Washington Department of Fish and Wildlife
Puget Sound Treaty Indian Tribes

Puget Sound Chinook Comprehensive Harvest Management Plan

Annual Report
The 2013-2014 Fishing Season

June, 2014

Acknowledgements

This data contained in this report are the result of the widespread work of Tribal and WDFW staff throughout the Puget Sound Region. Staff members directly contributing to preparation of this report include:

Puget Sound Treaty Tribes:

Pete Kairis (Skagit River System Cooperative), Alan Chapman & Ben Starkhouse (Lummi Nation), Ned Currence (Nooksack Tribe), Mike Mahovlich (Muckleshoot Tribe), Abby Welch (Port Gamble S'Klallam Tribe), Doug Morrill (Lower Elwha Klallam Tribe), Cindy Gray (Skokomish Tribe), Diego Holmgren (Tulalip Tribes), Jon Oleyar (Suquamish Tribe), Chris Phinney (Puyallup Tribe), Joe Peters (Squaxin Island Tribe), and Craig Smith (Nisqually Tribe).

Northwest Indian Fisheries Commission:

Will Beattie, Bill Patton, Amy Seiders, and Chris James.

Washington Department of Fish and Wildlife:

Kyle Adicks, Mark Downen, Randy Cooper, Brett Barkdull, Andrew Fowler, Kurt Perry, Pete Verhey, Jennifer Whitney, Natasha Geiger, Aaron Bosworth, Darcy Wildermuth, Larry Phillips, James Losee, Tara Livingood, Ryan Lothrop, Jon Carey, Steve Thiesfeld, Nathanael Overman, Bethany Craig, and Kendall Henry.

Table of Contents

List of Tables

Executive Summary

This annual report on the Puget Sound Chinook Comprehensive Harvest Management Plan summarizes information about salmon fisheries occurring between May 1, 2013 and April 30, 2014, and Chinook spawning escapement in 2013.

Commercial Chinook catch in Puget Sound pre-terminal fisheries was similar to the pre-season projection for the Strait of Juan de Fuca troll fishery, and substantially lower than projected in the Strait of Juan de Fuca and the San Juan Islands net fisheries, largely due to limited fishing opportunity for Fraser sockeye salmon. Commercial catches in the Nooksack, Skagit, and Stillaguamish/Snohomish terminal areas were all below expectation. Catches in South Sound and Hood Canal were above expectation.

Marine and freshwater landed recreational Chinook catch in the 2012-2013 season was estimated at 65,018, i.e., higher than the pre-season projection of 55,546. Creel survey-based estimates of catch in 2013-2014 mark-selective recreational fisheries in Areas 5, 9-10, and 11 are included in this report. Total encounter estimates for the 2013-14 marine area selective fisheries are presented and compared to pre-season projections for these areas.

Escapement in 2013 was higher than projected for the Suiattle, Cascade, Sauk, Upper Skagit, Upper Sauk, North Fork Stillaguamish, Skykomish, Cedar, White, Mid Hood Canal, and Elwha populations. Escapement was lower than projected for the Nooksack, Lower Skagit, Snoqualmie, Puyallup, and Dungeness populations.

Coded-wire tag sampling rates for 2012 commercial fisheries exceeded 20% in all areas except Area 13. Sampling rates for marine recreational fisheries achieved the 10% objectives, except in Area 12.

1 Introduction

The Puget Sound Chinook Harvest Management Plan mandates annual reporting of the performance of Chinook harvest management relative to the standards and guidelines of the plan (PSIT and WDFW 2010). This report fulfills that requirement by assessing the performance and effectiveness of fishery management actions adopted for the most recent management year. Included in this report are:

- Management objectives for the 2013-2014 management year (May 1, 2013 through April 30, 2014)
- Projected and actual commercial landed catch in Puget Sound, and descriptions of fisheries, for the 2013-2014 management year
- Projected and actual landed catch for 2013 Puget Sound recreational fisheries where creel surveys were conducted, and for all 2012 Puget Sound recreational fisheries
- Estimates of total encounters for mark-selective fisheries, and non-landed mortality for commercial fisheries with Chinook non-retention, where data are available
- Projected and actual spawning escapement for all Puget Sound Chinook populations in 2013, with details on estimation methods and surveys.
- 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 2012.

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) are shown in Table 1-1. Table 1-2 identifies the rates that were used as the ceiling for each Management Unit (MU) in 2013, and the projected exploitation rates and escapements for each unit, from the final pre-season FRAM model run (1213).

Pre-season fishery planning for 2013-2014 fisheries projected that natural spawning escapement would fall below the Low Abundance Thresholds for the Nooksack early, Stillaguamish, Green, and Mid-Hood Canal MUs, so CERC's were implemented for those units. The projected ER for the Snohomish exceeded the ER ceiling, due to northern fisheries, so the CERC was also implemented. Escapement projections for other MUs exceeded their LAT's.

Table 1-1. 2013 Puget Sound Chinook Harvest Management Objectives.				
Management Unit	**ER Ceiling**	**Critical ER Ceiling**	**Upper Management Threshold**	**Low Abundance Threshold**
Nooksack		7.0% SUS (9% allowed 1 of 5 years)	4,000	
North Fork			2,000	1,000
South Fork			2,000	1,000
Skagit summer / fall	50%	15% SUS	14,500	4,800
Upper Skagit summer				2,200
Sauk summer				400
Lower Skagit fall				900
Skagit spring	38%	18% SUS	2,000	576
Upper Sauk				130
Cascade				170
Suiattle				170
Stillaguamish	25%	15% SUS	900	700
North Fork summer			600	500
South Fork & MS fall			300	200
Snohomish	21%	15% SUS	4,600	2,800
Skykomish			3,600	1,745
Snoqualmie			1,000	521
Lake Washington	20% SUS	10% PTSUS		
Cedar River			1,680	200
Green	15% PTSUS	12% PTSUS	5,800	1,800
White River spring	20%	15% SUS	1,000	200
Puyallup fall	50%	12% PTSUS		500
South Prairie Creek			500	
Nisqually	56%			
Skokomish	50%	12% PTSUS	3,650 aggregate; 1,650 natural	1,300 aggregate; 800 natural
Mid-Hood Canal	15% PTSUS	12% PTSUS	750	400
Dungeness	10% SUS	6% SUS	925	500
Elwha	10% SUS	6% SUS	2,900	1,000
Western SJDF	10% SUS	6% SUS	850	500

Table 1-2. Management guidelines implemented and projected exploitation rates and escapements for Puget Sound Chinook from 2012-2013 pre-season planning (FRAM 1213).

Management Unit	ERC or CERC implemented	Projected ER[1]	Projected Escapement[1]	UMT	LAT
Nooksack	7% SUS	6.9% SUS	302	4,000	2,000
Skagit summer fall	50%	48.2	10,025	14,500	4,800
Skagit spring	38%	27.3%	921	2,000	576
Stillaguamish	15% SUS	12.1%	415	900	700
Snohomish	15% SUS	11.8%	3,035	4,600	2,800
L. Washington (Cedar)	20% SUS	17.3% SUS	985	1,680	200
Green	12% PT SUS	10.2% PTSUS	1,911	5,800	1,800
White	20%	19.8%	963	1,000	200
Puyallup	50%	50.0%	1,801	500 South Prairie	500
Nisqually	56%	55.8%	904		
Skokomish	50%	50.0%	1,710	3650 aggregate 1650 natural	1300 aggregate 800 natural
Mid Hood Canal	12% PT SUS	11.9% PT SUS	250	750	400
Dungeness	10% SUS	3.7% SUS	569	925	500
Elwha	10% SUS	3.5% SUS	2,569	2,900	1,000
Western SJDF	10% SUS	5.4% SUS	1,057	850	500

2 Commercial Harvest

This chapter provides post-season estimates of Chinook catch for Puget Sound commercial fisheries, and also includes 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 2013-14 List of Agreed Fisheries, which describes all salmon fisheries for all areas of Puget Sound and ocean fisheries off the Washington coast is attached as Appendix A. The final pre-season projections of catch under this regime were made in FRAM run number 1213.

Commercial, ceremonial, subsistence, and test fishery catch is accounted on fish tickets, i.e., receipts from transactions between fishers and buyers. Fish ticket data are stored in a database maintained jointly by WDFW and the Puget Sound Tribes. In some fisheries, particularly non-treaty purse seine fisheries, estimates of non-landed mortality are also available, for comparison to pre-season expectations. WDFW conducts on-the-water observations of by-catch in commercial fisheries, concentrating on areas and gears where Chinook retention is not allowed. Summary results of that monitoring are included below in Table 2-7 and Table 2-8.

Non-treaty troll, troll, and recreational catches in Washington coastal fisheries north of Cape Falcon were less than their quotas (Table 2-1). Comparisons of projected and actual Puget Sound catch are provided here for two pre-terminal areas (Strait of Juan de Fuca and San Juan Islands), and six regional terminal fisheries (Nooksack/Samish, Skagit, Stillaguamish/Snohomish, South Puget Sound, Hood Canal, and Strait of Juan de Fuca). General information is presented for the 2012-13 fisheries, including in-season

management actions that deviated from the pre-season plan, and explanations for differences in projected and actual catch.

Table 2-1. Projected and actual Chinook catch in Washington ocean and Puget Sound fisheries in 2013.

Fishery	Projected	Actual
Washington ocean non-treaty troll	44,000	41,900
Washington ocean recreational	48,000	30,837
Washington ocean treaty troll	52,500	49,417
Puget Sound pre-terminal net & troll total		
Strait of Juan de Fuca troll	5,350	5,461
Strait of Juan de Fuca net	1,300	620
San Juan Islands net *	8,065	3937
Nooksack-Samish terminal net	29,997	23,751
Skagit terminal net	4,643	3331
Stillaguamish-Snohomish net	8,980	2,206
South Puget Sound terminal net	31,525	32,691
Hood Canal terminal net	34,461	45,028
Strait Tributaries terminal net	4	3

* includes non-retention mortality in NT purse seine fishery

2.1 Strait of Juan de Fuca and San Juan Islands

Treaty net fisheries in the Strait of Juan de Fuca, and the San Juan Islands caught 574 and 3758 Chinook, respectively, primarily during the fisheries directed at Fraser River sockeye and pink salmon. Sockeye test fishing in Area 5 caught 45 Chinook.

Non-treaty fisheries targeting Fraser sockeye and pink in Areas 7 and 7A landed 84 Chinook. Because purse seines are required to release all Chinook, release mortality estimates are calculated using available data from on-water bycatch monitoring. Post-season analysis estimated 72 Chinook mortalities in this sockeye fishery, and 23 in the chum fishery, for a total of 95.

The Treaty troll fishery in the Strait of Juan de Fuca, exclusive of catch in Area 4B when it was managed under PFMC quotas, caught 5,461 Chinook.

2.2 Nooksack/Samish Terminal Area

Treaty Spring Chinook Ceremonial and Subsistence Fishery

The Lummi Nation conducted fishing with tanglenet gear on 22 days from April 1 to June 13, 2013. Total landed catch was 206 hatchery origin Chinook; 27 natural-origin Chinook were released. The encounter rate with NORs was close to the pre-season projection.

The Nooksack Tribe was allocated 32 Chinook for Ceremonial and Subsistence fisheries in preseason planning. A total of 31 were harvested. Of these, 2 were caught on May 9 and 10 for use in First Salmon Ceremony. The remaining 29 were caught in subsistence fisheries that occurred May 15 and May 23. All 31 were sampled, and only two were wild Chinook. Microsatellite DNA analysis of wild Chinook samples determined that all of them were of North/Middle Fork origin.

Table 2-2. Expected and actual Chinook catches in the Nooksack/Samish terminal area, 2013.

Area	Management Period	Projected	Actual
7B, 7C, 7D Treaty net	Chinook, coho, chum	12,935	12,995
7B, 7C Non-treaty net	Chinook, coho, chum	16,826	90,18
Nooksack Treaty net	Early Chinook, May-Jun	257	237
	Fall Chinook, Jul-Sep	781	1,497

Fall Chinook, Coho, and Chum Fisheries

The tribal fall Chinook fishery in Bellingham Bay (Area 7B), Samish Bay (7C), and Lummi Bay (7D) operated as planned from August 1 through September 6 (management weeks 32 – 36), with a catch of 10,000 Chinook. The coho fishery operated as planned from September 8 through October 26, with an incidental harvest of 2,995 Chinook. No Chinook were harvested incidentally during the chum fishery, which took place from October 27 to December 11. The total fall Chinook catch of 12,995 for Areas 7B, 7C and 7D was moderately higher than the preseason projection of 12,935.

The non-treaty fishery in Area 7B and 7C landed 9,018 Chinook from July through September, lower than the pre-season projection of 16,826. Seven Chinook were landed after September, compared to the projection of 80.

Fisheries for fall Chinook, coho, and chum in the Nooksack River occurred as planned in weeks 32 – 37, 38 - 43, and 44 - 51, respectively. The total Chinook catch was 1,497, falling short of the projected 830; 834 were caught during the Chinook period, 655 during the coho fishery, and 8 during the chum period.

2.3 Skagit Bay/Skagit River Terminal Areas

Spring Chinook Fisheries: Treaty commercial fisheries in the Skagit terminal area directed at hatchery spring Chinook were conducted in 2013. Fisheries were adjusted from the preseason schedule as noted in Table 2-3 due to in-season management needs. The 24 hour opening originally scheduled in week 22 for the Upper Skagit tribe was cancelled because of higher than expected catches in the previous two weeks. Incidental catch of spring Chinook also occurred during week 27 of the directed sockeye fishery, as Skagit River sub-area 78D-4 was still in the spring management period at that time. A total of 167 wild spring Chinook and 463 hatchery spring Chinook were caught in these fisheries, compared to 91 wild and 562 hatchery spring Chinook expected pre-season (FRAM Chin1213). An additional 10 hatchery springs and 4 wild springs were harvested for ceremonial purposes as modeled preseason.

Summer/Fall Chinook Fisheries: No treaty commercial fisheries directed at summer/fall Chinook were scheduled in the Skagit terminal area for 2013. However, as anticipated, incidental catch of summer/fall Chinook occurred in the sockeye, pink, and coho fisheries. Weeks 37-38 of the Upper Skagit Tribe's pink fishery were Chinook non-retention, as were weeks 41-42 of their coho fishery. Estimated Chinook encounters during those weeks were based on the ratio of Chinook to pinks or Chinook to coho in the test fisheries which occurred closest in time to the commercial fishery, and a release mortality rate of 52.4% was used to calculate estimated mortality. 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 encounters in these fisheries was 2,784 fish, compared to the pre-season expectation of 3,716. Total summer/fall mortality (estimated) was 2,251, compared to the pre-season expectation of 3,250. These expected encounters and mortalities were calculated by using the projected TAA from FRAM Chin1213 in the Skagit harvest rate model, since FRAM did not estimate encounters. An additional 55 summer/fall Chinook were harvested for ceremonial purposes, which was less than the pre-season modeled value of 220.

Terminal Area Test Fisheries: A suite of Skagit terminal area test fisheries targeting Chinook, sockeye, coho, and chum was conducted by the Skagit tribes in 2013. Some weeks of these fisheries were adjusted or cancelled, as noted in Table 2-3, in response to weather or flow concerns. Weeks 42-43 of the Spudhouse coho test fishery were conducted as Chinook non-retention. A total of 37 wild spring Chinook, 33 hatchery spring Chinook, and 315 summer/fall Chinook were encountered in these fisheries. Total summer/fall Chinook mortality in the test fisheries was 312. The pre-season expectation of mortalities in the test fisheries was 27 wild spring Chinook, 71 hatchery spring Chinook, and 408 summer/fall Chinook (FRAM Chin1213).

Summary: Overall, a total of 208 wild spring Chinook, 505 hatchery spring Chinook, and 2,618 summer/fall Chinook were killed in treaty commercial, C&S, and test fisheries. The preseason expectation based on FRAM Chin1213 was 122 wild springs, 643 hatchery springs, and 3,877 summer/falls. The preliminary (incomplete) post-season estimate of the terminal run size for wild springs (2,218) was considerably higher than the FRAM forecast (1,053), while that of hatchery springs (2,396) was slightly lower than the FRAM forecast (2,772). The preliminary post-season estimate (13,940) of summer/fall terminal run size was about the same as the FRAM forecast (13,943).

Table 2-3. Projected and actual landed catch and total mortality of Chinook in Skagit terminal area fisheries in 2013.

	Preseason Projected			Post-season Observed/Estimated			Difference	
Fishery	Schedule	Encounters	Mortality	Schedule	Encounters	Mortality	Encounters	Mortality
Test:								
Chinook	1 site, wks 19-35	169	169	No week 35	136	136	-33	-33
Sockeye	2 sites: A3 wks 23-30, Blakes wks 24-29	115	115	Blakes same	112	112	-3	-3
Coho	3 sites: Blakes wks 34-45, A3 wks 35-44, Spudhouse wks 35-44	221	221	Blakes no wk 36-37,45, Spudhouse no wk 36-37, Jetty same, Spudhouse wks 42-43 Ck release	136	133	-85	-88
Chum	3 sites, wks 44-45	0	0	Blakes, Jetty same, Bay only wk 44	0	0	0	0
Area 8/78C Hatchery Spring Chinook Swinomish and Sauk-Suiattle Tribes:								
Week 19	1 day	47	47	Same	54	54	7	7
Week 20	1 day	65	65	Same	3	3	-62	-62
Week 21	1 day	32	32	Same	70	70	38	38
Area 78C/78D Hatchery Spring Chinook Upper Skagit Tribe:								
Week 20	1 day	158	158	Same	250	250	92	92
Week 21	1 day	153	153	Same	246	246	93	93
Week 22	1 day	199	199	None	0	0	-199	-199
Area 8/78C/78D Chinook C&S Swinomish, Sauk-Suiattle, Upper Skagit Tribes:								
Sum/Fall-Spring Chin.	As needed	234	234	As needed	69	69	-165	-165
Areas 8/78C Sockeye Swinomish and Sauk-Suiattle Tribes:								
Week 25	1.125 days	18	18	Same	10	10	-8	-8
Week 26	4 days	80	80	Same	17	17	-63	-63
Week 27	4 days	78	78	Same	59	59	-19	-19
Week 28	4 days	89	89	Same	130	130	41	41
Week 29	1 day (SSIT only)	18	18	None	0	0	0	0
Area 78D/78O Sockeye Swinomish Tribe:								
Week 29	1 day	84	84	0.542 days	0	0	-84	-84
Week 30	0 days	0	0	0.083 days	0	0	0	0
Areas 78C/78D/78O Sockeye Upper Skagit Tribe:								
Week 27	0.583 days	7	7	0.5 days	15	15	8	8
Week 28	1 day	47	47	None	0	0	-47	-47
Areas 8/78C Pink Swinomish and Sauk-Suiattle Tribes:								
Week 35	5 days	703	703	5 days	420	420	-283	-283
Week 36	6 days	431	431	7 days	305	305	-126	-126
Week 37	6.667 days	429	429	3.833 days	77	77	-352	-352
Areas 78C/78D Pink Upper Skagit Tribe (wks 37-39 Chinook non-retention):								
Week 36	4.167 days	583	583	3.167 days	587	587	4	4
Week 37	3.167 days	314	164	3.292 days	321	168	7	4

Week 38	3.167 days	281	147	2.375 days	201	105	-80	-42
Week 39	3 days	278	146	None	0	0	-278	-146
Areas 8/78C Coho Swinomish and Sauk-Suiattle Tribes:								
Week 38	2 days	122	122	None	0	0	-122	-122
Week 39	2 days	38	38	Same	36	36	-2	-2
Week 40	2 days	8	8	Same	10	10	2	2
Week 41	1.167 days	3	3	5 days	6	6	3	3
Areas 78C/78D Coho Upper Skagit Tribe (Chinook non-retention):								
Week 42	1.167 days	86	45	0.417 days	134	70	48	25
Week 43	1 day	20	11	2.333 days	464	243	444	232
Areas 8/78C Chum Swinomish and Sauk-Suiattle Tribes:								
Week 46		0	0	None	0	0	0	0
Total Skagit Terminal Area:		**5,108**	**4,643**		**3,867**	**3,331**	**-1,224**	**-1,294**

2.4 Stillaguamish/Snohomish Terminal Area

The tribal net fishery in Area 8A caught 156 Chinook during the coho fishery. Tribal Chinook catch in Area 8D occurred from May through mid-September, with most of the catch occurring in late July through early August. Total 8D catch was 1876, including 999 used for ceremonial or subsistence purposes. Chinook catch was substantially lower than projected because the hatchery return was below the forecast.

