WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
PUGET SOUND TREATY INDIAN TRIBES **June 2005**

Comprehensive Management Plan for Puget Sound Chinook ~ Harvest Management Component

Annual Postseason Report 2004-05 Fishing Season

June 28, 2005

Northwest Indian Fisheries Commission

Washington Department of Fish and Wildlife

Annual Postseason Report

Puget Sound Chinook
Comprehensive Harvest Management Plan

2004-05 Fishing Season

Washington Department of Fish and Wildlife
and
Puget Sound Treaty Indian Tribes[1]

June 28, 2005

[1] Jamestown S'Klallam Tribe, Lower Elwha S'Klallam Tribe, Lummi Nation, Makah Tribe, Muckleshoot Tribe, Nisqually Tribe, Nooksack Tribe, Port Gamble S'Klallam Tribe, PuyallupTribe, Sauk-Suiattle Tribe, Skokomish Tribe, Squaxin Island Tribe, Stillaguamish Tribe, Suquamish Tribe, Swinomish Tribal Community, Tulalip Tribes, and Upper Skagit Tribe; Point No Point Treaty Council, Skagit River System Cooperative, and Northwest Indian Fisheries Commission.

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Chief Editors

Teresa Scott

Washington Department of Fish and Wildlife

Will Beattie

Northwest Indian Fisheries Commission

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Tribes

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Northwest Indian Fisheries Commission

Craig Bowhay, Bill Patton, Amy Seiders

Washington Department of Fish and Wildlife

Mark Baltzell, Captain Michael Cenci, Lee Ayn Dyer, Steve Foley, Tasha Geiger, Angelika Hagen-Breaux, Lee Hoines, Kirt Hughs, Chad Jackson, Karen Kloempken, Curtis Kraemer, Larrie LaVoy, John Long, Don Noviello, Terrie Manning, Susan Markey, Doug Milward, Deb Naylor, Laurie Peterson, Bruce Sanford, Jim Scott, Sheila Smith, Steven Thiesfeld.

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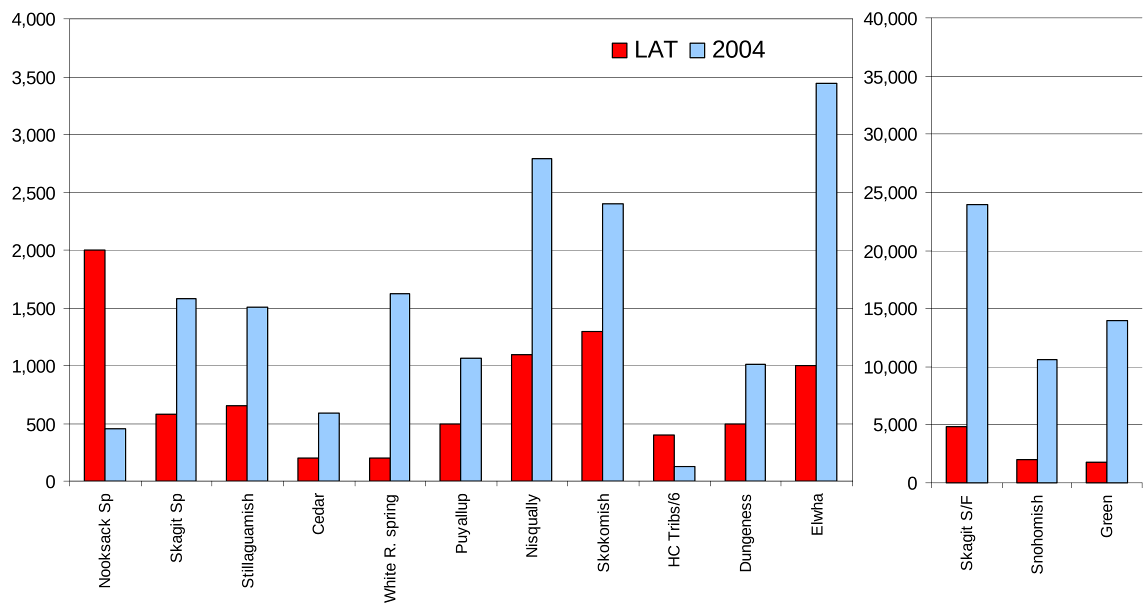
Executive Summary

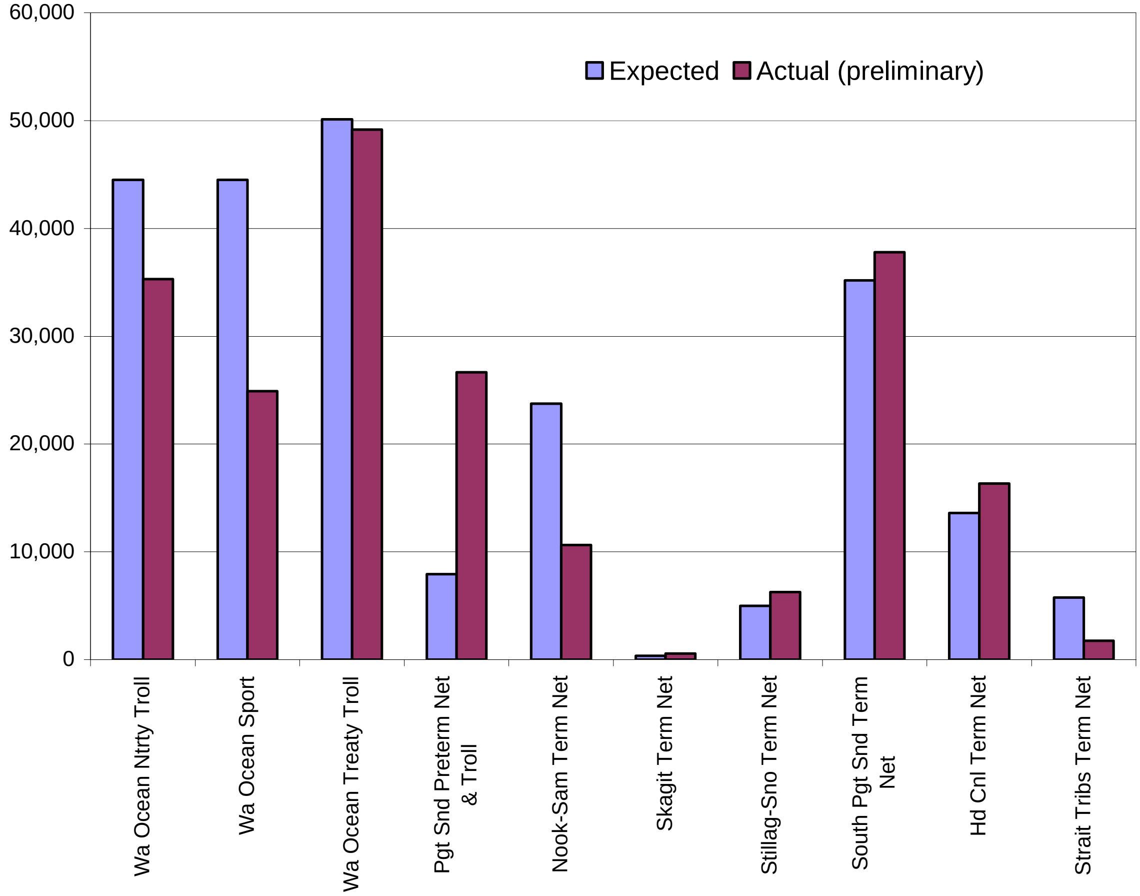
Management Year 2004 (May 2004 through April 2005) presented inconsistent fishery and population outcomes. Actual escapement was lower than projected for the Nooksack, Stillaguamish, Puyallup fall, White River spring, Mid-Hood Canal and Elwha management units. Nooksack, mid-Hood Canal, and Dungeness management units each returned at levels below the HMP Low Abundance Threshold (Figure 0-A), as was predicted preseason. Nooksack, Snohomish, mid-Hood Canal, and Dungeness units were managed for Critical Exploitation Rate Ceilings in the 2004-05 season.

Figure 0-A
2004 Escapement in Relation to CCHMP Low Abundance Threshold (LAT)



Fisheries were conducted as anticipated preseason, but catches in some of those fisheries exceeded preseason predictions. Overall, catches in major fisheries impacting Puget Sound Chinook were higher than expected preseason. Canadian impacts exceeded preseason projections by 30%. Puget Sound fisheries posted mixed results, but in the aggregate exceeded expectations by 9%. Pre-terminal net and troll fishery catch exceeded preseason predictions due to higher-than-anticipated treaty troll effort and success, and greater impacts during U.S. preterminal sockeye fisheries (Figure 0-B). Catches in the individual terminal areas of Skagit, Stillaguamish-Snohomish, South Puget Sound and Hood Canal terminal areas were higher than preseason projections, commensurate with higher-than-forecast run sizes of hatchery and/or natural Chinook there. Chinook harvests in the Nooksack-Samish terminal area were far below preseason expectations, matching the low returns of hatchery fall Chinook in that area.

Figure 0-B
Comparison of Preseason Predicted Catches with Preliminary Postseason Catch



In terms of fishery monitoring, most, if not all, sampling goals were met throughout Puget Sound, and the numbers of enforcement hours in the 2004 management year were up dramatically from previous years.

Overall, implementation of 2004 fisheries resulted in escapement higher or equal to projections for most stocks, with few exceptions. It is too soon to determine whether deviations in catch made a difference in total exploitation for the affected populations. This evaluation will be the subject of focused analysis, methods for which will be determined in the coming year.

1. Introduction

The Co-managers' Puget Sound Chinook Harvest Management Plan (HMP) mandates an annual report documenting the performance of Chinook harvest management relative to the standards and guidelines of the plan (Appendix A). The present 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:

- Population guidelines, preseason projected exploitation rates and preliminary postseason spawning escapements

- Fishery descriptions, including preseason projected catch and preliminary postseason catch estimates, and information about inseason regulation changes

- Recent historic exploitation rates, catches and spawners

- Descriptions of monitoring programs, including sample rates.

The annual management plan implementation period extended from May 1, 2004, through April 30, 2005 - the time period referred to as the "2004-05 management year". Although preliminary spawning escapement estimates and harvest numbers for net fisheries for 2004-05 are available, review of these estimates is still underway and further adjustments are expected. Therefore, ALL 2004-05 SEASON DATA PROVIDED IN THIS REPORT ARE TO BE CONSIDERED PRELIMINARY and subject to revision.

This report will not contain all of the information necessary to review plan performance for the most recent management year. Puget Sound recreational fishery harvest estimates that come from catch record cards are not available because the process of collecting catch records, data input, editing and analysis takes almost two years to complete. The exploitation rates on cohorts that contributed to 2004-05 fisheries cannot be calculated until requisite data are compiled.

Final recent-historic recreational catch and exploitation rate information will be reported in subsequent reports with a retrospective review of plan performance. This year's report will provide a historic perspective of recreational catches through 2003, and exploitation rates for the 1998-2000 management years.

2. 2004-09 HMP Management Objectives

Rebuilding Exploitation Rates (RERs), Critical Exploitation Rate Ceilings (CERCs) and spawner thresholds for 2004-05 fisheries, from Tables 1 and 3 of the 2004-09 HMP, are presented in Table 2-A. Discussion of derivation for these objectives can be found in the HMP document itself, with population details provided in HMP appendices.

In particular, “true” estimates of RER have been adjusted for some units based on assessments indicating that some bias may be expected with use of the Fishery Regulation Assessment Model (FRAM) tool. These adjustments are described in the management-unit-specific chapters in Appendix A to the CCHMP (Appendix A).

Note that, while Western JDF is included in the Puget Sound Chinook HMP, it is not included in the Puget Sound Chinook ESU, and is therefore not evaluated within this report.

Table 2-A 2004-09 HMP Guidelines

Management Unit	RER	CERC	Upper Management Threshold	Low Abundance Threshold
Nooksack [1,2]	under dev	7% / 9% SUS	4,000	
North Fork[1]			2,000	1,000
South Fork[1]			2,000	1,000
Skagit summer / fall	50%	15% SUS even-years;	14,500	4,800
Upper Skagit summer				
Sauk summer				
Lower Skagit fall				
Skagit spring	38%	18% SUS	2,000	576
Upper Sauk				
Cascade				
Suiattle				
Stillaguamish[1]	25%	15% SUS	900	650
North Fork summer[1]			600	500
South Fork & MS fall			300	na
Snohomish[1]	21%	15% SUS	4,600	2,000
Skykomish[1]			3,600	1,745
Snoqualmie[1]			1,000	521
Lake Washington	15% PTSUS	12% PTSUS		
Cedar River[1]			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[3]	under dev		1,100	
Skokomish[4]	15% PTSUS	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 JDF[5]	<10% SUS	6% SUS	850	500

Source: 2004-09 HMP Tables 1 and 3.

[1] Thresholds expressed as natural-origin spawners

[2] Expected SUS rate will not exceed 7% in 4 out of 5 years (See HMP Appendix A)

[3] Terminal fishery managed to achieve 1,100 natural spawners

[4] The threshold escapement of 800 natural and/or 500 hatchery (See HMP Appendix A)

[5] Western JDF is not included in the Puget Sound Chinook ESU, and is not evaluated within this report.

3. Predicted and actual spawning escapement estimates

This section summarizes natural Chinook spawning escapement in 2004 to each of the Puget Sound management units. Escapement is compared with levels projected by FRAM at the conclusion of pre-season planning (Table 3-A) to provide a preliminary assessment whether escapement objectives were achieved. Escapement estimates for 2004 are preliminary for all units, and subject to further revision. HMP objectives are also presented for comparison purposes.

There are a number of reasons why actual escapements may not match preseason expectations; the two most common are inaccurate preseason projections of fishery harvest and/or inaccurate preseason abundance forecasts. There can be many variations on these two themes, for example, the forecasted abundance may be correct, but the age structure is very different (causing fishery mortality to deviate from model predictions). Both the predicted spawning escapement and the actual escapement are estimates, and both are based on a number of assumptions - only if all the assumptions are accurate, or at least close to the actual values, will model predictions accurately reflect actual harvest and escapement. Furthermore, both of these predictors are based on historic information. If the historic information is not correct and/or if it does not reflect current conditions, then predictions would likely deviate significantly from actual events. For example, preseason forecasts based on escapements during periods of good ocean conditions will over-estimate when poorer conditions prevail. The majority of Chinook forecasts do not currently include marine or freshwater survival parameters; instead they rely on recent historical survival or abundance.

3.1 2004 Spawning Escapements

Table 3-A provides estimated escapement of Puget Sound natural spawning populations (in management units), accompanied by their “low abundance thresholds” (LAT) along with the 2004 FRAM model predictions.

Nooksack, Stillaguamish, Puyallup fall, White River spring, Mid-Hood Canal and Elwha each returned at less than preseason spawning escapement predictions. Nooksack, mid-Hood Canal and Dungeness units returned at levels below the HMP Low Abundance Threshold, as was predicted preseason.

Table 3-A
2004 HMP objectives, projected escapements and preliminary escapement estimates

	Management Unit	HMP Upper Management Threshold	HMP Low Abundance Threshold	Preseason Predicted Escapement	Preliminary Actual Escapement Estimates	Percent Change from Preseason Prediction
✸	Nooksack[4]	4,000		570	448	-21%
	North Fork	2,000	1,000		318	
	South Fork	2,000	1,000		130	
	Skagit summer/fall	14,500	4,800	20,507	23,778	16%
	Upper Skagit summer		2,200	16,355	20,135	
	Sauk summer		400	1,148	443	
	Lower Skagit fall		900	3,574	3,200	
	Skagit spring	2,000	576	1,184	1,575	33%
	Upper Sauk		130	406	700	
	Cascade		170	344	380	
	Suiattle		170	433	495	
	Stillaguamish	900	650	1,891	1,506	-20%
	North Fork summer	600	500		1,358	
	South Fork & MS fall	300	na		148	
✸	Snohomish	4,600	2,000	9,341	10,606	14%
	Skykomish	3,600	1,745		7,616	
	Snoqualmie	1,000	521		2,990	
	Lake Washington[1]			414	730	76%
	Cedar River	1,200	200		587	
	Green	5,800	1,800	5,898	13,991	137%
	White River spring	1,000	200	1,705	1,626	-5%
	Puyallup fall	0	500	2,149	1,065	-50%
	South Prairie Creek	500			573	
	Nisqually	1,100		2,079	2,788	34%
	Skokomish	3,650 aggregate; 1,650 natural	1,300 aggregate; 800 natural	1,262	2,398 natural	90%
✸	Mid-Hood Canal[4]	750	400	298	129	-57%
✸	Dungeness[4]	925	500	461	1,014	120%
	Elwha[2]	2,900	1,000	2,310	2,075	-10%

Management Unit	HMP Upper Management Threshold	HMP Low Abundance Threshold	Preseason Predicted Escapement	Preliminary Actual Escapement Estimates	Percent Change from Preseason Prediction
Western JDF[3]	850	500	557	955	71%

Sources: Predicted escapement:FRAM Chin1604 4/11/2004;

Actual escapement: Pers. Comm. Bruce Sanford, 3/19/04, per WDFW and Puget Sound Indian Tribes

[1] Includes only the Cedar River portion of the Lake Washington Management Unit

[2] Includes escapement to both natural spawning grounds and to the hatchery

[3] Western JDF is not included in the Puget sound chinook ESU, and is therefore not evaluated within this report.

[4] These stocks are in Critical Abundance status

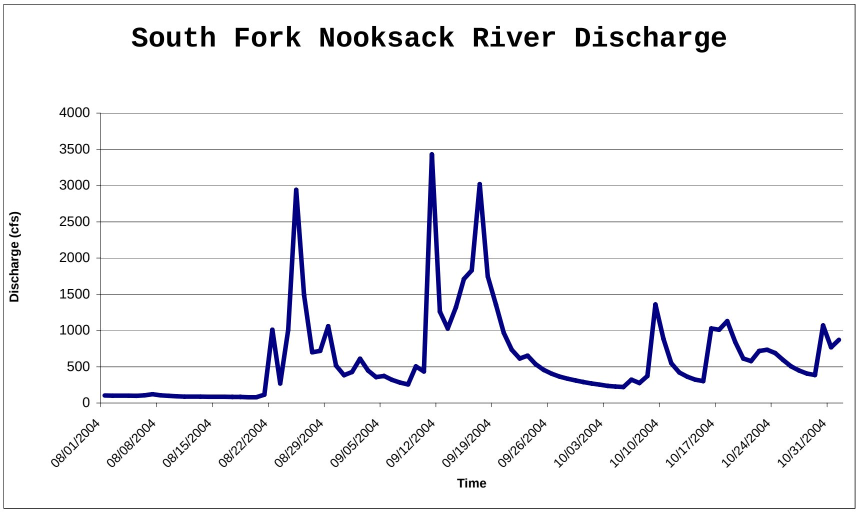
✸ Managed for Critical Exploitation Rate Ceiling (CERC) in 2004-05

3.1.1 Nooksack

The total Nooksack spring Chinook escapement estimate of 448 (north and south fork populations) shown on Table 3-A represents natural-origin recruits (NOR), as estimated from CWTs, otoliths and adipose clips. These are two distinct populations; North Fork NOR escapement was the highest in ten years, though still well below the critical threshold. South Fork NOR escapement, however, was nominally lower than in recent years, but there is substantial uncertainty about the estimate. North Fork Chinook have been supplemented with off-station hatchery releases for a number of years, resulting in large escapements of hatchery-origin recruits (HOR). In 2004 the HOR estimated return was 1,746, which comprised 85% of the total return to the North Fork. The high proportion of HORs is evidence of a very successful hatchery supplementation program, but very poor natural survival. (Bruce Sanford, WDFW, 5/4/05)

Escapement methodology for the South Fork works very well during years of good visibility. In 2004, however, the number of redds counted flattened out due to high flows and very poor visibility, and poor visibility also led to very few carcass recoveries. A high percentage of the escapement came from fish in Hutchinson Creek, where surveying conditions were undoubtedly somewhat better. Survey results are not expanded for periods when surveys could not be done, or when survey conditions were poor. During and after freshets, the South Fork is slower to clear than the glacial forks. River flow fluctuated from about 80 cfs to about 3,000 cfs at Wickersham gage, and repeated flow spikes occurred through the early Chinook window (Figure 3-A). A review of the survey data (% seen) revealed a number of instances when poor viewing conditions were noted. It is anticipated that actual escapement was higher than the estimates based on these survey data. The best estimate of natural production available at this time indicates that productivity is better in the South Fork than the North Fork. (Alan Chapman, Lummi, and Ned Currence, Nooksack, 5/4/05)

Figure 3-A
South Fork Nooksack River Discharge; Summer-Fall 2004



3.1.2 Skagit and Snohomish

Escapements of upper Skagit summer and Snohomish summer/fall Chinook have exhibited upward trends in recent years. The total return of the three Skagit stocks was 2.5 times greater than in 2003, and 60% greater than the 2000-2003 average. In the Snohomish system, the combined total (hatchery and natural origin included) escapement to the Skykomish and Snoqualmie Rivers was about 70% greater than in 2003 and 50% greater than the 2000-2003 average (Bruce Sanford, WDFW, 5/4/05). Both Snohomish populations have shown an increasing trend, but 2004 escapement to the Skykomish River was markedly higher than in recent years (Table 3-C) though this increase is due largely to increasing hatchery-origin returns; natural-origin returns have not improved, due, apparently, to habitat-related productivity constraints in freshwater.

3.1.3 Stillaguamish

Stillaguamish Chinook returned at 80% of the FRAM prediction. Conditions in 2004 were extremely difficult for spawning surveys with heavy turbidity and high water throughout most of the survey period. Ideally, a minimum of three flights on the Stillaguamish are necessary to construct an adequate redd curve to determine the total number of Chinook redds. However, an abnormal flood event in early September delayed surveys until the end of the month. This flood was followed by smaller rain events that activated slides along the SF Stillaguamish River, creating conditions too turbid for aerial observation. As a result only one flight was conducted on the SF Stillaguamish River and this flight came before the expected spawning peak. In addition to the limitations on the main stem, the tributary indexes were surveyed at half the preferred coverage level. Actual escapement, therefore, substantially exceeded the escapement estimate for the Stillaguamish. (Bruce Sanford, WDFW, 5/4/05)

The preseason forecast for Stillaguamish includes a natural origin component and a hatchery-origin component. The projected escapement number computed by FRAM is for the natural-origin component only. The post-season escapement estimate comprises all fish that actually spawned in natural spawning areas. Escapement in addition to this includes fish that were removed as broodstock for the Stillaguamish supplementation program. Both of these groups are mixtures of natural- and hatchery-origin fish. (Kit Rawson, Tulalip, 4/29/05)

Tribal and WDFW biologists believe that actual escapement exceeded the 2004 estimate. (John Drotts, Stillaguamish, 4/29/05)

3.1.4 Green

Green River Chinook returned at much higher levels than predicted. Green River management unit is characterized by a high HOR composition. (Bruce Sanford, WDFW, 5/4/05)

3.1.5 Puyallup

Natural fall Chinook escapement to the Puyallup River was estimated to be 1,065, which was significantly lower than 2,149 projected pre-season by the FRAM Both these numbers are a composite of natural- and hatchery-origin fish. The escapement estimate is based on surveys of the South Prairie / Wilkeson Creek tributary system, where clear water usually allows accurate counts. Expansion of these index surveys to the system total involves uncertainty, because glacial flour in the mainstem prevents accurate counts, and the proportion of total spawners in the South Prairie system is unknown. Tributaries in the upper basin, above Electron Dam are now being colonized by Chinook, since fish passage has been built at the dam.

The apparent shortfall in actual escapement was due, largely, to under-estimation of terminal fishing effort by FRAM. This problem has been addressed, in part, in subsequent versions of the terminal module. However, terminal harvest rates are difficult to predict because of high variance in fishing success in past years.

Escapement to the South Prairie system in 2004 exceeded 500 fish, a level that has been identified by the co-managers to provide adequate seeding of the system in the interim period while escapement methods are improved and system capacity is better understood. (Chris Phinney, Puyallup Tribe, 5/03/05).

3.1.6 White River Spring Chinook

According to the ACOE Mud Mountain Dam Weekly Fish Reports (available online), a total of 2,082 Chinook (1,414 adults and 668 jacks) were hauled upstream in 2004. Three possibilities exist for the number of NORs being less that predicted: fewer fish were in the return than were forecast, harvest exceeded the 0.20 ER, or more springs than normal spawned below the trap. The model prediction for escapement does not address the dichotomy between spring and fall. (Paul Hage, MIT, 5/3/05)

Based on MIT records, the upstream adults consisted of 1,182 NORs and 232 HORs. The upstream jacks consisted of 254 NORs and 414 HORs. There were also 22 NOR adults that were taken (and not returned) from the Buckley Trap for incorporation into the White River Hatchery broodstock. The NORs taken for the hatchery are in addition to the 1,414 adults hauled. (Richard Johnson, MIT, 5/3/05)

3.1.7 Nisqually

The escapement estimate for the Nisqually River was higher than in recent years - 2.5 times the 2000-2003 average. Though the same index areas were surveyed as in previous years, survey effort was higher in 2004. Freshets during the spawning period, however, probably had a more significant effect on escapement, causing Chinook to migrate quickly into and through the lower river, where the fishery occurs, and up onto the spawning grounds. Mark sampling in the Mashel River, which is thought to support the largest percentage of natural origin natural spawners, showed that about 50% of naturally spawning fish were hatchery strays. Uncertainty exists around the escapement estimate, which is based primarily on surveys of clear water tributaries. Glacial four complicates surveys in the mainstem, so the expansion of tributary counts to the entire system creates uncertainty. The expansion factor in current use was developed before the large-scale hatchery enhancement programs came on line. (Craig Smith, Nisqually Tribe, 6/10/05)

3.1.8 Mid-Hood Canal

Chinook productivity is critically depressed in the mid-Hood Canal watersheds, Hamma Hamma, Dosewallips and Duckabush (Bruce Sanford, 5/4/05). In 2004, no adult Chinook or redds were observed in the Duckabush River. An estimated 80 adults spawned in the Dosewallips River and 49 in the Hamma Hamma River. High numbers of chum spawning in these rivers may obscure Chinook redds, and introduce uncertainty into the survey data. A local hatchery supplementation program has been operating in the Hamma Hamma River, but few marked adults have been recovered, either from this program or those originating from George Adams Hatchery indicator stock program. The proportion of hatchery origin Chinook spawning in Mid Hood Canal rivers cannot be estimated, because local hatchery production is not mass marked.

3.1.9 Dungeness and Skokomish

These populations returned at much higher levels than predicted. However, both exhibit high HOR composition, which likely accounts for the unpredictability of estimating natural spawners. Regarding the Dungeness, the upward trend that is being exhibited is due to HOR returns and not increases in NORs. The HOR composition in 2003 for

Dungeness Chinook was estimated at 86%. For 2004, the HOR composition was 81%. (Bruce Sanford, WDFW, 5/4/05)

3.1.10 Elwha River

Escapement to the Elwha River was less than the number predicted by the FRAM run. However, spawning abundance was double the critical threshold, and pre-spawning mortality was very low. The estimate of returns to the rearing facility and of natural spawner abundance was technically as good as in previous years. Lacking estimates of pre-terminal ER or total abundance, we cannot yet determine whether fishery impacts exceeded the projected level in the SUS or Canada, or the whether the forecast was inaccurate. (Doug Morrill, Lower Elwha Klallam Tribe, 5/2/05)

3.2 Spawning Escapement Trends

Spawning escapements for most populations and management units have increased in the past decade, some dramatically (Figure 3-B). However, performance varies greatly between units.

Increases for some species are dramatic, but their significance is tempered by total abundance: For example, the apparent dramatic increase for Dungeness reflects a difference between 1,014 in 2004 compared with only 65 in 1994. While this increase is dramatic and welcome, these numbers are still low relative to Viable Salmonid Population (VSP) criteria for abundance.

In contrast, a jump in over 18,000 natural Skagit summer/fall spawners between 1994 and 2004 demonstrates success for that unit. Other units, such as Nooksack spring, are showing minimal progress (Figure 3-C).

Figure 3-B
Percent Change in 2004 Spawning Escapements from 1994

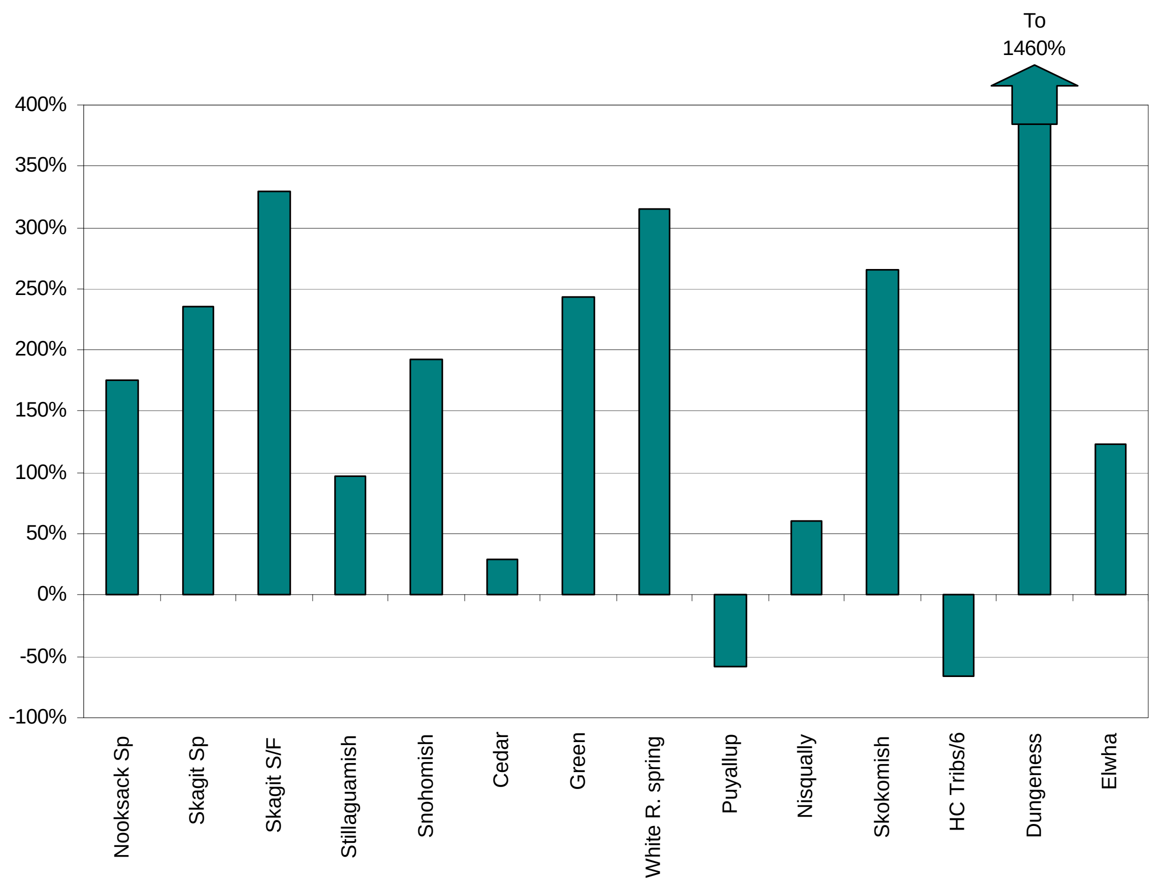


Figure 3-C
Skagit S/F, Nooksack, & Dungeness Spawner Trends – 1994-2004

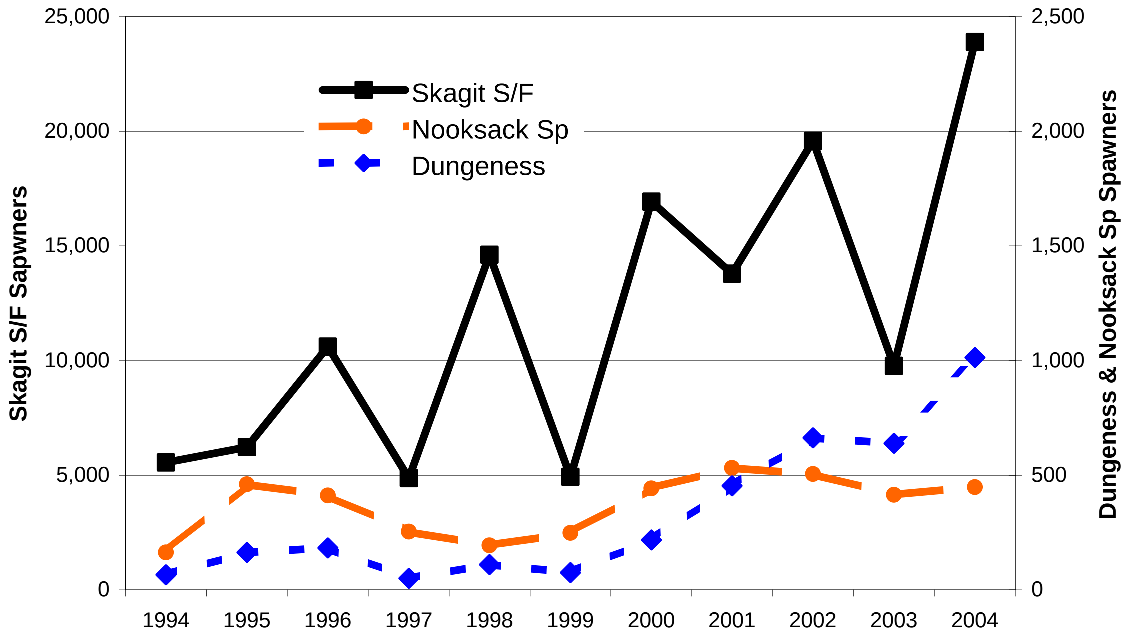


Table 3-B Historic Puget Sound Spawning Escapements by Population

	1984-1993 Avg [1]	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Nooksack Spring	527	163	461	412	254	194	249	443	532	506	414	448
NF Nooksack *	253	45	171	209	74	37	85	160	264	224	210	318
SF Nooksack	274	118	290	203	180	157	164	283	268	282	204	130
Skagit Spring	na	470	855	1,051	1,041	1,086	471	1,021	1,856	1,065	844	1,575
Cascade sp	na	173	225	208	308	323	83	273	625	340	298	380
Upper Sauk sp	na	130	190	408	305	290	180	388	543	460	193	700
Suiattle sp	na	167	440	435	428	473	208	360	688	265	353	495
Skagit S/F	10,987	5,561	6,226	10,613	4,872	14,609	4,924	16,930	13,793	19,591	9,777	23,891
Lower Sauk	726	112	278	1,103	295	460	295	576	1,103	910	1,493	443
Upper Skagit	8,012	4,565	5,948	7,989	4,168	11,761	3,586	13,092	10,084	13,815	7,123	20,145
Lower Skagit	2,249	884	0	1,521	409	2,388	1,043	3,262	2,606	4,866	1,161	3,303
Stillaguamish	883	763	775	1,244	1,156	1,540	1,098	1,622	1,349	1,588	988	1,506
North Fork Stillag.	753	667	599	993	930	1,292	845	1,464	1,066	1,253	883	1,358
South Fork Stillag.	145	96	176	251	226	248	253	158	283	335	105	148
Snohomish	3,908	3,626	3,176	4,851	4,295	6,304	4,799	6,092	8,164	7,220	6,214	10,606
Snoqualmie	1,051	728	385	1,032	1,937	1,892	1,344	1,427	3,589	2,895	1,975	2,990
Skykomish	2,857	2,898	2,791	3,819	2,358	4,412	3,455	4,665	4,575	4,325	4,239	7,616
North LWash tribs [1]	307	436	249	33	67	265	537	227	459	268	212	143
Cedar [2]	692	452	681	303	227	432	241	120	810	369	562	587
Green	6,622	4,078	7,939	6,026	9,967	7,312	11,025	6,170	7,975	13,950	10,042	13,991
White R. Spring	165	392	605	628	402	320	553	1,523	2,000	803	1,434	1,626
Puyallup	1,809	2,526	2,701	2,444	1,554	4,995	1,988	1,193	1,915	1,590	1,173	1,065
South Prairie Ck [2]		798	1,408	1,268	667	1,028	1,430	695	1,154	840	740	573
Nisqually	819	1,730	817	606	340	834	1,399	1,253	1,079	1,542	627	2,788
Skokomish	1,714	657	1,398	995	452	1,327	1,817	843	1,794	1,479	1,125	2,398
Mid-HC Tribs [3]	298	384	103	24	6	287	762	438	322	95	194	129
Dungeness	179	65	163	183	50	110	75	218	453	663	640	1,014
Elwha	4,240	1,546	1,812	1,875	2,527	2,409	1,629	1,959	2,208	2,376	2,305	3,443
Hoko	768	429	929	1,253	868	1,156	1,690	700	946	686	1,100	954

Footnotes:
[1] North Lake Washington Tributaries: Minimum estimate; does not include counts from index added in 2000
[2] Cedar estimates do not incorporate new redd-count methodology; South Prairie Ck. Counts = minimum spawner estimate
[3] Includes Hamma Hamma, Dosewallips and Duckabush
* Natural-origin recruits only

4. Exploitation Rates

Table 4-A shows the results of preseason planning for the 2004-05 season relative to the HMP exploitation rate objectives. Nooksack, Snohomish, mid-Hood Canal, and Dungeness units were managed for Critical Exploitation Rate Ceilings in the 2004-05 season. 2004-05 predicted exploitation rates all were less than or equal to the associated HMP Objective.

Table 4-A
2004-05 Preseason ERs and HMP ERs

Management Unit	HMP RER	HMP CERC	2004 Management Objective	Preseason Projected ERs /a	Percentage Point Difference
✸ Nooksack[1]	under dev.	7% SUS	7% SUS	6% SUS	-1%
Skagit summer / fall	50%	15%	50%	38%	-12%
Skagit spring	38%	18% SUS	38%	33%	-5%
Stillaguamish	25%	15% SUS	25%	23%	-2%
✸ Snohomish	21%	15% SUS	15% SUS	13% SUS	-2%
Lake Washington	15% PTSUS	12% PTSUS	15% PTSUS	10% PTSUS	-5%
Green	15% PTSUS	12% PTSUS	15% PTSUS	10% PTSUS	-5%
White River spring	20%	15% PTSUS	20%	19%	-1%
Puyallup fall	50%	12% PTSUS	12% PTSUS	10% PTSUS	-2%
Nisqually	under dev.	na	na	na	na
Skokomish	15% PTSUS	12% PTSUS	15% PTSUS	12% PTSUS	-3%
✸ Mid-Hood Canal[1]	15% PTSUS	12% PTSUS	12% PTSUS	11.5% PTSUS	-0.5%
✸ Dungeness[1]	<10% SUS	6% SUS	6% SUS	5% SUS	-1%
Elwha	<10% SUS	6% SUS	<10% SUS	4% SUS	-6%
Western JDF	<10% SUS	6% SUS	<10% SUS	5% SUS	-5%

Source: FRAM Chin1604; 4/11/2004

✸ Managed for Critical Exploitation Rate Ceiling (CERC) in 2004-05.

1 These stocks are in Critical Abundance status.

Table 4-B
FRAM Calibration Exploitation Rates by Population and Year

Management Unit	83-89 avg.	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL Adult Equivalent Exploitation Rates												
Nooksack early[1]	43%	30%	34%	34%	30%	27%	23%	18%	21%	15%	16%	16%
Skagit Sp natural	62%	48%	63%	56%	46%	50%	46%	44%	41%	28%	21%	30%
Skagit S/F nat[2]	66%	50%	54%	63%	65%	57%	60%	32%	38%	24%	33%	24%
Stillaguamish S/F	52%	44%	36%	41%	27%	27%	40%	34%	29%	14%	19%	25%
Snohomish S/F nat[2]	59%	49%	51%	60%	60%	47%	62%	42%	29%	23%	30%	25%
White River Sp[3]	46%	31%	44%	30%	22%	43%	31%	31%	20%	19%	25%	17%
Puyallup River	74%	66%	65%	67%	69%	69%	76%	67%	60%	36%	74%	72%
Preterminal Southern U.S. Adult Equivalent Exploitation Rates												
Hood Canal S/F	31%	25%	21%	40%	36%	45%	22%	26%	30%	9%	9%	13%
JDF Tributaries S/F	42%	45%	50%	30%	23%	26%	20%	29%	15%	10%	26%	37%
Lake Washington	26%	26%	27%	32%	24%	17%	15%	17%	19%	7%	8%	10%
Green River	26%	26%	27%	32%	24%	17%	15%	17%	20%	7%	8%	10%

Source: Chinook FRAM: 2002 calibration; 05/20/03 version (*gyy8; time4AEQfix*)

[1] "Nooksack Early" stock comprises an aggregation of North Fork and South Fork Early ("Spring" or "Native") stocks.

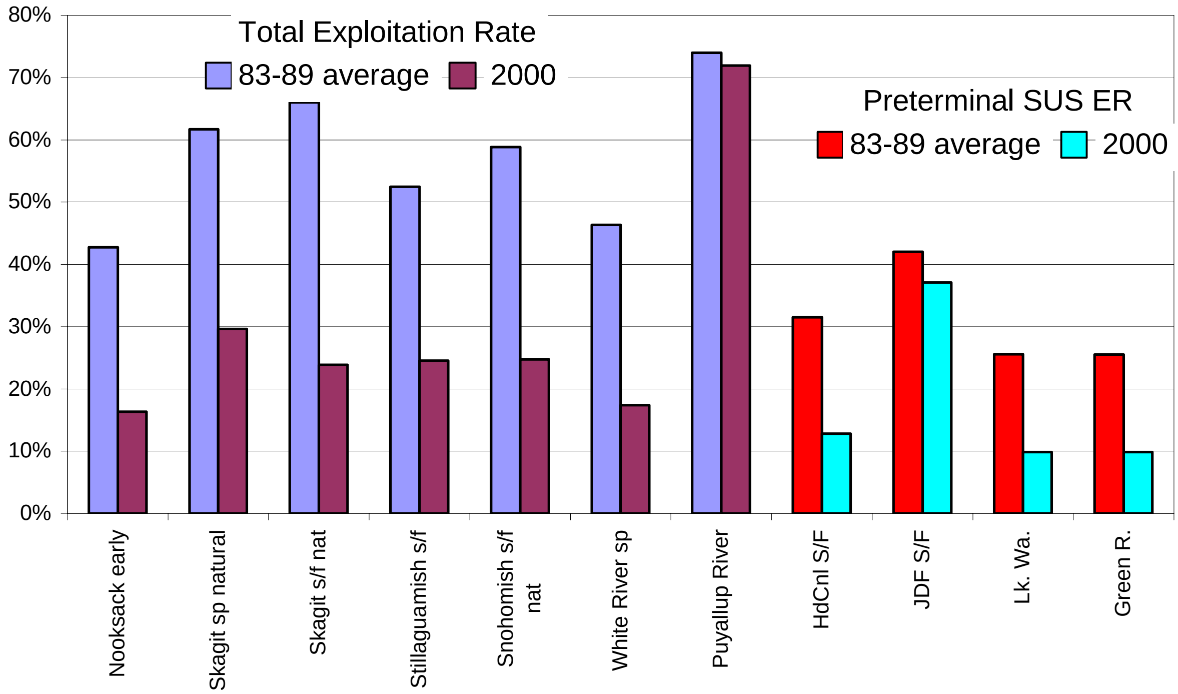
[2] Only the portion of Skagit and Snohomish fingerling and yearling stocks representing wild Chinook are presented in this table.

[3] "White River Spring" stock is represented by fingerlings originating from the White River.

4.1 Exploitation Rate Performance Review; Trends

Table 4-B presents total exploitation rate estimates for Puget Sound management units, taken from FRAM calibration. Estimates indicate a profound downward trend in exploitation throughout the 1990s. Exploitation for management units in the year 2000 range from 11% to 71% below the 1983-89 average exploitation rate (Figure 4-A).

Figure 4-A
Comparison of 2000 FRAM Exploitation Rates with the 1983-89 Average



4.2 Exploitation Rate Assessment

Success of the CCHMP is dependent upon whether its implementation promotes recovery. The key management approach in the CCHMP is the use of exploitation rate based objectives in preseason fishery decisionmaking. Therefore, one of the most important performance measures for the Plan, in terms of plan effectiveness and validation, is to assess whether actual exploitation rates met the Plan objectives (RERs or CERCs). Secondarily, managers need confidence that the tools employed for preseason decisionmaking accurately predict exploitation rate expected for an adopted annual fishing regime.

4.2.1 Did the management of fisheries achieve exploitation rates that were less than or equal to exploitation rate objectives in the Plan?

4.2.1.1 Comparing FRAM postseason estimates with Plan Objectives

The most immediate method of assessing the success of Plan implementation is to review postseason estimates of exploitation computed using FRAM. Actual postseason fishery catch estimates are input to the model, substituting for poreseason expected values, and exploitation rates (ER) for all management units are computed based on those postseason catch estimates. Exploitation rates computed using this method are then compared with Plan objectives (RER or CERC), and with pre-season projections. The strength of this method is the ability to employ the same modeling tool to predict outcomes using forecast assumptions and to compute outcomes using actual fishery and escapement data.

Annual postseason ERs are estimated through the FRAM calibration and validation process. It is anticipated that this post-season FRAM exercise will be conducted in at least three or four year intervals, concomitant with periodic re-calibration of the model. Re-calibration of the model is necessary when model strata and algorithms are changed or when new or updated CWT and abundance data are available. Historical abundance and catch data of the newly-recalibrated model produce an updated historical time series of annual exploitation rates (so-called FRAM validation runs).

Validation runs are made beginning with the 1983 management year (May 1983 – April 1984 season) and extend through the most recent year for which complete catch and escapement data are available (i.e. usually two years previous). The most recent re-calibration currently available was conducted in 2002, and extended post-season analyses through management year 2000 (May 2000 – April 2001; **Table 4-B**). The next re-calibration is expected to be completed in the fall of 2005, and will update post-season assessment through management year 2003.

4.2.1.2 Comparing CWT-based exploitation rates with Plan Objectives

FRAM-computed ERs represent estimates that are based on (“base-period”) assumptions for stock distribution, age structure and other variables that are representative of base period data. CWT-based ERs are considered more useful for extensive fishery performance evaluation because they more accurately reflect values for those variables on an annual fishery basis. CWT brood-year ERs, derived from cohort analysis of coded-wire tag recoveries, are then compared with Plan Objectives (RER or CERC) as a second measure of the success of plan implementation.

Methods for developing CWT-based ERs are still under consideration, and vary by management unit and population. The PSC Chinook Technical Committee (CTC) performs an annual exploitation rate analysis, values from which may be compared with RERs. Alternatively, the methods embodied in the Technical Recovery Team’s (TRT)

“Abundance and Productivity” (A&P) tables provide a source for cohort reconstruction, and age-specific ERs. Both the CTC and A&P methods rely on coded-wire tag (CWT) data to estimate fishing mortality. Methods used initially to develop RERs may also be useful in evaluating annual performance.

It is important to ensure that methods implemented are feasible (given the expertise, priorities and time available), relevant (consistent with methods used to develop management criteria), and provide continuity with other ongoing evaluations (such as those conducted by the CTC and TRT). Once those methods are established, it is anticipated that the co-managers will conduct these plan validation analyses at regular intervals, for example, every five years (as was indicated in the CCHMP).

4.2.2 How well does our primary fishery management decisionmaking tool predict exploitation rates?

Managers must periodically confirm that ERs predicted using our primary decisionmaking tool (FRAM) match, or exhibit a consistent relationship with, CWT rates, which we assume for analysis purposes to be the “true” rates. This is accomplished by comparing CWT-based brood-year exploitation rates with the ERs estimated postseason by FRAM on a management-year basis. In some cases, where CWT recovery data is not available or is not representative of natural migrants, FRAM may provide a better estimate of ‘true’ exploitation rate.

If the relationship between CWT-based exploitation rates and FRAM estimates shows a consistent bias, then a conversion factor is used to translate RERs into FRAM terms. Conversion factors are routinely evaluated and may be modified on a periodic basis. Such an adjustment would alter the CCHMP management objective employed for preseason planning.

FRAM and CWT ER estimates can differ considerably due to variations in age structure, maturation rates, stock distribution, escapement estimates, and other variables.

4.2.2.1 Differences in age structure and maturation rates

As previously noted, CWT-based constructions use age composition from escapement sampling or CWT-recoveries, whereas FRAM relies on ‘base-period’ age composition for most stocks. Differences in age structure and maturation rates affect estimates of natural mortality, harvest mortality and escapement.

4.2.2.2 Differences in harvest distribution

FRAM refers to base-period CWT data to form stock distribution. This may differ sharply from the catch distribution described by CWT recoveries from a given year’s fisheries. Difference in harvest distribution also affects estimates of indirect mortality.

4.2.2.3 Differences in escapement

Because exploitation rates for Puget Sound Chinook are quite low, the majority of CWT recoveries occur as spawning escapement in hatcheries or on spawning grounds. Unless CWT sampling programs at hatchery racks and spawning grounds accurately represent total escapement, exploitation rate estimates will be biased.

4.2.2.4 Correlating FRAM with CWT-based ERs

Bias in FRAM ERs may be difficult to detect because of the high degree of annual variability. However, if consistent bias appears in the FRAM estimates, actions will be taken as necessary to either buffer or adjust management objectives used for fishery planning. Demonstrating a significant correlation between CWT and FRAM estimates, even one that demonstrates consistent bias, will support the continued use of FRAM as a prediction and compliance monitoring tool.

5. 2004-05 Commercial Fisheries & Catch Summary

5.1 Introduction to Commercial Seasons

During April, 2004, comanagers completed development of the 2004-05 Management Year fishing seasons for treaty and nontreaty salmon fisheries in the ocean north of Cape Falcon and in Puget Sound (*2004-05 State/Tribal Agreed-to Fisheries Document*; PSIT and WDFW, 4/12/04; Appendix B, and excerpted within report). These regulations were expected to achieve management objectives for all Puget Sound Chinook management units. Catch quotas were imposed on coastal troll and recreational fisheries, whereas time-area restrictions were defined for Puget Sound recreational and commercial fisheries. For two management units, Green and Nisqually, monitoring programs provided inseason estimates of abundance that enabled adjustment of fisheries, when necessary, to ensure achievement of HMP objectives.

To ease interpretation, Table 5-A provides a legend of common abbreviations used throughout this document, primarily in the tables, and Table 5-B provides a crosswalk from management week numbers to their corresponding dates. Management Weeks run from Sunday through Saturday, with Management Week 1 being the first week to include a January date.

Table 5-A
Common Abbreviations

Abbreviation	Translation	Abbreviation	Translation
GN	Gillnet	MSF	Mark-Selective Fishery
PS	Purse Seine	NR	Non-Retention
RN	Reefnet	Wk	Mgmt Week Number (Sun-Sat)
RH	Round Haul	NLM	Non-Landed Mortality
SN	Setnet	TM	Total Mortality
T	Treaty	NT	Nontreaty
C&S	Ceremonial & Subsistence Fishery	SAF	Special Area Recreational Fishery
Ck	Chinook	Pk	Pink
Cm	Chum	Sh or Sthd	Steelhead
Co	Coho	Sox	Sockeye

Table 5-B
Management Week Numbers for 2004

Wk No.	Week Beginning Sun	Through Sat	Wk No.	Week Beginning Sun	Through Sat	Wk No.	Week Beginning Sun	Through Sat
1	28-Dec-03	3-Jan-04	19	2-May	8-May	37	5-Sep	11-Sep
2	4-Jan	10-Jan	20	9-May	15-May	38	12-Sep	18-Sep
3	11-Jan	17-Jan	21	16-May	22-May	39	19-Sep	25-Sep
4	18-Jan	24-Jan	22	23-May	29-May	40	26-Sep	2-Oct
5	25-Jan	31-Jan	23	30-May	5-Jun	41	3-Oct	9-Oct
6	1-Feb	7-Feb	24	6-Jun	12-Jun	42	10-Oct	16-Oct
7	8-Feb	14-Feb	25	13-Jun	19-Jun	43	17-Oct	23-Oct
8	15-Feb	21-Feb	26	20-Jun	26-Jun	44	24-Oct	30-Oct
9	22-Feb	28-Feb	27	27-Jun	3-Jul	45	31-Oct	6-Nov
10	29-Feb	6-Mar	28	4-Jul	10-Jul	46	7-Nov	13-Nov
11	7-Mar	13-Mar	29	11-Jul	17-Jul	47	14-Nov	20-Nov
12	14-Mar	20-Mar	30	18-Jul	24-Jul	48	21-Nov	27-Nov
13	21-Mar	27-Mar	31	25-Jul	31-Jul	49	28-Nov	4-Dec
14	28-Mar	3-Apr	32	1-Aug	7-Aug	50	5-Dec	11-Dec
15	4-Apr	10-Apr	33	8-Aug	14-Aug	51	12-Dec	18-Dec
16	11-Apr	17-Apr	34	15-Aug	21-Aug	52	19-Dec	25-Dec
17	18-Apr	24-Apr	35	22-Aug	28-Aug	53	26-Dec	1-Jan
18	25-Apr	1-May	36	29-Aug	4-Sep			

The following figure shows generalized 2004-05 fishing schedules and restrictions for Washington ocean and Puget Sound nontreaty commercial fisheries. Information for Puget Sound tribal fisheries, as well as details for nontreaty commercial fisheries, are detailed in sections 5.3 through 5.9. Note that area-specific details, such as sub-area closures, are not included in this figure, and may be found in the State-Tribal Agreed-to Fisheries Document (Appendix B). Standard nontreaty commercial closures and restrictions are available at the WDFW Puget Sound Commercial Salmon Fisheries web site at http://wdfw.wa.gov/fish/regs/commregs/salregs.htm.

Figure 5-A
2004-05 Nontreaty Anticipated Commercial Salmon Fishing Seasons

Note: Numbers within cells refer to numbers of days open per week

Fishing Area	Gear	May	Jun	Jul				August					Sep				Oct				Nov					Dec	
Week Beginning		2	6	4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12
Week No		19	24	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
1-4	Troll																										
6,7,7A	PS/GN																	2	2	2	2						
7	Reefnet													7	7	7	7	7	7	7	7	7					
6D	Skiff GN														4	5	5	5	5	5							
7B,C	PS/GN								*	1/1	1/3	1/3	3	3	7	7	7	7	7	5	5	5	5	5	5		
8	PS/GN								*	*	*																
8A	PS/GN								*	*	*	*				1/0	1/1	1/3	1/3	2/4	1/3	2/3	1/3	2/3			
8D	PS/GN								*	*	*	*			1/3	0/3	1/3	1/3	1/3	2/4	1/3	2/4	1/3	2/4			
10/11	PS/GN																	1/3	1/3	2/3	1/3	1/3	1/3	1/3			
9A	PS/GN										2	7	7	7	7	7	7	7	7	7							
12,12B	PS/GN																		1/3	2/3	1/3	1/3	1/3				
12C	PS/GN																					3	3	3			

Legend & Footnotes: 2004-05 Nontreaty Commercial Salmon Fishing Seasons

	Closed		Hatchery Chinook-directed
	PFMC Control: Coho MSF quota; Chin guideline; Release chum through 9/30		Coho Mgt Period (coho-directed)
	Fraser Panel control (sockeye mgt period)		Chum Mgt Period (chum-directed) (Red in August indicates summer chum)
* * * *	Chinook Mgt Period	Reefnet	Area 7 coho fishery: chin NR; unmarked coho NR through 9/30; chum NR through 9/30
Purse Seines	Chin NR; in all areas except 7B,C Chinook-directed openings Area 7, 7A, 10, 11, &7B prior to 9/5 Coho NR; Area 7,7A Chum NR through 9/30	Gillnets	Area 7,7A week 42 chum fishery: live box, limited soak time

5.2 Introduction to Commercial Catch

This section compares estimates of projected and landed commercial Chinook catch for the 2004-05 management year.

Expected catch reflects either pre-season quotas or catch projected by the final pre-season Chinook FRAM run (Run #1604). For the purposes of comparing preseason to postseason catch, figures in this document show landed catch only, except where noted. Projected landed catch is taken from a FRAM landed catch table (as transferred to the to the TAMX table in the report-generating spreadsheet TAMM); unmarked and marked estimates are summed. Because of this, projected catch figures appearing in this document will not match the figures provided in most of the preseason FRAM reports, since the latter provide total mortality estimates.

WDFW, the Northwest Indian Fisheries Commission, and individual tribes cooperate in tracking cumulative commercial catch by the non-Indian and Treaty Indian fleets, respectively, using Fish Receiving Tickets. “Fish Tickets” are documents recording sale from fisher to buyer. Information from fish tickets is summarized by WDFW and tribal staff and made available to fishery managers. This system enables tracking of catch for target species as well as species caught and retained incidentally.

Landed fishing mortality comprises a significant proportion of total fisheries mortality for Chinook. Non-landed mortality occurs when sub-legal Chinook are encountered and released, when regulations forbid the retention of Chinook. Commercial fishing gear causes additional non-landed mortality (e.g. troll drop-off, and net drop-out). Non-landed mortality is incorporated into preseason estimates of mortality (and, therefore, into projected exploitation and spawner rates), but 2004 estimates are not yet available for postseason use. Thus, postseason catch analyses compare projections of landed catch against the actual landed catch tabulated during the fishing season.

Separate evaluations of components of non-landed mortality estimates are conducted annually, and special studies add to the knowledge base feeding these estimates. For example, estimates are made for all ocean troll and recreational harvests and selected Chinook-release commercial fisheries. Additional discussion of monitoring and evaluation of commercial fishery non-landed mortality can be found in Section 5.10.

Preseason projections are made in consideration of differential impacts to natural and hatchery-origin Chinook, for some management units, however catch reporting does not provide hatchery/natural breakouts. Estimates of impacts to natural and hatchery fish, separately, are completed when runs are reconstructed postseason using information from commercial and sport catch data, information on catch in Canadian and Alaskan fisheries, and analyses of coded-wire tag recoveries (see section 4.2).

Conduct of each of the 2004-05 pre-terminal and terminal commercial fisheries is described below, highlighting any significant departures from pre-season expectations. Coastal troll and recreational fisheries, which were under the jurisdiction of the Pacific

Fisheries Management Council, and net and recreational fisheries in the Strait of Juan de Fuca and San Juan Islands-Georgia Strait are described with respect to their actual fishing schedule and current estimates of landed Chinook catch. Terminal fisheries for each Chinook management unit are also described, noting where in-season assessments of abundance informed management actions that may have resulted in changes from preseason intent.

Each section includes a table of preseason fishing schedules, followed by discussions of the conduct of seasons, summaries of expected catch and estimated actual landed Chinook catch, where such estimates are available, and discussions of specific fisheries, inseason abundance updates or studies conducted in each area.

5.2.1 Overview of Major Fisheries Affecting Puget Sound Chinook

Expected and actual Chinook catch for major fishery aggregates affecting Puget Sound Chinook are shown on Table 5-C. Overall, catches in fisheries impacting Puget Sound Chinook were higher than expected preseason. Canadian catch exceeded preseason projections by 30%. Increases in Canadian catch continue to be a serious problem facing the comanagers. For many Puget Sound management units, the majority of the total fisheries impact (including non-landed impacts) occurs in Canadian fisheries.

Puget Sound fisheries posted mixed results but, in the aggregate, exceeded expectations by 9%. Pre-terminal net and troll fishery catch far exceeded preseason predictions due to higher-than-anticipated treaty troll effort and success, and greater impacts during U.S. preterminal sockeye fisheries. Commercial catches in the individual terminal areas of Skagit, Stillaguamish-Snohomish, South Puget Sound and Hood Canal terminal areas were higher than preseason projections. Chinook harvests in the Nooksack-Samish terminal area were far below preseason expectations. Sections 5.3 through 5.9 provide discussions of circumstances in each of the groups of fisheries.

Beginning with Section 5.3, summaries of expected and preliminary actual landed Chinook catch for Puget Sound 2004-05 fisheries are provided, organized by management region. In general, preliminary estimates are available for all commercial harvest. Comparison of these estimates with pre-season expectations provides an initial assessment of the performance of this management regime. These estimates will be revised as agencies correct errors in the catch database.

Narratives are included for pre-terminal and terminal-area fisheries in Puget Sound, highlighting differences between the pre-season plan and inseason management in 2004-05. Natural Chinook are not significantly impacted by harvests in some terminal areas, for example, Tulalip Bay (Area 8D), Sinclair Inlet (Area 10E), Port Gamble and Quilcene Bays (Areas 9A and 12A), the Hoodsport Hatchery Zone (Area 12H), and Deep South Sound (Areas 13-13K), yet all terminal areas are included in this report, regardless of the level of impact to Puget Sound natural Chinook management units.

Table 5-C
Summary of 2004-05 Landed Catch in Major Fishery Aggregates

Fishery	FRAM 1604 Expected (landed)	Actual (preliminary)	Difference
Canadian North/Central BC, West Coast Vancouver Island, Georgia Strait Sport & Troll Fisheries	510,880	662,547	151,667
Washington[1] Ocean Nontreaty Troll (A-13)	44,500	35,300	-9,200
Washington[1] Ocean Recreational (A-18)	44,501	24,910	-19,591
Washington[2] Ocean Treaty Troll (A-15)	50,100	49,175	-925
Puget Sound Preterminal[3] Net & Troll	7,936	26,672	18,736
Nooksack-Samish Terminal Net	23,751	10,616	-13,135
Skagit[4] Terminal Net	366	567	201
Stillaguamish-Snohomish Terminal Net	4,974	6,253	1,279
South Puget Sound Terminal Net	35,171	37,803	2,632
Hood Canal Terminal Net	13,608	16,329	2,721
Strait Tribs Terminal Net	3	1	-2
Puget Sound Marine Sport[5]	42,844	na	na
Puget Sound Freshwater Sport[5]	9,610	na	na

Data sources include Pacific Salmon Commission Postseason reports; Pacific Fishery Management Council "Review" document appendix tables ("A-13" etc); and WDFW Fish Tickets (5/16/05)

[1] Catches are from Ocean areas 1-4 and include catches south to Cape Falcon, Oregon

[2] Catches in areas 2-4 and in Area 4B from May-September. May through September Area 4B troll managed with Area 4 ocean through PFMC

[3] Includes 4B, 5, 6 and 6C treaty troll catches that are not included under PFMC management (i.e. 4B from Jan-Apr & Oct-Dec; 5,6,6C from Jan-Dec)

[4] Non-landed (release) mortality estimates are provided on the Skagit detail table, below, but are not included in these values.

[5] Most Recreational catch estimates for Puget Sound marine and freshwater fisheries are not available until fall of the year following the end of the catch-record year. For this reason, estimates of catch by CRC area are not detailed in this table.

5.3 Strait of Juan de Fuca and San Juan Islands Preterminal Areas

A high northern diversion rate of Fraser sockeye caused U.S. sockeye fishing time in Areas 6, 7, and 7A to exceed the preseason expectation. Juan de Fuca troll effort and catch exceeded recent year expectation, and the fishery closed early.

5.3.1 Pre-terminal Agreed-to Fishing Schedules

Following is a summary of the fisheries planned for the 2004 season during the North of Falcon season-setting process.

Areas 5, 6, 6C Treaty Troll (Ntrty Closed)

NOTE: For Area 4B: 5/1-10/31 see Ocean Troll. For 11/1-12/31 and 1/1-4/15 see below

4/16/04-4/30/04	Closed
5/1-6/15	Closed
6/16-9/15	Open for salmon, chum release; Freshwater Bay, south of Angeles Pt./ Observatory Pt. line closed; Pt. Angeles Hbr. W. of line from tip of Ediz Hook to ITT Rayonier Dock closed; Hoko Bay closed, inside the area bounded by a line from Kydaka Point to Shipwreck Point; 1,000 foot closure around stream mouths; Area 6 closed east of line true north from Green Point.
9/16-4/15	Open for all salmon; in Area 6 chum release through 9/30; 1,000-foot closures around stream mouths

Areas 4B, 5, & 6C Treaty Net (Ntrty Closed)

Chinook	Open for setnet gear only, 6/16 through 8/14 in Areas 4B and 5 and 6C; 7 days a week; Hoko Bay closed, inside the area bounded by a line from Kydaka Point to Shipwreck Point and Freshwater Bay, south of Angeles Pt./ Observatory Pt. line closed. 1,000-ft. closure around stream mouths.
Sockeye	Start to be determined (7/18 est); end no later than 9/4.
Coho	Open for gillnets starting at 4 days per week (inseason adjustments based on cumulative catch) from the end of Fraser Panel control, through wb 10/3; 1,000 ft. closure around stream mouths. The gillnet catch number listed in FRAM #0419 will be used as management target and will not be greatly exceeded.
Chum	Open for gillnets, starting at 5 days per week (days may be added if effort is low), wb 10/10 through wb 11/7; 1,000-foot closure around stream mouths.

Areas 6, 7, & 7A Net

Chinook	All	Closed
Sockeye	Trty	Schedule to be determined. July, August ceremonial and subsistence fishery
	Ntrty	All vessel operators must complete best fishing practices certification prior to fishing. Schedule to be determined. Purse seine and reef net Chinook, coho, and chum NR.
Coho	Trty	Closed

	Ntrty All vessel operators must complete best fishing practices certification prior to fishing.	Reef net: 7 days/wk beginning end of Fraser Mgmt through chum mgmt Wk 46 (wb 11/7); Chinook NR; unmarked-coho release through 9/30, then coho non-selective. Chum retention prohibited until after 9/30. Subject to NOAA fisheries approval, retention of chum permitted 9/16 – 9/30 with a total harvest not to exceed 1,300 chum, with no more than 300 chum landed through 9/22.
Chum	Trty	Wks 42 (wb 10/10)-Wk 45 (wb 10/31); fishing pattern (3,3,3,3) dependent upon ISU and quotas.
	Ntrty All vessel operators must complete best fishing practices certification prior to fishing.	Wks 42 (wb 10/10) - Wk 45 (wb 10/31); Purse seine brailing required, Chinook and coho NR; GN Chinook and coho NR, live box, and limited soak time restrictions wk 42 only; fishing pattern: 2,2,2,2; dependent upon ISU and quotas. Reef nets through wk 46 (wb 11/7), 7 days per week through 11/13.
Subsistence	Trty	2/16-4/10 subsistence fishery

5.3.2 Preterminal Catch Summary Table

Table 5-D provides a preterminal, mixed-stock fisheries summary for Strait of Juan de Fuca and San Juan Islands fishing areas. Release requirements were applied to nontreaty commercial fisheries for Chinook, coho and chum salmon.

Table 5-D
Strait of Juan de Fuca – San Juan Islands Catch Summary

Fishery	Projected Landed Catch	In-Season Schedule	Actual Landed Catch	Postseason above or below preseason	Discussion
Areas 4B, 5, 6C Treaty Net	1,133	Open continuously, from noon 7/18-8/14; C&S 8/15	592	-541	
Area 4B, 5, 6C Troll Summer	1,457		562	-895	See Text
Winter	1,600	closed Feb. 3	19,559	17,959	
Areas 7/7A Treaty Net	2,750	Wb 7/25: 6 dys; Open continuously from 8/2-8/14;	5,232	2,482	See Text
Areas 7/7A Nontreaty Net	996	GN&PS Wk 31-33, 3-4-4, WK 42-46, 2-2-5-5-5	727	-269	Actual does not include 702 estimated purse seine nonlanded mortality (Table 5-R)

5.3.3 Preterminal Fishery Discussion

Some preterminal commercial Chinook catches exceeded preseason expectations.

5.3.3.1 Strait of Juan de Fuca Treaty Troll (Area 4B, 5, and 6C) Discussion

The 2004 – 2005 treaty troll fishery in the Strait of Juan de Fuca (Areas 4B, 5, and 6C) was planned to occur from June 15, 2004 through April 15, 2005 in Areas 5 and 6C, and from November 1, 2004 through April 15, 2005 in Area 4B. Area 4B is managed under ocean troll regulations during the months of May through September, and was closed for the month of October. Pre-season projected total catch for the Strait troll fishery was 2,650 Chinook. This projected total catch was calculated by averaging the last six years' catch for those months. The Makah Tribe closed the fishery on February 3, 2005, in order to limit catch to near 20,000. Total catch through February 3rd was 20,197 Chinook (Table 5-E).

Table 5-E.
Chinook catch during the 2004 – 2005 Treaty troll fishery in the Strait of Juan de Fuca.

Month	Catch Area		
	4B	5	6C
June-Sept		551	11
October		1168	0
November	6699	2564	0
December	7849	293	0
January	936	51	0
February	63	12	0
Total	15547	4639	11

(Dee McClanahan, Makah, and Amy Seiders, NWIFC; 3/25/05)

5.3.3.2 Fraser sockeye fishery summary

Treaty fisheries commenced in Areas 4B/5/6C on July 18 in accordance with the pre-season fishing plan. On July 26, treaty fisheries opened in Areas 6/7/7A. Two days later the first non-treaty fishery in Areas 7/7A was conducted. The following week (wb August 1), the U.S. continued treaty and non-treaty fisheries as planned. Northern diversion, meaning migration of sockeye through Queen Charlotte, Johnstone and Georgia Straits, rather than through the Strait of Juan de Fuca, was estimated at 70% early in the week and quickly rose to 90% by the end of the week. The week beginning August 8 was the last week major fisheries were planned in the U.S. As in prior weeks non-treaty fishers fished concurrent with treaty fishers in order to maximize effort. Non-treaty fisheries were open 4 days in week 33. The treaty fishery was open continuously. U.S. non-treaty and treaty commercial fisheries ended on August 13 and 14, respectively with an expectation of being consistent with True Late-run impact allowances and overall sockeye TAC.

Table 5-F
2004 U.S. Hours Fished and Sockeye Catches

Date	Non-Treaty 7/7A Net			Treaty		Sockeye Catch		
	GN	PS	RN	4B,5,6C	6,7,7A	Cumulative	Daily	Weekly
	Hours	Hours	Hours	Hours	Hours	Catch	Catch	Catch
18-Jul				12		0	0	6366
19-Jul				24		1054	1054	
20-Jul				24		1806	752	
21-Jul				24		3098	1292	
22-Jul				24		4515	1417	
23-Jul				24		5898	1383	
24-Jul				24		6366	468	
25-Jul				24		7271	905	57624
26-Jul				24	12	15614	8343	
27-Jul				24	24	22115	6501	
28-Jul	16	16	16	24	8	31781	9666	
29-Jul	16	16	16	24	20	45716	13935	
30-Jul	16	16	16	24	24	60015	14299	
31-Jul				24	8	63990	3975	
1-Aug			16	24		69999	6009	52743
2-Aug				24	20	78722	8723	
3-Aug	16	16	16	24	24	91993	13271	
4-Aug	16	16	16	24	24	97352	5359	
5-Aug	16	16	16	24	24	105252	7900	
6-Aug	16	16	16	24	24	112289	7037	
7-Aug				24	24	116733	4444	
8-Aug				24	24	122198	5465	78670
9-Aug				24	24	125610	3412	
10-Aug	16	16	16	24	24	135705	10095	
11-Aug	16	16	16	24	24	147536	11831	
12-Aug	16	16	16	24	24	165753	18217	
13-Aug	16	16	16	24	24	186411	20658	
14-Aug				24	24	195403	8992	
15-Aug				C&S		197029	1626	1626

Source: WDFW softdata 11/23/2004

Between July 18 and August 15, 197,000 sockeye were caught in U.S. waters. During this time period, Areas 4B/5/6C were open daily. The treaty fishery in Areas 6/7/7A was open for 19 days (including partial day openings) and the non-treaty fishery in Areas 7/7A was open for 11 days (12 days for reef nets). Given the high northern diversion of sockeye in 2004, the U.S. attempted to balance its goal of maximizing total U.S. sockeye catch and meeting domestic harvest sharing objectives. As a result, treaty fishers fished in common with non-treaty gill nets and purse seines during all non-treaty openings, with the exception of July 28, when the fishing time of the two fleets overlapped by only three hours. Separate treaty fishing days were also scheduled (Table 5-F). (Source: 2004 Annual Report of the Fraser River Panel, Pacific Salmon Commission, January 2005 – Angelika Hagen-Breaux, WDFW, 5/19/05)

5.3.3.3 Preterminal Treaty Net

Prediction of net fishery impacts on Chinook during fisheries directed at sockeye salmon has been problematic. At the time these preseason predictions are being made, the magnitude of the sockeye fishery is still unknown. This makes it difficult to predict how many days fishing will be open. Further, once the Chinook migration has begun, if more Chinook destined for Canadian rivers migrate through the Strait of Juan de Fuca than “average” (as opposed to down through the Strait of Georgia), then Chinook catches, albeit not of U.S.-origin fish, will be higher.

Another concern is that model predictions of catch and exploitation may not be taking into account the location of most of the fishing effort. It is widely believed that fish caught in more northerly portions of the San Juan Islands (SJI) areas are primarily of Canadian origin. Unfortunately, CWT recoveries used to predict impacts from this fishery have been consolidated for the entire SJI area, including both the northern and southern portions. Further study may be warranted in order to distinguish Chinook harvested in the northern SJI area (Area 7A) from the southern portion (Area 7). (Alan Chapman, Lummi, 5/4/05.)

Managers note this recurring under-prediction, but are reluctant to respond until it can be determined whether the difference between preseason predicted catch, which is loosely based on some historic average catch, and actual catch is significant for the stocks of concern. Answers to these and many other FRAM model validation and Plan evaluation questions will be pursued through the exploitation rate evaluation process described in Section 4.2 above.

5.4 Nooksack - Samish Terminal Area

In 2004, Nooksack River early Chinook escapement was projected to fall below the low abundance threshold of 2,000 (i.e. 1,000 in each of the North and South Forks). With from 67 to 87 percent of the harvest impacts on these stocks occurring in Canadian and Alaskan fisheries [Pacific Salmon Commission Joint Chinook Technical Committee Report TCChinook (04)-4], the comanagers have a limited ability to affect a reduction in the total exploitation rate on this management unit.

5.4.1 Nooksack-Samish Agreed-to Fishing Schedules

Following is a summary of the fisheries planned for the 2004 season during the North of Falcon season-setting process.

Bellingham Bay (Areas 7B, 7C, 7D; 7A On-Reservation) Net

Chinook	Trty	Areas 7B, 7C, & 7D: August 1 through September 4 (Wks 32-36), open weekly 4 PM Sunday to 4 PM Friday; closed south and west of a line from Oyster Creek to the fisheries marker on Samish Island, except that hand pull gill nets may fish from 4:00 PM Sunday - 4:00 PM Wednesday south to a line from Oyster Creek to Fish Point on Samish Island; fishing pattern: 5,5,5,5,5.
	Ntrty	Areas 7B & 7C: Wks 34 (wb 8/15)-Wk 36 (wb 8/29); PS limited to 4 boats/week with in-season adjustments. Subsequent seine openings dependent upon seine total catch in previous weeks; brailing required; PS coho and sockeye NR; PS fishing pattern: 1,1,1; GN wks 34-36; fishing pattern: 1,3,3.
Coho	Trty	Areas 7B, 7C: September 5 through October 23 (Wks 37-43), open Sunday 4 PM - Saturday 4 PM. 6,6,6,6,6,6,6.
		Areas 7B and 7D on reservation: September 5 through October 23 (Wks 37-43 open Sunday 4 PM through Saturday 4 PM. 6,6,6,6,6,6,6.
		7A on reservation fishery: September 26-October 23. Open 4 PM through Wednesday, 4 PM.
	Ntrty	Area 7B: Wks 37 (wb 9/5)-Wk 43 (wb 10/17); PS/GN; fishing pattern: 3,3,7,7,7,7,7.
Chum	Trty	Areas 7B, 7C, & 7D: October 24 - December 18 (Wks 44-51); open 3 days/wk. 3,3,3,3,3,3,3,3
	Ntrty	Area 7B: Wks 44 (wb 10/24)-Wk 49 (wb 11/28); PS/GN; 5 days/wk. Whatcom Creek Zone (east of line from Post Point to flashing red light at west entrance of Squalicum Harbor) open 7 days per week.
		Beach Seine: Wks 42 (wb 10/10)-Wk 46 (wb 11/7); 5 days/wk. E. of Governors Pt. to Bellingham airport.
Steelhead	Trty	Areas 7B, 7C, & 7D: December 16 - January 15 (Wks 51-53, Wks 1-3); open Sunday 4 PM through Friday 4 PM. 1,5,5,5,5

Nooksack River Treaty Net (Ntrty Closed)

NOTE: Nooksack Tribal river fishery openings will be 00:01 a.m. (Lummi openings at 4:00 p.m.) and will close at 4:00 p.m. (concurrent with Lummi), on a weekly basis.

Chinook	April, May; 7/2-3	April, May limited ceremonial/subsistence Chinook harvest as required. Harvest will not exceed 3 NOR (30 total) Chinook. 7/2-3; subsistence fishery, not to exceed 13 NOR (130 total) Chinook. Both the April, May and 7/2-3 fishery will occur in the north fork between Highway 9 bridge and Mosquito Lake Road Bridge (RM 36.6 to 40.8) and the Nooksack River between Slater Road Bridge and the river mouth (between river miles 0.0 and 3.5.
	8/1-9/4 (wks 32-36)	Open 4 PM Sunday and close 4 PM Friday, except wk 32 open 4 PM to Wednesday 4 PM. Fishing pattern: 3,6,6,6,6. The river is divided into five zones during this period. These zones open on subsequent weeks, proceeding upriver, to protect migrating spring Chinook.
Coho	9/5 - 10/23	Open Sunday 4 PM through Saturday 4 PM; 6 days/wk. 6,6,6,6,6,6,6
Chum	11/25-26	subsistence harvest

	10/24 – 12/18 (Wks 44-51);	Open 3 days/wk. 3,3,3,3,3,3,3,3.
Steelhead	12/16 – 1/15 (Wks 51-53; 1-3)	Open Sunday 4 PM through Friday 4 PM. 1,5,5,5,5.

5.4.2 Nooksack-Samish Terminal Catch Summary Table

Chinook harvests were lower than anticipated due to poor environmental conditions, minimal effort and a Samish fall Chinook return of less than preseason forecast.

Table 5-G
Nooksack-Samish Terminal Area Fisheries Summary

Fishery	Projected Landed Catch	In-Season Schedule	Actual Landed Catch	Postseason above or below preseason	Discussion
Areas 7B, 7C, 7D & Nooksack R. Treaty	14712		5605	-9107	
Area 7B, 7C Nontreaty Net	9039	Wk 34-36, GN 1-3-3, PS 1-1-1: Wk 37-49 GN&PS, 3-3-7-7-7-7-7-5-5-5-5-5-5	5011	-4028	Samish River Chinook run returned below PSF.

5.4.3 Nooksack-Samish Terminal Fisheries Discussion

Fishing conditions were poor in August and September due to local flooding in the Nooksack River. Hatchery fall Chinook returns were lower than forecast preseason, however hatchery broodstock collection goals were met. The Nooksack terminal area fisheries proceeded as expected with respect to effort and participation. The extended openings in the sockeye fishery reduced tribal effort in Bellingham Bay to the hard core fishers. (Alan Chapman, 5/4/05)

5.5 Skagit Bay and Skagit River Terminal Area

Chinook returns were higher than preseason forecast for both the hatchery spring and wild Chinook runs.

5.5.1 Skagit Agreed-to Fishing Schedule

Following is a summary of the fisheries planned for the 2004 season during the North of Falcon season-setting process.

Skagit Bay (Area 8) Net

[Note: Fishing schedules for Skagit Bay and Skagit River are preseason projections. Schedules may be changed in-season as necessary to meet management objectives.]

Chinook	All	Closed
Coho	Trty	Terminal Treaty HR target 20%
	Wks 39 – 43 (wb 9/19 - wb 10/17)	Swinomish fishing pattern: 2,2,3,3,2 Upper Skagit fishing pattern: 5.2,5.2,5.2,5.2,5.2
	Ntrty	Closed
Chum Test	Wks 44 - 45 (wb 10/24 -wb 10/31)	1 boat at jetty 2 day/wk 44 & 45, 1 boat in bay 1 day/wk 44 & 45.
Chum	Treaty	Closed
	Ntrty	Closed
Steelhead	Trty	Begins Wk 49 (wb 11/28).

Skagit River Treaty Net (Ntrty Closed)

Chinook	Areas 78C and 78D	closed
Sockeye	Area 78D:	Fishery dependent on ISU; If surplus, Upper Skagit open in Baker River down to Dalles Pool, Wk 28 (wb 7/4) – Wk 29 (wb 7/11), fishing pattern: 1,1, Chinook release, further openings depend on update.
Coho	Terminal Treaty HR target 20%.	
	Area 78C:	Swinomish - Wks 39 (wb 9/19) - Wk 43 (wb 10/17); fishing pattern: 2,2,3,3,2. Sauk-Suiattle – Wks 39 (wb 9/19) – Wk 43 (wb 10/17); fishing pattern: 5,5,5,5,5. Upper Skagit - Wks 39 (wb 9/19) - Wk 44 (wb 10/24); fishing pattern: 5.2,5.2,5.2,5.2,5.2,5.2; Chinook release through 10/11.
	Area 78D	Upper Skagit - Wks 39 (wb 9/19) - Wk 44 (wb 10/24); fishing pattern: 5.2,5.2,5.2,5.2,5.2,5.2. Chinook released or used for broodstock through 10/11; Skagit River closed above O'toole Creek.
Chum	Area 78C & D	Closed
River Test	Chinook	(Blakes) Wk 19 (wb 5/2)-Wk 35 (wb 8/22); 1 boat, 6 hours/wk.
	Coho	(Blakes & Spudhouse) Wk 34 (wb 8/15)-Wk 45 (wb 10/31); 2 boats, 12 hours/wk
	Coho	River Area 2 (78D)Wk 35 (wb 8/22)-Wk 44 (wb 10/24); 2 setnets, 24 hours/wk.
	Steelhead	Area 78D (Cockerham Island) Wk 50 (wb 12/5) – Wk 8 (wb 2/20); one drift gillnet, 4 hours /wk for scale composition data.
Steelhead	Swinomish / Sauk-Suiattle Area 78C	Begins Wk 49 (wb 11/28)

Upper Skagit Area 78D	Begins Wk 50 (wb 12/5)
Sauk-Suiattle	Sauk River begins Wk 1 (wb 1/2) mouth to Darrington Bridge. Lower 1 mile of Cascade River begins Wk 1 (1/2).

Swinomish Channel Treaty Net (Ntrty Closed)

Coho Closed unless Area 8 open

5.5.2 Skagit Terminal Catch Summary Table

Chinook encounters in the Skagit terminal area were greater than predicted preseason, primarily due to a higher-than-anticipated abundance of wild Chinook, evidenced by a wild spawning escapement that was 17% greater than forecast. In addition, rack returns of hatchery spring Chinook were 53% higher than forecast.

Table 5-H
Skagit Bay / Saratoga Passage (Area 8) and Skagit River (Areas 78C for lower, 78D for upper)
Projected and Actual Landed Catch and Total Mortality in 2004

Treaty Fishery	Preseason Projected			Post-season Observed/Estimated			Difference (Post-season minus Preseason)	
	Schedule	Landed Catch	Total Mortality	Schedule	Landed Catch	Total Mortality	Landed Catch	Total Mortality
Test:								
Chinook	1 site, wks 19-35	152	152	Same	205	205	53	53
Coho	3 sites, wks 34-45	137	137	Same	306	306	169	169
Baker Sockeye:								
Week 28	1 day	0	0	Same	0	0	0	0
Week 29	1 day	0	1	None	0	0	0	-1
Area 8/78C Coho:								
Week 39	2 days	25	28	Same	52	56	27	28
Week 40	2 days	26	27	4 days	4	4	-22	-23
Week 41	3 days	13	14	2 days	0	0	-13	-14
Week 42	3 days	6	6	3.167 days	0	0	-6	-6
Week 43	2 days	5	5	None	0	0	-5	-5

Treaty Fishery	Preseason Projected			Post-season Observed/Estimated			Difference (Post-season minus Preseason)	
Area 78D Coho:								
Week 39	5.167 days	0	22	Same	0	190	0	168
Week 40	5.167 days	0	11	0.5 days	0	0	0	-11
Week 41	5.167 days	0	21	None	0	0	0	-21
Week 42	5.167 days	0	0	None	0	0	0	0
Week 43	5.167 days	2	2	None	0	0	-2	-2
Week 44	5.167 days	0	0	None	0	0	0	0
Chum Fisheries:								
Area 8/78C	None	0	0	Wk 45: 1 day	0	0	0	0
Area 78D	None	0	0	Wk 45-6: 1.75-1.5	0	0	0	0
Total		**366**	**426**		**567**	**761**	**201**	**335**

Source: Bob Hayman, SRSC, 1/28/05

Note: No Nontreaty commercial fisheries were planned or conducted in Skagit Terminal Area

Although Sauk-Suiattle regulations in 2004 did not require Chinook release, it appears that, because release was required in previous years, the fishermen continued to release Chinook in 2004

* Daylight hrs open only in weeks 46-47; Sauk 3 daylight days wk 46

5.5.3 Skagit Terminal Fishery Discussion

Almost all Skagit terminal area impacts on Chinook were expected to occur during commercial fisheries targeted at coho salmon and during Skagit River test fisheries. Chinook release was required in Upper Skagit Tribal sockeye and coho fisheries (through week 41), Non-treaty purse seine fisheries, and river sport fisheries. Chinook retention was permitted in Swinomish gillnet fisheries, Sauk-Suiattle coho fisheries, Upper Skagit fisheries after week 41, and the test fisheries.

The Baker sockeye run was almost 2,000 fish under the preseason forecast; consequently, the Upper Skagit Tribal gillnet fishery was conducted for only 1 day (July 7-8), at the mouth of the Baker River. The sockeye run was three days earlier than the even year average, and sockeye catches (1666 sockeye) were very good on that 1 day. No Chinook were encountered (Table 5-H).

The coho run appeared to be somewhat larger than predicted preseason. Coho fisheries were conducted according to the preseason schedule during the first week, and Chinook encounters were higher than predicted. The Swinomish and Sauk-Suiattle schedules were increased the next week, and reduced the week after, and Chinook encounters decreased to less than predicted during those weeks. The Upper Skagit Tribe caught nearly their entire coho allocation in the first week of fishing, which caused their coho fishery to close weeks early. No Chinook could be retained during the Upper Skagit coho fishery (except those used for fall Chinook broodstock collection); however, because we estimated the Upper Skagit tribal Chinook impacts from the Chinook-to-coho ratio in the test fisheries (see below), and the tribal coho catch was huge (over 13,000), we estimated that Chinook release mortality in the Upper Skagit fishery was higher than predicted preseason. Eight of the Chinook encountered in the Upper Skagit coho fishery were used as broodstock for the fall Chinook indicator stock project.

The test fisheries were conducted essentially as scheduled, except that, due to floods, Blake's Drift Chinook test, Blake's Drift coho test, and the Spudhouse test were unfishable and/or cut short during week 35. During week 45 the Blake's Drift coho test, and the Jetty chum test were also cut short due to high water conditions. Chinook catches in the test fisheries were greater than projected preseason.

Skagit chum fisheries were conducted for more days than expected preseason, but no Chinook were caught in these fisheries.

It is estimated that there were 761 total Chinook mortalities (including non-retention mortalities) in Skagit terminal area net fisheries during the adult accounting period: 511 in test fisheries, 250 in coho fisheries, and none in chum or river sockeye fisheries. In comparison, it was projected preseason that there would be 426 total Chinook mortalities in Skagit terminal area net fisheries: 289 in test fisheries, 136 during coho fisheries, zero during chum, and 1 during the river sockeye fisheries. Thus, post-season estimated Chinook mortalities were 335 greater than what was projected preseason. This increase in mortalities was probably due in large part to the fact that the post-season estimate of terminal run size, 29,279 Chinook, was over 5,000 Chinook higher than the preseason forecast of 24,193. The post-season estimate of wild spawning escapement for all Skagit Chinook stocks, 25,353, was also considerably higher than the preseason forecast of 21,691. In addition, the rack return of hatchery spring Chinook was approximately 1,000 more than forecast – the preseason forecast of hatchery spring Chinook escapement was 2,037, compared to an observed hatchery rack escapement of 3,119.

Of the post-season estimated mortalities, 567 were landed catch. In comparison, it was projected preseason that the landed catch would be 366 in Skagit terminal area net fisheries. The remainder of the mortalities included releases during non-retention fisheries. The non-retention mortalities occurred during the Week 39 and 40 Upper Skagit and Sauk-Suiattle tribal coho fisheries, and were estimated by multiplying the tribe's coho catch by the Chinook/coho ratio in simultaneous test fisheries at the Spudhouse and Area 2. The preseason mortality rate (52.4% for gillnets) was applied to these encounters to estimate the applicable non-retention mortalities. (Bob Hayman, 1/28/05)

5.6 Stillaguamish and Snohomish Terminal Area

With the exception of Stillaguamish broodstock collection and area 8D fisheries directed at hatchery returns, encounters of Chinook in this terminal are were less than predicted preseason.

5.6.1 Stillaguamish-Snohomish Agreed-to Fishing Schedules

Following is a summary of the fisheries planned for the 2004 season during the North of Falcon season-setting process.

Area 8A Net

Chinook	Trty:	Closed (Ceremonial set-aside of up to 100 Chinook, July-September period)
	Ntrty	Closed
Coho	Trty	Wks 37 (wb 9/5)-Wk 42 (wb 10/10); 3 days per week. Update fishery weeks 37-40. Manage for CCMP breakpoints and rates.
	Test	Wk 37 – wk 42; 1 day per week, 2 GN landings per week.
	Ntrty PS	Wks 40-41 (wb 9/26 – wb 10/3): PS limited participation (2 boats per day) Wk 42 (wb 10/10): PS full fleet release Chinook, fishing pattern: 1,1,1; PS limited to area north of a line from the Clinton ferry dock to the Mukilteo ferry dock during Wk 40
	Ntrty GN	Wks 41 - 42 (wb 10/3 – wb 10/10) GN fishing pattern: 1,3; GN fish daylight hours
Chum	Trty	Wks 43 (wb 10/17) - Wk 48 (wb 11/21); 3 days per week; Manage for Stillaguamish and Snohomish harvest rates and minimum escapement goals based on in-season update.
	Test	Wks 43 (wb 10/17) – Wk 48 (wb 11/21), 1 day per week, 2 GN landings per week.
	Ntrty	Wks 43 (wb 10/17)-Wk 48 (wb 11/21); PS release Chinook; PS fishing pattern: 1,2,1,2,1,2; GN fishing pattern: 3,4,3,3,3,3.
Steelhead	Trty	Begins Wk 49 (wb 11/28); based on steelhead plan to be developed.
	Ntrty:	Closed

Area 8D Net

Chinook	Trty	Wk 19 (wb 5/2) - Wk 24 (wb 6/6) ceremonial and subsistence fishery. Commercial fishery begins Wk 25 (wb 6/13) Sun-Thurs. Wk 26 (wb 6/20) - Wk 38 (wb 9/12); Open noon Monday thru 11:59 pm Thursday for GN, BS and RH gear, setnet gear may open outside of these times.
	Ntrty	Closed (see recreational SAF)
Coho	Trty	Wk 39 (wb 9/19) - Wk 45 (wb 10/31); open to target Tulalip hatchery coho.
	Ntrty	Wks 39 (wb 9/19)-Wk 45 (wb 10/31); PS Chinook release; PS fishing pattern: 1,0,1,1,1,2,1; GN fish at night; GN fishing pattern: 3,3,3,3,3,4,3. PS Open concurrent with Ntrty 8A during Wks 41-Wk. 45. Closed east of the line from Mission Point to Hermosa Point.

Chum	Trty	Wk 46 (wb 11/7) - Wk 51 (wb 12/12); open to target Tulalip hatchery chum. Managed to allow for hatchery egg take needs based on Tulalip hatchery escapement updates and projections. All Area 8D fisheries will close concurrently as agreed to by regional co-managers to ensure egg take requirements are met.
	Ntrty	Wks 46 (wb 11/7)-Wk 48 (wb 11/21); open to target Tulalip hatchery chum. PS fishing pattern: 2,1,2; GN fishing pattern: 4,3,4. Closed east of the line from Mission Point to Hermosa Point. Managed to allow for hatchery egg take needs based on Tulalip hatchery escapement updates and projections. All Area 8D fisheries will close concurrently as agreed to by regional co-managers to ensure egg take requirements are met. PS open concurrent with Ntrty 8A.

Stillaguamish River Treaty Net (Ntrty Closed)

Chinook	Closed
Coho	Open Wk 39 (wb 9/19) - Wk 43 (wb 10/17); max 5 days per week.
Chum	Wks 44 (wb 10/24)-Wk 52 (wb 12/19); 5 days per week.
Steelhead	To be determined

Snohomish River Treaty Net (Ntrty Closed)

Chinook, Pink, Coho, Chum	Closed
Coho Test	Closed

5.6.2 Stillaguamish-Snohomish Terminal Fishery Summary Table

In 2004, terminal fishery catches, with the exception of Tulalip Bay and Stillaguamish river broodstock collection, were less than preseason expectations for all fisheries (Table 5-I). The Tulalip Bay (Area 8D) terminal net harvest of primarily hatchery returns was approximately 27% higher than expected preseason.

Table 5-I
Stillaguamish-Snohomish Terminal Fishery Summary

Fishery	Projected Landed Catch	In-Season Schedule	Actual Landed Catch	Postseason above or below preseason	Discussion
Area 8A Treaty	204	same	102	-102	August C&S only caught 10 Chinook (forecast at 100), Test fishery caught 0 Chinook.
Area 8A Nontreaty Net	38	Wk 40,41 LP@2PS ckNR; Wk 41 GN 1; Wk 42-47 GN 3,3,4,3,3,3; PS 1,1,2,1,2,1 ckcoNR	19	-19	Plus 12 additional estimated purse seine Chinook NLM; experienced minimal effort

Fishery	Projected Landed Catch	In-Season Schedule	Actual Landed Catch	Postseason above or below preseason	Discussion
Area 8D Treaty	4706	same	5987	1281	Tulalip hatchery Chinook return was greater than expected pre-season.
Area 8D Nontreaty Net	1	Wk 39-40 GN 3,3 PS 1,1; Wk 41-48 GN 3,3,3,4,3,4,3,4 PS ckNR 1,1,1,2,1,2,1,2	1	0	Represents purse seine Chinook NLM; experienced minimal effort
Stillaguamish R. Treaty	25	No Fishery; Broodstock collection only	144	25	There was no in-river commercial or C&S fishery; Broodstock Collection: captured 63 hens and 81 bucks from the North Fork Stillaguamish, which was more than anticipated preseason
Snohomish R. Treaty	0	closed	0	0	as expected

Sources: Kit Rawson (4/29/05); John Drotts (4/29/05)

5.6.3 Stillaguamish-Snohomish Terminal Fishery Discussion

5.6.3.1 Tulalip Bay Treaty Fishery

Tulalip hatchery Chinook survived to the terminal area at a slightly higher rate than forecasted preseason. Two factors were at work: 1) preterminal fishing rates were different from the preseason forecast and 2) recruitment of Tulalip Chinook to adult return was different from the preseason forecast. The net result of these two factors was that more Tulalip hatchery Chinook survived to the terminal fishery than were forecasted preseason, and more Chinook were caught than was anticipated preseason.

This may not be significant or relevant to natural stocks, however. The model computes an exploitation rate on natural stocks based on the planned pattern of fisheries in Area 8D. This rate does not depend upon the abundance of the Tulalip Chinook run. What we have to do well is to estimate the contribution of that fishery to the overall exploitation rate on stocks of concern. Evaluation of this and many other FRAM model validation and Plan evaluation questions will be pursued through the exploitation rate evaluation process described in Section 4.2 above. (Kit Rawson, 4/29/05)

5.7 South Puget Sound Terminal Area

Some extreme terminal fisheries harvested more Chinook than was predicted preseason, primarily due to returns higher than forecast. Fisheries in areas 10/11, 10E and 13A harvested or encountered fewer Chinook than expected.

5.7.1 South Sound Agreed-to Fishing Schedules

Area 10 Net

Chinook		Closed
Sockeye	Trty	Fishery dependent upon ISU (Ballard lock counts)
	Ntrty	Closed
Coho	Test	Gillnet: Wks 37 (wb 9/5)-Wk 39 (wb 9/19); 3 boats, 3 sites; fishing pattern: 2,2,2
	Trty	Closed, unless ISU indicates harvestable abundance. Quota based on tiered sharing formula, Wks 37(wb 9/5)-Wk 41(wb 10/3).
	Ntrty	Closed
Chum	Test	Purse Seine: Wks 41 (wb 10/3)-Wk 46 (wb 11/7); 1 site, fishing pattern: 1,1,1,1,1
	Trty	Quota based on tiered sharing formula; Wks 42 (wb 10/10)-Wk 48 (wb 11/21) fishing pattern – ISU dependent
	Ntrty	Wks 42 (wb 10/10)-Wk 48 (wb 11/21); PS Chinook and coho NR; PS fishing pattern: 1,1,2,1,1,1,1; GN fishing pattern: 3,3,3,3,3,3,3. ISU Dependent.

Area 10A Treaty Net (Ntrty Closed; see Section 6 for recreational SAF**)**

Chinook	Test	Gillnet: 7/21, 7/28, 8/4; 5 sites (Wednesday nights, if possible). Wk 33 – 34; 1 day/wk. Reference terminal management plan.
Coho	Wks 37 (wb 9/5)-Wk 44 (wb 10/30); fishing pattern: fishery will be open continuous from Wk 38 (Sept. 12) through Wk 39 (Sept. 24); starting Wk 40 (Sept. 26) fishery will revert back to 5 days/wk	
Chum	Wks 45 (wb 10/31)-Wk 48 (wb 11/27); fishing pattern to be determined.	
Steelhead	Wks 49 (wb 11/28)-Wk 52 (wb 12/19); evaluation fishery for ISU; fishing pattern: 3,3,3,3	

Duwamish/Green River (Area 80B) Treaty Net (Ntrty Closed)

Chinook	Wk 33 – 34	1 day/wk. Reference terminal management plan.
Coho	Wk 38 – Wk 45	Closed until Chinook clear or coho predominate. Clearance fishery on lower river (up to 16th Avenue Bridge) begins 9/9; (6 sites); fishing pattern: if Chinook clearance is met or coho predominate, fishery will open Wk 38 (Sept. 12) and be open continuous through Wk 39 (Sept. 24); starting Wk 40 (Sept. 26) fishery will revert back to 5 days/wk.
Chum	Wks 46 (wb 11/7)-Wk 48 (wb 11/27)	fishing pattern to be determined
Steelhead	Wks 49 (wb 11/28)-Wk 52 (wb 12/19)	evaluation fishery for ISU, fishing pattern: 3,3,3,3.

Area 10E Treaty Net (Ntrty Net Closed; see below for recreational SAF**)**

Chinook	Wks 30 (wb 7/18)-Wk 38 (wb 9/12); fishing pattern: 7days/wk. Possible extension for Sinclair Inlet
Coho	On-Reservation only; Wks 38 (wb 9/12)-Wk 43 (wb 10/17); setnet/beach seine; 7 days/wk.
Chum	Wks 43 (wb 10/17)-Wk 49 (wb 11/28); schedule dependent upon ISU.

Lake Washington System (includes lake, ship canal, & Lake Sammamish)

Areas 10F, 10G, 10C, 10D Treaty Net (Ntrty Closed)

Sockeye	Dependent upon ISU (lock counts). Potential fishery beginning Wk 28 (7/4).	
Chinook	10F, 10C & 10G closed; 10D will be based on ISU (lock counts)	
Coho	The coho fisheries in the four following areas are dependent upon the ISU (if lock counts project run size < 10,000 coho entering the lake, then no coho fishery):	
	Lower ship canal (below Ballard Locks)	Closed until Chinook clearance as seen in lock counts; anticipated pattern 3 days/wk.
	Upper ship canal (above Ballard Locks):	Species composition test fishery in mid September, 3 sites, or Chinook clearance as seen in lock counts: fishing pattern 5 days/wk.
	North end Lake Washington (North of Hwy. 520 bridge):	Species composition test fishery in mid-September (7 sites) or limited commercial fishery: fishing pattern 5 days/wk.

Lake Sammamish Treaty Net

Chinook and Coho	Fisheries will be based on ISU from the Ballard Lock counts.

Area 11 Net

Chinook	All	Closed
Coho	Trty:	Commercial fishery open beginning Wk 37 (wb 9/5); ISU dependent; gillnets 7 nights/wk. Could close any time.
	Ntrty:	Closed
Chum	Trty:	Commercial fishery open Wks 42 (wb 10/10)-Wk 46 (wb 11/7); gillnets 7 nights/wk, could close at anytime.
	Ntrty	Wks 42 (wb 10/10)-Wk 48 (wb 11/21); PS Chinook and coho NR; PS fishing pattern:1,1,2,1,1,1,1; GN fishing pattern: 3,3,3,3,3,3,3. ISU Dependent.

Area 11A Net Treaty Net (Ntrty Closed)

Chinook and Chum	Closed
Coho	Commercial fishery open Wks 36 (wb 8/29)-Wk 45 (wb 10/31); 3 nights/wk

Puyallup River (Area 81B) Treaty Net (Ntrty Closed)

Chinook	Test Fishery:	Wks 30 (wb 7/18)-Wk 34 (wb 8/15); 1 day/wk, drift net only.
	Commercial fishery	Begin Wks 33 (wb 8/8)-Wk 35 (wb 8/22)fishing pattern: 0.5,0.5,0.5.
Coho	Commercial fishery begin Wks 36 (wb 8/29)-Wk 42 (wb 10/10) fishing pattern: 1,3,3,4,4,4,3.5.	
Chum	Test fishery Wks 43 (wb 10/17)-Wk 46 (wb 11/7) 1 day/wk, drift net only .	
Winter Chum	Commercial fishery begin Wks 47 (wb 11/14) – Wk 53 (wb 12/26) no more than 24 total days.	

Steelhead	Incidental to chum fishery – see chum schedule.	

White River Treaty Net

Sp Chinook	Traditional fish drive. Ceremonial and subsistence fishery.
Coho/Chum	Begin 9/1, traditional fish drive; ceremonial and subsistence fishery. No directed commercial fishery.
Steelhead	Ceremonial and subsistence fishery.

Fox Island/Ketron Island (Area 13)

Chinook	Treaty:	8/1-9/15, 7 days/wk
	Ntrty:	closed
Coho	Treaty:	9/16-10/20, 7 days/wk
	Ntrty:	closed
Chum	Treaty:	Closed unless opened by Medicine Creek Treaty tribes' agreement
	[Ntrty:	Wks 49 (wb 11/28) – Wk 53 (wb 12/26); GN 5 boats. GN fishing pattern: 3,3,3,3,2. –WDFW]

Sequalitchew (Area 13) Treaty Net (Ntrty Closed)

Chinook and Chum	Closed
Coho	Closed

Carr Inlet (Area 13A) Treaty Net [1](Ntrty Closed) [1] Based on Medicine Creek Treaty tribal proposal annual regulations. Individual tribal regulations may deviate from this schedule.

Chinook	8/1-9/18, 7 days/wk, open in sections
Coho	9/19-10/23, in-season monitoring to meet hatchery escapement need
Chum	10/24-12/4, 7 days/wk

Chambers Bay (Area 13C) Treaty Net[1] (Ntrty Closed)

Chinook	Wks 31 (wb 7/25)-Wk 41 (wb 10/3); 3 days/wk
Coho	Wks 42 (wb 10/10)-Wk 44 (wb 10/24); 2 days/wk;
Chum	Wks 45 (wb 10/31)-Wk 48 (wb 11/21); 3 days/wk

Area 13D Treaty Net (Ntrty Closed)

Chinook	8/1-9/10 or earlier date dependent on in-season management needs; 7 days/wk
Coho	9/10-12/31 or earlier date dependent on in-season management needs:
Peale Pass (13D-3)	7 days/wk
Pickering Pass (13D-2)	7 days/wk
Dana Pass (13D-1)	7 days/wk
Southern Case (13D-4)	7 days/wk
Chum	Open approximately 10/27; 2-3 days per week; managed weekly by updates (~10/11)
Area 13E Net	Closed to all fishing

Budd Inlet (Area 13F) Treaty Net (Ntrty Closed)

Chinook	7/15-9/10 or earlier date dependent on in-season management needs; 7 days/wk
Coho	Closed
Chum	Open approximately 11/1, 2-3 days per week, managed by weekly in-season updates

Eld Inlet (Area 13G) Treaty Net (Ntrty Closed)

Chinook	8/1-9/10; opening dependent upon in-season data, outer portion only
Coho	Closed
Chum	Open approximately 11/1, 2-3 days per week, managed by weekly escapement updates

Totten Inlet (Area 13H) Treaty Net (Ntrty Closed)

Chinook	8/1-9/10; schedule dependent on in-season data
Coho	Closed
Chum	Open approximately 10/10, 2-3 days per week; managed by weekly escapement updates

Little Skookum Inlet (Area 13I) Treaty Net (Ntrty Closed)

Chinook	8/1-9/10; schedule dependent upon in-season data
Coho	Closed
Chum	Open approximately 12/1, 2-3 days per week; managed by weekly escapement updates

Hammersley Inlet (Area 13J) Treaty Net (Ntrty Closed)

Chinook	8/1-9/10 or earlier date dependent on in-season management needs
Coho	Closed
Chum	Open approximately, 9/18-12/25, 2-3 days/wk; managed by weekly escapement updates

Northern Case Inlet (Area 13K) Treaty Net (Ntrty Closed)

Chinook	8/1-9/10
Coho	9/10-12/31 or earlier date dependent on in-season management needs
Chum	Open approximately 9/18-12/25; 2-3 days/wk; managed by weekly escapement updates

Nisqually River (Area 83D) Treaty Net (Ntrty Closed)

Chinook	Wks 27 (wb 6/27)-Wk 39 (wb 9/19); 3 days/wk; The Nisqually Indian Tribe will manage the Nisqually River Chinook run to attain an 1,100 naturally spawning escapement goal. This will be achieved by running an in-season update and adjusting the fishing schedule accordingly.
Coho	Wks 40 (wb 9/26)-Wk 47 (wb 11/14); 3-4 days/wk
Chum	[Wks 48 (wb 11/21)-Wk 5 (wb 1/25); 4 days/wk – Nisqually Tribe]

McAllister Creek (Area 83F) Treaty Net (Ntrty Closed)

Chinook	Wks 27 (wb 6/27)-Wk 40 (wb 9/26); 3 days/wk
Coho	Wks 41 (wb 10/3)-Wk 48 (wb 11/21); 3-4 days/wk
Chum	Wks 49 (wb 11/28)-Wk 5 (wb 1/25); 4 days/wk

5.7.2 South Puget Sound Terminal Catch Summary Table

Very limited numbers of Chinook salmon were expected to be taken incidental to fisheries targeting harvestable sockeye, coho, and chum salmon in 2004 (Table 5-J). Fisheries in these areas were consistent with the preseason plan. Generally, actual Chinook interceptions exceeded preseason expectations.

Table 5-J
South Sound Fisheries Summary

Fishery	Projected Landed Catch	In-Season Schedule	Actual Landed Catch	Postseason above or below preseason	Discussion
Area 10/11 & 10E					
Area 10/11 Treaty	347	ISU quotas based on tiered sharing formula, coho - weeks 37-41; chum - weeks 42-48;	86	-261	Less incidental catch than expected
Area 10/11 Nontreaty Net	472	Wk 42-45: GN 3d/w; PS ckcoNR 1,2,2,1	410	-62	Plus an additional 439 purse seine Chinook NLM (Table 5-R)
Area 9/10 Test Fisheries (ACP & coho)	216	Coho gillnet test - weeks 37-39, 3 boats, 3 sites, fishing pattern 2,2,2; ACP chum purse seine - weeks 41-46, 1 sites, fishing pattern 1,1,1,1,1,1	283	67	About as expected; 29 caught in coho test; 254 caught in ACP chum test; more blackmouth at ACP than recent years' average (1998-2003);
Area 10E Treaty	7094	as planned	3229	-3865	Less than expected
Lake Washington					
Lake Washington Ship Canal & N. Lake Washington Sockeye Fishery	543	Directed Treaty net fisheries during 2004 in Lake Washington were conducted for sockeye and coho. Sockeye fisheries occurred in Area 10F, Ship Canal, between the July 12th and 20th, and in Area 10C, S. Lake Washington on the 22nd.	867	324	See Text

Fishery	Projected Landed Catch	In-Season Schedule	Actual Landed Catch	Postseason above or below preseason	Discussion
Lake Washington Ship Canal & N. Lake Washington Coho Fishery	Incl. above	Coho fisheries occurred between September 13th and October 25th in the Ship Canal and between October 4th and 13th in Area 10G, N. Lake Washington.	Above	Above	See Text
Lake Sammamish	0	Closed	0	0	Provision was made for directed Chinook fisheries in Lake Sammamish, but no directed fisheries occurred.
Elliott Bay/Green R.					
Area 10A Test	437	As planned	539	102	The Elliott Bay test fishery took 539 Chinook over three consecutive Wednesdays of the usual 12 hour, five boat tests.
Area 10A Treaty	4059		4246	187	See Text
Green R. Treaty	4791		4445	-346	See Text
Puyallup, White, Nisqually and Deep South Sound					
Areas 13, 13D-K Treaty	1237	Area 13 (Fox Island/Ketron Island): as planned: Chinook directed - weeks 32-38, 7 days/week; coho - weeks 38-43, 7 days/week; Area 13 (Sequalitchew): unplanned: coho - 9/30-10/6; Areas 13D-K: as planned: (see agreed-to pre-season document)	1451	214	Higher treaty fishing effort during Chinook management period than recent years' average (1996-2003) due to higher market values; unplanned opening of Sequalitchew site accounted for just 3 incidental Chinook.
Areas 13 Nontreaty	50	none	0	50	No fishery conducted

Fishery	Projected Landed Catch	In-Season Schedule	Actual Landed Catch	Postseason above or below preseason	Discussion
Area 13A Treaty	1841	as planned: Chinook directed - weeks 32-38, 7 days/week; coho - weeks 39-43, 7 days/week; chum - weeks 44-49, 7 days/week;	990	-851	Fewer than expected;
Area 13C and Chambers Ck. Treaty	883	as planned: Chinook directed - weeks 31-41, 3 days/week; coho - weeks 42-44, 2 days/week; chum - weeks 45-48, 3 days/week;	3471	2588	Much higher treaty fishing effort during Chinook management period than recent years' average (1998-2003) due to higher market values.
Puyallup R. Test	250		402	152	See Text
Puyallup/White River Treaty	914		3642	2728	
Nisqually/McAllister Treaty	12037	as planned: Chinook directed - weeks 27-39, 3 days/week; coho - weeks 40-47 3-4days/week;	13742	1705	Managed for escapement goal; catch expectation was based on harvest rate applied to pre-season forecast

5.7.3 South Sound Extreme Terminal Area Fishery Discussions

5.7.3.1 Lake Washington Extreme Terminal Area Escapement, Catch Summary And Fishery Discussion

Chinook returned to Lake Washington in higher numbers than forecast. The escapement index in the Cedar River was 569, and 173 for the northern tributaries. The hatchery contribution to escapement was 30% in the Cedar (67% to the upper basin) and 63% to the northern tributaries values very similar to those observed in 2003.

Directed Treaty net fisheries during 2004 in Lake Washington were conducted for sockeye and coho. Sockeye fisheries occurred in Area 10F, Ship Canal, between the

July 12th and 20th, and in Area 10C, S. Lake Washington on the 22nd. Coho fisheries occurred between September 13th and October 25th in the Ship Canal and between October 4th and 13th in Area 10G, N. Lake Washington.

Chinook harvested incidentally during net fisheries directed at sockeye and coho totaled 867, about 1.5 times the pre-season expectation. (Paul Hage, Muckleshoot Indian Tribe (MIT), 2/11/05)

5.7.3.1.1 Lake Washington Sockeye return and fishery discussion

The sockeye abundance estimate from the lock count was 410,000 fish, providing for 60,000 harvestable fish. Treaty fisheries were conducted in the Ship Canal and in the South end of Lake Washington. Fisheries were scheduled as early as possible to minimize Chinook impacts and fishers were advised to release live Chinook unharmed. Chinook incidentals were 53 in the Ship Canal and 1 in the South End for a total of 54 Chinook incidental to 2004 Treaty sockeye fisheries. (Paul Hage, MIT, 2/11/05)

5.7.3.1.2 Lake Washington Chinook return and fishery discussion.

Chinook escapement was estimated in-season from daily lock counts at the Ballard Locks. The estimate was 9185 Chinook. Incidental catch (867) plus returns to the Issaquah Hatchery (10,053), Portage Bay Hatchery (2,520), northern tributariess (173) and the Cedar River (569) total 14,182 Chinook. Compared to the pre-season forecast of 9430, the run was stronger than forecasted and may have been larger than was documented noting both Chinook mortalities at and above the locks potentially due to record high temperature in the lake, and additional Chinook beyond natural spawning index areas. Provision was made for directed Chinook fisheries in Lake Sammamish, but no directed fisheries occurred. (Paul Hage, MIT, 2/11/05)

5.7.3.1.3 Lake Washington Coho return and fishery discussion

The coho estimate as of the termination of counting at the Ballard locks was 35,000, meeting criteria for a coho fishery. Anticipated Treaty fisheries were conducted in the Ship canal and in North Lake Washington. Commencement of coho fisheries was delayed until October 4th in the upper Ship Canal to minimize Chinook impacts and fishers were advised to release live Chinook unharmed. Fisheries below the locks commenced on September 13th. Incidental Chinook catch in the Ship Canal was 90 below the locks and 700 above. Incidental Chinook in the North End of Lake Washington (Area 10G) numbered 28 for a total of 818 Chinook incidental to 2004 Treaty coho fisheries. Total Incidentals were projected to be about 543 in pre-season modeling. (Paul Hage, MIT, 2/11/05)

5.7.3.2 <u>Green River Extreme Terminal Area Escapement, Catch Summary (Including Elliott Bay) And Fishery Discussion</u>

Chinook returned to the Green River basin in greater numbers than forecast. Escapement to the river was just shy of 14,000, more than twice the escapement goal of 5800. The hatchery contribution to natural escapement was 63%, similar to that observed in 2003 and on par with the average of previous estimates based on CWT expansions.

The Elliott Bay test fishery was implemented according to the pre-season plan and indicated harvestable abundance for continued recreational fisheries and commencement of commercial Treaty net fisheries. Following plan criteria, two 12 hour Treaty fisheries were scheduled (August 12th and 19th). (Paul Hage, MIT, 2/11/05)

5.7.3.2.1 Green River test and commercial fishery discussion

The Elliott Bay test fishery, which involved five gillnet boats fishing for 12 hours each week, took 539 Chinook over three consecutive Wednesdays. This compared to the pre-season modeled catch of 437. Fisheries conducted in Elliott Bay on the 12th and 19th harvested 5842, and 2777 Chinook, respectively. Catch from the two openings was evenly distributed between the bay (4232) and the river (4286). Incidental catch during coho fisheries was 611 Chinook and C&S fisheries harvested 173 for a Treaty total of 9841 Chinook. This value was close to the modeled catch of 8414 Chinook for these areas. (Paul Hage, MIT, 2/11/05)

5.7.3.2.2 Green River hatchery/natural composition.

Hatchery origin Chinook comprised 78% of the catch in the bay, 70% of the catch in the river and a 63% contribution to natural escapement based on extensive sampling of treaty net fisheries and natural spawners. (Paul Hage, MIT, 5/3/05)

5.7.3.3 <u>White River Catch Discussion</u>

MIT C&S harvest was 94 with 66 prior to August 15th and 28 subsequent to that date (at the Buckley Trap). August 15 has historically been used as a cut-off between spring and fall timing. The preseason catch projection of 115 for MIT harvest does not address the dichotomy between spring and fall. (Paul Hage, MIT, 5/3/05)

5.7.3.4 <u>Puyallup terminal fishery discussion</u>

Terminal fisheries in the Puyallup River were predicted to catch 914 Chinook, but the actual catch was 3,252 Chinook were caught in the Puyallup, with limited fishing (i.e. three half days of fishing) directed at Chinook. Chinook remained in the lower river, and susceptible to fishing, for an extended period in spite of a good rain in August that should have pushed Chinook upriver. Managers have evaluated a number of variables (temp vs flow vs catch) that showed no correlation. Current thinking points toward a salinity issue. As in 2003, fishers were receiving good prices so overall effort was up. Finally, the actual run size exceeded preseason forecasts by about 600 fish. The FRAM terminal module under-estimated river catch, and should be updated to reflect recent higher in-river harvest rates.

A test fishery was conducted on the Puyallup during weeks 30 (WB 7/22) to 34 (WB 8/19), catching a total of 262 Chinook and 34 coho. This was the 5th year for the test, and managers are working with NWIFC biometricians to develop an inseason abundance update for Puyallup Chinook that may, in future, inform inseason management. (Chris Phinney, Puyallup, 5/3/05)

5.7.3.5 Nisqually Inseason Abundance Update

The in-season update, based on early-season CPUE,indicated that the Nisqually Chinook runsize was greater than forecast preseason, and that a greater number of fish could be (and were) harvested while still meeting the management (escapement) goals. The in-river net fishery was conducted as anticipated pre-season, (i.e. three days per week). (Bill Patton, NWIFC, 1/4/05)

5.7.3.6 Deep South Sound Treaty Net Catch

Harvests in 13, 13D-K and 13C/Chambers were higher because effort was higher. The prices that tribal fishermen were getting were higher in 2004 than in the recent years used to predict 2004 catches. Harvest was less in 13A probably due to the fact that more Puyallup fishermen chose to fish in Chambers Bay (13C) instead. (Bill Patton, NWIFC, 1/4/05) The nontreaty fishery planned for area 13 was canceled pursuant to inseason agreement with relevant tribes.

5.7.3.7 Area 9/10 Test Fisheries

Less Chinook than expected were caught in the coho gillnet test fishery, but more than expected were caught in the chum purse seine test fishery. The chum test fishery included one day more of fishing than in previous years. That extra day accounted for 23 more Chinook interceptions. Apparently, there were simply more blackmouth Chinook available to be taken as bycatch in 2004. (Bill Patton, NWIFC, 5/4/05)

5.8 Hood Canal Terminal Area

5.8.1 Hood Canal Fishing Schedules

Hood Canal Mainstem (Areas 12, 12B, 12C, 12D)

Treaty: 1,000 feet closure around streams which are closed to net fishing. Beach seines and hook and line gear release chum through 9/30 (through 10/10 if within 500' of western shore of Areas 12B and 12C).

Nontreaty: See WAC 220-47-307 for Nontreaty exclusion zones.

Chinook:	Trty:	Areas 12, 12B and 12D: Closed
		Area 12C: Open wb 7/18; through 8/24 no more than 4 days/wk. Gillnets restricted to 7" min mesh starting 8/1.

		Area 12H: Open wb 8/8 through wb 9/26; hook and line gear continuous; beach seines daylight hours Tues and Thur each week; possible in-season modifications; chum release.
	Ntrty	Closed
Coho	Trty:	Area 12: Open wb 9/26 through wb 10/10; for gillnets. Beach seines for coho only (release all Chinook and chum through 9/30) may start no earlier than 9/18.
		Area 12B: Open wb 10/1 through wb 10/17; for gillnets; 500 foot closure along western shore through 10/10; Beach seines for coho only (release all Chinook and chum through 9/30) may start no earlier than 9/21.
		Area 12C: Open wb 9/19 through wb 10/17; no more than 6 days/wk (possible in-season adjustments); gillnets may open no earlier than 10/1, with 500 foot beach closure from Ayock Pt. to approx. 2,000 feet south of Lilliwaup (at the large house, north of Octopus Hole) through 10/10; beach seines for coho (release all chum through 9/30) may start no earlier than 9/21.
		Area 12D (west of Madrona Pt. - local name): Open wb 9/19 through wb 10/17; gillnets may open no earlier than 10/1. Weekly schedules identical to Area 12C.
	Ntrty:	Closed
Chum	Trty	Area 12: Open wb 10/17 through wb 11/14, but no later than 11/20.
		Areas 12B – 12C: Open wb 10/24 through wb 11/14 in Area 12B and no later than wb 11/21 in Area 12C.
		Area 12D: Closed.
		Area 12H: [Hook and line gear open from wb 10/24 through wb 11/21; beach seines open Tuesday and Thursday for the first two weeks then Monday, Wednesday, and Friday starting 11/7 given hatchery escapement control measures; potential additional fishing days pending discussions with WDFW-WDFW]
	Ntrty:	Area 12-12B: Open Wks 43 (wb 10/17) through wk 47 (wb 11/14), PS release Chinook; PS fishing pattern: 1,2,1,1,1,; GN fishing pattern: 3,3,3,3,3, [North of Quatsap Point – Skokomish]
		Area 12C Open Wks 46 (wb 11/7) through wk 48 (wb 11/21) purse seine release Chinook; PS fishing pattern: 1,1,1; [GN fishing pattern: 3,3,3; potential additional GN days pending discussion with PNPTC and SkokomishTribe; BS (Hoodsport Hatchery Zone) fishery in wks 46-48 pending discussions with PNPTC and Skokomish Tribe – WDFW]
		Area 12D Closed
Port Gamble (Area 9A)		
Chinook	All	Closed
Coho	Trty:	Open wb 8/22 through wb 10/24, gillnet only.
	Test:	Open wb 8/5 through wb 10/3, gillnet only.
	Ntrty:	Open Wks 35 (wb 8/22) through wk 44 (wb 10/24); GN and skiff GN, both gears limited to 100 fathoms length and 60 meshes in depth; 2 days wk 35, then 7 days/wk; release Chinook; release chum through 9/30; release fish not to be retained by cutting ensnaring meshes. The beach area of the Port Gamble Indian Reservation, between Pt. Julia and the boundary marker at the south end of the reservation shall be closed to all fishing.

Chum	Trty:	Open wb 10/31 through wb 11/28.
	Ntrty:	Closed
Steelhead	Trty:	Open wb 12/5 through wb 1/23.

Quilcene/Dabob (Area 12A)

Coho	Trty:	Open wb 8/22 through wb 10/10; chum and Chinook release from hook and line and beach seine gear through 9/30; beach seines 5 days/wk daylight hours; hook and line open continuous; gillnets closed before 9/1 and limited to 1 day/wk 9/1 through 9/30. Gillnets will close if 12A summer chum escapement projected <1,500. Additional gillnet time may be added between 9/16 and 9/30 if coho harvest needs require it and 12A summer chum escapement projected >2,500. Beach seine advanced notification required prior to fishing.
	Ntrty:	Open Wks 35 (wb 8/22) through wk 40 (wb 9/26); BS gear only; 5 days/wk (M-F) 7 am–7 pm; Chinook and chum release. Beach seine advanced notification required prior to fishing.
Chum	Trty:	To be determined in-season.
	Ntrty:	Closed

Skokomish River (Area 82G) Treaty (Ntrty Closed)

Note: Hook and line gear and beach seines release chum through 10/15.

Chinook	Open wb 8/1 through wb 9/12; no more than 3 days/wk; closed to gillnets below SR 106.
Coho	Open wb 9/19 through wb 10/24; no more than 5 days/wk, (possible inseason modifications); closed to gillnets below SR 106 through 9/30.
Chum	Open wb 10/31 through wb 12/05.

Big Quilcene River (Area 82F) Treaty (Ntrty Closed)

Coho	Openings to be determined in-season, for coho only, as necessary, from wb 9/5 through wb 9/26; from U.S. Hwy 101 to the Quilcene Hatchery rack, hand held gear only (dipnets, hand lines, etc.)
Chum	Closed
Dosewallips R., Duckabush R., Hamma Hamma R., Union R.	Closed
Tahuya R., Dewatto R. Treaty (Ntrty Closed)	Closed

5.8.2 Hood Canal Terminal Fishery Summary Table

Table 5-K
Hood Canal Terminal Area Fisheries Summary

Fishery	Projected Landed Catch	In-Season Schedule	Actual Landed Catch	Postseason above or below preseason	Discussion
Area 9A	56	As planned	2	-72	Source: WDFW Fish Tickets
Area 9A Test	Incl. above	As planned	1		Source: Gray; catch as expected
Area 12A Treaty	18	As planned	884	866	Source: Gray; Of these, 20 show up in WDFW Fish Ticket Database as of 5/16/05
Areas 9A/12A Nontreaty	11	no effort	0	-11	Beach seine fishery has been discontinued
Areas 12, 12B, 12C Treaty	575	As planned	3,785	3,210	Chinook, coho, chum directed fisheries; Source: WDFW Fish Tickets
Areas 12, 12B Nontreaty Net	112		0	-112	No Chinook catch reported; Estimated 3 purse seine Chinook NLM (Table 5-R)
Area 12H	10,649		7,352	-3,297	Source: WDFW Fish Tickets
Skokomish, Big Quil R. Treaty	2,188		4,305	2,117	No catch in Big Quil. noted; Source: WDFW Fish Tickets

[Cindy Gray, PGST (3/25/05); Laura Hanlon, Skokomish (3/11/05)]

5.8.3 Hood Canal Fisheries Discussion

5.8.3.1 Hood Canal Treaty Catches

Area 9A is managed for hatchery returns. Area 12A is managed for summer chum escapement. If escapement is projected to be less than 1,500, then gillnets close. Additional gillnet time is granted if escapement is projected to be greater than 2,500. Catches in area 12A may have exceeded preseason expectations; reconciliation of fish tickets will verify whether those 884 fish were actually Chinook caught in area 12A. No Chinook were landed by nontreaty fishers in Hood Canal net fisheries. The sum of treaty catches in areas 12, 12B, 12C, and 12H about equaled the sum of preseason projections for those areas, however, catches in the Skokomish River exceeded preseason projections by about 2,000 Chinook.

5.8.3.2 Commercial Catch Sampling in Hood Canal

In 2004, the tribal commercial fishery in the Seabeck area at Big Beef Creek was sampled during the coho and chum seasons through joint WDFW/tribal activity. Sampling was conducted by one WDFW staffperson and supplemented by tribal and Big Beef research crewmembers when needed.

A total of 3,074 fish (1,785 coho and 1,289 chum, no Chinook) were observed. 1,742 fish were sampled for coded wire tags (CWT), and no fish were released. The samplers observed:

- 2,296 fish caught in beach seines and sampled 1,347 fish.
- 254 fish caught in gill nets and sampled 247 fish.
- 524 fish caught in set nets and sampled 27 fish.
- 121 fish sampled from mixed gillnets.

A total of 618 CWTs were sampled. The tag recovery rate was 35.47%. (Karen Kloempken, WDFW, 1/19/05)

5.9 Strait of Juan de Fuca Tributaries (including Dungeness Bay)

Catches in the Strait of Juan de Fuca tributaries were less than anticipated preseason.

5.9.1 Strait of Juan de Fuca Tributaries Fishing Schedules

Area 6D Dungeness Bay Net		
Chinook	All	Closed
Coho	Trty	Open 9/19 (contingent on NOAA approval) through wb 10/24; additional openings possible based on in-season information; Chinook and chum release and gillnets may fish daytime only, through 10/10; 1,500 ft closure around each river mouth.
	Ntrty	Open Wk 39 starting 9/21 through Wk 44 (wb 10/26) for skiff gillnet gear; 7am - 7pm, 5 days each week (M-F) except Monday 9/20; Chinook and chum release by cutting ensnaring meshes; 1,500 ft. (1/4 nautical mile) closure around each river mouth. Contingent on NOAA approval, fishery may start 9/20.
Chum	All	Closed
Dungeness River Treaty (Ntrty Closed)		
Chinook	Trty	Closed
Coho	Trty	To be determined in-season. Fishing up to 3 days/wk, for coho only, may occur no earlier than 10/16 and will be restricted to areas below the Dungeness hatchery intake using species selective (non-gillnet) gear.
Chum	Trty	Closed

Steelhead	Trty	Open starting wb 12/12 through wb 2/21.
Elwha River Treaty (Ntrty Closed)		
Chinook	Trty	Closed except Ceremonial Harvest of 1 fish in July
Coho	Trty	Open 9/12 through wb 10/31; days per week to be determined in-season.
Chum	Trty	Closed
Steelhead	Trty	Open starting wb 12/5 through wb 2/21.
Eastern SJF Misc. Treaty (Ntrty Closed)		
Steelhead	Trty	Open starting wb 12/12 through wb 2/21.
Western SJF Misc. Treaty (Ntrty Closed)		
Steelhead	Trty	Open starting wb 12/5 through wb 2/21; Lyre R. closed below Susie Creek through 1/1.

5.9.2 Strait of Juan de Fuca Tributaries Fisheries Summary Table

Seasons in the Dungeness and Elwha areas proceeded as expected preseason, however catches were lower than anticipated. (Table 5-L).

Table 5-L
Strait of Juan de Fuca Tributaries Fisheries Summary

Fishery	Projected Landed Catch	In-Season Schedule	Actual Landed Catch	Postseason above or below preseason	Discussion
Dungeness Bay & R. Treaty & Nontreaty Net	2	Coho fisheries 7d/wk 9/19 thru 11/3	0	-2	
Elwha R. Treaty Net	1	As planned	3	2	No impacts during coho-directed fishery
Hoko R. Treaty	na	na	na	na	No fisheries impacting Chinook
Other Strait Tributaries	na	na	na	na	No fisheries impacting Chinook

(Will Beattie, NWIFC; Scott Chitwood, JKT; Doug Morrill, LEKT; 5/2/05)

5.10 Nontreaty Commercial Fishery Bycatch Monitoring

WDFW annually conducts routine aerial nontreaty vessel counts and focused on-water monitoring as needed. In 2004, on-water surveys were conducted for nontreaty fisheries in areas 7/7A directed at sockeye salmon, and for chum-directed fisheries conducted in areas 10/11 (South Puget Sound) and 12/12B (Hood Canal). The 2004 monitoring schedule represented an increase over previous years, and twelve observers were hired to gather data in the various fisheries throughout Puget Sound.

Note that estimates of total bycatch reported below are preliminary and subject to change.

5.10.1 Commercial Sockeye Salmon Directed Fisheries (Areas 7 and 7A)

WDFW monitored 2004 nontreaty commercial purse seine catch and bycatch in both the Fraser-Panel-controlled sockeye salmon fisheries. Bycatch for these areas consisted of Chinook and coho salmon, as well as other non-target fish species, benthic invertebrates, and marine birds and mammals. This report focuses primarily on bycatch of Chinook and coho.

Encounters of “bycatch” species were tallied, and encounter rates (bycatch per 1000 target species) estimated using observer data collected during each fishery. Estimates of total “bycatch” will be based on those tallies, expanded using actual catch numbers reported on fish tickets for each Management Week. The expanded numbers will reflect estimates of total encounters, but do not represent the total bycatch mortality.

Table 5-M
Areas 7/7A Nontreaty Commercial Net Fishery Monitoring Summary

Mgmt Wk	Gear	Observations	SOX	PINK	CHIN	COHO	CHUM	Directed Species	Chin per 1000 Directed Species
31	PS	20	2701	Na	30	4	0	sockeye	11
32	PS	10	92	Na	2	0	0	sockeye	22
33	PS	17	763	Na	65	18	0	sockeye	85
42	PS	18	0	Na	6	181	965	chum	6
44	PS	5	0	Na	0	2	79	chum	0

WDFW staff observed a total of 56 purse seine sets in Areas 7 and 7A during the sockeye season and counted a total of 3,556 sockeye, 311 chum, 28 coho and 97 Chinook. During the fall chum season an additional 23 sets were observed and 6,531 chum, 7 coho and zero Chinook were counted.

5.10.2 Commercial Limited participation in 7B/C and 8A

For the last two years, limited participation purse seine fisheries were conducted in the Areas 7B and 7C hatchery-Chinook-directed fisheries (management period weeks 34-36) and for coho in Area 8A during week 41 in 2003 and week 40 and 41 in 2004. These limited participation fisheries were implemented to allow purse seine fishing in Area 7B, where only gill net fishing had been allowed in recent years, because it was feared that a full fleet purse seine fishery would erode the potential for gill net fishers to maintain their catch. In Area 8A, the limited purse seine fishery was implemented because managers judged that a full fleet fishery would have risked over-harvest.

In both years, the fishers authorized to participate in the limited participation fisheries were determined prior to the season via a drawing held by assigning individually numbered raffle style tickets to each vessel requesting to participate. The tickets were then placed in a box, and shaken. The tickets were then blindly drawn from the box by an impartial observer. The order the tickets were removed from the box became the rank order of the vessels registered to participate (i.e. the vessel represented by the first ticket to be drawn was the first vessel to be offered a chance to participate). After establishing the overall ranking, the owners of the top two ranked vessels that indicated a willingness to participate in that area (e.g. Area 7B) were contacted. If the operators declined the opportunity, the operator of the next vessel on the list was contacted. During the 2003 season fishers were contacted weekly which led to complaints of late notice and confusion as to which vessels were authorized. These problems were largely addressed 2004 by identifying the fishers eligible to fish in each week of the fishery pre-season. Despite this, there were some fishers that reported they could not participate only days before the particular fishery opening, necessitating contacting other fishers and publishing new emergency regulations. In other cases a designated fisher failed to participate without prior notice simply resulting in lost opportunity.

5.10.2.1 Area 7B and 7C Chinook

Chinook catches were low. In 2003 six purse seine vessels collectively landed 558 Chinook and in 2004 twelve boats only landed 197 Chinook. The most significant contributing factor was the lower-than-expected hatchery Chinook abundance during both years. The pre-season forecast in 2003 called for 46,000 Chinook to return to the Nooksack and Samish Rivers, but only 30332 returned. In 2004, a total of 34,300 Chinook was expected preseason but preliminary postseason evaluation of catch and escapement indicates a run size of about 20,000. The other factor that may have contributed to the low catch was the relative unfamiliarity of the participating fishers with finding and fishing the suitable purse seine sets in the area. Fishers worked the William Point area of Samish Island and Whiskey Rock near Wildcat Cove. There are limited areas of deep water near the shore at both sites and fishers experienced problems with net roll ups.

Limiting the purse seine fishery to two vessels in 2003 and four vessel per week in 2004 was effective in preventing the purse seine fleet from displacing the traditional gillnet harvest. The total purse seine catch of 558 Chinook in 2003 and 197 in 2004 was not large enough to significantly degrade the gillnet opportunity; the gillnet fleet landed 8,077 Chinook in 2003 and 4815 in 2004.

This opportunity will be expanded from limited-participation to full-fleet in 2005. The low catches experienced by fishers in the last two years demonstrates that this is not a highly productive fishery for purse seine gear. Additionally, there are only limited areas where it is feasible to fish purse seine gear in this area (i.e. the William Point area of Samish Island and Whiskey Rock near Wildcat Cove). Consequently, the fishery is expected to be self limiting in terms of both effort and catch rates. Currently scheduled full fleet purse seine fisheries during coho and chum season do not result in significant purse seine effort or catch. The ten year average of landing (1994-2003) for each gear is 897 gillnet landings and 5 purse seine landings. The relative catch of the two gear types is proportional to the landings. This fishery will be monitored by WDFW to ensure unexpectedly large catch rates do not occur, and if they do the purse seine fishery will be closed early.

5.10.2.2 Area 8A Coho

The two vessels that participated in the 2003 Area 8A limited participation coho fishery landed 415 coho, whereas only 128 were landed in 2004 by the three of four vessels authorized to participate.

This limited-participation opportunity will be continued in 2005. Commercial purse seine fishers maintain an interest in any opportunity to access coho salmon and did not want to give up this limited fishery. Expansion of the fishery was considered, but the history of purse seine effort in Area 8A is episodic; generally only a couple of vessels participate, but occasionally large numbers of vessel participate and take very substantial numbers [100,000 or more per week] of salmon. This level of coho harvest would not be acceptable at this time.

5.10.2.3 Results

The bycatch of coho and sockeye was very low in the 7B –7C Chinook purse seine fishery. The relatively small number of fish taken per set allowed prompt handling of the by-catch in terms of fish back in the water quickly. The significant crab by-catch consisting mainly of Dungeness crab with small proportion of red rock crab observed in 2003 was not observed in 2004

The by-catch of other salmon species in the Area 8A fishery was not significant (Table 5-N).

Table 5-N
2003 & 2004 Area 8A Purse Seine Limited Participation Coho Fishery

Date	Participant Vessel	Coho	Sockeye	Chum	Pink	Chinook	Total Sets
10/6/2003	Vessel A	231	0	28	0	0	10
10/6/2003	Vessel B	184	0	18	1	0	8
2003 TOTALS	2 VESSELS	415	0	46	1	0	18
9/27/2004	Vessel B	28	0	1	0	0	5
9/27/2004	Vessel C	39	0	6	0	2	5
10/4/2004	Vessel D \1	61					Fish Ticket
10/4/2004	Vessel E						Did not fish
2004 TOTALS	4 VESSELS	128	0	7	0	2	10

1/ Vessel did not have a WDFW observer on board, so total number of sets is not known

5.10.3 Commercial Coho and Chum Directed Fisheries in Areas 8 and 8A

Very few Chinook were encountered during coho and chum fisheries in area 8A (Table 5-O). During the chum season, 19 sets were observed resulting in 6,531 chum, 7 coho and zero Chinook. No nontreaty net fishing occurred in area 8 in 2004.

Table 5-O
Areas 8/8A Nontreaty Commercial Net Fishery Monitoring Summary

Mgmt Wk	Gear	Area	Observa tions	SOX	PINK	CHIN	COHO	CHUM	Directed Species	Chin per 1000 Directed Species
40	PS	8A	10	0	0	2	67	7	coho	30
45	PS	8A	4	0	0	0	5	316	chum	0
46	PS	8A	15	0	0	0	2	6215	chum	0

5.10.4 Commercial South Sound and Hood Canal Chum Directed Fisheries

Chum fishing began in Areas 10 and 11 in the week beginning September 26 (Week 40), with purse seines starting the following week. During the Area 10 and 11 chum directed fishery, purse seines were not allowed to keep Chinook or coho.

WDFW staff observed a total of 76 purse seine sets in Areas 10 and 11 for a total off 19,502 chum, 669 coho and 39 Chinook (Table 5-P). No gillnet observations were made; it is assumed that, since all salmon species can be legally retained, catches of all species will appear on fish tickets. Also, gillnet observations for seabird encounters are not a high priority in South Sound because that area is not heavily utilized by bird species of concern such as Marbled Murrelets.

Table 5-P
Areas 10/11 Nontreaty Commercial Chum Net Fishery Monitoring Summary

Mgmt Wk	Gear	Area	Observa tions	SOX	PINK	CHIN	COHO	CHUM	Chin per 1000 Chum
42	PS	10	20	0	0	6	470	4811	1
43	PS	10	17	0	0	9	101	2735	3
44	PS	10	18	0	0	10	80	8233	1
45	PS	10	21	0	0	14	18	3813	4

WDFW staff observed a total of 84 purse seine sets in Areas 12 and 12B for a total off 23,238 chum, 590 coho and 1 Chinook (Table 5-Q).

Table 5-Q
Hood Canal Nontreaty Commercial Chum Net Fishery Monitoring Summary

Mgmt Wk	Gear	Area	Observa tions	PINK	CHIN	COHO	CHUM	Chin per 1000 Chum
43	PS	12/12B	15	0	1	194	1323	1
44	PS	12/12B	11	0	0	72	1310	0
45	PS	12/12B	32	0	0	220	12404	0
46	PS	12/12B	26	0	0	60	7552	0

5.10.5 Total Nontreaty Commercial Bycatch Estimate

Table 5-R provides estimates of total Chinook encounters for 2004 nontreaty coimmercial fisheries. A 33% mortality rate was applied in purse seine fisheries in Areas 7 and 7A where brailing is required and a 45% mortality rate was used in all other fisheries where brailing was not required.

Table 5-R
Estimates of Chinook Bycatch in
2004 Nontreaty Puget Sound Commercial Fisheries

Area	Estimated Purse Seine Encounters	Estimated Mortality of PS Encounters	Gill Net Landings	Total
7&7A	2,127	702	25	997
8	0	0	0	0
8A&8D	27	12	7	39
10&11	975	439	6	472
12,12B-C	8	3	0	113

Encounters of “bycatch” species were tallied, and encounter rates (bycatch per 1000 target species) estimated using observer data collected during each fishery. Estimates of total “encounters” are based on those tallies, expanded using actual catch numbers reported on fish tickets for each Management Week. The expanded numbers reflect estimates of total encounters. Mortalities are calculated by applying a mortality rate to the estimated encounters (i.e. 45% in areas Puget Sound Areas other than 7&7A and 33% in Area 7&7A. The number reported for gillnet gear represents the number of fish sold to a buyer and recorded on fish tickets. Since it is unlawful to discard dead fish, there is no expectation that gillnet fishers are releasing any fish. Seal damaged fish are legal to release, but there are no data upon which to make an estimate of this type of release.

5.11 Nontreaty Commercial Fishery Management Measures

A number of special management measures are implemented annually for nontreaty commercial fishers (regulated by WDFW). These measures are intended to improve the logistics of fishery management and enforcement in potentially volatile fisheries or reduce nonlanded mortality of nontarget species. Following is a partial list of nontreaty regulatory provisions as identified to fishers preseason. Also provided are brief assessments of effectiveness for each measure in 2004 fisheries. Specific measures are also imposed for fishers regulated by each fishing tribe; these tribal fishery restrictions are not detailed in this report.

