

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

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# **Puget Sound Chinook Comprehensive Harvest Management Plan**

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Annual Report Covering  
The 2010-2011 Fishing Season

August 1, 2011

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## Executive Summary

This annual report on the Puget Sound Chinook Comprehensive Harvest Management Plan summarizes results of salmon fisheries occurring between May 1, 2010 and April 30, 2011. This includes comparisons of pre-season projections with actual catch in all commercial and some recreational fisheries. 2009 Recreational catch estimates are presented for those areas where data were not available in time for the 2009-2010 report. Chinook spawning escapement estimates for 2010 are reported for all Puget Sound populations, with details on escapement surveys and estimation methods. Comparisons are also made between pre-season projections of escapement, and actual results.

Commercial Chinook catch in Puget Sound pre-terminal net fisheries (i.e., the Strait of Juan de Fuca and Rosario / Georgia Straits) was higher than projected in all areas. This was primarily a result of the unexpected large return of Fraser River sockeye in 2010. Commercial catches in the Nooksack, Skagit, and Strait of Juan de Fuca terminal areas were all near expectations. Catch in South Sound in aggregate was near expectation, although some areas were well below and some were well above projections. Catch was slightly above preseason projections in the Stillaguamish/Snohomish (due to large catches in the Tulalip Bay extreme terminal area) and Hood Canal areas.

Marine and freshwater landed recreational Chinook catch in the 2009-2010 season was estimated, from a combination of creel and preliminary Catch Record Card data, to be 49,750, well below the pre-season projection of 61,000. Creel survey-based estimates of catch in 2009-2010 mark-selective recreational fisheries in Areas 5, 9-10, and 11, Skagit, Skykomish, and Nisqually rivers are included in this report. Total encounter estimates for the 2010-11 marine area selective fisheries were higher than expected in Area 5, but much lower than expected in Areas 9, 10 and 11.

Spring Chinook escapement was above predictions for Skagit, White and Dungeness, and below for Nooksack. For summer/fall stocks, escapement was lower than predicted for the majority of management units.

Coded-wire tag sampling of 2009 commercial fisheries achieved sampling rate above 20% in most, but not all areas. Areas 12C/12H (Hood Canal), 13A-F (South Sound), and the Puyallup/White rivers were the areas with the most substantial catches, but with sampling rates below 20%. All marine area recreational fisheries except Area 13 (South Sound) were sampled at rates between 10% and 50% for the year.



# 1 Introduction

The Co-managers' 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 2010-2011 management year (May 1, 2010 through April 30, 2011)
- Projected and actual commercial landed catch in Puget Sound, and descriptions of fisheries, for the 2010-2011 management year
- Projected and actual landed catch for 2010 Puget Sound recreational fisheries where creel surveys were conducted, and for all 2009 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 2010, with details on estimation methods and factors affecting the quality of estimates
- Summaries of biological sampling of spawning escapement, and estimates of contributions of hatchery- and natural-origin spawners where available
- 2009 Coded-wire tag sampling rates for commercial and recreational fisheries

## 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. Table 2 identifies the rates that were used as the ceiling for each Management Unit (MU) in 2010, and the projected exploitation rates and escapements for each unit, from the final pre-season FRAM model run (1010).

2010 was the first year of management under the revised Puget Sound Chinook Harvest Management Plan (PSIT and WDFW 2010). There were several changes to management objectives under the revised plan. The Skokomish and Nisqually Units, which were previously managed for PTSUS ERCs and fixed escapement goals, are now managed for total ERC's. The Lake Washington MU, previously managed for a PTSUS ERC of 15%, and a CERC of 12%, is now managed for a Total SUS ERC of 20%, and a CERC of 10%. Finally the LATs for the Stillaguamish MU was changed to 700 (500 North Fork and 200 South Fork).

Pre-season fishery planning for 2010-2011 fisheries projected that natural spawning escapement would fall below the critical abundance thresholds for the Nooksack early, Stillaguamish and Mid-Hood Canal MUs, and for the Suiattle population within the Skagit MU, so CERC's were implemented for those units. Model escapement projections for other MUs exceeded their LAT's.

Table 1. 2010 Puget Sound Chinook Harvest Management Objectives.				
Management Unit	ER Ceiling	Critical ER Ceiling	Upper Management Threshold	Low Abundance Threshold
Nooksack		7.0% SUS	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	
Snohomish	21%	15% SUS	4,600	2,000
Skykomish			3,600	1,745
Snoqualmie			1,000	521
Lake Washington	20% SUS	10% PTSUS		
Cedar River			1,200	200
Green	15% PTSUS	12% PTSUS	5,800	1,800
White River spring	20%	15% PTSUS	1,000	200
Puyallup fall	50%	12% PTSUS		500
South Prairie Creek			500	
Nisqually	65%			
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 2. Management guidelines implemented and projected exploitation rates and escapements for Puget Sound Chinook from 2010-2011 pre-season planning.

Management Unit	RER or CERC implemented	Projected ER <sup>1</sup>	Projected Escapement <sup>1</sup>	UMT	LAT
Nooksack	7.0% SUS	7.0% SUS	439	4,000	2,000
Skagit summer fall	50%	43.9%	12,719	14,500	4,800
Skagit spring	38%	27.0%	661	2,000	576
Stillaguamish	15% SUS	9.8% SUS	685	900	700
Snohomish	21%	20.3%	7,835	4,600	2,800
L. Washington (Cedar)	20% SUS	17.5% SUS	1,349	1,680	200
Green	15% PT SUS	9.0% PTSUS	5,802	5,800	1,800
White	20%	19.3%	1,453	1,000	200
Puyallup	50%	50.0%	1,428	500 South Prairie Cr	500
Nisqually	65%	64.4%	2,983		
Skokomish	50%	49.8%	1,592	3650 aggregate 1650 natural	1300 aggregate 800 natural
Mid Hood Canal	12% PT SUS	11.7% PTSUS	138	750	400
Dungeness	10% SUS	4.2% SUS	535	925	500
Elwha	10% SUS	4.0% SUS	1,261	2,900	1,000
Western SJDF	10% SUS	4.1% SUS	1,781	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 regime agreed to for the 2010-11 fishing season is described in detail in the Co-managers List of Agreed-to Fisheries, which describes all salmon fisheries for all areas of Puget Sound and ocean fisheries off the Washington coast (see Appendix). The final pre-season projections of catch under this regime were made in FRAM run number 1010.

Actual catch is accounted by summarizing fish tickets, which are the sales receipts used for recording commercial, C&S, and research fishery landings. 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 11.

Recreational, non-treaty troll and treaty troll catches in Washington coastal fisheries north of Cape Falcon were substantially less than their quotas (Table 3). 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 2010-2011 fisheries, including in-season management actions that deviated from the pre-season plan, and explanations for differences in projected and actual catch.

Table 3. Summary of projected and actual Chinook catch in Washington ocean and Puget Sound fisheries in 2010.		
Fishery	Projected	Actual
Washington ocean non-treaty troll	56,000	45,099
Washington ocean recreational	61,000	36,874
Washington ocean treaty troll	55,000	33,381
Puget Sound pre-terminal net & troll total		
Strait of Juan de Fuca troll	9,600	3,323
Strait of Juan de Fuca net	1,344	2,245
San Juan Islands net	4,807	6,840
Nooksack-Samish terminal net	19,434	19,285
Skagit terminal net	2,013	1,961
Stillaguamish-Snohomish net	2,301	2,832
South Puget Sound terminal net	49,384	35,188
Hood Canal terminal net	18,905	22,112
Strait Tributaries terminal net	5	3

## 2.1 Strait of Juan de Fuca and San Juan Islands

The treaty troll fishery in the Strait of Juan de Fuca operates in Areas 4B, 5, and 6C; however, fishing in Area 4B from May through September is regulated as part of the coastal troll fishery under regulations adopted by the PFMC. The fishery in Area 5 and 6C was open, as planned, from June 13 through September 30, closed for the month of October, then open from November 1, 2010 through April 15, 2011. Chinook catch for the summer period was 238; catch during the winter period, through March 30, 2011, was 3,085. Pre-season planning modeled the summer and winter catch at 1100 and 8500, respectively.

Gillnet fisheries in Areas 4B, 5, and 6C were directed at Fraser sockeye, coho, and chum. A small-scale setnet fishery directed at Chinook was open from June 20 through August 14. Under control of the PSC Fraser River Panel, the sockeye fishery operated from the week beginning July 11 through September 21, a much lengthier fishery than anticipated due to very high Fraser sockeye abundance. The coho-directed fishery was open three weeks in September and early October, followed by the chum fishery extending through November. Incidental Chinook harvest during the sockeye and coho fishery was 2,045 (the NMFS representative to the Fraser Panel reported bycatch of 1770 in sockeye fishery, through September 21). Commercial sale of Chinook was stopped when catch in the sockeye fishery exceeded 1,300; subsequent catch was utilized for subsistence

purposes by tribal members. There were no Chinook caught during the chum fishery. Total Chinook catch in Strait gillnet fisheries was 2,245, exceeding the pre-season projected landed catch of 1,344.

Tribal and non-treaty net fisheries for sockeye in Areas 7 and 7A were lengthier and involved much greater fishing effort than anticipated due to the large Fraser return. The NMFS representative to the Fraser Panel reported that treaty Chinook bycatch was 6,617 (the post-season total accounted for on fish tickets was slightly higher, 6668). Commercial sale of Chinook stopped when catch reached 4,200; subsequent harvest was utilized for subsistence purposes by tribal members. Landed bycatch of 4,670 was input to pre-season modeling.

Non-treaty purse seines fishing in Areas 7 and 7A are required to release all Chinook, so non-treaty bycatch projections for 7/7A fisheries included expected numbers of Chinook encounters, multiplied by an assumed mortality rate of 33% for summer fisheries, or 46% for fall (chum) fisheries. Pre-season projections were for 2,194 release mortalities in non-treaty sockeye purse seine openings. The post-season estimate of release mortalities was 1,641. An additional 171 Chinook were landed by gillnet, compared to a pre-season projection of 137.

Fall chum catch and fishing opportunity were limited due to low in-season abundance estimates provided by Canada, in accordance with Annex IV, Chapter 6 of the Pacific Salmon Treaty. A total of 23,617 chum were harvested by treaty and non-treaty fishers. No Chinook were landed during the fishery. Due to the unexpected closure of 7/7a chum fisheries, no samples are available from the non-treaty purse seine fishery for estimation of bycatch.

## **2.2 Nooksack/Samish Terminal Area**

### Spring Chinook C&S

Tribal ceremonial and subsistence fisheries for early Chinook in the Nooksack River were conducted between April 7th and May 27th.; Fishing occurred in the North Fork between the Highway 9 bridge and the mouth of Racehorse Creek (RM 36.6 to 45.2), and in the mainstem between the Slater Road bridge and the mouth (RM 0.0 – 3.5), with intent to limit the catch of South Fork-origin Chinook. In total, 114 Chinook were harvested; 112 were sampled to determine their origin, from CWT, scale and otolith analysis (Table 4). Available information indicates that up to 15 of the fish harvest were of natural origin. Pre-season planning for this fishery projected that 116 early Chinook would be harvested, 17 of which would be of natural origin. Analysis of additional otoliths, and genetic analysis of tissue samples, may further adjust estimates of catch origin and stock composition.

Table 4. Mark sampling summary for the 2010 tribal C&S fishery for early Chinook in the Nooksack River.

Date	Tribe	Area Open	Catch	Kendall Hatchery Origin				Otolith marked	NOR No CWT no mark
				CWT no Adclip	Ad-clip no CWT	CWT & Ad-clip	No CWT No Adclip		
7-Apr	Lummi	MS	2			1		1	
19-Apr	Lummi	MS	10	1	4	4		1	
27-Apr	Nooksack	NF	0						
4-May	Lummi	MS	13	3	6	3		1	
7-May	Lummi	MS	30	6	14	7		3	
12-May	Nooksack	NF	1				1	1	
13-May	Lummi	MS	6	3	1	1		1	
16-May	Lummi	MS	20	5	8	2		5	
17-May	Lummi	MS	8	2	2	4			
19-May	Nooksack	NF	4		2		2	2	
21-May	Nooksack	NF	4		3		1		
25-May	Nooksack	NF & MS	13		5	4	2	11	
27-May	Nooksack	NF & MS	3		1			1	

### Fall Chinook, coho, and chum fisheries

Tribal fisheries for fall Chinook are directed at hatchery production originating from the Samish Hatchery and Lummi Bay facilities. Chinook fisheries operated as planned in Bellingham Bay (7B), Samish Bay (7C) and Lummi Bay (7D), during weeks 31 – 36, and in the Nooksack River, during weeks 37 – 44. The fall Chinook-directed fishery harvested 10,933 fish in Areas 7B, C, and D, and 530 fish in the River (Table 5). Approximately 35% of the tribal fall Chinook harvest was caught in August, and 70% in September. Subsequent fisheries for coho and chum involved incidental harvest of 84 Chinook in 7B, C, & D, and 46 in the River. The non-treaty fishery in Areas 7B and 7C caught a total of 7,578 Chinook, slightly below the pre-season projection. In total, Treaty and non-treaty harvest of fall Chinook was very close to the preseason projected volume.

Area	Timestep	Projected	Actual
7B, 7C, 7D Treaty net	Jul-Sep	9,500	11,017
	Oct-Dec	180	
7B, 7C Non-treaty net	Jul-Sep	8,783	7,547
	Oct-Dec	71	31
Nooksack Treaty net	Early Chinook, May-Jun	116	114
	Fall Chinook, Jul-Sep	784	576

### 2.3 Skagit Bay/Skagit River Terminal Areas

The majority of 2010 Skagit terminal area impacts on Chinook were expected to occur during commercial fisheries targeted at hatchery spring Chinook, sockeye targeted

commercial fisheries, Ceremonial and Subsistence fisheries targeted at summer/fall timed Chinook (590 fish divided among the three Skagit Tribes), commercial fisheries targeted at coho salmon, Skagit River test fisheries, and during a mark-selective sport fishery targeting hatchery spring Chinook (see Chapter 3 for discussion of recreational fisheries). Chinook non-retention was required in the river recreational fisheries before June 1 and after July 15. No non-treaty commercial fisheries were scheduled in Area 8 during 2010. Chinook retention was permitted in Treaty fisheries, the test fisheries, and during the spring Chinook selective river sport fishery June 1 through July 15 (for marked fish only).

Test fisheries were conducted mostly as scheduled preseason, except the Blake's Drift coho test did not take place in Management Week (hereafter as week) 45, Spudhouse coho test in week 42, and the River Area 2 coho test (changed to River Area 3 after week 35), in weeks 40, 41, 42, or 43. Weeks 22 and 23 Blakes Chinook test fisheries were not conducted per preseason plans to address spring Chinook management objectives. A new sockeye test occurred in weeks 26 through 29, modified from a research tagging project planned preseason in River Area 3. The weeks 44 and 45 Blakes Drift chum test fishery took place in both weeks 44 and 45. One Bay and one Jetty chum test fishery occurred in each of weeks 44 and 45. Chinook catches in the test fisheries were less than expected by 50 Chinook. During spring-run timing catch was 24; expected catch was 28, less than expected by 4 fish. During summer/fall-run timing catch was 82; expected catch was 173, less than expected by 91. During the coho test fisheries, Chinook catch was 372, compared to 200 predicted, and more than expected by 172. The sockeye test was initially a mark and recapture sockeye river travel time study with a small mesh net capturing the sockeye for tagging and releasing, as such no Chinook mortalities were expected because of the gear type and careful handling. As the season progressed, the study was modified to a test fishery for future use as a sockeye inseason update. Twenty-four Chinook were caught in the sockeye test fishery, of which 18 wild fish were released (expected 52.4% release mortality or 10 fish), and 8 hatchery fish were retained for a total of 15 fish (including retained hatchery fish and release mortalities), when 72 encounters (with no mortality) were expected (Table 6). Overall, the Chinook catch in all the test fisheries combined, 501 Chinook, was 143 Chinook more than the preseason prediction of 358.

