0.00: Mouth	RM 0.70: Bridge	0	0	0
Bear Cr (19.0196)	2019-12-12	RM 0.00: Mouth	RM 0.70: Bridge	0	0	0
Bear Cr (19.0196)	2019-11-01	RM 0.70: Bridge	RM 1.30: Marker	0	0	0
Bear Cr (19.0196)	2019-11-13	RM 0.70: Bridge	RM 1.30: Marker	0	0	0
Bear Cr (19.0196)	2019-11-20	RM 0.70: Bridge	RM 1.30: Marker	0	0	0
Bear Cr (19.0196)	2019-12-04	RM 0.70: Bridge	RM 1.30: Marker	0	0	0
Bear Cr (19.0196)	2019-12-12	RM 0.70: Bridge	RM 1.30: Marker	0	0	0 0
Bear Cr (19.0196)	2019-11-01	RM 1.30: Marker	RM 1.70: Falls	0	0	0
Bear Cr (19.0196)	2019-11-13	RM 1.30: Marker	RM 1.70: Falls	0	0	0
Bear Cr (19.0196)	2019-11-20	RM 1.30: Marker	RM 1.70: Falls	0	0	0
Bear Cr (19.0196)	2019-12-04	RM 1.30: Marker	RM 1.70: Falls	0	0	0
Bear Cr (19.0196)	2019-12-12	RM 1.30: Marker	RM 1.70: Falls	0	0	0 0
Cub Cr (19.0197)	2019-11-01	RM 0.00: Mouth	RM 0.40: Bridge	0	0	0
Cub Cr (19.0197)	2019-11-13	RM 0.00: Mouth	RM 0.40: Bridge	0	0	0
Cub Cr (19.0197)	2019-11-20	RM 0.00: Mouth	RM 0.40: Bridge	0	0	0
Cub Cr (19.0197)	2019-12-04	RM 0.00: Mouth	RM 0.40: Bridge	0	0	0
Cub Cr (19.0197)	2019-12-12	RM 0.00: Mouth	RM 0.40: Bridge	0	0	0 0
Cub Cr (19.0197)	2019-11-01	RM 0.40: Bridge	RM 0.80: Marker	0	0	0
Cub Cr (19.0197)	2019-11-13	RM 0.40: Bridge	RM 0.80: Marker	0	0	0
Cub Cr (19.0197)	2019-11-20	RM 0.40: Bridge	RM 0.80: Marker	0	0	0
Cub Cr (19.0197)	2019-12-04	RM 0.40: Bridge	RM 0.80: Marker	0	0	0
Cub Cr (19.0197)	2019-12-12	RM 0.40: Bridge	RM 0.80: Marker	0	0	0 0
Cub Cr (19.0197)	2019-11-01	RM 0.80: Marker	RM 1.10: Log Jam	0	0	0
Cub Cr (19.0197)	2019-11-13	RM 0.80: Marker	RM 1.10: Log Jam	0	0	0
Cub Cr (19.0197)	2019-11-20	RM 0.80: Marker	RM 1.10: Log Jam	0	0	0
Cub Cr (19.0197)	2019-12-04	RM 0.80: Marker	RM 1.10: Log Jam	0	0	0
Cub Cr (19.0197)	2019-12-12	RM 0.80: Marker	RM 1.10: Log Jam	0	0	0 0
Hoko R (19.0148)	2019-11-01	RM 20.40	RM 20.80	0	0	0
Hoko R (19.0148)	2019-11-13	RM 20.40	RM 20.80	0	0	0
Hoko R (19.0148)	2019-11-20	RM 20.40	RM 20.80	0	0	0
Hoko R (19.0148)	2019-12-04	RM 20.40	RM 20.80	0	0	0
Hoko R (19.0148)	2019-12-12	RM 20.40	RM 20.80	0	0	0

Table 4-42. Summary of Hoko River Chinook surveys by Makah Fisheries Management staff in 2019.

