Washington Department of Fish and Wildlife
Puget Sound Treaty Indian Tribes

Puget Sound Chinook Comprehensive Harvest Management Plan

Annual Report
The 2023-2024 Fishing Season

December 2024

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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, 2023, and April 31, 2024, and Chinook spawning escapement in 2023. It also includes harvest information relevant to the 2022-2023 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) 2022.

Commercial Chinook catch in Puget Sound pre-terminal and terminal fisheries was lower than projected pre-season in most fisheries except for some select terminal areas targeting terminal hatchery runs (i.e. Gorst Creek, Minter Creek, and Hoodsport Hatcheries) as well as preterminal fisheries targeting Fraser River Pink salmon.

Marine and freshwater landed recreational Chinook catch in fisheries where Chinook retention was allowed, based on catch record cards, in the 2021-2022 season was estimated at 47,390 compared to the pre-season projection of 40,229. Creel survey-based estimates of catch in 2022-2023 summer mark-selective recreational fisheries in Areas 5, 6, 7, 9, 10, and 11, winter MSF in Areas 10 and 11 as well as the North Fork Nooksack recreation spring Chinook MSF are included in this report. Total encounter estimates for intensively monitored 2022-23 summer marine area selective fisheries and the North Fork Nooksack recreational spring Chinook fishery are presented and compared to pre-season projections for these areas.

Escapement for summer/fall and spring-run management units were generally greater than projected. Exceptions to this include Skagit River spring Chinook, Stillaguamish summer/fall Chinook, Snohomish summer/fall Chinook, Green River fall Chinook, White River spring Chinook, and Mid-Hood Canal fall Chinook.

Coded-wire tag sampling rates for calendar year 2021 commercial fisheries exceeded 20% in most areas except for MCA 13D-F, Hood Canal marine areas, and Strait of JDF net and troll fishery. Sampling rates for marine recreational fisheries exceeded the 10% objectives in all areas.

1 Introduction

The Puget Sound Chinook Harvest Management Plan (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 fulfills that requirement and that of the Terms and Conditions in the 2022 Harvest Biological Opinion (WCRO-2023-00552) by assessing the performance and effectiveness of treaty and non-treaty commercial fishery management actions adopted for the most recent management year, May 2023 through April 2024. Included in this report are:

- Management objectives for the 2023-2024 management year (May 1, 2023, through April 30, 2024)
- Projected and actual commercial landed catch in Puget Sound and descriptions of fisheries for the 2023-2024 management year
- Projected and actual landed catch for 2022 Puget Sound recreational fisheries where Chinook retention was allowed and creel surveys were conducted as well as for 2021 Puget Sound recreational sport fisheries where Chinook retention was allowed.
- Estimates of total encounters for 2022 summer Chinook mark-selective fisheries and non-landed mortality for commercial fisheries with Chinook non-retention where data are available.
- Projected and actual 2023 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 2022 escapements.
- 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 2022 (January to December 2022).

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 2023 (Table 1-1). The final pre-season FRAM model run (Chin2023) highlighted the rates that were used as the ceilings for each Management Unit (MU) in 2023, and the projected exploitation rates and escapements for each unit (Table 1-2).

Pre-season fishery planning for 2023-2024 fisheries projected that natural spawning escapement would fall below the Low Abundance Thresholds (LAT) for the Nooksack early, Skagit summer/falls, Snohomish, 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. 2023 Puget Sound Chinook Harvest Management Objectives.

Management Unit	ER Ceiling	Critical ER Ceiling	Low Abundance Threshold
Nooksack			
North Fork		10.9% SUS	400 [a]
South Fork			200 [a]
Skagit summer / fall	52%	17% SUS	7,844 [a]
Upper Skagit summer			2,200 [a]
Sauk summer			400 [a]
Lower Skagit fall			900 [a]
Skagit spring	36%	10.7% SUS	1,024 [a]
Upper Sauk			130 [a]
Cascade			170 [a]
Suiattle			170 [a]
Stillaguamish	9% SUS UM /14% SUS M.	Co-manager discussion	900 [b]
Snohomish	9.3% SUS	8.3% SUS	3,250 [a]
Skykomish			2,015 [a]
Snoqualmie			1,132 [a]
Lake Washington Cedar River	500 Escapement (15% PT SUS)	12% SUS	200
Green	2,744 Escapement (15% PTSUS)	12% SUS	1,098
White River spring	22% SUS	15% SUS	400
Puyallup fall	1,170 Escapement (15% PT SUS)	15% SUS	468
Nisqually	47%	50% Reduction of SUS ER	6,300
Skokomish	50%	12% PTSUS	1,300 aggregate; 800 natural
Mid-Hood Canal [c]			200
Dungeness	10% SUS	6% SUS	500
Elwha	10% SUS	6% SUS	2,000
Western SJDF	10.6% SUS	6.3% SUS	500

[a] Abundance Thresholds are NOR specific.

[b] Stillaguamish LAT is terminal runsize and does not account for terminal fishery impacts.

[c] The exploitation rate for mid-Hood Canal Chinook in Puget Sound marine fisheries will be the exploitation rate associated with achieving the management objectives for the 14 other management units within the Puget Sound Chinook ESU. Mid-Hood Canal freshwater fisheries directed at Chinook salmon will be closed.

Table 1-2. Management guidelines implemented and projected exploitation rates and escapements for Puget Sound Chinook Management Units for 2023 – 2024 pre-season planning (FRAM Chin2023).

Management Unit	ERC or CERC implemented	Projected ER	Projected Escapement
Nooksack	10.9% SUS	10.9% SUS	396 [a]
Skagit summer fall	17% SUS	16.6% SUS	10,120 [a]
Skagit spring	36% Total	24.4% Total	1,972 [a]
Stillaguamish	9% UM SUS/14% M SUS	9%UM SUS/14% M SUS	1,255 [b]
Snohomish	8.3% SUS	8.3% SUS	3,295 [a]
L. Washington (Cedar)	500 Escapement / 15% PT SUS	12.1% PT SUS	638
Green	2,744 Escapement / 15% PT SUS	12% PT SUS	3,762
White	22% SUS	17.1% SUS	2,391
Puyallup	1,170 Escapement / 15% PT SUS	12.1% PT SUS	2,682
Nisqually	47%	46.7%	6,304
Skokomish	50%	49.8%	2,101
Mid Hood Canal [c]			12
Dungeness	10% SUS	4.7% SUS	923
Elwha	10% SUS	4.9% SUS	2,722
Western SJDF	10.6% SUS	2.8% SUS	2,364

[a] NOR specific escapement estimates.

[b] Stillaguamish LAT is forecasted terminal runsize and does not account for terminal fishery impacts.

[c] The exploitation rate for mid-Hood Canal Chinook in Puget Sound marine fisheries will be the exploitation rate associated with achieving the management objectives for the 14 other management units within the Puget Sound Chinook ESU. Mid-Hood Canal freshwater fisheries directed at Chinook salmon will be closed.

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 2023–24 List of Agreed Fisheries (https://nwifc-fisheriesservices.s3.amazonaws.com/wp/wp-content/uploads/20221104172707/2022-2023-Final-LOAF-w-signatures.pdf) describes salmon fisheries for all areas of Puget Sound and ocean fisheries off the Washington coast. The final pre-season projections of catch under this regime were made in FRAM run number Chin2023.

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 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 areas (Nooksack/Samish, Skagit, Stillaguamish/Snohomish, South Puget Sound, Hood Canal, and Strait of Juan de Fuca). General information is presented for the 2023–24 fisheries, including in-season management actions that deviated from the pre-season plan, and explanations for differences in projected and actual catch.

Table 2-1. Projected and actual Chinook net and troll catch, including release mortalities from selective net fisheries, in waters of the Washington coast and Puget Sound fisheries in 2023.

Fishery	Projected	Actual
Washington ocean non-treaty troll	39,000	37,722
Washington ocean recreational	39,000	30,114
Washington ocean treaty troll	45,000	28,460
Puget Sound pre-terminal net & troll total		
Strait of Juan de Fuca troll	3,289	4,516
Strait of Juan de Fuca net	552	843
PSC Test Fishery		
San Juan Islands net [a]	7,931	10,566
San Juan Islands/Bell. Bay C&S		
Nooksack-Samish terminal net	20,184	27,438
Skagit terminal net	5,098	4,264
Stillaguamish-Snohomish net	4,754	4,114
South Puget Sound terminal net	33,556	33,888
Hood Canal terminal net	24,291	39,060
Strait Tributaries terminal net	3	4

[a] includes non-retention mortality in NT purse seine fishery: Total non-retained Chinook observations per observed set, summed, multiplied by total effort (sets), and multiplied by agreed to mortality rates for adult and juvenile Chinook.

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 843 and 9,891 Chinook, respectively. Catch in the Strait of Juan de Fuca primarily occurred during the Chinook set net fishery while catch in the San Juan Islands area occurred during the Fraser River Pink salmon directed fishery.

Non-treaty fisheries targeting Fraser chum salmon in Areas 7 and 7A were closed in 2023. Since non-tribal purse seines are required to release all Chinook, release mortality estimates are calculated using available data from on-water by-catch monitoring (Reported in detail below in tables 2-8 and 2-9). An estimated 660 Chinook release mortalities occurred during the pink directed non-tribal purse seine fishery in Areas 7 and 7A. An additional 15 Chinook were landed in reef net fisheries prosecuted in Areas 7 and 7A.

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 4,516 Chinook. One thousand one hundred eighty-five Chinook were caught during the summer SJD troll fishery while 3,331 were caught during the winter SJD troll fishery.

2.2 Nooksack/Samish Terminal Area

Treaty Spring Chinook Ceremonial and Subsistence Fishery

The Lummi Nation conducted fishing with tangle-net gear from during the 2023 season along with limited community C&S openings. Total landed catch was 320 hatchery-origin Chinook and 12 (including one jack) natural-origin Chinook with an additional 30 natural-origin (including jacks) and 22 HOR Chinook salmon encountered and released. Applying the expected release mortality rate of 30% to the encounters results in nine NOR and seven HOR (including jacks) estimated mortalities. The total encounter of NORs (n=42, including released and retained, adult and jack fish) was lower than the pre-season projection of 93 NOR adults. Genetic results for the released NORs are not currently available to determine population origin.

A commercial fishery for Lummi Sea Pond early Chinook hatchery returns was prosecuted in 2022. A total of 90 Chinook, including three NORs, were harvested in that fishery in 2023. The preseason projection was for 362 Chinook.

In 2023, the Nooksack Tribe conducted a permit only, subsistence fishery. A total of 165 Chinook were caught in the traditional C&S fisheries and all were sampled. One hundred fifty-nine of the 165 Chinook were determined to be hatchery-origin based on adipose-fin marks, CWT detections, or otolith results. Of the six NORs, three were determined to be NF/MF origin and three were SF NOR origin.

The Tribes 2023 total NOR mortality is estimated to be 30 early-run NORs, pending additional analysis of remaining biological samples. The pre-season projection was 37 NOR mortalities.

Table 2-2. Expected and observed Chinook catches in the Nooksack/Samish terminal area, 2023.

Area	Management Period	Projected	Actual
7B, 7C, 7D, Treaty net[1]	Chinook, Pink, Coho, Chum	10,445	16,183
7B, 7C Non-treaty net	Chinook, pink, coho, chum	5,895	10,222
Nooksack River Treaty net	Early Chinook, May-Jun[2]	2,514	536
	Fall Chinook, Aug-Oct	1,446	497

[1] Includes 7A on-reservation catch during coho management.
[2] Includes Lummi Bay fishery targeting returns to Lummi Sea Ponds.

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 9th and in Samish Bay (7C) from August 1st through September 15th, with a catch of 14,492 Chinook. The coho fishery operated as planned from September 11th through October 29rh, with an incidental harvest of 1,691 Chinook. During the 7A on-reservation Coho fishery from September 8th through October 2nd, zero Chinook were incidentally harvested. No Chinook were harvested incidentally during the chum fishery. The

total fall Chinook catch of 16,183 for Areas 7B, 7C, and 7D was greater than the preseason projection of 10,445 (Table 2-2).

The non-treaty fishery in Area 7B and 7C landed 10,222 Chinook from July through October, lower than the pre-season projection of 5,895. Eleven Chinook were forecasted to be landed during the chum fishery, with 0 landed.

Fisheries for fall Chinook, Pink, Coho, and Chum salmon in the Nooksack River occurred as planned from August 1 – September 9, September 11 – October 22, and October 30 – December 14, respectively. The total Chinook catch was 497, less than the projected catch of 1,446 fish; 418 were caught during the Chinook period and 79 during the coho fishery. No Chinook were harvested during the chum period.

2.3 Skagit Bay/Skagit River Terminal Areas

Spring Chinook Fisheries: Tribal commercial fisheries in the Skagit terminal area directed at hatchery spring Chinook were conducted in 2023 as scheduled preseason, although adjusted in timing and duration in response to ESA, tribal, and environmental needs. A total of 207 wild and 2,890 hatchery spring Chinook were encountered and retained in these directed spring Chinook fisheries. The final pre-season modeled projections in Chinook FRAM 2023 were 236 wild and 2,872 hatchery spring.

An additional 30 wild spring chinook and 40 hatchery spring Chinook were harvested incidentally in directed Sockeye fisheries, compared to 19 wild spring Chinook and 12 hatchery spring Chinook projected preseason.

A total of 6 wild and 30 hatchery spring Chinook were harvest in tribal ceremonial and subsistence (C&S) spring Chinook fisheries, compared to 15 wild and 32 hatchery expected pre-season.

Total spring Chinook mortalities across all of these tribal commercial and C&S fisheries were 243 wild and 2,960 hatchery fish, compared to the pre-season modeled 270 wild and 2,916 hatchery mortalities.

Summer/Fall Chinook Fisheries: No treaty commercial fisheries directed at summer/fall Chinook were scheduled in the Skagit terminal area for 2023. However, as anticipated, incidental harvest of summer/fall Chinook occurred in the Sockeye, Pink, and Coho fisheries. The Sockeye, Pink, 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 mortalities in these fisheries were 579 fish, compared to the pre-season expectation of 1,524 based on Chinook FRAM 2023.

There was no tribal ceremonial and subsistence (C&S) harvest of summer/fall Chinook in 2023, so C&S harvest was zero compared to zero expected pre-season.

Total summer/fall Chinook mortalities across all of these tribal commercial and C&S fisheries were 579 in these fisheries, compared to the pre-season expectation of 1,524 based on Chinook FRAM 2023.

Terminal Area Test Fisheries: A suite of Skagit terminal area test fisheries targeting Steelhead, Chinook, Sockeye, Coho, and Chum were conducted by the Skagit tribes in 2023. 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 30 wild spring Chinook, 54 hatchery spring Chinook, and 398 summer/fall Chinook mortalities occurred in these fisheries. The pre-

season expectation of mortalities in the test fisheries was 33 wild spring Chinook, 35 hatchery spring Chinook, and 399 summer/fall Chinook.

Summary: Overall, a total of 273 wild spring Chinook, 3,014 hatchery spring Chinook, and 977 summer/fall Chinook were harvested in treaty commercial, C&S, and test fisheries. The preseason expected mortalities based on Chinook FRAM 2023 was 303 wild springs, 2,951 hatchery springs, and 1,923 summer/falls.

Table 2-3. Skagit terminal area projected and actual hatchery and wild Chinook catches for Skagit terminal area tribal fisheries in 2023. Weekly projections were made by plugging the FRAM Chin2023 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	122	122	Wks 23-27, 29-34	26	26	-96	-96
Sockeye	2 sites: Area 3 wks 23-30, Blakes wks 24-29	67	67	Area 3 wks 23-26, 29-30; Blakes wks 25-28	83	83	16	16
Coho	3 sites: Blakes wks 34 - 45, Area 3 wks 34-42, Spudhouse wks 35-44	273	273	Blakes wks 35-43 and 45; Area 3 wks 35-36,38-39,4-,43; Spudhouse wks 34-40, 42-43	346	346	73	73
Chum	3 sites, wks 44-45	0	0	Jetty wk 44, no Blakes/Bay	0	0	0	0
Steelhead	2 sites, wks 8-18	5	5	Wks 8-17	27	27	22	22
Area 8/78C Spring Chinook Fishery Swinomish Tribe:								
Week 18	7 days	462	462	Same	374	374	-88	-88
Week 19	7 days	277	277	Same	689	689	412	412
Week 20	5 days	279	279	Same	180	180	-99	-99
Week 21	4 days	167	167	Same	293	293	126	126
Area 78P Spring Chinook Fishery Sauk-Suiattle Tribes:								
Wk 20-28	Wk 20: 5 days; Wk 21: 7 days; Wk 22: 4 days; wks 23-28: 3 days/wk	1,000	1,000	Wk 20: 4.67 days; Wk 21: 7 days; Wk 22: 4 days; wk 23: 3 days; wk 24: 2.83 days	706	706	-294	-294
Area 78C/78D Spring Chinook Fishery Upper Skagit Tribe:								
Week 18	0 day	0	0	None	0	0	0	0
Week 19	1 day	270	270	2.25 days	629	629	359	359
Week 20	1 day	363	363	1 days	0	0	-363	-363
Week 21	0.917 days	291	291	1.167 days	226	226	-65	-65
Area 8/78C/78D/78P Chinook C&S Fishery Swinomish, Sauk-Suiattle, Upper Skagit Tribes:								
Sum/Fall-Spring Chin.	As needed	47	47	As needed	36	36	-11	-11
Areas 8/78C Sockeye Fishery Swinomish Tribe:								
Week 26	3 days	18	18	Same	11	11	-7	-7
Week 27	3 days	31	31	Same	41	41	10	10
Week 28	3 days	43	43	Same	48	48	5	5
Week 29	2 days	59	59	Same	0	0	-59	-59
Area 78D/78O Sockeye Fishery Swinomish Tribe:								
Week 27	0 days	0	0	None	0	0	0	0
Week 28	1 day	3	3	None	0	0	-3	-3
Week 29	1 day	3	3	2.124 days	0	0	-3	-3
Week 30	None	0	0	0.708 days	0	0	0	0
Week 31	None	0	0	None	0	0	0	0
Areas 78C/78D/78O Sockeye Fishery Upper Skagit Tribe:								
Week 27	1 day	53	53	2.333 days	117	117	64	64
Week 28	0.5 days	41	41	2.333 days	120	120	79	79
Week 29	None	0	0	2.333 days	136	136	136	136

Areas 8/78C Pink Fishery Swinomish Tribe:								
Week 36	3 days	229	229	None	0	0	-229	-229
Week 37	3.5 days	164	164	None	0	0	-164	-164
Area 78C/78D Pink Fishery Upper Skagit Tribe:								
Week 36	1.167 days	203	203	1.167 days	0	0	-203	-203
Week 37	3 days	178	178	None	0	0	-178	-178
Week 38	3 days	131	131	None	0	0	-131	-131
Area 78B/78P Pink Fishery Sauk-Suiattle Tribe:								
None	None	0	0	None	0	0	0	0
Areas 8/78C Coho Fishery Swinomish Tribe:								
Week 38	None	0	0	2 days	10	10	10	10
Week 39	1 day	27	27	1.083 days	2	2	-25	-25
Week 40	1 day	8	8	0.75 days	1	1	-7	-7
Week 41	None	0	0	None	0	0	0	0
Week 42	None	0	0	None	0	0	0	0
Areas 78P Coho Fishery Sauk-Suiattle Tribe:								
Wks 38-44	Wks 38-44: 3 days/wk	300	300	Wk 36: 0.67 days; wk 37: 6 days; wk 38-39: 3 days; wk 40: 2.791 days	63	63	-237	-237
Areas 78B Coho Fishery Sauk-Suiattle Tribe:								
None	None	0	0	None	0	0	0	0
Areas 78C/78D Coho Fishery Upper Skagit Tribe:								
Week 39	None	0	0	None	0	0	0	0
Week 40	0.375 days (release ck)	57	30	None	0	0	-30	-30
Week 41	0.376 days	25	25	2 days	79	79	54	54
Week 42	0.188 days	9	9	2 days	21	21	12	12
All Terminal Area Chum Fishery Swinomish, Upper Skagit Sauk-Suiattle Tribes:								
None	None	0	0	None	0	0	0	0
Total Skagit Terminal Area:		**5,205**	**5,178**		**4,264**	**4,264**	**-914**	**-914**

2.4 Stillaguamish/Snohomish Terminal Area

The tribal net fishery in Area 8A was open for the 2023/2024 fishing season for Ceremonial Chinook and commercial Pink and Coho salmon fisheries. Nine Chinook salmon were taken in September during the Pink salmon directed fishery with 22 taken during the Coho salmon directed fishery. Thirty-two l Chinook salmon were harvested for ceremonial needs in Area 8A during 2023 (Table 2-4). Non-treaty commercial fishing in Area 8A was closed for the 2023-2024 season.