1. **Quick reporting now in effect for ALL Puget Sound commercial salmon fisheries.**

   “Quick Reporting” by fish dealers and fishers selling their catch under a “Direct Retail Sales Endorsement” is in effect for ALL salmon fisheries.”

   In 2004, this program was very effective at generating timely in-season estimates of catch and effort. Compliance was generally good and steps are being taken to improve the compliance rate next year. (I.e. buyers with compliance issues have been identified and will be monitored closely next season.)

2. “Fish Friendly” Certification Required:

“All vessel operators fishing in Areas 7 or 7A must be in possession of a “Fish Friendly” certification obtained by attending one of two “Fish Friendly” workshops being presented in May and June by WDFW Puget Sound Harvest Management Unit staff.”

In an effort to improve the level of understanding and compliance of commercial salmon fishers required to use selective fishing techniques in Areas 7 and 7A mandatory attendance of a training workshop was imposed on all fishers operating commercial fishing gear in those areas during the 2004 season.

Workshops were held at the locations and dates listed on Table 5-S, below.

Table 5-S
2004 Fish Friendly Best Fishing Practices Workshops

Date	Location	Number Certified
May 22, 2004	Best Western Cottontree Inn, Mount Vernon	218
June 19, 2004	Washington Department of Fish and Wildlife, Mill Creek Office	42
July 26, 2004	Purse Seine Vessel Owners Association, Seattle	11
July 27, 2004	Individual Session -Martin Bojocich	1
September 23, 2004	Washington Department of Fish and Wildlife, Olympia Office	10
October 8, 2004	Purse Seine Vessel Owners Association, Seattle	11
2004 Total		**293**

Compliance with the certification requirement appeared to be very high, as demonstrated by the large number of attendees and the lack of a reported incidence of uncertified fishers on the fishing grounds.

3. Special Limited-participation Fisheries:

Area 13 gillnet: A limited participation fishery (5 gillnet boats) was tentatively scheduled in a portion of Area 13 near the mouth of the Nisqually River for Weeks 49-53, 3 days per week. This fishery was cancelled based on in-season negotiation with the Nisqually tribe.

7B/C & 8A purse seine: Limited participation was anticipated in the Area 7B/7C Bellingham Bay Chinook fishery during weeks 34 through 36 (4 seine boats) and in the Area 8A coho fishery during weeks 40 and 41 (2 seine boats).

Results of these opportunities are discussed in section 5.10.2.1.

4. Purse Seine Release of Incidentally Caught Fish:

“Retention of the following salmon taken with purse seine gear is prohibited:

3.5 Chinook in Areas 7, 7A, 8, 8A, 8D, 10, 11, 12, 12B & 12C at all times;

3.5 Coho in Areas 7, 7A, 10, and 11 at all times, and 7B prior to September 5;

3.5 *Chum in Areas 7 & 7A during sockeye and pink directed openings."*

Concern continues regarding compliance with these rules. Refer to Section 8.1 for information gained through on-water monitoring of these fisheries.

5. Special Handling for species required to be released by purse seines:

*"In addition to the requirement to land all salmon on deck with the hatch cover(s) closed, brailing is required during **ALL** fishery openings in Areas 7 & 7A, and during 7B & 7C Chinook-directed fishing. All salmon captured in the seine net must be removed using a brailer or dip net*.*

3.5 All salmon must be immediately sorted, and those required to be released must be placed in an operating recovery box or released into the water before the next brail may be brought on the deck.

3.5 Small numbers of fish may be brought on board the vessel by pulling the net in without mechanical or hydraulic assistance.

3.5 A brailer is defined as a bag of web hung on a rigid hoop attached to a handle; the bag shall be opened by releasing a line running through rings attached to the bottom of the bag; the web shall be of a soft knotless construction and the mesh size may not exceed 57 mm (2.25 inches).

3.5 *A dip net is defined as a hand-held net with a shallow bag of soft, knotless web."*

Concern continues regarding compliance with these rules. Refer to Section 8.1 for information gained through on-water monitoring of these fisheries.

6. Purse Seine Recovery boxes:

"Vessels using two recovery boxes or a single two-chamber recovery box during all fishing in area 7 and 7A will be allowed 25% more fishing time than vessels not so equipped and operated. Each box and chamber shall be operating during any time that the net is being retrieved or picked. The flow in the recovery box will be a minimum of 16 gallons per minute in each chamber of the box, not to exceed 20 gallons per minute. Each chamber of the recovery box must meet the following dimensions as measured from within the box; the inside length measurement must be 48 inches, the inside width measurements must be 10 inches, and the inside height measurement must be 16 inches. Each chamber of the recovery box must include a water inlet hole between 3/4 inch and 1 inch in diameter, centered horizontally across the door or wall of chamber and 1 3/4 inches from the floor of the chamber. Each chamber of the recovery box must include a water outlet hole opposite the inflow that is a least 12 inches in diameter. The center of the outlet hole must be located a minimum of 12 inches above the floor of the box or chamber. The fisher must demonstrate to WDFW employees, fish and wildlife

enforcement officers, or other peace officers, upon request, that the pumping system is delivering the proper volume of fresh saltwater into each chamber. Any fish that is bleeding or lethargic must be placed in the recovery box prior to being released."

Concern continues regarding compliance with these rules. Refer to Section 5.10 for information gained through on-water monitoring of these fisheries.

7. Purse Seine"Rolling Wedge" Evaluation:

"As a pilot project, the Department will evaluate the "rolling wedge" technique as a potential alternative to brailing:

3.5 Any vessel desiring to participate in this evaluation, according to the provisions identified below, must notify Don Noviello at WDFW (360) 902-2717 by June 1.

3.5 Each participating vessel will be required to pay $100/ day ("opening") for a WDFW on-board observer/monitor.

3.5 Gear specifications and fish handling intent will be defined as part of project design; a list of provisions will be developed for participating vessels that will require Department and vessel operator signatures ("formal agreement").

3.5 Fish will be brought over the side of the vessel only rather than stern.

3.5 No more than 125 fish may be on deck at one time.

3.5 *Fishing operations will be under the direction of a monitor/observer (and according to intent of evaluation) and any deviations from evaluation provisions may only occur by approval of on-board monitor."*

Participation in this program was limited to one individual for one day and did not result in enough data for conclusions to be made. There is currently no additional effort planned for this evaluation.

8. Gillnet recovery boxes:

"Gill net participation in the week 42 chum fishery in Areas 7 and 7A requires utilization of on-board recovery boxes, and soak time (first mesh in to last mesh out) for gill net sets is not to exceed 45 minutes."

This program held effort down to 6 landings during week 42 as fishers opted out of the fishery instead of complying for just one week.

9. Gillnet Registration:

Daily registration (hail in-hail out) was required in order to participate during gillnet chum openings in Areas 7, 7A, 8A, 10, 11, 12,12B and 12C. To "hail in," the gear operator must submit: 1) their name, 2) a telephone number where they can be reached and 3) the specific area they will be fishing. This report must be made 24 hours in advance of each day of fishing (with exceptions for short-notice openings) by using FAX, E-mail or Toll-free telephone call. To "hail out," the operator must call and notify the Department as they prepare to leave the fishing area and provide adequate notification as to where and when they will land their fish.

This program inspired numerous complaints about the technical difficulty of complying, and ultimately did not produce information that was more reliable than information obtained via the quick reporting system. Because of this, the program will be discontinued in 2005.

10. Marking gill nets:

"Any gill net, attended or unattended, must have affixed within five feet of each end of the net, a buoy, float, or some other form of marker, visible on the corkline of the net, on which shall be marked in a visible, legible and permanent manner the name and gill net license number of the fisher."

No problems noted.

11. Reef Net salmon release requirements:

"Release Chinook at all times, and release wild coho through September 30 (wild coho are identified by an intact adipose fin)."

No problems noted.

12. Beach seine openings:

"Daily registration (hail in-hail out) will be required to participate during all beach seine openings. See "Daily registration" on page 4. Beach seine open fishing hours are 7 AM to 7 PM Monday through Friday within these season range dates: Quilcene Bay - August 23 through October 1, and in the portion of Area 7B designated for beach seining - October 11 through November 6."

No landings were made in the 2004 beach seine fishery and the program has been suspended.

13. Beach seine by-catch non-retention:

"It is unlawful to retain Chinook and chum salmon taken with beach seine gear in Area 12A."

Program suspended, see above.

14. Reducing Seabird Entanglements:

"Gill nets used in Area 7 and 7A sockeye and pink-directed (odd years only) fisheries must be constructed with 5-inch mesh, white opaque, minimum 210d/30 (#12) nylon twine in the first 20 meshes below the corkline. Gillnet fishing is also restricted to daylight hours in areas 7 and 7A, which, when combined with use of the highly-visible bird strip, has been shown to reduce gillnet entanglements of seabirds. Purse seines are required to maintain at least four openings in the cork line that are at least 12 inches in length so that seabirds may easily escape from the closed seine net. Both gillnets and purse seines are required to release live

seabirds; all dead marbled murrelets are to be turned over to the U.S. Fish and Wildlife Service via WDFW biologists.

These provisions are requirements of an ESA Section 7 Biological Opinion issued by the U.S. Fish and Wildlife Service for Puget Sound nontreaty commercial net fisheries in 2001."

No problems noted.

15. Sub-area Closures:

Twenty-four sub-area closures, called Fishery Exclusion Zones or Seasonal Closures, are imposed by WDFW for commercial salmon fisheries within Puget Sound. Purposes for these closures include prevention of fishing impact on fish milling at river mouths, closure of areas where stocks of concern are known to occur, reduction of fishing gear contact with benthic substrates, separation of recreational fishers and boaters from commercial fishing activity, and separation of treaty and nontreaty fishers.

The U.S. Coast Guard regulates fishing vessels relative to vessel congestion, including adjacent to ferry traffic lanes, if necessary. The U.S. Navy imposes regulations that prevent interactions with naval vessels in transit. Washington Department of Transportation also advises fishing vessels to stay clear of the Hood Canal Floating Bridge.

Many sub-area closures in northern Puget Sound waters are mentioned in the marbled murrelet BiOp as having benefits for seabird avoidance in addition to the primary intended benefit. The BiOp indicates that nontreaty commercial and recreational fisheries are "not likely to jeopardize the continued existence of the marbled murrelet" as long as the conservation measures already implemented by WDFW remain in effect.

No problems were noted with implementation of these closures in 2004. (Don Noviello, WDFW, 5/3/05)

5.12 Recent Historic Commercial Catches

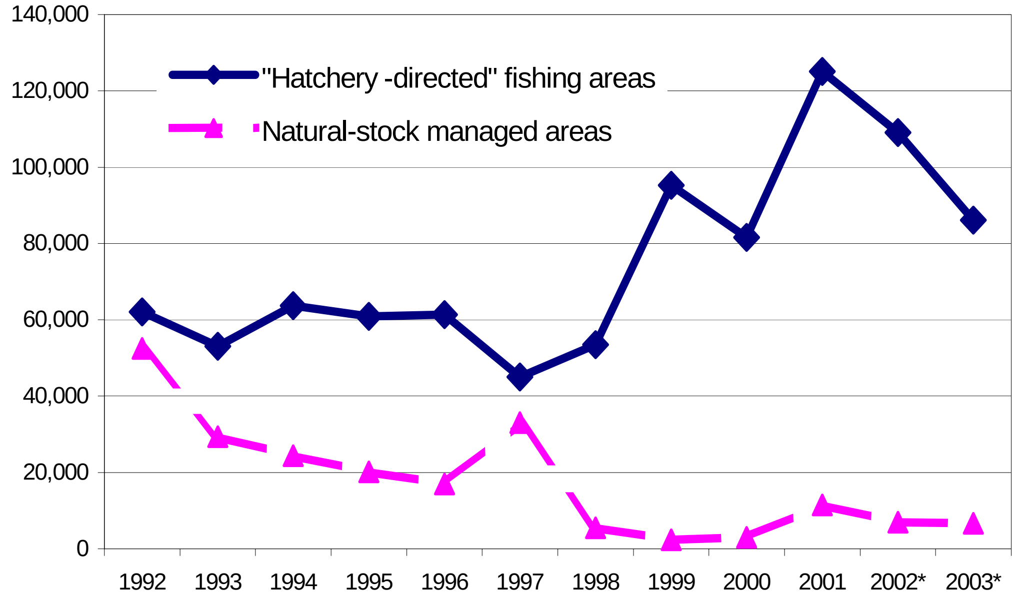
Below are tables showing recent historic commercial catches, including ceremonial and subsistence and take home catches reported on fish tickets, as well as any estimates recorded on fish tickets of the number of carcasses associated with egg sales.

5.12.1 Historic Commercial Catch Discussion

Generally, Chinook harvests have reduced dramatically in fishing areas where natural Chinook impacts are a concern (Figure 5-B).

Figure 5-B
Puget Sound Commercial Chinook Net Catch (Treaty & Nontreaty combined)

Note: "Hatchery-Directed" areas include 7B/C, 10/11, 9A/12A, 12 nontreaty fisheries and 7B/C, 8D,



10, 10A, Lk. Wa., Green, 10E, Puyallup, 13-13K, Nisqually, 9A/12A, 12C/12H, Skokomish for treaty fisheries. Other areas are included as "natural-stock managed" areas.

Catches in areas targeting primarily hatchery Chinook have increased since the late 1990's, primarily as a result of higher returns related to improving marine survival conditions.

Table 5-T
1992-2003 Treaty Indian Puget Sound Commercial Chinook Catches[1]

Area	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002[3]	2003[3]
Troll 4B PFMC[2]	3724	2045	732	415	2179	1299	272	663	587	7094	1461	87
Non-PFMC Troll[2]	31370	10422	3419	6406	9910	847	707	658	347	1974	1783	436
NET GEAR:												
4B/5/6/6C	939	1418	5864	4769	604	492	265	589	782	931	1074	908
7/7A	6884	6546	4862	3002	2965	18476	3308	3	768	953	2170	4761
6D	1	1	0	0	0	0	1	0	0	0	0	1
Elwha R.	143	100	34	2	2	1	2	17	0	0	0	0
7B,C,D	8486	10832	9935	8180	10232	9054	9593	22796	17510	30896	20701	9943
Nook. R.	2230	194	925	2134	1659	1749	405	2248	997	806	408	562
8	129	63	0	121	4	229	0	35	0	21	1	67
Skagit R.	1970	1297	493	2885	231	850	297	328	451	211	286	245
8A/8D	3961	4094	4677	8643	11382	8626	7227	15438	7726	5458	5520	9257
Stillag. R.	6	0	0	66	0	0	5	0	0	0	0	0
9	1	2	0	0	0	0	0	0	0	0	0	0
10	6750	1556	928	876	440	53	569	69	280	246	91	214
10A	5023	3443	5065	3229	4165	473	1866	646	3558	4364	1657	1339
Green R.	3465	3085	3246	884	4068	167	1670	2152	4105	4696	9877	2876
10C,D,F,G	2175	1521	29	61	53	58	4	0	591	3297	182	396
10E	3599	1818	4734	6515	2895	1932	2950	5261	3764	6561	4787	7966
11	120	1	0	10	7	0	0	0	0	0	0	1
11A	4	41	43	107	93	109	107	25	0	148	0	0
Puyallup R.	718	1705	3566	5001	4886	2700	1581	1884	1982	6712	4749	2290
White R.	0	0	0	3	0	0	9	0	3	83	0	115
13	483	263	293	124	0	5	413	153	4458	120	152	65
Nisq./ McAll.	2116	5304	9347	12201	7636	7675	8405	16395	4531	10528	17027	17788
13A	1326	309	886	642	75	75	259	3836	2430	2380	973	2166
13C	3290	2088	1766	3206	2459	1148	4860	559	1408	336	689	922
Chambers.	0	0	0	0	0	67	0	0	0	0	0	0
13D-K	5432	4332	6136	5032	3354	414	632	5194	4817	3030	1005	1146
12, 12B	35	108	7	5	0	1	0	0	0	34	90	0
9A, 12A	7	5	27	35	7	11	66	83	30	338	4	0
12C,D,H	81	456	40	0	0	6	1059	7956	11094	21481	21080	17850

Area	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002[3]	2003[3]
Skok. R.	676	456	249	0	0	0	1	1080	943	5830	2649	2852
Purdy Ck.	0	22	16	0	0	0	0	0	0	0	0	0

[1] Includes commercial, ceremonial & subsistence, take home, and egged carcasses;

[2] Troll fisheries in area 4B during May-September are controlled by PFMC regulations; other areas and times are non-PFMC controlled.

[3] denotes preliminary data

Source: 1992-2002 WDFW Fish Ticket Database (7/04); 2003 (5/05); 1992-2003 Troll (5/23/05)

Table 5-U
1992-2003 Nontreaty Puget Sound Commercial Net Chinook Catches

Area	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002*	2003*
6/7/7A	7035	7279	8988	2283	969	10739	496	0	61	17	59	66
7B/7C	6675	9105	9593	3532	7629	10690	11910	9243	11369	18002	17564	8406
8	104	0	3	54	0	14	0	0	0	8	0	
8A/8D	63	12	1	17	2	0	0	4	0	0	0	
10/11	5592	2489	2243	642	444	67	12	247	30	2	0	93
9A/12	9	19	0	2	2	3	10	18	8	0	3	2

Source: 1992-2002 WDFW, PSIT Fish Ticket Database (7/04); 2003 (5/05)

* Preliminary

6. 2004-05 Recreational Seasons & Catch Summary

Included in this section are fisheries descriptions, highlighting significant inseason deviations from preseason expectations. The following sections present expected (modeled) recreational catch for the current (2004-05) management year, inseason creel survey results, where available, expected and actual recreational Chinook catch for Puget Sound Areas 6 –13 for .the 2003-04 management year, and recent historic recreational catches.

6.1 Introduction to Seasons

Regulations implementing the *2004-05 State/Tribal Agreed-to Fisheries Document* were expected to achieve management objectives for all Puget Sound Chinook management units.

Figure 6-A depicts generalized 2004-05 fishing schedules and restrictions for recreational fishing seasons in the ocean and Puget Sound. Note that area-specific details, such as sub-area closures, are not included in this summary table, and may be found in the State-Tribal Agreed-to Fisheries Document (Appendix B). Standard recreational closures and restrictions are detailed in the Washington State Sport Fishing Rules – Pamphlet Edition. Current-year recreational fishing regulations can be accessed at https://fortress.wa.gov/dfw/erules/efishrules/index.jsp .

6.1.1 Recreational Fishing Seasons, As Anticipated Preseason

Area 5 Recreational

5/1-6/30	Closed
7/1-8/10	2 fish limit, (chinook 22" min size); unmarked chinook, unmarked coho, and chum release; Areas 5 & 6 season quota of 3,500 landed chinook, afterwards, chinook release. South of the Kydaka Pt./Shipwreck Pt. line – closed to salmon angling.
8/11-9/30	2 fish limit; chinook, unmarked coho, and chum release. South of the Kydaka Pt./Shipwreck Pt. line – closed to salmon angling.
10/1-10/31	Closed
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size).
12/1-2/15	Closed
2/16-4/10	1 fish limit (chinook 22" min size).
4/11-4/30	Closed

Area 6 Recreational

5/1-6/30	Closed
7/1-8/10	2 fish limit, (chinook 22" min size); unmarked coho, chum, and chinook release, except W. of true N/S line through "2" buoy near tip of Ediz Hook retention of marked chinook allowed; Areas 5 & 6 season quota of 3,500 landed chinook, afterwards, release chinook. South of Angeles Pt./ Observatory Pt. line – closed to angling. Pt. Angeles Hbr. W. of line from tip of Ediz Hook to ITT

	Rayonier Dock – closed to salmon angling. Dungeness Bay closed.
8/11-9/30	2 fish limit; chinook, unmarked coho, and chum release. South of Angeles Pt./Observatory Point line - closed to angling through 8/31. Pt.Angeles Hbr. W. of a line from the tip of Ediz Hook to ITT Rayonier Dock – closed to salmon angling through 8/31. Dungeness Bay closed.
10/1-10/31	Closed, except Dungeness Bay (see: Dungeness Bay Recreational below.)
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size)
12/1-2/15	Closed
2/16- 4/10	1 fish limit (chinook 22" min size). Dungeness Bay closed.
4/11-4/30	Closed

Dungeness Bay Recreational

5/1-9/30	Closed
10/1-10/31	Two fish limit, coho only
11/1-4/30	Closed

Dungeness River Recreational

(mouth to hatchery intake pipe at RM 11.3)	10/16 - 12/31	4 fish limit, coho only; 12" min size.

Elwha River Recreational

(mouth to Aldwell Lake Dam)	6/1 - 2/28/05	Trout and other game fish open, except closed for all species 6/1-9/30 from mouth to marker at outfall of WDFW rearing channel.
	10/1 - 11/15	6 fish limit, coho only; no more than 4 adults; 12 inch min. size. Closed waters – 50 yards above to 50 yards downstream of Elwha Tribal Hatchery outfall.

Hoko River Recreational

(mouth to cement bridge (mile 7.0) on Hoko/Ozette Hwy.)	9/1 - 10/31	Closed to salmon. Fly fishing gear only 9/1-10/31 for trout and other game fish.

All other STRAIT OF JUAN DE FUCA REGION freshwater recreational closed to salmon angling.

Area 7 Recreational

5/1-6/30	Closed
7/1-7/31	2 fish limit, 1 chinook (chinook 22" min size); Closed waters - Rosario Strait (easterly of line from Lummi Rks/Peapod Rks/Lydia Shoal due S to Black Rock, southerly to the eastern most point on James Island, and southerly to the marker on Bird Rocks, westerly to the marker across to Lopez Pass), E. Strait of Juan de Fuca, and Bellingham Bay closed.
8/1-9/30	2 fish limit, 1 chinook (chinook 22" min size), release unmarked coho, release chum; Closed waters - S Rosario Strait and E Strait of Juan de Fuca (E of boundary line drawn true S of Salmon Bank buoy), Bellingham Bay closed 8/1-8/15; Samish Bay closed.
10/1-10/31	2 fish limit, release chinook; Samish Bay closed 10/1-10/15.
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size).
12/1-1/31	Closed
2/1-3/31	1 fish limit, (chinook 22" min size).
4/1-4/30	Closed

Bellingham Bay Terminal Area Recreational

5/1-8/15	Closed
8/16-10/31	4 fish limit, 2 chinook (chinook 22" min size); Samish Bay closed thru 10/15.
11/1-4/15	Same as Area 7
4/16-4/30	Closed

Nooksack River Recreational; mainstem and North Fork

(from Lummi Indian Reservation boundary to yellow marker at the FFA high school barn in Deming)	9/1 – 12/31	2 fish limit, 12" min size, release unmarked chinook and unmarked coho. All Species-night closure and non-buoyant lure restriction 8/1-11/30.
(from yellow marker at the FFA high school barn in Deming to confluence of North and South forks)	10/16 – 12/31	2 fish limit, 12" min size, release chinook and unmarked coho. All Species-night closure and non-buoyant lure restriction 10/1-11/30.
(from confluence of North and South forks to Maple Creek on North Fork)	10/1 – 10/31	2 fish limit, 12" min size, release chinook and unmarked coho. All Species-night closure and non-buoyant lure restriction 8/1-11/30.

Nooksack River Recreational, South Fork

(from mouth to Skookum Creek)	10/16 – 12/31	2 fish limit, 12" min size, release chinook and unmarked coho. All Species-selective gear rules 6/1–2/28, and night closure 8/1-10/31.

Samish River Recreational

(from mouth to Thomas Rd. Bridge)	7/1 – 12/31	2 fish limit, 12" min size. All Species-night closure and non-buoyant lure restriction 8/1-12/31
(from Thomas Rd. Bridge to I-5 Bridge)	10/1 – 12/31	2 fish limit, 12" min size. All Species-night closure and non-buoyant lure restriction 8/1-12/31.

Dakota Creek Recreational

(mouth to Giles Road Bridge)	10/1 – 12/31	2 fish limit, 12" min size.

Whatcom Creek Recreational

(mouth to yellow markers below foot bridge below Dupont St. in Bellingham)	8/1 – 12/31	6 fish/2 adult limit, 12" min size. All Species – night closure and non-buoyant lure restriction 8/1-12/31.

All other NOOKSACK/SAMISH TERMINAL REGION freshwater recreational: Closed to salmon angling.

Area 8-1 Recreational

5/1-7/31	Closed
8/1-9/30	2 fish limit, chinook release.
10/1- 10/31	2 fish limit, chinook release.
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size)
12/1-1/31	Closed

2/1-3/31	1 fish limit, (chinook 22" min size)	
4/1-4/30	Closed	

Baker River Recreational

(mouth to Hwy 20 Bridge)	7/1 – 7/31*	2 fish limit, sockeye only, 12" min size. *Closed from 12:01 AM 7/6 through 2:00 PM 7/7 and from 12:01 AM 7/12 through 2:00 PM 7/13.

Cascade River Recreational

(mouth to Rockport-Cascade Road Bridge)	9/16 – 11/30	4 fish limit, coho only, 12" min size.

Skagit River Recreational

(mouth to Memorial Hwy. Bridge (Hwy 536 at Mt. Vernon))	9/1 – 12/31	3 fish limit, 12" min size, release chum, release chinook.
(From Memorial Hwy Bridge to Gilligan Creek)	9/1 – 12/31	3 fish limit, 12" min size, release chum, release chinook.
(From Gilligan Creek to Dalles Bridge at Concrete)	9/16 – 12/31	3 fish limit, 12" min size, release chum, release chinook. All Species – night closure and non-buoyant lure restriction 7/1 - 11/30.
(From Dalles Bridge at Concrete to Cascade River)	7/1 – 7/31	2 sockeye only; 12" min size; open only downstream of a point 200' above the E bank of the Baker River. All Species-night closure and non-buoyant lure restriction 7/1-11/30.
	9/16 – 12/31	3 fish limit, 12" min size, release chum, release chinook. All Species – night closure and non-buoyant lure restriction July 1 through 11/30. Closed Waters – between a line projected across the thread of the river 200'above the east bank of the Baker River and a line projected across the thread of the river 200' below the west bank of the Baker River 6/16-6/30 and 8/1-8/31.

All other SKAGIT TERMINAL REGION freshwater recreational closed to salmon angling.

Area 8-2 Recreational

5/1-7/31	Closed
8/1-9/30	2 fish limit, chinook release.
10/1-10/31	2 fish limit, chinook release.
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size).
12/1-2/15	Closed
2/16-4/10	1 fish limit, (chinook 22" min size).
4/11-4/30	Closed

Tulalip Special Area Recreational Fishery

Same as Area 8-2 Recreational, except during the period 6/18-9/27:	6/18*-9/27	Open 12:01 AM Friday – 11:59 AM Monday each week. Open within Tulalip Special Area boundaries only. Closed east of the line from Mission Point to Hermosa Point. 2 fish limit, (chinook 22" min. size). * May open later than 6/18

Snohomish River Recreational

(mouth to confluence of Skykomish and Snoqualmie rivers, including all channels)	8/1 – 8/31	2 fish limit, 12" min size, pink only, all species -selective gear rules. All Species-night closure and non-buoyant lure restriction 8/1-11/30.
	9/1 – 12/31	2 fish limit, 12" min size, release chinook and pink. All Species-night closure and non-buoyant lure restriction 8/1-11/30.

Snoqualmie River Recreational

(mouth to Snoqualmie Falls, including all channels)	9/1 – 12/31	2 fish limit, 12" min size, release chinook and pink. All Species-selective gear rules 6/1-11/30, except motors allowed; night closure 9/1-11/30. Closed Waters – within Puget Power tunnels at falls, and within 50' of any point on Puget Power's lower Plant #2 (north bank).

Skykomish River Recreational

(From mouth to Lewis St. Bridge in Monroe)	9/1 – 12/31	2 fish limit, 12" min size, release chinook and pink. Fishing from any floating device prohibited 11/1-2/28 from the boat ramp below Lewis Street Bridge at Monroe to 2500' downstream. All species - night closure and non-buoyant lure restriction 8/1-11/30.
(From Lewis St. Bridge in Monroe to Wallace River)	6/16* – 7/31	2 fish limit, 12" min size, marked chinook only. All species - night closure and non-buoyant lure restriction 6/1-11/30. Managed for hatchery broodstock. Evaluation by co-managers by June 30, about possibility of earlier fishery closure. * May open later than 6/16.
	9/1 – 12/31	2 fish limit,12" min size, release chinook and pink. All species - night closure and non-buoyant lure restriction through 11/30.
(From Wallace River to the forks)	9/1 – 12/31	2 fish limit, 12" min size, release chinook and pink. All species – night closure and non-buoyant lure restriction 8/1–11/30. Closed Waters – from 1500' upstream to 1000' downstream of Reiter Ponds outlet 6/1 to 8:00 a.m. 8/1 and within this 2,500' section, fishing from any floating device within this area prohibited 8:00 a.m. 8/1-3/31.

Wallace River Recreational

(mouth to 200' upstream of water intake of salmon hatchery)	9/1 – 11/30	2 fish limit, coho only, 12" min size. Fishing from any floating device prohibited 11/1-2/28

Stillaguamish River Recreational

(river and all sloughs downstream of Warm Beach-Stanwood Hwy)	9/1 – 12/31	2 fish limit, 12" min size, release chinook and pink. All Species-night closure and non-buoyant lure restriction 8/1-11/30.
(Warm Beach-Stanwood Hwy upstream to forks)	9/1 – 12/31	2 fish limit, 12" min size, release chinook and pink. All Species-night closure 8/1-11/30 and selective gear rules except motors allowed 6/1-11/30. Closed Waters – from water control structure/barrier dam (downstream of I –5) 200'downstream.

All other STILLAGUAMISH/SNOHOMISH TERMINAL REGION freshwater recreational closed to salmon angling.

Area 9 Recreational

5/1-7/15	Closed
7/16-7/31	2 fish limit, chinook release.
8/1-9/30	2 fish limit, chinook and chum release.
10/1-10/31	2 fish limit, chinook release.

11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size)
12/1-1/31	Closed
2/1-4/15	1 fish limit, (chinook 22" min size)
4/16-4/30	Closed

Edmonds Pier Recreational

6/1-4/30/05	2 fish limit, 1 chinook (22" min size), release chum 8/1-9/30.

Hood Canal Bridge Recreational

Year-round	Closed

Area 10 Recreational

5/1-6/15	Closed
6/16-6/30	Catch-and-release in waters N of Meadow Pt./Pt. Monroe line.
7/1-10/31	2 fish limit, chinook release, release chum 8/1-9/15;
	Shilshole Bay (East of Meadow Point/West Point line) Closed 7/1-8/31
	Outer Elliott Bay (E of West Pt./Alki Pt line to Pier 91/Duwamish Head line) Closed to salmon angling 7/1-8/31
	Inner Elliott Bay (E of Pier 91/Duwamish Head line) Closed to salmon angling 7/1-8/31 except for indicated openings identified in "Elliott Bay Recreational" section below Elliott Bay fishing piers open; see below
	Special gear restrictions in Duwamish Waterways area when open.
	See "Sinclair Inlet Recreational" section below for chinook retention fishery
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size)
12/1-12/15	Closed
12/16-2/28	1 fish limit, (chinook 22" min size); Agate Pass closure beginning 1/1.
3/1-4/30	Closed

Area 10 Piers Recreational

Seacrest Pier, Pier 86, Waterman Pier, Bremerton Boardwalk, Illahee State Park Pier	6/1-4/30/05	2 fish limit, 1 chinook (22" min size), release chum 8/1-9/15

Elliott Bay Recreational SAF

7/16-8/22	Open E of Pier 91/Duwamish Head line, weekly 12:01 a.m. Friday through 11:59 p.m. Sunday, 7/16–8/22, 2 fish limit, (chinook 22" min size), release chum beginning 8/1. Special gear restrictions in Duwamish Waterways area when open.
8/23-8/31	Closed
9/1-4/30	Same as Area 10.

Sinclair Inlet Recreational SAF

5/1-6/30	same regulations as Area 10
7/1-9/30	Open S of Manette Bridge, S of line drawn true W from Battle Point, and W of line drawn true S from Point White; 2 fish limit, (chinook 22" min size), release chum 8/1-9/15.
10/1-4/30	same regulations as Area 10

Green River Recreational

(1st Avenue Bridge to Pacific Highway South Bridge)	9/1 – 12/31	6 fish/3 adult limit, 12" min size, release chinook. All Species-night closure and non-buoyant lure restriction Sept. 1-Nov. 30. Fishing from any floating device prohibited 11/1-2/28.
(Pacific Highway South Bridge to S.W. 43rd St./S 180th St. Bridge)	9/16 – 12/31	6 fish/3 adult limit, 12" min size, release chinook. All Species-night closure and non-buoyant lure restriction Sept. 16-Nov. 30. Fishing from any floating device prohibited 11/1-2/28.
(S.W. 43rd St./ S. 180th St Bridge to the S. 277th Bridge in Auburn)	10/1 – 12/31	6 fish/3 adult limit, 12" min size, release chinook. All Species-night closure and non-buoyant lure restriction 10/1-11/30. Fishing from any floating device prohibited 11/1-2/28.
(S. 277th Bridge to Auburn-Black Diamond Rd Bridge)	10/16 – 12/31	6 fish/3 adult limit, 12" min size, release chinook. All Species-night closure and non-buoyant lure restriction 10/16-11/30. Fishing from any floating device prohibited 11/1-3/15.
(from Auburn-Black Diamond Rd Bridge to Tacoma Headworks Dam)	11/1 – 12/31	2 fish limit, 12" min size, chum only. All Species-night closure and non-buoyant lure restriction 8/1-11/30. Closed Waters-within 150' of the Palmer Ponds outlet rack and within 150' of the mouth of Keta (Crisp) Creek.

The 2004/2005 WDFW sport pamphlet will reflect the following season end dates for trout and other game fish fall/winter season. These end dates are subject to change based on State-Tribal agreement:

Mouth to S. 277th Bridge in Auburn: Feb. 15

S. 277th Bridge to Tacoma Headworks Dam: Feb. 28

Soos Creek Recreational

(mouth to bridge near hatchery residence)	10/9 – 10/31	2 fish limit, 12" min size, coho only.Juvenile anglers (under 15 years old) only, 1 single hook; night closure through 10/31

Lake Washington Recreational

East of the Montlake Bridge	July	Dependent upon ISU (lock counts). Potential fishery, starting date to be determined. 2 fish limit, sockeye only, 12" min. size.
North of Hwy 520 Bridge	9/16 – 10/31	2 fish limit, coho only, 12" min size

Lake Sammamish Recreational

8/16 – 11/30	2 fish limit, 12" min size, release sockeye. Closed: waters within 100 yards of the mouth of Issaquah Creek are closed to salmon fishing.

All other SOUTH SOUND AREA 10 REGION freshwater: Closed to salmon angling.

Area 11 Recreational

5/1-6/15	Closed
6/16*-10/31	2 fish limit, (chinook 22" min size); Commencement Bay (E of Cliff House Restaurant/Sperry Dock line) closed to salmon fishing through 7/31. * May open later than 6/16.
11/1-12/31	2 fish limit, 1 chinook (chinook 22" min size)
1/1-2/15	Closed
2/16-4/10	1 fish limit (chinook 22" min size)
4/11-4/30	Closed

Dash Point Dock, Point Defiance Boathouse Dock, Les Davis Pier, Des Moines Pier and Redondo Pier	6/1-4/30/05	2 fish limit; 1 chinook (22" min size)

Puyallup River Recreational:

(from 11th St. Bridge to Carbon River)	9/1 – 12/31	6 fish/2 adult limit, 12" min size, release unmarked adult chinook. All species – single point barbless hooks required 8/1-11/30.

Carbon River Recreational

(mouth to Voight Creek)	9/1 – 11/30	6 fish/4 adult limit, no more than 2 adults may be marked chinook; 12" min size, release unmarked adult chinook, and release chum. All Species night closure, non-buoyant lure restriction, and single point barbless hooks 8/1-11/30.

All other SOUTH SOUND AREA 11 REGION freshwater recreational Closed to salmon angling

Area 13 Recreational

5/1-6/15	Closed.
6/16*-6/30	2 fish limit, (chinook 22" min size); Carr Inlet (N of Penrose Pt./Green Pt. Line) closed.* May open later than 6/16.
7/1-10/31	2 fish limit, chinook 22" min size; release unmarked coho 7/1-10/31; Carr Inlet (N of Penrose Pt./Green Pt. Line) closed 7/1-7/31, except open to fly-fishing-only for marked hatchery coho; Minter Creek mouth closed through 9/30; Lower Budd Inlet closure zone 7/16-10/31.
11/1-12/31	2 fish limit, 1 chinook (chinook 22" min size)
1/1-4/30	1 fish limit, (chinook 22" min size). Carr Inlet (North of Penrose Pt./Green Pt. line) closed 4/16-4/30.

Fox Island Pier Recreational

6/1-4/30/05	2 fish limit, 1 chinook (22" min size); release unmarked coho 7/1-10/31

Chambers Creek Estuary Recreational

(downstream of markers 400' below Boise-Cascade Dam to Burlington Northern Railroad Bridge)	7/1 – 11/15	6 fish/2 adult limit, 12" min size, release unmarked coho.

Deschutes River Recreational

(from Old Hwy 99 Bridge on Capitol Blvd in Tumwater to Henderson Blvd Bridge)	7/1 – 11/30	6 fish/2 adults limit, 12" min size, release coho.
(upstream of Henderson Blvd Bridge)	7/1 – 11/30	6 fish/2 adults limit, 12" min size, release coho, selective gear rules.

Kennedy Creek Recreational

(mouth to northbound Hwy. 101 Bridge)	10/1 – 11/30	6 fish/2 adults limit, 12" min size, release coho, barbless hooks required. Night closure and non-buoyant lure restriction 10/1-12/31.

McAllister Creek Recreational

(mouth to Olympia-Steilacoom Rd Bridge)	7/1 – 11/30	6 fish/4 adult limit, 12" min size. All species – night closure and non-buoyant lure restriction 8/1- 11/30.

McLane Creek Recreational

(from a line 50' north of and parallel to the Mud Bay Rd. Bridge to a line 100' upstream of and parallel to the south bridge on Hwy.101)	7/1 – 11/30	6 fish/2 adults limit, 12" min size, release coho.

Minter Creek Recreational

(mouth to 50' downsteam of hatchery rack)	11/1 – 12/31	4 fish limit, 12" min size, chum only.

Nisqually River Recreational

(mouth to the military tank crossing bridge, one mile upstream of the mouth of Muck Creek)	7/1 –1/31	6 fish/2 adults limit, 12" min. size. All species – night closure and non-buoyant lure restriction 8/1- 11/30.

All other SOUTH SOUND AREA 13 REGION freshwater recreational closed to salmon angling.

Area 12 Recreational

5/1-6/30	Closed
7/1-8/31	North of Ayock Pt. – Closed except see Quilcene/Dabob Bay Recreational below.
9/1-10/15	North of Ayock Pt. – 4 fish limit, coho only.
7/1-10/15	South of Ayock Pt. - 4 fish limit, 2 chinook (chinook 22" min size); release chum.
10/16-12/31	4 fish limit, 1 chinook (chinook 22" min size).
1/1-2/15	Closed
2/16-4/10	1 fish limit (chinook 22" min size).
4/11-4/30	Closed

Hood Canal Bridge Recreational	Year-round	Closed

Quilcene/Dabob Bay Recreational

5/1-8/15	Closed
8/16-10/15	4 fish limit, coho only.
10/16-12/31	4 fish limit, 1 chinook (22" min size).
1/1-2/15	Closed
2/16-4/10	1 fish limit (chinook 22" min size).
4/11-4/30	Closed

Hoodsport Hatchery Zone Recreational

Same as Area 12 except:

7/1-12/31	4 fish limit, only 2 chinook greater than 24"; chum release 7/1-10/15; night closure.

Dewatto River Recreational

(mouth to Dewatto-Holly Rd. Bridge)	9/16 – 10/31	2 fish limit, 12" min size, coho only. Single point barbless hooks required.
Dosewallips River Recreational		
(mouth to Hwy. 101 Bridge)	11/1 – 12/15	2 fish limit, 12" min size, chum only
Duckabush River Recreational		
(mouth to Mason Co. PUD #1 overhead electrical distribution line)	11/1 – 12/15	2 fish limit, 12" min size, chum only
Quilcene River Recreational		
(from Rodgers St. to Hwy 101 Bridge)	8/16 – 10/31	4 fish, 12" min size, coho only, selective gear rules and night closure.
Skokomish River Recreational		
(mouth to Hwy. 101 Bridge)	8/1 – 8/31	Closed to all fishing.
	9/1 – 9/30	1 fish limit, 12" min size, release chum. All Species-night closure, non-buoyant lure restriction, and single point barbless hooks required through 11/30.
	10/1 – 10/15	6 fish/4 adult, only 1 of which may be an adult chinook, 12" min size, release chum. All Species-night closure, non-buoyant lure restriction, and single point barbless hooks required through 11/30.
	10/16 – 12/15	6 fish/4 adult, only 1 of which may be an adult chinook, 12" min size. All Species-night closure, non-buoyant lure restriction, and single point barbless hooks required through 11/30.
Tahuya River Recreational		
(mouth to marker 1 mile above N. Shore Rd. Bridge)	9/16 – 10/31	2 fish limit, 12" min size, coho only. Single point barbless hooks required.

All other HOOD CANAL REGION freshwater recreational closed to salmon angling.

Figure 6-A
2004-05 Recreational Fishing Seasons

Numbers within cells refer to bag limit variations

Fishing Area	May				Jun				Jul				Aug				Sep				Oct				Nov				Dec				Jan				Feb				Mar				Apr			
1									2	2	2	2	2	2	2	2	2	2	2	2																												
2									2	2	2	2	2	2	2	2	2	2	2	2																												
3									2	2	2	2	2	2	2	2	2	2																														
4									2	2	2	2	2	2	2	2	2	2	2																													
5									M	S	M	S	M	2	2	2	2	2	2	2					2	1	2	1											1	1	1	1	1	1	1	1		
6									M	S	M	S	M	2	2	2	2	2	2	2					2	1	2	1											1	1	1	1	1	1	1	1		
7									2	1	2	1	2	1	2	1	2	1	2	1	2	2	2	2	2	1	2	1									1	1	1	1	1	1	1	1				
8-1													2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1									1	1	1	1	1	1	1	1				
8-2													2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1											1	1	1	1						
9											2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1									1	1	1	1	1	1	1	1	1	1		
10							C	R	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1			1	1	1	1	1	1	1	1	1	1								
11							2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1											1	1	1	1	1	1	1	1		
13							2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12 N																	4	4	4	4	4	4	4	1	4	1	4	1	4	1	4	1							1	1	1	1	1	1	1	1		
12 S									4	2	4	2	4	2	4	2	4	2	4	2	4	2	4	1	4	1	4	1	4	1	4	1							1	1	1	1	1	1	1	1		

Legend & Footnotes: 2004-05 Recreational Fishing Seasons

Symbol	Description	Symbol	Description
2 2 2 2	2-bag (any salmon)	2 1 2 1	2/1-bag, any salmon, only 1 of which can be Chinook
2 2 2 2 (crosshatched)	2-bag, Chinook NR	2 1 2 1 (striped)	2/1 bag; coho MSF
M S M S	2-bag; coho & Chinook MSF	4 4 4 4 (crosshatched)	4-bag coho only (Chinook NR)
2 2 2 2 (crosshatched)	2-bag coho MSF, Chinook NR	4 1 4 1	4/1 bag; any salmon, only 1 of which can be Chinook
2 2 2 2	2-bag coho MSF	4 2 4 2 (shaded)	4/2 bag; any salmon, only 2 of which can be Chinook, chum NR
	Closed	1 1 1 1	1 bag (any salmon).
C R	Catch and Release only	Note:	See Appendix B for subarea openings, chum NR, and other details.

6.2 Introduction to Recreational Catch

Expected catch reflects either pre-season quotas or landed catch estimated by the final pre-season Chinook FRAM run (Run #1604). For the purposes of preseason versus postseason comparison, catch figures provided in this document are landed catch only. Because of this, expected catch figures appearing in this document will not match the figures provided in most of the preseason FRAM reports, since the latter provide total mortality estimates (i.e. landed catch plus mortality caused by release or encounter with fishing gear).

Because direct harvest of Chinook is prohibited in many cases, non-landed fishing mortality comprises a significant proportion of total recreational fisheries mortality for Chinook. Non-landed mortality occurs when sub-legal Chinook are encountered and released, and when regulations forbid the retention of Chinook. Non-landed mortality is incorporated into preseason estimates of mortality (and, therefore, into projected exploitation and spawner rates), but is not commonly estimated postseason. Thus, postseason catch analyses presented in this report compare projections of landed catch against the actual landed catch tabulated during and after the fishing season.

Although the majority of fishing effort directed at Puget Sound Chinook occurs in the summer and fall, significant recreational fisheries authorized under the annual plan are in progress during the winter and spring period. Marine and freshwater recreational harvest during this period averages 13,000 (based on a 1992-2003 average) total Chinook.

In Washington ocean recreational fisheries and Strait of Juan de Fuca Area 5 mark-selective fishery (MSF), recreational catch is estimated during the fishing season through creel surveys. For other areas and times, recreational catch is estimated postseason using recreational catch record card (CRC) reports.

6.2.1 2004-05 Recreational Catch Discussion

Table 6-A summarizes projected landed catches in Puget Sound recreational fisheries, and, where available, provides inseason estimates with which to evaluate management performance. As noted above, mark-selective Chinook recreational catch in area 5 and portions of area 6 were estimated inseason from July 1 through August 8, 2004, after which the fishery switched to Chinook non-retention. Recreational catch in Puget Sound Areas 6 – 13, and in Area 5 outside of the summer period, is estimated from catch record cards. Preliminary CRC estimates of catch in 2004-05 will be available late in 2005 and reported in the 2005 post-season report.

Table 6-A 2004-05 Expected Recreational Catches and Seasons; preliminary inseason catch estimates provided where available.

Fleet/Fishing Area	Projected Landed Chinook Catch	Estimated actual landed Chinook catch[1]	Remarks
Area 5,6 Recreational	6,792		
Area 5 Recreational MSF ONLY	3,500	3,571	See narrative, below
Area 7 Recreational	3,856		
Nooksack-Samish Freshwater Recreational	5,050		
Area 8-1 Recreational	0		1,689 NLM projected
Skagit R. Recreational	20		
Area 8-2 Recreational	1,886		
Area 8D Recreational SAF	1,981		
Stillaguamish R. Recreational	6		
Snohomish R. Recreational (excl. SkyMSF)	11		
Skykomish MSF component	457		
Area 9 Recreational	5,754		
Area 10/11 Recreational	12,939		
"Area 10E" Recreational SAF	1,500		
Lake Washington, Sammamish, Cedar Recreational	103		24 NLM projected
Area 10A Nontreaty Recreational SAF	3000		
Green R. Recreational	0		27 NLM projected
Puyallup/White R. Recreational	1,396		101 NLM projected
Area 13 Recreational	4,099		
Nisqually/McAllister Recreational	1,418		
Chambers, Deschutes, Kennedy, Johns recreational	145		
Area 12 Recreational	1,037		
Skokomish R. Recreational	1,461		
Strait Tributaries Freshwater Recreational	0		
Puget Sound Marine Sport	42,844		
Puget Sound Freshwater Sport	9,610		

Source: Chinook FRAM 1604

[1] Catch estimates for most area/months are not yet available

6.3 2004-05 Recreational Fishery Monitoring

Chinook harvest in 'quota fisheries', which include Area 1-4 / 4B recreational fisheries under the jurisdiction of the Pacific Fisheries Management Council, is monitored inseason through a creel survey methodology that provides inseason catch estimates with which the fishery is managed. Though not a quota fishery per se, the Area 5 recreational fishery is monitored in similar fashion to ensure the harvest "ceiling" is not exceeded. For this fishery, WDFW conducts creel surveys (angler interviews) according to a sampling design that achieves the desired level of statistical precision and accuracy (2004 Fishery Monitoring Operational Plan, WDFW Puget Sound and Ocean Sampling Program, April 2004, Appendix C).

Ocean recreational catch is reported annually by the Pacific Fisheries Management Council in the Annual Review of Ocean Salmon Fisheries, available at http://www.pcouncil.org/salmon/salsafe.html .

In 2004, over 80,000 recreational anglers were interviewed in Puget Sound, 6,900 Chinook sampled, and 591 Chinook CWTs collected (Table 6-B). Samples by month and area, and recent sampling rates, are presented in Section 8.1.

Table 6-B
2004 Recreational Fishery Sampling Summary by CRC Area

	5	6	7	8-1	8-2	9	10	11	12	13	Total
Chinook Sampled	847	668	330	41	517	262	2,070	1,699	265	217	6,916
Anglers Sampled	18,044	6,891	6,034	1,787	10,268	5,976	15,487	10,182	2,618	3,220	80,507
Chinook CWTs Collected	139	85	33	4	57	25	118	106	10	14	591

Source: Puget Sound Sampling Program, Karen Kloempken, 5/2/05

Recreational Chinook harvest in Puget Sound is generally estimated from sampling of catch record cards that anglers are required to maintain and return. In past years the 'punch card' estimates have been validated by creel surveys for specific areas. Creel surveys may also be conducted to monitor 'special area' and/or 'special rule' recreational fisheries.

In 2004, creel surveys relevant to Chinook harvest were conducted in Areas 5/6 selective fishery, Elliott Bay, the Skykomish River selective Chinook sport fishery, the Skokomish river sport fishery (nonselective), and the Carbon river selective Chinook sport fishery

6.3.1 Strait of Juan de Fuca Marine Recreational Fishery Discussion

Approximately 28% of legal sized Chinook available to the area 5 and 6 recreational fishery were marked in 2004 (FRAM 1604).

Table 6-C
Areas 5/6 2004 Recreational Chinook Catch Estimate

Fishery	Angler Trips	Harvested Chinook	Released Chinook
Area 5	25,161	2,889	12,378
Area 6	4,276	682	1,421
Total	**29,437**	**3,571**	**13,799**

Following is an excerpt from the executive summary of the 2004 Chinook Selective Fishery, Marine Areas 5 and 6 report, available in its entirety as Appendix D. A draft evaluation of the 2003 and 2004 selective fisheries in areas 5 and 6 is also included as Appendix E.

During the summer of 2004, the second year of a pilot recreational Chinook salmon *Oncorhynchus tshawytscha* ("Chinook") fishery that was limited to retention of marked (adipose clipped) hatchery Chinook salmon occurred in Marine Area 5 and the western portion of Marine Area 6 in Puget Sound. Objectives were: 1) increase meaningful recreational opportunity while meeting conservation goals for Puget Sound Chinook salmon defined by the Puget Sound Chinook Harvest Management Plan; and 2) collect information necessary to enable evaluation and planning of future potential Chinook mark-selective fisheries. Marine Areas 5 and 6 are located in Washington waters of the Strait of Juan de Fuca. The Chinook Selective Fishery was scheduled to begin on July 1, 2004 and continue through August 10 (41 days) or until a quota of 3,500 Chinook was kept, whichever occurred first. The fishery started on July 1, 2004 and ran continuously for 39 days through August 8.

We estimated that anglers made 29,437 trips during the Chinook Selective Fishery (July 1 – August 8). Those anglers kept an estimated 3,571 Chinook and 9,543 coho salmon *O. kisutch* ("coho"). Area 5 accounted for 85% of the effort (25,161 angler trips) and 81% of the Chinook kept (2,889) for a rate of 0.11 Chinook kept per angler trip. Area 6 accounted for 4,276 angler trips and 682 Chinook kept for a higher catch rate of 0.16 Chinook kept per angler trip. Based on creel surveys, Area 5 anglers released an estimated 12,378 Chinook, 25,794 coho, and 88 other or unidentified salmon. Area 6 anglers released an estimated 1,421 Chinook, 126 coho, and 19 other or unidentified salmon (Table 6-C).

During the Chinook Selective Fishery (July 1-August 8), samplers fishing from the test boats landed 169 Chinook in Area 5 and 148 Chinook in Area 6. In Area 5, 92% of the

Chinook encountered and landed by the test boat were caught using downriggers, even though they were only fished 69% of the time. In Area 6, all the Chinook encountered and landed by the test boat were caught using downriggers, even though they were only fished 78% of the time. Utilizing other gear types resulted in fewer encounters and fewer biological samples for both areas than would have occurred if the test boats had used downriggers exclusively as they did in 2003.

During the Chinook Selective Fishery time period, 44% of the legal-size fish caught by test boats were marked in Area 5 and 48% of the legal-size Chinook were marked in Area 6. The mark rate on sublegal-size Chinook was 36% (n=59) for Area 5, but only five sublegal-size Chinook were caught by the test boat in Area 6. Chinook caught on test boats were larger in Area 6 than in Area 5. The percent of legal-size Chinook (22" or larger) was significantly different (X^2 = 49.8, ρ < 0.0001) between Area 6 (97%) and Area 5 (65%).

During the 2004 Chinook Selective Fishery only 35 Chinook were reported landed on Voluntary Trip Reports (VTR's) turned in by anglers in Area 5, while 112 Chinook were reported landed on VTR's in Area 6. During the Chinook Selective Fishery time period, 40% of the legal-size Chinook were reported as marked in Area 6, which was lower than the mark rate from test fishing.

Twenty-nine double index coded wire tags were recovered in Areas 5 and 6 from July 1 through August 8. Based on the proportion of the catch that was sampled and the ratio of marked to unmarked double index coded wire tagged Chinook for each hatchery, we estimated that anglers caught and released 96 legal-size, unmarked double index tagged Chinook, and that the additional mortality of unmarked legal-size double index tagged Chinook due to a selective fishery compared to a non-selective fishery was 10 fish.

Test boat catches consistently showed a higher mark rate than reported from the creel survey and the VTR's. We felt the mark rates from the test boat were the best estimate of the true mark rate. Using the total number of Chinook encounters from the creel survey (17,370) and apportioning into four categories of legal-size marked, legal-size unmarked, sublegal-size marked, and sublegal-size unmarked, suggests that anglers released 1,841 legal-size and marked Chinook, or 34% of the fish they could have kept. We also estimated the number of encounters by assuming that anglers kept all Chinook that were legal-size and marked, and estimating the number of fish in the other three categories based upon the proportions they were caught in the test boats. Using this method, we estimated the total encounters at 11,456 Chinook. It appears unrealistic that anglers released one-third of the fish that were legal to keep, and it is also unrealistic that all legal fish were kept. The true number of encounters likely lies between the two estimates of encounters, i.e. between 11,456 and 17,370 Chinook.

Using the encounters from the creel survey and a release mortality rate of 15% for legal-size fish and 20% for sublegal-size fish, we estimated the total mortalities of Chinook in the selective fishery at 5,865, of which 1,674 were unmarked. Using the encounters estimated by assuming anglers kept all legal fish and a release mortality rate of 15% for legal-size fish and 20% for sublegal-size fish, we estimated total mortalities at 4,901 fish, of which 1,106 were unmarked fish.

Based on the estimated number of total encounters from the creel survey (the highest number) and apportioning them based on the test boat catch rates, we estimated the 2004 fishery encountered 7,485 unmarked legal-size Chinook and 1,743 unmarked sublegal-size Chinook. These estimates are below the predicted encounters of 7,993 unmarked legal-size Chinook and 4,935 unmarked sublegal-size Chinook as produced in the final preseason run of the Fishery Regulation Assessment Model (FRAM), and suggests this fishery did not hinder nor jeopardize achievement of the overall conservation goals for Puget Sound Chinook.

Compliance with existing regulations, and the regulation prohibiting bringing unmarked salmon on board a vessel, was considered an integral part of a successful fishery. No citations or warnings were issued for retention of unmarked Chinook, nor were any warnings or citations issued for bringing an unmarked salmon on board a vessel.

In summary, the second year of the pilot marine Chinook selective fishery was successful with respect to the objective of increasing meaningful recreational opportunity within conservation constraints for Puget Sound Chinook. Anglers were allowed to fish for and retain Chinook for 39 days in Areas 5 and 6, compared with only 5 days in Area 5 in 2002. Angler effort in Area 5 was double the effort in 2002 during the same time frame. Using data from the test fishery sampling during the Chinook Selective Fishery, nearly half, or one in two, of the legal-size Chinook encountered were marked and could be retained by anglers.

The pilot fishery was also successful with respect to the objective of implementing monitoring and sampling programs to obtain management information for evaluation and planning of potential future selective Chinook fisheries. Estimated encounters were less than pre-season predictions, suggesting that this fishery did not hinder or jeopardize achievement of overall conservation goals for Puget Sound Chinook. Compliance with fishing regulations was good during the fishery. The number of mortalities of unmarked double index coded wire tagged fish was negligible.

(Steven Thiesfeld and Angelika Hagen Breaux, WDFW, 1/14/05)

6.3.2 2004 Nooksack River Creel Survey- Summary

A creel census was conducted on the Nooksack River during the fall Chinook fishing season that opened 9/1/04. The focus of the creel survey was to obtain angler presence and catch data on the river. We had one staff scientific technician scheduled Thursday through Monday to perform creel surveys. Approximately 33 ½ miles of the Nooksack River were surveyed from Marine Drive Bridge at RM 2.0 to RM 35.5 at the Deming bus barn. An average of twenty (20) fishing sites were checked each day. The creel survey was conducted 9/1/04 through 10/9/04 forty hours a week.

The Nooksack River was turbid (muddy) and high for most of the creel survey time period. Due to the condition of the river, we assumed a reduced angler effort and the catch was poor. River conditions did begin to improve (clear) near the end of September, contributing to an increase in angler effort.

A total of 207 anglers were interviewed. Three (3) Chinook and two (2) Coho were kept (Table 6-D). We recovered otoliths, scale and tissue samples from one Chinook. The analysis of the one Chinook sample indicated it was a three year-old ad-clipped fish.

Table 6-D
Number of Anglers Observed by week - Nooksack River Fall Chinook Fisheries

Statistical Week Dates	Anglers Interviewed			Fish Kept	
(Monday to Sunday)	SHORE	BOAT	TOTAL	CHINOOK	COHO
8/30/04 to 9/05/04	6	0	6	0	0
9/06/04 to 9/12/04	18	2	20	1	0
9/13/04 to 9/19/04	11	0	11	0	0
9/20/04 to 9/26/04	33	13	46	0	0
9/27/04 to 10/03/04	66	57	123	2	2
10/04/04 to 10/10/04 (1 day sampled)	1	0	1	0	0
GRAND TOTAL	135	72	207	3	2

(Reported by Tasha Geiger-Fish & Wildlife Biologist, Region 4)

6.3.3 Skykomish River Creel Survey

In 2004, recreational anglers participated in a selective Chinook fishery on the Skykomish River. The fishery went from June 16th through July 31st and was confined to the area of the Skykomish River between the mouth of the Wallace River downstream to the Lewis Street Bridge in the City of Monroe. Anglers were allowed to keep two hatchery Chinook with a minimum size of 12 inches.

To assess angler effort, catch, and total harvest WDFW conducted a creel survey on the Skykomish River during the selective Chinook fishery. A two-stage sampling design was used to conduct the creel survey. Days of the month were divided into two strata, weekdays and weekends. Each stratum had a fishing day length of approximately 16 hours (6:00AM to 10:00PM) that was divided into two substrata, an early (6:00AM to

1:59PM) and late (2:00PM to 10:00) period. On Fridays and weekend days, creel surveyors sampled both the early and late periods. However, on weekdays creel surveyors could sample only the early or late period. For weekdays, early and late substratums were chosen randomly with an equal probability of being selected.

During the creel survey two pieces of information were collected, angler effort and catch data. Effort counts were made by counting the number of boat trailers and/or cars at the 8 access sites within the fishery boundary. Information collected from angler interviews included number in party, angler type (i.e., boat or shore), whether or not anglers have completed their trip, gear type (i.e., bait or lure), start and stop time, number of trailers and cars associated with the party, and the number of fish kept and released by species.

Methods used to expand effort and angler catch data to estimate total effort and harvest are outlined in WDFW Methods Manual-Creel Information From Sport Fisheries (Hahn 2000). The average impact per day of fishing in Washington (i.e., $132/day) was taken from WDFW Economic Factors Analysis report.

A total of 1,006 boat and shore anglers were interviewed during the creel survey on the Skykomish River. These anglers spent a total 6,220 hours on the water. Anglers were primarily targeting Chinook and steelhead. Creel checkers recorded 33 Chinook and 26 steelhead harvested by recreational anglers. From this data, estimated total effort and Chinook harvest is 22,006 hours and 189, respectively. The total estimated value of this selective Chinook fishery is $591,000. Summaries of angler statistics calculated from the Skykomish River selective Chinook fishery are presented on Table 6-E and Table 6-F (Chad Jackson, 2/14/05)

Table 6-E
2004 Skykomish MSF Creel Survey Effort & Economics Summary

EFFORT SUMMARY:	JUNE		JULY		COMBINED		
	BOAT	SHORE	BOAT	SHORE	BOAT	SHORE	TOTAL
NO. ANGLERS INTERVIEWED	395	73	367	171	762	244	1,006
TOTAL HOURS OF FISHING	2,656.77	249.40	2,669.83	644.12	5,326.60	893.52	6,220.12
EST. TOTAL EFFORT (HOURS.)	7,440.50	6,274.50	5,081.10	3,210.10	12,521.60	9,484.60	22,006.20
EST. AVGERGE TRIP LENGTH (HOURS.)	6.6	3.5	7.3	3.7	NA	NA	NA
EST. NUM. ANGLER TRIPS	1,127	1,793	696	868	1,823	2,661	4,484
ECONOMIC SUMMARY:	JUNE		JULY		COMBINED		
	BOAT	SHORE	BOAT	SHORE	BOAT	SHORE	TOTAL
[1]ESTIMATED VALUE OF FISHERY	$148,764	$236,676	$91,872	$114,576	$240,636	$351,252	$591,888

[1]Source: WDFW Economic Factors Analysis (2004 Average Economic Impact per Day of Fishing-$132.00)

Table 6-F
2004 Skykomish MSF Creel Survey Catch Summary

HARVEST & CATCH SUMMARY:	JUNE		JULY		COMBINED		
	BOAT	SHORE	BOAT	SHORE	BOAT	SHORE	TOTAL
NUMBER OF FISH CHECKED							
Chinook	22	2	8	1	30	3	33
Chinook-Jack	2	0	3	0	5	0	5
Steelhead	8	0	15	3	23	3	26
Cutthroat	1	0	2	1	3	1	4
Rainbow	0	0	0	4	0	4	4
UI Salmonid	0	0	0	0	0	0	0
Bull Trout	0	0	0	0	0	0	0
Other Species	0	0	0	0	0	0	0
NUMBER OF FISH RELEASED							
Chinook	13	0	6	0	19	0	19
Chinook-Jack	4	0	23	9	27	9	36
Steelhead	12	1	6	0	18	1	19
Cutthroat	6	0	44	1	50	1	51
Rainbow	5	0	9	3	14	3	17
UI Salmonid	5	0	15	12	20	12	32
Bull Trout	10	1	2	1	12	2	14
Other Species	13	0	15	5	28	5	33
AVG. HPUE (Fish/Hour-all species)	0.005	0.009	0.010	0.007	NA	NA	NA
AVG. CPUE (Fish/Hour-all species)	0.032	0.180	0.260	0.213	NA	NA	NA
ESTIMATED HARVEST							
Chinook	34	117	23	15	57	132	189
Chinook-Jack	3	0	8	0	11	0	11
Steelhead	12	0	42	46	54	46	100
Cutthroat	2	0	6	15	8	15	23
Rainbow	0	0	0	61	0	61	61
UI Salmonid	0	0	0	0	0	0	0
Bull Trout	0	0	0	0	0	0	0
Other Species	0	0	0	0	0	0	0
ESTIMATED NUMBER RELEASED							
Chinook	31	0	20	0	51	0	51
Chinook-Jack	10	0	76	42	86	42	128
Steelhead	29	32	20	0	49	32	81
Cutthroat	14	0	145	5	159	5	164
Rainbow	12	0	30	14	42	14	56
UI Salmonid	12	0	49	55	61	55	116
Bull Trout	24	32	7	5	31	37	68
Other Species	31	0	49	23	80	23	103

6.3.4 Lake Washington Sockeye Fishery

A short nontreaty recreational fishery was scheduled based on the estimated 53,000 surplus sockeye (403,000 minus 350,000 escapement goal), resulting in about 26,500 sockeye available for recreational harvest. The management of the 2004 Lake Washington sockeye fishery provided for a tremendous level of angler participation with a high success rate: In 2 ½ days of fishing, nearly 28,000 anglers caught an estimated 27,600 sockeye, averaging about 1 sockeye per angler (Table 6-G).

Table 6-G
Lake Washington sockeye fishery dates and catches.

Date	Anglers	Sockeye Caught	Catch per Angler	Chinook Harvested
7/17/04	13,780	13,743	1.0	0
7/24/04	9,795	10,922	1.1	2
7/29/04	4,182	2,961	0.7	3
Total	27,757	27,626		5

(Steven Thiesfeld, WDFW, 5/4/05)

6.3.5 Elliott Bay Recreational Fishery Inseason Catch Estimate

This fishery is managed annually to achieve inseason management objectives. The fishery was scheduled at 3 days per week from July 16 through August 22, and proceeded as planned.

Table 6-H
Elliott Bay Recreational Fishery Inseason Catch Estimates

Jul 16 - Aug 12	Boats	Anglers	Catch				Released			
			Chinook	Coho	Pink	Sockeye	Total	Chinook	Coho	Pink
Grand Total	5,787	12,110	2,733	667	5	2	5,477	3,161	244	0

Source: Steven Thiesfeld, WDFW, 5/4/05; Puget Sound Sampling Program, Laurie Peterson, 5/6/05

Preseason expected catch for the Elliott Bay recreational SAF was 4,700 landed Chinook. Post-season estimates are 2,733 Chinook landed and 3,161 released in 18 fishing days (Table 6-H). (Steven Thiesfeld, WDFW, 5/4/05)

6.3.6 Puyallup/Carbon River Selective Chinook Recreational Fishery

The Washington Department of Fish and Wildlife (WDFW) conducted a second year of creel surveys during the Chinook selective fishery on the Carbon River in the fall of 2004. This survey was designed to estimate angler effort, numbers of salmon kept and released by species, and percent of Chinook that were marked (adipose fin clipped).

We used a random stratified creel survey at four access sites to monitor the Carbon River recreational fishery. The creel survey was conducted from September 1 through October 31, covering two of the three months that salmon fishing is open on the Carbon River. Angler effort and fish encounters were estimated using data collected during angler interviews and vehicle counts. These data were used to estimate weekly catch and effort in the fishery. Weekly effort was estimated by averaging effort estimates from AM and PM strata, then expanding by weekday and weekend day strata.

After calculating angler effort, fish encounters were estimated. Harvest Per Unit Effort (HPUE) and Catch Per Unit Effort (CPUE) were estimated from data collected during angler interviews. The total numbers of reported fish kept and fish released by anglers were divided by the total angling hours, as reported by anglers, for each stratum. These estimated HPUEs and CPUEs were then multiplied by the estimated total angling hours per strata, from car counts, to estimate total fish harvest and encounters.

Anglers spent an estimated 51,047 hours fishing the Carbon River from September 1 through October 31, 2003. These anglers kept an estimated 710 adult Chinook and 1,913 coho. They also reported releasing an estimated 779 Chinook and 941 coho (Table 6-H). No pink salmon and only two chum, caught during the last week of the survey, were recorded during angler interviews.

Table 6-I
The actual number of adult Chinook observed during the Carbon River creel survey and the expanded number for the fishery.

Origin	Kept fish		Released fish	
	Observed	Expanded	Reported	Expanded
Marked	66	660	27	248
Unmarked	6	40	38	368
Mark status unknown [1/]	1	10	13	163
Total	73	710	78	779

Source: Steven Thiesfeld, WDFW, 5/4/05
Note 1/ - The angler refused to have the fish sampled. The surveyor could only distinguish that the fish was a Chinook.

Biological data were collected from 76 of the Chinook kept. Of these Chinook, only five were less than 24 inches. Therefore, jack Chinook contribution to the number of Chinook kept was very low. Jack Chinook were not included in Table 6-I.

We also conducted a creel survey during the Chinook selective recreational fishery on the Puyallup River in the fall of 2004. This survey was designed to develop a general sense of angler effort and salmon catch patterns during the fishery and look at mark rates of Chinook and coho.

A random stratified creel survey was used at six access sites to monitor Puyallup River recreational fishery. The creel survey was conducted from September 1 through October 13. We used an access point survey to monitor the Chinook selective recreational fishery on the Puyallup River. To collect data to evaluate the fishery, WDFW interviewed anglers at six access sites. These six access sites were selected based on limited historic knowledge of the fishery, and trends observed during the survey. Anglers returning to vehicles were asked what time they started and stopped fishing, what species they were targeting, how many of each species they caught and kept, how many they released, and whether the fish they encountered had a clipped adipose fin.

Along with angler interviews, vehicle counts at access sites were conducted. Vehicle counts provided data used to evaluate angler effort. During angler interviews, biological samples of as many fish as possible were collected. Surveyors measured the fork length of each fish using measuring boards. Each fish was examined for markings and checked for coded-wire-tags. If coded-wire tags (CWT) were detected, the snout of the fish was removed and delivered to the WDFW CWT lab for analysis.

Anglers reported catching eight Chinook from September 1 through October 10. Of these eight fish five were harvested. Four of the five harvested fish had clipped adipose fins and one was reported without any visible marking. All harvested Chinook were caught within the first three weeks of the fishery, four within the first eleven days. Anglers reported releasing three Chinook. All released fish were reported as having clipped adipose fins and were caught within the first two weeks of the fishery.

Biological data were collected on all five of the harvested Chinook. Scales were collected for age analysis and fork lengths were recorded. All of the Chinook were adults, greater than 24 inches long. No CWTs were recovered from the Chinook sampled. (Steven Thiesfeld, WDFW, 5/4/05)

6.3.7 Hood Canal Recreational Fishery Monitoring

Recreational fishery monitoring occurred in marine areas as well as in the Skokomish River.

6.3.7.1 Hood Canal Marine Recreational Sampling

Three WDFW samplers were dedicated to sampling the 2004 Hood Canal Sport fishing season. Sampling was conducted at Seabeck Harbor (Marina) and the Hood Canal Ramp (Potlatch). Six roving samplers were also employed to sample various sites on the north end of Area 12.

A total of 345 salmon were sampled, 116 Chinook and 229 coho. The total tag recovery rate was 13.33%. Broken out by species, the tag recovery rates were 1.44% for Chinook and 11.88% for coho. (Source: Karen Kloempken, WDFW, 1/18/05)

6.3.7.2 Skokomish Creel Survey Results

For the 2004 Skokomish Sport Fishery, WDFW employed one sampler that sampled three sites along the Skokomish River. Sample sites were above the Highway 106 Bridge, at the Highway 106 Bridge, and below the Highway 106 Bridge. We conducted a standard baseline sample survey with no catch estimates or car counts.

Sampling was conducted for the full month of September and 563 anglers were sampled. There were 120 Chinook and 38 coho sampled. For the Chinook and coho that were sampled, 98 and 25, respectively, were adults, and 6 and 3, respectively, were jacks. Only three coded wire tags were recovered, for an overall tag recovery rate of 1.8%. (Source: Karen Kloempken, WDFW, 1/18/05)

6.4 Previous Year (2003-04) Recreational Catch Evaluation

Preliminary Catch Record Card (CRC) estimates of recreational salmon catch in Puget Sound are provided for the 2003-04 “license year” (April 1, 2003 through March 31, 2004) on Table 6-J. In the 2003-04 management year, recreational catches were generally below the preseason expectation.

Table 6-J
Expected and Preliminary Actual 2003-04 Puget Sound Recreational Chinook Catches

Area	Expected Chinook Catch (FRAM 1603)	Preliminary Estimated Chinook Catch	Numerical difference (Actual - Expected)	Percent Difference (Actual /Expected)
MARINE				
Area 5	6,464	3,858	-1,174	-18%
Area 6		1,432		
Area 7	4,313	3,036	-1,277	-30%
Area 8-1	1,478	447	-1,031 (See text)	-70%

Area	Expected Chinook Catch (FRAM 1603)	Preliminary Estimated Chinook Catch	Numerical difference (Actual - Expected)	Percent Difference (Actual /Expected)
Area 8-2	1,886	3,058	See text	62%
Area 9	5,179	1,257	-3,922	-76%
Area 10	12,828	4,636	1,191 (See text)	9%
Area 11		9,383		
Area 12	1,045	1,449	404 (See text)	39%
Area 13	3,766	1,489	-2,277 (See text)	-60%
Marine Total	36,959	30,045	-6,914	-19%
FRESHWATER				
7 & 7A Independents	na	6	6	na
Strait	1	47	46	See text
Nook-Sam-Whatcom	3,702	3,434	-268	-7%
Skagit	20 NLM	280	280	See text
Stilly-Sno	506	339	-167	-33%
South Sound\1	3,328	3,390	62	2%
Hood Canal	2,649	3,435	786	30%

\1 Plus an addition 18 NML in Lake Washington

6.4.1 Previous Year Recreational Catch Discussion

Marine recreational catches, overall, were about 6,914 below predictions Puget Sound wide, based on these preliminary numbers. Only areas 8-2, 10/11, and 12 experienced greater-than-anticipated harvests. It is not known at this time whether this excess catch impacted the total exploitation rates on ESA listed stocks.

Preseason projections for CRC Area 8-1, 8-2 and "Tulalip Special" fisheries are disjointed, so comparison of postseason catch estimates with preseason projections is problematic. In 2003, Area 8-2 expected catch represented the Tulalip Bubble fishery only. The winter blackmouth fishery had a combined expected catch for 8-1 and 8-2, shown in the area 8-1 cell. So the 8-2 or 8D expected catch of 1,886 should be compared to July – Sept 8-2 catch only, or 1,875 fish. The 8-1 expected catch of 1,478 should be compared to the annual 8-1 catch plus the 8-2 catch from October-June or 1,878 fish.

Areas 10, 11 and 13 catches are difficult to compare to preseason predictions because many Chinook in these areas are caught as blackmouth, or subadults. The catch of one blackmouth, or subadult, does not equal one “adult equivalent” but something less than that. Since preseason projections are expressed in “adult equivalent” terms, this means that the preseason prediction and the postseason catch estimates will not align. Clearly, it is the exploitation on critical stocks that is of primary concern, and not total number of fish caught. Future planned evaluations of exploitation will tell managers whether area 10/11 (or any other) overharvests are meaningful.

After many years of poor catches, CRC Area 12 catches have improved in recent years. Anglers appear to be “rediscovering” the canal. Adult returns to George Adams hatchery have increased in the past few years even though hatchery production has remained relatively static. These increased returns suggest that ocean survival has increased and/or that prior fishery interceptions have decreased. It appears that recreational harvest in Area 12 also reflects the increased survival rates for Hood Canal Chinook.

Preliminary freshwater recreational catch estimates exceeded preseason predictions in the Skagit, Hood Canal and Strait tributaries freshwater fisheries. These preliminary data have not yet been verified, and during the CRC process of reviewing and correcting data, many of the anomalies will be attributed to errors in the data entry, data editing, or angler recording errors. Generally these errors are corrected and all, or only a few Chinook, will remain reported for these systems once the CRC process is complete.

South Sound freshwater catches were reported in Deschutes, Nisqually, Puyallup, White, and Green Rivers and in Lake Washington system. Some of these may potentially represent Chinook, or coho misidentified as Chinook, in Lake Washington, which was open to coho fishing 9/16-10/31. However, most of the Chinook reported caught in Lake Washington are actually from legal fisheries in Lake Sammamish, which did not have a separate catch code. Starting in 2005, Lake Sammamish has a separate catch code and future catches should be reported for each lake separately. Chinook retention was allowed in the Deschutes, Nisqually, Puyallup/Carbon (MSF), and Green Rivers. Five Chinook were reported caught in the White River, which was closed to salmon fishing. Again, some errors will be researched and corrected during the catch reconciliation process.

Previous-year creel survey results in the Skokomish River indicate that CRC methods may underestimate sport catch in the Skokomish, however a catch estimate was not made from the 2004 creel data. (Steven Thiesfeld, WDFW, 5/4/05)

6.5 Recent-Historic (1992-2003) Recreational Chinook Catch

Following are tables showing recent historic Chinook catches by recreational fishers by area or area-grouping.

Table 6-K
1992-2003 Puget Sound Marine Recreational Chinook Catches

CRC Area	1992 *	1993 *	1994 *	1995 *	1996 *	1997 *	1998 *	1999 *	2000 *	2001 *	2002 **	2003 ***
5 & 6	38,090	32,216	1,661	6,349	4,825	12,238	2,159	1,378	1,626	4,050	3,920	5,290
7	6,636	6,916	5,795	7,863	12,674	9,155	3,069	2,747	3,437	6,613	6,544	3,036
8-1	2,123	2,275	1,771	2,449	1,810	1,225	508	590	615	901	855	447
8-2	6,205	5,493	2,324	5,519	4,398	5,894	1,029	1,151	1,796	2,592	3,058	3,058
9	20,076	15,745	5,920	13,351	18,023	10,641	3,118	4,076	3,189	4,004	3,401	1,257
10	12,229	8,551	12,994	13,526	12,244	8,920	3,486	1,569	2,960	3,887	4,817	4,636
11	8,633	6,778	13,847	16,378	15,316	9,602	9,154	12,822	7,625	13,745	10,129	9,383
12	508	355	544	159	380	592	347	1,346	1,084	446	1,816	1,449
13	3,233	1,837	3,361	4,205	2,399	2,158	3,244	3,060	1,655	2,589	1,518	1,489
Total Marine	97,733	80,166	48,217	69,799	72,069	60,425	26,114	28,739	23,987	38,827	36,058	30,045

* Data in years 1992 - 2001 is based on Calendar Year, (Jan 1 - Dec 31) even though fishing license year changed in 1999 to non calendar year.

** This years total includes January - March 2002 plus April 2002 - December 2002 plus Jan - March 2003.

*** Preliminary, based on CRC license year April 1, 2003 - March 31, 2004

Source: WDFW Recreational Catch Record Card Estimates (Terri Manning, WDFW, 1/5/05)

Table 6-L
1992-2003 Puget Sound Freshwater Recreational Chinook Catches

Freshwater Areas	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003*
7 & 7A Independents	0	0	7	14	3	0	19	3	7	0	10	6
Straits	9	19	12	0	4	18	0	11	0	0	81	59
Nook-Sam-Whatcom	1,026	3,437	1,616	2,338	1,934	3,112	6,924	2,940	1,871	4,283	6,182	3,484
Skagit	204	521	0	91	17	100	40	46	19	0	76	275
Stilly-Sno	275	758	60	51	35	24	44	46	7	218	373	324
South Sound	927	3,982	3,982	4,402	2,981	2,187	3,470	4,619	2,493	4,062	3,798	3,878
Hood Canal	102	149	57	6	4	27	13	1,144	600	3,175	137	3,306

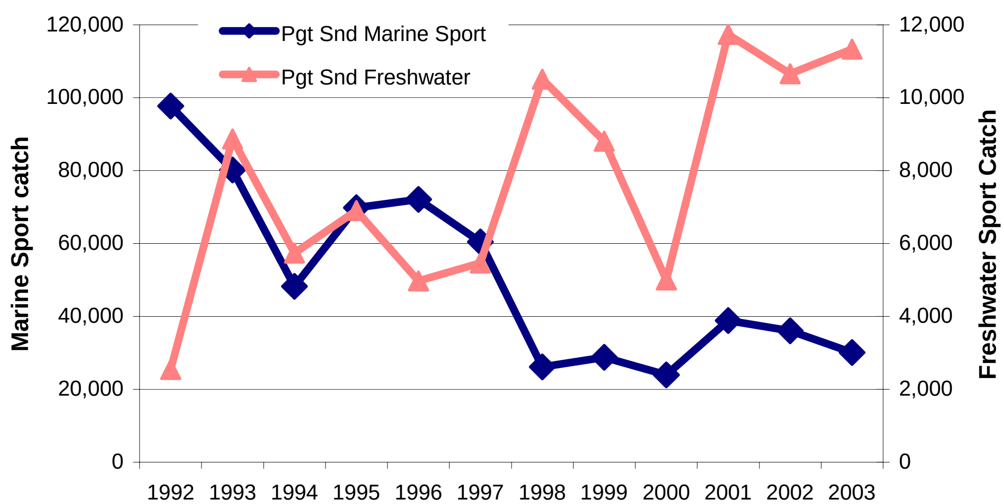
* Preliminary

Source: WDFW Recreational Catch Record Card Estimates (Terri Manning, WDFW, 12/2/04)

6.5.1 Discussion of Recent-Historic Catches

Recreational Chinook catches continue to remain well below historical levels. Recreational Chinook harvest in 2003-04 was only 13.5% of the 1979-79 average of 228,488 Chinook. Marine sport catch, in particular, showed a marked decline (Figure 6-B, left axis), while freshwater sport (right axis) catch increases in areas predominated by hatchery Chinook have bolstered the total freshwater sport catch. The latter demonstrates the shift in effort to freshwater fishing in light of severe marine fishery closures. Season and bag limit restrictions will continue to limit overall recreational fishery harvest. (Steven Thiesfeld, WDFW, 5/4/05)

Figure 6-B
Trends in Puget Sound Marine and Freshwater Sport Chinook Catch



7. Meeting federal objectives and requirements

7.1 PFMC Salmon Plan Criteria

Conservation objectives for Puget Sound Chinook are not included in the PFMC Coastwide Salmon Management Plan, so analysis of consistency with that plan is not provided. However, consistency is implied with NMFS' approval of ocean fishing regulations emerging from the PFMC process, since that consistency is examined during evaluations of fishery proposals throughout the process.

7.2 ESA compliance requirements

Although preliminary escapement data are provided for the 2004-05 management year, complete assessment of the execution of fisheries affecting Puget Sound Chinook, relative to achievement of ESA provisions, cannot be completed until exploitation rates are available for all management units. Initial assessment of spawning escapement for the 2004-05 year indicates that some populations did not achieve the escapements predicted preseason, but returned well above the "low abundance threshold" for most natural populations, with the exceptions of Nooksack and Mid-Hood Canal.

7.3 PST objectives

It is anticipated that post-season assessment of brood year exploitation rates will indicate that the 2004 fishing season met the PST objectives for the southern U.S. Individual Stock Based Management (ISBM) Fishery. The fishing regime developed and agreed-to by the co-managers through the Pacific Fishery Management Council and North of Falcon forum was evaluated with the Chinook FRAM prior to final adoption for compliance with PST objectives.

Table 7-A
PSC Chinook U.S. Escapement Indicator Stocks Relevant to the CCHMP

Stock Group	Escapement Indicator Stock	PST General Obligation (Index)	PST Escapement Goal Agreed?
North Puget Sound Natural Springs	Nooksack	Index less than 0.60 unless PST escapement goal achieved	No
	Skagit		No
Puget Sound natural summer / falls	Skagit		No
	Stillaguamish		No
	Snohomish		No
	Lake Washington		No
	Green River		No
Washington Coastal fall naturals	Hoko		No

The 1999 Chinook agreement requires that ISBM fisheries be managed over time to contribute to the achievement of MSY or other agreed biologically-based escapement objectives. The Puget Sound escapement indicator stocks for monitoring achievement of this objective are Nooksack early, Skagit spring, Skagit fall, Stillaguamish, Snohomish, Lake Washington, and Green River (Table 7-A). The Hoko stock is used within the PST forum as part of the indicators for the Washington Coastal stock group.

ISBM fisheries for the US include:

- South Puget Sound marine net and sport and freshwater sport and net;
- North Puget Sound marine net and sport and freshwater sport and net;
- Juan de Fuca marine net, troll and sport and freshwater sport and net;
- Washington Coastal marine net, troll and sport and freshwater sport and net;
- Washington Ocean marine troll and sport;
- Columbia River net and sort;
- Oregon marine net, sport and troll;
- Idaho (Snake River Basin) freshwater sport and net.

The PST objectives state that when a stock's spawning objective is not attained, reductions in exploitation from the 1979-82 base period are required. The general obligation for southern U.S. fisheries is a 40% reduction ("index" = 0.60) from the base period if it is anticipated that an escapement objective will not be achieved. If this general obligation is insufficient to meet the escapement objectives for particular stocks, then further reductions are to occur. These additional reductions should result in either the achievement of the escapement objective or, when taken together with the general obligation, be at least equivalent to the average of reductions that occurred for the stock group during the years 1991-1996.

The management objectives incorporated within the Puget Sound Comprehensive Chinook Plan were structured to be more restrictive than the obligations contained within the PST Chinook annex. The achievement of the Comprehensive Chinook management objectives identified for these stocks during preseason fishery planning are considered to translate to achievement of PST obligations.

7.3.1 Expectations for achievement of PST Objectives

The management objectives incorporated within the Puget Sound Comprehensive Chinook Plan were structured to be more restrictive than the obligations contained within the PST Chinook annex. The achievement of the Comprehensive Chinook management objectives identified for these stocks during preseason fishery planning are considered to translate to achievement of PST obligations.

The PSC Chinook Technical Committee reviews the performance of the AABM (aggregate abundance based management) and ISBM fisheries, as well as results in terms of population performance, as data become available. Results of those analyses are reported by the CTC; reports are available through the Pacific Salmon Commission.

A formal CWT-based post-season assessment of past U.S. ISBM performance has not occurred because of lack of bilateral agreement on Puget Sound spawning escapement goals, insufficient data (e.g. lack of stock specific tag codes, base period CWT recoveries), and disagreement on policies to deal with overages and/or underages by either country. Annually, however, the CTC does conduct a preliminary post-season model assessment of brood year exploitation and a summary of these for the U.S. ISBM Fisheries is contained in Table 7-B.

Table 7-B
CTC Post-Season Indices for U.S. ISBM fisheries

Escapement Indicator Stock	U.S. ISBM Model Indices *				
	1999	2000	2001	2002	2003
Nooksack early	0.241	0.269	0.134	0.064	0.121
Skagit spring	0.241	0.269	0.179	0.147	0.119
Skagit summer/fall	0.265	0.179	0.816	0.311	0.406
Stillaguamish	0.252	0.221	0.397	0.213	0.184
Snohomish	0.080	0.078	0.484	0.135	0.072
Lake Washington	0.564	0.587	0.625	1.282	0.768
Green	0.564	0.587	0.634	0.375	0.263
Hoko	0.434	0.292	0.431	0.527	0.682

Source: Annual Exploitation Rate and Analysis and Model Calibration Report for 2004, (TCChinook (04)-4); Appendix B.2.

* An index less than or equal to 0.6 indicates compliance with the General Obligation; indices over 0.6 indicates that the General Obligation was exceeded. This does not indicate a lack of compliance, however, since this provision only applies if the spawning escapement objective was not met for two consecutive years.

Review of the CTC's preliminary post-season model assessments indicates a record of well exceeding the general obligation for southern U.S. fisheries of a 40% reduction from the base period for management units projected not to achieve escapement. Exceptions to this include the projected ISBM indices for the Lake Washington and Hoko management units (note that Hoko is not formally included within the Puget Sound Chinook ESU). However, model projections for these management units must be viewed cautiously as the model is extremely sensitive at low exploitation rates (< 20%). The low overall stock size also confounds this assessment. The formal CWT-based post-season review when conducted may yield a different result.

As mentioned in Section 4.2, it is anticipated that evaluations of exploitation rate relative to the Puget Sound Comprehensive Chinook Harvest Management Plan will coincide with the formal CTC CWT-based review indicated above.

8. Monitoring & Adaptive Management

The co-managers jointly and individually conduct a variety of fisheries monitoring activities that are essential to evaluating and improving management. These include catch monitoring (including bycatch and incidental mortality studies), encounter surveys, in-season creel surveys, coded-wire tag recovery sampling, biological sampling of catch and escapement to describe populations structure by age, sex and (hatchery or natural) origin, and escapement surveys and estimation.

Monitoring is divided into several components: Fisheries (boats and fishers) are monitored to estimate catch, encounters, and non-landed mortality rates, and methods differ from area to area depending upon specific needs. Catch is sampled for coded-wire tags and biological samples. Escapement is estimated through surveys, sampling and estimation. Special studies are conducted to meet specific management or research needs. Regulatory compliance is monitored through enforcement presence and contacts.

This section provides an overview of ongoing monitoring activities such as biological sampling and escapement monitoring. Since data summarization and analysis generally requires at least one year for completion, most products from the most recent management year are incomplete at this time.

8.1 Catch monitoring

The Puget Sound Salmon Management Plan[1] (PSSMP) requires WDFW and the Puget Sound treaty Indian tribes to maintain a joint "Catch Recording System" so that *"all commercial catches for treaty and nontreaty fishermen"* are recorded in timely manner and maintained for access by all fishery managers. This includes not only commercially-sold fish, but also *"ceremonial and subsistence catches, and the number of fish taken home by fishermen during commercial fisheries." "Processing of fish tickets, collection of data, correction of errors, and finalization of data shall be carried out under an agreed-upon joint catch monitoring system which recognizes the need and responsibility of each party to correct its own fish ticket information."*

Accordingly, WDFW, the Northwest Indian Fisheries Commission, and individual tribes cooperate in tracking cumulative commercial catch by the non-Indian and Treaty Indian fleets, respectively, using Fish Receiving Tickets, which are documents recording sale from fisher to buyer. Information from fish tickets is summarized by WDFW and tribal staff and made available to fishery managers. This system enables tracking of catch for target species as well as species caught and retained incidentally.

[1] Order Adopting Puget Sound Salmon Management Plan ; 626 F.Supp. 1527 ; Plan dated 5/15/1985 ; Section 11.3 : Catch Recording System.

Similarly, the PSSMP requires that *"[r]ecreational catches shall be estimated through an agreed-upon sport catch estimation system established following a joint study to evaluate estimation methods."* In Washington ocean recreational fisheries, Strait of Juan de Fuca Area 5 mark-selective fishery (MSF), and other selected fishing areas, recreational catch is estimated during the fishing season through specialized creel surveys. For other catch areas and times, recreational catch is estimated postseason using recreational catch record card (CRC) reports, following an elaborate angler subsampling methodology.

Commercial and recreational catch estimates for the 2004-05 management year are presented in sections 5 and 6, respectively. Information regarding special recreational creel surveys conducted in the 2004-05 management year is incorporated within the recreational fishery evaluation (Section 6.3). Similarly, results for specific commercial fishery bycatch monitoring activities are included in Section 5.10. In particular, incidental Chinook harvest is carefully monitored in Strait of Juan de Fuca sport fisheries, and nontreaty preterminal net fisheries in the San Juan Islands-Georgia Strait, and in central Puget Sound, as well as in terminal area fisheries directed at pink and coho salmon.

Ocean and Juan de Fuca troll catch and summaries of Puget Sound net catch are reported annually by the Pacific Fisheries Management Council in the Annual Review of Ocean Salmon Fisheries, available at http://www.pcouncil.org/salmon/salsafe.html . Historic catch estimates for Puget Sound commercial and recreational fisheries are provided in Sections 5.12 and 6.5, respectively.

8.2 Biological Sampling Summary

Commercial catch is sampled cooperatively by WDFW and tribal fisheries agencies; WDFW samples the recreational fisheries. An increasing proportion of all hatchery Chinook and coho production in Washington is now mass-marked with an adipose clip, so that mark is no longer useful as an indicator of CWt presence. Therefore, recovery of coded-wire tags requires electronic sampling of all Chinook and coho to determine whether a coded-wire tag is present. The effectiveness of electronic sampling equipment has been demonstrated, but the large increase in the number of adipose-clipped coho and Chinook has correspondingly increased the effort required to check the desired proportion of the total catch.

When catch and sampling data are acceptably complete, CWT sampling rates are calculated to determine whether the overall sampling objectives have been achieved. Most of these sampling data are summarized by calendar year rather then the management year being reported for catch and escapement.

8.2.1 Chinook Sampled and Coded-Wire Tag Recoveries

Commercial and recreational catch is sampled to recover coded-wire tagged Chinook and coho. The objective for commercial fisheries is to sample 20% of the catch each week in each catch area. The objective for recreational catch is to sample 10% of the catch each month in each area. These sampling rates have been shown to generate sufficient recoveries of "indicator tag groups" to estimate catch distribution and fishery-specific exploitation or harvest rates.

"Indicator" stocks are hatchery releases from each production region in Puget Sound and the Washington coast, as well as the Columbia River and British Columbia. They are coded-wire tagged and marked with an adipose clip. Selection of indicator stocks, marking, sampling, and analysis of tag recovery data is funded by the Pacific Salmon Commission. The Pacific States Marine Fisheries Commission maintains an electronic database containing all CWT release and recovery data.

Numbers of Chinook sampled and numbers of CWTs recovered by month in 2004 recreational fisheries are summarized in Table 8-A and Table 8-B, respectively. CWT sampling rates in commercial fisheries are summarized in Table 8-C.

Table 8-A
Chinook sampled in 2004 Recreational Fisheries

Month	Catch Area									
	5	**6**	**7**	**8-1**	**8-2**	**9**	**10**	**11**	**12**	**13**
Jan	0	0	0	0	0	0	58	0	0	2
Feb	44	134	131	21	62	124	30	25	32	7
Mar	5	91	78	5	90	28	0	31	50	0
Apr	33	36	0	0	56	16	0	20	9	2
May	0	0	0	0	0	0	0	0	0	0
Jun	1	0	0	0	0	0	0	390	0	3
Jul	567	270	31	0	115	0	516	320	3	11
Aug	151	89	44	1	143	30	1,356	819	144	175
Sep	42	1	36	0	3	1	11	27	27	14
Oct	0	0	0	0	1	0	3	22	0	0
Nov	4	47	10	14	47	63	65	25	0	1
Dec	0	0	0	0	0	0	31	20	0	2
Total	847	668	330	41	517	262	2,070	1,699	265	217

Source: Susan Markey 3/15/05

Table 8-B
2004 Chinook CWTs collected in Puget Sound Recreational Fisheries

Month	Recreational Catch Area									
	5	6	7	8-1	8-2	9	10	11	12	13
Jan	na	na	na	na	na	na	4	na	na	0
Feb	9	24	16	1	8	11	3	1	2	0
Mar	1	12	10	0	6	6	na	2	3	na
Apr	6	6	na	na	9	0	na	0	0	0
May	na	na	na	na	na	na	na	na	na	na
Jun	1	na	na	na	7	na	na	25	na	1
Jul	93	28	3	na	10	na	28	16	0	0
Aug	19	5	2	0	11	2	71	54	5	12
Sep	9	1	2	na	0	0	2	4	0	1
Oct	na	na	na	na	0	Na	1	3	na	na
Nov	1	9	0	3	6	6	4	0	na	0
Dec	na	na	na	na	na	Na	5	1	na	0
Total	139	85	33	4	57	25	118	106	10	14

Note: Cells with "na" denote strata for which no Chinook were sampled; "0" indicates Chinook were sampled but no CWTs were collected.

Source: Susan Markey 3/15/05

A total of 6,916 Chinook were sampled by the Puget Sound sampling crew during 2004 calendar year recreational fisheries (Table 8-A). 591 CWTs were collected from those sampled Chinook (Table 8-B). 1,919 CWTs were collected in commercial fisheries (Table 8-C). More CWTs are recovered in commercial fisheries because sampling rates are higher, and because commercial fisheries present a higher overall magnitude of instantaneous catch.

Table 8-C
2004 Chinook Sampled, CWTs collected & AdClips counted in Puget Sound Commercial Fisheries

Commercial Catch Area	Chinook Sampled	CWT Recoveries	No. AdClips
5	145	9	48
6	24	0	1
7	2,196	30	194
7A	672	14	18
7B	2,985	176	2,077
7C	3,384	167	2,720
7D	4	0	4
Nooksack R	47	4	29
Skagit R	537	49	50
8A	26	1	5

Commercial Catch Area	Chinook Sampled	CWT Recoveries	No. AdClips
8D	3,907	367	463
10	117	11	47
10A	3,070	213	2,041
10E	1,782	84	1,295
10F	364	78	302
10G	10	3	8
Duwamish R	2,795	165	1,867
13	21	0	17
13A	426	15	341
13C	5,047	52	2,688
13D	1	0	0
13F	127	1	119
Nisqually R	3,009	278	2,500
Puyallup R	1,706	172	1,106
09A	1	0	1
12	2	1	0
12A	1	1	1
12C	160	3	1
12H	1,400	11	72
Skokomish R.	432	14	18
TOTAL	34,398	1,919	18,033

Source: Susan Markey 3/15/05

8.2.2 Historic Chinook CWT Sampling Rates

Sampling objectives for Puget Sound recreational and commercial fisheries are provided in the annual Puget Sound Sampling Plan (Appendix C). Overall, sampling objectives for recreational fisheries (found in Appendix C) have been met or exceeded in most Puget Sound fisheries (Table 8-D). Sampling rates in Puget Sound commercial fisheries generally exceed 20% (Table 8-E), and are often much higher.

Table 8-D
CWT Sampling Rates for Chinook in 1998-2003 Recreational Fisheries

Area /Year	Month											
Area 5	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	0%	16%	12%	60%			18%	19%	14%	20%	0%	0%
2002	0%	34%	11%	25%	0%	0%	22%	12%	42%	0%	1%	0%
2001		24%	0%	12%	0%	26%	26%	23%	22%	0%	0%	

Area /Year	Month											
2000		32%		43%	0%			17%	25%			0%
1999		46%	45%	1%				17%	24%			
1998		38%	13%	15%				26%	19%			
Area 6	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003		47%	70%	23%	0%		41%	42%			33%	0%
2002		19%	34%	37%		0%	0%		33%	0%	35%	
2001	0%	29%	35%	20%			0%	39%	29%	14%	15%	
2000		8%	60%	12%						0%	25%	33%
1999		33%	41%	19%				25%	33%	0%	13%	40%
1998		22%	12%	2%				35%	27%	2%	7%	12%
Area 7	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	33%	19%	15%	0%	0%	0%	15%	13%	15%	20%	14%	0%
2002	0%	10%	31%	9%	0%	0%	4%	15%	14%	0%	18%	0%
2001		23%	17%	17%	0%	3%	6%	15%	14%	14%	6%	0%
2000		45%	47%	23%	0%	0%	8%	11%	14%	21%	11%	43%
1999		13%	35%	23%			16%	16%	23%	25%	12%	
1998	18%	20%	21%	9%			16%	12%	9%	7%	9%	
Area 8-1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	25%	7%	1%			0%	0%	14%	50%	22%	11%	
2002		2%	8%	7%				0%		0%	27%	
2001	0%	4%	1%	0%		0%	0%	33%		3%	6%	0%
2000			13%	10%			0%	0%	25%		20%	15%
1999		4%	18%	2%						0%	30%	40%
1998	8%	10%	5%	17%				20%	17%		6%	
Area 8-2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	0%	44%	16%	32%	0%	0%	22%	21%	18%	38%	30%	
2002		25%	27%	22%	0%	24%	16%	27%	20%	1%	38%	0%
2001		16%	13%	9%	0%	22%	16%	12%	10%	11%	11%	0%
2000		29%	23%	22%	0%	0%	34%	20%	10%	25%	1%	0%
1999		8%	18%	27%			5%	23%	22%	50%		
1998	16%	13%	14%	6%			31%	13%	23%	23%		
Area 9	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	40%	17%	6%	0%	0%		9%	5%	12%	21%	17%	0%
2002	0%	7%	8%	11%	0%	14%	2%	13%	15%	0%	40%	
2001	0%	12%	13%	7%	28%	3%	2%	6%	9%	13%	14%	0%
2000		11%	4%	9%	0%	2%	2%	7%	22%	11%	10%	5%

Area /Year	Month										
1999	0%	8%	13%	24%		9%	8%	3%	9%	18%	17%	2%
1998	25%	13%	17%	15%			4%	12%	14%	9%	13%	
Area 10	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	24%	8%	0%		0%	0%	58%	41%	47%	11%	3%	11%
2002	0%	1%	14%	13%		0%	22%	46%	45%	6%	16%	17%
2001	0%	11%	17%	16%	0%	5%	49%	41%	26%	10%	7%	8%
2000		37%	66%	38%	0%	0%	8%	32%	33%		7%	3%
1999		24%	55%	48%			4%	22%	40%	9%	15%	6%
1998	29%	32%	16%	21%			9%	19%	31%	22%	10%	14%
Area 11	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	18%	29%	37%	13%	36%	26%	19%	17%	21%	25%	18%	26%
2002	0%	12%	21%	19%	0%	0%	20%	28%	22%	18%	22%	44%
2001	0%	16%	13%	10%	38%	22%	16%	19%	16%	16%	6%	19%
2000		13%	29%	25%	0%	22%	16%	17%	17%	16%	6%	24%
1999		11%	15%	20%		30%	19%	17%	14%	21%		6%
1998	9%	2%	14%	27%	20%	14%	19%	20%	24%	27%	15%	11%
Area 12	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	0%	23%	8%	9%	0%	0%	25%	9%	9%	10%		0%
2002	0%	0%	36%		22%	0%	0%	22%	5%	4%	12%	14%
2001		18%	2%	5%			4%	11%	5%			
2000			44%	0%	0%		4%	13%	10%	1%	0%	86%
1999		1%	15%	5%			0%	13%	14%	0%	0%	28%
1998	15%	36%	21%				0%	9%	6%	13%	13%	7%
Area 13	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	0%	0%		11%	18%	0%	8%	16%	17%			12%
2002	0%	40%	10%	0%	12%	33%	3%	17%	18%			2%
2001	0%	16%	29%	2%	29%	10%	8%	8%	8%	0%		2%
2000		8%	2%	35%	14%	1%	29%	16%	20%	20%	5%	500%
1999		25%	2%	16%	19%	10%	4%	16%	12%	14%		
1998	5%	4%	10%	21%	1%	6%	7%	8%	9%	20%	21%	9%

Note: Blank cells denote strata for which catch was zero; 0% means there was catch (e.g., from an open pier in a closed area), but none was sampled

Source: Susan Markey 3/15/05

Table 8-E
2001-03 Puget Sound Commercial Net Fishery Chinook Sampling Rates (includes C&S and Take Home)

Catch Area	2003			2002			2001		
	Catch	Number Sampled	% Sampled	Catch	Number Sampled	% Sampled	Catch	Number Sampled	% Sampled
4B Neah Bay	98	0	0%	57	0	0%	432	30	7%
Area 5 Clallam Bay	810	616	76%	1,017	537	53%	499	202	40%
Sekiu R.	2	0	0%	na	na	na	na	na	na
Area 6D Dungeness Bay	1	0	0%	na	na	na	na	na	na
Area 7 San Juan Islands	1,734	784	45%	562	171	30%	305	170	56%
Area 7A Point Roberts	3,108	1,387	44%	1,669	820	49%	665	291	44%
Area 7B Bellinhan Bay	10,994	2,945	26%	30,550	7,588	25%	40,641	13,744	34%
Nooksack River	622	247	39%	447	297	66%	1,098	644	59%
Area 7C Samish Bay	7,366	3,064	41%	7,712	707	9%	7,447	1,242	17%
Area 7D Lummi Bay	9	2	22%	3	3	100%	17	1	6%
Area 8 Skagit Bay	69	32	46%	1	0	0%	29	11	38%
Skagit River	340	327	96%	294	255	87%	235	230	98%
Area 8A Saratoga Passage	359	146	40%	5,520	1,758	32%	429	14	3%
Area 8D Tulalip Bay	8,931	5,102	57%	With Area 8A	With Area 8A	With Area 8A	5,024	1,733	34%
Area 9 Admirality Inlet	na	na		na	na	na	29	0	0%
Area 10 Seattle	217	220	101%	117	115	98%	327	166	51%
Area 10A Elliott Bay	1,924	1,681	87%	1,499	1,045	70%	4,778	1,544	32%
Duwamish River	2,876	1,332	46%	7,976	5,108	64%	4,170	2,479	59%
Area 10C South Lake Washington	na	na		na	na	na	285	0	0%
Area 10D Lake Sammamish	204	203	99%	na	na	na	1,809	0	0%
Area 10E East Kitsap	7,616	1,984	26%	4,794	693	14%	6,625	1,662	25%
Area 10F Ship Canal	302	178	58%	135	63	47%	na	na	na
Area 10G North Lake Washington	65	63	96%	na	na	na	20	3	15%
Area 11 East And West Passage	93	1	1%	na	na	na	0	5	
Puyallup River	2,482	1,534	61%	4,749	3,038	64%	7,330	1,757	24%
White R.	117	0	0%	na	na	na	na	na	na
Area 11A Commencement Bay	na	na		na	na	na	148	0	0%
Area 13	230	165	71%	152	0	0%	117	0	0%
Nisqually River	17,833	4,833	27%	11,834	7,198	61%	10,467	6,282	60%
Area 13A Carr Inlet	2,166	497	22%	973	111	11%	1,248	32	3%
Area 13C Chambers Bay	922	187	20%	689	412	60%	336	52	15%
Area 13D Dana Passage	399	203	50%	4	0	0%	106	24	23%
Area 13F Budd Inlet	691	32	4%	28	28	100%	241	0	0%
Area 13I Skookum Inlet	na	na		na	na	na	62	0	0%
Area 13K Case Inlet	56	22	39%	na	na	na	241	17	7%
McAllister Creek	na	na		317	0	0%	232	0	0%
Minter Creek	na	na		40	0	0%	na	na	na
Area 9A Port Gamble Bay	2	0	0%	3	0	0%	2	2	100%

Catch Area	2003			2002			2001		
	Catch	Number Sampled	% Sampled	Catch	Number Sampled	% Sampled	Catch	Number Sampled	% Sampled
Area 12B Quilcene/Dabob Bays	na	na		4	0	0%	338	0	0%
Area 12B Central Hood Canal	na	na		90	0	0%	na	na	na
Area12C South Hood Canal	1,327	252	18%	21,110	3,493	17%	3,161	1,081	34%
12H Tribal Hoodsport Hatchery SubArea	16,654	2,527	15%	na	na	na	na	na	na
Big Quilcene R.	91	0	0%	na	na	na	na	na	na
Duckabush R.	0	5	0%	na	na	na	na	na	na
Skokomish River	3,065	520	16%	2,656	242	9%	586	237	40%
Total	93,775	31,091		83,199	29,947		95,488	32,335	

Note: Blank cells denote strata for which catch was zero; 0% means there was catch, but none was sampled
"na" denotes strata that were not sampled
Source: Susan Markey 3/15/05

In conclusion, sampling rates tend to be good for Puget Sound commercial and recreational fisheries.

8.3 Escapement Monitoring

The estimation and sampling of natural spawning escapement is an essential element in assessing the annual abundance of Chinook, which ultimately enables the estimation of fisheries exploitation rates and assessment of the performance of fisheries management regimes. Concurrent biological sampling of spawners in a number of areas provides essential data on the age composition of the return and the hatchery or wild origin of adults. Cohort strength estimates are also based on the escapement and harvest of age-2 through age-6 adults from any brood year.

Fishery managers have emphasized the need to understand the contribution of hatchery-origin salmon to natural spawning, whether of local hatchery origin or strays from other facilities or river systems. With the increase in mass marking of hatchery fish, spawning ground sampling is now able to collect this essential information. Depending on the accuracy required of such estimates, more sampling effort may be required than has previously been expended on collecting biological data on the spawning grounds to determine age and sex composition and origin of spawners.

8.4 Regulatory Compliance

WDFW enforcement officers monitor recreational fisheries in all marine catch areas, from ocean Catch Record Card (CRC) Area 1 (and including the Columbia River Buoy 10 fishery) through Puget Sound CRC Area 13. This effort is designed to measure and monitor adherence to wild salmon release rules, as well as general fishing rule compliance.

Following is a summary of enforcement activities by officers of the Washington Department of Fish and Wildlife (WDFW) for the 2004 marine salmon fishery. Originally designed as a program to monitor adherence to wild coho salmon release rules, increased patrols in marine areas have had a positive impact on overall regulation compliance issues. With the expansion of selective fishing to other species, along with concerns raised during the North of Falcon (NOF) season setting process, marine recreational fishery enforcement has expanded throughout the Washington Coast and Puget Sound. Enforcement presence in the eighteen marine areas was accomplished by vessel, dock patrols, and joint operations with other enforcement agencies.

8.4.1 Regulatory Compliance in 2004 Puget Sound Recreational Fisheries

Developing compliance rate estimations for fish and wildlife violations are difficult. Uniformed presence on the water or at the dock provides visible deterrence to violations, thereby altering the behavior of those who may violate natural resource laws. In some instances, the contact to violation ratio may be merely a reflection of the effectiveness of the individual officer at discovering a violation. Therefore, estimated compliance rates compiled from uniformed enforcement activity may not be an accurate measure of actual compliance, but rather, serves best as an index when comparing one area to another, or one season to the next.

The average for estimated compliance with the wild coho release rule in the eight applicable Salmon Management Catch Areas was 99.45%. The estimated rate of compliance with overall salmon rules for all thirteen monitored Salmon Management Catch Areas was 88.4% compared to 84.6 % in 2003 (Table 8-F).

A selective Chinook fishery was implemented during the 2004-05 season in the Strait of Juan de Fuca recreational fishery (CRC Areas 5 and 6). Concern over compliance in this fishery translated to a prioritization for enforcement presence in these areas over adjacent ocean CRC areas. Compliance in the Strait of Juan de Fuca recreational fishery was about 83% in area 5 and 91% in area 6[1]. Compliance with wild coho release was about 99.2%[2] in area 5 and 100% in area 6. Compliance with Chinook release after the retention period closed also about 99.4%[3] in area 5. A total of 120 citations and 110 warnings were issued during the 290 enforcement hours in the Strait summer fishery.

Compliance in CRC area 7 fishery, including for mark-selective coho and Chinook rules, was high. Overall compliance was 86.2%, with a coho mark-release compliance of 99.5% and Chinook mark-release compliance of 99.7%. There were a total of 1076 contacts in 400 enforcement hours, and 119 citations and 430 warnings were issued.

Officers also patrolled SMCA's 8-1 and 8-2 to enforce Chinook salmon closures in effect. Enforcement efforts included the Tulalip Terminal fishery in Area 8-2. Wild coho release was required in CRC area 13 and compliance was high this season. Patrol

---

1 % compliance with overall salmon regulations = total rule violations associated with salmon only (license, gear, possession, season and area) / total contacts.

2 % compliance for possession of unmarked coho = total unmarked fish violations / total contacts.

3 % compliance for possession of unmarked Chinook = total unmarked fish violations / total contacts.

effort was also committed to Area 9 and 12 for the protection of summer chum. Additional commitments were made for Area 10 due to bubble fisheries in Elliott Bay and Sinclair Inlet, which allowed access to surplus hatchery stocks of Chinook while the remainder of the area was closed to Chinook retention.

The 2004 average for compliance with overall salmon rules in marine areas 8-1 through 13 was 84.1%. Officers made 3,136 contacts in 1,063 enforcement hours, wrote 371 citations, and issued 312 warnings.

Compliance with overall salmon rules varied widely (from 77.9% in area 13 to 92.9% in area 8-1) throughout Puget Sound, however compliance with mark-selective and species-release rules was generally high (99% and higher) everywhere this was monitored (Table 8-F).

Table 8-F
Enforcement Effort and Regulatory Compliance in 2004 Puget Sound Recreational Fisheries

CRC Area	Overall Compliance[1]	Coho Mark-Release[2]	Chinook Mark-Release[3]	Contacts	Citations	Warnings	Enforcement Hours
5	83.0%	99.2%	99.4%	795	85	69	154
6	91.0%	100.0%	na	422	35	41	136
7	86.2%	99.5%	99.7%	1076	119	40	400
8-1	92.9%	na	100.0%	182	13	1	78
8-2	79.8%	na	96.3%	356	58	27	137
9	86.5%	na	100.0%	377	37	14	79
10	82.2%	na	na	529	44	83	242
12	85.1%	99.7%[4]	na	915	75	98	206
13	77.9%	99.9%	na	777	144	89	321

1 % compliance with overall salmon regulations = total rule violations associated with salmon only (license, gear, possession, season and area) / total contacts.

2 % compliance for possession of unmarked coho = total unmarked fish violations / total contacts.

3 % compliance for possession of unmarked Chinook = total unmarked fish violations / total contacts.

4 This figure represents compliance with summer chum release regulations.

8.4.2 Trends In Compliance

In general, 2004 compliance with regulations in the recreational fishery was up two to fourteen percentage points from 2003 levels. Exceptions included compliance with general rules in areas 5, 6, 8-1, and12, which dropped from one to seven percentage points in 2004. Trends for overall compliance are increasing since reporting began in 2000, and compliance with mark-selective rules continues to be very good. Refer to Appendix D for more details on area-by-area compliance in 2004,and comparisons with compliance in previous years.

8.5 Plan Evaluation and Adaptive Management

Success of the CCHMP is dependent on whether its implementation promotes recovery. This means that overall Plan evaluation stretches beyond compliance to examine whether CCHMP objectives, assuming they are being met, are valid in achieving the Plan's goal (i.e. minimize the risk that harvest will inhibit recovery). Determining the answer to this complex question requires not only that exploitation be reviewed, but also that population parameters be reevaluated. These evaluations will confirm that management actions have the desired result through improved understanding of how the populations and ecosystems function.

We must periodically review the tools we use to identify target exploitation rates (e.g. tools that estimate freshwater productivity and marine survival simulations that look at effects of alternatives ERs on population response) to ensure they continue to reflect our current understanding of population dynamics and relationships between populations and their habitat.

For populations or management units that are managed under RER objectives, periodic reassessment of the spawner/recruit function that underlies the RER is necessary. Productivity may change as habitat conditions in watersheds either degrade or improve. There will be uncertainty about how quickly such a change may be detected, given the characteristic 'noise' in spawner/recruit relationships. In any case, as more data accumulate for successive broods, and more or better data are available to quantify marine and freshwater survival parameters, the productivity function upon which RERs are based may be re-estimated.

If the productivity function or any of its parameters change, it will be necessary to re-assess whether the current exploitation rate ceiling will result in the desired probabilities of achieving the rebuilding threshold and avoiding critical abundance status. In the end, Plan RER objectives may be adjusted to ensure that fishery-related mortality does not impede the ability of natural Puget Sound Chinook populations to respond to improvements in habitat productivity and capacity.

Appendices

A Comprehensive Chinook Management Plan – Harvest Component 2004-2009 (PSIT and WDFW, March 1, 2004)

B State/Tribal Agreed-to Fisheries Document (PSIT and WDFW, 4/12/04)

C 2004-05 Puget Sound Sampling Program Operating Plan (March 30, 2004)

D 2004 Chinook Selective Fishery, Marine Areas 5 and 6 (Thiesfeld & Hagen-Breaux)

E Evaluation of the 2003 and 2004 Chinook Mark-Selective Fisheries, Marine Areas 5 and 6 (Thiesfeld)

F WDFW 2004 Selective Salmon Fishery Enforcement Report

Appendix A

COMPREHENSIVE MANAGEMENT PLAN

FOR PUGET SOUND CHINOOK:

HARVEST MANAGEMENT COMPONENT

March 1, 2004

Puget Sound Indian Tribes and
Washington Department of Fish and Wildlife

Available at
http://wdfw.wa.gov/fish/papers/ps_chinook_management/harvest/ps_chinook_harvest.pdf

Appendix B

State/Tribal Agreed-to Fisheries Document

4/12/04

PSIT and WDFW

Appendix C

2004-05 Puget Sound Sampling Program Operating Plan

March 30, 2004

Appendix D

2003 Chinook Selective Fishery, Marine Areas 5 and 6

By

Steven L. Thiesfeld
Angelika Hagen-Breaux

January 12, 2005

Washington Department of Fish and Wildlife
Fish Program
600 Capitol Way North
Olympia, Washington 98501

Appendix E

Evaluation of the 2003 and 2004 Chinook Mark-Selective Fisheries, Marine Areas 5 and 6

Steven L. Thiesfeld

Final Draft
January 14, 2005

Washington Department of Fish and Wildlife
Fish Program
600 Capitol Way North
Olympia, Washington 98501

Appendix F

STATE OF WASHINGTON

DEPARTMENT OF FISH AND WILDLIFE

ENFORCEMENT PROGRAM

STATEWIDE MARINE PATROL DIVISION

2004 WASHINGTON MARINE SALMON FISHERY COMPLIANCE REPORT

December 10, 2004

Captain Michael Cenci

COMPREHENSIVE MANAGEMENT PLAN

FOR PUGET SOUND CHINOOK:

HARVEST MANAGEMENT COMPONENT

Puget Sound Indian Tribes

And

The Washington Department of Fish and Wildlife

March 1, 2004

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Executive Summary

This Harvest Management Plan outlines objectives that will guide the Washington co-managers in planning annual harvest regimes, as they affect listed Puget Sound chinook salmon, for management years 2004 - 2009. These objectives include total or Southern U.S. exploitation rate ceilings, and / or spawning escapement goals, for each of fifteen management units. This Plan describes the technical derivation of these objectives, and how these guidelines are applied to annual harvest planning.

The Plan guides the implementation of fisheries in Washington, under the co-managers' jurisdiction, but it considers the total harvest impacts of all fisheries, including those in Alaska and British Columbia, to assure that conservation objectives for Puget Sound management units are achieved. Accounting of total fishery-related mortality includes incidental harvest in fisheries directed at other salmon species, and non-landed chinook mortality.

The fundamental intent of the Plan is to enable harvest of strong, productive stocks of chinook, and other salmon species, and to minimize harvest of weak or critically depressed chinook stocks. However, the Puget Sound ESU currently includes many weak populations. Providing adequate conservation of weak stocks will necessitate foregoing some harvestable surplus of stronger stocks.

The rebuilding exploitation rate (RER) objectives stated for management units (Table 1) are ceilings, not annual target rates. The objective for annual, pre-season fishery planning is to develop a fishing regime that will exert exploitation rates that do not exceed the objectives established for each management unit. For the immediate future, annual target rates that emerge from pre-season planning will, for many management units, fall well below their respective ceiling rates. While management units are rebuilding, annual harvest objectives will intentionally be conservative, even for relatively strong and productive populations.

To insure that the diversity of genetic traits and ecological adaptation expressed by all populations in the ESU is protected, low abundance thresholds are specified (Table 1). These thresholds are intentionally set above the level at which a population may become demographically unstable, or subject to loss of genetic integrity. If abundance (i.e., escapement) is forecast to fall to or below this threshold, harvest impacts will be further constrained, by Critical Exploitation Rate Ceilings, so that escapement will exceed the low abundance threshold or the ceiling rate is not exceeded.

Rebuilding exploitation rates are based on the most current and best available information on the recent and current productivity of each management unit. Quantification of recent productivity (i.e., recruitment and survival) is subject to uncertainty and bias. The implementation of harvest regimes is subject to management error. The derivation of RERs considers specifically these sources of uncertainty and error, and manages the consequent risk that harvest rates will exceed appropriate levels. The productivity of each management unit will be periodically re-assessed, and harvest objectives modified as necessary, so they reflect current status.

Table 1.Rebuilding exploitation rates (RERs), expressed either as total, southern U.S. (SUS), or pre-terminal southern US (PT SUS) rates, upper management thresholds, and low abundance thresholds for Puget Sound chinook.

Management Unit	RER	Upper Management Threshold	Low Abundance Threshold
Nooksack [1]	Under development	4,000	
North Fork		2,000	1,000
South Fork		2,000	1,000
Skagit summer / fall	50%	14,500	4,800
Upper Skagit summer		8,434	2,200
Sauk summer		1,926	400
Lower Skagit fall		4,140	900
Skagit spring	38%	2,000	576
Upper Sauk		986	130
Cascade		440	170
Siuattle		574	170
Stillaguamish [1]	25%	900	650
North Fork summer		600	500
South Fork & MS fall		300	N/A
Snohomish [1]	21%	4,600	2,800
Skykomish		3,600	1,745
Snoqualmie		1,000	521
Lake Washington	15% PT SUS		
Cedar River [1]		1,200	200
Green	15% PT SUS	5,800	1,800
White River spring	20%	1,000	200
Puyallup fall	50%		500
South Prairie Creek		500	
Nisqually		1,100	
Skokomish	15% PT SUS	3,650 aggregate, 1,650 natural	1,300 aggregate 800 natural
Mid-Hood Canal	15% PT SUS	750	400
Dungeness	10% SUS	925	500
Elwha	10% SUS	2,900	1,000
Western JDF	10% SUS	850	500

[1] thesholds expressed as natural-origin spawners

This Plan will be submitted to the National Marine Fisheries Service (NMFS), for evaluation under the conservation standards of the Endangered Species Act. Criteria for exemption of state / tribal resource management plans from prohibition of the 'take' of listed species, are contained under Limit 6 of the salmon 4(d) Rule (50 CFR 223:42476). The 4(d) criteria advocate that harvest should not impede the recovery of populations, whose abundance exceeds their critical threshold, from increasing, and that populations with critically low abundance be guarded against further decline, such that harvest will not significantly reduce the likelihood of survival and recovery of the ESU. This Plan assures that the abundance of all populations will increase, if habitat conditions improve to support increased productivity, and that the harvest will be conducted more conservatively than required by the ESA.

1. Objectives and Principles

This Harvest Management Plan consists of management guidelines for planning annual harvest regimes, as they affect Puget Sound chinook, for the 2004 - 2009 management years. The Plan guides the implementation of fisheries in Washington, under the co-managers' jurisdiction, and considers the total harvest impacts of all fisheries on Puget Sound chinook, including those in Alaska, British Columbia, and Oregon. The Plan's objectives can be stated succinctly as intent to:

> *Ensure that fishery-related mortality will not impede rebuilding of natural Puget Sound chinook salmon populations, to levels that will sustain fisheries, enable ecological functions, and are consistent with treaty-reserved fishing rights.*

This Plan will constrain harvest to the extent necessary to enable rebuilding of natural chinook populations in the Puget Sound evolutionarily significant unit (ESU), provided that habitat capacity and productivity are protected and restored. It includes explicit measures to conserve and rebuild abundance, and preserve diversity among all the populations that make up the ESU. The ultimate goal of this plan, and of concurrent efforts to protect and restore properly functioning chinook habitat, is to rebuild natural productivity so that natural chinook populations will be sufficiently abundant and resilient to perform their natural ecological function in freshwater and marine systems, provide related cultural values to society, and sustain commercial, recreational, ceremonial, and subsistence harvest.

The co-managers and the Puget Sound Shared Strategy have adopted abundance and productivity goals for each population, which are the endpoint for all aspects of recovery planning, which will include components for management of harvest and hatchery production, and conservation and restoration of freshwater and marine habitat.

In order to achieve recovery, the Harvest Management Plan adopts fundamental objectives and guiding principles. The Plan will:

- **Conserve the productivity, abundance, and diversity** of the populations that make up the Puget Sound ESU.

- **Manage risk.** The development and implementation of the fishery mortality limits in this Plan incorporate measures to manage the risks, and compensate for the uncertainty associated with estimating current and future abundance and productivity of populations. In addition, the 'management error' associated with forecasting abundance and the impacts of a given harvest regime is built into simulating the long-term dynamics of individual populations. Furthermore, the Plan commits the co-managers to ongoing monitoring, research, and analysis, to better quantify and determine the significance of risk factors, and to modify the Plan as necessary to minimize such risks.

- **Meet ESA jeopardy standards**. The ESA standard, as interpreted by the NMFS, is that activities, such as harvest regulated by this Plan, may be exempted from the prohibition of take, prescribed in Section 9, only if they do not "appreciably reduce the likelihood of survival and recovery" of the ESU (50 CFR 223 vol 65(1):173). This Plan meets that standard, not just for the ESU as a whole, but in several respects sets a more rigorous standard for conserving the abundance, diversity, and productivity of each component population of natural chinook within the ESU.

- **Provide opportunity to harvest surplus production from other species and populations.** This Plan provides for continued harvest of sockeye, pink, and coho salmon, as well as the abundant hatchery production of chinook from Puget Sound and the Columbia River This Plan eliminates directed fisheries on depressed Puget Sound chinook but permits incidental catch of these runs in fisheries aimed at other runs with harvestable surpluses. The level of incidental catch is constrained by specific conservative exploitation rate ceilings or other management objectives.

- **Account for all sources of fishery-related mortality**, whether landed or non-landed, incidental or directed, commercial or recreational, and occurring in the U.S. (including Alaska) or Canada, when assessing total exploitation rates.

- **Adhere to the principles of the Puget Sound Salmon Management Plan** (PSSMP), and other legal mandates pursuant to *U.S. v. Washington* (384 F. Supp. 312 (W.D. Wash. 1974), and *U.S. v Oregon*, to ensure equitable sharing of harvest opportunity among tribes, and among treaty and non-treaty fishers.

- **Achieve the guidelines on allocation of harvest benefits and conservation objectives that are defined in the 1999 Chinook Chapter of Annex IV to the Pacific Salmon Treaty.**

- **Ensure exercise of Indian treaty rights**. Indian fishing rights were established by treaties, and further defined by federal courts in *U.S. v Washington.* The exercise of fishing rights by individual tribes is limited to 'usual and accustomed' areas, according to their historical use of salmon resources.

This Harvest Plan affects, primarily, management of Treaty Indian and non-Indian commercial and recreational salmon fisheries in Puget Sound, including net fisheries directed at steelhead. The geographic scope of the Plan encompasses fishing areas south of the Canadian border in the Strait of Juan de Fuca (east of Cape Flattery), and Georgia Strait. The Secretary of Commerce, through the Pacific Fisheries Management Council, is responsible for management of ocean salmon fisheries (i.e. troll and recreational) along the Oregon / Washington coast (i.e. in Areas 1 – 4B, from May through September). As participants in the PFMC / North of Falcon processes, the Washington co-managers consider the impacts of these ocean fisheries on Puget Sound chinook, and may modify them to achieve management objectives for Puget Sound chinook (PSSMP Section 1.3). Fisheries mortality in Alaska, Oregon, and British Columbia is also accounted in order to assess, as accurately as possible, total fishing mortality of Puget Sound chinook. Mortality of Puget Sound chinook in other Washington commercial and recreational fisheries, e.g. those directed at rockfish, halibut, shellfish, or trout, is not directly accounted.

Natural chinook abundance and productivity in Puget Sound is generally depressed, and for some populations, at critically low levels. Therefore, harvest of these populations must be limited, as part of a comprehensive recovery plan that addresses impacts from harvest, hatchery practices, and degraded habitat. Managing salmon fisheries in Washington to achieve this low impact on Puget Sound natural populations requires accounting of all sources of fishery-related mortality in all fisheries. This is not a trivial task since directed, incidental, and non-landed mortality must all be taken into account, and since Puget Sound chinook salmon are affected by fisheries in a large geographical area extending from southeast Alaska to the Oregon coast. However, since the 1980s research has focused on assessing fishing mortality across the entire range of Puget Sound chinook, so a large body of data and sophisticated computer models are available to quantify harvest rates and catch distribution.

The management regime will be guided by the principles of the Puget Sound Salmon Management Plan (PSSMP), and other legal mandates pursuant to *U.S. v. Washington* (384 F. Supp. 312 (W.D. Wash. 1974), and *U.S. v Oregon*, in equitable sharing of harvest opportunity among tribes, and among treaty and non-treaty fishers. The PSSMP is the framework for planning and managing harvest so that treaty rights will be upheld and equitable sharing of harvest opportunity and benefits are realized. The fishing rights of individual tribes are geographically limited to 'usual and accustomed' areas that were specifically described by subproceedings of *U.S. v. Washington*. This Plan is based on the principles of the PSSMP that assure that the rights of all tribes are addressed. Allocation of the non-Indian share of harvest among commercial and recreational users is decided by the policy of the Washington Department of Fish and Wildlife.

The 1999 Chinook Chapter to Annex IV of the Pacific Salmon Treaty also limits harvest in many of the fisheries that impact Puget Sound chinook. The abundance-based chinook management framework contained in the Chapter applies fishery-specific constraints to achieve reduced harvest rates when escapement goals for indicator stocks are not achieved (see section V.B.1). This Plan states how the annual fishing regime developed by the co-managers will comply with the PST agreement. Nearly all of the fisheries implemented under this Plan will be directed at the harvest of species other than chinook or directed at strong chinook runs from other regions or strong hatchery chinook runs from Puget Sound. Therefore, nearly all of the anticipated harvest-related mortality to natural Puget Sound chinook will be incidental to fisheries directed at other stocks or species. Consequently, a wide range of management plans and agreements had to be taken into account in developing this plan.

Harvest-related mortality must be assessed in the context of other constraints on chinook survival. Non-harvest mortality is several orders of magnitude greater than the impact of harvest. If an adult female lays 5,000 eggs, and only two to six of those survive to adulthood, the non-harvest mortality rate exceeds 99.9%. Consequently, a small increase in the rate of survival to adulthood has a much greater effect on abundance than reduction of harvest. Increasing productivity, i.e. the recruitment per female spawner, is essential to recovery. Listing of the Puget Sound ESU has engendered a broad effort, shared by federal, tribal, state, and local governments and the private sector, to protect and restore habitat. Therefore, harvest must be managed so as not to impede recovery, if the capacity and productivity of habitat increases

This Plan sets limits on annual fishery-related mortality for each Puget Sound chinook management unit. The limits are expressed either as exploitation rate ceilings, which are the maximum fraction of the total abundance that can be subjected to fishery-related mortality, or natural escapement thresholds, which trigger additional fishery conservation measures Exploitation rate ceilings for complex management units, comprised of more than one populations, were based, to the extent possible, on estimates of productivity for each component. Implementing this Plan requires assessing the effects of fisheries (i.e. the resulting escapement) for individual populations.

The Plan asserts a specific role for harvest management in rebuilding the Puget Sound ESU and its population components. Implementing the Plan will enable attainment of optimum (MSH) escapement for some populations, but for most populations constraint of harvest can only assure that escapement will remain stable and enable the population to persist. Moreover, constraint of harvest will provide increased escapement to take advantage of any increased productivity or capacity, should favorable conditions more favorable to survival occur. However, for a small number of critically depressed populations, harvest constraint cannot assure persistence, though extraordinary measures will be implemented to avoid increasing the risk of their extinction. Specific attention is paid to the projected escapement of all individual populations during annual fishery planning, and harvest restrictions applied where necessary to protect all populations. However, recovery of Puget Sound population depends on improving productivity (i.e., the capacity of freshwater and estuarine habitat, and the survival of embryonic and juvenile chinook in that habitat). Reducing harvest has no effect on productivity, except when such constraint may prevent escapement from falling to the point of biological instability.

The development and implementation of the fishery mortality limits in this Plan incorporate measures to manage the risks and compensate for the uncertainty associated with quantifying the abundance and productivity of populations, where the information is available for such assessment. In addition, the ‘management error’ associated with forecasting abundance and estimating the impacts of a given harvest regime is built into the simulation of the future dynamics of individual populations, which is the basis for selecting exploitation rate objectives for some units. Furthermore, the Plan commits the co-managers to ongoing monitoring, research and analysis, to better quantify and determine the significance of risk factors, and to modify the Plan as necessary to minimize such risks.

The 2001 and 2003 versions of the Plan (PSIT and WDFW 2001; PSIT and WDFW 2003) responded to the conservation standards of Section 4(d) of the Endangered Species Act (ESA), after Puget Sound chinook were listed as threatened. However, management objectives and tools have been evolving since the early 1990s in response to the declining status of Puget Sound stocks. Concern over the declining status of Puget Sound and Columbia River chinook has motivated conservation initiatives in the arena of the Pacific Salmon Treaty, and of the Pacific Fisheries Management Council (PFMC). Efforts continue within these forums to address the current status of Puget Sound chinook. This Plan as well will continue to evolve as necessary to address changing management requirements and the needs of this fishery resource.

The ESA conservation standard, as implemented by the NMFS in the salmon 4(d) rule, is that activities that involve take of listed chinook, such as harvest regulated by this plan, may be exempted from the prohibition of take, prescribed in Section 9, if they do not ”appreciably reduce the likelihood of survival and recovery” (50 CFR 223 vol 65(1):173) of the ESU. This Plan meets that standard, and in several respects sets more rigorous standards for conserving the abundance, diversity and geographic distribution of Puget Sound chinook.

2. Population Structure – Aggregation for Management

This section describes the population structure of the Puget Sound chinook ESU, and how populations of similar run timing are aggregated for the purposes of harvest management in some river systems.

2.1 Population Structure

Puget Sound chinook comprise an evolutionarily distinct unit (ESU) defined by the geographic distribution of their freshwater life stages, life history, and genetic characteristics (Myers et al. 1998). This ESU includes many independent populations. The central intent of this Plan is to manage fishery-related risk, in order to conserve genetic and ecological diversity throughout the ESU, and to apply this standard to all its composite populations. The Chinook Status Review (Myers et al. 1998) designated the ESU to include populations originating from river basins beginning at the Elwha River, in the Strait of Juan de Fuca, continuing east and south through Puget Sound, and north to the Nooksack River. This Plan also includes chinook originating in the Hoko River, in the western Strait of Juan de Fuca.

Puget Sound chinook populations are classified, according to their migration timing, as spring, summer, or fall chinook, but specific return timing toward their natal streams, entry into freshwater, and spawning period varies significantly within each of these 'races'. Run timing is an adaptive trait that has evolved in response to specific environmental and habitat conditions in each watershed. Fall chinook are native to, or produced naturally, in the majority of systems, including the Hoko, lower Skagit, Snohomish, Cedar, Green, Puyallup, Nisqually, Skokomish, and mid-Hood Canal rivers, and in tributaries to northern Lake Washington. Summer runs originate in the Elwha, Dungeness, upper Skagit, lower Sauk, Stillaguamish, and Skykomish rivers. Spring (or 'early') chinook are produced in the South and North Forks of the Nooksack River, the upper Sauk River, Suiattle River, and Cascade River in the Skagit basin, and the White River in the Puyallup basin.

Puget Sound chinook populations were formerly identified in the Salmon and Steelhead Stock Inventory (WDF et al. 1993); the 2001 Harvest Plan was generally based on the SASSI designation. This Plan conforms with the Puget Sound Technical Recovery Team's (TRT) more recent population delineation (Ruckelshaus et al. 2004) that was developed as part of recovery planning. The Plan omits some populations that were included in the SASSI, either because recent assessment concludes that they are extinct, or that they exist only due to artificial production in the drainage, or as strays from other natural populations or hatchery programs. These include fall chinook in the Samish River, Gorst Creek and other streams draining into Sinclair Inlet, White River, Deschutes River, and several independent tributaries in South Puget Sound, which are only present due to local hatchery programs. Spring chinook in the Snohomish, Nisqually, Skokomish, and Elwha systems are extinct; spring chinook are no longer produced at Quilcene National Fish Hatchery.

The freshwater life history of most Puget Sound chinook populations primarily involves short freshwater ('ocean-type') residence following emergence (i.e. juvenile fish transform into smolts and emigrate to the marine environment during their first year). A small (less than 5 percent) proportion of juvenile fall chinook, and a larger and variable proportion of juvenile spring and summer chinook in some systems rear in freshwater for 12 to 18 months before emigrating, but expression of this 'stream-type' life history is believed to be influenced more by environmental factors than genotype (Myers et al. 1998).

The oceanic migration of Puget Sound chinook typically extends up from the Washington coast as far north as southeast Alaska, with a large, for some stocks a majority, of their harvest taken in the southern waters of British Columbia. Adult chinook generally become sexually mature at the age of three to six years, although a small proportion of males ('jacks') may mature precociously, at age-two. Most Puget Sound chinook mature at age-3 or age-4.

Freshwater life history and maturation rates for Puget Sound chinook populations were reviewed extensively in the Status Review (Myers et al. 1998).

Puget Sound chinook are genetically distinct and uniquely adapted to the local freshwater and marine environments of this region. Retention of their unique characteristics depends on maintaining healthy and diverse populations. A central objective of the Plan is to assure that the abundance of each population is conserved, at a level sufficient to protect its genetic integrity.

The most recent allozyme-based analysis of the genetic structure of the Puget Sound ESU indicates six distinct population aggregates – North and South Fork Nooksack River early, Skagit / Stillaguamish / Snohomish rivers, south Puget Sound and Hood Canal summer / falls, White River springs, and Elwha River (Ruckelshaus et al. 2004). Adult returns to South Sound and Hood Canal are influenced by large-scale hatchery production that utilized common original broodstock (primarily from the Green River), so their apparent genetic similarity may not have been true of indigenous populations. However analysis of samples collected from 33 spawning sites indicate that, with few exceptions, allele frequencies are significantly different, and that spatial or temporal isolation of spawning populations has maintained genetic distinctiveness, even among similar-timed populations within a watershed.

Life history traits were also useful in delineating natural population structure within Puget Sound. In order to determine the current population structure, the TRT (Ruckelshaus et al. 2004) examined juvenile freshwater life history, age of maturation, spawn timing, and physiographic characteristics of watersheds. Chinook also spawn naturally in other areas that may or may not have supported self-sustaining populations historically. Occurrence in these areas is thought be a consequence of straying from nearby natural systems or returns from hatchery programs. The most notable examples are in South Puget Sound, e.g. streams draining into Sinclair Inlet, and the Deschutes River entering Budd Inlet.

2.2 Management Units

A population is a biological unit. A management unit, in contrast, is an operational unit, whose boundaries depend on the fisheries acting on that unit. Salmon management units can range in size from something as large as the West Coast Vancouver Island (WCVI) coho run, which was managed as one unit in the WCVI troll fishery, to something as small as the males that return to a particular hatchery release site.

Prior to the conclusion of *U.S. v Washington* in 1974, almost all fisheries on Puget Sound salmon were conducted in marine waters, with no explicit management units or escapement goals. The Boldt Decision, however, encouraged the development of significant tribal fisheries at the mouths of Puget Sound rivers, and required the development of spawning escapement goals for each management unit. This left the co-managers (and the court) with the task of defining what the management units would be. It was now possible, with significant fisheries at the mouths of rivers, to manage for separate escapement goals for units returning to areas as small as a separate river system. However, unless there were differences in run timing between groups of fish, it was not possible to manage separately for finer units without perpetually wasting large numbers of harvestable fish. Therefore, the court-ordered PSSMP prescribed that management units would not be established for units smaller than a system that flows into saltwater, unless component populations exhibit a difference in migration timing, or as otherwise agreed by the co-managers. With this understanding, the co-managers defined the natural chinook management units in Puget Sound (Table 2), conforming, with the exception of the Mid-Hood Canal unit, to the TRT population delineation. The default escapement goal for these natural management units was maximum sustained harvest (MSH) escapement.

Table 2. Management units for natural chinook in Puget Sound.

Management Unit	Component Populations (category)
Nooksack Early	North Fork Nooksack River (1 South Fork Nooksack River (1)
Skagit Summer / Fall	Upper Skagit River Summer (1) Lower Sauk River Summer (1) Lower Skagit River Fall (1)
Skagit Spring	Upper Sauk River (1) Siuattle River (1) Upper Cascade River (1)
Stillaguamish	North Fork Stillaguamish River Summer (1) South Fork & mainstem Stillaguamish River Fall (1)
Snohomish	Skykomish River Summer (1) Snoqualmie River Fall (1)
Lake Washington	Cedar River Fall (1) North Lake Washington Tributaries Fall (2)
Green	Green River Fall (1)
White	White River Spring (1)
Puyallup	Puyallup River Fall (2)
Nisqually	Nisqually River Fall (2)
Skokomish	North and South Fork Skokomish River Fall (2)
Mid-Hood Canal [1]	Hamma Hamma River Fall (2) Duckabush River Fall (2) Dosewallips River Fall (2)
Dungeness	Dungeness River Summer (1)
Elwha	Elwha River Summer (1)
Western Strait of Juan de Fuca [2]	Hoko River Fall (1)

[1] The three rivers comprise one population.
[2] The western Strait of Juan de Fuca management unit is not part of the listed Puget Sound ESU.

For the next several years, management units were the smallest units considered in management of fisheries in Puget Sound. Then, in the early 1990s, the co-managers undertook the Wild Salmonid Restoration Initiative. As part of this initiative, they published a list, known as SASSI, of all the identified or hypothesized separate salmon populations in Washington, and their status. For chinook, some of these populations were the same as the existing management units, and some were smaller components of management units. Guided by this list, the co-managers then developed a Wild Salmonid Policy (WDFW et al. 1997), which was intended to review and revise as necessary the existing management objectives. Although the Wild Salmonid Policy was not adopted by all the tribes, there was agreement to accept the genetic diversity performance standard:

"*No stocks will go extinct as a result of human impacts, except in the unique circumstance where exotic species or stocks may be removed as part of a specific genetic or ecological conservation plan*."

Of the 15 management units covered in this Plan (Table 2), six contain more than one population. The other nine management units each consist of one population This Plan includes management measures intended to conserve the viability of all populations (see Chapter 6, and the management unit profiles for Skagit, Stillaguamish, and Snohomish in Appendix A). . This significant change in management means that management units are no longer the smallest units considered in management of Puget Sound fisheries. It does *not* mean that separate populations must be managed for the same objective as the management units (i.e., MSH escapement). It means that each separate population is managed to avoid its extinction.