Hatchery spring-timed Chinook-directed Treaty commercial fisheries encompassed catch from weeks 19–21 Swinomish and Sauk-Suiattle fisheries and weeks 19–21 Upper Skagit fishery. Preseason catch projections of hatchery (241) and natural (79) spring-timed Chinook were modeled (FRAM Chin1010) for the Treaty commercial and C&S fisheries—total 320. Postseason spring-timed Chinook catches for those same time periods totaled 459; 496 hatchery and 73 natural origin spring Chinook—a difference of 252 more hatchery origin Chinook and 3 less natural origin Chinook, or a total difference of 249 spring-timed Chinook.

The sockeye directed commercial fishery was modeled as a placeholder preseason to account for Chinook and coho impacts if the terminal abundance was updated to harvestable levels inseason. The postseason Baker sockeye run was approximately 22,637, five times the preseason forecast of 4,485 sockeye in 2010—program objectives required 6,300 sockeye. The sockeye run was two days earlier than the last five even-year average; the 50% trap return date was July 15 rather than the expected date of July 17. The average 50% date of all even years is July 15. Baker sockeye Treaty commercial fisheries encompassed catch during weeks 29–30 Swinomish; weeks 29–30 Sauk-Suiattle; and week 29 Upper Skagit Tribes. Total preseason summer/fall-timed Chinook catch projections were modeled (FRAM Chin1010) for the Treaty commercial sockeye fisheries—total 488. Postseason summer/fall-timed Chinook catches during the commercial sockeye fishery, for those same time periods, totaled 187 fish—a difference of 301 fewer than modeled as the placeholder fishery. Though not anticipated preseason, a sport fishery directed toward sockeye opened July 16-31 during 2010 when a harvestable



abundance of sockeye was estimated inseason; catch data was not available at the time of this report. A Baker Lake sport fishery opened July 22 and no Chinook impacts were expected.

The Swinomish and Sauk-Suiattle Tribes commercial fisheries were scheduled to open the coho fishery in week 39 and the Upper Skagit Tribe starting week 40 (Table 6). Coho abundance was expected to be "Normal" (i.e., ER ceiling of 60%). Early test fishery catches (week 38) of coho indicated a run that may be smaller than forecast, 75,826. The preliminary (weeks 38-39) test fishery ISU model indicated a return of about 121,285 coho, larger than predicted by preseason forecast of terminal area abundance (TAA was 89,540 as predicted by FRAM coho1016). The final ISU model, cumulative catch/cumulative hours indicated a terminal return of 157,888 coho. Reflective of forecast and supported by the inseason updates, the Swinomish and Sauk-Suiattle Tribes' coho fishery opened weeks 39 and 41 as expected, added on a day in week 42 and increased open days in week 43 from 1 day to 1.5 days. Upper Skagit Tribe opened as scheduled in week 40 through 41; increased the open days in week 42 from 1.167 to 2.167 and week 43 1.167 days to 1.417 days. The Treaty coho commercial fishery was expected to catch 265 summer/fall-timed Chinook and observed catches were 588 (Table 6). Preliminary observed wild and hatchery terminal return abundance of coho was approximately 58,000, lower than the both the preseason forecast and the inseason update.

There was no preseason forecast of harvestable chum though a one day fishery placeholder fishery was scheduled in week 46 for Swinomish and Sauk-Suiattle Tribes and one day each of fishing in week 47 for the Upper Skagit Tribe; the opening dependent on the ISU. No Chinook mortalities were anticipated in the placeholder fisheries. The ISU of chum abundance, 59,822 (postseason estimate of the terminal abundance was 45,012), indicated that the terminal run size abundance was more than the preseason forecast of approximately 48,000 chum, and was under the escapement goal of 116,500 fish and 500 additional fish for the Upper Skagit Tribe's Red Creek Hatchery, therefore no treaty commercial chum fisheries occurred. Non-treaty chum directed fisheries were not scheduled preseason based on the low preseason forecast.

There were 1,468 total Chinook observed mortalities in Skagit Treaty terminal area commercial and C&S net fisheries during the adult accounting period: 130 in the C&S fisheries (6 spring-timed and 124 S/F-timed); 563 spring-timed Chinook in the hatchery spring Chinook directed fishery; 187 summer/fall-timed Chinook in the Baker sockeye fishery; 588 summer/fall-timed Chinook in the coho fishery; and no chum fishery occurred in 2010. There were 501 total Chinook mortalities estimated in Skagit terminal area Test Fisheries during the adult accounting period: 24 spring-timed Chinook and 477 summer/fall-timed Chinook in Test Fisheries.

In comparison, catch projections during preseason planning indicated that 1,657 Chinook would be caught in Skagit Treaty terminal area commercial and C&S fisheries: 6 spring-timed and 584 summer/fall-timed in the C&S fisheries; 314 during the hatchery spring Chinook directed fisheries; 488 summer/fall-timed Chinook from a placeholder modeled Baker sockeye directed fishery; 265 summer/fall-timed Chinook during coho fisheries; a placeholder chum directed fishery was modeled (forecast below escapement objectives) though zero summer/fall-timed Chinook were expected. While 356 Chinook were projected to be caught in Skagit terminal area Test Fisheries; 36 spring-timed and 320 summer/fall-timed Chinook. Thus, post-season observed Skagit terminal treaty commercial and C&S Chinook mortalities were 189 fewer Chinook than what was projected preseason. One hundred thirty-seven more Chinook than expected were also caught in the terminal area Test Fisheries.

This increase in observed mortalities from projected mortalities occurred on both spring-timed and summer/fall-timed Chinook—though for springs the number of wild mortalities

during the C&S and commercial hatchery-directed fishery were lower; 73 observed compared to 76 predicted preseason, while the number of hatchery spring Chinook mortalities was higher; 496 observed compared to 244 predicted preseason. The observed discrepancy in observed hatchery spring Chinook catch is in part expected as until 2005 hatchery strays were purposely avoided when conducting wild escapement surveys. Since, the stray rate has been estimated at about 22%. Most of the lower than projected catch occurred during the directed sockeye fishery (301 fewer) and the C&S fishery (460 fewer), while higher than projected catch occurred in test fisheries, hatchery spring Chinook, and coho directed fisheries. Of the post-season estimated mortalities in tribal fisheries, all were landed catch, because Chinook retention was allowed during all tribal fisheries.

While total expected summer/fall-timed Chinook catches during the treaty commercial and C&S fisheries were lower than expected, 444, spring-timed Chinook catches were higher than expected (246)—though differences were in observed hatchery spring catches. Preseason prediction of terminal treaty commercial and C&S harvest rate of spring-timed Chinook was 9.87% (768 TRS); the preliminary postseason estimated harvest rate was about 4.86%, using a preliminary terminal return of 1,502 wild spring Chinook; even though catches were 3 fewer fish than expected, the majority of the difference in harvest rate is realized due to the observed doubling of the expected terminal return. Despite the lower than expected summer/fall-timed catches by 444 Chinook, harvest rates were only slightly lower postseason (9.2%) compared to preseason (9.6%), because the preliminary observed return of 9,800 was about 70% of expected PSF of approximately 13,900 Chinook. Total observed Chinook catches (spring-timed and summer/fall-timed combined) from Treaty commercial and C&S catch combined with test fishery catch (1,961) was 52 fewer Chinook than projected preseason, 2,013.

Table 6. Skagit terminal area projected and actual Chinook catches for treaty fisheries in 2010.								
	Preseason Projected			Post-season Observed/Estimated			Difference (Post-season minus Preseason)	
Fishery	Schedule	Encounters	Total Mort.	Schedule	Encounters	Total Mort.	En-counters	Total Mort.
<b>Test:</b>								
Chinook	1 site,wks 19-21,24-35	156	156	Same	106	106	-50	-50
sockeye	none	0	0	Wks 26-29	24	15	24	15
Coho	3 sites, wks 34-45	200	200	Wks 34-44	372	372	172	172
Chum	3 sites, wks 44-45	0	0	Same	0	0	0	0
Sockeye Research	1 sites, wks 24-27	72	0	None	0	0	-72	0
<b>Area 8/78C Hatchery Spring Chinook Swinomish and Sauk-Suiattle Tribes:</b>								
Week 19	1 day/1 day	23	23	Same	44	44	21	21
Week 20	1 day/1 day	55	55	Same	32	32	-23	-23
Week 21	1 day/1 day	44	44	Same	28	28	-16	-16
<b>Area 78C/78D Hatchery Spring Chinook Upper Skagit Tribe:</b>								
Week 19	1 day	39	39	Same	230	230	191	191
Week 20	1 day	79	79	Same	125	125	46	46
Week 21	1 day	73	73	Same	104	104	31	31
<b>Area 8/78C/78D Chinook C&amp;S Swinomish, Sauk-Suiattle, Upper Skagit Tribes:</b>								
SummerFall/Spring Chinook	Variable to target	590	590	Variable to target	130	130	-460	-460
<b>Areas 8/78C Sockeye Swinomish and Sauk-Suiattle Tribes:</b>								
Week 29	1 day	107	107	2 days	79	79	-28	-28
Week 30	1 day	153	153	1.375 days	76	76	-77	-77
<b>Areas 78C/78D Sockeye Upper Skagit Tribe:</b>								
Week 29	1 day	73	73	1.208 days	32	32	-41	-41
Week 30	1 day	155	155	None	0	0	-155	-155
<b>Areas 8/78C Coho Swinomish/Sauk-Suiattle Tribes:</b>								
Week 39	4 days/7 days	45	45	4 days/7 days	79	79	34	34
Week 40	3 days/7 days	22	22	3 days/7 days	10	10	-12	-12
Week 41	2 days/7 days	6	6	2 days/7 days	2	2	-4	-4
Week 42	None/7 days	0	0	1 day/7 days	2	2	2	2
Week 43	1 day/7 days	2	2	1.5 days/7 days	1	1	-1	-1
<b>Areas 78C/78D Coho Upper Skagit Tribe:</b>								
Week 40	2.167 days	100	100	2.167 days	325	325	225	225
Week 41	2.167 days	68	68	2.167 days	73	73	5	5
Week 42	1.167 days	20	20	2.167 days	65	65	45	45
Week 43	1.167 days	2	2	1.417 days	31	31	29	29
<b>Areas 8/78C Chum Swinomish/Sauk-Suiattle Tribes:</b>								
Week 46	1 day/1/day	0	0	Same	0	0	0	0
<b>Area 78C/78D Chum Upper Skagit Tribe:</b>								
Week 47	1 day	0	0	Same	0	0	0	0
<b>Total Skagit Terminal Area</b>		<b>2,085</b>	<b>2,013</b>		<b>1,970</b>	<b>1,961</b>	<b>-115</b>	<b>-52</b>

## 2.4 Stillaguamish/Snohomish Terminal Area

Chinook-directed commercial, ceremonial, and subsistence fisheries occurred only in Area 8D, targeting fish returning to the Tulalip Hatchery. The preseason plan included Chinook fishing through week 38, but the fishery was shortened in-season to close week 33.

Chinook harvest in Area 8D was 2,829, 38% higher than projected (Table 7). There were no Chinook caught in coho or chum fisheries in 8D. Although C&S fishing for Chinook was open in Area 8A, and incidental catch was anticipated during the coho fishery in 8A, only one Chinook was caught. Two Chinook were harvested in the Stillaguamish River for ceremonial purposes.

Non-treaty commercial fishing in Area 8A was limited to coho-directed openings. There was one estimated Chinook release mortality from purse seine during the coho period. There were no Chinook landed by non-treaty gillnet.

Table 7. Projected (FRAM 1010) and actual Chinook net harvest in the Stillaguamish - Snohomish terminal area non-treaty commercial and treaty fisheries in 2010.			
Area		Projected	Actual
8A Commercial	Trty	215	1
	Ntrty	0	0
8A Test	Test		
8D Commercial	Trty	2,046	2,829
	Ntrty	0	0
Stillaguamish R. Net	Treaty	40	2

## 2.5 South Puget Sound Terminal Areas

Table 8 compares projected and actual catches for 2009 South Puget Sound treaty fisheries. Descriptions of the treaty and non-treaty commercial fisheries by terminal area are in the following sections.

Table 8. Pre-season projections and actual Chinook catch in 2010 South Puget Sound Treaty terminal net fisheries.			
Area	Management Period	Projected	Actual
Area 9/10/11	Coho & Chum (test & treaty)	216	31
	A9 T subsist H&L	700	19
	10/11 NT chum	14	4
Area 10E	Chinook	3,410	2,481
Area 10A	Chinook (test)	437	72
	Chinook/coho	1,065	14
	Chum	60	
Duwamish River	Chinook/coho	3,900	511
Lake Washington/ Ship Canal	Sockeye/coho	1,003	3
Lake Sammamish	Chinook	5,000	676
Puyallup River	Spring Chinook (C&S)	250	229
	Fall Chin C&S	100	112
	Chinook/Coho	3,513	2,775
Areas 13D-K	Chinook/Coho/Chum	8,576	3,562
Area 13& 13A	Chinook/Coho/Chum	4,584	2,313
Areas 13C/Chambers	Chinook	6,689	676
Nisqually River	Chinook/coho	9,853	21,706

### 2.5.1 Marine Areas 9, 10 & 11

A limited-scale Suquamish Tribe subsistence fishery in Area 9 caught 19 Chinook; the pre-season plan projected a larger C&S catch with other tribes participating. There were no other fisheries in Area 9 in 2010, except a one-night chum test fishery.

In Areas 10/11 incidental Chinook harvest was anticipated to occur in the coho and chum test fisheries, and in commercial coho and chum fisheries. Aggregate actual harvest in these test and treaty fisheries (31) was less than the projected level (216). Total mortality in the non-treaty chum fishery was 15 (11 release mortalities and 4 landed), well below the pre-season projection of 257.

### 2.5.2 Lake Washington

There were no Chinook-directed fisheries in Lake Washington or the Ship Canal. The fishery in Lake Sammamish targeting local hatchery production harvested 676 Chinook,

which was substantially lower than the pre-season projection of 5,000. In-season monitoring of Chinook passage at Ballard Locks assesses return abundance to the Cedar River and local hatcheries. Sockeye and coho returns to Lake Washington were insufficient to allow opening directed fisheries. The tribal C&S fisheries for Lake Washington sockeye involved incidental catch of 3 Chinook.

### **2.5.3 Elliott Bay/Duwamish River**

Catch in the test fishery in Area 10A to assess the strength of the Green – Duwamish Chinook return was very low (72), so planned, subsequent commercial fisheries in 10A and the Duwamish River (80B) did not occur. A 12-hour tribal ceremonial and subsistence fishery for Green River Chinook, operating in the lower Green/Duwamish River, harvested 226 fish. Incidental Chinook catch during the coho and chum fisheries in Elliott Bay (10A) harvested 14 fish, which was lower than the expected 60. Incidental Chinook Catch during the coho and chum fisheries in the Duwamish River (80B) was 285 fish.

### **2.5.4 Area 10E (Sinclair Inlet)**

A Chinook-directed fishery in Sinclair Inlet (10E) targets local hatchery production. The fishery operated from July 18 through September 11 (weeks 30 – 37), one week shorter than planned. Total catch (2481) was 73% of the projected level (3410). There were no Chinook harvested in subsequent coho and chum fisheries in 10E.