Tribal Chinook catch in Area 8D occurred from May through September, with most of the catch occurring during June and July. Total 8D catch was 4,047, including 194 for ceremonial or subsistence purposes (Table 2-4). Tribal Chinook catch was less than projected in area 8D.

Coho directed non-treaty commercial fishing in Area 8D was projected to impact three Chinook but remained closed for the 2023-2024 season.

The Stillaguamish Tribe harvested four chinook for ceremonial purposes from the Stillaguamish River in 2023 (Table 2-4).

Table 2-4. Projected (FRAM Chin2023) and actual Chinook net fishery harvest in the Stillaguamish – Snohomish terminal area in 2023.

Area		Projected	Actual
8A Commercial	Treaty	384	31
	Treaty C&S	Up to 100	32
	Ntrty	0	0
8A Test		N/A	--
8D Commercial	Treaty	4,339	3,853
	Treaty C&S		194
	Ntrty	3	0
Stillaguamish R. Net	C&S/Coho	28	4

2.5 South Puget Sound Terminal Areas

Table 2-5. Projected and actual Chinook catch in 2023 South Puget Sound net fisheries.

Area	Management Period	Projected	Actual
Area 9/10/11	Coho (A10 – Test)	0	0
	Chum (A9 – Test)	111	76
	A9 (Trty. C&S + chum)	510	50
	Trty Pink/Coho/Chum (A10/11)	140	0
	NT Pink/Chum (A10/11)	273 [a]	113 [a]
Area 10E	Treaty Chinook/coho/chum	3,865	5,373
Area 10A	Chinook (test/C&S/Comm)	1,410	1,955
	Pink/Coho/chum	91	247
Duwamish River	Chinook/Pink/Coho/Chum	9,152	6,398
	Coho (Test/C&S)		17
L Washington/Ship Canal	Sockeye/coho/ C&S	924	2,391
	Test/Research	N/A	--
Lake Sammamish	Chinook/Coho	1	0
Puyallup River	Spring/Fall C&S	845	261 [b]
	Chinook/Coho	6,668	5,742
White River	Spring/Fall C&S	-- [c]	278
	Coho	--	0
Areas 13, 13D-K	Chinook/Coho/Chum	1,659	3,047
Area 13A	Chinook/Coho/Chum	2,478	1,301
Areas 13C/Chambers	Chinook	513	2,428
Nisqually River	Chinook/coho	4,834	4,211 [b]
McCallister Cr.	Chinook	87	0

[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 594 fish.

Marine Areas 9, 10 & 11

The Coho salmon test fishery in area 10 was not implemented in 2023. The Chum salmon test fishery at Apple Cove Point (Area 9) incidentally caught a total of 76 Chinook (Table 2-5), below the estimated 111.

An estimated 113 Chinook release mortalities occurred during the pink and chum directed non-treaty purse seine and gill net fisheries in area 10 and 11. The treaty Pink, Coho, and Chum salmon fisheries in Area 10 harvested zero chinook. Fisheries directed at Chinook and Coho salmon in Area 10E harvested 5,374 Chinook Salmon (Table 2-5). No Chinook were harvested during the Chum fishery in area 10E.

Fifty Chinook salmon were harvested in Area 9 for C&S purposes or during the Chum salmon fishery.

Lake Washington

There were no Chinook directed fisheries in Lake Washington, the Ship Canal, or North Lake Washington. Sockeye returns to Lake Washington were insufficient to allow any directed fisheries. The Muckleshoot Tribe conducted a C&S fishery in the Lake Washington Ship Canal in 2023 which harvested 328 Chinook. Incidental Chinook catch during the Coho fishery in Lake Union, and the upper and lower Ship Canal harvested 1,062 Chinook. The Muckleshoot Tribe conducted a Coho directed commercial fishery in North Lake Washington with a total by-catch of 1,001 Chinook. The coho directed fisheries in Lake Sammamish incidentally harvested zero Chinook salmon.

The Lake Washington warm water test fishery, conducted by the Muckleshoot Tribe was prosecuted in spring (May-June) of 2023. Monthly reports were provided separately to NOAA for this research.

Elliott Bay/Duwamish River

The Chinook test fishery in Area 10A harvested 384 Chinook in 2023. A Chinook-directed commercial fishery occurred in Area 10A and the Duwamish River, with 1,341 and 5,732 Chinook salmon, respectively. In 10A, there were 247 Chinook caught in September during the Coho directed fishery by Muckleshoot Indian Tribe. In the Duwamish River, 65 Chinook were caught during the coho test fishery to determine Chinook clearance. During the Coho directed fishery in the Duwamish River, 1,186 Chinook were caught incidentally as well as 20 Chinook caught during the Chum directed fishery.

Puyallup River and White Rivers

Ceremonial and subsistence fisheries in the Puyallup River caught 238 adult spring Chinook salmon during management weeks 21–27. Based on fisheries sampling data, an additional 23 fall-run Chinook, were taken during the spring C&S fishery. The Muckleshoot Tribe had an additional spring Chinook C&S fishery in the White River which caught 278 spring Chinook. Besides the 23 fall Chinook taken during the spring C&S, no other fall Chinook C&S fisheries occurred. The pre-season projected C&S catch was 845.

Fall Chinook catch was 2,944 during the Chinook directed fishery. The coho fishery in the Puyallup and White River occurred from management week 37 (September 5th) to management week 42 (October 10th) and incidentally harvested 2,798 Chinook salmon, mostly during early September (Table 2-5).

Marine area 13 & sub areas (Deep South Sound)

The Chinook fishery in Carr Inlet (13A) caught 1,282 Chinook (Table 2-5), in August and early September (weeks 32 – 36). Pre-season projected catch was 2,478. This fishery targets Minter Creek Hatchery Chinook returns where no natural origin fish are returning to spawn. The Coho fishery in 13A incidentally harvested three Chinook, with a preseason expectation of 10.

The Chinook fishery at Chambers Bay (13C) occurred between July 26 through October 10 with 2,482 Chinook harvested (Table 2-5). The preseason catch projection was 512.

Chinook directed fisheries in 13D and Budd Inlet (13F) occurred from mid-July through early-September; total catch was 2,932. Chinook caught incidentally during the Coho fishery (Week 37-40) in 13D totaled 53 fish. Zero Chinook were caught during the Fox Island (Area 13) coho fishery. The total preseason catch projection for both areas was 1,659.

Nisqually River

The treaty commercial fishery in the Nisqually River harvested an estimated 3,646 Chinook, excluding jacks, but including fish for Ceremonial and Subsistence purposes, with a pre-season projected commercial catch, excluding jacks, of 4,834 (Table 2-5).

The selective gill net fishery in the Nisqually River harvested 561 Chinook salmon during the 2023 with an estimated additional six mortalities after release.

2.6 Hood Canal

Tribal Chinook directed fishing in 12C occurred as planned from July 19 through August 31 with a catch of 4,888. Thirty-nine Chinook were landed in 12C during the Coho directed fishery in October. In marine catch area 12B, 34 Chinook was harvested while no Chinook were landed in 12 during the tribal Coho directed fishery.

Tribal Chinook harvest in the Hoodsport Hatchery Zone (12H) was 15,388 and occurred as planned from July 12 through September 12. Catch was greater than the preseason expectation of 10,026.

Tribal chinook troll fishery in areas 12/12B had zero effort so no Chinook were landed in 2023.

Chinook harvest in the Skokomish River occurred as planned from August 3 (wb 8/2) through August 27 (wb 8/23) landing 7,239 fish. No Chinook were harvested during the Coho directed fishery in October. 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 23 through August 16 landing 57 fish.

In Port Gamble (Area 9A), 83 Chinook were harvested, primarily in mid-August to mid-September during Coho fisheries.

Non-treaty commercial fisheries in the Hoodsport Zone (12C) harvested 5,886 Chinook salmon (Table 2-6). There were no Chinook landed in other non-treaty fisheries in Hood Canal in 2023 but 7 release mortalities were estimated to have occurred in purse seine fisheries (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 2023.

Area	Target Species	Projected	Actual
(12, 12B-12D, 9A) (T)	Chin, Coho, Chum	2,744	5,044
(12-12C, 9A) (NT)	Chum, Coho	16	7 [a]
(12, 12B) Troll (T)	Chinook, Coho	200	0
12A Net (T)	Coho	52	0
12H Net (T)	Chinook, Chum	10,026	15,338
12C Hoodsport Zone Net (NT)	Chinook, chum	5,000 [b]	5,886
Skokomish River (82G) (T)	Chin, Coho, Chum	6,453	7,239
(82J) (T)	*Chinook*		*57*
	Total	24,291	39,060 [c]

[a] Values reported are release mortalities.

[b] The co-managers pre-season agreement was for 5,000 and increased by in-season in the NT Hoodsport Zone net catch, but 10,000 was modeled in CHIN2522.

[c] 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 Dungeness River were closed or provided very limited fishing opportunity, with no Chinook harvested in 2023. Four Chinook were harvested for Ceremonial and Subsistence purposes in the Elwha River (Table 2-7).

Table 2-7. Projected and actual catches of Chinook in Strait of Juan de Fuca terminal net fisheries in 2023.

Terminal Area	Projected	Actual
Area 6D & Dungeness River Treaty	0	0
Area 6D Non-Treaty	0	0
Elwha River Treaty (C&S)	3	4
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

Since 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 2023 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 2023 Puget Sound non-treaty salmon net fisheries. Data collected by on-board fishery observers represented as cumulative catch composition by total sets observed. This data does not represent total mortality which is calculated.

Area	Gear type	# sets observed	Chinook	Coho	Sockeye	Pink	Chum	Steelhead
7	PS	2	385	69	52	8,057	3	0
7A	PS	10	39	16	21	1,303	0	0
8A	PS				Closed			
10	PS	100	315	902	38	62,117	4,522	2
11	PS	15	2	14	0	0	1,078	1
12	PS	42	2	15	0	0	3,482	0
12B	PS	34	0	12	0	0	3,973	0
7	GN	0	0	0	0	0	0	0
7A	GN	0	0	0	0	0	0	0
10	GN	8	0	0	0	0	710	0
11	GN	0	0	0	0	0	0	0
12	GN	60	0	0	0	0	764	0
12B	GN	21	0	0	0	0	596	0

Table 2-9. Total pre-season projected and post-season estimated Chinook mortality (landed + released) in Puget Sound non-treaty commercial salmon fisheries in 2023.

	Total Mortality	
Area	Projected	Actual
6D	0	0
7/7A	3,184	675
7B/7C	5,895	10,222
8	N/A	Closed
8A	N/A	Closed
8D	3	Closed
10/11	273	113
12-12C/9A	16	7
12C Hoodsport	5,000	5,886

3 Recreational Harvest

This chapter summarizes expected recreational catch in Puget Sound marine waters and freshwater tributaries for the 2023-2024 management year and presents catch estimates available from Chinook MSF that were intensively monitored using creel during that period. Due to the cycle of recovery and analysis of Catch Record Cards (CRCs) used by recreational anglers, complete catch estimates for all areas where Chinook retention was allowed are not yet available. Since complete Chinook MSF and NS catch estimates were not available for all areas in the annual report covering the previous management cycle, projected and actual recreational Chinook MSF and NS catches for the 2022-2023 management year are also included here, except for winter MSFs in marine catch area 13, which only account for catch through March 31, 2023.

3.1 2022-2023 Recreational Chinook MSF and NS Catch

Mark-selective and non-selective Recreational Chinook harvest in 2022-2023, estimated from preliminary Catch Record Card (CRC) data through March 31, 2023, and creel estimates where available, was 45,385 fish, compared to a preseason projection of 47,709. 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 2522) and actual (preliminary, where available) Chinook catches in Puget Sound Chinook MSF and NS recreational fisheries during the 2022-2023 season.

Area/Fishery	Projected	Actual
Area 5-6		
Area 5 Summer MSF	3,891	3,945
Area 5 Winter MSF	1,727	1,329
Area 6 Summer MSF	6,050	4,791
Area 6 Winter MSF	Closed	--
Other		
Strait Tributaries		
Area 7		
Summer MSF	1,800	1,766
Winter MSF	Closed	--
Nooksack/Samish FW	8,021	8,680
NF Nooksack Spring Chinook	1,296	105
Area 8-1 & 8-2		
Winter MSF	Closed	--
Skagit River		
Spring MSF	613	536
Area 8D SAF	0	0
Stillaguamish River	2	0
Snohomish River		
Skykomish MSF	655	600
Area 9		
Summer MSF	4,700	4,697
Winter MSF	Closed	--
Area 10		
Summer MSF	3,966	4,261
Winter MSF	594	286
Area 11		
Summer MSF	3,396	3,396
Winter MSF	237	106
Area 10E SAF	253	1,572
Lake Sammamish	1	0
Area 10A SAF	278	251
Green River	484	298
Puyallup River		
Carbon R MSF	702	431
Puyallup R MSF	1,164	1,319
Area 13		
Summer MSF	2,852	3,548
Winter MSF	473	174 *
Chambers Cr	26	101
Nisqually	2,698	1,428
Deschutes	8	0
Area 12		
Summer MSF	1,822	1,939
Winter MSF	Closed	--
Skokomish River	Closed	--

* All CRC estimates of catch through 3/31/2023

3.2 2023-2024 Recreational Chinook MSF Catch

Projected Chinook catches for 2023-2024 recreational Chinook MSF fisheries are listed in Table 3-2. The recreational fishing regime included Chinook mark selective fisheries (MSF) for portions of the year in Marine Areas 5 through 13 and in several rivers. WDFW conducted intensive sampling and monitoring of Chinook summer MSFs in Marine Areas 5, 6, 7, 9, 10 and 11 as well as the winter Chinook MSF in Marine Area 10 and 11, 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 2023-2024 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 2024 annual report.

Table 3-2. Projected (FRAM 2023) and actual (preliminary, where available) Chinook MSF catches in Puget Sound recreational fisheries during the 2023-2024 season.

Area/Fishery	Projected	Actual
Area 5-6		
Area 5 Summer MSF	3,906	3,540
Area 5 Winter MSF	1,400	
Area 6 Summer MSF	7,258	5,429
Area 6 Winter MSF	Closed	
Other		
Strait Tributaries		
Area 7		
Summer MSF	2,181	2,082
Winter MSF	Closed	
Nooksack/Samish FW	12,443	
NF Nooksack Spring Chinook	Closed	
Area 8-1 & 8-2		
Winter MSF	Closed	
Skagit River		
Spring MSF	611	
Area 8D SAF	643	
Stillaguamish River	3	
Snohomish River		
Skykomish MSF	96	
Area 9		
Summer MSF	4,300	4,564
Winter MSF	Closed	
Area 10		
Summer MSF	3,566	3,416
Winter MSF	515	
Area 11		
Summer MSF	4,802	1,808
Winter MSF	250	
Area 10E SAF	367	
Lake Sammamish	1	
Area 10A SAF	841	
Green River	1,095	
Puyallup River		
Carbon R MSF	691	
Puyallup R MSF	1,506	
Area 13		
Summer MSF	2,763	
Winter MSF	396	
Chambers Cr	19	
Nisqually	1,793	
Deschutes	5	
Area 12		
Summer MSF	2,288	
Winter MSF	Closed	
Skokomish River	Closed	

3.2.1 Marine Area 5 Summer MSF

2023 was the 21st consecutive year of summer mark-selective fishing in Marine Area 5. The fishery was open for the entirety of the season that was planned preseason, from July 1 through August 15.

WDFW conducted comprehensive fishery monitoring activities during the Area 5 mark selective fishery. 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 (2024).

For Area 5, WDFW estimates that 3,540 Chinook were landed, compared to preseason projections of 3,906 (Table 3 3).

Table 3-3. Comparison of modeled (FRAM 2023) and estimated total Chinook encounters for the 2023 Area 5 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	8,593	2,797	5,796	28
	AD	13,519	4,458	9,061	3,878
	Total	22,112	7,255	14,857	3,906
	% Marked	61	61	61	99
Estimated (Creel) Encounters	UM	5,720	3,064	2,656	50
	AD	14,913	3,881	11,031	3,490
	Total	20,633	6,946	13,687	3,540
	% Marked	72	56	81	99

3.2.2 Marine Area 6 Summer MSF

2023 was the 21st consecutive year of summer mark-selective fishing in Marine Area 6. The fishery was open for the entirety of the season that was planned preseason, from July 1 through August 15.

WDFW's Puget Sound Sampling Unit (PSSU) implemented an intensive monitoring program, Reduced Murthy, using an aerial design in a sub-area of Marine Area 6 east of Ediz Hook throughout the season to collect the data needed to estimate key parameters characterizing the fishery and its impacts on unmarked salmon. Sampling activities included intensive dockside creel sampling, aerial surveys, test fishing and collection of voluntary salmon trip reports (STRs) from the angling public when possible. The fishery control for this Area was based on the preseason prediction of total legal-sized Chinook salmon encountered. Detailed descriptions of the sampling program and results are available in WDFW (2024).

For Area 6, WDFW estimates that 5,429 Chinook were landed, compared to preseason projections of 7,258 (Table 3 4).