The availability and quality of data to inform management of individual populations varies widely. For some populations, the only directly applicable data are spawning escapement estimates. In such cases, estimates of migratory pathways, entry patterns, age composition and maturation trends, age at recruitment, catch distribution and contributions must be inferred from the most closely related population for which such information is available. Obtaining the information to test and evaluate these inferences and assumptions is one of the key data needs identified in Chapter 7 of this Plan.

This Plan includes specific conservation measures for all populations within management units. However, it does not require that fisheries be managed to achieve the same objectives for each component population within a management unit (e.g., MSH escapement).

3. Status of Management Units and Derivation of Exploitation Rate Ceilings.

In this Plan, each management unit is classified according to its category and its abundance. The category determines the priority placed on recovery of that unit; the abundance determines the allowable harvest, depending on the category.

3.1 Management Unit Categories

The co-managers' Comprehensive Management Plan for Puget Sound chinook categorizes management units according to the presence of naturally produced, indigenous populations, the proportional contribution of artificial production, and the origin of hatchery broodstock.

- Category 1 units consist of native stocks that are predominantly naturally produced, or enhanced to a greater or lesser extent by hatchery programs that rear indigenous chinook.
- Category 2 units are predominantly of hatchery origin, in some cases comprised of non-indigenous broodstock, but where remnant indigenous populations may still exist, and where the habitat is capable of supporting self-sustaining natural production.
- Category 3 units are designated where production occurs only because of returns to a hatchery program, or due to straying from adjacent natural populations or hatchery programs. This Plan does not state harvest objectives for Category III units.

Conservation of Category 1 populations is the first priority of this plan, because they comprise genetically and ecologically essential and unique components of the ESU. The harvest management objectives for these units are set such that their recovery is not impeded, and the risk of decline in their status is very low. They include populations in the Nooksack, Skagit, Stillaguamish, Snohomish, Cedar, Green, White, Dungeness, Elwha, and Hoko rivers (Table 2). Hatchery supplementation is considered to be essential to protecting the genetic and demographic integrity of populations in the Nooksack, Stillaguamish, White, Dungeness, and Elwha rivers. Hatchery production in these systems is included in the ESA listing, because it deems essential to the recovery of the ESU (NMFS 1999).

Natural populations in the North Lake Washington tributaries, and the Puyallup, Nisqually, Skokomish, and mid-Hood Canal rivers have been heavily influenced by artificial production, in most cases based on non-indigenous stocks, and are, therefore, Category 2 management units. This influence persists, even in cases where artificial production may have been redesigned, scaled down, or terminated. Some Puget Sound stocks, most notably from the Green River, have been disseminated into several of these systems, and into the Snohomish system.

Past hatchery programs, frequently using non-indigenous stocks, were managed without informed consideration of the risk to indigenous populations, particularly when viewed in the light of current understanding of the ecological and genetic interactions of natural and hatchery production. Their primary goal was to enhance fisheries. Hatchery production was seen as a solution to increasing demand for fishing opportunity, particularly following the resolution of *U.S. v. Washington*, and the rapid urban growth around Puget Sound. This approach was also perceived to mitigate for severe and continuing habitat losses, including those from hydropower development, irrigation and other withdrawals, agricultural and forest practices, to name a few.

The policy intent was to fully utilize this increased hatchery production, and manage harvest primarily to achieve sufficient escapement to meet the broodstock requirements of the hatchery programs. The potential for restoring natural production in these systems was low, because of degraded habitat. The resulting high exploitation rates were not sustainable by the native, natural chinook populations.

This Plan emphasizes conservation of Category 2 populations, in order to assure their continued viability. In some cases, large-scale hatchery enhancement programs operate in these systems, and hatchery returns contribute significantly to natural spawning. There is continued focus on quantifying the capacity of habitat in these rivers, and the current productivity of naturally spawning chinook. Until the results of these studies are credible, constraint of harvest will assure stable natural escapement, and in some cases provide variable increasing escapement in excess of the interim escapement goals. Where hatchery programs have been implemented specifically as mitigation for habitat loss, e.g. in the Nisqually River and Skokomish River, where habitat loss has resulted in greatly reduced fishing opportunity, harvest may take priority over increasing escapement beyond the level of assuring persistence, until the capacity of habitat is clearly defined, or functional habitat is restored. Assuring the viability of all these populations now preserves future options to manage for higher natural-origin production later, should those populations be deemed essential to a recovered ESU.

Specific harvest objectives have not been established for Category 3 populations in this Plan, so their status is not discussed here in detail. Hatchery programs have been established on systems where there is no evidence of historical native chinook production. In these areas, terminal harvest is frequently managed to remove a very high proportion of the returning chinook, in excess of the broodstock required to perpetuate the program. However, if the harvest falls short of this objective, excess adults may spawn naturally, or be intentionally passed above barriers to utilize otherwise inaccessible spawning areas. Straying into adjacent streams is also likely under this condition. While some natural production may occur in these systems, the available habitat is not suitable to enable sustained production without the continued infusion of hatchery returns or strays.

3.2 Abundance Designations

This Plan classifies Puget Sound chinook management units into two abundance classifications: those that usually have harvestable surpluses, and those that usually don't. For those units without harvestable surpluses, the management units and their component populations are further classified by whether their abundance exceeds or is lower than their low abundance threshold. These abundance classifications are used to set the maximum allowable fishery-related mortality (see Implementation – Chapter 5).

3.2.1 Abundances with Harvestable Surpluses

The co-managers will establish an upper escapement level (hereafter, the 'upper management threshold'), as the threshold for determining whether a MU has harvestable surplus. Consistent with the PSSMP, this threshold will be the escapement level associated with optimum productivity (i.e. maximum sustainable harvest (MSH), unless a different level is agreed to. After factoring in expected Alaskan catches, Canadian catches, and incidental, test, and ceremonial and subsistence catches in southern U.S. fisheries, if an MU is expected to have a spawning escapement greater than the upper management threshold, that MU will be classified as having harvestable surplus

Derivation of Upper Management Thresholds

The upper management threshold was calculated for some MUs (Skagit summer - fall, Skagit spring, Stillaguamish, and Snohomish) under current habitat conditions. The method used to calculate current productivity depends on the data available for that MU. Some MUs have data on spawning escapement, juvenile production, habitat measurements, CWT distribution, and adult recruitment; other units may have data only on escapement and terminal run size; and other units may have only index escapement counts and terminal area catches. The method used for each MU is described in its Management Unit Profile (Appendix A). Once the current productivity and capacity are calculated, the upper management threshold, depending on how it is defined, can be estimated from such methods as standard spawner-recruit calculations (Ricker 1975), empirical observations of relative escapement levels and catches, or Monte Carlo simulations that buffer for error and variability (Hayman 2003).

For other MUs, the upper management threshold was set as the current escapement goal. In some cases this level is the best available estimate of current MSH escapement. In other cases (e.g. Nooksack, Puyallup, Nisqually, Skokomish, Mid Hood Canal, and Dungeness) the current escapement goal is substantially higher than current MSH level, according to habitat-based analysis of current productivity.

Establishing the current MSH escapement level, or a buffered surrogate, as the upper management threshold is a conservative standard that assigns harvest management its rightful share of the burden of conservation, assures long-term increases in abundance, and does not impede recovery. As habitat conditions improve, this threshold can be increased to account for increased productivity or capacity (see Chapter 7, Plan Review).

3.2.2 Abundances With No Harvestable Surpluses

A MU that is projected to have a spawning escapement below its upper management threshold lacks harvestable surplus. Under this plan, no commercial or sport fisheries in Puget Sound can be conducted that target on MUs without harvestable surplus (see Application to Management section). Moreover, incidental impacts on each MU must be less than the specified ceiling rebuilding exploitation rate (RER). This ceiling is further reduced if the abundance of any MU, or a component population of a MU, is below a specified low abundance threshold (LAT).

Derivation of Rebuilding Exploitation Rates

Rebuilding exploitation rates were established for the Skagit summer / fall, Skagit spring, Stillaguamish, and Snohomish management units after simulating the future dynamic abundance of each unit under a range of exploitation rates. The RER is the highest exploitation rate that met the most restrictive of the following risk criteria:

- A very low probability (less than five percentage points higher than under zero harvest) of abundance declining to a calculated point of instability; and either

- A high probability (at least 80%) of the spawning escapement increasing to a specified threshold (see MU Profiles in Appendix A for details), **or** the probability of escapements falling below this threshold level differs from a zero harvest regime by less than 10 percentage points.

The simulation models relied on detailed information about the current productivity of the populations in question, including estimates of annual spawning escapement, maturation rates, harvest-related mortality that enable reconstruction of historical cohort abundance, and variability in marine and freshwater survival. With initial escapement and annual exploitation rate specified, the simulation predicts recruitment, harvest mortality, and escapement, for 25 years, under variable marine and freshwater survival and management error typical of recent years. Management error includes the differences between anticipated and actual chinook catch, changes in the harvest distribution of contributing stocks, and error in forecasting abundance.

The essential data, and the methods used for derivation of the recruitment functions, upper and lower threshold values, and selection of the RER, for each of the four management units, are detailed in Appendix A.

Risk tolerance criteria were chosen subjectively, through joint technical cooperation by tribal, state, and federal biologists, as adequately conservative for depressed chinook populations; they were not specified as jeopardy standards in the NMFS' salmon 4(d) rule. Upper and lower escapement criteria were derived by various methods, which are detailed in Appendix A. The upper 'rebuilding escapement threshold' is not equivalent, for all management units, the upper management thresholds which defines harvestable abundance. The lower 'critical abundance threshold' is not equivalent to the low abundance threshold applied as an indicator of critical status for management purposes.

The simulations indicate that the conservative risk criteria will be met if actual annual target exploitation rates are at the level of the RER. However, this Plan envisions actual annual exploitation rates to be less than the RER, for some units by substantial margins (see Table 12, Chapter 6), so the actual probability of increasing abundance is expected to exceed the 80% / 10% criteria, and the actual probability of falling to the point of instability is expected to be less than 5% higher than under zero harvest.

For units without such data, the ceiling rates were set with reference to observed minimum rates, or harvest ceilings set by the Pacific Salmon Treaty (see Appendix A). For these management units, total or southern U.S. (SUS, i.e., due to Washington and Oregon fisheries) exploitation rate ceilings are generally established at the low level of the late 1990s, which resulted in stable or increasing spawning escapement. These ceilings are usually SUS exploitation rates between 10 and 20 percent. Since this Plan eliminates fisheries targeted at MUs without harvestable abundance, these ceilings allow the spawning escapements for these units to benefit from the recent reductions in Canadian and U.S. fisheries, in some cases providing terminal runs that exceed the upper management threshold.

Derivation of Low Abundance Thresholds

Demographic and genetic theory indicates that when the spawning abundance of a salmon population falls to a very low level, there is a significant increase in the risk of demographic instability, loss of genetic integrity, and extinction. This level, termed the point of biological instability, has not been quantified for all salmon populations, but genetic and demographic theory has drawn its boundaries (McIlhaney et al. 2000). At low spawner abundance, ecological and behavioral factors can cause a dramatic decline in productivity. Low spawner density can affect spawning success by reducing the opportunity for mate selection, or finding suitable mates. Depensatory predation can significantly reduce smolt production. However, the level at which these factors exert their effect will differ markedly between populations.

The low abundance threshold (LAT), which triggers extraordinary conservation measures in fisheries (Table 3), is set well above the point of instability, so that harvest mortality can be constrained, severely if necessary, to prevent populations from becoming unstable. The derivation of the LAT varied, according to the data available for each population. In some cases, the threshold was set at or above an historical low escapement from which the population rebounded (i.e. survivors from that low brood escapement produced a higher number of subsequent spawners). In other cases, where spawner-recruit and management error data were deemed sufficient, we calculated a threshold at which the probability of falling below the calculated point of instability was acceptably low. In other cases, where specific data were lacking, we used values from the literature that estimated minimum effective population sizes that would avoid demographic instability or loss of genetic integrity (e.g., Franklin 1980; Waples 1990; Lande 1995; McElhany et al. 2000).

For example, thresholds for Skagit summer and fall populations were calculated as the forecast escapement level for which there is a 95 percent probability that actual escapement will be above the point of instability (i.e., 5 percent of the replacement escapement level). This calculation accounted for the difference between forecast and actual escapement in recent years, and the variance around recruitment parameters. For the Stillaguamish management unit, escapement of 500 was identified as the low abundance threshold, because this level has resulted in recruitment rates of 2 – 5 adults per spawner. For other Puget Sound populations the low abundance threshold was set in accordance with the scientific literature, or more subjectively, at annual escapement of 200 to 1,000 (see Appendix A).

3.3 Response to Critical Status

This harvest Plan is designed to constrain fisheries impacts on all listed Puget Sound management units by eliminating all but a few fisheries directed at listed chinook. The only directed fisheries, defined as those where a majority of encounters are listed chinook, are a few tribal ceremonial and subsistence fisheries with small harvests, or terminal fisheries targeting management units with fixed escapement goals where harvestable surpluses have been identified. If abundance declines, and the spawning escapement for any population or management unit is projected to fall to or below its low abundance threshold, the co-managers will implement extraordinary restrictions on SUS fisheries to increase the spawning escapement above the low threshold, or reduce the SUS exploitation rate to or below a specified ceiling level.

This response results in a significant reduction in incidental impacts on listed chinook, but preserves minimal harvest access to surplus production of non-listed chinook, and other salmon species. The response to critical status describes exploitation rate ceilings and fisheries that provide minimally acceptable access to sockeye, pink, chum, coho, and chinook salmon for which harvestable surpluses have been identified.

This response to critical status is intended to prevent further decline in abundance, toward the point of biological instability. Restriction of harvest will not, by itself, enable recovery of populations that have suffered severe decline in abundance, resulting from loss and degradation of properly functioning chinook habitat conditions. Restriction of fishing below the level defined in this critical response would effectively eliminate treaty and non-treaty opportunity on non-listed species and populations, without ensuring recovery. If further resource protection is necessary, it must be found by reducing exploitation rates in mixed-stock fisheries north of Washington State in Canadian and Alaskan fisheries, improving habitat conditions, and/or providing artificial supplementation where necessary and appropriate.

Table 3. Rebuilding exploitation rates, low abundance thresholds and critical exploitation rate ceilings for Puget Sound chinook management units.

Management Unit	Rebuilding Exploitation Rate	Low Abundance Threshold	Critical Exploitation Rate Ceiling
Nooksack North Fork South Fork	Under development	 1,000 [1] 1,000 [1]	7% / 9% SUS [3]
Skagit summer / fall Upper Skagit summer Sauk summer Lower Skagit fall	50%	4,800 2200 400 900	15% SUS even-years 17% SUS odd-years
Skagit spring Upper Sauk Upper Cascade Suiattle	38%	576 130 170 170	18% SUS
Stillaguamish North Fork Summer South Fk & MS Fall	25%	650 [1] 500 [1] N/A	15% SUS
Snohomish Skykomish Snoqualmie	21%	2,800 [1] 521 [1] 1745 [1]	15% SUS
Lake Washington Cedar River	15% PT SUS	 200 [1]	12% PT SUS
Green	15% PT SUS	1,800	12% PT SUS
White River spring	20%	200	15% SUS
Puyallup fall	50%	500	12% PT SUS
Nisqually	Terminal fishery managed to achieve 1,100 natural spawners		
Skokomish	15% PT SUS	1,300 [2]	12% PT SUS
Mid-Hood Canal	15% PT SUS	400	12% PT SUS
Dungeness	10% SUS	500	6% SUS
Elwha	10% SUS	1,000	6% SUS
Western JDF	10% SUS	500	6% SUS

[1] natural-origin spawners.
[2] The threshold is escapement of 800 natural and/or 500 hatchery (see Appendix A).
[3] Expected SUS rate will not exceed 7% in 4 out of 5 years (see Appendix A)

The management response to critical status has two principal components:

1. A Critical Exploitation Rate Ceiling (CERC) is established for each management unit (Table 3), imposing an upper limit on SUS impacts when spawning escapement for that unit is projected to fall below its low abundance threshold. The CERCs are defined as total SUS ceiling exploitation rates for most management units. For the Lake Washington, Green, Puyallup, Nisqually, Mid Hood Canal and Skokomish units, the ceiling rates apply only to pre-terminal fisheries. For these units, additional terminal fishery management responses are detailed in the unit profiles (Appendix A). Except for Mid-Hood Canal, they are composite populations in that hatchery production contributes substantially to fisheries and natural spawning

The MFR, which is described in detail in Appendix C for fisheries in Puget Sound and Washington coastal ocean areas, provides for Treaty Indian and non-Indian harvest of the surplus abundance of non-listed chinook, and sockeye, pink, coho, and chum salmon.

The MFR represents the lowest level of fishing mortality on listed chinook that is possible, while still allowing a reasonable harvest of non-listed salmon. Reducing tribal fisheries to those specified in the MFR, while requiring significant sacrifice of fishing opportunity guaranteed by treaty rights, represent the minimum level of fishing that allows some exercise of those rights, and demonstrates their commitment to contribute, with concomitant and essential habitat protection and other recovery actions, to the recovery of Puget Sound chinook salmon to levels that would satisfy their treaty rights.

The co-managers established the CERCs, after policy consideration of the MFR, and examination of FRAM simulations of the recent fisheries regimes that responded to critical status for some management units. Exploitation rates associated with constant mortality in SUS fisheries will change, in part due to variation in the abundance of stocks from British Columbia, the Columbia River, and Puget Sound, and variation in intercepting fishing mortality exerted by fisheries in British Columbia and Alaska. The CERCs reflect this source of variation (i.e. they are, in some cases, higher than the SUS exploitation rates projected in recent years). Furthermore, if significant changes are made to the FRAM that alter the calculation of exploitation rates, these ceilings may be adjusted in consultation with the NMFS.

2. Within the constraint established by the CERCs, southern U.S. fisheries will be limited so that their impact on critical management units does not exceed the levels projected to occur with the 2003 fisheries (see Implementation, below). The CERCs, thus, impose a hard ceiling on SUS exploitation rates, but annual fishing plans are likely to result in impacts that fall below the CERC for some critical units. New fisheries, beyond those planned for 2003, will not be implemented with the intention of increasing impacts on critical units, unless other fisheries are shaped to reduce fishing mortality on those units to an equivalent degree.

4. The Fisheries and Jurisdictions

Puget Sound chinook contribute to fisheries along the coast of British Columbia and Alaska, in addition to those in the coastal waters of Washington and Puget Sound. Their management, therefore, involves the local jurisdictions of the Washington co-managers, and the jurisdictions of the State of Alaska, the Canadian Department of Fisheries and Oceans, the Pacific Salmon Commission, and the Pacific Fisheries Management Council.

4.1 Southeast Alaskan Fisheries

In Southeast Alaska (SEAK) chinook are harvested in commercial, subsistence, personal use, and recreational fisheries throughout Southeast Alaska. Since 1995, the total landed chinook catch has ranged from 217,000 to 339,000 (Table 4). These fisheries are managed by the Alaska Board of Fisheries and the Department of Fish and Game, under oversight of the North Pacific Fisheries Management Council to ensure consistency of fisheries management objectives with the Sustainable Fisheries Act (1996).

Commercial fisheries employ troll, gillnet, and purse seine gear. Commercial trolling accounts for about 68% of the chinook harvest (NMFS 2002). Approximately 6% of the catch of chinook and coho is taken outside of State waters, in the Economic Exclusive Zone (EEZ). The majority of troll catch occurs during the summer season; but ‘winter’ and ‘spring’ troll seasons are also scheduled from October through April. The summer season usually opens on July 1st, targeting chinook, then shifts to a coho-directed fishery in August. Incidental harvest of pink, chum, and sockeye salmon also occurs in the troll fishery. Gillnet and seine fisheries occur within State waters, and target pink, sockeye, and chum salmon, with substantial incidental catch of coho, and relatively low incidental catch of chinook.

Table 4. Chinook salmon harvest, all fisheries combined, in Southeast Alaska, 1998 – 2002 (PSC 2001, PSC 2002).

1998	271,000
1999	251,000
2000	263,300
2001	260,000
2002	442,200

Recreational fishing in Southeast Alaska, in recent years, has comprised more than 500,000 angler days annually. It occurs primarily in June, July, and August. A majority of the effort is associated with non-resident fishers, and is targeted at chinook salmon. Fishing is concentrated in the vicinity of the major populations centers; Ketchikan, Petersburg, Sitka, and Juneau, but it also occurs along the coast of Prince of Wales Island and other remote areas. Fishing in the vicinity of Sitka accounts for 47% of the recreational chinook harvest (Jones and Stokes 1991).

Chinook from the Columbia River, Oregon coast, Washington coast, west coast of Vancouver Island (WCVI), and northern B.C. contribute significantly to harvest in Southeast Alaska (CTC 2003). Few Puget Sound chinook are caught in Alaska, except for Strait of Juan de Fuca stocks, which have significant exploitation rates in Southeast Alaska (up to 30% of the catch of Elwha, and, in some years, over 50% of the catch of Hoko chinook). Also, in some years, between 5%

and 10% of the catch of Stillaguamish chinook has been taken in Southeast Alaska (Chinook TC 1999).

More than 3,000 subsistence and personal use permits were issued in Southeast Alaska in 1996 (NMFS 2002), but only a small proportion of the subsistence harvest of salmon (33,000 in 1996) is made up of chinook.

4.2 Fisheries in British Columbia

In British Columbia, troll fisheries occur on the northern coast and on the WCVI. Conservation concerns over WCVI and Fraser River chinook and coho stocks have constrained these fisheries in recent years. Commercial and test troll fisheries directed at pink salmon in northern areas, and sockeye on the WCVI and the southern Strait of Georgia incur relatively low incidental chinook mortality. Time / area restrictions, and selective gear regulations have been implemented to reduce the harvest of weak chinook and coho stocks.

Net fisheries, including gillnet and purse seine gear, in British Columbia marine inshore waters are primarily directed at sockeye, pink, and chum salmon, but also incur incidental chinook mortality. Conservation measures have limited chinook retention in many areas. Chinook catch in the Northern B.C. and WCVI troll fisheries increased markedly in 2002 (Table 5).

Table 5. Landed chinook harvest in British Columbia inshore marine fisheries in 2001 and 2002 (CDFO 2001, CDFO 2002).

	2001	2002
Northern BC troll	13,100	94,748
WCVI troll	77,000	133,693
Georgia Strait troll	485	369
Northern BC net	22,035	11,041
Central BC net	4,589	4,827
Native North and Central	7,231	5,379
Johnstone Strait net	1,000	1,025
WCVI outside sport	36,000	22,009
QCI & North coast sport	38,500	41,300
Central coast sport	7,736	6,305
JDF, GS, JS sport	57,526	84,426
Total	265,202	404,753

Recreational harvest of chinook in the Queen Charlotte Islands and on the WCVI have been similarly constrained by time / area and size regulations to conserve weak chinook stocks. Nearshore waters along the entire WCVI were closed to salmon fishing in 1999 – 2001 (CDFO 2000; CDFO 2001). Limited recreational fisheries have been implemented in the 'inside' waters of the WCVI (e.g. in Nootka Sound, Esperanza Inlet, and Tlupana Inlet). Marine recreational fisheries occur along the Central B.C. coast, Johnstone Strait, Georgia Strait, and the Strait of Juan de Fuca. Sport fisheries in inshore marine areas comprise the largest portion of the chinook harvest in southern B.C.

Fisheries in northern B.C. target local stocks, but chinook from the Columbia River, Washington and Oregon coasts, Georgia Strait, and the WCVI are also caught (CTC 2001). Puget Sound chinook make up a minor portion of the catch, but a significant portion of the mortality of North Sound and Strait of Juan de Fuca spring and summer/fall chinook can occur in these fisheries (see Catch Distribution, below). WCVI fisheries, which target on Columbia River, Puget Sound, and Georgia Strait stocks, have a major impact on all Puget Sound summer/fall stocks, with a lower, but significant impact on springs. Georgia Strait fisheries target on Georgia Strait and Puget Sound chinook, and have heavy impacts on North Sound springs, North Sound summer/falls, and Hood Canal summer/falls, and significant, but lower impacts on all other Puget Sound stocks (Chinook TC 1999).

4.3 Washington Ocean Fisheries

Treaty Indian and non-treaty commercial troll fisheries directed at chinook, coho, and pink salmon, and recreational fisheries directed at chinook and coho salmon are scheduled from May through September, under co-management by the WDFW and Treaty Tribes. The Pacific Fisheries Management Council (PFMC), pursuant to the Sustainable Fisheries Act (1996), oversees annual fishing regimes. Tribal fleets operate within the confines of their usual and accustomed fishing areas. Principles governing the co-management objectives and the allocation of harvest benefits among tribal and non-Indian users, for each river of origin, were developed under *Hoh v Baldrige* (522 F.Supp. 683 (1981)). The declining status of Columbia River origin chinook stocks has been the primary constraint on coastal fisheries, though consideration is also given to attaining allocation objectives for troll, terminal net, and recreational harvest of coastal-origin stocks from the Quillayute, Queets, Quinault, Hoh, and Grays Harbor systems. These fisheries primarily target Columbia River chinook (Chinook Technical Committee 2001). Puget Sound chinook make up a low percentage of the catch, with South Sound and Hood Canal stocks exploited at a slightly higher rate than North Sound and Strait of Juan de Fuca chinook.

The ocean troll fishery (Table 6) has been structured, in recent years, as chinook-directed fishing in May and June, and chinook- and coho-directed fishing from July into mid-September, to enable full utilization of Treaty and non-Treaty chinook and coho quotas. These quotas (i.e. catch ceilings) are developed in a pre-season planning process that considers harvest impacts on all contributing stocks. Time, area, and gear restrictions are implemented to selectively harvest the target species and stock groups. In general, the chinook harvest occurs 10 to 40 miles offshore, whereas the coho fishery occurs within 10 miles off the coast, but annual variations in the distribution of the target species cause this pattern to vary. The majority of the chinook catch has, in recent years, been caught in Areas 3 and 4 (which, during the summer, includes the westernmost areas of the Strait of Juan de Fuca – Areas 4B). In the last five years, troll catch has ranged from 18,000 to 93,000 (Table 6).

Table 6. Commercial troll and recreational landed catch of chinook in Washington Areas 1 – 4, 1998 – 2002 (Simmons et al. 2002).

	Treaty Troll	Non-Treaty troll	Recreational	Total
1998	14,859	5,929	2,187	22,975
1999	27,664	17,456	9,887	55,007
2000	7,770	10,269	8,478	26,517
2001	28,100	21,229	22,974	72,303
2002	39,184	53,819	57,821	150,824

In odd-numbered years, the coastal troll fishery may also target pink salmon, the majority of which originate in the Fraser River. In the last six odd-numbered years, the annual troll harvest of pink salmon has ranged from 1,800 to 48,300.

Recreational fisheries, in Washington Ocean areas, are also conducted under specific quotas for each species, and allocations to each catch area. WDFW conducts creel surveys at each port to estimate catch and keep fishing impacts within the overall quotas. Most of the recreational effort occurs in Areas 1 and 2, adjacent to Ilwaco and Westport. Generally recreational regulations are not species directed, but certain time / area strata have had chinook non-retention imposed, as conservation concerns have increased, and to enable continued opportunity based on more abundant coho stocks. In the last five years, recreational chinook catch in Areas 1 – 4 has ranged from 2,187 to 53,819 (Table 3).

Puget Sound chinook stocks comprise less than 10 percent of coastal troll and sport catch (see below for more detailed discussion of the catch distribution of specific populations). The contribution of Puget Sound stocks is higher in northern areas, along the coast. The exploitation rate of most individual chinook management units in these coastal fisheries is, in most years, less than one percent. However, these exploitation rates vary annually in response to the varying abundance of commingled Columbia River, local coastal, and Canadian chinook stocks.

Amendment 14 to the PFMC Framework Management Plan restricts the direct oversight of conservation to those chinook stocks whose exploitation rate in fisheries under the jurisdiction of the PFMC (i.e., coastal ocean fisheries between the borders of Mexico and British Columbia, including Washington catch areas 1 – 4) have exceeded two percent, in a specified base period. However, the PFMC must also align its harvest objectives with conservation standards required for salmon ESUs, listed under the Endangered Species Act. Additionally, this Plan, along with the Puget Sound Salmon Management Plan, commits the co-managers to explicit consideration of coastal fishery impacts, to ensure that the overall conservation objectives are achieved for all Puget Sound Management Units. This requires accounting all impacts on all management units, even in fisheries where contribution is very low.

4.4 Puget Sound Fisheries

4.4.1 Tribal Ceremonial and Subsistence Fisheries

Indian tribes schedule ceremonial and subsistence chinook fisheries to provide basic nutritional benefits to their members, and to maintain the intrinsic and essential cultural values imbued in traditional fishing practices and spiritual links with the natural resources. The magnitude of ceremonial and subsistence harvest of chinook is small relative to commercial and recreational harvest, particularly where it involves critically depressed stocks.

4.4.2 Commercial Chinook Fisheries

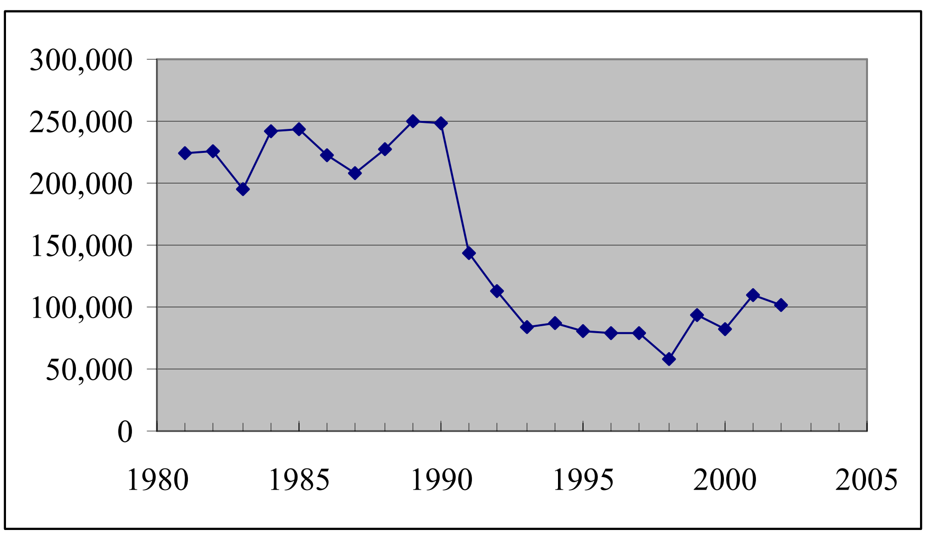
Commercial salmon fisheries in Puget Sound, including the U.S. waters of the Strait of Juan de Fuca, Rosario Strait, Georgia Strait, embayments of Puget Sound, and Hood Canal, are co-managed by the tribes and WDFW under the Puget Sound Salmon Management Plan. Several tribes conduct small-scale commercial troll fisheries directed at chinook salmon in the Strait of Juan de Fuca and Rosario Strait. In the western Strait of Juan de Fuca, most of the effort occurs in winter and early spring, with annual closure from mid-April to mid-June to protect maturing spring chinook. Annual harvest has ranged from 1,000 to 2,000 in the last five years.

Commercial net fisheries, using set and drift gill nets, purse or roundhaul seines, beach seines, and reef nets are conducted throughout Puget Sound, and in the lower reaches of larger rivers. These fisheries are regulated, by WDFW (non-treaty fleets) and by individual tribes, with time/area and gear restrictions. In each catch area, harvest is focused on the target species or stock according to its migration timing through that area. Management periods are defined as that interval encompassing the central 80% of the migration timing of the species, in each management area. Because the migration timings of different species overlap, the actual fishing schedules may be constrained during the early and late portion of the management period to reduce impacts on non-target species. Incidental harvest of chinook also occurs in net fisheries directed at sockeye, pink, and coho salmon.

Due to current conservation concerns, chinook-directed commercial fisheries are of limited scope and are mostly directed at abundant hatchery production in terminal areas; Bellingham /Samish Bay and the Nooksack River, Tulalip Bay, Elliot Bay and the Duwamish River, Lake Washington, the Puyallup River, the Nisqually River, Budd Inlet, Chambers Bay, Sinclair Inlet, southern Hood Canal and the Skokomish River. Purse or roundhaul seine vessels operate in Bellingham Bay and Tulalip Bay, although these are primarily gillnet fisheries. A small-scale, onshore, marine set gillnet fishery is conducted in the Strait of Juan de Fuca and on the coast immediately south of Cape Flattery. Small scale gillnet research or evaluation fisheries are also used in-season to acquire management and research data in the Skagit River, Elliot Bay, Puyallup River, and Nisqually River. Typically, these involve two or three vessels making a prescribed number of sets at specific locations, one day per week, during the run's passage.

Total commercial net and troll harvest of chinook has fallen from levels in excess of 200,000 in the 1980s to an average of 89,500 for the period 1998 – 2002. (Figure 1).

Figure 1. Commercial net and troll catch of chinook in Puget Sound, 1980 – 2002 (TFT database).



4.4.3 Commercial Sockeye, Pink, Coho, and Chum Fisheries

Net fisheries directed at Fraser River sockeye are conducted annually, and at Fraser River pink salmon in odd-numbered years, in the Strait of Juan de Fuca, Georgia Strait, and the Straits and passages between them (i.e., catch areas 7 and 7A). Nine tribes and the WDFW issue regulations for these fisheries, as participants in the Fraser River Panel, under Pacific Salmon Treaty Annexes. Annual management plans include sharing and allocation provisions, but fishing schedules are developed based on in-season assessment of the abundance of early, early summer, summer, and late-run sockeye stocks and pink salmon.

Sockeye harvest has exceeded 2 million in the last ten years, but the fishery has been constrained in recent years due to lower survival and pre-spawning mortality of sockeye, so harvest has ranged from 20,000 to 512,500 since 1998 (Table 7). In the last six seasons (1991 – 2001) the fishery for Fraser River pink salmon in harvested up to 1.74 million fish (Table 7). Most of the pink salmon harvest is taken by purse seine gear. Specific regulations to reduce incidental chinook mortality, including requiring release of all live chinook from non-treaty purse seine fishery hauls, have reduced incidental contribution to less than 1% of the total catch.

Table 7. Fraser sockeye and pink salmon harvest, and incidental chinook catch, in Puget Sound, 1996 – 2002. (TFT database, 2002 data are preliminary).

		1996	1997	1998	1999	2000	2001	2002
Strait of	sockeye	30,314	12,509	26,728	20,230	41,974	34,973	45,600
Juan de Fuca	pink	6	3,017	35	4,105	91	7,064	173
	chinook	606	492	264	589	640	931	1,074
Rosario and	sockeye	243,918	1,268,078	499,939	22	428,661	206,435	389,921
Georgia Strait	pink	1	1,740,356	807	10	253	466,494	21
	chinook	3,934	29,215	3,804	3	1091	970	2,229

Commercial fisheries directed at Cedar River sockeye stocks occur in Elliot Bay, the Ship Canal, and Lake Washington, and much smaller scale fisheries on Baker river sockeye may occur in the Skagit River. The Cedar River stock does not achieve harvestable abundance consistently, but significant fisheries occurred in 1996, 2000, and 2002. However, these fisheries exert very low incidental chinook mortality.

Commercial fisheries directed at Puget Sound-origin pink salmon occur in terminal marine areas and freshwater in Bellingham Bay and the Nooksack River, Skagit Bay and Skagit River, and Possession Sound / Port Gardner (Snohomish River system). In the last six seasons, catch in the Nooksack system has ranged up to 17,500; in the Skagit system catch has ranged up to 525,000, and in the Snohomish system catch has ranged up to 86,100 (Table 8). Terminal-area pink fisheries involve significant incidental catch of chinook.

Table 8. Commercial net fishery harvest of pink salmon from the Nooksack, Skagit, and Snohomish river systems, 1991 – 2001. 2001 data are preliminary. (TFT database).

	Bellingham Bay & Nooksack River	Skagit Bay & Skagit River	Possession Sound & Port Gardner
1991	17,447	133,672	46,039
1993	1,335	143,880	9,648
1995	7,339	524,810	48,006
1997	1,196	46,169	34,537
1999	2,484	32,339	13,055
2001	12,280	198,534	86,097

Commercial fisheries directed at coho salmon, also occur throughout Puget Sound and in some rivers. Coho are also caught incidentally in fisheries directed at chinook, sockeye, pink, and chum salmon. In the last five years total landed coho catch has ranged from 107,646 to 315,124, with over 40% of the catch taken in central and south Puget Sound, and 20% taken in each of the Nooksack – Samish, and Snohomish regions (Table 9). Catch in every region has increased since 2000 relative to the late-1990s, but is still below the levels of the early 1990s, when the total harvest exceeded one million coho.

Table 9. Landed coho harvest for Puget Sound net fisheries, 1998 - 2002. Regional totals include freshwater catch (TFT database).

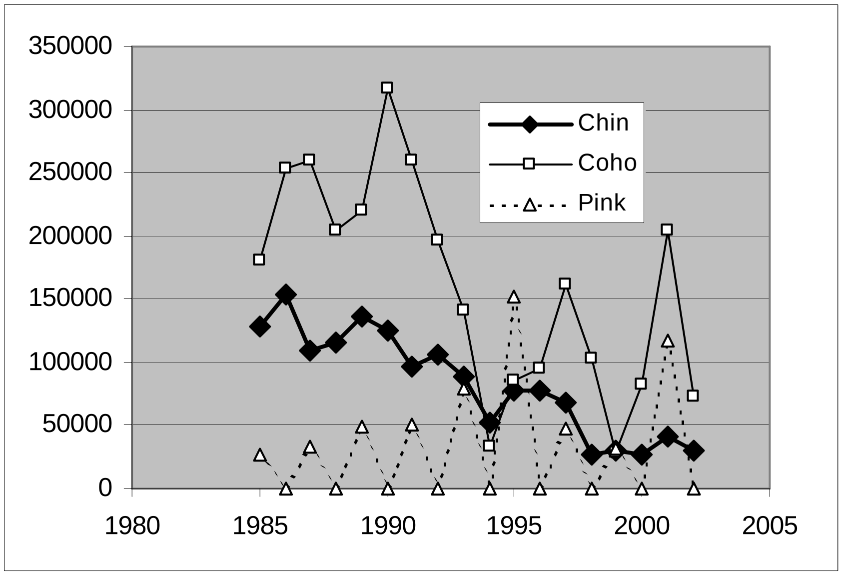
	Strait of Juan de Fuca	Georgia & Rosario Strait	Nooksack Samish	Skagit	Stillaguamish Snohomish	So Puget Sound	Hood Canal	Total
1998	8,083	1,980	22,892	10,359	24,743	65,617	21,974	155,648
1999	5,586	1	50,175	7,411	18,439	21,189	4,845	107,646
2000	4,338	1,501	67,587	11,151	86,328	186,397	20,860	378,162
2001	15,521	721	76,232	15,948	60,863	137,327	8,512	315,124
2002	9,458	3,638	50,863	7,688	48,578	107,236	7,547	235,008

4.4.4 Recreational Fisheries

Recreational salmon fisheries in Puget Sound occur in marine (Areas 5 – 13) and freshwater areas, under regulations promulgated by the Washington Department of Fish and Wildlife. In marine areas, the principal target species are chinook and coho salmon. Since the mid-1980s the total annual marine harvest of chinook has steadily declined from levels in excess of 100,000 in the late 1980s to an average of 31,150 in the last five years (Figure 2). Marine-area coho harvest has varied widely in the last five years, averaging 98,250. Odd-year pink salmon harvest has also varied widely; it exceeded 117,000 in 2001.

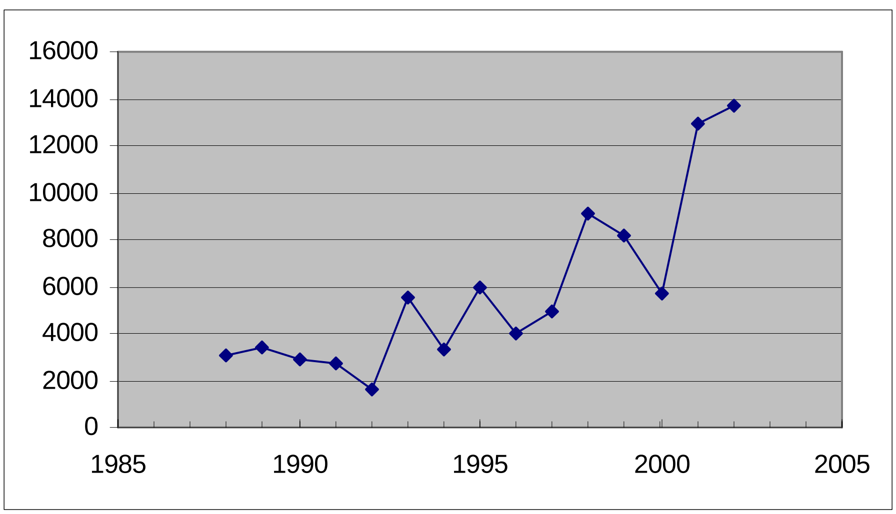
Recreational fisheries that target immature chinook ('blackmouth') occur during the summer months (July – September), and continue through the fall and winter months, and into the early spring, primarily in central Puget Sound. Recreational chinook catch has been increasingly constrained to avoid overharvest of weak Puget Sound populations. Recreational fisheries are managed under the same harvest objectives for chinook and coho salmon that apply to commercial fisheries. WDFW has exercised their policy prerogative in allocating, in recent years, more of the non-Treaty fishing opportunity to the recreational sector.

Figure 2. Recreational salmon catch in Puget Sound marine areas, 1985 – 2002 (WDFW CRC estimates; 2002 data are preliminary).



Perhaps in response to increasingly constrained bag limits and seasons in marine areas, and the increasing abundance of some stocks, recreational harvest of chinook in freshwater areas of Puget Sound has shown an increasing trend since the early 1990s (Figure 3).

Figure 3. Recreational chinook harvest in Puget Sound freshwater areas 1988 - 2002 (WDFW Catch Record Card estimates; excludes jacks).



4.4.5 Non-Landed Fisheries Mortality

In all fisheries, each type of commercial and recreational gear also exerts 'non-landed' mortality on chinook. The rates currently used to assess non-landed mortality are shown below (Table 10). A more detailed description of the basis for these rates and their application is included in Appendix B.

Hook-and-line fisheries are regulated by size limits, recreational bag limits, and non-retention periods. A proportion of all fish not kept will die from hooking trauma. A large body of relevant literature expresses a very broad range of hooking mortality rates. Rates are assumed to be higher for commercial troll than recreational gear, and higher for smaller fish. As bag limits on recreational fisheries have decreased, the proportion of non-landed mortality has risen accordingly. The Washington co-managers and the PFMC have periodically reviewed the literature, and adjusted the non-landed mortality rates associated with hook-and-line fisheries, so that fisheries simulation models used in management planning express the best available science. For hook and line gear, the release mortality (or "shaker mortality") rate refers to the percentage of fish which are brought to the boat and released, because they are below the legal size limit, or a species for which regulations preclude retention. Drop-off mortality rate is calculated as a proportion of the landed catch, but refers to fish that are hooked but escape before being brought to the boat.

The various types of net gear also exert non-landed mortality. Studies to quantify rates are difficult to design and implement, so few reference data are available. Though survival of gillnet entanglement is not well understood, a small proportion, currently assumed to be 3% of landed catch in pre-terminal areas, 2% in terminal fisheries, drops out of the mesh before the gear is retrieved. Marine mammal predation adds a significant additional loss in many areas of Puget Sound, but their effect varies from year to year, and among areas. The assumed rates do not express this variation in mammal predation, and the few available studies that exist are specific to certain areas (Young 1989). Purse seine gear, for the non-treaty fleet, has been modified, by regulation, to reduce the catch of immature chinook by incorporating a strip of wide-mesh net at the surface of the bunt. Nonetheless, small chinook are caught by seine gear, and are assumed more likely to be killed. Non-treaty seine fishers have been required to release all chinook in all areas of Puget Sound in recent years, in order to allocate mortality to other fisheries. Mortality rates vary due to a number of factors, but studies have shown that two-thirds to half of chinook survive seine capture, particularly if the fish are sorted immediately or allowed to recover in a holding tank before release. Because total catch is typically small for beach seine and reef net gear, chinook may be released without harm. Research continues into net gear that reduces release mortality, with promising results from recent tests of tangle nets (Vander Haegen et al. 2003; Vander Haegen et al. 2002(a); Vander Haegen et al. 2002(b); Vander Haegen et al. 2001). In any case, non-landed mortality is accounted by managers, according to the best available information, to quantify the mortality associated with harvest.

Table 10 . Chinook incidental mortality rates applied to commercial and recreational fisheries in Washington.

Fishery	Release Mortality	Drop-off, Drop-out, etc
Ocean Recreational	14%	5%
Ocean troll - barbless hooks	26%	5%
- barbed hooks	30%	5%
Puget Sound recreational	> 22" - 10%	5%
	< 22" - 20%	5%
Gillnet		terminal areas - 2% pre-terminal areas - 3%
Skagit Bay	52.4%	
Purse Seine	immature fish- 45%	0%
	mature fish - 33%	0%
Beach Seine		
Skagit Bay pink fishery	50%	0%
Reef Net	0%	0%

4.5 Regulatory Jurisdictions Affecting Washington Fisheries

Fisheries planning and regulation by the Washington co-managers are coordinated with other jurisdictions, in consideration of the effects of Washington fisheries on Columbia River and Canadian chinook stocks. Pursuant to *U.S. v Washington* (384 F. Supp. 312), the Puget Sound Salmon Management Plan (1985) provides fundamental principles and objectives for co-management of salmon fisheries.

The Pacific Salmon Treaty, originally signed in 1984, commits the co-managers to equitable cross-border sharing of the harvest and conservation of U.S. and Canadian stocks. The Chinook Chapter of the Treaty, which is implemented by the Pacific Salmon Commission, establishes ceilings on chinook exploitation rates in southern U.S. fisheries The thrust of the original Treaty, and subsequently negotiated agreements for chinook, was to constrain harvest on both sides of the border in order to rebuild depressed stocks.

The PFMC is responsible for setting harvest levels for coastal salmon fisheries in Washington, Oregon, and California. The PFMC adopts the management objectives of the relevant local authority, provided they meet the standards of the Sustainable Fisheries Act. The Endangered Species Act has introduced a more conservative standard for coastal fisheries, when they significantly impact listed stocks.

4.5.1 Puget Sound Salmon Management Plan (U.S. v. Washington)

The PSSMP remains the guiding framework for jointly agreed management objectives, allocation of harvest, information exchange among the co-managers, and processes for negotiating annual harvest regimes. At its inception, the Plan implemented the court order to provide equal access to salmon harvest opportunity to Indian tribes, but its enduring principle is to “promote the stability and vitality of treaty and non-treaty fisheries of Puget Sound …. and improve the technical basis for …management.” It defined management units (see Chapter III), and regions of origin, as the basis for harvest objectives and allocation, and established maximum sustainable harvest (MSH) and escapement as general objectives for all units. The PSSMP also envisioned the adaptive management process that motivated this Plan. Improved technical understanding of the productivity of populations, and assessment of the actual performance of management regimes in relation to management objectives and the status of stocks, would result in continuing modification of harvest objectives.

4.5.2 Pacific Salmon Treaty

In 1999, negotiations between the U.S. and Canada resulted in a new, comprehensive chinook agreement, which replaced the previous fixed-ceiling regime with a new approach based on the annual abundance of stocks. It includes increased specificity on the management of all fisheries affecting chinook, and seeks to address the conservation requirements of a larger number of depressed stocks, including some that are now listed under the ESA.

The new agreement establishes exploitation rate guidelines or quotas for fisheries subject to the PST based on the forecast abundance of key chinook stocks. This regime will be in effect for the 1999 through 2008 period. Fisheries are classified as aggregate abundance-based management regimes (AABM) or individual stock-based management regimes (ISBM). As provided in the new chinook chapter of the agreement: "an AABM fishery is an abundance-based regime that constrains catch or total adult equivalent mortality to a numerical limit computed from either a pre-season forecast or an in-season estimate of abundance, and the application of a desired harvest rate index expressed as a proportion of the 1979-1982 base period." (PSC 2000).

Three fishery complexes are designated for management as AABM fisheries: 1) the SEAK sport, net and troll fisheries; 2) the Northern British Columbia troll (statistical areas 1-5) and the Queen Charlotte Islands sport (statistical areas 1 - 2); and 3) the WCVI troll (statistical areas 21,23-27, and 121-127) and sport, for specified areas and time periods. The estimated abundance index each year is computed by a formula specified in the agreement for each AABM fishery. Table 1 of the chinook chapter of the new Annex IV specifies the target catch levels for each AABM fishery as a function of that estimated abundance index.

All chinook fisheries subject to the Treaty that are not AABM fisheries are classified as ISBM fisheries, including freshwater chinook fisheries. As provided in the new agreement, "an ISBM fishery is an abundance-based regime that constrains to a numerical limit the total catch or total adult equivalent mortality rate within the fisheries of a jurisdiction for a naturally spawning chinook stock or stock group." For these fisheries the agreement specifies that Canada and the U.S. shall reduce the total adult equivalent mortality rate by 36.5% and 40% respectively, relative to the 1979-1982 base period, for a specified list of indicator stocks. In Puget Sound these include Nooksack early, Skagit summer/fall and spring, Stillaguamish, Snohomish, Lake Washington, and Green stocks.

If such reductions do not result in the biologically based escapement objectives for a specified list of natural-origin stocks, ISBM fishery managers must implement further reductions across their fisheries as necessary to meet those objectives or as necessary to equal, at least, the average of those reductions that occurred during 1991-1996. Although the specified ISBM objectives must be achieved to comply with the agreement, the affected managers may choose to apply more constraints to their respective fisheries than are specifically mandated by the agreement. The annual distribution of allowable impacts is left to each country's domestic management processes.

4.5.3 Pacific Fisheries Management Council

The Pacific Fisheries Management Council (PFMC) provides recommendations to the Secretary of Commerce regarding management regulations and sets annual harvest levels for salmon and groundfish fisheries in the coastal marine waters of Washington, Oregon, and California, within the 200-mile EEZ of the United States. The Council was created by the Magnuson Fishery Management and Conservation Act in 1977, and re-authorized by Congress' passage of the Sustainable Fisheries Act in 1996. The Council coordinates and oversees the ocean fishery management objectives among the three state jurisdictions by mandating regulations that prevent overfishing and maintain sustainable harvest. The Council's function is to assure that conservation objectives are achieved for all chinook and coho stocks, and that harvest is equitably shared among the various user groups. The State of Washington asserts jurisdiction regarding regulation of fisheries inside the EEZ (i.e., within three miles of the coast), by adopting the same catch quotas that are approved annually by the PFMC.

The fundamental principles and implementation of the conservation standards are outlined in the Framework Management Plan (FMP). The Council has adopted amendments to the FMP to address specific conservation and management issues. The FMP includes specific management goals and objectives for salmon stocks, usually stated as escapement goals or exploitation or harvest rates. These objectives are based on the fundamental principle of providing optimum yield, which was re-defined to mean 'maximum sustainable yield, as reduced by relevant economic, social, or ecological factors" (PFMC 1999).

Amendment 14 to the Pacific Coast Salmon Plan included conservation objectives, expressed as the number of natural, adult spawners, for chinook stocks from Puget Sound and the Strait of Juan de Fuca. These objectives could be revised without FMP amendment according to procedures in the PSSMP. Stocks listed under the ESA are treated as the third exception to the application of overfishing criteria in the SFA. The NMFS conducts a consultation to determine whether the impact of coastal fisheries pose jeopardy to listed species. The PFMC considers the requirements of the ESA are sufficient to also achieve the intent of the SFA's overfishing provision. This implies that it is insufficient to just achieve current MSH escapement; the objective to achieve recovery to MSH escapement under restored habitat conditions. Meeting the jeopardy standard may be sufficient to stabilize the population until freshwater habitat is restored (Amendment 14 Section 3.2.4.3).

4.6 Distribution of Fishing Mortality

A significant portion of the fishing mortality on many Puget Sound chinook stocks occurs outside the jurisdiction of this plan, in Canadian and, in some cases, Southeast Alaskan fisheries (Table 11), based on recoveries of coded-wire tagged indicator stocks. Of the Puget Sound indicator stocks, more than half of the total mortality of Stillaguamish summer, Hoko fall, Nooksack early, and Skagit spring chinook occurs in Alaska and Canada. Washington ocean troll fisheries generally account for a small proportion of the mortality of Puget Sound chinook, but their impact exceeds 5 percent of total fisheries-related mortality for Skokomish and South Puget Sound fall indicator stocks. Puget Sound net and Washington sport fisheries account for the largest proportion of fishing mortality for most Puget Sound stocks

Table 11. Distribution of harvest for Puget Sound chinook indicator stocks, expressed as an average (1996-2000) proportion of total, annual, adult equivalent fishing exploitation rate (CTC 2003).

	Alaska	B.C.	Washington troll	Puget Sound Net	Washington Sport
Samish Fall	2.3%	43.0%	1.8%	40.2%	12.7%
Stillaguamish Sum	17.8%	50.3%	0.3%	2.6%	29.1%
South Puget Snd Fall	2.0%	29.6%	6.0%	21.7%	40.7%
Nisqually Fall	0.5%	14.5%	2.6%	44.9%	37.6%
Skokomish Fall	1.7%	37.4%	9.0%	7.2%	44.7%
Hoko Fall	74.2%	25.3%	0.0%	0.6%	0.0%
Nooksack Spring	1.6%	75.7%	1.5%	3.0%	18.3%
Skagit Spring	1.0%	51.4%	1.2%	7.1%	39.2%
White River Spring	0.0%	4.5%	0.6%	3.5%	91.4%

4.7 Trends in Exploitation Rates

FRAM 'validation' runs, which incorporate catch and stock abundance from post-season assessment, are available for management years 1983 – 2000, and provide an index of the trend in the total exploitation rate of Puget Sound chinook (A. Rankis, NWIFC, pers comm. October 27, 2003). For these models, post-season abundances, in terms of total recruitment, are estimated from the observed terminal run sizes by using pre-terminal expansion factors estimated either from CWT preterminal exploitation rates, or from fishing effort scale factors

For Category 1 MUs, fisheries management has reduced exploitation rates steadily since the 1980s. Total exploitation rates on Skagit, Stillaguamish, and Snohomish units have declined 56 to 64 percent from the 1983 - 1987 average to the 1998 – 2000 average (Figure 4). Total exploitation rates on spring chinook have also declined. The average rate on Nooksack early chinook has declined 63 percent, on White River spring chinook 51 percent, and on Skagit spring chinook 57 percent. (Fig 5). (A. Rankis, NWIFC pers. comm. October 27, 2003)

Figure 4. Trend in total exploitation rate for Skagit, Stillaguamish, and Snohomish summer/fall chinook management units (post season FRAM estimates).

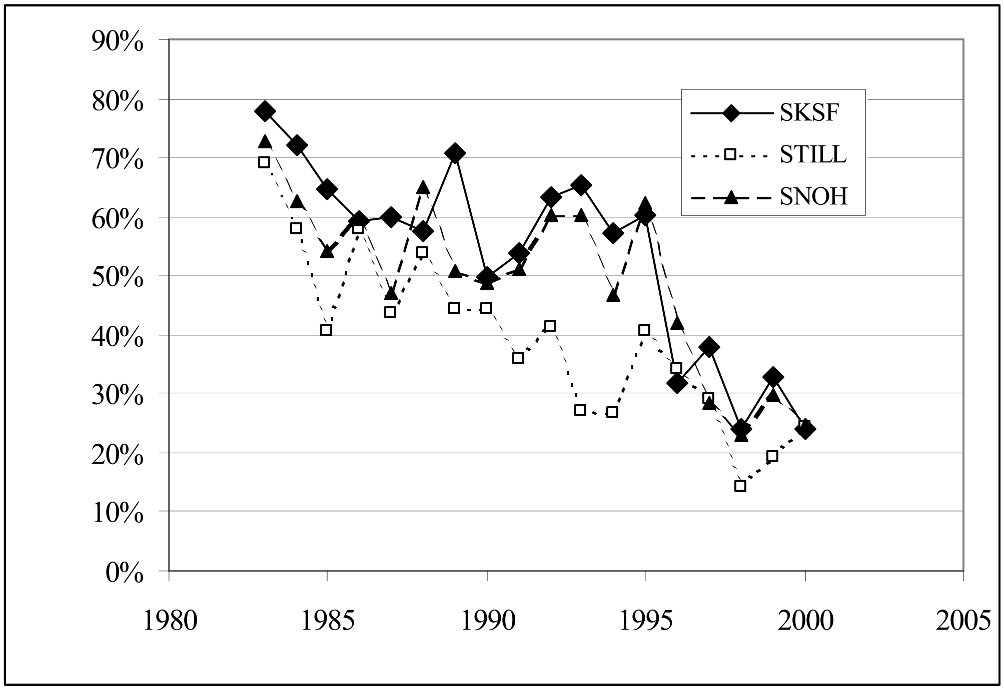
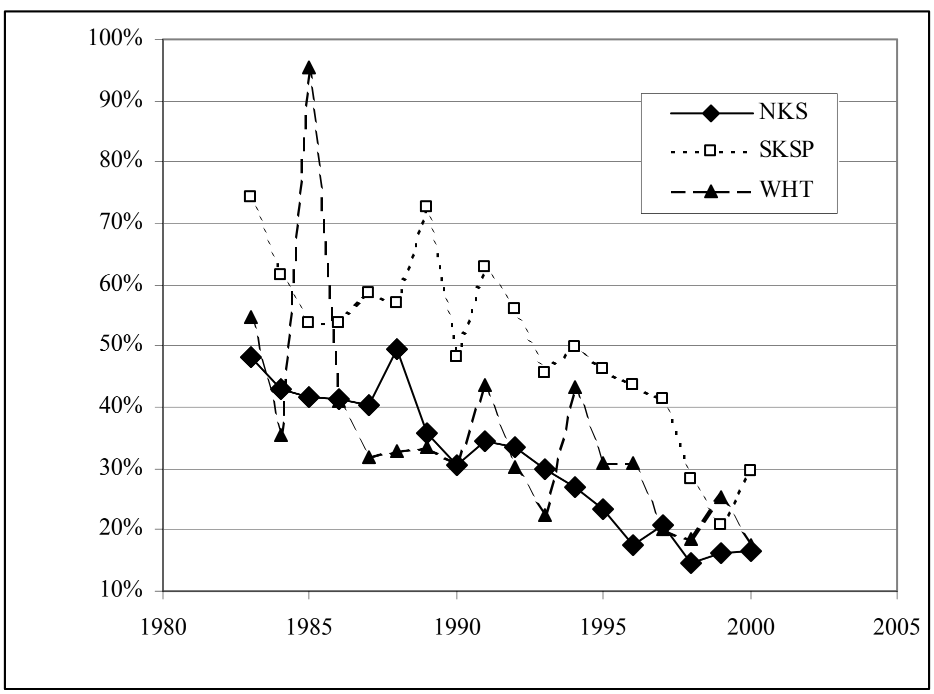


Figure 5. Trend in total exploitation rate for Nooksack, Skagit, and White spring chinook management units (post-season FRAM estimates).



5. Implementation

5.1 Management Intent

The co-managers' primary intent is to control impacts on weak, listed chinook populations, in order to avoid impeding their rebuilding, while providing sufficient opportunity for the harvest of other species, abundant returns of hatchery-origin chinook, and available surpluses from stronger natural chinook stocks. For the duration of this Plan, directed fisheries that target listed chinook populations are precluded, unless a harvestable surplus exists, and except for very small-scale tribal ceremonial and subsistence harvest, and research-related fisheries in a few areas.

For the purposes of this Plan, 'directed' fisheries are defined as those in which more than 50 percent of the total fishery-related mortality is made up of listed, Puget Sound-origin chinook. Total mortality includes all landed and non-landed mortality (see Appendix B).

Landed and non-landed incidental mortality of listed chinook will occur in fisheries directed at non-listed hatchery-origin chinook and other salmon species, but will be strictly constrained by harvest limits that are established expressly to conserve listed chinook.

5.2 Rules for Allowing Fisheries

The annual management strategy, for any given chinook management unit, shall depend on whether a harvestable surplus is forecast. This Plan prohibits targeted harvest on listed populations of Puget Sound chinook, unless they have harvestable surplus. In other words, if a management unit does not have a harvestable surplus, then harvest-related mortality will be constrained to incidental impacts. Directed and incidental fishery impacts are constrained by stated harvest rate ceilings or escapement goals for each management unit. The following rules define how and where fisheries can operate:

- Fisheries may be conducted where there is reasonable expectation that more than 50 percent of the resulting fishery-related mortality will accrue to management units and species with harvestable surpluses, as defined in Chapter 3.
- Within this constraint, the intent is to limit harvest of listed chinook populations or management units that lack harvestable surplus, not to develop a fishing regime that exerts the highest possible impact that does not violate specified ceiling exploitation rates or escapement goals.
- Incidental harvest of weak stocks will not be eliminated, but to avoid increasing the risk of extinction of weak stocks, harvest impacts will be reduced to the minimal level that still enables fishing opportunity on non-listed chinook and other species, when such harvest is appropriate.
- Exceptions may be provided for test fisheries that are necessary for research, and limited tribal ceremonial and subsistence fisheries.

Where it is not possible to effectively target productive natural stocks or hatchery production, without a majority of the fishery impacts accruing to runs without a harvestable surplus, use of the above rules will likely necessitate foregoing the harvest of much of the surplus from those more productive management units.

5.3 Rules That Control Harvest Levels

The co-managers' will use the following guidelines when assessing the appropriate levels of harvest for proposed annual fishing regimes:

- The annual fishing regime will be devised to meet the conservation objectives of the weakest, least productive management unit or component population. Because these units commingle to some extent with more productive units, even in terminal fishing areas, meeting the needs of these units may require reduction of the exploitation on stronger units to a significantly lower level than the level that would only meet the conservation needs of the stronger units.

- A management unit shall be considered to have a harvestable surplus if, after accounting for expected Alaskan and Canadian catches, and incidental, test, and tribal ceremonial and subsistence catches in southern U.S. fisheries, an MU is expected to have a spawning escapement greater than its upper management threshold [1] (see Section III), and its projected ER is less than its RER ceiling. In that case, additional fisheries (including directed fisheries) may be implemented until the exploitation rate ceiling is met, consistent with the Rules for Allowing Fisheries (above), or its expected escapement equals the upper management threshold. In this case, impacts may *not* be limited to incidental harvest mortality. The array of fisheries that may harvest the surplus can be widened, to include terminal-area, directed fisheries.

- Implementation of SUS fisheries targeting harvestable surplus for any management unit will be initiated conservatively. Consistent forecasts of high abundance, substantially above the upper management threshold, and preferably corroborated by post-season assessment, would be necessary to initiate such fisheries. This condition is not expected to be met for any Puget Sound management unit within the duration of this plan.

- If a MU does not have harvestable surplus, then, consistent with the rules for allowing fisheries (above), only incidental, test, and tribal ceremonial and subsistence harvests of that MU will be allowed in Washington areas.

- The projected exploitation rate for management units with no harvestable surplus will not be allowed to exceed their rebuilding exploitation rate ceiling (RER). In the event that the projected ER exceeds the ceiling RER, the incidental, test, and subsistence harvests must be further reduced until the ceiling RER is not exceeded (except as noted below).

- The annual fishing regime must meet the guidelines established by the Pacific Salmon Treaty chinook agreement, such that the non-ceiling fishery index will not exceed the Treaty-mandated ceiling (see Section IV, Pacific Salmon Treaty). If the ISBM index is projected to be exceeded, U.S. fisheries must be further reduced until the mandated ceiling is achieved.

[1] For complex management units, meeting the unit upper threshold may not meet the upper thresholds for all component populations.

- After accounting for anticipated Alaskan and Canadian interceptions, test fisheries, ceremonial and subsistence harvest, and incidental mortality in southern U.S. fisheries, if the spawning escapement for any management unit is expected to be lower than its low abundance threshold, Washington fisheries will be further shaped until either the escapement for the unit is projected to exceed its low abundance threshold, or its projected exploitation rate does not exceed the CERC (see section 5.5, below).

- The comanagers may implement additional fisheries conservation measures, where analysis demonstrates they will contribute significantly to recovery of a management unit, in concert with other habitat and enhancement measures.

5.4 Steps for Application to Annual Fisheries Planning

Annual planning of Puget Sound fisheries proceeds concurrently with that of coastal fisheries, from February through early-April each year, in the Pacific Fishery Management Council and North of Cape Falcon forums. These offer the public, particularly commercial and recreational fishing interest groups, access to salmon status information and opportunity to interact with the co-managers in developing annual fishing regimes. Conservation concerns for any management unit are identified early in the process. The steps in the planning process are:

Abundance forecasts are developed for Puget Sound, Washington coastal, and Columbia River chinook management units in advance of the management planning process. Forecast methods are detailed in documents available from WDFW and tribal management agencies. Preliminary abundance forecasts for Canadian chinook stocks, and expected catch ceilings in Alaska and British Columbia, are obtained through the Pacific Salmon Commission or directly from Canada Department of Fisheries and Oceans.

The Pacific Fishery Management Council's annual planning process begins in March by establishing a range of allowable catch ('options') for each coastal fishery. For Washington fisheries, this involves recreational and commercial troll chinook catch quotas for Areas 1 – 4 (including Area 4B in the western Strait of Juan de Fuca).

An initial regime for Puget Sound fishing is evaluated. Recreational fisheries are initially set at levels similar to the previous year's regime. Incidental chinook harvest in pre-terminal net fisheries is projected from recent-year catch data, and the anticipated scope of fisheries for other species in the current year. Terminal area net fisheries in chinook management periods are scaled to harvest surplus production and achieve natural and / or hatchery escapement objectives. The fishery regimes for pre-terminal and terminal net fisheries directed at other salmon species are initially set to meet management objectives for those species.

The FRAM is configured to simulate this initial regulation set for all Washington fisheries, based on forecast abundance of all contributing chinook management units. Spawning escapement for each population, and total and SUS exploitation rates, projected by this model run, are then examined for compliance with management objectives for each Puget Sound chinook management unit, and their component populations.

The initial model runs are used to reveal the scope and magnitude of conservation concerns for any management units in critical status (i.e. where escapement falls short of the low abundance thresholds), and a more general perspective on the achievement of management objectives for all other management units. In accordance with the preceding rules that control harvest levels, regulations governing directed and incidental chinook harvest impacts are adjusted, through technical assessment and negotiation among the co-managers, in order to arrive at a fishery regime that addresses the conservation concerns for weak stocks, ensures that exploitation rate ceilings are not exceeded and / or escapement objectives are achieved for all other units, while achieving the annual harvest objectives of the co-managers.

5.5 Response to Critical Status

When initial FRAM modeling indicates that Puget Sound Chinook units are in critical status (i.e., projected escapement their low abundance thresholds):

1. The pre-season 2003 SUS fishing regime will be modeled, with current forecast abundance, to determine an SUS ER for each critical stock.

2. The objective of pre-season planning will be to achieve an SUS ER less than or equal to that rate (from step 1), provided that rate is below the CERC.

3. If the 2003 fisheries-based rate exceeds the CERC for any critical management unit, the CERC will be the planning objective.

However, the co-managers may, by mutual consent, set the annual management objective for any critical unit between the 2003 fisheries-based rate and the CERC. Under no circumstances will the CERC be exceeded.

Response to Expanding Northern Fisheries

In 2002 and 2003, chinook harvest in some coastal fisheries in British Columbia increased substantially, indicating that those fisheries may reach the limits imposed by Annex IV, Chapter 3 (1999) of the Pacific Salmon Treaty, within the duration of this harvest plan. Increasing Canadian fishery impacts on Puget Sound chinook, in combination with recent SUS fishing regimes, may result in total fisheries impacts exceeding the rebuilding exploitation rates (RER) for one or more of those Puget Sound chinook management units that have total RERs established in this plan.

During preseason planning, if the total exploitation rate for a management unit is projected to exceed the RER established by this Plan (Table 3), the co-managers will constrain their fisheries such that either the RER is not exceeded, or the SUS exploitation rate is less than or equal to the CERC. Modeling exercises have demonstrated potential for this to occur for several Puget Sound units that are unlikely to fall into critical status in the duration of this plan. The CERC, in this circumstance, would constrain SUS fisheries to the same degree as if that unit were in critical status. While this measure imposes a further conservation burden on Washington fisheries, pursuant to the underlying rationale for the MFR, it maintains access to the harvestable surplus of non-listed chinook, and other species

Because of annual variability in abundance among the various populations, there is no single fishing regime that can be implemented from one year to the next to achieve the management objectives for all Puget Sound chinook units. The co-managers have, at their disposal, a range of management tools, including gear restrictions, time / area closures, catch or retention limits, and complete closures of specific fisheries. Combinations of these actions will be implemented in any given year, as necessary, to insure that management objectives are achieved.

Discretionary Conservation Measures

The co-managers may, by mutual agreement, implement further conservation constraint on SUS fisheries, in response to critical status of any management unit, or in response to declining status or heightened uncertainty about status of any management unit, or to achieve allocation objectives. In doing so, they will consider the most recent information regarding the status and productivity of the management unit or population, and past performance in achieving its management objectives. The conservation effect of such measures may not always be quantifiable by the FRAM, but, based on the best available information on the distribution of stocks, will be judged to have beneficial effect

5.7 Compliance with Pacific Salmon Treaty Chinook Agreements

The proposed regime will be examined for compliance with PST chinook agreements, and further adjustments implemented as necessary to achieve compliance.

In 1999, the parties to the Pacific Salmon Treaty agreed to a new abundance-based chinook management regime for fisheries in the United States and Canada. Southern U.S. fisheries are to be conducted as individual stock-based management (ISBM) fisheries keyed to specific stock groups. With respect to Puget Sound chinook, this agreement refers to the abundance status (i.e. spawning escapement) of certain indicator stock groups with respect to their identified escapement goals[2]. The summer/fall indicator group includes the Hoko, Skagit, Stillaguamish, Snohomish, Lake Washington, and Green units; the spring indicator group includes Skagit spring and Nooksack early units. Stepped reductions in ISBM fisheries will be imposed when two or more of these indicator units are projected not to meet their escapement objectives. These reductions will comply with the pass through provisions and general obligations for individual stock-based management regimes (ISBM) pursuant to the chinook chapter within the US/Canada Pacific Salmon Treaty.

Escapement projected by the FRAM, at the conclusion of pre-season planning, will be compared to PST objectives. According to the PST agreement: "the United State shall reduce by 40%, the total adult equivalent mortality rate, relative to the 1979-82 base period, in the respective ISBM fisheries that affect those stocks." The reduction shall be referred to as the "general obligation".

For those stock groups for which the general obligation is insufficient to meet the agreed escapement objectives, the jurisdiction within which the stock group originates shall implement additional reductions:

i) reductions as necessary to meet the agreed escapement objectives; or

ii) which taken together with the general obligation, are at least equivalent to the average of those reductions that occurred for the stock group during the years 1991-96.

[2] Escapement goals for the Puget Sound indicator stocks, equivalent to the upper management thresholds stated in this plan, have been proposed to the Joint Chinook Technical Committee of the Pacific Salmon Commission for incorporation into the chinook agreement.

The Chinook Technical Committee defined the non-ceiling fishery index (CTC 1996). The PST defers to any more restrictive limit mandated by the Puget Sound chinook management plan, or otherwise implemented by the co-managers.

5.8 Regulation Implementation

Individual tribes promulgate and enforce regulations for fisheries in their respective ‘usual and accustomed’ areas, and WDFW promulgates and enforces non-Indian fishery regulations, consistent with the principles and procedures set forth in the PSSMP. All fisheries shall be regulated to achieve conservation and sharing objectives based on four fundamental elements: (1) acceptably accurate determinations of the appropriate exploitation rate, harvest rate, or numbers of fish available for harvest; (2) the ability to evaluate the effects of specific fishing regulations; (3) a means to monitor fishing activity in a sufficient, timely and accurate fashion; and (4) effective regulation of fisheries, and enforcement, to meet objectives for spawning escapement, harvest sharing, and fishery impacts.

The annual fishing regime, when developed and agreed-to by the co-managers through the PFMC and NOF forums, will be summarized and distributed to all interested parties, at the conclusion of annual pre-season planning. This document will summarize regulatory guidelines for Treaty Indian and non-Indian fisheries (i.e. species quotas, bag limits, time/area restrictions, and gear requirements) for each marine and freshwater management area on the Washington coast and in Puget Sound. Preseason forecasts and management agreements will be detailed in Management Status reports, as required by the Puget Sound Salmon management Plan. Regulations enacted during the season will implement these guidelines, but may be modified, based on catch and abundance assessment, by agreement between parties. In-season modifications shall be in accordance to the procedures specified in the PSSMP and subsequent court orders.

Further details on fishery regulations may be found in the respective parties regulation summaries, and other State/Tribal documents. The co-managers maintain a system for transmitting, cross-indexing and storing fishery regulations affecting harvest of salmon. Public notification of fishery regulations is achieved through press releases, regulation pamphlets, and telephone hotlines.

5.9 In-season Management

Fisheries schedules and regulations may be adjusted or otherwise changed in-season, by the co-managers or through other operative jurisdictions (e.g. the Fraser Panel, Pacific Fisheries Management Council). Schedules for fisheries governed by quotas, for example, may be shortened so that harvest quotas are not exceeded. Commercial net fishery schedules in Puget Sound may be modified to achieve allocation objectives or in reaction to in-season assessment of the abundance of target stocks, or of stocks harvested incidentally. In each case, the co-managers will assess the effect of proposed in-season changes with regard to their impact on natural chinook management units, and determine whether the management action constrains fishery impacts within the harvest limits stated in this plan. Particular attention will be directed to in-season changes that impact management units or populations in critical status, or where the pre-season plan projections indicated that total impacts were close to ceiling exploitation rates or projected escapement close to the respective escapement goals.

The co-managers will notify the NMFS when in-season management decisions will result in an exploitation rate higher than the relevant ceiling prescribed by this Plan or escapement less than the low abundance threshold for any management unit. The notification will include a description of the change, an assessment of the resulting fishing mortality, and an explanation of how impacts of the action still achieve the larger objective of not impeding recovery of the ESU.

5.10 Enforcement

Non-treaty commercial and recreational fishery regulations are enforced by WDFW. The WDFW Enforcement Program currently employs 163 personnel. Of that number, 156 are fully commissioned Fish and Wildlife officers who ensure compliance with licensing and habitat requirements, and enforce prohibitions against the illegal taking or poaching of fish and wildlife (www.wa.gov/wdfw/enf/enforce.htm). The Fish and Wildlife Enforcement Program is primarily responsible for enforcing the Washington State Fish and Wildlife Code (Title 57). However, officers are also charged with enforcing many other codes as well, and are often called upon to assist local city, county, other state, or tribal law enforcement agencies. On an average, officers currently make more than 300,000 fisheries-related public contacts annually (93% of Enforcement FTE's are field deployed). WDFW Enforcement also cooperates with the U.S. Fish and Wildlife Service, the NMFS Enforcement branch, and the U.S. Coast Guard in fisheries enforcement.

Each tribe exercises authority over enforcement of tribal commercial fishing regulations, whether fisheries occur on or off their reservation. In some cases enforcement is coordinated among several tribes by a single agency (e.g. the Point No Point Treaty Council is entrusted with enforcement authority over Lower Elwha Klallam, Jamestown S'Klallam, and Port Gamble S'Klallam, tribal fisheries). Enforcement officers of one tribal agency may be cross-deputized by another tribal agency, where those tribes fish in common areas. Prosecution of violations of tribal regulations occurs through tribal courts and governmental structures.

Participation by Indian and non-treaty fishers in pre-season fishery planning, at local meetings conducted by tribal resource managers and WDFW, and through the Pacific Fisheries Management Council hearings and the North of Cape Falcon forum, promotes education about salient conservation concerns that are of particular relevance to planning fisheries. These forums also promote a wide awareness of changes in regulations, well in advance of the onset of most fisheries, directly to fishers and through the news media.

6. Conservative Management

This chapter summarizes the conservative rationale and technical methods underlying the harvest management objectives of the Plan, noting how they have changed from previous management practices, and how they exceed the conservation standards of the ESA. As stated in Chapter 1, this Plan constrains harvest of all management units to the point where fishing mortality does not impede rebuilding and eventual recovery of the ESU. However, rebuilding and recovery is, for most populations, contingent on restoring the functionality of habitat. Harvest constraint will play an essential role in maintaining the existing diversity of populations that make up the ESU, by stabilizing, and in some cases increasing natural spawning escapement. However, rebuilding more robust population abundance, and effecting progress toward recovery, depends on the restoration of higher productivity that will only result from improved habitat quality.

The conservation standard of the ESA, as expressed in Limit 4 of the salmon 4(d) rule (50 CFR 223 vol 65 p 170 - 188) regarding state / tribal harvest management plans (Limit 6), is that harvest-related mortality must not "appreciably reduce the likelihood of survival and recovery of the ESU". The 4(d) rule defines 'survival and recovery' as protecting the abundance, productivity, and diversity of the ESU. . Limit 6 of the 4(d) rule asserts that harvest actions should: 1) maintain healthy populations at abundance above their recovery thresholds; 2) not impede the recovery of populations whose abundance is above their low threshold but below their recovery threshold; and 3) not impose increased demographic or genetic risk on populations at critically low abundance, unless imposing greater risk does not appreciably reduce the likelihood of survival and recovery of the entire listed ESU (50 CFR 223, 65(132): 42476).

The management objectives and constraints imposed by the Plan will maintain healthy populations (i.e., those at or near the abundance associated with recovery) by assuring that spawning escapement is sufficient for optimum productivity (MSH escapement). However the abundance of most of the populations in Puget Sound is well below the level associated with recovery, and in some cases is severely or chronically depressed. For some of these depressed populations, harvest constraint can only maintain escapement at the optimum level associated with current habitat quality. When that optimum level is not defined with certainty, harvest constraint will experimentally probe optimum capacity by providing higher numbers of spawners in some years, to better define current productive capacity. For very depressed populations, harvest will be severely constrained. Extraordinary measures defined by the Plan are expected to assure that the abundance of these populations will remain above their point of instability. However, because natural production (survival) is so reduced for these weak populations, some populations require hatchery supplementation for their maintenance Further harvest constraint would not materially improve the likelihood that these populations will survive in the long term.

Considering the significant influence that harvest has on abundance (i.e. spawning escapement), the objectives and conservation measures contained in this Plan were developed with specific intent to maintain all populations at their current status and allow them to rebuild as other constraining factors are alleviated. This chapter describes how the Plan's objectives protect the abundance and diversity of the ESU.

6.1 Harvest Objectives Based on Natural Productivity

The harvest objectives for each management unit are stated as ceiling exploitation rates or escapement goals for naturally spawning or, for some units, natural-origin chinook. Though fisheries in some areas are shaped to harvest surplus hatchery production, the primary objective is to assure protection and conservation of natural populations.

Specifying the objectives for all management units in terms of natural production is a significant change, when compared to past management practices. Formerly, management of some units was based primarily on harvesting surplus hatchery production, without regard to the consequences of these high harvest rates on natural-origin chinook. These units were designated ‘secondary’ in the Puget Sound Salmon Management Plan. This Plan imposes conservation constraints on harvest for all natural populations. It establishes specific escapement goals for Category II (formerly secondary) units, to ensure that natural production remains viable. For these units, in-season abundance assessment tools, followed by specific management responses when abundance falls short of the forecast level, will be implemented or under development.

Prior to 1998, chinook harvest objectives were stated as escapement goals for many Puget Sound management units. The PSSMP stated the preference that escapement goals be based on achieving maximum sustainable harvest, which implied the ability to quantify current natural productivity (i.e. spawner – recruit functions) and productive capacity. However, the escapement goals that were established by the co-managers for ‘primary’ management units were not always biologically based, but often consisted of an historical average of escapement during a period of relatively high abundance and survival, (i.e. 1968 - 1977 for summer fall stocks, 1959 - 1968 for Skagit River spring stocks). For most units, these historical escapements were a result of fishing levels in the base years, and were not related to the current capacity or quality of spawning or freshwater rearing habitat, or marine survival, particularly as habitat conditions were further degraded through the 1980s and 1990s. These goals were in effect until the late 1990s. Continuing decline in stock status, and the subsequent listing of Puget Sound chinook as threatened, with its requirement for development of recovery goals, prompted re-assessment of the old escapement goals, and development of new harvest objectives for many management units.

This Plan commits the co-managers to setting harvest and escapement objectives for all management units to conform with their current or recent productivity, to the extent the requisite data are available. Rebuilding exploitation rate ceilings may be developed and implemented, within the duration of this plan, for additional management units. For other units, even where current productivity is estimated, shaping of terminal fisheries to achieve escapement goals, particularly where in-season assessment provides more accurate estimates of abundance, will remain the preferred management approach. In-season assessment methods will be developed and refined, and escapement estimates refined, to improve the performance of escapement goal management.

6.2 Accounting for Uncertainty and Variability

Uncertainty and annual variability are inherent in estimating the productivity of salmon populations. In order to manage the associated risk, the derivation of biologically based harvest objectives must account and compensate for this uncertainty and variability. Methods outlined in Chapter 3, and described in detail in Appendix A, describe how the current procedure for developing rebuilding exploitation rates accomplishes this objective. This strategy may be summarized as follows:

- To the extent possible, variability in freshwater and marine survival rates will be quantified separately;

- Simulation of population dynamics will incorporate a range of values for marine and freshwater survival parameters that were typical of recent years, and therefore probably characteristic of the immediate future;
- Even when current survival is relatively high, as is currently believed to be the case for marine survival of Puget Sound populations, the simulation will assume lower survival in the future;
- Adaptive management will update these objectives as actual exploitation rates, escapement, and survival are monitored closely.

6.3 Protection of Individual Populations

This Plan establishes harvest limits (i.e. ceiling exploitation rates) for entire management units, but annual fishing planning will also pay specific attention to the status (i.e., projected spawning escapement) of individual populations, where a unit consists of more than one population, providing that data are available that quantify productivity and capacity for those populations. Annual exploitation rate targets will be influenced by escapement that is projected for each population, by the fishery simulation model, and the recent historical trend in population escapement. Actual exploitation rates, for most units, are likely to fall well below the exploitation rate ceilings, due to concern for weak or critical populations. Specific conditions are established for implementing fisheries that would increase the exploitation rate up to the ceiling for any unit. In order to guard against escapement declining to a level that may jeopardize demographic or genetic integrity, a low abundance threshold is established, for each population, as triggers for further constraint of harvest.

6.3.1 Populations exceeding their low abundance thresholds

Escapement for most Puget Sound chinook populations has, in recent years, exceeded the critical abundance threshold referred to in the 4(d) rule. Harvest of these populations is managed such that escapement, if habitat conditions allow, will attains or exceed the level associated with optimum current productivity (see Table 12) This assurance of stable or increasing escapement achieves the 4(d) standard of not impeding recovery of the ESU.

For populations with sufficient data, current productivity is quantified by spawner – recruit analysis (see Chapter 3). Freshwater conditions are highly variable, so ‘current’ productivity reflects the range of survival and recruitment rates observed in recent years. Exploitation rate ceilings are established for these units at the level consistent with achieving MSH escapement (Table 14) Implementation of this harvest plan will result in actual exploitation rates that are lower than that ceiling in most years, thereby intentionally exceeding MSH escapement under current conditions. The strategy of managing harvest under exploitation rate ceilings, as implemented under this plan, carries some risk of exceeding the spawning capacity of habitat, and lowering productivity, but will enable higher production should conditions in freshwater improve.

The strategy of this Plan is to probe the productivity of populations at increased escapement levels, and capitalize on favorable environmental conditions as they occur, or as habitat is restored. It also recognizes the current limits of management tools. Given the current accuracy of abundance forecasting, and the capability of the fishery simulation model, exploitation rates for a specified fishery regime can be projected with greater accuracy than spawning escapement. Exploitation rates may also be consistently and accurately estimated post-season, enabling continual, adaptive assessment of management performance.

The Plan sets also sets total exploitation rate objectives for the Puyallup fall and White spring populations that have been demonstrated to provide adequate seeding of spawning habitat. Analysis of the current potential of habitat (see Profile, Appendix A) suggests that the productivity is quite low in the Puyallup system, but returns from local hatchery production have contributed significantly to natural spawning and smolt production. Returns to the White River have increased, under the current exploitation rate objective, to levels well in excess of the low abundance threshold. Research is underway to refine estimates of current productivity and habitat capacity in these systems.

For other management units, exploitation rate ceilings are specified in this plan for southern U.S. fisheries, or ceilings are specified for pre-terminal fisheries in combination with specific terminal-area management measures, to assure that the naturally- populations remain viable. For the duration of this plan they will persist, at abundance substantially above their low abundance thresholds. The upper management threshold for some of these units may be achieved or exceeded in some years. For other units, the upper management threshold will be achieved only if existing habitat constraints are alleviated. Hatchery-origin chinook contribute to natural spawning in these systems, and provide a necessary measure of assurance that natural production will be stable or increase in these systems where habitat conditions cannot currently sustain abundance absent supplementation

6.3.2 Management Units In Critical Status

The critical or near-critical abundance expected for a small group of Puget Sound populations, will necessitate severe constraint of fisheries, in order to prevent further decline in their status, and achieve the conservation guidelines stated under Limit 6 of the 4(d) rule. For some populations (e.g. the North and South Fork Nooksack and Dungeness), recent natural-origin spawning escapement has been consistently below their low abundance thresholds (Table 3). Extraordinary fisheries conservation measures, described in Chapters 3 and 5, are prescribed by this Plan to prevent further decline in natural-origin spawner abundance.

For some other populations, escapement has in some years fallen below their low abundance thresholds (e.g., Lake Washington, Mid Hood Canal). Hatchery supplementation programs have maintained natural spawning abundance, in some cases well above their low threshold, for some populations (e.g. Stillaguamish, White, and Elwha), but natural productivity has been chronically depressed. As described in their management unit profiles (Appendix A) terminal area fisheries affecting these populations have, in recent years, been constrained or eliminated, as if they were in critical status. Upper management thresholds been established for these populations, but, because of their status, the objective most relevant to current management is their low abundance threshold. Habitat-based analyses of productivity indicate that the upper management threshold is substantially higher than current MSH for the North Fork and South Fork Nooksack, Mid-Hood Canal, and Dungeness populations. However, the management intent is to exceed current MSH escapement as often as possible, to guard against the uncertain ecological and genetic risks of low abundance.

Table 12. Escapement levels (upper management thresholds) consistent with optimum productivity or capacity under current habitat conditions, and recent escapement for Puget Sound chinook management units

Management Unit	Upper Mgmt Threshold [1]	1997	1998	1999	2000	2001	2002
Nooksack early	4000 [2]	254	194	251	444	531	513
Skagit spring	2000 [3]	1041	1086	471	1021	1856	1065
Skagit sum / fall	14500 [3]	4872	14609	4924	16930	13793	19591
Stillaguamish S/F	900 [4]	1156	1540	1098	1646	1349	1588
Snohomish S/F	4600 [5]	4292	6304	4799	6092	8164	7220
L. Washington Cedar River	1200 [6]	227	432	241	120	810	369
Green R.	5800 [7]	9967	7300	9100	6170	7975	13950
White R. spring	1000 [8]	400	316	553	1523	2002	803
Puyallup	1200 [9]	1550	4995	1986	1193	1915	1,590
Nisqually	1100 [10]	340	834	1399	1253	1079	1,542
Skokomish	3650 [11]	2337	6761	9119	4959	10729	1,479
Mid Hood Canal	750 [12]	N/A	287	873	438	322	65
Dungeness	925 [13]	50	110	75	218	453	633
Elwha River	2900 [14]	2517	2358	1602	1851	2208	2,376
Juan de Fuca Hoko River	850 [15]	765	1618	1497	612	768	645

[1] Management threshold from quantified current productivity or best available estimate of current habitat capacity
[2] Nooksack Endangered Species Action Team 2000.
[3] Hayman 2003,
[4] Stillaguamish management unit profile (Appendix A)
[5] Snohomish management unit profile (Appendix A)
[6] Hage et al. 1994.
[7] Ames and Phinney 1977.
[8] WDFW et al 1996. Natural-origin spawners transported past Mud Mountain Dam
[9] Puyallup citation?.
[10] Nisqually Chinook Recovery Team. 2001. Nisqually Chinook Recovery Plan.
[11] Ames and Phinney 1977. Composite of 1,650 natural spawners and hatchery escapement target of 2000.
[12] U.S. v. Wash. Civil 9213, Ph. I (Proc. 83-8). Order Re: Hood Canal Management Plan (1985).
[13] Smith and Sele 1994.
[14] Ames and Phinney 1977. Composite of 500 natural and 2,400 hatchery escapement. Hatchery is listed as essential to recovery.
[15] Ames and Phinney 1977. Modified to exclude capture of adults for supplementation program.

6.4 Equilibrium Exploitation Rates

Managing harvest under rebuilding exploitation rate ceilings assures stable or increasing escapement for those management units. The underlying recruitment function, which is based on current performance, predicts that productivity declines as abundance (escapement) increases, such that for any level of escapement an exploitation rate may be identified that assures replacement of the parent brood. Setting the rebuilding exploitation rate objective conservatively, with a view to recent abundance, assures a high probability that escapement will trend upward. The following analysis illustrates this concept for the Skagit River summer / fall and spring management units.

The equilibrium exploitation rate at each level of spawning escapement (i.e., the exploitation rate that would, on average, maintain the spawning escapement at the same level) was calculated from the Ricker spawner-recruit parameters used in the RER analyses that set the ER ceilings for each management unit. These equilibrium rates are represented by the curve that forms the border between the shaded and white regions in Figures 6 and 7. Note that, due to declining productivity, the equilibrium ER *decreases* as escapement increases. In the region below this curve (i.e., the exploitation rate is lower than the equilibrium rate that applies to that level of spawning escapement), escapement should, on average, increase in the next cycle. In the region above this curve, escapement should, on average, decrease in the next cycle.

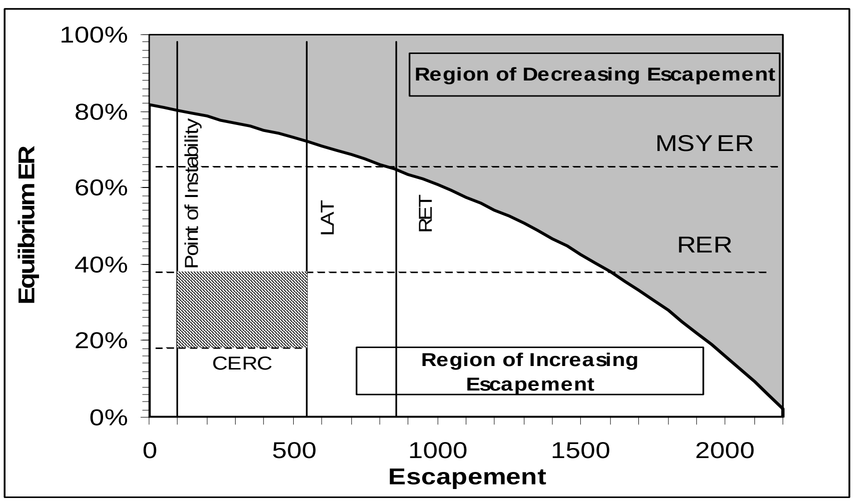
For Skagit chinook, NMFS' "viable threshold" is the same thing as the "rebuilding escapement threshold" that was used in the RER analyses to set the ER ceiling. For Skagit spring chinook, this is the MSY escapement level, which, from the Ricker spawner-recruit parameters that were used in the RER analysis, is about 850 spawners (Fig. 6). The Limit 6 "critical threshold", however, is NOT the same thing as the "critical threshold" defined in this plan – the Limit 6 threshold is a point of instability below which the spawner-recruit relation destabilizes and the risk of extinction increases greatly. The low abundance threshold in this plan, in contrast, is a buffered level that is set sufficiently *above* the point of instability that the risk of getting an escapement below the point of instability, through management error or uncertainty, is low. The critical threshold for Skagit spring chinook, in this plan, is 576 spawners; the point of instability (i.e., the Limit 4 "critical threshold"), calculated using the Ricker parameters from the RER analysis and Peterman's (1977) rule-of-thumb, (i.e., that the point of instability is 5% of the replacement level), would be about 110 spawners (Fig. 6)."

The plan mandates that, if escapement is projected to fall below the LAT, SUS fisheries will be constrained to exert an exploitation rate less than or equal to the CERC, though the total exploitation rate may range higher, as shown in the crosshatched region in Figure 6, due to northern fisheries.

For Skagit spring chinook, when abundance is between the point of instability and the viable threshold, this plan's ER ceiling is well within the region of increasing escapement (Fig. 6), which satisfies the criterion that the plan must allow abundances in this range to increase to the viable level. In fact, even ER's significantly *above* the ER ceiling satisfy this criterion. For escapements greater than the viable threshold, the ER ceiling allows for increasing escapements up to the point where the ER ceiling intersects the equilibrium ER curve. This occurs at an escapement of about 1700 (Fig. 6). For escapements above that level, if harvest met the ER ceiling each year (which is not what is expected under this plan), escapements would tend to decrease in the next cycle; however, they would be expected to stabilize around an escapement of about 1700, which is well above the viable threshold. Thus, the plan also satisfies the criterion that, for escapements above the viable threshold, abundance will, on average, be maintained in that region.

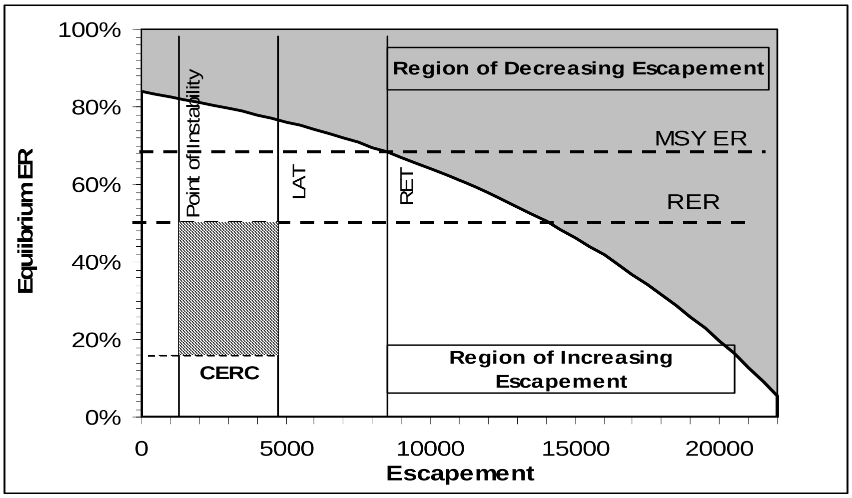
For escapements below the point of instability, recruitments will, by definition, be inconsistent and largely unrelated to the escapement level. This means that harvest management cannot be used effectively to increase escapements above the point of instability. Rebuilding above this level could only be accomplished through fortuitous returns or increase in productivity. This plan deals with abundances below the point of instability largely by trying to prevent abundance from getting that low. For Skagit springs, the trigger for reducing SUS impacts to the minimum regime occurs at a threshold of 576, which is over 5 times higher than the calculated point of instability, and, at that threshold and exploitation rate, is well within the region of increasing escapement (Fig. 6). In the event that abundance falls below the point of instability, and then was followed by a fortuitous recruitment that exceeded that level, the ceiling exploitation rate is low enough that equilibrium momentum will tend to increase the escapement further, rather than reduce it to below the point of instability again. Thus, this plan should not increase the genetic and demographic risk of extinction for Skagit springs. In practical application, the lowest observed Skagit spring chinook escapement has been 470 (in 1994 and 1999), which is over 4 times higher than the calculated point of instability – escapements have exceeded 1,000 during each of the last 3 years, which is higher than the viable threshold, and again indicates that this plan should not increase the genetic and demographic risk of extinction for Skagit springs.

Figure 6. The equilibrium exploitation rate, at each escapement level, for Skagit spring chinook. Exploitation rates below the curve should, on average, result in higher escapements on subsequent cycles; exploitation rates above the curve should, on average, result in lower escapements on subsequent cycles. Equilibrium rates were calculated from the Ricker parameters that were used for the RER analysis used to set the ER ceiling for the Skagit spring chinook management unit. The MSY exploitation rate (MSY ER), rebuilding exploitation rate (RER), and critical exploitation rate ceiling (CERC), and three escapement levels – the calculated point of instability, the low abundance threshold (LAT), and the rebuilding escapement threshold (RET), are marked for reference (see text)



For Skagit summer/fall chinook, the rebuilding escapement threshold is approximately 8500 spawners; the low abundance threshold is 4800; and the calculated point of instability is approximately 1100. As with Skagit springs, in the range between the point of instability and the MSH escapement level, the ER ceiling is well within the region of increasing escapement (Fig. 7), which satisfies the criterion that the plan must allow abundances in this range to increase to the viable level. For escapements greater than the calculated MSH level, the ER ceiling allows for increasing escapements up to an escapement of about 13,500 (Fig. 7). If escapement was higher than that, and harvest met the ER ceiling each year (which, again, is not what is expected under this plan), escapements would be expected to stabilize around an escapement of about 13,500, which is well above the viable threshold. Thus, this plan also satisfies the criterion that, for escapements above the viable threshold, summer/fall abundance will, on average, be maintained in that region.

Figure 7. The equilibrium exploitation rate, at each escapement level, for Skagit summer/fall chinook.
Exploitation rates below the curve should, on average, result in higher escapements on subsequent cycles; exploitation rates above the curve should, on average, result in lower escapements on subsequent cycles. Equilibrium rates were calculated from the Ricker parameters that were used for the RER analysis used to set the ER ceiling for the Skagit summer/fall chinook management unit. The MSY exploitation rate (MSY ER), rebuilding exploitation rate (RER), and critical exploitation rate ceiling (CERC), and three escapement levels – the calculated point of instability, the low abundance threshold (LAT), and the rebuilding escapement threshold (RET), are marked for reference (see text).



As previously noted for Skagit spring chinook, the combined impacts from northern fisheries and constrained SUS fisheries, that would be implemented if the summer / fall unit were to decline to critical status, would be expected to exert total exploitation rates well below the equilibrium rate, and assure higher subsequent escapement *well below the equilibrium ER* that applies to escapements between the LAT and the point of instability, so, on average, equilibrium pressures would force escapement to increase.

As with spring chinook, it is not possible to project any relation between escapement and recruitment for escapements below the point of instability. To prevent summer/fall escapements from falling below this level, the trigger for reducing SUS impacts to the minimum regime occurs at a threshold of 4800, which is over 4 times higher than the calculated point of instability, and, at that threshold and exploitation rate, is well within the region of increasing escapement (Fig. 7). The same equilibrium momentum would, on the next cycle, tend to increase escapements further, rather than reduce them, if escapement did drop below the point of instability and then experienced a fortuitous recruitment. In terms of actual observations, the lowest observed Skagit summer/fall chinook escapement has been 4900 (in 1997 and 1999), which is over 4 times higher than the calculated point of instability, and escapement has exceeded 13,500 during each of the last 3 years, which is well above the calculated MSH escapement level. Thus, for Skagit summer/fall chinook, this plan should not increase the genetic and demographic risk of extinction.

6.5 Reduction in Exploitation Rates

The annual exploitation rate targets that will result from implementing this Plan will likely be substantially lower than the rates that occurred in the 1980s. Annual exploitation rates for Category 1 management units have declined 44 to 64 percent, based on comparison of the 1983-1987 and 1998 -2000 average rates estimated by post-season FRAM runs (Table 13). Pre-season model projections confirm that total exploitation rates are being held to this low level in the past three years. Exploitation rates in Washington fisheries (ocean and Puget Sound areas combined) have fallen 28 to 77 percent for Category 1 units.

Table 13. Decline in average total, adult-equivalent exploitation rate, from 1983 – 1987 to 1998-2000, and 2001 – 2003, for Category 1 Puget Sound chinook management units (post-season FRAM estimates for 1983 – 2000, preseason estimates for 2001- 2003).

	83-87 Avg	98-00 Avg	% Decline	01 - 03 Avg	% Decline
Skagit S/F	0.67	0.27	59.7%	0.34	49.0%
Stillaguamish	0.54	0.19	64.1%	0.15	71.2%
Snohomish	0.59	0.26	56.4%	0.20	66.8%
Green	0.65	0.36	44.1%	0.49	24.0%
Nooksack Spr	0.43	0.16	63.3%	0.17	60.1%
Skagit Spr	0.60	0.26	56.6%	0.22	62.8%
White	0.52	0.20	60.5%	0.19	62.8%
JDF	0.76	0.38	50.7%	0.18	76.5%

In consequence, the actual risk incurred by management units with RER objectives will be lower than the 4(d) risk criteria used to select the RERs. The probability of achieving the upper management threshold, or current MSH escapement, will be higher than 80%, and the probability of falling to critical abundance will also be reduced. For MUs without RER objectives, Table 12 suggests that risks due to excessive harvest pressure have already been substantially eliminated.

6.6 Recovery Goals

The Washington co-managers have identified recovery goals for several Puget Sound management units, based on quantitative assessment of the potential productivity associated with recovered habitat conditions (Table 14). These interim planning targets are intended to assist local governments, resource management agencies, and public interest groups with identifying harvest and hatchery management changes, and habitat protection and restoration measures necessary to achieve recovery in each watershed and the ESU as a whole. Recovery goals are expressed as a range of natural-origin or natural spawning escapement and associated recruitment rates (i.e. adult recruits per spawner). The lower boundary represents the number of spawners that will provide maximum surplus production (i.e. MSH) under properly functioning habitat conditions, assuming recent marine survival rates. The upper boundary represents the equilibrium escapement under these conditions, (i.e. the number of adults surviving to spawn is equal to the parent brood-year escapement).

In most cases, the management objectives (upper management thresholds), and recent escapements, are substantially below the lower end of the recovery range (see section 6.7, below), reflecting their different points of reference with regard to habitat quality. Notable exceptions include the Upper Skagit summer, Cascade Spring, and Siuattle Spring populations, where recent escapement has exceeded the lower boundary of the recovery goals. These three examples notwithstanding, upper management thresholds represent MSH escapement under current habitat conditions, and imply that current conditions limit the potential for recovery for most populations.

Table 14. Escapement levels and recruitment rates for Puget Sound chinook populations, at MSH and at equilibrium, under recovered habitat conditions.

Population	MSH		Equilibrium
	Escapement	Adult R/S	Escapement [1]
North Fork Nooksack	3,400	3.3	14,000
South Fork Nooksack	2,300	3.6	9,900
Upper Cascade Spring	290	3.0	1,160
Suiattle Spring	160	2.8	610
Upper Sauk Spring	750	3.0	3,030
Lower Skagit Fall	3,900	3.0	15,800
Upper Skagit Summer	5,380	3.8	26,000
Lower Sauk Summer	1,400	3.0	5,580
North Fork Stillaguamish	4,000	3.3	18,000
South Fork Stillaguamish	3,600	3.4	15,000
Snoqualmie	5,500	3.6	25,000
Skykomish	8,700	3.4	39,000
Puyallup	5,300	2.3	18,000
Nisqually	3,400	3.0	13,000
Mid Hood Canal	1,320	2.9	5,200
Dungeness	1,170	3.0	4,740

[1] Recruitment (returns per spawner) at equilibrium, by definition, equals 1.0.

With the exceptions noted above, the recovery goals are not of immediate relevance to current harvest management objectives. A subset, at least, of management units will have recover for the ESU to be de-listed, but ESU recovery (i.e. that subset or alternative subsets of recovered units) has not been defined. The recovery goals, as stated by the co-managers, exceed the increase in abundance and productivity necessary for delisting.

6.6.1 Harvest Constraint Cannot Effect Recovery

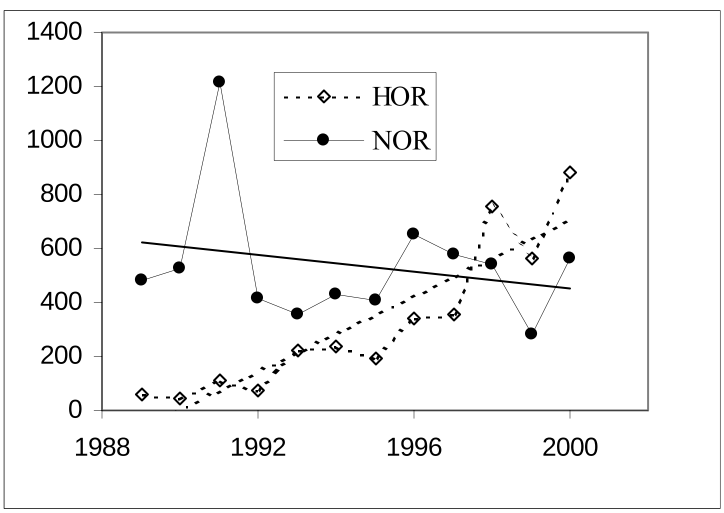
Population recovery (i.e., increase in abundance to levels well above the stated upper thresholds, for most populations) cannot be accomplished solely by constraint of harvest. If harvest mortality is not excessive, and spawning escapement is not reduced to the point where depensatory mortality and other ecological factors become significant and threaten genetic integrity, harvest does not affect productivity. Productivity is primarily constrained by the quality and quantity of freshwater and estuarine environment that determines embryonic and juvenile survival, and oceanic conditions that influence survival up to the age of recruitment to fisheries.

Physical or climatic factors, such as stream flow during the incubation period, will vary annually, and are expected in some years to markedly reduce smolt production. The capacity of chinook to persist under these conditions is primarily dependent on their diverse age structure and life history, and habitat factors (e.g. channel structure, off-channel refuges, and watershed characteristics that determine runoff) that mitigate adverse conditions

For several Puget Sound populations, mass marking of hatchery production has enabled accurate accounting of the contribution of natural- and hatchery-origin adults to natural escapement. Sufficient data has accumulated to conclude that a significant reduction of harvest rates, in concert with increased marine survival, has increased the number of hatchery-origin fish that return to spawn, whereas returns of natural-origin chinook, though stable, have not increased. It is evident that natural production has not increased under reduced harvest pressure, and is constrained primarily by the condition of freshwater habitat. Therefore, the current, relatively low, harvest rates proposed in the HMP, are not impeding recovery.

These escapement data are also available for the North Fork Nooksack and Skykomish populations, but the North Fork Stillaguamish trend is cited here as an example. Fingerlings released by the summer chinook supplementation program are coded wire tagged, enabling accurate estimation of their contribution to escapement. Harvest exploitation rates have fallen 70% since the late 1980s (Table 12). The return of hatchery-origin chinook has increased markedly, exceeding 800 in 2000, while natural-origin returns have remained relatively stable, averaging 522 in the last five years. (Figure 8),

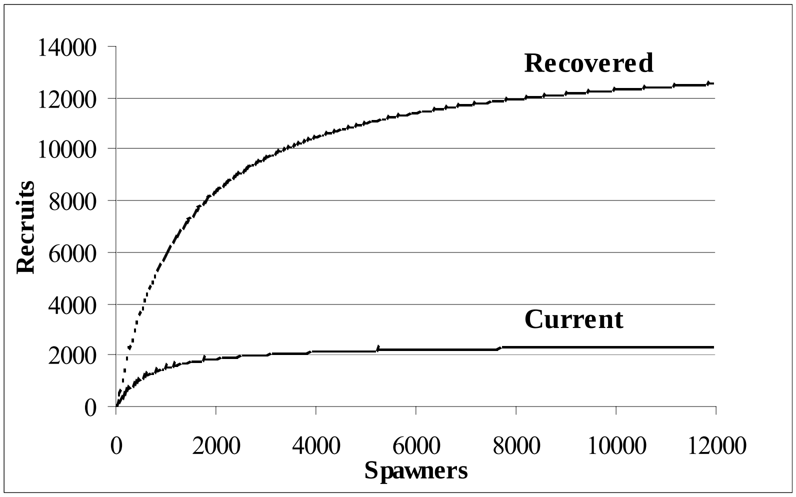
Figure 8. The return of natural-origin (NOR) chinook to the North Fork Stillaguamish River has not increased, while the number of hatchery-origin adults (HOR) have increased significantly under reduced harvest rates



Harvest constraint has, for most populations, resulted in stable or increasing trends in escapement on the spawning grounds (for many populations this includes a large proportion of hatchery-origin adults). But the trend in NOR returns strongly suggests that, although escapement may be stable or even trend upward toward or above the optimum (MSH) level associated with current habitat condition, NOR recruitment will not increase much beyond that level unless constraints limiting freshwater survival are alleviated. Habitat quality appears to be the biggest constraint on freshwater productivity.

Spawner-recruit functions for the North Fork Stillaguamish population, under current and recovered habitat conditions, provide an example (Figure 9). Derived from EDT analysis of habitat capacity under current and recovered conditions, they demonstrate that natural production is now constrained to a ceiling (asymptote) far below that associated with recovery ('properly functioning condition' or 'PFC+').

Figure 9. Productivity (adult recruits) of North Fork Stillaguamish summer chinook under current and recovered habitat (PFC+) conditions. Beverton-Holt functions derived from habitat analysis using the EDT method.



The reduction of harvest pressure in SUS fisheries has, at least, stabilized NOR escapement, and the listed hatchery supplementation program further guards against catastrophic decline. While acknowledging the risk of density dependent effects, implementing the HMP will experimentally test production at these higher escapement levels, and capitalize on favorable freshwater survival conditions that may occur. Under the current harvest objectives, NOR escapement may achieve the current MSH level, but a significant increase in productivity will be necessary for the population to recover. Further harvest constraint will not, by itself, effect an increase above the asymptote associated with current productivity, until habitat conditions improve.

Very similar conclusions can be drawn from examination of current NOR escapement trends in the North Fork Nooksack, Skykomish, and Dungeness rivers. In these systems, NOR returns have remained at very low levels, while total natural escapement has increased where hatchery supplementation programs exist. The contrast between current productivity, and the higher level of recruitment possible under restored habitat condition is marked in all cases.

6.7 Protecting the Diversity of the ESU

The Plan includes management objectives for 21 chinook populations in the Puget Sound ESU, and the one population (the Hoko River) in the western SJDF. The HMP provides a high degree of assurance that, within its six-year duration, all of these populations will persist. The Plan asserts that all extant populations are valuable diversity elements of the ESU. It will allow some populations to reach their viable thresholds, hold others at stable abundance levels, well above their critical thresholds, and assure persistence of those at or near critical abundance. It assures that no population will decline to extinction as a result of harvest.

Highly conservative management objectives are established for the eight natural populations in the Skagit and Snohomish systems. Despite habitat constraints in their watersheds and estuaries, these core populations, in the aggregate, comprise abundant and essential natural production by indigenous stocks that is not dependent on hatchery augmentation. These populations inhabit large watersheds, with habitat, capable of supporting genetically diverse subpopulations of chinook with diverse life histories. The Plan, therefore, emphasizes protection of these core populations which, for the foreseeable future, comprise the strongest element of the ESU, given the uncertainty about recovery of production in other more densely developed and degraded watersheds Protection of these core populations is essential to the integrity of the ESU.

Management objectives for these populations are based on a low tolerance for risk of decline to critical status. Should survival rates and abundance decline, ceiling exploitation rates for SUS fisheries would be reduced. This lower exploitation rate would be well below the equilibrium ER (see section 6.4) that applies to escapements between the LAT and the point of instability, so, on average, equilibrium pressure would force escapement to increase. The rebuilding exploitation rate ceiling provides similar assurance that, given sufficient abundance, under current productivity (survival) conditions, escapement will achieve the level associated with optimum productivity (MSH), as defined by the rebuilding escapement threshold. Escapement will increase, even at exploitation rates higher than the RER, according to the equilibrium exploitation rate assessment, so the RER ceiling gives assurance of not impeding rebuilding. Furthermore, annual target exploitation rates for these populations are expected to be substantially lower than their respective ER ceilings, in most years, thus further improving the probability that escapement will increase or remain at optimum levels. .

Indigenous populations persist in the North Fork Nooksack, North and South Forks of the Stillaguamish River, the Cedar River, the White River, the Green River, the Elwha River and the Dungeness River. Natural spawning is supplemented by hatchery production in the North Fork Nooksack, North Fork Stillaguamish, White, Green, Elwha, and Dungeness rivers, and, for the foreseeable future, will be required, in order to maintain these populations at current abundance levels. Non-indigenous populations persist, and are supplemented by hatchery production, in the Puyallup, Nisqually, and Skokomish rivers.

Except for the Stillaguamish system, the productivity of the naturally spawning chinook in these systems is not yet quantified. Rebuilding exploitation rate and critical exploitation rate ceilings for the Stillaguamish populations provide the same kind of risk-averse management objectives provided for the core, larger populations described above. Habitat-based analysis (EDT), or other information, suggests that natural productivity is very low in the remainder of these systems. Constrained fishing exploitation rates will continue to assure that escapement to natural spawning areas will meet or exceed current escapement goals.

The ecological and genetic risks associated with hatchery supplementation programs, as well as their benefits to ESU diversity and harvest opportunity, have been addressed and considered in the Puget Sound Chinook Hatchery Management Plan (2003). For most of these populations the benefits provided by hatcheries in maintaining higher levels of natural production and continued harvest opportunity may outweigh their ecological or genetic risks. Fishery constraints, by either exploitation rate ceilings and / or escapement goals, are expected to maintain the current status of these ten populations, well above their low abundance thresholds. For the remaining populations, pre-terminal or total SUS harvest is constrained by ER ceilings, and terminal fisheries are carefully structured to meet, and in many cases exceed, natural escapement goals. For the populations whose abundance has been at critical or near-critical levels in the recent past (e.g. the

Nooksack, Stillaguamish, Cedar[3], and White rivers), terminal-area harvest has been and will continue to be tightly constrained to minimize even the small remaining incidental fishery mortality. Rebuilding of abundance to viable levels for these populations may be a long-term prospect (100+ years), dependent on alleviating habitat constraints. The potential for recovery may be higher in drainages that are not heavily urbanized or developed for industrial purposes, such as the Nooksack, the Stillaguamish, and the Elwha systems, providing that stringent habitat protection measures are implemented. Habitat protection and restoration is being aggressively pursued in each watershed.

Populations with critically low abundance are present in the South Fork Nooksack, Mid-Hood Canal, and Dungeness rivers. A hatchery supplementation program has increased the returns to the Dungeness system in recent years, and affords assurance that this population will not become extinct. Harvest mortality of these populations, in SUS waters, is highly constrained because of their critical status, and because the precision of fishery simulation modeling for these small populations is subject to error. The harvest plan, by imposing very low SUS exploitation rate ceilings, will ensure that their risk of extinction is not increased, and will provide sufficient escapement to these rivers to allow these populations to persist in the near term. Critical exploitation rate ceilings will assure small but significant increases in the proportion of each population that escapes to spawn, and maintenance of their genetic diversity. However, given the status of the South Fork Nooksack and Mid-Hood Canal populations, the comanagers will consider the need for artificial supplementation programs to protect them against extinction.

The limits on harvest mortality provided by this plan, or further reduction of incidental harvest mortality in SUS fisheries, will not, by themselves, provide assurance of increased abundance or viability. They can only contribute to recovery of the ESU if habitat constraints are alleviated.

The role of harvest management to enable recovery of the ESU is to ensure that spawning escapement is sufficient to optimize the productivity of populations, in the context of current habitat conditions. Harvest objectives and their implementation will compensate for the uncertainty in productivity and for management error. The constraints on harvest exerted by the HMP assure that the majority of any increase in abundance associated with favorable survival in the freshwater or the marine environment, will accrue to escapement, in order to facilitate increased future production that benefits from the improved productivity conditions. Implementation of the HMP will, in general, allow escapements higher than the current MSH level, to capitalize on the production opportunity provided by favorable, higher freshwater survival conditions. For populations with more uncertain current productivity, implementation will provide stable natural escapement (in many cases considerably higher than the optimum level likely under current conditions) to preserve options for recovering production throughout the ESU in the long term.

In summary, the HMP provides a high degree of assurance that, for the next six years, the core indigenous populations in the Puget Sound ESU will continue to rebuild, and that all other populations will persist at, or above, their current abundance. A recovered ESU will necessarily include regional balance (i.e. geographic and diversity). The NMFS has not yet defined which of the extant populations are essential to a recovered ESU, so the qualifying language in the 4(d) rule, with respect to non-essential populations, does not provide a criterion for the adequacy of this plan. Clearly, systems where non-indigenous populations have been established through

[3] An independent population may also exist in the northern tributary streams of Lake Washington, but specific management objectives for that population await development of key information regarding the abundance and distribution of natural-origin chinook in those streams.

hatchery programs also comprise valuable elements of geographic and genetic diversity. But the ability of harvest management to preserve all existing diversity is limited. Despite the optimism created by the complex recovery planning effort now underway, the current diversity of the ESU may not persist unless habitat constraints are alleviated, thus allowing the natural productivity of chinook population to increase. For those populations that are unlikely to recover in the near term, due to habitat constraints, the HMP preserves the future option to recover if the collective societal will is exerted to preserve their habitat.

6.8 Summary of Conservation Measures

1. Exploitation rates have been substantially reduced from past levels. The fisheries constraints in this plan will keep ER's at low rates.

2. Exploitation rate ceilings established for each management unit using the best available biological information, have been shown to achieve a high degree pf probability of stable abundance under current habitat constraints, while not impeding recovery to higher abundance as habitat conditions and marine survival allow.

3. Rebuilding exploitation rates are ceilings, not annual targets for each management unit. Under current conditions most management units are not producing a harvestable surplus, as defined by this plan, so weak stock management procedures that assure meeting conservation needs of the least productive unit(s) forces the annual target rates for most units below the RER ceiling. Projected ER's in 2000 – 2002 for the Skagit, Stillaguamish, and Snohomish management units were substantially below their respective ceiling rates (Table 15).

Table 15. Annual projected total exploitation rates compared with RERs for natural chinook management units in Puget Sound.

Management Unit	RER	Projected ER			
		2000	2001	2002	2003
Skagit summer/fall	52%	26%	38%	24%	48%
Skagit spring	42%	21%	22%	24%	23%
Stillaguamish summer/fall	25%	13%	17%	14%	17%
Snohomish summer/fall	35% (2000); 32% (2001-02); 24% (2003)	20%	21	18%	19%

4. If a harvestable surplus is available for any management unit, that surplus will only be harvested if a fishing regime can be devised that is expected to exert an appropriately low incidental impact on weaker commingled populations, so that their conservation needs are fully addressed.

5. Exploitation rate objectives will be met for each MU, unless interceptions in Canadian and Alaskan fisheries increase to the extent that unacceptable further reductions in Washington fishing opportunity, on harvestable chinook or species, is necessary to achieve those objectives.

6. If annual abundance is forecast to result in escapement at or below the low abundance threshold, SUS fisheries exploitation rate will be further reduced to the CERC. The low abundance thresholds are intentionally set at levels substantially higher than the actual point of biological instability, so that fisheries conservation measures are implemented to prevent abundance falling to that point.

7. High exploitation rates in the past may have selected against larger, older spawners, thereby changing the age composition or reducing the size of spawning chinook. To the extent that this has occurred, the reduction in exploitation rates required under this plan will increase the proportion of larger, older spawners. The potential for size-, age-, and sex-selective effects of fisheries on spawning chinook are reviewed in Appendix F.

8. The reduction in exploitation rates required under this plan will increase the number of chinook carcasses on the spawning grounds. Any increase in productivity that results from this increase in carcasses will accelerate recovery beyond what was assumed when deriving the ceiling ER's (see Chapter 8 and Appendix D for a more detailed discussion of the nutrient re-cycling role of salmon carcasses).

9. Under all conditions of management unit status, whether critical or not, the co-managers maintain the prerogative to implement conservation measures that reduce fisheries-related mortality farther below any ceiling stated in this Plan. Responsible resource management will take into account recent trends in abundance, freshwater and marine survival, and management error for any unit.

7. Monitoring, Assessment and Adaptive Management

The performance of the fishery management regime will be evaluated annually, to assess whether management objectives were achieved, and identify the factors contributing to success or failure of management. This performance assessment will be documented in an annual report, to be completed by mid-February each year for reference during the annual fishery management planning process.

While much of the information in the annual report will be preliminary, and it can only point to major events, the annual review is intended to inform the co-managers of any significant reasons for possible deviations from expected outcomes in the immediately preceding season. To the extent possible, the co-managers will use this information to assess whether these deviations were caused by the management system, or to unpredictable variation in the catch distribution of the various management units, migration timing, freshwater entry timing, or other environmental and behavioral factors. Management system inaccuracies might include error or bias in abundance forecasts, inaccuracy or bias in the FRAM fishery simulation, inaccurate in-season abundance assessment tools, or the failure of specific regulations to constrain harvest-related impact in the desired manner.

The co-managers recognize that some degree of inaccuracy and imprecision is inherent in these aspects of the management system. The intent of the annual review is to detect significant and consistent inaccuracies that may become problematic over the short term, and to adjust existing tools or devise new tools, to address them.

7.1 Monitoring and Evaluation

The Northwest Washington Indian Tribes and the Washington Department of Fish and Wildlife (WDFW), independently and jointly conduct a variety of research and monitoring programs that provide the technical basis for fisheries management. These activities were mandated by the PSSMP in 1985, though activities related to chinook management have evolved as management tools have improved. Monitoring and assessment essential to the management of Puget Sound chinook is described in detail below, with discussion of how the information is used to validate and improve management regimes. This section is not an exhaustive inventory of chinook research. A wide variety of other studies are underway to identify factors that limit chinook production in freshwater, and to monitor the effectiveness of habitat restoration.

7.1.1 Catch and fishing effort

Chinook harvest in all fisheries, including incidental catch, and fishing effort are monitored and compared against pre-season expectations. Commercial catch, and ceremonial, subsistence, and ‘take-home’ harvest in Washington waters are recorded on sales receipts (‘fish tickets’), copies of which are sent to WDFW and tribal agencies and recorded in a jointly maintained database. A preliminary summary of catch and effort is available four months after the season, though a final, error-checked record may require a year or more to develop.

Catch and effort are estimated in-season for certain chinook fisheries that are limited by catch quotas, such as the ocean troll and recreational fisheries that are managed under the purview of the Pacific Fisheries Management Council. Recreational catch in Areas 1 – 6 is estimated in-season by creel surveys. Creel sampling regimes have been developed to meet acceptable standards of variance for weekly catch.

For other Puget Sound fishing areas, recreational harvest is estimated from a sample of catch record cards obtained from all anglers. The baseline sampling program for recreational fisheries provides auxiliary estimates of species composition, effort, and catch per unit effort (CPUE) to the Salmon Catch Record Card System. The baseline sampling program is geographically stratified among Areas 5-13 in Puget Sound. For this program, the objectives are to sample 120 fish per stratum for estimation of species composition, and 100 boats per stratum for the estimation of CPUE.

Catch and effort summaries allow an assessment of the performance of fishery regulations in constraining catch to the desired levels. Time and area constraints, and gear limitations, are imposed by regulations, but with some uncertainty regarding their exact effect on harvest. For many fisheries, catch is often projected preseason based on the presumed effect of specific regulations. Post-season comparison to actual catch assesses the true effect of those regulations, and guides their future application or modification.

Incidental mortality in fisheries directed at other species has comprised an increasingly significant proportion of the total harvest mortality of Puget Sound chinook, after the elimination of most directed harvest . For many commercial net fisheries in Puget Sound, incidental mortality is projected by averaging a recent period, either as total chinook landed or as a proportion of the target species catch. Recent-year data are the basis for continually updating these projections.

Non-landed mortality of chinook is significant for commercial troll, recreational hook-and-line, and certain net fisheries, regulations for which may mandate release of sub-adult chinook, or all chinook, during certain periods. Studies are periodically undertaken to estimate encounter rates and hooking mortality for these fisheries. Findings from these studies are required to validate the encounter rates and release mortality rates used in fishery simulation models.

Higher priority has been assigned to sampling the catch from certain terminal-area fisheries, to collect biological information about mature chinook. Collection of scales, otoliths, and sex and length data will characterize the age and size composition of the local population, and distinguish hatchery- and natural-origin fish.

7.1.2 Spawning escapement

Chinook escapement is estimated from surveys in each river system. A variety of sampling and computational methods are used to calculate escapement, including cumulative redd counts, peak counts of live adults, cumulative carcass counts, and integration under escapement curves drawn from a series of live fish or redd counts. A detailed description of methods used for Puget Sound systems is included in Appendix E.

Escapement surveys also provide the opportunity to collect biological data from adults to determine their age, length, and weight, and to recover coded-wire tags. Tissue or otolith samples are also used to determine whether they are of hatchery or wild origin, and coded wire tags or otoliths may be used to identify strays from other systems. Depending on the accuracy required of such estimates, more sampling effort will be directed to gathering basic biological data to determine age and sex composition. State and tribal technical staff are currently focusing attention on the design and implementation of these studies.

Escapement surveys also describe the annual variation in the return timing of chinook populations. Given that terminal-area fisheries for chinook have been highly restricted or eliminated throughout Puget Sound, escapement surveys are increasingly relied on to monitor run timing, as well as age composition.

7.1.3 Reconstructing Abundance and Estimating Exploitation Rates

Estimates of spawning escapement and its age composition, and of fishery exploitation rates enable reconstruction of cohort abundance. After adjustment to account for non-landed and natural mortality, these estimates of recruitment define the productivity of specific populations. The principal intent of the current chinook harvest management regime is to set management unit objectives based on the current productivity of their component populations. These objectives will change over time, therefore, in response to change in productivity.

Indicator stocks, using local hatchery production, have been developed for many Puget Sound populations, as part of a coast-wide program established by the Pacific Salmon Commission. These include Nooksack River early, Skagit River spring, Stillaguamish River summer, Green River fall, Nisqually River fall, Skokomish River fall, and Hoko River fall stocks. Additional indicator stocks are being developed for Skagit River summer and fall, and Snohomish summer stocks. To the extent possible, indicator stocks have the same genetic and life history characteristics as the wild stocks that they represent. Indicator stock programs are intended to release 200,000 tagged juveniles annually, so that tag recoveries will be sufficient for accurate estimation of harvest distribution and fishery exploitation rates.

Commercial and recreational catch in all marine fishing areas in Washington is sampled to recover coded-wire tagged chinook. For commercial fisheries, the objective is to sample at least 20% of the catch in each area, in each statistical week, throughout the fishing season. For recreational fisheries, the objective is to sample 10% of the catch in each month / area stratum. These sampling objectives have been consistently achieved or exceeded in recent years (cite Milward or annual 2001 and 2002 annual reports). Mass marking of hatchery-produced chinook, by clipping the adipose fin, has necessitated electronic sampling of catch and escapement to detect coded-wire tags.

Coded-wire tag recovery data enables the calculation of total, age-specific fishing mortality in specific fisheries. These estimates of fishery mortality may be compared with those made by the fishery simulation model (FRAM) to check model accuracy. The FRAM may incorporate forecast or actual abundance and catch, which are scaled against base-year abundance and fisheries. It is recognized that the model cannot perfectly simulate the outcome of the coast-wide chinook fishing regime, so, periodically, the bias in simulation modeling will be assessed. The migration routes of chinook populations may vary annually, and the effect of changing fisheries regulations cannot be perfectly predicted in terms of landed or non-landed mortality.

Mark-selective fisheries, if implemented on a large scale, will exert significantly different landed and non-landed mortality rates on marked and unmarked chinook populations. Accurate post-season assessment of age- and fishery-specific harvest mortality, through a gauntlet of non-selective and mark-selective fisheries, represents a daunting technical challenge, particularly due to the complex age structure of chinook. Release of double index CWT groups (i.e. equal numbers of marked (adipose clipped) and unmarked fish containing distinct tag codes) has been initiated for many indicator stocks, as a means of maintaining the objectives of the coast-wide CWT indicator stock programs. Analyses are in progress to assess if the accuracy of exploitation rates is significantly reduced.

7.1.4 Smolt Production

Smolt production from several Puget Sound management units is estimated to provide additional information on the productivity of populations, and to quantify the annual variation in freshwater (i.e. egg-to-smolt) survival. Methods and locations of smolt trapping studies are described in detail elsewhere (e.g. Seiler et al. 2002, Patton 2003), but in general, traps are operated through the outmigration period of chinook (January – August). By sampling a known proportion of the channel cross-section, with experimental determination of trapping efficiency, estimates of the total production of smolts are obtained. These estimates are essential to understanding and predicting the annual recruitment, particularly in large river systems where freshwater survival has been shown to vary greatly. Abundance forecasts may incorporate any indications of abnormal freshwater survival.

Survival of juvenile chinook is highly dependent on favorable conditions in the estuarine and near-shore marine zones. For many Puget Sound basins, degraded estuarine and near-shore marine habitat is believed to limit chinook production. Studies are underway to describe estuarine and early marine life history, and to quantify survival through the critical transition period as smolts adapt to the marine environment (Beattie 2002).

7.2 Annual Chinook Management Report

The co-managers will write an annual report on chinook fisheries management. Post-season review is part of the annual pre-season planning process, and is necessary to permit an assessment of the parties' annual management performance in achieving spawning escapement, harvest, and allocation objectives. The co-managers review stock status annually and where needed, identify actions required to improve estimation procedures, and correct bias. Such improvements provide greater assurance that objectives will be achieved in future seasons. Annual review builds a remedial response into the pre-season planning process to prevent excessive fishing mortality levels relative to the conservation of a management unit. The annual report will include:

Fisheries Summary

The chronology and conduct of all fisheries within the co-managers' jurisdiction will be summarized, comparing expected and actual fishing schedules, and landed chinook catch. Significant deviations from the pre-season plan will be highlighted, with a summary of in-season abundance assessments and changes in fishing schedules or regulations.

Catch

Landed catch of chinook in all fisheries during the management year (May – April) will be compared with pre-season expectations of catch, including revised estimates of landed catch for the previous management year. For the most recent management year, preliminary estimates of commercial catch from all fisheries will be reported. Creel survey-based estimates of recreational catch in Areas 1 – 6 will also be available. The causes of significant discrepancies between expected and actual catch will be examined, with a view to improving the accuracy of the pre-season projections.

Non-landed Mortality:
Recreational and troll fisheries typically allow retention of chinook above a minimum size, or prohibit retention of chinook during some periods. The ocean troll fishery has been monitored since 1999, using on-board observers and fishers to collect data on encounters with sub-legal chinook. These studies enable comparison of encounters, and consequent mortality, with pre-season expectations.

Spawning Escapement
Spawning escapement for all management units will be compared to pre-season projections, with detail on individual populations reported as possible. Escapements will be compared to escapement goals and critical escapement thresholds. Final and detailed estimates of escapement for the previous year will also be tabulated.

Sampling Summary
The annual review will also include summary of CWT sampling rates achieved in the previous year, and describe biological sampling (i.e., collection of scales, otoliths, and sex and size data) of catch and escapement.

Exploitation Rate Assessment
Annual, adult equivalent exploitation rates for each management unit will be estimated periodically, using the FRAM, incorporating actual chinook catch from all fisheries, and estimates of the actual annual abundance of all chinook units, based on spawning escapement or terminal abundance. These rates will be compared to the preseason expected ER's and ceiling ER's. The 2002 annual report will include post-season FRAM estimates through 2000. Methods are also being developed for assessing annual exploitation rates, for management units with representative indicator stocks, based on coded-wire tag data.

ISBM Index Rates:
The annual report will summarize the Chinook Technical Committee's assessment of whether non-ceiling fishery exploitation rates for indicator management units achieved the PST benchmarks (either 60% of the 1979-1982 mean non-ceiling rate or the 1991-1996 average reduction compared with that base period), for units failing to achieve agreed escapement goals for two consecutive years

The following assessments will be done every 5 years:

Cohort Reconstruction and Exploitation Rate (from CWT data)
Coded-wire tag data will be used to reconstruct brood year AEQ recruitment and exploitation rates for management units with representative indicator stocks, for the five most recently completed broods with complete data. Because coded-wire tag recoveries require at least one year to process and record, estimates for a given brood year will be made six years later, (i.e. after the brood is completely matured).

Comparison to FRAM
The AEQ fishing year and brood year exploitation rates generated from coded-wire tag data will be compared to the corresponding rates estimated annually from post-season runs of the assessment model. Biases will be examined and either accounted for or corrected in future management.

Spawner-Recruit Parameters
The spawner-recruit parameters used to generate the ceiling ER's, thresholds, and recovery goals will be re-examined by including the most recent data on escapement, juvenile production, habitat productivity, marine survival, and recruitment. As appropriate, the ceiling ER's, thresholds, and recovery goals will be updated to account for changes in productivity.

7.3 Spawning Salmon – A Source of Marine-derived Nutrients

Adult salmon provide essential marine-derived nutrients to freshwater ecosystems, as a direct food source for juvenile or resident salmonids and invertebrates, and as their decomposition supplies nutrients to the food web. A body of scientific literature, reviewed in Appendix D, supports the contention that the nutrient re-cycling role played by salmon is particularly important in nutrient-limited, lotic systems in the Northwest. Some studies assert that declining salmon abundance and current spawning escapement levels exacerbate nutrient limitation in many systems. Controlled experiments to test the effect of fertilizing stream systems with salmon carcasses or nutrient compounds show increased primary and secondary productivity, and increased growth rates of juvenile coho and steelhead.

The question this issue poses to chinook harvest management is whether the management objectives stated in this Plan will result in spawning escapement levels that, in fact, are likely to cause or exacerbate nutrient limitation, and thus negatively influence the growth and survival of juvenile chinook, or otherwise constrain recovery of listed populations. Several aspects of this issue are relevant to determining whether such negative influence exists

The role of adult chinook must be examined in the context of escapement (i.e. nutrient potential) of all salmon species. In the large river systems that support chinook, escapements of pink, coho, and chum salmon comprise a large majority of total nutrient input. Changing chinook escapement, therefore, will not increase nutrient loading significantly.

The fertilizing influence of salmon carcasses on chinook depends on a complex array of factors, including their proximity to chinook rearing areas, the influence of flow and channel structure on the length of time carcasses are retained, and chinook life history.

Harvest management strategy must be informed by credible direct or circumstantial evidence indicating that chinook survival is currently limited by nutrient supply.

Post-emergent survival of juvenile chinook is undoubtedly affected by a complex array of other biotic and physical factors. The incidence and magnitude of peak flow during the incubation season, for example, is correlated very strongly with outmigrant smolt abundance in the Skagit River and other Puget Sound systems (Seiler et al. 2000).

Currently available evidence does not support the contention that increasing escapement goals, for chinook or other species, would likely to result in higher chinook abundance or, in the long term, increased harvestable surplus. Under exploitation rate management, which this Plan describes for several management units, escapement will increase as abundance increases. These principles have been in effect since 1998, and increases in escapement have resulted in some systems. This has the same effect as increasing the escapement goal.

The nutrient benefit of increased escapement affects, predominantly, smolt production from that brood year, especially for chinook populations that outmigrate as sub-yearlings. Spawner – recruit analyses will reflect the potential effect of nutrient loading on productivity. Regular updating of the spawner – recruit function is mandated by this plan, and will detect changes in productivity that result from widely variable, and in some systems, increasing, nutrient loading associated with spawning escapement of all salmon.

Unquestionably, further study of the potential for nutrient limitation of chinook growth and survival is warranted. Studies should be designed and implemented to test nutrient limitation hypotheses in several chinook-bearing systems, and in smaller tributary systems that allow controlled experimental design. These studies should include monitoring secondary production of aquatic macroinvertebrates, fingerling condition, smolt abundance and survival to adulthood under controlled conditions to allows isolation of the effect of carcass nutrient loading. They will be difficult to design and implement, such that results are clear and unconfounded by the complexity of physical factors and trophic dynamics freshwater systems. Such studies may, ultimately, lead to quantifying nutrient loading thresholds where effects on chinook growth and survival are evident, to guide harvest management.

Manipulating spawning escapement, or supplementing nutrient loading with surplus hatchery returns will require resource management agencies to consider benefits and potential negative effects from a wider policy perspective. Artificial nutrient supplementation, despite its potential benefits to salmon production, contradicts the long-standing effort to prevent eutrophication of freshwater systems. Use of surplus carcasses from hatcheries also has serious potential implications for disease transmission. Public policy will, therefore, have to be carefully crafted to meet potentially conflicting mandates to protect water quality and restore salmon runs (Lackey 2003).

7.4 Age- and Size-Selective Effects of Fishing

Commercial and recreational salmon fisheries exert some selective effect on the age, size, and sex composition of mature adults that escape to spawn (Appendix F). When and where fisheries operate, the catchability of size and age classes of fish associated with different gear types, and the intensity of harvest determine the magnitude of this selective effect. In general, hook-and-line and gillnet fisheries are thought to selectively remove older and larger fish. To a certain extent related to the degree to which age at maturity and growth rate are genetically determined, subsequent generations may composed of fewer older-maturing or faster growing fish. Fishery-related selectivity has been cited as contributing to long-term declines in the average size of harvested fish, and the number of age-5 and age-6 spawners. Older, larger female spawners are believed to produce larger eggs, and dig deeper redds, which improve survival of embryos and fry. .

There is no evidence of long-term or continuing trends in declining size or age at maturity for Puget Sound chinook.. Available data suggest that the fecundity of mature Skagit River summer chinook has not declined from 1973 to the present. (Orrell 1976; SSC 2002). The age composition of Skagit summer / fall chinook harvested in the terminal area has varied widely over the last 30 years, particularly with respect to the proportions of three and four year-old fish, but there is no declining trend in the contribution of five year-olds, which has averaged 15 percent (Henderson and Hayman 2002; R. Hayman, SSC December 9, 2002, pers comm.)

7.5 Amendment of the Harvest Management Plan

The Plan will continue to evolve. Harvest objectives will change in response to change in the status and productivity of chinook populations. It is likely that the assessment tools will evolve to improve estimation of spawning escapement and cohort abundance. Data gaps are identified for each management unit in their profiles (Appendix A). As these new data accumulate, the co-managers will periodically re-assess harvest objectives for all management units. In general this will occur on a five-year cycle, unless information suggests that rapidly changing status demands more frequent attention.

8. Glossary

Abundance - Abundance is the number of individuals comprising a population or a component of the population, at a given life stage. Abundance may be expressed as brood year escapement (spawners of all ages that survive from one brood year) or return year escapement (the individuals maturing and returning to spawn in a single year). Abundance goals are expressed as numeric life stage targets reflective of the capacity of the associated ecosystem.

Adult Equivalent (AEQ) - The adjustment of fishing mortality to account for the potential contribution of fish of a given age to the spawning escapement, in the absence of fishing. Because not all unharvested fish will survive to contribute to spawning escapement, a two-year-old chinook has a lower probability of surviving to spawn, in the absence of fishing, than does a five-year-old.

Catch Ceiling - A fishery catch limitation expressed in numbers of fish. A ceiling fishery is managed so as not to exceed the ceiling. A ceiling is not an entitlement. [see also **catch quota**]

Catch Quota - A fishery catch allocation expressed in numbers of fish. A quota fishery is managed to catch the quota; actual catch may be slightly above or below the quota. [see also **catch ceiling**]

Cohort Analysis - Reconstruction of the abundance of a population or management unit prior to the occurrence of any fishing mortality. The calculation sums spawning escapement, fisheries-related mortality, and adult natural mortality.

Cohort Size (initial) - The total number of fish of a given age and stock at the beginning of a particular year of life.

Coded-Wire Tag (CWT) - Microtags are implanted in juvenile salmon prior to their release from hatcheries. Recovered by sampling catch and escapement, the binary code on the tag provides specific information about the age and origin of the fish.

Low abundance threshold - A spawning escapement level, set intentionally above the point of biological instability, which triggers extraordinary fisheries conservation measures to minimize fishery related impacts and increase spawning escapement.

Diversity - Diversity is the measure of the heterogeneity of the population or the ESU, in terms of the life history, size, timing, and age structure. It is positively correlated with the complexity and connectivity of the habitat.

Drop-off Mortality - The fraction of salmon encountered by a particular gear type that "drop-off" before they are landed, and die from their injuries prior to harvest or spawning.

Escapement – Adult salmon that survive fisheries and natural mortality, and return to spawn.

Evaluation or Test Fishery - A fishery scheduled specifically to obtain technical or management information, e.g. run timing, abundance, and age composition.

Exploitation Rate (ER) **-** Total mortality in a fishery or aggregate of fisheries expressed as the proportion of the sum of total mortality plus escapement.

Extreme Terminal Fishery – A fishery in freshwater that is assumed to harvest fish from the local management unit.

Fishery – Harvest by a specific gear type in a specific geographical area during a specific period of time.

FRAM - The Fishery Regulation Assessment Model is a simulation model developed to estimate the impacts of Pacific Coast fisheries on chinook and coho stocks.

Gamma Distribution - The gamma distribution is member of the exponential family of distributions. Values of the gamma distribution are positive, ranging from zero to infinity, a property which makes it attractive for modeling variances. Shape and scale parameters describe the distribution.

Harvest Rate (HR) - Total fishing mortality of a given stock expressed as a proportion of the total fish abundance available in a given fishing area at the start of a time period.

Landed Catch – Harvested fish that are taken aboard vessels or shore and retained by fishers. [see also **Nonlanded Mortality**]

Management Period – Based on information about migration timing, the management period is the time interval during which a given species or management unit may be targeted by fishing in a specified area. [see also **Management Unit**]

Management Unit - A stock or group of stocks that are aggregated for the purpose of achieving a management objective.