### **2.5.5 Puyallup River**

Tribal ceremonial and subsistence fisheries for White River spring Chinook, operating in the Puyallup River mainstem and in the White River, harvested 229 fish; the pre-season projected catch was 250. Fall-Chinook directed fishing in the Puyallup River operated, as planned, in management weeks 34 and 35 (between August 15 and August 29, and there was incidental Chinook catch during the subsequent coho fishery, primarily in weeks 36 and 37. Total fall Chinook harvest was 2,775, 80% of the projected volume.

### **2.5.6 Marine area 13 & sub areas (Deep South Sound)**

Chinook fisheries in the marine areas of deep South Sound harvested fewer fish than pre-season projections. In Case Inlet (13D) and Budd Inlet (13F) 3,562 fish were caught, or 42% of the projected volume. In Carr Inlet (13A) and Area 13 harvest was 2,313, or 50% of the projected volume. The fishery operating adjacent and in Chambers Bay (13C) caught only 676 Chinook, or 10% of the projected volume. In general these outcomes can be attributed primarily to lower than expected survival of hatchery releases.

### **2.5.7 Nisqually River**

The Chinook fishery in the Nisqually River was planned to operate on a reduced schedule, relative to previous years: two days a week during weeks 29 (wb 7/11), 30 (wb 7/18), 32 (wb 8/1), 33 (wb 8/8), 35 (wb 8/22), and 36 (wb 8/29), and three days a week in wks 38 (wb 9/12) and 39 (wb 9/19). Incidental Chinook harvest also occurred during the subsequent coho fishery in weeks 41 – 44. This fishery schedule differed from previous years by fishing two days per week instead of three, and closing some mid-season weeks, instead of terminating the Chinook fishery early. In 2010 Chinook fishery openings totaled 456 hours, substantially fewer than the 2009 total of 576 hours.

Management intent was to reduce the terminal harvest rate to 40%. Based on a preliminary accounting of tribal catch and escapement (recreational catch is not available) the terminal harvest rate was 49%. Mid-season closures to increase escapement were not as effective as planned, apparently because Chinook built up in the estuary rather than migrating upriver during those periods. River fishing area during the subsequent coho fishery was restricted to reduce incidental Chinook catch. Fishing was closed above Clear Creek hatchery through week 41 then moved up to Kalama Creek hatchery slough, until the early closure of the coho fishery. The total Chinook harvest was 21,706, more than double the pre-season projection.

## **2.6 Hood Canal**

Treaty Chinook-directed fisheries operated as planned in southern Hood Canal (12C), beginning the week of July 18th; gillnet fisheries ran until August 24th with beach seine fisheries continuing through August 31st. For the duration of these fisheries a total of 3,768 Chinook were landed, down by approximately 16% from 2008 and 2009 catch levels.

At the Hoodsport Hatchery Zone (12H), a Chinook-directed fishery operated July 18th through September 9th, harvest totaling 8,627 which was 17% lower than in 2009 (Table 9). This fishery was closed two weeks early, in order to meet escapement/broodstock needs for the Hoodsport Hatchery and other, local hatchery facilities that were not making egg take requirements.

The Chinook fishery in the Skokomish River operated as modeled, from August 2nd through September 18th resulting in a total harvest of 9,653, an increase of 44% from 2009. This dramatic shift of increased catch can be partially attributed to the lower catch that occurred during terminal area fisheries in 12C and at the Hoodsport Hatchery Zone. In 2010, Chinook had the tendency to move down the eastern side of Hood Canal with minimal cross canal movement as determined from fishers' specific site landings. During the Coho fishery (September 19th through November 13th), incidental harvest of Chinook was low, landing only 98 fish.

The total catch in these terminal fisheries (12C, 12H, and the river) was 22,048, exceeding the preseason projection by 36%. This is likely related to forecast accuracy, rather than unexpectedly high harvest rates or fishing effort.

Incidental harvest of 64 Chinook occurred during treaty Coho fisheries in northern Hood Canal (12 and 12B), Port Gamble (9A), and Quilcene /Dabob Bay (12A).

Non-treaty commercial fishing in Hood Canal was restricted to chum-directed fisheries. There were an estimated 19 Chinook release mortalities during the purse seine fishery, higher than the projection of 5. There were no Chinook landed by gillnet during the chum fishery, compared to the projection of 2.

Table 9. Projected (FRAM 1010) and actual Chinook catch and exploitation rates in Hood Canal terminal area net fisheries, 2009			
Area	Target Species	Catch	
		Projected	Actual
Hood Canal Marine Net (12-12D,9A) (T)	Chinook, Coho, Chum	2,733	3,832
Hood Canal Marine Net (12-12B,9A) (NT)	Chum, Coho	2	0
12H Net (T)	Chinook, Chum	9,663	8,627
Skokomish River (82G/J) (T)	Chinook, Coho, Chum	6,507	9,653
	Total	18,905	22,112

## 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. Three Chinook were harvested for ceremonial purposes in the Elwha River (Table 10).

Table 10. Projected and actual catches of Chinook in Strait of Juan de Fuca terminal net fisheries, 2010.		
Terminal Area	Projected	Actual
Area 6D & Dungeness River Treaty	1	0
Area 6D Non-Treaty	0	0
Elwha River Treaty (C&S)	4	3
Hoko River Treaty	0	0

## 2.8 Non-Treaty Commercial Monitoring Data and Total Mortality Estimates

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 2010, efforts were concentrated on purse seine openings in Areas 7/7A, 8A, 10/11, and 12/12B. Summaries of observer data for 2010 are presented in Table 11. 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 12.



Table 11. Summary of commercial fishery observation data for 2010 Puget sound non-treaty salmon net fisheries.

Area	Gear type	# sets observed	Chinook	Coho	Sockeye	Pink	Chum	Steelhead
10	PS	40	0	8	0	0	2,606	0
11	PS	39	1	11	0	0	3,645	0
12	PS	50	3	61	0	0	7,422	0
12B	PS	31	0	45	0	0	3,800	0
7	PS	53	195	77	44,375	4	7	1
7A	PS	53	222	17	8,024	1	0	0
8A	PS	13	2	83	0	0	3	0

Table 12. Total pre-season projected and post-season estimated Chinook mortality (landed + released) in Puget Sound non-treaty commercial salmon fisheries in 2010.

Area	Total Mortality (released + landed)	
	Projected	Actual
6D	0	N/A (0 landed)
7/7A	2,658	1,812
8A	0	1
10/11	257	15
12/12B	7	19
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 2010-2011 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 2009-2010 management year are also included here.

### **3.1 2009-2010 Recreational Catch**

Total Recreational Chinook harvest in 2009-10, estimated from a combination of Catch Record Cards (CRC) and creel estimates where available, was 49,750, compared to a preseason projection of around 61,000. Note that CRC estimates are still in draft format, and subject to future revision. Catches were higher than projected in the fisheries in Areas 5 and 6. Catches were much lower than projected in the majority of marine fisheries inside Puget Sound, and in the majority of freshwater fisheries as well (Table 13).

Table 13. Projected (FRAM 2309) and actual Chinook catches in Puget Sound recreational fisheries during the 2009-2010 season. Many of these estimates are based on preliminary analysis of Catch Record Card data, and will be revised in the future.

Area/Fishery	Projected	Actual
Area 5-6		
MSF (July-August)	4,500	8,640
Other	858	2,058**
Strait Tributaries	0	17
Area 7	4,353	4,001
Non MSF	2,194	2,583
MSF (December-April)	2,159	1,418
Nooksack/Samish FW	4,644	4,805
Area 8-1 & 8-2		
MSF	1,539	1,113
Skagit River		
Spring MSF	307	144
Summer	752	116
Area 8D SAF	1,033	95
Stillaguamish River	0	6
Snohomish River		
Skyokomish MSF	173	321
Area 9		
Summer MSF	8,851	3,248
Winter MSF	2,545	1,584
Area 10		
Area 10 Summer MSF	2,923	1,643
Area 10 Winter MSF	1,781	398
Area 11		
Area 11 Summer MSF	6,438	3,318
Area 11 other	281	315**
Area 10E SAF	960	1,480
Lake Sammamish	257	91
Area 10A SAF	1,930	1,480
Green River	400	227
Puyallup River		
Carbon R MSF	1,264	582
Puyallup R MSF	772	2,005
Area 13		
Area 13 Summer MSF	1,015	1,243
Area 13 other	168	31**
Chambers Cr	46	15
Nisqually	1,970	1,174
Deschutes	227	174
Area 12	612	832**
Skokomish River	5,864	4,368

\*\* Through March 31, 2010

## **3.2 2010-2011 Recreational Catch**

### **3.2.1 Expected catch**

Projected Chinook catches in 2010-2011 recreational fisheries are listed in Table 14. Total projected catch was 56,500. The recreational fishing regime included mark selective fisheries (MSF) for portions of the year in marine areas 5, 6, 8-1, 8-2, 7, 9, 10, 11, 12 and 13, and in the Skagit, Skykomish, Puyallup, Carbon and Nisqually rivers. For those fisheries where creel survey estimates of harvest are available, those estimates are listed as actual catches in Table 14. Intensive sampling efforts were applied to marine area selective fisheries throughout the year, and to several freshwater selective fisheries, so estimates of landed catch and total encounters are available for the many of those fisheries. Brief summaries of results of those sampling programs are included below. In-depth analyses of sampling and statistical methods are available in a series of reports produced by WDFW. The latest final reports are available online at: [http://wdfw.wa.gov/conservation/fisheries/chinook/selective\\_chinook\\_tech\\_reports.html](http://wdfw.wa.gov/conservation/fisheries/chinook/selective_chinook_tech_reports.html). Many of the results presented here are from draft reports, which will be available online in the future.

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. For marine fisheries, catch estimates are made using CRC estimates of total catch, combined with species composition data obtained from the baseline sampling program. Because of the timing of the annual reporting cycle for the CRC program, these estimates will not be available until 2012.

Table 14. Projected (FRAM 1010) and actual (preliminary, where available) Chinook catches in Puget Sound recreational fisheries during the 2010-2011 season.

Area/Fishery	Projected	Actual
Area 5-6		
MSF (July-August)	4,700	5,716*
Other	882	
Strait Tributaries	0	
Area 7	4,616	
Non MSF		
MSF (January-April)		
Nooksack/Samish FW	4,852	
Area 8-1 & 8-2		
MSF	1,587	
Skagit River		
Spring MSF	376	234
Area 8D SAF	604	
Stillaguamish River	0	
Snohomish River		
Skyokomish MSF	500	213
Area 9		
Summer MSF	5,334	5,331
Winter MSF	2,489	
Area 10		
Area 10 Summer MSF	2,216	3,030
Area 10 Winter MSF	1,738	
Area 11		
Area 11 Summer MSF	6,440	3,947
Area 11 other	866	
Area 10E SAF	1,024	
Lake Sammamish	283	
Area 10A SAF	1,800	
Green River	0	
Puyallup River		
Carbon R MSF	1,364	
Puyallup R MSF	787	
Area 13		
Area 13 Summer MSF	733	
Area 13 other	334	
Chambers Cr	49	
Nisqually	2,147	3,312
Deschutes	236	
Area 12	701	
Skokomish River	5,680	
* Area 5 only		

### 3.2.2 Marine Areas 5 & 6 Summer MSF

2010 was the 8<sup>th</sup> year of summer mark-selective Chinook fishing in marine areas 5 & 6. The 2010 fishery was scheduled to open for a set season, July 1 through August 15.

WDFW conducted comprehensive fishery monitoring activities during the Areas 5 and 6 mark-selective fisheries. Sampling activities in Area 5 included dockside creel sampling (with in-season catch and effort estimates), on-the-water effort surveys (boat surveys), and intensive efforts to distribute and collect voluntary trip reports (VTRs) from the angling public. The Area 6 design consisted of baseline angler/catch sampling only and therefore did not have an on-the-water (i.e., boat surveys, test fishing) sampling component. In both Areas 5 and 6, 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 (2011).

For Area 5, a total of 5,716 Chinook were estimated to have been landed (5,703 marked and 14 unmarked (Table 15)).

Due to the alternate sample design for area 6, comparisons will not be possible until Catch Record Card data can be combined with sampling data to generate total harvest and encounter estimates.

Table 15. Comparison of modeled (i.e., using FRAM, model run 1010) and estimated total Chinook encounters for the Area 5, July 1-Aug. 15, 2010 mark-selective Chinook fishery.					
Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	Unmark.	5,547	3,877	1,670	39
	Mark.	10,208	5,358	4,850	4,661
	Total	15,755	9,235	6,520	4,700
	% Mark.	64.0	54.0	74.0	98.0
Estimated (Creel) Encounters	Unmark.	9,114	4,974	4,140	14
	Mark.	9,682	6,276	3,405	5,703
	Total	18,796	11,251	7,545	5,716
	% Mark.	51.5	55.8	45.1	99.8

### 3.2.3 Marine Areas 9 & 10 Summer MSF

In 2010, a recreational mark-selective fishery occurred for the fourth consecutive summer in marine areas 9 and 10. The 2010 fishery was managed as a fixed season, from July 16-August 31, rather than being managed to a quota. As in the previous years, WDFW's Puget Sound Sampling Unit (PSSU) implemented an intensive monitoring program in Areas 9 and 10 during their 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 (2011).

Total harvest in Areas 9 and 10 was estimated to be 5,331 and 3,030 Chinook, respectively (8,361 total,( Table 16)). Anglers released an estimated 3,864 Chinook (1,490 marked, 2,374 unmarked) in Area 9 and 4,148 Chinook (1,457 marked, 2,692 unmarked) in Area 10 (8,012 estimated releases overall). In-season estimates of encounters with unmarked Chinook were lower than pre-season projections in both areas.

Table 16. Comparison of modeled (i.e., using FRAM, model run 1010) and estimated total Chinook encounters for the Areas 9 and 10 July 16-August 31, 2010 mark-selective Chinook fisheries.						
Area	Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
9	FRAM Encounters	Unmark.	4,882	2,047	2,835	20
		Mark.	14,953	6,108	8,845	5,314
		Total	19,835	8,155	11,680	5,334
		% Mark.	75	75	76	100
	Estimated (Creel) Encounters	Unmark.	2,413	2,158	255	39
		Mark.	6,782	6,022	759	5,292
		Total	9,194	8,180	1,014	5,331
		% Mark.	74	74	75	99
10	FRAM Encounters	Unmark.	3,374	1,744	1,630	174
		Mark.	6,007	2,347	3,660	2,042
		Total	9,381	4,091	5,290	2,216
		% Mark.	64	57	69	92
	Estimated (Creel) Encounters	Unmark.	2,734	1,059	1,675	42
		Mark.	4,444	3,383	1,062	2,988
		Total	7,178	4,441	2,737	3,030
		% Mark.	62	76	39	99

### 3.2.4 Area 11 Summer MSF

A summertime recreational mark-selective fishery was implemented for the fourth year in Area 11 in 2009, 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 3,974 Chinook were landed during the fishery (Table 17 (from WDFW 2011)). Anglers released an estimated 2,991 Chinook (1,481 marked, 1,510 unmarked). Unmarked encounters were well below pre-season projections.