Table 3-4. Comparison of modeled (FRAM 2023) and estimated total Chinook encounters for the 2023 Area 6 sub-area summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	4,873	3,211	1,662	32
	AD	13,242	8,306	4,936	7,226
	Total	18,115	11,517	6,598	7,258
	% Marked	73	72	75	100
Estimated (Creel) Encounters	UM	6,984	3,587	3,398	20
	AD	12,836	6,041	6,796	5,409
	Total	19,821	9,627	10,193	5,429
	% Marked	65	63	67	100

3.2.3 Marine Area 7 Summer MSF

2023 was the 8th year of summer mark-selective Chinook fishing in Marine Area 7. In 2023, Area 7 was planned to be open for a three-day period beginning on July 13, then closed to assess catch and encounter totals versus management controls. Subsequent openings were scheduled for July 21 and July 28-29 based on remaining available catch and encounters. In 2023, the fishery in Area 7 opened in July for a total of 6 days.

WDFW conducted comprehensive fishery monitoring activities during Area 7 mark selective fishery. 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 (2024).

For Area 7, WDFW estimates that 2,082 Chinook were landed, compared to preseason projections of 2,181 (Table 3 5).

Table 3-5. Comparison of modeled (FRAM 2023) and estimated total Chinook encounters for the 2023 Area 7 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	4,258	3,158	1,100	32
	AD	3,915	2,471	1,444	2,149
	Total	8,173	5,629	2,544	2,181
	% Marked	48	44	57	99
Estimated (Creel) Encounters	UM	2,951	2,361	590	10
	AD	4,427	2,361	2,066	2,071
	Total	7,379	4,722	2,656	2,082
	% Marked	60	50	78	100

3.2.4 Marine Area 9 Summer MSF

In 2023, a recreational MSF occurred for the 17th consecutive summer in Marine Area 9. Similar to the management paradigm in Area 7, Area 9 was planned to be open for a three-day period beginning on July 13, then closed to assess total catch and encounters versus management controls. Subsequent openings were scheduled for July 20-22 and July 27-28 based on remaining available catch and encounters. In 2023, the fishery in Area 9 opened in July for a total of 8 days.

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 (2024).

An estimated 4,564 Chinook were landed in Area 9, compared to a preseason projection of 4,300 (Table 3.6).

Table 3-6. Comparison of modeled (FRAM 2023) and estimated Chinook encounters for the 2023 Area 9 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	2,598	1,214	1,384	12
	AD	12,384	4,929	7,455	4,288
	Total	14,982	6,143	8,839	4,300
	% Marked	83	80	84	100
Estimated (Creel) Encounters	UM	2,241	1,165	1,076	13
	AD	9,772	5,110	4,662	4,551
	Total	12,013	6,276	5,738	4,564
	% Marked	81	81	81	100

3.2.5 Marine Area 10 Summer MSF

In 2023, a recreational MSF occurred for the 16th consecutive summer in Marine Area 10. The summer recreational MSF was planned preseason in Area 10 from July 13 through August 31, 2023. The fishery closed early on August 4 to allow managers to re-evaluate remaining quota and the status of the legal mark rate within the test fishery. The fishery was then re-opened from August 11-13 and again August 18-20, 2023. In 2023, the fishery in Area 10 opened for a total of 27 days.

WDFW's Puget Sound Sampling Unit (PSSU) implemented an intensive monitoring program in Area 10 throughout the season to collect the data needed 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 (2024).

An estimated total of 3,416 Chinook were landed during this fishery, compared to the pre-season projection of 3,566 (Table 3 7).

Table 3-7. Comparison of modeled (FRAM 2023) and estimated Chinook encounters for the 2023 Area 10 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	3,583	1,265	2,318	25
	AD	9,500	4,070	5,430	3,541
	Total	13,083	5,335	7,748	3,566
	% Marked	73	76	70	99
Estimated (Creel) Encounters	UM	4,009	1,483	2,526	35
	AD	10,433	3,624	6,809	3,381
	Total	14,442	5,107	9,335	3,416
	% Marked	72	71	73	99

3.2.6 Marine Area 11 Summer MSF

In 2023, a recreational MSF occurred for the 17th consecutive summer in Marine Area 11. The fishery was planned to occur from June 1 through September 30, 2023. In June, the fishery was closed early on the 11th due to reaching the unmarked encounter limit for the month of June. The fishery was reopened on July 1-2, 6-9, 13-14 and was closed due to reaching the sublegal and unmarked encounter limits for the July-September period. In 2023, the fishery in Area 10 opened for a total of 16 days.

WDFW's Puget Sound Sampling Unit (PSSU) implemented an intensive monitoring program in Area 11 throughout the season to collect the data needed 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 (2024).

An estimated total of 1,808 Chinook were landed during this fishery, compared to the pre-season projection of 4,802 (Table 3.8)

Table 3-8. Comparison of modeled (FRAM 2023) and estimated Chinook encounters for the 2023 Area 11 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	2,903	1,544	1,359	31
	AD	9,667	5,484	4,183	4,771
	Total	12,570	7,028	5,542	4,802
	% Marked	77	78	75	99
Estimated (Creel) Encounters	UM	2,577	1,569	1,008	13
	AD	5,042	2,017	3,025	1,795
	Total	7,619	3,585	4,034	1,808
	% Marked	66	56	75	99

3.2.7 North Fork Nooksack Spring Chinook MSF

In 2023, the recreational spring Chinook MSF was closed.

4 Spawning escapement

This section compares natural Chinook escapement estimates for 2023 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 below projected estimates, except for Dungeness River spring/summer-run Chinook salmon.

For summer/fall populations, escapements were greater than projected for all management units, except the Skagit River summer/fall, Stillaguamish summer/fall, Snohomish summer/fall, Cedar River fall, Green River fall and Mid-Hood Canal fall-runs Chinook escapements were less than forecasted abundance.

Table 4-1. Pre-season projections and preliminary post-season estimates of 2023 Puget Sound Chinook escapement.

Management Unit		NOR	HOR	Total	Projected (FRAM 2023)
Nooksack	NF			N/A	72 [1]
	SF			N/A	324 [1]
Skagit spring	Suiattle	360		360	528 [1]
	Cascade	353		353	175 [1]
	Sauk	471		471	1,269 [1]
	Total spring	1,184		1,184	1,972 [1]
Skagit summer/fall	Sauk summer	559			334 [1]
	Upper Skagit summer	8,330			7,974 [1]
	Lower Skagit fall	2,899			1,417 [1]
	Total summer/fall	11,788		11,788	10,120 [2]
Stillaguamish	Total	452	414	864 [3]	1,152
Snohomish	Skykomish	1,138	1,060	1,198	2,481 [1]
	Snoqualmie	423	222	645	814[1]
	Total	1,561	1,282	2,843	3,295 [1]
Lake Washington	Cedar	426	234	660	638
Green		484	1,229	1,713	3,762
Puyallup		1,073	2,820	3,893	2,682
White		924	1,220	2,144 [4]	2,391 [4]
Nisqually		1,003	7,085	8,088 [5]	6,304
Skokomish		892	3,884	4,776	2,101
Mid Hood Canal	Dosewallips			2	
	Duckabush			3	
	Hamma Hamma			5	
	Total			10	12
Dungeness		363	712	1,075 [6]	923
Elwha		192	3,658	3,850 [7]	2,722
Hoko				4,393	2,363

1. Natural-origin only.
2. Skagit Su/Fa projection total includes NOR and HOR escapement to the spawning grounds.
3. Includes NORs and HORs collected for broodstock (n=136) from the North Fork which are part of the FRAM Projection.
4. Includes NORs, HORs, and 1,501 vent-clipped acclimation pond fish trucked and 513 fall NOR adults 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. Uncertainty exists around the NOR estimate as there is no ability to validate USACOE sampling.
5. Includes 1,215 (1,003 NOR's and 212 HOR's) volitional spawners, as well as hatchery rack return of 6.869.
6. Includes 128 fish removed from the river for use as broodstock.
7. TRS estimated from SONAR. Includes adult fish collected for broodstock. Estimate does not include jacks.

4.1 Nooksack River Early Chinook

Nooksack River early (spring) Chinook escapement estimates are summarized by population (North and Middle Fork (NF/MF) and South Fork (SF)) and account for all spawners of each population regardless of where they spawn in the Nooksack Basin (i.e. accounting for each population of spawners in both the NF/MF and SF basins). Escapement estimates are carcass-based for the NF/MF basin and redd-based for the SF basin. Population assignments are made for each individual carcass observed by using a combination of genetic, external mark, CWT, and otolith biological data collected during surveys. For unmarked, or putative wild fish, genetic stock assignments are the primary means to assign probable population for each individual.

North/Middle Fork early (spring) Chinook

The North and Middle Forks of the Nooksack River originate from Mount Baker glaciers and are typically turbid with moderate or lower flows during summer due to glacial melt. Co-managers have modified their escapement methods as needed, depending on the survey conditions to reflect what they believe to be the most accurate estimates. The 2019 -2022 escapement estimates are presented here. The 2023 estimates are pending but are not yet available.

Because of the unpredictability of redd viewing conditions during spring Chinook spawning seasons (mid-July through late-September) within the North and Middle Forks and their tributaries, a carcass-based methodology is used instead of a redd-based methodology. This methodology was developed from five years of surveys with good substrate visibility (1991, 1992, 1995, 1996, 2000) which enabled annual cumulative redd counts. Redd counts in those years were multiplied by 2.5 fish per redd to estimate basin population abundances. The carcass counts in each of those five years was then expanded to match the respective redd-based population abundance estimates. The averaged expansion needed in those five years was 3.48 fish 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, 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 those four years, expanding total enumerated redds by 2.5 adults per redd in the Middle Fork and applying the 3.48 fish per carcass expansion factor only to the North Fork carcass counts during those years.

Beginning in 2009 and continuing through 2022, visibility was lower in the Middle Fork which limited redd detection efficiency 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. A Middle Fork-specific carcass expansion factor was calculated in a method similar to the North Fork; by expanding carcass counts observed during 2005 through 2008 when good viewing conditions were present during the spawning season. The total number of redds was multiplied by 2.5 fish per redd to estimate total spawners and then divided by the number of carcasses observed resulting in a 1.91 average expansion factor per observed carcass. The carcass expansion factor of 1.91 continues to be used for Middle Fork surveys due to persistent limited redd visibility.

From 2013-2022, Peat Bog Creek and Bear Creek (tributaries to the Middle Fork) also showed higher carcass counts than prior to 2013. Therefore, during this period, carcass counts from all tributaries to the Middle Fork that are surveyed were enumerated but not expanded. Surveys were frequent and the unexpanded tributary carcass counts were considered to reflect total Chinook more accurately, given consistent low flow and clear water conditions.

Beginning in 2010 and continuing through 2022, another significant change in early Chinook escapement estimate methodology was applied in Kendall Creek, a tributary to the North Fork. The change resulted in carcasses observed in Kendall Creek and Kendall Slough no longer being expanded, and instead were considered to be 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.

Starting in 2016, co-managers began using genetic-based stock assignments to apportion total basin escapement estimates to different genetic stocks present in the system. Tissues are collected from all carcasses sampled to genetically assign individuals 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. The DNA results from the natural origin return (NOR) carcasses were applied to apportion the estimated total NORs in the North/Middle Fork basin to one of the three genetic baseline stocks. As such, the North/Middle Fork Chinook escapement estimates are the number of naturally spawning natural-origin early-timed North/Middle Fork chinook and Kendall Creek Hatchery origin Chinook in the Nooksack forks, including those within the South Fork (see next section and Table 2). Further, 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 2022 NF/MF Chinook escapement estimate is 905 in the North Fork and Middle Fork basins (49 NORs and 856 HORs; Table 4-2. Early timed Chinook spawning escapements for 2019 - 2022 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), plus an additional 107 in the South Fork basin (9 NORs and 98 HORs; Table 4-3. Early timed Chinook spawning escapements for 2019 - 2022 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.

). There were an additional 28 pre-spawn mortalities (PSMs) in the South Fork (1 NOR and 27 HORs; Table 4-4). NF/MF NOR escapement was similar to 2021 and slightly higher than 2019 and 2020, and HOR escapement was much higher than 2020.

> Table 4-2. Early timed Chinook spawning escapements for 2019 - 2022 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 Nooksack Basins					
Year	NF/MF NOR	Kendall HOR	SF NOR	SF HOR	Fall NOR	Fall HOR
2019	32	831	10	79	11	1
2020	38	198	7	100	15	15
2021	55	985	59	313	24	23
2022	44	861	10	271	0	1

South Fork Nooksack early (spring/summer) Chinook

The South Fork watershed is a non-glacial system and the summer low flow visibility is much better than in the North and Middle Forks, although visibility can deteriorate after fall rain freshets begin. The South Fork escapement methodology is a redd-based estimate instead of

carcass-based. Escapement estimates are calculated by multiplying the total number of redds observed by 2.5 adults per redd.

From 2017 through 2021 the methodology applied 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).

In 2022, Nooksack basin co-managers agreed to include all redds through October 14 and all carcasses recovered through October 21 in the SF escapement methodology based on review of biological sample results.

Prior to 2017, assumption #3 only included redds that were built through September 30 and carcass recoveries through October 7. However, 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.

Starting in 2016, co-managers began using genetic-based stock assignments to apportion South Fork basin escapement estimates to Chinook stocks known to occur in the basin. DNA is collected from all carcasses in order to assign individuals to one of the three Nooksack baseline stocks using probability estimates: South Fork early Chinook, North/Middle Fork early Chinook, or Samish/Nooksack fall Chinook. The DNA stock assignment results are then used to apportion the redd-based South Fork escapement estimate to each of the three baseline genetic stocks (Table 4-3).

Hatchery origin (HOR) fish are identified based on adipose fin clip marks, otolith marks, and/or CWT presence and subsequently assigned to their respective hatchery stock origin. Furthermore, because the WDFW Molecular Genetics Lab (Lab) staff has genotyped the adult broodstock spawned for the Skookum Hatchery chinook program, they are able to use parentage-based molecular techniques to identify individual offspring that had a single parent and both parent assignments of hatchery chinook broodstock. From 2017 through 2022, the Lab used this parentage-based technique for field sampled carcasses which assigned to the South Fork baseline but did not have field observed indicators recorded that identified them as hatchery-origin fish (primarily CWTs). The Lab recommended that Nooksack co-managers consider individuals as South Fork HORs that assigned as offspring of two hatchery broodstock parents if spawning records were consistent, or at least were spawned on the same date. Therefore, these individuals are included as South Fork HORs instead of South Fork NORs. As of brood-year 2017, the Skookum hatchery program now otolith marks all South Fork Skookum hatchery releases. Starting with return year 2022, all returning HORs are otolith marked and we no longer assess stock assignments based on only on genetic parentage-based assignments for natural escapement purposes. As such, the South Fork Chinook escapement estimates are the number of naturally spawning NOR early-timed South Fork Chinook and Skookum Creek HOR Chinook in the Nooksack basin, including those within the North/Middle Forks (see previous section and Table 4-2).

> The 2022 South Fork population escapement estimate is 2,954 in the South Fork basin (275 NORs and 2,679 HORs; Table 4-3. Early timed Chinook spawning escapements for 2019 - 2022 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.

) and 281 in the North Fork basin (10 NORs and 271 HORs; Table 4-2). Pre-spawn mortalities (PSM) are not included in South Fork basin escapement estimates and are separately summarized for 2019 - 2022 in Table 4-4 below.

Table 4-3. Early timed Chinook spawning escapements for 2019 - 2022 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 Basin					
Year	SF NOR	SF HOR	NF/MF NOR	NF/MF HOR	Fall NOR	Fall HOR
2019	61	369	6	9	8	27
2020	243	1,085	45	67	30	10
2021	92	717	4	107	26	19
2022	275	2,679	9	98	31	11

Recent years have seen substantial Chinook pre-spawn mortality events during warm summer periods in the South Fork Nooksack. In 2021, the Nooksack co-managers observed an unprecedented pre-spawn mortality event where over 2,000 Chinook died before they had the chance to spawn in the South Fork basin. This led to a total of 2,432 pre-spawn mortalities in the South Fork over the course of the spawning season. This was a raw count of Chinook carcasses that did not show any evidence of spawning, and was likely an underestimate, given that it was not logistically feasible to sample every carcass before they deteriorated or were carried downstream. Total counts of all South Fork basin PSM Chinook from 2019 through 2022 are summarized in Table 4-4.

It was not feasible to fully sample every carcass during the 2021 PSM event, so Lummi staff employed a subsampling scheme to determine which carcasses would be fully sampled. All data collected would be the same for both sampled and subsampled groups, except fully sampled fish would include additional biological data such as: fin clip for genetics, CWT extraction (if present), otoliths, and scales. Fork length and sex were collected for most subsampled fish but not all. All unmarked & untagged fish (putative NORs) were fully sampled and not subject to the subsampling scheme. On the first day of the PSM event in 2021 that saw several hundred carcasses in a small area, Lummi staff subsampled 1 in 5 from each group based on mark status (Groups were: ad-clipped only, ad-clipped + CWT, and CWT only). After the first day, Lummi staff changed to a 1 in 10 subsampling scheme to be able to better handle the PSM event and still be able to gather representative data from each group. This 1 in 10 scheme was generally used during any survey where staff estimated there were >100 carcasses present. Notes on PSM observations and subsampling scheme used were included in survey data sheets. The same subsampling scheme was employed throughout 2022 in the South Fork, with a 1 in 10 rate applied in each instance where subsampling PSMs was necessary.

There were environmental variables that likely played a role in the PSM event including a “heat dome” event in late June 2021 that saw local temperatures above 100ºF over several days and consistent low-flow, high water temperature conditions throughout the South Fork basin. These cumulative stressors led to the proliferation of several pathogens (*Flavobacterium columnare*, *Ichthyophthirius multifiliis*, and freshwater diatoms) that were confirmed by a WDFW senior veterinarian who performed necropsies on carcasses of 4 PSM Chinook.

In 2022, the South Fork basin continued to exhibit high water temperature and low flow conditions throughout the spawning season that were likely tied to the increased prevalence of pre-spawn mortalities. At the USGS Saxon Bridge gage (USGS ID 1221000), temperatures were routinely above the 16˚C TMDL temperature goal for seasonal salmonid spawning conditions between July and September, with a maximum observation of 23.2˚C (Figure 4-1). River discharge was also below the minimum instream flow goal of 300 cfs (WAC 173-501-030) from late July through the end of the spawning season in mid-October (Figure 4-2).

The escapement estimate is an expanded value based on the number of redds, while the PSM carcasses are raw counts, and thus not directly comparable. However, it is important to note that we observed 364 spawned or partially spawned carcasses throughout the 2021 survey season. Therefore, PSM carcasses accounted for over 86.7% of all carcasses observed (2,796) in the SF basin in 2021. In 2022, we observed 947 spawned or partially spawned carcasses, 167 of unknown spawn status, and 1,100 PSMs. This shows that PSM's accounted for 50% of all carcasses observed (n = 2,214) in the South Fork in 2022.