Maximum Sustainable Harvest (MSH) - The maximum number of fish of a management unit that can be harvested on a sustained basis, that will result in a spawning escapement level that optimizes productivity.

MSH Exploitation Rate – The maximum sustainable harvest (MSH) exploitation rate is the proportion of the stock abundance that could be harvested if long-term yield was to be maximized. The MSH exploitation rate is typically computed assuming stable stock productivity, although annual variability may occur.

Non-landed Mortality – Fish not retained that are otherwise killed as a result of encountering fishing gear. It includes a proportion of sub-legal fish that are captured and released, hook-and line drop-off, and net drop-out mortality. [see **Landed Catch**]

Non-treaty Fisheries - All fisheries that are not treaty Indian fisheries. [see **Treaty Fisheries**]

North of Cape Falcon Forum– A pre-season, management planning process for fisheries in Washington and Oregon, consisting of two public meeting, which occur between the March and April Pacific Fishery Management Council meetings. These meetings provide for an opportunity for discussion, analysis and negotiation among management entities with authority over southern US fisheries.

Parties - The State of Washington and 17 Puget Sound tribes comprise the parties to this plan.

Point of instability - that level of abundance (i.e., spawning escapement) that incurs substantial risk to genetic integrity, or exposes the population to depensatory mortality factors.

Pre-terminal Fishery- A fishery that harvests significant numbers of fish from more than one region of origin.

Productivity - Productivity is the ratio of the abundance of juvenile or adult progeny to the abundance of their parent spawners

Recruitment – Production, quantified at some life stage (e.g. smolts or sub-adults) from a single parent brood year.

Run Size - The number of adult fish in an allocation unit, management unit, stock or any aggregation thereof that is subject to harvest in a given management year.

Shaker Mortality - Nonlanded fishing mortality that results from releasing sub-legal fish, or non-target species. [see **Nonlanded Mortality**]

Southern US Non-Ceiling Index – The index compares the expected AEQ mortalities (assuming base period exploitation rates and current abundance) with the observed AEQ mortalities, by calendar year, over all non-ceiling fisheries in southern US. This index originates from the pass through provision of the Pacific Salmon Treaty.

Stock - a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season.

Terminal Fishery - A fishery, usually operating in an area adjacent to or in the mouth of a river, which harvests primarily fish from the local region of origin, but may include more than one management unit. Non-local stocks may be present, particularly in marine terminal areas.

Treaty Fisheries - Fisheries authorized by tribes possessing rights to do so under the Stevens treaties (see also **Non-treaty Fisheries).**

Tribes - Puget Sound treaty tribes that are parties to this Plan include the: Lummi, Nooksack, Swinomish, Upper Skagit, Sauk-Suiattle, Tulalip, Stillaguamish, Muckleshoot, Suquamish, Puyallup, Nisqually, Squaxin Island, Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Makah.

Viable – In this plan, this term is applied to salmon populations that have a high probability of persistence (i.e. a low probability of extinction) due to threats from demographic variation, local environmental variation, or threats to genetic diversity. This meaning differs from that used in some conservation literature, in which viability is associated with healthy, recovered population status (see McElhany et al. 2000).

9. REFERENCES

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Appendix A: Management Unit Status Profiles

Nooksack River Management Unit Status Profile

Component Stocks

North/Middle Fork Nooksack early chinook
South Fork Nooksack early chinook

Geographic description

The Nooksack River natural chinook management unit is comprised of two early-returning, native chinook stocks that are genetically distinct, geographically separated, and exhibit slightly different migratory and spawning timing. They have been combined into a management unit because their similar migration timing through the fishing areas in the Nooksack River, below the confluence with the South Fork, and Bellingham and Samish Bays.

The North and Middle Forks drain high altitude, glacier-fed streams. Early-timed chinook spawn in the North Fork and Middle Fork from the confluence of the South Fork (RM 36.6) up to Nooksack Falls at RM 65, and in the Middle Fork downstream of the diversion dam, located at RM 7.2. Spawning also occurs in numerous tributaries including Deadhorse, Boyd, Glacier, Thompson, Cornell, Canyon, Boulder, Maple, Kendall, Racehorse, and Canyon Lake creeks. A hatchery-based egg bank and restoration program has operated at the Kendall Creek facility since 1981. Since then up to 2.3 million fingerlings, 142,458 unfed fry and 348,000 yearlings have been released annually into the North Fork, or at various acclimation sites. The yearling release program was discontinued after the 1996 brood because returns showed that survival rates were lower than those of fed fry releases. Since 2001, fingerlings have been released into the Middle Fork, in anticipation of removal of a blocking diversion dam. Beginning in 2003, the Kendall Creek program releases were downsized due to habitat capacity and straying concerns.

The South Fork drains a lower-elevation watershed that is fed primarily by snowmelt and rainfall, not by glaciers. Consequently, river discharges are relatively lower and temperatures relatively higher than the North and Middle forks during mid to late summer and early fall. Some South Fork tributaries have temperature regimes more similar to those in the North and Middle Forks during the late summer and early fall. A hatchery-based egg bank and restoration program operated at the Lummi Skookum Creek facility in brood years 1980 – 1993, but was discontinued when the returns to the hatchery ladder did not occur in significant numbers, and the capture of wild broodstock was not considered appropriate at such low abundances.

Life History Traits

Nooksack early chinook enter the lower Nooksack River from March through July, and migrate upstream over a 30 – 40 day period to holding areas. In the North / Middle Fork spawning occurs in the upper reaches from mid-July through late September, peaking in August. Spawning is currently concentrated in the North Fork, from RM 44 to RM 64, but may not represent the historical spawning distribution. The current distribution may be influenced by station and off-station release locations. Early chinook spawn in the South Fork from its confluence with the North Fork to a cascade at RM 30.4, and in Hutchinson, Skookum, Deer and Plumbago creeks. In the mainstem South Fork spawning is currently concentrated between RM 8 and RM 21. Hutchinson Creek has had the majority of the tributary spawning in recent years. South Fork spawning begins in August, and peak spawning occurs two to three weeks later than in the North / Middle Fork.

The North/Middle Fork Restoration Program utilizes several release strategies from the Kendall Creek Hatchery. Thermal otolith marks are applied to each release group, so their survival and spawning distribution can be evaluated when the fish return as adults. Otolith analysis has shown that strays into the South Fork, while small relative to the total returns of cultured fish to the watershed, can make up to 46% of the early stocks returning to the South Fork.

The release strategy in the of the North/Middle Fork restoration program was changed in 2001 to reduce the on-station release from Kendall Hatchery, which had shown the highest stray rate into the South Fork, from 900,000 fingerlings in 1998 in a series of reductions to 150,000 fingerlings in 2003, the current release goal. At the same time the total off-station release was reduced from 1,700,000 fingerlings in 1999 to 400,000 fingerlings in the North Fork, 200,000 in the Middle Fork, and 50,000 remote site incubator fry in the North Fork in 2003.

Earlier analysis of scales collected from North Fork spawners showed that a large majority (91%) emigrated from freshwater at age-0(WDFW 1995 cited in Myers et al 1998). In contrast, a larger and highly variable (as much as 69 percent) proportion South Fork spawners emigrated as yearling smolts. A more thorough, recent review of the adult scale data collected from natural-origin spawners, for those years when at least 40 samples collected, determined that 29% and 38% of North/Middle and South Fork early chinook, respectively, migrated from the river as yearlings. The number of naturally-produced fingerling and yearling smolts produced by the North / Middle and South forks has not been quantified.

Available information on the age composition of adults returning to the North/Middle forks and the South Fork is presented in Table 1, and indicate a predominance of age-4 returns. Age-5 proportions of these magnitudes are also observed among other Puget Sound spring chinook stocks, e.g. the Suiattle River and White River. Low sample sizes as a result of difficulties in recovering carcasses on the spawning ground require caution in the interpretation of this data.

Table 1. Estimates of the age composition of returning adult early chinook in the North / Middle and South Forks of the Nooksack River.

	Age 2	Age 3	Age 4	Age 5
North / Middle Fork	1%	16%	73%	10%
South Fork	0%	12%	72%	16%

Status

The current status of the Nooksack early chinook stocks is critical. The geometric mean number of natural-origin spawners in the North / Middle Fork, for 1998 – 2002, was 124, though NOR escapement has increased slightly in recent years from very low levels in the late 1990s (Table 2). The number of native, natural-origin spawners in the South Fork remains low, but is also apparently stable. The geometric mean NOR escapement in South Fork, for 1998 – 2002, was 224.

Table 2. Natural-origin escapement of early chinook to the North / Middle Forks and South Fork of the Nooksack River.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
No/Mid Fork	335	8	171	209	74	37	85	160	264	224
South Fork	235	118	290	203	180	157	166	284	267	289

Total natural spawning escapement has been substantially higher, due to returns from the Kendall Creek Hatchery supplementation program, which is considered essential to the protection and recovery of the North / Middle Fork population. In the North / Middle Fork, escapement has increased markedly since 1998, and exceeded 3,700 in 2002. The number of natural spawners in the South Fork has also increased, and reached 625 in 2002 (Table 3).

Table 3. The total number of natural early chinook spawners (i.e., hatchery- and natural-origin) in the North / Middle and South Forks of the Nooksack River. North / Middle Fork estimates exclude hatchery turnbacks.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
No Mid Fk	445	45	224	537	574	370	823	1242	2185	3741
South Fk	235	118	290	203	180	157	290	373	420	625

Survey effort has increased to better estimate the abundance and distribution of spawners throughout the Nooksack Basin, but turbidity due to the glacial origin of the North and Middle Forks hampers efforts to enumerate live fish or redds.

North/Middle Fork escapement in the last three years has been more than three times the average for the preceding five-year period (1992-96), while South Fork populations escapement has been stable at about 200 for the last five years. The recent increase in escapement to the North/Middle Fork (Table 4, Figure 1) is attributable in large part to the increase in releases from the Kendall Creek supplementation program, although earlier increases might be related to the reduction of Canadian harvest in the late 1990s. Recruits per natural-origin spawner in the North and Middle Forks have consistently remained below one recruit per pair of spawners. Preliminary estimates of the number of natural origin spawners in the North/Middle Forks, as determined from otolith studies, indicate that the return rate of natural origin spawners for brood years 1992 through 1995 ranged from 0.08 to 0.59 per spawner (Table 5), well below the replacement rate. The large and increasing number of hatchery-origin fish escaping to the North and Middle Forks suggests that harvest in the southern U.S. is not impeding the rebuilding of the abundance of natural origin spawners. The failure of the NORs to show a substantial increase in abundance similar to that of hatchery-origin fish, during the restricted fisheries in the late 1990s, suggests limitations in the ability of existing habitat conditions to support substantial productivity from the increased spawner abundance.

Table 4: Origin of Spawners in the North/Middle Forks of the Nooksack River (Co-Manager unpublished data).

Return Year	Natural Origin	Cultured Origin	Hatchery Turnbacks	Total
1995	171	53		224
1996	209	328		537
1997	74	500		574
1998	37	333		370
1999	85	738		823
2000	160	1082	891	2133
2001	264	1921	4802	6987
2002	224	3517	3731	7472

Figure 1. Natural-origin and total natural escapement to the North / Middle Fork of the Nooksack River, and Kendall Creek Hatchery releases three years prior.

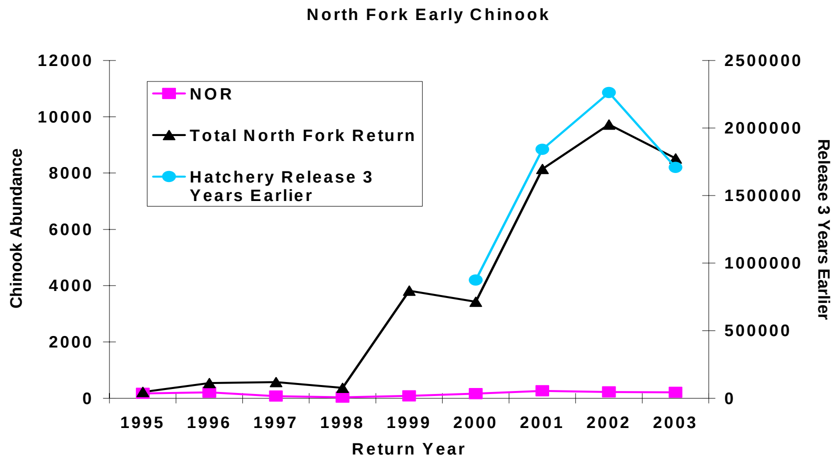


Table 5. Natural origin return per spawner rates for early chinook in the North/Middle Fork of the Nooksack River (Co-Manager unpublished data).

Brood Year	Natural Spawners	Total Age 2 - 6 Returns	Return per Spawner
1992	493	185	0.38
1993	445	76	0.17
1994	45	25	0.56
1995	224	17	0.08
1996	533	247	0.46
1997	574	339	0.59
1998	370	103	0.36
1999*	823	149	0.18

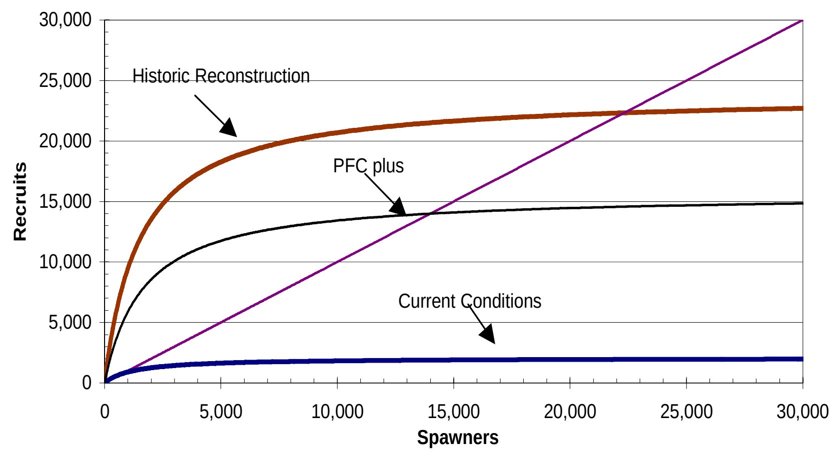
* age 3 and 4 returns only

While there is high variability in the relationship between natural-origin spawners and subsequent returns per spawner for the North / Middle Fork population, and statistical relationship is not significant, the data suggest that the recruitment rate is lower at higher spawner abundance. With the significant increase in natural spawners in recent years, the next four years will provide a clearer picture of the relationship between the number of spawners in the wild and the subsequent recruitment.

The Ecosystem Diagnosis and Treatment (EDT) methodology has produced habitat-based estimates of the productivity and abundance of the Nooksack early populations, under current, historical, and recovered (i.e. 'properly functioning' as identified by the NMFS in the FEMAT process) habitat conditions.

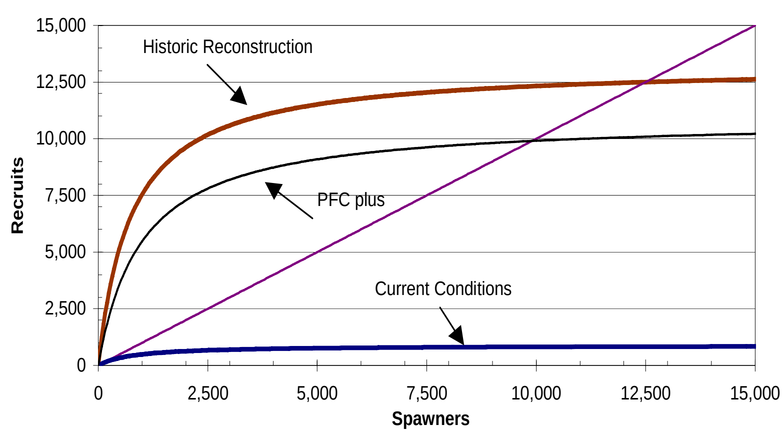
The EDT results for the North/Middle Forks under current conditions estimate capacity at 2,059 adults, equilibrium (i.e. replacement) abundance at 760, and productivity 1.6 adult recruits per spawner, without consideration of fisheries mortality. These results largely agree, but suggest slightly higher productivity than the spawner –recruit relationship derived directly from NOR escapements (Table 4). The EDT analysis indicates that productivity under recovered habitat conditions would be much greater (Figure 2).

Figure 2. Spawner-recruit relationships under current, recovered, and historical habitat conditions in the North / Middle Fork of the Nooksack River, as estimated by EDT analysis.



A similar analysis of the current productivity in the South Fork indicates adult capacity of 885, equilibrium (i.e., replacement) abundance of 80,and a return of 1.1 recruits per spawner. Productivity under recovered conditions would be far in excess of the current level. (Figure 3)

Figure 3. The spawner – recruit functions for South Fork Nooksack early chinook under current, recovered, and historic habitat conditions, as estimated by the EDT method.



The status of the South Fork stock is more difficult to determine in the absence of a reliable brood year return per spawner. The comparison of South Fork early escapement to the early escapement four years later suggest an average spawner replacement rate of 1.21 (Table 6). With the advent of otolith marks for each release strategy in the Kendall Creek Hatchery Program, the North/Middle Fork stock has been identified in the early chinook spawners in the South Fork. Because the 1991 release was the first to be otolith marked and pre-dated the substantial releases of cultured fish in the North and Middle Forks, it is assumed that the straying of North/Middle Fork chinook into the South Fork was low prior to 1995.

Table 6. Origin and replacement rate of early chinook spawners in the South Fork Nooksack River

Brood Year	South Fork stock (no mark)	North Fork stock	Stray - Other or unknown	Total	NOR Brood year +4	Replacement Rate
1991	365			365	290	0.79
1992	103			103	203	1.97
1993	235			235	180	0.77
1994	118			118	157	1.33
1995	166	87	37	290	166	0..57
1996	284	74	14	373	284	1.4
1997	267	138	15	420	267	1.48
1998	289	289	44	625	289	1.84
1999	204	217	148	570	204	0.7
					average =	1.29

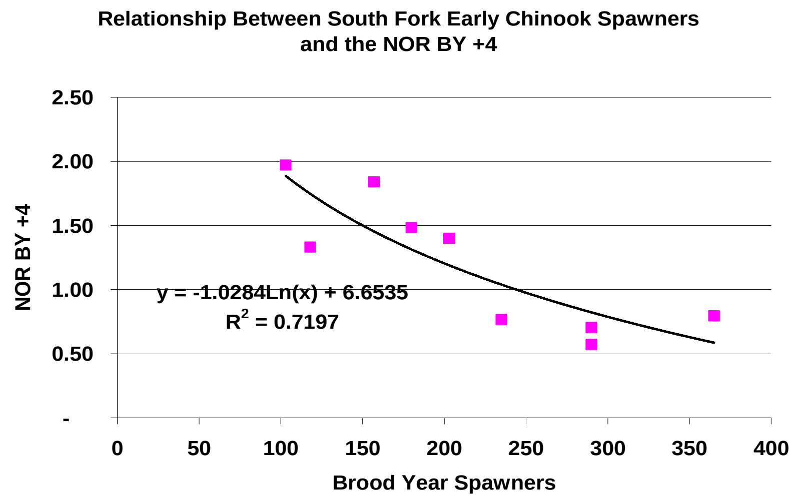
Recent information indicates that as much as 46% of the early chinook spawners in the South Fork have been strays from the Kendall Creek Hatchery program.

Table 7. Estimates of the contributions the native South Fork stock to natural spawning in the South Fork of the Nooksack River, 1999 - 2003.

Return Year	Total Early	South Fork Stock Number	South Fork Stock Percent
1999	290	166	57%
2000	373	284	76%
2001	420	267	64%
2002	625	289	46%
2003	570	204	36%

The relationship between the number of early chinook spawners in the South Fork and the number of natural origin recruits to the spawning grounds 4 years after the brood year (Figure 4) strongly suggests that habitat conditions constrain productivity in the South Fork. This relationship assumes that the reproductive success of the North Fork and other strays is similar to that of the South Fork population, and that the unmarked fish represent only NORs returning to the South Fork, regardless of the origin of the stock.

Figure 4. The relationship between natural origin early chinook spawners in the South Fork and their replacement rate for spawners four years later.



Harvest distribution

Recoveries of coded-wire tagged North Fork early chinook indicate that a majority of the historic harvest mortality occurs outside of Washington waters, primarily in Georgia Strait and other net and recreational fisheries in British Columbia (Table 8). The principles of abundance-based management of chinook, which were agreed to in the re-negotiated Pacific Salmon Treaty Chinook Annex in 1999, did not constrain harvest of Nooksack early chinook in Georgia Strait, where they comprise less than one percent of the total catch. Conservation measures aimed at reducing spring chinook harvest in the Strait of Juan de Fuca and northern Puget Sound have been in place since the late 1980s. There have been no directed commercial fisheries in Bellingham Bay and the Nooksack River since the late 1970's. Incidental harvest in fisheries directed at fall chinook in Bellingham Bay and the lower Nooksack River was reduced in the late 1980s by severely reducing July fisheries. Since 1997, there has been a very limited subsistence fishery in the lower river in early July. Commercial fisheries in Bellingham Bay that target fall chinook have been delayed until August for tribal fishers, and mid-August for non-treaty fishers. After 1997, the release of summer fall chinook from the Kendall hatchery was moved down to the tidal portion of the river and then to the Maritime Heritage Hatchery on the eastern shore of Bellingham Bay, and then eliminated entirely. Fall chinook production at the Lummi Sea Ponds facility was reduced by about 50% to about 1.0 million fingerlings in 1995. This has shifted the emphasis of the terminal area fishery away from the Nooksack River to the Samish Bay and Lummi Bay areas and reduced the proportion of the tribal harvest taken in the Nooksack River.

Table 8. Average harvest distribution of Nookack early chinook, for management years indicated, as percent of total adult equivalent fishery mortality (CTC 2003).

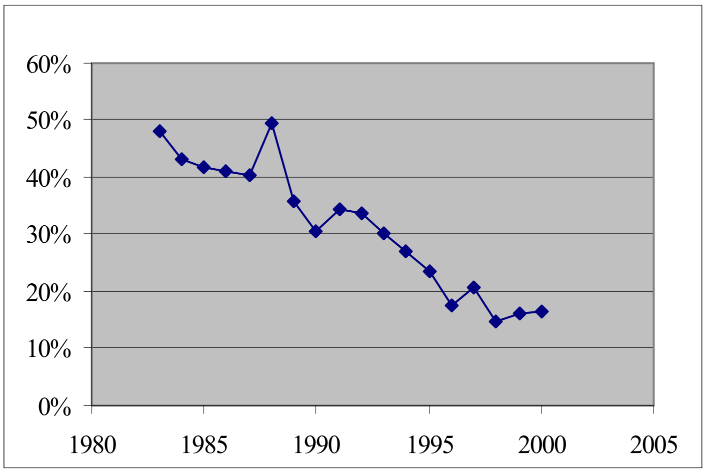
	Alaska	B.C.	Wa troll	PS net	Wa sport
1995-1999 yearlings	0.0%	67.4%	1.9%	6.4%	24.3%
1997-2001 fingerlings	21.5%	65.8%	3.0%	1.5%	8.2%

Coded-wire tag recoveries indicate that, in Washington waters, Nooksack early chinook have been caught in the Strait of Juan de Fuca troll fishery, recreational fisheries in southern and northern Puget Sound, and net fisheries (primarily in Areas 7 and 7A, Bellingham Bay, and the Nooksack River) in northern Puget Sound. The Kendall Creek facility currently releases only fingerling early chinook.

Exploitation rate trends:

The total annual fisheries exploitation rate for Nooksack early chinook, as estimated by post-season FRAM runs, has declined 59 percent, since the 1980s (Figure 1), from levels in excess of 40 percent in 1983 – 1988, to less than 20 percent in the last five years. Some uncertainty is associated with the absolute value of FRAM-based exploitation rates, but they are believed to accurately index the trend in rates. There are no current CWT data to enable a specific computation for the South Fork stock.

Figure 5. Total adult equivalent Exploitation rate of Nooksack early chinook for management years 1983 – 2000, estimated by post-season FRAM runs.



Management Objectives

Management objectives for Nooksack early chinook constrain harvest under co-manager jurisdiction so that it **will not impede recovery**, while allowing for the exercise of treaty-reserved fishing rights and providing non-treaty fishing opportunity on harvestable salmon. The management objective will assure that natural-origin chinook, significantly in excess if MSY escapement levels under current conditions, escape to the spawning grounds to test existing habitat conditions to promote the recovery of the North / Middle and South Fork populations.

The upper management threshold for each Nooksack early population is set at 2,000 NOR spawners. The low abundance threshold for each population is 1,000 NOR spawners. For the next six years it is not expected that the abundance of natural origin spawners of either of the Nooksack early chinook stocks will exceed the low abundance threshold. Under this circumstance, fisheries that impact the escapement of these stocks will be shaped so a critical exploitation rate ceiling of 9% in southern US fisheries is not exceeded; the co-managers' intent is to constrain fisheries so that the projected SUS rate does not exceed 7% in more than once in the next six years.

The low abundance management threshold is currently under review and under current conditions may be significantly less than 1000 spawners. After reviewing the best available information the co-managers in consultation with NMFS may establish more appropriate low abundance management thresholds.

With 87% percent of the total annual harvest mortality occurring in Alaskan and Canadian fisheries (Table 8), the scope for total reducing fisheries impacts in Washington waters is limited. Net, troll, and recreational fisheries in Puget Sound have been shaped to minimize incidental chinook mortality to extent possible while maintaining fishing opportunity on other species such as sockeye and summer/fall chinook. The net fishery directed at Fraser River sockeye, in catch areas 7 and 7A in late July and August, has caught very few Nooksack early chinook.

Table 9. Estimates of the Origin of the Early Chinook Stocks Entering the Nooksack River.

Return Year	North Fk NOR	Total NF & Stray to SF	South Fk NOR	Total River Entry	NF + SF NOR	Percent NOR
1995	171	224	290	514	461	90%
1996	209	537	203	740	412	56%
1997	74	574	180	754	254	34%
1998	37	370	157	527	194	37%
1999	85	3820	166	3986	251	6%
2000	160	3426	284	3710	444	12%
2001	264	8146	267	8413	531	6%
2002	224	9723	289	10012	513	5%
2003	210	8519	204	8723	414	5%

There will be a limited ceremonial and subsistence harvest of Nooksack early chinook in the river, amounting to less than 10 natural origin spawners, and co-migrating cultured stock in excess of spawning requirements, as determined during preseason modeling. In addition, a limited tribal subsistence fishery, targeted at less than 20 natural origin spawners and co-migrating cultured stock in excess of spawning requirement, will occur in early July to meet minimum tribal requirements. These fisheries will occur from Slater Road crossing to the river mouth in the lower Nooksack, and from the Mosquito Lake road crossing down to the SR 9 bridge in the lower North Fork. The projected total harvest of early chinook by in-river tribal ceremonial and subsistence fisheries will be determined, during preseason planning, with reference to forecasted abundance of natural-origin and hatchery returns.

Fisheries in Bellingham Bay and the Nooksack River directed at fall chinook will not open prior to August 1. Subsequent fishing in the Nooksack River occurs in progressively more upstream zones as early chinook clear these areas. Thus the area extending two miles downstream of the confluence of the North and South Forks will not open prior to September 16.

Total exploitation rates projected by the FRAM model for the 2001 – 2003 management years were 18%, 15%, and 20%, respectively. The analysis supporting derivation of a rebuilding exploitation rate (RER) for the Nooksack MU is in progress. It is recognized that tag data do not exist to support a direct analysis of the productivity of the South Fork stock, and given its status, there is ample reason to exert conservative caution in planning fishing regimes.

The co-managers are evaluating the productivity, abundance and diversity of the early chinook runs that could be expected from the Nooksack watershed under properly functioning habitat conditions, as well as those that might have been expected to exist under historical conditions at Treaty time. The calculation of a normal exploitation rate has not be made but at the current escapement goal of 2000 natural origin spawners in each population, and an exploitation rate of 60%, a AEQ recruit abundance of 5,000 in each population would be anticipated. An ambitious and long-term effort to restore and protect habitat, working in concert with appropriate hatchery production and harvest management regimes, is essential to recovery.

Data gaps

Following are the highest priority needs for technical information necessary to understand stock productivity and refine harvest management objectives:

1) Improve estimates of population specific total escapement to the Nooksack basin, with emphasis on North/Middle and South Fork populations, including natural origin fish, and age data on these fish.
    a) Secure resources to read backlog of otoliths collected at the Kendall Creek hatchery to provide a complete evaluation of the contribution of the different release strategies.
    b) Improve the microsatellite DNA stock baselines of all chinook in the Nooksack Basin and conduct analyses to evaluate
        i) the NOR contribution of North/Middle Fork strays to the South Fork that can no longer be identified by otolith marks
        ii) the most appropriate break point to separate early and late chinook spawning in the South Fork
        iii) the relative success of chinook in the South Fork of the different populations as indicated by samples from the South Fork Smolt Trap
        iv) the relative success of North/Middle Fork spawners as indicated by samples collected at the Hovander smolt trap after eliminating the supplementation production identifiable by external mark (Calcein flourescense or fin clip)
    c) Develop alternative spawning ground population estimates that will allow:
        i) Update pre-spawning migration behavior through radio tags or DIDSON technology.
        ii) Increase recovery of carcasses on the spawning ground to improve estimates of the NOR age structure, yearling/sub-yearling contributions, and population composition.

2) Investigate rearing conditions in the river and the estuary and near shore areas to assist in the development of habitat restoration and protection actions.
3) Improve estimates of stock specific natural early chinook smolt outmigration from the North/Middle and South Fork populations and late timed chinook.
4) Develop stock/recruit functions, or other estimates of freshwater survival data to monitor the productivity of the two populations and late timed chinook.
5) Collect information to determine whether the current SUS fishing regime, or the hatchery supplementation program, are exerting deleterious selective effects on the size, sex, or age structure of spawners.

Skagit River Management Unit Status Profiles

Component Stocks

Summer/fall chinook management unit
- Lower Sauk River (summer)
- Upper Skagit River mainstem and tributaries (summer)
- Lower Skagit River mainstem and tributaries (fall)

Spring chinook management unit
- Upper Sauk River
- Suiattle River
- Upper Cascade River

Geographic description

There are two wild chinook management units originating in the Skagit River system - spring and summer/fall chinook. . The co-managers (WDFW and WWIT 1994) identified three spring and three summer/fall populations. The Puget Sound TRT concurred with this delineation in their assessment historical population structure (Currens et al. in prep. 2003).

Summer/fall management unit

The three populations tentatively identified within the summer/fall management unit are: Upper Skagit summers, Lower Sauk summers, and Lower Skagit falls. Upper Skagit summer chinook spawn in the mainstem and certain tributaries (excluding the upper Cascade River), from above the confluence of the Sauk River to Newhalem. Spawning also occurs in Diobsud, Bacon, Falls, Goodell, Illabot, and Clark creeks. Gorge Dam, a hydroelectric facility operated by Seattle City Light, prevents access above river mile (RM) 96, but historical spawning in the high-gradient channel above this point is believed to have been very limited. The lower Sauk summer stock spawns primarily from the mouth of the Sauk to RM 21 - separate from the upper Sauk spring spawning areas above RM 32. The lower mainstem fall stock spawns downsteam of the mouth of the Sauk River, and in the larger tributaries, including Hansen, Alder, Grandy, Jackman, Jones, Nookachamps, Sorenson, Day, and Finney creeks.

Skagit summer/fall stocks are not currently supplemented to a significant extent by hatchery production. A PSC indicator stock program collects summer broodstock (about 40 spawning pairs per year) from the upper river. Eggs and juveniles are reared at the Marblemount Hatchery. The objective of the program is to release 200,000 coded-wire tagged fingerlings for monitoring catch distribution and harvest exploitation rate. Summer chinook fingerlings are acclimated in the Countyline Ponds before they are released. Development of a lower river fall indicator stock was initiated in 1999, with similar production objectives. Production programs for fisheries enhancement of Skagit summer/fall chinook, and plants of fall chinook fingerlings into the Skagit system from the Samish Hatchery have been discontinued.

Spring management unit

The Skagit spring management unit includes stocks originating in the upper Sauk, the Suiattle, and upper Cascade rivers. The upper Sauk stock spawns in the mainstem, primarily above the town of Darrington up to RM 40, the Whitechuck River, and tributary streams. The Suiattle stock spawns in several tributaries including Buck, Downey, Sulphur, Tenas, Lime, Circle, Straight, and Big creeks. Cascade springs spawn in the mainstem above RM 19, and are thus spatially separated from the lower Cascade summer chinook. Spring chinook reared from Suiattle River broodstock are released from the Skagit Hatchery. Annual releases averaged 112,000 yearlings for the period 1982 – 1991 (WDF et al. 1993). Since then, about 250,000 subyearlings have also been released each year. All spring chinook releases are coded-wire tagged.

Life History Traits

The upper mainstem and lower Sauk River and summer stocks spawn from September through early October. Operational constraints imposed by the Federal Energy Regulatory Commission on the Skagit Hydroelectric Project's operation have, to some extent, mitigated the effects of flow fluctuations on spawning and rearing in the upper mainstem, and reduced the impacts of high flood flows by storing runoff from the upper basin. The lower river fall stock enters the river and spawns later than the summer stocks; spawning peaks in October. Age of spawning is primarily 4 years, with significant Age 3 and Age 5 fish. Most summer/fall chinook smolts emigrate from the river as subyearlings, though considerable variability has been observed in the timing of downstream migration and residence in the estuary, prior to entry into marine waters (Hayman et al. 1996).

Spring chinook begin entering freshwater in April, and spawn from late July through early September. Adult spring chinook returning to the Suiattle River are predominantly age-4 and age-5 (WDF et al. 1993 and WDFW 1995 cited in Myers et al. 1998). Glacial turbidity from the Siuattle River and Whitechuck River limit egg survival in the lower Sauk River. Analysis of scales collected from adults on the spawning grounds indicates that the proportion of spawners that outmigrated as yearlings ranged from 20% to 85% in the Suiattle, 35% to 45% in the Upper Sauk, and 10% to 90% in the Upper Cascade system.

Status

Stocks that comprise the summer/fall management unit are depressed. Annual spawning escapement has increased in the last five years (Table 1), but approached the critical threshold of 4,800 in 1997 and 1999. The geometric mean of the last five years' escapement was 12,690, an increase from the geometric mean of 1992-1996, 7,537 (Myers et al. 1998). Recent assessment of freshwater productivity for summer/fall chinook suggests that the current MSY escapement is about 14,500 (see below).

Table 1. Spawning escapement of Skagit River chinook, 1992- 2002.

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Sauk sum	469	205	100	263	1103	295	460	295	576	1103	910
U Skagsum	5548	4654	4565	5948	7989	4168	11761	3586	13092	10084	13815
L Skag fall	1331	942	884	866	1521	409	2388	1043	3262	2606	4866
S/F MU	7348	5801	5549	7077	10613	4872	14609	4924	16930	13793	19591
Cascade sp	205	168	173	226	208	308	323	83	273	625	340
Siuattle sp	201	292	167	440	435	428	473	208	360	688	265
Sauk sp	580	323	130	190	408	305	290	180	388	543	460
Sprg MU	986	783	470	856	1051	1041	1086	471	1021	1856	1065

Spawning escapement for the spring unit has been consistently below 2,000, but has, with the exception of 1994 and 1999, been above the critical abundance threshold of 576. The geometric mean of escapement in 1998 – 2002 was 1,006.

Harvest distribution

Coded-wire tag recovery data for PSC indicator stocks provide a description of the harvest distribution of Skagit chinook, and contrast the differences between summer / fall and spring stocks. Yearling and fingerling releases from Marblemount Hatchery describe the distribution of spring chinook. The Samish Hatchery fall fingerling releases are believed to provide an accurate surrogate for describing the distribution of Skagit summer / fall chinook. Local summer and fall indicator stocks are being developed. Approximately 33 percent of the mortality of summer / fall chinook has occurred in fisheries in British Columbia and Alaska (i.e. outside the jurisdiction of the Washington co-managers). Twelve percent of summer / fall chinook are caught in Washington ocean fisheries. Puget Sound net fisheries and Washington sport fisheries accounted for 54 percent and 11 percent, respectively, of total summer / fall fishing mortality (Table 2). The harvest distribution of yearling and fingerling spring chinook differ, with about 51 and 75 percent of mortality occurring in northern fisheries, respectively. Puget Sound net fisheries account for 4 percent. Washington recreational fisheries account for 43 percent of yearling mortality, and 20 percent of fingerling mortality.

Table 2. Average harvest distribution of Skagit River chinook, for management years 1997 – 2001, as percent of total adult equivalent fishery mortality (CTC 2003 in press)

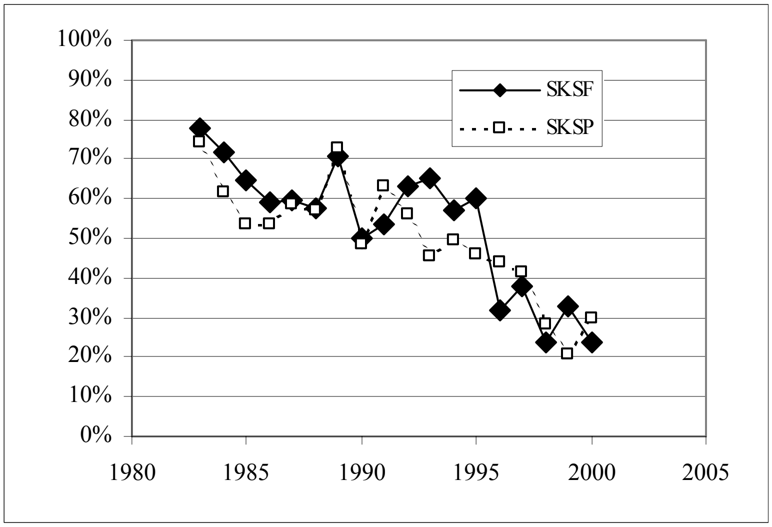
	Alaska	B.C.	Wash. Ocean	Puget Sound Net	Washington sport
Summer Fall	2.6%	30.5%	1.9%	54.1%	11.0%
Spring yrlng	1.1%	50.2%	1.8%	4.2%	42.7%
Spring fing	7.6%	67.6%	0.5%	3.8%	20.5%

Coded wire-tagged Skagit summer and fall indicator stocks, reared from indigenous broodstock at the Marblemount Hatchery, are now being released, and will allow more accurate estimation of harvest distribution and exploitation rates.

Exploitation rate trend:

Annual (management year) exploitation rates for Skagit summer/falls, as estimated by post-season FRAM runs, , have fallen 60 percent, from levels in excess of 60 percent in 1983 – 1987, to an average of 27 percent in 1998 - 2000. Over the same period, exploitation rates for spring chinook have fallen 57 percent, from similar historical levels to a recent average of 26 percent (Figure 1).

Figure 1. Total AEQ fisheries exploitation rate of Skagit summer / fall and spring chinook, estimated from post-season FRAM runs for management years 1983 – 2000.



Management Objectives

Derivation of Upper Management Thresholds

The Puget Sound chinook Evolutionarily Significant Unit (ESU) was listed as "threatened" under the Endangered Species Act in 1999, reflecting the overall poor abundance of the ESU (Myers *et al.* 1998). While the overall abundance of the ESU is poor, and fisheries have been significantly reduced as a result (Puget Sound Indian Tribes and Wash. Dept. Fish and Wildlife 2003), there may exist, from time to time, management units within the ESU that have relatively high abundance, which could support additional harvests. In order to access these harvestable fish, the abundance level that can support additional harvests must first be quantified for each management unit

In the harvest management component of the Puget Sound Comprehensive Chinook Management Plan ("Comprehensive Chinook"), this threshold for harvestable abundance (hereafter, "upper management threshold") is expressed as a spawning escapement level. Under this plan, a management unit has harvestable abundance if, after accounting for expected Alaskan and Canadian catches, and incidental, test, and tribal ceremonial and subsistence catches in southern U.S. fisheries, the spawning escapement is expected to exceed this level, and the unit's projected exploitation rate is expected to be less than its exploitation rate (ER) ceiling. In such cases, additional fisheries, including directed fisheries (fisheries in which this unit comprises the majority of the catch), may be implemented until either the ER ceiling is met, or the expected escapement equals the management threshold (Puget Sound Indian Tribes and Wash. Dept. Fish and Wildlife 2003).

Under the court-ordered Puget Sound Salmon Management Plan, the default threshold that defines harvestable surplus is the level that provides maximum sustained harvest. This objective can, however, be modified by co-manager agreement. For the Skagit summer/fall and spring chinook management units, recognizing the inherent variability in forecasting and recruitment, we define the management threshold as the escapement level that, within the framework of Comprehensive Chinook, is most likely to maximize the long-term catch of that unit. This paper describes the methods used to calculate those thresholds for both Skagit chinook management units.

Methods

Given this definition, the upper management threshold can be calculated analytically. To do this analysis, I wrote a QuickBasic program (CkUBPAge.BAS) (Appendix I) that simulates recruitment, catches, and escapement over a selected period of years, under conditions of uncertainty and error in management, and environmental variation. Because each Skagit chinook management unit is believed to be composed of three separate populations, I wrote this program to simulate up to six populations, each of which can have different productivity and capacity. To mimic current management, the harvest rate is applied on a calendar year basis; thus, each age that matures in a given year experiences the same harvest rate, but each age within a cohort can be harvested at a different rate.

Before doing the modeling, however, it was necessary to resolve three input and modeling questions:

Do we use spawner-recruit parameters that apply to current habitat conditions, or to properly functioning conditions (PFC)?

Because we lack agreed recruitment values for the separate Skagit chinook populations, I used spawner-recruit parameters that had been derived from a habitat-based method, Ecosystem Diagnosis and Treatment (EDT) (Lichatowich *et al.* 1995; Mobrand Biometrics 1999), to get the population-specific spawner-recruit parameters. But because EDT gave Beverton-Holt spawner-recruit parameters under historic conditions and PFC, as well as current conditions, we had a choice to make: which set of parameters should we use for this modeling?

The co-manager policy decision was to use current habitat conditions. The ER ceilings were calculated under assumed current survival rates, so it seemed consistent to assume current conditions when setting the management thresholds. In response to questions about whether this assumption would be responsive to any improvements in habitat, it was noted that these thresholds will be re-evaluated after 5 years, and also that harvest rates would be limited to the current ER ceiling, so if productivity did improve, constraining harvests to the current ER ceiling would allow for escapements to increase above the management threshold. Analyses for Snohomish chinook indicated that, while the calculated MSY escapement under current conditions (approximately 3,000) has been exceeded only 32% of the time in past years, if habitat improved to PFC, and the ER ceiling calculated under current conditions (24%) remained in place, the new MSY escapement (approximately 6,000) would be exceeded 95% of the time, even though the MSY escapement doubled (C. Kraemer, WDFW, *pers. comm.*).

Which point of instability estimates would be used for the summer/fall populations?

For Skagit summer/fall chinook, two sets of point of instability estimates were available: a set derived in 1999 (J. Scott, WDFW, *pers. comm.*), which has been used by NOAA Fisheries for their assessments, and 5% of the EDT-derived historic capacity (5% of capacity is a rule-of-thumb point of instability estimate discussed in Peterman 1977).

Empirical observations indicated that the EDT-derived estimates were too high. In 5 of the last 10 years, Lower Skagit and Lower Sauk escapements were both below the EDT-derived numbers, and in each case, the recruits/spawner rate was well above 1.0 (my program assumes that recruits/spawner averages 1.0 for escapments below the point of instability). During that same time, we did have one Lower Sauk escapement that was also less than its 1999-estimated point of instability, and the recruits/spawner rate for that brood was also well above 1.0, which indicates that that number may also be an overestimate of the point of instability, but, lacking any alternatives, I used the set of estimates derived in 1999 as the points of instability for Skagit summer/falls (Table 1).

Because there were no alternative estimates from earlier years for Skagit springs, and the EDT-derived estimates were the only ones available, I used 5% of the EDT-derived historic capacity as the points of instability for Skagit springs (Table 1). There have been no observed escapements below this point for Suiattle springs, and one near that level for the Upper Cascade population; however, that was in 1999, and the returning brood has not yet fully recruited. For Upper Sauk springs, there have been three observations below its point of instability, two of which have fully recruited, and in both cases the recruits/spawner rate exceeded 1.0.

When modeling a regime that includes a directed fishery, should the denominator used in the calculation of the target ER be the predicted recruitment, or the actual recruitment?

When there is a directed fishery, I modeled the target harvest rate as the harvestable number divided by the recruitment (see Step 8c below). The question was whether the denominator in that calculation should be the predicted recruitment or the actual recruitment. I decided that using the predicted recruitment more accurately simulates our real-world management, in which harvestable numbers are calculated according to predictions; therefore, I used the predicted recruitment in the denominator of that equation.

With these modeling and input questions answered, the steps used to generate the upper management thresholds are as follows:

1. Set the initial inputs. Run-specific inputs are the range of management thresholds that will be tested, the number of runs for each management threshold (each of which starts with a different random number sequence), the number of years for each run, and the populations that will be modeled in the run. Management inputs are the management error distribution, the forecast error distribution, the distribution of freshwater peak flows and marine survival, and the management unit-specific ERs: the ceiling ER, the average ER under incidental fisheries only, the average ER when abundance is critical, the minimum possible ER, and the maximum possible ER. Population-specific inputs are the Beverton-Holt spawner-recruit parameters, point of instability (the escapement level below which the mean recruits/spawner is 1), cohort age composition, initial escapements, and initial recruitments for the ages that precede the recruitments that result from the initial escapements. These inputs are listed in Tables 1 to 5.

2. Set the management threshold.

3. Seed the random number generator

4. Begin each year of a run. Simulate environmental variation that year by multiplying a randomly-chosen freshwater survival factor (Table 4) by the exponential of a cyclically-generated marine survival factor (Table 5). The marine survival factor is of the form:

$$\text{Factor} = A * \sin((\text{Year} / c) + b - 1/c) + \sigma_{sine} * \varepsilon$$

Where A is half the amplitude of the sine curve; b is the starting point on the sine curve, in radians, in Year 1 of the run, with b set at the start of each run to vary randomly between -2π and 2π (i.e., the marine survival cycle can start in Year 1 of each run anywhere from the beginning of the down cycle to the beginning of the up cycle); c * 6 gives the approximate period of the cycle (e.g., c = 4 gives about a 24-year cycle); 1/c is an adjustment I needed to account for starting the run in Year 1, rather than Year 0; σ_{sine} is the standard deviation of the spread around the sine curve; and ε is a normally-distributed error variable with a mean of 0 and standard deviation = 1. A and c were calculated by fitting a sine curve by least squares to the natural logarithms of the 1980-1992 marine survival indices provided by Jim Scott (J. Scott, WDFW, *pers. comm.*) (Table 5; Fig. 1). σ_{sine} is the standard deviation of those indices around that fitted curve.

5. From the spawning escapements that have been initially input or calculated through the program, and the environmental variation factor produced in Step 4, use the Beverton-Holt parameters to generate the population-specific recruitments that will result in 3 to 5 years, and distribute them by age according to the cohort age composition of the population.

6. Sum the age-specific and population-specific recruitments that apply to the current year to calculate the current year's true total recruitment.

7. Multiply the true recruitment by a randomly-chosen forecast error value (Table 2) to calculate the current year's forecasted total recruitment.

8. Using the forecast, generate the current year's target ER. Assume initially that the ER is the average ER under incidental fisheries. If:

   a) The resulting escapement would be less than the sum of the points of instability for all populations modeled, then the critical abundance ER becomes the target;

   b) Otherwise, if the resulting escapement would be less than the management threshold, then the average ER under incidental fisheries remains the target;

   c) Otherwise, the harvestable number is the lesser of the difference between the recruit forecast and the management threshold, and the recruit forecast multipled by the ER ceiling. The target ER becomes the harvestable number divided by the recruit forecast.

9. Divide the target ER by a randomly-chosen management error value (Table 3), to generate the actual ER. Constrain this ER so that it is between the minimum and maximum possible ERs (Table 1).

10. Multiply the actual ER by the true recruitment to generate the catch, and multiply each population-specific and age-specific component of the true recruitment by the complement of the actual ER to get the escapement by population.

11. Go to Step 4 and repeat for 40 years.

12. Increment the random number generator, go to Step 3, and repeat 1000 times.

13. Go to Step 2 and use a different management threshold. Continue until I've identified the management threshold that produces the highest mean catch. That level becomes the management threshold for the Skagit chinook unit being examined.

Results

In preliminary model runs, I tested the sensitivity of the model results to three inputs that are fairly arbitrary: the number of years per run; the number of runs (each started with a different random number seed) for each management threshold tested; and the starting random seed. The results were not affected by the number of runs (the minimum number I tested was 1000 runs) or by the random seed; however, the estimate of the summer/fall chinook management threshold that maximized long-term catch was sensitive to the number of years per run (more years/run gave higher management thresholds). This sensitivity occurred because, as modeled, when abundance drops below the point of instability, it tends to stay there. If this occurs in, e.g., year 20 of a 25-year run, the long-term average catch gets depressed for only 5 years, whereas catch can be depressed for 20 years if this occurs in year 20 of a 40-year run. So there's more of a penalty to falling below the point of instability in longer runs. Since it's more likely that abundance will drop below the point of instability when the management threshold is lower, the runs with more years should favor higher management thresholds.

So I had a subjective decision to make: what should be the number of years per run? I chose 40 years/run (Table 1), feeling that this provided a middle-ground on the penalty for letting abundance fall below a point of instability – more than a 25-year run, and less than a 100-year run (the lengths of the runs were also limited by the amount of time it took to run the program). A 40-year run is about 10 generations of chinook salmon, and approximately 2 marine survival cycles, which I felt provided a sufficient range of variability in the analysis.

Skagit summer/fall chinook:

The maximum mean modeled catch, 13,094, occurred at management thresholds of both 14,000 and 15,000 (Table 6). I therefore split the difference, thereby deriving a Skagit summer/fall chinook management threshold of 14,500. As explained above, I used 40-year runs to derive this threshold. If I had used 25-year runs (which is the time period that was used to establish the ceiling ERs), the maximum mean modeled catch would have occurred at a management threshold of 12,000. With 100-year runs, the maximum mean modeled catch would have occurred at a management threshold of 16,000.

Skagit spring chinook:

The maximum mean modeled catch, 1598, occurred at management thresholds of both 2000 and 2100 (Table 7). Splitting the difference would give a management threshold of 2050. However, while rounding the threshold to the nearest hundred is consistent with other Puget Sound chinook goals, rounding to the nearest ten isn't. So the choice was between 2000 and 2100, and, since the previous Skagit spring chinook goal had been rounded to the nearest thousand (3000), the co-managers agreed to use 2000 as the management threshold for Skagit spring chinook. For springs, the management threshold was not sensitive to the number of years/run; with both 25-year runs and 100-year runs, the management threshold would still have been 2000.

Discussion

It might be argued that there is not much difference between the average catches shown in Tables 6 and 7, and that a different management threshold might be selected with little effect on long-term catch. That may or may not be true (I didn't examine the degree of fluctuation between individual catch years). However, the intent of this exercise was to calculate an answer that had *a* *single solution* that would achieve previously-defined criteria, in order to avoid the conflicts that result from trying to agree on arbitrary buffers or numbers that "look good". In this case, the criterion was maximization of mean catch, no matter how small the difference in mean catch. And, while there was subjectivity involved in some of the inputs (e.g., years/run – see above), it was objective in that the analysis yielded a single solution.

The proposed management thresholds, 14,500 for summer/falls and 2,000 for springs, are considerably higher than the MSY escapement levels that would be calculated analytically, without consideration of management error and environmental variation, from the spawner-recruit parameters listed below. From the parameters listed below, using Ricker's (1975) formulae for computing MSY escapement levels in a Beverton-Holt function, the MSY escapement levels under current conditions would be 7,700 for summer/falls and 900 for springs. Thus, by accounting for observed levels of management error and bias (both the forecasts and the target exploitation rates have tended to be overestimates of the post-season numbers – see Tables 4 and ?), and environmental variation, and by assuming the incidental catch rates observed in recent years under the Comprehensive Chinook framework, the management thresholds that maximize long-term catch are approximately double the MSY escapement levels calculated from formulae that do not account for those factors.

For summer/falls, this management threshold of 14,500 is almost the same as the former spawning escapement goal, 14,900, that was set in 1977. It is somewhat surprising that the two numbers are so close, since the former goal was nothing more than the average escapement calculated for the years 1965-1976 (Ames and Phinney 1977), and no analysis of production relationships was involved in its calculation.

For Skagit springs, on the other hand, the management threshold of 2,000 is considerably lower than the former spawning escapement goal of 3,000, which was set in 1975. This former goal was also calculated only as the average of escapements from an earlier period of years (1959-1973 in this case), rounded to the nearest thousand (Management and Research Division 1975), and the fact that the currently-calculated threshold is significantly different is not a great surprise, especially given that the biologists who now do the spawning escapement estimates have expressed considerable skepticism about the accuracy of the escapement estimates from those earlier years (P. Castle, WDFW, *pers. comm.*). In addition, it has been noted (C. Kraemer, WDFW, *pers. comm.*) that, with exploitation rates on springs slashed by about 70% in recent years, it would be expected that there would be a significant increase in resulting run sizes if there is a lot of unused capacity in the system. The fact that run sizes have instead remained fairly stagnant probably indicates that recent escapement levels (the highest in recent years was about 1900) are not far under the system capacity. By this reasoning, therefore, using directed fisheries to crop off escapement, when the escapement is expected to exceed 2,000, would be unlikely to detract from future production.

In summary, the calculated upper management thresholds for Skagit chinook are:

Skagit summer/fall chinook:	14,500
Skagit spring chinook:	2,000

Table 3. Input values used to generate management thresholds for Skagit summer/fall and spring chinook. See Tables 4 to 6 and Appendix I for data sources.

Run-Specific Inputs:
Number of years/run: 40
Number of runs: 1,000
Initial random seed: -15,000
Increment between seeds: 1

Management and Environmental Inputs:
Forecast Error: (See Table 2)
Exploitation Rate Error: (See Table 3)

ER Inputs:	Summer/Fall Chinook	Spring Chinook
Ceiling ER	52%	42%
Mean ER Under Incidental Fisheries	34%	28%
Mean ER Under Critical Abundance	29%	25%
Minimum Possible ER	15%	6%
Maximum Possible ER	90%	90%

Distribution of Peak Flows: See Table 6
Marine Survival Parameters (see Table 7 for the historic indices):
A (half of amplitude): 0.53
Period: 24 years
c (period/6): 4
σ_{sine}: 0.633
Maximum Deviation Factor from Spawner-Recruit Curve: 5.0
Minimum Deviation Factor from Spawner-Recruit Curve: 0.1

Population-Specific Inputs:

	Up Skagit Summers	Lo Skagit Falls	Lo Sauk Summers	Up Sauk Springs	Suiattle Springs	Up Casc Springs
Bev-Holt a	17,600	10,600	4,500	2,600	500	900
Slope at Origin	9.2	3.3	5.9	8.5	8.2	8.0
Point of Instability	967	251	200	210	40	80
% Age 3	25%	25%	25%	5%	5%	5%
% Age 4	60%	60%	60%	59%	59%	59%
% Age 5	15%	15%	15%	36%	36%	36%
Initial Escapement	9,600	2,300	610	350	430	330
Initial Recruitment	Calculated by age as Initial Escapement/(1-Incidental ER) * Age Comp					
Extinction Level	10	10	10	10	10	10

Table 4. Run size estimation error values used in the program to generate management thresholds for Skagit summer/fall and spring chinook. The in-season update (ISU) error was used, rather than the preseason forecast error, because directed fisheries (which would be conducted if the escapement is predicted to exceed the management threshold) would most likely be managed according to an in-season update.

Year	ISU	Post-Season	Difference	% Error (ISU/Post - 1)
1984	15838	16791	-953	-5.7%
1985	23360	25444	-2084	-8.2%
1986	18583	22500	-3917	-17.4%
1987	17347	13542	3805	28.1%
1988	18992	16229	2763	17.0%
1989	21403	13568	7835	57.7%
1990	16586	20615	-4029	-19.5%
1991	17382	9707	7675	79.1%
1992	17933	11855	6078	51.3%
1993	15150	8255	6895	83.5%
Mean	18257	15851	2407	26.6%
Std Dev	2507	5597	4782	39.4%
SE Mean	793	1770	1512	12.5%

Table 5. Exploitation rate error values used in the program to generate management thresholds for Skagit summer/fall and spring chinook. The error values used in the program are the 1988-93 and 1997-2000 rates listed in the two right-hand columns, under "S/F Ck" and "Spr Ck". The 1997-2000 values were calculated from the validation (post-season) and FRAM ER Index (preseason) values shown in this table. The 1988-1993 error values were calculated by Gutmann (1998).

	Validation Run		FRAM ER Index		FRAM Preseason U		% Difference (PSF/Validation - 1)		
Year	S/F Ck	Spr Ck	S/F Ck	Spr Ck	S/F Ck	Spr Ck	S/F Ck	Spr Ck	Combined
1988	58%	59%					22.6%	8.1%	
1989	71%	75%					-10.1%	-17.7%	
1990	50%	50%					12.6%	-0.6%	
1991	53%	65%					-7.1%	-16.2%	
1992	63%	57%					-12.7%	-6.9%	
1993	65%	46%					-18.6%	20.8%	
1994	57%	51%							
1995	60%	47%							
1996	30%	45%							
1997	37%	42%	85.0%	80.6%	51.3%	47.3%	38.7%	12.5%	
1998	23%	30%	62.7%	53.6%	37.9%	31.4%	64.6%	4.7%	
1999	33%	23%	74.9%	74.4%	45.2%	43.6%	37.1%	89.6%	
2000	24%	32%	45.2%	39.4%	27.3%	23.1%	13.8%	-27.9%	
2001			62.8%	37.7%	37.9%	22.1%			
2002			40.7%	41.4%	24.6%	24.3%			
2003									
89-93 avg	60.4%	58.6%					-2.2%	-2.1%	-2.2%
97-02 avg	29.3%	31.8%	61.9%	54.5%	37.4%	31.9%	38.5%	19.7%	29.1%
all yrs avg							14.1%	6.6%	10.4%
Std Dev							27.0%	32.8%	29.5%
SE Mean							8.5%	10.4%	6.6%

Table 6. Freshwater flow survival values for Skagit chinook. The values used in the program to compute management thresholds are those in the column labeled "Ratio to Mean". "RI" is flood return interval. Survival rates were calculated from a relation between flood return interval and incubation survival, using survival vs. peak flow data provided by Seiler *et al.* (2002), and converting peak flow to a flood return interval (E. Beamer, Skagit System Cooperative, *pers. comm.*).

Date	Brood Year	Survival	Ratio to Mean	Peak Discharge	RI (yr)
December 26, 1972	1972	17.5%	1.15	53600	1.8
January 16, 1974	1973	16.0%	1.05	77600	4.3
December 21, 1974	1974	17.6%	1.15	51400	1.6
December 4, 1975	1975	6.2%	0.40	130000	30.9
January 19, 1977	1976	17.6%	1.15	52800	1.7
December 3, 1977	1977	16.9%	1.11	65600	2.8
November 8, 1978	1978	18.0%	1.18	40300	1.1
December 19, 1979	1979	10.6%	0.69	112000	15.7
December 27, 1980	1980	10.2%	0.66	114000	17.0
February 16, 1982	1981	17.5%	1.14	55800	1.9
December 4, 1982	1982	16.5%	1.08	71600	3.5
January 5, 1984	1983	14.8%	0.97	88200	6.5
January 0, 1900	1984	18.0%	1.18		1.0
January 19, 1986	1985	16.4%	1.07	72800	3.6
November 24, 1986	1986	16.6%	1.08	70700	3.4
December 10, 1987	1987	18.2%	1.19	32100	0.8
October 17, 1988	1988	17.4%	1.14	56700	2.0
December 5, 1989	1989	13.4%	0.88	97800	9.2
November 25, 1990	1990	1.5%	0.10	152000	70.3
February 1, 1992	1991	18.0%	1.18	40100	1.1
January 26, 1993	1992	18.3%	1.19	27600	0.7
December 11, 1993	1993	18.2%	1.19	32100	0.8
December 28, 1994	1994	17.3%	1.13	58600	2.1
November 30, 1995	1995	3.5%	0.23	141000	46.6
January 20, 1997	1996	17.7%	1.15	50800	1.6
October 5, 1997	1997	17.0%	1.11	64800	2.7
December 14, 1998	1998	17.3%	1.13	58200	2.1
November 13, 1999	1999	16.1%	1.05	76000	4.1
October 21, 2000	2000	18.3%	1.19	26700	0.6
January 8, 2002	2001	16.5%	1.08	71900	3.5
Mean		15.3%	1.000	70441	8.2
Std Dev		4.4%	0.290	33040	
SE Mean		0.81%	0.053	6135	

Table 7. Values used to fit a sine curve to the natural logarithm of the marine survival index for Skagit summer/fall chinook. Period of cycle is approximately 24 years.

Brood Year	Marine S Index	ln(index)	aSin((Yr+b)/c)	Deviation	Dev-squared
80	0.755	-0.2810	0.52832	-0.8094	0.655059
81	4.313	1.4616	0.501463	0.9602	0.921928
82	1.232	0.2086	0.443427	-0.2348	0.055126
83	1.281	0.2476	0.357822	-0.1102	0.01214
84	1.783	0.5783	0.249969	0.3283	0.1078
85	0.413	-0.8843	0.126574	-1.0109	1.021881
86	2.352	0.8553	-0.00469	0.8600	0.739526
87	0.739	-0.3025	-0.13566	-0.1668	0.02782
88	0.775	-0.2549	-0.2582	0.0033	1.1E-05
89	0.801	-0.2219	-0.36469	0.1428	0.02039
90	1.66	0.5068	-0.4485	0.9553	0.912626
91	0.293	-1.2276	-0.50442	-0.7232	0.522962
92	0.374	-0.9835	-0.52898	-0.4545	0.206585
				SSE	5.20385
Mean	1.290077	-0.02288		MSE	0.400
Median	0.801	-0.22189		RMSE	0.63269

a =	0.53
b =	2
c =	4

Figure 2. The best fit sine-curve to Skagit summer/fall chinook marine survival indices for brood years 1980-1992. The period of the curve is about 24 years.

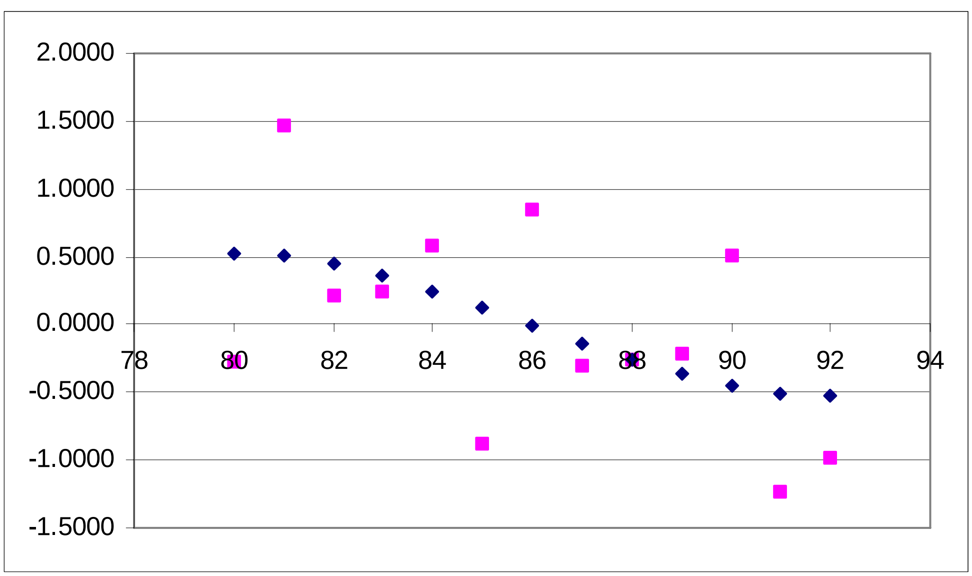


Table 8. Modeled mean annual catch, escapement, number of directed fisheries, and number of population extinctions, in 1,000 runs of 40 years each, at different management thresholds, for Skagit summer/fall chinook. Threshold with maximum catch is bolded.

Skagit Summer/Fall Chinook

Management Threshold	Mean Catch	Mean Escapement	Number of Directed Fisheries	Population Extinctions
10000	12943	9430	29190	7
11000	13003	9706	27435	6
12000	13053	10000	25565	4
13000	13083	10290	24338	4
14000	13094	10579	23167	1
15000	13094	10885	21783	0
16000	13084	11189	20599	0
17000	13066	11484	19480	0
18000	13044	11780	18493	0
19000	13006	12085	17348	0
20000	12961	12386	16243	0

Table 9. Modeled mean annual catch, escapement, number of directed fisheries, and number of population extinctions, in 1,000 runs of 40 years each, at different management thresholds, for Skagit spring chinook. Threshold with maximum catch is bolded.

Skagit Spring Chinook

Management Threshold	Mean Catch	Mean Escapement	Number of Directed Fisheries	Population Extinctions
1500	1569	1664	28056	0
1600	1578	1692	27244	0
1700	1586	1724	26317	0
1800	1592	1755	25323	0
1900	1597	1785	24441	0
2000	1598	1812	23483	0
2100	1598	1838	22558	0
2200	1596	1860	21732	0
2300	1592	1880	20922	0
2400	1587	1898	20145	0
2500	1582	1916	19499	0

Derivation of exploitation rate objectives

Summer / fall chinook

The management objectives for Skagit summer/fall include a recovery exploitation rate that insures, while maintaining fishing opportunity, that harvest will not impede recovery, and low abundance thresholds that guard against abundance falling below the point of instability (Hayman 1999a; 2000a; 2000b). Recovery exploitation rate objectives were developed to meet the following criteria:

1) The percentage of escapements less than the critical abundance (i.e. escapement) threshold increases by less than 5 percentage points relative to the baseline (i.e., in the absence of fishing mortality).

2) Escapements at the end of 25 years exceed the rebuilding escapement threshold at least 80% of the time; **or** the percentage of escapements less than the rebuilding threshold at the end of 25 years differs from the baseline by less than 10 percentage points.

The critical abundance threshold is defined as that which would result in a 5 percent probability that the management unit would become extinct (i.e. fall below 100) at the end of ten years. Since a satisfactory method to calculate critical escapement has not been developed, escapement equal to 5 percent of the stock replacement level was chosen (Hayman 1999a). Replacement escapement is based on the current productivity of the management unit, and therefore incorporates parameters that define the Ricker stock / recruit functions for Skagit units, and recent freshwater and marine survival. For the summer / fall unit, the critical escapement level is 1,165 (Hayman 2000a and 2000b).

The rebuilding escapement threshold is that current level for which there is a 99 percent probability that the run will persist at viable levels. Put another way, if current exploitation rates and freshwater and marine survival conditions were maintained, the probability that the run would go extinct (i.e., fall below 100) at the end of 100 years would fall below one percent. The rebuilding escapement threshold for summer / fall chinook was computed by simulating the population dynamics for 100 years, given a recent average brood year exploitation rate and age composition of escapement, for a range of initial escapement levels. Simulations were replicated 2,000 times, until an initial escapement resulted in extinction in fewer than 1 percent of those replicate runs (Hayman 1999a; 2000b). The rebuilding escapement threshold is 4,700 for the summer/fall unit

With the critical and rebuilding escapement levels established, the population dynamics of the summer / fall Skagit unit was simulated for 25-year periods into the future. The simulation model incorporated the average age composition and age-specific escapement of the units, and randomly or cyclically varying productivity and management error parameters. Each model run used an input exploitation rate, and was replicated 2000 times. The probabilities of exceeding the recovery escapement level, or falling below the critical escapement level, at the end of the simulation period were computed for each run from the 2000 outcomes. A range of exploitation rates, from 0 to 80 percent, were simulated to determine the maximum exploitation rate at which the conservation criteria were met (Hayman 1999a; 2000b). The Washington co-managers have set a rebuilding exploitation rate ceiling of 5 percent for the Skagit summer/fall management unit, as estimated from coded-wire tag recoveries. This management objective was developed from productivity functions characteristic of brood years of Skagit chinook, and was translated into an annual exploitation rate, that is output from the FRAM model, of 50% (Table 4). This exploitation rate objective was set to be 82 percent of the mean rate from fishing years 1989-1993 for summer/fall chinook (Hayman 2000c).

Low abundance thresholds ("crisis escapement levels") were also established for the summer/fall management unit. These thresholds are defined as the pre-season forecast escapement for which there is a 95 percent probability that the actual escapement will be above the point of instability, given management error and uncertainty about what level the point of instability is (Hayman 1999a;2000b). The derivation of these thresholds takes into account the difference between forecast and observed escapement in previous years, and variance of the spawner-recruit parameters used to calculate the point of instability, thereby reducing the probability of actual escapement falling below the actual point of stock instability. The derivation involved varying the preseason forecast until the area of overlap between the management error distribution curve and the uncertainty curve about the point of instability is less than 5% of the error distribution curve (Hayman 2000b).

In low-abundance years, when projected spawning escapement (from the FRAM model) fall to the lower thresholds, fisheries managers will implement further conservation measures in fisheries to reduce mortality, as described in Section 3 and Appendix C. For the summer/fall management unit, the low abundance threshold is 4,800. For the summer/fall unit, low abundance thresholds have been developed for each component population, so that forecast weakness in any one population may trigger the more conservative harvest regime. The low abundance thresholds for Upper Skagit summers, Lower Sauk summers, and Lower Skagit falls are 2,200, 400, and 900, respectively (Hayman 2000a).

The escapement of individual summer/fall populations may be projected from the aggregate escapement, which is output from the simulation model, in proportion to brood year escapement for each population, or in proportion to estimated age-3 and age-4 adults recruited from their brood-year escapement. Survival rates to compute recruitment will be those implied by the Ricker spawner / recruit function for each population.

Spring chinook

Population	***Modeled CET***	***Modeled RET***	A&P RER	FRAM RER
Suiattle	170	400	50%	41%
Upper Sauk	130	330	46%	38%
Cascade	170	Data insufficient to derive a spawner-recruit analysis. RERs for other Skagit spring populations will be used as surrogate		
Spring MU	470[4]	990	47%	38%

Introduction

The rebuilding exploitation rate (RER) is the highest allowable ("ceiling") exploitation rate for the population under normal conditions of stock abundance. This rate is designed to meet the objective that, compared to a hypothetical situation of zero harvest impact, the impact of harvest at this rate will not significantly impede the opportunity for the population to grow towards the recovery goal. Fisheries are then managed to not exceed the ceiling rate. Recovery will require changes to harvest, hatchery, and habitat management. However, our task involves examining only the impacts of harvest on survival and recovery within the context of actions that are occurring in the other sectors affecting listed salmon. Therefore, we evaluate the RER based on Monte Carlo projections of the near-term (25 years) future performance of the population under current productivity conditions, i.e., assuming that the impact of hatchery and habitat management actions remain as they are now. The RER will be periodically evaluated to see if the actions taken in hatchery and habitat management, or changes in natural environmental

[4] In order to account for management error and uncertainty, the spring chinook LAT in this plan will remain at 576 (Hayman 2000b).

conditions would require revisions of our assumptions about productivity or capacity. The RER is defined as the rate that would result in escapements unlikely to fall below a critical escapement threshold (CET) and likely to rebuild above a rebuilding escapement threshold (RET). All sources of fishing-related mortality are included in the assessment of harvest.

There are two phases to the process of determining an RER for a population. The first, or model fitting phase, involves using recent data from the target population itself, or a representative indicator population, to fit a spawner-recruit relationship representing the performance of the population under current conditions. Population performance is modeled as

$$R = f(S, \mathbf{e}),$$

where S is the number of fish spawning in a single return year, R is the number of adult equivalent recruits[5], and **e** is a vector of environmental, density-independent correlates of annual survival.

Several data sources are necessary for this: a time series of natural spawning escapement, a time series of total recruitment, age distributions for both of these, and time series for the environmental correlates of survival. In addition, one must assume a functional form for f , the spawner-recruit relationship. Given the data, one can numerically estimate the parameters of the assumed spawner-recruit relationship to complete the model fitting phase.

The second, or projection phase, of the analysis involves using the fitted model in a Monte Carlo simulation to project the probability distribution of the near-term future performance of the population assuming that current conditions of productivity continue. Besides the fitted values of the parameters of the spawner-recruit relationships, one needs estimates of the probability distributions of the variables driving the population dynamics, including the process error (including first order autocorrelation) of the spawner-recruit relationship itself and each of the environmental correlates. Also, since fishing-related mortality is modeled in the projection phase, one must estimate the distribution of the deviation of actual fishing-related mortality from the intended ceiling. This is termed "management error" and its distribution, as well as the others are estimated from available recent data.

We used the viability and risk assessment procedure (VRAP)(N. Sands, in prep.) for the projection phase. For a series of target exploitation rates the population is repeatedly projected for 25 years. From the simulation results we computed the fraction of years in all runs where the escapement is less than the CET and the fraction of runs for which the average of the spawning escapements in years 21-25 is greater than the RET. Target exploitation rates for which the first fraction is less than 5% and the second fraction is greater than 80% (or less than 10% than would have occurred without harvest) are considered acceptable for use as ceiling exploitation rates for harvest management. These are the RERs.

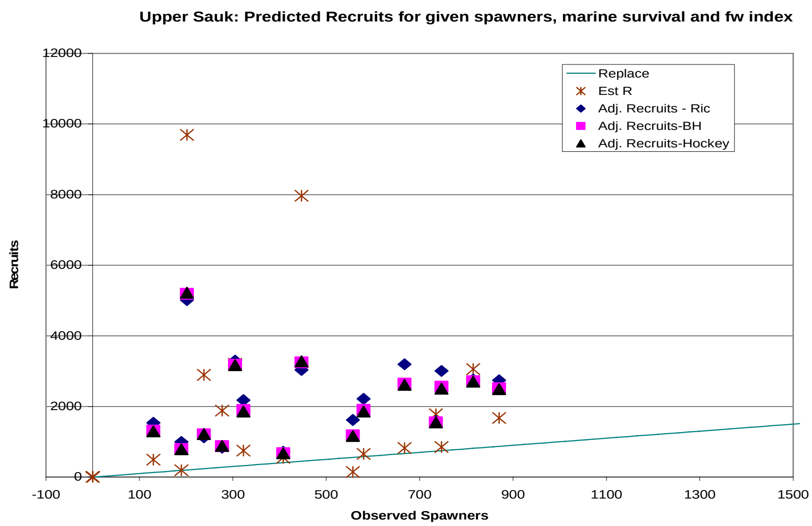
[5] Equivalently, this could be termed "potential spawners" because it represents the number of fish that would return to spawn absent harvest-related mortality.

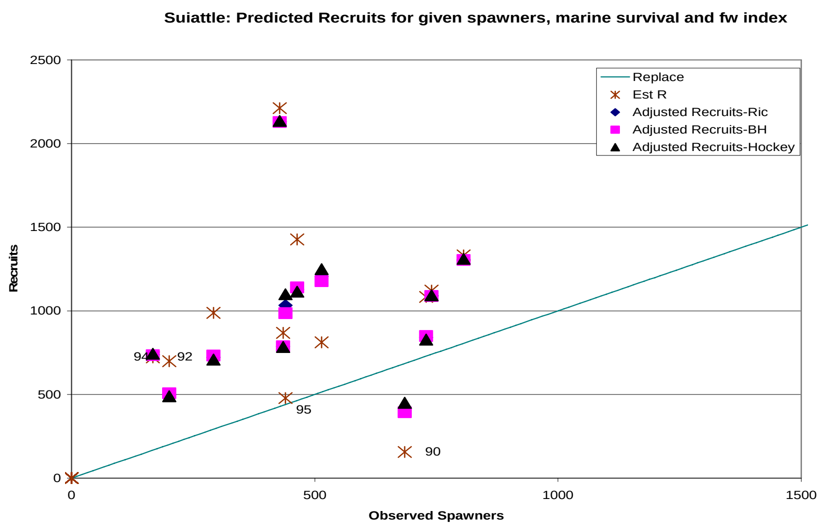
MODEL FITTING PHASE

General

To derive the Suiattle and Upper Sauk spring chinook RERs, we examined the 1981 to 1997 brood years. Uncertainty about data quality of escapement and fishing rates, and residual analyses that indicated a change in system productivity, precluded use of data before 1980. After adjusting for environmental factors, there was no evidence of depensation in the data (Figures 3a and 3b). The 1997 brood year was the last year for which data were available to conduct complete cohort reconstruction.

Figures 3a and 3b. Upper Sauk (1a) and Suiattle (1b) spring chinook recruits adjusted for marine and freshwater environmental conditions





The symbols marked Adj. Recruits (-Bev, -Ric, and –Hoc) in the above figures denote the recruits that would have been produced without the influence of the environmental correlates that drive year to year survival. This allows us to look at the effect of spawners only on the number of recruits produced. We need to remove the effects of other factors, such as the environment, if we want to look for possible depensation which is a function of the number of spawners. Adjusted recruits are calculated for each year as follows:

$$\text{Adjusted recruits} = \frac{\text{Recruits}}{(\text{Annual Environmental Factor/Average Environmental Factor})}$$

$$\text{Annual Environmental Factor} = (\text{Marine survival index\^{}c})(e^{(d*\text{freshwater flow})})$$

$$\text{Average Environmental Factor} = \sum_{year=1}^{t} Annual\_Environmental\_Factor \Big/ t$$

Where c and d are constants from the spawner-recruit relationship

Escapement estimation methods changed in 1994. Although the two methods result in different escapement estimates in any one year, preliminary comparisons of the two methods do not indicate a consistent difference. There was some concern that because the correlation between the old and new method was weaker for the Upper Sauk than for the Suiattle population, it might preclude use of the data to derive an RER for the Upper Sauk spring population. For the Suiattle, the coefficient of variation of the escapement estimates made before this method change is approximately the same as the coefficient of variation of the estimates since 1994, which indicates comparable measurement accuracy in both time periods; in contrast, the greater coefficient of variation in the Upper Sauk before 1994 indicates that measurement error in the Upper Sauk was probably greater before 1994 than since that time (Table 10).

Table 10. Average number of spawners with standard deviation and coefficient of variation (CV) for three time periods.

	Cascade	Upper Sauk	Suiattle
1952-1974			
average		1225	825
st dev		917	378
Cv		75%	46%
autocorrel		0.35	0.27
1975-1993			
average	192	540	546
st dev	84	384	234
Cv	44%	71%	43%
autocorrel		0.22	0.16
1994-2002			
average	284	309	385
st dev	151	138	158
Cv	53%	45%	41%
autocorrel		0.39	(0.37)

While more variable than those of the Suiattle, the Upper Sauk escapements correlated with independent estimates of marine survival, both before and after the change in escapement estimation methods in 1994. This suggests that the estimates prior to 1994 provide useful information about the behavior of the population. If the data were random, one would not expect any correlation with marine survival, and, in fact, when this assumption was tested, the randomized data had no correlation with any marine survival indices (probability of recruitment fit from random data = 96.2-99.9%)(N. Sands, memo to Skagit RER workgroup, 9/2/03). For the Upper Sauk data, since the information is used to derive the productivity parameter for the spawner-recruit models, we also looked to see if the ratio of recruits/spawner (productivity) was significantly different depending on which escapement estimation method was used. Examination of the 1989-1997 data did not indicate a significant difference in the slopes (t-stat = -1.5; prob = 0.1<x< 0.2) or intercepts (t-stat = 1.34; prob = 0.2) of the relationship between spawners and the natural log of recruits/spawner using the old and new escapement estimates. Therefore, we concluded that we did not have sufficient data to demonstrate that the spawner-recruit relationship for the Upper Sauk spring population would be significantly different depending on the escapement estimation methodology used. Therefore, we used the available escapement data (1981-1993 using peak live and dead counts, 1994-1997 using redd counts) to derive the spawner-recruit parameters for the Upper Sauk population (Table 11). When sufficient data is available using the current method based on cumulative redd counts, the RERs will be revised based on that method.

Table 11. Comparison of R/S values under the escapement estimation methods used before and after 1994. The 1989 brood year would be the first returns affected since they would return as 5 year olds in 1994.

	Spawners		Recruits		R/S estimates		Difference
Brood yr	old	new	old	new	old	new	(oldR/S-newR/S)
1989	668	668	1325	821	2.0	1.2	0.8
1990	557	557	659	146	1.2	0.3	0.9
1991	747	747	4282	852	5.7	1.1	4.6
1992	580	580	844	656	1.5	1.1	0.3
1993	323	323	711	749	2.2	2.3	-0.1
1994	574	130	498	496	0.9	3.8	-2.9
1995	1115	190	191	193	0.2	1.0	-0.8
1996	1079	408	553	551	0.5	1.4	-0.8
1997	264	305	3193	3212	12.1	10.5	1.6
1989-97 geomean	596	379	897	589	1.5	1.6	
1989-97 minimum	264	130	191	146	0.2	0.3	
1989-97 maximum	1,115	747	4,282	3,212	12.1	10.5	
1989-97 st. deviation	293	215	1,407	920	3.8	3.2	

Fishery Rates

Fishery rates for both populations were based on the Skagit spring yearling chinook hatchery indicator stock. Although the stock also has a significant fingerling component (41% and 50% on average for the Suiattle and Upper Sauk, respectively), there are only four years (three consecutive) of available exploitation rate data for the fingerling component; too few to define a spawner-recruit relationship. Preliminary analysis indicates there may be differences between yearling and fingerling exploitation rate patterns, but the data is insufficient to determine with any certainty the direction and magnitude of those differences. We considered using fingerling data from the Nooksack early populations, but that population has a much lower percentage of naturally-occurring yearlings and a different harvest pattern, so there was a great deal of uncertainty about whether the Nooksack population would be representative. A Skagit spring chinook fingerling hatchery indicator stock has been established and the co-managers' are collecting data on fingerling exploitation rate patterns. We will re-examine the data for differences in exploitation rate patterns when several more years of data are available. The hatchery indicator stock is used to represent the natural component also because the natural component is not tagged.

The Pacific Salmon Commission Chinook Technical Committee (CTC) CWT exploitation rate analysis for the Skagit spring indicator stock by age was used for brood years 1981 to 1996, ages 2-4 for brood year 1997 and ages 2-3 for brood year 1998. The 1997 age 5+ fishery rate was based on an average of the 1995-96 rates and the 1998 ages 4-5+ were based on an average of the 1996-1997 rates because the current CTC CWT exploitation rate analysis is not complete for these ages for these brood years. For the purposes of the analysis, fishing rates through brood year 1997 were used since this is the most recent brood year for which we have the most available information. Fishery rates will continue to be updated as data become available.

Maturation Rates

Maturation rates were derived from age data collected from scales from the spawning grounds combined with the age-specific fishing rates described above. Age data taken from scales sampled from the spawning grounds were available for return years 1986-90 and 1992-2001 for the Suiattle, and 1986, 1992-95 and 1997-2001 for the Upper Sauk population (WDFW and SSC data 2002). However, we identified two potential concerns that should be taken into account when using the data: 1) age 2 fish are generally underrepresented in spawning ground samples for several reasons: e.g., carcasses decay faster, the smaller body size makes them more susceptible to being washed downstream, they are less visible to samplers; and 2) only eight years for the Suiattle and five years for the Upper Sauk had a sufficient number of samples to use. The age structure for other years was extrapolated from the average brood year age composition of the years that met the sample size criterion to reconstruct brood year and calendar year escapements by age. The age structure is then adjusted to minimize the difference between both the estimated calendar year escapements and the observed calendar year escapements, and the estimated brood year escapements and the observed brood year escapements for each year for which data are not available. Scale samples collected from areas immediately adjacent to the hatchery were excluded because the presence of hatchery fish was assumed to be substantial. Both yearling and fingerling age data were used in order to represent the full range of life histories present in the basin.

Hatchery Effectiveness/Hatchery Contribution to Natural Spawning

The coded-wire tag indicator stock program is the only hatchery production of Skagit spring chinook in the Skagit basin. Straying of hatchery fish onto the spawning grounds from either inside or outside the basin has been negligible based on spawner survey information (WDF et al. 1993, Skagit RER Workgroup 2003). Therefore, hatchery effectiveness is not considered an issue in the derivation of spawner-recruit parameters for the Skagit spring chinook populations.

Spawner-recruit Models

The data were fitted using three different models for the spawner recruit relationship: the Ricker (Ricker 1954, as referenced in Ricker 1975), Beverton-Holt (Beverton and Holt 1957, as referenced in Ricker 1975), and hockey stick (Barrowman and Meyers 2000). The simple forms of these models were augmented by the inclusion of environmental variables correlated with brood year survival. A wide variety of marine and freshwater covariates were evaluated and the ones with the best correlations to estimated recruits/spawner were chosen for further analysis. For marine survival we tried several indices of survival based on chinook coded-wire tag groups from: several Canadian hatcheries in Georgia Strait; several Washington coastal hatcheries; North Puget Sound hatcheries only; South Puget Sound hatcheries only, an aggregate of groups from throughout Puget Sound; Hood Canal hatcheries only; and an aggregate of Puget Sound spring chinook hatcheries. We also evaluated the spawner-recruit function assuming marine survival does not influence the relationship. The other environmental correlate, associated with survival during the period of freshwater residency, was the maximum daily average October 1-February 28 stream flow during the fall and winter of spawning and incubation from the 1) Sauk River USGS gauge near Sauk (gauge # 12189500), 2) the Whitechuck gauge (gauge # 12186000, which is actually on the Sauk just upstream from the Whitechuck), and 3) the Mount Vernon gauge (gauge # 12200500). For the Upper Sauk, we also evaluated the level of spring releases from the Marblemount Hatchery, and the peak instantaneous flow from October to September at the Sauk River gauge (# 12189500). During the time period that escapement and fishing rates data were available, we evaluated the spawner-recruit relationship for three time periods: 1981-1997, 1984-97 and 1986-1997. The spawner-recruit relationship, after adjusting for environmental conditions, appeared relatively constant based on an analysis of the residuals. The results, detailed in Sands (2003), are summarized in Tables 3 and 4, with parameter estimates shown in Tables 5 and 6. A good fit was defined as one with probability of less than 5% for escapement and less than 20% for recruits of being a random fit.

Equations for the three models are as follows:

$$(\mathbf{R} = \mathbf{aS}e^{-\mathbf{bS}})(\mathbf{M}^{\mathbf{c}}e^{\mathbf{dF}})$$ [Ricker]

$$(\mathbf{R} = \mathbf{S}/[\mathbf{bS} + \mathbf{a}])(\mathbf{M}^{\mathbf{c}}e^{\mathbf{dF}})$$ [Beverton-Holt]

$$(\mathbf{R} = min[\mathbf{aS}, \mathbf{b}])(\mathbf{M}^{\mathbf{c}}e^{\mathbf{dF}})$$ [hockey stick]

In the above, M is the index of marine survival and F is the freshwater correlate.

Table 12. Results of the spawner-recruit relationship fits for various marine and freshwater covariates for the Suiattle spring chinook population. For each run, the best S/R function fit is noted.

Years	Marine Survival Index	Freshwater Discharge	Model Fit (% esc, % recruit)
1981-97	N. Puget Sound cycle	Sauk max daily ave. Oct-Feb	0, 1
	Puget Sound cycle	Sauk max daily ave. Oct-Feb	0, 0
	Puget Sound cycle	Whitechuck max daily ave	Same as Sauk
	Puget Sound cycle	Mt. Vernon max daily ave	Same as Sauk
	Georgia Strait cycle	Sauk max daily ave. Oct-Feb	0, 2
1984-97	N. Puget Sound cycle	Sauk max daily ave. Oct-Feb	2, 4
	Puget Sound cycle	Sauk max daily ave. Oct-Feb	0, 3
	Puget Sound cycle	Whitechuck max daily ave	Same as Sauk
	Puget Sound cycle	Mt. Vernon max daily ave	Same as Sauk
	Georgia Strait cycle	Sauk max daily ave. Oct-Feb	
1986-97	N. Puget Sound cycle	Sauk max daily ave. Oct-Feb	
	Puget Sound cycle	Sauk max daily ave. Oct-Feb	0, 25
	None	**Sauk max daily ave. Oct-Feb**	**0, 11**

Table 13. Results of the spawner-recruit relationship fits for various marine and freshwater covariates for the Upper Sauk spring chinook population. For each run, the best S/R function fit is noted.

Years	Marine Survival Index	Freshwater Discharge	Model Fit (% esc, % recruit)
1981- 97	**Puget Sound cycle**	**Sauk max daily ave. Oct-Feb**	**0,3**
	Puget Sound cycle	Whitechuck max daily ave	Same as Sauk
	Puget Sound cycle	Marblemount spring releases	0,2
	Puget Sound cycle	Instantaneous Sauk Peak Oct-Sep	0,1
	N. Puget Sound cycle	Instantaneous Sauk Peak Oct-Sep	0,1
	Hood Canal ave.	Instantaneous Sauk Peak Oct-Sep	0,15
	Georgia Strait cycle	Sauk max daily ave. Oct-Feb	0,7
1985-97	Puget Sound cycle	Whitechuck max daily ave	0,9
1986-97	Puget Sound cycle	Whitechuck max daily ave	1,16
	Georgia Strait cycle	Sauk max daily ave. Oct-Feb	3,21
	Hood Canal ave.	Instantaneous Sauk Peak Oct-Sep	2,47

The model fits were evaluated based on the size of the predictive error (MSE), probability of the model being fit by random for escapement data and recruits, the ability of the model to estimate productivity at low abundance and the reasonableness of the model's predicted performance at higher escapement levels, relative to our observations. As seen from Tables 12 and 13, most of the model runs met the criteria for a low probability of resulting from random fit.

For the Suiattle population, the model with the lowest probability of a random fit was the model using the Puget Sound cycle for the marine index and the Sauk maximum daily average winter freshwater flow during 1981-97. However this model and several others did a poor job of estimating productivity at low abundance even though the probability of random fit was low. The model for the 1986-97 period assuming no influence from marine survival and using the Sauk maximum daily average winter freshwater flow had the best overall combination of a low predictive error, probability of random fit and estimate of productivity at low abundances compared with the other model runs (Figures 2 and 3, Tables 5a and 5b). In particular, the data points were well distributed along the spawner-recruit curve, both the predicted and observed data fit the curve defined by the spawner-recruit relationship well, and there was little difference among the three spawner-recruit functions (Figure 3). Finally, while both the 1981-97 and 1986-97 relationships estimated capacity at about 800 spawners, the 1981-97 relationship implied considerable redd superimposition between 400 and 800 spawners which has not been observed in the field with escapements in this range.

For the Upper Sauk population, there were two models with the lowest probability of a random fit: the peak Oct-Feb winter freshwater flow combined with 1) the North Puget Sound fall fingerling cycle marine index; and 2) the Puget Sound cycle marine index, during 1981-97. However, the data points for the models for the period 1981-97 using the Puget Sound marine index were better distributed along the spawner-recruit curve (Figures 4 and 5). There was little difference in the fit among the models using the Puget Sound cycle marine index or their estimates of the escapement at maximum sustained yield[6] (Tables 6a and 6b). The model using the Puget Sound cycle for the marine index and the Sauk maximum daily average winter flow for

[6] The Beverton-Holt function did a poor job of describing productivity at low escapement regardless of the model.

the 1981-97 period was used as the representative model of this group for purposes of deriving the RER since it fit well and it matched the freshwater variable used for the Suiattle .

Figure 4. Comparison of observed and predicted recruitment for the Suiattle spring population, brood years 1981-97 data, the Puget Sound cycle marine index and Sauk maximum daily average winter flows, under three different models of the spawner-recruit relationship. The corresponding spawner-recruit parameters are listed in Table 5a.

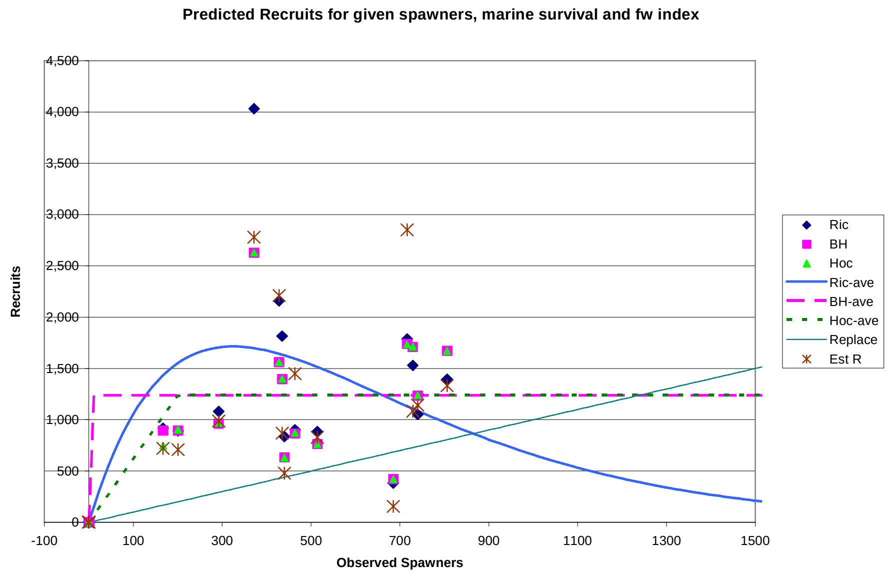


Figure 5. Comparison of observed and predicted recruitment for the Suiattle spring population, brood years1986-97 data, no marine index and Sauk maximum daily average winter flows, under three different models of the spawner-recruit relationship. The corresponding spawner-recruit parameters are listed in Table 5b

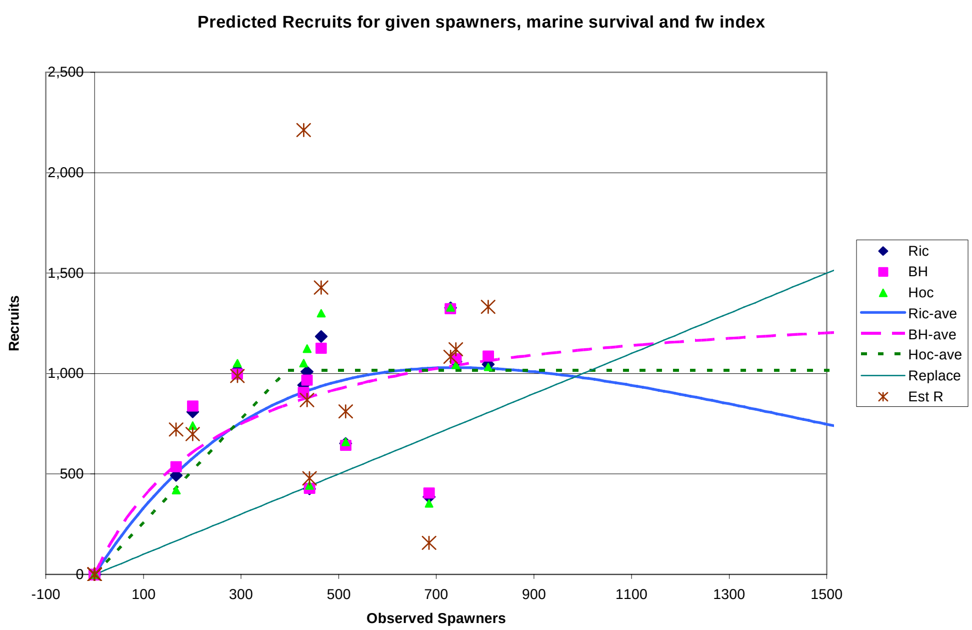


Table 14a (left) and 14b (right). Results of spawner-recruit analysis for the Suiattle using different time periods and environmental covariates.

	14a			14b		
Marine Index	**Puget Sound cycle**			**none**		
Freshwater variable	**Sauk maximum daily ave. Oct-Feb**			**Sauk maximum daily ave. Oct-F**		
calendar years esc. compared	**1986-1997**			**1991-1997**		
brood years used	**1981-1997**			**1986-1997**		
Parameter Estimates With Smallest S	**Ric**	**Bev**	**Hoc**	**Ric**	**Bev**	**Hoc**
a - productivity	27.8956	0.0000	13.1729	6.5805	0.1112	4.6642
b - Spawners	0.003293	0.000380	2,648	0.001351	0.000417	1,835
c - Marine	0.8132	0.7634	0.7604	0.9800	0.9800	0.9800
d - Freshwater	-0.000012	-0.000017	-0.000017	-0.000022	-0.000021	-0.000024
SSE	0.287	0.707	0.705	0.019	0.024	0.016
MSE (esc)	0.036	0.088	0.088	0.005	0.006	0.004
autocorrelation in error	0.090	0.018	0.027	-0.034	-0.147	0.040
R - esc	0.949	0.866	0.867	0.992	0.989	0.993
F(3,8)	24.122	8.035	8.063	118.032	93.600	138.566
PROBABLITIY	0.0%	0.8%	0.8%	0.0%	0.0%	0.0%
MSE (recruits)	0.272	0.274	0.270	0.215	0.227	0.195
autocorrelation in error	0.028	-0.068	-0.059	-0.163	-0.127	-0.220
R - recruits	0.822	0.750	0.748	0.636	0.614	0.684
F(3,13)	9.014	5.579	5.506	3.060	2.728	3.959
PROBABLITIY	0.6%	2.3%	2.4%	15.6%	17.9%	11.3%
Ave.Pred. Error	1020	1218	1219	469	480	440

	Ric	Bev	Hoc	Ric	Bev	Hoc
slope at origin, intrinsic prod.	27.90	1000.00	13.17	6.58	9.00	4.66
average MS*FW factor	0.75	0.66	0.65	0.57	0.59	0.55
cv MS/FW	61/17	57/23	57/24	0/34	0/32	0/36
adjusted productivity at origin	20.79	657.36	8.61	3.78	5.31	2.58
replacement level	920	1,730	1,730	980	1,160	1,020
capacity = spawners for max recruits	300	1,730	200	740	1,420	400
max recruits	2,320	1,730	1,730	1,030	1,420	1,020
MSY spawners	260	10	210	410	350	400
MSY recruits	2,300	1,730	1,730	890	810	1,020
MSY ER	0.89	0.99	0.88	0.54	0.57	0.61
ave ER last 3yrs	0.72	0.72	0.72	0.69	0.69	0.69

Figure 6. Comparison of observed and predicted recruitment for the Upper Sauk spring population, brood years 1981-97 data, the North Puget Sound cycle marine index and peak instantaneous Oct-Sep flow at the Sauk gauge, under three different models of the spawner-recruit relationship.

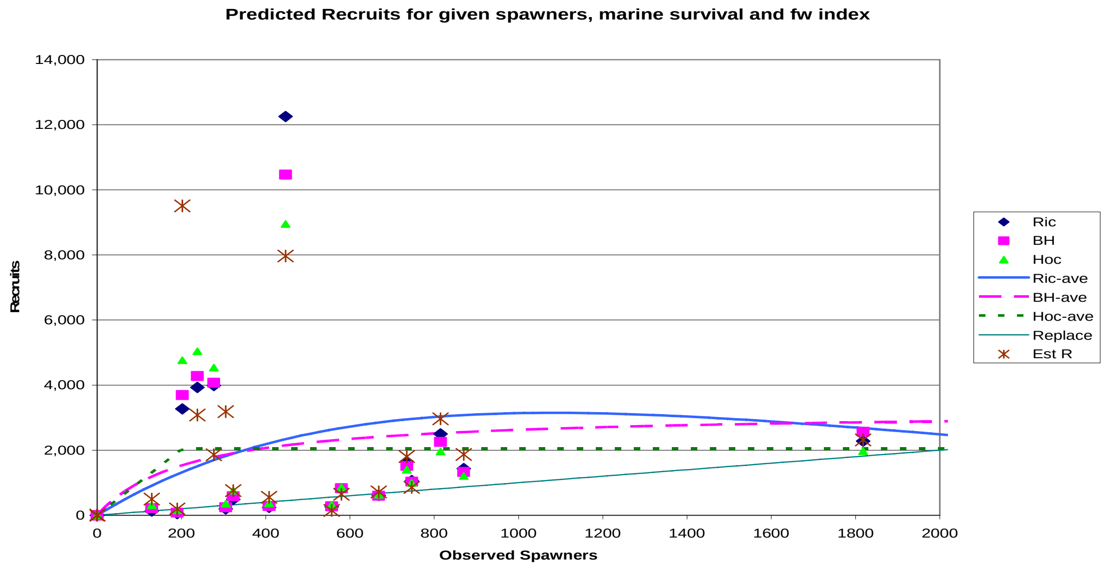


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Figure 7. Comparison of observed and predicted recruitment for the Upper Sauk spring population, brood years1981-97 data, the Puget Sound cycle marine index and peak instantaneous Oct-Sep flow at the Sauk gauge, under three different models of the spawner-recruit relationship. The corresponding spawner-recruit parameters are listed in Table 6a.

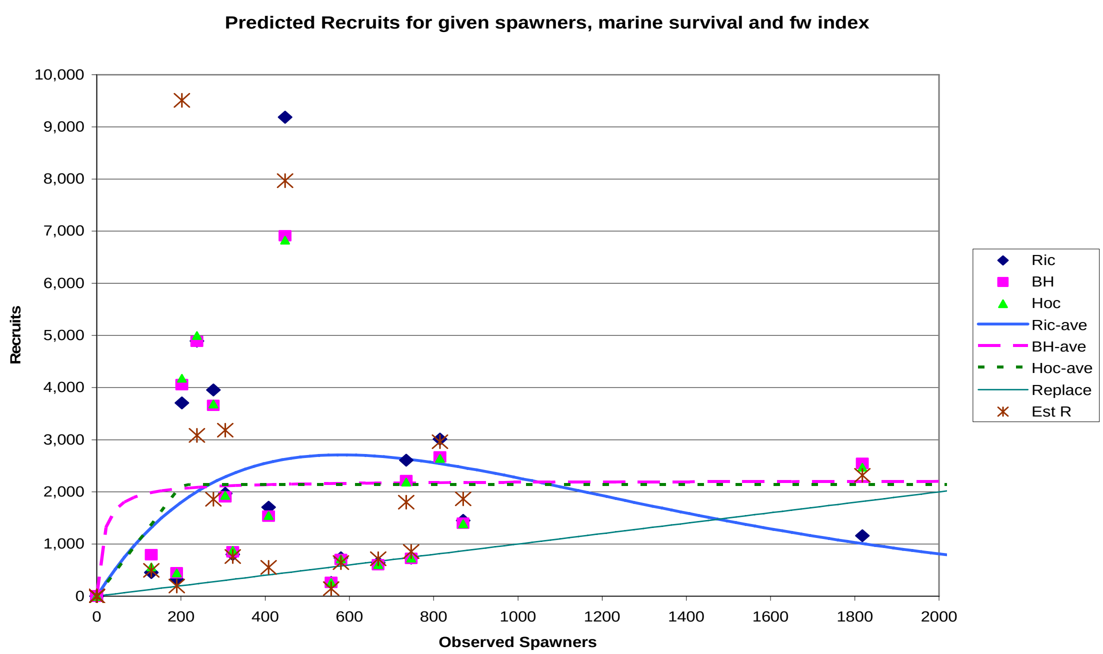

Table 15a (left) and 15b (right). Results of spawner-recruit analysis for the Upper Sauk using different freshwater environmental covariates.

marine index	**Puget Sound cycle**			**Puget Sound cycle**		
freshwater index	**inst. peak Oct-Sep. winter flow**			**Sauk maximum daily average winter flow (Oct-Feb)**		
= calendar years esc. compared	**1986-1997**			**1986-1997**		
= brood years used	**1981-1997**			**1981-1997**		
	Ric	**Bev**	**Hoc**	**Ric**	**Bev**	**Hoc**
a - productivity	24.5562	0.0035	20.7467	21.3694	0.0037	17.1128
b - Spawners	0.001721	0.000232	4,191	0.001745	0.000282	3,457
c - Marine	1.2134	1.0926	1.0766	1.1330	1.0135	0.9991
d - Freshwater	-0.000021	-0.000020	-0.000020	-0.000026	-0.000022	-0.000022
SSE	0.216	0.253	0.238	0.119	0.259	0.245
MSE (esc)	0.027	0.032	0.030	0.015	0.032	0.031
autocorrelation in error	0.736	-0.362	-0.276	0.481	-0.184	-0.166
R - esc	0.974	0.969	0.971	0.986	0.969	0.970
F(3,8)	48.666	41.413	44.111	90.778	40.732	42.923
PROBABLITIY	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MSE (recruits)	0.350	0.325	0.308	0.418	0.401	0.388
autocorrelation in error	0.147	0.429	0.375	0.163	0.410	0.372
R - recruits	0.763	0.808	0.812	0.693	0.721	0.723
F(3,13)	6.040	8.131	8.385	4.002	4.700	4.749
PROBABLITIY	1.9%	0.8%	0.7%	5.2%	3.6%	3.5%
Ave.Pred. Error	1919	1769	1752	2145	2094	2087

	Ric	**Bev**	**Hoc**	**Ric**	**Bev**	**Hoc**
slope at origin, intrinsic prod.	24.56	286.46	20.75	21.37	268.20	17.11
average MS*FW factor	0.52	0.51	0.51	0.59	0.61	0.61
cv MS/FW	87/36	79/35	78/35	82/33	74/30	73/30
adjusted productivity at origin	12.68	147.43	10.60	12.57	163.52	10.39
replacement level	1,480	2,200	2,140	1,450	2,160	2,100
capacity = spawners for max recruits	580	2,220	200	570	2,160	200
max recruits	2,710	2,220	2,140	2,650	2,160	2,100
MSY spawners	480	180	220	460	150	220
MSY recruits	2,670	2,040	2,140	2,590	1,990	2,100
MSY ER	0.82	0.91	0.90	0.82	0.92	0.90
ave ER last 3yrs	0.72	0.72	0.72	0.72	0.72	0.72
set survival	0.16	0.18	0.19	0.19	0.23	0.23
adj MSY sp	330	90	200	330	90	200
adj MSY recruits	730	670	760	760	710	790
adj MSY ER	0.55	0.87	0.74	0.57	0.87	0.75

Critical Abundance Threshold

The critical abundance threshold (CAT) represents a boundary below which uncertainties about population dynamics increase substantially. If sufficient stock-specific information is available, we can use the population dynamics relationship to define this point. Otherwise, we use alternative population-specific data, or general literature-based guidance. In this case, the CAT is 170 and 130 for the Suiattle and Upper Sauk spring chinook populations, respectively, and 470 for the spring MU, using the smallest previously observed escapement from which there was a greater than 1:1 return per spawner. Other escapements in this range have also generated returns per spawner of greater than one (Skagit RER Workgroup 2003). NOAA Fisheries has also provided some guidance on the range of critical thresholds in its document, *Viable Salmonid Populations* (McElhaney et al. 2000). The VSP guidance suggests that effective population sizes of less than 500 to 5,000 per generation, or 125 to 1,250 per annual escapement, are at increased risk. The CATs of 130 and 170 fall within the lower end of this range, reasonable for a small population (Upper Sauk: 1980-2002 range = 130-1,818, average = 459; Suiattle: 1980-2002 range = 167-1094, average =503).

It is important to distinguish between the CAT used in this RER calculation, and the LAT used in this harvest management plan. Although the Suiattle and Upper Sauk modeled CET numbers are the same as their LATs (see Tables 1 and 3 of the harvest management plan), they don't represent the same thing. The modeled CAT is an assumed point of instability; however, because the CAT's used in the RER calculation are escapement levels from which the observed return per spawner was greater than 1:1, it is likely that these modeled CAT levels are in fact well above the true points of instability, a bias that will build conservatism into the calculated RER. The LAT, on the other hand, is a trigger point below which additional management actions are taken to prevent escapement from falling below the true CAT. The LATs that were used for the Skagit summer/fall populations and the spring management unit during the last 3 years were calculated as the preseason escapement forecasts for which there is a 5% probability that the post-season escapement number will be less than the point of instability (Hayman 2000a; Hayman 2000b). Interestingly, using the spawner-recruit parameters derived from this RER analysis, the LAT for Suiattle chinook was calculated as 170 (assuming a quasi-extinction threshold of 63), which is the same as the modeled CAT number that was derived using the 1:1 return rate as the criterion. The calculated LAT for Upper Sauk chinook would be 250, which is higher than the number calculated from the 1:1 return rate criterion; however, because of the greater variance about the Upper Sauk spawner-recruit relation, the estimated probability that an escapement of 130 would be below the point of instability was unrealistically high, given that we have observations that indicate that it in fact is not below this point. Thus, for Upper Sauk chinook, we set the LAT at the same value as the modeled CAT (130). Assuming that the Upper Sauk point of instability is 72 (as calculated from the spawner-recruit parameters), and the past observed range of management error, the probability that a forecasted escapement of 130 would result in an observed escapement below the point of instability was only 0.2%. For the Skagit spring MU, the calculated LAT was 576 (Hayman 2000b), which is over 100 chinook higher than the CET assumed in this analysis (470). Because there is nothing in the LAT calculation that appears to contradict our observations (e.g., there is a very low probability that an escapement of 470, the lowest observed escapement with a return rate greater than 1:1, is below the point of instability), we retained 576 as the LAT in this harvest management plan.

Rebuilding Escapement Threshold

The RET represents a higher abundance level that would generally indicate recovery or a point beyond which ESA type protections are no longer required. Again, because we are isolating the effects of harvest, the RET in this context represents an escapement level consistent with estimates of the current productivity and capacity of the Upper Sauk and Suiattle spring chinook populations. The RET is the smallest escapement level such that the addition of one additional spawner would be expected to produce less than one additional future recruit under current conditions of productivity[7]. This level is also known as the maximum sustainable yield (MSY) escapement. The rebuilding threshold varies with the assumed freshwater covariate and also with the particular form of the spawner-recruit relationship.

For the Suiattle, using the maximum daily flow in the Sauk River from October through February, we derived the RET for each spawner-recruit function. These values were: 410 – Ricker, 350 – Beverton-Holt, and 400 – hockey stick (Table 5a). Since all three models performed similarly (Table 2), we propose to use the average of these estimates as the RET. This average is 400 natural origin spawners (rounding to the nearest 100 spawners).

For the Upper Sauk, using the maximum daily flow in the Sauk River from October through February and the Puget Sound cycle marine index, we derived the RET for each spawner-recruit function. These values were: 460 – Ricker and 220 – hockey stick, under the 1981-97 marine survival rates. However, in our VRAP runs (see next section) we assumed that marine survival in the near future would be more similar to the generally lower rates estimated for 1988-95, for which the RET values were: 330 – Ricker and 200 – hockey stick (Table 6b). For reasons explained in the next section, we discarded the hockey stick analysis and used the Ricker value, 330, as the RET for Upper Sauk. The Beverton-Holt spawner-recruit function did a poor job of estimating productivity at low abundance and, therefore, was not used to estimate a RET.

It is extremely important to recognize that the RET is not an escapement goal but rather a level that is expected to be exceeded most of the time ($\geq$ 80%) under the RER. It is also the case that, should the productivity conditions for the population improve, the RET and the corresponding RER will increase under improved conditions. However, since we will not be able to detect these changes immediately, the RER under current conditions provides a conservative approach because it assumes conditions are poorer than may actually exist. Should conditions improve, the probability of exceeding the RET using the RER computed for current conditions will also increase over the probability computed under current conditions. Thus the RET serves as a step in the progression to recovery which will occur as the contributions from all sectors are realized.

Rebuilding Exploitation Rate Derivation

We projected the performance of the Suiattle and Upper Sauk spring population at target exploitation rates in the range of 0 to 0.80 at intervals of 0.02 using the fitted values of a, b, c, and d (see model equations above) for the Upper Sauk spawner-recruit models, and using the fitted values of a, b, and d for the 3 Suiattle models (which had no marine survival parameter; hence, no c value). As described above, for the Suiattle, we used the 1986-97 brood year model run using the Sauk monthly maximum average flow during the winter, and no marine survival parameter. For the Upper Sauk, we used the 1981-97 brood year model run using the Puget Sound marine cycle index and the Sauk maximum daily average flow during the winter. The freshwater environmental correlate (maximum daily average flow) was projected using the average and

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[7] An alternative definition of RET, i.e., the initial escapement level from which there is less than 1% probability that the unit will go extinct in 100 years, was used to set the RER for the Skagit summer/fall and spring management units during the last 3 years (Hayman 1999; Hayman 2000a; Puget Sound Indian Tribes and WDFW 2001; Puget Sound Indian Tribes and WDFW 2003). However, the programming necessary to use this definition for the Skagit spring populations has not been completed, so RETs that use this definition for the Skagit spring populations were not calculated.

variance observed for the 1981-1997 period. For the Upper Sauk, the marine survival environmental correlate (Puget Sound cycle) was projected using the average and variance observed for the 1988-95 period, a period of low marine survival. West coast salmon have been experiencing a period of low marine survival. Although there are preliminary indications that marine conditions are improving, it has not yet been confirmed for Puget Sound. The CETs were 170 and 130 for the Suiattle and Upper Sauk, respectively, derived as described above. The RETs were the MSY escapement levels (also described above) adjusted for environmental conditions. When adjusted for projected environmental conditions the RETs for the Upper Sauk population were: 330 – Ricker and 200 – hockey stick. Since marine survival did not influence the spawner-recruit relationship, no adjustment for environmental conditions to the RET was required for the Suiattle population.

For each combination of spawner-recruit relationship and exploitation rate we ran 1000 25-year projections. Estimated probabilities of exceeding the RET were based on the number of simulations for which the average of the spawning escapements in years 21-25 exceeded the RET. Estimated probabilities of falling below the CET were based on the number of years (out of the total of 25,000 individual years projected for each target exploitation rate for a particular spawner-recruit relationship) that the spawning escapement fell below the CET. For each spawner-recruit relationship the sequence of Monte Carlo projection running through the target exploitation rate range from 0 to 0.80 started with the same random number seed so that the results for the different spawner-recruit models would be comparable.

Detailed results of these projections are in Tables 18 to 21, and summarized results are in Tables 16 and 17. For the Suiattle, the indicated target exploitation rates are 0.48 – Ricker, 0.52 – Beverton-Holt, and 0.51 – hockey stick. Since all three models performed similarly, we propose to use the average of these values as the target rebuilding exploitation rate. This average is 0.50, rounding down to the nearest whole percentage exploitation rate.
For the Upper Sauk, the target exploitation rates that meet the RER criteria are 0.46 – Ricker and 0.62 – hockey stick. A comparison of the habitat in the areas used by the three Skagit spring populations indicated the productivities of the three Skagit spring populations should be similar based on habitat characteristics and land use (B. Hayman, memo to Skagit RER workgroup, 7/15/03). In addition, a VRAP analysis of the Skagit spring management unit (all three spring populations combined) indicated an RER of 0.47 (Tables 18 - 21; N. Sands memo to Skagit RER workgroup, Summary of Skagit springs results, 7/15/03). Since the Ricker target exploitation rate of 0.46 was more similar to the RER for the Suiattle (0.50) and to the Skagit management unit, it was chosen as the RER for the Upper Sauk spring chinook population.

To make the RER compatible with the fishery model used in fishery planning (the FRAM model), the RERs derived from data in the A&P tables were converted to a FRAM equivalent RER using a simple regression between the exploitation rate estimates from the A&P table and post season exploitation rate estimates derived from FRAM. Using this conversion, the FRAM RERs used for annual preseason fishery planning purposes were 0.41 and 0.38 for the Suiattle and Upper Sauk, respectively.

Table 16. Results of the VRAP projections of the Suiattle chinook stock under current conditions showing the indicated target exploitation rate for each form of the spawner-recruit relationship.

	Target	#fish	%runs	%yrs	%runs	1st	LastYrs
Model	ER	Mort.	extinct	<critical	end>rebuilding	Year	Ave.
Ricker	0.48	577	0	0.3	82.3	474	578
Beverton-Holt	0.52	601	0	0.7	80.9	451	500
Hockey-Stick	0.51	635	0	0.4	81.0	460	552

Table 17. Results of the VRAP projections of the Upper Sauk chinook stock under current conditions showing the indicated target exploitation rate for each form of the spawner-recruit relationship.

	Target	#fish	%runs	%yrs	%runs	1st	LastYrs
Model	ER	Mort.	extinct	<critical	end>rebuilding	Year	Ave.
Ricker	0.46	516	0.2	0.5	80.5	620	505
Hockey-Stick	0.62	646	0.9	3.7	85.0	432	327

Table 18**.** Summary of projections of the Suiattle spring chinook population at different target exploitation rates for three different forms of the spawner-recruit relationship.

	Pr (final esc > rebuilding threshold) %				Pr (annual esc < critical threshold) %		
Target ER	**B-H**	**Ricker**	**Hockey-St**		**B-H**	**Ricker**	**Hockey-St**
0.00	100	99.7	100		0	0.1	0
0.02	100	99.8	100		0	0.1	0
0.04	100	99.9	100		0	0	0
0.06	100	99.5	100		0	0	0
0.08	100	99.8	100		0	0.1	0
0.10	100	99.8	100		0	0	0
0.12	100	99.9	100		0	0	0
0.14	100	99.8	100		0	0	0
0.16	100	99.8	100		0	0	0
0.18	100	99.7	100		0	0	0
0.20	100	99.8	100		0	0	0
0.22	100	99.5	99.9		0	0.1	0
0.24	100	99.7	100		0	0	0
0.26	100	99.5	99.9		0	0	0
0.28	100	99.6	99.9		0	0	0
0.30	100	99	99.9		0	0.1	0
0.32	100	98.7	99.3		0	0	0
0.34	99.7	98.9	99		0	0	0
0.36	99.7	97.4	99		0	0	0
0.38	99.7	96.5	98.2		0	0	0
0.40	99.6	95.8	96.5		0	0.1	0
0.42	97.9	92.4	97.1		0.1	0.1	0
0.44	96	87.6	96.1		0.1	0.1	0
0.46	94.5	87.5	93.7		0.1	0.1	0.1
0.48	91.8	**82.3**	90.1		0.2	0.3	0.1
0.50	87.8	74.7	**84.3**		0.4	0.4	0.3
0.52	**80.9**	66.7	**78.7**		0.7	0.8	0.5
0.54	73.3	56	71		1.3	1.3	0.8
0.56	65.7	46.8	57.5		1.9	1.7	2
0.60	53.5	35.4	47.6		3.2	3.2	2.9
0.62	38	23.3	34		**5.6**	**5.6**	**5.4**
0.64	27.3	14.1	22.1		9.1	9.6	9.8
0.66	16.6	5.8	10.9		13.6	15.3	16.8
0.68	9.4	4.1	3.7		21	23.7	28.4

Table 19. Summary of projections of the Upper Sauk spring chinook population at different target exploitation rates for three different forms of the spawner-recruit relationship.

Target ER	Pr(final esc > rebuilding threshold)%		Pr(ann. Esc. < critical threshold) %	
	Ricker	Hockey-St	Ricker	Hockey-St
0.00	98.5	100.0	0.3	0.0
0.02	99.2	100.0	0.3	0.0
0.04	97.8	100.0	0.3	0.0
0.06	97.5	100.0	0.2	0.0
0.08	99.3	100.0	0.2	0.0
0.10	98.3	100.0	0.2	0.0
0.12	98.7	100.0	0.2	0.0
0.14	98.1	100.0	0.3	0.0
0.16	98.8	100.0	0.1	0.0
0.18	97.5	100.0	0.2	0.0
0.20	97.5	100.0	0.2	0.0
0.22	96.9	100.0	0.2	0.0
0.24	96.9	100.0	0.1	0.0
0.26	96.2	100.0	0.1	0.0
0.28	96.1	100.0	0.2	0.0
0.30	96.0	100.0	0.1	0.0
0.32	94.7	100.0	0.2	0.0
0.34	95.0	100.0	0.2	0.0
0.36	93.3	100.0	0.2	0.0
0.38	92.2	100.0	0.3	0.0
0.40	92.4	99.7	0.2	0.0
0.42	88.9	99.9	0.3	0.0
0.44	86.1	99.8	0.3	0.0
0.46	**80.5**	99.7	0.5	0.0
0.48	76.7	99.4	0.7	0.0
0.50	74.2	99.0	0.7	0.0
0.52	69.4	97.6	1.1	0.0
0.54	62.9	96.5	1.6	0.1
0.56	55.5	95.9	2.3	0
0.58	48.9	95.4	**3.4**	0
0.60	35.9	89.8	5.6	0.4
0.62	27.8	**85.0**	8.1	0.9
0.64	21.4	78.5	11.4	**2.6**
0.66	12.0	65.4	16.9	6.5

Table 20. Results of spawner-recruit analysis for the Skagit spring management unit using different freshwater environmental covariates.

calendar years esc. compared **1989-1997**
brood years used **1984-1997**

Parameter Estimates With Smallest SSE

	Ric	Bev	Hoc
a - productivity	9.6393	0.0255	5.7893
b - Spawners	0.000759	0.000220	4,185
c - Marine	0.6669	0.5731	0.5839
d - Freshwater	-0.000009	-0.000009	-0.000008
SSE	0.126	0.108	0.107
MSE (esc)	0.025	0.022	0.021
autocorrelation in error	-0.189	-0.060	0.036
R - esc	0.942	0.951	0.951
F(3,5)	13.108	15.642	15.776
PROBABLITIY	1%	1%	1%
MSE (recruits)	0.463	0.426	0.429
autocorrelation in error	0.372	0.428	0.332
R - recruits	0.746	0.764	0.765
F(3,10)	4.175	4.663	4.708
PROBABLITIY	8%	7%	6%
Ave.Pred. Error	2054	2026	1996

	Ric	Bev	Hoc
slope at origin, intrinsic prod.	9.64	39.25	5.79
average MS*FW factor	0.87	0.85	0.87
cv MS/FW	48/15	42/15	43/14
adjusted productivity at origin	8.41	33.54	5.01
replacement level	2,810	3,780	3,620
capacity = spawners for max recruits	1,320	3,880	720
max recruits	4,080	3,880	3,620
MSY spawners	990	540	720
MSY recruits	3,930	3,200	3,610
MSY ER	0.75	0.83	0.80
ave ER last 3yrs	0.73	0.73	0.73

Table 21. Summary of projections of the Skagit spring chinook management unit at different target exploitation rates for the Ricker spawner-recruit relationship.

Target ER	Pr(final esc > rebuilding threshold)%	Pr(ann. Esc. < critical threshold) %
0.00	98.20	0.7
0.02	98.00	0.5
0.04	98.2	0.6
0.06	97.90	0.5
0.08	98.80	0.5
0.10	97.70	0.5
0.12	97.70	0.4
0.14	98.00	0.4
0.16	97.60	0.5
0.18	98.00	0.4
0.20	97.40	0.4
0.22	96.90	0.4
0.24	97.90	0.3
0.26	97.40	0.3
0.28	95.60	0.4
0.30	96.10	0.4
0.32	95.60	0.4
0.34	95.00	0.3
0.36	92.10	0.3
0.38	92.70	0.4
0.40	91.60	0.4
0.42	88.50	0.4
0.44	88.20	0.6
0.46	**83.60**	0.6
0.48	**78.30**	0.7
0.50	76.20	1.0
0.52	71.60	1.3
0.54	66.20	1.8
0.56	58.10	1.7
0.60	51.90	2.5
0.62	39.90	3.3
0.64	36.30	**5.3**
0.66	25.10	7.9
0.68	15.70	12.2

The ceiling exploitation rates defined in this plan, which are intended to maximize long-term harvestable numbers and prevent extinction for the Skagit spring and summer/fall management units separately, are consistent with a “no jeopardy” ruling. The jeopardy standards themselves were explicitly used to calculate those rates, and the calculated ceiling rates are comparable to the rates on Skagit summer/fall chinook that were evaluated and approved in the Northern Fisheries Biological Opinion (NMFS 2000), which, depending on abundance, ranged from about 50 to 70 percent. Additional conservatism, beyond that evaluated in the Northern BO, is also provided. Critical abundance threshold escapement levels, below which additional actions would be required, are established for both the spring and summer/fall chinook management units separately, and for each of the three summer/fall populations proposed in WDFW & WWTIT (1994). The intent of this Plan is to take actions that prevent extinction of individual populations, while maximizing long-term harvestable numbers and achieving ESA jeopardy standards for the two Skagit wild chinook management units

During pre-season fishery planning, the impacts from a proposed fisheries management regime will be simulated, and escapement projected, based on the forecast abundance of all contributing chinook units (including those from British Columbia, the Washington coast, and the Columbia River, as well as those from Puget Sound). If the projected escapement of either management unit, or of any Skagit summer/fall or spring population falls below their low abundance threshold, further management actions will be triggered to reduce fishing mortality, as described in Chapter 5 and Appendix C. The FRAM fisheries simulation model, which is currently in use, estimates escapement for the Skagit summer/fall management unit, but that management unit total may be resolved into component stocks in proportion to their forecasted total abundance.

An analysis of how this regime would have functioned if it had been applied in previous years indicates that the exploitation rates would generally have been significantly lower than observed, and that the management response to critical status would have been triggered in two of the recent years (R. Hayman, Skagit System Cooperative pers comm.)

Data gaps

Priorities for filling data gaps to improve understanding of stock / recruit functions or population dynamics simulations necessary to testing and refining harvest management objectives include:

- Consistent release of coded-wire tagged fingerling summer and fall chinook to enable direct assessment of harvest distribution, and estimation of harvest exploitation rates and marine survival rates;.
- Estimates of natural-origin smolt abundance from spring chinook production areas.
- Estimates of estuarine and early-marine survival for fingerling and yearling smolts.
- Limiting factors on yearling chinook abundance

Stillaguamish River Management Unit Status Profile

Component Stocks

Stillaguamish summer chinook
Stillaguamish fall chinook

Geographic description

The Stillaguamish River management unit includes summer and fall stocks which are distinguished by differences in their spawning distribution, migration and spawning timing, and genetic characteristics. The summer stock, a composite of natural and hatchery-origin supplemental production, spawns in the North Fork, as far upstream as RM 34.4 but primarily between RM 14.3 and 30.0, and in the lower Boulder River and Squire Creek. Spawning also occurs in French, Deer, and Grant creeks, particularly when flows are high. The fall stock, which is not enhanced or supplemented by hatchery production, spawns throughout the South Fork and the mainstem of the Stillaguamish River (WDF et al. 1993), and in Jim Creek, Pilchuck Creek, and lower Canyon Creek. Despite the small overlap in spawning distribution, it is likely that the two stocks are genetically distinct.

Allozmye analysis of the summer stock show it to be most closely related to spring and summer chinook stocks from North Puget Sound, and the the Skagit River summer stocks in particular. The fall stocks align most closely with South Sound MAL, which includes Green River falls and Snohomish River summer and falls.

Life History Traits

Summer run adult enter the river from May through August. Spawning begins in late August, peaks in mid-September, and continues past mid-October. Fall chinook enter the river much later – in August and September. The peak of spawning of the fall stock occurs in early to mid-October, about three weeks later than the peak for the summer stock. The age composition of mature Stillaguamish River summer chinook, based on scales collected from 1985 – 1991 was as follows: 4.9% age-2, 31.9% age-3, 54.7% age-4, and 8.5% age-6 (WDF 1993 cited in HGMP). Juvenile summer chinook produced in the Stillaguamish River primarily (95%) emigrate as sub-yearlings (WDF 1993 cited in HGMP).

Status

WDF et al. (1993) classified both the summer and fall stocks as depressed, due to chronically low escapement. Degraded spawning and rearing habitat currently limit the productivity of chinook in the Stillaguamish River system (PFMC 1997). After analyzing the trends in spawning escapement through 1996, the PSC Chinook Technical Committee concluded that the stock was not rebuilding toward its escapement objective (CTC 1999).

Aggregate spawning escapement for Stillaguamish summer/fall chinook has averaged 1,341 (geometric mean) over the period 1997 – 2001. From 1988 through 1995 escapement ranged from 700 to 950 (except 1991), and since 1995 has ranged from 1100 to over 1600. The geometric mean of escapement in the last five years (1998 - -2002) was 1429, which was higher than the mean of 1009 from the preceding five years (Myers et al. 1998). From 1985 – 1991 the average escapements of summer and fall chinook were 879 and 145, respectively (WDF et al.

1993). In the last five years (1998-2002) escapement to the South Fork ranged from 226 – 335), while escapement to the North Fork ranged from 845 to 1403 . Escapement to the North Fork has comprised an average of 81% of total escapement since 1997 (K. Rawson, Tulalip DNR, pers comm., February 10, 2003).

Table 1. Spawning escapement of Stillaguamish summer/fall chinook, 1993-2002.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
North Fork	583	667	599	993	930	1292	845	1403	1066	1253
South Fork	345	287	223	251	226	248	253	243	283	335
Total	928	954	822	1244	1156	1540	1098	1646	1349	1588

The total annual abundance of Stillaguamish summer/fall chinook for the period 1979 – 1995, estimated as potential escapement (i.e. the number of chinook that would have escaped to spawn absent fishing mortality), ranged from 1,300 to 2,500 without showing a clear positive or negative trend (PSSSRG 1997). However, the productivity, as indexed by the trend in MSY exploitation rate, declined substantially through this period.

The summer chinook supplementation program, which collects broodstock from the North Fork return, was initiated in 1986 as a Pacific salmon Treaty indicator stock program, and its current objective is to release 200,000 tagged fingerling smolts per year. Most releases are into the North Fork, via acclimation sites; relatively small numbers of smolts have been released into the South Fork. This supplementation program is considered essential to the recovery of the stock, so these fish are included in the listed ESU. The program contributes substantially to spawning escapement in the North Fork.

Harvest distribution

Recoveries of coded-wire tagged North Fork Stillaguamish summer chinook provide an accurate description of recent harvest distribution. Northern fisheries in Alaska and British Columbia account for 73 percent of total harvest mortality (Table 2). Washington ocean fisheries account for 4 percent. Washington sport fisheries account for 24 percent of total fisheries mortality.

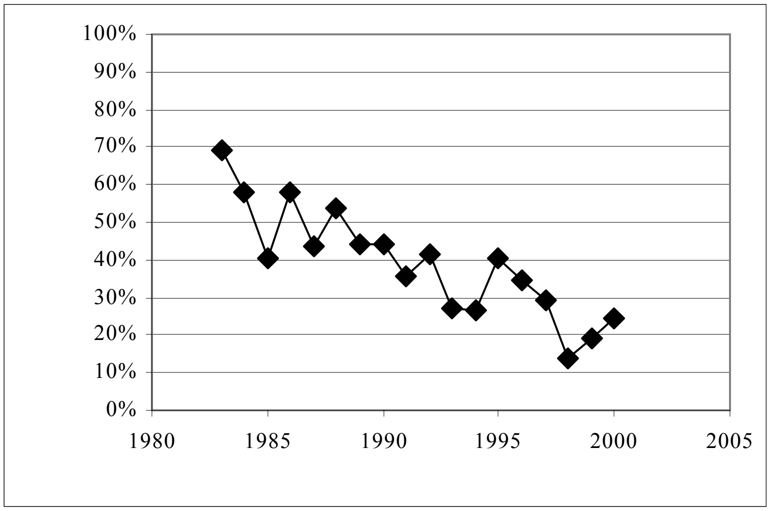
Table 2. The harvest distribution of Stillaguamish River summer chinook, expressed as an average proportion of annual adult equivalent harvest mortality for 1996 - 2000 (CTC03-1 in press)). Update with 2001??

Alaska	B.C.	WashingtonT roll	Puget Sound Net	Washington sport
26.7%	46.3%	0.5%	2.8%	23.8%

Exploitation rate trends:

Post-season FRAM runs, incorporating actual catch in all fisheries and actual abundance, indicate that total fishery-related, adult equivalent, exploitation rates for Stillaguamish chinook have fallen 64 percent, from 1983 – 1987 to 1998 – 2000.

Figure 1. Total adult equivalent fishery exploitation rate of Stillaguamish chinook from 1983 – 2000, estimated by post-season FRAM runs.



Management Objectives

The management guidelines for Stillaguamish chinook include an exploitation rate objective and a critical escapement threshold. The exploitation rate objective is the maximum fraction of the production from any brood year that is allowed to be removed by all sources of fishery-related mortality, including direct take, incidental take, and non-landed mortality. The exploitation rate is expressed as an adult equivalent rate, in which the mortality of immature chinook is discounted relative to their potential survival to maturity.

Analysis specific to Stillaguamish summer chinook was completed to develop the exploitation rate objective to reflect, to the extent possible, the current productivity of the stock. Brood year recruitment (i.e., number of recruits per spawner) was estimated, for brood years 1986 through 1993, by reconstructing the total abundance of natural origin chinook that were harvested or otherwise killed by fisheries, or escaped to spawn. The resulting brood year recruitment rates were partitioned into freshwater and marine survival rates. The future abundance (i.e. catch and escapement) of the stock was simulated for 25 years, using a simple population dynamics model, under total fishery exploitation rates that ranged from 5 percent to 60 percent. In the model, production from each year's escapement was subjected to randomly selected levels of freshwater and marine survival, and randomly selected levels of management error. Each model run (i.e. for each level of exploitation rate) was replicated one thousand times, and the set of projected population abundances analyzed to determine the probability of achieving the management objectives. The simulation for Stillaguamish summer chinook, across a range of exploitation rates (Table 3), indicated that total exploitation rates below 0.35 met the recovery criteria.

Table 3. Summary of results of 1,000 runs of the simulation model at each exploitation rate.

Exploitation Rate	Probability of Falling below critical	Probability of recovery	Median Escapement ratio	Median Escapement
0.00	1%	96%	2.75	3,597
0.05	1%	96%	2.81	3,377
0.10	1%	96%	2.76	3,165
0.15	2%	95%	2.66	2,964
0.20	2%	95%	2.56	2,758
0.25	3%	93%	2.57	2,418
0.30	4%	92%	2.48	2,210
0.35	6%	92%	2.46	1,920
0.40	7%	91%	2.29	1,686
0.45	11%	87%	2.14	1,444
0.50	17%	80%	1.92	1,180
0.60	41%	52%	1.04	648
0.70	73%	12%	0.27	259
0.80	94%	0%	0.02	55

The fishery management objectives for the 2000 management year was to realize an exploitation rate that, if imposed consistently over a future time interval

- would not increase the probability that the stock abundance would fall below the critical escapement threshold, after 25 years, by more than five percentage points higher than were no fishing mortality to occur; and

- would result in at least an 80 percent of greater probability of the stock recovering (i.e. escapement exceeding the current level) after 25 years.

Stock recovery, for this analysis, was defined as the average spawning escapement for the final three years in the simulation period exceeding the average for the first three years in the simulation period (Rawson 2000).

At the present time, there is very little information concerning the productivity of the Stillaguamish fall stock other than the fact that the average abundance of this stock has been approximately 50% of the Stillaguamish summer stock based on relative escapement. Incorporating this lower estimate of abundance, and assuming the same productivity (i.e. recruitment rates), the simulation model predicted that exploitation rates below 35% met the first management objective. The probability of rebuilding at this exploitation rate was 96%. This analysis indicates that a target exploitation rate of 0.35 would also be appropriate for the Stillaguamish fall stock.

The Washington co-managers have set an exploitation rate guideline of 0.25, as estimated by the FRAM simulation model, for the Stillaguamish chinook management unit. According to the simulation model this level of exploitation results in a 4 percent risk of the stocks falling below the critical escapement threshold of 500, and affords a 92 percent probability of recovery (i.e., that spawning escapement will exceed the current average level).

The low abundance threshold for North Fork Stillaguamish chinook is 500 natural-origin spawners. Reconstruction of the total brood abundance of adult Stillaguamish chinook suggests that escapements of 500 (+/- 50) can result in recruitment rates ranging from two to five adults per spawner (Rawson 2000). The genetic integrity of the stock may be at risk and depensatory mortality factors may affect the stock when annual escapement falls below this threshold to 200 (NMFS BO 2000). The critical threshold for South Fork Stillaguamish chinook is undetermined pending further analysis of data. The low abundance threshold for the Stillaguamish management unit is based on the 1996-2002 average fraction of the natural escapement for the years 1996-2002 that was in the North Fork. This average was .813 (range: .770 - .852). Thus a management unit escapement of 500/.813 = 615 would, on average, include 500 North Fork fish. The range of management unit escapement thresholds computed this way is 586 to 649. Based on this, we have selected a low abundance threshold of 650 for the Stillaguamishmanagement unit. Whenever spawning escapement is projected to be below this level, fisheries will be managed to either achieve the critical exploitation rate ceiling , or exceed the low abundance threshold .

Data gaps

Priorities for filling data gaps to improve understanding of stock / recruit functions or population dynamics simulations necessary to testing and refining harvest management objectives include:

- Spawning escapement estimates that include variance for summer and fall stocks
- Estimates of natural-origin smolt production (freshwater survival to the estuary)

Snohomish River Management Unit Status Profile

Component Stocks

The stock structure of summer/fall chinook in the Snohomish basin is based on the report of the Puget Sound TRT (2001) suggesting that there are two populations of summer/fall chinook in the Snohomish basin. The comanagers have reviewed this report along with additional information, and have tentatively concluded that the former four-stock structure of Snohomish chinook should be revised to conform to the TRT's population structure.

Summer/fall chinook management unit

Skykomish
Snoqualmie

Geographic description

Skykomish chinook spawn in the mainstem of the Skykomish River, and its tributaries including the Wallace and Sultan Rivers, in Bridal Veil Creek, the South Fork of the Skykomish between RM 49.6 and RM 51.1 and above Sunset Falls (fish have been transported around the falls since 1958), and the North Fork up to Bear Creek Falls (RM 13.1). Relative to spawning distribution in the 1950's, a much larger proportion of summer chinook currently spawn higher in the drainage, between Sultan and the forks of the Skykomish (Snohomish Basin Salmonid Recovery Technical Committee (SBSRTC) 1999). There is some indication that spawning in the North Fork has declined over the last twenty years (Snohomish Basin Salmonid Recovery Technical Committee (SBSRTC) 1999). Fish spawning in Snohomish mainstem and the Pilchuck River are currently considered to be part of the Skykomish stock pending further collection of genetic stock identification data.

Snoqualmie chinook spawn in the Snoqualmie River and its tributaries, including the Tolt River, Raging River, and Tokul Creek.

There is some uncertainty whether a spring chinook stock once existed in the Snohomish system. Suitable habitat may still exist in the upper North Fork, above Bear Creek Falls.

Life History Traits

Summer chinook enter freshwater from May through July, and spawn, primarily, in September, while fall chinook spawn from late September through October. However, fall chinook spawning in the Snoqualmie River continues through November. The peak of spawning in Bridal Veil creek is in the second week of October (i.e. slightly later than the peak for fish spawning in the mainstem of the Skykomish. Natural spawning in the Wallace River occurs throughout September and October (Washington (State). Dept. of Fisheries. et al. 1993).

The age composition of returning Snoqualmie River fall chinook showed a relatively strong age-5 component (28 percent), relative to other Puget Sound fall stocks. Age-3 and age-4 fish comprised 20 and 46 percent, respectively, of returns in 1993 – 1994 (Myers et al. 1998).

Most Snohomish summer and fall chinook smolts emigrate as subyearlings, but, based on scale data, an annually variable, but relatively large, proportion of smolts are yearlings. Of the summer chinook smolts sampled in 1993 and 1994, 33 percent were yearlings (Myers et al. 1998). Based on scale data, 25 to 30 percent of returning fall chinook also showed a stream-type life history (Snohomish Basin Salmonid Recovery Technical Committee (SBSRTC) 1999). No other summer or fall chinook stocks in Puget Sound produces this high a proportion of yearling smolts. Rearing habitat to support yearling smolt life history is vitally important to the recovery of these stocks.

Management Unit / Stock Status

Total natural spawning escapement of Snohomish summer/fall stocks has ranged between 2,700 and 8,200 since 1990, and has exceeded the 1968-1979 average of 5,237 only four times since 1980: in 1998, 2000, 2001, and 2002 (Table 1). However, due in part to reduced exploitation rate, escapement has rebounded from the levels observed in the early 1990s.

Table 1. Natural spawning escapement of Snohomish summer/fall chinook salmon, 1990-2002. Total estimates of natural spawning escapement were provided by WDFW using the escapement estimation method described by Smith and Castle (Smith and Castle 1994). Estimates of the natural origin fraction of the natural escapement are based on recoveries of thermally marked otoliths (Rawson et al. 2001)

Year	Snoqualmie	Skykomish	Total	Nat. Origin
1990	1277	2932	4209	
1991	628	2192	2820	
1992	706	2002	2708	
1993	2366	1653	4019	
1994	728	2898	3626	
1995	385	2791	3176	
1996	1032	3819	4851	
1997	1937	2355	4292	3525
1998	1892	4412	6304	2856
1999	1344	3455	4799	2436
2000	1427	4665	6092	3024
2001	3589	4575	8164	6336
2002	2895	4325	7220	
average	1443	3146	4791	
average %	31.4%	68.6%		

A portion of the natural spawning fish are the survivors of releases from the Wallace River and Bernie Kai-Kai Gobin (Tulalip) facilities. Since 1997 it has been possible to estimate the natural origin portion of the natural escapement because all chinook production at the Bernie Kai-Kai Gobin and Wallace River hatcheries has been thermally mass-marked and there has been comprehensive sampling of natural spawning areas for otoliths (Rawson et al. 2001). In most years the natural origin component of the natural escapement is significantly smaller than the total natural escapement estimate, although in 2001 the natural origin portion alone of the natural escapement was higher than the total natural escapement in any prior year since at least 1980 (Table 1 and state/tribal chinook escapement database).