Non-treaty Chinook catch in Area 8A was 3 Chinook, during the coho fishery.

The Stillaguamish Tribes harvested 10 Chinook for ceremonial and subsistence purposes.

Table 2-4. Projected (FRAM 1213) and actual Chinook net fishery harvest in the Stillaguamish - Snohomish terminal area in 2013.

Area		Projected	Actual
8A	Trty	1021	156
	Ntrty	19	3
8A Test		8	
8D Commercial	Trty	7664	1876
	Ntrty	0	0
Stillaguamish R. Net	Treaty	68	10

2.5 South Puget Sound Terminal Areas

Table 2-5. Projected and actual Chinook catch in 2013 South Puget Sound net fisheries.

Area	Management Period	Projected	Actual
Area 9/10/11	Coho (test)	55	15
	Chum (test)	34	34
	A9 (T) subsist H&L	729	95
	Treaty pink coho chum	256	16
	NT pink chum	7	1
Area 10E	Treaty Chinook	3,927	8723
Area 10A	Chinook (test)	177	0
	Chinook C&S	0	175
	coho/chum	65	10
Duwamish River	coho	1010	296
L Washington/Ship Canal	Sockeye/coho	742	218
Lake Sammamish	Chinook	2355	0
Puyallup River	Spring C&S	322	341
	Fall C&S	79	15
	Chinook/Coho	2,431	1,474
Areas 13D-K	Chinook/Coho/Chum	4717	4,957
Area 13 & 13A	Chinook/Coho/Chum	1703	529
Areas 13C/Chambers	Chinook	4139	5010
Nisqually River	Chinook/coho	8827	10782

Marine Areas 9, 10 & 11

In test fisheries in Area 10 for coho, and for chum at Apple Cove Point, there was incidental catch of 49 Chinook.

The non-treaty chum-directed fishery in Area 10 and 11 incidentally harvested 2 Chinook, with a total estimated mortality of 40. The treaty chum fishery harvested no Chinook. The fisheries directed at Chinook and coho in Area 10E harvested 8,723 Chinook. The pre-season forecasted return to Area 10E was 7,911 Chinook. The tribe typically harvests about 50% of the extreme terminal run. The projected catch in 10E was based on recent average harvest rate. The larger than predicted run, higher effort, and higher market value contributed to the observed 2013 catch.

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 Suquamish and Muckleshoot tribes conducted C&S fisheries in the Lake Ship Canal targeting sockeye, with total by catch of 3 Chinook. The Muckleshoot Tribe conducted a C&S fishery on Chinook with a total catch of 18. Incidental Chinook catch during the coho fishery in Lake Union, and the upper and lower Ship Canal harvested 186 Chinook, which was

well less than expected. There were no Chinook-directed fisheries in Lake Sammamish. There were no coho-directed fisheries in North Lake Washington or Lake Sammamish.

Elliott Bay/Duwamish River

The Chinook test fishery in Area 10A did not occur. There were no Chinook-directed fisheries in 10A or the Duwamish River. In 10A there were 175 Chinook harvested by Muckleshoot for C&S purposes, and 10 additional Chinook were caught incidentally during the pink, coho, and chum fisheries. In the Duwamish River; 296 Chinook were caught incidentally during the pink/coho fishery, which was well below the projected number.

Puyallup River and White Rivers

Ceremonial and subsistence fisheries for White River spring Chinook in management weeks 20 – 27 caught 302 fish – 156 in the Puyallup River and 146 in the White River. The pre-season projected catch was 300.

Ceremonial and subsistence catch of fall Chinook in the Puyallup River was 15 fish. The fall Chinook catch was 1,474 in the half-day opening during the Chinook period and the subsequent coho fishery.

Marine area 13 & sub areas (Deep South Sound)

The Chinook fishery in Carr Inlet (13A) caught 698 Chinook, in August and early September (weeks 32 – 39). Pre-season projected catch was 1,703.

The Chinook fishery at Chambers Bay (13C) occurred in weeks 33 – 39, and caught 4,338 fish. The preseason catch projection was 4,139.

Chinook fisheries in Case Inlet (13D) and Budd Inlet (13F) occurred from late-July through September (weeks 30 – 41); total catch was 4,781. The preseason catch projection was 4,717.

Nisqually River

The treaty commercial fishery in the Nisqually River caught 10,782 Chinook and zero Ceremonial and Subsistence. The Chinook-directed gillnet fishery was conducted July 28 through August 27; catch was10,636 (through coho and chum directed 11/5/13) . A Chinook beach seine fishery, requiring release of unmarked Chinook, was open from September 1 to October 2. Retained catch was 146 marked Chinook, 151 encountered, with a preseason projection of 392 total encounters. Approximately 1% of the total Chinook catch was taken during the coho period in weeks 40 – 47.

The pre-season management objective was for the terminal harvest rate to not exceed 27.1% on unmarked Chinook. Based on the estimate of unmarked terminal run size (3,658) the extreme terminal harvest rate on unmarked Chinook was 29.8%. Based on the preliminary accounting of marked terminal run size (32,071) the extreme terminal harvest rate on marked Chinook was 30.2%

2.6 Hood Canal

Treaty Chinook directed fishing in 12C occurred as planned from July 15 thru August 31 (weeks 30 – 36). Catch was 8,126, with only14 of those landed during the first two weeks of the coho fishery at the end of September.

Chinook harvest in the Hoodsport Hatchery Zone (12H) was 27,826 and occurred as planned from July 16 through September 19. Catch exceeded the pre-season projection due to early returns at the Hoodsport Hatchery resulting in 81% of catch taken first three weeks of August.

Chinook harvest in the Skokomish River occurred as planned from August 4 through September 14 (during the Chinook period). Total Chinook harvest of 8,894 was lower than pre-season projections, in part because run timing was earlier than expected; 710 of those taken during the coho period. In 2013, Chinook exhibited an early entry pattern with fish beginning to move into the river in late June and early July, before fisheries began and contributed to the over-escapement at the George Adams Hatchery.

Terminal area Chinook catch exceeded the pre-season projections, due to hatchery returns exceeding the forecasted level. However, terminal harvest rates on unmarked/untagged Chinook remained within the pre-season projection levels regardless of in-season estimates of abundance greater than forecasted levels..

In Port Gamble (Area 9A) 180 Chinook were harvested, primarily in mid to late August (weeks 34 and 35) during coho fisheries. Catch exceeded the pre-season projection of 132.

Chinook catch in other areas of Hood Canal were very low, as expected: 2 were landed in Area 12 /12B and 2 Quilcene Bay (12A), all of these during coho fisheries directed on hatchery stocks.

There were 2 Chinook landed in non-treaty fisheries in Hood Canal in 2013, with a total estimated mortality of 55.

Table 2-6. Pre-season projected and observed catch of Chinook in Hood Canal terminal area net fisheries in 2013.

Area	Target Species	Projected	Actual
(12, 12B-12D, 9A) (T)	Chin, coho, chum	7226	8306
(12-12C, 9A) (NT)	chum, coho	2	0
12A Net (T)	Coho	117	2
12H Net (T)	Chinook, chum	16318	27826
Skokomish R (82G/J) (T)	Chin, coho, chum	10801	8894
	Total	34461	45028

2.7 Strait of Juan de Fuca

Due to the continued depressed status of Chinook populations, terminal fisheries in the Dungeness River and Elwha River were closed or provided very limited fishing opportunity. No Chinook were caught in the Dungeness Bay (6D) coho fishery. Five Chinook were harvested for ceremonial purposes in the Elwha River (Table 2-6).

Table 2-7. Projected and actual catches of Chinook in Strait of Juan de Fuca terminal net fisheries in 2013.

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

2.8 Non-Treaty Commercial Monitoring and Total Mortality

Because non-treaty vessels are required to release non-target species in many fisheries, WDFW conducts on-water monitoring to provide data on encounters of non-target species. In 2012, an effort was made to sample gillnets more intensively than in the many recent years. Summaries of observer data for 2012 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 in below in Table 2-9.

Table 2-8. Commercial fishery observation data for 2013 Puget Sound non-treaty salmon net fisheries.

Area	Gear type	# sets observed	Chinook	Coho	Sockeye	Pink	Chum	Steelhead
10	PS	5	0	2	0	0	195	0
11	PS	8	0	1	0	0	662	0
7	PS	25	34	138	3,870	28	568	1
7A	PS	40	45	61	2,562	14	407	1
8A	PS	30	0	677	0	0	3	0
10	GN	51	2	41	0	0	4,120	0
12	GN	33	3	20	0	0	1,995	1
12B	GN	13	0	4	0	0	1224	0
12C	GN	6	0	1	0	0	117	0
7	GN	11	3	0	204	2	7	0
7A	GN	6	0	7	0	0	152	1
12A	BS	13	0	323	0	0	47	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 2013.

	Total Mortality	
Area	Projected	Actual
6D	0	N/A (0 landed)
7/7A	1,460	111
8	0	N/A (no openings)
8A	2	0
10/11	170	196
12/12B	40	55
9A/12A	0	N/A (0 landed)

3 Recreational Harvest

This chapter summarizes expected recreational catch in Puget Sound marine waters and freshwater tributaries for the 2013-2014 management year, and presents catch estimates available from creel studies for 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 are not yet available. Since complete catch estimates were not available for all areas in the annual report covering the previous management cycle, projected and actual recreational catches for the 2012-2013 management year are also included here.

3.1 2012-2013 Recreational Catch

Total Recreational Chinook harvest in 2012-2013, estimated from preliminary Catch Record Card (CRC) data and creel estimates where available, was 65,983, compared to a preseason projection of 55,546. The CRC estimates are preliminary and subject to revision. Projected and actual catches for individual fisheries are shown in Table 3-1. Updated estimates of total mortality in mark-selective fisheries, for those fisheries where estimates are available, are presented in final reports available at http://wdfw.wa.gov/publications/search.php?Cat=Fishing / Shellfishing.

Table 3-1. Projected (FRAM 1512) and actual (preliminary creel & preliminary CRC) landed Chinook catches in Puget Sound recreational fisheries during the 2012-2013 season.

Area/Fishery	Projected	Actual
Area 5-6		
Area 5 Summer MSF	4,779	6,060
Area 6 Summer MSF	1,187	5,572
Area 6 Winter MSF	1,458	1,430
Other	784	427*
Strait Tributaries	0	0
Area 7		
Non MSF	2,510	3,596
MSF (December-April)	3,090	3,578
Nooksack/Samish FW	5,783	9,599
Area 8-1 & 8-2		
MSF	2,053	644
Skagit River		
Spring MSF	339	190
Area 8D SAF	521	223
Stillaguamish River	0	0
Snohomish River		
Skykomish MSF	345	135
Area 9		
Summer MSF	4,458	7,256
Winter MSF	1,178	1,553
Area 10		
Summer MSF	2,511	3,161
Winter MSF	1,979	178
Area 11		
Summer MSF	7,667	5,038
Winter Non-Selective	627	416
Winter MSF	337	171
Area 10E SAF	1,175	21**
Lake Sammamish	268	229
Area 10A SAF	0	0
Green River	0	0
Puyallup River		
Carbon R MSF	1,050	152
Puyallup R MSF	680	496
Area 13		
Summer MSF	1,394	826
Winter Non-Selective	205	150*
Chambers Cr	65	144
Nisqually	2,290	4,119
Deschutes	203	3
Area 12		
Summer MSF	470	2,073
Winter MSF	1,046	367*
Skokomish River	5,094	8,176

* Estimates through 3/31/2013

**10E catch included in estimate for Area 10 MSF for the period when both were open concurrently.

3.2 2013-2014 Recreational Catch

Projected Chinook catches for 2013-2014 recreational fisheries are listed in Table 3-2. The recreational fishing regime included mark selective fisheries (MSF) for portions of the year in Marine Areas 5 through 13 and in a number of rivers. WDFW conducted intensive sampling and monitoring of MSFs in Marine Area 5, 9, 10 and 11, which provided the estimates in Table 3-2. Brief summaries of Chinook catch and encounters resulting from these sampling programs are included below. The analysis of 2013 summer fisheries is still in draft, but will be available, with similar previous years' analyses on the WDFW website:

http://wdfw.wa.gov/publications/search.php?Cat=Fishing / Shellfishing.

For 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 2014 annual report.

Table 3-2. Projected (FRAM 1213) and actual (preliminary, where available) landed Chinook catches in Puget Sound recreational fisheries during the 2013-2014 season.

Area/Fishery	Projected	Actual
Area 5-6		
Area 5 Summer MSF	4,896	8,564
Area 6 Summer MSF	1,538	
Area 6 Winter MSF	1,736	
Other	904	
Strait Tributaries	0	
Area 7		
Non MSF	2,826	
MSF (December-April)	3,744	
Nooksack/Samish FW	5,967	
Area 8-1 & 8-2		
MSF	2,652	
Skagit River		
Spring MSF	381	
Area 8D SAF	251	
Stillaguamish River	0	
Snohomish River		
Skykomish MSF	873	
Area 9		
Summer MSF	4,940	4,724
Winter MSF	1,377	
Area 10		
Summer MSF	2,687	3,534
Winter MSF	2,214	
Area 11		
Summer MSF	6,187	3,146
Winter Non-Selective	719	
Winter MSF	403	
Area 10E SAF	83	
Lake Sammamish	272	
Area 10A SAF	0	
Green River	0	
Puyallup River		
Carbon R MSF	426	
Puyallup R MSF	1,945	
Area 13		
Summer MSF	1,604	
Winter Non-Selective	219	
Chambers Cr	59	
Nisqually MSF	3,793	
Deschutes	130	
Area 12		
Summer MSF	841	
Winter MSF	813	
Skokomish River MSF	8,265	

3.2.1 Marine Area 5 Summer MSF

2013 was the 11th year of summer mark-selective Chinook fishing in Marine Area 5. The 2013 fishery was opened for a set season, from July 1 through August 15.

WDFW conducted comprehensive fishery monitoring activities during the Area 5 MSF. Sampling activities included dockside creel sampling and intensive efforts to distribute and collect voluntary trip reports (VTRs) from the angling public. An enhanced Voluntary Trip Report (VTR) 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 (2014).

For Area 5, WDFW estimates that 4,896 Chinook were landed (4,862 marked and 34 unmarked (Table 3-33-4). Total encounters were higher than projected pre-season for both marked and unmarked fish.

Table 3-3. Comparison of modeled (FRAM 1213) and estimated total Chinook encounters for the 2013 Area 5 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	4,473	3,368	1,105	34
	AD	9,999	5,589	4,410	4,862
	Total	14,472	8,957	5,515	4,896
	% Marked	69	62	80	99
Estimated (Creel) Encounters	UM	16,048	7,265	8,783	159
	AD	17,695	8,589	9,106	8,405
	Total	33,743	15,854	17,889	8,564
	% Marked	52	54	51	98

3.2.2 Marine Areas 9 & 10 Summer MSF

In 2013, recreational MSFs occurred for the seventh consecutive summer in Marine Areas 9 and 10. These fisheries were scheduled to be open from July 16 through August 31, however, due to higher than expected legal-sized encounter rates, the Area 9 fishery was closed on August 5 and the Area 10 fishery was closed on August 19. As in previous years, WDFW's Puget Sound Sampling Unit (PSSU) implemented an intensive monitoring program in Areas 9 and 10 during the summer seasons in order 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 (2014).

Total harvest in Areas 9 and 10 was estimated at 4,724 and 3,534 Chinook, respectively, compared to preseason projections of 4,940 and 2,687. As mentioned above, the fisheries were closed early, as estimated legal-sized encounters had reached the pre-season guidelines.

Table 3-4. Comparison of modeled (FRAM 1213) and estimated Chinook encounters for the 2013 Areas 9 and 10 summer Chinook MSFs.

	Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
Area 9	FRAM Encounters	UM	1,780	870	910	17
		AD	11,068	5,658	5,410	4,923
		Total	12,848	6,528	6,320	4,940
		% Marked	86	87	86	100
	Estimated (Creel) Encounters	UM	1,589	1,192	397	18
		AD	7,152	5,364	1,789	4,706
		Total	8,742	6,556	2,186	4,724
		% Marked	82	82	82	100
Area 10	FRAM Encounters	UM	2,286	841	1,445	50
		AD	8,126	3,031	5,095	2,637
		Total	10,412	3,872	6,540	2,687
		% Marked	78	78	78	98
	Estimated (Creel) Encounters	UM	1,924	304	1,620	23
		AD	6,173	3,947	2,227	3,512
		Total	8,097	4,251	3,846	3,534
		% Marked	76	93	58	99

3.2.3 Marine Area 11 Summer MSF

In 2013, a summer recreational MSF was implemented in Area 11 for the seventh consecutive year, running from June 1 through September 30. WDFW's Puget Sound Sampling Unit (PSSU) implemented an intensive monitoring program in Area 11 to collect the data needed to provide in-season catch estimates and to estimate key parameters characterizing the fishery and its impacts on unmarked salmon. An estimated total of 3,146 Chinook were landed during the fishery, compared to the pre-season projection of 6,187 (Table 3-5). Unmarked legal encounters were above projection, while unmarked sublegal and total encounters were below projection.

Table 3-5. Comparison of modeled (FRAM 1213) and estimated Chinook encounters for the 2013 Area 11 summer Chinook MSF.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	UM	1,608	893	715	27
	AD	10,222	7,082	3,140	6,160
	Total	11,830	7,975	3,855	6,187
	% Marked	86	89	82	100
Estimated (Creel) Encounters	UM	1,993	1,324	669	35
	AD	4,781	3,513	1,268	3,111
	Total	6,774	4,837	1,938	3,146
	% Marked	71	73	66	99

4 Spawning escapement

This section compares natural Chinook escapement estimates for 2013 with pre-season escapement projections, and management thresholds.