Table 4-4. Early timed Chinook pre-spawn mortality (PSM) raw counts for 2019 - 2022 return years in the South Fork basin.

	South Fork Basin PSM					
Year	SF NOR	SF HOR	NF/MF NOR	NF/MF HOR	Fall NOR	Fall HOR
2019	2	30	0	1	0	0
2020	1	34	0	1	0	4
2021	41	2,292	2	82	4	11
2022	29	1,026	1	27	2	8

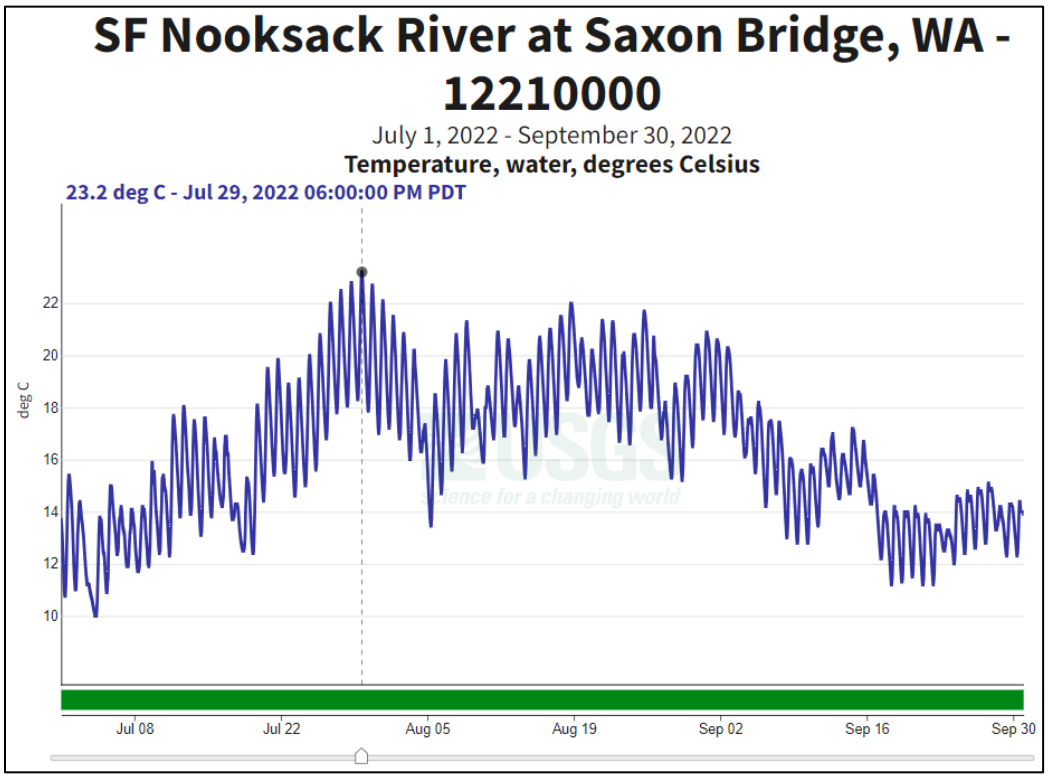

Figure 4-1. Water temperatures measured at the USGS Saxon Bridge gage from July – September, 2022.

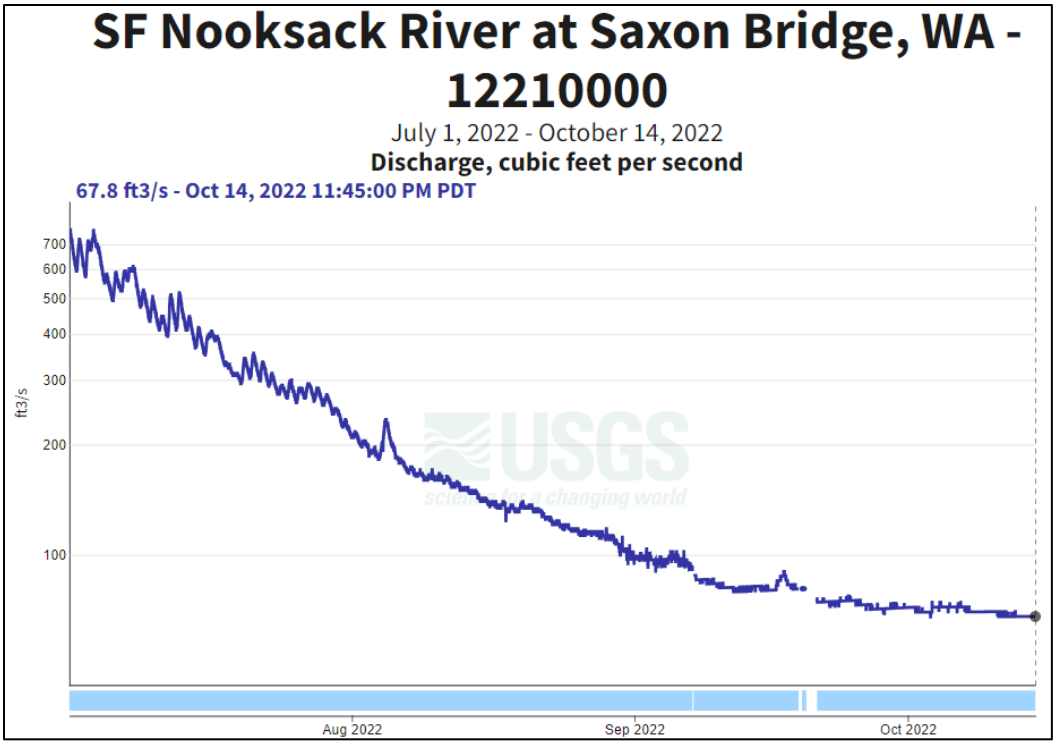

Figure 4-2. Discharge (cfs) measured at the USGS Saxon Bridge gage from July – mid-October, 2022.

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 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), Sauk-Suiattle Indian Tribe, and Seattle City Light, performed work and contributed data necessary to complete the escapement estimates and predictions for the Skagit River Basin Chinook salmon stocks.

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 except for 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 July 25 through September 29. The survey goal was to cover each index every 7 -10 days 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 logjam that had been a passage barrier on Buck Creek in previous years (approximately RM 1.2) remained in 2023. The logjam continues to be a total passage barrier with no live Chinook or Chinook redds observed upstream of the logjam. A total of 144 redds were observed in 2023.

A total of 56 Suiattle spring Chinook carcasses were observed, and 43 were collected and sampled; 1 carcass was adipose clipped but not tagged, and 42 were wild unmarked fish. The season total redd count was 144 (Table 4-5).

Table 4-5. Suiattle River spring Chinook 2023 spawning ground survey redd counts. This table includes only observed redds.

Stream	WRIA	Survey method	Reach (RM)	Location[*1]	Redds
Big Creek	3.0723	Foot	0.0-0.6	7.8	0
Tenas Creek	3.0761	Foot	0.0-0.5	9.6	0
Straight Creek	3.0797	Foot	0.0-0.1	15.1	0
Buck Creek	3.0813	Foot	0.0-1.7	18.1	34
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	92
Sulfur Creek	3.0973	Foot	0.0-0.9	26.3	14
Milk Creek	3.1022	Foot	0.0-0.1	28.6	4
				Total redds	144

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

The preliminary 2023 Suiattle River Spring Chinook escapement estimate was 360 fish (rounded). All data and estimates of escapement were preliminary at the time of reporting.

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 varying distances (less than one river mile) dependent upon stream flow and available spawning habitat.

Surveys of all known spawning habitat occurred from July 24 through October 2. Mainstem surveys were conducted by foot or pontoon boat depending on the stream features of the index. Historically this survey interval for this population was one pass every 10-14 days, but to find and sample more carcasses, surveys of these reaches occurred up to twice per week in 2023. One pass would focus on redds and carcasses, the next pass would focus only on carcasses.

A total of 20 carcasses were observed and 20 were able to be collected and sampled in the upper Cascade spring Chinook area in 2023. 13 of the carcasses were unmarked and untagged wild Chinook, 2 carcass was adipose clipped and untagged, 3 were adipose clipped and tagged, and 2 were coded wire tagged only.

Surveyors located 141 redds in 2023 (Table 4-6**Error! Not a valid bookmark self-reference.**). The 2023 upper Cascade River spring Chinook spawning escapement estimate was 353 fish. All data and estimates of escapement were preliminary at the time of reporting.

Table 4-6. 2023 Cascade River spring Chinook redd counts.

Stream	WRIA	Survey method	Reach (RM)	Location[*1]	Redds
Cascade River	3.1411	Foot	8.1-9.0	18	12
Marble Creek	3.1451	Foot	0.0-0.3	0	1
Cascade River	3.1411	Foot/Raft	9.0-12.4	46	57
Cascade River	3.1411	Foot	12.4-15.8	45	56
Cascade River	3.1411	Foot	15.8-18.6	32	38
Kindy Creek	3.1528	Foot	0.0-0.5	0	0
North Fork Cascade River	3.1605	Foot	0.0-0.1	0	0
South Fork Cascade River	3.1411	Foot	0.0-0.5	0	0
				Total redds:	**141**

[*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 39.7. 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 19. The survey interval goal was to survey all indexes upstream of the White Chuck River every 7-10 days 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 161 Sauk River spring Chinook carcasses were observed and 114 were recovered and sampled. 108 carcasses sampled were wild unmarked and untagged fish, 1 were adipose clipped and untagged,1 was clipped and coded wire tagged, 2 was coded wire tagged and not clipped, and 2 carcass was unknown due to compromised tissue. There were 187 redds located upstream of the White Chuck River by ground-based surveys, and 1 (rounded) AUC estimated redds downstream of the White Chuck River in the section surveyed by helicopter (Table 4-7).

The 2023 upper Sauk River spring Chinook preliminary escapement estimate was 471 fish. All data and estimates of escapement were preliminary at the time of reporting.

Table 4-7. Upper Sauk River spring Chinook redd counts from 2023 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	66
Falls Creek	3.1182	Foot	0.0-0.2	34.9	1
Sauk River	3.0673	Foot/Float	37.8-39.7	37.8	6
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	1
North Fork Sauk River	3.0673	Foot	40.1-41.3	40.1	10
				Total redds (rounded):	**188**

[*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 6 through October 31 (Table 4-8).

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 488 Skagit summer Chinook carcasses were observed, and 401 carcasses were recoverable and sampled; 367 carcasses were unmarked and untagged wild Skagit summer Chinook, 6 carcasses were adipose clipped only (no cwt), 25 were adipose clipped and CWT present, and 3 were CWT only.

We observed 217 Skagit summer Chinook redds in the tributaries and estimated 3,115 redds in the mainstem reaches.

The expected 2023 escapement of Skagit River summer Chinook was 8,330 fish (rounded). All data and estimates of escapement were preliminary at the time of reporting.

Table 4-8. Skagit summer Chinook redd counts from 2023 spawning ground surveys.

Stream	WRIA	Survey method	Reach (RM)	Location[*1]	Redds
Goodell Creek	3.1867	Foot	0.0-1.3	92.9	3
Falls Creek[*3]	3.1780	Foot	0.0-0.4	4.0	0
Bacon Creek	3.1774	Foot	0.0-4.2	82.9	118
Diobsud Creek	3.1750	Foot	0.0-1.3	80.7	0
Cascade River	3.1411	Foot/Float	0.0-4.2	78.1	94
Illabot Creek	3.1346	Foot	0.0-2.6	71.6	2
				Total redds:	217

[*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 20 and continued through October 23 but no Sauk summer Chinook redds or carcasses were observed (Table 4-9).

Weather and stream conditions were generally favorable for aerial surveys of the mainstem Sauk summer Chinook indexes. An estimated total of 224 redds were built in the mainstem throughout spawning. The 2023 escapement estimate was 559 Sauk summer Chinook (rounded).

A total of 7 Sauk summer Chinook carcasses were recovered and samples. Four were unmarked and untagged wild Sauk summer Chinook, 1 was adipose clipped and coded wire tagged, 1 was coded wire tag only, and 1 was unknown due to a compromised head. All data and estimates of escapement were preliminary at the time of reporting.

Table 4-9. Lower Sauk River summer Chinook redd counts from 2023.

Stream	WRIA	Survey method	Reach (RM)	Location[*1]	Redds by method		
					Foot surveys	AUC	Linear regression
					Actual	Estimated	Predicted
Dan Creek	3.1079	Foot	0.0-0.8	16.8	0	N/A	N/A
Hilt Creek	3.0678	Foot	0.0-0.5	0.6	0	224	N/A
Grand total redds from all methods (rounded):					0	224	0

[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 few

large and small tributary streams depending on flow conditions. Tributary surveys were conducted by foot every seven to fourteen days. Encountered carcasses were sampled for scales, measured for fork length, and checked for coded wire tags. Tributary redds were counted and marked with flagging to prevent repeated counting.

Skagit fall Chinook spawning surveys began September 5 and continued through November 9 (Table 4-10). A total of 68 carcasses were observed, of which 53 were able to be collected and sampled. 49 carcasses were from wild unmarked and untagged fish, and 1 was from adipose clipped and untagged fish, 2 were adipose clipped and coded wire tagged, and tag status of one carcass could not be determined due to carcass condition. Four helicopter flight redd surveys were conducted and tributary surveys were conducted by foot every seven to fourteen days. Tributary surveys identified 23 redds, and these were summed with 1,119 AUC estimated mainstem redds from the four aerial surveys. Redd counts were multiplied by 2.5 fish per redd to calculate escapement.

The 2023 escapement estimate of Skagit River fall Chinook was 2,854 fish (rounded). All data and estimates of escapement were preliminary at the time of reporting.

Table 4-10. Lower Skagit River fall Chinook redd counts from 2023 spawning ground surveys.

Stream	WRIA	Survey method	Reach (RM)	Redds
Skagit River	3.0176	Flight	24.5-56.5	661
Skagit River	3.0176	Flight	56.5-67.2	458
Hansen Creek	3.0265	Foot	3.0-4.5	0
Day Creek	3.0299	Foot	0.0-2.2	5
Jones Creek	3.0332	Foot	0.0-1.3	0
Grandy Creek	3.0337	Foot	0.0-1.4	5
Alder Creek	3.0359	Foot	0.0-1.6	1
O'Toole Creek	3.0365	Foot	0.0-0.2	0
Mill Creek	3.0375	Foot	0.0-0.2	0
Pressentin Creek	3.0385	Foot	0.0-0.4	0
Finney Creek	3.0392	Foot	0.0-7.0	12
Jackman Creek	3.0626	Foot	0.0-0.7	0
EF Nookachamps Creek	3.0230	Foot	3.5-5.1	0
			Total Redds	1,142

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 most of the 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 most of the 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 incorporating the transgenerational genetic mark recapture (tGMR) 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 tGMR-based escapement estimate results from the years 2008 through 2022. The tGMR-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. The tGMR estimates require genetic sampling of adult non-pre-spawn carcasses in the fall and of young-of-the-year juvenile fish the following spring. When the final tGMR escapement estimate is completed, it then replaces the initial redd-based tGMR 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. Prior 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 most of their known distribution. Surveyed areas were the North Fork from RM 0.0 to 34.4 and North Fork tributaries including Squire, Segelson, French, Brooks, and Grant creeks, and Boulder River. Escapement was estimated using expansion of cumulative redd counts (2.5 fish per redd) from raft and foot surveys and then multiplying by the tGMR correction factor. Survey conditions for counting Chinook in the North Fork Stillaguamish were generally good to excellent throughout the spawning period. The first redds were detected on August 17th in the North Fork, and last one was detected November 1 in the North Fork. A total of 178 Chinook redds were counted on the North Fork of the Stillaguamish in 2023 (Table 4-11). The redd-based escapement estimate was 447 fish (Table 4-11). The tGMR-adjusted provisional escapement estimate is 763 fish (NOR 399, HOR 364). An additional 136 fish (NOR 57, HOR 79) were taken for hatchery broodstock and were not included in the tGMR adjusted provisional escapement estimate but are included the ETRS (extreme terminal runsize) and origin proportioning for the watershed.

Table 4-11. North Fork Stillaguamish summer and fall Chinook redd counts in 2023.

Stream	WRIA	Method	Reach (RM)	Redds	Escapement
North Fork	5.0135	Foot/Float	0.0-14.3	22	55
North Fork	5.0135	Foot/Float	14.3-30.0	129	323
North Fork	5.0135	Foot/Float	30.0-34.4	23	58
Grant Creek	5.0156	Foot	0.0-0.4	0	0
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	1	3
French Creek	5.0246	Foot	0.0-3.0	0	0
Squire Creek	5.026	Foot	0.0-4.0	3	8
Brown Creek	5.0265	Foot	0.0-1.0	0	0
			Total Redds	**178**	
	Redd-based Escapement Estimate				**447**
	GMR adjusted EE (provisional)				**630**

South Fork and Mainstem Stillaguamish summer and fall Chinook

South Fork and Mainstem Stillaguamish summer and fall Chinook escapement in 2023 was estimated by 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 Silvana 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 miles 34.7 to 55.1 include Granite Falls and Robe Canyon and are rarely surveyable due to poor visibility from turbidity and limited return for the effort required to conduct surveys there. No Chinook redds were observed in the upper SF in 2023. The mainstem aerial index reach, from mouth (RM 0.0) to the forks (RM 17.8), was flown twice in 2023, September 13 and October 2.

A total of 37 Chinook redds were found in the Mainstem Stillaguamish and South Fork Stillaguamish River and tributaries in 2023 (Table 4-12). The redd-based escapement estimate was 94 adult fish, which expanded to 133 (NOR 72, HOR 61) adult fish with the application of the tGMR correction factor (Table 4-12).

Table 4-12. South Fork and Mainstem Stillaguamish summer and fall Chinook redd counts in 2023.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Mainstem	5.0001	Flight	6.0-17.8	14	35
South Fork	5.0001	Foot/Float	17.8-34.7	16	40
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	5	13
Siberia Creek	5.0324	Foot	0.0-0.4	0	0
Canyon Creek	5.0359	Foot	0.0-0.5	1	3
		Total Redds		**37**	
		Redd-based Escapement Estimate			**94**
		GMR adjusted EE (provisional)			**133**

Carcass sampling and escapement composition

WDFW and Stillaguamish Tribe Natural Resources staff conducted spawning ground survey work and carcass sampling in the North and South Forks of the Stillaguamish River and their tributaries. Stillaguamish Tribal staff also sample the broodstock collected from the spawning grounds for hatchery production. Tribal staff focused their Chinook carcass sampling efforts in the North Fork between the mouth and Swede Heaven Bridge (RM 0.0 to 30.0) and WDFW staff focused on the remaining spawning grounds in the watershed. In total, 366 complete carcasses (status of both adipose fin and CWT was determined) were sampled in the Stillaguamish River; 136 in broodstock collection, 230 combined in the North Fork and South Fork reaches (Table 4-13). The sampling rates of Chinook carcasses, not including those with unknown mark dispositions, were 30.1% for the spawning grounds and 100% for the broodstock. These rates were calculated by dividing the number of carcasses sampled by the escapement estimate (tGMR EE) for each sampling location.