Harvest distribution and exploitation rate trends:

Assessment of exploitation rate trends for Snohomish summer/fall chinook is difficult because there has been no coded-wire tagged indicator stock representing the management unit. Post-season runs of the FRAM model show a clearly declining trend in annual fishing year exploitation rate over the past two decades (Table 2). These validation runs use the same projection model used in preseason planning, but use post-season estimates of spawning escapement and fishery harvest and non-catch mortality instead of preseason abundance and fishing level predictions. Thus, these runs adjust for observed abundances and fishing levels, but they assume the stock composition of fisheries is the same as the base period stock composition used in the FRAM model.

Table 2. Adult equivalent (AEQ) exploitation rates (ER) by fishing year for the Snohomish summer/fall chinook management unit from post-season runs of the FRAM model for 1983-2000 (April 2003 revision of FRAM validation runs, personal communication, Andy Rankis, NWIFC, and Larrie LaVoy, WDFW) and from pre-season FRAM model predictions for 1999-2003[8]. The ceiling exploitation rate column is the maximum allowable annual AEQ exploitation rate from the management plan that was in effect for the year[9].

	AEQ ER		
Fishing Year	**Postseason**	**Preseason**	**Ceiling ER**
1983	73%		
1984	64%		
1985	55%		
1986	60%		
1987	48%		
1988	66%		
1989	52%		
1990	49%		
1991	52%		
1992	61%		
1993	62%		
1994	50%		
1995	65%		
1996	44%		
1997	29%		
1998	25%		
1999	31%	31%	38%
2000	26%	20%	35%
2001		21%	32%
2002		18%	32%
2003		19%	24%

[8] FRAM runs 99NP, 00NP, 01NP, 02NP, and 03NP.
[9] These are documented in the annual Stillaguamish/Snohomish regional status reports available from Tulalip Fisheries, 7615 Totem Beach Rd., Marysville, WA 98271. Management objectives that were in effect for years before 1999 are also documented in regional status reports for those years.

Table 3. Brood year exploitation rates reported in the Puget Sound Technical Recovery Team's Abundance and Productivity tables for the Skykomish and Snoqualmie chinook populations.

Brood Year	Skykomish	Snoqualmie
1980	86%	86%
1981	88%	87%
1982	84%	77%
1983	68%	67%
1984	82%	83%
1985	75%	74%
1986	76%	74%
1987	70%	69%
1988	76%	78%
1989	74%	75%
1990	67%	59%
1991	54%	39%
1992	56%	61%
1993	61%	64%
1994	54%	54%
1995	46%	38%
1996	51%	44%
1997	46%	43%
1998	48%	46%

Management Objectives

Management objectives for Snohomish summer/fall chinook include an upper limit on total exploitation rate, to insure that harvest does not impede the recovery of the component stocks, and a low abundance threshold (LAT) for spawning escapement to trigger reduced fishing effort under low returns to maintain the viability of the stocks. Fisheries will be managed to achieve a total adult equivalent exploitation rate, associated with all salmon fisheries, not to exceed 24 percent. These impacts include all mortalities related to fisheries, including direct take, incidental take, release mortality, and drop-off mortality.

Lacking direct information on the extent to which the current fisheries regime may disproportionately harvest any single stock, the spawning escapement of each stock will be carefully monitored for indications of differential harvest impact. Average escapement during the period of 1965 – 1976 will be the benchmark for this monitoring (Snohomish Basin Salmonid Recovery Technical Committee (SBSRTC) 1999).

The Puget Sound Salmon Management Plan mandates that fisheries will be managed to achieve maximum sustainable harvest (MSH) for all primary[10] natural management units. The recovery exploitation rate is likely to be lower than the rate associated with MSH under current conditions of productivity, as in the case where recovery involves increasing the current level of productivity. The conservatism implied by the recovery exploitation rate imbues caution against the potential size and age selectivity of fisheries, and the effects of that selectivity on reproductive potential, and potential uncertainty and error in management.

[10] A primary management unit is one for which fisheries are directly management to achieve a particular escapement goal or exploitation rate.

LOW ABUNDANCE THRESHOLD FOR MANAGEMENT

A low abundance threshold of 2,800 spawners (natural origin, naturally spawning fish) for the Snohomish management unit is established (see estimation procedure below) as a reference for pre-season harvest planning. If escapement is projected to fall below this threshold under a proposed fishing regime, extraordinary measures will be adopted to minimize harvest mortality. Directed harvest of Snohomish natural origin chinook stocks, (net and sport fisheries in the Snohomish terminal area or in the river) has already been eliminated. Further constraint, thus, depends on measures that reduce incidental take.

The low abundance threshold for the management unit was derived from critical escapement thresholds for each of the Snoqualmie, and Skykomish populations in a two-step process. Critical escapement thresholds are levels that we don't want to go below under any circumstances. For each population, the critical escapement threshold was determined and then expanded to an adjusted level for management use according to the following formula:

$$E_{man,p} = E_{crit,p} / [(R/S)_{low,p} * (1-RER_{mu})] \quad [1]$$

Where $E_{man,p}$ is the lower management threshold for population ***p;***
$E_{crit,p}$ is the critical threshold for population ***p;***
$R/S_{low,p}$ is the average of recruits/spawner for population ***p*** under low survival conditions; and
RER_{mu} is the RER established for the management unit

The following describes the $\boldsymbol{E_{man,p}}$ for the Snoqualmie and Skykomish stocks within the Snohomish management unit. The following analysis is based on estimates of natural spawning escapement to the Snohomish system, by population, for the most recent twelve years (Table 1) .

Maximum Exploitation Rate Guideline

INTRODUCTION

The rebuilding exploitation rate (RER) is the highest allowable ("ceiling") exploitation rate for a population under recovery given current habitat conditions , which define the current productivity and capacity of the population. This rate is designed to meet the objective that, compared to a hypothetical situation of zero harvest impact, the impact of harvest under this Plan will not significantly impede the opportunity for the population to grow towards the recovery goal. Since recovery will require changes to harvest, hatchery, and habitat management and since this Plan only addresses harvest management, we cannot directly evaluate the likelihood of this plan's achieving its objective. Therefore, we evaluate the RER based on Monte Carlo projections of the near-term future performance of the population under current productivity conditions, in other words, assuming that hatchery and habitat management remain as they are now and that survival from environmental effects remain as they are now.

We choose the RER such that the population is unlikely to fall below a critical threshhold[11] (CT) and likely to grow to or above a rebuilding escapement threshold (RET). The CT is chosen as the smallest previously-observed escapement from which there was a greater than 1:1 return per

[11] Note that, there are other provisions of this plan that call for further reduction of the exploitation rate ceiling should the abundance be observed or expected to be near the lower threshold. This will provide additional protection against falling below the lower threshold that is not considered in this section, which address only the conditions under which the RER would apply.

spawner, while the RET is chosen as the smallest escapement level such that the addition of one additional spawner would be expected to produce less than one additional future recruit under current conditions of productivity. This level is also known as the maximum sustainable harvest (MSH) escapement. It is extremely important to recognize, though, that under this Plan the RET is not an escapement goal but rather a level that is expected to be exceeded most of the time. It is also the case that, when the productivity conditions for the population improve due to recovery actions, the RET will usually increase (MSH escapement does not increase in the Hockey stick model if productivity and capacity increase together as in eq. 5) and the probability of exceeding the RET using the RER computed for current conditions will also increase over the probability computed under current conditions. Thus the RET serves as a proxy for the true goal of the plan, which can only be evaluated once we have information on likely future conditions of habitat that will result from recovery actions, and hatchery as well as harvest management.

It also follows from the above, given that the likely chance of achieving the RET is greater than 50%, that the actual harvest from the population under this Plan will be less than the maximum sustainable harvest, the amount less being dependent on the likelihood (%) of achieving the RET. All sources of fishing-related mortality are included in the assessment of harvest, and nearly 100% of the fishing-related mortality will be due to non-retention or incidental mortality; only a very small fraction is due to directed fishing on Snohomish populations.

There are two phases to the process of determining an RER for a population. The first, or model fitting phase, involves using recent data from the target population itself, or a representative indicator population, to fit a spawner-recruit relationship representing the performance of the population under current conditions. Population performance is modeled as

$$R = f(S, \mathbf{e}),$$

where S is the number of fish spawning in a single return year, R is the number of adult equivalent recruits[12], and **e** is a vector of environmental, density-independent correlates of annual survival. The purpose of this phase is to be able to predict the recruits from spawners and environmental covariates into the future. What is important here is to simulate a pattern of returns into the future, not predict returns for specific years.

Several data sources are necessary for this analysis: a time series of natural spawning escapement, a time series of total recruitment (obtained from run reconstruction based on harvest and escapement data), age distributions for both of these, and time series for the environmental correlates of survival. In addition, one must assume a functional form for f, the spawner-recruit relationship; in our case three different forms were examined. Given the data, one can numerically estimate the parameters of the assumed spawner-recruit relationship to complete the model fitting phase.

The second, or projection phase, of the analysis involves using the fitted model in a Monte Carlo simulation to predict the probability distribution of the near-term future performance of the population assuming that current conditions of productivity continue. Besides the fitted values of the parameters of the spawner-recruit relationships, one needs estimates of the probability distributions of the variables driving the population dynamics, including the process error (including first order autocorrelation) of the spawner-recruit relationship itself and each of the environmental correlates. Also, since fishing-related mortality is modeled in the projection

[12] Equivalently, this could be termed "potential spawners" because it represents the number of fish that would return to spawn absent harvest-related mortality.

phase, one must estimate the distribution of the deviation of actual fishing-related mortality from the intended ceiling. This is termed "management error" and its distribution, as well as the others are estimated from available recent data.

We used the viability and risk assessment procedure (VRAP, N J Sands, in prep.) for the projection phase. For each trial RER value, the population is repeatedly projected for 25 years. From the simulation results we computed the fraction of years in all runs where the escapement is less than the LAT and the fraction of runs for which the final year's escapement (average of last 3 years) is greater than the UAT. Trial RERs for which the first fraction is less than 5% and the second fraction is greater than 80% are considered acceptable for use as ceiling exploitation rates for management under this plan.

MODEL FITTING PHASE

General

The model used to estimate the spawner recruit parameters uses fishing rate and maturation rate estimates along with the spawning estimates to determine the time series of total recruitment needed.

Preterminal Fishery Rates

Fishery rates were based on an aggregate of Puget Sound summer/fall chinook hatchery indicator stock populations (Stillaguamish, Green, Grovers, George Adams, Nisqually, Samish). Although a new indicator stock tagging program has been implemented to represent Skykomish wild chinook, there is currently no coded-wire-tag (CWT) recovery data available that is directly representative of the Snohomish populations and no direct measure of fishery exploitation on the wild populations. We evaluated two options for estimating fishery rates on the Snohomish populations: 1) an aggregate of Puget Sound summer/fall chinook hatchery coded-wire-tag (CWT) indicator stocks using the Pacific Salmon Commission Chinook Technical Committee (CTC) exploitation rate indicator stock analysis (CTC 1999 for method, Dell Simmons pers. Comm. for most recent data); and 2) estimates from the CTC chinook model (CTC 1999).

Option 1 relies on CWT recoveries from individual years to reconstruct the fishery rates for that year, but is dependent on a consistently high rate of catch and escapement sampling to make precise estimates. After further evaluation, we determined that catch and escapement sampling for most of the populations within the aggregate meet or exceed their target sampling rates in most years. Snohomish populations may not have the same distribution as the populations within the aggregate. Puget Sound summer/fall chinook populations show some similarity in the general trend over time of exploitation in preterminal fisheries. Although it is logical to assume that Snohomish summer/fall populations follow a similar trend with respect to the change over time in the rate of preterminal exploitation, concern remains that the aggregate Puget Sound indicator stocks may not accurately reflect the true exploitation rates of Snohomish populations. Also, the indicator stocks that comprise the aggregate are not likely to represent harvest patterns of yearling outmigrant or "stream type" (Healy 1991). Scale pattern analysis of Snohomish Chinook shows that a significant portion of the return is stream type from both fingerling and yearling populations.

Under Option 2, the CTC model uses CWT recoveries from the Stillaguamish indicator stock during the 1979-1982 base period to estimate fishery exploitation on the Snohomish population in subsequent years so estimates are less subject to year-year variability in sampling rates. The CTC model appears to best reflect the pattern of reduced overall exploitation they expected to see in the early 1990s in response to more restrictive fishing regimes. Again, it is possible that the distribution and exploitation of the Stillaguamish and Snohomish populations are different.

We chose Option 1 because we determined that, for the purposes of deriving an RER, year specific fishery rates would be better than estimates derived from a base period based on a limited number of Stillaguamish CWT recoveries. Option 1, by using an aggregate set of populations, maximizes the use of the available data and smoothes differences in any one year associated with a particular population. Also, we were able to address most of the concerns we had with Option 1. In addition, Therefore, the aggregate was used as a surrogate to represent the Snohomish populations in preterminal fisheries. Fishery rates were derived from the CTC CWT exploitation rate analysis for each population in the aggregate and averaged across all populations for each year for which data were available.

The average CTC CWT exploitation rate analysis for fall indicator stocks by age was used for brood year 1979 to 1994, ages 2-4 for brood year 1995 and ages 2-3 for brood year 1996. The 1995 age 5+ fishery rate was based on an average of the 1993-94 rates. The 1996 ages 4-5+ were based on an average of the 1994-1995 rates because the current CTC CWT exploitation rate analysis is not complete for these ages for these brood years. However, available data for ages 2 and 3 indicate fishery rates were similar in 1994-1996. Fishery rates will continue to be updated as data become available.

Terminal Fishery Rates

Terminal area fisheries include mature chinook harvested in net fisheries throughout Puget Sound and in recreational fisheries in the Snohomish River system and Area 8D. The in-river recreational fishery harvest is partitioned into natural and hatchery-produced components based on the relative magnitudes of the escapement to natural areas and to the Wallace River Hatchery.

The stock composition of the Area 8D recreational and net harvest is estimated using results of recoveries of thermally-marked otoliths from Tulalip hatchery. The otolith recoveries are used to estimate the Tulalip hatchery contribution to this fishery for the brood years from 1997 on (Rawson et al. 2001), which is subtracted from the total catch. The remaining catch is partitioned into components based upon the relative run strengths of the Stillaguamish and Snohomish chinook returns to their rivers. In particular, the Snohomish natural fraction is estimated as the Snohomish natural escapement plus the Snohmish natural portion of the in-river recreational harvest divided by the sum of the escapements to the Stillaguamish and Snohomish Rivers and the in-river harvests of chinook in those rivers. For years before 1997 the procedure is the same, except that the proportional contribution of Tulalip hatchery fish to Area 8D is assumed to be the average of the values measured for 1997-2001.

The stock composition of the Area 8A net harvest is estimated using the relative proportions of all the Stillaguamish/Snohomish stocks passing through Area 8A. Only chinook harvested during the so-called “adult accounting period” of July1 through September 30 are included in this analysis. Other chinook harvested in Area 8A are part of the preterminal fishing rate. In particular, the Snohomish natural fraction is the sum of the Snohomish natural escapement, the Snohomish natural fraction of the in-river harvest, and the Snohomish natural fraction of the 8D harvest, divided by the sum of the total escapement and harvest in both rivers plus the Area 8D harvest and escapement to Tulalip hatchery.

To the three harvest components computed above (in-river, 8D, and 8A) the harvest of mature Snohomish natural chinook in Puget Sound net fisheries outside of Area 8A must be added. This computation was completed using coded-wire tag recoveries by Jim Scott and Dell Simmons of the CTC. The terminal, or mature fishery, fishing rate is then the sum of the harvest in the four components divided by the numerator plus the Snohomish natural escapement.

Maturation Rates

We also considered two options for the maturation rates (the fraction of each cohort that leaves the ocean to return to spawn during the year): 1) maturation rates derived from age data collected from scales and otoliths from the spawning grounds combined with the age-specific fishing rates described above; 2) estimates derived from the CTC model for the Snohomish model population. In general, fish matured at older ages under option 1 than option 2, and no fish matured as two year olds. We decided to use option 1 because it is a more direct measure of the age structure of the spawners and relies on age specific data for the populations.

However, we identified two potential concerns that should be taken into account when using the data: 1) age 2 fish are generally underrepresented in spawning ground samples for several reasons: e.g., carcasses decay faster, the smaller body size makes them more susceptible to being washed downstream, they are less visible to samplers; and 2) only one year, 1989, had a sufficient number of samples to use. The age structure for other years was extrapolated from 1989 by using the 1989 age composition to reconstruct brood year and calendar year escapements by age. The age structure is then adjusted to minimize the difference between the estimated calendar year escapements and the observed calendar year escapements for each year for which data are not available.

Hatchery Effectiveness

No adjustments were made for the relative fecundity of naturally-spawning hatchery-produced fish as compared with natural-origin fish, since there is no available data for the effectiveness of hatchery spawners in the wild when compared with their natural origin counterparts for Puget Sound chinook. For the RER analysis, we assumed all spawners were equally fecund regardless of their origin. This is a conservative assumption since it would tend to underestimate productivity (assuming hatchery fish are less effective) and, therefore, the resulting RER, minimizing the possibility of adopting a harvest objective that was too high (Table 4.)

Table 4. Intrinsic Productivity (MSY Exploitation Rate) by Production Function for the Skykomish chinook population.

Hatchery Effectiveness	Ricker	Beverton-Holt	Hockey Stick
Not Effective	7.58 (49%)	14.14 (65%)	8.07 (77%)
Half as Effective	6.26 (52%)	8.34 (65%)	4.55 (63%)
Equal Effectiveness	5.49 (47%)	6.51 (53%)	3.66 (51%)

Spawner-recruit Models

The data were fitted using three different models for the spawner recruit relationship: the Ricker (Ricker 1975), Beverton-Holt (Ricker 1975), and hockey stick (Barrowman and Myers 2000). The simple forms of these models were augmented by the inclusion of environmental variables correlated with brood year survival. For marine survival we used an index based on the common signal from a several chinook coded-wire tag groups released from Puget Sound hatcheries (J Scott, Washington Department of Fish and Wildlife, personal communication). We tried two indices: one (PS6) used tag groups from throughout Puget Sound; the other (NPS2) used coded wire tags from North Puget Sound hatcheries only. The other environmental correlate, associated with survival during the period of freshwater residency, was the September-March peak daily mean stream flow during the fall and winter of spawning and incubation.

Equations for the three models are as follows:

$$(\mathbf{R} = \mathbf{aS}e^{-\mathbf{bS}})(\mathbf{M}^{\mathbf{c}}e^{\mathbf{dF}}) \quad \text{[Ricker]}$$

$$(\mathbf{R} = \mathbf{S}/[\mathbf{bS} + \mathbf{a}])(\mathbf{M}^{\mathbf{c}}e^{\mathbf{dF}}) \quad \text{[Beverton-Holt]}$$

$$(\mathbf{R} = min[\mathbf{aS},\mathbf{b}])(\mathbf{M}^{\mathbf{c}}e^{\mathbf{dF}}) \quad \text{[hockey stick]}$$

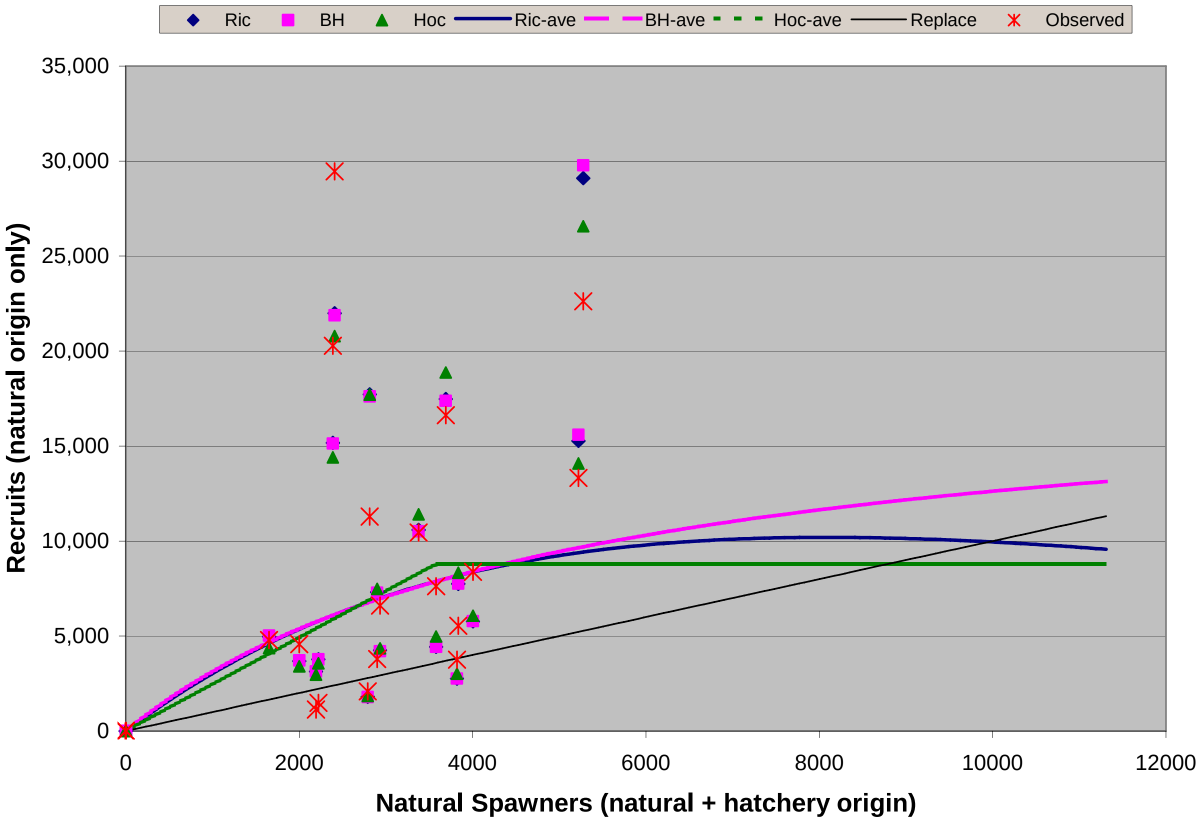
In the above, a is the density independent parameter, b is the density dependent parameter, c is the parameter for marine survival, d is the parameter for the freshwater covariate, M is the index of marine survival, and F is the freshwater correlate, peak Sep-Mar mean daily flow in this case.

Data used for the Skykomish Population

The Skykomish RER was based on analyses of the 1979-1996 brood years. Uncertainty about accuracy of escapement data and completeness of catch data precluded use of data before 1979. The 1996 brood year was the last year for which data were available to conduct a complete cohort reconstruction. There was no evidence of depensation or of a time trend in the data after adjustment for environmental variables.

Results

Figure 1. Comparison of observed and predicted recruitment numbers for the Skykomish chinook



population, brood years 1979 – 1996, under three different models of the spawner-recruit relationship (see text for further details).

The results of model fitting for various combinations of environmental correlates are summarized in Table 7 and graphed in Figure 1. We used the parameters from the fits using the NPS2 marine survival index and using both the marine and freshwater environmental correlates (upper right corner of Table 7).

PROJECTION PHASE

We projected the performance of the Skykomish stock at exploitation rates in the range of 0 to .30 at intervals of .01 using the fitted values of a, b, c, and d for the three spawner-recruit models. All projections were made assuming low marine survival using the average and variance of the marine survival indices observed for the most recent 10-year period. The freshwater environmental correlate (peak winter flow) was projected using the average and variance observed for the entire period used in the model fitting phase. Projections were run for target exploitation rates varying from 0 to .50, in increments of .01. The lower abundance threshold (LAT) was 1,745, derived as described above. The upper abundance threshold was the MSH escapement level (also described above). This biological reference point varies with the assumed marine survival and also with the particular form of the spawner-recruit relationship. We used the average marine survival index for the low marine survival period to obtain the RET for each spawner-recruit function. These values were: 3,500 – Ricker, 3,600 – Beverton-Holt, and 3,600 – hockey stick.

For each combination of spawner-recruit relationship and exploitation rate we ran 1000 25-year projections. Estimated probabilities of exceeding the RET were based on the number of simulations for which the final spawning escapement exceeded the RET. Estimated probabilities of falling below the LAT were based on the number of years (out of the total of 25,000 individual years projected for each combination) that the spawning escapement fell below the LAT. For each spawner-recruit relationship the sequence of Monte Carlo projection running through the exploitation rate range from 0 to .30 started with the same random number seed so that the results for the different spawner-recruit models would be comparable.

Detailed results of these projections are in Table 8, and summarized results are in Table 5. Indicated target exploitation rates are 0.25 – Ricker, 0.27 – Beverton-Holt, and 0.22 – hockey stick. Since there is no basis to choose one of these models over the other, we propose to use the average of these values as the target exploitation rate. This average is 0.24, rounding down to the nearest whole percentage exploitation rate.

Table 5. Results of the VRAP projections of the Skykomish chinook stock under current conditions showing the indicated target exploitation rate for each form of the spawner-recruit relationship.

Model	TgtER	#fish Mort.	% runs extnct	% yrs <LEL	% runs end>UEL	1st Year	LastYrs Ave.
Ricker	0.25	1671	0	4.0	80.0	2123	5711
Bev-Holt	0.27	1889	0	4.5	80.3	2084	6149
H-Stick	0.22	1427	0	3.0	81.3	2172	5747

MANAGEMENT UNIT REBUILDING EXPLOITATION RATE AND LOWER ESCAPEMENT THRESHHOLDS

The management unit maximum exploitation rate was set at 0.24, which is the average of the maximum allowable rates computed for the Skykomish stock using the three different spawner-recruit relationships. This is assumed to provide the appropriate protection to both populations. It was not possible to obtain a fit of the Snoqualmie data to any of the spawner-recruit models, with or without the use of environmental correlates. It is believed that this is due to the fact that some of the escapement estimates for the Snoqualmie are unreliable, and biased low, due to poor visibility in some years.

The lower abundance threshold for management was set starting with critical escapement levels, expands these per population management thresholds, and expands again to a management unit threshold based on the average contribution of each population to the management unit's escapement.

The second step in deriving the management unit lower threshold was to expand each stock's lower management threshold by dividing the percentage of the total escapement that the stock is expected to comprise.

We can then compute the total system escapement required such that we expect each stock to achieve its lower escapement management threshold by dividing the percentage of the total escapement the stock is expected to comprise. The expected percentages of each stock came from the recent 12-year escapement breakout by stock (Table 1). Averaging the ratios of the two stocks' estimated NOR escapements over the twelve years gives an average Snoqualmie fraction of 37.7% of the total.

Table 6. Derivation of the lower management threshold for each Snohomish chinook population and the management unit escapement necessary to achieve this level for each population.

	Snoqualmie	Skykomish
Critical level	400	942
Low R/S	1.01	0.71
Exp. rate	.24	.24
Low threshold	521	1745
Implied MU LT	1,381	2,802

The maximum of the management unit lower thresholds required to achieve the lower thresholds for the two stocks is 2,800 (Table 6), which was chosen as the management unit lower threshold for management planning purposes. Because this is so much higher than the indicated management threshold for protection of Snoqualmie escapement, this Plan is providing extra protection to the Snoqualmie stock pending acquisition of better escapement data.

INTERPRETATION OF FRAM MODEL FOR PRESEASON PLANNING

Currently the comanagers use the Fishery Regulation Assessment Model (FRAM) for preseason planning of total fishery impacts (Table 2). Because a different set of exploitation rates (Table 3) was used in the model fitting phase for Snohomish Chinook, it is important to assess whether preseason exploitation rates from FRAM are directly comparable with the RER derived in the projection phase described above.

The exploitation rates in Tables 2 and 3 cannot be directly compared for a number of reasons. First, the A&P rates (Table 3) are brood year rates, while the FRAM rates (Table 2) are calendar or fishing year rates. FRAM is based on applying current year abundances and fishery exploitation levels to average fishery-specific exploitation rates observed form coded-wire tag recoveries in a base period (Larrie Lavoy, WDFW, personal communication). In contrast the preterminal rates in the A&P tables use current year coded-wire tag recoveries from indicator groups.

Second, FRAM more accurately represents Snohomish Chinook by modeling both the fingerling outmigrant or "ocean type" and yearling outmigrant or "stream type" (Healy 1991) components of the Snohomish run. Comparison of coded-wire tag recoveries from hatchery groups released as age-0 fingerlings as compared with groups released as age-1 yearlings consistently shows differences in patterns of fishery exploitation. FRAM utilizes CWT recovery information from Wallace River (Skykomish) yearling production releases as well as fingerling CWT data to accurately reflect Snohomish Chinook distributions (Larrie LaVoy, WDFW, personal communication). Because yearling recovery data are not incorporated into the A&P tables, these rates may not be an accurate reflection of the true rates for Snohomish Chinook.

Finally, the two models use different set of indicator coded-wire tag groups to represent the Snohomish management unit. This is more difficulty for the Snohomish than for other management units because there is no local indicator coded-wire tag stock available for

Snohomish ocean type Chinook, although a program of double-index tagging at Wallace River hatchery began in 2000 with hopes of developing an appropriate indicator group.

In summary, information available at this time indicates that there is some management risk to using FRAM as we implement annual fishing plans with the intention of achieving our Plan objectives. However, given the uncertainties in estimates associated with estimates of exploitation rates in both the A&P tables and with FRAM, it is not clear that one is more accurate in representing true Snohomish Chinook exploitation rates. Therefore, some additional, precaution is called for in using FRAM to assess whether a given package of proposed fisheries will result in an exploitation rate below the RER guideline of 0.24 for the Snohomish. Therefore, the comanagers will initially use a guideline of 0.21 for the Snohomish instead of the 0.24 derived in the projection phase of this analysis. This guideline was the highest preseason projected exploitation rate for Snohomish since the 2000 application of the comanagers' plan (Table 2). The range of preseason exploitation rates primarily reflects variation in abundance of other chinook stocks and changes in the pattern or level of fisheries outside the comanagers' jurisdiction. Given the procedures in place for annual implementation of the plan, particularly with respect to our intention of not increasing fisheries and our record of managing fisheries to levels that are below exploitation rate ceilings, our expectation is for preseason Snohomish Chinook exploitation rates less than 0.21. Since observed spawning escapements have been increasing during this period (Table 1), consistently above the comanagers' former goal of 5,250 (Ames and Phinney 1977), and generally the largest observed since the beginning of the database in 1965, we feel that recent management has met this plan's objective of reducing fishery impacts so that the population can recover if other factors improve.

In addition, as part of our commitment to evaluate performance of the Plan and modify it as necessary to ensure objectives are achieved, the comanagers intend to l review in detail the implications of the differences between the A&P and FRAM exploitation rates. This may result in the need to recompute RER estimates, compute a quantitative adjustment for FRAM projections.

Data gaps

Priorities for filling data gaps to improve understanding of stock / recruit functions, harvest exploitation rate, and marine survival:

- Annual implementation of a double-index coded-wire tagging program using fingerling summer chinook from Wallace River Hatchery to enable direct assessment of harvest distribution, and estimation of harvest exploitation rates and marine survival rates. (Initiated beginning with the 2000 brood year).

- Estimates of natural-origin smolt abundance from chinook production areas. (Outmigrant trapping began in the Skykomish in 2000 in the Snoqualmie in 2001).

- Estimates of estuarine and early-marine survival for fingerling and yearling smolts.

- Quantification of the contribution of hatchery-origin adults to natural spawning for each stock. (Research is underway. Estimates of hatchery contribution to natural spawning populations is available for the 1997 through 2001 return years.)

Table 7. Results of model fits for different combinations of environmental correlates.

	PS(6) for marine, FW			NPS(2) for marine, FW		
	Ric	Bev	Hoc	Ric	Bev	Hoc
a - productivity	4.1658	0.2400	4.1658	5.1234	0.1782	3.6572
b - Spawners	0.000000	0.000000	42,216	0.000124	0.000035	13,092
c – Marine	0.8330	0.8330	0.8330	0.6418	0.6394	0.6313
d - Freshwater	-0.000011	-0.000011	-0.000011	-0.000014	-0.000014	-0.000014
SSE	2.414	2.414	2.414	0.343	0.345	0.347
MSE (esc)	0.268	0.268	0.268	0.038	0.038	0.039
autocorrelation in error	0.199	0.199	0.199	-0.366	-0.358	-0.449
R	0.680	0.680	0.680	0.895	0.891	0.891
F	2.579	2.579	2.579	12.096	11.569	11.568
PROBABLITIY	0.1184	0.1184	0.1184	0.0016	0.0019	0.0019
MSE (reruits)	0.564	0.564	0.564	0.276	0.278	0.255
autocorrelation in error	-0.390	-0.390	-0.390	-0.133	-0.126	-0.147
Ave.Pred. Error	7237	7237	7237	3994	4092	3999

	No Freshwater, PS(6)			No Freshwater, NPS(2)		
	Ric	Bev	Hoc	Ric	Bev	Hoc
a - productivity	2.8789	0.3474	2.8789	4.6677	0.0761	3.9737
b - Spawners	0.000000	0.000000	42,216	0.000254	0.000132	6,238
c – Marine	0.8398	0.8398	0.8398	0.6986	0.7042	0.7341
d - Freshwater	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	2.897	2.897	2.897	1.056	1.057	1.065
MSE (esc)	0.290	0.290	0.290	0.106	0.106	0.106
autocorrelation in error	0.203	0.203	0.203	0.175	0.141	0.116
R	0.617	0.617	0.617	0.862	0.855	0.877
F	3.066	3.066	3.066	14.505	13.605	16.739
PROBABLITIY	0.0915	0.0915	0.0915	0.0011	0.0014	0.0006
MSE (reruits)	0.447	0.447	0.447	0.298	0.304	0.316
autocorrelation in error	-0.372	-0.372	-0.372	-0.071	-0.088	-0.069
Ave.Pred. Error	7773	7773	7773	4310	4437	4089

	No Marine			No Marine or Freshwater		
	Ric	Bev	Hoc	Ric	Bev	Hoc
a - productivity	3.7071	0.2697	3.7071	2.7118	0.3688	2.7118
b - Spawners	0.000000	0.000000	19,851	0.000000	0.000000	66,517
c – Marine	1.0062	1.0000	1.0000	0.5000	0.5000	0.5000
d - Freshwater	-0.000010	-0.000010	-0.000010	-0.000001	-0.000001	-0.000001
SSE	3.463	3.463	3.463	3.758	3.758	3.758
MSE (esc)	0.346	0.346	0.346	0.342	0.342	0.342
autocorrelation in error	0.086	0.086	0.086	-0.017	-0.017	-0.017
R	0.435	0.435	0.435	0.299	0.299	0.299
F	1.164	1.164	1.164	1.076	1.076	1.076
PROBABLITIY	0.3512	0.3512	0.3512	0.3219	0.3219	0.3219
MSE (reruits)	0.768	0.768	0.768	0.789	0.789	0.789
autocorrelation in error	-0.324	-0.324	-0.324	-0.369	-0.369	-0.369
Ave.Pred. Error	7838	7838	7838	7938	7938	7938

Table 8. Summary of projections of the Skykomish population at different target exploitation rates for three different forms of the spawner-recruit relationship.

	Pr(final esc > UAT) %			Pr(ann. Esc. < LAT) %		
Target ER	**B-H**	**Ricker**	**Hockey-St**	**B-H**	**Ricker**	**Hockey-St**
0.00	99.20	96.60	96.30	0.30	0.50	0.50
0.01	99.40	97.80	96.50	0.40	0.70	0.60
0.02	99.00	96.40	95.80	0.50	0.70	0.60
0.03	98.70	95.80	95.60	0.40	0.60	0.50
0.04	98.10	95.60	94.70	0.40	0.70	0.60
0.05	98.40	96.40	95.80	0.50	0.70	0.70
0.06	97.80	95.10	94.30	0.60	0.90	0.80
0.07	97.40	94.70	93.20	0.60	0.90	0.80
0.08	97.80	94.90	94.00	0.60	0.90	0.80
0.09	97.50	94.80	93.70	0.70	1.00	1.00
0.10	97.40	94.20	92.70	0.70	1.00	1.00
0.11	96.90	94.10	92.20	0.90	1.20	1.10
0.12	95.70	92.10	90.50	0.80	1.20	1.20
0.13	96.50	93.40	90.70	1.20	1.60	1.60
0.14	96.00	92.10	90.30	1.10	1.40	1.40
0.15	95.60	90.40	89.30	1.20	1.50	1.60
0.16	93.60	90.90	88.20	1.60	2.00	2.00
0.17	93.70	89.80	87.00	1.50	1.80	2.00
0.18	91.40	87.90	84.60	1.60	1.90	2.10
0.19	91.10	87.70	83.80	2.10	2.50	2.80
0.20	91.00	86.90	83.90	1.90	2.30	2.60
0.21	91.00	87.90	84.40	2.10	2.40	2.80
0.22	90.70	87.30	**82.50**	2.30	2.70	3.00
0.23	86.40	82.70	78.70	2.80	3.20	3.70
0.24	86.40	82.30	77.10	3.40	3.70	4.40
0.25	84.30	**80.00**	75.30	3.50	4.00	4.80
0.26	85.80	82.40	76.90	3.30	3.90	**4.70**
0.27	**80.30**	77.10	71.50	4.50	**4.90**	6.10
0.28	77.90	73.90	68.70	**4.50**	5.00	6.30
0.29	78.40	73.90	65.80	5.10	5.60	7.20
0.30	75.20	72.00	65.60	5.20	5.60	7.50

Lake Washington Management Unit Status Profile

Component Stocks

Cedar River Fall
North Lake Washington Tributaries Fall

Geographic distribution

Fall chinook are produced in three basins in the Lake Washington watershed, the Cedar River, at the south end of Lake Washington; Big Bear Creek and its tributary Cottage Creek (the “Northern Tributaries” which are tributaries of the Sammamish Slough), and Issaquah Creek, the principle inlet at the south end of Lake Sammamish. Historically, chinook also spawned in other smaller tributaries to Lake Washington (e.g. – May and Kelsey creeks) and the Sammamish Slough, (e.g. Little Bear, Swamp, and North creeks). Recent field studies indicate sporadic use of these streams.

About ten miles of Bear Creek, and three miles of Cottage Creek, are accessible to chinook. Recent surveys have located concentrated spawning between RM 4.25 and 8.75 in Bear Creek and the entire three miles of Cottage Lake Creek. Approximately 75% of the total chinook escapement in Bear/Cottage is in Cottage Lake Creek. Spawning in Issaquah Creek occurs predominately in reaches between RM 1 and the Issaquah hatchery (Ames et al. 1975). Chinook surplus to hatchery needs are often passed upstream of the rack and spawn in Issaquah Creek.

In the Cedar River, access above RM 21 has been blocked by the Landsburg diversion dam since its construction in 1901. Access to an additional 15 miles of habitat above Landsburg became available in 2003 with the completion of fish passage facilities. There is very little chinook spawning in the Cedar River downstream of RM 5.0.

Hatchery contribution

Hatchery production currently exists at Issaquah Creek (chinook and coho), the University of Washington (chinook and coho), and the Cedar River (sockeye). Due to present and historic enhancement efforts, adults that return to Issaquah Creek are presumed to be predominately of hatchery origin. Outplants were made to most of the tributaries to the Lake Washington basin from the Issaquah and Green River hatcheries, during the period of record (1952 on). Many of these plants continued through the early 1990s. The one exception is the Cedar River where the last plants were in 1964.

Genetic information

Allozyme analysis of samples collected from Cedar River chinook suggest that this stock is genetically distinct, but closely related to that in the Green River (Marshall, 1995b). Genetic samples from chinook in Bear/Cottage Creek are similar to those from Issaquah Creek. Green River hatchery fish were outplanted into the Cedar River system from 1952 to 1964. Until 1916 the Cedar River drained into the Green River, so a close relationship is not surprising. Sampling and genetic analysis of returns to the North Lake Washington tributaries and other independent tributaries is in progress, and preliminary analysis suggests that chinook in Bear/Cottage Creek have similar genetics to chinook returning to Issaquah Creek.

Life History Traits

Juvenile trapping in the Cedar River has shown that the outmigration is bimodal with most of the fish entering the lake prior to April as fry. A smaller percentage of these fish rear in the river to smolt size and outmigrate between May and July. On the average, 75% of the outmigrants are fry. These fry rear along the lakeshore, growing quickly and leave the lake as zero-age smolts. The smolts that migrate out of the river are thought to reach the Locks about the same time as the fry, although some fish are still migrating out of the river in late July. The migration through the Locks begins in mid-May and continues until at least September. Recent PIT tagging of Cedar River chinook suggests that the Cedar River fish migrate out later in the season than hatchery chinook. The Cedar River chinook fry that rear along the lakeshore are unique in that most, if not all, of the chinook stocks that use a lake for rearing are age one or two smolts. The Lake Washington stocks also have a protracted smolt outmigration, with a large percentage of the run outmigrating after July 1.

Adult chinook enter the Lake Washington basin from late May through September, and enter drainages from mid-August through early November. Spawning is usually complete by mid-November.

Status

Annual monitoring of the return through Ballard Locks has, since 1994, provided in-season assessment of the total abundance of chinook. Escapement surveys are conducted annually on index reaches in the Cedar River (RM 0 – 21.4), Bear Creek (RM 1.3 – 8.8) and Cottage Lake Creek (RM 0 – 2.3), and some of the smaller tributaries to Lake Washington. An additional mile of upper Cottage Lake Creek, above the index reach (i.e. up to RM 3.3), is also routinely surveyed. Hatchery rack counts occur at Issaquah Creek Hatchery and the University of Washington facility. Since 2003, returns of mass marked hatchery releases from Issaquah Creek Hatchery have enabled assessment of natural- and hatchery-origin chinook at the Ballard Locks and in natural spawning escapement.

For Cedar River, the geometric mean escapement (i.e. live fish counts in the index reach) from 1993 – 1997 was 319; for 1998 - 2002 the mean was 327. For the North Lake Tributaries, the 1993 – 1997 mean escapement to index reach (i.e. live count) was 110; for 1998 – 2002 the mean increased to 330 (Table 1).

Table 1. Escapement estimates for of Lake Washington fall chinook, 1993-2002 (MIT et al. 2003), based on live fish counts in the index reaches of the Cedar River (RM 0 – 21.4), and the North Lake Tributaries (RM 1.3 – 8.8 in Bear Creek, and RM 0 – 2.3 in Cottage Lake Creek).

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Cedar River	156	452	681	303	227	432	241	120	810	369
N. Lake Tribs	89	436	249	33	67	265	537	228	458	268

Additional, and more extensive survey coverage and redd counts, conducted since 1999, have improved our understanding of the distribution and abundance of natural spawning for the two Lake Washington populations (Table 2).

Table 2. Redd count-based estimates of escapement to the Cedar River index reach, and live-fish estimates of escapement to upper Cottage Creek (RM 2.3 – 3.3), 1999 – 2002.

	1999	2000	2001	2002
Cedar River – Redd counts	180	53	395	266
- Expanded by 2.5 fish / redd	450	133	988	665
Upper Cottage Creek – live counts	195	104	231	92

Redd count-based estimates for the Cedar River index reach suggest that escapement has substantially exceeded the standard live-count estimates. The supplemental surveys of upper Cottage Lake Creek indicate that approximately 30% of natural spawning in the Bear Creek system has occurred above, and in addition to, that in the index reach. The additional abundance identified in Table 2, when added to the index counts, still does not fully account for escapement to the Cedar River and North Lake tributaries.

Harvest distribution

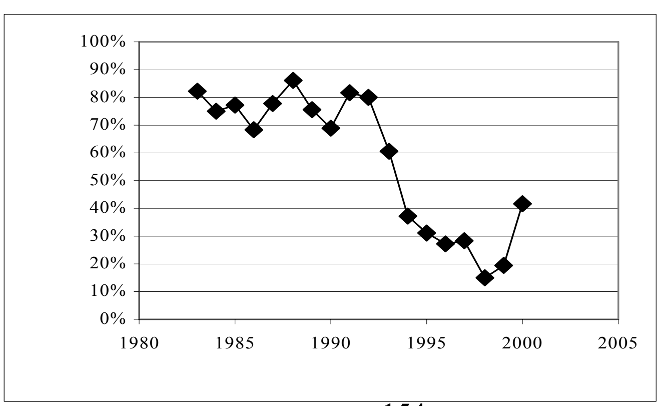
The harvest distribution of Lake Washington chinook has not been directly assessed because representative coded-wire tagged hatchery releases are only available for a few brood years from the Issaquah Hatchery in the late 1980s, and the University of Washington hatchery in the late 90s. However, because of their similar life history and genetic heritage, tagged fingerling releases from Central Puget Sound facilities (Soos Creek hatchery on the Green River, and Grovers Creek Hatchery on the Kitsap Peninsula) facilities provide the best available representation of pre-terminal harvest distribution (see Green River profile).

Terminal harvest of Lake Washington chinook has been minimized since 1994 by regulatory measures that have eliminated directed harvest and reduced incidental impacts in Shilshole Bay, the Ship Canal, and in Lake Washington. Commercial and recreational fisheries directed at sockeye and coho salmon have been specifically shaped to minimize impacts on chinook. Recreational fishing regulations focus effort on Issaquah Hatchery returns.

Exploitation rate trends

Based on post-season FRAM runs, average total annual exploitation rates on the aggregate of natural and hatchery-produced Lake Washington chinook have fallen 66 percent from levels in the 1980s to 1996 – 2000.

Figure 1. Total annual, adult equivalent, fisheries exploitation rate of Lake Washington chinook, estimated by post-season FRAM runs for management years 1983 – 2000.



Management Objectives

The upper management threshold (escapement goal) for the Lake Washington unit is 1,200 (i.e. live count) in the Cedar River index reach. This goal was derived as the average escapement observed from 1965 – 1969, and represents the best available estimate of habitat capacity (Hage et al. 1994). However, current habitat conditions constrain productivity and have prevented achievement of the goal in recent years (Table 1).

The current management objective for the Lake Washington unit is to constrain the exploitation rate, in pre-terminal southern U.S. fisheries, to a level less than or equal to 15%. This objective was derived from highly constrained regimes planned for the 1998 – 2000 management years. Directed terminal fisheries have been closed for ten years, and pre-terminal exploitation rates have been declining. Terminal area fisheries have been reduced to the Minimum Fisheries Regime to conserve Lake Washington chinook, even though forecast abundance has exceed the low abundance threshold. This fishing regime has stabilized escapement.

Management objectives are not currently specified for the North Lake Washington tributaries population. Estimated escapement to the Bear Creek / Cottage Creek index areas averaged 350 during the period from 1983 – 1992 (Hage et al. 1994), and the co-managers previously adopted this as an interim escapement goal. The aforementioned management objectives, for the Cedar River population, provide adequate protection for the North Lake population, as demonstrated by stable escapement levels observed in the last ten years (Tables 1 and 2). The long-term objective for Lake Washington chinook is to increase productivity to the point that the natural escapement goal is regularly met or exceeded.

Anticipating that productivity and abundance will remain low during the term of this plan, the co-managers will continue to implement the recent management actions which constrain impacts on Lake Washington natural chinook to very low incidental levels. These harvest measures ensure that harvest impacts are consistent with recovery of listed stocks. The co-managers will continue to refine their harvest management for Lake Washington natural chinook by shaping terminal fisheries for sockeye and coho to minimize incidental impact on chinook.

The low abundance threshold of 200 for the Cedar River population was set substantially above the historically low escapement from which the stock recovered (e.g. the 1993 escapement of 156). If pre-season fishery simulation modeling indicates that escapement will fall below 200, conservation measures will be implemented to further reduce the pre-terminal SUS exploitation rate to a level no greater than 12%, and terminal fisheries will also be shaped to reduce impacts on Lake Washington chinook, while maintaining fishing opportunity on harvestable sockeye and coho salmon (see Appendix C).

These objectives are intended to maintain the diversity of the naturally reproducing populations that comprise the management unit. Diversity is expressed in various aspects of life history, including the age composition of mature fish, migration timing, and spawning and rearing distribution. Harvest constraint has been exerted, over the last ten years, to maintain stable spawning escapements to the Cedar River and the North Lake tributaries, but is not capable, by itself, of improving their status. If habitat protection and restoration measures succeed in alleviating the primary constraints on productivity in these systems, harvest management will respond by ensuring that spawning escapement is sufficient to optimize production, so that abundance will rebuild.

Data gaps

The highest priority will be placed on collecting the data needed to quantify the productivity of Lake Washington stocks. Until the fundamental aspects of productivity are defined it will be difficult to assess the success of recovery actions, whether they entail improvement in habitat productivity or production supplementation.

Table 3. Data gaps related to harvest management, and projects required to address those data needs.

Data gap	Research needed
Estimates of total spawning escapement for each stock.	Mark/recapture study, repeated for a minimum of three years; or an alternate approach to expanding index reach counts to total escapement. First done in FY2000
Estimates of natural smolt production in Issaquah Creek.	Fry/smolt trapping in Issaquah Creek to supplement ongoing trapping in the Northern Tributaries and the Cedar River.
Quantification of fry and smolt survival in Lake Washington and the Ship Canal.	Smolt trapping at the locks to quantify mortality as smolts transit the lake and the locks. Trapping at the locks has proven to be very difficult.
Quantification of freshwater predation on smolts	Continuation of the Lake Washington Studies Project to further quantify fish, bird and lamprey predation. Fish predation research has been completed and is being written up. Bird predation work has not been started
Comprehensive estimates of incidental fishing mortality.	Creel surveys of recreational fisheries that target other species. The approach should be research oriented.
Estimates of bias in ladder counts at Ballard Locks, relative to spawning ground surveys.	Tagging and tracking of adult chinook from the locks and the ladder to estimate repeat passage. Started in 1998, research is complete and is awaiting write-up.
Estimate of spawning and production above Landsburg Dam	Spawner surveys to account for fish passed above the dam, fry/smolt trapping at or near the dam to independently assess upper basin productivity and survival.
Estimates of hatchery stray rates for Cedar and North Lake Tributaries	All ages are ad-clipped beginning in 2004. Enumerate ad-clipped fish during spawner surveys; sample for and collect CWTs.
Assess pre-spawning mortality	Quantify pre-spawning mortality related to environmental variables like water temperature.

Related Data Questions

Is chinook survival from emergent fry to adult (smolt?) correlated with early life history strategy? (i.e. – what are the relative survival rates of fry outmigrants compared to smolt outmigrants in the Cedar River). Is survival different in the upper basin than it is in the lower basin?

Is scour of chinook redds related to the magnitude of peak flow events in the Cedar River, and the position of redds in the stream channel?

What is the relationship between flow at Landsburg and the availability of water at the Locks for operating the smolt slides?

Green River Management Unit Status Profile

Component Stocks

Green River Fall Chinook

Geographic description of spawner distribution

Fall chinook are produced in the mainstem Green River and in two major tributaries - Soos Creek and Newaukum Creek. Adults that spawn in Soos Creek are presumed to be predominantly of hatchery origin. However, recent investigations into straying raise questions regarding this, and other assumptions related to run reconstruction. (See stock status, below). Newaukum Creek spawners appear to be closely related to the spawners in the mainstem.

Spawning in the mainstem Green River occurs from RM 26.7 up to RM 61. Spawning access higher in the drainage is blocked by the City of Tacoma's diversion dam, and at RM 64 by Howard Hanson Dam. Spawning occurs in the lower 10 miles of Newaukum Creek. Adults returning to the hatchery at RM 0.7 of Soos Creek may also spawn naturally and adults surplus to program needs at the Soos Cr. Hatchery are often passed upstream.

Life History Traits

Fall chinook begin entering the Green River in July, and spawn from mid-September through October. Ocean-type freshwater life history typifies summer/fall stocks from South Puget Sound, with 99 percent of the smolts outmigrating in their first year (WDFW 1995 cited in Myers et al 1998). A long-term average of the age composition of adults returning to the Green River indicates the predominance of age-4 fish (62 percent), with age-3 and age-5 fish comprising 26 percent and 11 percent, respectively (WDF et al 1993, WDFW 1995 cited in Myers et al 1998).

Status

The SASSI review (WDF et al 1993) classified Green River chinook as healthy, because spawning escapement had consistently met the objective since 1978. Spawning escapement has increased recently, with the mean of the 1997–2002 escapement (9077) exceeding that for the preceding five-year period (4799). Total escapement fell below the nominal goal of 5,800 in 1992 – 1994, which triggered an assessment of factors contributing to the escapement shortfall by the PFMC (PSSSRB 1997). However, escapement has exceeded the goal in each subsequent year.

Table 1. Spawning escapement of Green River Fall Chinook, 1992-2002.

1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
5,267	2,476	4,078	7,939	6,026	9,967	7,300	9,100	6170	7975	13950

It is known that returns from hatchery production contribute substantially to natural spawning in the Green River and tributaries. Viability of the naturally spawning stock, absent the hatchery contribution, is uncertain because hatchery returns may be masking poor natural productivity (Myers et al 1998). Analysis of coded wire tags recovered from the spawning grounds and the in-river fishery has yielded highly variable results. Collection of data from Chinook mass-marked since 2000 began in 2003 and is expected to provide better estimates of straying and contribution as analysis is completed.

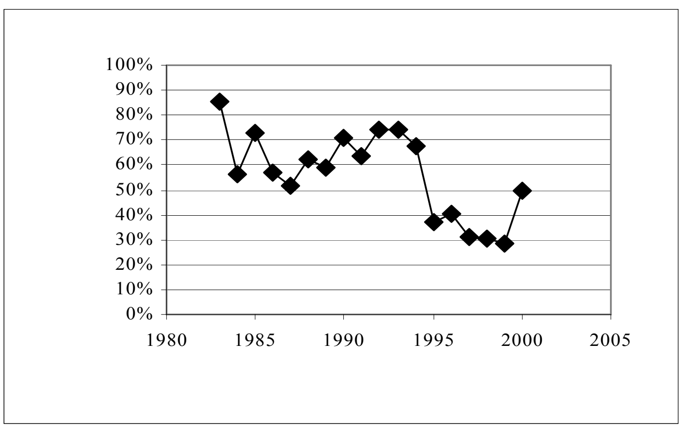
The nominal escapement goal is based on approximate estimates of escapement in the 1970's, and may not reflect the productivity constraints associated with current degraded habitat, but will be used to guide fisheries management until natural capacity is better quantified. Escapement estimation methods are under review. Surveys have been expanded in recent years to calibrate assumptions regarding the relationship between index area counts and total escapement and the third year of a mark/recapture method, also for the purpose of calibration of escapement estimates, was just completed.

Hatchery facilities currently operate on Soos Creek, Keta Creek and Icy Creek. Broodstock has always been collected from local returns, so the hatchery stock presumably retains its native genetic character. Allozyme analysis has shown no detectable difference between hatchery-reared and naturally spawning adults (Marshall et al 1995).

Harvest distribution and exploitation rate trends:

Post-season FRAM runs, incorporating actual catch and stock abundance indicate that annual exploitation rates for Green River chinook have declined 45 percent from levels in the 1980s to 1996 – 2000 (Figure 1). As noted above, recent years' spawning escapement has consistently exceeded the goal.

Figure 1. Total annual, adult equivalent, fishery exploitation rates for Green River chinook for management years 1983 – 2000, estimated by post-season FRAM runs.



Coded-wire tagged fingerling releases from the Green River (and Grovers Creek) describe harvest distribution in recent years. Fisheries in British Columbia and Alaska account for 32 percent of total fishing mortality. Washington recreational and Puget Sound net fisheries account for 38 percent and 24 percent of total mortality, respectively (Table 3).

Table 3. The harvest distribution of Green River chinook, expressed as a proportion of total annual, adult equivalent exploitation. (CTC 2003).

	Alaska	B.C.	Washington Troll	Puget Sound net	Washington sport
1997 – 2001	2.1%	30.1%	9.4%	23.7%	37.7%

Management Objectives

The co-managers manage fisheries to meet or exceed the spawning escapement goal of 5,800 Green River chinook. This goal has been met or exceeded in 10 of the last 13 years. The co-managers expect that the goal will continue to be met or exceeded as a result of this management approach. The co-managers expect to further refine their management plan for Green River chinook in response to on-going ESA recovery planning, to ensure harvest impacts are consistent with recovery of listed stocks and emerging policies for hatchery management. When the escapement is expected to be less than 5,800, the co-managers will discuss what additional actions, beyond those identified below, may be appropriate to bring the escapement above the 5,800 level.

Management objectives for Green River chinook include an exploitation rate objective for pre-terminal Southern U. S. fisheries and a procedure to manage terminal-area fisheries that is based on an inseason abundance triggers to assure that the escapement goal will be achieved. This management regime assures that harvest of Green River chinook will not impede recovery of the ESU.

Washington preterminal fisheries impacts on Green River chinook are managed at or below a 15 percent 'SUS' exploitation rate, as estimated by the FRAM model. Pre-terminal fisheries include the coastal troll and recreational fisheries managed under the Pacific Fisheries Management Council, and commercial net and recreational fisheries in Puget Sound outside of Elliott Bay.

Due to more restrictive pre-terminal fisheries in recent years, a greater proportion of allowable harvest has been available in the terminal fishery in Elliott Bay and the Duwamish (lower Green) River, where tribal net fisheries and recreational fisheries are managed on the basis of terminal abundance triggers.

Terminal area abundance is estimated annually utilizing a test fishery conducted since 1989. Using this data, two thresholds (triggers) have been set below which planned directed fisheries would not proceed. A value below 100 chinook for the test fishery would cause cancellation of subsequent commercial and sport fisheries. A value below 1000 chinook for the first commercial opening would cause cancellation of any further chinook-directed fishing. These values corresponded with a total run of about 15,000 chinook.

Management thresholds were met in 2000, 2001, 2002 and 2003. Terminal area chinook-directed treaty net and sport fisheries were implemented as scheduled. Natural escapement for 2000, 2001 and 2002 are provided in Table 1. The preliminary estimate for 2003 escapement is more than 7000 spawners.

A critical-abundance threshold of 1,800 natural spawners is established for the Green River management unit on the basis of the lowest observed escapement resulting in a higher escapement four years later. If natural escapement is projected to fall below this threshold during pre-season planning, then additional management measures will be implemented in accordance with procedures established in Appendix C, to minimize fishery-related mortalities.

Data gaps

Several aspects of the productivity of Green River chinook are potentially affected by hatchery-origin fish spawning naturally. The abundance, timing, spawning distribution, and age structure of natural-origin chinook may be masked by the presence of hatchery-origin fish. The viability of the natural origin population cannot be accurately assessed without determining the effects of hatchery straying, so the need for this information will prioritize research. Below are descriptions of the data needs and how they are being addressed.

Data need	Related project
Quantification of the proportion of natural escapement that is comprised of hatchery strays.	Completion of a CWT data set for refinement of current CWT-based estimates. (work in progress) Mass marking of hatchery production. (Brood years 1999-2002 marked
Re-evaluation of escapement estimation methodology	Expanded surveys to calibrate expansion of index area data to total. (begun in 1998 – work continues.) Mark/recapture study to independently calibrate total escapement estimate in association with expanded survey effort. (done in 2000-2002, report in progress)
Estimation of the number of Chinook fry and smolts that emigrate annually from the mainstem Green and Newaukum Creek.	Trap placement in the mainstem Green 1999-2002)
Estimation of differential survival of natural and hatchery origin Chinook in-situ in the Green.	A literature review of methodologies that may have utility for an in-situ experiment should be done.
Estimation of estuarine hooking mortality if selective fisheries are proposed for Elliott Bay.	A literature review and preliminary study design should be done.

White River Spring Chinook Management Unit Profile

Component stocks

White River Spring Chinook

Geographic description

White River Spring Chinook are trapped at the Puget Sound Energy diversion dam in Buckley and transported into the upper watershed, above Mud Mountain Dam, where they spawn primarily in the West Fork White River, Clearwater River, Greenwater River, and Huckleberry Creek. They also spawn in the lower mainstem White, below the diversion dam at RM 23.4 where river conditions preclude estimates of spawner abundance.

The White River population is the only spring stock still present in southern Puget Sound, is geographically isolated from summer/fall stocks, and genetically distinct from all other chinook stocks in Puget Sound. The White River Hatchery program, and the Minter Hupp Complex supplement production. The stock has, in past years, been maintained as captive brood at the Hupp Springs and Peale Pass net pen facilities. The supplementation program is considered essential to recovery, so hatchery production is included in the listed ESU.

Life History Traits

Spring chinook enter the Puyallup River from May through mid-September, and spawn from mid-September through October. All adipose-bearing fish arriving at the Buckley trap without detectable CWT's are passed upstream. CWT fish are transferred to the White River Hatchery and confirmed as White River Spring Chinook by genetic testing before they are incorporated into the broodstock supplementation program.

Fry emerge from the gravel in late winter and early spring. In contrast to other spring stocks in Puget Sound, White River chinook smolts emigrate primarily (80 percent) as subyearlings (SSSCTC 1996), after a short rearing period of three to eight weeks. Adults mature primarily at age-3 or age-4.

Status

Escapement of White River chinook exceeded 5,000 in the early 1940's, but the construction of hydroelectric and flood control dams, and degradation of the spawning and rearing habitat, reduced abundance to critical levels in the 1970's. Escapement was less than 100 through the 1980s and fell below 10 in 1984 and 1986. A supplementation program has been operating since 1971, and it has succeeded in raising escapement to levels between 300 and 600 in recent years (Table 1). The geometric mean of escapement in 1992 – 1996 was 477, and for the three more recent years, 413.

Table 1. Spawning escapement of White River spring chinook, 1993-2002.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Upper River	409	392	605	630	400	316	553	1523	2002	803
Broodstock	1444	2033	1982	924	822	454	429	740	814	
Total	1853	2425	2587	1554	1222	770	982	2263	2816	

The upper river figure represents untagged fish captured at the Buckley trap and transported to upstream spawning grounds (ACOE data cited in HGMP). Broodstock includes collections at Minter Creek, South Sound Net Pens, and the White River Hatchery, and excludes jacks through 1995 (WDFW et al. 1996 cited in HGMP). Broodstock values from 1996 on represent collection at White River Hatchery only.

The status of White River spring chinook has been considered critical. Returns in recent years have improved, but evaluation of natural-origin versus hatchery-origin returns is not complete. Degraded spawning and rearing habitat, and the migration blockage imposed by dams, currently imposes severe constraints on natural productivity. The contribution of natural-origin adults to spawning escapement has not been quantified, but there is evidence to suggest that the stock is not currently viable in the absence of supplementation. The supplementation program succeeded in raising escapement above the critically low levels seen in the 1970's and 1980s, and it may continue to protect the viability of the stock, but natural production will not recover until the habitat constraints are addressed.

Harvest distribution and exploitation rate trends

Based on recoveries of coded-wire tagged yearling released from White River and Hupp Springs hatcheries during calendar years 1996 – 2000, 90 percent of the total harvest mortality of White River springs has taken place in Puget Sound recreational fisheries. An average of five percent of total mortality occurred in British Columbia fisheries.

Table 2. The recent average distribution of annual harvest mortality for yearling White River spring chinook, expressed as a proportion of total annual adult equivalent exploitation rates (CTC 2003)

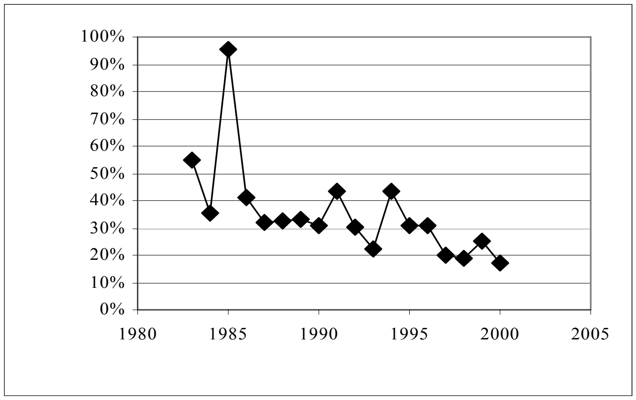
	Alaska	B.C.	Wa troll	PS net	Wa sport
1996 - 00	0.0%	5.4%	0.8%	3.9%	90.0%

Increasingly conservative management of Washington fisheries has resulted in a declining trend in total exploitation rate over the last six years, as estimated by post-season FRAM runs that incorporate actual catch and stock abundance (Figure 1). The average rate for management years 1998 – 2000 was 61 percent lower than the average for management years 1983 – 1987. . The fisheries simulation model (FRAM) has been modified to incorporate only White River fingerling tag codes, which show a slightly different harvest distribution than yearlings that comprise the PSC Indicator Stock.

Management Objectives

Fisheries in Washington will be managed to achieve a total exploitation rate, including fisheries in British Columbia, no greater than 20 percent. This exploitation rate ceiling, which is three points higher than the ceiling in the 2001 Harvest Management Plan, reflects changes in coded-wire tag and historical catch data incorporated in the most recent calibration of FRAM (L. LaVoy, WDFW, memorandum to co-manager technical staff, February 12, 2002). Achievement of this rate requires continued constraint of Puget Sound net and recreational fisheries, and allows minimal tribal ceremonial and subsistence fisheries in the river. Tag recovery and escapement data are insufficient, at present, to support direct assessment of the productivity of the stock.

Figure 1. Total annual, adult equivalent fisheries exploitation rate for White River Spring Chinook for management years 1983 – 2000, estimated by post-season FRAM runs.



The current management objective constrains fishing mortality and, in recent years, has provided spawning escapement well in excess of the critical threshold of 200. Escapement below this level is believed to present significant risk to genetic diversity and exposure to depensatory mortality factors, particularly when considering the low productivity of naturally spawning fish.

If preseason fishery simulation modeling suggests that escapement will not exceed the low abundance threshold, further conservation measures will be implemented in fisheries that catch White River chinook, so as to reduce their total exploitation rate to a level that is defined by modeling the fishing regime described in Appendix C. A conservative approach is warranted in managing this stock, and projected escapement near the critical threshold, or failure to achieve broodstock collection objectives, will be considered grounds to re-institute the captive brood program.

Data gaps

- Description of spawning distribution in the upper White River system.
- Quantification of hatchery- and natural-origin adults on the spawning grounds.
- Estimation of natural smolt production.
- Estimation of pre-spawning mortality of adults that are trapped and transported above Mud Mountain dam.

Puyallup River Fall Chinook Management Unit Status Profile

Component Stocks

Puyallup River fall chinook
South Prairie Creek fall chinook

Geographic description

Fall chinook spawn primarily in South Prairie Creek (a tributary of the Carbon River) up to RM 15, the Puyallup mainstem up to Electron Dam at RM 41.7 , the lower Carbon River up to RM 8.5, Voights's Creek, Fennel Creek, Canyon Falls Creek, Clarks Creek, Clear Creek and Kapowsin Creek, and, possibly, the lower White River. Surplus Voights Creek Hatchery adult chinook are currently released to spawn naturally above the Electron diversion and juvenile chinook produced at the Puyallup Voights Creek Hatchery are outplanted to acclimation ponds in the upper Puyallup River, above the diversion dam. Construction of a fishway at Electron Dam is expected to re-establish adult access to the upper river, however, downstream juvenile passage is still deficient in the near future.

Life History Traits

Hatchery programs have introduced non-native stocks, primarily of Green River origin, into the Puyallup system, so it is not clear that naturally spawning chinook bear the native genetic legacy. A remnant native stock may persist in South Prairie Creek, though genetic testing to date has not been conclusive in that respect.

Freshwater entry into the Puyallup River begins in late July, and spawning occurs from mid-September through mid-November. Based on scale samples collected in 1992-93, returning adults were primarily (76 percent) age-4, and age-3 and age-5 fish made up 16 and 6 percent of the sample (WDF et al. 1993 cited in Myers et al. 1998). South Prairie Creek age samples taken between 1992 and 2002 provides a mean age composition, based on brood contribution of the 1991-1997 broods, of 1.0% age-2, 19.1% age-3, 67.3% age-4, 12.3% age-5 and 0.3% age-6 fish (WDFW, unpublished data). Juveniles exhibit ocean-type life history, primarily, with estimated 97 percent of smolts emigrating as subyearlings (WDF et al. 1993 cited in Myers et al. 1998).

Status

Between 1994 and 2001, escapement to the South Prairie Creek sub-basin has ranged from 667 to 1430 fish, averaging 1048. The turbid nature of the Puyallup and Carbon rivers, due to its their glacial origin, makes enumeration of spawners or redds difficult in the mainstem, so the accuracy of the system-wide estimates is uncertain.

The former nominal escapement goal, that was intended principally to assure adequate broodstock to hatchery programs, was 3,250, including natural spawning and escapement to the hatcheries.

Harvest distribution and exploitation rate trends:

The harvest distribution of Puyallup fall chinook has not been assessed, because a local indicator stock has not been consistently coded-wire tagged. Distribution in pre-terminal fisheries is likely similar to that of the South Sound fingerling indicator stock, which is composed of tagged releases from the Green River (Soos Creek) and Grovers Creek. This distribution is shown, above, in the Green River profile.

Post-season FRAM runs, which incorporate actual catch in all fisheries and actual abundance of all chinook stocks, indicate the total, annual, adult-equivalent exploitation rate for Puyallup fall chinook declined sharply from 1995 – 1998, and that rates have since increased as improved survival has enabled increased harvest, while still achieving the escapement objectives.

Management Objectives

Since the existence of an indigenous fall chinook stock in the Puyallup system is uncertain, and current natural production is substantially augmented by hatchery-origin fish, the harvest management objectives will reflect the need to adequately seed natural spawning areas until the productive capacity of habitat is quantified, and the existence of an indigenous stock is resolved. Until recently fisheries were managed to supply adequate broodstock to the hatchery programs.

The harvest management objective for Puyallup fall chinook is to not exceed a total exploitation rate of 50 percent, to assure that a viable, natural-spawning population is perpetuated. Pre-season fisheries planning, to not exceed this ceiling rate, has been shown to result in spawning escapement of more than 500 to the South Prairie Creek - Wilkeson Creek complex. . Though escapement estimation methods have evolved recently to better quantify total fall chinook escapement to the entire Puyallup system, as previous described, water clarity in South Prairie Creek still affords the most reliable index.. Achieving escapement to South Prairie / Wilkeson of at least 500, according to the most recent surveys, indicates that the entire system is seeded adequately to assure viable natural production. Based on more comprehensive spawning surveys, including monitoring of recolonization of the basin above Electron Dam, the co-managers expect, in the near future, to develop a system escapement goal for fall chinook.

Pre-terminal and terminal fisheries in Puget Sound were constrained in 1999 and 2000 to achieve this objective. The productive capacity of habitat in South Prairie Creek, or in the Puyallup mainstem and tributaries is not quantified, so a system-wide escapement goal has not been established. By reducing the total exploitation rate, relative to those levels in the early- to mid-1990s, this harvest regime will is intended to provide stable or increasing levels of natural escapement. Achieving higher natural escapement, under the new management objective, will experimentally probe the productivity of natural spawners in the system.

A low abundance threshold of 500 spawners, for the entire system, is established for the Puyallup fall management unit. If escapement is projected to fall below this threshold, fisheries-related mortality will be reduced to a level defined by the fisheries regime described in Appendix C. The threshold is set above the point of stock instability, to prevent escapement from falling to that level which incurs substantial risk to genetic integrity, or expose the stocks to depensatory mortality factors.

Should the forecast, terminal-area abundance of Puyallup chinook fall below the low abundance threshold, and the forecast be confirmed by the evaluation fishery in the river (see below), extraordinary conservation measures would be implemented to limit harvest mortality and provide for natural spawning escapement. Directed chinook fishing (i.e., during the fall chinook management period) would be reduced to no more than one day per week for tribal fishers to meet their ceremonial and subsistence needs. Recreational fisheries would be limited to mark selective fisheries in the Carbon River. With concomitant reductions in preterminal fishing mortality, the total SUS exploitation rate would be expected to be approximately 25%.

Data gaps

- Improve spawning escapement estimates for the Puyallup River and/or validate the use of South Prairie Creek and Wilkeson Creek counts as an index for the system.

- Estimate the contribution of hatchery- and natural-origin adults to natural spawning , by mass-marking hatchery production. Brood year 1999 hatchery production was 100% marked.

- Develop a spawner – recruit function for natural-origin, naturally spawning chinook to validate the recovery exploitation rate objective. This task is dependent on completion of the two preceding tasks.

- Conduct an evaluation fishery, during the early weeks of the fall chinook management period, in the Puyallup mainstem, to collect catch and catch-per-effort data that may, in future, become the basis for in-season assessment of stock abundance. Statistical models relating catch or CPUE to abundance will, in addition to several other sources of information regarding migration timing and progress of the river fishery, inform the fishery managers regarding possible changes in the fishery schedule, should these indicators suggest that abundance differs significantly from the pre-season forecast.

Nisqually River Chinook Management Unit Status Profile

Component Stocks
Nisqually fall

Geographic description

Adult chinook ascend the mainstem of the Nisqually River to river mile 40, where further access is blocked by the La Grande and Alder dams, facilities that were constructed for hydroelectric power generation by the City of Tacoma's public utility. It is unlikely that chinook utilized higher reaches in the system, prior to the dams' construction. Below La Grande dam the river flows to the northwest across a broad and flat valley floor, characterized by mixed coniferous and deciduous forest and cleared agricultural land. Between river miles 5.5 and 11 the river runs through the Nisqually Indian Reservation, and between river miles 11 and 19 through largely undeveloped Fort Lewis military reservation. At river mile 26, a portion of the flow is diverted into the Yelm Power Canal, which carries the water 14 miles downstream to a powerhouse, where the flow returns to the mainstem at river mile 12. A fish ladder provides passage over the diversion. Both Tacoma's and Centralia's FERC license requires minimum flows in the mainstem Nisqually.

Fall chinook spawn in the mainstem above river mile 3, in numerous side channels, as well as in the lower reaches of Yelm Creek, Ohop Creek, the Mashel River and several smaller tributaries. Production is augmented by production at the Kalama Creek and Clear Creek hatcheries, which are operated by the Nisqually Tribe.

Life History Traits

Adult fall chinook enter the Nisqually River system from July through September, and spawning activity continues through November. After emerging from the gravel, juveniles typically spend two to six months in freshwater before beginning their seaward migration. Residence time in their natal streams may be quite short, as the fry usually move downstream into higher order tributaries or the mainstem to rear. Extended freshwater rearing for a year or more, that typifies some Puget Sound summer/fall chinook stocks, has not been observed in the Nisqually system.

Returning adults mature primarily at age-3 and age-4, comprising 45 and 31 percent, respectively (WDF et al. 1993, WDFW 1995 cited in Myers et al. 1998).

Stock Status

It is generally agreed that native spring and fall chinook stocks have been extirpated from the Nisqually River system, primarily as a result of blocked passage at the Centralia diversion, de-watering of mainstem spawning areas by hydroelectric operations, a toxic copper ore spill associated with a railroad trestle failure, and other freshwater and marine habitat degradation (Barr, 1999). Studies are underway to determine whether any genetic evidence suggests persistence of the native stock. Initial results indicate that the existing naturally-spawning and hatchery stocks are identical, and were derived from hatchery production that utilized, principally, Puyallup River and Green River fall chinook. Like other stocks in South Puget Sound, in which current production is based on naturalized and supplemented returns from a hatchery program, the Nisqually has been managed to achieve escapement sufficient to provide broodstock to the enhancement program.

Natural escapement has met the escapement goal of 1,100 since 1999. The escapement intent shifted and the goal was increased to 1,100 for the 2000 management year (see below). Recent natural spawning escapement has ranged from 340 to 1,700 (Table 2), and hatchery returns have ranged from 1370 to 13,481, in the period between 1993 and 2002. Escapement surveys are difficult in the mainstem river because of the turbidity caused by glacial flour.

Table 1. The abundance of fall chinook returning to the Nisqually River system.

	River Net	Escapement		
Year	Catch	Hatchery	Natural	Total
1993	4024	1370	1655	3025
1994	6183	2104	1730	3834
1995	7171	3623	817	4440
1996	5365	2701	606	3307
1997	4309	3251	340	3591
1998	7990	4067	834	4901
1999	14614	13481	1399	14880
2000	6836	4923	1253	6176
2001	14098	7612	1079	8691
2002	11687	10794	1532	12326

Harvest distribution and exploitation rate trend:

The harvest distribution of Nisqually chinook has been described by analysis of coded-wire tagged fingerling chinook released from Clear Creek and Kalama Creek hatcheries. In recent years 15 percent of the total harvest mortality has occurred in British Columbia and Alaska, primarily in Georgia Strait. Washington troll fisheries have accounted for 14 percent of total fishery mortality. Recreational (ocean and Puget Sound) and net fisheries in Puget Sound , have accounted for 43 and 39 percent of total mortality, respectively.

Table 2. The recent average harvest distribution of Nisqually River fall chinook, expressed as the proportion of annual, adult equivalent fisheries exploitation rate (CTC 2003)
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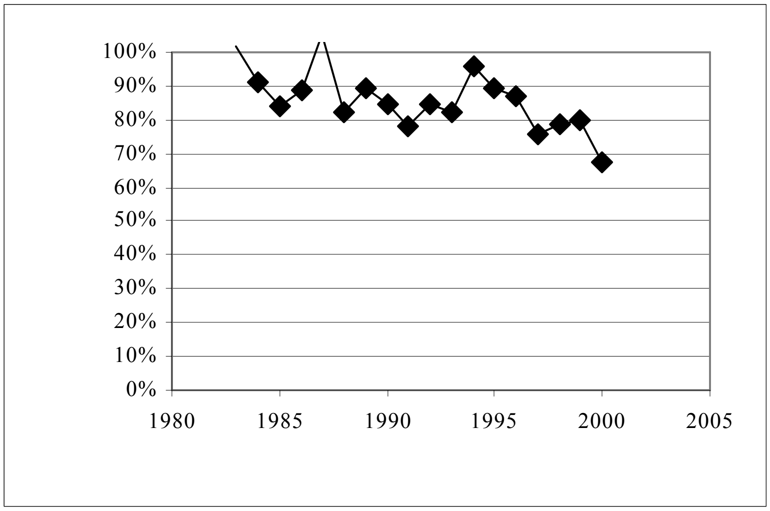
	Alaska	B.C.	Washington Troll	Puget Sound net	Washington sport
1997 – 2001	0.5%	14.2%	3.5%	38.7%	43.1%

The total annual exploitation rate for Nisqually chinook has declined slightly since 1993, as described by post-season FRAM runs (Figure 1). FRAM rates are assumed to accurately index the recent trend in exploitation rate, but may not accurately quantify annual exploitation rates, because of the lack of CWT data in the model base period,

Figure 1. Total annual, adult equivalent fisheries exploitation rate of Nisqually fall chinook, from 1983 – 2000, estimated by post-season FRAM runs.



Management Objectives

Because the Nisqually management unit is not a unique, native stock, the need to optimize natural production from natural-origin spawners will be balanced with the fishery enhancement objectives of the hatchery programs. In this sense, the Nisqually unit is similar to other South Puget Sound and Hood Canal natural units where production comprises non-native, introduced chinook stocks, and where natural productivity is severely constrained by habitat degradation. For these units, management intent is distinct from other Puget Sound management units in which production comprises, primarily, native, naturally-spawning stocks.

Analysis of habitat capacity, using the Ecosystems Diagnosis and Treatment methodology (NCRT 2001), enabled derivation of a Beverton-Holt spawner – recruit function that expresses the production potential for a sequence of life stage segments in the mainstem river and major tributaries under currently existing habitat conditions (Moussali and Hilborn 1986). Solution of this production function by standard methods (Hilborn and Walters 1992) estimated that optimum productivity (MSY) under current habitat conditions is achieved by escapement of 1100.

A rebuilding exploitation rate has not been developed for the Nisqually chinook stock. Further analysis, enabled by better quantification of natural escapement, and assessment of the contribution of natural-origin adults to that escapement, mayl allow development of a rebuilding exploitation rate harvest objective based on natural productivity.

The terminal fisheries are managed based on an inseason runsize estimated by the relationship of total runsize and catch success for the tribal commercial net fishery. This method for updating the runsize in-season will initially be applied with information through the third week of August. Subsequent updates will be conducted as catch data continues to accumulate. To enable the fishery to be managed for the 1,100 escapement goal, managers will translate the total runsize to an expected escapement by making an assumption of the proportion of the total run that will spawn naturally. When the in-season update indicates that the escapement goal (1,100) will not be achieved, terminal area fisheries will be constrained by agreement between the co- managers with the objective of increasing spawner abundance to a level at or above the escapement goal.

If forecasted abundance declines very dramatically from the levels observed in recent years, and the in-season assessment confirms the forecast, the comanagers will implement extraordinary conservation measures for the terminal commercial and recreational fisheries to insure the viability of the population. Such measures may include reduced fishing schedules prior to and after the update at the end of August, and closure of chinook-directed fishing in September, after the update. The subsequent coho fishery may be shaped to reduce incidental chinook mortality, but opportunity to catch the entire harvestable surplus of coho will be maintained. In any case, limited chinook harvest will occur as necessary to meet the ceremonial and subsistence needs of tribal members.

Data gaps

- Improve total natural escapement estimates, including age-specific estimates of both natural and hatchery-origin recruits and develop stock-recruit analysis.
- Test the accuracy of the in-season assessment of extreme terminal abundance, and improve the in-season update model as new data allows.
- Quantify the current natural productivity of the system.

Skokomish River Management Unit Status Profile

Component Stocks

Skokomish summer/fall

Geographic description

Spawning takes place in the mainstem Skokomish River up to the confluence with the South and North forks, in the South Fork of the Skokomish River, primarily below RM 5.0, and in the North Fork up to RM 17, where Cushman Dam blocks higher access. Most spawning in the North Fork occurs below RM 13, because flow fluctuation associated with operations of the hydroelectric facility limit access and spawning success higher in the system (WDF et al. 1993).

On the North Fork Skokomish, two hydroelectric dams block passage to the upper watershed. However, a small, self-sustaining population of landlocked chinook salmon is present in Lake Cushman, upstream of the dams. Adults spawn upstream of the lake in the North Fork Skokomish River from river mile 28.2 to 29.9 during November.

Life History Traits

Genetic characterization of the Skokomish chinook stocks has, to date, been limited to comparison of adults and juveniles collected from the Skokomish River with adults from other Hood Canal and Puget Sound populations. Genetic collections were made during 1998 and 1999 in the Skokomish River and there appeared to be no significant genetic differentiation between natural spawners and the local hatchery population. It appears that Hood Canal area populations may have formed a group differentiated from south Puget Sound populations, possibly indicating that some level of adaptation may be occurring following the cessation of transfers from south Sound hatcheries (Anne Marshall, WDFW memo dated May 31, 2000). Current adult returns are a composite of natural- and hatchery-origin fish. During 1998 and 1999, known hatchery-origin fish comprised from 13% to 41% of the samples collected on the natural spawning grounds. Genetic analysis of samples collected from Lake Cushman was inconclusive as to stock origin, and the adults sampled exhibited low genetic variability. (Marshall, 1995a).

Summer/fall chinook enter the Skokomish River starting in late July with the majority of the run entering from mid-August to mid-September. Chinook in the Skokomish River spawn from mid-September through October with peak spawning during mid-October. Adults mature primarily at age-3 (33%) and age-4 (43%); the incidence of age 2 fish (jacks) is highly variable. In 1999, based on a sample of 143 fish, the age composition of naturally-spawning chinook in the Skokomish River system was estimated to be 2.8% age 2, 58.0% age 3, 38.5% age 4, and 0.7% age 5 fish (Thom H. Johnson, WDFW memo dated November 8, 2000). In 2000 and 2001, the age composition of naturally spawning chinook was 16.1% and 1.2% age 2, 11.3% and 58.3% age 3, 71.0% and 36.9% age 4, and 1.6% and 3.6% age 5, respectively (Thom H. Johnson, pers. Comm.. 12/3/02). Consistent with most other summer/fall populations in Puget Sound, naturally produced smolts emigrate primarily during their first year; 2 percent of the smolts may migrate as yearlings (Williams et al. 1975 cited in Myers et al. 1998). In the Skokomish River, most naturally-produced chinook juveniles emigrate during the spring and early summer of their first year of life as fingerlings (Lestelle and Weller 1994).

Status

The SASSI classified Hood Canal summer/fall chinook as a single stock of mixed origin (both native and non-native) with composite production (sustained by wild and artificial production) (WDFW et al. 1992). The combination of recent low abundances (in all tributaries except the Skokomish River) and widespread use of hatchery stocks (often originating from sources outside Hood Canal) led to the conclusion in SASSI that there were no remaining genetically unique, indigenous populations of chinook in Hood Canal. However, a sampling effort is currently under way (led by WDFW in cooperation with NMFS and Treaty Tribes) to collect genetic information from chinook juveniles and adults in the tributaries of Hood Canal. This investigation is intended to provide further information on the genetic source and status of existing chinook populations.

The existence of historical, indigenous populations, that have not been significantly impacted by past management practices and that have remained distinct and sustainable is at least questionable. The genetic sampling effort referenced above is intended to help resolve remaining uncertainty about the existence of any historical, indigenous populations. In the interim, management measures have been formulated to provide reasonable protection for naturally spawning chinook and adequate flexibility for future change.

Historically, the Skokomish River supported the largest natural chinook production of any stream in Hood Canal. However, habitat degradation has severely reduced the productive capacity of the mainstem and South Fork portions of the system. As previously noted, the North Fork has been blocked by two hydroelectric dams. Hatchery chinook production has been developed at Washington State's George Adams and McKernan hatcheries to augment harvest opportunities and to provide partial mitigation for reduced natural production in the Skokomish system, primarily caused by the North Fork dams. The Skokomish Tribe, whose reservation is located near the mouth of the river, has a reserved treaty right to harvest chinook salmon.

Over the period from 1998 – 2002, natural spawning escapement ranged from 926 to 1,913, exceeding the nominal goal of 1,650 twice (Table 1)

Table 1. Total spawning escapement of Skokomish River fall chinook, 1993 - 2002.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Hatchery	612	495	5196	3100	1885	5584	8227	4033	8816	8828
Natural	960	657	1398	995	452	1177	1692	926	1913	1,479
Total	1572	1152	6594	4095	2337	6761	9919	4959	10729	10307

Harvest distribution and exploitation rate trends:

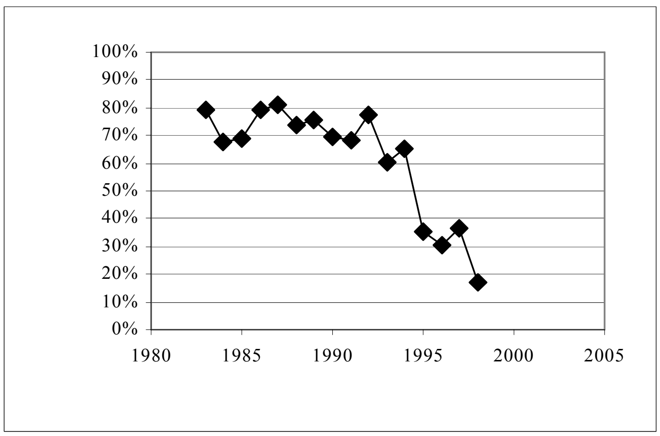
The harvest distribution of Skokomish chinook is best described by recovery of coded-wire tagged fingerlings released from George Adams Hatchery. The average for calendar years 1996 – 2000 indicates that 33 percent of harvest mortality was associated with Canadian and Alaskan fisheries, 13 percent with Washington ocean troll fisheries, 48 percent in recreational fisheries, and 10 percent with net fisheries in Puget Sound.

Table 2. Average harvest distribution of Skokomish River summer/fall chinook, for management years 1997 – 2001, as percent of total adult equivalent fishery mortality (CTC2003).

Years	Alaska	B.C.	Washington troll	Puget Sound net	Washington sport
1997-2001	2.4%	30.9%	8.9%	10.2%	47.7%

The total annual (i.e., management year) exploitation rate, computed by post-season FRAM runs, declined substantially between 1991 and 1998 (Figure 1). The subsequent increase in exploitation rate reflects increased abundance, due in part to improved marine survival, which has allowed higher harvest while still meeting escapement objectives.

Figure 1. Total fishery-related, spawner equivalent exploitation rates of Skokomish River summer/fall chinook for management years 1983 – 1998, estimated by post-season FRAM runs.



Management Objectives

The immediate and short-term objective for Skokomish River is to manage chinook salmon as a composite population (including naturally and artificially produced chinook). The composite population will be managed, in part, to achieve a suitable level of natural escapement; and to continue hatchery mitigation of the effects of habitat loss; and to provide to the Skokomish Tribe partial mitigation for its lost treaty fishing opportunity. Habitat recovery and protection measures will be sought to improve natural production. Over time, alternative management strategies will be explored that may lead to improved sustainable natural production, and reduced reliance on mitigative hatchery support for the Skokomish stock and fisheries.

The nominal escapement goal for the Skokomish River is 3,650. It is the sum of spawner requirements for 1,650 in-stream spawners (HCSMP; 1985) and 2,000 spawners required for the maintenance of on-station hatchery production (see 1996 Production Evaluation MOU, PNPTC-WDFW-USFWS; 2002 Framework Plan, WDFW-PNPTT). Recent composite escapements have been substantially above the 3,650 fish level, averaging 6,941 for the 1997 – 2001 period, and exceeding the 3,650 goal in four of the last five years. In the same period, natural escapement has averaged 1,332, and exceeded 1,650 twice. Escapements to the hatchery have averaged 5,709 fish and have exceeded the 2,000 fish goal in four of the last five years. (Table 1).

The escapement goal of 3,650, along with its component requirements for natural and hatchery spawners, (WDF Tech. Rept. 29, 1977; PSSMP, 1985; HCSMP, 1985; HCSMP Prod MOU,

1996) is intended to maintain full hatchery mitigation and meet current estimates of MSY escapement to natural spawning areas, under current habitat conditions.

A low abundance threshold escapement of 1,300, represents the aggregate of 800 natural spawners and 500 adults returning to the hatchery rack. At these levels, the hatchery escapement component represents the minimum requirement to maintain production. The natural escapement component threshold is set at approximately 50% of the current MSY estimate and represents a level necessary to ensure in-system diversity and spatial distribution (Magnuson-Stevens Act, National Standard for Overfishing Review Threshold). In the 1997 – 2001 period, the critical threshold was exceeded in all years for this management unit. Component critical thresholds in these years were exceeded in all years for hatchery escapement, and in four of the last five years for natural escapement.

During the recovery period, pre-terminal fisheries in southern U.S. areas (SUS), will be managed to ensure a ceiling rate of exploitation of 15%, or less, as estimated by the FRAM model (est. of 1997-1999 SUS preseason impacts). Pre-terminal fisheries include the coastal troll and recreational fisheries managed under the Pacific Fisheries Management Council, and commercial and recreational fisheries in Puget Sound, outside Hood Canal. Terminal fisheries are managed to achieve the escapement goal of 3,650. If the recruit abundance is insufficient for the goal to be met, OR regardless of the total escapement, the naturally spawning component of this population is expected to fall below 1,200 spawners, OR the hatchery component is expected to result in less than 1,000 spawners, additional terminal fishery management measures will be taken, with the objective of meeting or exceeding these spawner levels. The following management measures have been taken in recent years for this purpose, and will be considered in 2003:

- Commercial and recreational fisheries in northern Hood Canal areas (WDFW Areas 12 and 12B) will be reduced or eliminated in the months of July through September.
- Commercial and recreational fisheries in southern Hood Canal areas (WDFW Areas 12C and 12D) will be "shaped" to direct the majority of the fishing effort to the Hoodsport Hatchery zone, thus greatly reducing impacts to the Skokomish Management Unit. In 2000, approximately 90% of the total commercial harvest in Area 12C was directed at, and taken, in that zone.
- In the Skokomish River, Treaty Indian commercial fisheries will be limited in August and September, to areas upstream of the Skokomish delta milling area (upstream of the SR 106 crossing), and downstream of the U.S. 101 crossing.
- In the Skokomish River, recreational salmon fisheries will be limited, through September, to areas upstream of the mouth and downstream of the U.S. 101 crossing.

If, despite the implementation of the above measures, the projected escapement is expected to be less than 1,300 total spawners, OR regardless of the total escapement, the naturally spawning component of this population is expected to fall below the critical threshold of 800 spawners, OR the hatchery component is expected to result in less than 500 spawners, pre-terminal SUS fisheries will be constrained to minimize mortality, in accordance with conservation measures described in Appendix C, or more restrictive measures that have been evaluated and agreed-to by the co-managers for the year in question. In Hood Canal terminal areas, additional management measures will be taken, with the objective of meeting or exceeding these critical spawner levels.

All of the measures shall initially be based on preseason forecasted abundance and escapement projections and may be adjusted during the season, following any inseason reassessment of the terminal abundance. As of 2002, the Co-managers have investigated the feasibility of developing a sufficiently accurate method to derive in-season estimates of abundance, using available commercial and/or recreational, as well as hatchery and/or natural escapement data. However, no approach was found that would result in better estimates when compared to preseason forecasts.

This management regime recognizes the need to optimize natural production in the Skokomish River. However, production potential is currently severely constrained by reduced habitat capacity and quality in the South Fork, and by the influence of the hydroelectric and re-regulation dams on the North Fork. The current productive capacity of habitat has not been quantified in terms of the number of adults required to fully seed the available spawning area or optimize smolt yield.

Principles that underlie the current management intent for Skokomish River chinook include:

Full recovery of natural productivity in the Skokomish River cannot occur under the current hydroelectric operating regime and degraded habitat status;

The management regime will provide adequate seeding of existing habitat and insure the maintenance of in-system diversity and spatial distribution by assuring that (if available) at least 800, and up to 1,650 (the currently estimated level of MSY), natural spawners reach the spawning grounds;

Natural production is dependent on the mitigative hatchery program to partly support natural escapement;

Hatchery- and natural-origin spawners appear to be genetically similar, and have demonstrated their capacity to adapt to the Skokomish River environment.

Access to harvest opportunity on returning adults produced by the enhancement program at George Adams Hatchery is mandated as partial mitigation for the effects of operation of the City of Tacoma's hydroelectric facility.

The recovery objective for the ESU, which includes conservation and rebuilding of natural production that is representative of the geographic and genetic diversity that characterizes the ESU, is served, in part, by assuring that natural production of locally-adapted populations is recovered in the mid-Hood Canal streams (Duckabush River, Dosewallips River, and Hamma Hamma River) where habitat quality does not constrain to the extent that it does in the Skokomish River.

Management objectives for the Skokomish River management unit will evolve in response to improved understanding of natural productivity, and success in restoring the productive potential of habitat in the system.

Data gaps

- Continue to improve escapement estimates for the South and North Forks of the Skokomish River.
- Develop means to assess the contribution of Skokomish hatchery and natural origin adults to the fishery and to hatchery and natural escapements.
- Quantify the current natural productivity (in terms of recruits per spawners) and natural capacity (in terms of adults and juvenile migrants) of the system.

Mid-Hood Canal Management Unit Status Profile

Component Sub-populations

Hamma Hamma River summer/fall
Dosewallips River summer/fall
Duckabush River summer/fall

Geographic description

Chinook spawn in the Hamma Hamma River mainstem up to RM 2.5, where a barrier falls prevents higher access. Spawning can occur also in John Creek when flow permits access. A series of falls and cascades, which may be passable in some years, block access to the upper Duckabush River at RM 7, and to the upper Dosewallips River at RM 14. Spawning may also occur in Rocky Brook Creek, a tributary to the Dosewallips. Most tributaries to these three rivers are inaccessible, high gradient streams, so the mainstem provides nearly the entire production potential.

Life History Traits

Genetic characterization of the mid-Hood Canal Management Unit (MU) has, to date, been limited to comparison of adults returning to the Hamma Hamma River in 1999 with other Hood Canal and Puget Sound populations. These studies, although not conclusive, suggest that returns to the Hamma Hamma River are not genetically distinct from the Skokomish River returns, or recent George Adams and Hoodsport hatchery broodstock (A. Marshall, WDFW unpublished data). The reasons for this similarity are unclear, but straying of chinook that originate from streams further south in Hood Canal, and hatchery stocking, could be contributing causes.

Status

The Mid-Hood Canal MU is comprised of chinook local sub-populations in the Dosewallips, Duckabush and Hamma Hamma watersheds. These sub-populations are at low abundance (Table 1). Current chinook spawner surveys are typically limited to the lower reaches of each stream. In the Hamma Hamma River, the majority of the chinook spawning habitat is currently being surveyed. In the Dosewallips and Duckabush rivers, however, the areas surveyed are transit areas and do not include all spawning areas. Upper reaches of the Dosewallips and Duckabush have been more routinely surveyed since 1998, but few chinook adults or redds have been observed. Prior to 1986 no reliable estimates are available because all escapement estimates for these rivers were made by extrapolation from the Skokomish River.

Table 1. Natural spawning escapement of Mid-Hood Canal fall chinook salmon, 1993-2002.

River	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
HammaHamma	28	78	25	11	na	172	557	381	248	32
Duckabush	17	9	2	13		57	151	28	29	20
Dosewallips	67	297	76	na		58	54	29	45	43
Total	142	384	103	na		287	762	438	322	95

In 1992, SASSI classified Hood Canal summer/fall chinook as a single stock of mixed origin (both native and non-native) with composite production (sustained by wild and artificial production) (WDFW et al. 1992). The combination of recent low abundances (in all tributaries except the Skokomish River) and widespread use of hatchery stocks (often originating from sources outside Hood Canal) led to the conclusion in SASSI that there were no remaining genetically unique, indigenous populations of chinook in Hood Canal. A study is currently underway to characterize the genetic profile of chinook juveniles and adults in the mid-Hood Canal MU.

In 2002, when SASSI was updated to SaSI, mid-Hood Canal chinook were classified as a single stock, comprised of chinook salmon which currently spawn in the Hamma Hamma, Duckabush and Dosewallips watersheds (WDFW et al. 2002). In 2002, the stock status was rated as "Critical" in SaSI, primarily because of chronically low spawning escapements whose average escapement abundance, over the 1991 – 2002 period, failed to meet the established low escapement threshold of 400.

Harvest distribution and exploitation rate trends:

The harvest distribution of mid-Hood Canal chinook, and recent fishery exploitation rates, cannot be directly assessed because none of the component sub-populations have been coded-wire tagged. However, it is reasonable to assume, given their similar life history, that tagged fingerling chinook released from the George Adams Hatchery, on the Skokomish River, follow a similar migratory pathway and experience mortality in a similar set of pre-terminal fisheries in British Columbia and Washington. A summary of recent analyses of the Skokomish River data are shown in that profile.

Management of the terminal area fisheries in Hood Canal enables some separation of harvest between Skokomish/ Hoodsport and the mid-Hood Canal natural MU. With only Hoodsport and Skokomish tags available to model terminal impacts, the selective intent of the terminal regime will be estimated based on the freshwater entry period for mid-Canal rivers, and the distribution of historical net catch among the sub-areas of Hood Canal.

It is reasonable to conclude that mid-Hood Canal sub-populations experienced a decline similar to that of Skokomish River chinook, but their total exploitation rate has been lower, because the terminal area fishery, which can harvest a significant proportion of Skokomish chinook, has been restricted to the southern end of Hood Canal since the early 1990s.

Management Objectives

The management objective for the mid-Hood Canal MU is to maintain and restore sustainable, locally adapted, natural-origin chinook sub-populations. Management efforts will initially focus on increasing the abundance in the MU and its local, natural sub-populations. Fisheries are being restricted to accommodate the escapement objectives.

The existence of historical, indigenous populations that have remained distinct and sustainable is at least questionable and while additional genetic sampling may help resolve any remaining uncertainty, the Co-managers' intent is to support their ongoing local diversity adaptation.

During the recovery period, fisheries in southern U.S. areas (SUS), will be managed to achieve a preterminal (PT) AEQ rate of exploitation of less than15%, as estimated by the FRAM model (see Section IV). This exploitation rate is the same as that for the remainder of the Hood Canal management units because no means exist to separately assess the exploitation of the mid-Hood Canal unit, and there is no indication that its exploitation pattern is different between Hood Canal

MUs. In this case, preterminal fisheries include the coastal troll and recreational fisheries managed under the Pacific Fisheries Management Council, and the marine commercial and recreational fisheries in Puget Sound. The extreme terminal areas for this management unit include the freshwater areas in each river.

The migratory pathway and harvest distribution of mid-Hood Canal chinook is presumed to be similar to that of the Skokomish River indicator stock, although that stock's return continues past the mid-Canal area and reaches the Skokomish River, farther south. The FRAM simulation model suggests that the terminal (Area 12C) and extreme-terminal (in-river) fisheries may harvest up to 25% of the Skokomish terminal run. However, terminal-area fisheries at the far southern end of Hood Canal, near the mouth of or in the Skokomish River, are not believed to harvest significant numbers of adults returning to the mid-Hood Canal rivers of origin. Time and area restrictions are believed to be effective in relieving harvest pressure on the mid-Hood Canal sub-populations.

When the escapement goal of 750 spawners (established as interim MSY in Hood Canal Salmon Management Plan (HCSMP)) is not expected to be met, recreational and commercial fisheries will be adjusted to the extent necessary to exert a PT SUS AEQ exploitation rate of less than 15%, or meet the escapement target, whichever occurs first. These measures shall also include the closure of all extreme terminal (freshwater) fisheries that are likely to impact adult spawners of these sub-populations. These measures will be considered in order to ensure that the PT SUS AEQ exploitation rate will not exceed 15%.

A low abundance threshold of 400 chinook spawners has been established for the mid-Hood Canal MU, which is approximately 50% of the current MSY goal for the mid-Hood Canal sub-populations, in the HCSMP (1985). If escapement is projected to fall below this threshold, further conservation measures will be implemented in pre-terminal and terminal fisheries to reduce mortality and ensure that the projected PT SUS AEQ exploitation rate does not exceed 12.0%. The best available information indicates that escapement has been below the low abundance threshold in three out of the last five years. The co-managers recognize the need to provide across-the-board conservation measures in this circumstance, and to avoid an undue burden of conservation falling on the terminal fisheries.

Unless genetic studies conclude that distinct populations persist in individual mid-Hood Canal streams, the primary focus of management will be to ensure that sufficient spawners escape to these systems to maintain self-sustaining sub-populations. These sub-populations will contribute geographic diversity to the ESU by their adaptation to the unique environmental conditions found in these drainages of the east slope of the Olympic Mountains.

Data gaps

- Continue to improve escapement estimates
- Test the accuracy of the pre-season forecasts
- Develop means to assess the origin composition of adults in the escapement
- For each sub-population, and the MU, reassess spawner requirements and quantify the current productivity (in terms of recruits per spawner) and capacity (in terms of adults and juvenile migrants).

Dungeness Management Unit Status Profile

Component Stocks

Dungeness River chinook

Distribution and Life History Characteristics

Chinook spawn in the Dungeness River up to RM 18.9, where falls, just above the mouth of Gold Creek, block further access. Spawning distribution , in recent years, has been weighted toward the lower half of the accessible reach with approximately two-thirds of the redds located downstream of RM 10.8. Chinook also spawn in the Graywolf River up to RM 5.1.

The entry timing of mature chinook into the Dungeness River is not described precisely, because of chronically low returns of adults. It may occur from spring through September. Adult weir operations in 1997 and 2001 indicate that most of the adult chinook return has entered the river by early August. Spawning occurs from August through mid-October (WDF et al. 1993). At the current low level of abundance, no distinct spring or summer populations are distinguishable in the return. Chinook typically spawn two weeks earlier in the upper mainstem than in the lower mainstem (WDF et al. 1993). Ocean- and stream-type life histories have been observed among juvenile chinook in the system, with extended freshwater rearing more typical of the earlier-timed segment (Ames et al. 1975). Hirschi and Reed (1998) found that a significant number of chinook juveniles overwinter in the Dungeness River.

Smolts from the Dungeness River exhibit primarily an ocean-type life history, with age-0 emigrants comprising 95 to 98 percent of the total (WDF et al. 1993, Smith and Sele 1995, and WDFW 1995 cited in Myers et al. 1998). Adults mature primarily at age four (63%), with age 3 and age 5 adults comprising 10% and 25%, of the annual returns, respectively (PNPTC 1995 and WDFW 1995 cited in Myers et al. 1998).

Stock Status

The SASSI report (WDF et al. 1993) classified the Dungeness spring/summer as critical due to a chronically low spawning escapement to levels, such that the viability of the stock was in doubt and the risk of extinction was considered to be high. Dungeness chinook continued to be classified as critical in the SaSI report (WDFW 2003) because of continuing chronically low spawning escapements.

The nominal escapement goal for the Dungeness River is 925 spawners, based on historical escapements observed in the 1970's and estimated production capacity re-assessed in the 1990s (Smith and Sele 1994). This goal has not been achieved in the past 17 years. The mean spawning escapement level, since 1998, has been 298 (Table 1). It should be noted however that the increase in escapements, observed in recent years, is partly due to a captive brood supplementation program.

Table 1. Spawning escapement of Dungeness River chinook 1986 - 2002.

Return Year	Escapement
1986	238
1987	100
1988	335
1989	88
1990	310
1991	163
1992	153
1993	43
1994	65
1995	163
1996	183
1997	50
1998	110
1999	75
2000	218
2001	453
2002	633
1998 – 2002 Mean: 298	

Chinook production in the Dungeness River is constrained, primarily, by degraded spawning and rearing habitat in the lower mainstem. Significant channel modification has contributed to substrate instability in spawning areas, and has reduced and isolated side channel rearing areas. Water withdrawals for irrigation during the migration and spawning season have also limited access to suitable spawning areas.

The co-managers, in cooperation with federal agencies and private-sector conservation groups, have implemented a captive brood stock program to rehabilitate chinook runs in the Dungeness River. The primary goal of this program is to increase the number of fish spawning naturally in the river, while maintaining the genetic characteristics of the existing stock. The first returns of age-4 adults, from the brood year 1996 release of 1.8 million fingerlings, occurred in 2000. Uncertainty over the survival of these fingerlings has led managers to project abundance conservatively, (i.e., discount the potential return from supplementation).

In addition to the broodstock program, the local watershed council (Dungeness River Management Team) and a work group of state, tribal, county and federal biologists have been working on several habitat restoration efforts. Based on the 1997 report, “Recommended Restoration Projects for the Dungeness River” by the Dungeness River Restoration Work Group, local cooperators have installed several engineered log jams, and acquired small riparian refugia properties. Other projects including larger scale riparian land acquisition, dike setback, bridge lengthening and setback, as well as estuary restoration are in the planning, analysis and proposal phases.

Management Objectives

The management objective for Dungeness chinook is to stabilize escapement and recruitment, as well as to restore the natural-origin recruit population basis through supplementation and fishery restrictions. Pre-terminal incidental harvest is constrained to a ceiling AEQ exploitation rate of

10.0% in the southern U.S. Directed terminal commercial and recreational harvests have not occurred in recent years, and incidental harvest in fisheries directed at coho and pink salmon have been regulated to limit chinook mortality .

Direct quantification of the productivity of Dungeness chinook will require either the accumulation of sufficient coded-wire tag recoveries to reconstruct cohort abundance, or an alternate method of measuring freshwater (egg-to-smolt) and marine survival. Releases from the supplementation program are represented by coded-wire tagged groups, adipose fin marked groups, otolith marked groups and blank wire tag groups. Recoveries of these tags, otoliths, and marks will enable cohort reconstruction. However, given the degraded condition of spawning and rearing habitat in the lower mainstem, it must be assumed that current natural productivity is critically low. The captive brood supplementation program will be suspended, following production from the 2003 brood year.

The lack of stock specific historical tag information has necessitated the interim use of a neighboring representative stock in fishery simulation modeling of Dungeness chinook salmon. Tagged Elwha Hatchery fingerlings are used by the FRAM to estimate the harvest distribution and exploitation rates for all Strait of Juan de Fuca chinook management units. (See Elwha Profile, below). Also, for units with very low abundance, such as the Dungeness, the FRAM model's accuracy may be limited. However, the co-managers will continue to develop and adopt conservation measures that protect critical management units, while realizing the constraints on quantifying their effects in the simulation model.

Lacking sufficient direct assessment of the productivity of Dungeness chinook, it may be appropriate to examine what is known about other Puget Sound management units with similar life history and similar status. The status of Nooksack River early chinook, in particular the South Fork Nooksack management unit, is also classified as critical, due to chronically low spawning escapement. Degraded habitat is known to constrain freshwater survival in the Nooksack system, as it does in the Dungeness. The recovery exploitation rate of the Nooksack units has been estimated to be 20 percent (NMFS 2000). The harvest objective for Dungeness (i.e., to maintain exploitation in southern U.S. fisheries below 10 percent), implies a total exploitation rate of 20 percent or less, given that approximately half of the harvest of Dungeness chinook may occur in southern fisheries.

The critical escapement threshold for the Dungeness River is 500 natural spawners, which is approximately 50% of the escapement goal. Whenever natural spawning escapement for this stock is projected to be below this threshold, SUS fisheries will be managed to further reduce incidental mortality. Until the supplementation program is successful in rebuilding returns to levels sufficient to provide escapement levels above this threshold, harvest will be constrained, to SUS incidental AEQ impacts of less than 6.0%.

Data gaps

- Describe freshwater entry timing
- Continue to collect scale or otolith samples to describe the age composition of the terminal run.
- Describe the fishery contribution and estimate fishery-specific exploitation rates from CWT recoveries.
- Estimate marine survival.
- Estimate annual smolt production per spawner (i.e. , freshwater survival)

Elwha River Management Unit Status Profile

Component Stocks

Elwha River chinook

Geographic Distribution and Life History Characteristics

Summer chinook spawn naturally in the portions of the lower 4.9 miles of the Elwha River, below the lower Elwha dam, though most of the suitable spawning habitat is below the City of Port Angeles' water diversion dam at RM 3.4. Their productive capacity is very low, because of extremely restricted suitable habitat. Their productivity is also very low due to severely altered and degraded spawning and rearing habitat, and high water temperatures during the adult entry and spawning season, which contribute to pre-spawning mortality (see Table 2, below).

Entry into the Elwha River begins in early June and continues through early September. Spawning begins in late August, and peaks in late September and early October (WDF et al. 1993). Elwha chinook mature primarily at age 4 (57%), with age 3 and age 5 fish comprising 13% and 29%, of annual returns, respectively (WDF et al. 1993, WDFW 1995, PNPTC 1995 cited in Myers et al. 1998).

Naturally produced smolts emigrate primarily as subyearlings. Roni (1992) reported that 45 to 83% of Elwha River smolts emigrated as yearlings, and 17 to 55 percent as subyearlings, but this study did not differentiate naturally produced smolts from hatchery releases of yearlings. The Elwha Channel facility no longer releases yearling smolts.

Status

Elwha River chinook were designated as "healthy" in the SASSI document (WDF et al. 1993), which considered productivity in the context of the currently available habitat for natural production. However, in the past decade, the total spawner goal of 2,900 was not met in any year (see Table 1). Therefore, in the SaSI report (WDFW 2003), the Elwha Management Unit was classified as depressed, because of the negative escapement trend and chronically low levels of spawning escapement. The stock is a composite of natural and hatchery production. In the Elwha River, chinook production is limited by two hydroelectric dams which block access to upstream spawning and rearing habitat. Recovery of the stock is dependent on removal of the two dams, and restoration of access to high quality habitat in the upper Elwha basin and certain tributaries. Chinook produced by the hatchery mitigation program in the Elwha system are considered essential to the recovery, and are included in the listed ESU.

The comanagers have concluded that recovery of the Elwha stock is not possible unless the dams are removed and access to pristine, productive habitat, which lies largely within Olympic National Park, is restored.

The nominal spawning escapement goal of 2,900 for Elwha River chinook has not been achieved, even in the absence of in-river fishery impacts, in the past 10 years. The average number of spawners over the last five years has been 2,079, which is somewhat higher than the average of the preceding five years (1993-1997), which was 1,611..

Table 1. Total spawning escapement of Elwha River chinook, 1993 – 2002.

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1,562	1,216	1,150	1,608	2,517	2,358	1,602	1,851	2,208	2,376

Pre-spawning mortality has been a significant factor affecting natural and hatchery production in the Elwha system. High water temperature during the period of freshwater entry and spawning is exacerbated by impoundment of the river behind the two upstream dams. It contributes directly to prespawning mortality, and in some years, promotes the infestation of adult chinook by *Dermocystidium*. Pre-spawning mortality has ranged up to 68% of the extreme terminal abundance (Table 2), largely due to parasitic infestation.

Table 2. Prespawning mortality of Elwha River chinook.

Return Year	Hatchery Voluntary Escapement	In-River Gross Escapement	Gaff-Seine Removals	Hatchery Prespawn Mortality	In-River Prespawn Mortality	Total Prespawn Mortality
1986	1,285	1,842	505	376	482	27.4%
1987	1,283	4,610	1,138	432	1,830	38.4%
1988	2,089	5,784	506	428	50	6.1%
1989	1,135	4,352	905	148	412	10.2%
1990	586	2,594	886	160	64	7.0%
1991	970	2,499	857	108	N/A	3.1%
1992	97	3,762	672	26	2,611	68.3%
1993	165	1,404	771	7	0	0.5%
1994	365	1,181	749	61	269	21.3%
1995	145	1,667	518	37	625	36.5%
1996	214	1,661	1,177	147	120	14.2%
1997	318	2,209	624	3	7	0.4%
1998	138	2,271	1,551	51	0	2.1%
1999	113	1,512	609	23	0	1.4%
2000	177	1,736	1,021	62	0	3.2%
2001	195	2,051	1,396	38	0	1.7%
2002	473	1,943	1,080	40	0	1.7%

Harvest Distribution and Exploitation Rate Trend

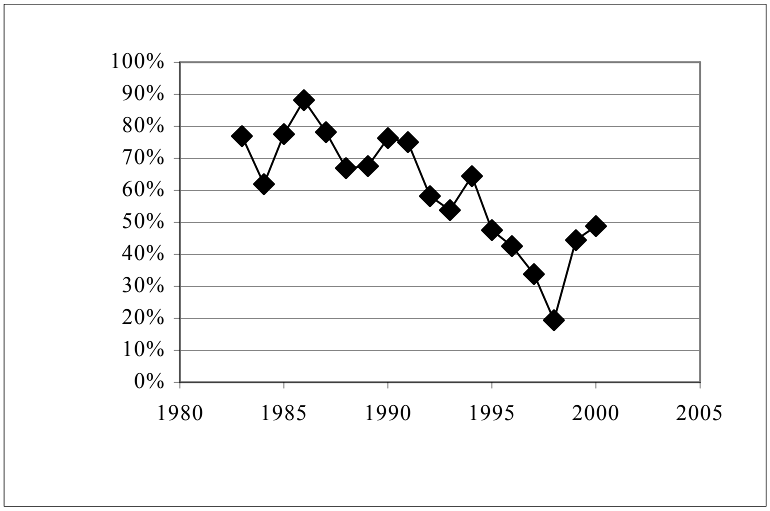
Based on recoveries in 1993 – 1997 of tagged fingerlings released from the local hatchery, Elwha River chinook are a far-north migrating stock, as evidenced by 16% and 59% of total mortality occurring in Alaskan and British Columbian fisheries, respectively (Table 3). Net fisheries in Puget Sound account for only 1% of total fishing mortality, and Washington troll and sport fisheries account for 11%, and 22%, respectively.

Table 3. The average distribution of adult equivalent annual fishing mortality for Elwha River chinook, estimated from post-season FRAM runs (CTC 2003)

Years	Alaska	B.C.	Wash. Troll	Puget Sound Net	Washington sport
1993 – 97	16.2%	58.8%	1.9%	0.8%	22.3%

Post-season FRAM simulations indicate that the total exploitation rate of Elwha River chinook has exhibited a declining trend since 1988 (Figure 1). These post-season FRAM estimates represent the aggregate of JDF units, but are believed to correctly represent the trend in ER for the Elwha unit. The 1998 – 2000 mean exploitation is 51% lower than the average from the 1983 – 1987 period.

Figure 1. Total adult-equivalent exploitation rate for Elwha River chinook, estimated by post-season FRAM runs.



Management Objectives

Fisheries in Washington waters, including those under jurisdiction of the Pacific Fisheries Management Council, when the escapement goal is not projected to be met, will be managed so as not to exceed a "Southern U.S." incidental AEQ exploitation rate of 10.0% on Elwha chinook. Harvest at this level will assist recovery by providing adequate escapement returns to the river to perpetuate natural spawning in the limited habitat available, and provide broodstock for the supplementation program. It represents a significant decline in harvest pressure from southern U.S. fisheries. The SUS exploitation rate on the Strait of Juan de Fuca management unit aggregate averaged 33% for return years 1990 – 1996. Actual SUS AEQ exploitation rates for more recent years have not been calculated, however they were projected to be 7%, 5.0%, 5.2%, 4.8% and 4.7% respectively, in the final pre-season FRAM simulation models for management years 1999 through 2003.

The low abundance threshold for the Elwha River is 1,000 spawners, which represents a composite of 500 natural and 500 hatchery spawners. Whenever spawning escapement for this stock is projected to be below these levels, SUS fisheries will be managed to further reduce incidental AEQ mortality to less than 6.0%.

Data Gaps

- Estimates of total and natural smolt production from the Elwha River.
- Estimates of the age composition and description of life history of smolts.

Status Profile for the Western Strait of Juan de Fuca Management Unit

Component Stocks

Hoko River fall chinook

Geographic description

Fall chinook spawn primarily in the mainstem of the Hoko River, from above intertidal zone to RM 22, but primarily between RM 3.5 (the confluence of the Little Hoko River) to the falls at RM 10. Chinook may ascend the falls and spawn in the upper mainstem up to RM 22, and the lower reaches of larger tributaries such as Bear Creek (RM 0 to 1.2) and Cub Creek (RM 0 – 0.8), Ellis Creek (0 – 1.0), the mainstem (RM 0 – 2.5) and North Fork (RM 0 – 0.37), of Herman Creek, and Brown Creek(0 – 0.8). Chinook also spawn in the lower 2.9 miles of the Little Hoko River. Historically, chinook have also spawned in other Western Strait streams, including the Pysht, Clallam, and Sekiu rivers. Recent surveys of the Sekiu counted 52 and 12 chinook in 1998 and 1999, respectively. Their origin is unknown, but they are assumed to be strays from the Hoko system.

Currently, chinook from the Hoko Hatchery are being outplanted into the upper Hoko mainstem and tributaries of the upper and lower portions of the watershed, to seed high quality habitat, which has not been utilized consistently for spawning or rearing. Re-introduction to the Sekiu River, and other western Strait streams that once supported chinook, is also being planned.

Life History Traits

Based on scales collected from natural spawners and broodstock from 1988 – 1999, returning Hoko River adults are predominately age 5 (49%) and age 4 (31%) , with age 3 and age 6 adults comprising 8% and 10%, respectively, of the mean annual return (MFM 2000. The available data suggest that most smolts produced in the Hoko system emigrate as subyearlings (Williams et al. cited in Myer et al. 1998).

Status

The established escapement goal for Hoko River chinook is 850 natural spawners. This goal, first presented in 1978 in WDF *Technical Report 29*, is based on early estimates of freshwater habitat capacity. The total escapement goal is 1,050, which includes 200 brood stock for the supplementation and reintroduction program. For the Hoko chinook stock as a whole, the combined spawning escapement (natural plus hatchery) has averaged 1,243 spawners in the past five years. Total returns to the river (terminal run size shown above) have exceeded 850 chinook in 8 of the last 15 years).

Numbers of natural chinook spawners have significantly increased since the inception of the supplementation program in 1982, from counts of less than 200, before hatchery supplementation was initiated, to exceeding the natural escapement goal of 850 in three out of the last six years (the 1997 to 2002 average is 1,052 natural spawners). While natural-origin recruits and the recent and overall escapements have shown increasing trends in abundance since the early 1980s, the proportion of natural-origin spawners relative to the proportion of hatchery-origin spawners has declined in recent years. Nearly half the Hoko River natural spawners in most years may be attributed to the supplementation program (MFM 2000). Despite the recent escapements that have exceeded the goal of 850 natural spawners,, this goal has only been achieved in four of the last 15 years (1988 to 2002; Table 1).

Table 1. Natural spawning escapement of chinook and hatchery broodstock removals from the Hoko River, 1988 – 2002.

Return Year	Natural Spawners	Hatchery Brood Stock	Total Escapement
1988	686	90	776
1989	775	67	842
1990	378	115	493
1991	894	112	1,006
1992	642	98	740
1993	775	119	894
1994	332	96	428
1995	750	155	905
1996	1,228	37	1,265
1997	765	126	891
1998	1,618	104	1,722
1999	1,497	191	1,688
2000	612	119	731
2001	768	178	946
2002	443	237	680
1997 – 02 Avg	1,052	191	1,243
Goal:	850	200	1,050

Although the escapement goals set in Technical Report 29 have been commonly accepted over the past two decades, it is not certain that the spawner level of 850 is the optimum chinook escapement level for the Hoko River. Further analysis of habitat suitability and usage should be conducted to determine whether spawning or rearing habitat limits chinook production in the Hoko. Additional years of cohort reconstruction may also shed light on the stock-recruitment relationship for Hoko chinook, which may lead to revision in the escapement goal.

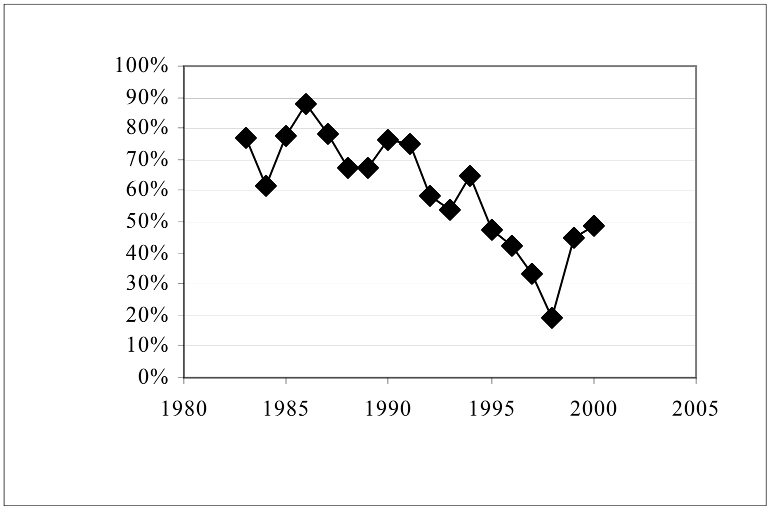
Harvest Distribution and Exploitation Rate Trends

The migration pathway, and harvest distribution, of Hoko River chinook has been described from recoveries of coded-wire tagged fish released from the Hoko Hatchery. The tag data suggest that Hoko chinook are harvested primarily by coastal fisheries in Southeast Alaska and British Columbia (Table 2).

Table 2. Harvest distribution of Hoko River chinook expressed as a proportion of total, annual, adult equivalent exploitation (CTC2003)

Years	Alaska	B.C.	Wash. Troll	Puget Sound Net	Washington sport
1997 - 2001	70.8%	26.5%	1.3%	0.1%	1.2%

Figure 1. Trend in total, adult equivalent, fisheries mortality for Juan de Fuca River chinook management units, estimated by post-season FRAM runs.



Post-season FRAM estimates indicate that the average annual exploitation rates for Juan de Fuca chinook units has declined 51 percent, from 1983-1987 to 1996-2000. These data are believed to correctly represent the trend for the Hoko River unit.

Although Hoko chinook were harvested at rates that should be reasonable for most Puget Sound chinook, even this exploitation rate was higher than would allow for replacement of spawners. This low productivity of Hoko chinook is very likely related to degraded freshwater habitat, including recurrent flooding and erosion, with poor marine survival. Almost the entire watershed (98%) has been clearcut, and 60% of the watershed is currently in a clearcut state (i.e., clearcuts <20 years old). There are 350 miles of roads in the 72 square mile watershed (M.Haggerty, Makah Fisheries Management, personal communication, 2000.)

Management Objectives

Management guidelines include a recovery exploitation rate objective for the Western Strait of Juan de Fuca management unit and a critical escapement threshold. The recovery exploitation rate objective is a maximum of ten percent in southern U.S. fisheries. It represents a lower exploitation rate than these stocks have experienced on average, and a rate that is achievable (and has been achieved in recent years), through conservative fishery management (Table 2). Recent years have shown that the nominal escapement goal can be achieved, with favorable marine survival, under this management regime.

The critical escapement threshold for the Hoko River is 500 natural spawners. Whenever natural spawning escapement for this stock is projected to be below this level, the harvest management plan will call for fisheries to be managed to achieve a lower rate than the interim 10% ceiling SUS exploitation rate.

Data gaps

- Reconstruct abundance of more recent brood years from CWT data
- Derive a spawner/recruit relationship for Hoko chinook

Appendix B. Non-landed Mortality

The fishery simulation model (FRAM) used by the co-managers for pre-season management planning and post-season assessment allows specification of non-landed mortality rates for different fisheries strata and gear types, in order to estimate total fisheries-related mortality for all component stocks. Non-landed mortality comprises a significant proportion of total fisheries mortality. This document summarizes the non-landed mortality rates that are currently specified by the FRAM chinook model (Table 1), and discusses the sources of these rates

When sub-legal fish (i.e. those less than the minimum allowable size) or species for which retention is disallowed are caught, a proportion (i.e. the releases mortality rate) subsequently die. This occurs frequently in commercial troll and recreational hook-and-line fisheries, for which regulations specify a minimum size limit, and may specify, for certain period, non-retention of chinook or coho. Non-retention of chinook may also be specified for certain net fisheries, where the fisherman tends the gear constantly (gillnets), or the gear design (seines) allows live capture and release of non-target species.

Drop-off or drop-out mortality is defined as that which occurs when fish are hooked or entangled by the gear, but they escape before being landed. The rate is applied to the number of landed fish.

Table 1 - Chinook Incidental Mortality Rates Assumed for FRAM Model Fisheries in Washington.

Fishery	Release Mortality	Drop-off, Drop-out, and other
Ocean Recreational	14%	5%
Ocean Troll – barbless hooks Barbed hooks	26% 30%	5% 5%
Puget Sound Recreational	> 22” 10% < 22” 20%	5% 5%
Gillnet Skagit Bay	 52.4%	2% terminal; 3% preterminal
Purse Seine	45% immature 33% mature	0%
Beach Seine Skagit Bay pink fishery	 50%	
Reef Net	None Assessed	0%

Ocean troll and recreational fisheries

Sources of Incidental Mortality

Incidental mortalities in troll fisheries are related to the duration of retention and non-retention periods, size limit regulations, and gear type. Size limits have been used extensively for these fisheries and have changed only a few times since 1979. Recreational and troll fisheries have been allowed to retain fish larger than 24” since the mid- 1980s. Troll fishing techniques differ, depending on whether the target species is chinook of coho. When coho are targeted, encounters with chinook have been reduced, but not eliminated, by species-specific gear, location, and fishing technique. Other management measures to reduce incidental chinook catch, such as landing limits, ratio fisheries, or chinook non-retention fisheries are seldom utilized. Marine mammal predation, ‘sorting’, and other sources of mortality associated with hook and line gear are not accounted in FRAM. ‘Sorting’ refers to release of legal fish in order to retain a larger fish later.

Estimates of Incidental Mortality

The effects of size limits on incidental mortality are modeled by a growth function to estimate what proportion of stock are of legal size at each time step. Encounter rates are calculated by the FRAM, using growth functions specific to each contributing stock to determine the proportion of legal and sub-legal fish, in each age class, present in each time step. Assuming that all ages are equally vulnerable to fishing, the fishery-specific exploitation rate is then applied to estimate legal and sub-legal encounters. Incidental mortality is then estimated by applying mortality rate appropriate to the fishery and gear type. FRAM also allows direct input of encounter rates if they are estimated from direct sampling of fisheries. With funding from the CTC, the Makah Tribe has monitored chinook encounter rates in troll fisheries in Washington Catch Areas 1 – 4 for 1998 - 2001. These data have been incorporated into pre-season fisheries modeling.

Release mortality associated with non-retention periods are calculated as ratios of non-retention days to normal retention days within the model base period. Drop-off mortality for hook-and-line fisheries is distinguished from landed catch by FRAM (i.e. may be reported separately). The current drop-off mortality rate is five percent. This value was derived from a negotiation process and is generally thought to include marine mammal interactions and illegal catch.

Historical estimates of incidental chinook mortality in troll and recreational fisheries, that are provided in the attached spreadsheets, were made by FRAM in ‘validation’ runs that reconstructed fisheries mortality, post-season, from known catch and stock abundance for the years 1983 – 1996. They are annual estimates, including impacts during the October – April time step that precedes the May – September period when most fishing occurs. These estimates express incidental mortality in the same terms as landed catch; they are not adjusted for adult equivalence. They provide a historical perspective on incidental mortality during the 1983-1985 base period, and under the more constrained fishing regimes of 1991 – 1996.

Measures to Reduce Incidental Mortalities

Incidental mortality has been reduced by requiring the use of barbless hooks in troll and recreational fisheries. During periods of chinook-directed fishing, trollers have been required to use large plugs to reduced interactions with sub-legal fish and coho. Time and area considerations are weighed in the structuring of ratio and non-retention fisheries to minimize incidental mortality to the extent possible.

Reduction of Incidental Mortality

Further reduction of incidental mortality in chinook fisheries will primarily be accomplished by measures designed to reduce encounters through time and area restrictions. The status of chinook stocks in Washington State may require reduction of exploitation rates. Future studies may show reductions in release mortality for different hook types and sizes for troll and recreational fisheries.

Net Fisheries

Sources of Incidental Mortality

Drift and set gillnet fisheries are conducted in Grays Harbor and Willapa Bay on the Washington coast, throughout Puget Sound, and in freshwater. However, net fisheries directed at chinook currently occur only in a few areas where harvestable, hatchery-origin chinook may be targeted. These areas include Bellingham Bay and the Nooksack River, Tulalip Bay, Elliot Bay and the Green River, the Puyallup River, Nisqually River, southern Hood Canal and the Skokomish River, and other discrete areas in southern Puget Sound. Incidental mortality occurs in these fisheries as a result of net drop-out and marine mammal predation. Gillnet fisheries retain all fish because the mortality of released fish is believed to be high. Harbor seals and sea lions cause significant incidental mortality in many pre-terminal and terminal gillnet fisheries in Puget Sound, but this source is not accounted in current fishery models or planning.

Purse seine fisheries are conducted in Georgia Strait / Rosario Strait, Southern Puget Sound, and Hood Canal, and are primarily directed at sockeye, pink, coho, and chum salmon. The only seine fishery directed at chinook occurs in Bellingham / Samish Bay.
Incidental mortality, in the context of this discussion, results from injury or stress during capture, or from handling the fish in order to release them. Mortality may be immediate or may occur after some delay from injury or disease.

Non-Indian reef net fisheries that target sockeye and, in some years, coho salmon are conducted in Puget Sound catch areas 7 and 7A. In recent years they have been required to release all chinook salmon, but no associated incidental mortality has been accounted in fishery planning. Reef net hauls catch relatively few fish, and the gear and handling cause relatively minor injuries (e.g. stress, scale loss), so incidental mortality is thought to be very low.

Marine mammal interactions incur significant incidental mortality in many Puget Sound gillnet fisheries, but they have not been generally quantified. A limited number of area-specific studies provide some quantification (PNPTC 1986; 1988?)

Estimates of Incidental Mortality

Drop-out mortality for gillnet fisheries are accounted by FRAM as 3% of landed pre-terminal gillnet catch and 2% of terminal landed gillnet catch. Many factors affect the drop out rate, including mesh dimension, net material and hanging design, sea state, and the frequency of picking. Drop-out rates were derived by technical consensus among state and tribal biologists, because of lack of data from direct sampling. Gillnets fished in the traditional manner are assumed to have a release mortality of a hundred percent. Incidental mortality due to marine mammal predation is highly variable, but is thought to be substantial in many areas in Puget Sound. There has been no systematic sampling of these fisheries that might enable accurate quantification, though anecdotal evidence abounds, and there have been several efforts to document the incidence of scars on spawning chinook.

When chinook are released following capture in purse seine fisheries, immediate and delayed mortality is significantly lower for large chinook than for smaller chinook (Ruggerone and June 1996). Incidental mortality is accounted in the FRAM model as 45% for immature fish (i.e. those caught in fall coho and chum fisheries), and 33% for mature fish caught in sockeye and pink fisheries. Pre-season projections of encounters for any given fishery are based on historic catch, and differential mortality calculated for large and small fish and reported as part of landed mortality. Since FRAM aggregates the incidental mortality associated with all types of net gear for a given fishery, the expected distribution of catch among different gear types underlies the estimate. 'Drop-out' mortality is not accounted for purse seine, roundhaul seine, or beach seine fisheries.

Estimates of mortality in net fisheries, that were included in the previous transmittal to the CTC, were based on a study conducted by WDFW in 1976-1985 (Shepard 1987). Observed encounters per set were expanded to estimate mortality in chinook directed fisheries and encounters per landing in other fisheries. These estimates were previously reported to PSC, but vary widely from FRAM estimates due to differences in methodology. We suggest that FRAM estimates provide the most useful comparison between the base period and more recent year; these are provided in attached spreadsheets.

Estimates of gillnet drop-out mortality from the FRAM validation set, for 1979 – 1985, and 1991 - 1996, are reported for marine net fisheries in North and South Puget Sound, Strait of Juan de Fuca, Grays Harbor, and Willapa Bay. Mortality, during these intervals, in freshwater net fisheries is reported as 2% of the landed catch in each river. River fisheries in this report include the Nooksack, Skagit, Snohomish, Lake Washington (including the Ship Canal), Green, Nisqually, and Skokomish rivers in Puget Sound, and the Sooes, Quileute, Queets, and Quinault rivers on the Washington coast.

Release mortality from purse seine fisheries is hard to tease out of FRAM validation runs. It is calculated by spreadsheet outside of FRAM and input as part of the landed catch. For a given FRAM net fishery, release mortality is dependent on the relative volume of purse seine, beach seine, and gillnet catch; no additional release mortality is assigned to beach seine and gillnet catch.

Measures to Reduce Incidental Mortality

Incidental chinook mortality has been reduced in gillnet fisheries by time and area restrictions that restrict effort during the chinook migration period, which has been specifically defined for all Puget Sound fishing areas. When migration periods for other salmon species overlap, (e.g. for pink or coho salmon), fisheries directed at those species are shortened to reduce chinook encounters.

Commercial net fishers may reduce marine mammal interactions by using 'seal bombs' or may obtain permits to shoot harbor seals and sea lions in some cases.

Since 1973, non-Indian fishery regulations have required that purse seines incorporate a strip of larger mesh at the top of the bunt to allow immature chinook to escape. In 1996, the minimum gill net mesh size for chum fisheries was increased to 6-1/4 from 5-3/4 inch mesh, in order to reduce the incidental catch of immature chinook. In 1997 all purse seine fisheries required release of all chinook. Gillnet fisheries were allowed to retain chinook because release mortality is assumed to be 100%. In 1998 shoreline closures in Rosario Strait (Area 7) were adopted, designed to reduce impacts on chinook salmon while still providing opportunities during sockeye and pink-directed fisheries. In 1999 purse seines were required to use brailers or hand dip nets to remove salmon from seine nets during sockeye and pink salmon fisheries in 7/7A to reduce by-catch mortality (R. Bernard, WDFW, pers comm. October 19, 2000).

Future Reduction of Incidental Mortality

Further reduction in the incidental mortality of chinook in net fisheries will involve coordinated study and development of more selective gear, more effective release techniques, mitigation of marine mammal interactions, and, perhaps, reductions in fishing opportunity.

A study, funded under NMFS' Saltonstall-Kennedy program, is currently being conducted by WDFW to evaluate tangle nets as an alternative to conventional gillnet gear. Tangle nets are constructed of smaller-mesh, loosely hung, monofilament that catches salmon by the teeth or jaw, rather than behind the opercle and gills. Previous studies in British Columbia suggested that non-target species could be released from this gear with low associated mortality. Fishing power with respect to target species, and survival of non-target salmon species caught and released from tangle nets, are being analyzed at two sites in Puget Sound. It may be possible to improve the survival of chinook caught in purse seines with careful handling or by allowing fish to recover in a tank prior to their release.

In certain circumstances fishing opportunity, where species other than chinook are the target, may be further constrained, or planned to achieve a specific level of incidental mortality. These measures require accurate in-season monitoring to assess when the threshold of landed chinook catch has been achieved.

Appendix C. Minimum Fisheries Regime

Non-Treaty Ocean Troll and Recreational Fisheries:.

- Chinook and coho quotas and seasons adopted by the PFMC.
- Exploitation rates on critical Puget Sound Chinook management units will not exceed the range projected to occur for management years 2000 – 2003 (see Chapter 5).

Treaty Ocean Troll Fishery:

- Chinook and coho quotas and seasons adopted by the PFMC.
- Exploitation rates on critical Puget Sound Chinook management units will not exceed the range projected to occur for management years 2000 – 2003 (see Chapter 5).

Strait of Juan De Fuca Treaty Troll Fisheries:

- Open June 15 through April 15.
- Use barbless hooks only.

Strait of Juan De Fuca Treaty Net Fisheries:

- Setnet fishery for Chinook open June 16 to August 15. 1000-foot closures around river mouths.
- Gillnet fisheries for sockeye, pink, and chum managed according to PST Annex.
- Gillnet fisheries for coho from the end of the Fraser Panel management period, to the start of fall chum fisheries (approximately Oct. 10).
- Closed mid-November through mid-June.

Strait of Juan De Fuca Non-treaty Net Fisheries:

- Closed year-around.

Area 5/6 Recreational Fishery:

- May 1-June 30 closed.
- July 1 – Sept 30 Chinook mark selective fishery not to exceed two months, and not to exceed 3500 landed catch in 2004. In subsequent years, this may be extended by agreement of the co-managers, else, Chinook non-retention.
- October closed
- 1-Chinook bag limit in November.
- December 1 - February 15 closed
- 1-fish bag limit February 16-April 10
- April 11-30 closed

Strait of Juan De Fuca Terminal Treaty Net Fisheries:

- Hoko, Pysht, and Freshwater Bays closed May 1 – October 15.
- Elwha River closed April 1 through mid-September, except for minimal ceremonial harvests.
- Dungeness Bay (6D) closed March 1 through mid-September; Chinook non-retention mid-September – October 10.
- Dungeness River closed March 1 through September 30. Chinook non retention when open, except for minimal ceremonial harvests.
- Miscellaneous JDF streams closed March 1 through November 30.

Strait of Juan De Fuca River Recreational Fishery:
- June 1 – Sept 30 Elwha River closed to all fishing from river mouth to WDFW channel. At all other times and places, Chinook non-retention.
- Dungeness closed to salmon 12/1 through 10/15.
- Dungeness Chinook non-retention 10/16 through 11/30.
- Close other streams.

Area 6/7/7A Treaty and Non-treaty Net Fisheries:
- Sockeye, pink, and chum fisheries managed according to PST Annex.
- Net fisheries closed from mid-November through mid-June.
- Area 6A Closed.
- Non-treaty purse seine and reef net fisheries Chinook non-retention.
- Non-treaty gillnet fishery Chinook ceiling of 700.
- Non-treaty closure within 1500 feet of Fidalgo Island between Deception Pass and Shannon Pt; and within 1500 feet of Lopez and Decatur Islands between Pt Colville and James Island.

Area 7 Recreational Fishery:
- May 1-June 30 closed.
- 7/1-7/31 1 fish limit, Rosario Strait and Eastern Strait of Juan de Fuca
- closed; Bellingham Bay closed.
- 8/1-9/30 1 fish limit, Southern Rosario Strait and Eastern Strait Juan de
- Fuca closed Bellingham Bay closed.
- 8/1-8/15, Samish Bay closed.
- Chinook non-retention 10/1-10/31
- 11/1-11/30 1 fish limit.
- December-February 15 closed
- 1-fish bag limit February 16-April 10
- April 11-30 closed

Nooksack/Samish Terminal Area Fisheries:
- Bellingham Bay (7B) and Samish Bay (7C) closed to commercial fishing from April 15 through July 31.
- Area 7B/7C hatchery fall Chinook fishery opens August 1.
- Pink fishery opens August 1.
- Ceremonial fishery in late May limited to 10 natural-origin Chinook.
- Subsistence fishery limited 20 natural-origin Chinook between July 1-4.
- Ceremonial and subsistence harvest to be taken in the lower river, and between the confluence of the South Fork and the confluence of the Middle Fork.
- Nooksack River commercial fishery for hatchery fall Chinook opens August 1 in the lower river section; and staggered openings in up-river sections will occur over 4 successive weekly periods. (see Appendix A).
- Bellingham Bay recreational fishery closed in July.
- Samish Bay recreational fishery closed August 1-15.
- Chinook non-retention in Nooksack River recreational fisheries.
- 2-Chinook bag limit after October 1 in Nooksack River.
- 2-fish bag limit from July 1 to December 31 in Samish River.