In general, FRAM projects natural escapement of unmarked Chinook. For some MUs where hatchery-origin adults contribute to natural spawning, the FRAM projections of escapement include natural-origin recruits (NOR) and hatchery-origin recruits (HOR) that spawn naturally. This includes projections for the Skagit, Cedar, Green, Puyallup, Skokomish, Mid-Hood Canal, Dungeness, and Elwha. For the White MU, the projection includes fish of natural origin and 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 natural-origin escapement for the Nooksack, Skagit spring, Stillaguamish 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.

Spring Chinook escapements were above predictions for the Skagit and White populations. Skagit spring escapement exceeded the Upper Management Threshold. Escapement to the Dungeness was lower than projected and below the LAT. Escapement to the Nooksack was ???.

For summer/fall populations, escapement was higher than predicted for all management units, except Puyallup. South Stillaguamish escapement was below the LAT.

Table 4-1. Preseason projections and estimates of Puget Sound Chinook natural spawning escapement in 2013

Management Unit		NOR	HOR	Total	Projected (FRAM 1512)
Nooksack	NF	100		1347	173 [1]
	SF	10		243	129 [1]
Skagit spring	Suiattle	620		620	191 [1]
	Cascade	310		310	235 [1]
	Sauk	1,080		1,080	494 [1]
	Total spring	2,010		2,010	921 [1]
Skagit summer/fall	Upper Skagit summer	8,399		8,399	7,498 [1]
	Sauk summer	530		530	423 [1]
	Lower Skagit fall	1,391		1,391	1,859 [1]
	Total summer/fall	10,320		10,320	10,025 [2]
Stillaguamish	NF	470	303	773	331 [1]
	SF	51	30	81	84 [1]
	Total	521	333	854 [3]	415 [1]
Snohomish	Skykomish	1,860	495	2,355	1,891 [1]
	Snoqualmie	770	119	889	1,144 [1]
	Total	2,630	614	3,244	3,035 [1]
Lake Washington	Cedar	1,610	240	1,850	985
	Sammamish	254	2,393	2,647	
Green		524	1,517	2,041	1,740
Puyallup		175	599	774	1,801
White		910 [4]	2,734	3,644	963 [4]
Nisqually		1,257	1,036	2,293	904 [1]
Skokomish		224	1,498	1,722	1,710
Mid Hood Canal	Dosewallips			4	
	Duckabush			7	
	Hamma Hamma			661	
	Total	358	314	672	250
Dungeness		91	187	278 [5]	569
Elwha				5,510 [6]	2,659
Hoko		725	681	1,406 [7]	1,057

1. Natural-origin only.

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

3. Additional 73 NOR and 59 HOR were collected for broodstock. The NOR's were part of the FRAM projection.

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

5. Includes 110 fish removed from the river for use as broodstock. Estimation of escapement complicated by large abundance of pink salmon.

6. Includes 3,580 fish spawning in the Elwha plus 1,930 fish captured and transported to the Elwha Channel.

7. Includes 750 adults collected for broodstock (635 HOR, 115 NOR)

4.1 Nooksack River Early Chinook

North and Middle Fork early (spring) Chinook

The Nooksack River North and Middle Forks originate from Mount Baker glaciers and are typically turbid with moderate or lower flows during summer due to glacial melt. Co-managers have modified the escapement methodology as conditions change, even from year to year. Over the last eight years co-managers have modified the North and Middle Fork escapement methodologies at least four times. We modify our methods as needed to most accurately expand data to reflect the conditions encountered during the season.

Because of the unpredictability of redd viewing conditions during Spring Chinook spawning seasons (late July through late September), a carcass based methodology is the norm instead of a redd based methodology. The escapement estimate is the number of naturally spawning natural origin and hatchery origin Chinook in the North and Middle Forks and their tributaries. Traditionally this was derived by expanding the total number of carcasses from the two watersheds by a 3.48 expansion factor. This factor was derived from five years when good visibility enabled cumulative redd counts multiplied by 2.5 fish per redd to estimate total population abundances. The total carcass counts in each of these five years was expanded to match the respective redd based total population abundance estimates. The averaged expansion needed in these five years was 3.48 carcasses per carcass enumerated to match the redd based estimates.

However, beginning in 2005, an alternative method was developed in the Middle Fork sub-basin. From 2005 through 2008 lower water flows and good viewing conditions enabled the spawn surveys on the Middle Fork to account for a high percentage of redds built in the river. Because of this, co-managers shifted to a redd based methodology, expanding total enumerated redds by 2.5 adults per redd. The 3.48 expansion factor was applied only to the North Fork carcass counts in those years.

In 2009 higher than normal water flows and associated limited visibility in the Middle Fork limited redd observations during the early Chinook spawning season. As a result co-managers adjusted the Middle Fork escapement methodology to account for these less than optimal viewing conditions. The following methodology was agreed to for the 2009 through 2012 early Chinook returns in the Middle Fork watershed.

A carcass expansion factor (1.91) was calculated in a method similar to the North Fork's 3.84, expanding carcass counts using the 2005- 2008 years with good viewing conditions. The total number of redds multiplied by 2.5 fish per redd to estimate total spawners was divided by the number of carcasses observed to create an average expansion factor (Table 4-2). The average of those four years was used to calculate the 2009 through 2012 Middle Fork escapement.

In 2013, there was a debris flow in the Upper Middle Fork on May 31 which traveled nearly 4 miles. The river downcut through deposited materials the rest of the year, and survey conditions were poor in downstream areas. The vast majority of carcasses encountered were in tributaries (primarily Peat Bog Creek). This was a much higher percentage of all subbasin carcasses than had previously been observed. So in 2013 co-managers expanded the 45 enumerated Middle Fork carcasses by 1.91, but did not expand tributary carcasses. Unexpanded tributary carcass counts were considered to more accurately reflect total Chinook in those low and clear water tributaries. Surveys were frequent.

Table 4-2. Ratios of redd-based escapement estimates to numbers of carcasses observed Middle Fork Nooksack early Chinook, 2005 - 2008.

Return Year	MF Redds observed	MF estimate based on redds x 2.5	ALL MF carcasses observed	MF Expansion %
2005	116	290	219	1.32
2006	71	178	150	1.19
2007	106	265	150	1.77
2008	114	285	85	3.35
4 year Average				**1.91**

There was another significant change in methodology introduced in 2010 for the North Fork/Middle Fork Nooksack River spring/early Chinook escapement estimate. The carcasses observed in Kendall Creek were not expanded, and instead were considered the total counts, like the tributary counts in the Middle Fork in 2013. This 2010 change for Kendall Creek and Slough continued through 2013. The prior assumption that the Kendall Creek and Slough carcass enumerations should be expanded by 3.48, like all other North Fork sub-basin carcasses. High densities in this limited area with frequent surveys resulted in co-managers no longer expanding these near-hatchery spawners beginning in 2010. We continue to use the (3.48) expansion for the rest of the North Fork Nooksack sub-basin carcass recoveries.

Table 4.3 displays total population abundance estimates from 2005 through 2013. Annual adjustments in methodology described above are reflected in the table. The total 2013 North/Middle Fork population escapement estimate is 1,347, which is the highest in the past three years. The hatchery origin portion of the escapement is 1,247, and the natural origin (wild) portion is estimated to be 100 Chinook. That is one of the lowest recent abundances. Returns to Kendall Hatchery are not shown in Table 4-3, and are excluded from the population escapement estimate.

Table 4-3. Estimates of Chinook escapement to the North / Middle Forks of the Nooksack River, 2005 - 2013.

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total North Fork carcasses includes; sampled, un-sampled and non-sampled carcasses observed, excluding Kendall Creek and Slough	505	289	337	282	498	272	130	115	174
North Fork carcasses (above row) multiplied by 3.48 expansion factor	1757	1006	1173	981	1733	947	452	400	606
Kendall Creek and Slough carcasses (not expanded)						707	199	179	341
Middle Fork Estimate based on 2.5 fish per redd	290	178	265	285	na	na	na	na	n/a
Middle Fork Estimate based on 2005-2008 average carcass to redd ratio (1.91)	na	na	na	na	170	378	214	179	**n/a**
Middle Fork mainstem estimate based on 2005-2008 averaged carcass to redd ratio (1.91)									86
Middle Fork tributary carcasses (Peat Bog and Bear Creek not expanded)									314
Combined North/Middle Fork Population Escapement Estimate	**2047**	**1184**	**1438**	**1266**	**1903**	**2032**	**865**	**758**	**1347**
North Fork and Kendall Creek and Slough natural origin (from otolith reads)	11.4%	27.3%	26.8%	27.3%	14.1%	9.7%	7.3%	38.7%	9.22%
Middle Fork estimated NOR (from otolith reads)	3.5%	20.2%	7.4%	13.6%	13.4%	11.3%	24.5%	31.9%	2.0%
Total natural origin Chinook	**210**	**311**	**334**	**307**	**269**	**205**	**99**	**281**	**100**

Table 4-4. Middle Fork Nooksack early Chinook escapement estimates, 2005 - 2013.

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total Number Carcasses observed	220	123	150	85	89	198	112	94	359
Middle Fork mainstem carcasses									45
Middle Fork tributary carcasses									314
Number redds surveyed in 6 miles of Middle Fork	116	71	106	114	na	na	na	na	na
Fish/Redd (2.5) X redds surveyed	290	178	265	285	na	na	na	na	na
M Fk Mainstem Carcasses x MF expansion (1.91)	na	na	na	na	170	378	214	179	86
Total Middle Fork Estimate	**290**	**178**	**265**	**285**	**170**	**378**	**214**	**179**	**400**

South Fork Nooksack early (spring) Chinook

This report updates escapement estimate information for South Fork Nooksack Chinook from 2011, 2012, and 2013. South Fork Nooksack Chinook population estimated abundances were comparatively strong in 2011 and 2012, but 2013 is the lowest population abundance estimate dating back to 1999, which is the first year reflecting DNA based estimates. Fisheries co-managers consider the 2013 estimate a minimum estimate. This is primarily due to the unusually large abundance of pink salmon in 2013 which obscured the ability to enumerate Chinook redds. Consequently the total redd count was comparatively low, and the carcasses sampled per redd enumerated was quite high. We did not adjust our estimate to reflect this and instead are reporting our estimate as a minimum estimate. See Table 4. For summarized stock composition and origin of total Chinook for the three years described below. The South Fork Nooksack has no glaciers, though viewing conditions can deteriorate with significant precipitation. The methodology assumes all redds are accurately counted in all geographic spawning areas utilized, that no spawning Chinook after October 1 are early timed Chinook, and that Chinook that spawn through Sept. 30 die within 1 week (by October 7).

2011

In 2011 the total early Chinook escapement estimate was derived by expanding a total of 188 redds enumerated from the start of spawning to October 1 by 2.5 adults per redd,for a total of 470 adults. Additionally, there were 14 non-spawning carcasses. A total of 137 spawned carcasses were sampled providing information for estimating the contribution of South Fork population Chinook, as well as other stocks to the total escapement. Natural origin components were distinguished by microsatellite DNA analysis of 51 carcasses. Additional to the 51, 29 other carcasses were unmarked (natural origin) but there was no tissue analysis for various reasons. Individual samples of the 51 were assigned according to their best fit to the three Nooksack baseline stocks. Assignments were 15 South Fork early/spring Chinook (29.41%), 15 North/Middle Fork early Chinook (29.41%), and 21 Samish/Nooksack summer-

fall Chinook (41.18%)). Stock ratios derived from these assignments were applied to the remaining unanalyzed, unmarked carcasses to generate stock composition of all the natural origin (wild) carcasses.

Kendall Creek Hatchery and other hatchery-origin adults were identified by adipose fin clip marks, otoliths or CWTs from 57 hatchery origin carcasses. Kendall Creek Hatchery origin were determined for 50 of these, based on otolith marks and/or coded wire tags. The remaining 7 hatchery carcasses sampled were summer/fall Chinook, or unknown origin.

These estimates result in apportioning the total of 470 spawning Chinook to October 1 as 81 South Fork population spring Chinook (all natural origin), and an additional three native South Fork Chinook that were non-spawning, 81 North/Middle Fork population natural origin spring Chinook, and one additional non-spawning natural origin North/Middle Fork Chinook, 113 summer/fall stock natural origin Chinook, and one additional non-spawning summer/fall carcass, 172 North/Middle Fork Kendall Hatchery origin strays, 24 summer fall or unknown hatchery origin strays, and 8 additional non-spawning summer/fall or unknown hatchery origin strays.

2012

In 2012 the total early Chinook escapement estimate was derived by expanding a total of 203 redds enumerated to October 1 by 2.5 adults per redd, for a total of 508 adults. Additionally, there were 21 non-spawning carcasses. A total of 137 spawned carcasses were sampled, providing information for estimating the contribution of South Fork population Chinook, as well as other stocks to the total escapement. Natural origin components were distinguished by microsatellite DNA analysis of 83 carcasses. Additional to the 83, 29 other carcasses were unmarked (natural origin), but there was no tissue analysis. Individual samples of the 83 wild Chinook were assigned according to their best fit to the three Nooksack baseline stocks. Assignments were 26 South Fork spring/early Chinook (31.33%), 37 North/Middle Fork spring/early Chinook (44.58%), and 20 Samish/Nooksack summer-fall Chinook (24.10%). Stock ratios derived from these assignments were applied to the remaining unanalyzed, unmarked carcasses to generate stock composition of all the natural origin (non-hatchery) carcasses.

Kendall Creek Hatchery and other hatchery-origin adults were identified by adipose fin clip marks, otoliths or CWTs from 33 hatchery origin spawned carcasses. Kendall Creek Hatchery origin was determined for 22 of these 33, based on otolith marks and/or coded wire tags. The remaining 11 hatchery carcasses sampled were summer/fall Chinook or unknown origin.

These results apportion the total of 508 spawning Chinook to October 1 as 121 South Fork population spring Chinook (all natural origin), and an additional one wild native South Fork Chinook that was non-spawning, 172 North/Middle Fork population natural origin spring Chinook, and one additional non-spawning natural origin North/Middle Fork Chinook, 93 summer/fall stock natural origin Chinook, and two additional non-spawning summer/fall stock carcasses. The hatchery origin stock estimates are 81 Kendall Hatchery origin strays, with an additional 17 non-spawners, and 41 summer/fall stock or unknown origin hatchery strays.

2013

In 2013 the total early Chinook escapement estimate was derived by expanding a total of 97 redds enumerated to October 1 by 2.5 adults per redd,for a total of 243 adults. Despite the

abundant pinks which were spawning with Chinook, were did not expand this cumulative redd count. Additionally, there were 44 non-spawning carcasses, and this includes prespawn mortalities. A total of 100 spawned carcasses were sampled, providing information for estimating the contribution of South Fork population Chinook, as well as other stocks to the total escapement. Natural origin components were distinguished by microsatellite DNA analysis of 25 carcasses. Additional to the 25, two other carcasses were unmarked (natural origin), but there was no tissue analysis. Individual samples of the 25 wild Chinook were assigned according to their best fit to the three Nooksack baseline stocks. Assignments were four South Fork spring/early Chinook (16.00%), 15 North/Middle Fork spring/early Chinook (60.00%), and six Samish/Nooksack summer-fall Chinook (24.00%). Stock ratios derived from these assignments were applied to the remaining unanalyzed, unmarked carcasses to generate stock composition of all the natural origin (non-hatchery) carcasses.

Kendall Creek Hatchery and other hatchery-origin adults were identified by adipose fin clip marks, otoliths or CWTs from 73 hatchery origin spawned carcasses. Kendall Creek Hatchery origin were determined for 67 of these 73, based on otolith marks and/or coded wire tags. The remaining six hatchery spawned carcasses sampled were summer/fall Chinook or unknown origin. No adult returns from the early releases from the Skookum Hatchery South Fork Nooksack spring Chinook population rebuilding program were predicted to return in 2013, and none were encountered. A small number of returns are anticipated in 2014.

These results apportion the total of 243 spawned Chinook to October 1 as 10 South Fork population spring Chinook (all natural origin), and one additional wild native South Fork Chinook that was non-spawning (a pre-spawn mortality), 39 North/Middle Fork population natural origin spring Chinook, 16 summer/fall stock natural origin Chinook, and two additional non-spawning carcasses. The hatchery origin stock estimates are 162 Kendall Hatchery origin strays, with an additional 39 non-spawning carcasses, and 15 summer/fall stock or unknown origin hatchery strays, and two additional non-spawning carcasses. Again, the estimate of 10 South Fork population spawners is considered a minimum estimate, and likely underestimates the true population spawning abundance.8

Table 4-5. 2011 - 2013 South Fork Nooksack Chinook stock composition estimates to October 1 and escapements.

Return Year	**2011**	**2012**	**2013**
Total spawners	470	508	243
Additional nonspawners from all sources	14	21	44
North Fork Hatchery stray spawners	172	81	162
Summer/fall stock hatchery strays or unknown hatchery origin	24	41	15
North/Middle Fork spring Chinook natural origin spawners in South Fork	81	172	39
Nooksack/Samish fall Chinook natural origin spawners in South Fork	93	17	16
South Fork Nooksack early/spring Chinook population spawners	**81**	**121**	**10**
Total Chinook	484	529	287

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 Cascade River are the major tributaries to the Skagit River, but there are also numerous smaller anadromous tributaries flowing both into the major tributaries, and also into the Skagit River directly. Five hydroelectric projects are in the basin, two on the Baker River at river miles (RM) 1.6 and 9.3, and three on the Skagit River at RM 96.6, 100.9, and 105.1.

Population escapements were calculated by various methods based on redd counts or predicted by linear regression. We sampled Chinook carcasses 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, pontoon boat, and jet boat. Calculation of escapement for Skagit summer and Skagit fall Chinook, Sauk River spring (one 0.9 mile mainstem index) and Sauk River summer Chinook has relied heavily on aerial redd surveys of extensive mainstem sections. Due to a combination of environmental factors conditions no aerial surveys were conducted in 2013.

Additional personnel from the Skagit Fisheries Enhancement Group (SFEG), Skagit River System Cooperative (SRSC), the Upper Skagit Indian Tribe (USIT), Seattle City Light, and Puget Sound Energy, also collaborated to complete the escapement estimates.

Methods and Results

Methodology Change for Mainstem Chinook Surveys.

Of the six Chinook populations that spawn in the Skagit Basin documentation of mainstem spawning of four of the populations has relied on total redd counts performed from a helicopter. In 2013 the combination of high and turbid stream flows and highly abundant pink salmon led to the decision to abandon flight efforts for Upper Sauk spring Chinook that spawn downstream of the White Chuck River, Sauk River summer Chinook, Skagit River summer Chinook, and Skagit River Fall Chinook.