River	Date	Upper RM	Lower RM	Live	Dead	Redd
Bear Cr	9/25/2019	0.66	0.00	0	0	0
Bear Cr	10/9/2019	0.66	0.00	0	0	1
Bear Cr	10/24/2019	0.66	0.00	2	0	0
Brown's Cr	9/19/2019	0.59	0.00	3	0	2
Brown's Cr	10/2/2019	1.3	0.97	0	0	0
Brown's Cr	10/2/2019	0.97	0.59	0	0	0
Brown's Cr	10/2/2019	0.59	0.00	0	0	0
Brown's Cr	10/21/2019	0.97	0.59	16	2	2
Brown's Cr	10/21/2019	0.59	0.00	30	3	3
Cub Cr	9/25/2019	0.37	0.00	0	0	0
Cub Cr	10/9/2019	0.37	0.00	0	0	0
Cub Cr	10/24/2019	0.37	0.00	0	0	0
Ellis Cr	9/25/2019	0.45	0.00	0	0	0
Ellis Cr	10/9/2019	0.45	0.00	0	0	0
Ellis Cr	10/24/2019	0.45	0.00	9	0	0
Herman's Cr (Main)	10/1/2019	2.00	0.00	0	0	1
Herman's Cr (Main)	10/21/2019	2.00	0.00	8	0	0
Herman's Cr (NF)	10/1/2019	0.37	0.00	0	0	0
Herman's Cr (NF)	10/21/2019	0.37	0.00	0	0	0
Hoko River	9/30/2019	15.50	13.00	15	0	7
Hoko River	10/11/2019	18.30	15.50	39	6	4
Hoko River	10/14/2019	21.70	20.40	0	0	0
Hoko River	10/14/2019	20.40	18.30	14	1	3
Little Hoko R	9/23/2019	2.00	0.00	0	0	0
Little Hoko R	10/4/2019	2.00	0.00	0	0	0
Little Hoko R	10/24/2019	2.00	0.00	2	0	1
Tsooes Yess R	9/5/2019	9100 Bridge	Hatchery	0	0	0
Tsooes Yess R	9/13/2019	Hatchery	Bridge	59	1	0

Hoko Broodstock Collection

For the 2019 Hoko Chinook broodstock season, 381 females, 447 males, and 36 jacks returned to the Hoko Falls Hatchery pond facility. Of the 864 total fish that returned to the pond, 127 females, 125 males and 10 jacks were lethally spawned. Ten fish died in the pond prior to spawning and two additional females were lethally spawned but their eggs were non-viable. The remaining 246 females, 318 males, and 26 jacks were released back to the river to spawn naturally (Table 4-43).

Table 4-43. Number of female, male, and jack Chinook that returned to the Hoko Falls Hatchery in 2019 that were spawned, released back to the river to spawn naturally, culled, surplused, or died before spawning.

Se	Rack count	Pond Mortality	Surplused	Lethal spawned (Viable)	Non-Viable Spawned	Returned to stream
Female	381	6	0	127	2	246
Male	447	4	0	125	N/A	318
Total adults	**828**	**10**	**0**	**252**	**2**	**564**
Jack	36	0	0	10	N/A	26
Total fish	**864**	**10**	**0**	**262**	**2**	**590**

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

The 2019 adult escapement estimate for Hoko Chinook is 1,561 spawning in the river (natural origin and hatchery origin combined) and 264 returning to and remaining at the hatchery for an adult terminal runsize (TRS) of 1,825. The following methods were used to calculate the final TRS:

1) Hoko Falls Hatchery adult return 828 (381 females and 447 males).

2) Number of adult Chinook broodstock spawned at hatchery: 127 females and 125 males spawned = 252 adults. Two females were lethally spawned, but their eggs were non-viable, while 10 adults died before spawning.

3) Two-hundred forty-six females and 318 males at the hatchery were released back to the river during a two day period, October 3rd and 4th. Of this total, 170 females, 256 males, and 2 jacks were floy tagged and released. Seventy-six females, 62 males, and 24 jacks were released without tags

4) During the 2019 spawning season, WDFW staff counted 343 redds (343 redds x 2.5 adults per redd = 858 fish). The 2.5 adults per redd is equal to one female and 1.5 males per redd.

5) During the 2019 spawning season, the MFM staff counted 127 live fish and 12 dead fish for a total of 139 fish.