Skagit Terminal Area Net Fisheries:

- Skagit Bay and lower Skagit River closed to commercial net fishing from mid-February to August 22 in pink years, and until week 37 (~September 10) in non-pink years.
- Upper Skagit River closed to commercial net fishing from mid-March to August 22 in pink years, and until week 42 (~October 10) in non-pink years, unless there is an opening for Baker sockeye in July.
- Upper Skagit and Sauk-Suiattle fisheries on Baker sockeye require 5½ "
- maximum mesh, and Chinook non-retention.
- Half of the Upper Skagit and Sauk-Suiattle share of Baker sockeye will be taken at the Baker Trap, rather than in river fisheries.
- No Chinook update fishery or directed commercial Chinook fishery.
- Treaty pink update fishery limited to 2 days/week during weeks 35 and 36, and Non-treaty update limited to 1 day/week, gillnets only.
- Pink fishery gillnet openings in the Skagit River limited to a maximum of 3 days/week, regardless of pink numbers. Beach seines may be used on other days, with Chinook non-retention.
- Up to 40% of the Upper Skagit share of pink salmon will be taken in Skagit Bay.
- Release Chinook from beach seines in Skagit Bay.
- Chinook non-retention required in pink fisheries in the upper river.
- Tribal coho openings delayed until Week 39 in the Bay and lower river, and until Week 42 in the upper river.
- Chinook test fisheries limited to 1 boat, 6 hrs/week.

Skagit River Recreational Fisheries:

- Chinook non-retention.

Area 8A and 8D Net Fisheries:

- Area 8A Treaty fishery Chinook impacts incidental to fisheries directed at coho, pink, chum, and steelhead.
- Effort in the Treaty pink fishery will be adjusted in-season to maintain Chinook impacts at or below those modeled during the pink management period.
- Area 8D Treaty Chinook fisheries limited to C & S beginning in May, and to 3 days/wk during the Chinook management period.
- Non-treaty pink fishery limited to 1 day/week for each gear.
- Non-treaty purse seine fishery Chinook non-retention.
- Area 8D non-treaty Chinook impacts incidental to fisheries directed at coho and chum.

Stillaguamish River Net Fisheries:

- Treaty net fishery Chinook impacts incidental to fisheries directed at pink, chum, and steelhead.
- Treaty pink fishery schedule limited to maintain Chinook impacts at or below the modeled rate.

Stillaguamish River Recreational Fisheries:

- Chinook non-retention.
- Use barbless hooks from September 1 to December 31.

Snohomish River Fisheries:
- Net fisheries closed.
- Chinook non-retention in river recreational fisheries.

Area 8-1 Recreational Fisheries:
- 5/1-8/31 closed.
- Chinook non-retention 9/1-10/31.
- 11/1-11/30 1 fish limit.
- 12/1-2/15 closed.
- 1-fish bag limit February 16 – April 10.
- 4/11-4/30 closed.

Area 8-2 Recreational Fisheries:
- 5/1-7/31 closed.
- Chinook non-retention 8/1-10/31.
- 11/1-11/30 1 fish limit.
- 12/1-2/15 closed.
- 1-fish bag limit February 16 – April 10.
- 4/11-4/30 closed.
- 1-Chinook bag limit in Tulalip Bay in August and September.
- Tulalip Bay openings limited to 12:01 AM Friday to 11:59 AM Monday each week.

Area 9 Net Fisheries:
- Net fisheries limited to research purposes.

Area 9 Recreational Fisheries:
- 5/1-7/31 closed.
- Chinook non-retention 8/1-10/31.
- 11/1-11/30 1 fish limit.
- 12/1-2/15 closed.
- 1-fish bag limit February 16 – April 10.
- 4/11-4/30 closed.

Area 10 Net Fisheries:
- Closed from mid-November through June and August.
- Sockeye net fishery during first three weeks of July when ISU indicates harvestable surplus of Lake Washington stock.
- Net fisheries for coho and chum salmon will be determined based on in-season abundance estimates of those species. Limited test fisheries will begin the 2nd week of September. Commercial fisheries schedules will be based on effort and abundance estimates. Marine waters east of line from West Point to Meadow Point shall remain closed during the month of September for Chinook protection. Chinook live release regulations will be in effect

Lake Washington Terminal Area Fisheries:

- Chinook run size update from lock count to re-evaluate forecasted status.
- No Chinook directed commercial fishery in the Ship Canal or Lake Washington.
- Net fishery impacts incidental to fisheries directed at sockeye and coho. Sockeye and coho fisheries dependant on lock count ISU. Incidental Chinook impact minimized by time, area and live Chinook-release restrictions. Sockeye fisheries scheduled as early as possible. Coho fishery delayed until September 15th when 95.2% of the Chinook run has cleared the locks.
- Possible directed Chinook fishery in Lake Sammamish for Issaquah Hatchery surplus.
- Cedar River and Issaquah Creek closed to recreational fishing.
- Chinook non-retention in Sammamish River, Lake Washington, Lake Union, Portage Bay, and Ship Canal recreational fisheries

Area 10A Treaty Net Fisheries:

- Chinook gillnet test fishery 12 hours/week, 3 weeks, beginning mid-July to re-evaluate forecasted status.
- No Chinook directed commercial fishery.
- Net fishery impacts incidental to fisheries directed at coho. Coho opening delayed until September 15th.

Duwamish/Green River Fisheries:

- Commercial Chinook fishery dependant on Area 10A test fishery results.
- No Chinook directed commercial fishery.
- Net fishery impacts incidental to fisheries directed at coho. Coho opening delayed until September 15th and restricted to waters below the 16th Ave Bridge. Coho opening above the 16th Ave Bridge to the turning basin delayed until September 22nd. Coho opening above the turning basin up to the Hwy 99 Bridge delayed until September 29th.
- Chinook non-retention in river recreational fisheries

Area 10E Treaty Net Fisheries:

- Closed from mid November until last week of July.
- Chinook net fishery 5 day/wk last week of July through September 15.
- Chinook impacts incidental to net fisheries directed at coho and chum, from mid-September through November

.Area 10 Recreational Fisheries:

- 5/1-6/30 closed.
- Chinook non-retention 7/1-10/31.
- 11/1-11/30 1 fish limit.
- 12/1-2/15 closed.
- 1-fish bag limit February 16 – April 10.
- 4/11-4/30 closed.

Area 11 Net Fisheries:

- Closed from end of November to beginning of September.
- No Chinook-directed fishery
- Net fishery Chinook impacts incidental to fisheries directed at coho and chum.
- Non-treaty purse seine fishery Chinook non-retention.

Area 11A Net Fisheries:
- Closed from beginning of November to end of August.
- Net fishery Chinook impacts incidental to fisheries directed at coho.

Puyallup River System Fisheries:
- Net fisheries closed from beginning of February to beginning of August.
- Limit gill net test fishery for Chinook to 1 day a week, scheduled from mid-July through August 15.
- Chinook net fisheries limited to 1 day/week, August 15 – September 10 (delayed to protect White River spring Chinook.
- Muckleshoot on-reservation fisheries on White River limited to hook and line C & S fishing for seniors, with a limit of 25 Chinook.
- Net fishery Chinook impacts incidental to fisheries directed at coho and chum.
- 2-Chinook bag limit in river sport fisheries.
- Chinook non-retention before August 1 in Puyallup River sport fishery.
- Chinook non-retention before September 1 in Carbon River sport fishery.
- Chinook non-retention in White River.

Area 11 Recreational Fisheries:
- 5/1-5/30 closed.
- 1-fish limit June 1 – November 30.
- 12/1-2/15 closed.
- 1-fish limit February 16 – April 10.
- 4/11-4/30 closed.

Fox Island/Ketron Island Net Fisheries:
- Closed from end of October to August 1.
- Net fishery Chinook impacts incidental to fisheries directed at coho and chum.

Sequalitchew Net Fisheries:
- Net fishery Chinook impacts incidental to fisheries directed at coho.

Carr Inlet Net Fisheries:
- Closed from beginning of October through August 1.
- Net fishery Chinook impacts incidental to fisheries directed at coho and chum.

Chambers Bay Net Fisheries:
- Closed from end of mid-October to August 1.
- Net fishery Chinook impacts incidental to fisheries directed at coho and chum.

Area 13D Net Fisheries:
- Closed from mid-September to August 1.
- Net fishery Chinook impacts incidental to fisheries directed at coho and chum.

Henderson Inlet (Area 13E) Net Fisheries:
- Closed year-around.

Budd Inlet Net Fisheries:
- Closed from mid-September to July 15.
- Net fishery Chinook impacts incidental to fisheries directed at coho and chum.

Areas 13G-K Net Fisheries:
- Closed Mid-September to August 1.
- Net fishery Chinook impacts incidental to fisheries directed at coho and chum.

Nisqually River and McAllister Creek Fisheries:
- Chinook fishery late-July through September, up to three days per week dependent on in-season abundance assessment (see Appendix A).
- Coho fishery October through mid-November.
- Late chum fishery mid-December – mid-January.
- Nisqually River recreational closed February 1 through May 31.
- McAllister Creek recreational closed December 1 through May 31.
- Chinook non-retention in June recreational fishery.
- 2-Chinook bag limit.

Area 13 Recreational Fisheries:
- 1-fish bag limit May 1-November 30.
- 12/1-2/15 closed.
- 1-fish bag limit February 16 – April 10.
- 4/11-4/30 closed.

Hood Canal (12, 12B, 12C, 12D) Treaty Net Fisheries: (also see: Skokomish and Mid-Hood Canal Management Unit profiles in Appendix A):
- Chinook directed treaty fishery limited to Areas 12C and 12H.
- Coho directed fisheries in Areas 12 and 12B delayed to Sept. 24; in Area 12C, to Oct. 1. Beach seines release Chinook through Oct. 15.
- 1,000 foot closures around river mouths, when rivers are closed to fishing.
- Net fisheries closed from mid December to mid July

Area 9A Treaty Net Fisheries:
- Closed from end of January to mid-August (dependent upon pink fishery).
- Beach seines release Chinook through Oct. 15.

Area 12A Treaty Net Fisheries:
- Closed from mid-December to mid-August.
- During coho and chum fisheries, beach seines release Chinook through Oct. 15.

Hood Canal Freshwater Treaty Net Fisheries:
- Dosewallips, Duckabush, and Hamma Hamma rivers closed.
- Skokomish River Chinook fishery August 1 – September 30, limited to two to five days per week.
- Skokomish River closed March – July 31(also see: Skokomish MU profile in Appendix A).

Area 12 Recreational Fishery:

- 5/1-6/30 closed.
- Chinook non-retention 7/1-10/15.
- 10/16-12/31 1-fish limit.
- 1/1-2/15 closed.
- 1-fish bag limit February 16 – April 10.
- 4/11-4/30 closed.

Hood Canal Freshwater Recreational Fisheries:

- Closed March 1 to May 31.
- Chinook non-retention from June 1 to February 29 in all rivers.
- Dosewallips, Duckabush, and Hamma Hamma closed in September and October.

Appendix D. Role of Salmon in Nutrient Enrichment of Fluvial Systems

INTRODUCTION

Continued declines in abundance of Pacific salmon (*Oncorhynchus* spp.) populations have focused increased attention on factors limiting their survival. While the decline in abundance of Pacific salmon stocks (National Research Council 1996) has been attributed to may factors, just recently have researchers focused their attention on the nutrient re-cycling role of returning adult salmon in maintaining productive freshwater ecosystems. Given that Pacific salmon accumulate the significant majority of their body mass while in the marine environment (Groot and Margolis 1991), returning runs of adult salmon potentially represent a substantial source of marine-derived nutrients (MDN) for freshwater and riparian communities (Larkin and Slaney 1996; Gresh et al. 2000; Murota 2002; Schoonmaker et al. 2002). Research has shown that the addition of nutrients to freshwater systems can influence community structure and increase stream productivity at several trophic levels (Kline et al. 1990; Piorkowski 1995; Quamme and Slaney 2002). Benefits include increased growth and density of juvenile salmonid populations (Johnston et al. 1990; Bradford et al. 2000; Ward and Slaney 2002). Gresh et al. (2000) estimate that the current contribution of MDN from adult Pacific salmon to rivers in the Pacific Northwest is as low as 6-7% of historic levels and that the resulting 'nutrient deficit' could be exacerbating continued declines in salmon abundance or impeding recovery.

The concept of a 'nutrient deficit' has several implications for current fisheries management, harvest strategies and recovery of depressed salmon stocks. It is asserted that current harvest management strategies for salmon stocks fail to consider the importance of MDN for maintaining properly functioning ecosystems and self-sustaining salmon populations (Micheal 1998; Cederholm et al. 2000; Gresh et al. 2000; Bilby et al. 2001). More directly, current escapement goals for salmon runs may be perpetuating a negative feedback loop in salmon population dynamics (Larkin and Slaney 1996, 1997). Ideally, research might quantify the nutrient input, and escapement density, necessary to optimize ecosystem function, viable salmon runs, and harvest. However, nutrient dynamics in aquatic systems are often complex (Northcote 1988; Polis et al. 1997; Bisson and Bilby 1998; Murphy 1998; Naiman et al. 2000) and depend on numerous site-specific factors including the species of salmon, spawning density and location, stream discharge regimes, stream habitat complexity, basin geology, light, temperature and community structure. Researchers are just beginning to recognize and understand these complexities in relation to salmon and MDN. In this paper I will review the current state of knowledge on the relationship between Pacific salmon, MDN and stream ecosystem function in the context of determining 'ecologically based' salmon escapement goals.

NUTRIENT PATHWAYS

Adult salmon contain proteins, fats and other biochemicals comprised of marine- origin carbon, nitrogen and phosphorous (Mathisen et al. 1988). Returning adult salmon act as vectors in delivering nutrients of marine origin to terrestrial ecosystems through excretion (O'Keefe and Edwards 2002), gametes and carcasses (Mathisen et al. 1988). In general, stream biota incorporate salmon-derived nutrients through three primary pathways: 1) trophic transfer following uptake of inorganic nutrients by primary producers; 2) streambed microfaunal uptake of dissolved organic matter released by salmon carcasses; and 3) direct consumption of salmon carcasses, eggs and fry (Cederholm et al. 1999). Additionally, high flow events and scavenging by birds and mammals (Cederholm et al. 1989, 2000; Ben-David et al. 1998) can deliver salmon-derived nutrients to riparian and upland communities (Garten 1993; Wilson and Halupka 1995; Helfield and Naiman 2001; Hocking and Reimchen 2002; Reimchen et al. 2002).

STABLE ISOTOPE AND PROTEIN STUDIES

Applied relatively recently to the issue of salmon and MDN, stable isotope analysis has allowed researchers to quantitatively identify nutrient sources and further understand nutrient pathways in freshwater systems. Carbon, nitrogen, and phosphorous are typically considered principal nutrients that limit ecosystem productivity (Gregory et al. 1987; Peterson and Fry 1987; Murphy 1998). While phosphorous has only one stable isotope, limiting our ability to distinguish the origin of phosphorous, carbon (C) and nitrogen (N) have two stable isotopes. The isotopic properties of carbon and nitrogen provide natural tracers for determining differences in stable isotope abundance in trophic food webs. Stable isotope ratios are typically expressed as $\delta^{13}C$ and $\delta^{15}N$ values and represent the level of enrichment or depletion of the heavier isotope C or N relative to a standard (Peterson and Fry 1987). Spawning salmon contain higher proportions of the heavy isotopes carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$, Mathisen et al. 1988; Piorkowski 1995; Bilby et al. 1998). Nitrogen is especially applicable in salmon-derived nutrient studies due to the dichotomous nature in N sources between Pacific salmon (oceanic N) and terrestrial and freshwater systems (atmospheric N_2, Peterson and Fry 1987; Kline et al. 1997).

Kline et al. (1990) developed an isotope-mixing model to investigate the incorporation of MDN in Sashin Creek, southeastern Alaska. The isotope-mixing model allows for determination of percent contribution of marine nitrogen across trophic levels. The study design compared isotope ratios between a lower reach, accessed primarily by pink salmon (approximately 30,000 adults annually), and an upper control reach isolated from anadromous fish. Isotope values indicate that standing crop of periphyton in the anadromous section was dependent on marine N, with levels greater than 90% immediately after spawning and near 50% at other times of the year. The sustained marine N signal in periphyton further indicated nutrient retention. Stonefly nymphs and caddis fly larvae also showed high levels of enrichment in April possibly due to overwintering retention and trophic transfer through periphyton and decomposers (e.g. fungi). The isotope model suggested that turbellarians were incorporating marine N through direct consumption of salmon eggs. In rainbow trout, high levels of $\delta^{15}N$ were found with increasing isotope values as the size of trout increased. Using a dual isotope method, Kline et al. (1990) concluded that trout from the enriched section were likely incorporating a portion of marine N from autochthonous production (dependent on primary producer uptake of remineralized nutrients) as well as direct feeding on salmon carcasses and eggs. Researchers surmise that MDN have a trophic-wide effect in the anadromous section of Sashin Creek. They also note that the use of fertilizers to alleviate nutrient loss in streams may not adequately substitute for salmon carcasses and eggs that are directly fed upon by consumers and decomposers, a point further developed in this review.

Since the Kline et al. (1990) study, numerous investigators have used stable isotope methods to distinguish MDN pathways in lotic systems (Bilby et al. 1996, 1998, 2001; Helfield and Naiman 2001; Piorkowski 1995; Winter et al. 2000). These studies show similar results indicating incorporation of MDN in food webs with anadromous runs of salmon. However, results do not universally indicate the degree of importance or pathways of MDN across different lotic systems. In an in-depth ecosystem study on five creeks in southcentral Alaska, Piorkowski (1995) used stable isotopes to distinguish marine N in stream food webs. The five study creeks are used by multiple species of anadromous salmon of which Piorkowski (1995) found different isotopic composition between adult salmon species with chinook salmon being significantly more enriched in $\delta^{15}N$ (due to increased ocean residence time) as compared to pink, coho and chum salmon. Isotope samples were collected from organisms at several trophic levels. Samples from sites with adult salmon returns indicated that the diets of grayling, rainbow trout, and coho salmon fry were predominately comprised of salmon tissue and eggs. Also, examination of stream macroinvertebrates revealed increased taxa richness and diversity in anadromous stream sections compared with non-anadromous sections. Despite this, results failed to detect a significant marine N signal between control and treatment sites in samples of riparian vegetation, algae, and stream macroinvertebrates (grazers) and implies that marine N was not significantly incorporated through pathways of primary production. Piorkowksi (1995) notes that results markedly differ from the Sashin Creek study (Kline et al. 1990) and are likely due to two important considerations: 1) Sashin Creek received a much larger run of salmon utilizing a smaller stream area; and 2) total dissolved nitrogen content in Sashin Creek was likely much lower given intense precipitation (nutrient flushing), causing the system to be more dependent on seasonal pulses of salmon-derived nutrients.

Many headwater streams in the Pacific Northwest exhibit low levels of primary and secondary productivity (Gregory et al. 1987; Bilby and Bisson 1992), and are systems typically preferred by adult coho salmon for spawning (Sandercock 1991). Bilby et al. (1996) compared isotope ratios in four tributaries of the Snoqualmie River, Washington, to determine the influence of coho salmon carcasses on food webs of headwater streams. Overall, the study suggests that even modest inputs of MDN can influence small streams. $\delta^{15}N$ and $\delta^{13}C$ values were similar between anadromous and non-anadromous streams prior to coho salmon spawning; during and shortly after spawning, elevated $\delta^{15}N$ values were found in stream biota (epilithic organic matter and stream invertebrates) and riparian foliage. Juvenile coho salmon more than doubled their weight following the appearance of spawning adults. Using an isotope model assuming no direct consumption on salmon carcasses and eggs (resulting in a conservative estimate without trophic fractionation), juvenile coho salmon were enriched approximately 30% with marine N. As well, researchers found rapid uptake of MDN through chemical sorption by streambed gravel. Chemical uptake of dissolved organic matter by streambed substrate was similar in both light and dark controlled experiments. Bilby et al. (1996) stress the importance of chemical sorption for initial nutrient uptake in headwater streams where primary production is limited during winter due to cold temperatures, low light levels, and frequent scouring by high flow events.

Carcass tissue and eggs appear to be an important food source for juvenile fish during winter periods and may play a critical role when other food items are less available. In four streams in southwestern Washington, Bilby et al. (1998) observed significant increases in density, weight and condition factor of juvenile steelhead and coho salmon following addition of hatchery spawned coho carcasses (with some eggs remaining). In enriched stream sections, 60-96% of stomach contents of juvenile steelhead and coho salmon were comprised of carcass flesh and eggs (with eggs being the preferred food item) while carcass material was present. Also, diet content of juvenile coho salmon had five times the amount of invertebrate biomass as compared to non-enriched areas. While significant increases in density and condition factor of juvenile coho salmon and steelhead were observed in carcass enriched areas, fish were not marked to confirm site fidelity throughout the study period. Even so, increased fish size and condition factor has implications for higher survival for both juvenile coho salmon (Bell 2001; Brakensiek 2002; Hartman and Scrivener 1990; Quinn and Peterson 1996; Holtby 1988) and steelhead (Ward and Slaney 1988) and subsequent returns of adults (Hager and Noble 1976; Bilton et al. 1982).

Findings by Wipli et al. (in review) further corroborate conclusions by Bilby et al. (1998) on the importance of salmon carcasses and eggs for juvenile coho salmon. In experimental and natural streams in Southeast Alaska, Wipfli et al. (in review) found strong positive correlations between salmon carcass loading rates and growth of juvenile coho salmon, cutthroat trout and Dolly Varden char. Over a 60 day experiment, juvenile coho salmon gained over 60% of fish body mass in study reaches with the highest carcass loading rates (4 carcasses / m^2). Similarly, cutthroat trout and Dolly Varden char exhibited growth rates over five times higher in carcass rich areas as compared to control areas. Nutritional status of juvenile coho salmon was evidenced by concentrations of triacylglyceride (TAG) and ratios of marine-based to terrestrial-based fatty acids in juvenile samples; both percent TAG and fatty acid ratios increased with increasing density of carcasses. TAG concentrations in juvenile fish correspond to storage of marine-derived long-chain n-3 fatty acids and indicates direct benefits of salmon carcasses to growth and nutritional status of stream salmonids.

BOTTOM-UP EFFECTS OF NUTRIENT ENHANCEMENT

Studies reviewed thus far indicate that stream delivery of MDN and biogenic material from returning adult salmon provide an immediate food resource for fish and can influence lotic food webs. Addition of nutrients can certainly have a bottom-up effect in freshwater systems, boosting primary production and ultimately benefiting fish populations (Johnston et al. 1990; Bradford et al. 2000; Ward et al. 2002; Wilson et al. 2002). This management concept has seen successful application in lake enrichment programs in Alaska and British Columbia where returning runs of sockeye salmon have increased as a result of manual application of nutrients. The extensive knowledge and management success in sockeye rearing lakes is due, in part, to the relative simplicity of these systems in food web and nutrient dynamics, as compared to fluvial systems (Kline et al. 1997; Kyle et al. 1997). Sockeye salmon rearing lakes have generally been identified as oligotrophic systems, primarily limited by phosphorous. Ratio additions of nitrogen and phosphorous have successfully elevated lake rearing capacities for juvenile sockeye salmon through increased zooplankton production (Hyatt and Stockner 1985; Kyle et al. 1997; Bradford et al. 2000). British Columbia has carried this management tool further and begun fertilizing large river systems in efforts to boost declining steelhead and coho salmon populations. Results so far show overall stimulation of system productivity with increased density and growth of juvenile coho salmon and steelhead as well as earlier age at outmigration of steelhead (Johnston et al. 1990; McCubbing and Ward 2000; Ward and Slaney 2002). Whether manual fertilization of large river systems can recover coho salmon and steelhead runs remains to be seen. While certainly a management and research tool, it is questionable if manual nutrient supplementation programs can adequately replace ecosystem function of spawning adult salmon.

Examples of manual supplementation studies are raised to illustrate issues of trophic capacity in relation to fish production. Productivity can be defined as the capacity of a system to produce a product of interest (Bisson and Bilby 1998). A nutrient limited system can mean food limited in the interest of fish production (Chapman 1966; Dill et al. 1981; Johnston et al. 1990). While adult salmon carcasses and eggs provide a direct food resource for fish populations, salmon-derived nutrients can potentially influence fish production through autotrophic and heterotrophic pathways as well (see Vannote et al. 1980, Bilby and Bisson 1992). Wipfli et al. (1998) conducted highly replicated tests of adding salmon carcasses in experimental and natural stream channels in Alaska to assess responses in primary production. Biofilm production (a food source for aquatic invertebrates) increased approximately 15 times in the carcass enriched section (with an approximate return run size of 75,000 pink salmon) compared to the upstream control section. Further, total macroinvertebrate densities increased up to 8 and 25 times in artificial and anadromous stream sections, respectively, as compared to control sections. Similar results were found in a follow-up study by Wipfli et al. (1999), and also suggest a threshold level of response in biofilm production (over a two-month study period) in relation to carcass loading rates (up to 1.45 kg, the lowest carcass loading rate in artificial channels). Both studies (Wipfli et al. 1998, 1999) show trophic responses to MDN and suggest potential growth benefits to fish through increased availability of fish food organisms (see also Perrin et al. 1987, Johnston et al. 1990, Perrin and Richardson 1997, Quamme and Slaney 2002). Wipfli et al. (1999) caution however, that the capacity for stream systems to retain marine nutrients and the long-term effects of 'excessive' carcass loadings for stream productivity have yet to be sufficiently addressed by researchers (O'Keefe and Edwards 2002).

STREAM RETENTION OF SALMON CARCASSES

Stream incorporation of marine-derived nutrients necessitates that salmon carcasses are retained for a sufficient period of time. Cederholm and Peterson (1985) investigated winter retention of coho salmon carcasses in several small streams on the Olympic Peninsula in western Washington. They initially released 180 carcasses throughout nine streams with varying abundance of large woody debris. One week following releases, 78 (43%) of the study carcasses were identified of which 80% were within 200 m of initial placement. Carcass retention was positively correlated with increases in large woody debris. The researchers speculated that carcass retention could be even higher in unlogged streams where large woody debris loading was higher as compared to their study streams.

In a similar follow-up study on carcass retention in Olympic Peninsula streams, Cederholm et al. (1989) released 945 tagged coho salmon carcasses, of which 174 were implanted with radio transmitters to more definitively determine the fate of mobilized carcasses. Few study carcasses were flushed beyond 600 m with a median travel distance of 49.5 m from initial placement. Again, large woody debris was influential in retaining salmon carcasses with the majority of carcasses found in pools. Cederholm et al. (1989) also assessed retention during high flows by depositing 25 radio-tagged carcasses at the beginning of a flood event (estimated discharge 6.20 m^3/s). Following the flood event, 21 of the 25 radio-tagged fish were located within 600 m of initial placement, with a median travel distance of 66 m. Ten of the radio-tagged carcasses were found on stream banks well above low flow levels. In a different study, Glock et al. (1980) investigated retention of chum salmon carcasses on a much larger system, the Skagit River in Washington. Although carcasses drifted as far as 39 km within the first five days, the majority of carcasses (20%) were located within 1.5 km of initial placement. Habitat, discharge, amount of large-woody debris, and species of salmon appear to be important factors in considering retention of salmon carcasses in fluvial systems.

The study by Cederholm et al. (1989) also revealed significant predation by mammals and birds on salmon carcasses. Approximately 22 taxa of mammals and birds were documented consumers of salmon carcasses. Surveys identified 374 partially eaten study carcasses removed from stream channels with 88% of these carcasses located within 15 m of the stream bank. Cederholm et al. (2000) provide a more extensive review of wildlife-salmon relationships that documents over 138 species having a 'strong' positive life-history relationship to Pacific salmon. This and other research suggests the ecological relationships between salmon and wildlife (Wilson and Halupka 1995; Ben-David et al. 1998; Wilson et al. 1998). Further, wildlife species appear to play a significant role in the removal of salmon carcasses from lotic systems where nutrient benefits may be more realized in riparian and upland communities (Cederholm et al. 2000; Garten 1993; Helfield and Naiman 2001; Reimchen et al. 2002).

IMPLICATIONS FOR FISHERIES MANAGEMENT

Although research to date provides evidence of the role of salmon-derived nutrients in ecosystem function, this complex relationship is poorly understood. Further understanding of the ecosystem context of returning adult salmon and MDN will require both the synthesis of several scientific disciplines and human values. Given the high cultural and economic value of salmon, and the public mandate to recover natural salmon populations, fisheries managers must insure that harvest practices do not impede recovery. Research on salmon and MDN frequently implies that current harvest management strategies exacerbate the risk of further decline in salmon populations, due to removal of salmon and nutrients bound for terrestrial systems. However, the science of quantifying salmon escapement goals necessary to properly functioning ecosystems is still in infancy.

Nonetheless, research is beginning to focus on quantifying nutrient input levels necessary to improve juvenile salmon survival. Bilby et al. (2001) used stable isotope levels from juvenile coho salmon collected throughout western Washington to test for a marine N threshold level in juvenile fish. Representative of 26 stream reaches from 12 different watersheds, juvenile coho salmon samples were collected in late February and early March over a seven-year period. Juvenile samples were only collected in known areas where no other anadromous fish spawn. Cutthroat trout were collected above anadromous barriers in the same systems that juvenile coho salmon samples were collected. Isotope values from cutthroat trout represented $\delta^{15}N$ background levels used to establish site-specific ratio index measures of marine N enrichment in relation to $\delta^{15}N$ values from juvenile coho salmon. Also, tissue samples were collected from hatchery returns of adult coho salmon throughout the region to relate $\delta^{15}N$ values from cutthroat trout and juvenile coho. Adult returns of coho salmon to each creek were determined using spawner count and stream habitat data; average weights from adult hatchery returns were used to estimate biomass (wet-weight kg / m^2) of spawners in each study creek.

Bilby et al. (2001) found that $\delta^{15}N$ values were consistently higher, by study site, for juvenile coho salmon as compared to cutthroat trout. However, isotope values revealed considerable variation between study streams for both cutthroat trout (ranging from 4.5‰ to 8.5‰, the per mil deviation of $^{15}N/^{14}N$ from air N_2, Peterson and Fry 1987; Kline et al. 1990) and juvenile coho salmon (5.8‰ to 11.7‰). Cutthroat $\delta^{15}N$ values suggest other sources of marine N, or possibly nutrient fractionation (Peterson and Fry 1987; Kline et al. 1990). Variation in isotope values reveals the need to establish basin-specific background isotope levels when using isotope methods.

Using the relationship between estimated carcass abundance and ^{15}N index values of enrichment in juvenile coho salmon, Bilby et al. (2001) found that enrichment levels increased with increasing carcass abundance. The relationship also revealed a point of diminishing enrichment of marine N in juvenile coho salmon above carcass abundance levels of 0.10 kg/m^2; in locations where carcass abundance was less than 0.10 kg/m^2, enrichment index values averaged 0.19± 0.11(one standard error) as compared to 0.48± 0.13 in areas with carcass abundance above 0.10 kg/m^2. Carcass abundance of 0.10 kg/m^2 approximately equals 120 fish/km^2, above which marine N in juvenile coho salmon rapidly approached a ‘saturation level’. Based on previous findings (Bilby et al. 1996, 1998), researchers in this study assumed that juvenile coho salmon were primarily incorporating marine N through direct consumption of salmon carcasses and eggs. Given this premise, the saturation level found in coho salmon parr could be interpreted as the maximum level of dietary enrichment for this trophic interaction. Based upon spawner escapement data and research findings, Bilby et al. (2001) conclude that the majority of coho salmon spawning streams in western Washington are well below capacity for incorporating more marine-derived nutrients.

From both a research and management perspective, there are numerous limitations to applying results from Bilby et al. (2001) as a standard for salmon escapement goals (many of which the researchers acknowledge). First, study sites were purposely chosen to only include areas with spawning coho salmon and no other returns of anadromous salmonid species. This implies that results may only be applicable in such areas and questions if marine nutrient dynamics would be similar in systems with returning runs of multiple salmon species. The temporal distribution of spawning by numerous species of salmon can mean prolonged input of marine nutrients, which may be more effectively incorporated within a system (due to nutrient flushing) at a lower density of spawners for a given species. Second, juvenile coho salmon alone are probably not an appropriate indicator for determining whether productivity in a system is nutrient limited (Simberloff 1998). The marine N signal found in juvenile coho salmon has been primarily attributed to direct consumption of salmon carcasses and eggs. If this is indeed the primary mechanism for nutrient uptake then isotope values from juvenile coho salmon are less revealing of other pathways for incorporation and trophic distribution of MDN within a system. Third, uncertainty remains as to whether increasing the input of salmon-derived nutrients to fluvial systems will subsequently result in higher returns of adult salmon. Results from the Bilby et al. (2001) study would suggest this due to higher $\delta^{15}N$ index values in juvenile coho salmon from systems with higher carcass densities. The effects of hatchery-origin salmon, that spawn naturally, must also be considered.

Gaps remain in our understanding of nutrient dynamics in fluvial systems. While it appears that salmon-derived nutrients can benefit sockeye salmon, cutthroat trout and coho salmon populations, at this time there are no research publications that directly establish the relationship between MDN and chinook salmon. ‘Ocean-type’ juvenile chinook, which comprise most of the production in Puget Sound, generally spend between three to nine months in freshwater before outmigrating (Healey 1991), a much shorter period than coho and steelhead (Montgomery et al. 1996; Healey 1991). Degraded spawning habitat and winter flow conditions, with direct influence on egg survival and emergence, may be more critical to chinook production than inputs of MDN. Upon outmigrating from the freshwater environment, juvenile chinook salmon may reside in estuarine environments for extended periods of time where conditions are critical for early growth and survival (Simenstad 1997; Simenstad et al. 1985).

Numerous questions arise in considering the potential role of MDN for ocean-type chinook salmon populations. Whether newly emerged chinook salmon fry actively feed on salmon carcasses and eggs has not been established and further questions if carcasses are retained for a sufficient period of time, especially in large river systems with peak winter flow events. The immediate benefits of MDN for chinook salmon fry is most likely limited given the relatively short time juveniles reside in freshwater. However, the River Continuum Concept (Vannote et al. 1980) suggests that upstream inputs of MDN affect downstream communities. This concept questions nutrient dynamics and source-sink effects within a river basin.

Ultimately, the benefits of MDN for juvenile chinook salmon may be more fully realized in estuaries (Simenstad 1997). That said, in some instances the eutrophication of estuaries associated with agricultural and urban development may be negatively affecting fish habitat and survival (Bricker et al. 1999). Currently, little is known about the effects of salmon and MDN on estuaries.

At a watershed scale, the connectivity of nutrient cycles and the pathways involved needs further investigation. Such considerations question the relative importance and actual contribution of MDN from different species of spawning salmon. In many river systems throughout the Pacific Northwest, returns of chum and pink salmon comprise the majority of spawner biomass. These species typically spawn in the lower portion of stream and river systems. This implies that chum and pink salmon contribute substantial inputs of MDN to environments used by ocean-type juvenile chinook salmon. Whether survival of juvenile chinook salmon is limited by nutrient deficiencies needs to be evaluated in a multi-species context. Furthermore, the relative contribution by adult returns of different salmon species to both ecosystem function and salmon populations with unique life-history strategies needs to be more fully recognized.

In considering the importance of MDN to ecosystem function and sustaining salmon populations, the large returns of adult salmon runs recently experienced throughout the Pacific Northwest dictates that an experiment is now in-progress. The current scenario provides unique research opportunities to assess if marine nutrient inputs are limiting salmon populations. This will necessitate that isotope methods are further developed and tested (see Kline 2002) to properly reveal MDN in food-web dynamics. Assessment of watershed nutrient levels will be necessary to determine regional variation. Identification of bottlenecks in survival to salmon populations will require careful monitoring of population dynamics across fish life-stages. Long-term studies on a larger spatial scale need to be initiated before we can properly understand the contributions of salmon and MDN to ecosystem function. The multiple values associated with salmon necessitates that this understanding be further developed and integrated between numerous disciplines before ecosystem based escapement goals for Pacific salmon can be a realized and effective management approach.

Appendix E. Escapement Estimation

Introduction

Accurate estimates of chinook spawning escapement are essential to management of Puget Sound chinook stocks. They represent the most immediate post-season monitoring of stock abundance and are essential to subsequent forecasting and reconstruction of cohort strength. Total escapement is also an invaluable measure for survival and productivity measurements, which is important in developing escapement goals and recovery objectives. With the availability of other relevant data, abundance reconstruction enables the estimation of cohort survival (returns per spawner), which, in turn, is the basis for setting harvest exploitation rate objectives. It is appropriate, therefore, to scrutinize the survey and computation methods utilized to estimate escapement with respect to the accuracy and precision of the resulting estimates.

The listing of the Puget Sound chinook has created further determination to improve escapement estimates. However, it is important to realize that accurate and precise estimates of escapement come at a cost. Given the limits on staff and funding, along with logistic limitations, a careful triage is required to determine where existing deficiencies should be addressed. The co-managers' chinook harvest management plan includes a mandate to insure effective monitoring of the productive status of Puget Sound chinook stocks.

There has not been a formal Puget Sound-wide review of escapement estimation methods since Smith and Castle (1994). However, a summary of escapement methods is documented each year, concurrently with preseason forecasts. A critical assessment of escapements has been a major task of the Chinook Technical Committee (CTC) of the Pacific Salmon Commission, especially those populations used as indicator stocks. Concerns about Puget Sound estimates has focused on the following issues:

1) accuracy and precision of estimates of total or partial escapement (including the testing of inherent assumptions);
2) Natural Management Units lacking estimates of total escapement;
3) currency of escapement goals: females or PED, vs total;
4) straying – contribution of hatchery-origin adults;
5) accounting of natural returns to hatchery rack;
6) age composition of escapement.

This document summarizes current methods for estimating escapement and describes recent work intended to validate or improve escapement estimates.

Current Methods

Spawner surveys, with the intent of estimating abundance, are conducted in all waters where naturally sustainable populations exists (category 1 and 2 watersheds). In addition, some category 3 watersheds are also surveyed. There are two basic types of surveys—census and index. Census surveys are conducted where all fish (carcasses or redds) can be counted. This implies that all redds and/or fish are visible and all spawning areas can be viewed so that there is no expansion of the estimate to account for unsurveyed areas. In the case of a redd census, all redds must be visible and all spawning areas must be viewed. In some areas, a marked redd census is used, where redds are marked, usually with a colored stone, to avoid recounting the redd during subsequent surveys.

Weirs can also provide opportunity to census returning fish. However, weirs are generally associated with the collection of hatchery brood stock and not natural spawning populations. In cases where excess fish are passed upstream, fish can be counted directly. Other situations include Baker Dam, which has a trap-and-haul facility to pass fish over the dam, as does the Mud Mountain Dam (Buckley Trap) on the White River. On the Snohomish system, chinook are trapped and hauled over Sunset Falls. Although counting sites such as these may provide accurate estimates of fish passing a single point, estimates may not necessarily reflect of spawning success.

With watershed that are too large to survey their entire length, and/or all potential spawning sites, index areas are used to estimate total spawner abundance. These are selected (non-random) sites where chinook are likely to concentrate. Although index areas may represent only a portion of the watershed, they usually incorporate a significant component of the spawning population. Index areas can be used to estimate either fish (carcasses or live fish) and/or redds. Surveys are conducted periodically throughout the spawning period, and include such information as location, time, date, water conditions, number of redds, live and dead counts, along with collecting scales for age data. Counts are conduct on foot or by floating the index areas. In the case of redd counts, aerial surveys are often used either exclusively or in conjunction with ground surveys.

Once the counts are completed and data assimilated, the actual estimates are usually calculated using peak counts, cumulative counts or area-under-the-curve (AUC). Peak count estimates are simply the highest number of observations made within a specific time period, such as one day. Once that number is identified it is expanded to account for such factors as non-surveyed areas, fish per redds, visibility, etc. Cumulative counts involve enumerating observed fish and/or redds over a period of time, usually the spawning period, and summing the observations. This usually requires some sort of marking program to prevent recounting. A more sophisticated variation of this is AUC which accounts for the entire duration of fish presence, using specific observation dates that are compared to the total spawning duration. This produces a curve of the counts that has typically been constructed for either redds or fish. This method has been widely used by many previous management biologists for various northeast Pacific salmon (Ames and Phinney 1977, Bue et al. 1998, Hilborn et al. 1999, Hill 1997, Liao 1994, Smith and Castle 1994). In the case of redds, the left side of the curve, the last date before the first redd is formed defines the beginning of the curve (i.e. the last date with zero redds). Ground observation and interpolation may be needed to specify this date. Straight lines are typically used to connect each subsequent count of visible redds, although some researchers have attempted curvilinear fits (Ames 1984). On the right side of the curve, the first date where the count is judged to be zero (known or interpolated from ground observation) forms the end of the curve. The area-under-the-curve (AUC) is the sum of the areas between each subsequent count, beginning and ending with the zero count dates, a method known as trapezoidal approximation (Hahn 1998, Hahn et al. 2001, Hilborn et al. 1999, Hill 1997). Each segment AUC is simply the sum of the two adjacent counts divided by two then multiplied by the number of days between the count dates plus one (i.e. simply subtract the earlier date from the later date). The total AUC is the sum of the segment AUCs. For redds, the primary variables are redd-life (the duration of redd visibility) and fish per female (since it is the female that builds the redd).

Nearly all escapement estimates of Puget Sound chinook are translated into total escapement for the watershed. The systems where escapement estimates reflect only the index areas are North Lake Washington tributaries and Skokomish River. Within the Lake Washington system, counts at the Ballard Locks estimate annual returns, but do not account for fall-back or pre-spawning mortality. Ballard counts also cannot be used to estimate escapement to individual watersheds. Skokomish mainstem counts are used to provide relative comparisons with two tributaries (Hunter and Vance creeks), which are generally not surveyed.

Improving current methods

There are four basic ways that may potentially improve escapement estimates: 1) expand indices (area of surveys), 2) conduct more frequent surveys, 3) re-establish base years by calibrating expansion factors or total estimates by comparing it with alternate methods, or by 4) testing basic assumptions such as expansion factors, spawner density, redd life, fish per female, adults per redd, etc.

Parameters such as confidence intervals and standard deviations have generally not been applied with any significance to escapement estimates. Exceptions include some of the work funded through the Chinook Technical Committee (CTC) of the Pacific Salmon Commission, such as those conducted on the Stillaguamish, Snohomish and Green rivers. Attention has focused on gaining more confidence of some basic assumptions, such as redd life and fish per redd. In many large river systems in Puget Sound chinook escapement is assessed by making repeated counts of redds, plotting these counts against time, then calculating the total number of redds from the area under the curve. Each redd has been assumed to represent one female and 1.5 males in calculating escapement. Whether made by aerial, boat, or foot survey, redd counts are subject to errors associated with visibility, insufficient survey frequency, observer error, false redds, superimposition, and the inability of distinguishing chinook redds from pink salmon redds. Assumptions regarding redd life and sex composition have been based on a few supporting, mostly old, studies, with the standard assumption for redd life as 21 days (Ames and Phinney 1997 and Orrell 1976 and 1977). Because the cumulative effects of these sources of error have not been quantified, the accuracy and precision of the resulting estimates is unknown.

A recent study (Hahn et al. 2001) examined redd estimators, as applied to chinook escapement to the Skagit and Stillaguamish rivers, and reached the following conclusions:

- The accuracy and precision of redd census ranged from very good (C.V. 10 – 15%) to uncertain, depending on conditions in each stream or river. Aerial surveys (particularly helicopter) were accurate in some streams, and varied from foot or boat surveys in others. More frequent aerial surveys were believed necessary to accurately define the spawning curve in some systems.
- The secondary assumption that females build only one redd was generally supported by field observations, though the potential for multiple redds per female or false redds exists in certain streams.
- Estimates of sex composition based on carcass counts or gillnet test fisheries engender significant, but unquantified bias. Thus the assumption that 1.5 males per female was not validated. Males and small chinook are undersampled by carcass surveys and gillnet samples.
- Intensive foot surveys to mark and monitor redds found that redd life varied significantly from 21 days in some systems.
- Covariance between the area under the curve and redd density is presumed, but should be quantified.
- Mark / recapture methods for estimating escapement and its variance, such as have been employed in the North Fork Stillaguamish River and Green River in recent years, are affected by several factors that bias their result. The resulting estimates (Conrad 1993, 1994, 1995, 1996, 1997; Nason 1999) were substantially lower than concurrent redd count-based estimates, and were probably affected by unequal probability of capture, non-random mixing and loss of marked carcasses from the study reach. However, recent

studies on the Green River show mark and release estimates to be higher than the standard redd and carcass estimates (Hahn et al. 2000).

Redd census techniques employed successfully in large river systems are usually supplemented by carcass counts and/or redd surveys in tributaries where aerial census may be impossible. Estimates of total escapement for a given stock may therefore be composed of several techniques. Details for each management unit are summarized within each watershed section.

CTC funded studies have specifically been devoted to improving estimates. On the Skagit attempts have been made to compare the existing escapement estimates with a live mark-recapture estimate. The primary objective of the study was to estimate the drainage-wide escapement of chinook salmon returning to the Skagit basin and to evaluate the fishwheel and beach seine sites in the lower Skagit River for capturing adult chinook salmon. The study was conducted for two years (2000 and 2001), and it was determined that these two methods alone would not capture enough fish to generate a reliable mark-recapture estimate of escapement (Smith et al, 2002). For 2002, the primary objective remains as a mark-recapture study. However, the planned method of capture included tangle nets and angling. In addition, radio-telemetry was also planned to investigate the distribution and behavior of chinook after capture and release.

Another mark-recapture study has also been underway on the Green River for three years (2000, 2001 and 2002). Adults are captured with a beach seine and released, with subsequent recapture within the spawning areas. This study has proved more successful than the Skagit study in that the number of marks and recaptures has been high enough to provide credible estimates. Studies have also been conducted on the Stillaguamish and Snohomish river systems. Final reports for all years should be forthcoming shortly

Oregon has used similar methods in assessing their coastal fall chinook populations. Standard index areas have been chosen based on survey history as well as being a valid representative of spawning escapement. which is indexed as the peak count of live and dead fish observed in a given survey area. Because standard survey sites were not chosen from a randomized sampling design, spawner density estimates obtained from these sites are used only to provide relative abundance (Jacobs 2001).

However, for coho Oregon uses a different approach. A review of the Oregon Coast Naturals (OCN) spawning survey program by Oregon State University Department of Statistics led to the initiation of the OCN escapement methodology study in 1990. This study involved the development and experimental implementation of a stratified random sampling (SRS) approach, which consists of randomly selecting spawning survey sites from geographical strata and estimating spawner abundance from visual counts in these survey sites (ibid). This approach follows EPA's Environmental Monitoring and Assessment Program (EMAP), which is similar to that of the National Park monitoring. The basis of this program is to avoid bias through random selection of sampling units and to use a sampling design that estimates population attributes that can produce reliable, absolute values of population abundance.

Some discussion has been initiated regarding its use for Washington chinook. However, there are several major disadvantages in implementing this sort of method. Among the most critical would be that present index areas would no longer be used, thus making past data unusable for comparison purposes. Because chinook spawn in specific areas, a large number of sampling sites would be required to provide adequate observations, and there would likely be many samples with no observations. The cost of identifying new sites and their subsequent monitoring would be more expensive and require additional staff to carry out than with current methods.

In general, assumptions regarding uniform spawning density have not been tested. This assumption applies not only to waters outside index areas but also to different times. Chinook will spawn in different areas in different years, depending upon changing environmental conditions, run size, human factors, etc., and the use of a single constant, or expansion factor, may not provide accurate estimates or be comparable from year to year. Survey conditions can also change, making it more or less difficult in observing fish and redds. In problem areas, estimates can be improved by expanding index areas. However, it should be noted that, in terms of recovery assessment, annual trends are as important as the escapement numbers, and changing survey procedures may result in estimates that are not comparable to previous surveys. In such cases, the importance of accurate estimates versus precise trend information must be weighed.

One remedy is to incorporate supplemental areas, which are spawning sites that are not included as index areas. Another method is to survey the entire watershed where chinook spawn. This is only feasible in smaller rivers where access is available throughout the entire length of the watershed or, in larger rivers, by using aerial-redd surveys where conditions allow complete view of the river substrate.

In summary, escapement estimates can be improved, but it is unlikely that there are new methods that will replace the current ones. Actual improvement of any population estimate will likely have unique requirements specific to the watershed. Some watersheds, for example, are inherently difficult to survey regardless of available resources. However, before a decision is made to invest resources to further improve an estimate, it is importance to weigh the needed information and the status of the stock against the potential benefits and costs..

Refining escapement goals

Fixed escapement goals have been used as the performance standard for harvest management. However, they were merely averages of escapements for various years during the 1960s and 70s (Ames et al. 1977) and did not necessarily reflect habitat productivity nor maximum sustain yield, upon which harvest goals were based. Because of the need to closely monitor the performance of the annual harvest regime, harvest management plans now calls for developing exploitation rate objectives for as many management units as possible, based on current and potential productivity. Basically this requires estimating the productivity (stock:recruit) function for the populations and implies that harvest rates can be associated with an escapement range for a given watershed.

Nevertheless, the question of escapement objectives remains under consideration within at least three forums. The Technical Recovery Team, which is coordinated through NMFS, has defined a number of parameters necessary for recovery. Among them is abundance of natural-origin recruits, which is expected to include both ESU and specific watershed criteria. The Ecosystem Diagnosis Treatment (EDT) process has also developed an initial review of some Puget Sound watersheds and identified escapement ranges based on properly functioning conditions (Molbrand 2000, Anonymous 2002). Finally the Chinook Technical Committee has been involved with a review of escapement goals throughout Washington (Hahn et al. 2001). All of the above review sources have started releasing results, and it is expected that additional information will be forthcoming. It is expected that escapement objectives will change as new information, such as habitat productivity, stray rates and other hatchery/wild interactions, become available.

The need to estimate escapement accurately is not lessened under this exploitation rate management system since escapement abundance remains a primary measure of stock health. If the harvest regime operates as planned, and abundance is close to what is forecasted, the escapement should also conform to pre-season expectations. The co-managers are committed to assessing the performance of the harvest regime annually, and modifying fishery regulations as necessary to assure that exploitation rate objectives are met. Over the longer term, regular assessment of stock productivity, for which accurate assessment of survival and productivity is essential, will also modify the harvest objectives to insure that recovery will not be hindered.

Straying

Estimating the contribution of first-generation, hatchery-origin adults to natural spawning is essential to understanding the natural productivity of any chinook population. Natural productivity (i.e. survival) can only be estimated by distinguishing hatchery and natural-origin components of harvest and escapement. In most Puget Sound systems, hatchery production is directed towards harvest augmentation, whereas only a few programs are directed at recovery. The concern is that hatchery fish may intermingle and interbreed with natural-origin chinook, resulting in direct interactions, such as competition for food and space and/or indirect interactions such as reduced fitness due to genetic modifications. Various studies with salmonids species have reported potential genetic and behavioral hazards to natural production caused by the interactions with hatchery fish. (Ames et al. 1984; Fleming and Gross 1995; Pearson and Hopley 1999; Reisenbichler 19??; Chilcote 2002).

Hatchery-origin adults are usually distinguished by some identifying mark, either externally, such as a fin clip (which may signify that the fish also carries a coded-wire tag), or internally, such as an otolith mark. Double index tagging (DIT) programs, which are intended to estimate mortality in selective fisheries of unmarked fish, involve coded-wire tagging two equal-size groups of hatchery releases, only one of which is externally marked by an adipose clip.

Estimation of stray rates is made more certain if hatchery production is mass-marked, which allows spent adults or carcasses to be quickly examined. Where DIT programs exist, unmarked fish will pass through an electronic tag detector to recover CWTed fish. Studies in the Green River suggest that carcass sampling provides superior estimates of the contribution of hatchery fish to natural spawning as compared to sampling extreme terminal (freshwater) catch. In the case of otoliths marks, otoliths are dissected from a sample of unmarked carcasses to establish the presence of this mark group. Otolith marking has been used successfully to estimate the stray rates of Tulalip Hatchery fall chinook into adjacent watersheds (Rawson et al. 2001).

In the case of recovery programs, it is not desirable to mark hatchery fish since they are liable to be harvested during selective fisheries. However, an internal or external mark (other than an adipose clip) would still allow the ability to identify hatchery returns in the escapement. This has been the case for Nooksack and White River spring chinook as well as for Dungeness River chinook. Selective fishing for chinook has not yet been widely implemented by the Washington co-managers, but mass marking programs have been initiated not just in anticipation of future selective recreational fisheries, but as a way to better determine hatchery/wild interactions and stray rates. In turn this will help address the productivity characteristics of the watershed.

Age and sex composition

Estimating spawning escapement and cohort reconstruction require information on the age and sex composition of the return. Escapement estimates, as discussed above, rest on assumptions about the number of redds that each female builds, and pre-spawning mortality. Reconstruction of the cohorts comprising brood year abundance requires estimates of the age composition of annual returns. The age and sex of returning adult chinook may be determined by sampling terminal or extreme terminal (i.e. freshwater) fisheries, carcasses of spawned-out fish, or fish returning to hatcheries.

Terminal fisheries, carcass surveys, hatchery rack collections are all used to obtain samples. However, each of these sampling methods may engender bias into the result. Gillnet gear that is designed to target chinook is often selective of larger fish, and may not catch jack males. The catchability of each size class of chinook may also vary under different conditions of flow and turbidity in the river. Terminal fishing occurring in the bays adjacent to the river mouth can be equally selective, and may intercept significant numbers of fish destined to other systems. Hahn et al. (2001) concluded that larger sample sizes from terminal fisheries would improve estimates. Recreational catch may also be selective, but it may be logistically difficult to obtain large enough sample sizes. In addition, recreational fisheries may not operate across the entire migration period nor target within terminal areas.

Carcass sampling tends to undersample small fish and males, but studies differ in their conclusions in this regard (Conrad 1996; various studies cited in Hahn et al. 2001). The magnitude of true bias is usually unknown, because carcass retrieval can only be compared with other, possibly biased, samples, such as those from fisheries or hatchery racks. The fieldwork involved is labor and time intensive, and frequently complicated by high flow, turbidity, and debris. 'Carcass life' (i.e. the time window available to sampling) is often affected by predators removing carcasses before they can be sampled, and by fish moving or being swept out of the sampling area. Carcass weirs have not been employed in Puget Sound streams.

Hatchery racks allow sampling throughout the entire migration period, allowing scales or other samples can be collected at frequent intervals. However, hatchery returns may not be representative of wild populations, particularly where non-indigenous stocks have been used. For many wild stocks there is no associated hatchery program, precluding rack and brood stock sampling. These include the South Fork Nooksack springs, Skagit falls (though broodstock collection for a PSC Indicator Stock has begun), Lake Washington / Cedar, and Mid-Hood Canal rivers.

In general, sampling should:

- encompass the entire migration period.
- be representative of single stocks or populations;
- Be designed to achieve unbiased and statistically significant results
- be random but represent the population.

Methods currently used for each management unit

Smith and Castle (1994) documented escapement estimate methods within Puget Sound and the Straits of Juan de Fuca. In general, these methods continue to apply. However, for most watersheds, there are on-going efforts to maintain and improve spawner estimates. The following reflects the current methods as of 2002.

Hoko: (Ground surveys, redd census)
The Makah Tribe and WDFW conduct surveys using cumulative redd counts for the mainstem and tributaries found between river miles 1.5 to 21.7, which represents the entire range where chinook spawn in the Hoko basin. Redd counts are multiplied by 2.5 adults/redd. There are ten mainstem reaches plus 13 reaches within tributaries, which include the Little Hoko River, a tributary to the lower mainstem, and Browne's, Herman, N.F. Herman, Ellis, Bear and Cub Creeks, which are tributaries to the upper mainstem. The Makah Tribe also surveys the mainstem and other independent tributaries in the Sekiu basin, including Carpenter, S. Fork Carpenter, and Sunnybrook Creeks, and unnamed tributaries (WRIA 19.0215, 19.0216, and 19.0218). The escapement estimates for these two rivers are based on total natural escapement for the Hoko basin, plus broodstock capture, and total escapement in the Sekiu basin.

Elwha: (Ground surveys, redd census using AUC)
Spawning chinook are limited to the lower 4.8 river miles below the dam. The preferred method of estimating adult escapement, in the mainstem, is plotting visible redds versus date and calculating the area under the curve, resulting in redd-days, which are divided by the 21-day redd life. The resulting redd total is added to the number of redds counted by the Lower Elwha Tribe in the 1 mile, Hunt's Road side channel index. The total redd count is then multiplied by 2.5 adults/redd.

Dungeness: (Ground surveys, redd index counts)
Since 1986, cumulative redd count surveys have been conducted from RM 0 to 18.7 in the mainstem Dungeness and from RM 0 to 5.0 in the Gray Wolf mainstem. Counts are multiplied by 2.5 adults/redd. A captive brood program has been underway in this system since 1992, with the first releases from this production effort occurring in 1995. The various families and year classes are uniquely marked with cwt and otoliths. Hence surveys also sample for these items.

Nooksack, North Fork: (Ground surveys, carcass index counts)
The primary difficulty is the turbid conditions that usually exist in the north fork, making redd counts impossible. Estimates are cumulative carcass counts in established index areas in the north and middle forks. Total estimate is scaled to a single year when carcass and redd counts were visible throughout the duration of the spawning period. With the return of otoliths marked fish, their sampling has become routine. Recent changes to production goal at Kendall Hatchery has led to the elimination of the summer/fall release program and reduction in the release of native, spring stock. Past escapement estimates have been complicated by spawn timing overlap of native and introduced stocks.

Nooksack, South Fork: (Aerial and ground surveys, redd census)
There are at least three groups of chinook that can be identified as spawning in the South Fork: 1) South Fork natives, identified by DNA and lack of other distinguishing marks, 2) North Fork natives as strays from the Kendall Creek hatchery restoration program (otolith marks, CWT) or natural strays (DNA) and 3) Green River /Soos Creek chinook as strays originating from hatchery programs past and present (DNA, adipose clips and CWTs). A total chinook estimate is derived from redd surveys conducted on foot by teams of two, done weekly from the middle of August

until the first week in November in all sections of the river and in 2.6 miles of tributary streams. Redds are counted, and expanded by a factor of 2.5 chinook per redd (i.e. 1 female and 1.5 males per redd) to obtain a total estimate. Because of high flows late in the survey season, the confidence in the total estimate deteriorates. Native chinook are estimated from the numbers of redds detected prior to September 29. An initial estimate of the North Fork native chinook is calculated from the proportions of carcasses which can be identified by otolith mark, or CWT and fin clip as coming from the recovery program. This estimate is subtracted from the total early native chinook estimate to provide an estimate of the South Fork native chinook spawning population**.**

Samish: (Ground surveys, redd/carcass census)
This system is considered a Category 3 watershed, which, historically, did not possess as sustainable chinook population. However, large numbers of summer/fall chinook (introduced) fish are released from Samish Hatchery each year. As a result, natural spawning does occur in the river below the hatchery. In addition, fish surplus to hatchery needs are released above the hatchery. This stock is managed for harvest augmentation and is managed only for achieving hatchery brood needs. Estimates are made using peak visible redd counts, multiplied by 0.95 to estimate true redds and then by 2.5 fish per redd. If river conditions are not conducive for redd counts; carcass counts are made on weekly basis. Fish spawning above the hatchery are counted as they are passed upstream over the rack.

Skagit: (Mainstem-aerial surveys, redd index counts; tributaries-ground surveys, redd census and index counts)
The entire Skagit and known spawning areas in the Sauk and Cascade rivers have been surveyed by helicopter on either a weekly (odd years) or biweekly (even years) basis. During odd years, surveys are concentrated within the first half of the run with a straight line connecting the peak to the end of redd visibility. This is due to the large numbers of pink salmon spawning in the same location as chinook salmon. Earlier chinook spawners are located in the upper Sauk, Suiattle and Cascade rivers. Later spawners typically spawn in the mainstem Skagit, associated tributaries and the Sauk River.

For the earlier-timed chinook, data from 1994 to present is not comparable to previous escapement estimates. This is due to a new escapement methodology, using expanded cumulative redd counts, which is thought to represent the total spawner population better than the pre-1994 method using peak live plus dead counts. (Rebecca Bernard, Skagit System Co-op, personal communication).

Studied funded through the Chinook Technical Committee (CTC) has provided initial assessments of the validity of the current escapement estimates. Work conducted in 1998 and 1999 showed that the 21-day redd life was a valid assumption for Skagit chinook (Hahn et al. 1998) But work still remains in testing the 2.5 fish per redd. To accomplish this, and to establish as base year for future estimates, the basic plan was to proceed with a mark and recapture study, using a fish wheel to capture adult chinook. This fish wheel was used for two years without success (too few fish were captured). In 2002 attempts were be made to use a combination of collection methods including tangle nets, angling and radio-telemetry (CTC January 8, 2002).

Lower Skagit Mainstem fall**:** Data are total escapement estimates based on redd counts from the mainstem Skagit between the town of Sedro Woolley and the mouth of the Sauk River and in Finney and Day creeks. Three fixed wing aerial surveys are conducted from RM 15.6 to RM 67.1. There is a turbidity problem downstream of the Sauk, which questions the assumption of old surveys of 100% visibility. AUC estimates for three reaches using Sept 15 as start date on lower reach and Sept 1 for upper two reaches. End dates are December 1 for lower and middle reach and Nov 15 for upper reach. The old method used Sept 1 - Dec 1 for all reaches. Tributary census is conducted in Finney, Johnson, Jackson creeks.

Upper Skagit Mainstem/Tributaries :This stock was formerly known as Upper Skagit Mainstem/Tribs summer chinook. In the 2002 SaSI revision, the run-timing designation ("summer") has been dropped from most Puget Sound chinook stock names because timing designations have been applied inconsistently to Puget Sound chinook stocks. Total escapement estimates are based on redd counts from the mouth of the Sauk River to Newhalem, the lower Cascade River (RM 0.0 to 6.5) and in Illabot, Diobsud, Bacon, Falls and Goodell creeks. Surveys include three helicopter flights of upper mainstem, plus two helicopter flights and three ground surveys on the lower Cascade (RM 0.0 – 0.9), using Aug 15 to Nov 1 as AUC period (previous assumption has been Nov 8).

***Lower Sauk (fall*):** Total escapement estimates are based on redd counts from the mouth of the Sauk upstream to the town of Darrington (RM 0.0 to 21.1). Aerial counts below mouth of Suiattle are not conducted due to turbidity. This sediment concentration is believed to inhibit spawning downstream, and past estimates assumed 22% of redds occur below RM 13.2. However, a simulation based on 1996 flights suggested that the majority of fish spawn below RM 13.2. Three flights are made above confluence (RM 13.2 – 21.1 Darrington Br.), with foot surveys of Dan Creek slough, which is now part of the mainstem. The estimate is a redd census above RM 13.2 plus assumed number downstream plus tributary counts times 2.5 fish per female.

Upper Sauk spring: Total escapement estimate is based on redd counts from the town of Darrington up to the forks (RM 21.2 to 39.7), in the North Fork Sauk from the mouth upstream to the falls and in the South Fork Sauk from the mouth to about RM 2.5. A new escapement methodology was developed beginning in 1994, using expanded cumulative redd counts, which are thought to represent the total spawner population better than peak live-plus-dead counts. (Rebecca Bernard, Skagit System Co-op, personal communication). The new estimates are not comparable to the estimates in the 1992 SASSI.

Surveys include five helicopter surveys and six ground surveys to monitor redds and count carcasses. Foot 'census' is thought to underestimate numbers due to width and depth of some reaches, and the fact that foot counts consistently yield lower numbers than aerial counts. Aerial-based AUC determined endpoints of Aug 15 and Nov 1. Redd life arbitrarily assumed to be mean of values derived from foot survey (22.9 days) and back-calculation from aerial AUC (37.5 days) = 30.2 days. Total escapement is based on 2.5 fish per redd. Other samples have show different female to male ratios such as the lower river test fishery (1.65) and carcass surveys (1.42).

Suiattle: Total escapement estimates are based on redd counts in Big, Tenas, Straight, Circle, Buck, Lime, Downey, Sulphur, Milk creeks. As mentioned above, new escapement methodology was developed beginning in 1994. Prior to 1994 four index areas (Big, Tenas, Buck, Sulphur) were used, averaging peak live-plud-dead count/mile from these areas. Since 1994 cumulative redd counts have been used. Index areas now include Big, Buck (excluded summer strays – early Oct), Circle, Downey, Lime, Milk, Straight, Sulphur and Tenas creeks along with Whitechuck River. The estimate assumed no redds in the turbid portion of the mainstem. Of all systems in this study, Siuattle thought to have highest potential for multiple redds per female. However, the present estimate remains based on 1 female per redd, or 2.5 fish per redd.

Upper Cascade springs: Total escapement estimate for this stock is based on redd counts from the mainstem Cascade River above RM 7.8, the lower reaches of the north and south forks of the

Cascade, and in Marble, Found, Kindy, and Sonny Boy creeks. As with the other early stock, new escapement methodology was developed beginning in 1992. Data for the estimates originated from five surveys conducted on foot and two helicopter flights (RM 7.8 – 18.6). Redds are multiplied by 2.5 fish per redd.

Stillaguamish: (Ground and aerial surveys, redd census using AUC (NF) and peak counts (SF))

Smith and Castle 1994 mentioned that the Stillaguamish escapement estimate used the same method as Skagit (aerial survey calibrated by foot surveys of index reaches). One to three flights have been used, with assumed starting dates for redd visibility. Redd counts were summed at 21-day intervals to get cumulative total redds times 2.5 fish per redd. Studies began in 1998 to improve the accuracy and precision spawning estimates by testing redd life and the number of female per redd. Aerial surveys were increased as well as the foot surveys, and both were compared throughout the sampling period.

North Fork Stillaguamish summer: Escapement estimates are made using cumulative redd counts within the mainstem and North Fork derived by graphing visible redds versus survey date.Although there were some discrepancies between redd count on the foot versus floot surveys, Hahn (2001) concluded that the estimates of chinook redds and of female spawners were precise and accurate. Seventy-five percent of the redds were censused with surveys every three to five days; water remained low and clear during this time with little canopy overhang, and good estimates of redd life were made (20-day).

South Fork Stillaguamish fall Escapement estimates are based on peak redd counts multiplied by 2.5 fish/redd. Tributaries surveyed include Boulder, Squire and Jim creeks. Assumption include: zero redds below the confluence of the North and South forks, 2.5 fish per redd and 21-day redd life. Hahn et al. (2001) stated precision and accuracy of the fall chinook estimate was uncertain. The primary problem in the AUC method was due to the inability to measure redd life. Low redd density and poor visibility at times also attribute to this uncertainty.

Snohomish River: (Aerial and ground surveys, redd census using AUC; direct census for Sunset Falls, index on Sultan)

Skykomish This stock now includes Snohomish summer, Wallace Summer and Bridal Vail Creek fall chinook stocks as well as a portion of the Snohomish fall chinook stock. Spawning occurs throughout the mainstem Skykomish and Snohomish rivers, Wallace River, Bridal Vail Creek Sultan River, Elwell Creek and in the North and South Fork Skykomish including fish passed above Sunset Falls. Natural spawning also occurs in the Wallace River, but many of these spawners originate from the Wallace River Hatchery, located at the confluence of May Creek and Wallace River. Escapement estimates are derived using cumulative redd curves from aerial surveys in index area RM 20.5-49.6 on Skykomish mainstem and South Fork to Sunset Falls. Calculation uses 21-day intervals. Additional surveys are conducted on Wallace River using cumulative redd counts times 2.5 fish/redd and .95 (true redds). Estimate is based on mid-Sept visible redds / total escapement ratio in prior year. Added to this is the number of fish trucked above Sunset Falls.

Snoqualmie*:* The Snoqualmie stock is composed of Snohomish fall chinook, which spawn in the Snoqualmie River and its tributaries, including Tolt and Raging rivers and Tokul Creek. Spawning also takes place in Pilchuck and Sultan rivers. Spawn timing occurs from mid-September through October. Snoqualmie escapement is based on aerial survey of 10.1 miles of index out of 39.6 miles of river below Snoqualmie Falls, and calculated using area under the curve. Redd days are divided by 21-day redd life times 0.95 and 2.5 fish per redd. No expansion factor is used.

Both sets of estimates are intended to be total estimates although there are some small tributaries that are not surveyed nor included in the final estimate. However, it is considered to be less than five percent of the surveyed areas.

Cedar River: (Ground surveys, live counts using AUC)
Cedar River escapement is estimated using live counts, plotting counts versus survey dates and calculating the area under the curve. Counts are obtained from float surveys throughout the river length below the dam. Redds have been enumerated since 1999, and at some point redd counts may be used to produce escapement estimates.

North Tributaries: (Ground surveys, live counts in index areas using AUC):
Spawning ground index areas have been established in Bear and Cottage creeks. Since 1998 other portions of the Bear Creek watershed are also surveyed annually, but are not part of the index areas used for estimates. There is no expansion to unsurveyed areas in other north tributaries. Escapement for Bear and Cottage creeks is based on live counts and area under the curve methodology. The index areas are: Bear Ck--RM 1.3 to 8.8, Cottage Lake Ck.-- RM 0-2.3.

Issaquah Creek: (Ground surveys, carcass and live fish counts using AUC):
This watershed is not believed to have historically supported a sustainable population of chinook and is classified as a Category 3 system. Returns to Issaquah Creek are believed to be entirely the result of hatchery production. Many more fish return beyond brood stock needs and the surplus is allowed to spawn naturally. Escapement estimates on Issaquah Creek are calculated as the sum of the individual carcass counts plus the live count from the last survey. For the East Fork, the estimate is based on live counts and area under the curve methodology.

Green River: (Aerial and ground surveys, redd index counts)
There are a considerable number of hatchery fish released from this watershed each year, and, as a result, the proportion of hatchery strays among natural spawners is high. Based upon CWT recoveries from carcasses sampled on the spawning grounds, the estimated annual proportion of hatchery strays averages about 60 percent, and ranges from about 25 to over 90 percent of the total natural spawners.

The standard method used to estimate the annual natural spawning escapement in the system employs the use of a single 1.6 mile index reach (River Mile 41.4 to 43.0) where individual redds are counted and marked weekly by raft to obtain a season cumulative redd count. Concurrent weekly aerial counts of visible redds are made in all reaches (including the index reach) from RM 29.7 to 47.0. At the end of the spawning season, the highest (peak) weekly aerial count of visible redds in the index reach is compared to the cumulative total of redds in the index reach, and an adjustment factor is derived. The peak weekly aerial count from non-index reaches is adjusted by this factor, and an estimate of cumulative redds is obtained for the reaches surveyed only by air. This estimate, when combined with the cumulative redds in the index, yields the total estimated redds for the surveyed portion of the mainstem Green.

An expansion factor of 2.6 is then applied to the surveyed mainstem redds to estimate the total redds for the entire system, including tributaries. This expansion factor was derived by Ames and Phinney (1977) after comparing their estimates of escapement in the surveyed reaches in 1976 and 1977 to estimates of total escapement in the system obtained from independent mark-recapture studies conducted by the Muckleshoot Tribe and the U.S. Fish and Wildlife Service in those years. Total system redds are multiplied by 2.5 fish/redd to convert system redds to the escapement estimate of individual chinook.

Beginning in 1999, funding originating from the Pacific Salmon Commission has been directed at improving spawning estimates on the Green River. Objectives have included estimating population size using live mark and recapture, developing new redd index expansion, comparing area under the curve method, testing chinook redd visibility, estimating number and proportion of hatchery-origin chinook and age composition. This work continues through 2002.

Puyallup (fall): Ground surveys, cumulative redd counts (even years), AUC (odd years)

With the large hatchery releases into Puyallup River, it is likely that some unquantified proportion of natural spawning fish are hatchery origin. Thus the extent of natural sustainability is unknown. Puyallup basin hatchery chinook production is currently 100% adipose marked, which will help determine natural production levels and stock status.

Annual spawning ground surveys are reliable in the South Prairie Creek system (considered to be the most productive portion of the watershed) and in the mainstem tributaries, where fish and redds are observable. In other spawning areas (Puyallup mainstem and the Carbon River), glacial flour reduces visibility and prevents credible observation in most years. Historically, estimates were based on the 1975 and 1976 tagging studies, which used South Prairie Creek index peak live count multiplied by a factor of 37 to estimate total escapement. However, there has been a lack of confidence in this method, and beginning in 1999 estimates were calculated using a different method. This involved using South Prairie Creek cumulative redd counts during even years, while odd years would be based on area under the curve (AUC) using live counts. This difference was needed to adjust for the presence of pink salmon during odd years. Redd based estimates can also be calculated for the following Puyallup River tributaries: Fennel, Canyon, Kapowsin and Clarks creeks. In 2000, the tributary escapement ratio was applied to the mainstem Puyallup to estimate Year 2000 spawners. For the Carbon, in 1999 water conditions were conducive for good redd counts within some river reaches. Reaches with incomplete data were expanded using South Prairie Creek spawn timing-curve. In 2000, river conditions did not allow counts, and an indirect estimate of relative returns between 1999 and 2000 were used. Although this method is considered an improvement over the old method, escapement estimates previous to 1999 are not comparable to recent year estimates. .

White River Spring Chinook: (Trap census over dam, no estimate below dam)
Although there has been a significant increase in the number of chinook returning to the White River, it is largely due to the successful hatchery program. There is no evidence that the population has re-established itself naturally or achieved self-sustainability. Improvements have been made in the upper watershed related to habitat and fish passage, but those actions have not been necessarily credited with the increased abundance levels. There is also concern that the increased numbers of chinook are, at least partially, attributable to a fall stock that has become more predominate. Recent year spawning information shows that the fall run of chinook has increased in abundance. However there has been no estimate of total escapement. Those fish passed over the dam are counted, but fish spawning below the dam are not surveyed. However, chinook are enumerated in Boise Creek and the lower White River below Buckley Trap.

Nisqually: (Ground surveys, fish and redd index, peak counts)
Given that a large number of hatchery fish are released into this watershed, it is believed that a significant proportion of natural spawners are hatchery strays, but no direct information is

available to verify this. This system is difficult to survey since it is glacial fed. Abundance estimates are fair at best; stock origin information is poor.

Since 2000, all hatchery chinook have been marked, making it possible to determine the hatchery/wild composition of natural chinook spawners in the future. Spawning surveys are conducted on Nisqually mainstem from RM 21.8 to 26.2 and on Mashel from RM 0 to 3.2 to obtain peak redd count on the Nisqually and peak fish count of the Mashel. An expansion factor of 2.5 is used for the Nisqually relative to the Mashel, followed by a 6.82 expansion for both systems. Ohop Creek (RM 4.6-6.3) has also been surveyed for cumulative redd counts and carcass sampling the last two years (2001 and 2002).

Skokomish: (Ground counts, fish and cumulative redd counts in index areas)
As described in the current co-managers' Puget Sound Comprehensive Chinook Management Plan, the immediate and short-term objective is to manage Skokomish River chinook salmon as a composite population, comprised of naturally and artificially produced chinook. Hence, natural production is dependent on the chinook hatchery program to partly support natural production. Based on the sampling of adult chinook carcasses on the natural spawning grounds, chinook released from the George Adams Hatchery on Purdy Creek or from Endicott Ponds on the lower Skokomish River stray in substantial numbers onto Skokomish system natural spawning areas. Hatchery chinook releases are not currently mass-marked, but they are now double-index tag groups. In addition, genetic (allozyme) analysis results to date suggest that there is no significant genetic differentiation between Skokomish natural spawners and George Adams hatchery chinook (A. Marshall, WDFW memo dated May 31, 2000).

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 12.7), and South Fork (R.M. 0 to 2.2). In addition, escapement estimates are made for tributaries including Purdy Creek, Vance Creek, and Hunter Creek.

Since 1991, live and dead adults, along with visible redds were counted in Skokomish River index areas using foot and raft surveys (Smith and Castle 1994). Surveys were done every 10 to 14 days from late August through October. In one index area of the Skokomish (RM 8 to 9), new redds were flagged and visible redds were counted each survey, cumulative redds for the season was determined, and escapement for this index was estimated as cumulative redds times 2.5 adults/redd. For each remaining section, the peak count of visible redds in a section was multiplied by the ratio in the RM 8 to 9 index of cumulative redds :: number of visible redds at peak which was then multiplied by 2.5 adults/redd to estimate escapement for a section.

Since 1991, escapements to Hunter Creek and Vance Creek were estimated using the spawners/mile for RM 0.8 to 2.2 in the South Fork and the available habitat in each creek (i.e., 1.7 miles for Hunter Creek and 0.5 miles for Vance Creek). Escapements to Purdy Creek were based on the counts of live chinook downstream of George Adams Hatchery (Smith and Castle 1994).

To improve escapement estimates, (1) surveys were scheduled every 7 to 10 days beginning in 1998, (2) new redds and visible redds were counted each survey in more sections of the mainstem Skokomish (RM 5.3 to 6.3, 6.3 to 8, and 8 to 9) and South Fork (RM 0 to 2.2) beginning in 2000, (3) a helicopter flight was made most seasons during peak spawning to count redds and adult chinook in the South Fork upstream of RM 2.2, and (4) foot surveys were made in Hunter and Vance creeks to spot check chinook abundance and better determine escapement there.

Coded-wire tag (CWT) data and age and sex composition data have been routinely collected for chinook returning to George Adams Hatchery. More intensive sampling has been done since 1998 on the natural spawning grounds; however, more frequent sampling would improve sample sizes. The mass marking of chinook released from the hatcheries would improve the ability to determine both the level of straying by hatchery chinook and natural chinook productivity in the Skokomish River system.

Mid-Hood Canal: (Ground surveys, live peak fish counts in index areas)
The Mid Hood Canal management unit is comprised of chinook populations of the Hamma Hamma, Duckabush, and Dosewallips watersheds. All of these populations are at low abundance. As described in Smith and Castle (1994), chinook escapement for the Hamma Hamma, Duckabush and Dosewallips rivers was estimated as (peak count of live fish in each stream) x (escapement for Skokomish RM 8-9 index / peak live count for Skokomish RM 8-9 index) x (available habitat / surveyed habitat in each stream). This method was used since few chinook adults or redds were counted and chinook spawner surveys were limited to the lower reaches of each stream.

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

In the Dosewallips and Duckabush rivers, the reaches surveyed are spawning and transit areas, but do not include all spawning areas. Upper reaches have been occasionally surveyed in the Dosewallips and Duckabush since 1998, but few adults have been observed. It has been possible to count chinook redds in the upper Dosewallips and Duckabush river reaches (especially in years without pink salmon). However, counts of live chinook are conducted on in the lower reaches since chinook redds cannot be identified due to concurrent spawning of summer chum salmon. Current escapement estimates are derived from counts of live chinook adults and chinook redds.

It has been assumed that many of the naturally-spawning chinook in the Hamma Hamma, Duckabush, and Dosewallips rivers have, in recent years, been due to straying of hatchery spawners as well as adult returns from hatchery fry released into these rivers. However, sampling for CWTs and age information indicate that few hatchery adults have been recovered. The mass marking of chinook released from the hatcheries would improve the ability to determine both the level of straying by hatchery chinook and natural chinook productivity in these rivers. In addition, a smolt trap was installed on the Hamma Hamma River in 2002 with one objective being to assess natural chinook productivity.

Priorities for Improving Escapement Estimation

To identify priorities for improving escapement estimates, recovery goals and objectives must be clearly stated. The basic template should refer to the ESU as a whole rather than individual stocks. Since recovery can represent any number of different outcomes, the process must be iterative and based on the outcomes of strategies that may be experimental. However, regardless of the specific results, the basic guidelines of a healthy ESU can be stated.

Populations have been classified according to the historical presence of chinook and the present status of native (indigenous) stocks. Category 1 watersheds are those that possess indigenous stocks; Category 2 are those that once possessed sustainable indigenous chinook populations but they have either been lost or no longer sustainable; Category 3 watersheds are those that historically never possessed sustainable populations of chinook.

Category 1 watersheds would be of high priority, as would those in Category 2. Within the first category, highest priority would go to those stocks that are at critical abundance levels and where escapement estimates are considered unreliable (imprecise and inaccurate). Perhaps the single stock that best fits this would be the South Fork Nooksack stock. Another concern would be White River spring chinook. Both of these populations have been recently infiltrated with other stocks, which is causing some concern regarding genetic integrity in the direction of recovery. Cedar River chinook is another population that needs close scrutiny. Although the escapement greatly improved in 2001, previous years returns were in dramatic decline, with the 2000 estimate of 120 adults. For other systems like the Skagit, Stillaguamish and Snohomish, as mentioned, additional studies have been underway to test some of the major assumptions, and it is believed that this will improve accuracy and precision of current methods. In the Green River , a mark and recapture estimation method has provided significantly different results than the traditional method. Analysis of the differing escapement estimates for 2001 and 2002 will help determine the method used in future An important component on the Green is determining stray rates. Since all hatchery fish are now been marked before release, the estimation natural-origin recruits and habitat productivity will improve.

As important as accurate escapement estimates is the need to identify hatchery stray from natural-origin recruits. This is especially true for Category 2 watersheds where past management direction has focused on hatchery production at the expense of natural sustainability. For Nisqually and Puyallup chinook, marking of hatchery fish and subsequent evaluation of natural production must be maintained as an important objective. One difficulty common to both of these systems is inability to survey mainstem spawning reaches because of glacial turbidity. Experimental application of the “change in ratio” method, which estimates total natural escapement and the proportion of natural-orogin adults, began in 2001

Past management for Skokomish River has also been hatchery-oriented, and to date there has been no attempt to determine stray rates and natural productivity. It would also be useful to test the assumptions for Vance and Hunter creeks, which are estimated indirectly. A production study on the Hamma Hamma is currently underway that involves intensive spawner surveys as well as smolt out-migration

Appendix F. Selective Effects of Fishing

Introduction

The direct juvenescence or 'fishing-down' effect (shift toward younger ages and smaller fish) that must result from size-selective fishery harvest has been recognized for nearly 100 years (see Ricker's (1975, p. 260) discussion of Baranov's 1918 paper). But it seems only very recently that the possible genetic impacts of selective fisheries on fish populations have generated widespread concern among fishery scientists and ecologists. For example, Conover and Munch (2002) published a highly visible article noting that "current models and management plans for sustainable yield ignore the Darwinian consequences of selective harvest." In a similar vein, in the leading European quantitative fisheries journal, Law (2000) noted that "Fisheries managers should be alert to the evolutionary changes caused by fishing, because such changes are likely to be hard to reverse ...." Although this general concern may appear to be very recent, astute fisheries scientists have long speculated concerning the possible genetic impacts of selective fisheries on chinook salmon populations. Indeed, nearly 100 years ago Rutter (1904) expressed concern that gillnet fisheries in California's Sacramento River, selective for larger and older chinook salmon, might generate long-term selection toward age two male jacks and small adults due to selection against survival and reproduction of larger and older adults. More recently, but still a full thirty years before the recent Conover and Munch paper, Ricker (1980, 1981) published extremely provocative reports concerning the possibility that size-selective fisheries on chinook salmon might, in the long-term, result in age composition of chinook salmon populations that would be composed almost exclusively by age 2 male jacks and age 3 adult females. Thus, it is accurate to state that the potential long-term consequences of selective fisheries on chinook salmon have been recognized for almost 100 years. Yet, it is also accurate to state that fishery management plans have not yet attempted to address these potential long-term consequences. In part this is because much of the evidence for selective effects of fishing (e.g., change in the size or age composition of catch or spawners) is circumstantial, and is strongly influenced by other factors such as marine productivity.

Selective Fisheries

It is important to define more explicitly and carefully a number of terms and concepts. In particular, it is critical to define carefully just what one means by "selective fishing", to distinguish among the kinds of selective fishing to which chinook salmon populations may be exposed, and finally to distinguish between the rather immediate and direct fishing-down consequences of selective fishing and the potential long-term genetic consequences of selective fishing.

Generally, a fishery is characterized as selective whenever different components of a population of fish are exploited at different rates in recreational or commercial fisheries. Traditionally, most fisheries have been sex-selective (e.g., only males may be harvested in the commercial fishery for Dungeness crabs, Cancer magister) and/or size-selective (e.g., groundfish fisheries in which regulated codend mesh size theoretically allows small fish to escape whereas large fish are trapped in the codend; or the minimum size limit for male Dungeness crabs). In fisheries for chinook salmon, there are no sex-selective fisheries of which we are aware, but most fisheries are size-selective. For example, ocean commercial and recreational fisheries typically have minimum size limits, thereby generating greater exploitation rates on larger and older fish than on younger and smaller fish. Terminal gillnet fisheries typically select for fish that are within an intermediate size range that usually dominates runs. Often, such terminal gillnet selection is almost *"age-selective"* fishing. For example, in California's Klamath River the Native American gillnet fishery uses a mesh size that deliberately targets age 4 fish; most age 3 and younger fish pass through nets whereas many age 5 fish are too large to be caught by gill nets.

The above examples of selective fisheries apply within individuals populations of fish. Other types of selective fisheries operate in the peculiar context of ocean and freshwater fisheries for salmon. First, in both ocean and terminal fisheries, salmon managers must grapple with the so-called "mixed stock" harvest problem (see, e.g., Bevan 1987). In the ocean, a large number of salmon stocks originating from different river basins may be vulnerable to fishing at similar times and locations and may therefore suffer similar ocean exploitation rates. Optimal harvest policies would instead call for application of *stock-specific* exploitation rates that depend on the underlying stock productivity which, of course, must vary among salmon stocks. For a variety of reasons, the time, location or physical attributes of fish that may be caught in ocean fisheries may be deliberately structured so as to be *stock-selective*. For example, ocean fisheries off California and Oregon are structured so that the overall ocean exploitation rate on Klamath River fall chinook is quite low (to allow for terminal harvest in recreational and Indian fisheries), whereas ocean exploitation rates for chinook salmon originating from the Sacramento River (with no Indian terminal fisheries) are much higher. Mixed-stock fisheries are often constrained so that the exploitation rate appropriate to commingled weak stocks is not exceeded.

Similar, but often unintentional, *stock-selective* fisheries may take place in freshwater as a consequence of regulations. For example, in a large river system with a large number of distinct chinook salmon stocks, each with its own distinct river entry pattern, open and closed periods for fisheries may result in differential exploitation rates being applied to different stocks. If harvest in not allowed until a substantial number of fish have escaped to spawn, then it seems inevitable that exploitation rates are lower for those stocks that enter earlier as compared to those stocks that enter when fisheries are open. The most extreme examples of stock-selective fisheries for chinook salmon are those that call for the release of all fish with adipose fins present clips, whereas a certain number of fish (specified by bag or possession limits) may be retained so long as adipose fins are not present. These policies are deliberately designed to produce, at least in theory, greater exploitation rates for hatchery fish (often marked) than for wild fish (typically unmarked). Finally, ocean fisheries may also be *species-selective* as, for example, results when coho salmon must be released if caught whereas chinook salmon may be retained.

The "fishing-down" process and long-term genetic selection

The "theory of a fishery", as first advanced by Baranov (1918; see Ricker 1978), recognized *fi*shing-down as an inevitable consequence of size-selective fishing when only fish above a certain minimum size limit were legal targets of exploitation. The direct cumulative effect of removing larger and older fish is to shift the age structure of a fish population toward younger and smaller fish. Although these historical results were obtained for typical iteroparous (repeat spawning) teleost fish, similar results obtain for a semelparous (single spawning) chinook salmon population subjected to a size-selective ocean fishery (Hankin and Healey 1986). In classical fisheries population models, growth rates of fish are fixed and independent of population density, and fishing down-effects are therefore predictable and reversible. The extent to which genotypes of a populations are changed by selective fishing must be related to the harvest rates imposed by these fisheries and their duration. If selective fishing were eliminated, then one would expect the age and size structure of a population to return to exactly the state that existed prior to introduction of size-selective fishing. (Possible to make a general statement that selective effect is dependent on the harvest or exploitation rate, so that reducing the rate would reduce the effect?)

Concerns regarding the potential genetic impact of fishing have arisen in part because minimum size limits theoretically result in differential exploitation rates being applied to *fast-growing* as opposed to *slow-growing* fish. If growth rates of fish were genetically inherited and if realized size at age were highly correlated with genetically inherited growth rates, then the greater mortality on fast-growing fish and resulting dominance of slow-growing fish among spawners would, over the long-term, result in selection for slow-growing fish.. If such fishery-induced genetic changes took place, then a population would not return to its original state if fishing were eliminated entirely. Instead, if fishing were relaxed or eliminated slow-growing fish could become the norm. Exactly this kind of selective fishery result was documented, under a controlled laboratory setting, in *Menidia menidia* by Conover and Munch (2002). These laboratory results may or may not be relevant to "real" fish populations and fisheries, however.

Long-term genetic changes due to selective fisheries

Size-Selective Fisheries.

In ocean fisheries for chinook salmon, minimum commercial size limits typically mean that only a fraction of the age 3 adults from a given stock are vulnerable to commercial capture. If those age 3 fish that are above the legal size limit were genetically programmed "fast-growing" fish, then one might imagine that selective fisheries would be generating long-term selection for reduced growth rates, as described above.

Possible fishery-induced selection for reduced growth rates would, however, be complicated by several factors in chinook salmon fisheries. First, the actual size that a salmon reaches at a particular age may not be highly correlated with a genetically determined "growth rate" for several reasons. The realized size of a fish at a given age must reflect unknown interactions between inherent growth rate, variability in supply and quality of food, and variability in environment (especially variability in water temperature). Actual size at age may not, in general, be highly correlated with some underlying "growth rate"

Second, long-term genetic selection due to size-selective ocean fisheries may be stronger for (reduced) age at maturity than for growth rate. As shown by Hankin et al. (1993) and others, age at maturity is an inherited trait in chinook salmon. Generally, older aged parents will produce progeny that mature at older ages, whereas younger aged parents will produce progeny that mature at younger ages. This kind of effect is especially pronounced for age 2 males (jacks). If jacks are used as parents, there will be a strong tendency for male progeny to also mature as jacks. Therefore, if younger aged salmon spawned randomly on the spawning grounds, then size-selective fisheries for chinook might select for earlier age at maturity.

Third, for chinook salmon (see Hankin 1993 and references therein) there is substantial evidence that age at maturity depend in part on size at age. For a fixed age, say age 2, fish that are smaller are less likely to mature at that age than are fish that are larger. Through this interaction between size at age and maturity, size-selective fisheries, through removal of fish that are larger at age, might instead select for fish that mature at later ages!.

Finally, spawning behavior of chinook salmon may to some extent alleviate the kind of long-term genetic shift toward younger age at maturity that might be expected to result from size-selective fisheries. Baxter (1991) found that larger and older chinook salmon, especially males, enjoyed greater reproductive success on spawning grounds that younger and smaller males. Thus, even if size-selective fisheries generated substantial shifts toward younger aged spawners, this kind of size-dependent mating success might at least partially buffer against such fishery-induced shifts to younger ages.

Ricker (1976) and Henry (1972) calculated the loss in potential yield that results from size-selective ocean fishery capture of immature and maturing chinook salmon as compared to terminal fishery capture of mature fish only. Calculated losses range from 30-50% of total yield. In two important reports, Ricker (1980, 1981) examined changes in average size of chinook salmon (and other Pacific salmon species) and presented a number of plausible hypotheses that might explain the apparent decline in average size of harvested chinook salmon. Included among these hypotheses was the possibility that size-selective fisheries had selected for long-term genetic changes in age at maturity. Hankin and Healey (1986) presented analysis of an age-structured Ricker stock-recruitment model and, among other things, attempted to calculate the maximum possible changes in mean age of spawning populations that could be explained as a direct consequence of *fishing-down* effects. They contrasted these calculated values with observed changes in mean ages in some populations. Hard (in press) used age-structured quantitative genetics models to assess the possible long-term genetic effects of size-selective fishing on chinook salmon populations

Stock-Selective Fisheries.

There seems little doubt that certain stock-selective fisheries must have long-term genetic effects on chinook salmon populations. Suppose, for example, that a terminal fishery were regulated by allowing harvest to take place only after a certain number of fish were estimated to have escaped to spawn. In that case, the fishery-related mortality rate would be much less for fish (or stock type) in the early part of the run than for fish (or stock type) in the late part of the run. Because run timing (stock type) is known to be an inherited trait, such fishery harvest policy should, in the long-term, unintentionally select for early-returning fish (or for a particular stock type). (See Nicholas and Hankin 1988 for examples of this phenomenon in a hatchery setting.)

Lawson and Sampson (1986) examined the potential impacts of stock-selective ocean fisheries on non-catch mortalities of species (e.g., coho vs chinook) or stock types (e.g., hatchery vs wild) that may not be landed in stock-selective fisheries. Such prohibited species or stock types would be captured but then released. Ricker (1958) presented modeling results showing that total yields in mixed stock ocean fisheries were considerably less than those that could be achieved if stocks could be managed and harvested separately. (This same theme was later noted by Hilborn (1985).
Evidence for Inheritance of Traits

Donaldson and Menasveta (1961) provide evidence that growth rate, survival rate, disease resistance and temperature tolerance are all traits which are subject to deliberate artificial selection in a hatchery setting. Ricker (1972) provides an extensive review of older studies that provide evidence that age at maturity and other traits are inherited trait, but also presents information on environmental influences on these same traits. By contrasting the rates of production of jacks in two chinook salmon stocks reared in a hatchery environment under controlled conditions, Hard et al. (1985) provide evidence that the tendency to produce age 2 male jacks is an inherited trait. Hankin et al. (1993) summarize evidence that age at maturity (all ages) is an inherited trait based on age-specific mating experiments carried out at Oregon's Elk River Hatchery. These analyses attempt to account for the fishery-induced biases that might result from differential mortality on older-maturing as compared to younger-maturing fish. Both Hankin (1993) and Hard et al. (1985) provide evidence that jacking rate does not depend on growth rate alone, but size nevertheless has an important effect (Hankin 1993, Silverstein et al. 1998), with faster-growing fish (at age) generally maturing earlier. If growth rates are sufficiently enhanced in hatchery environments, then mature yearling chinook can apparently be produced (Clark and Blackbird 1994). Heath et al. (1994a) carried out known matings designed to assess inheritance of jacking rate with male parents that were jacks or non-jacks. They found a significant sire age effect, but did not find that jacking was related to growth rate. Heath et al. (1994b) used DNA probes to show that allele distributions differed between maturing and immature chinook salmon of the same age and stock. Heath et al. (1999) presented experimental evidence for a maternal effect (via female egg size) on offspring size during early life (first several months, but thereafter no effect could be detected.

Behavior and Life History

Numerous papers have stressed the possible importance of large size in naturally spawning populations of chinook salmon. Baxter (1991) observed spawning behavior of fall chinook salmon in northern California and found that larger-sized males enjoyed much greater spawning success than smaller-sized males. Females exhibited behaviors suggesting their preference for mates that exceeded their size. Berejikian et al. (2000) found that there was a greater amount of time between successive nests for females paired with small males than with large males and suggested that this behavior might be an important means of achieving mate choice (i.e., finding a preferred larger-sized male. Healey and Heard (1984) examined variation in fecundity of chinook salmon among many chinook populations. Using life history models, they found that age-specific increases in fecundity would not "justify" the old ages at which many chinook salmon spawn. Presumably, there are some additional important benefits of large size and late age at maturation.

Egg size of chinook salmon varies across populations and within populations. Within a given population, egg sizes are generally larger for larger and older fish than for smaller and younger fish. Silver stein and Hershberger (1992) found that females with larger egg sizes were more likely to produce progeny that matured precociously. Healey (2001) reported that stream type chinook salmon, that typically spend more than a full year in freshwater prior to ocean entry, have smaller eggs and generally make a smaller reproductive investment than do ocean type chinook salmon, that typically enter saltwater during their first year of life.

Detecting Selective Effects of Fishing

Ricker (1980, 1981), previously mentioned, presented evidence for declines in average size and age of Pacific salmon, including chinook salmon, and listed a number of possible explanations for these declines. More recently, Bigler et al. (1996) found a decreasing average body size in 45 of 47 salmon populations in the Northern Pacific. They found that body size was inversely related to population abundance and speculated that enhancement programs during the 1980s and 1990s have increased population sizes but reduced growth rates due to competition for food in the ocean. Clearly, these kinds of causes could result in the same kinds of reductions in size at age as might be caused by long-term genetic selection against fast-growing fish.

There is substantial cause for concern regarding long-term genetic effects of both stock-selective and size-selective fishing on chinook salmon stocks. Of these two kinds of selective fisheries, the effects of stock-selective fisheries seem most clear and most easily minimized. If terminal fisheries consistently result in substantial removal of specific temporal components of a stock's spawning run, then it seems inevitable that there will be strong selection against perpetuation of these temporal components. This kind of effect would seem avoidable by regulating open and closed terminal fishing periods so that continuous fishing periods are always short (say, no more than 3 days duration), and so that the duration of fishing periods is always short compared to the duration of closed periods. Terminal net fisheries in Puget Sound are scheduled in this manner – pulsed openings scheduled over the duration of the run.

It seems clear that size-selective ocean fishing on immature chinook salmon can shift the age distribution of adult spawners toward smaller and younger fish. A long-term genetic shift to younger aged spawners would result (1) *If* chinook salmon mated randomly, without regard to age, on spawning grounds, and (2) *if* age at maturity were independent of growth rate. However, (3) larger and older male chinook salmon (and possibly females) generally have greater mating success than smaller and younger male chinook salmon (and possibly females); (4) fast-growing chinook salmon tend to mature at younger ages than slow-growing chinook salmon, but are selected *against* in size-selective ocean fisheries; and (5) size at age may have only a weak correlation with some inherent genetically inherited "growth rate". Together, items (3)-(5) may reverse or ameliorate the kinds of long-term genetic effects that one might expect if items (1) and (2) were valid. Most of these potential long-term genetic effects again seem avoidable. If ocean fishing for chinook salmon were prohibited by regulation (see Ricker 1976 for one example calculation of the improved yield that could result!), and if all sizes and ages of chinook salmon were equally vulnerable to terminal fisheries (e.g., by fishing gill nets of variable mesh sizes in Indian fisheries), then it would seem unlikely to expect any long-term genetic changes in age at maturity of chinook salmon stocks.

The absence of explicit consideration of possible long-term genetic impacts of selective fishing in management plans for chinook salmon stocks probably reflects the ambiguity and complexity of potential impacts for this species. No chinook salmon stocks have yet been reduced to the extreme scenario (only jacks and age 3 females) sketched by Ricker (1980, 1981), but it is also certainly true that one would be hard-pressed to find a stock of chinook salmon for which one might claim that the largest fish seen today are as large as those seen 100 years ago. Of course, given classical fishing-down effect that results from ocean fisheries, one would not expect to see these large fish even if there were no long-term genetic changes in age or size at maturity.

2004-5 State/Tribal Agreed-to Fisheries Document
(May 1, 2004 – April 30, 2005)

I. Treaty/Non-Treaty Ocean Fisheries (FRAM #0419 & #1604)

Treaty Troll Quota	49,000 chinook; 75,000 coho
Non-Treaty TAC	89,000 chinook; 270,000 coho
NT Troll TAC	44,500 chinook; selective fishery impacts associated with a landed catch of 67,500 marked hatchery coho
Recreational TAC	44,500 chinook and selective fishery impacts associated with a landed catch of 202,500 marked hatchery coho

TREATY TROLL

Areas 2, 3, 4 & 4B

5/1-6/30 Chinook directed fishery with sub quota of 22,500 chinook;

7/1-9/15 All salmon species with sub quota of 26,500 chinook or quota of 75,000 coho; chum release 8/1-9/30.

NON-TREATY TROLL

U.S./Canada border to Cape Falcon

5/1-6/30 All salmon except coho with 29,800 chinook quota; the fishery will be managed to provide remaining quota of 500 chinook for a June 26-30 open period with a 50 fish per vessel landing limit for the 5-day open period. Columbia and Cape Flattery Control Zones closed. Trip limits, gear restrictions, and guidelines may be implemented or adjusted in-season. Vessels must land and offload their fish within 24 hours of any closure of this fishery and within the area or in Garibaldi. State regulations require that Oregon licensed limited fish sellers and fishers intending to transport and deliver their catch outside the area notify Oregon Department of Fish and Wildlife one hour prior to transport away from the port.

<u>U.S.-Canada Border to Cape Falcon</u>

July 8 thru earliest of Sept. 15 or preseason chinook subquota of 14,700 or coho quota of 67,500. The 67,500 coho quota includes a subarea quota of 8,000 coho for the area between the U.S.-Canada border and the Queets River. All salmon except no chum retention north of Cape Alava during August and September (all retained coho must have a healed adipose fin clip, except an in-season conference call may occur to consider allowing retention of all legal sized coho between Cape Falcon and the Queets River no earlier than September 1). Fishery is open Thursday through Sunday prior to August 11, and Wednesday through Sunday thereafter. Landing and possession limit of 125 chinook per vessel per 5-day open period prior to August 11. An in-season conference call may occur no later than August 10 to consider reducing the landing and possession limit beginning August 11. Columbia and Cape Flattery Control Zones closed. Trip limits, gear restrictions, and guidelines may be implemented or adjusted in-season. Vessels must land their fish within 24 hours of any closure of this fishery and within the area or in Garibaldi. State regulations require that Oregon licensed limited fish sellers and fishers intending to transport and deliver their catch outside the area notify Oregon Department of Fish and Wildlife one hour prior to transport away from the port.

NON-TREATY RECREATIONAL

<u>Area 1</u>: Leadbetter Point to Cape Falcon (Oregon)

6/27-9/30 (101,250 coho sub quota) Open Sunday-Thursday except there may be a conference call in-season no later than July 28 to consider opening 7 days per week; 2 fish per day, only one of which may be a chinook; retained coho must have a healed adipose fin clip; chinook minimum size limit 26 inches; chinook guideline: 8,000; closed in Columbia Control Zone; closed between Cape Falcon and Tillamook Head beginning Aug 1.

Buoy 10

8/1-8/15 Open 7 days/week; 2 fish per day, only one of which may be a chinook; retained coho must have a healed adipose fin clip; release sockeye and chum, and unmarked coho. Barbed hooks allowed.

8/16-9/30 Open 7 days/week; 2 fish per day, only one of which may be a chinook; retained coho must have a healed adipose fin clip; release sockeye and chum, and unmarked coho. Barbed hooks allowed.

10/1-12/31 Open 7 days/week; 6 fish per day, 2 adults, only one of which may be a chinook; retained coho must have a healed adipose fin clip; release sockeye, chum, and unmarked coho. Barbed hooks allowed.

1/1/04-3/31/05 Open 7 days/week; 6 fish per day, 2 adults; retained chinook must have a healed adipose fin clip; release sockeye, chum, unmarked coho and unmarked chinook. Barbed hooks allowed.

North Jetty

Open 7 days per week when Area 1 or Buoy 10 area is open. When Buoy 10 area and Area 1 are open concurrently, the daily limit and minimum size restrictions follow the most liberal regulations of those areas. Barbed hooks allowed.

Area 2: Queets River to Leadbetter Point

6/27-9/19 (74,900 coho sub quota) Open Sun-Thur except there may be a conference call in-season no later than July 28 to consider opening 7 days per week; 2 fish per day, only one of which may be a chinook; retained coho must have a healed adipose fin clip; chinook minimum size limit 26 inches; chinook guideline: 30,800.

Area 2-1 (east of a line from Leadbetter Point to Cape Shoalwater): Willapa Bay

6/27-8/15 Open concurrent with Area 2, when Area 2 is open for salmon. Area 2 rules apply.

8/16-1/31/05 6 fish limit, 2 adults; 12" min size limit; single-point barbless hooks required.

Area 2-2 (east of line between tips of exposed jetties): Grays Harbor

West of Buoy 13 line

6/16 – 9/19 Open concurrent with Area 2, when Area 2 is open for salmon. Area 2 rules apply.

East of Buoy 13 line

6/27-9/15 Closed for salmon.

9/16-11/30 6 fish limit, 2 adults, only 1 of which may be an adult chinook; 12" min size limit; single-point barbless hooks required.

Westport Boat Basin and Ocean Shores Boat Basin

8/16-1/31/05 6 fish limit, 4 adults; 12" min size limit; barbed hooks allowed; night closure and non-buoyant lure restriction.

Area 3: Cape Alava to Queets River

6/27-9/19 (5,200 coho sub quota) Open 7 days/week; 2 fish per day, only one of which may be a chinook; retained coho must have a healed adipose fin clip; chinook minimum size limit 26 inches; chinook guideline: 1,900.

LaPush Late Season Area

9/25-10/10 (100 coho sub quota; 100 chinook sub quota) Fishery restricted to the area north of 47°50'00" N latitude and south of 48°00'00" N latitude in state waters (within 3 miles of shore). Regulations as described above.

Area 4: US/Canada border to Cape Alava and east to Sekiu River

6/27-9/19 (21,050 coho sub quota) Open 7 days/week; 2 fish per day, only one of which may be a chinook. Chum non-retention during August and September. Retained coho must have a healed adipose fin clip; chinook minimum size limit 26 inches; chinook guideline: 3,700; chinook non-retention east of Bonilla-Tatoosh line beginning August 1. Closed to salmon angling east of a true North-South line through Sail Rock, July 1-31.

II. PUGET SOUND including STRAIT OF JUAN de FUCA and SAN

JUAN ISLANDS fisheries

STRAIT OF JUAN DE FUCA

Areas 5, 6, 6C Treaty Troll (Ntrty Closed)

NOTE: For Area 4B: 5/1-10/31 see Ocean Troll. For 11/1-12/31 and 1/1-4/15 see below.

5/1-6/15	Closed
4/16/04-4/30/04	Closed
6/16-9/15	Open for salmon, chum release; Freshwater Bay, south of Angeles Pt./ Observatory Pt. line closed; Pt. Angeles Hbr. W. of line from tip of Ediz Hook to ITT Rayonier Dock closed; Hoko Bay closed, inside the area bounded by a line from Kydaka Point to Shipwreck Point; 1,000 foot closure around stream mouths; Area 6 closed east of line true north from Green Point.
9/16-4/15	Open for all salmon; in Area 6 chum release through 9/30; 1,000-foot closures around stream mouths

Areas 4B, 5, & 6C Treaty Net (Ntrty Closed)

Chinook	Open for setnet gear only, 6/16 through 8/14 in Areas 4B and 5 and 6C; 7 days a week; Hoko Bay closed, inside the area bounded by a line from Kydaka Point to Shipwreck Point and Freshwater Bay, south of Angeles Pt./ Observatory Pt. line closed. 1,000-ft. closure around stream mouths.
Sockeye	Start to be determined (7/18 est); end no later than 9/4.
Coho	Open for gillnets starting at 4 days per week (inseason adjustments based on cumulative catch) from the end of Fraser Panel control, through wb 10/3; 1,000 ft. closure around stream mouths. The gillnet catch number listed in FRAM #0419 will be used as management target and will not be greatly exceeded.
Chum	Open for gillnets, starting at 5 days per week (days may be added if effort is low), wb 10/10 through wb 11/7; 1,000-foot closure around stream mouths.

Area 5 Recreational

5/1-6/30	Closed
7/1-8/10	2 fish limit, (chinook 22" min size); unmarked chinook, unmarked coho, and chum release; Areas 5 & 6 season quota of 3,500 landed chinook, afterwards, chinook release. South of the Kydaka Pt./Shipwreck Pt. line – closed to salmon angling.
8/11-9/30	2 fish limit; chinook, unmarked coho, and chum release. South of the Kydaka Pt./Shipwreck Pt. line – closed to salmon angling.
10/1-10/31	Closed
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size).
12/1-2/15	Closed
2/16-4/10	1 fish limit (chinook 22" min size).
4/11-4/30	Closed

Area 6 Recreational

5/1-6/30	Closed

7/1-8/10	2 fish limit, (chinook 22" min size); unmarked coho, chum, and chinook release, except W. of true N/S line through "2" buoy near tip of Ediz Hook retention of marked chinook allowed; Areas 5 & 6 season quota of 3,500 landed chinook, afterwards, release chinook. South of Angeles Pt./ Observatory Pt. line – closed to angling. Pt. Angeles Hbr. W. of line from tip of Ediz Hook to ITT Rayonier Dock – closed to salmon angling. Dungeness Bay closed.
8/11-9/30	2 fish limit; chinook, unmarked coho, and chum release. South of Angeles Pt./ Observatory Point line - closed to angling through 8/31. Pt.Angeles Hbr. W. of a line from the tip of Ediz Hook to ITT Rayonier Dock – closed to salmon angling through 8/31. Dungeness Bay closed.
10/1-10/31	Closed, except Dungeness Bay (see: Dungeness Bay Recreational below.)
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size)
12/1-2/15	Closed
2/16- 4/10	1 fish limit (chinook 22" min size). Dungeness Bay closed.
4/11-4/30	Closed

STRAIT of JUAN de FUCA TERMINAL AREAS

Area 6D (Dungeness Bay)

Chinook		Closed
Coho	Trty:	Open 9/19 (contingent on NOAA approval) through wb 10/24; additional openings possible based on in-season information; chinook and chum release and gillnets may fish daytime only, through 10/10; 1,500 ft closure around each river mouth.
	Ntrty:	Open Wk 39 starting 9/21 through Wk 44 (wb 10/26) for skiff gillnet gear; 7am - 7pm, 5 days each week (M-F) except Monday 9/20; chinook and chum release by cutting ensnaring meshes; 1,500 ft. (1/4 nautical mile) closure around each river mouth. Contingent on NOAA approval, fishery may start 9/20.
Chum		Closed

Dungeness River Treaty (Ntrty Closed)

Chinook	Closed
Coho	To be determined in-season. Fishing up to 3 days/wk, for coho only, may occur no earlier than 10/16 and will be restricted to areas below the Dungeness hatchery intake using species selective (non-gillnet) gear.
Chum	Closed
Steelhead	Open starting wb 12/12 through wb 2/21.

Elwha River Treaty (Ntrty Closed)

Chinook	Closed except Ceremonial Harvest of 1 fish in July
Coho	Open 9/12 through wb 10/31; days per week to be determined in-season.
Chum	Closed
Steelhead	Open starting wb 12/5 through wb 2/21.

Eastern SJF Misc. Treaty (Ntrty Closed)

Steelhead	Open starting wb 12/12 through wb 2/21.

Western SJF Misc. Treaty (Ntrty Closed)

Steelhead	Open starting wb 12/5 through wb 2/21; Lyre R. closed below Susie Creek through 1/1.

Dungeness Bay Recreational:

5/1-9/30	Closed
10/1-10/31	Two fish limit, coho only
11/1-4/30	Closed

Freshwater Recreational Salmon Fisheries:

Dungeness River:

(mouth to hatchery intake pipe at RM 11.3)		
	10/16 – 12/31	4 fish limit, coho only; 12" min size.

Elwha River:

(mouth to Aldwell Lake Dam)	6/1 - 2/28/05	Trout and other game fish open, except closed for all species 6/1-9/30 from mouth to marker at outfall of WDFW rearing channel.
	10/1 – 11/15	6 fish limit, coho only; no more than 4 adults; 12 inch min. size. Closed waters – 50 yards above to 50 yards downstream of Elwha Tribal Hatchery outfall.

Hoko R:

(mouth to cement bridge (mile 7.0) on Hoko/Ozette Hwy.)		
		Closed to salmon. Fly fishing gear only 9/1-10/31 for trout and other game fish.

All other STRAIT OF JUAN DE FUCA REGION freshwater:
Closed to salmon angling.

SAN JUAN ISLANDS/POINT ROBERTS AREA

Areas 6, 7, & 7A Net

Chinook		Closed
Sockeye	Trty:	Schedule to be determined. July, August ceremonial and subsistence fishery
	Ntrty:	All vessel operators must complete best fishing practices certification prior to fishing. Schedule to be determined. Purse seine and reef net chinook, coho, and chum NR.
Coho	Trty:	Closed
	Ntrty:	All vessel operators must complete best fishing practices certification prior to fishing. Reef net: 7 days/wk beginning end of Fraser Mgmt through chum mgmt Wk 46 (wb 11/7); chinook NR; unmarked-coho release through 9/30, then coho non-selective. Chum retention prohibited until after 9/30. Subject to NOAA fisheries approval, retention of chum permitted 9/16 – 9/30 with a total harvest not to exceed 1,300 chum, with no more than 300 chum landed through 9/22.
Chum	Trty:	Wks 42 (wb 10/10)-Wk 45 (wb 10/31); fishing pattern (3,3,3,3) dependent upon ISU and quotas.
	Ntrty:	All vessel operators must complete best fishing practices certification prior to fishing. Wks 42 (wb 10/10) - Wk 45 (wb 10/31); Purse seine brailing required, chinook and coho NR; GN chinook and coho NR, live box, and limited soak time restrictions wk 42 only; fishing pattern: 2,2,2,2; dependent upon ISU and quotas. Reef nets through wk 46 (wb 11/7), 7 days per week through 11/13.
Subsistence	Trty:	2/16-4/10 subsistence fishery.

Area 7 Recreational

5/1-6/30	Closed
7/1-7/31	2 fish limit, 1 chinook (chinook 22" min size); Closed waters - Rosario Strait (easterly of line from Lummi Rks/Peapod Rks/Lydia Shoal due S to Black Rock, southerly to the eastern most point on James Island, and southerly to the marker on Bird Rocks, westerly to the marker across to Lopez Pass), E. Strait of Juan de Fuca, and Bellingham Bay closed.
8/1-9/30	2 fish limit, 1 chinook (chinook 22" min size), release unmarked coho, release chum; Closed waters - S Rosario Strait and E Strait of Juan de Fuca (E of boundary line drawn true S of Salmon Bank buoy), Bellingham Bay closed 8/1-8/15; Samish Bay

closed.

10/1-10/31	2 fish limit, release chinook; Samish Bay closed 10/1-10/15.
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size).
12/1-1/31	Closed
2/1-3/31	1 fish limit, (chinook 22" min size).
4/1-4/30	Closed

NOOKSACK/SAMISH TERMINAL REGION

Bellingham Bay (Areas 7A, 7B, 7C, 7D) Net

Chinook Trty: Areas 7B, 7C, & 7D: August 1 through September 4 (Wks 32-36), open weekly 4 PM Sunday to 4 PM Friday; closed south and west of a line from Oyster Creek to the fisheries marker on Samish Island, except that hand pull gill nets may fish from 4:00 PM Sunday - 4:00 PM Wednesday south to a line from Oyster Creek to Fish Point on Samish Island; fishing pattern: 5,5,5,5,5.

Ntrty: Areas 7B & 7C: Wks 34 (wb 8/15)-Wk 36 (wb 8/29); PS limited to 4 boats/week with in-season adjustments. Subsequent seine openings dependent upon seine total catch in previous weeks; brailing required; PS coho and sockeye NR; PS fishing pattern: 1,1,1; GN wks 34-36; fishing pattern: 1,3,3.

Coho Trty: Areas 7B, 7C: September 5 through October 23 (Wks 37-43), open Sunday 4 PM - Saturday 4 PM. 6,6,6,6,6,6,6.

Areas 7B and 7D on reservation: September 5 through October 23 (Wks 37-43 open Sunday 4 PM through Saturday 4 PM. 6,6,6,6,6,6,6.

7A on reservation fishery: September 26-October 23. Open 4 PM through Wednesday, 4 PM.

Ntrty: Area 7B: Wks 37 (wb 9/5)-Wk 43 (wb 10/17); PS/GN; fishing pattern: 3,3,7,7,7,7,7.

Chum Trty: Areas 7B, 7C, & 7D: October 24 - December 18 (Wks 44-51); open 3 days/wk. 3,3,3,3,3,3,3,3.

Ntrty: Area 7B: Wks 44 (wb 10/24)-Wk 49 (wb 11/28); PS/GN; 5 days/wk. Whatcom Creek Zone (east of line from Post Point to flashing red light at west entrance of Squalicum Harbor) open 7 days per week.

Beach Seine: Wks 42 (wb 10/10)-Wk 46 (wb 11/7); 5 days/wk. E. of Governors Pt. to Bellingham airport.

Steelhead Trty: Areas 7B, 7C, & 7D: December 16 - January 15 (Wks 51-53, Wks 1-3); open Sunday 4 PM through Friday 4 PM. 1,5,5,5,5.

Nooksack River Treaty Net (Ntrty Closed)

NOTE: Nooksack Tribal river fishery openings will be 00:01 a.m. (Lummi openings at 4:00 p.m.) and will close at 4:00 p.m. (concurrent with Lummi), on a weekly basis.

Chinook	April, May limited ceremonial/subsistence chinook harvest as required. Harvest will not exceed 3 NOR (30 total) chinook. July 2-3; subsistence fishery, not to exceed 13 NOR (130 total) chinook. Both the April, May and July 2-3 fishery will occur in the north fork between Highway 9 bridge and Mosquito Lake Road Bridge (RM 36.6 to 40.8) and the Nooksack River between Slater Road Bridge and the river mouth (between river miles 0.0 and 3.5. August 1-September 4 (Wks 32-36); Open 4 PM Sunday and close 4 PM Friday, except wk 32 open 4 PM to Wednesday 4 PM. Fishing pattern: 3,6,6,6,6. The river is divided into five zones during this period. These zones open on subsequent weeks, proceeding upriver, to protect migrating spring chinook.
Coho	September 5 – October 23; open Sunday 4 PM through Saturday 4 PM; 6 days/wk. 6,6,6,6,6,6,6
Chum	November 25-26 subsistence harvest. October 24 - December 18 (Wks 44-51); open 3 days/wk. 3,3,3,3,3,3,3,3**.**
Steelhead	December 16 - January 15 (Wks 51-53, Wks 1-3); open Sunday 4 PM through Friday 4 PM. 1,5,5,5,5.

Bellingham Bay Terminal Area Recreational

5/1-8/15	Closed
8/16-10/31	4 fish limit, 2 chinook (chinook 22" min size); Samish Bay closed thru 10/15.
11/1-4/15	Same as Area 7
4/16-4/30	Closed

Freshwater Recreational Salmon Fisheries:

Nooksack River and North Fork:

(from Lummi Indian Reservation boundary to yellow marker at the FFA high school barn in Deming)

9/1 – 12/31	2 fish limit, 12" min size, release unmarked chinook and unmarked coho. All Species-night closure and non-buoyant lure restriction 8/1-11/30.

(from yellow marker at the FFA high school barn in Deming to confluence of North and South forks)

10/16 – 12/31	2 fish limit, 12" min size, release chinook and unmarked coho. All Species-night closure and non-buoyant lure restriction 10/1-11/30.

(from confluence of North and South forks to Maple Creek on North Fork)

10/1 – 10/31	2 fish limit, 12" min size, release chinook and unmarked coho. All Species-night closure and

		non-buoyant lure restriction 8/1-11/30.
Nooksack River, South Fork:		
(from mouth to Skookum Creek)	10/16 – 12/31	2 fish limit, 12" min size, release chinook and unmarked coho. All Species-selective gear rules 6/1–2/28, and night closure 8/1-10/31.
Samish River:		
(from mouth to Thomas Rd. Bridge)	7/1 – 12/31	2 fish limit, 12" min size. All Species-night closure and non-buoyant lure restriction 8/1-12/31.
(from Thomas Rd. Bridge to I-5 Bridge)	10/1 – 12/31	2 fish limit, 12" min size. All Species-night closure and non-buoyant lure restriction 8/1-12/31.
Dakota Creek:		
(mouth to Giles Road Bridge)	10/1 – 12/31	2 fish limit, 12" min size.
Whatcom Creek:		
(mouth to yellow markers below foot bridge below Dupont St. in Bellingham)	8/1 – 12/31	6 fish/2 adult limit, 12" min size. All Species – night closure and non-buoyant lure restriction 8/1-12/31.

All other NOOKSACK/SAMISH TERMINAL REGION freshwater:
Closed to salmon angling.

SKAGIT TERMINAL REGION

Skagit Bay (Area 8) Net

[Note: Fishing schedules for Skagit Bay and Skagit River are preseason projections. Schedules may be changed in-season as necessary to meet management objectives.]

Chinook Closed

Coho Terminal Treaty HR target 20%.
Trty: Swinomish-Wk 39 (wb 9/19) - Wk 43 (wb 10/17); fishing pattern: 2,2,3,3,2.
Upper Skagit - Wk 39 (wb 9/19) - Wk 43 (wb 10/17); fishing pattern: 5.2,5.2,5.2,5.2,5.2.
Ntrty: Closed.

Chum Test: Wk 44 (wb 10/24) - Wk 45 (wb 10/31); 1 boat at jetty 2 day/wk 44 & 45, 1 boat in bay 1 day/wk 44 & 45.

Treaty: Closed
Ntrty: Closed

Steelhead Trty: Begins Wk 49 (wb 11/28).

Skagit River Treaty Net (Ntrty Closed)

Chinook Areas 78C and 78D : closed.

Sockeye Area 78D: Fishery dependent on ISU; If surplus, Upper Skagit open in Baker River down to Dalles Pool, Wk 28 (wb 7/4) – Wk 29 (wb 7/11), fishing pattern: 1,1, chinook release, further openings depend on update.

Coho Terminal Treaty HR target 20%.
Area 78C: Swinomish - Wks 39 (wb 9/19) - Wk 43 (wb 10/17); fishing pattern: 2,2,3,3,2. Sauk-Suiattle – Wks 39 (wb 9/19) – Wk 43 (wb 10/17); fishing pattern: 5,5,5,5,5. Upper Skagit - Wks 39 (wb 9/19) - Wk 44 (wb 10/24); fishing pattern: 5.2,5.2,5.2,5.2,5.2,5.2; chinook release through 10/11.
Area 78D: Upper Skagit - Wks 39 (wb 9/19) - Wk 44 (wb 10/24); fishing pattern: 5.2,5.2,5.2,5.2,5.2,5.2. Chinook released or used for broodstock through 10/11; Skagit River closed above O'toole Creek.

Chum Area 78C & D: Closed

River Test

Chinook (Blakes) Wk 19 (wb 5/2)-Wk 35 (wb 8/22); 1 boat, 6 hours/wk.
Coho (Blakes & Spudhouse) Wk 34 (wb 8/15)-Wk 45 (wb 10/31); 2 boats, 12 hours/wk
Coho River Area 2 (78D)Wk 35 (wb 8/22)-Wk 44 (wb 10/24); 2 setnets, 24 hours/wk.
Steelhead Area 78D (Cockerham Island) Wk 50 (wb 12/5) – Wk 8 (wb 2/20); one drift gillnet, 4 hours /wk for scale composition data.

Steelhead Swinomish/Sauk-Suiattle Area 78C: Begins Wk 49 (wb 11/28)
Upper Skagit Area 78D: Begins Wk 50 (wb 12/5)
Sauk-Suiattle: Sauk River begins Wk 1 (wb 1/2) mouth to Darrington Bridge. Lower 1 mile of Cascade River begins Wk 1 (1/2).

Swinomish Channel Treaty Net (Ntrty Closed)

Coho Closed, unless Area 8 open.

Area 8-1 Recreational

5/1-7/31 Closed

8/1-9/30	2 fish limit, chinook release.
10/1- 10/31	2 fish limit, chinook release.
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size)
12/1-1/31	Closed
2/1-3/31	1 fish limit, (chinook 22" min size)
4/1-4/30	Closed

<u>Freshwater Recreational Salmon Fisheries:</u>

Baker River: (mouth to Hwy 20 Bridge)	7/1 – 7/31*	2 fish limit, sockeye only, 12” min size. *Closed from 12:01 AM 7/6 through 2:00 PM 7/7 and from 12:01 AM 7/12 through 2:00 PM 7/13.
Cascade River: (mouth to Rockport-Cascade Road Bridge)	9/16 – 11/30	4 fish limit, coho only, 12” min size.
Skagit River: (mouth to Memorial Hwy. Bridge (Hwy 536 at Mt. Vernon))	9/1 – 12/31	3 fish limit, 12” min size, release chum, release chinook.
(From Memorial Hwy Bridge to Gilligan Creek)	9/1 – 12/31	3 fish limit, 12” min size, release chum, release chinook.
(From Gilligan Creek to Dalles Bridge at Concrete)	9/16 – 12/31	3 fish limit, 12” min size, release chum, release chinook. All Species – night closure and non-buoyant lure restriction 7/1 - 11/30.
(From Dalles Bridge at Concrete to Cascade River)	7/1 – 7/31	2 sockeye only; 12” min size; open only downstream of a point 200’ above the E bank of the Baker River. All Species-night closure and non-buoyant lure restriction 7/1-11/30.

9/16 – 12/31	3 fish limit, 12" min size, release chum, release chinook. All Species – night closure and non-buoyant lure restriction July 1 through 11/30. Closed Waters – between a line projected across the thread of the river 200'above the east bank of the Baker River and a line projected across the thread of the river 200' below the west bank of the Baker River 6/16-6/30 and 8/1-8/31.

All other SKAGIT TERMINAL REGION freshwater:
Closed to salmon angling.

STILLAGUAMISH/SNOHOMISH TERMINAL REGION

Areas 8A Net

Chinook	Trty:	Closed (Ceremonial set-aside of up to 100 chinook, July-September period)
	Ntrty:	Closed
Coho	Trty:	Wks 37 (wb 9/5)-Wk 42 (wb 10/10); 3 days per week. Update fishery weeks 37-40. Manage for CCMP breakpoints and rates.
	Test:	Wk 37 – wk 42; 1 day per week, 2 GN landings per week.
	Ntrty:	Wks 40 (wb 9/26)-Wk 42 (wb 10/10); PS limited participation Wks 40-41 (2 boats per day), full fleet Wk 42, PS release chinook, fishing pattern: 1,1,1; PS limited to area north of a line from the Clinton ferry dock to the Mukilteo ferry dock during Wk 40; GN fish daylight hours, GN Wks 41 and 42 fishing pattern: 1,3.
Chum	Trty:	Wks 43 (wb 10/17) - Wk 48 (wb 11/21); 3 days per week; Manage for Stillaguamish and Snohomish harvest rates and minimum escapement goals based on in-season update.
	Test:	Wks 43 (wb 10/17) – Wk 48 (wb 11/21), 1 day per week, 2 GN landings per week.
	Ntrty:	Wks 43 (wb 10/17)-Wk 48 (wb 11/21); PS release chinook; PS fishing pattern: 1,2,1,2,1,2, GN fishing pattern: 3,4,3,3,3,3.
Steelhead	Trty:	Begins Wk 49 (wb 11/28); based on steelhead plan to be developed.
	Ntrty:	Closed

Areas 8D Net

Chinook	Trty:	Wk 19 (wb 5/2) - Wk 24 (wb 6/6) ceremonial and subsistence fishery. Commercial fishery begins Wk 25 (wb 6/13) Sun-Thurs. Wk 26 (wb 6/20) - Wk 38 (wb 9/12); Open noon Monday thru 11:59 pm Thursday for GN, BS and RH gear, setnet gear may open outside of these times.

Ntrty: Closed

Coho Trty: Wk 39 (wb 9/19) - Wk 45 (wb 10/31); open to target Tulalip hatchery coho.
Ntrty: Wks 39 (wb 9/19)-Wk 45 (wb 10/31); PS chinook release; PS fishing pattern: 1,0,1,1,1,2,1; GN fish at night; GN fishing pattern: 3,3,3,3,3,4,3. PS Open concurrent with Ntrty 8A during Wks 41-Wk. 45. Closed east of the line from Mission Point to Hermosa Point.

Chum Trty: Wk 46 (wb 11/7) - Wk 51 (wb 12/12); open to target Tulalip hatchery chum. Managed to allow for hatchery egg take needs based on Tulalip hatchery escapement updates and projections. All Area 8D fisheries will close concurrently as agreed to by regional co-managers to ensure egg take requirements are met.

Ntrty: Wks 46 (wb 11/7)-Wk 48 (wb 11/21); open to target Tulalip hatchery chum. PS fishing pattern: 2,1,2; GN fishing pattern: 4,3,4. Closed east of the line from Mission Point to Hermosa Point. Managed to allow for hatchery egg take needs based on Tulalip hatchery escapement updates and projections. All Area 8D fisheries will close concurrently as agreed to by regional co-managers to ensure egg take requirements are met. PS open concurrent with Ntrty 8A.

Stillaguamish River Treaty Net (Ntrty Closed)

Chinook	Closed
Coho	Open Wk 39 (wb 9/19) - Wk 43 (wb 10/17); max 5 days per week.
Chum	Wks 44 (wb 10/24)-Wk 52 (wb 12/19); 5 days per week.
Steelhead	To be determined.

Snohomish River Treaty Net (Ntrty Closed)

Chinook, Pink, Coho, Chum	Closed
Coho Test	Closed

Area 8-2 Recreational

5/1-7/31	Closed
8/1-9/30	2 fish limit, chinook release.
10/1-10/31	2 fish limit, chinook release.
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size).
12/1-2/15	Closed
2/16-4/10	1 fish limit, (chinook 22" min size).
4/11-4/30	Closed

Tulalip Special Area Recreational Fishery

Same as Area 8-2 Recreational, except during the period 6/18-9/27:

6/18*-9/27 Open 12:01 AM Friday – 11:59 AM Monday each week. Open within Tulalip Special Area boundaries only. Closed east of the line from Mission Point to Hermosa Point. 2 fish limit, (chinook 22” min. size).

* May open later than 6/18

Freshwater Recreational Salmon Fisheries:

Snohomish River:
(mouth to confluence of Skykomish and Snoqualmie rivers, including all channels)

	8/1 – 8/31	2 fish limit, 12” min size, pink only, all species - selective gear rules. All Species-night closure and non-buoyant lure restriction 8/1-11/30.
	9/1 – 12/31	2 fish limit, 12” min size, release chinook and pink. All Species-night closure and non-buoyant lure restriction 8/1-11/30.

Snoqualmie River:
(mouth to Snoqualmie Falls, including all channels)

	9/1 – 12/31	2 fish limit, 12” min size, release chinook and pink. All Species- selective gear rules 6/1-11/30, except motors allowed; night closure 9/1-11/30. Closed Waters – within Puget Power tunnels at falls, and within 50’ of any point on Puget Power’s lower Plant #2 (north bank).

Skykomish River:

(From mouth to Lewis St. Bridge in Monroe)	9/1 – 12/31	2 fish limit, 12” min size, release chinook and pink. Fishing from any floating device prohibited 11/1-2/28 from the boat ramp below Lewis Street Bridge at Monroe to 2500’ downstream. All species - night closure and non-buoyant lure restriction 8/1-11/30.
(From Lewis St. Bridge in Monroe to Wallace River)	6/16* – 7/31	2 fish limit, 12” min size, marked chinook only. All species - night closure and non-buoyant lure restriction 6/1-11/30. Managed for hatchery broodstock. Evaluation by co-managers by June 30, about possibility of earlier fishery closure. * May open later than 6/16.
	9/1 – 12/31	2 fish limit,12” min size, release chinook and pink. All species - night closure and non-buoyant lure restriction through 11/30.
(From Wallace River to the forks)	9/1 – 12/31	2 fish limit, 12” min size, release chinook and

pink. All species – night closure and non-buoyant lure restriction 8/1–11/30. Closed Waters – from 1500' upstream to 1000' downstream of Reiter Ponds outlet 6/1 to 8:00 a.m. 8/1 and within this 2,500' section, fishing from any floating device within this area prohibited 8:00 a.m. 8/1-3/31.

Wallace River:

(mouth to 200' upstream of water intake of salmon hatchery)

9/1 – 11/30	2 fish limit, coho only, 12" min size. Fishing from any floating device prohibited 11/1-2/28.

Stillaguamish River:

(river and all sloughs downstream of Warm Beach-Stanwood Hwy)

9/1 – 12/31	2 fish limit, 12" min size, release chinook and pink. All Species-night closure and non-buoyant lure restriction 8/1-11/30.

(Warm Beach-Stanwood Hwy upstream to forks)

9/1 – 12/31	2 fish limit, 12" min size, release chinook and pink. All Species-night closure 8/1-11/30 and selective gear rules except motors allowed 6/1-11/30. Closed Waters – from water control structure/barrier dam (downstream of I –5) 200'downstream.

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All other STILLAGUAMISH/SNOHOMISH TERMINAL REGION freshwater:

Closed to salmon angling.

ADMIRALTY INLET AREA

Area 9 Net Closed

Area 9 Recreational

5/1-7/15	Closed
7/16-7/31	2 fish limit, chinook release.

8/1-9/30	2 fish limit, chinook and chum release.
10/1-10/31	2 fish limit, chinook release.
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size)
12/1-1/31	Closed
2/1-4/15	1 fish limit, (chinook 22" min size)
4/16-4/30	Closed

Edmonds Pier Recreational

6/1-4/30/05 2 fish limit, 1 chinook (22" min size), release chum 8/1-9/30.

Hood Canal Bridge Recreational

Year-round Closed

SOUTH SOUND REGION

Area 10 Net

Chinook	Closed	
Sockeye	Trty:	Fishery dependent upon ISU (Ballard lock counts)
	Ntrty:	Closed
Coho	Test:	Gillnet: Wks 37 (wb 9/5)-Wk 39 (wb 9/19); 3 boats, 3 sites; fishing pattern: 2,2,2
	Trty:	Closed, unless ISU indicates harvestable abundance. Quota based on tiered sharing formula, Wks 37(wb 9/5)-Wk 41(wb 10/3).
	Ntrty:	Closed
Chum	Test:	Purse Seine: Wks 41 (wb 10/3)-Wk 46 (wb 11/7); 1 site, fishing pattern: 1,1,1,1,1
	Trty:	Quota based on tiered sharing formula; Wks 42 (wb 10/10)-Wk 48 (wb 11/21) fishing pattern – ISU dependent.
	Ntrty:	Wks 42 (wb 10/10)-Wk 48 (wb 11/21); PS chinook and coho NR; PS fishing pattern: 1,1,2,1,1,1,1; GN fishing pattern: 3,3,3,3,3,3,3. ISU Dependent.

Area 10A Treaty Net (Ntrty Closed)

Chinook	Test: Gillnet: 7/21, 7/28, 8/4; 5 sites (Wednesday nights, if possible). Wk 33 – 34; 1 day/wk. Reference terminal management plan.
Coho	Wks 37 (wb 9/5)-Wk 44 (wb 10/30); fishing pattern: fishery will be open continuous from Wk 38 (Sept. 12) through Wk 39 (Sept. 24); starting Wk 40 (Sept. 26) fishery will revert back to 5 days/wk
Chum	Wks 45 (wb 10/31)-Wk 48 (wb 11/27); fishing pattern to be determined.

Steelhead	Wks 49 (wb 11/28)-Wk 52 (wb 12/19); evaluation fishery for ISU; fishing pattern: 3,3,3,3.

Area 10E Treaty Net (Ntrty Net Closed)

Chinook	Wks 30 (wb 7/18)-Wk 38 (wb 9/12); fishing pattern: 7days/wk. Possible extension for Sinclair Inlet
Coho	On-Reservation only; Wks 38 (wb 9/12)-Wk 43 (wb 10/17); setnet/beach seine; 7 days/wk.
Chum	Wks 43 (wb 10/17)-Wk 49 (wb 11/28); schedule dependent upon ISU.

Duwamish/Green River (Area 80B) Treaty Net (Ntrty Closed)

Chinook	Wk 33 – 34; 1 day/wk. Reference terminal management plan.
Coho	Closed until chinook clear or coho predominate. Clearance fishery on lower river (up to 16th Avenue Bridge) begins 9/9; (6 sites); fishing pattern: if chinook clearance is met or coho predominate, fishery will open Wk 38 (Sept. 12) and be open continuous through Wk 39 (Sept. 24); starting Wk 40 (Sept. 26) fishery will revert back to 5 days/wk.
Chum	Wks 46 (wb 11/7)-Wk 48 (wb 11/27); fishing pattern to be determined.
Steelhead	Wks 49 (wb 11/28)-Wk 52 (wb 12/19); evaluation fishery for ISU, fishing pattern: 3,3,3,3.

Lake Washington System (includes lake, ship canal, & Lake Sammamish)
Areas 10F, 10G, 10C, 10D Treaty Net (Ntrty Closed)

Sockeye	Dependent upon ISU (lock counts). Potential fishery beginning Wk 28 (7/4).
Chinook	10F, 10C & 10G closed; 10D will be based on ISU (lock counts)
Coho	The coho fisheries in the four following areas are dependent upon the ISU (if lock counts project run size < 10,000 coho entering the lake, then no coho fishery): Lower ship canal (below Ballard Locks): Closed until chinook clearance as seen in lock counts; anticipated pattern 3 days/wk. Upper ship canal (above Ballard Locks): Species composition test fishery in mid September, 3 sites, or chinook clearance as seen in lock counts: fishing pattern 5 days/wk. North end Lake Washington (North of Hwy. 520 bridge): Species composition test fishery in mid-September (7 sites) or limited commercial fishery: fishing pattern 5 days/wk. Lake Sammamish: Chinook and Coho fisheries will be based on ISU from the Ballard Lock counts.

Area 10 Recreational

5/1-6/15	Closed
6/16-6/30	Catch-and-release in waters N of Meadow Pt./Pt. Monroe line.
7/1-10/31	2 fish limit, chinook release, release chum 8/1-9/15; Shilshole Bay (East of Meadow Point/West Point line) closed 7/1-8/31; Outer Elliott Bay (E of West Pt./Alki Pt line to Pier 91/Duwamish Head line) closed to salmon angling 7/1-8/31; Inner Elliott Bay (E of Pier 91/Duwamish Head line) closed to salmon angling 7/1-8/31 except for indicated openings identified in "Elliott Bay Recreational" section below and Elliott Bay fishing piers open. Special gear restrictions in Duwamish Waterways area when open. See "Sinclair Inlet Recreational" section below for chinook retention fishery.
11/1-11/30	2 fish limit, 1 chinook (chinook 22" min size)
12/1-12/15	Closed
12/16-2/28	1 fish limit, (chinook 22" min size); Agate Pass closure beginning 1/1.
3/1-4/30	Closed

Elliott Bay Recreational

7/16-8/22	Open E of Pier 91/Duwamish Head line, weekly 12:01 a.m. Friday through 11:59 p.m. Sunday, 7/16–8/22, 2 fish limit, (chinook 22" min size), release chum beginning 8/1. Special gear restrictions in Duwamish Waterways area when open.
8/23-8/31	Closed
9/1-4/30	Same as Area 10.

Sinclair Inlet Recreational

7/1-9/30	Open S of Manette Bridge, S of line drawn true W from Battle Point, and W of line drawn true S from Point White; 2 fish limit, (chinook 22" min size), release chum 8/1-9/15.

5/1-6/30 and 10/1-4/30 same regulations as Area 10.

Area 10 Piers Recreational; Seacrest Pier, Pier 86, Waterman Pier, Bremerton Boardwalk, Illahee State Park Pier

6/1-4/30/05	2 fish limit, 1 chinook (22" min size), release chum 8/1-9/15

Area 10 Freshwater Recreational Salmon Fisheries:

Green River:

(1st Avenue Bridge to Pacific Highway South Bridge)

9/1 – 12/31	6 fish/3 adult limit, 12" min size, release chinook. All Species-night closure and non-buoyant lure restriction Sept. 1-Nov. 30. Fishing from any floating device prohibited 11/1-2/28.

(Pacific Highway South Bridge to S.W. 43rd St./S 180th St. Bridge)

	9/16 – 12/31	6 fish/3 adult limit, 12" min size, release chinook. All Species-night closure and non-buoyant lure restriction Sept. 16-Nov. 30. Fishing from any floating device prohibited 11/1-2/28.

(S.W. 43rd St./ S. 180th St Bridge to the S. 277th Bridge in Auburn)

	10/1 – 12/31	6 fish/3 adult limit, 12" min size, release chinook. All Species-night closure and non-buoyant lure restriction 10/1-11/30. Fishing from any floating device prohibited 11/1-2/28.

(S. 277th Bridge to Auburn-Black Diamond Rd Bridge)

	10/16 – 12/31	6 fish/3 adult limit, 12" min size, release chinook. All Species-night closure and non-buoyant lure restriction 10/16-11/30. Fishing from any floating device prohibited 11/1-3/15.

(from Auburn-Black Diamond Rd Bridge to Tacoma Headworks Dam)

	11/1 – 12/31	2 fish limit, 12" min size, chum only. All Species-night closure and non-buoyant lure restriction 8/1-11/30. Closed Waters- within 150' of the Palmer Ponds outlet rack and within 150' of the mouth of Keta (Crisp) Creek.

The 2004/2005 WDFW sport pamphlet will reflect the following season end dates for trout and other game fish fall/winter season. These end dates are subject to change based on State-Tribal agreement:

mouth to S. 277th Bridge in Auburn – Feb. 15
S. 277th Bridge to Tacoma Headworks Dam – Feb. 28

Soos Creek:

(mouth to bridge near hatchery residence)	10/9 – 10/31	2 fish limit, 12" min size, coho only. Juvenile anglers (under 15 years old) only, 1 single hook; night closure through 10/31.

Lake Washington:

East of the Montlake Bridge	July	Dependent upon ISU (lock counts). Potential fishery, starting date to be determined. 2 fish limit, sockeye only, 12" min. size.

North of Hwy 520 Bridge 9/16 – 10/31 2 fish limit, coho only, 12" min size.

Lake Sammamish:

8/16 – 11/30 2 fish limit, 12" min size, release sockeye. Closed: waters within 100 yards of the mouth of Issaquah Creek are closed to salmon fishing.

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All other <u>SOUTH SOUND AREA 10 REGION freshwater</u>:
Closed to salmon angling.