August and September of 2013 were characterized by high flow volumes and a series of uncharacteristically strong rainstorms for the fall season in Washington. While flows were too high and turbid to perform flights of the mainstems of the Sauk and Skagit Rivers, on the ground survey personnel were observing what appeared to be indications of an enormous pink salmon return that was characterized by spawning pink salmon occupying all available spawning gravel in some tributary indexes. From experience enumerating spawning Chinook in years of high pink abundance, particularly the 2009 run, it was well known dense concentrations of pinks could turn over or brush clean nearly all spawning substrate. If Chinook have spawned or are concurrently spawning in the same habitat as pinks, the activities of the pink salmon can make identification of Chinook redds from the air nearly impossible, and extremely difficult and often impossible by boat.

By late September no flights had occurred and the normal Sauk and Skagit summer Chinook peak spawning time had arrived. After numerous discussions it was decided flights would no longer be considered for the duration of spawning. The presumption was even if flows and turbidity decreased enough to fly, there would not be a way to determine when the actual peak of spawning had occurred or would occur, and existing Chinook redds had likely been

obscured by pink salmon spawning. However it was also possible, but less likely that redds had not been built and therefore had not been obscured. Either way there was no way to know for sure.

Historically, the number of mainstem redds constructed by each of the populations was estimated using the area under the curve (AUC) methodology. With no mainstem redd counts available in 2013 linear regression predictions were used for mainstem redds for the Sauk spring, Skagit summer, and Skagit fall Chinook populations, and a linear regression prediction of escapement was used for the Sauk summer Chinook population (Table 4-6).

Table 4-6. Variables used for linear regression predictions of mainstem redds for Sauk spring, Skagit summer, and Skagit fall Chinook.

Chinook population	Y	X
Sauk spring	Redds below White Chuck River	Redds above White Chuck River
Sauk summer	Sauk summer Chinook escapement	Skagit summed summer and fall Chinook escapements
Skagit summer	Skagit summer Chinook mainstem redds	Skagit summer Chinook tributary redds
Skagit fall	Skagit fall Chinook mainstem redds	Skagit fall Chinook tributary redds

Common assumptions have historically been applied to population estimates for all Skagit basin Chinook populations to account for unforeseen issues such as index sections that had no visibility during a flight. Likewise necessary assumptions of 21 day redd life, assumed 2.5 fish per redd and assumed similar spawning trends between populations have also been applied to complete AUC calculations. As a result of the application of common assumptions to complete spawning curves and estimate spawners it is possible annual results may be biased in ways that led to the suggestion of relationships between Chinook populations and within populations over time that actually do not exist and any perceived "strength" of relationship supported by goodness of fit was coincidental. However it is also possible there are relationships between the summer Chinook populations and adult survival across populations was influenced by similar variables. Additional years of environmental conditions favoring numerous flights at regular intervals throughout spawning will be needed to support the efficacy of linear regression predictions of spawning Chinook populations.

Suiattle River Spring Chinook

In the Suiattle River spring Chinook spawn in large clear water tributaries draining into the turbid mainstem. Limited spawning activity has historically been documented in the glacially influenced highly turbid mainstem with the exception of spawning in the clear water lens formed at tributary junctions. In 2011 an unusual combination of environmental variables reduced turbidity in the mainstem and resulted in conditions apparently suitable for off channel and mainstem Suiattle River spring Chinook spawning. In 2013 the Suiattle River was similar to historical norms and the river flowed with high turbidity and low visibility during spring Chinook spawning. No spring Chinook use was observed or were redds presumed constructed in the Suiattle mainstem or off channel habitats. Redds found at the junction of a tributary and the mainstem within the tributaries clear water lens were included in the tributary count.

Surveys were conducted from 5 August 2013 through 18 September 2013. Tributary indexes were surveyed for new redds every seven to fourteen days depending on access and spawning densities to ensure all redds were enumerated. The indexes included all known spawning habitat for each tributary. Tributary spawning surveys were conducted on foot, but access to the indexes was by vehicle or mountain bike. Encountered Chinook carcasses were scale sampled, measured for fork length, and checked for presence of coded wire tags. Redds were marked with survey flagging to prevent double counting during subsequent surveys. The total redd count was multiplied by 2.5 fish per redd to estimate escapement.

The logjam that had been a passage barrier on Buck Creek in previous years (approximately river mile 1.2) remained in 2013 and appeared even larger than observed in 2012. No Chinook redds or live Chinook were observed above the log jam despite ideal spawning gravel.

A total of 79 Suiattle spring Chinook carcasses were observed in 2013 and 73 were able to be sampled. All sampled carcasses were unmarked wild spring Chinook. The season total redd count was 248 redds (Table 4-7). The 2013 Suiattle River Spring Chinook escapement estimate was 620 fish (rounded).

Table 4-7. Spring Chinook redd counts in Suiattle River tributaries in 2013.

Stream	WRIA	Survey method	Reach (RM)	Location[*1]	Redds
Big Creek	3.0723	Foot	0.0-0.6	7.8	8
Tenas Creek	3.0761	Foot	0.0-0.5	9.6	6
Straight Creek	3.0797	Foot	0.0-0.1	15.1	3
Buck Creek	3.0813	Foot	0.0-1.7	18.1	39
Circle Creek	3.0892	Foot	0.0-0.2	18.4	0
Lime Creek	3.0897	Foot	0.0-0.5	20.8	5
Downey Creek	3.0919	Foot	0.0-2.1	24.4	124
Sulfur Creek	3.0973	Foot	0.0-0.9	26.3	57
Milk Creek	3.1022	Foot	0.0-0.1	28.6	6
					Total redds: 248

Upper Cascade River Spring Chinook

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

Cascade spring Chinook surveys occurred from 19 August 2013 through 19 September 2013. The surveys included all known spawning habitat. Mainstem surveys were conducted by foot or pontoon boat depending on the stream features of the index. The survey protocol was to survey each index every ten to fourteen days. All new redds were marked with survey flagging to ensure they were only counted once. The total redd count was multiplied by 2.5 fish per redd to estimate escapement. All recoverable carcasses were scale sampled, measured for fork length, and electronically checked for coded wire tags. The Cascade River was turbid throughout spawning in 2013. Survey complication from high stream flows have frequently been an issue in the past, but generally visibility returns to at least fair conditions when flows began receding. The addition of high turbidity in 2013 made surveys especially challenging. The source of the turbidity was the South Fork Cascade River and was the result of already high flows in August and heavy rain in early September. Visibility was near zero in the south fork throughout spawning. Reduced visibility and high flows throughout the Cascade River spring Chinook indexes may have obscured some redds and carcasses from being observed and counted.

Eleven upper Cascade spring Chinook carcasses were located in 2013. Ten of these were sampled, 9 were unmarked and untagged, one fish was adipose clipped with no coded wire

tag, and one carcass was adipose present but the head had been eaten and was unable to be electronically sampled.

We identified and marked 124 redds in 2013 (Table 4-8). The 2013 upper Cascade River spring Chinook spawning escapement estimate was 310 fish.

Table 4-8. Spring Chinook redd counts in the Cascade River in 2013.

Stream	WRIA	Survey method	Reach (RM)	Location[*1]	Redds
Cascade River	3.1411	Foot	8.1-9.0	8.1	4
Marble Creek	3.1451	Foot	0.0-0.3	8.6	1
Cascade River	3.1411	Foot/Raft	9.0-12.4	9.0	42
Cascade River	3.1411	Foot	12.4-15.8	12.4	60
Cascade River	3.1411	Foot	15.8-18.6	15.8	15
Kindy Creek	3.1528	Foot	0.0-0.5	16.2	0
North Fork Cascade R.	3.1605	Foot	0.0-0.1	18.6	2
South Fork Cascade R.	3.1411	Foot	0.0-0.5	18.6	0
					Total redds: 124

[*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

Upper Sauk River spring Chinook spawn 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 40.0. A high gradient section of the Sauk River beginning 0.9 river miles downstream of the White Chuck River acts as a separation point for 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 river mile 5.0, upstream of the area known as Monte Cristo Lake.

We surveyed the upper Sauk River spring Chinook spawning areas from 14 August 2013 through 26 September 2013. Surveys were conducted by foot or pontoon boat on indexes above the White Chuck River every 10 to 14 days. Normally the index below the White Chuck River was surveyed by helicopter every two weeks because it was too treacherous to raft or walk. However in 2013 no helicopter surveys were performed because of a combination of high river flows and spawning habitat inundated with pink salmon. Recovered carcasses were sampled for scales, fork length, and presence of coded wire tags. Redds located during foot or pontoon boat surveys were counted and marked with survey flagging.

A total of 177 Sauk spring Chinook carcasses were located in 2013 and 159 of the carcasses were sampled. Of the sampled carcasses 153 were wild fish, four were adipose clipped, coded wire tagged, or both, and the mark status of two was undetermined due to missing parts of the carcass.

There were 421 redds located upstream of the White Chuck River by ground based surveys (Table 4-9). Because no aerial surveys were conducted downstream of the White Chuck River we used a linear regression of 2012 to 2006 redds (2007 was not included because only two flights occurred) downstream of the White Chuck river and redds upstream of the Chuck River (Table 4-10). Based on the 421 redds observed during ground based surveys 11 redds were expected in the spring Chinook section below the White Chuck (R^2=.31).

Table 4-9. Spring Chinook redd counts in the Upper Sauk River in 2013.

Stream	WRIA	Survey method	Reach (RM)	Location[1]	Redds
Sauk River	3.0673	Flight	31.0-31.9	31.0	Did not survey
Sauk River	3.0673	Foot/Float	31.9-34.5	31.9	133
Sauk River	3.0673	Foot/Float	34.5-37.8	34.5	192
Falls Creek	3.1182	Foot	0.0-0.2	34.9	18
Sauk River	3.0673	Foot/Float	37.8-39.7	37.8	9
South Fork Sauk River	3.1204	Foot	0.0-3.5	0.0	39
South Fork Sauk River	3.1204	Foot	4.4-5.0	4.4	4
North Fork Sauk River	3.0673	Foot	39.7-40.1	39.7	5
North Fork Sauk River	3.0673	Foot	40.1-41.3	40.1	21
				Total redds (rounded):	432

[1]Location refers to river mile location of tributary mouth on mainstem, or lower river mile terminus of a mainstem index.
*[2]Predicted using linear regression of redds estimated by area under the curve in flown section with redds observed by ground counts.

Table 4-10. Spring Chinook redd counts in the Sauk River used for regression prediction of redds below the White Chuck River in 2013.

Run year	Number of Redds		Percent redds downstream of White Chuck River	Estimated escapement
	Upstream of White Chuck	Downstream of White Chuck		
2012	718	12.5	1.7	1,826
2011	135	3.1	2.3	345
2010	306	1	0.3	768
2009	144	2.9	2.0	367
2008	379	14.3	3.8	983
2006	395	22	5.6	1,043

Chinook were observed spawning in Falls Creek in 2013 after being absent in 2012. The first documented Chinook spawning in Falls Creek was in 2008 and spawning has been observed annually since with the exception of 2012. Low flows in 2012 may have inhibited passage to Falls Creek.

Total redds from ground based counts and expected redds from the linear regression were summed and multiplied by 2.5 fish per redd to estimate escapement. The 2013 upper Sauk River spring Chinook escapement estimate was 1,080 fish.

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 Gorge Powerhouse at RM 94.3. Documented spawning has also occurred in several tributary streams. Tributaries were surveyed by foot or pontoon boat at an interval of every seven to fourteen days to ensure all redds were enumerated before redd life expired. Skagit River mainstem redds were normally surveyed by helicopter with all visible redds counted. However high flows, low visibility, and abundant pink salmon resulted in the inability to perform flight surveys and therefor no mainstem surveys in 2013. Tributary surveys covered most of the known spawning area with the exception of 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. Time constraints due to limited personnel resources prevented us from surveying all known spawning habitat.

Recovered carcasses were scale sampled, 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 or were so badly decomposed they disintegrated upon disturbance. All redds located during tributary surveys were counted and marked with survey flagging. The total number of Skagit River mainstem redds was predicted using linear regression.
Skagit summer Chinook tributary spawning surveys occurred regularly from 3 September 2013 through 31 October 2013 (Table 6). Linear regression of 2012 through 2006 Skagit summer Chinook mainstem and tributary redds was used to predict the expected number of redds constructed in the mainstem (Table 4-12).

Table 4-11. Skagit Summer redd counts in 2013.

Stream	WRIA	Survey method	Reach (RM)	Location[1]	Redds
Illabot Creek	3.1346	Foot	0.0-2.6	71.6	18
Cascade River	3.1411	Foot/Float	0.0-4.2	78.1	28
Diobsud Creek	3.1750	Foot	0.0-1.3	80.7	31
Bacon Creek	3.1774	Foot	0.0-4.2	82.9	76
Falls Creek[2]	3.1780	Foot	0.0-0.4	4.0	1
Goodell Creek	3.1867	Foot	0.0-1.3	92.9	7
					Total redds:161

[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 3.1780 is a tributary of Bacon Creek. The mouth is located at river mile 4.0 of Bacon Creek on the right bank.

Table 4-12. Skagit summer Chinook redd counts used in regression prediction of mainstem redds in 2013.

Run year	Number of redds		Tributary redd percent of escapement	Estimated escapement
	Tributaries	Mainstem		
2012	183	3,740	4.7	9,808
2011	97	1,695	5.4	4,480
2010	144	2,514	5.4	6,644
2009	88	2,028	4.2	5,290
2008	226	3,150	6.7	8,441
2007	85	3,857	2.2	9,855
2006	282	6,204	4.3	16,215

Unlike previous years, Chinook carcass sampling was limited in 2013 because staff were assigned to concurrent pink salmon spawning ground surveys. However Chinook carcasses were collected and sampled as time allowed during mainstem Skagit pink salmon surveys.

A total of 272 Skagit summer Chinook carcasses were found in 2013 and a total of 169 carcasses were sampled. A total of 145 carcasses were unmarked wild Chinook and 16 carcasses were hatchery origin.

We observed 161 summer Chinook redds in the tributaries and the linear regression predicted 3,359 redds were expected in the mainstem Skagit River (R^2=.56). The summed total actual redd count from tributary indexes and the expected mainstem redd count from the linear regression were summed and multiplied by 2.5 fish per redd to estimate escapement. The 2013 total estimated escapement of Skagit summer Chinook was 8,399 fish.

Lower Skagit Fall Chinook

Skagit fall Chinook spawn in the mainstem Skagit River from the vicinity of RM 24.5 to the mouth of the Sauk River (RM 67.2). They have also been documented spawning in a variable number of large and small tributary streams depending on flow conditions. Tributary surveys were conducted by foot every seven to fourteen days. Encountered carcasses were scale sampled, measured, and checked for coded wire tags. Tributary redds were counted and marked with flagging to prevent repeated counting. Redds counted in the tributaries and estimated redds from the AUC calculation were summed, and multiplied by 2.5 fish per redd to estimate escapement. Upper Skagit Tribal staff conducted redd counts in Grandy Creek and part of Finney Creek. The Skagit Fisheries Enhancement group surveyed Hansen Creek, and Alder Creek.

We were unable to conduct any aerial surveys of the main stem Skagit River fall Chinook spawning zone in 2013 due to poor weather and/or poor water visibility. River conditions in the mainstem Skagit can be extremely poor in fall of year and 2013 was worse than usual. Note: Refer to general discussion at beginning of the Chinook section of this report for explanation of how 2013 fall Chinook escapement was estimated i.e., a linear regression of 2006 to 2012 Skagit summer Chinook tributary redds and estimated mainstem redds was used to predict 2013 mainstem redds. The preliminary 2013 Skagit fall Chinook escapement estimate was 1,391 fish and is dependent on co-manager review and agreement which had not yet occurred at publication.

We surveyed most of the known tributary spawning areas from 16 September 2013 through November 11 2013 (Table 4-13). In general weather and stream flow conditions while poor , allowed survey intervals to be met throughout the spawning period. Finney Creek again turned turbid quickly with rainfall in 2013, but by watching forecasts and stream flows carefully we were able to plan our surveys around poor conditions.

Table 4-13. Lower Skagit fall Chinook redd counts in 2013.

Stream	WRIA	Survey method	Reach (RM)	Redds
Skagit River	3.0176	No Flight	24.5-56.5	--
Skagit River	3.0176	No Flight	56.5-67.2	--
Hansen Creek	3.0265	Foot	3.0-4.3	0
Day Creek	3.0299	Foot	0.0-2.2	28
Jones Creek	3.0332	Foot	0.0-1.3	0
Grandy Creek	3.0337	Foot	0.0-1.1	1
Alder Creek	3.0359	Foot	0.0-1.6	0
O'Toole Creek	3.0365	Foot	0.0-0.2	0
Pressentin Cr	3.0385	Foot	0.0-0.4	2
Finney Creek	3.0392	Foot	0.0-6.0	27
Jackman Creek	3.0626	Foot	0.0-0.7	1
			Total redds:	59

Lower Sauk River Summer Chinook

Lower Sauk River summer Chinook 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 during spawning summer Chinook use of Dan Creek has been intermittent. Any carcasses located in Dan Creek were scale sampled, measured for fork length, and checked for presence of tags and marks. The lower Sauk River is too wide and braided, and spawning too sparsely distributed, for effective survey by foot or pontoon boat, so mainstem Sauk River redd counts are in most years conducted by helicopter surveys. No flights were conducted in 2013 due to high water, poor visibility, and highly abundant pink salmon spawning.

Dan Creek had passable stream flows throughout spawning and was surveyed regularly from 20 September through 31 October 2013. A linear regression of 2012 through 2006 Sauk summer Chinook estimated escapements and the summed estimated escapements of Skagit summer and fall Chinook were used to predict the 2013 Sauk summer Chinook escapement.

Table 4-14. Lower Sauk River summer Chinook redds counts in 2013.

Stream	WRIA	Survey method	Reach (RM)	Location[*1]	Redds
Sauk River	3.0673	Not surveyed	0.0-13.2	0.0	- -
Sauk River	3.0673	Not surveyed	13.2-21.1	13.2	- -
Dan Creek	3.1079	Foot	0.0-0.8	16.8	4
Sauk River	3.0673	Not surveyed	21.1-31.0	21.1	- -
					Total redds: 4

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

Table 4-15. Skagit and Sauk Chinook escapement estimates used in regression prediction of Sauk escapement in 2013.

	Sauk	Skagit		
Year	Summer	Summer	Fall	Total
2013		8,801	1,551	10,352
2012	715	9,808	3,295	13,103
2011	210	4,480	820	5,300
2010	356	6,644	1,017	7,661
2009	250	5,290	1,439	6,729
2008	383	8,441	2,685	11,126
2007	538	9,855	1,053	10,908
2006	1,095	16,215	3,508	19,723

Five Sauk summer Chinook carcasses were located in 2013 and we sampled two of these; both were wild (unmarked) fish.

Because the annual Sauk summer Chinook escapement included any redds from the intermittent Dan Creek spawning component, redds found in Dan Creek in 2013 were not used toward the predicted escapement nor were the number of redds expected in Dan Creek predicted to compare to what was actually observed. The linear regression predicted the 2013 Sauk summer Chinook expected escapement was 530 fish (R^2=.94).