Escapement of Chinook by origin (hatchery origin recruits – HOR, and natural origin recruits – NOR) was determined in a two-step process. First, the proportion of HOR carcasses of the total complete carcasses is calculated. This rate is applied to the spawning ground tGMR adjusted provisional escapement estimate. Second, after the HOR rate is applied to the spawning ground escapement estimate, the brood stock fish by origin are added to the corresponding escaped, or natural spawners, by origin. For 2023, a total of 220 intact carcasses were found and sampled on the spawning grounds. An additional 10 incomplete carcasses, without heads, were also found but were not included in origin proportioning because they could not be sampled for coded-wire tags (CWTs). Of the 220 complete carcasses,101 (45.9%) were determined to be of hatchery origin. HOR/NOR sample proportions applied to the tGMR provisional adjusted escapement of 763 results in 324 HOR adults. Then the number of hatchery origin adults known in the broodstock (79) are added to the estimated spawning ground hatchery adults (350), for a watershed escapement hatchery proportion of 52.2%.This methodology is used due to the reduced sampled sizes on the spawning grounds and differences in timing of broodstocking that can in some years cause the broodstock samples to weight the total proportion in a magnitude not reflective of the returning population (Table 4-13).

Table 4-13. Stillaguamish Chinook sample proportions and HOR:NOR composition in 2023.

	Sampled	Sampled Hatchery	Sampled Natural	% Hatchery	% Natural	GMR Esc EST	% Sampled
GMR Adjusted EE1	220	101	119	45.9%	54.1%	731	30.1%
Broodstock (NF)	136	79	57	58.1%	41.9%	136	100.0%
Stillaguamish Totals				47.8%	52.2%	867	

4.4 Snohomish River

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

Escapement estimates of naturally spawning Chinook salmon returning to the Snohomish watershed are calculated from cumulative redd counts made from physical surveys of their spawning grounds, and from counts of adult fish passed at Sunset Falls. Additionally, redd

estimates for non-surveyed reaches on Raging River, North Fork Tolt River and Cherry Creek were expanded based on redds per mile of adjacent surveyed reaches. Survey methods included ground-based walking and float surveys, as well as aerial surveys conducted from a helicopter. Ground counted redds were monitored using marked-redd-census methodology. Ground surveys were done at a frequency of seven to ten days, to not miss new redds. Redds in ground-surveyed reaches were enumerated, marked with a GPS waypoint, and flagged to prevent re-counting on subsequent surveys. Aerial surveys were conducted on the Snohomish, Skykomish, North Fork Skykomish and Snoqualmie Rivers at target intervals of two weeks. Aerial surveys provided total visible redd counts 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, less Sunset Falls. The live count of Chinook passed above the trap at Sunset Falls on the South Fork of the Skykomish was added to redd-based total for the total escapement estimate. Additionally, in some reaches where there was poor redd visibility and carcass counts exceeded redd-based estimates, the carcass counts were added to the overall escapement instead of redd-based expansions (Wallace River, Elwell, Olney, Proctor, Bridal Veil, and lower Tokul creeks). Carcasses encountered were sampled for scales, DNA, CWT, adipose fin mark status, and otoliths. Hatchery and natural fractions determined from these samples are applied to the redd-based escapement estimates for each subwatershed and summed to estimate total hatchery- and natural-origin Chinook escapements for each population and the basin total.

Skykomish summer/fall Chinook

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

Survey conditions were good for most of the spawning season. Normal fall rains came at the end of October that interrupted survey coverage, but overall frequency and number of surveys was acceptable. For the most part, survey intervals were kept at seven to ten days. Four aerial surveys were flown on the mainstem Snohomish, Skykomish, and North and South Fork Skykomish Rivers at two-week intervals between mid-September and mid-November.

A total of 592 Chinook redds were found in the Skykomish River, its tributaries, and in the Pilchuck River in 2023 (Table 4-14). The spawning escapement estimate for the Skykomish population (including Sunset Falls trap counts) was 2,198 adult fish (1,138 NOR, 1,060 HOR; Table 4-16). An additional 4,870 adult hatchery-origin fish (including 32 jacks) and 76 adult and 3 jack natural-origin fish recruited to Wallace River Hatchery and were included in the hatchery escapement and not this natural escapement estimate. Total adult NOR Skykomish escapement (natural spawning + broodstock collection) was 1,214 Chinook.

Table 4-14. Skykomish summer/fall Chinook redd counts and escapement, 2023.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Snoh-Sky (Mainstems)	7.0012	Float/Flight	13.2-51.5	365	913
NF Skykomish	7.0982	Foot/Flight	0.0-13.5	79	198
SF Sky (Sunset Falls)	7.0012	Trap/Haul	51.5-up		514
Pilchuck River	7.0125	Foot/Float	2.0-26.5	41	103
Woods Creek	7.0826	Foot/Float	0.0-3.5	0	0
Elwell Creek	7.0865	Foot	0.0-1.0	0	1
Sultan River	7.0881	Foot/Float	0.0-9.7	86	216
Wallace River (lower)	7.094	Foot/Float	0.0-4.4	14	64
Wallace River(upper)	7.094	Foot/Float	4.4-7.3	7	100
Olney Creek	7.0946	Foot	0.0-0.6	0	5
Proctor Creek	7.097	Foot	0.0-0.4	0	3
Bridal Veil Creek	7.1248	Foot	0.0-0.4	0	81
			Total Redds	592	
			Escapement		2,198

Snoqualmie summer/fall Chinook

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

Survey conditions were good for monitoring Chinook spawning until the end of October when fall rainstorms significantly increased stream flows, delaying or preventing some surveys.

In 2023, 645 Chinook were estimated to have escaped to the Snoqualmie Basin based on a total count of 234 redds (Table 4-15). Based on carcass sampling results, the escapement estimate is composed of 423 NORs and 222 HORs (Table 4-16).

Table 4-15. Snoqualmie fall Chinook redd counts and escapement by reach, 2023.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Snoqualmie River (Lower)	7.0219	Float	20.5-24.9	22	55
Snoqualmie River (Upper)	7.0219	Float	32.9-39.6	108	270
Cherry Creek	7.0240	Foot	1.8-3.5	1	3
Tolt River (Lower)	7.0291	Foot/Float	0.0-6.0	14	35
Tolt River (Upper)	7.0291	Foot/Float	6.0-8.9	6	15
NF Tolt River	7.0291	Foot	8.9-11.3	5	13
SF Tolt River	7.0302	Foot	0.0-2.3	3	8
Raging River	7.0384	Foot	0.0-4.6	34	85
Raging River (Upper)	7.0384	Foot	4.6-13.2	31	76
Tokul Creek (Lower)	7.044	Foot	0.0-0.3	5	75
Tokul Creek (Upper)	7.044	Foot	0.3-0.6	4	10
		Total Redds		**234**	
		Escapement Estimate			**645**

Sampling and HOR:NOR summary

State and Tribal field staff sampled 556 complete Chinook carcasses (where the status of CWT, otolith mark, and adipose fin mark could be ascertained) within the Snohomish basin. Additionally, adipose fin and CWT status was determined for 83 live Chinook passed at Sunset Falls. In total, the Chinook carcass sampling rate on the spawning grounds and at Sunset Falls was 19.6% (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/ tagged carcasses and unmarked/ untagged carcasses to the escapement estimate by reach groupings and to live fish sampled at Sunset Falls) (Table 4-16). Hatchery contribution estimates were estimated for subbasins and aggregated into strata to derive the annual estimates of natural- and hatchery- origin escapement as described in Rawson, Kramer and Volk (2001), which allows for inclusion of escapement reaches where sample sizes were small or no sampling occurred.

Table 4-16. Snohomish Chinook carcass sampling and escapement composition in 2022.

Stratum	Escapement	No. Hatchery	No. Natural	% Hatchery	% Natural	Number Sampled	Percent Sampled
Skykomish	922	391	531	42.37%	57.63%	59	6.4%
Bridal Veil	279	220	59	78.95%	21.05%	95	34.1%
SF Sky *	514	149	365	28.99%	71.01%	83	16.1%
Pilchuck River	103	103	70	32.14%	67.86%	28	27.2%
Sultan River	216	216	98	54.76%	45.24%	42	19.4%
Wallace River	164	149	15	91.11%	8.89%	90	54.9%
Skykomish Population	2,198	1,060	1,138	48.23%	51.77%	397	18.1%
Snoqualmie	560	182	378	32.53%	67.47%	83	14.8%
Tokul	85	40	45	47.37%	52.63%	76	89.4%
Snoqualmie Population	645	222	423	34.42%	65.58%	159	24.7%
Snohomish Total	2,843	1,282	1,561	45.10%	54.90%	556	19.6%

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

Key for Grouped Stratum and Populations:

Skykomish Population:

Bridal Veil: Bridal Veil Creek, NF Skykomish River, SF Sky (Sunset Falls)
Sultan: Sultan River
Skykomish: Snoh-Sky (Mainstems), Elwell Creek, Olney Creek, Woods Creek, Proctor Creek
Pilchuck: Pilchuck River
Wallace: Wallace River (Upper and Lower)

Snoqualmie Population:

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

4.5 Cedar River

Prior to 1999, live counts and Area Under the Curve (AUC) methods were used to estimate Chinook spawning abundance in the Cedar River. Since 1999, Chinook redds have been enumerated and mapped in the Cedar River via floating surveys, and escapement estimated by expanding the redd count by 2.5. Cedar River redd surveys are considered to be a complete census of the mainstem river, where every Chinook redd in the Cedar system is counted. Redd surveys are conducted between RM 4.2 and RM 21.8 (Landsburg Dam) 2-3 times per week for the duration of the Chinook spawning period. The portion of the river upstream from 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 2023, a total of 264 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, 259 were observed in the Cedar River mainstem (210 below Landsburg Dam and 49 above), and 5 were observed in the small tributaries to the Cedar River. Expansion of 2.5 Chinook per redd resulted in the estimated escapement of 660 (Table 4-1). Carcass surveys in the Cedar River indicated that 65% of the naturally spawning adult Chinook were natural origin (unclipped) and 35% were hatchery origin (clipped).

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 2023 was estimated at 2110.

Big Bear/Cottage Lake Creeks

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

The Bear Creek/Cottage Creek area was surveyed weekly during the 2023 spawning season. The escapement estimate was 239 Chinook. Of these, 104 were estimated in the Bear Creek mainstem, and 135 were estimated in Upper and Lower Cottage Creek. Carcass surveys in the Big Bear/Cottage Lake system indicated that 13% of the naturally spawning adult Chinook were natural origin and 87% were hatchery origin.

Issaquah Creek System

Issaquah Creek is surveyed weekly from the Issaquah Hatchery (located at river mile 3.0), downstream to SE 56th St. (located at river mile 1) 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 2023 spawning season, and total escapement was estimated at 1871 Chinook. This estimate includes 1818 in the mainstem below the hatchery, and 53 from the East Fork. Carcass surveys in the Issaquah Creek system indicated that 4% of the naturally spawning adult Chinook were natural origin and 96% were hatchery origin.

Chinook escapement to Issaquah Hatchery in 2023 was 5922 (5844 adults and 78 jacks); of which 101 adults and 0 jacks were intentionally released upstream to spawn in upper Issaquah Creek.

4.6 Green River

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

New Chinook redds were counted weekly over three days by boat and twice during the season from an aerial survey in the mainstem river between River Mile (RM) 25.4 to 48.5 (Lower River

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

A rigorous surveying schedule began on September 6 and continued through November 7; although visibility was limited for several surveys, no surveys were suspended because of high flows. Redd counts from Metzler Side Channel were conducted on September 26, October 19, and November 1. 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 13 and 18, 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 (22 redds) and Hwy 167 to Transfer Shack (0 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 22 redds.

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

Post season analysis of the season totals indicates that peak spawning activity varied by section, but was generally highest during the first week of October (Table 4-17 and Table 4-18). By the end of surveys, the week of October 15, 93.9% of the redds (580 of 618) 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 2023.

	Week[1]									
Section	3-Sep	10-Sep	17-Sep	24-Sep	1-Oct	8-Oct	15-Oct	22-Oct	29-Oct	Total
Headworks	0	0	11	41	58	35	26	10	2	183
Lower Gorge	-	0	0	3	19	13	8	4	1	48
Middle River	0	0	0	21	152	47	26	18	3	267
Lower River [1]	-	0	-	10	-	12	-	0	-	22
Newaukum Creek	-	0	46	41	7	4	0	-	-	98
Total	0	0	57	116	236	111	60	32	6	618

[1]An aerial survey on October 13 was used to estimate 0 redds for the survey season in the Hwy 167 to transfer shack reach.

Table 4-18. Aerial survey counts of Chinook redds in the Green River, 2023.

	Week[1]									
Section	3-Sep	10-Sep	17-Sep	24-Sep	1-Oct	8-Oct	15-Oct	22-Oct	29-Oct	Total
Headworks	-	-	-	-	-	69	49	-	-	118
Gorge	-	-	-	-	-	35	22	-	-	57
Lower Gorge	-	-	-	-	-	25	14	-	-	39
Middle River	-	-	-	-	-	138	34	-	-	172
Lower River	-	-	-	-	-	30	7	-	-	37
Hwy 167-Transfer Shack	-	-	-	-	-	0	0	-	-	0
Total	-	-	-	-	-	297	126	-	-	423

[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 266 redds plus 1 from MSC, 48 from the Lower Gorge, 183 from the Headworks, and 22 in the Lower River plus 0 in the Hwy 167-Transfer Shack reach. The G/A ratio for the Lower Gorge was 1.92 (48/25) resulting in a calculated 67 redds for the "Gorge". A total of 587 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 44 and for the section "Whitney Hill Bridge" to mouth" was 54, totaling 98 redds in Newaukum Creek.

Applying the constant 2.5 Chinook/redd (1.5 males:1.0 female), an estimate of 1,713 naturally spawning Chinook was generated for the Green River Basin (Table 4-1).

Although surplus returns to the Soos Creek or Keta Creek hatcheries have been planted in the mainstem in previous years, no Chinook were planted in 2023.

River flows during the 2023 Chinook spawning season were low, especially during the first half of the season, and no surveys had to be suspended because of high flows (Table 4-19).

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 2023. Weekly discharges are 7-day averages of mean daily discharge beginning with the day listed.

	Week								
USGS Gauge	3-Sep	10-Sep	17-Sep	24-Sep	1-Oct	8-Oct	15-Oct	22-Oct	29-Oct
Palmer	205	217	222	222	311	306	308	290	348
Auburn	317	329	339	393	467	469	492	465	540
Newaukum Creek	13	12	13	18	18	15	16	14	-

Carcass sampling

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

A total of 336 carcasses were sampled for standard biological data by Green River crews in 2023; 259 (20 DIT+ 33 CWT&AD + 197 AD (including AD with thermal marks; no CWT) + 9 thermal marked with no adipose fin and no CWT) or 77.8% (after excluding 3 with unknown origin) 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, 2023.

Section	Biological Samples	Adipose Clipped	Thermal Marks	MIT Tags[1]	CWT[2] & Ad-Clipped	DIT[2]
Headworks	123	83	5	-	13	0
Lower Gorge	13	5	1	-	1	0
Middle River	44	16	1	-	3	6
Lower River	13	6	0	-	0	6
Metzler Side Channel	4	4	0	-	0	0
SubTotal: River	**197**	**114**	**7**	**-**	**17**	**12**
Newaukum: 400th to Whitney Hill Br	50	31	0	-	7	4
Newaukum: Whitney Hill Br to Mouth	89	52	2	-	9	4
SubTotal: Newaukum	**139**	**83**	**2**	**-**	**16**	**8**
Grand Total:	***336***	***197***	***9***	***-***	***33***	***20***

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

[2] 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, 2023.

	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	197	45	150	2	29	168	12	45	17	121	0	2
Newaukum Creek	139	29	109	1	26	113	8	29	16	85	0	1
Green River Basin Total	336	74	259	3	55	281	20	74	33	206	0	3

[1]From 2014 through 2019, Chinook released from the Palmer Hatchery were thermal marked but not adipose fin clipped. Starting in 2020, Chinook were adipose fin clipped and thermal marked when water supply was sufficient (2021-2022).

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

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

4.7 White River

The escapement estimate for White River Spring Chinook is derived from trap counts at the Army Corps of Engineers' Mud Mountain Dam Fish Passage Facility (MMD FPF), and hatchery returns to the White River Hatchery (WRH). 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 FPF 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, sampling is limited, particularly during the latter part of the Chinook run. Consequently, the proportions of hatchery and natural-origin spring and fall Chinook transported above the dam once sampling wraps up are uncertain. Records of trap and haul operations conducted in the absence of state or tribal fisheries managers are a subject of ongoing concern.

The number of adult Chinook sampled at the WRH and at the Buckley Trap prior to the termination of sampling was 2,984. Of these, 613 were natural-origin (NORs) 1,166 were hatchery origin (HORs) and 1,205 were 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 21% and APs made up 40% of the sampled adult Chinook. At the Buckley Trap and FPF, 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 to estimate the origin of unsampled adults. In addition, 119 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 2023. Results are a combination of sampled and un-sampled adults at the FPF.

Origin	Adults	Jacks	Totals
Wild (NOR)	924	108	1,032
Acclimation Pond	1,501	345	1,847
Totals	**2,425**	**453**	**2,878**

There are two hatchery programs for White River spring Chinook: Minter Creek/Hupp Springs program and the White River Hatchery. The Minter Creek/Hupp Springs program was initiated in the mid-1970's in response to steep declines in population abundance. The spring Chinook program was subsequently expanded following completion of the Muckleshoot Tribe's White River Hatchery in 1989. In 2023, escapement to the Minter Creek/Hupp Springs hatchery was 838 adults and 225 jacks. Escapement to the White River Hatchery in 2023 was 859 adults and 2 jacks. These fish were either collected at the FPF or volunteered to the WRH trap on the north side of the diversion dam. An additional 1,220 adults and 450 jacks were passed above Mud Mountain Dam that originated from the White River Hatchery program. These fish were identified through CWT sampling.

4.8 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.

The escapement estimate includes fall-timed Chinook spawning in the lower White River downstream of the Buckley diversion dam trap. These fish have been enumerated by PTF biologists through spawning ground surveys since 2002 but were not accounted for in escapement estimates prior to 2009.

South Prairie Creek

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 2023 is 1418 spawners. This escapement is made up of 977 NORs and 441 HORs. The 2023 SPC redd estimate/AUC estimate ratio was 1.66, based on even-year data from 1994 to 2022. The 2023 AUC spawner curve yielded an escapement estimate of 855 spawners for SPC. Expanding the SPC AUC-based escapement (855 x1.66) yielded a South Prairie escapement of 1418. Wilkeson Creek contributed an additional 481 Chinook (124 NORs and 357 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 2023 SPC escapement, including Wilkeson Creek, utilized in the Carbon River escapement expansion is an adjusted area under the curve (AUC) escapement estimate accounting for the average even-year (1994-2022) ratio of redd-based escapement and live fish AUC estimate exclusively in SPC multiplied by the 2023 AUC live fish estimate for SPC sub-basin.