<u>Area 11 Net</u>

Chinook Closed

Coho Trty: Commercial fishery open beginning Wk 37 (wb 9/5); ISU dependent; gillnets 7 nights/wk. Could close any time**.**

Ntrty: Closed

Chum Trty: Commercial fishery open Wks 42 (wb 10/10)-Wk 46 (wb 11/7); gillnets 7 nights/wk, could close at anytime.

Ntrty: Wks 42 (wb 10/10)-Wk 48 (wb 11/21); PS chinook and coho NR; PS fishing pattern:1,1,2,1,1,1,1; GN fishing pattern: 3,3,3,3,3,3,3. ISU Dependent.

<u>Area 11A Net Treaty Net (Ntrty Closed)</u>

Chinook and Chum Closed

Coho Commercial fishery open Wks 36 (wb 8/29)-Wk 45 (wb 10/31); 3 nights/wk

<u>Puyallup River (Area 81B) Treaty Net (Ntrty Closed)</u>

Chinook Test Fishery: Wks 30 (wb 7/18)-Wk 34 (wb 8/15); 1 day/wk, drift net only. Commercial fishery begin Wks 33 (wb 8/8)-Wk 35 (wb 8/22); fishing pattern: 0.5,0.5,0.5.

Coho Commercial fishery begin Wks 36 (wb 8/29)-Wk 42 (wb 10/10); fishing pattern: 1,3,3,4,4,4,3.5.

Chum Test fishery Wks 43 (wb 10/17)-Wk 46 (wb 11/7); 1 day/wk, drift net only.

Winter Chum Commercial fishery begin Wks 47 (wb 11/14) – Wk 53 (wb 12/26), no more than 24 total days.

Steelhead Incidental to chum fishery – see chum schedule.

<u>White River (Treaty)</u>

Sp Chinook Traditional fish drive. Ceremonial and subsistence fishery.

Coho/Chum Begin 9/1, traditional fish drive; ceremonial and subsistence fishery. No directed commercial fishery.

Steelhead Ceremonial and subsistence fishery.

<u>Area 11 Recreational</u>

5/1-6/15 Closed

6/16*-10/31	2 fish limit, (chinook 22" min size); Commencement Bay (E of Cliff House Restaurant/Sperry Dock line) closed to salmon fishing through 7/31. * May open later than 6/16.
11/1-12/31	2 fish limit, 1 chinook (chinook 22" min size)
1/1-2/15	Closed
2/16-4/10	1 fish limit (chinook 22" min size)
4/11-4/30	Closed

Dash Point Dock, Point Defiance Boathouse Dock, Les Davis Pier, Des Moines Pier and Redondo Pier

6/1-4/30/05 2 fish limit; 1 chinook (22" min size)

Area 11 Freshwater Recreational Salmon Fisheries:

Puyallup River:

(from 11th St. Bridge to Carbon River)	9/1 – 12/31	6 fish/2 adult limit, 12" min size, release unmarked adult chinook. All species – single point barbless hooks required 8/1-11/30.

Carbon River:

(mouth to Voight Creek)	9/1 – 11/30	6 fish/4 adult limit, no more than 2 adults may be marked chinook; 12" min size, release unmarked adult chinook, and release chum. All Species night closure, non-buoyant lure restriction, and single point barbless hooks 8/1-11/30.

All other SOUTH SOUND AREA 11 REGION freshwater:
Closed to salmon angling.

Fox Island/Ketron Island (Area 13) [1]

Chinook	Treaty:	8/1-9/15, 7 days/wk
	Ntrty:	closed
Coho	Treaty:	9/16-10/20, 7 days/wk
	Ntrty:	closed
Chum	Treaty:	Closed unless opened by Medicine Creek Treaty tribes' agreement
	[Ntrty:	**Wks 49 (wb 11/28) – Wk 53 (wb 12/26); GN 5 boats. GN fishing pattern: 3,3,3,3,2. –WDFW]**

Sequalitchew (Area 13) Treaty Net (Ntrty Closed)

[1] Based on Medicine Creek Treaty tribal proposal annual regulations. Individual tribal regulations may deviate from this schedule.

Chinook and Chum	Closed
Coho	Closed

<u>Carr Inlet (Area 13A) Treaty Net [1](Ntrty Closed)</u>

Chinook	8/1-9/18, 7 days/wk, open in sections
Coho	9/19-10/23, in-season monitoring to meet hatchery escapement need
Chum	10/24-12/4, 7 days/wk

<u>Chambers Bay (Area 13C) Treaty Net[1] (Ntrty Closed)</u>

Chinook	Wks 31 (wb 7/25)-Wk 41 (wb 10/3); 3 days/wk
Coho	Wks 42 (wb 10/10)-Wk 44 (wb 10/24); 2 days/wk;
Chum	Wks 45 (wb 10/31)-Wk 48 (wb 11/21); 3 days/wk

<u>Area 13D Treaty Net (Ntrty Closed)</u>

Chinook 8/1-9/10 or earlier date dependent on in-season management needs; 7 days/wk

Coho 9/10-12/31 or earlier date dependent on in-season management needs:

<u>Peale Pass (13D-3)</u> - 7 days/wk
<u>Pickering Pass (13D-2)</u> - 7 days/wk
<u>Dana Pass (13D-1)</u> - 7 days/wk
<u>Southern Case (13D-4)</u> - 7 days/wk

Chum Open approximately 10/27; 2-3 days per week; managed weekly by updates (~10/11)

<u>Area 13E Net</u> **Closed to all fishing**

<u>Budd Inlet (Area 13F) Treaty Net (Ntrty Closed)</u>

Chinook	7/15-9/10 or earlier date dependent on in-season management needs; 7 days/wk
Coho	Closed
Chum	Open approximately 11/1, 2-3 days per week, managed by weekly in-season updates

<u>Eld Inlet (Area 13G) Treaty Net (Ntrty Closed)</u>

Chinook	8/1-9/10; opening dependent upon in-season data, outer portion only
Coho	Closed
Chum	Open approximately 11/1, 2-3 days per week, managed by weekly escapement updates

<u>Totten Inlet (Area 13H) Treaty Net (Ntrty Closed)</u>

Chinook	8/1-9/10; schedule dependent on in-season data
Coho	Closed
Chum	Open approximately 10/10, 2-3 days per week; managed by weekly escapement updates

<u>Little Skookum Inlet (Area 13I) Treaty Net (Ntrty Closed)</u>

Chinook	8/1-9/10; schedule dependent upon in-season data
Coho	Closed
Chum	Open approximately 12/1, 2-3 days per week; managed by weekly escapement updates

<u>Hammersley Inlet (Area 13J) Treaty Net (Ntrty Closed)</u>

Chinook	8/1-9/10 or earlier date dependent on in-season management needs
Coho	Closed
Chum	Open approximately, 9/18-12/25, 2-3 days/wk; managed by weekly escapement updates

<u>Northern Case Inlet (Area 13K) Treaty Net (Ntrty Closed)</u>

Chinook	8/1-9/10
Coho	9/10-12/31 or earlier date dependent on in-season management needs
Chum	Open approximately 9/18-12/25; 2-3 days/wk; managed by weekly escapement updates

<u>Nisqually River (Area 83D) Treaty Net (Ntrty Closed)</u>

Chinook	Wks 27 (wb 6/27)-Wk 39 (wb 9/19); 3 days/wk; The Nisqually Indian Tribe will manage the Nisqually River chinook run to attain an 1,100 naturally spawning escapement goal. This will be achieved by running an in-season update and adjusting the fishing schedule accordingly.
Coho	Wks 40 (wb 9/26)-Wk 47 (wb 11/14); 3-4 days/wk
Chum	**[Wks 48 (wb 11/21)-Wk 5 (wb 1/25); 4 days/wk – Nisqually Tribe]**

<u>McAllister Creek (Area 83F) Treaty Net (Ntrty Closed)</u>

Chinook	Wks 27 (wb 6/27)-Wk 40 (wb 9/26); 3 days/wk
Coho	Wks 41 (wb 10/3)-Wk 48 (wb 11/21); 3-4 days/wk
Chum	Wks 49 (wb 11/28)-Wk 5 (wb 1/25); 4 days/wk

<u>Area 13 Recreational</u>

5/1-6/15	Closed.
6/16*-6/30	2 fish limit, (chinook 22" min size); Carr Inlet (N of Penrose Pt./Green Pt. Line) closed. * May open later than 6/16.
7/1-10/31	2 fish limit, chinook 22" min size; release unmarked coho 7/1-10/31; Carr Inlet (N of Penrose Pt./Green Pt. Line) closed 7/1-7/31, except open to fly-fishing-only for marked hatchery coho; Minter Creek mouth closed through 9/30; Lower Budd Inlet closure zone 7/16-10/31.
11/1-12/31	2 fish limit, 1 chinook (chinook 22" min size)
1/1-4/30	1 fish limit, (chinook 22" min size). Carr Inlet (North of Penrose Pt./Green Pt. line) closed 4/16-4/30.

Fox Island Pier Recreational

6/1-4/30/05 2 fish limit, 1 chinook (22" min size); release unmarked coho 7/1-10/31

Area 13 Freshwater Recreational Salmon Fisheries:

Chambers Creek Estuary:

(downstream of markers 400' below Boise-Cascade Dam to Burlington Northern Railroad Bridge)

7/1 – 11/15 6 fish/2 adult limit, 12" min size, release unmarked coho.

Deschutes River:

(from Old Hwy 99 Bridge on Capitol Blvd in Tumwater to Henderson Blvd Bridge)

7/1 – 11/30 6 fish/2 adults limit, 12" min size, release coho.

(upstream of Henderson Blvd Bridge) 7/1 – 11/30 6 fish/2 adults limit, 12" min size, release coho, selective gear rules.

Kennedy Creek:

(mouth to northbound Hwy. 101 Bridge) 10/1 – 11/30 6 fish/2 adults limit, 12" min size, release coho, barbless hooks required. Night closure and non-buoyant lure restriction 10/1-12/31.

McAllister Creek:

(mouth to Olympia-Steilacoom Rd Bridge) 7/1 – 11/30 6 fish/4 adult limit, 12" min size. All species – night closure and non-buoyant lure restriction 8/1- 11/30.

McClane Creek:

(from a line 50' north of and parallel to the Mud Bay Rd. Bridge to a line 100' upstream of and parallel to the south bridge on Hwy.101) 7/1 – 11/30 6 fish/2 adults limit, 12" min size, release coho.

Minter Creek:

(mouth to 50' downsteam of hatchery rack) 11/1 – 12/31 4 fish limit, 12" min size, chum only.

Nisqually River:

(mouth to the military tank crossing bridge, one mile upstream of the mouth of Muck Creek)

7/1 –1/31 6 fish/2 adults limit, 12" min. size. All species – night closure and non-buoyant lure restriction 8/1- 11/30.

All other SOUTH SOUND AREA 13 REGION freshwater:

Closed to salmon angling.

HOOD CANAL REGION

Hood Canal Mainstem (Areas 12, 12B, 12C, 12D)

Treaty: 1,000 feet closure around streams which are closed to net fishing. Beach seines and hook and line gear release chum through 9/30 (through 10/10 if within 500' of western shore of Areas 12B and 12C).
Nontreaty: See WAC 220-47-307 for Nontreaty exclusion zones.

Chinook:

Trty: Areas 12, 12B and 12D: Closed
Area 12C: Open wb 7/18; through 8/24 no more than 4 days/wk. Gillnets restricted to 7" min mesh starting 8/1.
Area 12H: Open wb 8/8 through wb 9/26; hook and line gear continuous; beach seines daylight hours Tues and Thur each week; possible in-season modifications; chum release.

Ntrty: Closed

Coho Trty: Area 12: Open wb 9/26 through wb 10/10; for gillnets. Beach seines for coho only (release all chinook and chum through 9/30) may start no earlier than 9/18.
Area 12B: Open wb 10/1 through wb 10/17; for gillnets; 500 foot closure along western shore through 10/10; Beach seines for coho only (release all chinook and chum through 9/30) may start no earlier than 9/21.
Area 12C: Open wb 9/19 through wb 10/17; no more than 6 days/wk (possible in-season adjustments); gillnets may open no earlier than 10/1, with 500 foot beach closure from Ayock Pt. to approx. 2,000 feet south of Lilliwaup (at the large house, north of Octopus Hole) through 10/10; beach seines for coho (release all chum through 9/30) may start no earlier than 9/21.

Area 12D (west of Madrona Pt. - local name): Open wb 9/19 through wb 10/17; gillnets may open no earlier than 10/1. Weekly schedules identical to Area 12C.

Ntrty: Closed

Chum Trty: Area 12: Open wb 10/17 through wb 11/14, but no later than 11/20.
Areas 12B – 12C: Open wb 10/24 through wb 11/14 in Area 12B and no later than
wb
11/21 in Area 12C.
Area 12D: Closed.
Area 12H: **[Hook and line gear open from wb 10/24 through wb 11/21; beach seines open Tuesday and Thursday for the first two weeks then Monday, Wednesday, and Friday starting 11/7 given hatchery escapement control measures; potential additional fishing days pending discussions with WDFW-**

WDFW]

Ntrty: Area 12-12B: Open Wks 43 (wb 10/17) through wk 47 (wb 11/14), PS release chinook; PS fishing pattern: 1,2,1,1,1,; GN fishing pattern: 3,3,3,3,3, **[North of Quatsap Point – Skokomish]**

Area 12C : Open Wks 46 (wb 11/7) through wk 48 (wb 11/21) purse seine release chinook; PS fishing pattern: 1,1,1; **[GN fishing pattern: 3,3,3; potential additional GN days pending discussion with PNPTC and SkokomishTribe; BS (Hoodsport Hatchery Zone) fishery in wks 46-48 pending discussions with PNPTC and Skokomish Tribe – WDFW]**

Area 12D: Closed

Port Gamble (Area 9A)

Chinook Closed

Coho Trty: Open wb 8/22 through wb 10/24, gillnet only.

Test: Open wb 8/5 through wb 10/3, gillnet only.

Ntrty: Open Wks 35 (wb 8/22) through wk 44 (wb 10/24); GN and skiff GN, both gears limited to 100 fathoms length and 60 meshes in depth; 2 days wk 35, then 7 days/wk; release chinook; release chum through 9/30; release fish not to be retained by cutting ensnaring meshes. The beach area of the Port Gamble Indian Reservation, between Pt. Julia and the boundary marker at the south end of the reservation shall be closed to all fishing.

Chum Trty: Open wb 10/31 through wb 11/28.

Ntrty: Closed

Steelhead Trty: Open wb 12/5 through wb 1/23.

Quilcene/Dabob (Area 12A)

Coho Trty: Open wb 8/22 through wb 10/10; chum and chinook release from hook and line and beach seine gear through 9/30; beach seines 5 days/wk daylight hours; hook and line open continuous; gillnets closed before 9/1 and limited to 1 day/wk 9/1 through 9/30. Gillnets will close if 12A summer chum escapement projected <1,500. Additional gillnet time may be added between 9/16 and 9/30 if coho harvest needs require it and 12A summer chum escapement projected >2,500. Beach seine advanced notification required prior to fishing.

Ntrty: Open Wks 35 (wb 8/22) through wk 40 (wb 9/26); BS gear only; 5 days/wk (M-F) 7 am–7 pm; chinook and chum release. Beach seine advanced notification required prior to fishing.

Chum Trty: To be determined in-season.

Ntrty: Closed

Skokomish River (Area 82G) Treaty (Ntrty Closed)

Note: Hook and line gear and beach seines release chum through 10/15.

Chinook	Open wb 8/1 through wb 9/12; no more than 3 days/wk; closed to gillnets below SR 106.
Coho	Open wb 9/19 through wb 10/24; no more than 5 days/wk, (possible inseason modifications); closed to gillnets below SR 106 through 9/30.
Chum	Open wb 10/31 through wb 12/05.

Big Quilcene River (Area 82F) Treaty (Ntrty Closed)

Coho	Openings to be determined in-season, for coho only, as necessary, from wb 9/5 through wb 9/26; from U.S. Hwy 101 to the Quilcene Hatchery rack, hand held gear only (dipnets, hand lines, etc.)
Chum	Closed

Dosewallips R., Duckabush R., Hamma Hamma R., Union R. Closed

Tahuya R., Dewatto R. Treaty (Ntrty Closed) Closed

Area 12 Recreational

ENTIRE AREA

5/1-6/30	Closed
7/1-8/31	North of Ayock Pt. – Closed except see Quilcene/Dabob Bay Recreational below.
9/1-10/15	North of Ayock Pt. – 4 fish limit, coho only.
7/1-10/15	South of Ayock Pt. - 4 fish limit, 2 chinook (chinook 22" min size); release chum.

ENTIRE AREA

10/16-12/31	4 fish limit, 1 chinook (chinook 22" min size).
1/1-2/15	Closed
2/16-4/10	1 fish limit (chinook 22" min size).
4/11-4/30	Closed

Hood Canal Bridge Recreational

Year-round	Closed

Quilcene/Dabob Bay Recreational

5/1-8/15	Closed
8/16-10/15	4 fish limit, coho only.
10/16-12/31	4 fish limit, 1 chinook (22" min size).
1/1-2/15	Closed
2/16-4/10	1 fish limit (chinook 22" min size).
4/11-4/30	Closed

Hoodsport Hatchery Zone Recreational

Same as Area 12 except:

7/1-12/31	4 fish limit, only 2 chinook greater than 24"; chum release 7/1-10/15; night closure.

Hood Canal Freshwater Recreational Salmon Fisheries:

Dewatto River:		
(mouth to Dewatto-Holly Rd. Bridge)	9/16 – 10/31	2 fish limit, 12" min size, coho only. Single point barbless hooks required.
Dosewallips River:		
(mouth to Hwy. 101 Bridge)	11/1 – 12/15	2 fish limit, 12" min size, chum only
Duckabush River:		
(mouth to Mason Co. PUD #1 overhead electrical distribution line)		
	11/1 – 12/15	2 fish limit, 12" min size, chum only
Quilcene River:		
(from Rodgers St. to Hwy 101 Bridge)	8/16 – 10/31	4 fish, 12" min size, coho only, selective gear rules and night closure.
Skokomish River:		
(mouth to Hwy. 101 Bridge)		
	8/1 – 8/31	Closed to all fishing.
	9/1 – 9/30	1 fish limit, 12" min size, release chum. All Species-night closure, non-buoyant lure restriction, and single point barbless hooks required through 11/30.
	10/1 – 10/15	6 fish/4 adult, only 1 of which may be an adult chinook, 12" min size, release chum. All Species-night closure, non-buoyant lure restriction, and single point barbless hooks required through 11/30.
	10/16 – 12/15	6 fish/4 adult, only 1 of which may be an adult chinook, 12" min size. All Species-night closure, non-buoyant lure restriction, and single point barbless hooks required through 11/30.
Tahuya River:		
(mouth to marker 1 mile above N. Shore Rd. Bridge)		
	9/16 – 10/31	2 fish limit, 12" min size, coho only. Single point barbless hooks required.

All other <u>HOOD CANAL REGION freshwater</u>:
Closed to salmon angling.

PUGET SOUND SAMPLING PROGRAM OPERATING PLAN

I. GENERAL SAMPLING OBJECTIVES AND PROCEDURES

The basic mission of the Puget Sound Sampling Program is to provide the historical time series needed for monitoring salmon and marine fish stocks and managing the salmon fisheries of the State. These databases provide recreational and commercial fisheries statistics.

A. SAMPLING OBJECTIVES

The Puget Sound Sampling Program has the following sampling objectives in order of priority:

1) *Provide catch per unit effort and species composition of salmon and marine fish in recreational fisheries. This sampling activity is also described as "Baseline Sampling". Baseline information is used in conjunction with the catch record card (CRC) system to compute catch by species and area. Baseline catch information is also collected for marine fish.*

2) *Sampling for coded wire tags (CWT) in sport and commercial fisheries. The objective is to provide stock specific estimation of population parameters, such as fishery contribution and marine survival as part of the Coast-Wide CWT program.*

3) *Sampling for chum age composition.*

4) *Sampling for chinook age composition.*

5) *Obtaining adipose mark rates from selective fisheries.*

6) *Other goals consist of biological sampling for length, sex and genetic stock identification (GSI) to provide valuable information about return by age and sex, size and stock composition.*

Table 1: Sample Size Goals

Objective	Gear	Samples per stratum
CRC Species composition	Recreational	120 fish per area-stratum
CRC CPUE	Recreational	100 boats per area-stratum
CWTs	Commercial	20% of harvest by species-area-week
	Recreational	10% of harvest by species-area-stratum (includes sampling for mark rate)
Chum age and length	Gillnet	200 fish per area-week
	Purse seine	200 fish per area-week
Chinook age and length	Recreational	Every chinook sampled, secondary to other goals
	Gillnet	150 per area-week
	Purse seine	150 per area-week

Puget Sound Sampling also conducts catch estimates for Terminal Area Fisheries and quota management, when requested.

Since 1998, all coho are sampled electronically for CWTs and since 2001 all chinook are also sampled electronically, because the adipose fin-clip is no longer the visual indicator of the CWT. New information will be collected to meet the data needs of selective fisheries management, such as the adipose mark status of landed tagged and untagged coho/chinook, and marked/unmarked ratios in the fishery.

B. Baseline Sampling

1) Goals

The main objective of the sport fishery baseline sampling program is to provide auxiliary data for the Salmon Catch Record Card System and the Marine Fish Catch Estimate, species composition to estimate sport harvest by species and CPUE (catch per angler trip) to estimate total effort or catch.

2) Objectives

a) *Species Composition*

b) *Catch per Unit Effort*

c) *Estimate marked to unmarked ratios in selective fisheries*

d) *Estimate unmarked retention error*

3) Sampling unit

The basic sampling unit for species composition is a fish.

The basic sampling unit for CPUE is an interview.

4) Sampling strata

Strata are set per catch record card area and time. Duration of a stratum can range from one week to several months based on angler effort and success (see table 2).

Strata have, in the past, been area-week, however sampling goals have not been met for area-week, typically where sport harvests are small, e.g. during the winter in Areas 12 and 13.

In order to provide minimally biased estimates of harvest by species and total effort, weekly strata should only be defined for Areas 5, 6, 9 and 10 during the months June-October. These months represent the time period of highest effort, and also during these months, species composition changes as fisheries move from targeting chinook to targeting coho salmon. Otherwise sampling goals should be achieved between months or combination of months. From November through May most of the sport harvest is chinook, although chum are taken in November in certain areas.

Table 2: Typical Puget Sound Recreational Sampling Strata

Area	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April
5	Month	Week	Week	Week	Week	Week	2 Months		Month	Month	Month	Month
6	Month	Week	Week	Week	Week	Week	2 Months		Month	Month	Month	Month
7	Month	Month	Month	Month	Month	Month	2 Months		Month	Month	Month	Month
81	Month	Month	Month	Month	Month	Month	2 Months		Month	Month	Month	Month
82	Month	Month	Month	Month	Month	Month	2 Months		Month	Month	Month	Month
9	Month	Week	Week	Week	Week	Week	Month	Month	Month	Month	Month	Month
10	Month	Week	Week	Week	Week	Week	Month	Month	Month	Month	Month	Month
11	Month	Month	Month	Month	Month	Month	Month	Month	Month	Month	Month	Month
12	5 Mo.	Month	Month	Month	Month	Month	2 Months		5 Months			
13	2 Months		Month	Month	Month	Month	2 Months		2 Months		2 Months	

5) Sample size

Sampling size is set at 120 fish per stratum for estimation of species composition and 100 boats per stratum for the estimation of CPUE.

6) Assumptions

Species composition of sampled sites can be applied to the entire CRC area.

Anglers answer questions accurately and do not conceal fish.

7) Data collection

The baseline sampling program is geographically stratified by catch record card areas; Areas 5-13 in Puget Sound. The species composition and CPUE data are collected through angler interviews at landing sites within each area and combined for area estimates. Indices of angler success (CPUE and catch distribution) can be estimated from these data, however it should be noted that the objective of the sampling program is to provide estimates for entire catch record card areas, and is not designed to provide information on small or localized fisheries within a catch record card area.

Since 1992, sampling efforts have focused on high impact sites to ensure that sample sizes are adequate for analysis. Catch and release data is now being included in all sport sampling interviews in order to assess total salmon mortality in sport fisheries. Mark status of landed salmon is recorded during the interview to assess marked to unmarked ratios and unmarked retention error in selective fisheries.

8) Analysis

Strata are analyzed for achievement of sampling goals. Sampling goals are typically not met in areas and months with low effort. Area 13 catch from October through March rarely exceeds 100 salmon, so even if every fish could be sampled, monthly strata would not be met. Strata falling short will be lumped whenever possible to ensure that CPUE estimates are based on at least 100 boats, otherwise effort estimates may be highly biased. Species composition is applied to total catch (from the CRC system) to arrive at estimates of total catch by species in a catch record card area, and CPUE is used to estimate angler-effort.

C. CWT SAMPLING

1) Goal

Sampling for coded-wire-tags (CWT) in sport and commercial fisheries represents one part of the coast-wide CWT Program, the objective of which is to provide for stock specific estimation of population parameters, such as fishery contribution and marine survival. The CWT program is also important to brood-stock programs and the evaluation of hatchery and supplementation programs.

2) Sampling unit

The basic sampling unit is a coho or a chinook salmon

3) Sample size

The sampling goal for commercial fisheries is 20% of the chinook and coho harvest per area per week.

The recreational sampling goal for coho and chinook is 10% of the harvest per area and per month.

4) Assumption

CWT composition of the sample can be applied to the entire fishery (harvested catch).

5) Data collection

Coho and chinook will be sampled electronically for the presence of a tag, because the adipose fin clip is no longer the external indicator of a tag.

If a tag is detected, the sampler will remove the head for analysis in the lab. Adipose mark status is recorded for tagged and untagged coho/chinook during sampling.

In order to achieve the coho and chinook CWT goal of 10%, sampling levels were increased starting in 1998 and again in 2001.

D. CHUM AGE AND LENGTH COMPOSITION

1) Objective

The objective of this sampling activity is to estimate the age composition of the catch of chum salmon in Puget Sound. These data are crucial to the estimation of return by age class used in forecasting chum returns in Puget Sound. The forecast depends on an unbroken time series of return by age data. Each year's data contributes to three brood-year's return by age estimates, and so the loss of one year's sampling impacts three years.

2) Sampling unit

The basic sampling unit is one chum salmon.

3) Sample size

Sample size is 200 chum per area, commercial fishery, week, and gear. Gill net gear, Indian and non-Indian can be considered one gear stratum, but purse seines must be sampled separately.

4) Data collection and estimation

Chum age is determined by scale analysis. Samplers remove two scales per fish for analysis in the lab. Samples are combined from all sampled fisheries to estimate the total age composition.

Estimation of return by age class necessitates estimation of numbers by age for catch and escapement by stock. The Puget Sound chum salmon stocks are divided into several stocks by geographic and temporal characteristics. Estimation of brood year return requires that harvest and escapement in each year be allocated to age classes. These estimates, with parent year escapement and other auxiliary variables are used for forecasting return by age.

E. CHINOOK AGE AND LENGTH COMPOSITION

1) Objective

The objective of this sampling program is to estimate the age composition of chinook catch, especially the proportion of yearlings in Puget Sound recreational fisheries.

2) Sampling unit

The sampling unit is a chinook.

3) Sample size

All chinook in sport fisheries are sampled.

4) Data collection and estimation

Chinook age is determined by scale analysis. Samplers remove three scales per fish for analysis in the lab. Samples are combined from all sampled fisheries to estimate the total age composition.

Currently use of chinook salmon age composition in sport fisheries is limited. The major use of the data is made in chinook model evaluation. Primary focus of interest is the proportion of yearlings in sport catch.

F. OTHER STUDIES

The Puget Sound Sampling Program carries out other sampling related activities, as requested. Examples are genetic stock identification sampling (GSI), DNA sampling, shellfish sampling, and collection of commercial fish tickets.

G. IN-SEASON CATCH ESTIMATES

In 2004 we expect to conduct catch estimates during the Area 5 and 6 chinook selective fishery, the Area 5 coho selective fishery, the Elliott Bay chinook sport fishery, the Lake Washington sockeye fishery, the Nisqually chinook sport fishery, and the Skokomish chinook sport fishery.

1) Goal

Estimate harvest and effort in fisheries managed by a quota or ceiling and in some freshwater sport fisheries (see appendix for freshwater sample designs). Descriptions below pertain to the Area 5/6 and the Elliott Bay catch estimate. The Lake Washington sample design is currently under development.

2) Sampling Unit

The basic sampling unit is an angler trip.

3) Sampling Strata

Sampling is stratified into weekend and weekday periods.

4) Sample Size

Sampling size will be established based on previously tested designs for Terminal Area Fisheries and will be sufficient to provide total estimates of harvest and effort to be within 15% of the point estimate at a 95% confidence level.

5) Assumption

Boat survey is an unbiased estimate of proportion of anglers accessing fisheries from non-sampled sites.

The proportion of total effort accessing the fishery at site A represents the proportion of total catch landed at site A.

All anglers exiting at a sampled site are interviewed and all anglers accurately report their harvest.

6) Data Collection and Estimation

An exit survey method is the most efficient and least biased method of conducting catch estimates.

All anglers exiting a fishery at pre-selected high use sites are interviewed, thus providing a census of harvest and effort for that site on that day. Missed anglers are counted, and the average harvest per angler is used to estimate their harvest.

Sites are chosen for sampling according to their “size”. The size measure is the proportion of the effort that on average uses that site to access the fishery. Boat surveys are used to obtain size measure. Each boat survey covers the entire open area.

Entire days are sampled.

Total harvest is estimated first for each day, expanding over all sites. Then the daily average for weekend days and weekdays is estimated and expanded over all day in these two strata.

II. MONITORING SELECTIVE FISHERIES IN PUGET SOUND

A. INTRODUCTION

In order to minimize sport angler impact on weak wild coho and chinook salmon stocks, selective fisheries, where adipose marked coho/chinook are harvested while those with the adipose fin intact are required to be released, are being proposed for various areas in Puget Sound. If such fisheries are approved, it is desirable to monitor fisheries in-season to estimate how many salmon are being encountered, adipose mark rate by species, species composition of encounters, unmark retention error, legal/sub-legal rates of chinook, mortalities of retained and released salmon, as well as mortalities of marked and unmaked double index tag groups.

Conducting monitoring of this type requires new methods and additional resources. The existing sampling program, operating mostly at recreational boat launches, is not designed to measure all of these parameters adequately.

B. STUDY DESIGN

1) Objectives

a) Estimate the marked to unmarked proportion encountered in the fishery.

b) Estimate the number of salmon retained and released by species.

c) Estimate unmarked retention error.

d) Estimate the species composition.

e) Estimate legal/sub-legal rates of chinook

f) Estimate the mortality of retained and released salmon by marked/un-marked and legal/sub-legal status.

g) Estimate the mortality of marked and un-marked DIT groups

2) Sampling Strategies

A number of strategies will be employed to meet the sampling objectives. More than one strategy may be used by area to collect the necessary information (see table 3). Not each strategy is equally suitable to reach all stated sampling objectives. Fishing effort and success, the presence of charters, the cooperation of volunteers, etc., will determine which approach should be used to collect the necessary information. In areas with low coho/chinook catch, none of the strategies may provide enough information to get a good estimate of marked to unmarked rations. In these areas, rather than spending resources on hook-and-line test fisheries, we will use sampling resources to get the best possible dock-side sample of baseline information, CWTs and unmarked recognition error (see details below).

(a) Dock-Side Interviews:

Several of the parameters mentioned above have been estimated for years using dock-side angler interviews, such as the number of salmon released relative to the number of salmon retained and the number of chinook encountered relative to the number of coho. Unmarked retention error can be estimated with this method, by recording the number of unmarked and landed coho/chinook observed dock-side during a selective fishery for that species. Beginning in 1999 we also collect information about the mark status of coho/chinook released when under “wild coho/chinook release management”.

(b) Volunteer Trip Reports:

Anglers will be approached by WDFW with the request to fill out trip reports while fishing in selective fisheries. Volunteers will record the number of fish encountered by species, the number of fish dropped off, the number of marked and unmarked coho/chinook, as well as legal and sub-legal chinook.

(c) Charter Boat Ride-Alongs:

WDFW observers will record the outcome of each hook-up on a charter boat during a selective fishery. The following data will be collected: Date, area, species hooked, result of hook-up (fish landed, released, dropped-off), mark status, size (legal versus sub-legal), fish alive or dead at release. Any seabirds hooked or marine mammals encountered will also be documented. Sampling is conditional on a sufficient number of anglers fishing on charters.

(d) Hook-and-Line Test Fishery:

WDFW technicians conduct a recreational test fishery in selective fishing areas. These samplers observe the outcome of individual hook-ups and record all important fisheries parameters.

(e) Non-selective fisheries:

Marked to unmarked ratios from non-selective fisheries could be compared to adjacent selective fisheries, when appropriate.

3) Sample Size

Sample size is set at 100 coho/chinook encounters per area and week for coho and per area and month for chinook. In cases where samples are hard to obtain, strata may be combined to get the necessary sample size. In areas where the sample size cannot be achieved, we will concentrate our resources on dock-side sampling.

For the test fishery, the sampling goal is set at a minimum of 100 salmon encounters per stratum (management regime).

4) Assumptions

The major assumptions necessary are:

1. Test fishery and charter boat hook-ups are representative of the fleet.
2. Volunteers filling out trip reports fish in a manner representative of the fishing fleet.
3. Volunteers can correctly identify salmon and mark status.
4. Anglers provide accurate information.

5) Estimating Marked to Unmarked Proportion of Coho/Chinook

The marked to unmarked coho/chinook ratio, is the most important new information that will be collected for selective fisheries.

An independent estimate of marked to unmarked ratios, can be applied to information of the numbers of coho/chinook encountered and retained, collected during dock-side interviews, to compute estimates of marked to unmarked ratios of released coho and chinook.

*Marked Salmon Released = Number of Salmon Encounters * Proportion Marked – Marked Salmon Landed*

*Unmarked Salmon Released = Number of Salmon Encounters * Proportion Unmarked – Unmarked Salmon Landed*

All strategies from above can be used to get an estimate of marked to unmarked ratios.

Dock-side interviews and volunteer observers will be our primary source of information in areas with low, spread-out angler effort and success. WDFW samplers working at standard sampling sites will ask anglers if they would volunteer to make records of their next fishing trip (and subsequent trips thereafter). Volunteers will record information on every salmon encounter.

Volunteer trip reports will be compared to dock-side interviews and data from charter ride-alongs, and test fisheries to evaluate how representative they are for an area.

Another source of information of marked to unmarked coho/chinook ratios can come from non-selective fisheries in the vicinity of a selective fishery, e.g. southern area 11 ratios could be applied to area 13. Ratios from purse seine fisheries, if representative of the ratios in the sport fishery, can also be a source of data.

6) Estimate the Number of Coho/Chinook Retained and Released

Information of the number of coho/chinook retained and released will be provided using dock-side interview information.

7) Estimate Unmarked Retention Error

Unmarked retention error occurs when anglers land unmarked salmon during a mark selective fishery for that species. Unmark retention error is defined as the number of unmarked salmon landed relative to the number of unmarked salmon encountered. A special effort will be made to get a good dock-side estimate of unmarked retention error to validate model inputs of selective fisheries in Puget Sound. Additional samplers will be available to boost dock-side sampling rates.

Unmarked salmon concealed by anglers that are aware of non-compliance will not be detected with dock-side sampling.

8) Estimate the Number of Salmon Encountered by Species

Information of the number of salmon encountered (retained plus released) by species has been collected for several years during dock-side interviews. Interview information will be used when providing encounters by species. This information is also collected during sampling methods 2-4.

9) Legal/Sub-Legal Rates of Chinook

The proportions of legal versus sub-legal chinook encountered will be estimated using test fishing information.

10) Mortality of Retained and Released Salmon by Marked/Un-marked and Legal/Sub-legal Status

In catch record card areas without test fishing and insufficient voluntary trip report data, the mortality will be computed applying a release mortality to released marked and un-marked salmon and adding this mortality to marked and unmarked catch. Releases of unknown mark status will be apportioned using the mark rate in the fishery.

In Areas with sufficient test fishing or VTR data the proportions marked/legal, marked/sub-legal, un-maked/legal, un-marked/sub-legal from test fishing or trip reports will be applied to encounters, in order to compute these ratios for the number of fish released. A release mortality is then applied to the releases by group and added to the catches.

11) Mortalities of Marked and Un-marked Double Index Tag (DIT) Groups

At least 10% of the fishery will be sampled for coded wire tags with a goal of 20% for any chinook selective fisheries. Recovered DITs from marked salmon will be expanded by the sampling rate to compute the mortality of the group. The mortality of the unmarked DIT group will be computed by applying a release mortality to the expanded, marked DIT group after multiplying the group by lamda (un-marked/marked ratio). Lamda at release will be used whenever appropriate to approximate the ratio in the fishery.

Table 3: Monitoring Selective Recreational Fisheries in Puget Sound

Area	Strategies
5	Test fishery Charter ride-alongs (if available) Volunteer Trip Reports
6	Volunteer Trip Reports

	Charter ride-alongs (if available) Test fishing
7	Volunteer Trip Reports Mark Ratio from Treaty Gill Net Fishery
8.1	Volunteer Trip Reports
8.2	Volunteer Trip Reports Charter ride-alongs
9	Volunteer Trip Reports Charter rid-alongs (if available) Test fishing
10	Volunteer Trip Reports Charter ride-alongs (if available) Test fishing
11	Volunteer Trip Reports
12	Volunteer Trip Reports Boost sampling rates
13	Volunteer Trip Reports

C. SAMPLING PLAN FOR PROPOSED SELECTIVE CHINOOK FISHERIES IN AREAS 5 – 13, OCTOBER, 2005 THROUGH APRIL, 2006

Our major strategy for sampling the proposed selective chinook fisheries is through dock-side interviews. WDFW will collect information on effort, retained catch, released catch, as well as mark rate information of all chinook and coho encountered. WDFW intends to increase chinook sampling rates during the proposed time period to 20%. This will be achieved by adding sampling staff.

Table 4: Number of Staff Sport Sampling by Area and Month during a Non-Selective Chinook Fishery and during a Selective Chinook Fishery

Month	Straits Staff Non Selective	Straits Staff Selective	North Sound Non Selective	North Sound Staff Selective	Mid Sound Staff Non Selective	Mid Sound Staff Selective	South Sound Staff Non Selective	South Sound Staff Selective
Oct	3	4	4	4	4	4	5	5
Nov	1.5	3	3.5	3.5	3	4	5	5
Dec	1	3	3	3	3	4	3	4
Jan	1	3	3	3	3	4	3	4
Feb	1.5	3	3	3	3	4	3	4
Mar	2	3	3	3	3	4	3	4
April	2	3	3	3	3	4	3	4

The Puget Sound Sampling program will collect mark rate information using the following strategies (see above).

1. Dock-side Sampling
2. Test Fishing
3. Charter Ride-Alongs
4. Volunteer Trip Reports

WDFW will add two test fishing boats during the October through April time period to collect encounter rate and mark rate information. Technicians will take lengths, scale and DNA samples. The test boats will operate in areas where sport and test catches would be high enough to warrant test fishing. Core test fishing areas would be Areas 6, 7, 8.2, 9, 10 and 11.

2004 Chinook Selective Fishery,
Marine Areas 5 and 6

By

Steven L. Thiesfeld
Angelika Hagen-Breaux

January 14, 2005

Washington Department of Fish and Wildlife
Fish Program
600 Capitol Way North
Olympia, Washington 98501

EXECUTIVE SUMMARY

During the summer of 2004, the second year of a pilot recreational Chinook salmon *Oncorhynchus tshawytscha* ("Chinook") fishery that was limited to retention of marked (adipose clipped) hatchery Chinook salmon occurred in Marine Area 5 and the western portion of Marine Area 6 in Puget Sound. Objectives were: 1) increase meaningful recreational opportunity while meeting conservation goals for Puget Sound Chinook salmon defined by the Puget Sound Chinook Harvest Management Plan; and 2) collect information necessary to enable evaluation and planning of future potential Chinook mark-selective fisheries. Marine Areas 5 and 6 are located in Washington waters of the Strait of Juan de Fuca. The Chinook Selective Fishery was scheduled to begin on July 1, 2004 and continue through August 10 (41 days) or until a quota of 3,500 Chinook was kept, whichever occurred first. The fishery started on July 1, 2004 and ran continuously for 39 days through August 8.

We estimated that anglers made 29,425 trips during the Chinook Selective Fishery (July 1 – August 8). Those anglers kept an estimated 3,576 Chinook and 9,537 coho salmon *O. kisutch* ("coho"). Area 5 accounted for 86% of the effort (25,174 angler trips) and 81% of the Chinook kept (2,900) for a rate of 0.12 Chinook kept per angler trip. Area 6 accounted for 4,251 angler trips and 676 Chinook kept for a higher catch rate of 0.16 Chinook kept per angler trip. Based on creel surveys, Area 5 anglers released an estimated 12,392 Chinook, 25,800 coho, and 113 other or unidentified salmon. Area 6 anglers released an estimated 1,409 Chinook, 126 coho, and 3 other or unidentified salmon.

During the Chinook Selective Fishery (July 1-August 8), samplers fishing from the test boats landed 169 Chinook in Area 5 and 148 Chinook in Area 6. In Area 5, 92% of the Chinook encountered and landed by the test boat were caught using downriggers, even though they were only fished 69% of the time. In Area 6, all the Chinook encountered and landed by the test boat were caught using downriggers, even though they were only fished 78% of the time. Utilizing other gear types resulted in fewer encounters and fewer biological samples for both areas than would have occurred if the test boats had used downriggers exclusively as they did in 2003.

During the Chinook Selective Fishery time period, 44% of the legal-size fish caught by test boats were marked in Area 5 and 48% of the legal-size Chinook were marked in Area 6. The mark rate on sublegal-size Chinook was 36% (n=59) for Area 5, but only five sublegal-size Chinook were caught by the test boat in Area 6. Chinook caught on test boats were larger in Area 6 than in Area 5. The percent of legal-size chinook (22" or larger) was significantly different (X^2 = 49.8, $\rho < 0.0001$) between Area 6 (97%) and Area 5 (65%).

During the 2004 Chinook Selective Fishery only 35 Chinook were reported landed in Area 5 on Voluntary Trip Reports (VTR's) turned in by anglers, while 112 Chinook were reported landed on VTR's in Area 6. During the Chinook Selective Fishery time period, 40% of the legal-size Chinook were reported as marked in Area 6, which was lower than the mark rate from test fishing.

Twenty-nine double index coded wire tags were recovered in Areas 5 and 6 from July 1 through August 8. Based on the proportion of the catch that was sampled and the ratio of marked to

unmarked double index coded wire tagged Chinook for each hatchery, we estimated that anglers caught and released 95 legal-size, unmarked double index tagged Chinook, and that the additional mortality of unmarked legal-size double index tagged Chinook due to this selective fishery compared to a non-selective fishery was 10 fish.

Test boat catches consistently showed a higher mark rate than reported from the creel survey and the VTR's. We felt the mark rates from the test boats were the best estimate of the true mark rate. Using the total number of Chinook encounters from the creel survey (17,377) and apportioning into four categories of legal-size marked, legal-size unmarked, sublegal-size marked, and sublegal-size unmarked based on test fishing results, suggests that anglers released 1,834 legal-size and marked Chinook, or 34% of the fish they could have kept. We also estimated the number of encounters by assuming that anglers kept all Chinook that were legal-size and marked, and estimating the number of fish in the other three categories based upon the proportions they were caught in the test boats. Using this method, we estimated the total encounters at 11,481 Chinook. It appears unrealistic that anglers released one-third of the fish that were legal to keep, and it is also unrealistic that all legal fish were kept. The true number of encounters likely lies between the two estimates of encounters, i.e. between 11,481 and 17,377 Chinook.

Using the encounters from the creel survey (apportioned by category based on test fishing) and a release mortality rate of 15% for legal-size fish and 20% for sublegal-size fish, we estimated the total mortalities of Chinook in the selective fishery at 5,870, of which 1,676 were unmarked. Using the encounters estimated by assuming anglers kept all legal fish and a release mortality rate of 15% for legal-size fish and 20% for sublegal-size fish, we estimated total mortalities at 4,910 fish, of which 1,109 were unmarked fish.

Based on the estimated number of total encounters from the creel survey (the highest number) and apportioning them based on the test boat catch rates, we estimated the 2004 fishery encountered 7,498 unmarked legal-size Chinook and 1,738 unmarked sublegal-size Chinook. These estimates are below the predicted encounters of 7,993 unmarked legal-size Chinook and 4,935 unmarked sublegal-size Chinook as produced in the final pre-season run of the Fishery Regulation Assessment Model (FRAM).

Compliance with existing regulations, and the regulation prohibiting bringing unmarked salmon on board a vessel, was considered an integral part of a successful fishery. No citations or warnings were issued for retention of unmarked Chinook, nor were any warnings or citations issued for bringing an unmarked salmon on board a vessel.

In summary, the second year of the pilot marine Chinook selective fishery was successful with respect to the objective of increasing meaningful recreational opportunity within conservation constraints for Puget Sound Chinook. Anglers were allowed to fish for and retain Chinook for 39 days in Areas 5 and 6, compared with only 10 days and 5 days in Area 5 in 2001 and 2002, respectively. Angler effort in Area 5 was double the effort in 2002 during the same time frame. Using data from the test fishery sampling during the Chinook Selective Fishery, nearly half, or one in two, of the legal-size Chinook encountered were marked and could be retained by anglers.

The pilot fishery was also successful with respect to the objective of implementing monitoring and sampling programs to obtain management information for evaluation and planning of potential future selective Chinook fisheries. Estimated encounters were less than pre-season predictions. Compliance with fishing regulations was good during the fishery. The number of mortalities of unmarked double index coded wire tagged fish was negligible.

INTRODUCTION

In recent years, abundant runs of hatchery salmon have been mixed with depressed runs of wild salmon in the Northwest in both marine and freshwater environments. Providing opportunities to harvest those abundant hatchery stocks while protecting wild stocks has been challenging. One tool for allowing harvest of abundant hatchery fish while limiting impacts on wild stocks is "Selective Fishing". In recreational selective fisheries, anglers are generally allowed to retain fin clipped ("marked") hatchery fish and are required to release unclipped ("unmarked") fish. These unmarked fish are typically wild fish, but also include some unmarked hatchery fish. While selective coho salmon *Oncorhynchus kisutch* ("coho") fisheries have occurred in Oregon, Washington, and British Columbia at various times since 1998, and selective Chinook salmon *O. tshawytscha* ("Chinook") fisheries have occurred in freshwater areas since 2000, a selective Chinook fishery had not been conducted in marine waters prior to 2003.

During the summers of 2003 and 2004, a selective Chinook recreational fishery was implemented in waters of the Strait of Juan de Fuca with the objectives of: 1) increasing meaningful recreational opportunity while meeting conservation goals for Puget Sound Chinook salmon defined by the Puget Sound Chinook Harvest Management Plan; and 2) collecting information necessary to enable evaluation and planning of future potential Chinook mark-selective fisheries. The Northwest Treaty Tribes and the Washington Department of Fish and Wildlife (WDFW) reached agreement to consider selective Chinook sport fishing in this area for the 2003 and 2004 seasons as part of a pilot program. It was thought that a pilot fishery limited in time and area, as described below, would allow managers to evaluate the success of the fishery and the monitoring and sampling programs.

The 2004 Chinook Selective Fishery started on July 1, 2004 and ran continuously through August 8, 2004 in Marine Area 5 and the western portion of Marine Area 6. Marine Areas 5 and 6 (hereafter: Areas 5 and 6) are located in Washington waters of the Strait of Juan de Fuca, running from the Sekiu River easterly to Low Point, and from Low Point to approximately Whidbey Island, respectively (Figure 1). Chinook selective fishing in Area 6 was open only from Low Point easterly to Ediz Hook because the eastern portion of Area 6 has many more boat ramps and other access points, and would have required substantially more sampling effort to obtain precise estimates of harvest and effort. Additional closures to help achieve fishery objectives were established: 1) in the eastern half of Marine Area 4; 2) near the mouths of the Sekiu and Hoko rivers; 3) near the mouth of the Elwha River; and 4) in Port Angeles Harbor.

Anglers were allowed to retain two marked (adipose fin clipped) Chinook salmon $\geq$ 22" (56 cm) as part of their daily limit, and were required to immediately release, unharmed, any unmarked Chinook caught. Integral to the selective fishery was a new salmon handling regulation starting in 2003 stating, "Any salmon to be released may not be brought on board a vessel." This regulation was modified slightly and applied throughout Puget Sound in 2004, including Areas 5 and 6. The 2004 regulation stated "It is illegal to bring a wild salmon, or a species of salmon, aboard a vessel if it is unlawful to retain those salmon. "Aboard a vessel" was defined as "inside the gunwale". During the Chinook Selective Fishery anglers were also allowed to retain pink *O. gorbuscha* ("pink"), sockeye *O. nerka*, and marked hatchery coho salmon.

The 2004 season was scheduled to run from July 1, 2004 through August 10, 2004 (41 days), or until a quota of 3,500 hatchery Chinook salmon was caught and retained by anglers. The fishery was closed by emergency regulation effective at 11:59 p.m., August 8, 2004 because the quota was reached.

A preliminary analysis of the 2003 Chinook Selective Fishery was completed and is reported by Thiesfeld and Hagen-Breaux (2004). This report focuses on methods and results from 2004.

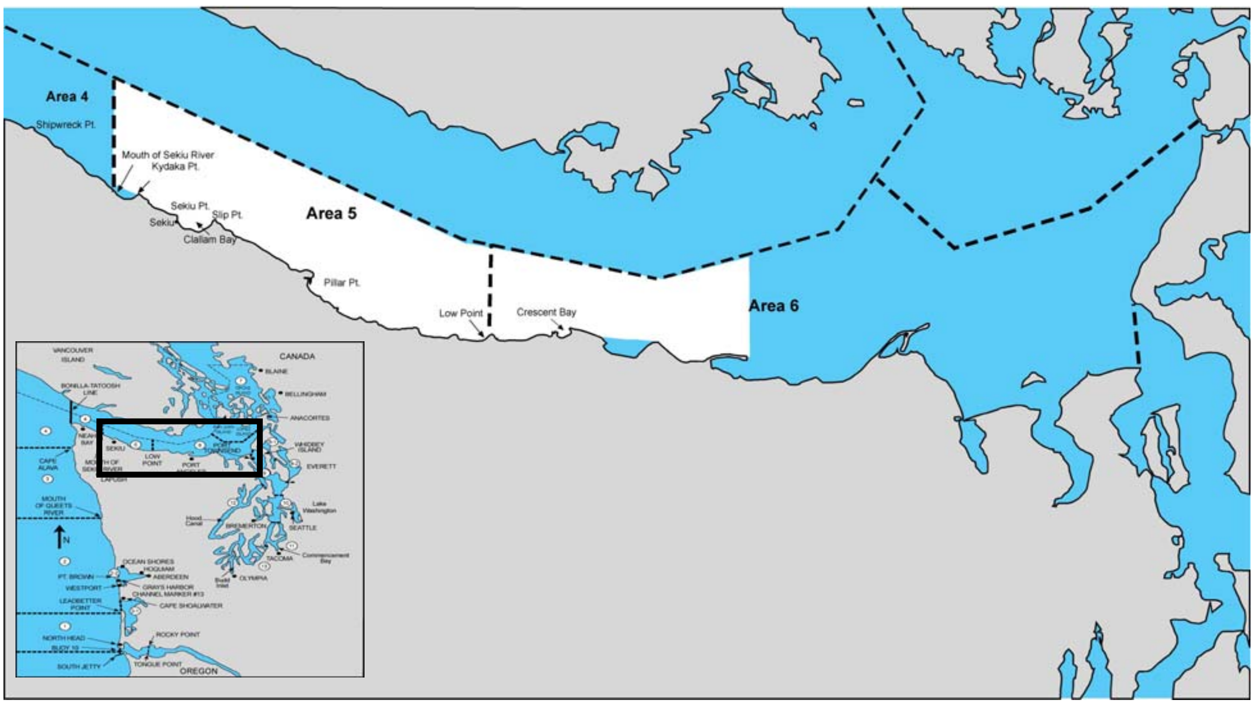

Figure 1. Location of the 2004 Chinook Selective Fishery (shown in white) in Marine Areas 5 and 6.

METHODS

Methods in 2004 were similar to those in 2003; a detailed description of which is available in Thiesfeld and Hagen-Breaux (2004). We describe only changes to methods here, or methods that needed elaboration from those presented in the 2003 report.

Access Site Size Determination

Between July 1 and August 8, five surveys were conducted by boat in Area 5, and seven surveys in Area 6, to determine the proportion of effort (or "size") for each access site.

Angler Interviews

Samplers collected scales and fork lengths measured to the nearest centimeter from randomly selected Chinook. Samplers collected scales and lengths from 404 Chinook in Area 5 and from 269 Chinook in Area 6. Fork lengths were converted to total lengths for analysis using the recommended equations presented in Conrad and Gutmann (1996). Because we measured fork length to the nearest centimeter and the minimum size of Chinook that anglers could retain was set in total length at exactly 22" (559 mm), and because of the variability associated with determining a conversion factor, some of the measured fish were actually legal-size if total length was measured, but were classified as sub-legal based on measuring fork length and then converting to total length. In addition, some anglers retained fish that were clearly sub-legal size. For this document, fish that were clearly sub-legal, and sub-legal size fish that may have been legal-size if total length was measured, were considered legal-size fish, but we footnoted the tables where a portion of the legal-size harvest was potentially sub-legal size.

Anglers on all boats were surveyed from a selected set of two docks or access points per area during a day; except that if some boats and anglers could not be surveyed, the boats were enumerated and harvest and effort data were expanded to account for the missed boats. During the Chinook Selective Fishery, only 39 boats were missed in Area 5 while 2,593 were interviewed, and one boat was missed in Area 6 while 1,024 were interviewed.

As time permitted, surveyors also randomly recorded the predominant (based on time) angling method used by the boat being interviewed according to the following categories: weight and bait (either mooching or trolling), downrigger trolling, trolling with divers, jigging, or other (e.g. fly fishing). After July 18, data was summarized only for those boats that actually encountered Chinook. Test fishing boats used results of the angling method survey in order to more accurately represent the fishery (see Test Fishing).

Test Fishing

One test boat fished out of Sekiu (Area 5) from July 1 through September 26, and one boat fished out of Port Angeles (Area 6) from July 1 through August 8. Both the Sekiu boat and the Port Angeles boat fished 38 of the 39 open days during the Chinook Selective Fishery.

Samplers attempted to capture Chinook from July 1 through August 8 through their choice of area to fish, depth, gear type and fishing methods. Samplers attempted to fish with gear types in the same proportion of time as anglers were fishing that gear based on the angler interviews (see Angler Interviews).

We used a simple season long average to estimate mark rates of legal-size and sub-legal size fish. We calculated a rate weighted by weekly catch to determine the proportion of fish that were legal-size and marked, legal-size and unmarked, sublegal-size and marked, and sublegal-size and unmarked.

Voluntary Trip Reports

We used a simple season long average to estimate mark rates of legal-size and sub-legal size fish. We calculated a rate weighted by weekly catch to determine the proportion of fish that were legal-size and marked, legal-size and unmarked, sublegal-size and marked, and sublegal-size and unmarked.

Coded Wire Tag Impacts

To determine the number of additional mortalities of unmarked double index coded wire tagged Chinook resulting from the selective fishery, we analyzed recovered coded wire tags and separated out tags from double index groups. We then utilized the methods described by WDFW (2002) to estimate the number of unmarked Chinook with double index tags that would have been encountered, and applied a 10% selective fishing mortality rate to estimate the number of mortalities. We used 10% instead of 15% because drop off mortality would occur to both marked and unmarked fish equally. Because the fishery sampling rate changed throughout the fishery and among areas, we estimated encounters and mortalities for each recovered double index tag individually, and then summed the estimated mortalities for each hatchery and brood year. Variance was also estimated with methods described by WDFW (2002), and was estimated for individual tags, then summed for each hatchery and brood year.

The estimate of unmarked mortalities was calculated by:

$$\hat{U}_a^{MSF} = \lambda^{REL} \hat{M}_a^{MSF} sfm$$

with associated variance:

$$Var(\hat{U}_a^{MSF}) \approx \left(\lambda^{REL}\right)^2 sfm^2 \hat{M}_a^{MSF} \frac{1-s}{s}.$$

where:

sfm = selective fishing mortality rate,
$U_{a,i}^{MSF}$ = aged a unmarked but tagged mortalities from stock i in the mark-selective fishery,
$M_{a,i}^{MSF}$ = aged a marked and tagged mortalities from stock i in the mark-selective fishery,
s = sampling rate of the catch,
λ^{REL} = unmarked to marked ratio at release for fish in a DIT group, and
V(U) = variance of estimator U.

Total Encounters and Mortalities

We calculated total encounters and mortalities two ways. These two estimates result in a range of encounters and mortalities. First, total encounters from the creel survey were apportioned into four categories (legal-size and marked, legal-size and unmarked, sublegal-size and marked, and sublegal-size and unmarked) based on the weighted rates each of those categories of fish were captured by test boats. For example, if 20% of the Chinook caught by the test boat in Area 5 were legal-size and unmarked, then we estimated that 20% of the Chinook encountered in Area 5 were legal-size and unmarked. We then subtracted the known harvest of each category to estimate the number of releases by category. Release mortality rates of 15% and 20% were applied to legal and sublegal releases, respectively, to estimate the number of released fish that died. We then summed the estimated harvest and estimated release mortalities for a total estimated mortality for each Area. Variance was calculated as:

$$V(TM_{ijk}) = (1 - sfm_i)^2 * V(C_{ijk}) + (E_k^{\;2} * V(TFP_{ijk}) + V(E_k) * TFP_{ijk}^{\;2}) * sfm_i^{\;2}$$

where:

Tm_{ijk} = Total mortality in size group *i* (legal or sublegal), mark status *j* (marked or unmarked) and area *k* (5 or 6),
sfm_i = selective fishing mortality rate in size group *i* (legal or sublegal),
$V(C_{ijk})$ = variance of retained catch in size group *i*, mark status *j*, and area *k*,
C_{ijk} = retained catch in size group *a*, mark status *b*, and area *i*,
E_k = total encounters in area *k*,
$V(TFP_{abi})$ = variance of the proportion of test boat catch in size group *i*, mark status *j*, and area *k*,
$V(E_k)$ = variance of total encounters in area *k*, and
TFP_{ijk} = proportion of test boat catch in size group *i*, mark status *j*, and area *k*,

Secondly, we estimated the total encounters by assuming that anglers kept all legal-size marked Chinook, and divided the number of legal-size marked fish kept by the proportion of the test boat catches those fish represented for each area. The total encounters were then apportioned into the same four categories used in the previous method based on the proportion of the test boat catches each category represented.

RESULTS AND DISCUSSION

Effort and Catch

We estimated that anglers made 29,425 trips during the Chinook Selective Fishery (July 1 – August 8, statistical weeks 27 - 32; see Appendix A for dates associated with statistical weeks). Those anglers kept an estimated 3,576 Chinook 9,537 coho and 33 pink (Table 1). Area 5 accounted for 86% of the effort (25,174 angler trips) and 81% of the Chinook kept (2,900) for a rate of 0.12 Chinook kept per angler trip. Area 6 accounted for 4,251 angler trips and 676 Chinook kept for a higher catch rate of 0.16 Chinook kept per angler trip. Based on interviews, Area 5 anglers released an estimated 12,392 Chinook, 25,800 coho, 37 pink, and 113 other or unidentified salmon. Also based on interviews, Area 6 anglers released an estimated 1,409 Chinook, 126 coho, 3 pink, and 3 other or unidentified salmon. The total of 25,174 angler trips in Area 5 was more than double the effort observed during a similar period in 2002. From July 1 through August 9, 2002, anglers made 11,883 trips in Area 5 to catch 1,792 Chinook.

Effort was initially high in Area 5, declined during the third week of the season, and then rose modestly during the last week of the Chinook Selective Fishery (Figure 2). In Area 6, there was no real trend to effort (Figure 3). Chinook harvest essentially declined throughout the fishery in Area 5, except for a slight increase during the last week of July (Figure 4). As with effort, there wasn't much of a trend for harvest in Area 6, except that harvest was generally higher during the last half of the season versus the first half (Figure 5). The number of Chinook kept per angler in Area 5 was fairly consistent during the fishery (Figure 6). The number of Chinook kept per angler was initially high in Area 6, but declined dramatically during mid-July, before rebounding during the last half of the season (Figure 7).

A total of 3,576 Chinook were kept during the Chinook Selective Fishery. Of this total, 3,571 were marked and 5 were unmarked (Table 2). Based on angler interviews, a total of 13,802 Chinook were released during the fishery based on angler interviews and the appropriate expansions. We estimated that anglers encountered 15,292 Chinook in Area 5 and 2,085 in Area 6, for a total of 17,377 encounters. Angler interview data suggested that only 24% of the fish were marked in Area 5 and only 33% were marked in Area 6. Nearly 90% of the unmarked Chinook caught and released by anglers were caught in Area 5 (Table 3). Weekly sampling data and estimates are presented in Appendix Tables B, C, D and E.

Table 1. Recreational salmon catch estimate during the Chinook Selective Fishery in Marine Areas 5 and 6, July 1 through August 8, 2004. The released numbers are based on angler interviews. Values may not add exactly due to rounding error.

	Trips		Harvested			Released			
Fishery	Boats	Anglers	Chinook	Coho	Pink	Unidentified or Other	Chinook	Coho	Pink
Area 5	10,709	25,174	2,900	9,459	30	113	12,392	25,800	37
Area 6	2,251	4,251	676	78	3	3	1,409	126	3
Total	12,960	29,425	3,576	9,537	33	116	13,802	25,926	40

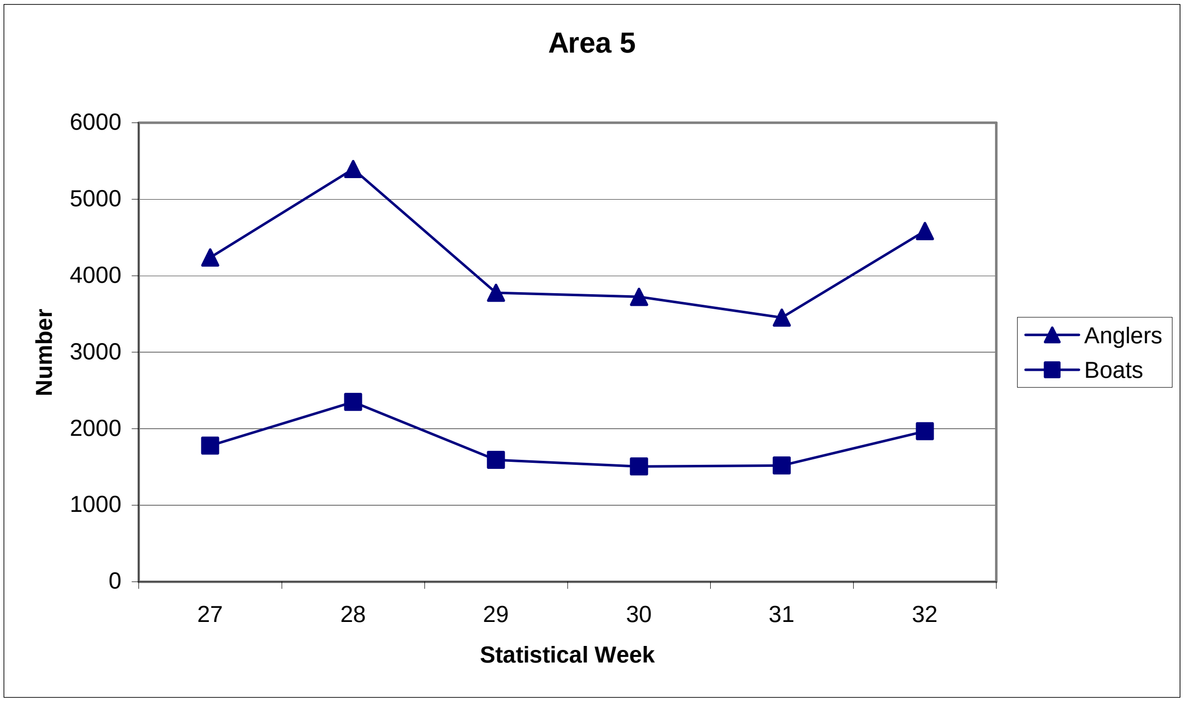

Figure 2. Weekly angler effort in Marine Area 5 for the 2004 Chinook Selective Fishery, July 1 through August 8, 2004. Note the first week includes only four days.

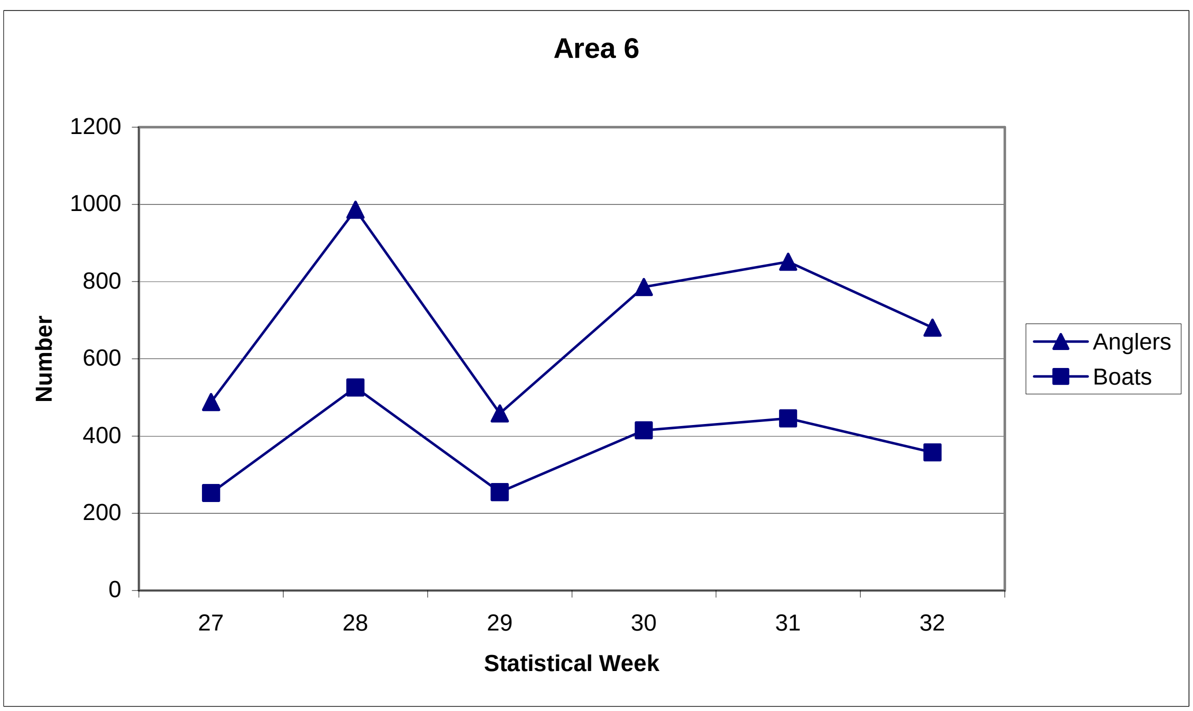

Figure 3. Angler effort in Marine Area 6, by week, for the 2004 Chinook Selective Fishery, July 1 through August 8, 2004. Note the first week includes only four days.

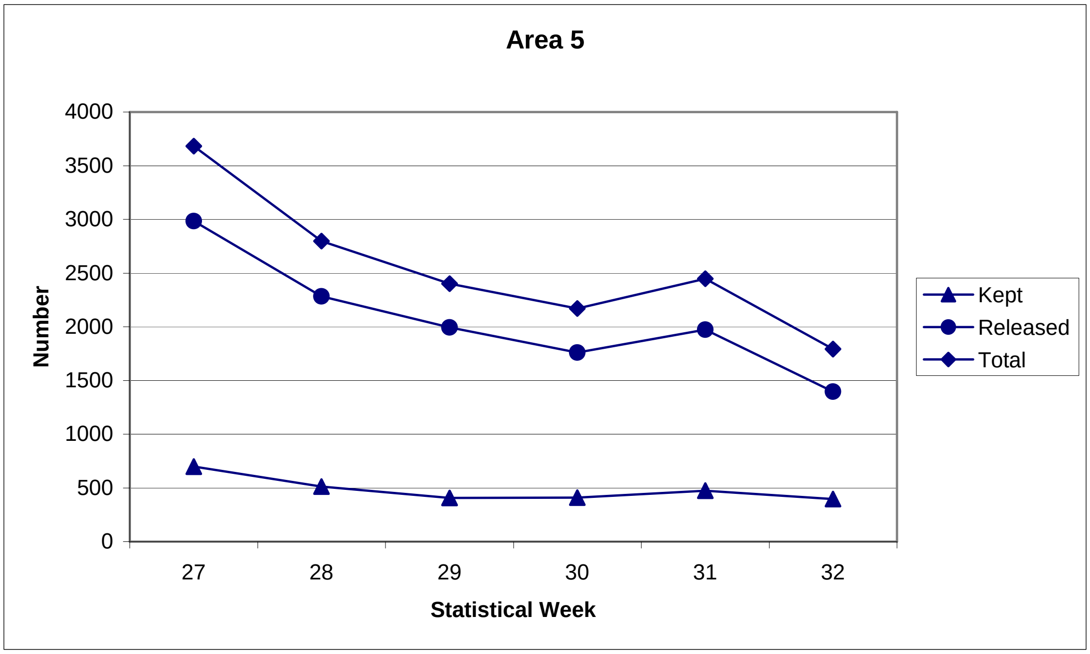

Figure 4. Catch of Chinook salmon from angler interviews in Marine Area 5, by week, for the 2004 Chinook Selective Fishery, July 1 through August 8, 2004. Note the first week includes only four days.

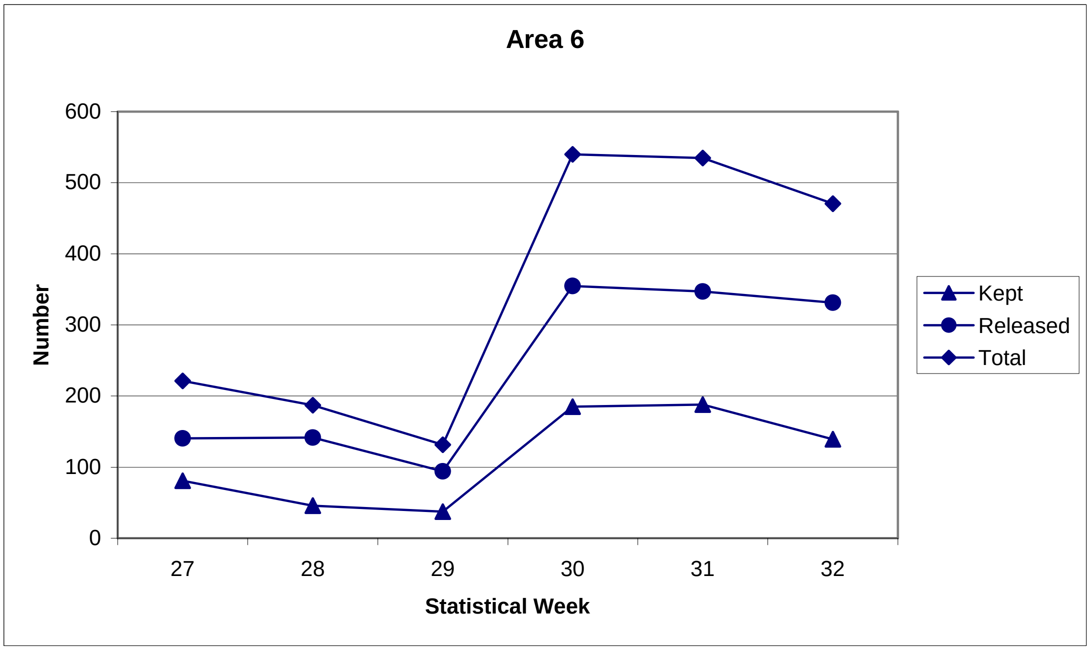

Figure 5. Catch of Chinook salmon from angler interviews in Marine Area 6, by week, for the 2004 Chinook Selective Fishery, July 1 through August 8, 2004. Note the first week includes only four days.

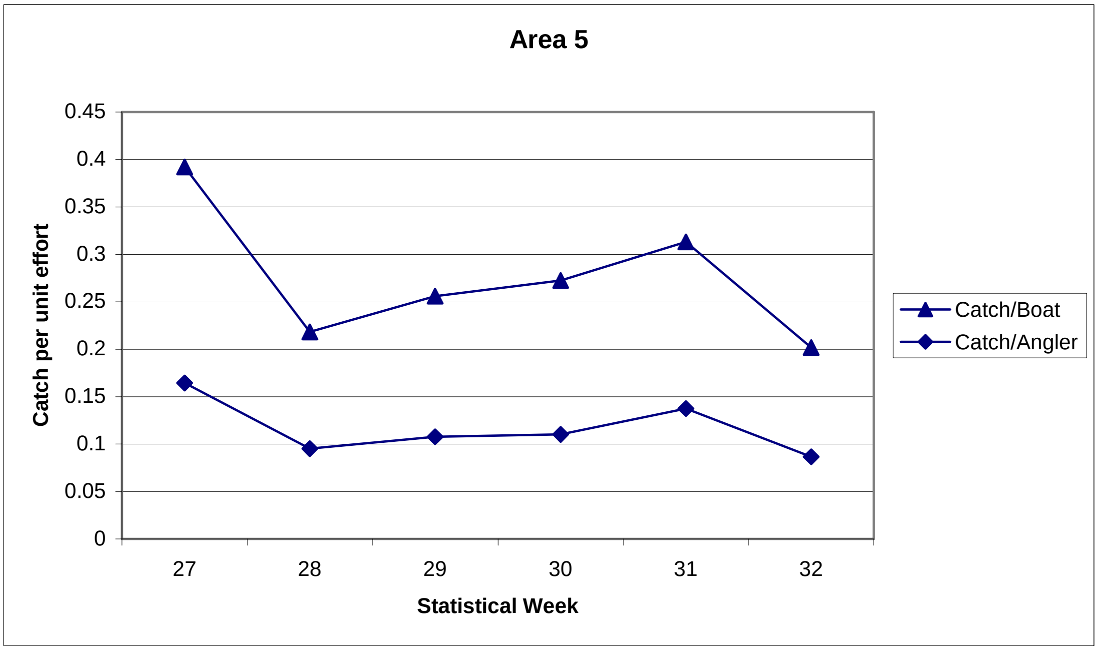

Figure 6. Catch per unit effort for kept Chinook salmon in Marine Area 5, by week, for the 2004 Chinook Selective Fishery, July 1 through August 8, 2004. Note the first week includes only four days.

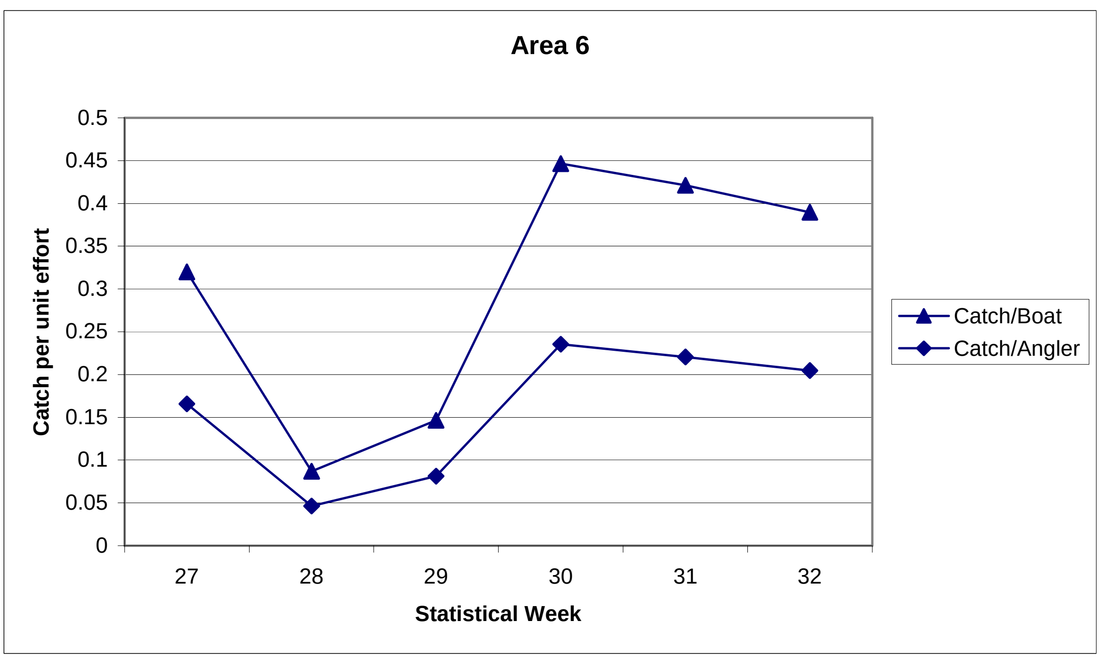

Figure 7. Catch per unit effort for kept Chinook salmon in Marine Area 6, by week, for the 2004 Chinook Selective Fishery, July 1 through August 8, 2004. Note the first week includes only four days.

Table 2. Estimates of Chinook kept and released, by mark status, during the Chinook Selective Fishery in Marine Areas 5 and 6, July 1 through August 8, 2004. Data are from creel surveys. Values may not add exactly due to rounding error.

	Total Kept	Marked Kept	Unmarked Kept	Total Released	Marked Released	Unmarked Released	Unknown Released	Total Encounters
Area 5	2,900[a]	2,900	0	12,392	806	10,836	750	15,292
Area 6	676[b]	671	5	1,409	23	1,337	50	2,085
Total	3,576			13,802				17,377

a. Includes up to 194 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.
b. Includes up to 3 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.

Table 3. Summary of creel survey estimates of marked and unmarked Chinook catch and variances (in parentheses) during the Chinook Selective Fishery in Marine Areas 5 and 6, July 1 through August 8, 2004. Values may not add exactly due to rounding error.

	Chinook Kept			Chinook Released			
Area	Marked	Unmarked	Total	Marked	Unmarked	Unknown	Total
5	2,900[a]	0	2,900	806	10,836	750	12,392
	(51,584)	(0)	(51,584)	(18,105)	(728,746)	(31,297)	(778,148)
6	671[b]	5	676	23	1,337	50	1,409
	(4,301)	(9)	(4,310)	(35)	(16,238)	(358)	(16,631)
5 and 6 Combined	3,571	5	3,576	829	12,173	800	13,802
	(55,885)	(9)	(55,894)	(18,140)	(744,985)	(31,654)	(794,779)

a. Includes up to 194 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.
b. Includes up to 3 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.

Test Fisheries

Test boats attempted to replicate the fishing methods used by anglers encountering Chinook by utilizing fishing methods in the same proportions reported by anglers. Weather and concentrations of spiny dogfish *Squalus acanthias* caused some adjustments to the projected schedule. However, samplers attempted to follow the schedule as best as possible. Downriggers were the most commonly used method by anglers in both areas, followed by bait (Table 4) and therefore were the most commonly used method by samplers fishing from the test boats (Table 5). Test boats fished bait less time than anglers did, and fished downriggers more often than anglers did. Bait was especially under-represented in Area 6 where dogfish concentrations were particularly troublesome.

During the Chinook Selective Fishery (July 1-August 8), samplers fishing from the test boats landed 169 Chinook in Area 5 (Table 6) and 148 Chinook in Area 6 (Table 7). In Area 5, 92% of the Chinook encountered and landed by the test boat were caught using downriggers, even though they were only fished 69% of the time. In Area 6, all the Chinook encountered and landed by the test boat were caught using downriggers, even though they were only fished 78% of the time. Utilizing other gear types resulted in fewer encounters and fewer biological samples for both areas than would have occurred if the test boats had used exclusively downriggers as they did in 2003.

During the Chinook Selective Fishery time period, 44% of the legal-size fish were marked in Area 5 and 48% of the legal-size Chinook were marked in Area 6 (Table 8). Based on these data, anglers could retain nearly one of every two legal-size Chinook they encountered during the fishery. The mark rate on sublegal Chinook was 36% (n = 59) for Area 5, but only five sublegal Chinook were encountered in Area 6 (Table 8). With the exception of week 27, mark rates for legal-size Chinook were very similar in both areas from week to week during the Chinook Selective Fishery (Figure 8). The mark rate decreased in both areas after the first week of the fishery, and then doubled from mid-July to late July (statistical weeks 29 - 31), before declining during the last week of the season.

Chinook caught by test boats were larger in Area 6 than in Area 5 (Figures 9 and 10). The percent of fish that were legal size (22" or larger) was significantly different ($X^2 = 49.8$, $\rho < 0.0001$) between Area 6 (97%) and Area 5 (65%). The average size of fish in Area 5 was 67 cm with a minimum of 37 cm and a maximum of 109 cm (n = 169), while the average size in Area 6 was 82 cm with a minimum of 49 cm and a maximum of 113 cm (n = 148).

Table 4. Percent of time that anglers fished various methods during the Chinook Selective Fishery in Marine Areas 5 and 6, July 1 through August 8, 2004.

	Area 5				Area 6				
Dates	Weight and Bait	Down-rigger	Jig	Diver	Weight and Bait	Down-rigger	Jig	Diver	Other
July 1 – July 18	24	67	2	7	31	45	18	3	3
July 19 – August 8	32	62	2	3	25	53	21	1	0

Table 5. Percent of time that test boats fished various methods during the Chinook Selective Fishery in Marine Areas 5 and 6, July 1 through August 8, 2004.

	Area 5				Area 6			
Statistical Week	Weight and Bait	Down-rigger	Jig	Diver	Weight and Bait	Down-rigger	Jig	Diver
27	0	100	0	0	0	100	0	0
28	0	100	0	0	0	100	0	0
29	18	47	18	16	21	53	24	2
30	29	65	2	4	14	62	24	0
31	29	65	2	4	13	72	13	2
32	29	65	2	4	0	100	0	0
Weighted Average	21	69	5	5	9	78	12	1

Table 6. Catch data and calculations used to estimate weekly weighted mark rate and variance for Chinook salmon caught on test boats during the Chinook Selective Fishery in Marine Area 5, July 1 through August 8, 2004. Upper table shows the catch by week. Middle table shows the rates of marked and unmarked fish by week. Bottom table shows the weekly rate weighted (multiplied) by proportion of the total catch, and a season-long weighted mark rate (sum of the weekly data).

		Week						
Size	Mark Status	27	28	29	30	31	32	Total
Legal	Marked	5	6	3	10	17	7	48
	Unmarked	9	12	6	8	10	17	62
Sublegal	Marked	2	1	3	0	9	6	21
	Unmarked	0	2	8	5	18	5	38

	Week					
Weekly Rates multiplied by Catch	27	28	29	30	31	32
Legal Mark Rate	0.357	0.333	0.333	0.556	0.630	0.292
Sublegal Mark Rate	1.000	0.333	0.273	0.000	0.333	0.545
Combined Mark Rate	0.438	0.333	0.300	0.435	0.481	0.371
Proportion Legal and Marked	0.313	0.286	0.150	0.435	0.315	0.200
Proportion Legal and Unmarked	0.563	0.571	0.300	0.348	0.185	0.486
Proportion Sublegal and Marked	0.125	0.048	0.150	0.000	0.167	0.171
Proportion Sublegal and Unmarked	0.000	0.095	0.400	0.217	0.333	0.143

	Week						Season-long	Standard
Category	27	28	29	30	31	32	Weighted Rate	Error
Proportion of Catch (from Creel)	0.240	0.177	0.141	0.142	0.164	0.137		
Legal Mark Rate	0.086	0.059	0.047	0.079	0.103	0.040	0.41	0.124
Sublegal Mark Rate	0.240	0.059	0.038	0.000	0.055	0.075	0.47	0.334
Combined Mark Rate	0.105	0.059	0.042	0.062	0.079	0.051	0.40	0.062
Proportion Legal and Marked	0.075	0.051	0.021	0.062	0.052	0.027	0.29	0.084
Proportion Legal and Unmarked	0.135	0.101	0.042	0.049	0.030	0.066	0.42	0.146
Proportion Sublegal and Marked	0.030	0.008	0.021	0.000	0.027	0.023	0.11	0.061
Proportion Sublegal and Unmarked	0.000	0.017	0.056	0.031	0.055	0.020	0.18	0.142

Table 7. Catch data and calculations used to estimate weekly weighted mark rate and variance for Chinook salmon caught on test boats during the Chinook Selective Fishery in Marine Area 6, July 1 through August 8, 2004. Upper table shows the catch by week. Middle table shows the rates of marked and unmarked fish by week. Bottom table shows the weekly rate weighted (multiplied) by proportion of the total catch, and a season-long weighted mark rate (sum of the weekly data).

		Week						
Size	Mark Status	27	28	29	30	31	32	Total
Legal	Marked	11	3	5	17	24	9	69
	Unmarked	4	10	10	16	13	21	74
Sublegal	Marked	0	0	0	0	2	2	4
	Unmarked	0	0	0	0	1	0	1

	Week					
Weekly Rates	27	28	29	30	31	32
Legal Mark Rate	0.733	0.231	0.333	0.515	0.649	0.300
Sublegal Mark Rate	--	--	--	--	0.667	1.000
Combined Mark Rate	0.733	0.231	0.333	0.515	0.649	0.344
Proportion Legal and Marked	0.733	0.231	0.333	0.515	0.600	0.281
Proportion Legal and Unmarked	0.267	0.769	0.667	0.485	0.325	0.656
Proportion Sublegal and Marked	0.000	0.000	0.000	0.000	0.050	0.063
Proportion Sublegal and Unmarked	0.000	0.000	0.000	0.000	0.025	0.000

	Week						Season-long	Standard
Weekly Rates multiplied by Catch	27	28	29	30	31	32	Weighted Rate	Error
Proportion of Catch (from Creel)	0.120	0.068	0.055	0.274	0.278	0.206		
Legal Mark Rate	0.088	0.016	0.018	0.141	0.180	0.062	0.51	0.166
Sublegal Mark Rate	--	--	--	--	--	--	n/a	n/a
Combined Mark Rate	0.088	0.016	0.018	0.141	0.181	0.071	0.51	0.155
Proportion Legal and Marked	0.088	0.016	0.018	0.140	0.167	0.058	0.49	0.160
Proportion Legal and Unmarked	0.032	0.052	0.037	0.133	0.090	0.135	0.48	0.162
Proportion Sublegal and Marked	0.000	0.000	0.000	0.000	0.014	0.013	0.03	0.028
Proportion Sublegal and Unmarked	0.000	0.000	0.000	0.000	0.007	0.000	0.01	0.011

Table 8. Summary of the number of marked and unmarked, legal-size and sublegal-size Chinook salmon caught by test boats during the Chinook Selective Fishery in Marine Areas 5 and 6, July 1 through August 8, 2004.

	Legal-size			Sublegal-size			Total		
	Marked	Unmarked	% Marked	Marked	Unmarked	% Marked	Marked	Unmarked	% Marked
Area 5	48	62	44	21	38	36	69	100	41
Area 6	69	74	48	4	1	80	73	75	49

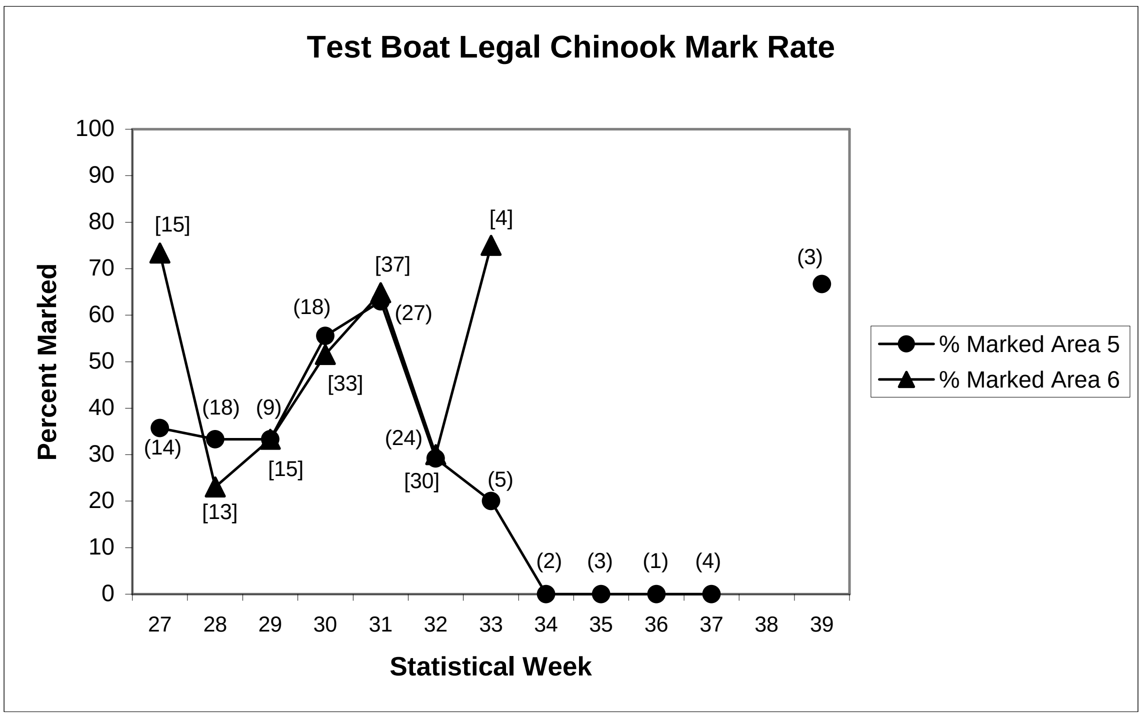

Figure 8. Mark rate (% adipose fin clipped) of legal-size Chinook caught by WDFW test boats in Marine Areas 5 and 6 during 2004. Sample sizes for Marine Area 5 are in ( ), while sample sizes for Marine Area 6 are in [ ]. The Chinook Selective Fishery occurred from July 1 through August 8, 2004 (statistical weeks 27 – 32). Note the first week includes only four days.

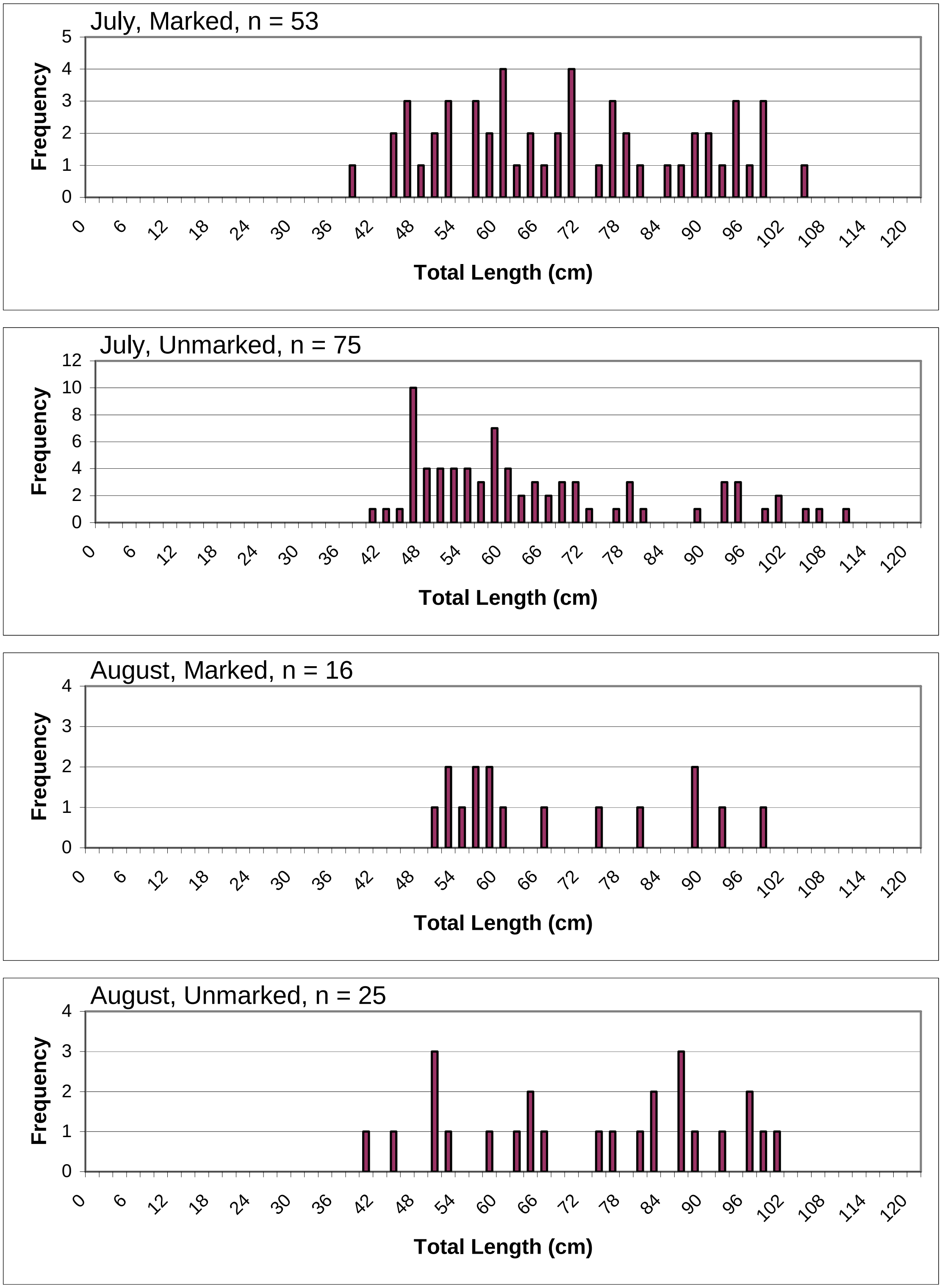

Figure 9. Length frequency histograms of Chinook salmon caught by test fishing boats sampling from July 1 through August 8, 2004, in Marine Area 5.

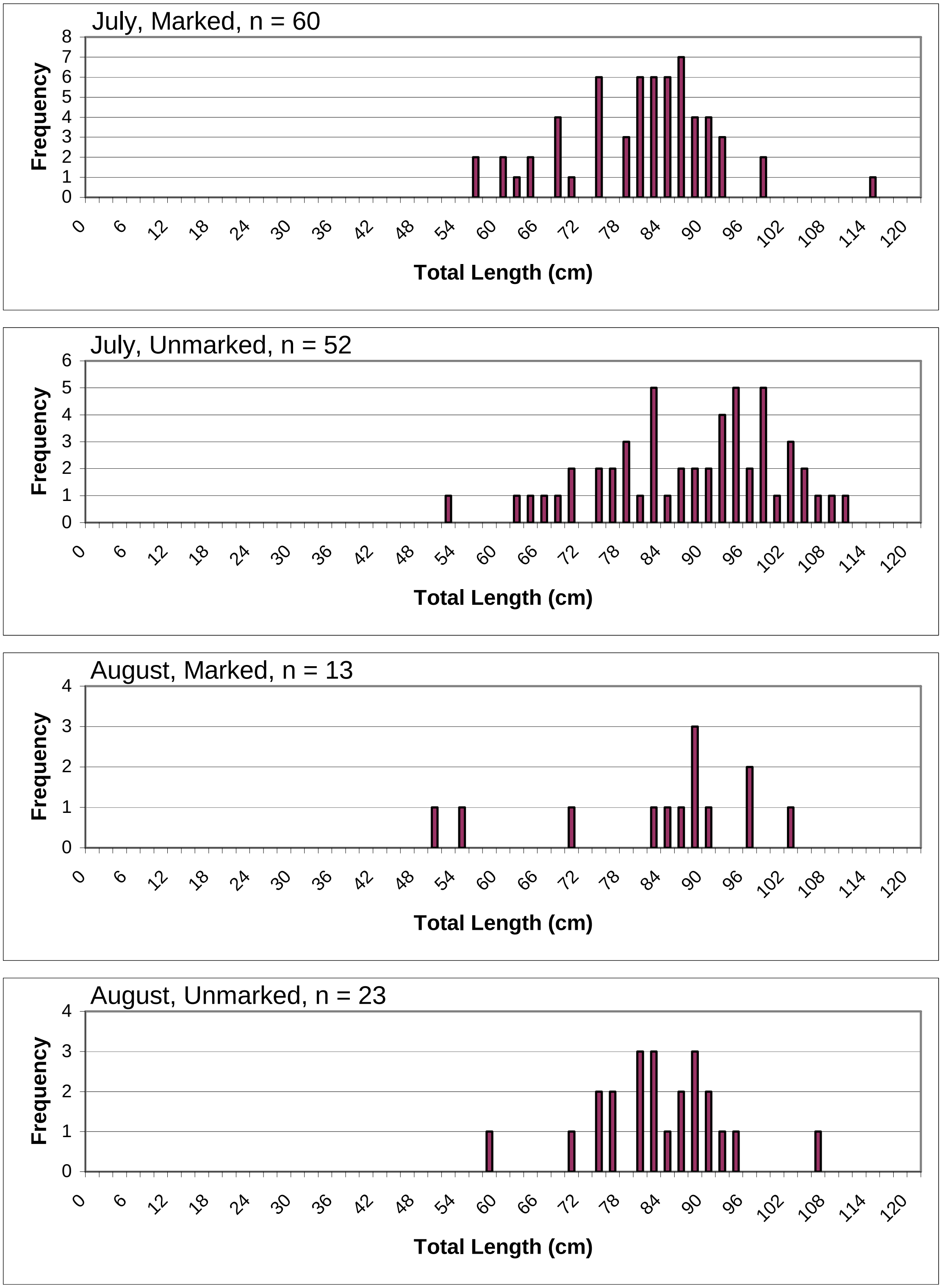

Figure 10. Length frequency histograms of Chinook salmon caught by test fishing boats sampling from July 1 through August 8, 2004, in Marine Area 6.

Voluntary Trip Reports (VTR's)

During the 2004 Chinook Selective Fishery only 35 Chinook were reported landed on VTR's in Area 5 (Table 9), while 112 Chinook were reported landed on VTR's in Area 6 (Table 10). Based on the very small sample size in Area 5, 57% of the fish recorded on VTR's were legal-size in Area 5 and 20% of these were marked. In Area 6, 93% of the Chinook encountered were legal-size and 40% of these were marked (Tables 10 and 11). In Area 6, VTR's showed a lower mark rate for legal-size fish than the test fishery. Mark rates of legal-size Chinook were lower for the VTR's than the test boat in Area 5 during the first two weeks of July (Figure 11), but there was no clear pattern between the two in Area 6 (Figure 12).

Coded Wire Tags

Samplers recovered 107 coded wire tags from harvested Chinook (Appendix F). Of these, 44 percent were Puget Sound stocks, 41 percent were Columbia River stocks, 11 percent were Canadian stocks, and the remainder from elsewhere. No tags were recovered from Strait of Juan de Fuca stocks in Washington. Twenty-nine double index coded wire tags were recovered in Areas 5 and 6 from July 1 through August 8 (Table 12). Fish from George Adams, Grovers Creek, and Chilliwack River hatcheries contributed the highest number of double index tags. We estimated that anglers caught and released 96 legal-size, unmarked double index tagged Chinook, and that the additional mortality of unmarked legal-size double index tagged Chinook due to a selective fishery compared to a non-selective fishery was 10 fish (Table 13).

Encounters and Total Mortalities

We used two methods for estimating Chinook encountered in the fishery. The first method was based on applying the weighted test fishery proportions of marked and unmarked or legal and sublegal size Chinook to the sum of landed catch plus the creel interview reports of Chinook released. Test boat catches consistently showed a higher mark rate than both the creel survey and the VTR's. Anglers may have missed marks on released fish and also may have classified smaller legal-size fish as sublegal fish, especially since anglers were encouraged to reduce the handling of fish that they released. Each Chinook caught by test boats was measured and examined, minimizing the potential of missing marks or mis-classifying fish as legal-size or sublegal-size. Therefore, we felt the mark rates from the test boat were the best estimate of the true mark rate. Using the total number of Chinook encounters from the creel survey and apportioning into the four categories of legal-size marked, legal-size unmarked, sublegal-size marked, and sublegal-size marked from the test fishing data, suggests that anglers released 1,489 legal-size and marked Chinook in Area 5 and 345 legal-size and marked Chinook in Area 6 (Table 14) for a total of 1,834 released; or 34% of the fish they could have kept.

Table 9. Catch by week for Chinook salmon caught by anglers reporting their catch on Voluntary Trip Reports (VTR's) during the Chinook Selective Fishery in Marine Area 5, July 1 through August 8, 2004.

		Week						
Size	Mark Status	27	28	29	30	31	32	Total
Legal	Marked	3	1					4
	Unmarked	12	4					16
Sublegal	Marked	2	1					3
	Unmarked	6	6					12

Table 10. Catch data and calculations used to estimate weekly weighted mark rate and variance for Chinook salmon caught by anglers reporting their catch on Voluntary Trip Reports (VTR's) during the Chinook Selective Fishery in Marine Area 6, July 1 through August 8, 2004. Upper table shows the catch by week. Middle table shows the rates of marked and unmarked fish by week. Bottom table shows the weekly rate weighted (multiplied) by proportion of the total catch, and a season-long weighted mark rate (sum of the weekly data).

		Week						
Size	Mark Status	27	28	29	30	31	32	Total
Legal	Marked	1	4	8	11	15	3	42
	Unmarked	8	3	11	14	21	5	62
Sublegal	Marked	0	0	0	0	2	0	2
	Unmarked	0	1	0	0	4	1	6

	Week					
Weekly Rates	27	28	29	30	31	32
Legal Mark Rate	0.111	0.571	0.421	0.440	0.417	0.375
Sublegal Mark Rate	--	0.000	--	--	0.333	0.000
Combined Mark Rate	0.111	0.500	0.421	0.440	0.405	0.333
Proportion Legal and Marked	0.111	0.500	0.421	0.440	0.357	0.333
Proportion Legal and Unmarked	0.889	0.375	0.579	0.560	0.500	0.556
Proportion Sublegal and Marked	0.000	0.000	0.000	0.000	0.048	0.000
Proportion Sublegal and Unmarked	0.000	0.125	0.000	0.000	0.095	0.111

	Week						Season-long	Standard
Weekly Rates multiplied by Catch	27	28	29	30	31	32	Weighted Rate	Error
Proportion of Catch (from Creel)	0.120	0.068	0.055	0.274	0.278	0.206		
Legal Mark Rate	0.013	0.039	0.023	0.120	0.116	0.077	0.389	0.112
Sublegal Mark Rate	--	--	--	--	--	--	na	n/a
Combined Mark Rate	0.013	0.034	0.023	0.120	0.112	0.069	0.372	0.106
Proportion Legal and Marked	0.013	0.034	0.023	0.120	0.099	0.069	0.359	0.104
Proportion Legal and Unmarked	0.106	0.025	0.032	0.153	0.139	0.115	0.570	0.127
Proportion Sublegal and Marked	0.000	0.000	0.000	0.000	0.013	0.000	0.013	0.021
Proportion Sublegal and Unmarked	0.000	0.008	0.000	0.000	0.026	0.023	0.058	0.053

Table 11. Summary of the number of marked and unmarked, legal-size and sublegal-size Chinook salmon caught by volunteers reporting their catch on Voluntary Trip Reports (VTR's) during the Chinook Selective Fishery in Marine Areas 5 and 6, July 1 through August 8, 2004.

	Legal-size			Sublegal-size			Total		
	Marked	Unmarked	% Marked	Marked	Unmarked	% Marked	Marked	Unmarked	% Marked
Area 5	4	16	20	3	12	20	7	28	20
Area 6	42	62	40	2	6	25	44	68	39

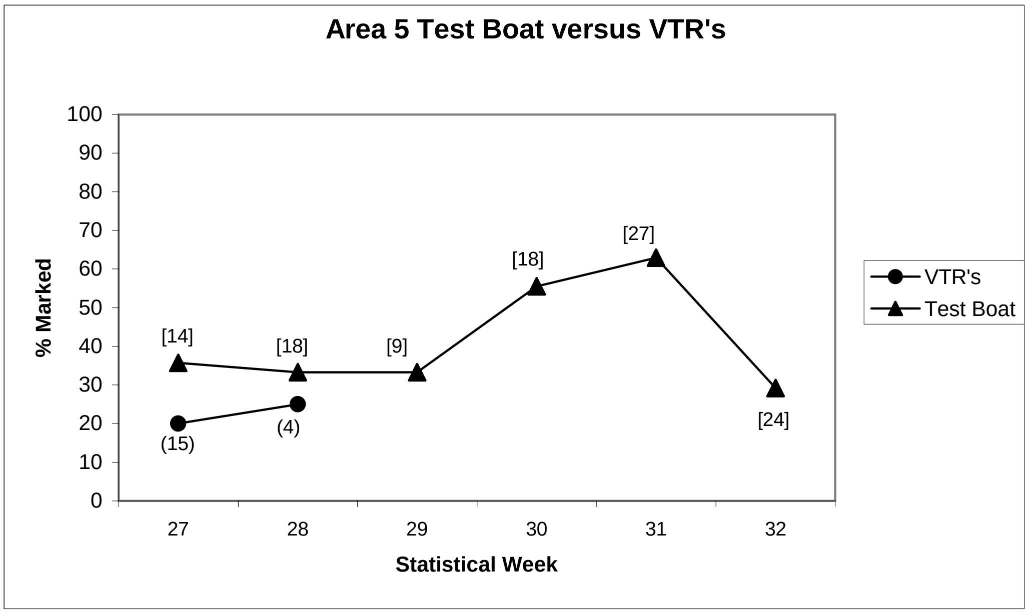

Figure 11. Mark rate (% adipose fin clipped) of legal-size Chinook salmon caught by WDFW test boats and anglers recording their catch on Voluntary Trip Reports (VTR's) in Marine Area 5 during 2004. Sample sizes for test boat are in ( ), while sample sizes for VTR's are in [ ]. The Chinook Selective Fishery was from July 1 through August 8. Note the first week includes only four days.

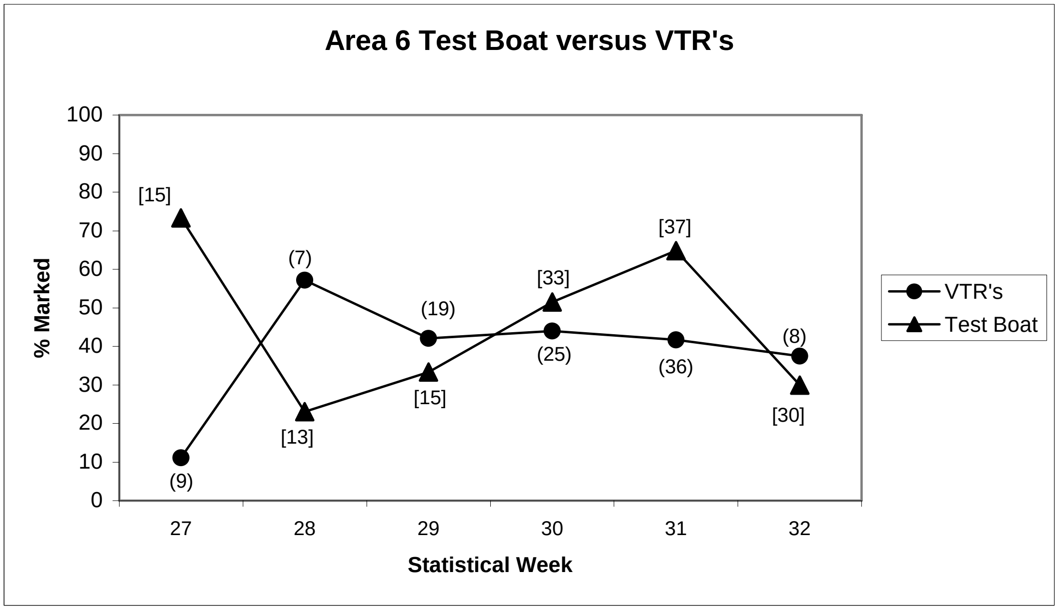

Figure 12. Mark rate (% adipose fin clipped) of legal-size Chinook salmon caught by WDFW test boats and anglers recording their catch on Voluntary Trip Reports (VTR's) in Marine Area 6 during 2004. Sample sizes for test boat are in ( ), while sample sizes for VTR's are in [ ]. The Chinook Selective Fishery was from July 1 through August 8. Note the first week includes only four days.

Table 12. Observed harvested Chinook salmon with Double Index Tag (DIT) coded wire tags during the 2004 Chinook Selective Fishery in Marine Areas 5 and 6, July 1 through August 8.

Area	Recovery Date	Tag Code	Brood Year	Rearing Hatchery	Release Site	Release Agency	Fork Length (CM)
5	July 24, 2004	184914	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO	64
5	July 5, 2004	184916	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO	63
5	July 6, 2004	184916	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO	61
5	July 25, 2004	184916	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO	76
5	July 17, 2004	185533	2002	H-CHILLIWACK R	R-CHILLIWACK R	CDFO	48
5	July 2, 2004	210279	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ	71
5	July 10, 2004	210279	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ	75
5	July 14, 2004	210279	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ	61
6	July 17, 2004	210279	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ	61
6	July 24, 2004	210279	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ	83
5	August 1, 2004	210390	2001	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ	57
5	August 1, 2004	210390	2001	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ	59
6	July 3, 2004	630189	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ	75
5	July 1, 2004	630668	2000	WALLACE R HATCHERY	WALLACE R 07.0940	WDFW	80
5	July 14, 2004	630669	2000	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW	78
6	July 3, 2004	630669	2000	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW	79
6	July 21, 2004	630669	2000	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW	65
6	July 23, 2004	630683	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW	75
6	July 14, 2004	630684	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW	86
6	July 29, 2004	630684	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW	81
5	July 10, 2004	630687	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ	80
6	July 23, 2004	630687	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ	65
6	July 27, 2004	630694	2000	MARBLEMOUNT HATCHERY	CASCADE R 03.1411	WDFW	76
5	July 4, 2004	636322	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW	63
5	July 10, 2004	636322	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW	61
5	July 17, 2004	636322	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW	69
5	July 20, 2004	636322	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW	56
5	July 25, 2004	636322	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW	45
6	July 3, 2004	636322	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW	65

Table 13. Observed number of double index tagged (DIT) Chinook kept by anglers, and the estimated mortality of unmarked double index tagged Chinook due to catch and release mortality, during the 2004 Chinook Selective Fishery in Marine Areas 5 and 6, July 5 through August 8.

Hatchery	Brood Year	DIT Tagged fish Observed	Estimated Harvest of Marked DIT fish	Variance of Estimated Harvest of Marked DIT Fish	Estimated Angler Releases of Unmarked DIT fish	Estimated Mortality of Unmarked DIT fish	Variance of Estimated Mortality of Unmarked DIT Fish	Standard Error of Estimated Mortality of Unmarked DIT Fish
George Adams	2000	3	7.14	10.02	7.21	0.72	0.10	0.32
George Adams	2001	6	22.62	70.03	21.22	2.12	0.62	0.79
Grovers Creek	2000	5	17.15	48.80	17.38	1.74	0.50	0.71
Grovers Creek	2001	2	7.48	20.49	7.50	0.75	0.21	0.45
Chilliwack	2001	4	15.00	41.80	14.71	1.47	0.40	0.63
Chilliwack	2002	1	3.84	10.93	3.83	0.38	0.11	0.33
Marblemount	2000	1	2.68	4.52	2.66	0.27	0.04	0.21
Nisqually	2000	2	5.53	10.55	5.46	0.55	0.10	0.32
Nisqually	2000	1	1.72	1.24	1.86	0.19	0.01	0.12
Soos Creek	2000	3	7.69	14.56	8.02	0.80	0.16	0.40
Wallace	2000	1	5.45	24.22	5.57	0.56	0.25	0.50
Total		29				9.54		

Table 14. Calculations used to estimate encounters and total mortality of Chinook salmon during the 2004 Chinook Selective Fishery in Marine Areas 5 and 6, July 1 through August 8. Uses the number of encounters obtained from dockside creel estimates, and apportions those encounters into categories of legal marked, legal unmarked, sublegal marked and sublegal unmarked according to the proportions those fish were caught by test fishing.

Area 5

Total Encounters (E) **15,292** (2,900 Retained + 12,392 Released from Creel Estimate)

V(E) 829,732

Test fishing proportions are used to split total encounters into legal marked/legal un-marked/sub-legal marked/sub-legal unmarked

	Test Fishery	V(TF)	Encounters	Retained[a]	V(Ret)	Mort Rate	Mortality	Released	sfm	Mortality	Total Mort	VAR	StErr	LCI	UCI	%SE
% legal marked	0.287	0.0070	4388.8	2900	51995	100%	2900	1489	15%	223	3123	76082	276	2583	3664	0.088
% legal Unmarked	0.425	0.0213	6499.1	0	0	100%	0	6499	15%	975	975	115691	340	308	1642	0.349
% sub-legal marked	0.110	0.0037	1682.1					1682	20%	336	336	35114	187	-31	704	0.557
% sub-legal unmarked	0.178	0.0201	2722.0					2722	20%	544	544	189268	435	-308	1397	0.799
Total			**15,292.0**				**2,900**	**12,392**		**2,079**	**4,979**					

Area 6

Total Encounters (E) **2,085** (676 Retained + 1,409 Released from Creel Estimate)

V(E) 20,941

Test fishing proportions are used to split total encounters into legal marked/legal un-marked/sub-legal marked/sub-legal unmarked

	Test Fishery	V(TF)	Encounters	Retained[b]	V(Ret)	Mort Rate	Mortality	Released	sfm	Mortality	Total Mort	VAR	StErr	LCI	UCI	%SE
% legal marked	0.487	0.0259	1016	671	4302	100%	671	345	15%	52	723	5756	76	574	871	0.105
% legal Unmarked	0.479	0.0264	999	5	9	100%	5	994	15%	149	154	2693	52	52	256	0.337
% sub-legal marked	0.027	0.0008	56					56	20%	11	11	137	12	-12	34	1.049
% sub-legal unmarked	0.007	0.0001	14					14	20%	3	3	22	5	-6	12	1.605
Total			**2,085**				**676**	**1,409**		**215**	**891**					

Computation of Variance on Total Mortality

E = Encounters

PPN Test = Proportions legal marked or legal unmarked or sub-legal marked or sub-legal unmarked from test fishery

sfm = Selective Fishery Mortality Rate

Variance = (1-sfm)^2 * V(Ret) + (E^2 * V(TF) + V(Tot Enc) * PPN Test^2) * sfm^2

a. Includes up to 194 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.

b. Includes up to 3 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.

The second method for estimating the number of encounters was based on the assumption that anglers kept all fish that were legal-size and marked and the number of fish in the other three categories were apportioned by weighted test boat catch rates. This method resulted in an estimate of 11,481 encounters (Table 15) compared to 17,377 encounters for the first method.

The first method produced a result that implied anglers were "sorting" their catch by releasing one-third of the fish that were legal to keep. The second method assumed that all retainable Chinook were kept. Given the relatively low catch rate of marked legal-size Chinook in this fishery (about one fish for every 8 anglers), it seems unlikely that extensive sorting was occurring. It is also unlikely that all legal-size and marked fish were kept; even in low success fisheries barely legal-size fish may be voluntarily released in hopes of landing a larger one. The true number of encounters likely lies between the two estimates of encounters (Table 16).

The range of encounters resulting from the two methods produces a corresponding range of mortalities. Using the first method and a release mortality rate of 15% for legal size and 20% for sublegal-size fish, we estimated the total mortalities of Chinook in the selective fishery at 5,870, which includes the harvest of 3,576 fish (Table 17). Based on the estimated 15,292 encounters of Chinook in Area 5, we estimated the total mortality of Chinook there at 4,979 fish, including the 2,900 harvested. Based on the estimated 2,085 encounters of Chinook in Area 6, we estimated the total mortality of Chinook there at 891 fish, including the 676 harvested. Overall, we estimated the total mortality of unmarked fish at 1,676 fish, of which 547 were sublegal-size fish and 1,129 were legal-size fish.

Using the encounters estimated by assuming anglers kept all legal fish, we estimated total mortalities at 4,910 fish, of which 1,109 were unmarked fish (Table 17). Of the unmarked fish, we estimated that 362 were sublegal-size and 747 were legal-size.

Based on the estimated number of total encounters from the creel survey (the highest number) and apportioning them based on the test boat catch rates, we estimated the 2004 fishery encountered 7,498 unmarked legal-size Chinook and 1,738 unmarked sublegal-size Chinook (Table 14). These estimates are below the predicted encounters of 7,993 unmarked legal-size Chinook and 4,935 unmarked sublegal-size Chinook as produced in the final pre-season run of the Fishery Regulation Assessment Model (FRAM), and suggests this fishery did not hinder nor jeopardize achievement of the overall conservation goals for Puget Sound Chinook.

Table 15. Estimated encounters of Chinook in the Area 5 and 6 Chinook selective fishery in 2004 based on test boat proportions. This method assumes that anglers retained all legal-size marked Chinook and then estimates the number in the remaining categories based on the ratio they were captured in the test fishing. Values may not add exactly due to rounding error.

	Area	Legal-size Marked	Legal-size Unmarked	Sublegal-size Marked	Sublegal-size Unmarked	Total
Proportion from Test Fishing	5	0.287	0.425	0.110	0.178	
	6	0.487	0.479	0.027	0.007	
Estimated Encounters	5	2,900[a]	4,294	1,112	1,799	10,105
	6	671[b]	659	37	10	1,377
	5 & 6 Combined	3,571	4,954	1,149	1,808	11,481

a. Includes up to 194 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.
b. Includes up to 3 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.

Table 16. Comparison of estimated encounters of Chinook in the Area 5 and 6 Chinook selective fishery in 2004. Test boat proportions method assumes that all legal-size marked Chinook were retained by anglers. Values may not add exactly due to rounding error.

Method	Area	Legal-size Marked Kept	Legal-size Marked Released	Legal-size Unmarked Kept	Legal-size Unmarked Released	Sublegal-size Marked Released	Sublegal-size Unmarked Released	Total Encountered
Creel and Test Boat	5	2,900[a]	1,489	0	6,499	1,682	2,722	15,292
	6	671[b]	345	5	994	56	14	2,085
	5 & 6 Combined	3,571	1,834	5	7,493	1,738	2,736	17,377
Test boat Proportions	5	2,900[a]	0	0	4,294	1,112	1,799	10,105
	6	671[b]	0	5	654	37	10	1,377
	5 & 6 Combined	3,571	0	5	4,949	1,149	1,808	11,481

a. Includes up to 194 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.
b. Includes up to 3 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.

Table 17. Comparison of estimated mortalities of Chinook in the Area 5 and 6 Chinook selective fishery in 2004. Test boat proportions method assumes that all legal-size marked Chinook were retained by anglers. Values may not add exactly due to rounding error.

Method	Area	Legal-size Marked Kept	Legal-size Marked Released	Legal-size Unmarked Kept	Legal-size Unmarked Released	Sublegal-size Marked Released	Sublegal-size Unmarked Released	Total Mortalities
Creel and Test Boat	5	2,900[a]	223	0	975	336	544	4,979
	6	671[b]	52	5	149	11	3	891
	5 & 6 Combined	3,571	275	5	1,124	348	547	5,870
Test boat Proportions	5	2,900[a]	0	0	644	222	360	4,126
	6	671[b]	0	5	98	7	2	783
	5 & 6 Combined	3,571	0	5	742	230	362	4,910

a. Includes up to 194 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.
b. Includes up to 3 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.

COMPLIANCE WITH REGULATIONS

Compliance with existing regulations, and the new regulation prohibiting bringing unmarked salmon on board a vessel, was considered an integral part of a successful fishery. Compared with 2002, WDFW enforcement staff conducted additional patrols and emphasis patrols to monitor compliance. Between July 1 and August 8, officers contacted 219 anglers in Area 5 and 220 anglers in Area 6. From those contacts, no citations or warnings were issued for retention of unmarked Chinook, nor were any warnings or citations issued for bringing an unmarked salmon on board a vessel. Also, out of 996 Chinook sampled by creel surveyors, only two were unmarked (0.2%). From the perspective of protecting wild Chinook and ensuring proper handling during release, the high compliance rate suggests that these objectives were obtained. Although this study was not designed to obtain an unbiased estimate of compliance, these data suggest a very high level of compliance in the fishery.

SUMMARY

The second year of the pilot marine Chinook selective fishery was successful with respect to the objective of increasing meaningful recreational opportunity within conservation constraints for Puget Sound Chinook. Anglers were allowed to fish for and retain Chinook for 39 days in Areas 5 and 6, compared with only 10 days and 5 days in Area 5 in 2001 and 2002, respectively. Angler effort in Area 5 was double the effort in 2002 during the same time frame. Using data from the test fishery sampling during the Chinook Selective Fishery, nearly half, or one in two, of the legal-size Chinook encountered were marked and could be retained by anglers.

The pilot fishery was also successful with respect to the objective of implementing monitoring and sampling programs to obtain management information for evaluation and planning of potential future selective Chinook fisheries. Estimated encounters were less than pre-season predictions. Anglers were able to fish for and retain Chinook 34 days more in 2004 than they did in 2002, with a lower mortality of unmarked legal-size Chinook suggesting that fishing selectively in this area has a lower impact on unmarked legal-size Chinook than fishing non-selectively. Compliance with fishing regulations was good during the fishery. The number of mortalities of unmarked double index coded wire tagged fish was negligible.

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Appendix A. 2004 statistical weeks used by Washington Department of Fish and Wildlife.

2004 Statistical Weeks (Monday - Sunday)

Stat. Mon	Week No.	Calendar Dates Start	Calendar Dates End	Julian Dates Start	Julian Dates End
Jan	1	01-Jan	04-Jan	1	4
	2	05-Jan	11-Jan	5	11
1	3	12-Jan	18-Jan	12	18
	4	19-Jan	25-Jan	19	25
	5	26-Jan	01-Feb	26	32
Feb	6	02-Feb	08-Feb	33	39
	7	09-Feb	15-Feb	40	46
2	8	16-Feb	22-Feb	47	53
	9	23-Feb	29-Feb	54	60
Mar	10	01-Mar	07-Mar	61	67
	11	08-Mar	14-Mar	68	74
3	12	15-Mar	21-Mar	75	81
	13	22-Mar	28-Mar	82	88
Apr	14	29-Mar	04-Apr	89	95
	15	05-Apr	11-Apr	96	102
4	16	12-Apr	18-Apr	103	109
	17	19-Apr	25-Apr	110	116
	18	26-Apr	02-May	117	123
May	19	03-May	09-May	124	130
	20	10-May	16-May	131	137
5	21	17-May	23-May	138	144
	22	24-May	30-May	145	151
June	23	31-May	06-Jun	152	158
	24	07-Jun	13-Jun	159	165
6	25	14-Jun	20-Jun	166	172
	26	21-Jun	27-Jun	173	179

Stat. Mon	Week No.	Calendar Dates Start	Calendar Dates End	Julian Dates Start	Julian Dates End
Jul	27	28-Jun	04-Jul	180	186
	28	05-Jul	11-Jul	187	193
7	29	12-Jul	18-Jul	194	200
	30	19-Jul	25-Jul	201	207
	31	26-Jul	01-Aug	208	214
Aug	32	02-Aug	08-Aug	215	221
	33	09-Aug	15-Aug	222	228
8	34	16-Aug	22-Aug	229	235
	35	23-Aug	29-Aug	236	242
Sep	36	30-Aug	05-Sep	243	249
	37	06-Sep	12-Sep	250	256
9	38	13-Sep	19-Sep	257	263
	39	20-Sep	26-Sep	264	270
Oct	40	27-Sep	03-Oct	271	277
	41	04-Oct	10-Oct	278	284
10	42	11-Oct	17-Oct	285	291
	43	18-Oct	24-Oct	292	298
	44	25-Oct	31-Oct	299	305
Nov	45	01-Nov	07-Nov	306	312
	46	08-Nov	14-Nov	313	319
11	47	15-Nov	21-Nov	320	326
	48	22-Nov	28-Nov	327	333
Dec	49	29-Nov	05-Dec	334	340
	50	06-Dec	12-Dec	341	347
12	51	13-Dec	19-Dec	348	354
	52	20-Dec	26-Dec	355	361
	53	27-Dec	31-Dec	362	366

Appendix B1. Sample rates for the 2004 Area 5 and 6 Chinook Selective fisheries, July 1 – August 8, 2004.

	Area 5			Area 6		
Week	Number of Chinook Sampled	Estimated Chinook Retained	Sample Rate	Number of Chinook Sampled	Estimated Chinook Retained	Sample Rate
27	128	697	0.184	47	81	0.582
28	151	513	0.294	17	46	0.372
29	106	407	0.260	16	37	0.429
30	100	410	0.244	87	185	0.470
31	127	475	0.267	70	188	0.373
32	80	397	0.202	69	139	0.495
Total	692	2,900	0.239	306	676	0.453

Appendix C1. Weekly sampling data from creel surveys conducted during the Chinook Selective Fishery in Marine Area 5, July 1 through August 8, 2004.

Statistic	Week 27	28	29	30	31	32	Total
Kept Chinook Sampled	128	151	106	100	127	80	692
Kept Chinook Marked	128	151	106	100	127	80	692
Released Chinook	531	688	543	458	529	274	3,023
Released Chinook Unmarked	458	638	465	408	457	247	2,673
Released Chinook Marked	33	33	62	30	20	10	188
Released Chinook Unknown Mark Status	40	17	16	20	52	17	162
Mark Rate (%)	26.0	22.4	26.5	24.2	24.3	26.7	24.8
Proportion of Catch[1]	0.24	0.18	0.14	0.14	0.16	0.14	
Weighted Mark Rate (%)	6.25	3.96	3.73	3.42	3.99	3.65	25.00
Variance							2

1. The weekly estimated harvest of Chinook divided by the estimated season total Chinook harvest (see Appendix D).

Appendix C2. Weekly sampling data from creel surveys conducted during the Chinook Selective Fishery in Marine Area 6, July 1 through August 8, 2004.

Statistic	Week 27	28	29	30	31	32	Total
Kept Chinook Sampled	47	17	16	87	70	69	306
Kept Chinook Marked	47	17	16	86	69	69	304
Released Chinook	83	53	36	180	137	169	658
Released Chinook Unmarked	73	53	35	169	136	160	626
Released Chinook Marked	2	0	0	6	1	4	13
Released Chinook Unknown Mark Status	8	0	1	5	0	5	19
Mark Rate (%)	40.2	24.3	31.4	35.1	33.8	31.3	33.5
Percent of Catch[1]	0.12	0.07	0.06	0.27	0.28	0.21	
Weighted Mark Rate (%)	4.80	1.64	1.73	9.61	9.39	6.46	33.64
Variance							13

1. The weekly estimated harvest of Chinook divided by the estimated season total Chinook harvest (see Appendix E).

Appendix D. Weekly creel survey estimates of marked and unmarked Chinook catch and variances (in parentheses) during the Chinook Selective Fishery in Marine Area 5, July 1 through August 8, 2004. Values may not add exactly due to rounding error.

Statistical Week	Chinook Kept			Chinook Released			
	Marked	Unmarked	Total	Marked	Unmarked	Unknown	Total
27	697	0	697	185	2,590	210	2,985
	(26,847)	(0)	(26,847)	(8,404)	(244,208)	(17,279)	(270,149)
28	513	0	513	114	2,116	54	2,284
	(2,875)	(0)	(2,875)	(528)	(102,257)	(416)	(103,048)
29	407	0	407	222	1,701	72	1,995
	(3,895)	(0)	(3,895)	(5,482)	(34,026)	(351)	(39,863)
30	410	0	410	137	1,545	78	1,760
	(2,556)	(0)	(2,556)	(2,766)	(43,432)	(830)	(47,030)
31	475	0	475	100	1,596	276	1,972
	(3,867)	(0)	(3,867)	(835)	(156,980)	(11,509)	(169,325)
32	397	0	397	47	1,289	61	1,397
	(11,543)	(0)	(11,543)	(88)	(148,009)	(636)	(148,734)
Total	2,900	0	2,900	806	10,836	750	12,392
	(51,584)	(0)	(51,584)	(18,105)	(728,746)	(31,297)	(778,148)

Appendix E. Weekly creel survey estimates of marked and unmarked Chinook catch and variances (in parentheses) during the Chinook Selective Fishery in Marine Area 6, July 1 through August 8, 2004. Values may not add exactly due to rounding error.

	Chinook Kept			Chinook Released			
Statistical Week	Marked	Unmarked	Total	Marked	Unmarked	Unknown	Total
27	81	0	81	3	119	18	141
	(242)	(0)	(242)	(0)	(1,096)	(66)	(1,162)
28	46	0	46	0	142	0	142
	(240)	(0)	(240)	(0)	(236)	(0)	(236)
29	37	0	37	0	93	1	94
	(137)	(0)	(137)	(0)	(989)	(0)	(990)
30	184	1	185	11	337	7	355
	(1,177)	(0)	(1,177)	(20)	(4,659)	(4)	(4,683)
31	184	3	188	4	343	0	347
	(2,132)	(9)	(2,141)	(9)	(6,623)	(0)	(6,632)
32	139	0	139	5	303	23	331
	(372)	(0)	(372)	(6)	(2,635)	(287)	(2,928)
Total	671	5	676	23	1,337	50	1,409
	(4,301)	(9)	(4,310)	(35)	(16,238)	(358)	(16,631)

Appendix F. Recoveries of coded wire tags from Chinook salmon during the Chinook Selective Fisheries in Marine Areas 5 and 6, July 1 through August 8, 2004.

Area	RecovDate	Tagcode	RcvMark	FKLcm	BroodYr	RearingHatchery	ReleaseSite	ReleaseAgency
05	Jul 11 2004	050780	AD Fin Clp	76	2001	SPRING CR NFH	SPRING CR 29.0159	FWS
05	Jul 17 2004	050780	AD Fin Clp	91	2001	SPRING CR NFH	SPRING CR 29.0159	FWS
05	Jul 24 2004	050780	AD Fin Clp	66	2001	SPRING CR NFH	SPRING CR 29.0159	FWS
05	Aug 1 2004	050784	AD Fin Clp	70	2001	MAKAH NFH ON SOOES R	SOOES R 20.0015	FWS
05	Jul 25 2004	062761	AD Fin Clp	43	2002	FEATHER R HATCHERY	BENICIA	CDWR
05	Jul 29 2004	065288	AD Fin Clp	55	2001	TRINITY R HATCHERY	TRINITY R HATCHERY	HVT
06	Jul 25 2004	093452	AD Fin Clp	76	2001	BIG CR HATCHERY	BIG CR (LWR COL R)	ODFW
05	Jul 11 2004	093628	AD Fin Clp	55	2001	BONNEVILLE HATCHERY	UMATILLA R	ODFW
05	Jul 21 2004	184448	AD Fin Clp	76	2001	H-COWICHAN R	R-COWICHAN BAY	CDFO
06	Jul 23 2004	184645	AD Fin Clp	70	2001	H-COWICHAN R	R-COWICHAN R	CDFO
05	Jul 4 2004	184706	AD Fin Clp	74	2001	H-SHUSWAP R	R-SHUSWAP R MID	CDFO
05	Jul 2 2004	184909	AD Fin Clp	69	2001	H-INCH CR	R-STAVE R	CDFO
05	Jul 6 2004	184909	AD Fin Clp	65	2001	H-INCH CR	R-STAVE R	CDFO
05	Jul 25 2004	184909	AD Fin Clp	74	2001	H-INCH CR	R-STAVE R	CDFO
05	Jul 24 2004	184914	AD Fin Clp	64	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Jul 5 2004	184916	AD Fin Clp	63	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Jul 6 2004	184916	AD Fin Clp	61	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Jul 25 2004	184916	AD Fin Clp	76	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Aug 1 2004	184921	AD Fin Clp	52	2002	H-CHEHALIS R	R-CHEHALIS R	CDFO
05	Jul 17 2004	185533	AD Fin Clp	48	2002	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Jul 2 2004	210279	AD Fin Clp	71	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 10 2004	210279	AD Fin Clp	75	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 14 2004	210279	AD Fin Clp	61	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
06	Jul 17 2004	210279	AD Fin Clp	61	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
06	Jul 24 2004	210279	AD Fin Clp	83	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 4 2004	210293	AD Fin Clp	67	2000	PUYALLUP TRIBAL HATC	COWSKULL ACCLIM POND	PUYA
05	Jul 17 2004	210294	AD Fin Clp	74	2000	PUYALLUP TRIBAL HATC	DIRU CR 10.0029	PUYA
06	Jul 29 2004	210294	AD Fin Clp	89	2000	PUYALLUP TRIBAL HATC	DIRU CR 10.0029	PUYA
05	Jul 16 2004	210324	AD Fin Clp	53	2001	BERNIE GOBIN HATCH	TULALIP CR 07.0001	TULA
05	Jul 10 2004	210343	AD Fin Clp	60	2001	COWSKL & RUSHWTR PDS	COWSKL & RUSHWTR PDS	PUYA
05	Jul 17 2004	210343	AD Fin Clp	65	2001	COWSKL & RUSHWTR PDS	COWSKL & RUSHWTR PDS	PUYA
06	Jul 24 2004	210343	AD Fin Clp	72	2001	COWSKL & RUSHWTR PDS	COWSKL & RUSHWTR PDS	PUYA
06	Jul 29 2004	210343	AD Fin Clp	60	2001	COWSKL & RUSHWTR PDS	COWSKL & RUSHWTR PDS	PUYA
05	Jul 25 2004	210344	AD Fin Clp	60	2001	PUYALLUP TRIBAL HATC	DIRU CR 10.0029	PUYA
05	Aug 1 2004	210390	AD Fin Clp	57	2001	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Aug 1 2004	210390	AD Fin Clp	59	2001	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 17 2004	210391	AD Fin Clp	65	2001	MARBLEMOUNT HATCHERY	SKAGIT R 03.0176	WDFW
05	Jul 2 2004	210392	AD Fin Clp	56	2001	KALAMA CR HATCHERY	KALAMA CR 11.0017	NISQ
05	Jul 9 2004	212950	AD Fin Clp	75	2000	MARBLEMOUNT HATCHERY	RED CR 03.1325	WDFW
05	Jul 10 2004	212951	AD Fin Clp	95	1999	HOKO FALLS HATCHERY	HOKO R 19.0148	MAKA
05	Jul 4 2004	630183	AD Fin Clp	59	2000	LYONS FERRY HATCHERY	CAPTAIN JOHNS PD	NEZP
06	Jul 3 2004	630189	AD Fin Clp	75	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
05	Jul 18 2004	630282	AD Fin Clp	88	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 10 2004	630398	AD Fin Clp	66	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
06	Jul 16 2004	630398	AD Fin Clp	79	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 24 2004	630398	AD Fin Clp	80	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 31 2004	630398	AD Fin Clp	76	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 1 2004	630668	AD Fin Clp	80	2000	WALLACE R HATCHERY	WALLACE R 07.0940	WDFW
06	Jul 3 2004	630669	AD Fin Clp	79	2000	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
05	Jul 14 2004	630669	AD Fin Clp	78	2000	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
06	Jul 21 2004	630669	AD Fin Clp	65	2000	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
05	Aug 1 2004	630678	AD Fin Clp	57	2000	LYONS FERRY HATCHERY	SNAKE R @PITTSBURG L	NEZP
05	Jul 23 2004	630678	AD Fin Clp	53	2000	LYONS FERRY HATCHERY	SNAKE R @PITTSBURG L	NEZP
05	Jul 31 2004	630678	AD Fin Clp	63	2000	LYONS FERRY HATCHERY	SNAKE R @PITTSBURG L	NEZP
06	Jul 23 2004	630683	AD Fin Clp	75	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
06	Jul 14 2004	630684	AD Fin Clp	86	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
06	Jul 29 2004	630684	AD Fin Clp	81	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 10 2004	630687	AD Fin Clp	80	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
06	Jul 23 2004	630687	AD Fin Clp	65	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
06	Jul 27 2004	630694	AD Fin Clp	76	2000	MARBLEMOUNT HATCHERY	CASCADE R 03.1411	WDFW
05	Jul 1 2004	630783	AD Fin Clp	68	2000	MCALLISTER HATCHERY	MCALLISTER CR11.0324	WDFW
05	Jul 25 2004	630794	AD Fin Clp	68	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 25 2004	630883	AD Fin Clp	75	2000	TUMWATER FALLS HATCH	CAPITOL LK (13)	WDFW
05	Jul 29 2004	630883	AD Fin Clp	83	2000	TUMWATER FALLS HATCH	CAPITOL LK (13)	WDFW
05	Aug 1 2004	630889	AD Fin Clp	51	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 16 2004	630889	AD Fin Clp	65	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 18 2004	630889	AD Fin Clp	55	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 30 2004	630889	AD Fin Clp	60	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 9 2004	630891	AD Fin Clp	54	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 16 2004	630891	AD Fin Clp	58	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 17 2004	630891	AD Fin Clp	53	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 25 2004	630891	AD Fin Clp	51	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 25 2004	630891	AD Fin Clp	45	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
06	Jul 31 2004	630896	AD Fin Clp	71	2001	MARBLEMOUNT HATCHERY	CASCADE CR 03.2584	WDFW

Appendix F. Continued.

Area	RecovDate	Tagcode	RcvMark	FKLcm	BroodYr	RearingHatchery	ReleaseSite	ReleaseAgency
05	Jul 6 2004	630996	AD Fin Clp	66	2000	SIMILKAMEEN HATCHERY	SIMILKAMEEN R 490325	WDFW
05	Jul 10 2004	631273	AD Fin Clp	66	2000	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 11 2004	631273	AD Fin Clp	64	2000	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 17 2004	631273	AD Fin Clp	67	2000	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 30 2004	631273	AD Fin Clp	61	2000	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 30 2004	631294	AD Fin Clp	63	2001	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
05	Jul 21 2004	631379	AD Fin Clp	64	2001	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
05	Jul 25 2004	631382	AD Fin Clp	58	2001	PRIEST RAPIDS HATCHE	COLUMBIA R AT PRIEST	WDFW
05	Jul 17 2004	631469	AD Fin Clp	56	2001	COWLITZ SALMON HATCH	COWLITZ SALMON HATCH	WDFW
05	Jul 24 2004	631548	AD Fin Clp	60			Unknown release data	
05	Jul 30 2004	631549	AD Fin Clp	54	2001	WELLS HATCHERY	COLUMBIA NEAR WELLS	WDFW
05	Jul 31 2004	631549	AD Fin Clp	62	2001	WELLS HATCHERY	COLUMBIA NEAR WELLS	WDFW
05	Jul 31 2004	631549	AD Fin Clp	55	2001	WELLS HATCHERY	COLUMBIA NEAR WELLS	WDFW
05	Aug 1 2004	631585	AD Fin Clp	53	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 5 2004	631585	AD Fin Clp	49	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 6 2004	631585	AD Fin Clp	52	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 11 2004	631585	AD Fin Clp	60	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 15 2004	631585	AD Fin Clp	56	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 17 2004	631585	AD Fin Clp	55	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 18 2004	631585	AD Fin Clp	50	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 21 2004	631585	AD Fin Clp	57	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 21 2004	631585	AD Fin Clp	53	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 29 2004	631585	AD Fin Clp	56	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 29 2004	631585	AD Fin Clp	53	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 18 2004	631587	AD Fin Clp	47	2001	DRYDEN POND	WENATCHEE R 45.0030	WDFW
05	Jul 27 2004	631587	AD Fin Clp	56	2001	DRYDEN POND	WENATCHEE R 45.0030	WDFW
05	Jul 29 2004	631780	AD Fin Clp	47	2002	VOIGHTS CR HATCHERY	VOIGHT CR 10.0414	WDFW
06	Jul 3 2004	636322	AD Fin Clp	65	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 4 2004	636322	AD Fin Clp	63	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 10 2004	636322	AD Fin Clp	61	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 17 2004	636322	AD Fin Clp	69	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 20 2004	636322	AD Fin Clp	56	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 25 2004	636322	AD Fin Clp	45	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW

Evaluation of the 2003 and 2004 Chinook Mark-Selective Fisheries, Marine Areas 5 and 6

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Washington Department of Fish and Wildlife
Fish Program
600 Capitol Way North
Olympia, Washington 98501

EXECUTIVE SUMMARY

During the summers of 2003 and 2004, a mark-selective Chinook salmon *Oncorhynchus tshawytscha* (“Chinook”) recreational fishery was implemented in waters of the Strait of Juan de Fuca with the objectives of: 1) increasing meaningful recreational opportunity while meeting conservation goals for Puget Sound Chinook salmon defined by the Puget Sound Chinook Harvest Management Plan; and 2) collecting information necessary to enable evaluation and planning of future potential Chinook mark-selective fisheries. The 2003 Chinook Mark-Selective Fishery started on July 5, 2003 and ran continuously through August 3, 2003 in Marine Area 5 and the western portion of Marine Area 6. The 2004 Chinook Mark-Selective Fishery started on July 1, 2004 and ran continuously through August 8, 2004 in the same areas. Marine Areas 5 and 6 (hereafter: Areas 5 and 6) are located in Washington waters of the Strait of Juan de Fuca, running from the Sekiu River easterly to Low Point, and from Low Point to approximately Whidbey Island, respectively.