The 2013 Sauk summer Chinook (and other populations expected proportions of escapement) escapement prediction should be viewed skeptically and used with extreme caution despite the apparent "goodness of fit". The escapement was predicted using independent variables that were the summed escapements of two populations. The greatest proportion of each of those 2013 escapement independent variables were the solved dependent variables from the prediction of mainstem redds for Skagit summer and Skagit fall Chinook. To put it more simply, the Sauk summer Chinook expected escapement was largely based on two other predicted escapements the accuracy of which are unknown. The three compared populations are recognized as unique populations. Skagit summer Chinook spawn upstream of the Sauk River in river flows moderated by agreement with the Seattle City Light power project, Sauk summer Chinook spawn from the mouth of the Sauk to downstream of a high gradient Sauk River section below the White Chuck River, and Skagit fall Chinook spawn in the Skagit River from the mouth of the Sauk River downstream. No known environmental, geological or anthropogenic barriers separate the populations.

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. The summer stock is a composite of natural and hatchery-origin supplemental production with the majority of spawning occurring in the North Fork Stillaguamish and its major tributaries, including Boulder River, and Deer, Grant, French, and Squire creeks. The natural-origin fall stock spawns primarily in the mainstem and South Fork Stillaguamish, in Pilchuck, Jim and Canyon creeks and in the North Fork Stillaguamish. Escapement is currently estimated for North Fork and South Fork Stillaguamish rather than summer and fall populations of Chinook.

Escapement estimates for the two Stillaguamish Chinook populations were calculated by multiplying the cumulative redd count by 2.5. Since 2008 Chinook redds found in the North and South Forks have been individually counted during periodic foot or raft surveys using the marked redd census method. Previous to 2008, redd counts in the North and South Forks were estimated using area under the curve methodology based on aerial surveys of North and South fork mainstem reaches as well as ground-based surveys of tributary streams. Aerial surveys continue to provide redd count data for the Lower Mainstem and upper South Fork. Since 2008 the Stillaguamish Tribe Department of Natural Resources has provided ground coverage of the North Fork Stillaguamish River from its mouth to river mile (RM) 30.0. WDFW staff surveyed the remaining known Chinook spawning areas in the Stillaguamish basin.

Surveys were conducted from mid-August to mid-November to encompass the spawn timing of both stocks. All known spawning habitat was surveyed either by foot or raft on a seven to fourteen day cycle or by helicopter every fourteen to twenty-one days. All ground-counted redds were flagged, enumerated and recorded with a GPS waypoint. Helicopter surveys counted total visible redds each successive 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 Chinook

North Fork Stillaguamish Chinook spawning surveys covered the entire known distribution. Surveyed areas were the North Fork from RM 0.0 to 34.4 and North Fork tributaries including Squire, Segelson, French, Brooks, and Grant creeks, and Boulder River.

Survey conditions for counting Chinook in the North Fork Stillaguamish were generally good throughout the spawning period, except below the mouth of Boulder River (RM 24.3) which added significant turbidity for most of the season. The first redds were detected August 26. Most redds were made by late-October with the final few constructed in early November. Flows in the North Fork were generally higher than normal for much of September and lower than normal in October. Rain events in late-September and November caused elevated stream levels and temporarily hampered some surveys with decreased visibility.

A total of 308 North Fork Stillaguamish Chinook redds were counted in 2013. The escapement estimate was 773 fish (470 NOR, 303 HOR). An additional 132 fish were taken for hatchery brood stock and were not included in the escapement estimate (73 NOR, 59 HOR). Total NOR North Fork Stillaguamish escapement (natural spawning + broodstock collection) was 543 Chinook. Table 4-16 lists redd counts and escapement estimates by surveyed reach.

Table 4-16. North Fork Stillaguamish summer Chinook redd counts in 2013.

Stream	WRIA	Method	Reach (RM)	Redds	Escapement
North Fork	5.0135	Foot/Float	0.0-14.3	7	18
North Fork	5.0135	Foot/Float	14.3-30.0	144	360
North Fork	5.0135	Foot/Float	30.0-34.4	64	160
Grant Creek	5.0156	Foot	0.0-0.4	2	5
Deer Creek	5.0173	Foot	0.0-6.0	NA	NA
Brooks Creek	5.0215	Foot	0.0-0.1	1	3
Boulder River	5.0229	Foot	0.0-2.9	6	15
French Creek	5.0246	Foot	0.0-3.0	4	10
Squire Creek	5.026	Foot	0.0-4.0	77	193
Brown Creek	5.0265	Foot	0.0-1.0	1	3
		Total Redds		**308**	
		Escapement Estimate			**773**

South Fork Stillaguamish Chinook

South-Fork Stillaguamish Chinook escapement in 2013 was estimated using expansion of cumulative redd counts (2.5 fish per redd) from aerial, foot, and raft surveys. Areas surveyed were the Mainstem between the mouth and the confluence of the North and South Forks (river miles 0.0 to 17.8), the South Fork from the confluence to Granite Falls (river miles 17.8 to 34.7), and from Red Bridge to Coal Creek (river miles 55.1 to 62.5), and Canyon, Jim, Siberia, and Pilchuck creeks.

Survey conditions were good while flows in the South Fork remained low. Rain generated flow pulses in early and late September reduced visibility during surveys. In mid-October below average flows were recorded for the remainder of the month. Flow and turbidity conditions in late September reduced survey frequency. South Fork redd counts are likely biased low due to lack of survey coverage in late September. The Mainstem aerial index reach, from the juvenile trap (RM 6.0) to the forks (RM 17.8) was flown once, October 15.

A total of 32 Chinook redds were found in the South Fork Stillaguamish River in 2013. The escapement estimate was 81 adult fish. Redd counts by surveyed reach and escapement estimates are listed in Table 4-17. Table 4-18 in the carcass sampling section lists HOR:NOR breakdown.

Table 4-17. Stillaguamish fall (South Fork) Chinook redd counts in 2013.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Mainstem	5.0001	Flight	6.0-17.8	2	5
South Fork	5.0001	Foot/Float	17.8-30.6	17	43
South Fork (upper)	5.0001	Foot	30.6-65.0	2	5
Pilchuck Creek	5.0062	Foot/Float	0.0-6.2	7	18
Jim Creek	5.0322	Foot/Float	0.0-4.1	4	10
Siberia Creek	5.0324	Foot	0.0-0.4	0	0
Canyon Creek	5.0359	Foot	0.0-0.5	0	0
		Total Redds		**32**	
		Escapement Estimate			**81**

Carcass sampling and escapement composition

WDFW and Stillaguamish Tribe Natural Resources staff conducted spawning ground survey work and carcass sampling in North and South Forks of the Stillaguamish River and their tributaries. Tribal staff focused their Chinook carcass recovery efforts in the North Fork between the mouth and Swede Heaven Bridge (RM 0.0 to 30.0) and WDFW staff focused on the remaining spawning grounds. In total, 386 complete carcasses (status of both adipose fin and CWT was determined) were sampled in the Stillaguamish River, 378 in the North Fork reaches and 8 in the South Fork reaches. An additional 21 sampled carcasses were categorized as “unknown” because either the adipose status or the cwt status was undetermined. The sampling rates of Chinook carcasses, not including those with unknown mark dispositions, were 48.9% for North Fork reaches, and 9.9% for South Fork reaches. These rates were calculated by dividing the number of carcasses sampled by the escapement estimate for each population.

Escapement of Chinook by origin (hatchery or natural) was determined by applying ratios of hatchery marked carcasses and unmarked carcasses to the escapement estimate by reach groupings. Grouping reaches into subsets of the populations allows the calculation of hatchery origin recruits (HOR) and natural origin recruits (NOR) for escapement reaches where sample sizes were small or no carcasses were sampled. Results of these calculations are listed in Table 4-18.

Table 4-18. Stillaguamish Chinook carcass sampling and escapement composition in 2013.

North Fork Stillaguamish	Escapement	No. Hatchery	No. Natural	% Hatchery	% Natural	No. Sample	percent sampled
NF Confluence to Deer Creek	18	4	14	20.0%	80.0%	5	27.8%
NF above Deer Creek	520	180	340	34.6%	65.4%	292	56.2%
NF Tributaries	235	119	116	50.5%	49.4%	81	34.5%
NF Totals	773	303	470	39.2%	60.8%	378	48.9%
South Fork Stillaguamish	81	30	51	37.5%	62.5%	8	9.9%
Stillaguamish Totals	854	333	521	39.0%	61.0%	386	45.2%

Key for Grouped Stratum and Populations:
NF Confluence to Deer Creek: North Fork Stillaguamish from RM0.0 to RM14.3
NF above Deer Creek - Deer Cr.: North Fork Stillaguamish from RM14.3 to RM34.4
NF Tributaries: Grant, Brooks, French Segelson, Squire, and Ashton creeks, and Boulder River
All "SF" reaches: Mainstem RM 0-17.8, South Fork Stillaguamish RM 17.8-70.0 and, Pilchuck, Jim, Siberia, and Canyon (RM 0.0-0.3) creeks

4.4 Snohomish River

There are two populations of Chinook in the Snohomish River basin - Skykomish summer/fall Chinook and Snoqualmie fall Chinook. The Skykomish stock spawns in the mainstem of the Skykomish River and its tributaries, including the Wallace and Sultan rivers, Bridal Veil Creek, the South Fork Skykomish (between RM 49.6 and RM 51.1 and above Sunset Falls) and the North Fork Skykomish (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. Survey methods included ground based walking and float surveys, and aerial surveys done from a helicopter. Ground counted redds were monitored using marked-redd-census methodology. Ground surveys were done at a frequency of seven to ten days so as to not miss new redds. Redds in ground-surveyed reaches were, enumerated, marked with a GPS waypoint and flagged to prevent re-counting on subsequent surveys. Aerial surveys were conducted on the Snohomish, Skykomish and North Fork Skykomish Rivers at target intervals of two weeks. Aerial surveys provided total visible redd counts per survey flight and were plotted against survey date for the area-under-curve (AUC) method to give total redd days. Total redd days were then divided by the assumed standard 21-day redd life to yield the estimated cumulative redds from aerial surveyed reaches. The cumulative redd count was then expanded by 2.5 (fish per redd) to estimate escapement. Additionally a count of Chinook passed above the trap at Sunset Falls on the South Fork of the Skykomish was made. Carcasses encountered were sampled for scales, DNA, CWT, adipose fin mark status, and otoliths.

Skykomish summer/fall Chinook

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

Survey conditions were good while stream flows were moderate for most of the spawning season. Survey intervals were kept to seven to ten days except for when rain-fed flow pulses in mid-September and November caused minor survey delays. Four aerial surveys were flown on the Mainstem Snohomish, Skykomish and North and South Fork Skykomish Rivers between September 18 and November 14.

A total of 870 Chinook redds were found in the Skykomish River and its tributaries in 2013. The spawning escapement estimate (including Sunset Falls trap counts) was 2,355 adult fish (1,860 NOR, 495 HOR). An additional 4,783 adult fish recruited into Wallace Hatchery and were not included in this escapement estimate (144 NOR, 4,639 HOR). Total NOR Skykomish escapement (natural spawning + broodstock collection) was 2,494 Chinook. Redd counts and escapement estimates by surveyed reach are listed in Table 4-19. Table 4-21 summarizes HOR:NOR results.

Table 4-19. Skykomish summer/fall Chinook redd counts and escapement, 2013.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Snoh-Sky (Mainstems)	7.0012	Float/Flight	20.5-51.5	378	945
NF Skykomish	7.0982	Foot/Flight	0.0-13.5	61	153
SF Sky (Sunset Falls)	7.0012	Trap/Haul	51.5-up	-	157
Pilchuck River	7.0125	Foot/Float	2.0-26.5	71	178
Woods Creek	7.0826	Foot/Float	0.0-3.5	2	5
Elwell Creek	7.0865	Foot	0.0-1.0	5	13
Sultan River	7.0881	Foot/Float	0.0-9.7	184	460
Wallace River (lower)	7.094	Foot/Float	0.0-4.4	72	180
Wallace River(upper	7.094	Foot/Float	4.4-7.3	88	220
OlneyCree	7.0946	Foot	0.0-0.6	0*	4
ProctorCreek	7.097	Foot	0.0-0.4	2	5
Bridal Veil Creek	7.1248	Foot	0.0-0.4	7*	35
			Total Escapement	**870**	**2,350**

*In Olney and Bridal Veil Creeks, carcass counts were greater than redd-based escapement estimates, therefore carcass counts were used as minimum escapements in these creeks.

Snoqualmie summer/fall Chinook

The escapement estimate for Snoqualmie summer/fall Chinook was made using cumulative redd counts from boat foot, and aerial surveys of known spawning habitat. Surveyed reaches were the Snoqualmie River and its tributaries, including the Tolt and Raging rivers and Cherry and Tokul creeks. Chinook redds were observed from the end of August to mid-November.

Survey conditions were good for most of the spawning season. Rainstorms in September elevated stream flows and turbidity and caused temporary interruptions in survey coverage.

In 2013 the escapement of 761 Chinook in the Snoqualmie Basin was based on a total count of 304 redds. Table 4-20 lists redd counts and escapement estimates by survey reach for Snoqualmie fall Chinook. Table 4-21 shows the HOR:NOR breakdown by reach.

Table 4-20. Snoqualmie fall Chinook redd counts and escapement by reach, 2013.

Stream Reach	WRIA	Method	Reach (RM)	Redds	Escapement
Snoqualmie River (Lower)	7.0219	Float	20.5-24.9	28	70
Snoqualmie River (Upper)	7.0219	Float	32.9-39.6	134	335
Tolt River (Lower)	7.0291	Foot/Float	0.0-6.0	52	130
Tolt River (Upper)	7.0291	Foot/Float	6.0-8.9	10	25
SF Tolt River	7.0302	Foot	0.0-2.3	14	35
Raging River	7.0384	Foot	0.0-4.6	45	113
Tokul Creek (Lower)	7.044	Foot	0.0-0.3	21	53
Tokul Creek (Upper)	7.044	Foot	0.3-0.6	0	0
		Total Redds		**304**	
		Escapement Estimate			**761**

Sampling and HOR:NOR summary

Field staff sampled 543 complete Chinook carcasses (status of CWT, otolith mark, and adipose fin mark are known) within the Snohomish basin. Additionally, adipose fin status was determined for 157 live Chinook passed at Sunset Falls. In total, the Chinook carcass sampling rate on the spawning grounds and at Sunset Falls was 21.6% (Table 4-21). This was calculated by dividing the number of carcasses and live fish sampled by the escapement estimate.

Escapement of Chinook by origin (hatchery or natural) was determined by applying ratios of hatchery marked carcasses and unmarked carcasses to the escapement estimate by reach groupings. Grouping reaches into subsets of the populations allows the calculation of hatchery origin recruits (HOR) and natural origin recruits (NOR) for escapement reaches where sample sizes were small or no carcasses were sampled. Results of these calculations are listed in Table 4-20.

Table 4-21. Composition of Snohomish Chinook escapement in 2013.

Stratum	Escapement	No. Hatchery	No. Natural	% Hatchery	% Natural	Number Sampled	Percent Sampled
Skykomish	972	135	837	13.9%	86.1%	101	10.4%
Bridal Veil	188	63	125	33.3%	66.7%	42	22.3%
SF Sky (Sunset Falls)*	157	6	151	3.8%	96.2%	157	100.0%
Pilchuck River	178	15	163	8.3%	91.7%	48	27.0%
Sultan River	460	0	460	0.0%	100.0%	46	10.0%
Wallace River	400	276	124	69.1%	30.9%	68	17.0%
Skykomish Population	**2,355**	**495**	**1,860**	**21.0%**	**79.0%**	**462**	**19.6%**
Snoqualmie	836	84	752	10.0%	90.0%	200	23.9%
Tokul	53	35	18	65.8%	34.2%	38	71.7%
Snoqualmie Population	**889**	**119**	**770**	**13.4%**	**86.6%**	**238**	**26.8%**
Snohomish Total	**3,244**	**614**	**2,630**	**18.9%**	**81.1%**	**700**	**21.6%**

*Sunset Falls sample: 100% of live fish sampled for adipose fin mark status only

Key for Grouped Stratum and Populations:

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

Snoqualmie Population
Snoqalmie: Snoqualmie River (Lower and Upper), Raging River, Tolt River (Lower and Upper), SF Tolt River, Cherry Creek.
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 escapement to 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 surveys are considered to provide a census of all redds. Redd surveys are conducted between RM 4.2 and RM 21.8 (Landsburg Dam) 2-3 times per week for the duration of the Chinook spawning period. The portion of the river upstream from the Landsburg Dam to the Cedar Falls powerhouse (RM 34.5), and the lower 4.2 miles of the Cedar mainstem are each surveyed once per week. Due to the overlap with sockeye spawning timing, Chinook redds are only included in the count if a female Chinook is present and actively attending a redd.

In 2013 a total of 740 Chinook redds were observed in the Cedar River mainstem during the spawning season (including the surveyed area upstream from Landsburg Dam and including all small tributaries). Of the 740 Chinook redds, 724 were observed in the Cedar River mainstem (638 below Landsburg Dam and 86 above), 9 were observed in Taylor Creek, and 7 were observed in Rock Creek, both small tributaries to the Cedar River. Expansion by 2.5 fish per redd resulted in the estimated escapement of 1,850 Chinook. A total of 470 adult Cedar River

Chinook were sampled for adipose fin clips in 2013. This sample indicated that 87% of the Cedar River Chinook were wild (unclipped) and 13% were hatchery origin (clipped) fish.

4.6 Sammamish River

The Sammamish Chinook population is composed of naturally spawning Chinook in the Big Bear/Cottage Lake Creek watershed and in the Issaquah Creek watershed. Chinook escapement to the Sammamish River/ North Lake Washington Tributaries in 2013 was estimated at 2,647 fish.

Big Bear/Cottage Lake Creeks

Estimating escapement to Big Bear Creek and Cottage Lake Creek involves weekly surveys of all known Chinook spawning areas to enumerate live and dead Chinook. Total spawning escapement is estimated using the AUC method, where live fish counts and 10-day stream life are used to calculate escapement.

The Bear Creek/Cottage Creek index area was surveyed weekly during the 2013 spawning season. The escapement estimate was 105 fish. Of these, 28 were counted in the Bear Creek mainstem, 52 in the Upper Cottage Creek Index, and 25 in the Lower Cottage Creek Index. A total of 27 Chinook were sampled for adipose fin clips in 2013. This sample indicated that 24% of all Chinook in the Bear/Cottage system were wild (unclipped) and 76% were hatchery origin fish.

Issaquah Creek System

Issaquah Creek is surveyed weekly from the Issaquah Hatchery (located at river mile 3.0), downstream to its confluence with Lake Sammamish to count Chinook carcasses. All Chinook carcasses are assumed to have spawned, and the cumulative carcass count is used as the escapement estimate for this reach of Issaquah Creek. East Fork Issaquah Creek is also surveyed weekly from its confluence with the Issaquah Creek mainstem, upstream to the High Point Trail crossing at approximately RM 3.0. Similar to the Issaquah Creek mainstem, the cumulative carcass count is used as the escapement estimate for the East Fork. In 2013, during a high water event, 1,069 Chinook were estimated to have passed upstream of the hatchery and into upper Issaquah Creek. These fish are included in the 2013 natural spawning escapement estimate.