Survey conditions were not suitable on the Carbon River during the 2023 spawning period. Consistent with the last ten years, the 2023/1999 SPC AUC escapement ratio (1900 / 1422 = 1.336) was applied to the 1999 Carbon River escapement (250) to estimate the 2023 value. This method estimated 334 Chinook spawning in the Carbon during 2023 (250 * 1.336 = 334). Based on mark sampling ratios observed in South Prairie Creek, the escapement was made up of 104 NORs and 230 HORs.

Puyallup River Tributaries

Aggregate escapement to Puyallup River tributaries in 2023 was estimated at 256 (Table 4-23). Based on mark sampling in these tributaries, 30 of these fish are NORs and 226 HORs.

Table 4-23. Chinook escapement estimates for Puyallup River tributaries, 2023.

Tributary	Escapement
Fennel Creek (WRIA 10.0406)	47
Canyon Falls Creek (10.0410)	1
Kapowsin Creek (10.0600)	70
Clear Creek (10.0022)	138
Clarks Creek (10.0027)	0
Tributary total	256

Mainstem Puyallup River

Chinook spawning escapement to the mainstem Puyallup River was estimated to be 338. This escapement comprised 65 NOR and 273 HOR Chinook, based on mark sampling ratios observed in mainstem tributaries.

As with the Carbon River, surveys of Puyallup River were not possible in 2023. 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 2023/1999 Puyallup tributary AUC ratio (196/113 = 1.731) was applied to the estimated 1999 Puyallup mainstem escapement (195) to estimate the 2023 escapement of 338 Chinook (195 * 1.731 = 338). The same even year (1994-2022) average AUC adjustment used for the Carbon River was applied to the Puyallup tributary AUC live-fish estimate to develop the 2023 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 2023 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 2023 was estimated to be 1,066 fish. This escapement is made up of 309 NORs and 757 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 2023 was 3,893. Based on carcass sampling, we estimated that 1,073 were NORs, and 2,820 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.

4.9 Nisqually River

Natural escapement to the Nisqually River in 2023 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 adult sampling location at RM 13 and proportion of those removals marked, and (3) the proportion of marked fish passing above the sampling location at RM 13 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 8,088 adult Chinook salmon (Table 4-1) with a preliminary natural spawning escapement of 1,215. The spawning escapement was composed of 1,003 natural-origin and 212 hatchery-origin adult fish volitionally escaping to the spawning grounds.

4.10 Hood Canal

Natural Chinook escapement to the Skokomish River and Mid-Hood Canal rivers in 2023 were 4,776 and 10, 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. When returns increased as the result of supplementation, the AUC method was employed as the primary method of escapement estimation. However, since the supplementation program ended with the 2016 brood year, no supplementation-origin fish are now returning. Numbers have dropped to pre-supplementation levels and estimation methods have reverted to those previously used at low abundances.

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 10 adults: two, three, and five Chinook in Dosewallips, Duckabush, and Hamma Hamma rivers, respectively (Table 4-24). During 2023, it is possible that some Chinook redds were not identifiable on the Dosewallips and Duckabush rivers in areas with summer chum spawning. However, based on the number of Chinook redds and adults observed during surveys and carcasses recovered during intensive weekly surveys, very few Chinook were present and the escapement estimates for Dosewallips and Duckabush rivers are considered in line with the actual order of magnitude for very low numbers.

The Dosewallips River was surveyed from RM 0 to RM 2.3, RM 3.6 to RM 6.7, but not RM 7 to RM 11; Rockybrook Creek, a tributary, was surveyed from RM 0 to RM 0.3. No Chinook redds

were identified and only three live fish observations were made in the Dosewallips River during 2023. 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 estimate of three individual live adults was made based on observations made in September and October. The Hamma Hamma River was surveyed from RM 0.3 to RM 1.8; John Creek, a tributary, was also accessible to Chinook and was surveyed from RM 0 to RM 1.6. The estimated total escapement to the Hamma Hamma River is five which is based on an AUC estimate in the mainstem. The FRAM preseason escapement projection was 12 for the Mid-Hood Canal (FRAM 2023) while the estimated escapement is 11 Chinook. Escapements to the Dosewallips, Duckabush and Hamma Hamma rivers 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) and redd accounting hybrid 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 redd 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 early 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 when weather and river flows allow. Weekly instantaneous live fish counts for the mainstem above the 101 Bridge are used to calculate fish days, which are then divided by a stream life value of 14 days (the average difference between peak average live counts and peak average redd deposition) then combined with redd-based escapement estimates for the North and South forks to estimate total Chinook escapement.

The total estimated spawner escapement to the Skokomish River is 4,776 (Table 4-24). This total includes 2,928 in the mainstem Skokomish, 1,708 Chinook in the North Fork, and 140 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, an AUC estimate from the mainstem above the 101 Bridge. The preseason escapement prediction was 2,101 (FRAM 2023).

Table 4-24. Summary of Chinook escapement to Hood Canal streams during 2023.

Area	Stream	Escapement	Comments
82 G/J	Skokomish R.	2,928	AUC MS03 and MS04 w 14-day SL
	Hunter Cr.	1,232	NOT INCLUDED
	N.F. Skokomish R.	1,708	Redd based
	S.F. Skokomish R.	140	Redd based
	Total	**4,776**	
12A	Little Quilcene R.	1	1 Chinook observed
	Big Quilcene R.	0	No Chinook observed
	Total	1	
12B	Dosewallips R.	2	AUC based on live fish
	Duckabush R.	3	AUC based on live fish
	Hamma Hamma R. a/	5	AUC Hamma
	Total	**10**	
12C	Dewatto R.	33	AUC
	Lilliwaup Cr.	23	AUC
	Total	**56**	
12D	Tahuya R.	2	AUC
	Union R.	108	Trap
	Total	**110**	
Hood Canal total		**4,953**	

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. The Skokomish, Dosewallips, Duckabush, and Hamma Hamma rivers continue to be prioritized for enhanced mark and CWT sampling, with WDFW also sampling Chinook carcasses for marks and CWTs on the Dewatto, Tahuya, and Lilliwaup rivers. Mark sampling also occurs in Hunter Creek and Purdy Creek (Skokomish Basin). The samples obtained from these streams are not included to calculate pHOS due to their likely bias toward hatchery Chinook based on their proximity to hatchery facilities.

Of the 422 Chinook sampled on the spawning grounds in Hood Canal rivers during 2023, 231 Chinook were adipose-clipped and 35 had CWTs. 26 unmarked Chinook were coded-wire tagged. We sampled 6.4% of the Chinook spawning escapement in the Skokomish River. In the Mid-Hood Canal rivers Chinook escapement, three fish were sampled in the Hamma Hamma River, but none were sampled in the Duckabush or Dosewallips Rivers. Overall, the sampling rate was 30% for Mid-Hood Canal and 8.5% for all Hood Canal rivers combined (Table 4-25).

Jacks are not included in Chinook spawning escapement nor pHOS estimates in Hood Canal. However, they are sampled when encountered on the spawning grounds.

Estimates of hatchery contribution to the natural spawning escapement were made based on the total number of CWT tags and marks recovered (unmarked CWT's + adipose-clips). These estimates can be subject to clip error and tag detection rates for the returning brood years.

Thus, the proportion of hatchery fish on the spawning escapement is also 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 2018 (age-5), BY 2019 (age-4), BY 2020 (age-3), and BY 2021 (age-2).

In 2023 there was close agreement in the two aforementioned methods, with mark sampling-based pHOS weighted estimated as 81% and expanded clip pHOS of 81.4% in the Skokomish River system (Table 4-25 and Table 4-26). Neither estimate includes Purdy Creek or Hunter samples because of the likely bias associated with hatchery mortality. Minor differences in sample size for the two methods is the result of fish with unreadable scales being excluded from the broodyear-based clip rate expansion. A total of 304 adult Chinook sampled in the Skokomish River system, 204 were adipose-marked (67%). Spawning escapement in the Skokomish River was comprised of about 81% hatchery-origin Chinook and 19% natural-origin Chinook (Table 4-25). Also, the commercial sampling of the tribal gillnet fishery in the mainstem was similar in composition with 89.84% hatchery-origin Chinook and 1.94% natural-origin Chinook. These estimates may be further refined as CWT data becomes available next fall. The substantial carcass recovery sample size along with the strong escapement, likely reflect robust estimates of HOR/NOR estimates for the Skokomish River in 2023.

Hatchery releases into the Hamma Hamma concluded with the last brood year release in 2014 making 2018 the last year Age 4 adults returned to the Hamma from the supplementation program, and Age-5 Chinook from the last supplementation release would have returned in 2019. Since supplementation origin fish are no longer returning, otoliths are no longer collected. Any Chinook carcasses encountered will continue to be 100% sampled for sex, length, scales, mark status, and coded wire tag. However, very few carcasses are recovered, due the low numbers of Chinook combined with scavenging and predation. From 2020 through 2022, snorkeling was also being employed to monitor for ad-clipped fish. However, snorkeling activities are currently on hold pending WDFW policy.

Because so few carcasses were recovered from the Duckabush and Dosewallips rivers, a long term HOR average for the Hamma Hamma (18%) was applied to the 2023 escapements (Table 4-25). Of the 10 fish estimated to have spawned in the MHC tributaries, we estimate 4 were NOR. However, the low carcass recovery sample size along with the extremely low escapement, highlight the uncertainty in the 2023 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, 2023.

Mgmt Unit and River	Spawner escapement	Chinook sampled		Tagged 1/			Untagged 1/			Unk. tagged 2/			Totals					pHOS
		Number	%	AD	NM	Unk	AD	NM	Unk	AD	NM	Unk	CWTs recovered	AD-clips observed	Rate 5/	HOR		NOR (weighted)
Skokomish																		
Mainstem	2,928	119	4.1%	4	10	0	85	18	2	0	0	0	14	89	0.85	2478	450	
Hunter	1,232	1001	81.3%	45	95	0	839	22	0	0	0	0	140	884	0.98	1205	27	
North Fk	1,708	175	10.2%	4	16	0	111	42	1	0	1	0	20	115	0.75	1286	422	
South Fk	140	10	7.1%	0	0	1	0	0	0	0	0	0	1	0	0.86	120	20	
Skokomish River total	*6,008*	*1,305*	*21.7%*	*53*	*121*	*1*	*1035*	*82*	*3*	*0*	*1*	*0*	*175*	*1,088*	*0.93*	*5,089*	*919*	*0.85*
Skokomish Total w/o Hunter	**4,776**	**304**	**6.4%**	**8**	**26**	**1**	**196**	**60**	**3**	**0**	**1**	**0**	**35**	**204**	**0.77**	**3884**	**892**	**0.81**
12A																		
Big Quilcene R.	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	NA	0	0	
Little Quilcene R.	1	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	NA			
12B																		
Hamma Hamma R. 3/	5	3	60.0%	0	0	0	3	0	0	0	0	0	0	3	1.00	5	0	
Duckabush R. 4/	3	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.18	1	2	
Dosewallips R. 4/	2	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.18	0	2	
Mid-Hood Canal total	**10**	**3**	**30.0%**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0.59**	**6**	**4**	
12C																		
Dewatto R.	10	4	40.0%	0	0	0	0	2	2	0	0	0	0	0	0.00	0	10	
Eagle Creek	33	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.96	32	1	
Lilliwaup R.	23	3	13.0%	0	0	0	3	0	0	0	0	0	0	3	1.00	23	0	
12D																		
Tahuya R.	2	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0.00	0	2	
Union R. 2/	108	108	100.0%	0	0	0	0	0	0	0	0	0	0	21	0.19	21	87	
Hood Canal total	**4,962**	**1,423**	**28.7%**	**8**	**26**	**1**	**202**	**62**	**5**	**0**	**1**	**0**	**35**	**231**	**0.80**	**3,965**	**997**	

1/ AD = adipose fin-clipped; NM = no mark; Unk = unknown

2/ Visual detection only live fish at the trap

3/ Based on ad-clip detections during snorkel survey

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, provissionary estimates

natural escapement = 997

hatchery escapement = 3965

Table 4-26. Chinook salmon spawner escapement origin based on carcasses sampled for marks and coded-wire tags (CWTs) in Hood Canal rivers, 2023.

Water	Skokomish, MS, NF, SF, Vance				
Year	2023				
	Age				
	21	31	41	51	Total
Mark rate	0.874	0.864	0.862	0.871	
ADB	1	4	2	1	
ADNB	6	62	67	1	
ADUkn	0	0	0	0	
ADNH	0	0	0	0	
Total ad-clipped	7	66	69	2	137
expanded	8	76	80	2	158
UMB	2	8	8	0	
UMNB	2	19	21	0	
UMNH	0	1	0	0	
Total no clip	4	28	29	0	
Adjusted	3	18	18	0	
Total mark status known	11	94	98	2	194
Proportion Hatchery Origin Spawners (pHOS)					**0.814**

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

4.11 Dungeness

Escapement Estimation:

Since 1986, surveys have been conducted by ground surveys throughout the spawning season from RM 0.5 to 18.7 in the mainstem Dungeness, and from RM 0.0 to 5.1 in the Gray Wolf mainstem (Figure 4-3) to generate cumulative redd counts for the season. Surveys begin in mid-August and end mid to late-October. Chinook temporal and spatial spawning distribution are documented by recording GPS waypoints for each redd observed by WDFW and JSKT fisheries staff. Files are shared between the agencies and maps are created by GIS specialists to show redd locations throughout the basin, with downloading shapefiles into ArcGIS and Google Earth Pro kmz file.

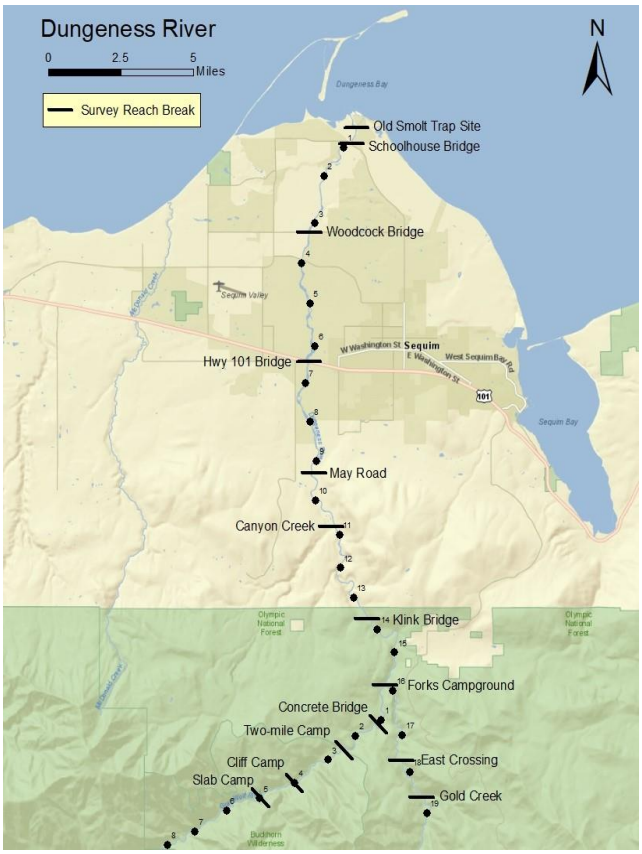

Figure 4-3 Dungeness basin survey index reaches.

The total Chinook redd count in the Dungeness basin for return year (RY) 2023 was 379. The lower basin (defined as RM 0.5- RM 10.8) count was 330 (87.1%), the upper basin (defined as RM 10.8- RM 18.7) count was 40 (10.0%), and the Gray Wolf River (RM 0.0-6.1) count was 9 (2.4%) (Table 4-27).

The total number of new redds observed is multiplied by 2.5 (1 female plus 1.5 males per redd) to estimate total number of spawning adults (Smith and Castle 1991, Orrell, 1977). In 2023, 370 Chinook redds were counted in the Dungeness (an estimated 925 adults) and 9 redds (an estimated 23 adults) were counted in the Gray Wolf for a total of 948 adults. There were an additional 127 adults trapped and netted from the river for the hatchery broodstock program. The broodstock collection value of 112 includes pre-spawn mortalities at Hurd Creek. The total estimated Chinook adult return to the river was 1,075.

Table 4-27. The number, density, distribution, and proportion of Chinook redds and estimated adults in the Dungeness and Gray Wolf rivers system in 2023.