6) The Terminal Run Size (TRS) is estimated at 1,825 adults when the 264 adult broodstock spawned at the hatchery (includes 10 pond mortalities and two non-viable females) are added to the natural escapement of 1,561. This total excludes 36 jacks**.**

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 1,553 HOR adults and 259 NOR adults (Table 4-44). The age composition of HOR total spawners consisted of 10 age-2 (0.6%), 806 age-3 (51.6%), 746 age-4 (47.7%), and 1 age-5 (0.06%). The age composition of NOR total spawners consisted of 26 age 2 (9.1%), 47 age 3 (16.5%), 211 age 4 (74.1%), and

1 age 5 (0.04%). The proportion of HOR spawners by age group were: age 2 (0.28), age 3 (0.94), age 4 (0.78) and age 5 (0.70)..

Table 4-44. Age and origin of broodstock and natural Chinook spawners in the Hoko Rver in 2019.

	Returns to Hatchery				Returns to River				Total Spawners				
		by Origin				by Origin				by Origin			
Brood	**Age**	**HOR**	**NOR**	**Totals**	**Age**	**HOR**	**NOR**	**Totals**	**Age**	**HOR**	**NOR**	**Totals**	**HOR Proportion**
2017	2	10	26	36	2	0	0	0	2	10	26	36	0.28
2016	3	64	14	78	3	742	33	775	3	806	47	853	0.94
2015	4	128	54	182	4	618	157	775	4	746	211	957	0.78
2014	5	1	1	2	5	0	0	0	5	1	1	2	0.50
2013	6	0	0	0	6	0	0	0	6	0	0	0	
2012	7	0	0	0	7			0	7	0	0	0	
	Unaged				Unaged				Unaged	0	0	0	
	Totals	**203**	**95**	**298**	**Totals**	**1,360**	**190**	**1,551**	**Totals**	**1,563**	**285**	**1,849**	**0.85**
Data sources:	Ages from scale cards collected by Makah Fisheries Management survey staff and Hoko Hatchery staff, and WDFW survey staff.												

Data source: Hap Leon, 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 8A, 10, North Hood Canal (9A, 12, 12A, 12B), 12C, and Strait of Juan de Fuca Troll were below 20% (Table 5-1). Marine area recreational fisheries were sampled at rates between 7.5%% and 35.4% 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 2018 (calendar year).

Catch Area/River	Catch	# Sampled	Sample Rate
7-7A	3,379	2,268	67%
7B-7C-7D-Nooksack River	10,670	4,843	45%
Skagit River/Bay	2,614	1,088	42%
8A	69	0	0%
8D	9,766	3,180	32%
Stillaguamish River	31	11	35%
10	41	1	2%
10E	7,064	3,214	45%
10F	132	117	89%
10G	1	1	100%
10A	617	583	94%
Duwamish River	10,469	5,257	50%
Puyallup/White rivers	7,081	3,249	46%
Nisqually River	8,326	3,537	42%
13A	2,206	1,466	66%
13C	135	57	42%
13D-F	7,978	6,659	83%
9	--	--	--
9A-12-12A-12B	65	7	11%
12C	15,847	1,404	9%
12H	18,050	7,473	41%
Skokomish River	10,084	1,871	19%
Purdy Creek	1,666	1,403	84%
Strait of JDF 4B-5-6 (Net)	2,230	1,133	52%
Strait of JDF 4B-5-6C (Troll) [a]	597	0	0%

[a] Includes 4B Summer Troll catch for 2017.

Table 5-2. Chinook coded-wire tag sampling rates for marine recreational fisheries in 2018.

Catch Area	Catch	# Sampled	Sample Rate
MARINE SPORT AREA 5	5,104	1,806	35.4%
MARINE SPORT AREA 6	9,412	2,162	23.0%
MARINE SPORT AREA 7	7,412	1,472	19.9%
MARINE SPORT PCA 8.1	529	165	31.2%
MARINE SPORT PCA 8.2	1,520	437	28.8%
MARINE SPORT AREA 9	9,101	2,294	25.2%
MARINE SPORT AREA 10	5,529	1,905	34.5%
MARINE SPORT AREA 11	7,453	2,228	29.9%
MARINE SPORT AREA 13	3,045	450	14.8%
MARINE SPORT AREA 12	2,925	218	7.5%

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7 9-Year Spawning Escapements

Nooksack Early Management Unit.