Table 17. Comparison of modeled (i.e., using FRAM, model run 1010) and estimated total Chinook encounters for the Area 11 summer 2010 mark-selective Chinook fishery, June 1-September 30, 2010.					
Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	Unmark.	7,524	2,869	4,655	58
	Mark.	21,181	7,336	13,845	6,382
	Total	28,705	10,205	18,500	6,440
	% Mark.	74	72	75	99
Estimated (Creel) Encounters	Unmark.	1,575	1,170	405	64
	Mark.	5,390	4,463	927	3,910
	Total	6,965	5,633	1,332	3,974
	% Mark.	77	79	70	98

### 3.2.5 Puyallup River Angler Surveys

The WDFW conducted a seventh year of angler surveys during the recreational mark selective Chinook fishery on the Puyallup River in 2010. This survey was designed to develop a general sense of salmon catch and angler effort patterns during the fishery, and provide information on mark rates of Chinook and coho.

Anglers reported catching 26 Chinook, of which 21 were kept and 5 were released. All but one of the harvested Chinook encountered by the surveyor were adipose clipped, and no CWTs were recovered. The one Chinook that was not adipose clipped had a clipped ventral fin. All Chinook released by anglers were unmarked. The total mark rate of Chinook encountered during the 2010 fishery was 77 percent. The highest CPUE for Chinook was observed during the second week of the fishery, the second week of August, but quickly dropped to levels below the average of past years.



### **3.2.6 Carbon River Angler Surveys**

The WDFW conducted a eighth year of angler surveys during the recreational mark selective Chinook fishery on the Carbon River in 2010. This survey was designed to estimate angler CPUE, percent of Chinook that were marked (adipose fin clipped), and to monitor angler effort. The survey was less intense than previous years, when the goal was to estimate total catch and encounters in the fishery.

Anglers reported catching 113 Chinook during the survey period. Of these 113 fish, 53 were kept and 60 were released. All harvested Chinook were adipose clipped. As with 2009, no Coded Wire Tags were recovered during the survey. The reported mark status of the 60 Chinook released by anglers was; 38 had a clipped adipose fin, 21 were unmarked, and 1 was unknown. The mark rate for all Chinook encounters was 81 percent. As in past years, CPUE during the first week of the fishery was the highest, but quickly dropped to levels below the average of past years.

### **3.2.7 CWT Sampling and Harvest Estimation in Sport Fisheries**

In 2010, WDFW undertook a project using PSC funding to review WDFW's freshwater sport fishery sampling programs, specifically the methods for estimating CWT recoveries from Puget Sound Chinook CWT indicator stocks in those fisheries. Through this project, creel estimates were completed for the Skagit spring, Skykomish summer, Nisqually fall, and Skokomish fall Chinook mark-selective fisheries. Preliminary creel estimates are available for the Skagit, Skykomish, and Nisqually fisheries. For the Skagit spring fishery, an estimated 234 adults were retained, compared to a pre-season projection of 376. In the Skykomish, 213 adults were retained, compared to the projection of 500. Finally for the Nisqually, 3,355 adults were retained (3,312 marked, 43 unmarked), compared to the projection of 2,147. Complete results for all of these sampling programs, including estimates of total mortality, will be available in a future final report.

## 4 Spawning escapement

This section presents natural Chinook escapement estimates for 2010, and compares them to projections from FRAM 1010, and management thresholds.

In general, pre-season FRAM projections are made for natural escapement (the number of Chinook spawning naturally). 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, Nisqually, Skokomish, Mid-Hood Canal, Dungeness, and Elwha. For the White MU, the projection includes all fish returning to the Buckley Trap or White River Hatchery facilities, including supplementation-origin fish that do not spawn naturally. 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. The comparisons in Table 18 represent the best currently available data for comparing predicted and actual escapements.

Spring Chinook escapement was above predictions for Skagit, White and Dungeness, and below for Nooksack. Nooksack escapement was below its Low Abundance Threshold. White River escapement exceeded its Upper Management Threshold, while Dungeness and Skagit escapements were between their lower and upper thresholds.

For summer/fall populations, escapement was lower than predicted for the majority of management units. Escapement to the Stillaguamish, Mid-Hood Canal and Skokomish units were below their lower thresholds. In general, it appears that survival rates for summer/fall stocks were below the levels forecasted for the 2010 return.

Details for each escapement estimate, including information on biological sampling of carcasses on the spawning grounds, and hatchery/natural-origin composition estimates, are presented in the following sections.

Table 18. Management thresholds, predicted 2010 escapement, and actual 2010 escapement estimates for Puget Sound Chinook management units.

Management Unit		NOR	HOR	Total	Projected (FRAM 1010)
Nooksack	NF	204	1,840	2,044	297 <sup>1</sup>
	SF	24 <sup>2</sup>	353	377	142 <sup>1</sup>
Skagit spring	Suiattle			263	159 <sup>1</sup>
	Cascade			330	197 <sup>1</sup>
	Sauk			768	304 <sup>1</sup>
Skagit summer/fall	Sauk summer			356 <sup>3</sup>	537 <sup>1</sup>
	Upper Skagit summer			6,664 <sup>3</sup>	9,558 <sup>1</sup>
	Lower Skagit fall			1,017 <sup>3</sup>	1,759 <sup>1</sup>
Stillaguamish	NF	405 <sup>4</sup>	358 <sup>5</sup>	763	528 <sup>1</sup>
	SF	20		20	158 <sup>1</sup>
Snohomish	Skykomish	1,836	675	2,511	4,653 <sup>1</sup>
	Snohomish	1,585	203	1,788	3,182 <sup>1</sup>
Lake Washington	Cedar	512	153	665	1,349
	Sammamish	79	1,702	1,781	
Green		847	1,245	2,092	5,802
Puyallup		481	1082	1,563	1,428
White		521	1,376 <sup>6</sup>	1,897	1,453
Nisqually		481	1,586	2,067	2,983
Skokomish		356	853	1,214	1,592
Mid Hood Canal		30	52	82	138
Dungeness		101	356	457 <sup>7</sup>	535
Elwha		102	1,176	1,278 <sup>8</sup>	1,261
Hoko		322	471	793 <sup>9</sup>	1,781

1. Natural-origin only.
2. SF NOR only. This is likely an underestimate, as poor survey conditions limited effort 2-3 weeks around the peak of spawning. This led to likely biased redd counts, and biased representation of SF NOR carcasses in sampling. An additional 49 NF/MF NOR's and 122 Fall NOR's were estimated in the SF.
3. An additional 63 Skagit Summer/Fall Chinook were collected for use as broodstock for the wild stock indicator program.
4. An additional 48 NOR's were collected from the spawning grounds for use as broodstock.
5. An additional 92 HOR's were collected from the spawning grounds for use as broodstock.
6. Includes 1,015 of White River hatchery origin, and 361 of acclimation pond origin.
7. Includes 90 fish used for hatchery broodstock and 22 surplus males at the hatchery.
8. Includes 709 fish used for hatchery broodstock and 5 pre-spawn mortalities.
9. Includes 473 fish used for hatchery broodstock.

## 4.1 Escapement surveys and estimation methods

### 4.2 North Puget Sound

#### 4.2.1 Nooksack River Early Chinook

North and Middle forks early Chinook

Since 2005, different methods have been used to estimate escapement to the North Fork and Middle Fork of the Nooksack River. In previous years the North/Middle estimate had been derived by expanding the total number of accounted, 'volitional recruit' carcasses observed in the North and Middle Forks by 3.48. This expansion factor was derived as the average ratio of cumulative redd counts and total carcass counts in five previous years. .

Due to lower flows and higher river bank exposure in 2005 - 2008, we believed that the spawning surveys accounted for the majority of redds in the Middle Fork. To avoid over-estimating escapement, it was decided to expand the Middle Fork redd count by the standard 2.5 fish per redd expansion factor) and to only apply the 3.48 expansion factor to the North Fork carcass counts. .

In 2009, higher than normal flows and associated scouring in the Middle Fork limited redd observations during the early Chinook spawning season, so the Co-managers decided to adjust the Middle fork escapement methodology to account for less than optimum viewing conditions. The following methodology was agreed to for the 2009 and 2010 early Chinook returns only in the Middle Fork. An expansion factor was calculated in a method similar to the North Fork (see explanation above). For 2005 - 2008, the escapement based on redd counts (# redds x 2.5) was divided by the number of carcasses observed. The average of these annual ratios was applied to carcass counts to calculate the 2009 and 2010 Middle Fork escapement (Table 19).

Table 19. Ratios of redd-based escapement estimates to numbers of carcasses observed for MF Nooksack early Chinook, 2005-2008, and 2009-2010 escapement estimates based on carcass expansions.

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
<b>4-year Average</b>				<b>1.91</b>
2009	na	na	89	170
<b>2010</b>	<b>na</b>	<b>na</b>	<b>204</b>	<b>390</b>

There was a further significant change in methodology for estimating the NF/MF Nooksack River escapement in 2010. The carcasses observed in Kendall Creek were believed to be an accurate census, and so were not expanded. Carcass counts for the remainder of the North Fork were expanded by 3.48. Our prior assumption that Kendall Creel is reflective

of the other areas nearby, like Wick's Slough, Bear Creek Slough, and Coal Creek slough, is no longer valid due to river flow changes in the North Fork Nooksack River. In 2010, due to river bank changes, Kendall Creek extended 0.4 miles downstream from the Kendall Creek Hatchery rack, creating more spawning habitat below the hatchery.

Following is a summary of the 2010 estimate of total natural escapement to the North / Middle Fork:

Kendall Creek area carcasses = 707

North Fork River expanded carcasses (272 x 3.48) = 947

North Fork total escapement = 1654

Middle Fork carcasses (204 x 1.91)= 390

Total NF/MF Nooksack = 2044

The main stem North Fork exhibited its characteristic glacial color throughout the summer survey season. The majority of spring Chinook spawning occurred in side channels off the mainstem or near the mouths of major tributaries.

Based on carcass sampling, the escapement was comprised of 1840 hatchery-origin recruits, and 204 natural-origin recruits, compared to a pre-season projection of 297 natural-origin recruits.

Total early Chinook escapement to the South Fork was estimated by expanding 219 redds counted prior to October 1 by 2.5, to estimate escapement 548; 24 were South Fork native Chinook. High flow and turbidity during the peak of the spawning season in September prevented accurate redd counts, so these estimates almost certainly are lower than actual escapement.

Sampling of 102 carcasses provided information for estimating the contributions of native South Fork and other stocks to the natural escapement (Table 20). Natural-origin components were distinguished by microsatellite DNA analysis of tissues from 16 unmarked carcasses, collected through Oct. 7. Individual samples were assigned according to their best fit to the three Nooksack baseline stocks (North/Middle Fork early Chinook, South Fork early Chinook, and Samish/Nooksack summer-fall Chinook). 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 origin) carcasses.

Kendall Creek Hatchery and other hatchery-origin adults were identified by marks, otoliths or CWTs from 49 carcasses, of which 44 were recovered in the South Fork, and five from Hutchinson Creek. Kendall Creek Hatchery and North Fork native returns comprised 54% and 9% of the total, respectively.

Most of the carcass samples were collected from the South Fork proper, two from Hutchinson Creek, and one from Plumbago Creek. Difficult survey conditions also limited carcass sampling in mid- to late-September, so it is uncertain whether the sampled fish accurately represent composition of escapement.

Table 20. 2010 South Fork early Chinook escapement estimate and other Chinook by stock, and origin through Oct. 1.

S Fk Chinook Origin and Stock	Percent of total Chinook	Estimated Chinook
North Fork Hatchery	54.6%	295
Other Hatchery	10.6%	58
North Fork NORs	8.9%	49
Fall Stock NORS	22.3%	122
Native South Fork Escapement	4.4%	24
Total Chinook to Oct. 1	100%	548

#### 4.2.2 Skagit River

Escapement estimates for the six populations of Skagit River Chinook were calculated by expanding redd counts by 2.5 fish/redd. Redds were counted by foot or float surveys in tributaries to the Skagit River and tributaries and upper reaches of the Sauk River. Visible redds in the main stem Skagit River, and in the Sauk River below the mouth of the White Chuck River, were counted by helicopter survey and escapement estimated using the area under the curve method. Due to the high cost associated with helicopter charter the number of aerial surveys was kept to a minimum but effective number. The first flight for a population generally occurred just after spawning began. Likewise, the final flight may have occurred before spawning was fully completed. Because redds were generally observed during the first flight and may be built after the last flight, actual beginning and end dates of main stem spawning populations were estimated using historical data and field observations.

Weather and flow conditions were favorable for conducting Chinook spawning surveys through most of 2010. A mid-September rainstorm elevated Cascade River flows beyond a level that was safe to survey for upper Cascade spring Chinook in two of the indexes for 21 days. The storm also elevated flows in other basins, but not enough to disrupt survey intervals. The 2010 data set was mostly complete with minimal deviation from our prescribed escapement estimate methodologies. Historically, surveying lower Sauk summer Chinook and lower Skagit fall Chinook has been difficult and routinely interrupted by weather and resulting flow conditions. This was not the case in 2010; we performed four flight surveys for each population and had uninterrupted survey intervals in the Lower Skagit Fall and Lower Sauk Summer Chinook tributary indexes.

##### Suiattle spring Chinook

Suiattle River spring Chinook spawn in the clear water tributaries of the turbid Suiattle River. Spawning has not regularly been observed throughout the turbid main stem, but has been documented in the main stem at interfaces with clear water tributaries. Historically surveyed streams include Big Creek, Tenas Creek, Straight Creek, Circle Creek, Buck Creek, Lime Creek, Downey Creek, Sulphur Creek, and Milk Creek. Circle Creek suffered severe habitat damage from a flood in 1990 which created fish passage issues and access to Circle Creek was eliminated during a 2003 flood which wiped out the vehicle bridge spanning the Suiattle River. In late 2009 and early 2010 the Forest Service contracted to have the Boundary Bridge (the bridge that connects Forest Service road 26

and 25) replaced restoring access to Circle Creek for 2010 Chinook spawning ground surveys.

The Suiattle River spring Chinook escapement estimation method has been used since 1994. Spawning ground indexes were surveyed on foot every 7 to 10 days. Redds were marked with dated PVC flagging tape and counted and recorded. The cumulative redd count from all surveyed tributaries (which is the entire known spawning area) was expanded by 2.5 fish per redd to calculate the escapement estimate.

The indexes surveyed in 2010 represented the total known spawning distribution of the population. The indexes included most clear water tributaries in the basin with enough flow to allow Chinook access. Redds constructed in the mixing zone between a tributary and the mainstem were included in the total for the tributary.

Access to the Suiattle River tributaries was restored to nearly pre 2003 flood ease in 2010 when the Forest Service contracted to have the bridge connecting road 26 and road 25 repaired. Additionally, the stretch of road from RM 12 to Downey Creek was roughly repaired to allow limited administrative vehicle access nearly to Downey Creek. Forest Service Road 26 beyond mile 12 remained closed to the public, but we acquired permission from Darrington District Ranger Peter Forbes to use the roads for access to the spring Chinook spawning ground survey indexes.

Tributaries were surveyed for spring Chinook redds between August 3 and September 24, 2010. The survey interval goal was generally maintained throughout the survey period. A total of 105 redds were identified by surveyors and the 2010 Suiattle River spring Chinook escapement estimate was 263 fish (Table 21).

Table 21. Suiattle River spring Chinook redd counts from 2010 spawning ground surveys. Redds found at the interface of the Suiattle River and a tributary were included in the count for the tributary. Dates without a redd count indicate no survey occurred that day on that stream.