The Issaquah Creek system was surveyed weekly during the 2013 spawning season, and total escapement was estimated at 2,542. This estimate includes 1,152 fish in the mainstem below the hatchery, 1,069 fish which escaped above the hatchery and into upper Issaquah Creek during high water, and 321 fish from the East Fork. A total of 273 adult Chinook from the Issaquah Creek system were sampled for adipose fin clips in 2013. This sample indicated that 9% of all Chinook in the Issaquah Creek system were wild (unclipped) and 91% were hatchery origin fish.

Chinook escapement to Issaquah Hatchery in 2013 was 2,670; no hatchery fish were intentionally released upstream to spawn in upper Issaquah Creek. Escapement to the University of Washington hatchery was 46 fish.

4.7 Green River

Beginning in 2009, Muckleshoot (MIT) and WDFW Biologists agreed to attempt weekly counts of new Chinook redds in all survey-able reaches of the Green River and Newaukum Creek

during Chinook spawning ground surveys, reasoning that so few redds were being dug, it was possible to count all redds in all reaches. This estimation methodology uses season total redd counts, without adjustment, in four of the six sections of the mainstem Green River. At the conclusion of the spawning season, the observed number of redds in these sections of the river is known, and the variance is zero. There may be observational error in these sections or spawning outside these sections. However these factors operate in all sampling programs and are not included in any variance estimates.

New Chinook redds were counted weekly over three days in the mainstem river between River Mile (RM) 25.4 to 48.5 (Lower River, Middle River, and Lower Gorge) and 59.2 to 61.0 (Headworks). Using 2 one-man pontoon boats or 2 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 the week of September 15 and continued through the week of October 27. Surveys were suspended during the week of September 29 when high flows prohibited safe conduct of surveys. A redd count from Metzler Side Channel was conducted on October 15. This count was added to the weekly count 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 9 and 22, 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; the Lower River, RM 26.7 to 33.8; and “Hwy 167 to Transfer Shack”, RM 25.4 to 26.7. 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 and Hwy 167 to Transfer Shack sections, the season total redd count was approximated as the sum of all redds observed during the two aerial surveys.

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

Although the extent to which high flows influenced Chinook spawning behavior when surveys could not be conducted is not known, post season analysis of the season totals indicates that spawning activity peaked during the week of September 22 in the mainstem and the week of October 6 in Newaukum Creek (Table 1). By the end of surveys the week of October 13, 97.4% of the redds (595 of 611) observed during boat and foot spawning ground surveys were complete. Similarly, Chinook redd counts during aerial surveys were almost twice as abundant on October 9 compared to October 22 (Table 4-23).

- Table 4-22. Chinook redd counts from foot and boat surveys of the Green River in 2013.

	Week							
Section	15-Sep	22-Sep	29-Sep	6-Oct	13-Oct	20-Oct	27-Oct	Total
Headworks	19	27	-	9	-	1	2	58
Lower Gorge	8	29	-	21	13	4	0	75
Middle River	34	144	-	57	97	5	3	340
Newaukum Creek	5	51	-	73	8	1	-	138
Total	66	251	-	160	118	11	5	611

- Table 4-23. Aerial survey counts of Chinook redds in the Green River, 2013.

Section	15-Sep	22-Sep	29-Sep	8-Oct	13-Pct	20-Oct	27-Oct	Total
Headworks	-	-	-	19	-	3	-	22
Gorge	-	-	-	80	-	20	-	100
Lower Gorge	-	-	-	31	-	24	-	55
Middle River	-	-	-	79	-	70	-	149
Lower River	-	-	-	7	-	4	-	11
Hwy 167-Transfer Shack	-	-	-	0	-	1	-	1
Total	-	-	-	216	-	122	-	338

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

The season total redd count from the Middle River was 338 redds plus 2 from MSC, 75 from the Lower Gorge, and 58 from the Headworks. The Lower River was not surveyed by boat in 2013; the season total was approximated by 11 redds observed during two aerial surveys of this section, and 1 redd was observed below the Lower River in the Highway 167 to Transfer Shack reach. The G/A ratio for the Lower Gorge was 2.42 (75/31) resulting in a calculation of 194 redds for the "Gorge". A total of 679 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 56 and for the section "Whitney Hill Bridge" to mouth" was 82, totaling 138 redds in Newaukum Creek.

Applying the constant 2.5 fish/redd (1.5 males:1.0 female), an estimate of 2,041 naturally spawning Chinook was generated for the Green River Basin.

During the season, 3,456 adults that returned to the Soos Creek hatchery were tagged by the Muckleshoot Indian Tribe, hauled upstream, and released in the mainstem. Although survival and spawning success of these fish is unknown, any redds created by these fish would have been counted during surveys, meaning that they are included in the natural spawning escapement estimate.

River flows during the 2013 Chinook spawning season were high (Table 4-24), resulting in surveys being suspended for 10 days near the peak of the spawning run. The extent to which the flood impeded spawning activity is unknown.

Table 4-24. Average weekly discharge (cfs) in the Green River in 2013.

	Week						
USGS Gauge	15-Sep	22-Sep	29-Sep	6-Oct	13-Oct	20-Oct	27-Oct
Palmer	265	501	1,740	1,159	719	486	454
Auburn	405	670	2,349	1,623	1,032	697	622
Newaukum Cr	19	26	74	33	27	23*	-

[1]*Data available through October 22 in Newaukum Creek.*

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 Spawned" variable was determined. The "Percent Spawned" variable was determined by inspection of the gonads of all female carcasses. Often this included resection of the gonads from the belly. Carcasses where all or nearly all eggs had been expelled were considered 100% spawned. The proportion of eggs estimated to have been expelled was noted for carcasses where eggs remained in the body cavity. A carcass noted as 10% spawned still had an estimated 90% of her total eggs remaining. Additionally, tagged fish from re-released hatchery returns were noted for all sampled carcasses.

A total of 713 carcasses were sampled for standard biological data by Green River crews in 2013 (Table 4-25); 549 (3 DIT+ 7 CWT&AD + 539 AD) or 77.0% were of hatchery origin as indicated by the presence of an adipose fin and/or presence of a CWT tag (Table 4-26).

Table 4-25. Summary of Chinook biological sampling in the Green River, 2013.

Section	Biological Samples	DNA Sampled	MIT Tags[1]	Additional MIT Tags[2]	CWT[3]	DIT[3]
Headworks	67	36	15	3	1	0
Lower Gorge	41	25	8	13	0	0
Middle River	305	163	151	32	2	0
Lower River	-	-	-	-	-	-
Metzler Side Channel	1	0	0	0	0	0
SubTotal: River	414	224	174	48	3	0
Newaukum: 400th to Whitney Hill Br	146	102	49	42	2	2
Newaukum: Whitney Hill Br to Mouth	153	98	53	31	2	1
SubTotal: Newaukum	299	200	102	73	3	3
Grand Total:	713	424	276	121	7	3

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

[2]"Additional MIT tags"; the number of MIT tags retrieved from heavily decomposed carcasses that could not be sampled.

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

Table 4-26. Coded wire tag sampling and origin of natural Chinook spawners in the Green River, 2013.

	Sampled					Adipose present		Adipose Clip	
	Number[2]	NOS	HOS	CWT	no CWT	DIT	no CWT	CWT	no CWT
Green River	414	120	291	3	411	0	120	3	288
Newaukum Creek	299	38	258	5	294	3	38	4	251
Green River Basin Total	713	158	549	8	705	3	158	7	539

[2]Includes 6 carcasses (3 Green River + 3 Newaukum Creek) for which adipose fin presence was unknown.

4.8 White River

The escapement estimate for White River Spring Chinook is derived from trap counts at the Army Corps of Engineers' Buckley Diversion Dam fish trap and hatchery returns to the Minter Creek/Hupp Springs and White River (WRH) hatcheries. Under ideal conditions the trap allows sampling and enumeration of all fish transported to the upper watershed. During odds years when pink salmon return, and years of relatively high coho returns, sampling at the Buckley trap is limited, particularly during the latter part of the Chinook run, so the proportions of hatchery and natural-origin Chinook transported above the dam are uncertain. Records of trap and haul operations conducted in the absence of state or tribal fisheries managers are a subject of ongoing concern. In 2013 complete sampling occurred through August 7th, but 2,495 Chinook (including jacks) of unknown origin were transported upstream after this date.

The total number of fish sampled at the White River Hatchery and the Buckley trap prior to the termination of sampling was 2,908 adults. Of these, 2,040 were natural- origin (NOR) and acclimation pond (AP) recruits. NORs made up 18% and APs made up 52% of the sampled Chinook. The ratio of adipose clipped to non-clipped fish among sampled fish was applied to unsampled fish passed upstream after August 7th. For all adults transported above the dam, an estimated 3,644 were adult NOR and AP Chinook; 51 adult NORs were taken to the White River Hatchery for use as broodstock.

Table 4-27. Estimated Number of Chinook hauled upstream of Buckley fish trap in 2013.

Origin	Adults	Jacks	Totals
Wild (NOR)	910	34	944
Acclimation Pond	2,734	177	2,911
Totals	**3,644**	**211**	**3,855**

There are two hatchery programs for White River spring Chinook. The Minter Creek/Hupp Springs program was initiated in the mid-1970's in response to steep declines in population abundance. This program was expanded following completion of the Muckleshoot Tribe's White River hatchery in 1989. In 2013 escapement to the Minter Creek/Hupp Springs hatchery was 685 (i.e., 684 adults and 1 jack). None of these fish were taken to the White River Hatchery.

Escapement to the White River hatchery in 2013 was 1,610 (1,516 adults and 94 jacks). These fish were either collected at the Buckley fish trap on the south side of the diversion dam, or volunteered to the hatchery trap on the north side of the diversion dam.

4.9 Puyallup River

The Puyallup Tribal Fisheries (PTF) and Washington Department of Fish and Wildlife (WDFW) staffs agreed to use an adjusted AUC-based methodology to estimate escapement for Chinook in the Puyallup River basin during odd years.

South Prairie Creek

Odd-year estimates for SPC are based on live count AUC adjusted by the mean South Prairie redd-based estimate/AUC-based estimate ratio. This adjustment is necessary because pink returns in odd years often preclude objective Chinook redd accounting and historic live count-based estimates have been very conservative when compared to redd-based estimates in this system. The South Prairie Creek (SPC) sub-basin spawning escapement estimate for 2013 is 54 spawners. This escapement is made up of 44 NORs and 10 HORs. The 2013 SPC redd estimate/AUC estimate ratio was 1.45, based on even-year data from 1994 to 2012. The 2013 AUC spawner curve yielded an escapement estimate of 36 spawners for SPC. Expanding the SPC AUC-based escapement (36 X 1.45) yielded a South Prairie escapement of 52. Wilkeson Creek contributed 2 Chinook 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 spawning timing curve with a high degree of confidence.

Survey conditions were not suitable on the Carbon River during the 2013 spawning period. Consistent with the last ten years, the 2013/1999 SPC escapement ratio (52 / 1422 = 0.0367) was applied to the 1999 Carbon River escapement (250) to estimate the 2013 value. This method estimated 9 Chinook spawning in the Carbon during 2013 (250 * 0.0367 = 9). Based on mark sampling rations observed in South Prairie Creek, the escapement was made up of 7 NORs and 2 HORs.

Mainstem Puyallup River Tributaries

Aggregate escapement to Puyallup River tributaries in 2013 was estimated at 526. Based on mark sampling in these tributaries, excluding Clark's Creek, 41 of these fish are NORs and 485 HORs.

Redd-based escapement estimates were calculated for most of the Puyallup River tributaries. No redds were observed in Canyon Falls Creek in 2013, although 6 dead fish were accounted for. Clarks Creek escapement was 190 fish.

Table 4-28. Chinook escapement estimates for Puyallup River tributaries, 2013.

	Escapement
Fennel Creek (WRIA 10.0406)	5
Canyon Falls Creek (10.0410)	6
Kapowsin Creek (10.0600)	17
Clear Creek (10.0022)	308
Clarks Creek (10.0027)	190
Tributary total	526

Mark sampling data collected in Clark's Creek are not used for the tributary mark rate estimate because, many of the Chinook produced and released from Clark's Creek hatchery are not marked, so the origin of natural spawners cannot be estimated.

Mainstem Puyallup River

Chinook spawning escapement to the mainstem Puyallup River was estimated to be 164. This escapement was made up of 72 NOR and 92 HOR Chinook, based on mark sampling ratios observed in mainstem tributaries.

As with the Carbon River, surveys of Puyallup River were not possible in 2013. WDFW and PTF staff believe that mainstem spawning escapement is closely related to the tributaries (Fennel, Canyon Falls, Kapowsin, and Clarks creeks). Therefore, the 2013/1999 Puyallup tributary ratio (95/113 = 0.8392) was applied to the estimated 1999 Puyallup mainstem escapement (195) to estimate 2013 escapement of 164 Chinook (195 * 0.8392 = 164).

The 2013 Chinook natural spawning escapement into Clark's Creek was not included in the tributary to Puyallup River mainstem ratio. For brood years contributing to the 2013 return, many of the Chinook released from Clark's Creek hatchery were not marked, so the origin of natural spawners could not be determined. Since 1999 is used as the base year, the 1999 natural spawning escapement estimate for Clark's Creek is used instead. We assume the proportion of hatchery origin fish spawning in Clark's Creek is higher than in the mainstem and other tributaries.

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 2013 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 2013 was estimated to be 21 fish. This escapement is made up of 12 NORs and 9 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 2013 is 774. Based on carcass sampling, we estimated that 175 were NORs, and 599 were HORs.. The estimate of NORs assumes the proportions of hatchery and natural origin spawners is the same in Puyallup River tributaries (except Clark's Creek), the Puyallup River mainstem, South Prairie Creek, and the Carbon River.

4.10 Nisqually River

Escapement to the Nisqually River in 2013 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 weir (in all fisheries and hatchery returns) and proportion of those removals marked, and (3) the proportion of marked fish returning to the weir to estimate the total return to the river and escapement above the weir.

Total return to the weir was estimated to be 1,847 Chinook (1,034 HOR, 813 NOR). 71 Chinook salmon trapped at the weir were removed from the river, leaving a total estimated upstream escapement of 1,776. Escapement downstream of the weir was calculated using the assumptions that downstream escapement was 28% of the return to the weir, and that the ratio of HOR/NOR below the weir was consistent with those encountered at the weir (Nisqually Chinook Stock Management Plan 2011). This resulted in an estimate of 517 fish spawning downstream of the weir (289 HOR, 228 NOR).

Total natural escapement was estimated to be 2,293 (1,257 HOR, 1,036 NOR).

4.11 Hood Canal

Natural Chinook escapement to the Skokomish River and Mid-Hood Canal rivers in 2013 were 1,722 ad 671, respectively (Table 4-29).

Table 4-29. Summary of Chinook escapement to Hood Canal streams during 2013.

Marine Area	Stream	Spawner escapement	Comments
- -	Skokomish R.	749	Redd counts + AUC in Hunter Cr. INDEX
	N.F. Skokomish R.	650	Redd counts + redds in McTaggart
	S.F. Skokomish R.	323	Redd counts + redds in Vance
	Total	1,722	
12A	Little Quilcene R.	3	3 chinook observed
	Big Quilcene R.	0	No chinook observed
	Total	3	
12B	Dosewallips R.	4	Redd counts + Rockybrook live/ dead observations
	Duckabush R.	7	AUC based on live fish observed
	Hamma Hamma R. a/	661	AUC adjusted for broodstock + John Creek AUC
	Total	672	
12C	Dewatto R.	37	AUC
	Lilliwaup Cr.	7	AUC
	Total	44	
12D	Tahuya R.	53	
	Union R.	32	Trap
	Total	85	
Hood Canal total		2,526	

/ Hamma natural escapement = 470 broodstock = 46, John Ck = 145

Hatchery chinook escapement, 2013 (WDFW In-Season Hatchery Escapement Report)	
George Adams Hatchery	21,444
Hoodsport Hatchery	2,379

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 in since 1998, but few adults have been observed. Current escapement estimates are derived from combinations of live Chinook adult counts and Chinook redd expansions, depending on flow conditions and fish distributions.

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

Summer chum salmon and pink salmon (in odd years) spawn at the same time as Chinook in the lower reaches of these three streams. Consequently, it can be difficult to distinguish Chinook redds from summer chum or pink redds unless Chinook are actively spawning and observed on redds. Pink salmon spawn predominately downstream of RM 6.7 on the Dosewallips, downstream of RM 2.6 on the Duckabush and throughout the reaches surveyed on the Hamma Hamma. Summer chum salmon spawn predominately downstream of RM 3.6 on the Dosewallips, downstream of RM 2.6 on the Duckabush and throughout the reaches surveyed on the Hamma Hamma. It has been possible to count Chinook redds in the upper Dosewallips and Duckabush River reaches (especially in years without pink salmon).

The WDFW conducted spawner surveys on the Dosewallips, Duckabush, and Hamma Hamma rivers every 7 to 10 days from late August or early September through October. The escapement estimate to all three systems combined was 672 adults: 4, 7, and 661 Chinook in Dosewallips, Duckabush, and Hamma Hamma rivers, respectively. During 2013, 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, few Chinook were present and the escapement estimates for Dosewallips and Duckabush rivers are considered accurate.

The Dosewallips River was surveyed from RM 0 to RM 2.3, RM 3.6 to RM 6.7, and RM 7 to RM 11; Rockybrook Creek, a tributary, was surveyed from RM 0 to RM 0.3. No Chinook redds were observed and the escapement estimate based on and AUC with 5 live fish observations in the Dosewallips River during 2013. The Duckabush River was surveyed from RM 0 to RM 2.6, RM 4.8 to RM 6. Although no Chinook redds were identified, a minimum of 7 individual live adults were observed and the escapement estimate is 7 Chinook in the Duckabush River during 2013. The Hamma Hamma River was surveyed from RM 0.3 to RM 1.8; John Creek, a tributary, was also accessible to Chinook and was surveyed from RM 0 to RM 1.6. The estimated total escapement to the Hamma Hamma is 661 which is the sum of the AUC estimate of natural spawners in the mainstem (516), 145 in John Creek, and 46 Chinook collected for broodstock). The FRAM preseason escapement projection was 250 for the Mid-Hood Canal (FRAM 1213). while actual escapement was 672 Chinook. A late September freshet was responsible for the high number of Chinook in Johns Creek for this time of year. Escapements to the Dosewallips River and Duckabush River were low as anticipated.

Skokomish River

Chinook spawning takes place in the mainstem Skokomish River up to the confluence with the South and North Forks at RM 9, in the South Fork (primarily up to RM 5.5), and in the North Fork from RM 9 to 15.7 (where Little Falls blocks further access). Natural escapement estimates are 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.