Stream and section	Reach	Lower	Upper	Total	2023	2023	2023	2023	2023 Redd	1998-2022
Lower Dungeness River (RM 0.5-RM 10.8)	Number	River mi.	River mi.	length (mi)	Redds	Redds/mi.	Adult est.	Adults/mi. est.	Proportion	Avg. redds/mi
Mouth to Woodcock Bridge	1	0.5	3.3	2.8	114	40.7	285	101.8	0.301	11.83
Woodcock Bridge to Hwy 101	2	3.3	6.4	3.1	94	30.3	235	75.8	0.248	14.81
Hwy 101 to Taylor Cut-Off - May	3	6.4	9.2	2.8	91	32.5	227.5	81.3	0.240	14.33
Taylor Cut-Off - May to Canyon Ck.	4	9.2	10.8	1.6	31	19.4	77.5	48.4	0.082	17.63
Total				**10.3**	**330**	**32.0**	**825**	**80.1**	**0.871**	**14.31**
Upper Dungeness River (RM 10.8-RM 18.7)										
Canyon Creek to Clink Bridge	5	10.8	13.8	3	13	4.3	32.5	10.8	0.034	5.97
Clink Bridge to Forks Campground	6	13.8	15.8	2	15	7.5	37.5	18.8	0.040	5.78
Forks Campground to East Crossing	7	15.8	17.5	1.7	4	2.4	10	5.9	0.011	5.39
East Crossing to Gold Creek	8	17.5	18.7	1.2	8	6.7	20	16.7	0.021	1.70
Total				**7.9**	**40**	**5.1**	**100**	**12.7**	**0.106**	**5.15**
Gray Wolf River (RM 0.0-RM 6.1)										
Mouth to RM 1.0 Bridge	9	0	1	1	5	5.0	12.5	12.5	0.013	5.56
RM 1.0 Bridge to Above 2 Mile Camp	10	1	2.5	1.5	4	2.7	10	6.7	0.011	2.85
Above 2 Mile Camp to Cliff Camp	11	2.5	4	1.5	0	0.0	0	0.0	0.000	0.27
Cliff Camp to Slab Camp -Suppl. Surveys	12	4	5.1	1.1	0	0.0	0	0.0	0.000	0.21
Slab Camp and upstream 1 mile -Suppl. Surveys	13	5.1	6.1	1	NS	NS	NS	NS	NS	0.00
Total				**6.1**	**9**	**1.5**	**22.5**	**3.7**	**0.024**	**1.70**
Dungeness Basin Grand Total				**24.3**	**379**	**15.6**	**948**	**39.0**	**1.000**	

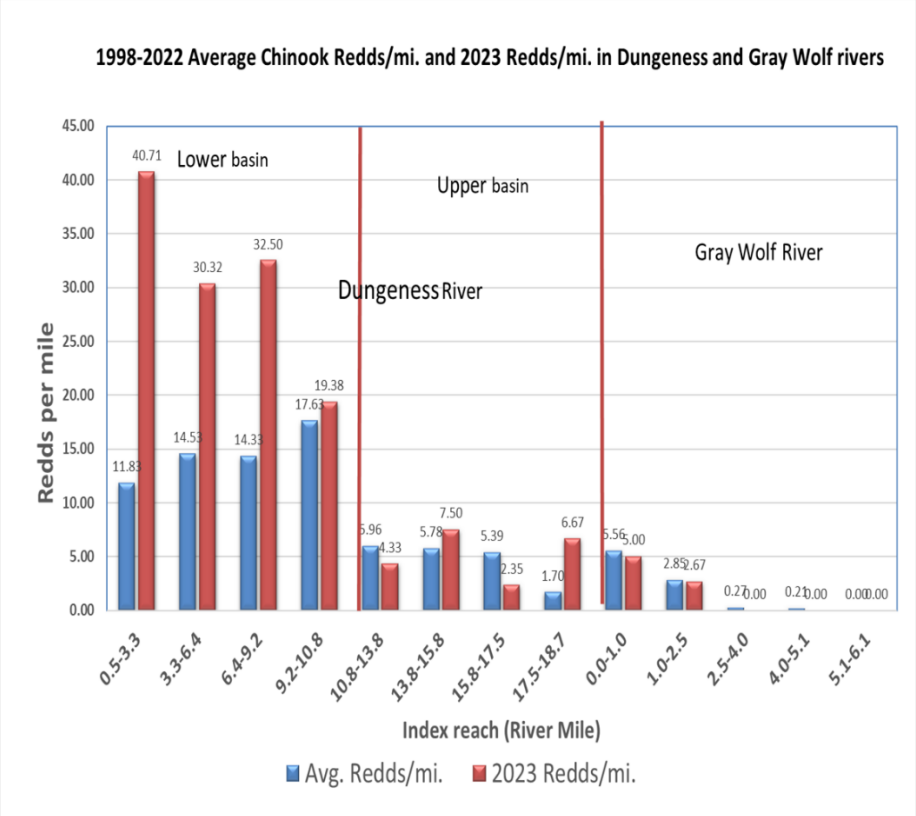

Figure 4-4. Redd densities.

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.

Since 1986, the Dungeness River Chinook total returns (HOR+NOR) have ranged from 50 in 1997, to 1,543 in 2006, and has averaged 466. The recent 5-year average total return is 825

and the recent 10-year average is 698. The 18-year average for NOR and HOR returns (years for which NOR and HOR returns were discerned) were 193 (30.5%) and 439 (69.5%), respectively. The recent 5-year average of NOR and HOR total returns were 333 (40.4%) and 492 (59.6%), respectively. The Chinook returns from 1986 to 2005 that could not be identified by origin and were labeled as "Unknown" (Figure 4-5).

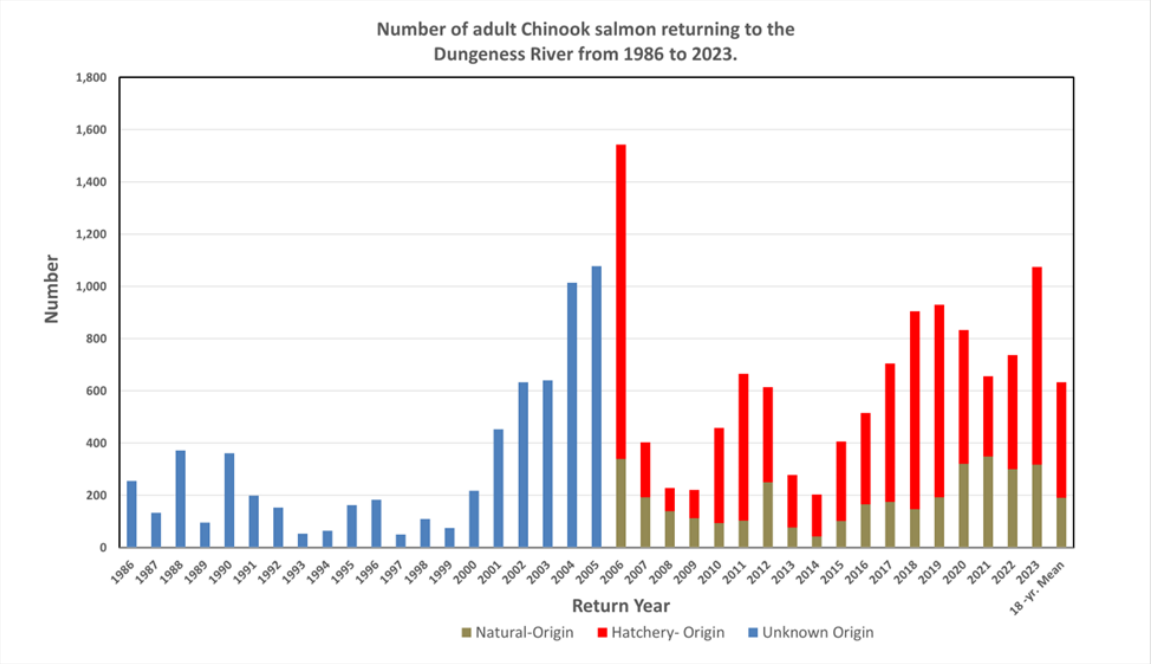

Figure 4-5. Estimated Number of Chinook salmon returning to the Dungeness basin from 1986 to 2023. The adults are broken into hatchery and natural origin in years where this data is available.

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 329 carcasses (124 broodstock collection and mortalities and 205 from natural spawners in the river). Of the total number of carcasses sampled, 231 of 329 (70.2%) were tagged (Table 4-28).

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 2023.

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	124	93	0.7500	31	0.2500
Spawning Ground Surveys (SGS)	205	138	0.6731	67	0.3268
Total sample size	329	231	0.7021	98	0.2979

Based on the CWT results and scale samples analyzed, the preliminary NOR/HOR composition for Return Year (RY) 2023 is 314 (29.21%) NOR and 761 (70.79%) HOR. The ages of the NOR Chinook for RY2023 consisted of, 15.3% age-3, 78.3% age-4, 6.4% age-5, and 0.0% age-6. The ages of the HOR Chinook for RY2023 consisted of, 43.2% age-3, 55.3% age-4, 1.5% age-5, and 0.0% age-6. The ages of all Chinook for RY2023 combined were, 35.2%% age-3, 62.0% age-4, 2.8% age-5, and 0.0% age-6 (Table 4-29).

Table 4-29. Total number and percentages of adult, age-3, age-4, age-5, and age-6 HOR and NOR Chinook returns in 2023.

	NOR	**Percentage**	**HOR**	**Percentage**	**Total**	**Percentage**
Age-3	48	15.3%	329	43.2%	378	35.2%
Age-4	246	78.3%	421	55.3%	666	62.0%
Age-5	20	6.4%	11	1.5%	31	2.8%
Age-6	0	0.0%	0	0.0%	0	0.0%
Total	314	100.0%	761	100.0%	1,075	100.0%

From 2006 to 2023, 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 349 and the number of HOR returns ranged from 90 to 1,204. Since RY2006, the percentages of NOR and HOR have averaged 189.8 (32.67%) NOR and 442.2 (67.33%) HOR, respectively. The percentages of HOR and NOR in the broodstock collection and natural spawners for RY 2006-2023 are documented in Table 4-30 and Figure 4-6.

Table 4-30. Total number of NOR and HOR natural spawners and broodstock collected in the mainstem Dungeness River for return years 2006-2023.

Return year	Natural spawners 1/ NOR	Natural spawners 1/ HOR	Natural spawners 1/ NOR+HOR	Broodstock collection 2/ NOR	Broodstock collection 2/ HOR	Broodstock collection 2/ NOR+HOR	Natural Spawners + Broodstock NOR	Percentage NOR Spawners + Broodstock	Natural Spawners + Broodstock HOR	Percentage HOR Spawners + Broodstock	Total returns NOR+HOR
2006	293	1,112	1,405	46	92	138	339	21.97%	1,204	78.03%	**1,543**
2007	146	159	305	47	51	98	193	47.89%	210	52.11%	**403**
2008	86	54	140	53	36	89	139	60.70%	90	39.30%	**229**
2009	71	57	128	42	50	92	113	51.36%	107	48.64%	**220**
2010	76	269	345	18	94	112	94	20.57%	363	79.43%	**457**
2011	83	452	535	21	109	130	104	15.64%	561	84.36%	**665**
2012	212	296	508	38	68	106	250	40.72%	364	59.28%	**614**
2013	46	122	168	31	79	110	77	27.70%	201	72.30%	**278**
2014	21	87	108	22	74	96	43	21.08%	161	78.92%	**204**
2015	65	200	265	37	105	142	102	25.06%	305	74.94%	**407**
2016	135	273	408	30	77	107	165	32.04%	350	67.96%	**515 4/**
2017	149	456	605	26	74	100	175	24.82%	530	75.18%	**705**
2018	127	661	788	20	97	117	147	16.24%	758	83.76%	**905**
2019	173	665	838	19	73	92	192	20.65%	738	79.35%	**930**
2020	294	439	733	27	70 + 3unk	100	321	38.54%	512	61.46%	**833**
2021	312	246	558	37	61	98	349	53.20%	307	46.80%	**656**
2022	256	369	625	44	68	112	300	40.71%	437	59.29%	**737**
2023	282	666	948	32	95	127	314	29.21%	761	70.79%	**1,075**
Mean	157.1	365.7	522.8	32.8	76.6	109.2	189.8	32.67%	442.2	67.33%	**638.9**

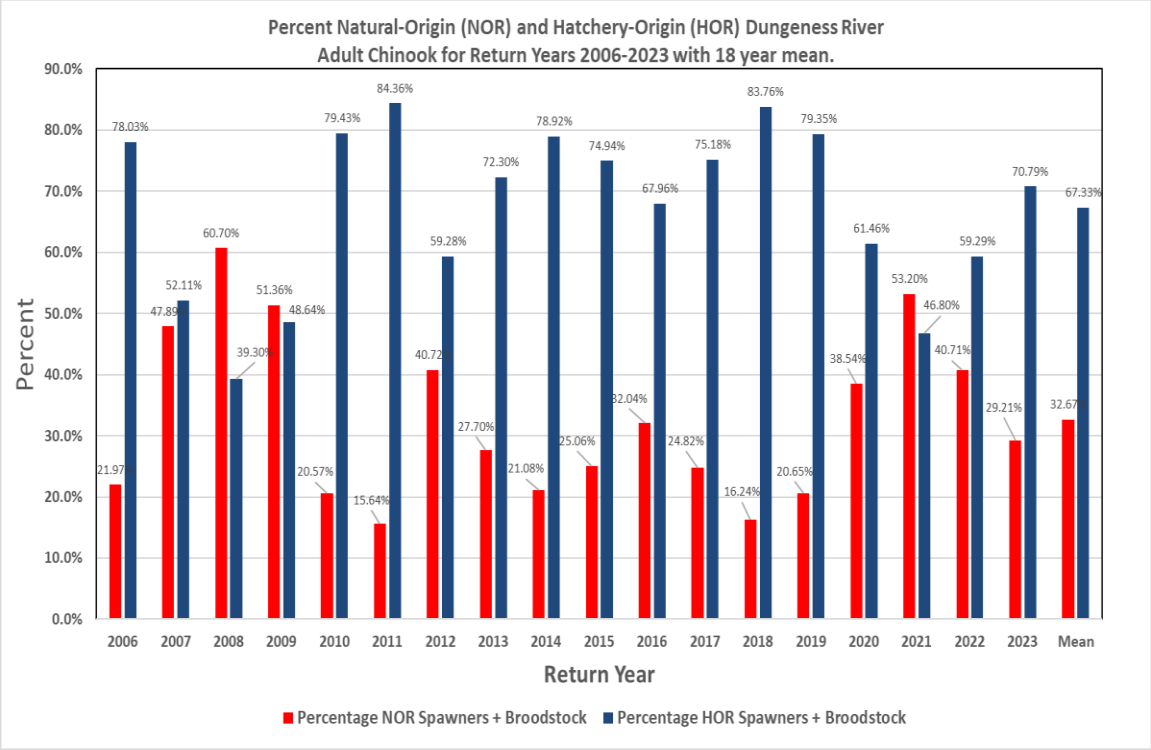

Figure 4-6. Percentages of NOR and HOR Dungeness River adult Chinook sampled from carcasses in broodstock collection and natural spawners in river for return years 2006-2023.

4.12 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 as described in Denton et al (2023). This technology improved Chinook escapement estimates due to the difficulty of observing redds and fish in turbid water conditions caused by the removal of the two dams. Jacks are excluded from the SONAR estimate. The final SONAR estimate of 2023 Chinook total adult return to the river is 3,850 (95% CI,3,700-4,000) Denton et al., 2023.

Chinook Spawning Abundance and Distribution:

An estimate of fish that spawned in the river (2,637) was calculated by subtracting fish collected for broodstock (715 WDFW hatchery and 494 LEKT hatchery) and fish harvested in ceremonial and subsistence fisheries (4 C&S) from the SONAR estimate of total adult run size (3,850; Table 4-31).

Table 4-31. Chinook broodstock collection, SONAR estimate of total adult return, and estimated number of natural spawning fish Elwha River in 2023.

Capture method	No. Males	No. Females	Total adults	No. Jacks	Total adults plus jacks
WDFW Hatchery					
Elwha Hatchery Trap Volunteers	292	69	361	37	398
River Collection Seining-Gill netting	197	102	299	1	301
Elwha River spawn (Gaff-Hook and line)	0	129	129	0	129
Gaff-Hook and line (Non-Viable Females)	0	104	104	0	104
Volunteers Returned to River to Spawn	-178	0	-178	-23	-161
WDFW Broodstock collection	**311**	**404**	**715**	**16**	**731**
LEKT Hatchery					
LEKT Hatchery Adult Chinook Trap	365	117	482	45	527
LEKT Hatchery Received from Netting	4	8	12	0	12
LEKT Adult Broodstock collection	**369**	**125**	**494**	**45**	**539**
LEKT C&S Harvest			**4**		4
SONAR adult estimate			**3,850**		
Estimated adult natural spawners in river /1			**2,637**		

/1 Natural spawners = SONAR estimate of 3,850 minus adult WDFW broodstock collection of 715, LEKT broodstock collection of 494, and 4 C&S harvest = 2,637

Data source: 2023 Elwha Hatchery broodstock collection numbers from Troy Tisdale, WDFW Hatchery Manager and Robert Blankenship LEKT Hatchery Manager. SONAR estimate from LEKT Tribe (Denton et al 2023).

Hatchery broodstock: total number of Chinook salmon collected for broodstock, including pond mortalities, gaffing from river and non-viable females.

Natural adult spawners= total number of Chinook salmon that spawn naturally, regardless of whether they are hatchery- or natural origin.

To determine the 2023 spatial distribution and density of Chinook redds in the Elwha River, 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 21) in the upper, middle, and lower watersheds. The Upper Elwha section is from Mills at rkm 21.5 to rkm 56.0, the Middle Elwha from Glines Power (rkm 21.1) to Aldwell North (rkm 7.9), and the Lower Elwha from Lower Dam (rkm 6.6) to Hunt Channel (rkm 2.0). Of 806 redds observed, 145 (17.9%) redds were in the Upper Elwha, 475 (58.9%) in the Middle Elwha, and 186 (23.1%) in the Lower Elwha. In addition to recording the number of redds, surveyors recorded the number of live and dead Chinook (Table 4-32, McHenry et al., 2023).

Table 4-32. 2023 Elwha River Chinook salmon spawners from Upper Watershed Dam to the mouth (McHenry et al. 2023).

Survey Reach	Rkm midpoint	No. Redds	Redds/km	Live Chinook	Dead Chinook	Pinks Live + Dead
Upper Elwha						
Upper Watershed	49.9	1	0.04	1	0	0
Geyser Valley	30	0	0.0	2	0	0
Cat Creek	0.7	0	0.0	0	0	0
Boulder Creek	0.2	9	30.0	3	0	7
Mills	21.5	135	30.0	128	0	203
Rica	23.9	0	0.0	0	0	0
UE Subtotal		**145**		**132**	**0**	**210**
		(17.9%)				
Middle Elwha						
Glines Powerhouse	19.1	43	53.7	26	14	37
Altaire Bridge	18.1	51	42.5	96	28	52
Elwha Ranger Stat.	17.8	79	33.5	158	43	323
Fisherman's Corner	16.1	43	32.3	48	15	115
ONP Boundary	14.9	21	14.0	21	4	37
McDonald Bridge	11.9	31	16.3	74	24	155
Little River	12.2	10	5.2	23	8	1,032
Indian Creek	12.1	80	20.8	129	35	132
Aldwell South	11.0	48	28.7	45	55	84
Aldwell North	8.8	69	28.7	42	15	65
ME Subtotal		**475**		**732**	**308**	**2,032**
		(58.9%)				
Lower Elwha						
Elwha Dam	6.1	21	26.2	499	66	923
Hwy 112 Bridge	4.9	72	48.0			0
County Bridge	3.2	75	39.5			0
East Channel	1.1	18	7.8			0
Hunt Road Channel	1.5	0	0			0
LE Subtotal		**186**		**499**	**66**	**923**
		(23.1%)				
Total		**806**		**1,360**	**374**	**3,165**

Biological Sampling:

WDFW, LEKT, and ONP personnel sampled carcasses using the methods described in Weinheimer et al (2015). Carcasses were sampled from naturally spawning fish in the mainstem river and from broodstock collected at the hatcheries. Carcasses were subsampled for fork length (cm), post-orbital hypural length (POH), sex, scales, otoliths, checked for clipped adipose fin, and a DNA fin clip was taken if fish gills showed a coloration of better than 50%. During each sampling day and after all samples were collected (sampled group), personnel tallied all remaining carcasses for sex, marks, and coded wire 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. For the 2023 season, a total of 157 and 80 Chinook broodstock were sampled at the WDFW Elwha and LEKT hatchery facilities, respectively. In addition, 232 carcasses were sampled in the river for a total of 469 carcasses were sampled for

DNA, otoliths, scales, and checked for marks (adipose clips), and tag (CWT) presence or absence (Table 4-33).

Hatchery-Origin Returns (HOR) are the total number of Chinook salmon whose parents were spawned in a hatchery, regardless of whether they themselves were spawned in hatchery or spawned naturally. Natural-Origin Returns (NOR) are the total number Chinook salmon whose parents spawned in the river, regardless of whether they themselves were spawned in hatchery or spawned naturally. Hatchery Origin Returns and Natural Origin Returns will be determined after all the otolith samples have been analyzed and CWTs have been matched with individual fish. False CWT detections can occur and the number of CWT fish in the table could be lower. Fish that could not be aged because of unreadable scale samples may be aged from otolith marked samples or decoded tags.