Stream	RM	New redds										Sum	
		8/3	8/4	8/12	8/13	8/23	8/24	9/2	9/3	9/13	9/14		9/24
Big Cr.	0.0-0.6	0			0		0	0		1		1	2
Tenas Cr.	0.0-0.6		0		1	5		1		1		2	10
Straight Cr.	0.0-0.7		0		1	0		0		0		0	1
Circle Cr.	0.0-0.1		0							0			0
Buck Cr.	0.0-0.7	0		2		0		0			10	1	13
Lime Cr.	0.0-0.5		0		0		2		1		2	0	5
Downey Cr.	0.0-2.1	0		14		21		20			6	0	61
Sulphur Cr.	0.0-0.9			0		3		2			2	1	8
Milk Cr.	0.0-0.1			2		2		1			0		5
Total redds:												105	

### Upper Cascade spring Chinook

Upper Cascade spring Chinook surveys cover the entire known spawning distribution of the population. Surveyed areas were the main stem Cascade River from river mile (RM) 8.1 to 18.6, the lower reaches of the North and South Fork Cascade Rivers, and indexes in two tributaries, Marble Creek and Kindy Creek.

The Cascade spring Chinook escapement estimate methodology was implemented in 1992. Indexes were surveyed by foot, or cata-raft when flows were too high. Redds were marked with dated PVC flagging and counted. The cumulative redd count was expanded by 2.5 fish per redd to calculate escapement.

Survey coverage in 2010 was nearly complete and maintained the prescribed survey interval of 10 to 14 days in all but two of the indexes. Due to a mid September storm and resulting elevated flows, we were unable to survey two main stem indexes from river mile 12.4 to 18.6 for 22 days. After flows abated we surveyed both sections and found flows had not caused scour as previously marked redds were intact, and many new redds were located and marked. The indexes were surveyed from August 18 through October 01, 2010 which was a week later than surveys had been concluded in previous years (Table 22). The late survey occurred because of the unusual high number of redds located in the RM 12.4 to 9.0 index on September 23 and after flows had declined from their storm caused peaks. We suspect higher than average flows caused upper Cascade spring Chinook to temporarily suspend spawning until flows decreased, at which point spawning recommenced. We found redds in all main stem indexes on the October 1, 2010 survey. The total number of upper Cascade spring Chinook redds in 2010 were 132. The escapement estimate was 330 fish.

Table 22. Redd counts from 2010 Upper Cascade River spring Chinook spawning ground surveys. Dates without a redd count indicate no survey occurred that day.

Stream	RM	New redds						Sum
		8/18	8/19	8/31	9/9	9/23	10/1	
Cascade River	8.1-9.0	2		6	3	0	1	12
Cascade River	9.0-12.4	6		22	7	13	3	51
Cascade River	12.4-15.8		20	23	8		3	54
Cascade River	15.8-18.6		3	7	2		1	13
SF Cascade River	18.6-19.3	0		0	0	0		0
NF Cascade River	0.0-0.1	0		0	0	0		0
Kindy Creek	0.0-0.5	0		0	0	0		0
Marble Creek	0.0-0.5	1		0	1	0	0	2
							132	

### Upper Sauk spring Chinook

Spawning ground surveys for upper Sauk River spring Chinook encompass the known spawning distribution of the population. Main stem Sauk River indexes were between RM



31.0 (which is 0.9 miles below the mouth of the White Chuck River) and RM 39.7, at the confluence of the North Fork Sauk and South Fork Sauk Rivers. The North Fork Sauk River was surveyed from the mouth upstream to an impassable falls, and the South Fork Sauk River was surveyed from the mouth to approximately RM 3.5 which is an assumed Chinook barrier most years.

Surveys were performed on foot or by cataraft except for the 0.9 mile index below the White Chuck River. The section from RM 31.0 to RM 31.9 is too dangerous to walk or float and is surveyed by helicopter. Redds in sections surveyed from the ground were marked with dated PVC flagging and recorded. All visible redds in the aerial survey sections were counted and recorded. Redd days were calculated from the aerial surveyed section using the area under the curve (AUC) method. Estimated redds were calculated by dividing redd days by redd life. The redd life value used was 21 days (Schuller, 1974). Actual and estimated redds were summed and expanded by 2.5 fish per redd to estimate escapement. The Sauk River spring Chinook escapement estimate methodology has remained unchanged since 1994.

Manageable flows throughout most of the 2010 season enabled complete survey coverage of all upper Sauk spring Chinook indexes. The run timing was again late with spawning beginning mid August and peak redd counts occurring in mid September. Historically, upper Sauk spring Chinook spawned from early August through late September and peak spawning occurred early September. However in recent years few redds were built before September 1, and spawning has occurred into October. Peak spawning in 2010 occurred during the second week of September which was one week later than the peak in 2008, and the same week as observed in 2009. Surveys began August 24 and concluded October 19 (Table 23).

Table 23. Upper Sauk River spring Chinook redd counts from 2010 foot surveys of spawning ground indexes. Dates without a redd count indicate no survey occurred on that day.

Stream	RM	New redds											Sum		
		8/24	8/25	9/3	9/10	9/15	9/16	9/27	9/30	10/1	10/7	10/8		10/19	
Sauk R. <sup>*1</sup>	31.0-31.9				1										1
Sauk R.	31.9-34.5		5		36		39		13		9			0	102
Sauk R.	34.5-37.8		4		18		42		16			12			92
Sauk R.	37.8-39.7	2		1			1		0		0				4
NF Sauk R.	39.7-40.1	0		4		11		2			0				17
NF Sauk R.	40.1-41.3	3		5		18		13			3				42
SF Sauk R.	0.0-2.9	0		0		20				12	9			0	41
Falls Cr.	0.0-0.3				1		3		3				1		8
Total redds:														307	

\*1: Redd on 9/9/10 flight.

A total of 307 redds were observed from RM 31.9 upstream and including the forks. The AUC method was not used for flight surveys in 2010 because only two redds were observed in the aerial index and they were more than 21 days apart. Additionally, the second redd observed was on October 19 and had timing overlapping the beginning of chum spawning. Because we were unsure what salmon species built the second redd, it

was omitted from the escapement estimate. The 2010 upper Sauk River spring Chinook escapement estimate was 768 fish.

#### Skagit Spring aggregate escapement

The 2010 observed spawning escapement of wild Skagit spring Chinook was 1,361, more than double the FRAM predicted escapement of 661. Although projected preseason to be below the LAT of 170, the escapement for the Suiattle spring Chinook was estimated at 263 fish, above the LAT. Though higher postseason than expected, the total wild spring Chinook escapement was below the Upper Management Threshold of 2,000, but higher than the Low Abundance Threshold of 576.

#### Upper Skagit summer Chinook

Skagit summer Chinook escapement estimation methodologies have remained unchanged since at least 1974. The escapement estimate is composed of a ground based survey redd count of tributaries and an aerial based main stem surveys with redds estimated using the AUC method. The survey protocol stipulates surveying nearly the entire known spawning distribution of the population which includes the main stem Skagit River from the mouth of the Sauk River (RM 67.2) to the Seattle City Light powerhouse at Newhalem (RM 94.3), and several tributaries. Tributaries surveyed were the lower Cascade River (RM 0.0 to 3.4) and also indexes in Illabot Creek, Diobsud Creek, Bacon Creek, Falls Creek (tributary of Bacon Creek) and Goodell Creek. All redds located in tributaries were marked with dated PVC tape and recorded. Infrequent spawning in some tributaries not normally surveyed has been documented historically, but limited staffing prevented us from monitoring those areas. The survey interval for tributaries was every 10 to 14 days and the interval for flights was approximately once every two weeks. Cumulative redds from all tributary counts were added to the AUC redd estimate and multiplied by 2.5 fish per redd to calculate the escapement estimate. The AUC method used an assumed redd life of 21 days (Schuller, 1974) to calculate total redds. Beginning and end points for the curve were estimated using field observations of redd construction and historical data

Tributary surveys began September 8 and concluded October 26, 2010. Weather conditions were favorable for surveys throughout most of the spawning period. A mid September rainstorm elevated flows, but did not impact spawning activity, existing redds, or our survey schedule. There were no fish passage issues observed in any of our tributary indexes in 2010. We surveyed the main stem Skagit River by helicopter four times beginning September 9 and concluding October 19. Weather conditions were favorable for all the flights.

We estimated 2,657 Skagit summer Chinook redds were constructed in the main stem Skagit River and its tributaries in 2010. Of all redds constructed, 144 redds were in the tributaries (Table 25). Based on flight surveys we estimated using the AUC 2,514 redds were in the main stem Skagit River indexes (Table 24). The 2010 Skagit River summer Chinook escapement estimate was 6,644 fish.

For the fifth consecutive year redds constructed in the tributaries prior to September 1 were not included in the total estimate. Carcass recoveries have shown these fish are hatchery strays from the Marblemount hatchery spring Chinook program, so they were enumerated separately.

Table 24. Skagit summer Chinook redd counts from 2010 Aerial surveys of the mainstem.

	RM	Redd Days					Total	Redds
		9/1-9/9	9/9-9/22	9/22-10/5	10/5-10/19	10/19-11/14		
Sauk - Cascade	67.2 - 78.1	280	1,788	4,297	5,502	4,290	16,156	769
Cascade - Shovelspur	78.1 - 89.5	420	3,478	7,573	8,505	6,240	26,215	1,248
Shovelspur - Newhalem	89.5 - 93.0	224	1,437	2,893	3,325	2,535	10,413	496
Mainstem sub-total							52,784	2,514

Table 25. Skagit summer Chinook redd counts from 2010 foot surveys of spawning grounds in tributaries to the Skagit.

	RM	9/8	9/9	9/10	9/22	9/23	10/4	10/5	10/14	10/15	10/26	Total
Cascade R.	0.0 - 0.9	1				3	0			1		5
Cascade R.	0.9 - 3.4	6				8	6			0		20
Cascade R.	0.0 - 3.4											0
Boulder Cr.	0.0 - 0.4	0			0		0					0
Goodell Cr.	0.0 - 0.7		0		0		1		1			2
Goodell Cr.	0.9 - 1.4		0				1		0			1
Bacon Cr.	0.0 - 1.5			7		12		8	4			31
Bacon Cr.	1.5 - 3.5			2		2		4	0			8
Bacon Cr.	3.5 - 4.2			1		2		6	0			9
Falls Cr.	0.0 - 0.2			1		0		0	0			1
Diobsud Cr.	0.0 - 1.1			2	6		22			0		30
Diobsud Cr.	1.1 - 1.4			1	1		2			0		4
Illabot Cr.	0.0 - 1.9	7					8	8		3	5	31
Illabot Cr.	1.9 - 2.6					0		2		0		2
Tributary Sub-total												144

#### Lower Sauk summer Chinook

Sauk River summer Chinook escapement was estimated by summing calculated main stem redds with redds counted in one tributary, and expanding the sum by fish per redd. The methodology has remained unchanged since at least 1974. The main stem was surveyed by helicopter at approximately two week intervals from the mouth of the Sauk River to RM 31.0. The reach from RM 31.0 to 31.9 (mouth of the White Chuck) was high gradient with limited spawning habitat and was assumed to separate the spring and summer Chinook stock distributions. Redd days were calculated by the AUC and divided by the assumed redd life of 21 days (Schuller 1974) to calculate total redds. Beginning and end points for the curve were estimated using field observations of redd construction and historical data. Any redds counted in the tributary were added to the AUC redds and the sum was multiplied by 2.5 fish per redd to calculate escapement. The area surveyed

represented the total known spawning distribution of the population. Dan Creek was the only tributary surveyed.

A major flood in October 2003 changed the distribution of summer Chinook spawning in the Sauk River from historic patterns. Downstream of the Suiattle River mouth the Sauk River experienced a loss of suitable gravel due to deposition of fine sediment and as a result, less spawning was observed. Upstream of the Suiattle River, new usable gravel had been deposited and increased spawning was observed. As an example of the changes, prior to the 2003 flood few redds were typically observed above the Darrington Bridge at RM 21.0 (spawning ground database). However, in recent years as much as 26% of the Sauk summer Chinook population has utilized the spawning habitat above the bridge. In 2010 16.5% of the redds were in this reach. The same change in spawning distribution has been observed with other species, most noticeably steelhead.

We surveyed the Sauk River four times by helicopter between September 9 and October 19, 2010. Flow and visibility conditions were generally favorable in the Sauk River upstream of the Suiattle River. However the index from the mouth of the Sauk River to the Suiattle River was not surveyable on the first flight due to Suiattle River turbidity. During the second week of October, and between the third and fourth flight survey, a high flow event brought Sauk River flows to a peak value of 10,400 cfs. The elevated river discharge flattened and obscured redds. Because of the greatly diminished redd life between flights we reduced the usual 21 day redd life (Schuller 1974) used in all other AUC estimates to 14 days for the redd count effected by the flow event. We began surveying Dan Creek September 27 and concluded October 15. Dan Creek had unusually adequate flows for passage throughout most of the spawning period. Three redds were counted in the Dan Creek indexes in 2010.

The preliminary 2010 Sauk summer Chinook escapement estimate was 356 fish. An estimated 139 redds were constructed in the Sauk River summer Chinook zone and three redds were counted in the tributary index. The 2010 Sauk River summer Chinook estimate is subject to change pending comanager review and agreement.

#### Lower Skagit fall Chinook

The Skagit River fall Chinook escapement was estimated using total redd counts from main stem Skagit River aerial surveys and new redd counts from 10 tributaries. The main stem was flown by helicopter at approximately two week intervals from Highway 9 at Sedro Woolley to the Sauk River Mouth. Redd days were estimated from the aerial counts using the AUC method. Beginning and end points for the curve were estimated using field observations of redd construction and historical data. Estimated redd days were then divided by an assumed redd life of 21 days to calculate total redds (Schuller 1974). The tributary cumulative redd count was added to the AUC derived redds and multiplied by 2.5 fish per redd to calculate escapement. Of the tributaries surveyed, Jackman Creek, two indexes on Finney Creek, Pressentin Creek, O'Toole Creek (supplemental index), Grandy Creek, Day Creek, Alder Creek, Jones Creek, and Hansen Creek were surveyed every 7 to 10 days and East Fork Nookachamps Creek was occasionally surveyed (Table 26). WDFW did not survey all the indexes. The Upper Skagit Indian Tribe (USIT) surveyed the upper index of Finney Creek, Grandy Creek, and East Fork Nookachamps Creek. The Skagit Fisheries Enhancement Group (SFEG) also participated in fall Chinook surveys. They surveyed Hansen Creek, Jones Creek, and Alder Creek. All tributaries were surveyed by foot, and all new redds were marked with dated PVC flagging and recorded. The areas surveyed represented nearly the entire known spawning distribution of the population. Some limited spawning may have occurred in tributaries not surveyed.

The main stem was surveyed by helicopter four times in 2010 from RM 24.5 (Highway 9 Bridge) to the mouth of the Sauk River (RM 67.2) beginning September 9 and ending on October 19. On the first flight river turbidity was high from Highway 9 to the Baker River and no redds were observed. Conditions from the Baker River to Sauk River were also poor on the first flight, but were not as bad as the lower section, and one redd was observed. All indexes were successfully surveyed on all subsequent flights. As in past years, the Baker and Sauk Rivers both added color and reduced visibility in the Skagit River during aerial surveys

Tributary surveys began September 14 and terminated November 15, 2010 (Table 26). With the exception of a couple of high water episodes, moderate flow conditions presented favorable surveying conditions throughout the fall Chinook spawning period allowing a full set of surveys to be completed.

From the flight data we estimated 267 redds were in the main stem section from the Highway 9 Bridge to the Sauk River and we documented 140 redds in the tributary indexes. The preliminary 2010 Skagit fall Chinook escapement estimate was 1,017 fish. The final escapement number is dependent on co-manager review and agreement which had not yet occurred at publication.