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 from late August through October. A cumulative new redd count for each section of the river was tabulated at the end of the season and multiplied by 2.5 fish per redd to estimate total Chinook escapement. In addition, foot surveys are made in Hunter and Vance creeks. Escapements to these tributaries are estimated based on redd counts and/or live Chinook observed.

In recent years, low flows at the mouth of the South Fork have prevented Chinook from accessing the lower South Fork early in the season. In 2013, however, Chinook were able to access the South Fork Skokomish throughout the season.

The total estimated spawner escapement to the Skokomish River is 1,722. . This total includes 311 in the mainstem Skokomish, 219 Chinook in Hunter Creek, 650 Chinook in the North Fork, , and 323 Chinook in the lower (RM 0 to RM 5.5) South Fork Skokomish. The preseason escapement prediction was 1,710 (FRAM 1213).

Mark Sampling

Mass marking has been implemented for releases from George Adams Hatchery, Hoodsport Hatchery, and Endicott Ponds. Double index tag groups have been released from George Adams Hatchery since 1998.The proportion of all Hood Canal hatchery Chinook that was 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) data and 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. During 2013, the Skokomish, Dosewallips, Duckabush, and Hamma Hamma rivers were targeted for enhanced mark and CWT sampling and WDFW also sampled Chinook carcasses for marks and CWTs on the Dewatto and Lilliwaup rivers.

Of the 294 Chinook sampled in Hood Canal rivers during 2013, 187 Chinook were adipose-clipped and, of these, 34 Chinook had CWTs. Twenty-nine unmarked Chinook were coded-wire tagged. We sampled 10.6% of Chinook spawner escapement in the Skokomish River, 9.2% of the Mid-Hood Canal Chinook spawner escapement (in the Hamma Hamma, Duckabush, and Dosewallips rivers), and had an overall sampling rate of 11.7% in all Hood Canal rivers combined (Table 4-30).

Jacks are not included in Chinook spawner escapement estimates in Hood Canal, but few jacks were sampled during 2013.

The proportion of hatchery fish in the spawning escapement is estimated based on age composition in the escapement, carcass sampling rate, and the proportion of hatchery production releases that was marked and/or tagged from BY 2007 (age 5), BY 2008 (age 4), and BY 2009 (age 3). Preliminary estimates of hatchery fish in the spawning escapement are also made based only on the total number of tags and marks recovered corrected for clip error rates for the returning brood years.

In the Skokomish River system, 143 of 182 (78%) Chinook sampled were adipose-marked (Table 4-30). A preliminary estimate is that spawning escapement in the Skokomish River was comprised of about 87% hatchery-origin Chinook and 13% natural-origin Chinook, with distinct variation in composition in the three principal reaches. In the mainstem the hatchery origin

proportion was 97%, while in the North and South forks the hatchery proportions were 51% and 85%, respectively.

Hatchery releases into the Hamma Hamma River are 100% CWT'ed and otolith marked. All Chinook carcasses were sampled for otoliths during 2013. In the Hamma Hamma River 27 of 53 (51%) Chinook sampled were CWT'ed. Preliminary estimates are that spawning escapement comprised 49% hatchery-origin Chinook and 51% natural-origin Chinook in the Hamma Hamma River. One unmarked/untagged Chinook was sampled in the Duckabush and 2 unmarked/untagged Chinook were sampled in the Dosewallips. Preliminary estimates based on CWT recoveries indicated that spawning escapement for Mid-Hood Canal Chinook was comprised of 51% natural-origin and 49% hatchery-origin Chinook. However, otolith analysis indicated a much higher proportion of hatchery-origin returns, 88.5%, with 5.7% hatchery-origin (ad-clipped with no otolith mark), and 5.9% natural-origin (unmarked with no otolith mark).

Table 4-30. Chinook carcass sampling in Hood Canal rivers, 2013.

	No.		Tagged 1/			Untagged			Unk. tagged 2/			CWTs	AD-clips			
River	Sampled	%	AD	NM	Unk	AD	NM	Unk	AD	NM	Unk	recov	observ	Rate	HOR	NOR
Mainstem Skokomish R.	123	16%	1	2	1	114	4	0	0	0	1	3	115	0.97	724	25
N.F. Skokomish R.	38	6%	0	0	0	16	16	0	2	1	3	0	18	0.51	334	316
S.F. Skokomish R.	21	7%	2	1	0	13	1	2	1	0	1	3	16	0.85	275	48
Skokomish R. tot	182	11%	3	3	1	143	21	2	3	1	5	6	149	0.77	1333	389
Big Quilcene R.	1	33%	0	1	0	0	0	0	0	0	0	0	0	1.00	3	0
Little Quilcene R.	0	0%	0	0	0	0	0	0	0	0	0	0	0			
HammaHamma R[3]	59	9%	1	26	0	1	25	0	1	5	0	27	3	0.89	585	76
Duckabush R.	1	14%	0	0	0	0	1	0	0	0	0	0	0	0.00	0	7
Dosewallips R.	2	50%	0	0	0	0	2	0	0	0	0	0	0	0.00	0	4
Mid-HC tot	62	9%	1	26	0	1	28	0	1	5	0	27	3	0.87	588	84
Dewatto R.	3	8%	0	0	0	3	0	0	0	0	0	0	3	1.00	37	0
Lilliwaup R.	1	14%	0	0	0	0	0	0	1	0	0	0	1	1.00	7	0
Tahuya R.	14	26%	1	0	0	13	0	0	0	0	0	1	14	1.00	53	0
Union R. 2/	32	100%	0	0	0	0	0	0	17	15	0	0	17	0.53	17	15
Hood Canal total	294	12%	5	29	1	160	49	2	22	21	5	34	187	0.81	2035	488

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

2/ Visual detection only live fish at the trap

3/ Supplementation origin fish calculated from otoliths

4.12 Dungeness

Since 1986, surveys by foot have been conducted throughout the spawning season from RM 0.0 to 18.8 in the mainstem Dungeness, and from RM 0 to 5.1 in the Gray Wolf mainstem, to generate a cumulative redd count for the season. The total redd count is multiplied by 2.5 to estimate the total number of adults. In 2013, 31 redds (78 adults) were counted in the Dungeness and no redds were counted in the Gray Wolf (Table 4-31). Due to the extremely large pink spawning population of 400 thousand in the basin and the difficulty of identifying all

Chinook redds, we calculated an expanded Chinook spawning escapement of 168. This estimate was based on the percentage (25%) of carcasses observed in entire population from past years. There were an additional 110 adults removed from the river and used for broodstock. The total estimated return to the river was 278, and was lower than the FRAM projected escapement of 569. 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. Because the forecasts for Strait of Juan de Fuca Chinook are based solely on average recent returns, they did not account for this reduction in production.

There were 151 carcasses sampled for scales and checked for CWTs. The majority of the adults sampled for scales and CWTs were collected from the lower river for broodstock. Based on the CWT results and scale samples analyzed, the preliminary HOR/NOR composition for RY2013 was 64.9% HOR and 35.1% NOR (Table 4-22) in the natural spawning population of 168. The numbers in Table 2 are preliminary and subject to change until otolith analysis from unmarked and untagged Chinook have been verified.

Table 4-31 The distribution of Chinook redds in the Dungeness Rivers system, 2009 - 2013.

Dungeness River	Lower River mile	Upper River mile	Total miles	2009	2010	2011	2012	2013
Mouth to Woodcock Bridge	0.5	3.3	2.8	12	17	18	68	2
Woodcock Bridge to HWY 101	3.3	6.4	3.1	4	17	46	40	13
Hwy 101 to May Rd.	6.4	9.2	2.8	14	37	63	44	6
May Rd. to Canyon Creek	9.2	10.8	1.6	12	38	34	26	5
Canyon Creek to Clink bridge	10.8	13.8	3.0	3	14	30	14	5
Clink Bridge to Forks Campground	13.8	15.8	2.0	3	8	12	3	0
Forks Campground to East Crossing	15.8	17.5	1.7	3	5	3	1	0
East Crossing to Gold Creek	17.5	18.7	1.2	0	0	1	0	0
Greywolf River								
Mouth to RM 1.0 Bridge	0.0	1.0	1.0	0	0	6	2	0
RM 1.0 Bridge to 2 Mile Camp	1.0	2.5	1.5	0	2	1	5	0
02 Mile Camp to Cliff Camp	2.5	4.0	1.5	0	0	0	0	0
Cliff Camp to Slab Camp	4.0	5.1	1.1	0	0	0	0	0
Slab Camp to 1.0 mile upstream	5.1	6.1	1.0	0	0	0	0	0
Grand total				51	138	214	203	31 *

Table 4-32 Chinook coded wire tag recoveries from the Dungeness River in 2013

No. recovered carcasses	Tag number/ Mark/Tag status	Brood year	No. released	Size at release	Estimated number in spawning population of 168	Percent HOR in escapement of 168	Percent NOR in escapement of 168	Estimated number in terminal run	Percent of terminal run
2	210968	2011	56,080						
1	210969	2011	54,104						
1	Lost tag	2011							
7	210894	2010	48,817		8	4.7%		15	5.4%
2	210895	2010	39,931		2	1.2%		3	1.1%
3	210986	2010	27,387		3	1.8%		5	1.8%
2	210893	2009	43,242	9-9.5/lb.	2	1.2%		4	1.4%
35	210563	2009	49,594	52 / lb.	40	23.8%		68	24.5%
38	210773	2009	50,400	59 / lb.	43	25.6%		77	27.7%
2	635270	2009			2	1.2%		4	1.4%
3	210846	2008	48,975	78 / lb.	3	1.8%		4	1.4%
0	210847	2008	49,750	44 / lb.	0	0.0%		0	0.0%
0	210848	2008	49,600	6.2 / lb.	0	0.0%		0	0.0%
2	210849	2008	49,600	9.9 / lb.	2	1.2%		2	0.7%
1	210774	2007	49,600	68 / lb.	1	0.6%		1	0.4%
2	210775	2007	49,300	34 / lb.	2	1.2%		3	1.1%
1	210776	2007	25,700	6.4 / lb.	1	0.6%		1	0.4%
0	No CWT+ No Mark HOR	2009			0	0.0%		0	0.0%
2	No CWT+ No Mark NOR	2009			2		1.2%	2	0.7%
0	No CWT+ No Mark HOR	2008			0	0.0%		0	0.0%
40	No CWT+ No Mark NOR	2008			45		26.8%	70	25.2%
0	No CWT+ No Mark HOR	2007			0	0.0%		0	0.0%
11	No CWT+ No Mark NOR	2007			12		7.1%	19	6.8%
Totals 151 a/					**168**	**64.9%**	**35.1%**	**278**	

a/ Excluded 2 year olds (n=4)

The age of the HOR Chinook for RY2013 consisted of 12.5% age 3, 80.5% age 4, 3.5% age 5, and 3.5% age 6. The age of the NOR Chinook consisted of 2.2% age 3, 76.9% age 4, 20.9% age 5, and no age 6 (Table 4-33). We recovered a total of 151 CWT Chinook during the season by the following age groups: 12 (age 3), 77 (age 4), 5 (age 5), and 4 (age 6). Three age 2 Chinook carcasses were observed during the season. Age 2 Chinook were not used for escapement expansion estimates.

Table 4-33. The age and origin of Chinook returns to the Dungeness River in 2013.

Age	Number HORs	Percent HORs	Number NORs	Percentage NORs	Total HOR+NORs	Percent
3	23	12.5%	2	2.2%	25	9.0%
4	151	80.5%	70	76.9%	221	79.5%
5	7	3.5%	19	20.9 %	26	9.4%
6	6	3.5%	0	0.00%	6	2.3%
Total	187		91		278	

4.13 Elwha River

The Elwha Dam removal project began in September 2011 and was completed by March 2012. The natural river flow was restored through the former Lake Aldwell. Prior to September 2012, Chinook spawning in the Elwha River was limited to the 4.8 miles below the dam with most natural spawning concentrated between RM 2.8 and 4.4. Before dam removal, Chinook surveys were conducted by raft and foot surveys. Beginning in September 2013, National Park Service, Lower Elwha Klallam Tribe, and National Marine Fisheries Service staff conducted foot surveys between the Glines Powerhouse and the old lower dam site in several sections listed in Tables 4a and 4b. Three Elwha tributaries, Hughes Creek, Little River and Indian Creek, were also included with these surveys. A total of 513 and 163 Chinook redds were observed upstream and downstream of the lower Elwha dam site, respectively in the mainstem Elwha River, 8 redds in Hughes Creek, 23 in Little River, and 58 in Indian Creek for a total of 765.

Table 4-34. The distribution of Chinook spawning in the Elwha River in 2013.

Elwha River – Section surveyed	RM sections	No. of Redds	Males	Females	Unknown	Carcasses	Jacks
Glines Powerhouse to Top of Altaire Canyon	13.3-12.9	162	132	103	60	77	2
Altaire Canyon to Altaire Bridge	12.9-12.5	11	0	2	0	10	0
Altaire Bridge to Griff Creek (Right Channel)	12.5-12.0	32	5	9	8	9	0
Griff Creek Rabbit Hole (Right Channel)	12.0-11.3	39	26	12	2	36	1
Altaire Split to Griff Creek (Left Channel)	12.5-12.0	10	6	5	17	21	0
Griff Creek Rabbit Hole (Left Channel)	12.0-11.3	34	4	6	20	15	0
Rabbit Hole to Fisherman's Corner	11.3-10.7	59	8	19	14	32	0
Fisherman's Corner to Park Boundary	10.7-9.7	13	7	3	23	33	0
Park Boundary to McDonald Bridge Gauge	9.7-8.5	45	4	0	108	47	4
McDonald Bridge Gauge to A-Frame	8.5-8.2	8	1	3	6	35	0
A-Frame to Highway 101 Bridge	8.2-7.7	16	0	0	13	6	0
Highway 101 Bridge to Gooseneck	7.7-6.3	68	19	19	24	20	0
Gooseneck to Elwha Dam	6.3-4.9	8	12	6	0	5	0
Gooseneck supplemental		8	0	0	10	1	0
Hughes Creek	0.45-0.0	8	6	7	0	39	1
Little River (RM 0.0-1.2)	1.2-0.0	23	23	12	0	9	0
Indian Creek (RM 0.0-1.2)	1.2-0.0	58	43	19	0	64	5
Totals upstream of Elwha Dam Site		602	296	225	305	459	13

Table 4-35. Number of Chinook and redds observed in the Elwha River RM 0.0 to 4.9.

Elwha River – Section surveyed	RM sections	No. of Redds	Males	Females	Unknown	Carcasses	Jacks
Dam outflow to Hwy 112 Bridge	4.9-4.4	51	0	0	81	16	0
Hwy 112 Bridge to Elwha weir	4.4-3.7	100	0	0	251	25	0
Elwha weir to New Bridge	3.7-3.2	9	0	0	13	20	0
New Bridge to Sisson's Riffle	3.2-2.8	3	0	0	0	0	0
Sisson's Riffle-Spruce Hole	2.8-2.3	0	0	0	13	0	0
Spruce Hole to Right Side Channel by LEK Hatchery	2.3-0.9	0	0	0	23	1	0
Hunt Channel	2.3-0.9	NS	NS	NS	NS	NS	NS
Elwha Bluff to mouth	0.7-0.2	0	0	0	0	0	0
Total downstream of lower dam		163	0	0	381	62	0
Grand Total (upstream + downstream of Elwha Dam)	15.75	765	296	225	686	521	13

We estimated total escapement by expanding survey redd counts for unsurveyed reaches, and for redds constructed after the final survey on September 17th (Table 4-36). The expanded estimate for total redds was 1,432.This redd total is multiplied by 2.5 to estimate total adults. For RY2013, the estimated number of natural spawning Chinook in the Elwha River based on redd counts was 3,580.

- Table 4-36. Elwha Chinook escapement survey coverage and redd count expansion in 2013.

Survey area	Total length (miles)	Unsurveyed length (miles)	Surveyed length (miles)	Percent surveyed	Observed redds	Expanded redds to unsurveyed area	Total redds
Mainstem Elwha River	13.3	4.9		100.0%	513	513	943
	4.9	0.0	4.93	100.0%	163	163	299
Indian Creek	1.5	0.3	1.2	80.0%	58	73	133
Little River	1.2	0.0	1.2	100.0%	23	23	42
Hughes Creek	0.45	0.0	0.45	100.0%	8	8	15
Total redds					**765**	**780**	**1,432**
Total adults (redds x 2.5 adults/redd)					**1,913**	**1,949**	**3,580**

In addition to spawning ground surveys in the area upstream of the former Elwha Dam site, adult Chinook were collected by various methods for broodstock purposes in the lower river. WDFW staff collected adults at the weir located near RM 4.1 and by gaff, net, seine, and trap methods. A total of 1,930 Chinook were removed from the river and used as brood stock for

the hatchery program (Table 4-37). The terminal run size to the river was 5,510 Chinook, higher than the FRAM prediction of 2,659.

Table 4-37. Chinook broodstock collection and total escapement to the Elwha River in 2013.

Method of capture	No. of males	No. of females	No. of jacks	Non-viable females	Total w/o jacks
Number of Chinook gaffed downstream of weir and spawned	0	0	0	0	0
Number of Chinook netted/gaffed in river downstream of weir and taken to hatchery	588	411	10	0	999
Number of Chinook transported from LEK Hatchery to WDFW Elwha Channel	118	28	11	0	146
Number of Chinook transported from Elwha River weir to WDFW Channel	90	77	0	0	167
Number of Chinook return to WDFW Channel Trap (Volunteers)	475	143	4	0	618
Totals	**1,271**	**659**	**25**	**0**	**1,930**
Estimated number of natural spawners in the river					**3,580**
Estimated total returns					**5,510**

SONAR Enumeration Method

SONAR technology is being used in the Elwha River as a method to improve enumeration of Chinook passage during the entire run from June through September. This technology will improve Chinook escapement estimates due to the difficulty of observing redds and fish in turbid water conditions caused by the removal of the two dams. The lower Elwha dam was removed in the spring of 2012 and the upper dam (Glines Canyon) will be removed in 2014. Denton et. al. (2013) used a DIDSON LR (long range) multi-beam sonar system to enumerate Chinook salmon in the Elwha River from June 25th, 2013 through September 8th, 2013. Their best estimate for the Chinook escapement to the Elwha River was 4,243 fish with a calculated 95% CI 3,739 -4,749.

CWT and Otolith Mark Recoveries

WDFW Elwha weir staff collected 299 otolith samples from Elwha Chinook in 2013. Otoliths were collected to help distinguish between hatchery and wild fish based on the presence or absence of otolith marks. Of the 299 samples, 276 had an otolith mark present (92.3%), 21 (7.07%) had no otolith mark present, and 2 were unreadable (0.07%). Of the 276 otolith mark recoveries, 1 was age 6, 9 were age 5, 219 were age 4, 38 were age 3, and 92 were age 2. WDFW field staff also collected additional otolith samples but these have not been analyzed to date.

Table 4-38 summarizes the number of tagged / unmarked, untagged / unmarked, and tagged / marked returns by sex and by brood year. The number of tags and their code numbers are listed in the table. The origin (hatchery or natural) of untagged fish will be determined by otolith analysis which is currently not available.