Table 4-33. Number of Chinook carcasses sampled for DNA, otolith, and CWT in the Elwha River and broodstock collected for WDFW and LEKT Hatchery facilities 2023.

Sample Type/ Sex ID	Natural River Spawners-Carcass Surveys (CS)	Broodstock LEKT Hatchery	Broodstock Netted-River WDFW Hatchery	Broodstock RP (Floy Tags) WDFW Hatchery	Broodstock Collection-Volunteer WDFW Hatchery	Grand Total Chinook Sampled
No. Chinook Sampled						
Female	107	40	70	0	9	226
Male	125	40	64	1	13	243
Total	**232**	**80**	**134**	**1**	**22**	**469**

Broodstock Sampling:

Biologists and technicians sampled broodstock (BS) carcasses on four different spawning days at both the WDFW and the LEKT hatcheries, September 5, 12, 19, and 26. Scales, otoliths, DNA, and mark and tag status were collected (**Error! Reference source not found.**). For the four spawning days, 237 (19.6%) of the 1,209 fish collected for broodstock between the two hatcheries were sampled for DNA, otoliths, and scales in addition to mark and tag status. All additional fish were checked for CWT and mark status. Table 4-34.

Table 4-34. Total number of female and male Chinook sampled during spawning operations on September 5, 12, 19, and 26, 2023 at the WDFW Elwha Hatchery facility.

Broodstock Collection Method	Female	Male	Total (Male + Female)
Lower Elwha Klallam Hatchery	**40**	**40**	**80**
September 5, 2023	7	10	17
September 12, 2023	14	10	24
September 19, 2023	**9**	**10**	**19**
September 26, 2023	**10**	**10**	**20**
WDFW -Netting River	**70**	**65**	**135**
September 5, 2023	19	15	34
September 12, 2023	21	19	40
September 19, 2023	20	20	40
September 26, 2023	10	10	20
WDFW Netted River-RP Fish	**0**	**1**	**1**
September 5, 2023	0	1	1
Volunteer	**9**	**13**	**22**
September 5, 2023	1	2	3
September 12, 2023	**4**	**4**	**8**
September 19, 2023	**4**	**6**	**10**
WDFW Volunteer R.P.Fish			
September 12, 2023	**0**	**1**	**1**
Grand Total	**119**	**118**	**237**
Percentage Female and Male	**50.2%**	**49.8%**	**100.0%**

River Carcass Collections - Natural Spawners (HOR and NOR):

WDFW, LEKT, and ONP biologists and technicians sampled river carcasses from fish that spawned naturally in the river. Carcasses were sampled between September 13 and October 6, 2023. Based on redd numbers from previous spawning seasons, the period between September 21 and September 28 provided the best opportunity for the peak redd count and sampling carcasses. Of the 232 carcasses, **(**107 females,125 males),81.0% were sampled in the mainstem river and 19.0% were sampled in tributaries (Indian Creek and Little River combined; **Error! Reference source not found.**). The female (107) to male (125) sex ratio for s ampled fish was 0.856:1.000.

Table 4-35. Number of female and male Chinook carcasses sampled in the mainstem Elwha River and tributaries by survey reach and date in 2023.

Method River Carcass Survey (CS)	Female	Male	Total (Male + Female)	Proportion Sampled in Reach
Elwha Dam to Mouth	**9**	**13**	**22**	**0.0948**
September 21, 2023	9	13	22	
Altaire Br. to Fisherman's Corner	**26**	**29**	**55**	**0.2371**
September 13, 2023	1	4	5	
September 20, 2023	25	25	50	
Glines to Altaire	**8**	**8**	**16**	**0.0690**
September 13, 2023	1	3	4	
September 20,2023	**7**	**5**	**12**	
Fisherman's Corner to US Hwy 101	**11**	**9**	**20**	**0.0862**
September 13, 2023	0	2	2	
September 20, 2023	**10**	**7**	**17**	
September 27, 2023	**1**	**0**	**1**	
Rica to Glines	**22**	**29**	**51**	**0.2198**
September 14, 2023	2	6	8	
September 20, 2023	16	18	34	
September 28, 2023	**4**	**5**	**9**	
US Hwy 101 to Elwha Dam	**14**	**9**	**23**	**0.0991**
September 13, 2023	1	0	1	
September 14, 2023	8	4	12	
September 21, 2023	**5**	**5**	**10**	
Indian Creek	**14**	**26**	**40**	**0.1724**
September 26 and 27, 2023	13	26	39	
October 6, 2023	**1**	**0**	**1**	
Little River	**2**	**2**	**4**	**0.0172**
September 27, 2023	2	2	4	
Gooseneck to Elwha Dam	**1**	**0**	**1**	**0.0043**
September 14, 2023	1	0	1	
Grand Total	**107**	**125**	**232**	**1.0000**
Percentage Female and Male	**46.12%**	**53.88%**	**100.0%**	

Broodstock and River Carcass Samples by Age and Sex

Of the 232 carcass samples (CS) from the river, 197 had readable scales, 89 were females and 108 were males. Female age classes consisted of 3.37% age 3, 77.53% age 4, and 19.10% age 5. Males age classes consisted of 2.61% age 2, 26.85% age 3, 66.67% age 4, and 6.48% age 5 (Error! Reference source not found.).

Of the 237 broodstock carcasses sampled 196 had readable scales, 104 were females and 92 were males. Female age classes consisted of 5.77% age 3, 76.92% age 4, and 17.31% age 5. Male age classes consisted of 2.17% age 2, 33.70% age 3, 59.78% age 4, 4.35% age 5 (Error! Reference source not found.).

Of the 469 total carcasses sampled, 393 had readable scales, 193 were females and 200 were males. Female age classes consisted of 4.66% age 3, 77.20% age 4, and 18.95% age 5. Male age classes consisted of 1.00% age 2, 30.00% age 3, 63.50% age 4, and 5.50% age 5. Combining the 393 readable scales for both sexes, the age classes consisted of 0.50 % age 2, 17.56% age 3, 70.23% age 4, and 11.70% age 5 (Table 4-36).

Table 4-36**.** Number and ages of female and male Chinook broodstock and river carcasses sampled in the hatchery and mainstem Elwha River in 2023.

Collection Method and Scale Age	Female Total	Female Prop.	Male Total	Male Prop.	Female + Male Total	Female + Male Prop. By Age
River Carcass Survey (CS)						
Age 2_1	0	0.0000	0	0.0000	0	0.0000
Age 2_2	0	0.0000	0	0.0000	0	0.0000
Age 3_1	3	0.0337	29	0.2685	32	0.1624
Age 3_2	0	0.0000	0	0.0000	0	0.0000
Age 4_1	64	0.7191	67	0.6204	131	0.6650
Age 4_2	5	0.0562	5	0.0463	10	0.0508
Age 5_1	15	0.1685	6	0.0556	21	0.1066
Age 5_2	2	0.0225	1	0.0093	3	0.0152
Age 6_1	0	0.0000.	0	0.0000	0	0.0000
Age 6_2	0	0.0000	0	0.0000	0	0.0000
Readable Scales	89	1.0000	108	1.0000	197	1.0000
Total (CS) Scales Sampled	107		125		232	
Broodstock Collection-Hatchery	**Female Total**	**Female Prop.**	**Male Total**	**Male Prop.**	**Female + Male Total**	**Female + Male Prop. By Age**
Age 2_1	0	0.0000	1	0.0109	1	0.0051
Age 2_2	0	0.0000	1	0.0109	1	0.0051
Age 3_1	6	0.0577	31	0.3370	37	0.1888
Age 3_2	0	0.0000	0	0.0000	0	0.0000
Age 4_1	74	0.7115	49	0.5326	123	0.6276
Age 4_2	6	0.0577	6	0.0652	12	0.0612
Age 5_1	16	0.1538	3	0.0326	19	0.0969
Age 5_2	2	0.0192	1	0.0109	3	0.0153
Age 6_1	0	0.0000	0	0.0000	0	0.0000
Age 6_2	0	0.0000	0	0.0000	0	0.0000
Readable Scales	104	1.0000	92	1.0000	196	1.0000
Total Hatchery Scales Sampled	119		118		237	

Carcass + Broodstock Collection	Female Total	Female Prop.	Male Total	Male Prop.	Female + Male Total	Female + Male Prop. By Age
Age 2_1	0	0.0000	1	0.005	1	**0.0025**
Age 2_2	0	0.0000	1	0.005	1	**0.0025**
Age 3_1	9	0.0466	60	0.3000	69	**0.1756**
Age 3_2	0	0.0000	0	0.0000	0	**0.0000**
Age 4_1	138	0.7150	116	0.5800	254	**0.6463**
Age 4_2	11	0.0570	11	0.0555	22	**0.0560**
Age 5_1	31	0.1606	9	0.0450	40	**0.1018**
Age 5_2	4	0.0289	2	0.0100	6	**0.0153**
Age 6_1	0	0.0000	0	0.0000	0	**0.0000**
Age 6_2	0	0.0000	0	0.0000	0	**0.0000**
Readable Scales	193	1.0000	200	1.0000	393	**1.0000**
Total Scales Sampled	**226**		**243**		**469**	

Mark/Unmark (fin clip) status, tag (CWT) presence/absence of Elwha Chinook broodstock and river carcasses in 2023.

Results of the 469 Chinook carcasses sampled in 2023 (232 river and 237 hatchery broodstock at the WDFW and LEKT hatcheries) for mark status (fin clip) and Coded Wire tag presence (CWT) are in Table 4-37. Results are pending final review.

Estimates of hatchery and natural origin are in table 4-38 and Figure 4-3. Sample size in Table 4-38 (445) does not include samples collected that could not be analyzed.

Table 4-37. Number and proportion, by mark/tag status, of female and male Elwha Chinook sampled during river carcass surveys (CS) and broodstock (BS) spawned at the Elwha hatcheries in 2023.

Mark/Tag status	**Carcass survey (CS)**	**Carcass survey (CS)**	**Carcass survey (CS)**	**Carcass survey (CS)**
Marked	Female	Male	Total	Proportion
AD+CWT	13	13	26	0.1121
AD Only	2	0	2	0.0086
Unmarked	Female	Male	Total	Proportion
CWT Only	7	9	16	0.0690
UMNB 1/	85	103	188	0.8103
Total	107	125	232	1.0000
Mark/Tag status	**Broodstock (BS)**	**Broodstock (BS)**	**Broodstock (BS)**	**Broodstock (BS)**
Marked	Female	Male	Total	Proportion
AD+CWT	29	27	56	0.2363
AD Only	3	1	4	0.0169
Unmarked	Female	Male	Total	Proportion
CWT Only	11	12	23	0.0970
UMNB 1/	76	78	154	0.6498
Total	119	118	237	1.0000
Mark/Tag status	**Carcass Survey + Broodstock**	**Carcass Survey + Broodstock**	**Carcass Survey + Broodstock**	**Carcass Survey + Broodstock**
Marked	Female	Male	Total	Proportion
AD+CWT	42	40	82	0.1748
AD Only	5	1	6	0.0128
Unmarked	Female	Male	Total	Proportion
CWT Only	18	21	39	0.0832
UMNB 1/	161	181	342	0.7292
Total	226	243	469	1.0000

4.13 Hoko

No description available at the time this report was submitted.

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) 2021 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 2021 generally exceeded the 20% sampling objective although North Hood Canal (9A, 12, 12A, 12B), 12C, 13D-F, and Strait of Juan de Fuca Troll were below 20% (Table 5-1). Marine area recreational fisheries were sampled at rates between 10.6% and 51.4% 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 2022 (calendar year).

Catch Area/River	Catch	# Sampled	Sample Rate
7-7A	5,310	2,431	46%
7B-7C-7D-Nooksack River	20,605	6,244	31%
Skagit River/Bay	4,762	2,292	48%
8A	24	4	17%
8D	1,659	713	43%
Stillaguamish River	3	2	66%
10	46	43	93%
10E	7,888	3,841	49%
10F	168	2	1%
10G	49	0	0%
10A	512	368	72%
Duwamish River	7,616	0	0%
Puyallup/White rivers	4,485	2,337	26%
Nisqually River	2,478	1,525	62%
McAllister Cr.	207	206	99%
13A	1,351	83	6%
13C	1,563	76	5%
13D-F	1,576	349	22%
9	60	60	100%
9A-12-12A-12B	234	29	12%
12C	12,168	3,285	27%
12H	22,879	5,504	24%
Skokomish River	3,199	1,716	54%
Purdy Creek	403	346	86%
Strait of JDF 4B-5-6 (Net)	4,117	0	0%
Strait of JDF 4B-5-6C (Troll)	473	0	0%

Table 5-2. Chinook coded-wire tag sampling rates for marine recreational fisheries in 2022.

Catch Area	Catch	# Sampled	Sample Rate
MARINE SPORT AREA 5	9,431	2,541	26.9%
MARINE SPORT AREA 6	4,918	2,529	51.4%
MARINE SPORT AREA 7	3,265	838	25.7%
MARINE SPORT PCA 8.1	10	0	0.0%
MARINE SPORT PCA 8.2	895	258	28.8%
MARINE SPORT AREA 9	5,186	1,160	22.4%
MARINE SPORT AREA 10	7,418	1,649	22.2%
MARINE SPORT AREA 11	3,606	1,474	40.9%
MARINE SPORT AREA 13	4,013	556	13.9%
MARINE SPORT AREA 12	1,939	205	10.6%

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7 9-Year (2014-2022) Spawning Escapements

Nooksack Early Management Unit.

Early timed Chinook spawning escapements for 2014 through 2022 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
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
2019	32	831	10	79	11	1
2020	38	198	7	100	15	15
2021	55	985	59	313	24	23
2022	49	856	10	271	0	1

Early timed Chinook spawning escapements for 2014 through 2022 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
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)
2019	61 (2)	369 (30)	6 (0)	9 (1)	8 (0)	27 (0)
2020	243 (1)	1,085 (34)	45 (0)	67 (1)	30 (0)	10 (4)
2021	92 (41)	717 (2,292)	4 (2)	107 (82)	26 (4)	19 (11)
2022	275 (29)	2,679 (1,026)	9 (1)	98 (27)	31 (2)	11 (8)

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

Skagit Springs Management Unit.

Year	Upper Sauk	Suiattle	Upper Cascade
2014	923	460	225
2015	743	478	188
2016	1,502	648	295
2017	1,630	898	323
2018	1,603	645	128
2019	551	400	180
2020	938	396	115
2021	1,024	433	145
2022	2,542	535	410

Skagit Summer/Falls Management Unit.

Year	Upper Skagit	Lower Sauk	Lower Skagit
2014	8,308	364	1,785
2015	10,705	406	2,203
2016	15,423	1,044	2,921
2017	7,792	1,001	3,638
2018	8,602	378	1,923
2019	10,155	319	1,336
2020	9,599	341	869
2021	6,410	233	664
2022	12,005	733	4,585

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)
2014	140 (57)	279 (87)
2015	482 (61)	227 (68)
2016	702 (76)	351 (65)
2017	548 (76)	522 (65)
2018	199 (44)	767 (102)
2019	196 (28)	748 (103)
2020	333 (49)	517 (88)
2021	425 (61)	307 (45)
2022	780 (69)	915 (67)

Snohomish Management Unit.

	Skykomish		Snoqualmie	
Year	NOR	HOR	NOR	HOR
2014	1,654	1,409	698	140
2015	1,585	1,449	694	135
2016	2,363	1,422	1,013	355
2017	2,790	1,584	1,409	336
2018	2,259	789	823	339
2019	569	397	443	233
2020	1,975	747	804	407
2021	1,414	607	611	367
2022	2,789	1,565	861	420

Lake Washington Management Unit.

	Cedar River		Sammamish River	
Year	NOR	HOR	NOR	HOR
2014	303	277	20	462
2015	1,177	631	52	936
2016	609	436	102	1,145
2017	1,557	491	153	1,371
2018	671	142	84	575
2019	599	256	101	264
2020	277	236		
2021	607	356		
2022	662	233		

Green River Management Unit.

Year	NOR	HOR
2014	756	1,974
2015	864	3,223
2016	2,566	7,497
2017	2,031	6,326
2018	2,177	4,714
2019	1,360	1,616
2020	1,967	2,333
2021	1,200	1,800
2022	2,117	3,470

Puyallup River Fall Management Unit.

Year	NOR	HOR
2014	468	793
2015	831	729
2016	713	1,822
2017	637	849
2018	486	1,833
2019	291	1,397
2020	542	1,208
2021	1,513	3,947
2022	1,175	2,532

White River Spring Management Unit.

Year	NOR	HOR	APP
2014	221	105	637
2015	360	472	736
2016	657	501	2,851
2017	686	2,953	2,749
2018	326	1,520	1,837
2019	344	588	2,013
2020	633	103	1,173
2021	706	2,090	1,552
2022	1,629	1,118	981

Nisqually River Management Unit. HOR's on the spawning grounds include trucked fish in 2017, 2018, 2019, and 2021.

Year	NOR	HOR
2014	528	512
2015	715	790
2016	796	168
2017	1,445	2,085
2018	435	1,850
2019	301	1,945
2020	472	100
2021	527	1,630
2022	543	2,939

Skokomish River Management Unit.

Year	NOR	HOR	Total
2014	109	740	849
2015	117	315	432
2016	179	1,163	1,342
2017			8,058
2018	103	2,356	2,459
2019	260	2,005	2,265
2020	69	2,052	2,061
2021	208	785	993
2022	930	4,465	5,395

Mid-Hood Canal Management Unit.

Year	Hamma Hamma	Duckabush	Dosewallips
2014	117	13	11
2015	236	20	3
2016	268	15	8
2017	365	2	7
2018	58	4	1
2019	18	3	0
2020	3	2	0
2021	3	2	3
2022	6	1	4

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
2014	21	87	*108*	22	74	*96*	**43**	**161**	***204***
2015	65	200	*265*	37	105	*142*	**102**	**305**	***407***
2016	135	273	*408*	30	77	*115*	**165**	**350**	***515***
2017	149	456	*605*	26	74	*100*	**175**	**530**	***705***
2018	127	661	*788*	20	97	*117*	**147**	**758**	***905***
2019	173	665	*838*	19	73	*92*	**192**	**738**	***930***
2020	297	436	*733*	26	74	*100*	**323**	**510**	***833***
2021	313	251	*564*	36	56	*92*	**349**	**307**	***656***
2022	256	369	*625*	44	68	*112*	**300**	**437**	***737***

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
2014	4,360
2015	4,112
2016	2,628
2017	3,100
2018	7,107
2019	7,500
2020	3,250
2021	2,630
2022	3,998

Hoko River Management Unit.

Year	HOR/NOR
2014	1,760
2015	2,877
2016	1,324
2017	1,225
2018	1,943
2019	1,815
2020	2,122
2021	1,070
2022	N/A