Table 26. Lower Skagit River fall Chinook redd counts from 2010 spawning ground surveys. Redd counts were provided from the E.F. Nookachamps Creek, Grandy Creek, and part of Finney Creek by the Upper Skagit Tribe. The Skagit Fisheries Enhancement group surveyed Jones Creek, Hansen Creek, and Alder Creek.

Stream	WRIA	Survey method	Reach (RM)	Redds
Skagit River	3.0176	Flight	24.5-56.5	63
Skagit River	3.0176	Flight	56.5-67.2	203
E.F. Nookachamps Creek	3.023	Foot	3.5-5.1	10
Hansen Creek	3.0265	Foot	3.0-4.3	0
Day Creek	3.0299	Foot	0.0-2.2	45
Jones Creek	3.0332	Foot	0.0-1.3	0
Grandy Creek	3.0337	Foot	0.0-1.1	5
Alder Creek	3.0359	Foot	0.0-1.6	0
O'Toole Creek	3.0365	Foot	0.0-0.2	0
Presentin Creek	3.0385	Foot	0.0-0.4	3
Finney Creek	3.0392	Foot	0.0-6.0	71
Jackman Creek	3.0626	Foot	0.0-0.7	6
Total redds (rounded):				407

#### Skagit Summer/Fall Chinook aggregate escapement

The 2010 observed spawning escapement of wild Skagit summer/fall Chinook, 8,037, plus the 63 wild summer Chinook removed from the river for the wild indicator broodstock totaled 8,100 Chinook, lower than the Upper Management Threshold (14,500), but higher

than the Low Abundance Threshold (4,800) for the fourth year in a row, even though three of four brood year escapements that contributed to the 2010 Skagit summer/fall Chinook run, were higher than 20,000, which was well in excess of the Upper Management Threshold. FRAM predicted spawning escapement of summer/fall natural and indicator stock was modeled at 12,719 Chinook.

#### Skagit Hatchery Spring Chinook Stray Rate Study

A study began in 2006 to determine the number of hatchery spring Chinook spawning in natural spawning areas prior to the onset of native summer Chinook spawning. The study was conducted by Washington Department of Fish and Wildlife and the Skagit River System Cooperative (SRSC), the management body for the Swinomish and Sauk-Suiattle tribes of Indians. Prior to 2005, no attempt had been made to enumerate the number of strays that did not enter the hatchery.

Weekly redd surveys were conducted by foot or pontoon boat in the Lower Cascade River (RM 0.0 – 3.4) and Boulder Creek, a tributary to the Cascade River where hatchery strays were known to spawn. Encountered carcasses were sampled for coded wire tags to ascertain origin. Tributaries to the upper Skagit River, Bacon Creek, Illabot Creek and Diobsud Creek were also surveyed by foot to determine whether strays were spawning in those streams.

Carcass recoveries revealed redds built before September 1 in the all the sites surveyed could be reasonably expected to have been constructed by hatchery spring Chinook strays.

Surveys began July 15, 2010. A cumulative total of 194 redds were observed in the Cascade River and another 38 redds were observed in other tributary indexes prior to September 1 (Table 27). Using an expansion of 2.5 fish per redd, an estimated 580 stray Marblemount Hatchery spring Chinook spawned in natural spawning areas.

Table 27. Redd counts from 2010 hatchery spring Chinook spawning surveys. Strays originate from the WDFW Marblemount Hatchery.

Stream	RM	New redds												Sum
		7/15	7/26	8/2	8/5	8/10	8/11	8/12	8/16	8/25	8/26	8/30	8/31	
Cascade R.	0.0-0.9	0							11		8		2	21
Cascade R.	0.9-3.4	1							20		9		11	41
Cascade R.	0.0-3.4		19	33			68							120
Boulder Cr.	0.0-0.4					7			4		1		0	12
Bacon Cr.	0.0-1.5											3		3
Bacon Cr.	1.5-3.5											0		0
Bacon Cr.	1.5-4.2				1									1
Bacon Cr.	3.5-4.2											1		1
Falls Cr.	0.0-0.2											0		0
Diobsud Cr.	0.0-1.4							2	8	3				13
Diobsud Cr.	0.0-1.1											1		1
Diobsud Cr.	1.1-1.4											1		1
Illabot Cr.	0.0-1.9											4		4
Illabot Cr.	0.9-2.0							12				0		12

Illabot Cr.	0.0-2.0	2		2
Illabot Cr.	1.9-2.6		0	0
			Total:	232

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### **4.2.3 Stillaguamish River**

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. Since 2008 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 on a seven to ten day cycle to maximize carcass sampling rates and ensure enumeration of all redds. All redds were flagged, enumerated and recorded with a GPS waypoint.

#### **Stillaguamish summer Chinook**

Stillaguamish summer Chinook spawning surveys covered the entire known distribution of the population. 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. The first redds were detected August 30. Peak redd deposition occurred on or about September 15. Following a flow spike on September 19, redd deposition decreased precipitously and the final redd was detected in early-October. Rainstorms caused elevated stream levels in mid-September and October and temporarily hampered some of the later surveys with decreased visibility.

A total of 305 Stillaguamish summer Chinook redds were counted in 2010. The escapement estimate was 763 fish. Based on carcass sampling, 405 of these were NOR's, and 358 were HOR's. An additional 140 fish were taken for hatchery brood stock and were not included in the escapement estimate (48 NOR, 92 HOR). Total NOR escapement (natural spawning + broodstock collection) was 453 Chinook, compared to a pre-season projection of 528. Table 28 lists redd counts and escapement estimates by surveyed reach.



Table 28. Stillaguamish Summer Chinook redd counts and escapement by survey reach in 2010.

<b>Stream Reach</b>	<b>WRIA</b>	<b>Method</b>	<b>Reach (RM)</b>	<b>Redds</b>	<b>Escapement</b>
North Fork	5.0135	Foot/Float	0.0-14.3	27	68
North Fork	5.0135	Foot/Float	14.3-30.0	242	605
North Fork	5.0135	Foot/Float	30.0-34.4	20	50
Grant Creek	5.0156	Foot	0.0-0.4	0	0
Deer Creek	5.0173	Foot	0.0-6.0	0	-
Brooks Creek	5.0215	Foot	0.0-0.1	0	0
Boulder River	5.0229	Foot	0.0-2.9	2	5
French Creek	5.0246	Foot	0.0-3.0	3	7.5
Squire Creek	5.026	Foot	0.0-4.0	11	27.5
Ashton Creek	5.0262	Foot	0.0-1.2	0	0
<b>Total Redds</b>				<b>305</b>	
<b>Escapement Estimate</b>					<b>763</b>

#### Stillaguamish fall Chinook

Fall Chinook escapement to the South Fork in 2010 was estimated using expansion of redd counts from foot and raft surveys. Areas surveyed were the South Fork from the confluence to Granite Falls (river miles 18.8 to 34.5), Canyon, Jim, Siberia, and Pilchuck Creeks. Aerial surveys were not conducted on the Lower Mainstem from the Interstate 5 highway bridges to the confluence at Arlington (river miles 11.0 to 17.8) in 2010 due to timing and fiscal constraints.

Survey conditions were challenging for the enumeration of new redds in the fall Chinook spawning reaches. Flow and turbidity conditions in the latter half of September and early-October hindered our ability to keep survey frequency between seven to ten days. Further complicating Chinook redd detection was the onset of Chum salmon spawning sometime around September 21. As a result of these factors, the redd count total and escapement estimate for the South Fork are likely biased low.

A total 8 Chinook redds were found in the South Fork Stillaguamish River in 2010. The escapement estimate was 20 adult fish, less than the preseason projection of 158. Redd counts by surveyed reach and escapement estimates are listed in Table 29.

Table 29. Stillaguamish fall chinook redd counts and escapement by survey reach in 2010.

<b>Stream Reach</b>	<b>WRIA</b>	<b>Method</b>	<b>Reach (RM)</b>	<b>Redds</b>	<b>Escapement</b>
Mainstem	5.0001	Flight	0.0-18.2	0	-
South Fork	5.0001	Foot/Float	18.0-30.3	7	18
South Fork (upper)	5.0001	Foot	30.3-65.0	0	0
Pilchuck Creek	5.0062	Foot/Float	0.0-6.2	0	0
Jim Creek	5.0322	Foot/Float	0.0-4.1	1	2.5
Siberia Creek	5.0324	Foot	0.0-0.4	0	0
Canyon Creek	5.0359	Foot	0.0-0.5	0	0
<b>Total Redds</b>				<b>8</b>	
<b>Escapement Estimate</b>					<b>20</b>

#### Carcass sampling

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). In total, the sampling rate of Chinook carcasses encountered by WDFW and Tribal staff on the spawning grounds of the North Fork, South Fork and their associated tributaries were 13.5% and 0.0%, respectively. These rates were calculated by dividing the number of carcasses sampled by the escapement estimate. Table 30 lists carcass sampling rates for each stream reach in the basin.

Table 30. Stillaguamish basin chinook spawning ground carcass sampling rates in 2010.

Reach	Total Sample	CWT Ad	CWT No clip	No CWT No clip	Escape Est.	Sample Rate
North Fork (RM 0.0-14.3)	6	0	0	1	68	8.80%
North Fork (RM 14.3-30.0)	87	50	1	6	605	14.40%
North Fork (RM 30.0-34.4)	9	7	0	2	50	18.00%
Grant Creek	0	0	0	0	0	0.00%
Deer Creek	0	0	0	0	0	0.00%
Brooks Creek	0	0	0	0	0	0.00%
Boulder River	0	0	0	0	5	0.00%
French Creek	0	0	0	0	7.5	0.00%
Segelson Creek	0	0	0	0	0	0.00%
Squire Creek	1	1	0	0	27.5	3.60%
Ashton Creek	0	0	0	0	0	0.00%
<b>TOTAL</b>	<b>103</b>	<b>58</b>	<b>1</b>	<b>9</b>	<b>763</b>	<b>13.50%</b>
South Fork (RM 18.2-30.6)	0	0	0	0	18	0.00%
Pilchuck Creek	0	0	0	0	0	0.00%
Jim Creek	0	0	0	0	2.5	0.00%
Siberia Creek	0	0	0	0	0	0.00%
Canyon Creek	0	0	0	0	0	0.00%
<b>TOTAL</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>20</b>	<b>0.00%</b>

#### 4.2.4 Snohomish River

Escapement estimates of naturally spawning Summer/Fall Chinook salmon returning the Snohomish River are calculated from cumulative redd counts made from physical surveys of their spawning grounds, and from counts of adult fish passed at Sunset Falls. Redd counts were multiplied by 2.5 (fish per redd) to yield escapement. 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 were flagged to prevent re-counting on subsequent surveys. GPS waypoints were recorded for most redds documented in ground-surveyed reaches. 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).

#### 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 favorable for enumeration of redds during most of the spawning season. Ground survey intervals were kept to seven to ten days except for when rain-fed flow pulses in mid-September and October caused minor survey delays. Early pulses of water in late August helped fish use some of the small tributaries such as Bridal Veil and Olney creeks. Four aerial surveys were flown on the Mainstem Snohomish, Skykomish and North and South Fork Skykomish Rivers between September 14 and October 20. Surveys of the Sultan River were conducted by Snohomish PUD using a combination of ground and aerial coverage.

The 2010 estimated escapement for Skykomish Chinook was 2,511 fish. Of these, 918 were estimated from aerial surveys of mainstem reaches, 1,262 were estimated from ground counts of tributary reaches, and 331 were adults trapped at Sunset Falls. Table 31 lists Skykomish Chinook spawning ground survey reaches, redd counts and escapement estimates.

#### Snoqualmie summer/fall Chinook

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

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

In 2010 the escapement of 1,788 Chinook in the Snoqualmie Basin was based on a total count of 715 redds. Table 32 lists redd counts and escapement estimates by survey reach for Snoqualmie fall Chinook.

Table 31. Skykomish summer/fall chinook redd counts and escapement, 2010.

<b>Stream Reach</b>	<b>WRIA</b>	<b>Method</b>	<b>Reach (RM)</b>	<b>Redds</b>	<b>Escapement</b>
Snoh-Sky (Mainstems)	7.0012	Float/Flight	20.5-51.5	321	802
NF Skykomish	7.0982	Foot/Flight	0.0-13.5	46	116
SF Sky (Sunset Falls)	7.0012	Trap/Haul	51.5-up	-	331
Pilchuck River	7.0125	Foot/Float	2.0-26.5	32	80
Woods Creek	7.0826	Foot/Float	0.0-3.5	9	23
Elwell Creek	7.0865	Foot	0.0-1.0	11	28
Sultan River	7.0881	Foot/Float	0.0-9.7	141	352
Wallace River (lower)	7.094	Foot/Float	0.0-4.4	52	130
Wallace River (upper)	7.094	Foot/Float	4.4-7.3	147	368
Olney Creek	7.0946	Foot	0.0-0.6	13	33
Proctor Creek	7.097	Foot	0.0-0.4	12	30
Bridal Veil Creek	7.1248	Foot	0.0-0.4	88	220
<b>Total Redds</b>				<b>886</b>	
<b>Escapement Estimate</b>					<b>2511</b>

Table 32. Snoqualmie Fall Chinook redd counts and escapement by reach in 2010.

<b>Stream Reach</b>	<b>WRIA</b>	<b>Method</b>	<b>Reach (RM)</b>	<b>Redds</b>	<b>Escapement</b>
Snoqualmie River (Lower)	7.0219	Float	20.5-24.9	182	455
Snoqualmie River (Upper)	7.0219	Float	32.9-39.6	324	810
Cherry Creek	7.024	Foot	1.8-3.5	3	8
Tolt River (Lower)	7.0291	Foot/Float	0.0-6.0	51	128
Tolt River (Upper)	7.0291	Foot/Float	6.0-8.9	47	118
SF Tolt River	7.0302	Foot	0.0-2.3	27	68
Raging River	7.0384	Foot	0.0-4.6	57	143
Tokul Creek (Lower)	7.044	Foot	0.0-0.3	24	60
Tokul Creek (Upper)	7.044	Foot	0.3-0.6	0	0
<b>Total Redds</b>				<b>715</b>	
<b>Escapement Estimate</b>					<b>1788</b>

## Carcass Sampling

WDFW field staff sampled 398 Chinook carcasses within the Snohomish basin. In total, the Chinook carcass sampling rate on the spawning grounds was 9.3%. This was calculated by dividing the number of carcasses sampled by the escapement estimate. Table 33 lists carcass sampling rates for each stream reach in the basin. Based on these samples, escapement of hatchery- and natural-origin escapement Chinook was estimated for both populations. For the Skykomish, the total escapement of 2,511 included an estimated 1,836 NORs and 675 HORs. For the Snohomish, the total escapement of 1,788 included 1,585 NORs and 203 HORs.

Table 33. Snohomish Chinook spawning ground carcass sampling rates by reach, 2010.