Early timed Chinook spawning escapements for 2006 through 2018 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.

	North./Middle Fork					
Year	NF NORs	Kendall HORs	SF NORs	SF HORs	Fall NORS	Fall HORs
2006	275	909	N/A	N/A	N/A	N/A
2007	334	1,104	N/A	N/A	N/A	N/A
2008	307	959	N/A	N/A	N/A	N/A
2009	260	1,643	N/A	N/A	N/A	N/A
2010	186	1,864	N/A	N/A	N/A	N/A
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 2006 through 2018 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.

	South Fork					
Year	SF Native NOR	SF HOR	N. Fk Early NOR	Kendall Cr. HOR	Fall NOR	Fall/other HOR
2006	61 (1)	0	102 (2)	72 (12)	191 (1)	90
2007	26 (3)	0	38 (6)	109 (3)	115 (13)	35
2008	80 (3)	0	105 (1)	109 (0)	126	23
2009	45 (0)	0	58	124 (4)	187	38
2010	21 (0)	0	43 (0)	293 (o)	107 (0)	29 (0)
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
2011	345	215	265
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	232
2018	1,603	645	128

Skagit Summer/Falls Management Unit.

Year	Upper Skagit	Lower Sauk	Lower Skagit
2010	6,644	356	1,017
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

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.

	MU Total	
Year	NOR (BS)	HOR (BS)
2010	329 (58)	508 (82)
2011	521 (45)	1,116 (128)
2012	988 (109)	799 (70)
2013	602 (73)	395 (59)
2014	157 (57)	262 (87)
2015	399 (61)	320 (68)
2016	615 (76)	438 (65)
2017	730 (76)	685 (65)
2018	118 (44)	496 (102)

Snohomish Management Unit.

	Skykomish		Snoqualmie	
Year	NOR	HOR	NOR	HOR
2010	1,836	676	1,585	203
2011	881	299	479	221
2012	2,462	1,283	898	481
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	2,783	1,591	1,401	344
2018	2,259	789	823	339

Lake Washington Management Unit.

	Cedar River		Sammamish River	
Year	NOR	HOR	NOR	HOR
2010	547	118	43	1,788
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

Green River Management Unit.

Year	NOR	HOR
2010	859	1,233
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	2,011	6,346
2018	2,231	4,660

Puyallup River Fall Management Unit.

Year	NOR	HOR
2010	529	979
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

White River Spring Management Unit.

Year	NOR	HOR	APP
2010	239	126	362
2011	450	369	983
2012	808	204	1,119
2013	795	931	2,734
2014	218	105	637
2015	358	490	736
2016	645	501	2,851
2017	630		2,994
2018	571		3,431

Nisqually River Management Unit.

Year	NOR	HOR
2010	353	1,714
2011	302	1,962
2012	617	1,850
2013	738	933
2014	528	512
2015	715	790
2016	796	168
2017	1,049	1,991
2018	416	1,842

Skokomish River Management Unit.

Year	NOR	HOR	Total
2010	162	1,052	1,214
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

Mid-Hood Canal Management Unit.

Year	Hamma Hamma	Duckabush	Dosewallips
2010	91	0	15
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

Dungeness River Management Unit.

	Natural Spawners[1/]			Broodstock Collection[2/]			Total Returns (Natural Spawners + Broodstock)		
Return year	NOR	HOR	*Total*	NOR	HOR	Total	NOR	HOR	Total
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	*115*	**165**	**350**	***523***
2017	166	439	*605*	26	74	*100*	**192**	**513**	***705***
2018	157	661	*788*	20	97	*117*	**147**	**758**	***905***

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
2010	1,278
2011	1,862
2012	2,638
2013	4,243
2014	4,360
2015	4,112
2016	2,628
2017	3,100
2018	7,107

Hoko River Management Unit.

Year	HOR/NOR
2010	793
2011	1,504
2012	663
2013	1,406
2014	1,760
2015	2,877
2016	1,324
2017	1,225
2018	1,943