Table 4-38. Age composition and coded wire tag sampling of Chinook returning to the Elwha Channel in 2013.

Sex	Total age	CWT No.	BY2008	BY2009	BY2010	BY2011	Grand Total
Female	3	No tag			7		7
	Age 3 Total				**7**		**7**
	4	210773		1			1
	4	635270		28			28
	4	635275		19			19
	4	635287		5			5
	4	635366+ADP		1			1
	4	No tag		213			213
	Age 4 Total			**267**			**267**
	5	631424	2				2
	5	634786	12				12
	5	No tag	8				8
	Age 5 Total		**22**				**22**
	All ages		**22**	**267**	**7**	**0**	**296**
Male	2	636170				3	3
	2	No tag				9	9
	Age 2 Total					**12**	**12**
	3	635977			57		57
	3	No tag			162		162
	Age 3 Total				**219**		**219**
	4	210893		1			1
	4	635270		63			63
	4	635275		30			30
	4	635287		4			4
	4	635367+ADP		1			1
	4	Lost tag		1			1
	4	No tag		210			210
	Age 4 Total			**310**			**310**
	5	634786	6				6
	5	No tag	2				2
	Age 5 Total		**8**				**8**
	All ages		**8**	**310**	**219**	**12**	**549**
unknown	Age 2	No tag				1	1
	Age 3	No tag			3		3
	Age 4	635287		1			1
	Age 5	No tag	1				1
	All ages		**1**	**1**	**3**	**1**	**6**
Grand total			**31**	**578**	**229**	**13**	**851**

Of the total of 235 CWTs recovered, two (0.80%) originated from the Dungeness Basin (WRIA18), two (0.80%) were from George Adams Hatchery at Purdy Creek (WRIA 16),

ten (4.25%) were from Morse Creek Hatchery (Elwha origin Chinook) in WRIA 18, one (0.40%) tag was lost before being identified, and the remaining 220 (93.6%) tags originated from the Elwha Hatchery (Table 8).The total number of tagged Chinook that returned to the Elwha River that were of Elwha origin stock was 230 (97.9%).

Table 4-39. Chinook coded wire tag recoveries at the Elwha Channel in 2013.

CWT No./Mark 1/	Rearing Hatchery	Release Site	Release date	Brood year	No. released	No. recovered	Proportion
210773-UM	Dungeness	Dungeness River	June 3, 2010	2009	49,694	1	0.004
210893-UM	Hurd Creek	Hurd Creek	April 21, 2011	2009	42,636	1	0.004
635270-UM	Elwha	Elwha River	April 13, 2011	2009	101,892	91	0.387
635275-UM	Elwha	Elwha River	April 13, 2011	2009	97,943	49	0.209
635287-UM	Morse Creek	Morse Creek	April 12, 2011	2009	201,548	10	0.043
635366+ADP	George Adams	Purdy Creek-	May 14, 2010	2009	227,151	1	0.004
631424-UM	Elwha	Elwha River	April 7, 2010	2008	99,470	2	0.008
634786-UM	Elwha	Elwha River	April 7, 2010	2008	95,303	18	0.077
636170-UM	Elwha	Elwha River	April 5, 2013	2011	195,864	3	0.013
635977-UM	Elwha	Elwha River	April 2, 2012	2010	212,900	57	0.243
635367+ADP	George Adams	Purdy Creek	May 14, 2010	2009	227,548	1	0.004
Lost tag				2009		1	0.004
Total						**235**	**1.000**

1/ Tag/ Mark status: CWT= coded wire tag number; ADP= adipose clipped; UM= unmarked or unclipped

Of the 851 Chinook samples, 233 (27.4%) were CWT and unmarked, 616 (72.4%) were untagged and unmarked, and 2 were CWT and adipose clipped. The 616 untagged and unmarked fish could be either hatchery origin (otolith marked) or natural origin (no otolith mark). A total of 296 (34.8%) were females, 549 (64.5%) were males, and 6 (0.7%) were sex could not be determined (Table 4-40).

Table 4-40. Mark sampling of Chinook at Elwha Channel in 2013.

Tag-Mark	Female	Male	Unknown	Total	Proportion Tag-Mark
CWT+ no mark	67	165	1	233	0.274
No tag+ no mark	228	383	5	616	0.724
CWT+ADP	1	1	0	2	0.002
Totals	296	549	6	851	1.000
Proportion	0.348	0.645	0.007	1.000	

The age class of the 851 samples consisted of 13 (1.5%) age 2; 229 (26.9%) age 3; 578 (67.9%) age 4; and 31 (3.7%) age 5. Ninety-six percent of the age 2 and 3 adult Chinook combined consisted of males. The percentages for ages 3, 4, and 5 females were 2.4%, 90.2%, and 7.4%, respectively. The percentages for ages 2, 3, 4, and 5 males were 2.2%, 39.9%, 56.5%, and 1.5%, respectively (Table 10). Origin (hatchery or wild) of none tagged fish will be determined by otolith analysis.

Table 4-41. Age and sex composition of Chinook sampled at the Elwha Channel in 2013.

Brood year	2011	2010	2009	2008	Total
Total age	**Age 2**	**Age 3**	**Age 4**	**Age 5**	
No. of females	0	7	267	22	**296**
Proportion by female age	0.000	0.024	0.902	0.074	1.000
Proportion by sex	0.000	0.031	0.463	0.733	0.350
No. of males	12	219	310	8	**549**
Proportion by male age	0.022	0.399	0.565	0.015	1.000
Proportion by sex	1.000	0.969	0.537	0.267	0.650
Total females + males	**12**	**226**	**577**	**30**	**845**
No. of sex und.	1	3	1	1	**6**
Grand total	**13**	**229**	**578**	**31**	**851**
Proportion	**0.015**	**0.269**	**0.679**	**0.037**	**1.000**

For the 2013 Elwha Chinook return year, a total of 4117 were estimated to have originated from fingerling releases and 1393 originated from yearling releases for a total of 5510. The total number of fingerling returns in the table includes any potential natural origin fish. The final numbers in the table are subject to change until the 2013 otolith analysis has been completed. Of the estimated 4117 fingerling returns, 26.5% (1089) were age 3; 72.1% (2967) were age 4, and 1.5% were age 5. Of the estimated 1393 yearling returns, 25.0% (347) were age 3; 66.3% (924) were age 4 and 8.8% (122) were age 5 (Table 4-42).

Table 4-42. Age of Elwha hatchery Chinook returns, 2006 - 2013.

Return Year	Total Age	Brood year	Returns from Fingerling Releases	Age %	Returns from Yearling Releases	Age	Total	Age %
2006	3	2003	183	0.0964	0	0.0000	183	0.0948
2006	4	2002	829	0.4368	33	1.0000	862	0.4464
2006	5	2001	870	0.4584	0	0.0000	870	0.4505
2006	6	2000	16	0.0084	0	0.0000	16	0.0083
2006	**Totals**		**1,898**	**1.0000**	**33**	**1.0000**	**1,931**	**1.0000**
2007	3	2004	234	0.2175	17	0.2429	251	0.2190
2007	4	2003	727	0.6757	53	0.7571	780	0.6806
2007	5	2002	105	0.0976	0	0.0000	105	0.0916
2007	6	2001	10	0.0093	0	0.0000	10	0.0087
2007	**Totals**		**1,076**	**1.0000**	**70**	**1.0000**	**1,146**	**1.0000**
2008	3	2005	795	0.7092	0	0.0000	795	0.6895
2008	4	2004	262	0.2337	21	0.6563	283	0.2454
2008	5	2003	64	0.0571	11	0.3438	75	0.0650
2008	6	2002	0	0.0000	0	0.0000	0	0.0000
2008	**Totals**		**1,121**	**1.0000**	**32**	**1.0000**	**1,153**	**1.0000**
2009	3	2006	109	0.0499	8	1.0000	117	0.0534
2009	4	2005	2,052	0.9396	0	0.0000	2,052	0.9361
2009	5	2004	23	0.0105	0	0.0000	23	0.0105
2009	6	2003	0	0.0000	0	0.0000	0	0.0000
2009	**Totals**		**2,184**	**1.0000**	**8**	**1.0000**	**2,192**	**1.0000**
2010	3	2007	529	0.4222	0	0.0000	529	0.4136
2010	4	2006	118	0.0942	21	0.8077	139	0.1087
2010	5	2005	606	0.4836	5	0.1923	611	0.4777
2010	6	2004	0	0.0000	0	0.0000	0	0.0000
2010	**Totals**		**1,253**	**1.0000**	**26**	**1.0000**	**1,279**	**1.0000**
2011	3	2008	792	0.4602	105	0.7343	897	0.4812
2011	4	2007	913	0.5305	24	0.1678	937	0.5027
2011	5	2006	16	0.0093	14	0.0979	30	0.0161
2011	6	2005	0	0.0000	0	0.0000	0	0.0000
2011	**Totals**		**1,721**		**143**	**1.0000**	**1,864**	**1.0000**
2012	3	2009	985	0.4937	43	0.2240	1,028	0.4701
2012	4	2008	933	0.4677	144	0.7500	1,077	0.4925
2012	5	2007	77	0.0386	5	0.0260	82	0.0375
2012	6	2006	0	0.0000	0	0.0000	0	0.0000
2012	**Totals**		**1,995**		**192**	**1.0000**	**2,187**	**1.0000**
2013	3	2010	1,089	0.2645	347	0.2491	1,436	0.2606
2013	4	2009	2,967	0.7207	924	0.6633	3,891	0.7062
2013	5	2008	61	0.0148	122	0.0876	183	0.0332
2013	6	2007	0	0.0000	0	0.0000	0	0.0000
2013	**Totals**		**4,117**		**1,393**	**1.0000**	**5,510**	**1.0000**

Note: Numbers in table above are subject to change based upon otolith analysis to determine origin (hatchery or natural).

4.14 Hoko

WDFW and Makah Fisheries staff conduct foot surveys to count redds in the mainstem between river miles 2.8 to 21.7 and tributaries, which represents all Chinook spawning area in the Hoko basin. There are ten mainstem and 13 tributary reaches, which include the Little Hoko River, a tributary to the lower mainstem, and Browne's, Herman, North Fork Herman, Ellis, Bear, and Cub creeks, which are tributaries to the upper mainstem. WDFW conducted four surveys from RM 3.4 to 10.2 during the 2013 return year. Makah Fisheries Management (MFM) surveyed the mainstem Hoko upstream of RM 10.2 and the Hoko tributaries. Survey conditions were poor after November 7 due to high water. We believe the poor survey conditions did not impact escapement estimates in the lower river due to historical spawning timing and the low numbers of fish and redds observed prior to the high water.

Table 4-43. Hoko River Chinook escapement surveys in 2013.

Date	Reach	Live	Dead	Total	New Redds	Visible Redds	Cumulative Redds
10/10/13	2.8 - 3.4						
	3.4 - 4.4	0	0	0	0	0	0
	4.4 - 5.6	4	0	4	1	1	1
	5.6 - 7.5	37	0	37	18	18	18
	7.5 - 8.4	10	0	10	11	11	11
	9.8 - 10.1	29	16	45	20	20	20
10/17/13	2.8 - 3.4						
	3.4 - 4.4	0	0	0	0	0	0
	4.4 - 5.6	6	0	6	0	1	1
	5.6 - 7.5	13	3	16	7	24	25
	7.5 - 8.4	12	0	12	3	14	14
	9.8 - 10.1	30	0	30	8	28	28
10/24/13	2.8 - 3.4						
	3.4 - 4.4	0	0	0	0	0	0
	4.4 - 5.6	5	0	5	6	7	7
	5.6 - 7.5	4	0	4	3	28	28
	7.5 - 8.4	3	0	3	8	22	22
	9.8 - 10.1	33	0	33	15	42	43
10/31/13	2.8 - 3.4						
	3.4 - 4.4	0	0	0	0	0	0
	4.4 - 5.6	1	0	1	5	10	12
	5.6 - 7.5	0	5	5	6	34	34
	7.5 - 8.4	0	0	0	2	23	24
	9.8 - 10.1	24	0	24	8	48	51
						Total	**121**

Redd counts are multiplied by 2.5 adults/redd to estimate natural escapement. Mainsteam redd counts from RM 7.5 to 8.4 were expanded to RM 8.4 to 8.7 using 26.6 redds/mile. No spawning was observed from RM 3.4 to 4.4. We assumed no redds were built between RM 2.0 and 2.8 based on observations in RM 2.4 to 4.4. The lower mainstem Hoko River from RM 2.0 to RM10.1 had an estimated 129 redds and the tributaries plus upper mainstem Hoko River had 91 redds (Table 4-44).

The total number of natural spawners in the river was 656, of which 45 were HOS origin and 611 were NOS origin (Table 4-45)**.** The estimate of 656 includes age 2 Chinook.

Makah Fisheries Management staff estimated an additional 18 adult Chinook in the Sekiu River.

Table 4-44. Observed and expanded redd counts in the Hoko River in 2013.

Stream	Reach	Unsurveyed length	Surveyed length	Observed redds	Expanded Redds	Total redds
Mainstem	RM 2.0 - 10.1	1.70	6.40	121	8	129
Mainstem	RM 10.1 - 11.0	0.00	0.90	2	0	2
Mainstem	RM 11.0 - 13.0	2.00	0.00	0	6	6
Mainstem	RM 13.0 - 15.5	0.00	2.50	9	0	9
Mainstem	RM 15.5 - 18.3	0.00	2.80	15	0	15
Mainstem	RM 18.3 - 20.4	0.00	2.10	10	0	10
Mainstem	RM 20.4 - 21.7	0.00	1.30	7	0	7
Brownes Cr.	RM 0.0 - .97	0.00	0.97	16	0	16
Ellis Cr.	RM 1.0 - 1.0	0.00	1.00	0	0	0
Herman Cr.	RM 0.0 - 2.0	0.00	2.00	4	0	4
NF Herman Cr.	RM 0.0 - .37	0.00	0.37	1	0	1
Johnson Cr.	RM 0.9 - .35	0.00	0.35	0	0	0
Little Hoko River	RM 0.0 - 1.0	2.50	1.00	6	15	21
Total Redds				191	29	220
Adults (redds * 2.5 adults/redd)				478	74	551

The total number of hatchery broodstock collected by Makah Fisheries Management (MFM) staff was 750, of which 435 returned to the hatchery (excluding jacks); 315 jacks returned to the hatchery, and 58 jacks were returned to the river to spawn. Of the 750 broodstock collected, 635 (84.7%) were HOS and 115 (15.3%) were NOS (Table 4-45)**.**

Table 4-45. Age and origin of broodstock and natural Chinook spawners in the Hoko River in 2013.

Age	In-River Spawners			Broodstock			Total Spawners		
	HOS	NOS	Total	HOS	NOS	Total	HOS	NOS	Total
2	0	116	116	202	113	315	202	229	431
3	23	92	116	300	8	292	323	85	408
4	22	229	251	125	9	134	147	238	385
5	0	154	154	8	1	9	8	155	163
6	0	19	19	0	0	0	0	19	19
Total	45	610	656	635	131	750	680	726	1,406

For RY 2013, the total number and percentage by age of the Chinook in-river spawners and broodstock collected, including jacks were 431 age 2 (30.7%), 408 age 3 (29.0%), 385 age 4 (27.4%), 163 age 5 (11.6%), and 19 age 6 (1.4%), and no age 7. The in-river spawners plus broodstock collected consisted of 680 (48.4%) HORs and 726 (51.6%) NORs (Table 4-45). The RY2013 Chinook terminal run size was estimated to be 1,406 adults.

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 in 2012 are summarized below, and were based on catches reported by local biologists, and sample sizes queried from the RMIS database. Sampling rates in commercial fisheries generally exceeded the objective, except in Area 13 (Table 5-1). Marine area recreational fisheries were sampled at rates between 9% and 33% for the year (Table 5-2).

Table 5-1. Chinook coded-wire tag sampling rates for commercial fisheries in 2010 (calendar year).

	Areas 4B & 5	Elwha R	Area 7/7A	Area 7B/C/D Nooksack R
Catch	1729	0	527	16,074
#Sampled	742		140	11,037
Rate	43%		27%	69%
	8/Skagit R	Area 8A	Area 8D	Stillaguamish
Catch	2675	11	376	12
#Sampled	2147	7	186	1
Rate	80%	64%	49%	8%

	Area 10	Area 10A	Area 10E	Area 10F	Duwamish	Puyallup / White R
Catch	56	113	1174	1033	333	2011
#Sampled	20	110	294	552	127	1365
Rate	36%	97%	25%	53%	38%	68%

	Area 13/13A	Area 13C	Area 13D-F	Nisqually R
Catch	495	3,831	4,025	11,441
#Sampled	34	1,482	223	2,760
Rate	7%	39%	6%	24%

	Area 9A/12B&C	Area 12H	Skokomish R
Catch	12221	29137	18037
#Sampled	3320	5429	3682
Rate	27%	19%	20%

Table 5-2. Chinook coded-wire tag sampling rates for marine recreational fisheries in 2012.

Catch Area	Catch	# Sampled	Sample Rate
Marine Sport Area 5	10319	2344	23%
Marine Sport Area 6	7648	2539	33%
Marine Sport Area 7	6562	1120	17%
Marine Sport Area 8.1	297	128	43%
Marine Sport Area 8.2	797	242	30%
Marine Sport Area 9	10266	1716	17%
Marine Sport Area 10	4344	1195	28%
Marine Sport Area 11	6465	1440	22%
Marine Sport Area 13	976	98	10%
Marine Sport Area 12	2702	245	9%

6 Literature Cited

Denton, K.P., McHenry, M., Moses, R., Liermann, M., Pess, G. 2013. 2013 Elwha River Chinook Escapement Estimate Based on DIDSON/ARIS Multi-Beam SONAR Data. 35 pp.

Ford, M.J., T. Lundrigan, and M. Baird. 2004. Population Structure of White River Chinook Salmon Draft Report. Watershed Northwest Fisheries Science Center, Conservation Biology Division, Seattle, WA.

Nisqually Chinook Work Group, 2011. Nisqually Chinook Stock Management Plan 2011. Report January 2011.

Puget Sound Indian Tribes and Washington Department of Fish and Wildlife. 2010. Comprehensive management plan for Puget Sound Chinook: Harvest management component. Northwest Indian Fisheries Commission, Olympia, WA. 230 pages.

Seber, G. A. F. 1982. The estimation of animal abundance and related parameters. New York: McMillan Publishing Company

Smith, C. and P. Castle. 1994. Puget Sound Chinook Salmon (Oncorhynchus tshawytscha) Escapement Estimates and Methods. Northwest Fishery Resource Bulletin. Project Report Series No. 1.

WDFW. 2014. 2013 Summer Mark-Selective Recreational Chinook Fisheries In Marine Areas 5, 6, 9, 10, 11, 12 and 13, Revised draft post-season report, January 30, 2014. Olympia, WA. 91 pages.

Appendix 1. 2013-14 List of Agreed Fisheries