Reach	Total Sample	CWT AD	CWT only	AD only	Escapement Estimate	Sample Rate
Snoh-Sky (mainstems)	133	3	0	11	802	16.60%
NF Skykomish	4	0	0	1	116	3.40%
SF Sky (Sunset Falls)	1	0	0	0	331	0.30%
Pilchuck River	2	0	0	1	80	2.50%
Woods Creek	0	0	0	0	23	0.00%
Elwell Creek	4	0	0	0	28	14.30%
Sultan River	17	0	0	0	352	4.80%
Wallace River (Upper)	30	3	1	15	130	23.10%
Wallace River (Lower)	23	1	2	14	368	6.30%
Bridal Veil Creek	29	0	1	4	220	13.20%
Olney Creek	3	0	0	0	33	9.10%
Proctor Creek	1	0	1	4	30	3.30%
Snoqualmie River (Lower)	24	1	0	1	455	5.30%
Snoqualmie River (Upper)	97	1	0	6	810	12.00%
Tokul Creek (Lower)	12	0	0	5	60	20.00%
Tokul Creek (Upper)	0	0	0	0	0	0.00%
Raging River	11	0	0	4	143	7.70%
Tolt River (Lower)	6	0	0	4	128	4.70%
Tolt River (Upper)	1	0	0	0	118	0.80%
SF Tolt River	0	0	0	0	68	0.00%
<b>TOTAL</b>	<b>398</b>	<b>9</b>	<b>5</b>	<b>70</b>	<b>4,299</b>	<b>9.30%</b>

## **4.3 South Puget Sound**

### **4.3.1 Lake Washington**

#### Cedar River

Prior to 1999, live counts and Area Under the Curve (AUC) methods were used to estimate Chinook spawning abundance in the Cedar River. Since 1999 Chinook redds have been enumerated and mapped in the Cedar River via floating surveys, and escapement estimated by expanding the redd count by 2.5. Cedar River redd surveys are considered to be a complete census, where every Chinook redd in the Cedar system is counted. Redd surveys are conducted between RM 4.2 and RM 21.8 (Landsburg Dam) 2-3 times per week. The portion of the river upstream from the Landsburg Dam, and the lower 4.2 miles of the Cedar mainstem are each surveyed once per week. The protocol requires that the surveyors must observe a female Chinook attending a redd to positively identify it as a Chinook redd.

In 2010 a total of 266 Chinook redds were observed in the Cedar River mainstem during the 2010 spawning season (including the surveyed area upstream from Landsburg Dam and including all small tributaries). Of the 266 redds, 39 were observed upstream from Landsburg Dam (3 of these 39 were located in Upper Rock Creek), and 227 were observed below Landsburg Dam (1 of these 277 was located in Taylor Creek). Expansion by 2.5 fish per redd resulted in the estimated escapement of 665 Chinook. A total of 301 adult Cedar River Chinook were sampled for adipose fin clips in 2010. This sample indicated that 77% of the Cedar River Chinook were wild (unclipped) and 23% were hatchery origin fish.

#### Sammamish River/North Lake Washington Tributaries

The Sammamish Chinook population is composed of naturally spawning Chinook in the Big Bear/Cottage Lake Creek watershed and in the Issaquah Creek watershed. Chinook escapement to the Sammamish River/ North Lake Washington Tributaries in 2010 was estimated at 1,781 fish.

#### Big Bear/Cottage Lake Creeks

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 fish days are calculated by the AUC method and divided by 10 day redd life to estimate escapement. Prior to 1998, the upper ~0.7 miles of Cottage Lake Creek were not surveyed.

The Bear Creek/Cottage Creek index area was surveyed 10 times, and the Cottage Creek index area (a subset of the Bear/Cottage Index area) was surveyed 20 times during the 2010 spawning season. The escapement estimate was 124 fish. Of these, 24 were counted in the Bear Creek mainstem, 50 in the Upper Cottage Creek Index, and 50 in the Lower Cottage Creek Index. A total of 105 Chinook were sampled for adipose fin clips in 2010. This sample indicated that 23% of all Chinook in the Bear/Cottage system were wild (unclipped) and 77% 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.

The Issaquah Creek system was surveyed 8 times during the 2010 spawning season. The total estimated escapement was 1,657 fish (1,563 fish from the mainstem and 94 fish from the East Fork). A total of 309 adult Chinook from the Issaquah Creek system were sampled for adipose fin clips in 2010. This sample indicated that 3% of all Chinook in the Issaquah Creek system were wild (unclipped) and 97% were hatchery origin fish.

Chinook escapement to Issaquah Hatchery was 3,099; 1,090 of these were released upstream to spawn in upper Issaquah Creek. Chinook passed above the hatchery are not included in the Issaquah Creek natural escapement estimate. Chinook escapement to the University of Washington hatchery was 2,054 fish.

### **4.3.2 Green River**

Over 56 kilometers (km) of the Green River, broken into 31 separate reaches, were surveyed for Chinook redds in 2010. The area surveyed covers the extent of Chinook spawning, from river km 98.2 at the Howard Hanson Dam headworks downstream to river km 43 in the city of Auburn, King County. Newaukum Creek is surveyed from the mouth upstream for 7.2 km. The surveys were conducted over a period of six weeks from September 23rd to October 25th. Green River flows recorded at Auburn were over double the median flows during a typical Chinook spawning season. However survey conditions remained favorable for most of the survey period with the exception of the week of October 18th. During this week high flows and low visibility made surveying the Upper reach of the river impossible.

Most of the surveyed area consists of medium to low gradient pool-tailout-riffle habitat sequences with the exception of the Gorge section, between river km 77.2 and 90.4. This section consists of steep canyon with a medium to steep gradient and boulder pool habitat creating discrete patches of spawning.

Chinook redds are counted by three methods in the Green River: On foot in tributaries and side channels and by helicopter and/or boat on the river main stem. Because of the low escapement in 2010 it was possible to conduct a complete census of redds in the Green River and Newaukum Creek.

Aerial surveys were used to estimate the total number of redds in the Gorge section which is not surveyed by raft. The aerial count for the Gorge section is expanded by the ground to air ratio (G/A). The G/A is calculated by dividing the season total raft counts by the flight-week raft counts for 5 downstream reaches surveyed by both methods.

The total count of redds was then summed across all reaches and multiplied by 2.5 (Orell, 1976) to generate the final estimate of male and female Chinook. A total of 723 redds were calculated in the Green River and 114 redds in Newaukum Creek. The estimated



escapement for 2010 is 2,092 Chinook. While this is an increase over the low calculated for 2009, it is still significantly below the historic average.

Naturally spawning Chinook carcasses found in the Green River and Newaukum Creek were sampled opportunistically for biological data during spawning ground surveys. A total of 534 carcasses were sampled between September 24 and November 15, 2010. Of the 534 carcasses sampled, 10 were jacks by size ( $\leq 54$ cm). Based on this carcass sampling, the natural spawning escapement was comprised of 1,245 HOS and 847 NOS (60% and 40%, respectively (Table 34)).

Table 34. Percentages of hatchery and wild fish in natural spawning escapement in the Green River, as estimated by adipose fin clips, 2003-2010.

Year	Adipose Fin Clip (Hatchery)	Un-clipped (Wild)	Total Carcasses Sampled
2003	56.40%	43.60%	567
2004	68.50%	31.50%	888
2005	59.90%	40.10%	892
2006	58.00%	42.00%	889
2007	59.10%	40.90%	570
2008	38.60%	61.40%	609
2009	73.80%	26.20%	237
2010	60.10%	39.90%	534

### 4.3.3 White River

Escapement estimates for White River spring Chinook comprise trap counts at the Army Corps of Engineers Buckley Diversion Dam fish trap (Buckley trap) and hatchery returns to the Minter Creek/Hupp Springs and White River hatcheries.

The Buckley Diversion Dam is a migration barrier to anadromous fish and contains a fish trapping facility where fish are trapped and trucked upstream of Mud Mountain dam. The Buckley trap enables enumeration of fish transported to the upper watershed. However, precise counts are dependent upon accurate species identification and record keeping. Records of trap and haul operations conducted in the absence of state or tribal fisheries managers are a subject of ongoing concern. The total number of natural-origin recruits (NOR) and acclimation pond (AP) Chinook trapped at Buckley was 1,053; of these 1,024 were hauled upstream of the dam (Table 35) and 29 NORs were taken to the White River hatchery for use as broodstock. .

Table 35. Numbers of Chinook hauled upstream of Buckley fish trap in 2010.

Origin	Adults	Jacks	Totals
Wild (NOR)	521	31	552
Acclimation Pond	361	111	472
<b>Totals</b>	<b>882</b>	<b>142</b>	<b>1,024</b>

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 2010 escapement to the Minter Creek/Hupp Springs hatchery was 353 adults and 12 jacks, for a total of 365.

Escapement to the White River hatchery in 2010 was 1,134. 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. Of the total, 1,015 were adults and 119 were jacks.

#### **4.3.4 Puyallup River**

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

##### South Prairie Creek

Survey coverage of the South Prairie system was very good in 2010. The cumulative redd count of 143 in South Prairie Creek, expanded by 2.5, yielded an escapement estimate of 358 spawners. The cumulative redd count in Wilkeson Creek was nine. However, a September 23 survey of Wilkeson Creek counted 23 live and one dead Chinook. An analysis of Wilkeson Creek survey data showed that a peak live/dead count would best represent escapement in 2010. The South Prairie Creek (SPC) sub-basin total spawning escapement estimate for 2010 is 382. Based on mark-sampling of carcasses observed, about 41 percent of these fish were unmarked, so the escapement was made up of 158 NORs and 224 HORs.

##### Carbon River

Because conditions in the Carbon River seldom allow accurate Chinook escapement surveys, estimates are based on the relationship between SPC and Carbon River escapement in 1999, when there accurate redd count data 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.

Suitable survey conditions never occurred on the Carbon River during the 2010 spawning period. Consistent with the last ten years, the 2010/1999 SPC escapement ratio ( $382 / 1422 = 0.2683$ ) was applied to the 1999 Carbon River escapement (250) to estimate the 2010 value. This method estimated 67 Chinook spawning in the Carbon during 2010 ( $250 * 0.2683 = 67$ ). Based on mark sampling ratios observed in South Prairie Creek, the escapement was made up of 28 NORs and 39 HORs. .

## Mainstem Puyallup River Tributaries

Aggregate escapement to Puyallup River tributaries in 2010 was estimated at 327. Based on mark sampling in these tributaries, excluding Clark's Creek, 82 of these fish are NORs and 245 HORs.

Redd-based escapement estimates were calculated for most of the Puyallup River tributaries. No redds or fish were observed in Canyon Falls Creek in 2010. Clarks Creek escapement was 198 fish based on an AUC calculation. The AUC methodology was used, because the number of observed fish outnumbered the redd-based estimate.

Puyallup River tributaries:	Escapement estimate:
Fennel Creek (WRIA 10.0406)	108
Canyon Falls Creek (10.0410)	0
Kapowsin Creek (10.0600)	12
Clear Creek (10.0022)	12
Clarks Creek (10.0027)	198
Tributary total	330

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 and the identification of origin of natural spawners cannot be made.

## Mainstem Puyallup River

Chinook spawning escapement into the mainstem Puyallup River is estimated to be 354 fish. This escapement was made up of 146 NOR and 208 HOR Chinook, based on mark sampling ratios observed in Puyallup River mainstem tributaries.

As with the Carbon River, surveys of Puyallup River were not possible in 2010. WDFW and PTF staff believe that Puyallup River mainstem spawning escapement trend is closely related to the tributaries (Fennel, Canyon Falls, Kapowsin, and Clarks creeks). Therefore, the 2010/1999 Puyallup tributary ratio ( $205/113 = 1.8142$ ) was applied to the estimated 1999 Puyallup mainstem escapement (195) to estimate 2010 escapement of 354 Chinook ( $195 * 1.8142 = 354$ ).

The 2010 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 2010 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. It cannot be assumed that the composition of Clark's Creek Chinook spawning escapement is the same as in the Puyallup River mainstem due to the proximity to Clark's Creek hatchery.

## Lower White River

The fall component of Chinook spawning in the lower White River and its tributaries, downstream of the Buckley diversion dam fish trap, are included in the 2010 Puyallup River basin fall Chinook escapement estimate. Spawning ground survey efforts by co-managers indicate that, in some years, a sizeable population of Chinook spawns 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 2010 was estimated to be 430 fish. This escapement is made up of 65 NORs and 365 HORs based on mark sampling ratios observed during spawning ground surveys.

### Total Puyallup Escapement

The total 2010 estimated Puyallup River naturally spawning fall Chinook escapement is 1,563 fish. It is estimated that 481 were NORs, and 1082 were HORs, based on mark-sampling of carcasses observed. The estimate of NORs assumes the proportion of hatchery versus natural origin spawners is the same between Puyallup River tributaries (except Clark's Creek) and the Puyallup River mainstem and SPC and the Carbon River.

## **4.3.5 Nisqually River**

Nisqually River fall Chinook spawn in the main stem of the Nisqually River from river mile (RM) 0 to RM 42 and in the Mashel River, which enters the Nisqually at RM 39.5, from RM 0 to RM 6.6. Chinook spawning the many smaller tributaries to the Nisqually River are believed to be of hatchery origin

### Mainstem Nisqually River surveys

Four surveys were conducted in the Nisqually mainstem index reach (RM 21.6 to 26.2) between September 22nd and October 14th. Live adults were observed during each survey and the peak count of 70 adults was observed on October 7th. Carcasses were recovered on all of the four surveys with the peak dead count of 15 observed on October 14th. A total of 38 adult carcasses were recovered from the mainstem. As indicated by missing adipose fin and/or the presence of a coded wire tag (CWT), 18 were of hatchery origin, 7 were unmarked and untagged, indicating natural origin, the origin of one unmarked fish without a head could not be determined, and 12 were not sampled.

### Mashel River surveys

Four surveys of the Mashel River index reach (RM 0 to 3.2) were conducted between September 9th and October 13th. A peak live count of 64 adults occurred on September 30th and October 6th. A peak dead count of 27 was observed on September 6th. During all Mashel River surveys 63 adult fall Chinook were recovered however only 46 were mark sampled; 36 were missing the adipose fin or were coded-wire tagged. .

## Total Escapement Estimate

The fall Chinook escapement estimate was calculated using the method developed by Herrington-Tweit and Newman (1986). The estimate is calculated as:

Escapement =  $6.81 * ((\text{peak live} + \text{dead Mashel index}) + (2.5 * (\text{peak live} + \text{dead Nisqually main stem index})))$

Based on the above equation the 2010 Nisqually River basin fall Chinook natural escapement estimate is 2,067 adults. Based on mark / CWT sampled, 54 of the 71 fish sampled were determined to be hatchery origin. The returning hatchery mark rate in 2010 was 96.3%. When corrected for unmarked hatchery origin natural spawners, the 2010 escapement is estimated to be comprised of approximately 1,586 (76.7%) hatchery-origin natural spawners and 481 (23.3%) natural-origin natural spawners.

## Discussion

The accuracy of this escapement estimation method has not been evaluated, so the estimates produced should be regarded as relative indexes of spawner abundance rather than total estimates of natural spawners. Also, the proportion of hatchery-origin spawners is likely higher than estimated, due to the disproportionate number of carcasses collected from the Mashel River. Ideally, carcass sampling would be proportionate to spawner abundance in the mainstem and the Mashel River.

## 4.4 Hood Canal

A summary of Chinook spawner escapement estimates for tributaries to Hood Canal during 2010 is provided in Table 36.

### 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 each river have been regularly surveyed in the Dosewallips and Duckabush since 1998, but few adults have been observed. Current escapement estimates are derived from a combination of counts of live Chinook adults and Chinook redds.

In the Hamma Hamma River, most of the Chinook spawning area is currently being surveyed. Since 1998, escapement was estimated from counts of cumulative new redds and/or from live Chinook using the area-under-the curve (AUC) method. A cooperative supplementation program was initiated in 1995 to rebuild Chinook abundance.

Table 36. Summary of Chinook escapement to Hood Canal streams during 2010.

Marine Area	Stream	Spawner escapement	Comment
--	Skokomish R.	701	Redd counts + AUC in Hunter Cr. Index
	N.F. Skokomish	325	Redd counts
	S.F. Skokomish	188	Redd counts
	Total	1214	
12A	Little Quilcene R.	0	No chinook
	Big Quilcene R.	0	No chinook
	Total	0	
12B	Dosewallips R.	15	Redd counts
	Duckabush R.	0	No chinook
	Hamma Hamma R. a/	67	AUC adjusted for broodstock
	Total	82	
12C	Dewatto R.	24	AUC
	Lilliwaup Cr.	5	Peak live+dead = 5
	Total	29	
12D	Tahuya R.	4	AUC
	Union R.	10	Trap
	Total	14	
<b>Hood Canal total</b>		<b>1339</b>	
a/ natural escapement = 43, broodstock = 24			

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).

During 2010, spawner surveys were conducted by WDFW 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 82 adults: 15, 0, and 67 Chinook in Dosewallips, Duckabush, and Hamma Hamma rivers, respectively. During 2010, 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 good.

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. Six Chinook redds, 5 live and 0 1 dead Chinook were observed and the escapement estimate is 15 Chinook in the Dosewallips River during 2010. The Duckabush River was surveyed from RM 0 to RM 2.6 and RM 4.8 to RM 6; Hatchery Creek, a tributary, was surveyed from RM 0 to RM 0.1. No Chinook redd and 0 live or dead adults were observed and the escapement estimate is 0 Chinook in the Duckabush River during 2010. 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 AUC escapement estimate is 67 Chinook in the Hamma Hamma (which includes 24 Chinook collected for broodstock) and no Chinook spawned in John Creek. Total escapement to the Hamma Hamma River system is estimated as 67 Chinook during 2010.

The FRAM preseason escapement estimate was 138 Chinook in Mid-Hood Canal during 2010 (FRAM 1010) while actual escapement was 82 Chinook. Chinook escapement on the Hamma Hamma River was comprised of about 78% supplementation-origin and 22% natural-origin spawners. The escapements to the Dosewallips River and Duckabush River were low as anticipated.

To better assess natural Chinook and chum production and productivity in Mid-Hood Canal rivers, a screw trap was installed on the Hamma Hamma River beginning in 2002 and a screw trap was installed on the Duckabush River beginning in 2008.

#### 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 17 (where Cushman Dam blocks further access). Natural escapement estimates are based on counts of Chinook redds in index areas 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). In addition, escapement estimates are made for Vance Creek and Hunter Creek. Since 2008, surveys have been conducted outside the index reaches from RM 2.2 to RM 5.5 in the South Fork, and are included in the total escapement estimate.

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 2010, however, Chinook were able to access the South Fork Skokomish throughout the season.

During 2010, total estimated spawner escapement is 1,214 Chinook in the Skokomish River system. Spawner escapement is comprised of 701 Chinook in the mainstem Skokomish (including 153 Chinook in Hunter Creek), 325 Chinook in the North Fork Skokomish, and 188 Chinook in the lower (RM 0 to RM 5.5) South Fork Skokomish (including 35 Chinook in Vance Creek).

The 2010 FRAM pre-season escapement prediction was 1,592 Chinook (FRAM 1010).

#### Hood Canal Chinook Mark Sampling

Mass marking has been implemented for Hood Canal hatchery Chinook, including releases from George Adams Hatchery, Hoodsport Hatchery, and Endicott Ponds. The proportion of all Hood Canal hatchery Chinook released that was either tagged and/or marked has incrementally increased since brood year 2003. For example, about 33%, 48%, 75%, 85% and 95% of brood year 2003 through brood year 2007 releases, respectively, were either tagged and/or marked. In addition, all of the Chinook released from the Hamma Hamma supplementation program were tagged and/or marked. These hatchery Chinook will return to Hood Canal predominately as age 3 and age 4 fish from 2006 through 2011.

Coded-wire tag (CWT) data and age and sex composition data have been routinely collected for Chinook returning to George Adams Hatchery since 1988 and Double Index tag groups of Chinook have been released since 1998.

More intensive sampling of Chinook on the natural spawning grounds has been done since 1998. During 2010, 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 during 2010.

Of the 123 Chinook sampled in Hood Canal rivers during 2010, 73 Chinook were adipose-marked and, of these, 1 Chinook had CWTs. No unmarked Chinook sampled in 2010 had CWTs. We sampled 7.5% of Chinook spawner escapement in the Skokomish River, 35.4% of the Mid-Hood Canal Chinook spawner escapement (in the Hamma Hamma, Duckabush, and Dosewallips rivers), and had an overall sampling rate of 9.2% in all Hood Canal rivers combined (Table 37).

Jacks are not included in Chinook spawner escapement estimates in Hood Canal, but few jacks were sampled during 2010.



Table 37. Spawner escapement and carcass sampling results for Hood Canal streams, 2010.

Management Unit	River	Spawner escapement	Chinook sampled		Tagged 1/			Untagged 1/			Unk. tagged 2/			Totals	
			Number	%	AD	NM	Unk	AD	NM	Unk	AD	NM	Unk	CWTs recovered	AD-clips observed
Skokomish	Mainstem Skokomish R.	701	65	9.3%	0	0	0	49	16	0	0	0	0	0	49
	N.F. Skokomish R.	325	21	6.5%	1	0	0	7	3	3	4	0	3	1	12
	S.F. Skokomish R. (lower)	188	5	2.7%	0	0	0	3	1	0	0	0	1	0	3
	<b>Skokomish River total 2/</b>	<b>1,214</b>	<b>91</b>	<b>7.5%</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>59</b>	<b>20</b>	<b>3</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>1</b>	<b>64</b>
12A	Big Quilcene R.	0	0	0%	0	0	0	0	0	0	0	0	0	0	0
	Little Quilcene R.	0	0	0%	0	0	0	0	0	0	0	0	0	0	0
12B	Hamma Hamma R. 3/	67	28	41.8%	0	0	0	6	22	0	0	0	0	0	6
	Duckabush R.	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0
	Dosewallips R. 4/	15	1	6.7%	0	0	0	0	1	0	0	0	0	0	0
	<b>Mid-Hood Canal total 5/</b>	<b>82</b>	<b>29</b>	<b>35.4%</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>23</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>6</b>
12C	Dewatto R.	24	2	8.3%	0	0	0	2	0	0	0	0	0	0	2
	Lilliwaup R.	5	1	0.0%	0	0	0	1	0	0	0	0	0	0	1
12D	Tahuya R.	4	0	0.0%	0	0	0	0	0	0	0	0	0	0	0
	Union R.	10	0	0.0%	0	0	0	0	0	0	0	0	0	0	0
	<b>Hood Canal total</b>	<b>1,339</b>	<b>123</b>	<b>9.2%</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>68</b>	<b>43</b>	<b>3</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>1</b>	<b>73</b>

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

2/ Of 91 adult chinook sampled, 64 (70.3%) were AD-clipped and/or CWTtagged; escapement of 1214 chinook in Skokomish River is partitioned as 360 natural-origin + 854 hatchery-origin.

3/ Releases from Hamma Hamma R. were otolith-marked; 21 of 27 adults (77.8%) sampled for otoliths were otolith-marked; so, escapement of 67 chinook in Hamma Hamma River is partitioned as 15 natural-origin (22.2%) and 52 hatchery-origin (77.8%).

4/ Escapement of 15 chinook in Dosewallips River is partitioned as 15 natural-origin + 0 hatchery-origin.

5/ Escapement of 82 chinook in Mid-Hood Canal is partitioned as 30 natural-origin (36.6%)+ 52 hatchery-origin (63.4%).

The proportion of hatchery fish in the spawning escapement will be estimated based on age composition in the escapement, sampling rate of the spawning escapement, and the proportion of hatchery production releases that was marked and/or tagged from BY 2005 (age 5), BY 2006 (age 4), and BY 2007 (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.

In the Skokomish River system during 2010, 64 of 91 (70%) Chinook sampled were adipose-marked (Table 37). A preliminary estimate is that spawning escapement in the Skokomish River was comprised of about 70% hatchery-origin Chinook and 30% natural-origin Chinook.

In Mid- Hood Canal, releases from the Hamma Hamma River supplementation program are 100% otolith marked and all Chinook carcasses were sampled for otoliths during 2010. In 2010, 21 of 27 (78%) Chinook sampled in the Hamma Hamma River were otolith-marked. Preliminary estimates are that spawning escapement was comprised of 78% supplementation (hatchery)-origin Chinook and 22% natural-origin Chinook in the Hamma Hamma River. During 2010, 0 Chinook were sampled in the Duckabush and 1 unmarked/untagged Chinook was sampled in the Dosewallips. Preliminary estimates are that spawning escapement for Mid-Hood Canal Chinook is comprised of 37% natural-origin and 63% hatchery-origin Chinook.

## 4.5 Strait of Juan de Fuca

### Dungeness

Since 1986, surveys have been conducted throughout the spawning season from RM 0 to 18.8 in the mainstem Dungeness, and from RM 0 to 5.0 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 2010, 136 redds (340 adults) were counted in the Dungeness and 2 redds (5 adults) were counted in the Gray Wolf for a total of 138 redds (345 adults). There were an additional 90 adults removed from the river for broodstock plus 22 surplus males at the Dungeness Hatchery, bringing the total estimated return to the river to 457, below the FRAM projected escapement of 535, and below the low abundance threshold of 500. The decrease 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 161 carcasses sampled for scales and checked for CWTs. The majority of the adults sampled for scales and CWTs were collected for broodstock. Very few carcasses could be recovered in the river due to the low natural escapement. Based on the CWT results and scale samples analyzed, the preliminary HOR/NOR composition for RY2010 was 77.9% HOR and 22.1% NOR. The age of the HOR Chinook for RY2010 consisted of 57.2% age 3, 40.8% age 4, 2.0% age 5, and no age 6. The age of the NOR Chinook consisted of 26.6% age 3, 60.6% age 4, 12.8% age 5, and 0.0% age 6. We recovered the following number of CWTs by age group: 56 age 3, 39 age 4, and two age 5. An additional 30 CWTs were recovered from age 2 Chinook.

### Elwha River

Chinook spawning in the Elwha is limited to the 4.8 miles below the dam, with most natural spawning concentrated between RM 2.8 and 4.4. Adult escapement in the mainstem is estimated by producing an AUC estimate of redd-days, which is divided by an assumed 21-day redd life to estimate total redds. That total is added to the number of redds counted in the 1-mile long Hunt's Road side channel index surveyed by the Lower Elwha Klallam Tribe. This redd total is multiplied by 2.5 to estimate total adults. For RY2010, the estimate of natural spawning Chinook was 564. An additional 644 Chinook were removed from the river by gaff and used as broodstock for the hatchery program. A total of 65 Chinook volunteered into the hatchery trap and were also used as broodstock for the hatchery. In addition, five hatchery pre-spawn mortalities were observed bringing the total return to the river to 1,278 Chinook, very close to the FRAM prediction of 1,261. WDFW field staff collected 288 otolith samples. Otoliths were collected to help distinguish between hatchery and wild fish based on the presence or absence of otolith marks. Of the 288 samples, 253 had an otolith mark present (87.8%), 22 (7.6%) had no otolith mark present, and 13 (4.5%) otoliths could not be read.

Using scale and otolith samples, the age composition consisted of 529 (41.4%) age 3, 139 (10.9%) age 4, 610 (47.7%) age 5, and 0.0% age 6.

## 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 one peak survey in the mainstem Hoko River from RM 2.8 to RM 3.4 and six surveys from RM 3.4 to 10.2 during the 2010 return year. Makah Fisheries Management (MFM) surveyed the mainstem Hoko upstream of RM 10.2 and the Hoko tributaries. Survey conditions were poor after the November 11 survey 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.

Redd counts are multiplied by 2.5 adults/redd to estimate natural escapement. The 2010 Chinook terminal run size was estimated to be 793 adults, below the FRAM prediction of 1,781. The escapement estimates for the upper mainstem Hoko River (RM 10.1 to 21.7) and all tributaries and lower mainstem Hoko River (RM 2.8 to 10.1), were 62 and 258, respectively. MFM staff collected 473 adult Chinook for broodstock and scale samples. Of the 473, 417 were males and 56 were females.

The age of the HOR Chinook for RY2010 consisted of 21 (4.5%) age 2, 373 (79.0%) age 3, 61 (12.9%) age 4, 15 (3.2%) age 5, 2 (0.4%) age 6, and no age 7. The age of the NOR Chinook consisted of 12 (3.7%) age 2, 258 (80.1%) age 3, 42 (13.1%) age 4, 10 (3.1%) age 5, no age 6s and age 7s. The estimated 2010 Chinook age composition was follows: 33 (4.1%) age 2, 631 (79.6%) age 3, 103 (13.0%) age 4, 24 (3.0%) age 5, 2 (0.3%) age 6, and no age 7s.

## 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. Chinook that are sampled for CWT's are also sampled for biological data (scales, length, sex). Rates from 2009 are presented here. Sampling rates in commercial fisheries were generally good (Table 38), with approximately 26,700 Chinook sampled for CWT, compared to total catch of around 89,400. Hood Canal (areas 9A, 12-12H & Skok R) and South Sound Marine (13 -13F) were the areas with the most substantial catches, but with sampling rates below 20%. All marine area recreational fisheries were sampled at rates between 10% and 50% for the year (Table 39), with the exception of Area 13. A total of 9,440 were sampled from an estimated 34,768 caught.

Table 38. Chinook coded-wire tag sampling rates for commercial fisheries in 2009 (calendar year).

### Net Catch

Area	Catch	Sampled	Rate
4	2	0	0.000
5	96	0	0.000
4B	3	0	0.000
6D	9	0	0.000

7	487	132	0.271
7A	527	306	0.581

7B	4873	2631	0.540
7C	5866	2837	0.484
7D	66	2	0.030
Nooksack R	580	84	0.145

8	130	60	0.462
8A	88	22	0.250
8D	1442	573	0.397
Skagit R	5657	3752	0.663

### Troll Catch

	Catch	Sampled	Rate
4B	6869	2736	0.398
5	2852	1572	0.551

Area	Catch	Sampled	Rate
10	3	1	0.333
10A	779	535	0.687
10E	728	195	0.268
10F	757	522	0.690
Green R	5254	2697	0.513
Puyallup R	2045	250	0.122
White R	118	0	0.000

13A	5400	238	0.044
13C	3517	29	0.008
13D	129	14	0.109
13F	6606	0	0.000
Nisqually R	14052	4528	0.322

9A	22	2	0.091
12A	69	0	0.000
12B	20	0	0.000
12C	4377	654	0.149
12D	288	35	0.122
12H	10443	2066	0.198
Skokomish R	6018	1047	0.174

Table 39. Chinook coded-wire tag sampling rates for marine recreational fisheries in 2009 (calendar year).			
Catch Area	Catch	# Sampled	Sample Rate
Area 5 - West SJF	8,179	2,244	27.4%
Area 6 - East SJF	2,965	815	27.5%
Area 7 - San Juan Islands	4,769	1,238	26.0%
Area 8.1 - Skagit Bay	634	197	31.1%
Area 8.2 - Port Gardiner	1267	563	44.4%
Area 9 - Admiralty Inlet	5,519	1,281	23.2%
Area 10 - Central Puget Sound	4,602	1,793	39.0%
Area 11 - Central Puget Sound	4,062	1,015	25.0%
Area 12 - Hood Canal	1,369	218	15.9%
Area 13 - South Puget Sound	1,402	76	5.4%

## 6 Literature Cited

- 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.
- 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.
- 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. 2011. 2010 Summer Mark-Selective Recreational Chinook Fisheries In Marine Areas 5, 6, 9, 10, 11, and 13, Post-season Report DRAFT. Olympia, WA. 88 pages.

## **Appendices**

### **Appendix 1. 2009-2010 Co-Managers' List of Agreed Fisheries (May 1, 2009 – April 30, 2010)**