Anglers were allowed to retain two marked (adipose fin clipped) Chinook $\geq$ 22” (56 cm) as part of their daily limit, and were required to immediately release, unharmed, any unmarked Chinook caught. During the Chinook Mark-Selective Fishery anglers were also allowed to retain pink *O. gorbuscha*, sockeye *O. nerka*, and marked hatchery coho *O. kisutch* salmon.

This report focuses on evaluating the two years of the pilot Chinook Mark-Selective Fishery. Some general comparisons to the 2001 and 2002 non-selective Chinook fisheries in Area 5 are presented for the purpose of evaluating success of the Mark-Selective Fishery with respect to the general objective of increasing recreational opportunity compared to non-selective alternatives. We also compared alternative methods for determining mark rates and encounters with sublegal-size fish. Expected impacts of the mark-selective fishery from the Fishery Regulation Assessment Model (FRAM) pre-season planning tool are compared with the measured outcomes. Finally, recommendations for applications to future mark-selective fisheries are also presented.

Angler opportunity increased three ways due to this selective fishery. First, recreational Chinook fishing opportunity was expanded from 10-day and 5-day seasons in 2001 and 2002, respectively, to 30-day and 39-day seasons in 2003 and 2004, respectively. Second, anglers harvested nearly twice as many Chinook in 2003 and 2004 than they did in 2001 and 2002. Third, a portion of Area 6 was open for Chinook retention during the summer compared to all of Area 6 being closed for Chinook retention during the summer in 2001 and 2002. Increases in effort were modest compared to 2001 but approximately double the effort levels observed in 2002. Other than simply having more days of fishing open for anglers, the increased opportunity is attributable to a relatively high mark rate of approximately 45% for legal-size Chinook and reasonably good catch rates (approximately one retained Chinook for every 7-8 anglers).

Success of the Pilot Project is also indicated by the results of WDFW public education and Enforcement activities. Information collected by the Enforcement program and from creel surveys over these two seasons indicated consistently high compliance with not retaining wild (unmarked) Chinook during the fishery.

Since the impacts on Chinook stocks are based on assumptions about the overall level of angler encounters with unmarked Chinook, we estimated the number of unmarked Chinook encounters and compared those estimates with the pre-season FRAM expectations. Except for the unmarked sublegal-size fish in 2003, the estimates of encounters of unmarked legal-size Chinook and unmarked sublegal-size Chinook were below predicted levels.

We tested the assumption that test boat catches were representative of angler catches and found that for marked legal-size Chinook they were similar, suggesting they were probably similar for unmarked fish and sublegal-size fish as well. In strata with sufficient sample sizes for comparison, estimates of mark rates and ratios of legal/sublegal-size derived from test boat data and Voluntary Trip Report (VTR) information were very similar. We recommend a more rigorously structured VTR program that includes training and certification by WDFW staff. Based on our findings, we recommend that test fishing or VTR data, or a combination of both, be used to provide information on both mark rates and legal/sublegal-size categories in future Chinook Mark-Selective Fisheries.

In conclusion, this mark-selective Chinook fishery was successful at many levels. First, we met our two primary objectives of increasing opportunity and collecting the information necessary to evaluate pertinent biological impacts, including impacts to coded wire tagged Chinook. Second, we have likely captured the magnitude of this mark-selective fishery in terms of effort and harvest, and that magnitude was similar to pre-season expectations. Third, a level of enforcement was achieved to ensure that angler compliance with fishing regulations was high. Fourth, we were able to evaluate two different methods of obtaining mark rates and legal to sublegal ratios, and they were very similar when sample sizes were sufficient. And finally, although dependent upon factors unique to the proposed area, season, stock composition, and management logistics, our findings have provided a solid foundation for building successful mark-selective Chinook fisheries in the future.

INTRODUCTION

In recent years, abundant runs of hatchery salmon have been mixed with depressed runs of wild salmon in the Northwest in both marine and freshwater environments. Providing opportunities to harvest those abundant hatchery stocks while protecting wild stocks has been challenging. One tool for allowing harvest of abundant hatchery fish while limiting impacts on wild stocks is "Mark-Selective Fishing". In recreational mark-selective fisheries, anglers are generally allowed to retain fin clipped ("marked") hatchery fish and are required to release unclipped ("unmarked") fish. These unmarked fish are typically wild fish, but also include some unmarked hatchery fish. While mark-selective coho salmon *Oncorhynchus kisutch* ("coho") fisheries have occurred in Oregon, Washington, and British Columbia at various times since 1998, and mark-selective Chinook salmon *O. tshawytscha* ("Chinook") fisheries have occurred in freshwater areas since 2000, a mark-selective Chinook fishery had not been conducted in marine waters prior to 2003.

During the summers of 2003 and 2004, a mark-selective Chinook recreational fishery was implemented in waters of the Strait of Juan de Fuca with the objectives of: 1) increasing meaningful recreational opportunity while meeting conservation goals for Puget Sound Chinook salmon defined by the Puget Sound Chinook Harvest Management Plan; and 2) collecting information necessary to enable evaluation and planning of future potential Chinook mark-selective fisheries. The Northwest Treaty Tribes and the Washington Department of Fish and Wildlife (WDFW) reached agreement to consider mark-selective Chinook sport fishing in this area for the 2003 and 2004 seasons as part of a pilot program. A pilot fishery limited in time and area, as described below, provided the opportunity for managers to evaluate the success of the fishery and the monitoring and sampling programs.

The 2003 Chinook Mark-Selective Fishery started on July 5, 2003 and ran continuously through August 3, 2003 in Marine Area 5 and the western portion of Marine Area 6. The 2004 Chinook Mark-Selective Fishery started on July 1, 2004 and ran continuously through August 8, 2004 in the same areas. Marine Areas 5 and 6 (hereafter: Areas 5 and 6) are located in Washington waters of the Strait of Juan de Fuca, running from the Sekiu River easterly to Low Point, and from Low Point to approximately Whidbey Island, respectively (Figure 1). The Chinook Mark-Selective Fishery in Area 6 was open only from Low Point easterly to Ediz Hook because the eastern portion of Area 6 has many more boat ramps and other access points, and would have required substantially more sampling effort to obtain sufficiently accurate estimates of harvest and effort. Additional closures to help achieve fishery objectives were established: 1) in the eastern half of Marine Area 4; 2) near the mouths of the Sekiu and Hoko rivers; 3) near the mouth of the Elwha River; and 4) in Port Angeles Harbor.

Anglers were allowed to retain two marked (adipose fin clipped) Chinook salmon $\geq$ 22" (56 cm) as part of their daily limit, and were required to immediately release, unharmed, any unmarked Chinook caught. Integral to the mark-selective fishery was a new salmon handling regulation starting in 2003 stating, "Any salmon to be released may not be brought on board a vessel." This regulation was modified slightly and applied throughout Puget Sound in 2004, including Areas 5 and 6. The 2004 regulation stated "It is illegal to bring a wild salmon, or a species of salmon, aboard a vessel if it is unlawful to retain those salmon. "Aboard a vessel" was defined as "inside the gunwale". During the Chinook Mark-Selective Fishery anglers were also allowed to retain pink *O. gorbuscha* ("pink"), sockeye *O. nerka*, and marked hatchery coho salmon.

The 2003 season was scheduled to run from July 5, 2003 through August 14, 2003 (41 days), or until a quota of 3,500 hatchery Chinook salmon was caught and retained by anglers. The fishery was closed by emergency regulation effective at 11:59 p.m., August 3, 2003 because the quota was reached. The 2004 season was scheduled to run from July 1, 2004 through August 10, 2004 (41 days), or until 3,500 hatchery Chinook salmon were caught and retained by anglers. The fishery was closed by emergency regulation effective at 11:59 p.m., August 8, 2004 because the quota was reached.

Analyses of the 2003 and 2004 fisheries were completed and are reported by Thiesfeld and Hagen-Breaux (2004) and Thiesfeld et al. (2004). This report focuses on evaluating the two years of the pilot Chinook Mark-Selective Fishery. Some general comparisons to the 2001 and 2002 non-selective Chinook fisheries in Area 5 are presented for the purpose of evaluating success of the Mark-Selective Fishery with respect to the general objective of increasing recreational opportunity compared to non-selective alternatives. We also compared alternative methods for determining mark rates and encounters with sublegal-size fish. Expected impacts of the mark-selective fishery from the Fishery Regulation Assessment Model (FRAM) pre-season planning tool are compared with the measured outcomes. Recommendations for applications to future mark-selective fisheries are also presented. Recommendations include methods and sampling levels that will ensure agreed to levels of precision for estimates of key assumptions or modeling parameters.

METHODS

Methods for estimating effort and harvest, mark rates, annual coded wire tag impacts, encounters and mortalities are detailed in Thiesfeld and Hagen-Breaux (2004) and Thiesfeld et al. (2004).

<u>Effort and Harvest</u>

Angler participation in mark-selective and non-selective fisheries is not directly comparable due to season, bag limit and other regulation differences. Nevertheless, we examined some general comparisons of the non-selective Chinook fisheries in 2001 and 2002 with the mark-selective Chinook fisheries in 2003 and 2004 in Area 5. The 2001 fishery was restricted to a total harvest of 2,000 Chinook and anglers were allowed to retain any one legal-size Chinook they caught. The quota was obtained in ten days of fishing (July 1, 2, 3, 4, 5, 6, 7, 8, 9, and 21). The 2002 fishery was restricted to a total harvest of 2,000 Chinook and anglers were allowed to retain any one legal-size Chinook they caught. The quota was obtained in five days of fishing (July 5, 6, 7, 8, and 15). The estimated effort and harvest for 2001 and 2002 are from unpublished data obtained by WDFW. However, the techniques used to estimate effort and harvest were identical to the methods described for 2003 and 2004.

Test Fishing

We used a T-test to compare mean length of Chinook caught by test boats and Chinook caught by anglers. We then used a Smirnov test (Conover 1980) to compare the distribution of the lengths.

Mark Rates

We used a simple season long average to estimate mark rates of legal-size and sub-legal size Chinook caught on test boats and Chinook caught by anglers and reported on Voluntary Trip Reports (VTR's). We calculated a rate weighted by weekly catch to determine the proportion of fish that were legal-size and marked, legal-size and unmarked, sublegal-size and marked, and sublegal-size and unmarked.

Encounters and Mortalities

State and Tribal managers estimate the effect of their fisheries on Chinook (and coho) using the FRAM during pre-season planning. Along with numerous other metrics, the FRAM can predict the number of encounters of Chinook for the Area 5 and 6 fishery. To evaluate whether the FRAM was accurately predicting the impacts of the Area 5 and 6 Chinook Mark-Selective Fishery, we compared the estimated number of encounters from the creel surveys and apportioned them into the four categories of legal-size marked, legal-size unmarked, sublegal-size marked, and sublegal-size unmarked with the number of encounters predicted by the FRAM.

Mortalities were calculated as described in Thiesfeld and Hagen-Breaux (2004) and Thiesfeld et al. (2004). To further evaluate the success of the Area 5 and 6 Chinook Mark-Selective Fishery, we compared the estimated mortalities of unmarked legal-size Chinook in 2003 and 2004 with the estimated number of unmarked legal-size Chinook harvested during the 2001 and 2002 non-selective fisheries in Area 5.

Double Index Coded Wire Tag Impacts

Multiple year interactive and mark-selective fishery mortality potential bias on the number of unmarked double index tagged Chinook (2003 and 2004) was calculated as outlined in WDFW 2002. This bias represents the potential error caused by using the original release ratios of marked to unmarked double index tagged Chinook in estimating the unmarked mortalities rather than a ratio that was adjusted to reflect the impact of the prior year's mark-selective fisheries. To calculate the potential maximum bias, we estimated the number of unmarked double index tagged fish that died due to release mortality during the two years of the mark-selective fishery and the number of unmarked double index tagged fish that were encountered but survived the mark-selective fishery in 2003. In this analysis, we assumed that all those unmarked survivors that did not mature and also survived to 2004 would be vulnerable to the fishery in Areas 5 and 6 in 2004. Those fish then contributed to increase the unmarked to marked ratio according to an assumed harvest rate (5%). Unmarked mortalities were calculated using both the release lambda as well as the re-calculated lambda. The difference between these two estimates was used to represent the multiple year impact of the 2003 Area 5 and 6 Chinook Mark-Selective Fishery, i.e. the maximum bias incurred by the mark-selective fishery in 2003 on the number of unmarked double index tagged mortalities in the 2004 mark-selective fishery.

Compliance with Release of Marked Chinook

An indication of angler compliance with releasing unmarked Chinook was derived from WDFW Enforcement officer contacts and violations observed. During these angler contacts, officers issued either a written warning or citation to any angler who had retained an unmarked Chinook. An additional indicator of compliance was calculated from the number of unmarked Chinook observed during the dockside creel surveys.

RESULTS AND DISCUSSION

Creel Surveys

The two years of the fishery were remarkable in their similarities, especially considering that 2003 was a “pink year” and 2004 was not. The 29,425 angler trips made in 2004 were slightly more than the 24,593 angler trips made in 2003 (Table 1). The season lasted 39 days in 2004, which was nine days longer than the 2003 fishery with the same daily limit and quota.

With the previously mentioned caveat about comparing participation in mark-selective and non-selective fisheries, we examined some general comparisons with 2001 and 2002. In 2001 and 2002, all of Area 6 was closed for Chinook retention during the summer. In 2003, about 25% of Area 6 was open for Chinook retention during the summer. Anglers in Area 5 fished for Chinook 30 days in 2003 versus 10 days in 2001 and 5 days in 2002; a three fold and six fold increase in Chinook fishing days, respectively. Anglers harvested 1,800 Chinook in Area 5 in 2001 and 1,782 in 2002. Anglers harvested 2,529 Chinook in Area 5 in 2003, plus an additional 964 in the portion of Area 6 where Chinook fishing was open, for a total Chinook catch of 3,493; nearly twice as many as in 2001 or 2002. In 2003, the number of angler trips in Area 5 during the Chinook Mark-Selective Fishery was about 23% higher than the number made during the same time period in 2001 and approximately double the effort observed during a similar period in 2002 (Table 2). During the same time periods of July 4th or 5th through August 3 in Area 5, anglers made 19,398 angler trips in 2003, compared to 15,832 and 10,505 angler trips in 2001 and 2002, respectively.

As in 2003, about one-quarter of Area 6 was open for Chinook retention during the summer compared with no opportunity during the summer in 2001 and 2002. Anglers in Area 5 fished for Chinook 39 days in 2004 versus 10 days in 2001 and 5 days in 2002; nearly a four fold and eight fold increase in Chinook fishing days, respectively. Anglers harvested 1,800 Chinook in Area 5 in 2001 and 1,782 in 2002. Anglers harvested 2,900 Chinook in Area 5 in 2004, plus an additional 676 in the portion of Area 6 where Chinook fishing was open for a total of 3,576 Chinook; again nearly twice as many as in 2001 or 2002. In 2004, angler trips in Area 5 during the Chinook Mark-Selective Fishery were only slightly higher than the same time period in 2001, but more than double the effort observed during a similar period in 2002 (Table 3). During the same time periods of July 1 through August 8th or 9th in Area 5, anglers made 25,174 angler trips in 2004 compared to 24,075 and 11,883 angler trips in 2001 and 2002, This information shows that angler effort was higher in 2003 and 2004 than in 2001 and 2002, but more importantly, angler opportunity to fish for and retain Chinook increased to 30 and 39 days in 2003 and 2004, respectively, compared to only 10 days and 5 days in 2001 and 2002, respectively.

Sublegal-size Chinook

In Area 5, sublegal-size fish (< 22" or 56 cm total length) comprised 54% of the Chinook encountered by test boats in 2003 and 35% of the Chinook encountered in 2004. However, very few sublegal-size Chinook were caught by the test boat in Area 6 (Figure 2). In 2003, only 6 percent of the total Chinook catch in Area 6 were sublegal-size, while in 2004, only 3 percent of the total Chinook catch were sublegal-size in Area 6. Based on these rates, there were few encounters and mortalities of sublegal-size Chinook in Area 6 during the 2003 and 2004 fisheries.

Legal-size Chinook Mark Rate

The mark rate on legal-size Chinook caught by samplers on test boats was similar in both Areas 5 and 6 between years. In Area 5, the mark rate was 43% in 2003 versus 44% in 2004 (Table 4). The mark rate in Area 6 was 45% in 2003 versus 48% in 2004. For Chinook caught by the test boats in Area 5, the rate that fish were both legal-size and marked increased from 20% in 2003 to 28% in 2004. In Area 6, this rate increased from 43% to 47%.

Sampling Rates

In 2003, weekly sampling rates (catch sampled/estimated catch retained) in Area 5 ranged from 0.175 to 0.268, with a season sampling rate of 0.227 (Table 5). In Area 6, sampling rates ranged from 0.323 to 0.539, with a season sampling rate of 0.378. In 2004, weekly sampling rates in Area 5 ranged from 0.184 to 0.294, with a season sampling rate of 0.239 (Table 6). In Area 6, sampling rates ranged from 0.372 to 0.582, with a season sampling rate of 0.453.

Test Boat versus VTR's

The number of Chinook reported on VTR's in Area 5 dropped from 179 in 2003 to only 35 in 2004. Where sample sizes were adequate, test boat results matched fairly closely with VTR's (Tables 7, 8, 9 and 10). In 2003, the percent marked for legal-size and sublegal-size fish were remarkably similar given that anglers were encouraged to minimize their handling of fish and did not measure each fish. When sufficient sample sizes can be obtained from reliable VTR's, they appear to provide good information on mark rates and the proportion of fish that are marked or unmarked and legal-size or sublegal-size.

In addition to low sample sizes from VTR's in 2004, the number of Chinook caught by the test boat in Area 5 declined. A substantial portion of the reduction can be directly attributed to the use of other fishing methods in 2004 versus using only downriggers in 2003. In Area 5, 92% of the Chinook encountered and landed by the test boat were caught using downriggers, even though they were only fished 69% of the time. In Area 6, all the Chinook encountered and landed by the test boat were caught using downriggers, even though they were only fished 78% of the time. Although other methods were used by anglers, those methods clearly weren't as effective for samplers on the test boats. Lower effectiveness may be due to the level of expertise and experience needed to be competent while mooching or jigging. The presence of spiny dogfish was especially troublesome while mooching in Area 6. Samplers there were buying a significant amount of bait and still ran out daily, and encountered very few salmon.

Test Boat Catch versus Angler Catch

To evaluate the assumption that test boat samples were representative of the fishery, length frequencies of marked legal-size Chinook caught by the test boats were compared to those caught by anglers. Length frequency distributions of marked legal-size Chinook harvested by anglers and measured by creel surveys were compared to distributions of marked legal-size Chinook captured by test boats (Figures 3 and 4). Mean length of marked legal-size Chinook was not significantly different for both Area 5 (t = 1.34, 0.50 > P > 0.10) and Area 6 (t = 0.32, P > 0.50). Distribution of the lengths of marked legal-size Chinook also was not significantly different in Area 5 (T_1 = 0.190, 0.10 > P > 0.05) or in Area 6 (T_1 = 0.096, P > 0.20). The results indicate that for marked legal-size Chinook, the test boat was representative of angler catch, and thus suggest that the test boat was representative of angler catch for sublegal-size fish and unmarked fish.

Encounters

We used two methods for estimating the number of Chinook encountered in the fishery. The first method was based on applying the weighted test fishery proportions of marked and unmarked or legal-size and sublegal-size Chinook to the sum of landed catch plus the expanded creel interview reports of Chinook released.

Using the total number of Chinook encounters from the 2003 creel survey (18,333) and apportioning into the four categories of legal-size marked, legal-size unmarked, sublegal-size marked, and sublegal-size unmarked based on the test fishing data, suggests that anglers released an estimated 850 legal-size and marked Chinook or 20% of the fish they could have kept, 5,202 legal-size and unmarked Chinook, 2,397 sublegal-size and marked Chinook, and 6,391 sublegal-size and unmarked Chinook (Table 11).

The second method for estimating the number of encounters was based on the assumption that anglers kept all fish that were legal-size and marked and the number of fish in the other three categories were apportioned by test boat catch rates. This method resulted in an estimate for 2003 of 14,688 encounters (Table 11) with 4,151 legal-size and unmarked released, 1,922 sublegal-size and marked released, and 5,123 sublegal-size and unmarked released.

Using the total number of Chinook encounters from the 2004 creel survey (17,377) and apportioning into the four categories, anglers released an estimated 1,834 legal-size and marked

Chinook (Table 12), or 34% of the fish they could have kept, 7,493 legal-size and unmarked Chinook, 1,738 sublegal-size and marked Chinook, and 2,736 sublegal-size and unmarked Chinook. The second method for estimating the number of encounters resulted in an estimate for 2004 of 11,481 encounters (Table 12) with 4,949 legal-size and unmarked released, 1,149 sublegal-size and marked released, and 1,808 sublegal-size and unmarked released.

The first method produces a result that implies anglers were "sorting" their catch by releasing 20% to 34% of the Chinook that were legal to keep. The second method assumes that all retainable Chinook were kept. Given the catch rate of legal-size Chinook in this fishery of about one fish for every 7-8 anglers, it seems unlikely that extensive sorting was occurring. It is also unlikely that all legal-size and marked fish were kept; even in low success fisheries, barely legal-size fish may be voluntarily released in hopes of landing a larger one. The true number of encounters likely lies between the two estimates of encounters.

Based on the estimated number of total encounters from the creel survey (18,333) and apportioning them based on the test boat catch rates, we estimated the 2003 fishery encountered 5,277 unmarked legal-size Chinook and 6,391 unmarked sublegal-size Chinook (Table 13), while the 2004 fishery encountered 7,498 unmarked legal-size Chinook and 2,736 unmarked sublegal-size Chinook (Table 13). Except for unmarked sublegal-size fish in 2003, these estimates are below the predicted encounters of unmarked legal-size Chinook and unmarked sublegal-size Chinook as produced in the final pre-season runs of the FRAM.

<u>Mortalities, 2001 and 2002 vs. 2003 and 2004</u>

For 2003, the range of encounters resulting from the two methods described above produces a corresponding range of mortalities. Using the first method and a release mortality rate of 15% for legal-size and 20% for sublegal-size fish, we estimated the total mortalities of Chinook in the mark-selective fishery at 6,158, which includes the harvest of 3,493 fish (Table 14). We estimated the total mortality of unmarked Chinook at 2,133 fish, of which 1,278 were sublegal-size fish and 855 were legal-size. Using the encounters estimated by assuming anglers kept all legal Chinook, we estimated total mortalities at 5,524 Chinook, of which 1,723 were unmarked fish (Table 14). Of the unmarked Chinook, we estimated that 1,025 were sublegal-size and 698 were legal-size.

For 2004, we estimated the total mortalities of Chinook in the mark-selective fishery at 5,870, which includes the harvest of 3,576 fish (Table 15). We estimated the total mortality of unmarked Chinook at 1,676 fish, of which 547 were sublegal-size fish and 1,129 were legal-size. Using the encounters estimated by assuming anglers kept all legal Chinook, we estimated total mortalities at 4,910 Chinook, of which 1,109 were unmarked fish (Table 15). Of the unmarked Chinook, we estimated that 362 were sublegal-size and 747 were legal-size.

During the ten-day fishery for Chinook in 2001, an estimated 1,415 legal-size unmarked Chinook were harvested (plus an additional 385 legal-size marked Chinook). During the five-day fishery for Chinook in 2002, an estimated 1,532 legal-size unmarked Chinook were harvested (plus an additional 249 legal-size marked Chinook). The range of total unmarked legal-size mortalities for the 2003 and 2004 mark-selective fisheries (698 – 1,129) is considerably lower than the number of legal-size unmarked fish that were harvested during either 2001 or 2002 (Table 16). If the mark rate observed in 2003 or 2004 occurred in 2001 and 2002, the number of mortalities of legal-size unmarked Chinook would be about equal to the number estimated in 2003 or 2004. However, the 2003 and 2004 estimates of total mortality include drop-off mortality and released fish, which were not included in the 2001 and 2002 estimates. Although anglers were allowed to retain any Chinook in 2001 and 2002, anglers sorting for larger fish still would have released some unmarked legal-size fish. Therefore, during the Chinook Mark-Selective Fishery, anglers were able to fish for and retain nearly twice as many Chinook, and fished 20 to 34 days more, in 2003 and 2004 than they did in 2001 and 2002, with an equal or lower mortality of unmarked legal-size Chinook.

Coded wire tags and Multi-year impacts on DIT groups

Puget Sound hatchery stocks comprised 55 percent and 46 percent of the recovered coded wire tagged Chinook during the Chinook Mark-Selective Fisheries in 2003 and 2004, respectively (Appendix Tables C, D, and E). Columbia River hatchery stocks comprised 37 percent and 43 percent of the recovered coded wire tagged Chinook during the Chinook Mark-Selective Fisheries in 2003 and 2004, respectively. Canadian hatchery stocks comprised 8 percent and 12 percent of the recovered coded wire tagged Chinook during the Chinook Mark-Selective Fisheries in 2003 and 2004, respectively. Only one tag was recovered from Strait of Juan de Fuca hatchery stocks; a Hoko River fish caught in 2004.

The estimate of 10 mortalities of unmarked double index tagged fish in 2004 was similar to the estimate of 14 for 2003. For both 2003 and 2004 the number of double index coded wire tags collected during the fishery, and the estimated number of mortalities of unmarked double index tagged fish, were less than the 31 predicted by WDFW (2002).

Of the double index tagged fish encountered in 2003, the 2000 brood year Grovers Creek Chinook were estimated to be the group with the most fish surviving to 2004 (Table 17). The estimated bias due to the Area 5 and 6 Mark-Selective Fishery was very low, less than 0.10 fish for any of the tagged groups (Table 18). Such a small bias is well within the uncertainty inherent in sampling and is not considered to have any appreciable impact on the viability of the coded wire tag system.

Based on these two years of evaluation, it appears that a mark-selective Chinook fishery of this magnitude has a negligible effect on the double index tag program and that reasonable predictions of the effects of a mark-selective fishery on the double index tag program are feasible.

Compliance with Release of Unmarked Chinook

Although the Pilot Study was not designed to obtain an unbiased estimate of compliance, (anglers releasing all unmarked Chinook), data from both enforcement contacts and dockside sampling indicated a very high level of compliance.

During the Chinook Mark-Selective Fishery in 2003, enforcement officers contacted 846 anglers and issued ten warnings or citations for retaining unmarked Chinook in Areas 5 and 6. During the Chinook Mark-Selective Fishery in 2004, enforcement officers contacted 439 anglers and issued no warnings or citations for the retention of unmarked Chinook in Areas 5 and 6. Therefore, the compliance rate for releasing unmarked Chinook, based solely on these officer contacts, was 99% in 2003 and 100% in 2004.

The enforcement data for Chinook compliance matches well with the rate that unmarked Chinook were observed in the dockside creel survey during the Chinook Mark-Selective Fishery. During 2003, out of 948 Chinook sampled by creel surveyors in Areas 5 and 6, 20 (2.1%) were unmarked. In 2004, out of 996 Chinook sampled by creel surveyors, only two (0.2%) were unmarked.

CONCLUSIONS AND RECOMMENDATIONS

The Area 5 and 6 Chinook Mark-Selective Fishery Pilot Project conducted in 2003 and 2004 was a success with respect to two major objectives. First, the Pilot Project provided an opportunity to determine if mark-selective fishing for Chinook salmon in Puget Sound would increase fishing opportunity compared with recent non-selective fishery alternatives, and based on our results, we conclude that mark-selective fishing can increase the level of meaningful recreational opportunity while meeting conservation and other management constraints. Second, the Pilot Project provided an opportunity to determine if we could effectively monitor and evaluate a marine mark-selective Chinook fishery, and again based on our results, we conclude that we can effectively monitor and evaluate marine mark-selective Chinook fisheries.

Angler opportunity increased three ways due to this selective fishery. First, recreational Chinook fishing opportunity was expanded from 10-day and 5-day seasons in 2001 and 2002, respectively, to 30-day and 39-day seasons in 2003 and 2004, respectively. Second, anglers harvested nearly twice as many Chinook in 2003 and 2004 than they did in 2001 and 2002. Third, a portion of Area 6 was open for Chinook retention during the summer compared to all of Area 6 being closed for Chinook retention during the summer in 2001 and 2002. In addition, our results suggest that angler participation in Area 5 increased over effort levels during the same 30-day and 39-day time periods in 2001 and 2002. Increases in effort were modest compared to 2001 but approximately double effort levels observed in 2002. Other than simply having more days of fishing open for anglers, the increased opportunity is attributable to a relatively high mark rate of approximately 45% for legal-size Chinook and reasonably good catch rates (approximately one retained Chinook for every 7-8 anglers).

Success of the Pilot Project is also indicated by the results of WDFW public education and Enforcement activities. Information collected by the Enforcement program and from creel surveys over these two seasons indicated consistently high compliance with not retaining wild (unmarked) Chinook during the fishery.

One of the most important intentions of our Area 5 and 6 mark-selective fishery sampling and monitoring program for 2003 and 2004 was to collect information that could be used to verify the accuracy of pre-season assumptions used in the planning process. Since the impacts on Chinook stocks are based on assumptions about the overall level of angler encounters with unmarked Chinook,we estimated the number of unmarked Chinook encounters and compared those estimates with the pre-season FRAM expectations. Except for the unmarked sublegal-size fish in 2003, the estimates of encounters of unmarked legal-size Chinook and unmarked sublegal-size Chinook were below predicted levels.

We tested the assumption that test boat catches were representative of angler catches and found that for marked legal-size Chinook they were similar, suggesting they were probably similar for unmarked fish and sublegal-size fish as well. We also compared alternative methods for determining mark rates and encounters with sublegal-size fish. In strata with sufficient sample sizes for comparison, estimates of mark rates and ratios of legal/sublegal-size derived from test boat data and Voluntary Trip Report (VTR) information were very similar. We recommend a more rigorously structured VTR program that includes training and certification by WDFW staff and additional measures that will result in increased sample sizes while ensuring the quality of data collected. Based on our findings, we recommend that test fishing or VTR data, or a combination of both, be used to provide information on both mark rates and legal/sublegal-size categories in future Chinook Mark-Selective Fisheries.

In conclusion, this mark-selective Chinook fishery was successful at many levels. First, we met our two primary objectives of increasing opportunity and collecting the information necessary to evaluate pertinent biological impacts, including impacts to coded wire tagged Chinook. Second, we have likely captured the magnitude of this mark-selective fishery in terms of effort and harvest, and that magnitude was similar to pre-season expectations. Third, a level of enforcement was achieved to ensure that angler compliance with fishing regulations was high. Fourth, we were able to evaluate two different methods of obtaining mark rates and legal to sublegal ratios, and they were very similar when sample sizes were sufficient. And finally, although dependent upon factors unique to the proposed area, season, stock composition, and management logistics, our findings have provided a solid foundation for building successful mark-selective Chinook fisheries in the future.

ACKNOWLEDGEMENTS

We thank the following individuals who contributed to this study. Numerous WDFW staff contributed to data collection and analysis. Larry Bennett, Connie Warren, and their crew collected much of this data and were quick to provide assistance with the education efforts. Mark Baltzell compiled the Voluntary Trip Reports and completed the necessary data analyses. Justin Secrist provided maps and other figures.

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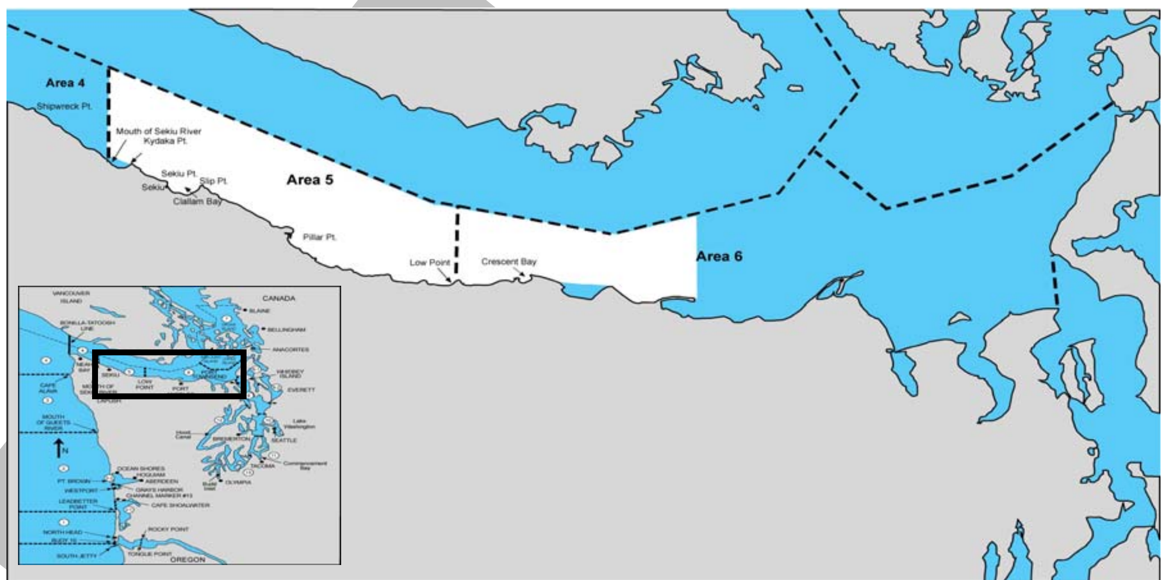


Figure 1. Location of the 2003 and 2004 Chinook Mark-Selective Fishery (shown in white) in Marine Areas 5 and 6.

Table 1. Recreational salmon catch estimates from creel surveys during the Chinook Mark-Selective Fisheries in Marine Areas 5 and 6, July 5 through August 3, 2003, and July 1 through August 8, 2004. Values may not add exactly due to rounding error.

			Trips		Harvested			Released			
Year	Fishery	Dates Open	Boats	Anglers	Chinook	Coho	Pink	Unidentified or Other	Chinook	Coho	Pink
2003	Area 5	July 5 – August 3	8,008	19,398	2,529	5,258	5,147	894	13,118	22,447	3,148
2004	Area 5	July 1 – August 8	10,709	25,174	2,900	9,459	30	113	12,392	25,800	37
2003	Area 6	July 5 – August 3	2,657	5,195	964	107	461	36	1,732	455	194
2004	Area 6	July 1 – August 8	2,251	4,251	676	78	3	3	1,409	126	3
2003	Total	July 5 – August 3	10,665	24,593	3,493	5,364	5,608	930	14,841	22,902	3,342
2004	Total	July 1 – August 8	12,960	29,425	3,576	9,537	33	116	13,802	25,926	40

Table 2. Estimated effort and harvest in the 2001 and 2002 non-selective Chinook fisheries in Area 5 compared to the 2003 Area 5 Chinook Mark-Selective Fishery, July 5 through August 3, 2003.

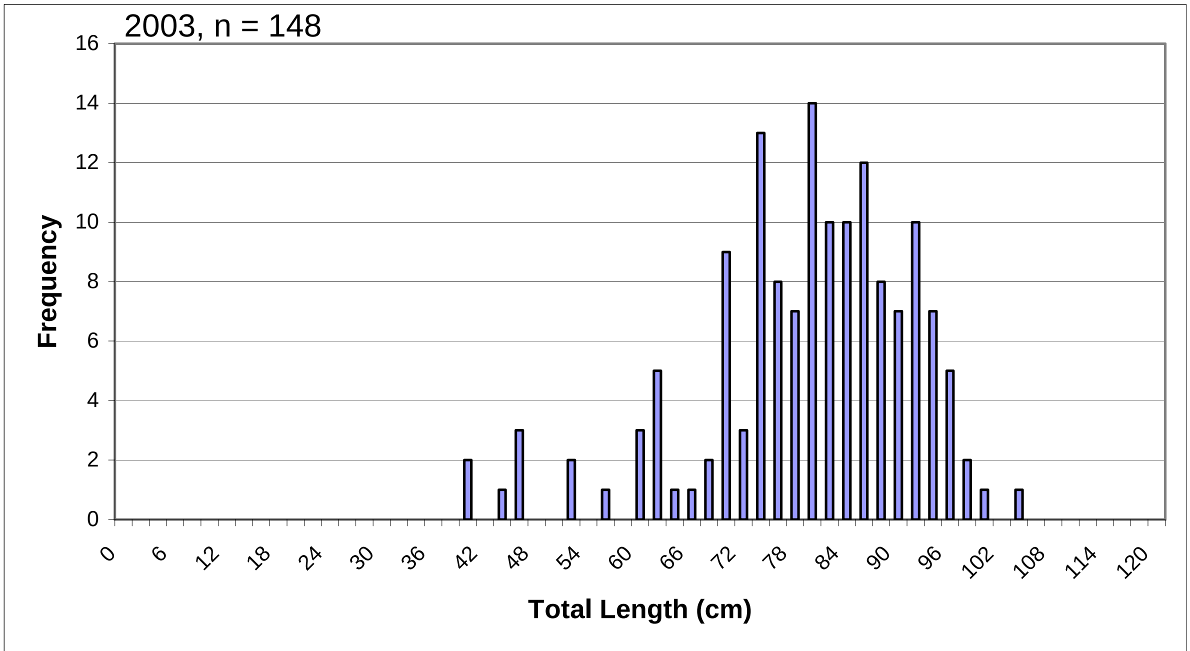
Year	Quota	Days Open for Chinook	Date of Comparison	Chinook Daily Limit (≥ 22")	Angler Trips	Chinook Harvested[a]
2001	2,000	6[b]	July 5 – August 3	Any 1	15,832	954
2002	2,000	5	July 4[c] – August 3	Any 1	10,505	1,782
2003	3,500[d]	30	July 5 – August 3	2 Marked	19,398	2,529

a. Does not include any illegal harvest during days that Chinook retention was not allowed.
b. Chinook retention was also allowed July 1 – July 4, for a total of 10 days open.
c. July 4 is the nearest date for which an estimate was made.
d. The quota applied to Area 5 and the western portion of Area 6.

Table 3. Estimated effort and harvest in the 2001 and 2002 non-selective Chinook fisheries in Area 5 compared to the 2004 Area 5 Chinook Mark-Selective Fishery, July 1 through August 8, 2004.

Year	Quota	Days Open for Chinook	Date of Comparison	Chinook Daily Limit (≥ 22")	Angler Trips	Chinook Harvested[a]
2001	2,000	10	July 1 – August 9[b]	Any 1	24,075	1,800
2002	2,000	5	July 1 – August 9[b]	Any 1	11,883	1,782
2004	3,500[c]	39	July 1 – August 8	2 Marked	25,174	2,900

a. Does not include any illegal harvest during days that Chinook retention was not allowed.
b. August 9 is the nearest date for which an estimate was made.
c. The quota applied to Area 5 and the western portion of Area 6.



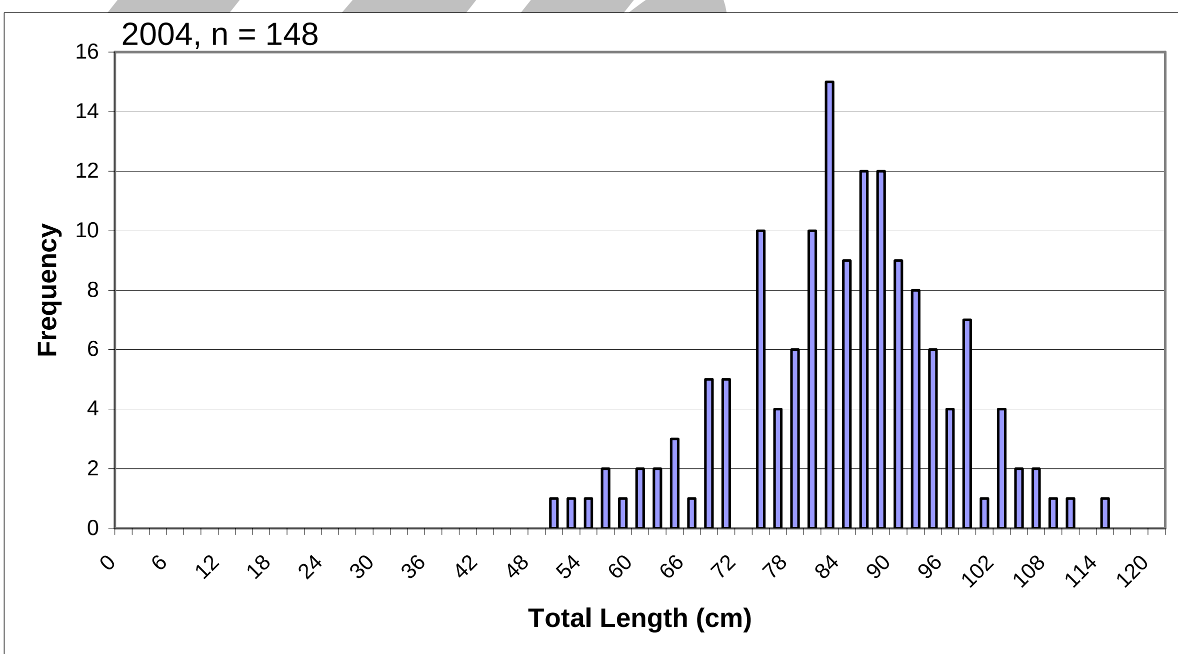


Figure 2. Length frequency histograms of Chinook salmon caught by test fishing boats sampling from July 5 through August 3, 2003 and July 1 through August 8, 2004, in Marine Area 6.

Table 4. Percent of legal-size Chinook salmon that were adipose fin clipped (mark rate) caught by test boats in the Area 5 and 6 Chinook Mark-Selective fisheries, July 5 – August 3, 2003, and July 1 – August 8, 2004.

	Year	Sample Size	Percent Marked
Area 5	2003	155	43
Area 5	2004	110	44
Area 6	2003	139	45
Area 6	2004	143	48

Table 5. Sample rates for the 2003 Area 5 and 6 Chinook Mark-Selective fisheries, July 5 – August 3, 2003.

	Area 5			Area 6		
Week	Number of Chinook Sampled	Estimated Chinook Retained	Sample Rate	Number of Chinook Sampled	Estimated Chinook Retained	Sample Rate
27	69	258	0.268	23	43	0.539
28	111	635	0.175	72	139	0.520
29	55	240	0.229	68	168	0.404
30	149	606	0.246	81	242	0.334
31	189	790	0.239	120	372	0.323
Total	573	2,529	0.227	364	964	0.378

Table 6. Sample rates for the 2004 Area 5 and 6 Chinook Mark-Selective fisheries, July 1 – August 8, 2004. Values may not add exactly due to rounding error.

	Area 5			Area 6		
Week	Number of Chinook Sampled	Estimated Chinook Retained	Sample Rate	Number of Chinook Sampled	Estimated Chinook Retained	Sample Rate
27	128	697	0.184	47	81	0.582
28	151	513	0.294	17	46	0.372
29	106	407	0.260	16	37	0.429
30	100	410	0.244	87	185	0.470
31	127	475	0.267	70	188	0.373
32	80	397	0.202	69	139	0.495
Total	692	2,900	0.239	306	676	0.453

Table 7. Percent of Chinook caught by test boats that were marked during the Chinook Mark-Selective Fishery in Marine Area 5, July 5 through August 3, 2003, and July 1 through August 8, 2004.

	2003		2004	
	Test Boats	VTR's	Test Boats	VTR's
Legal-size Percent Marked	43	44	44	20
Sample Size	*(155)*	*(85)*	*(110)*	*(20)*
Sublegal-size Percent Marked	27	32	36	20
Sample Size	*(180)*	*(94)*	*(59)*	*(15)*

Table 8. Percent of Chinook caught by test boats that were marked during the Chinook Mark-Selective Fishery in Marine Area 6, July 5 through August 3, 2003, and July 1 through August 8, 2004.

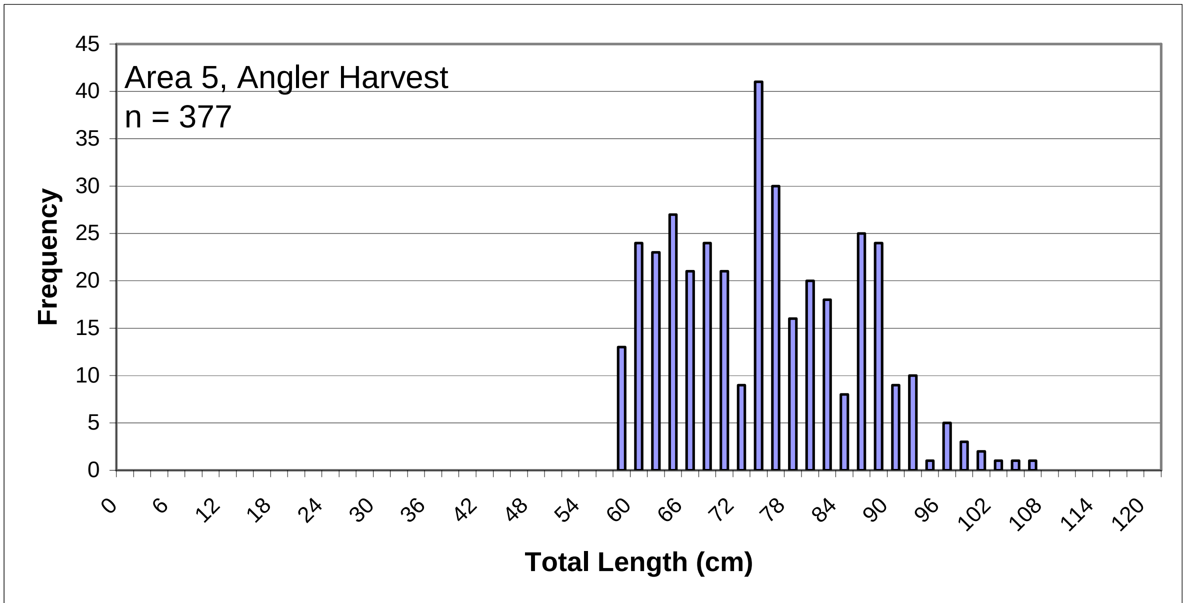
	2003		2004	
	Test Boats	VTR's	Test Boats	VTR's
Legal-size Percent Marked	45	43	48	40
Sample Size	*(139)*	*(67)*	*(143)*	*(104)*
Sublegal-size Percent Marked	33	38	80	25
Sample Size	*(9)*	*(13)*	*(5)*	*(8)*

Table 9. Weighted proportions of Chinook that were legal-size marked, legal-size unmarked, sublegal-size marked, and sublegal-size unmarked caught by test boats and as recorded by anglers on Voluntary Trip Reports (VTR's) during Chinook Mark-Selective Fishery in Marine Area 5, July 5 through August 3, 2003, and July 1 through August 8, 2004.

	2003		2004	
	Test Boats	VTR's	Test Boats	VTR's
Legal-size and marked	0.197	0.213	0.287	n/a
Legal-size and unmarked	0.254	0.290	0.424	n/a
Sublegal-size and marked	0.149	0.183	0.110	n/a
Sublegal-size and unmarked	0.400	0.314	0.178	n/a
Sample Size	*(335)*	*(179)*	*(169)*	*(35)*

Table 10. Weighted proportions of Chinook that were legal-size marked, legal-size unmarked, sublegal-size marked, and sublegal-size unmarked caught by test boats and as recorded by anglers on Voluntary Trip Reports (VTR's) during Chinook Mark-Selective Fishery in Marine Area 6, July 5 through August 3, 2003, and July 1 through August 8, 2004.

	2003		2004	
	Test Boats	VTR's	Test Boats	VTR's
Legal-size and marked	0.439	0.446	0.489	0.359
Legal-size and unmarked	0.485	0.459	0.477	0.570
Sublegal-size and marked	0.027	0.037	0.027	0.013
Sublegal-size and unmarked	0.049	0.058	0.007	0.058
Sample Size	*(148)*	*(80)*	*(148)*	*(112)*



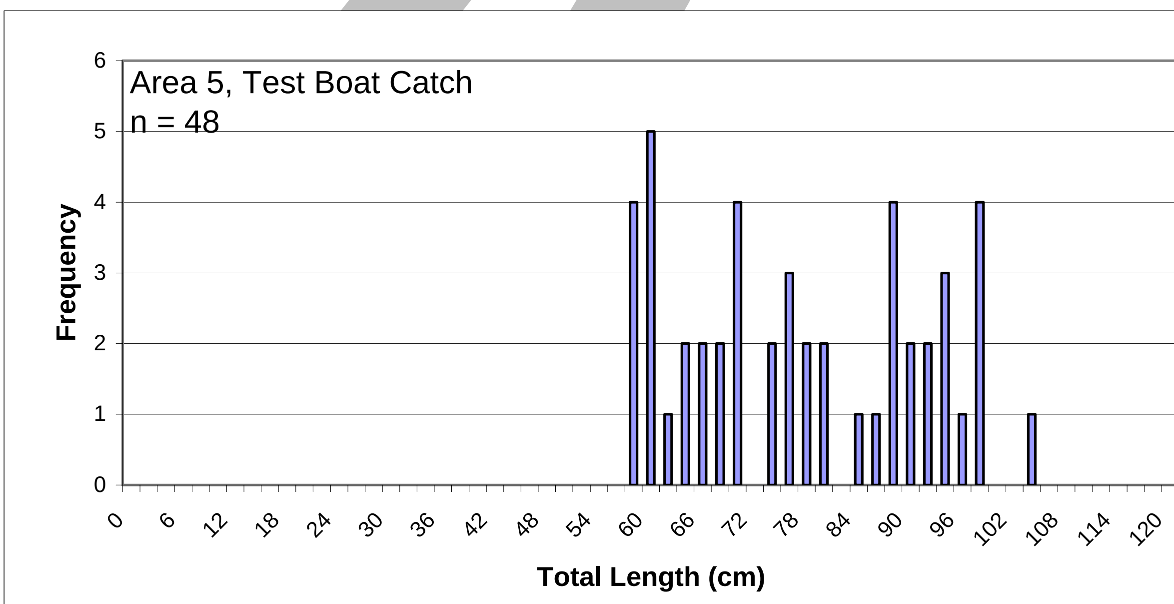
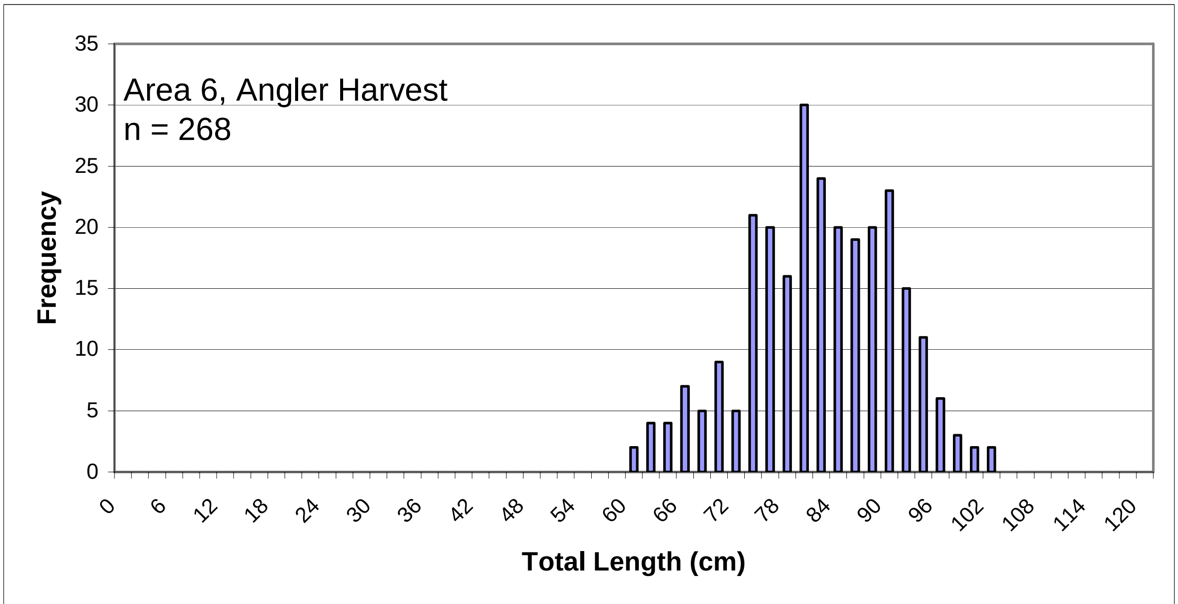


Figure 3. Length frequency distributions of marked legal-size Chinook kept by anglers and marked legal-size Chinook caught by test boat in Area 5 during the 2004 Chinook Mark-Selective Fishery, July 1 through August 8, 2004.



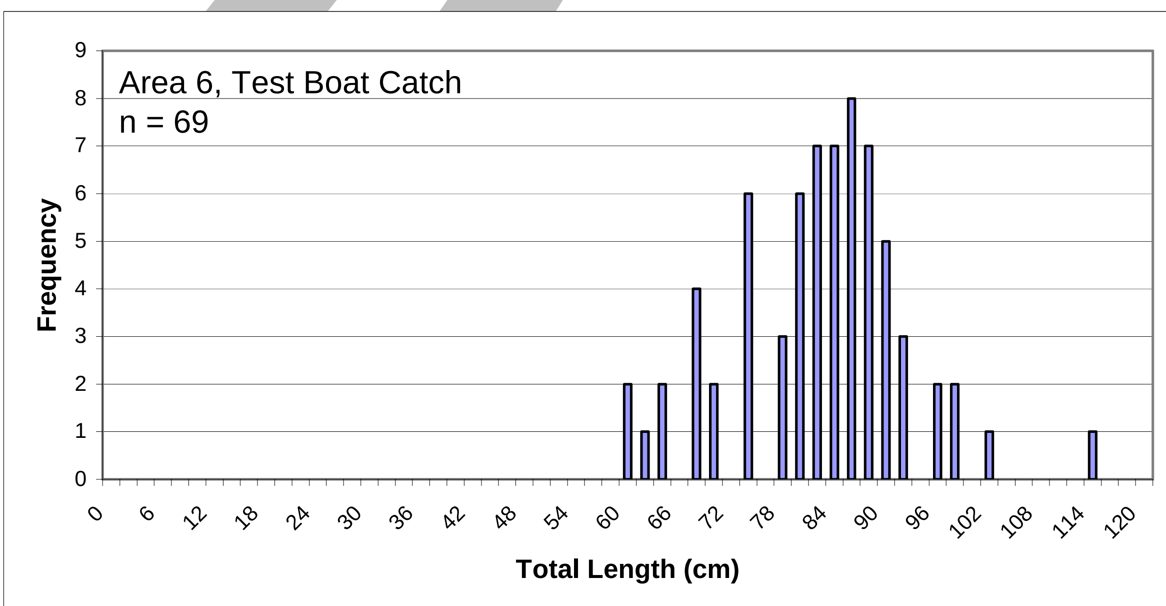


Figure 4. Length frequency distributions of marked legal-size Chinook kept by anglers and marked legal-size Chinook caught by test boat in Area 6 during the 2004 Chinook Mark-Selective Fishery, July 1 through August 8, 2004.

Table 11. Comparison of estimated encounters of Chinook in the Area 5 and 6 Chinook Mark-Selective Fishery in 2003. Test boat proportions method assumes that anglers retained all legal-size marked Chinook. Values may not add exactly due to rounding error.

Method	Area	Legal-size Marked Kept	Legal-size Marked Released	Legal-size Unmarked Kept	Legal-size Unmarked Released	Sublegal-size Marked Released	Sublegal-size Unmarked Released	Total Encountered
Creel and Test Boat	5	2,476	613	53	3,921	2,323	6,260	15,647
	6	941	238	22	1,281	74	131	2,686
	5 & 6 Combined	3,417 [a]	850	75	5,202	2,397	6,391	18,333
Test boat Proportions	5	2,476	0	53	3,133	1,863	5,019	12,543
	6	941	0	22	1,018	59	104	2,145
	5 & 6 Combined	3,417 [a]	0	75	4,151	1,922	5,123	14,688

a. Includes up to 203 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys of coded wire tagged harvested fish.

Table 12. Comparison of estimated encounters of Chinook in the Area 5 and 6 Chinook Mark-Selective Fishery in 2004. Test boat proportions method assumes that anglers retained all legal-size marked Chinook. Values may not add exactly due to rounding error.

Method	Area	Legal-size Marked Kept	Legal-size Marked Released	Legal-size Unmarked Kept	Legal-size Unmarked Released	Sublegal-size Marked Released	Sublegal-size Unmarked Released	Total Encountered
Creel and Test Boat	5	2,900 [a]	1,489	0	6,499	1,682	2,722	15,292
	6	671 [b]	345	5	994	56	14	2,085
	5 & 6 Combined	3,571	1,834	5	7,493	1,738	2,736	17,377
Test boat Proportions	5	2,900 [a]	0	0	4,294	1,112	1,799	10,105
	6	671 [b]	0	5	654	37	10	1,377
	5 & 6 Combined	3,571	0	5	4,949	1,149	1,808	11,481

a. Includes up to 194 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.
b. Includes up to 3 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.

Table 13. Comparison of FRAM model predictions of encounters with estimated encounters from creel surveys and test fishing during the Chinook Mark-Selective Fisheries in Marine Areas 5 and 6, July 5 through August 3, 2003, and July 1 through August 8, 2004.

	2003		2004	
	FRAM	Creel & Test Fishing	FRAM	Creel & Test Fishing
Legal-size & marked	3,045	4,267	3,043	5,405
Legal-size & unmarked	7,976	5,277	7,993	7,498
Sublegal-size & marked	2,815	2,397	2,690	1,738
Sublegal-size & unmarked	4,585	6,391	4,935	2,736
Total	18,421	18,333	18,661	17,377

Table 14. Comparison of estimated mortalities of Chinook in the Area 5 and 6 Chinook Mark-Selective Fishery in 2003. Test boat proportions method assumes that anglers retained all legal-size marked Chinook. Totals may not add up exactly due to rounding error.

Method	Area	Legal-size Marked Kept	Legal-size Marked Released	Legal-size Unmarked Kept	Legal-size Unmarked Released	Sublegal-size Marked Released	Sublegal-size Unmarked Released	Total Mortalities
Creel and Test Boat	5	2,476	92	53	588	465	1,252	4,926
	6	941	36	22	192	15	26	1,232
	5 & 6 Combined	3,417 [a]	128	75	780	479	1,278	6,158
Test boat Proportions	5	2,476	0	53	470	373	1,004	4,375
	6	941	0	22	153	12	21	1,148
	5 & 6 Combined	3,417 [a]	0	75	623	384	1,025	5,524

a. Includes up to 203 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys of coded wire tagged harvested fish.

Table 15. Comparison of estimated mortalities of Chinook in the Area 5 and 6 Chinook Mark-Selective Fishery in 2004. Test boat proportions method assumes that anglers retained all legal-size marked Chinook. Values may not add exactly due to rounding error.

Method	Area	Legal-size Marked Kept	Legal-size Marked Released	Legal-size Unmarked Kept	Legal-size Unmarked Released	Sublegal-size Marked Released	Sublegal-size Unmarked Released	Total Mortalities
Creel and Test Boat	5	2,900[a]	223	0	975	336	544	4,979
	6	671[b]	52	5	149	11	3	891
	5 & 6 Combined	3,571	275	5	1,124	348	547	5,870
Test boat Proportions	5	2,900[a]	0	0	644	222	360	4,126
	6	671[b]	0	5	98	7	2	783
	5 & 6 Combined	3,571	0	5	742	230	362	4,910

a. Includes up to 194 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.
b. Includes up to 3 fish that may be sublegal-size and marked Chinook based on measurements during creel surveys.

Table 16. Estimated harvest of unmarked legal-size Chinook in the 2002 non-selective Chinook fishery in Area 5 compared to the estimated mortalities of unmarked legal-size Chinook in the 2003 and 2004 Area 5 Chinook Mark-Selective Fishery.

Year	Quota	Days Open	Daily Limit (≥ 22")	Unmarked Legal-size Mortalities
2001	2,000	10	Any 1	1,415[a]
2002	2,000	5	Any 1	1,532[a]
2003	3,500	30	2 Marked	698 - 855
2004	3,500	39	2 Marked	747 – 1,129

a. Estimated harvest only from creel surveys. Does not include drop-off or release mortality, which are included in the 2003 and 2004 estimates.

Table 17. Estimated number of encountered unmarked DIT survivors from the Area 5 and 6 Chinook Mark-Selective Fishery in 2003 to 2004.

Hatchery	Brood year	Age in 2003	Estimated encounters of unmarked DIT fish in 2003	Estimated mortality of unmarked DIT fish in 2003[1]	Estimated number of unmarked DIT fish that survived	Maturity rate[2]	Over-winter survival rate[3]	Estimated Number of encountered unmarked DIT fish that survived to 2004
		a	$U\text{-}Enc^{2003} = M\text{-}Enc^{2003}\lambda^{Rel}$	$U^{2003} = U\text{-}Enc^{2003} * sfm$	$U\text{-}Surv^{2003} = U\text{-}Enc^{2003}(1\text{-}sfm)$	M	S_a	$U\text{-}Surv^{2003}(1\text{-}M)S$
George Adams	2000	3	11.420	1.15	10.37	0.18	0.8	6.80
Grovers Cr	1999	4	35.160	3.50	31.54	0.77	0.9	6.53
Grovers Cr	2000	3	19.780	2.01	18.05	0.08	0.8	13.28
Chilliwack	1999	4	4.070	0.40	3.60	0.51	0.9	1.59
Chilliwack	2000	3	4.070	0.41	3.67	0.18	0.8	2.41
Chilliwack	2001	2	4.180	0.41	3.69	0.03	0.7	2.50
Marblemount	1999	4	6.540	0.67	5.99	0.72	0.9	1.51
Nisqually	1999	4	7.470	0.73	6.59	0.68	0.9	1.90
Nisqually-A	2000	3	4.950	0.54	4.82	0.08	0.8	3.55
Nisqually-B	2000	3	9.900	0.98	8.80	0.08	0.8	6.48
Samish	1999	4	2.480	0.25	2.29	0.86	0.9	0.29
Soos Cr	1999	4	19.080	1.95	17.56	0.77	0.9	3.64
Soos Cr	2000	3	8.710	0.91	8.18	0.08	0.8	6.02
Wallace R	2000	3	5.710	0.58	5.25	0.10	0.8	3.78

[1] An *sfm* of 0.10 was used.

[2] The maturity rates were taken from FRAM inputs described in the Attachment II to the 2003 Area 5 and 6 Chinook Mark-Selective Fishery proposal to the Pacific Salmon Commission – Selective Fishery Evaluation Committee. For Wallace R., there were no such FRAM values, so the values for Marblemount 3 year-old Chinook were substituted.

[3] The survival rates are those used by the PSC-CTC.

Table 18. Estimated bias in numbers of incidental unmarked DIT mortalities in the 2004 Area 5 and 6 Chinook Mark-Selective Fishery.

Hatchery	Brood year	Estimated harvest of marked DIT fish in 2004[1]	Unmarked to marked ratio at release	Estimated number of encountered unmarked DIT fish	Adjusted number of encountered unmarked DIT fish[2]	Estimated number of unmarked DIT mortalities[3]	Adjusted number of unmarked DIT mortalities	Bias in number of unmarked DIT mortalities
		$M\text{-}Enc^{2004}$	λ^{Rel}	$U\text{-}Enc^{2004} = M\text{-}Enc^{2004}\lambda^{Rel}$	$U\text{-}AdjEnc^{2004} = U\text{-}Enc^{2004} + U\text{-}Surv^{2003}HR$	$U^{2004} = U\text{-}Enc^{2003} * sfm$	$U\text{-}Adj^{2004} = U\text{-}AdjEnc^{2003} * sfm$	$U^{2004} - U\text{-}Adj^{2004}$
George Adams	2000	7.14	1.009	7.20	7.54	0.72	0.75	-0.03
George Adams	2001	22.62	0.938	21.22	21.22	2.12	2.12	0.00
Grovers Cr	1999	0.00	0.997	0.00	0.33	0.00	0.00	0.00
Grovers Cr	2000	17.15	1.014	17.39	18.05	1.74	1.81	-0.07
Grovers Cr	2001	7.48	1.002	7.49	7.49	0.75	0.75	0.00
Chilliwack	1999	0.00	0.983	0.00	0.08	0.00	0.00	0.00
Chilliwack	2000	0.00	1.002	0.00	0.12	0.00	0.00	0.00
Chilliwack	2001	15.00	0.980	14.71	14.83	1.47	1.48	-0.01
Chilliwack	2002	3.84	0.996	3.83	3.83	0.38	0.38	0.00
Marblemount	1999	0.00	1.018	0.00	0.08	0.00	0.00	0.00
Marblemount	2000	2.68	0.990	2.65	2.65	0.27	0.27	0.00
Nisqually-A	2000	0.00	0.988	0.00	0.09	0.00	0.00	0.00
Nisqually-B	2000	1.72	1.083	1.86	2.04	0.19	0.20	-0.02
Samish	1999	5.53	1.057	5.46	5.79	0.55	0.58	-0.03
Soos Cr	1999	0.00	1.023	0.00	0.01	0.00	0.00	0.00
Soos Cr	2000	0.00	1.043	0.00	0.18	0.00	0.00	0.00

/1 The marked mortalities were taken from the 2004 WDFW post-season report on the Area 5/6 MSF.
/2 A harvest rate (HR) of 5% was used.
/3 An *sfm* of 0.10 was used.

Appendix A. 2003 and 2004 statistical weeks used by Washington Department of Fish and Wildlife.

2003 Statistical Weeks (Monday - Sunday)

Stat. Mon	Week No.	Calendar Dates Start	Calendar Dates End	Julian Dates Start	Julian Dates End
Jan	1	01-Jan	05-Jan	1	5
	2	06-Jan	12-Jan	6	12
1	3	13-Jan	19-Jan	13	19
	4	20-Jan	26-Jan	20	26
	5	27-Jan	02-Feb	27	33
Feb	6	03-Feb	09-Feb	34	40
	7	10-Feb	16-Feb	41	47
2	8	17-Feb	23-Feb	48	54
	9	24-Feb	02-Mar	55	61
Mar	10	03-Mar	09-Mar	62	68
	11	10-Mar	16-Mar	69	75
3	12	17-Mar	23-Mar	76	82
	13	24-Mar	30-Mar	83	89
Apr	14	31-Mar	06-Apr	90	96
	15	07-Apr	13-Apr	97	103
4	16	14-Apr	20-Apr	104	110
	17	21-Apr	27-Apr	111	117
	18	28-Apr	04-May	118	124
May	19	05-May	11-May	125	131
	20	12-May	18-May	132	138
5	21	19-May	25-May	139	145
	22	26-May	01-Jun	146	152
June	23	02-Jun	08-Jun	153	159
	24	09-Jun	15-Jun	160	166
6	25	16-Jun	22-Jun	167	173
	26	23-Jun	29-Jun	174	180

Stat. Mon	Week No.	Calendar Dates Start	Calendar Dates End	Julian Dates Start	Julian Dates End
Jul	27	30-Jun	06-Jul	181	187
	28	07-Jul	13-Jul	188	194
7	29	14-Jul	20-Jul	195	201
	30	21-Jul	27-Jul	202	208
	31	28-Jul	03-Aug	209	215
Aug	32	04-Aug	10-Aug	216	222
	33	11-Aug	17-Aug	223	229
8	34	18-Aug	24-Aug	230	236
	35	25-Aug	31-Aug	237	243
Sep	36	01-Sep	07-Sep	244	250
	37	08-Sep	14-Sep	251	257
9	38	15-Sep	21-Sep	258	264
	39	22-Sep	28-Sep	265	271
Oct	40	29-Sep	05-Oct	272	278
	41	06-Oct	12-Oct	279	285
10	42	13-Oct	19-Oct	286	292
	43	20-Oct	26-Oct	293	299
	44	27-Oct	02-Nov	300	306
Nov	45	03-Nov	09-Nov	307	313
	46	10-Nov	16-Nov	314	320
11	47	17-Nov	23-Nov	321	327
	48	24-Nov	30-Nov	328	334
Dec	49	01-Dec	07-Dec	335	341
	50	08-Dec	14-Dec	342	348
12	51	15-Dec	21-Dec	349	355
	52	22-Dec	28-Dec	356	362
	53	29-Dec	31-Dec	363	365

Appendix A. Continued.

2004 Statistical Weeks (Monday - Sunday)

Stat. Mon	Week No.	Calendar Dates Start	Calendar Dates End	Julian Dates Start	Julian Dates End
Jan	1	01-Jan	04-Jan	1	4
	2	05-Jan	11-Jan	5	11
1	3	12-Jan	18-Jan	12	18
	4	19-Jan	25-Jan	19	25
	5	26-Jan	01-Feb	26	32
Feb	6	02-Feb	08-Feb	33	39
	7	09-Feb	15-Feb	40	46
2	8	16-Feb	22-Feb	47	53
	9	23-Feb	29-Feb	54	60
Mar	10	01-Mar	07-Mar	61	67
	11	08-Mar	14-Mar	68	74
3	12	15-Mar	21-Mar	75	81
	13	22-Mar	28-Mar	82	88
Apr	14	29-Mar	04-Apr	89	95
	15	05-Apr	11-Apr	96	102
4	16	12-Apr	18-Apr	103	109
	17	19-Apr	25-Apr	110	116
	18	26-Apr	02-May	117	123
May	19	03-May	09-May	124	130
	20	10-May	16-May	131	137
5	21	17-May	23-May	138	144
	22	24-May	30-May	145	151
June	23	31-May	06-Jun	152	158
	24	07-Jun	13-Jun	159	165
6	25	14-Jun	20-Jun	166	172
	26	21-Jun	27-Jun	173	179

Stat. Mon	Week No.	Calendar Dates Start	Calendar Dates End	Julian Dates Start	Julian Dates End
Jul	27	28-Jun	04-Jul	180	186
	28	05-Jul	11-Jul	187	193
7	29	12-Jul	18-Jul	194	200
	30	19-Jul	25-Jul	201	207
	31	26-Jul	01-Aug	208	214
Aug	32	02-Aug	08-Aug	215	221
	33	09-Aug	15-Aug	222	228
8	34	16-Aug	22-Aug	229	235
	35	23-Aug	29-Aug	236	242
Sep	36	30-Aug	05-Sep	243	249
	37	06-Sep	12-Sep	250	256
9	38	13-Sep	19-Sep	257	263
	39	20-Sep	26-Sep	264	270
Oct	40	27-Sep	03-Oct	271	277
	41	04-Oct	10-Oct	278	284
10	42	11-Oct	17-Oct	285	291
	43	18-Oct	24-Oct	292	298
	44	25-Oct	31-Oct	299	305
Nov	45	01-Nov	07-Nov	306	312
	46	08-Nov	14-Nov	313	319
11	47	15-Nov	21-Nov	320	326
	48	22-Nov	28-Nov	327	333
Dec	49	29-Nov	05-Dec	334	340
	50	06-Dec	12-Dec	341	347
12	51	13-Dec	19-Dec	348	354
	52	20-Dec	26-Dec	355	361
	53	27-Dec	31-Dec	362	366

Appendix B. Observed recoveries of coded wire tags from Chinook salmon during the Chinook Mark-Selective Fisheries in Marine Areas 5 and 6, July 5 through August 3, 2003.

Area	RecovDate	Tagcode	RcvMark	FKLcm	BroodYr	RearingHatchery	ReleaseSite	ReleaseAgency
05	Aug 1 2003	050182	AD Fin Clp	80	1999	MAKAH NFH ON SOOES R	SOOES R 20.0015	FWS
05	Jul 14 2003	054421	AD Fin Clp	87	1999	SPRING CR NFH	SPRING CR 29.0159	FWS
05	Jul 20 2003	054523	AD Fin Clp	84	2000	SPRING CR NFH	SPRING CR 29.0159	FWS
05	Aug 2 2003	060270	AD Fin Clp	61	2000	MOKELUMNE R FISH INS	JERSEY PT,SAN JOAQ.R	EBMD
05	Jul 27 2003	065459	AD Fin Clp	57	2000	NIMBUS FISH HATCHERY	WICKLAND OIL NET PEN	CDFG
05	Aug 2 2003	093250	AD Fin Clp	65	2000	BIG CR HATCHERY	BIG CR (LWR COL R)	ODFW
05	Jul 8 2003	093250	AD Fin Clp	63	2000	BIG CR HATCHERY	BIG CR (LWR COL R)	ODFW
05	Jul 27 2003	093250	AD Fin Clp	67	2000	BIG CR HATCHERY	BIG CR (LWR COL R)	ODFW
05	Jul 8 2003	182811	AD Fin Clp	62	2000	H-COWICHAN R	R-COWICHAN BAY	CDFO
05	Jul 21 2003	184124	AD Fin Clp	81	1999	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Jul 19 2003	184336	AD Fin Clp	92	1999	H-NANAIMO R	R-NANAIMO R	CDFO
05	Aug 3 2003	184539	AD Fin Clp	72	2000	H-COWICHAN R	R-COWICHAN R	CDFO
05	Aug 1 2003	184551	AD Fin Clp	65	2000	H-CHEHALIS R	R-CHEHALIS R	CDFO
05	Jul 6 2003	184552	AD Fin Clp	58	2000	H-NANAIMO R	R-NANAIMO R	CDFO
05	Jul 26 2003	184614	AD Fin Clp	53	2000	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Aug 1 2003	184916	AD Fin Clp	56	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Aug 1 2003	210135	AD Fin Clp	78	1998	KALAMA CR HATCHERY	KALAMA CR 11.0017	NISQ
05	Jul 21 2003	210151	Unmarked	92	1998	MARBLEMOUNT HATCHERY	SKAGIT R 03.0176	WDFW
05	Aug 1 2003	210153	AD Fin Clp	68	1999	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Aug 3 2003	210153	AD Fin Clp	78	1999	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 6 2003	210153	AD Fin Clp	75	1999	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 13 2003	210153	AD Fin Clp	57	1999	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 25 2003	210153	AD Fin Clp	54	1999	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 25 2003	210153	AD Fin Clp	88	1999	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 26 2003	210153	AD Fin Clp	78	1999	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 27 2003	210153	AD Fin Clp	83	1999	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 30 2003	210153	AD Fin Clp	97	1999	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 30 2003	210153	AD Fin Clp		1999	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 12 2003	210166	AD Fin Clp	70	1999	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
05	Jul 27 2003	210166	AD Fin Clp	72	1999	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
05	Jul 7 2003	210221	AD Fin Clp	67	1999	BERNIE GOBIN HATCH	TULALIP CR 07.0001	TULA
05	Jul 11 2003	210269	AD Fin Clp	64	2000	KALAMA CR HATCHERY	KALAMA CR 11.0017	NISQ
05	Jul 19 2003	210269	AD Fin Clp	57	2000	KALAMA CR HATCHERY	KALAMA CR 11.0017	NISQ
05	Jul 30 2003	210269	AD Fin Clp	56	2000	KALAMA CR HATCHERY	KALAMA CR 11.0017	NISQ
05	Jul 31 2003	210269	AD Fin Clp	68	2000	KALAMA CR HATCHERY	KALAMA CR 11.0017	NISQ
05	Aug 2 2003	210272	AD Fin Clp	70	2000	BERNIE GOBIN HATCH	TULALIP CR 07.0001	TULA
05	Jul 11 2003	210272	AD Fin Clp	65	2000	BERNIE GOBIN HATCH	TULALIP CR 07.0001	TULA
05	Jul 13 2003	210273	AD Fin Clp	56	2000	BERNIE GOBIN HATCH	TULALIP CR 07.0001	TULA
05	Aug 2 2003	210279	AD Fin Clp	55	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Aug 3 2003	210279	AD Fin Clp	81	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 20 2003	210279	AD Fin Clp	65	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 26 2003	210279	AD Fin Clp	62	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 26 2003	210279	AD Fin Clp	75	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Aug 2 2003	210294	AD Fin Clp	54	2000	PUYALLUP TRIBAL HATC	DIRU CR 10.0029	PUYA
05	Jul 27 2003	630164	AD Fin Clp	70	1999	MARBLEMOUNT HATCHERY	CASCADE R 03.1411	WDFW
05	Aug 1 2003	630171	AD Fin Clp	87	1999	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
05	Aug 3 2003	630171	AD Fin Clp	79	1999	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
05	Jul 8 2003	630171	AD Fin Clp	56	1999	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
05	Jul 26 2003	630171	AD Fin Clp	77	1999	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
05	Jul 30 2003	630171	AD Fin Clp	73	1999	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
05	Jul 18 2003	630173	AD Fin Clp	77	1999	SAMISH HATCHERY	FRIDAY CR + SAMISH R	WDFW
05	Jul 16 2003	630186	AD Fin Clp	71	1999	COWLITZ SALMON HATCH	TOUTLE R-NF 26.0314	WDFW
05	Aug 3 2003	630189	AD Fin Clp	73	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
05	Jul 6 2003	630189	AD Fin Clp	67	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
05	Jul 13 2003	630196	AD Fin Clp	58	2000	ELOCHOMAN HATCHERY	ELOCHOMAN R 25.0236	WDFW
05	Jul 18 2003	630197	AD Fin Clp	76	1999	MARBLEMOUNT HATCHERY	CASCADE R 03.1411	WDFW
05	Jul 27 2003	630197	AD Fin Clp	84	1999	MARBLEMOUNT HATCHERY	CASCADE R 03.1411	WDFW
05	Jul 21 2003	630279	AD Fin Clp	66	2000	KALAMA FALLS HATCHRY	KALAMA R 27.0002	WDFW
05	Jul 8 2003	630282	AD Fin Clp	61	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 8 2003	630282	AD Fin Clp	68	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 13 2003	630282	AD Fin Clp	62	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 25 2003	630282	AD Fin Clp	65	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 27 2003	630282	AD Fin Clp	69	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Aug 1 2003	630398	AD Fin Clp	64	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 31 2003	630399	AD Fin Clp	70	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 31 2003	630399	AD Fin Clp	70	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 26 2003	630469	AD Fin Clp	58	1999	SIMILKAMEEN HATCHERY	SIMILKAMEEN R 490325	WDFW

Appendix B. Continued.

Area	RecovDate	Tagcode	RcvMark	FKLcm	BroodYr	RearingHatchery	ReleaseSite	ReleaseAgency
05	Jul 5 2003	630476	AD Fin Clp	62	1999	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 13 2003	630476	AD Fin Clp	58	1999	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 7 2003	630668	AD Fin Clp	57	2000	WALLACE R HATCHERY	WALLACE R 07.0940	WDFW
05	Jul 13 2003	630669	AD Fin Clp	55	2000	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
05	Jul 27 2003	630669	AD Fin Clp	53	2000	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
05	Jul 26 2003	630677	AD Fin Clp	56	2000	LYONS FERRY HATCHERY	BIG CANYON ACCL POND	NEZP
06	Aug 2 2003	630683	AD Fin Clp	69	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
06	Jul 24 2003	630683	AD Fin Clp	60	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
06	Jul 27 2003	630683	AD Fin Clp	58	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
06	Aug 1 2003	630687	AD Fin Clp	53	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
06	Jul 11 2003	630687	AD Fin Clp	56	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
06	Jul 16 2003	630697	AD Fin Clp	70	1999	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Aug 1 2003	630789	AD Fin Clp	55	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 19 2003	630789	AD Fin Clp	71	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Aug 2 2003	630790	AD Fin Clp	55	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 8 2003	630790	AD Fin Clp	52	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 26 2003	630790	AD Fin Clp	55	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 30 2003	630793	AD Fin Clp	56	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 27 2003	630794	AD Fin Clp	51	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 26 2003	630795	AD Fin Clp	50	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 11 2003	630867	AD Fin Clp	56	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 11 2003	630867	AD Fin Clp	63	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 27 2003	630867	AD Fin Clp	58	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Aug 2 2003	630868	AD Fin Clp	56	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Aug 1 2003	630872	AD Fin Clp	55	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 26 2003	630872	AD Fin Clp	59	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 27 2003	630872	AD Fin Clp	54	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 5 2003	630877	AD Fin Clp	55	2000	WASHOUGAL HATCHERY	WASHOUGAL R 28.0159	WDFW
06	Jul 24 2003	630989	AD Fin Clp	58	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Aug 2 2003	630990	AD Fin Clp	53	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 26 2003	630995	AD Fin Clp	50	2000	WELLS HATCHERY	COLUMBIA NEAR WELLS	WDFW
06	Jul 27 2003	631272	AD Fin Clp	53	2000	EASTBANK + DRYDEN	WENATCHEE R 45.0030	WDFW
06	Aug 2 2003	631273	AD Fin Clp	48	2000	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
06	Jul 27 2003	631273	AD Fin Clp	49	2000	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
06	Jul 21 2003	631312	AD Fin Clp	83	1999	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW

Appendix C. Observed Recoveries of coded wire tags from Chinook salmon during the Chinook Mark-Selective Fisheries in Marine Areas 5 and 6, July 1 through August 8, 2004.

Area	RecovDate	Tagcode	RcvMark	FKLcm	BroodYr	RearingHatchery	ReleaseSite	ReleaseAgency
05	Jul 11 2004	050780	AD Fin Clp	76	2001	SPRING CR NFH	SPRING CR 29.0159	FWS
05	Jul 17 2004	050780	AD Fin Clp	91	2001	SPRING CR NFH	SPRING CR 29.0159	FWS
05	Jul 24 2004	050780	AD Fin Clp	66	2001	SPRING CR NFH	SPRING CR 29.0159	FWS
05	Aug 1 2004	050784	AD Fin Clp	70	2001	MAKAH NFH ON SOOES R	SOOES R 20.0015	FWS
05	Jul 25 2004	062761	AD Fin Clp	43	2002	FEATHER R HATCHERY	BENICIA	CDWR
05	Jul 29 2004	065288	AD Fin Clp	55	2001	TRINITY R HATCHERY	TRINITY R HATCHERY	HVT
06	Jul 25 2004	093452	AD Fin Clp	76	2001	BIG CR HATCHERY	BIG CR (LWR COL R)	ODFW
05	Jul 11 2004	093628	AD Fin Clp	55	2001	BONNEVILLE HATCHERY	UMATILLA R	ODFW
05	Jul 21 2004	184448	AD Fin Clp	76	2001	H-COWICHAN R	R-COWICHAN BAY	CDFO
06	Jul 23 2004	184645	AD Fin Clp	70	2001	H-COWICHAN R	R-COWICHAN R	CDFO
05	Jul 4 2004	184706	AD Fin Clp	74	2001	H-SHUSWAP R	R-SHUSWAP R MID	CDFO
05	Jul 2 2004	184909	AD Fin Clp	69	2001	H-INCH CR	R-STAVE R	CDFO
05	Jul 6 2004	184909	AD Fin Clp	65	2001	H-INCH CR	R-STAVE R	CDFO
05	Jul 25 2004	184909	AD Fin Clp	74	2001	H-INCH CR	R-STAVE R	CDFO
05	Jul 24 2004	184914	AD Fin Clp	64	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Jul 5 2004	184916	AD Fin Clp	63	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Jul 6 2004	184916	AD Fin Clp	61	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Jul 25 2004	184916	AD Fin Clp	76	2001	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Aug 1 2004	184921	AD Fin Clp	52	2002	H-CHEHALIS R	R-CHEHALIS R	CDFO
05	Jul 17 2004	185533	AD Fin Clp	48	2002	H-CHILLIWACK R	R-CHILLIWACK R	CDFO
05	Jul 2 2004	210279	AD Fin Clp	71	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 10 2004	210279	AD Fin Clp	75	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 14 2004	210279	AD Fin Clp	61	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
06	Jul 17 2004	210279	AD Fin Clp	61	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
06	Jul 24 2004	210279	AD Fin Clp	83	2000	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 4 2004	210293	AD Fin Clp	67	2000	PUYALLUP TRIBAL HATC	COWSKULL ACCLIM POND	PUYA
05	Jul 17 2004	210294	AD Fin Clp	74	2000	PUYALLUP TRIBAL HATC	DIRU CR 10.0029	PUYA
06	Jul 29 2004	210294	AD Fin Clp	89	2000	PUYALLUP TRIBAL HATC	DIRU CR 10.0029	PUYA
05	Jul 16 2004	210324	AD Fin Clp	53	2001	BERNIE GOBIN HATCH	TULALIP CR 07.0001	TULA
05	Jul 10 2004	210343	AD Fin Clp	60	2001	COWSKL & RUSHWTR PDS	COWSKL & RUSHWTR PDS	PUYA
05	Jul 17 2004	210343	AD Fin Clp	65	2001	COWSKL & RUSHWTR PDS	COWSKL & RUSHWTR PDS	PUYA
06	Jul 24 2004	210343	AD Fin Clp	72	2001	COWSKL & RUSHWTR PDS	COWSKL & RUSHWTR PDS	PUYA
06	Jul 29 2004	210343	AD Fin Clp	60	2001	COWSKL & RUSHWTR PDS	COWSKL & RUSHWTR PDS	PUYA
05	Jul 25 2004	210344	AD Fin Clp	60	2001	PUYALLUP TRIBAL HATC	DIRU CR 10.0029	PUYA
05	Aug 1 2004	210390	AD Fin Clp	57	2001	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Aug 1 2004	210390	AD Fin Clp	59	2001	GROVERS CR HATCHERY	GROVERS CR HATCHERY	SUQ
05	Jul 17 2004	210391	AD Fin Clp	65	2001	MARBLEMOUNT HATCHERY	SKAGIT R 03.0176	WDFW
05	Jul 2 2004	210392	AD Fin Clp	56	2001	KALAMA CR HATCHERY	KALAMA CR 11.0017	NISQ
05	Jul 9 2004	212950	AD Fin Clp	75	2000	MARBLEMOUNT HATCHERY	RED CR 03.1325	WDFW
05	Jul 10 2004	212951	AD Fin Clp	95	1999	HOKO FALLS HATCHERY	HOKO R 19.0148	MAKA
05	Jul 4 2004	630183	AD Fin Clp	59	2000	LYONS FERRY HATCHERY	CAPTAIN JOHNS PD	NEZP
06	Jul 3 2004	630189	AD Fin Clp	75	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
05	Jul 18 2004	630282	AD Fin Clp	88	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 10 2004	630398	AD Fin Clp	66	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
06	Jul 16 2004	630398	AD Fin Clp	79	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 24 2004	630398	AD Fin Clp	80	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 31 2004	630398	AD Fin Clp	76	2000	PORTAGE BAY HATCHERY	PORTAGE BAY/SHIP CNL	UW
05	Jul 1 2004	630668	AD Fin Clp	80	2000	WALLACE R HATCHERY	WALLACE R 07.0940	WDFW
06	Jul 3 2004	630669	AD Fin Clp	79	2000	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
05	Jul 14 2004	630669	AD Fin Clp	78	2000	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
06	Jul 21 2004	630669	AD Fin Clp	65	2000	SOOS CREEK HATCHERY	BIG SOOS CR 09.0072	WDFW
05	Aug 1 2004	630678	AD Fin Clp	57	2000	LYONS FERRY HATCHERY	SNAKE R @PITTSBURG L	NEZP
05	Jul 23 2004	630678	AD Fin Clp	53	2000	LYONS FERRY HATCHERY	SNAKE R @PITTSBURG L	NEZP
05	Jul 31 2004	630678	AD Fin Clp	63	2000	LYONS FERRY HATCHERY	SNAKE R @PITTSBURG L	NEZP
06	Jul 23 2004	630683	AD Fin Clp	75	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
06	Jul 14 2004	630684	AD Fin Clp	86	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
06	Jul 29 2004	630684	AD Fin Clp	81	2000	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 10 2004	630687	AD Fin Clp	80	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
06	Jul 23 2004	630687	AD Fin Clp	65	2000	NISQUALLY HATCHERY	CLEAR CR 11.0013C	NISQ
06	Jul 27 2004	630694	AD Fin Clp	76	2000	MARBLEMOUNT HATCHERY	CASCADE R 03.1411	WDFW
05	Jul 1 2004	630783	AD Fin Clp	68	2000	MCALLISTER HATCHERY	MCALLISTER CR11.0324	WDFW
05	Jul 25 2004	630794	AD Fin Clp	68	2000	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
06	Jul 25 2004	630883	AD Fin Clp	75	2000	TUMWATER FALLS HATCH	CAPITOL LK (13)	WDFW
05	Jul 29 2004	630883	AD Fin Clp	83	2000	TUMWATER FALLS HATCH	CAPITOL LK (13)	WDFW
05	Aug 1 2004	630889	AD Fin Clp	51	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 16 2004	630889	AD Fin Clp	65	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 18 2004	630889	AD Fin Clp	55	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 30 2004	630889	AD Fin Clp	60	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 9 2004	630891	AD Fin Clp	54	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 16 2004	630891	AD Fin Clp	58	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 17 2004	630891	AD Fin Clp	53	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 25 2004	630891	AD Fin Clp	51	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
05	Jul 25 2004	630891	AD Fin Clp	45	2001	TURTLE ROCK HATCHERY	COL.R. @ TURTLE ROCK	WDFW
06	Jul 31 2004	630896	AD Fin Clp	71	2001	MARBLEMOUNT HATCHERY	CASCADE CR 03.2584	WDFW

Appendix C. Continued.

Area	RecovDate	Tagcode	RcvMark	FKLcm	BroodYr	RearingHatchery	ReleaseSite	ReleaseAgency
05	Jul 6 2004	630996	AD Fin Clp	66	2000	SIMILKAMEEN HATCHERY	SIMILKAMEEN R 490325	WDFW
05	Jul 10 2004	631273	AD Fin Clp	66	2000	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 11 2004	631273	AD Fin Clp	64	2000	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 17 2004	631273	AD Fin Clp	67	2000	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 30 2004	631273	AD Fin Clp	61	2000	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 30 2004	631294	AD Fin Clp	63	2001	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
05	Jul 21 2004	631379	AD Fin Clp	64	2001	COWLITZ SALMON HATCH	COWLITZ R 26.0002	WDFW
05	Jul 25 2004	631382	AD Fin Clp	58	2001	PRIEST RAPIDS HATCHE	COLUMBIA R AT PRIEST	WDFW
05	Jul 17 2004	631469	AD Fin Clp	56	2001	COWLITZ SALMON HATCH	COWLITZ SALMON HATCH	WDFW
05	Jul 24 2004	631548	AD Fin Clp	60			Unknown release data	
05	Jul 30 2004	631549	AD Fin Clp	54	2001	WELLS HATCHERY	COLUMBIA NEAR WELLS	WDFW
05	Jul 31 2004	631549	AD Fin Clp	62	2001	WELLS HATCHERY	COLUMBIA NEAR WELLS	WDFW
05	Jul 31 2004	631549	AD Fin Clp	55	2001	WELLS HATCHERY	COLUMBIA NEAR WELLS	WDFW
05	Aug 1 2004	631585	AD Fin Clp	53	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 5 2004	631585	AD Fin Clp	49	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 6 2004	631585	AD Fin Clp	52	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 11 2004	631585	AD Fin Clp	60	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 15 2004	631585	AD Fin Clp	56	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 17 2004	631585	AD Fin Clp	55	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 18 2004	631585	AD Fin Clp	50	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 21 2004	631585	AD Fin Clp	57	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 21 2004	631585	AD Fin Clp	53	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 29 2004	631585	AD Fin Clp	56	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 29 2004	631585	AD Fin Clp	53	2001	LYONS FERRY HATCHERY	SNAKE R-LOWR 33.0002	WDFW
05	Jul 18 2004	631587	AD Fin Clp	47	2001	DRYDEN POND	WENATCHEE R 45.0030	WDFW
05	Jul 27 2004	631587	AD Fin Clp	56	2001	DRYDEN POND	WENATCHEE R 45.0030	WDFW
05	Jul 29 2004	631780	AD Fin Clp	47	2002	VOIGHTS CR HATCHERY	VOIGHT CR 10.0414	WDFW
06	Jul 3 2004	636322	AD Fin Clp	65	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 4 2004	636322	AD Fin Clp	63	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 10 2004	636322	AD Fin Clp	61	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 17 2004	636322	AD Fin Clp	69	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 20 2004	636322	AD Fin Clp	56	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW
05	Jul 25 2004	636322	AD Fin Clp	45	2001	GEORGE ADAMS HATCHRY	PURDY CR 16.0005	WDFW

Appendix D. Chinook stocks observed in coded wire tagged Chinook caught during the Chinook Mark-Selective Fisheries in Marine Areas 5 and 6, July 5 through August 3, 2003, and July 1 through August 8, 2004.

Stock	Region	2003	2004
Chilliwack River	Fraser River	3	5
Harrison River	Fraser River	1	1
Shuswap River	Fraser River	0	1
Stave River	Fraser River	0	3
Cowichan River	Georgia Strait/Vancouver Island	2	2
Nanaimo River	Georgia Strait/Vancouver Island	2	0
Hoko River	Strait of Juan de Fuca	0	1
Big Soos Creek	Puget Sound	7	3
Clear Creek	Puget Sound	6	3
Deschutes River	Puget Sound	0	2
George Adams	Puget Sound	3	9
Grovers Creek	Puget Sound	15	7
Kalama Creek	Puget Sound	5	1
McAllister Creek	Puget Sound	0	1
Portage Bay UW	Puget Sound	8	5
Samish River	Puget Sound	1	0
Skagit River	Puget Sound	1	1
Skagit River	Puget Sound	3	3
Skykomish River	Puget Sound	3	1
Tulalip	Puget Sound	1	1
Voight Creek	Puget Sound	1	9
Wallace River	Puget Sound	1	0
Soees River	Washington Coast	1	1
Abernathy Creek	Lower Columbia River	1	0
Big Creek Hatchery	Lower Columbia River	3	1
Cowlitz River	Lower Columbia River	20	3
Elochoman River	Lower Columbia River	1	0
Kalama River	Lower Columbia River	1	0
Spring Creek	Lower Columbia River	1	3
Washougal River	Lower Columbia River	1	0
Umatilla River	Mid-Columbia River	0	1
Priest Rapids Hatchery	Upper Columbia River	0	1
Similkameen River	Upper Columbia River	1	1
Wells Hatchery	Upper Columbia River	1	12
Wenatchee River	Upper Columbia River	1	2
Lyons Ferry Hatchery	Snake River	5	19
American River	California	1	0
Feather River	California	0	1
Mokelumne River	California	1	0
Trinity River	California	0	1

STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE
ENFORCEMENT PROGRAM
STATEWIDE MARINE PATROL DIVISION

2004 WASHINGTON MARINE SALMON FISHERY COMPLIANCE REPORT

The following report is a summary of enforcement activities by Officers of the Washington Department of Fish and Wildlife (WDFW) for the 2004 marine salmon fishery. Originally designed as a program to monitor adherence to wild coho salmon release rules, increased patrols in marine areas have had a positive impact on overall regulation compliance issues. With the expansion of selective fishing to other species, along with concerns raised during the North of Falcon (NOF) season setting process, Officers tracked thirteen Salmon Management Catch Areas (SMCA) in 2004. Enforcement presence in the various marine areas was accomplished by vessel, dock patrols, and joint operations with other enforcement agencies.

Developing compliance rate estimations for fish and wildlife violations are difficult. Uniformed presence on the water or at the dock provides visible deterrence to violations, thereby altering the behavior of those who may violate natural resource laws. In some instances, the contact to violation ratio may be merely a reflection of the effectiveness of the individual officer at discovering a violation. Therefore, estimated compliance rates compiled from uniformed enforcement activity may not be an accurate measure of actual compliance, but rather, serves best as an index when comparing one area to another, or one season to the next.

The average for estimated compliance with the wild coho release rule in the eight applicable Salmon Management Catch Areas was 99.45%. The estimated rate of compliance with overall salmon rules for all thirteen monitored Salmon Management Catch Areas was 88.4% compared to 84.6 % in 2003.

SMCA AREA ONE AND TWO SUMMARY

The Columbia River / South Coast Marine Detachment is directly responsible for planning patrols for these SMCA's. Mark rates were poor but compliance still high. Salmon Management Catch Area Two became non-selective the last two weeks of the season.

AREA ONE
(Ilwaco, WA):

Enforcement Hours:

Docks	175
Vessel	219
Investigative	1
Interagency	0
Total	**395 hours**

Total Contacts: **1806**

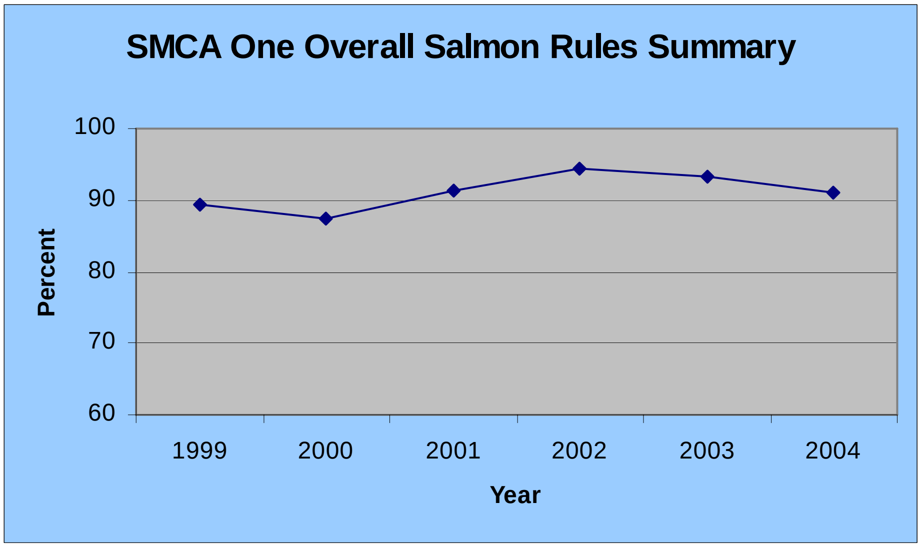
LIC VIOLATION	Arrest	**24**	Warnings	**49**	Total	**73**
GEAR VIOLATION	Arrest	**1**	Warnings	**0**	Total	**1**
OVERLIMIT	Arrest	**0**	Warnings	**0**	Total	**0**
BARBED HOOK–SALMON	Arrest	**21**	Warnings	**7**	Total	**28**
WILD COHO	Arrest	**8**	Warnings	**1**	Total	**9**
CHINOOK	Arrest	**0**	Warnings	**0**	Total	**0**
AREA /SEASON	Arrest	**13**	Warnings	**37**	Total	**50**
GROUNDFISH / HALIBUT	Arrest	**1**	Warnings	**0**	Total	**1**
BOAT SAFE	Arrest	**1**	Warnings	**0**	Total	**1**
WARRANT	Arrest	**0**	Warnings	**0**	Total	**0**
OTHER	Arrest	**26**	Warnings	**22**	Total	**48**
FAIL TO SUBMIT	Arrest	**0**	Warnings	**0**	Total	**0**
CRAB	Arrest	**3**	Warnings	**5**	Total	**8**
SEARCH / RESCUE	Arrest	**1**	Warnings	**7**	Total	**8**
UNDERSIZED	Arrest	**9**	Warnings	**2**	Total	**11**
DRUGS	Arrest	**0**	Warnings	**0**	Total	**0**

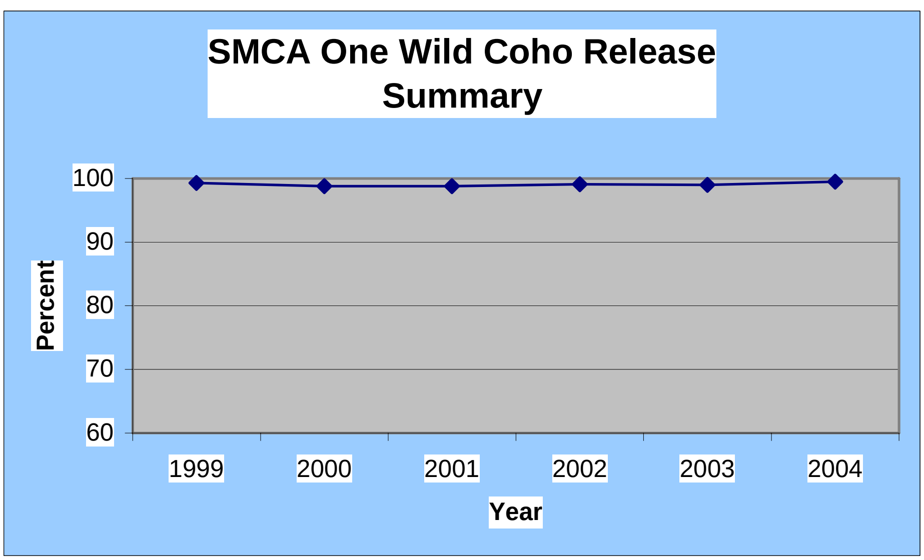
Total Citations: 108
Total Warnings: 130

Estimated compliance regarding overall salmon rules was 91%*
Estimated compliance regarding the possession of wild coho was 99.5%**

2003 / 2004 overall salmon rules compliance rate comparison: 93.2 / 90.5%
2003 / 2004 comparison of compliance with wild coho release rules: 98.7 / 99.5%
2003 / 2004 comparison of enforcement hours: 479 / 395 hours.
2003 / 2004 comparison of anglers contacted: 1801 / 1806 contacts.

SMCA One Summaries





AREA TWO
(Westport, WA):

Enforcement Hours:

Docks	226
Vessel	110
Investigative	13
Interagency	0
Total	**349 hours**

Total Contacts: **2069**

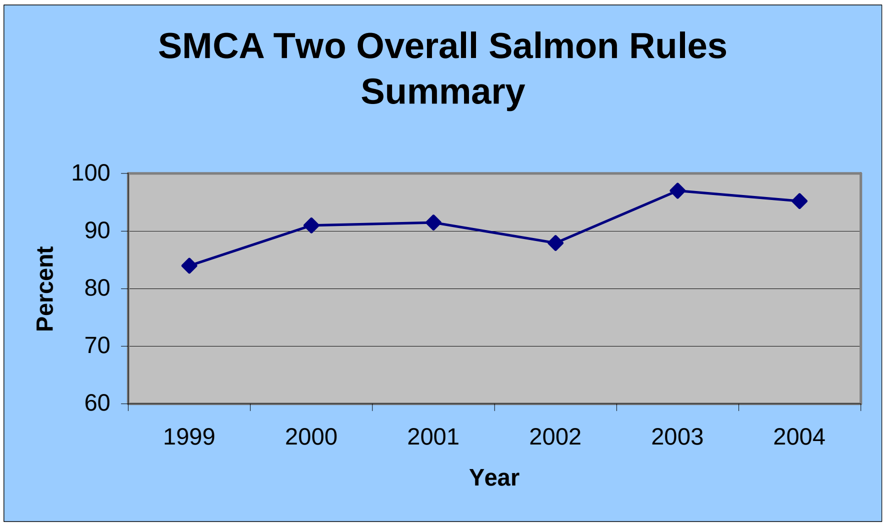
LIC VIOLATION	Arrest	**12**	Warnings	**41**	Total	**53**
GEAR VIOLATION	Arrest	**0**	Warnings	**0**	Total	**0**
OVERLIMIT	Arrest	**0**	Warnings	**0**	Total	**0**
BARBED HOOK	Arrest	**4**	Warnings	**31**	Total	**35**
WILD COHO	Arrest	**10**	Warnings	**0**	Total	**10**
CHINOOK	Arrest	**0**	Warnings	**0**	Total	**0**
AREA / SEASON	Arrest	**1**	Warnings	**0**	Total	**1**
GROUNDFISH / HALIBUT	Arrest	**2**	Warnings	**1**	Total	**3**
BOAT SAFE	Arrest	**6**	Warnings	**0**	Total	**6**
WARRANT	Arrest	**2**	Warnings	**0**	Total	**2**
OTHER	Arrest	**8**	Warnings	**5**	Total	**13**
FAIL TO SUBMIT	Arrest	**0**	Warnings	**1**	Total	**1**
CRAB	Arrest	**14**	Warnings	**26**	Total	**40**
SEARCH / RESCUE	Arrest	**4**	Warnings	**18**	Total	**22**
UNDERSIZED	Arrest	**12**	Warnings	**1**	Total	**13**
DRUGS	Arrest	**1**	Warnings	**0**	Total	**1**

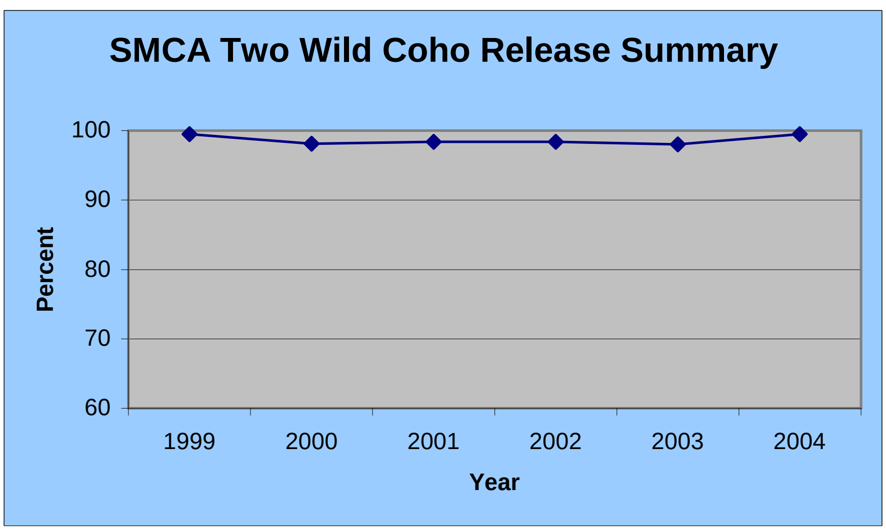
Total Citations: 76
Total Warnings: 124

Estimated compliance regarding overall salmon rules was 95.2%*
Estimated compliance regarding the possession of wild coho was 99.5 %**

2003 / 2004 overall salmon rules compliance rate comparison: 97% / 95.2%
2003 / 2004 comparison of compliance with wild coho release rules: 98% / 99.5%
2003 / 2004 comparison of enforcement hours: 438 / 349 hours
2003 / 2004 comparison of anglers contacted: 2164 / 2069 contacts

SMCA Two Summaries





SMCA AREA THREE, FOUR, FIVE AND SIX SUMMARY

The North Coast / Strait Marine Detachment has primary responsibility for patrolling these SMCA's. The North Sound Detachment assisted in patrolling part of SMCA Six. A selective chinook fishery was implemented this season in SMCA's Five and Six. Concern over compliance in this new fishery translated to more hours patrolling those fisheries versus SMCA 3 and 4. The presence of pink salmon resulted in some identification mistakes and thus the illegal possession of some unmarked chinook salmon. Those and intentional chinook possession violations were captured under "area / season".

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AREA THREE
(LaPush, WA):

Enforcement Hours:

Docks	31.5
Vessel	38
Investigative	0
Interagency	0
Total	**69.5 hours**

Total Contacts: **349**

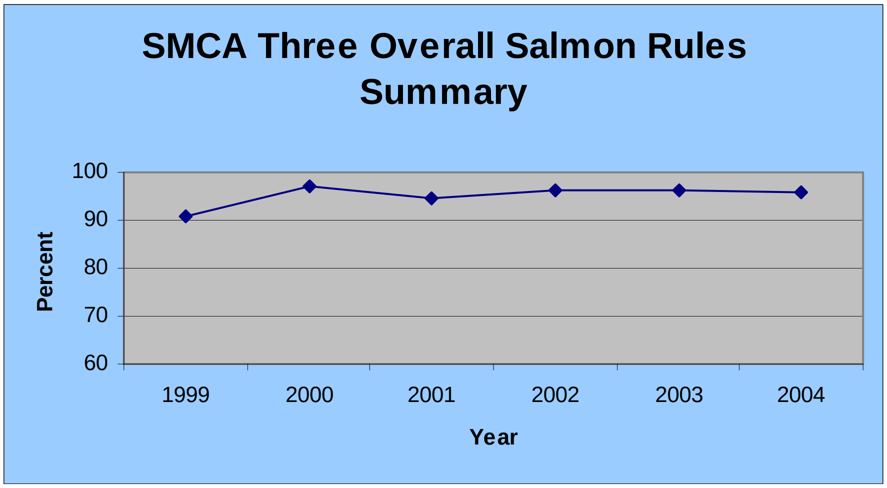
LIC VIOLATION	Arrest	**2**	Warnings	**2**	Total	**4**
GEAR VIOLATION	Arrest	**6**	Warnings	**0**	Total	**6**
OVERLIMIT	Arrest	**0**	Warnings	**3**	Total	**3**
WILD COHO	Arrest	**0**	Warnings	**0**	Total	**0**
CHINOOK	Arrest	**2**	Warnings	**0**	Total	**2**
AREA /SEASON	Arrest	**0**	Warnings	**0**	Total	**0**
GROUNDFISH / HALIBUT	Arrest	**1**	Warnings	**0**	Total	**1**
BOAT SAFE	Arrest	**0**	Warnings	**0**	Total	**0**
WARRANT	Arrest	**0**	Warnings	**0**	Total	**0**
OTHER	Arrest	**0**	Warnings	**1**	Total	**1**
DRUGS	Arrest	**0**	Warnings	**0**	Total	**0**

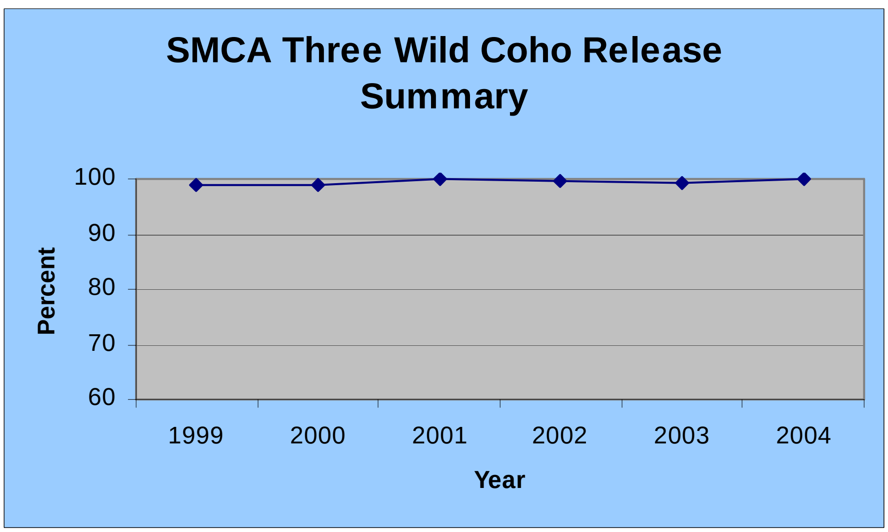
Total Citations: 11
Total Warnings: 6

Estimated compliance regarding overall salmon rules was 95.7%*
The estimated compliance regarding the possession of wild coho was 100%**

2003 / 2004 overall salmon rules compliance rate comparison: 96.2% / 95.7%
2003 / 2004 comparison of compliance with wild coho release rules: 99.3% / 100%
2003 / 2004 comparison of enforcement hours: 22 / 69.5 hours.
2003 / 2004 comparison of anglers contacted: 129 / 349 contacts.

SMCA Three Summaries





AREA FOUR
(Neah Bay, WA):

Enforcement Hours:

Docks	32
Vessel	132
Investigative	2
Interagency	0
Total	**166 Hours**

Total Contacts: **1069**

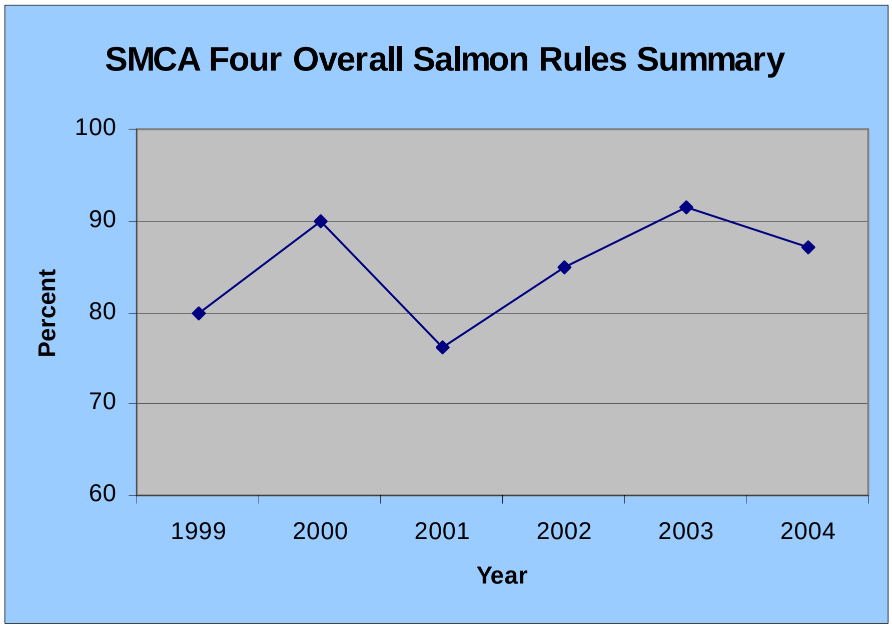
LIC VIOLATION	Arrest	**18**	Warnings	**39**	Total	**57**
GEAR VIOLATION	Arrest	**17**	Warnings	**22**	Total	**39**
OVERLIMIT	Arrest	**13**	Warnings	**5**	Total	**18**
WILD COHO	Arrest	**21**	Warnings	**0**	Total	**21**
CHINOOK	Arrest	**2**	Warnings	**0**	Total	**2**
AREA /SEASON	Arrest	**1**	Warnings	**0**	Total	**1**
GROUNDFISH/HALIBUT	Arrest	**12**	Warnings	**2**	Total	**14**
BOAT SAFE	Arrest	**2**	Warnings	**1**	Total	**3**
WARRANT	Arrest	**0**	Warnings	**0**	Total	**0**
OTHER	Arrest	**0**	Warnings	**5**	Total	**5**
DRUGS	Arrest	**0**	Warnings	**0**	Total	**0**
POSSESS UNLAWFUL CONDITIONS	Arrest	**3**	Warnings	**2**	Total	**5**

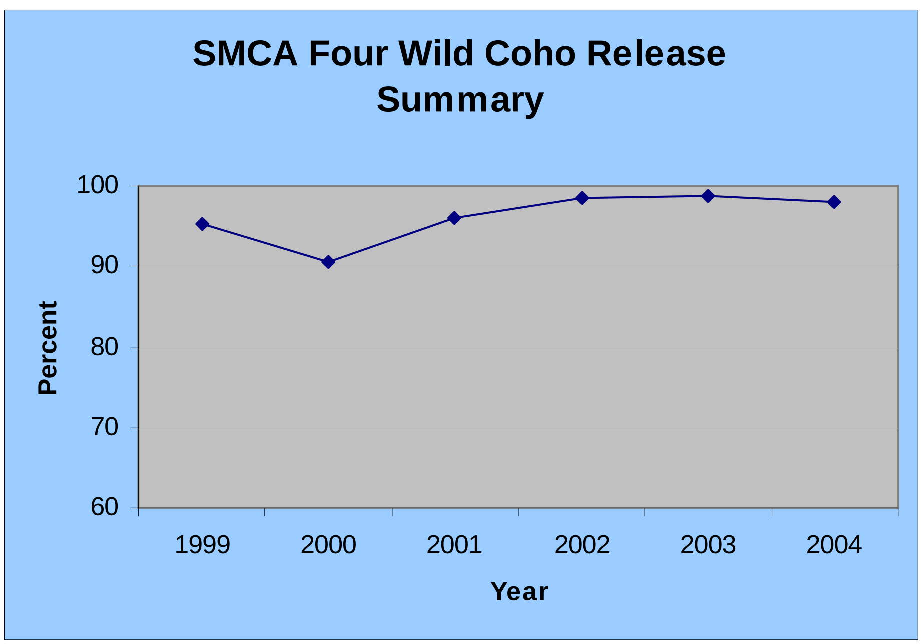
Total Citations: 89
Total Warnings: 76

Estimated compliance regarding overall salmon rules was 87%*
The estimated compliance regarding the possession of wild coho was 98%**

2003 / 2004 overall salmon rules compliance rate comparison: 91.5% / 87%
2003 / 2004 comparison of compliance with wild coho release rules: 98.8% / 98%
2003 / 2004 comparison of enforcement hours: 161 / 166 hours.
2003 / 2004 comparison of anglers contacted: 518 / 1069 contacts.

SMCA Four Summaries





AREA FIVE
(Sekiu, WA)

Enforcement Hours:

Docks	60
Vessel	86
Investigative	0
Interagency	8
Total	**154 hours**

Total Contacts: **795**

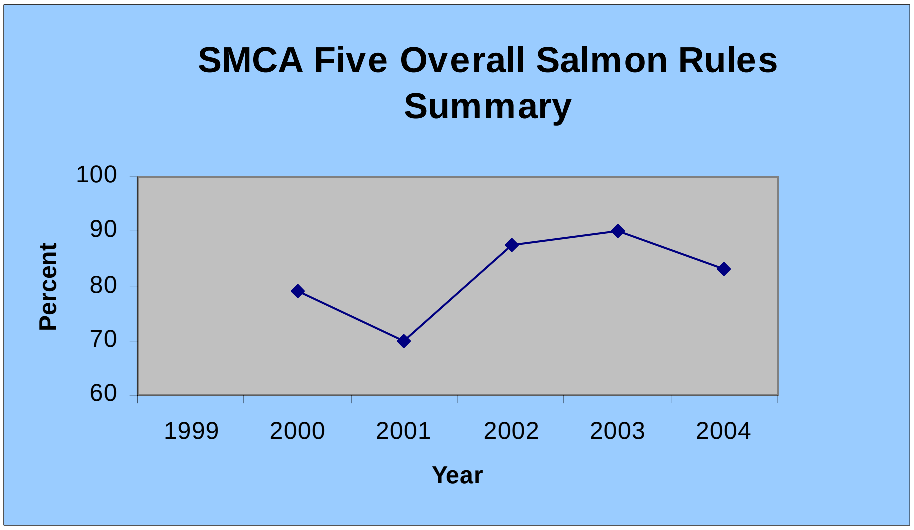
LIC VIOLATION	Arrest	**17**	Warnings	**21**	Total	**38**
GEAR VIOLATION	Arrest	**40**	Warnings	**27**	Total	**67**
OVERLIMIT	Arrest	**6**	Warnings	**11**	Total	**17**
WILD COHO	Arrest	**6**	Warnings	**0**	Total	**6**
CHINOOK	Arrest	**0**	Warnings	**1**	Total	**1**
AREA /SEASON	Arrest	**5**	Warnings	**0**	Total	**5**
GROUNDFISH/HALIBUT	Arrest	**2**	Warnings	**2**	Total	**4**
BOAT SAFE	Arrest	**6**	Warnings	**6**	Total	**12**
OTHER						
FAIL TO SUBMIT	Arrest	**2**	Warnings	**1**	Total	**3**
POSSESS UNLAWFUL CONDITIONS	Arrest	**1**	Warnings	**0**	Total	**1**

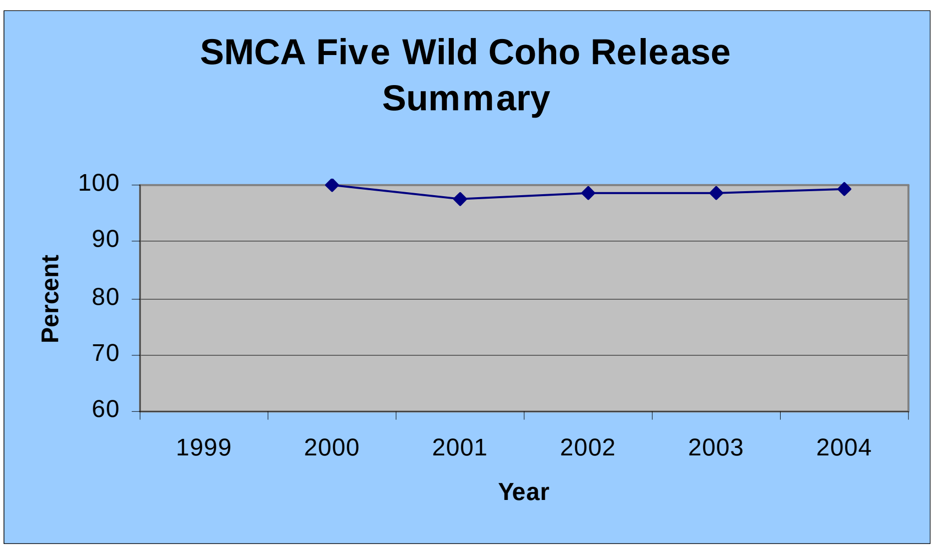
Total Citations: 85
Total Warnings: 69

Estimated compliance rate for overall salmon rules was 83%*
Estimated compliance for wild coho possession was 99.2%**
Estimated compliance for closed season chinook was 99.4%***

2003 / 2004 overall salmon rules compliance rate comparison: 90.2% / 83%
2003 / 2004 comparison of compliance with wild coho release rules: 98.7% / 99.2%
2003 / 2004 comparison of compliance with closed season for chinook: 99.2% / 99.4%
2003 / 2004 comparison of enforcement hours: 334 / 154 hours.
2003 / 2004 comparison of anglers contacted: 1662 / 795 contacts.

SMCA Five Summaries





AREA SIX
(Port Angeles, WA)

Enforcement Hours:

Dock	11
Vessel	87
Investigative	3
Interagency	35
Total	**136 hours**

Total Contacts: 422

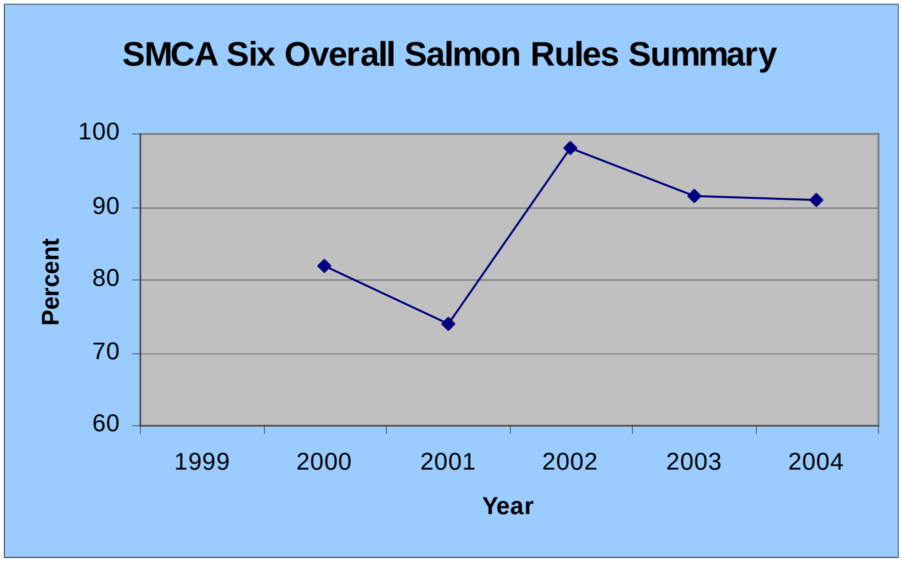
LIC VIOLATION	Arrest	**3**	Warnings	**4**	Total	**7**
GEAR VIOLATION	Arrest	**17**	Warnings	**8**	Total	**25**
OVERLIMIT	Arrest	**0**	Warnings	**0**	Total	**0**
WILD COHO	Arrest	**0**	Warnings	**0**	Total	**0**
CHINOOK	Arrest	**0**	Warnings	**0**	Total	**0**
AREA /SEASON	Arrest	**4**	Warnings	**2**	Total	**6**
BOAT SAFE	Arrest	**7**	Warnings	**24**	Total	**31**
OTHER CRAB	Arrest	**4**	Warnings	**3**	Total	**7**

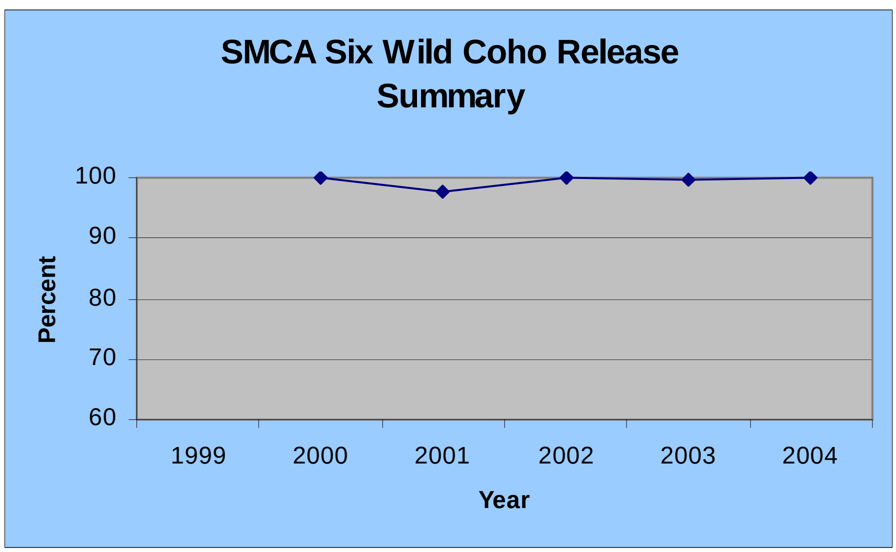
Total Citations: 35
Total Warnings: 41

Estimated compliance rate regarding overall salmon rules was 91%*
Estimated compliance for wild coho possession was 100%**

2003 / 2004 overall salmon rules compliance rate comparison: 91.6% / 91%
2003 / 2004 comparison of compliance with wild coho release rules: 99.6% / 100%
2003 / 2004 comparison of enforcement hours: 440 / 136 hours.
2003 / 2004 comparison of anglers contacted: 1013 / 422 contacts.

SMCA Six Summaries





SMCA AREA NINE, TEN, TWELVE AND THIRTEEN SUMMARY

The South Sound / Hood Canal Marine Detachment is responsible for patrol effort in these SMCA's. Wild coho release is only required in SMCA 13 and compliance was high this season. Patrol effort was also committed to Area 9 and 12 for the protection of summer chum. Additional commitments were made for Area 10 due to bubble fisheries in Elliot Bay and Sinclair Inlet, which allowed access to surplus hatchery stocks of chinook, while the remainder of the area was closed to chinook retention.

AREA NINE
(Edmonds, S/W Whidbey Island, WA):

Enforcement Hours:

Docks	28
Vessel	51
Investigative	0
Interagency	**0**
Total	**79 hours**

Total Contacts: **377**

LIC VIOLATION	Arrest	**10**	Warnings	**3**	Total	**13**
GEAR VIOLATION	Arrest	**27**	Warnings	**11**	Total	**38**
OVERLIMIT	Arrest	**0**	Warnings	**0**	Total	**0**
CHINOOK	Arrest	**0**	Warnings	**0**	Total	**0**
AREA /SEASON	Arrest	**0**	Warnings	**0**	Total	**0**
BOAT SAFE	Arrest	**0**	Warnings	**0**	Total	**0**
OTHER	Arrest	**0**	Warnings	**0**	Total	**0**

Total Citations: 37
Total Warnings: 14

Estimated compliance regarding overall salmon rules was 86.5 %*
Estimated compliance for closed season chinook was 100%***

2003 / 2004 overall salmon rules compliance rate comparison: 75.1% / 86.5%
2003 / 2004 comparison of enforcement hours: 203 / 79 hours.
2003 / 2004 comparison of anglers contacted: 590 / 377 contacts.

AREA TEN
(Bremerton, WA):

Enforcement Hours:

Docks	13
Vessel	228
Investigative	1
Interagency	0
Total	**242 hours**

Total Contacts: **529**

LIC VIOLATION	Arrest	**3**	Warnings	**11**	Total	**14**
GEAR VIOLATION	Arrest	**30**	Warnings	**39**	Total	**69**
OVERLIMIT	Arrest	**0**	Warnings	**0**	Total	**0**
CHINOOK	Arrest	**0**	Warnings	**1**	Total	**1**
AREA /SEASON	Arrest	**7**	Warnings	**3**	Total	**10**
GROUNDFISH / HALIBUT	Arrest	**0**	Warnings	**4**	Total	**4**
BOAT SAFE	Arrest	**2**	Warnings	**8**	Total	**10**
OTHER						
FAIL TO SUBMIT	Arrest	**1**	Warnings	**1**	Total	**2**
CRAB	Arrest	**1**	Warnings	**16**	Total	**17**

Total Citations: 44
Total Warnings: 83

Estimated compliance regarding overall salmon rules was 82.2 %*

2003 / 2004 overall salmon rules compliance rate comparison: 69.3% / 81.9%
2003 / 2004 comparison of enforcement hours: 633 / 242 hours.
2003 / 2004 comparison of anglers contacted: 678 / 529 contacts.

AREA TWELVE
(Hood Canal, WA, including the Quilcene River):

Enforcement Hours:

Docks	171
Vessel	19
Investigative	6
Interagency	10
Total	**206 hours**

Total Contacts: **915**

LIC VIOLATION	Arrest	**16**	Warnings	**17**	Total	**33**
GEAR VIOLATION	Arrest	**24**	Warnings	**44**	Total	**68**
OVERLIMIT	Arrest	**2**	Warnings	**0**	Total	**2**
CHINOOK	Arrest	**0**	Warnings	**0**	Total	**0**
CLOSED SEASON – CHUM	Arrest	**4**	Warnings	**13**	Total	**17**
POSSESS ESA – CHUM	Arrest	**1**	Warnings	**0**	Total	**1**
SNAG SALMON	Arrest	**13**	Warnings	**2**	Total	**15**
BOAT SAFE	Arrest	**0**	Warnings	**4**	Total	**4**
OTHER						
FAIL TO SUBMIT	Arrest	**0**	Warning	**3**	Total	**3**
CRAB	Arrest	**9**	Warning	**15**	Total	**24**
POSSESS SNAG	Arrest	**4**	Warning	**0**	Total	**4**
UNLAWFUL TAKE - CHUM	Arrest	**2**	Warning	**0**	Total	**2**

Total Citations: 75
Total Warnings: 98

Estimated compliance regarding overall salmon rules was 85.1%*
Estimated compliance regarding protection of summer chum was 99.7%

2003 / 2004 comparison of compliance with overall salmon rules: 86.1% / 84.1%

AREA THIRTEEN
(Olympia, WA):

Enforcement Hours:

Docks	11
Vessel	310
Investigative	0
Interagency	0
Total	**321 hours**

Total Contacts: **777**

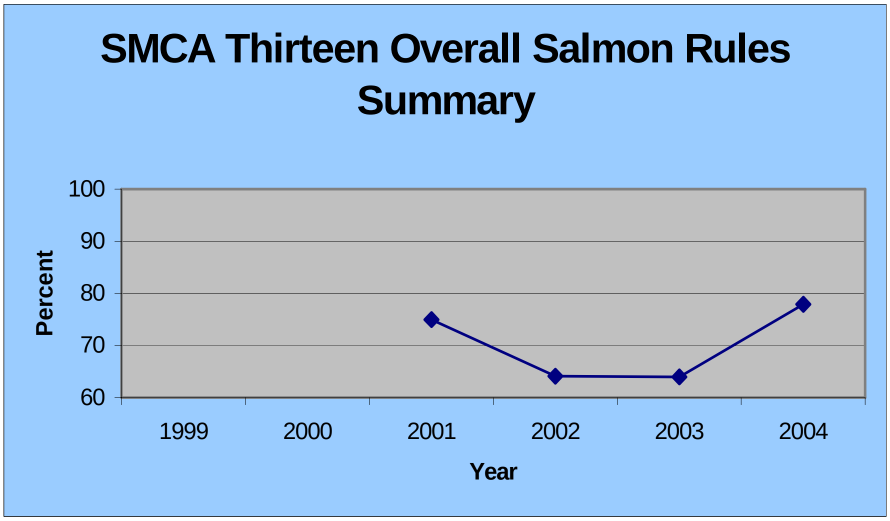
LIC VIOLATION	Arrest	**17**	Warnings	**11**	Total	**28**
GEAR VIOLATION	Arrest	**105**	Warnings	**36**	Total	**141**
OVERLIMIT	Arrest	**0**	Warnings	**0**	Total	**0**
WILD COHO	Arrest	**1**	Warnings	**0**	Total	**1**
CHINOOK	Arrest	**2**	Warnings	**0**	Total	**2**
AREA /SEASON	Arrest	**0**	Warnings	**0**	Total	**0**
GROUNDFISH / HALIBUT	Arrest	**14**	Warnings	**16**	Total	**30**
BOAT SAFE	Arrest	**2**	Warnings	**16**	Total	**18**
OTHER						
FAIL TO SUBMIT	Arrest	**1**	Warnings	**0**	Total	**1**
CRAB	Arrest	**2**	Warnings	**10**	Total	**12**

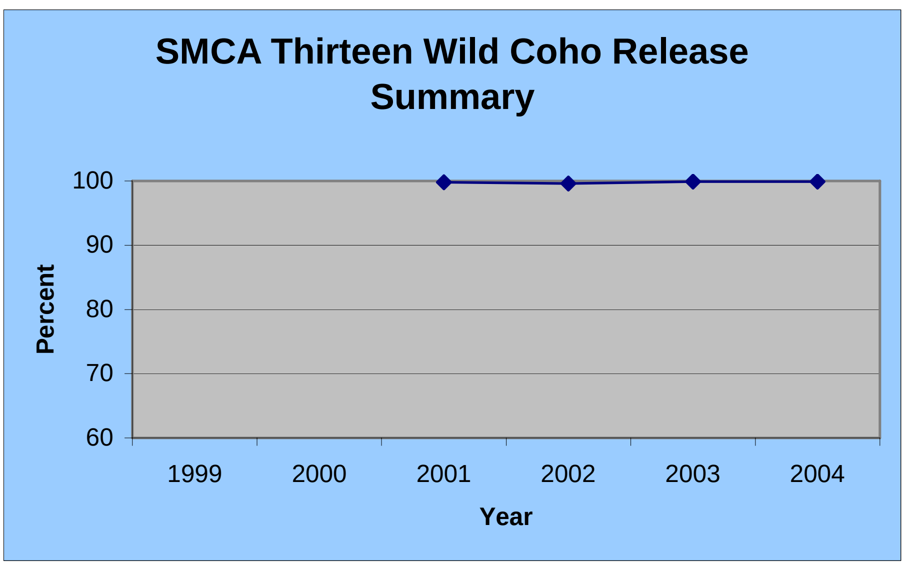
Total Citations: 144
Total Warnings: 89

Estimated compliance regarding overall salmon rules was 77.9%*
The estimated compliance regarding the possession of wild coho was 99.9%**

2003 / 2004 overall salmon rules compliance rate comparison: 64% / 77.9%
2003 / 2004 comparison of compliance with wild coho release rules: 99.9% / 99.9%
2003 / 2004 comparison of enforcement hours: 324 / 321 hours.
2003 / 2004 comparison of anglers contacted: 522 / 777 contacts.

SMCO Thirteen Summaries





SMCA AREA SEVEN, EIGHT-ONE, EIGHT- TWO, AND NINE SUMMARY

These SMCA's are the responsibility of the North Sound Marine Detachment. The only selective coho fishery in this marine region is SMCA Seven, which had high compliance with coho salmon release rules. Officers also patrolled SMCA's 8-1 and 8-2 to enforce chinook salmon closures in effect. Enforcement efforts included the Tulalip Terminal fishery in Area 8-2.

AREA SEVEN
(San Juan Islands, WA):

Enforcement Hours:

Docks	27
Vessel	358
Investigative	0
Interagency	15
Total	**400 hours**

Total Contacts: 1076

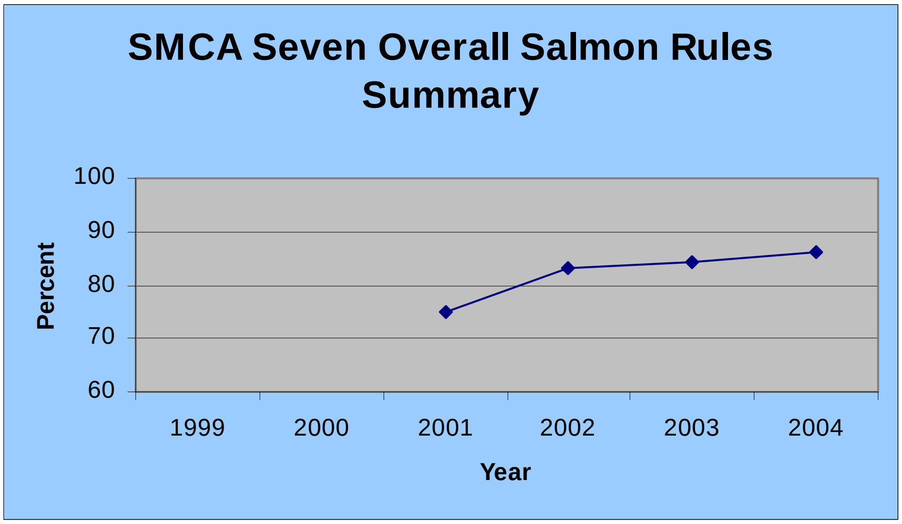
LIC VIOLATION	Arrest	**29**	Warnings	**2**	Total	**31**
GEAR VIOLATION	Arrest	**72**	Warnings	**37**	Total	**109**
OVERLIMIT	Arrest	**1**	Warnings	**0**	Total	**1**
WILD COHO	Arrest	**5**	Warnings	**0**	Total	**5**
CHINOOK	Arrest	**0**	Warnings	**0**	Total	**0**
AREA /SEASON	Arrest	**3**	Warnings	**0**	Total	**3**
GROUNDFISH / HALIBUT	Arrest	**3**	Warnings	**0**	Total	**3**
BOAT SAFE	Arrest	**6**	Warnings	**1**	Total	**7**
OTHER						
FAIL TO SUBMIT	Arrest	**0**	Warnings	**0**	Total	**0**
POSSESS UNLAWFUL	Arrest	**0**	Warnings	**0**	Total	**0**

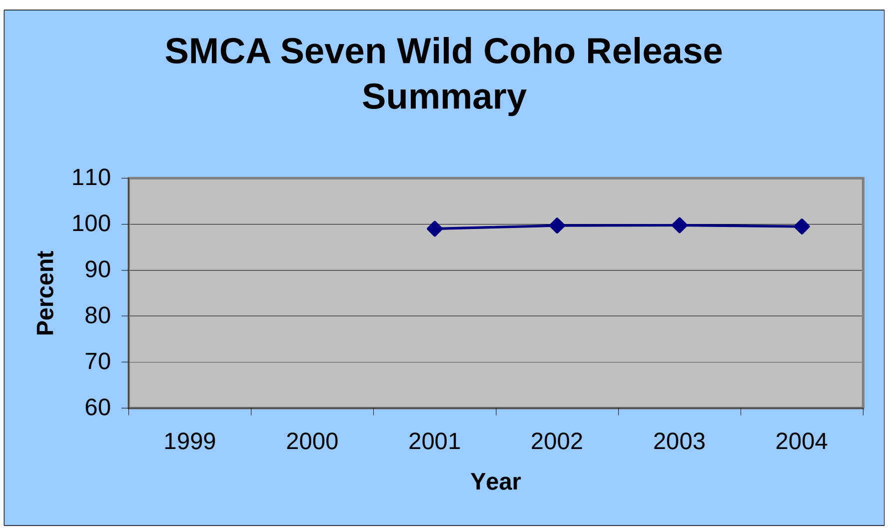
Total Citations: 119
Total Warnings: 40

Estimated compliance regarding overall salmon rules was 86.2%*
Estimated compliance regarding the possession of wild coho was 99.5%**
Estimated compliance regarding closed season chinook was 99.7%

2003 / 2004 overall salmon rules compliance rate comparison: 84.2% / 86.2%
2003 / 2004 comparison of compliance with wild coho release rules: 99.8% / 99.5%
2003 / 2004 comparison of enforcement hours: 669 / 400 hours.
2003 / 2004 comparison of anglers contacted: 1331 / 1076 contacts.

SMCO Seven Summaries





AREA EIGHT-ONE
(Saratoga Passage/Skagit Bay, WA):

Enforcement Hours:

Docks	34
Vessel	44
Investigative	0
Interagency	0
Total	**78 hours**

Total Contacts: **182**

LIC VIOLATION	Arrest	**3**	Warnings	**1**	Total	**4**
GEAR VIOLATION	Arrest	**9**	Warnings	**0**	Total	**9**
OVERLIMIT	Arrest	**0**	Warnings	**0**	Total	**0**
CHINOOK	Arrest	**0**	Warnings	**0**	Total	**0**
AREA /SEASON	Arrest	**0**	Warnings	**0**	Total	**0**
BOAT SAFE	Arrest	**1**	Warnings	**0**	Total	**1**

Total Citations: 13
Total Warnings: 1

Estimated compliance regarding overall salmon rules was 92.9%.
Estimated compliance regarding closed season chinook was 100%.

2003 / 2004 overall salmon rules compliance rate comparison: 95.5% / 92.9%
2003 / 2004 comparison of enforcement hours: 74 / 78 hours.
2003 / 2004 comparison of anglers contacted: 132 / 182 contacts.

AREA EIGHT-TWO
(Everett, Mukiteo, Tulalip, WA):

Enforcement Hours:

Docks	31
Vessel	106
Investigative	0
Interagency	0
Total	**137 hours**

Total Contacts: **356**

LIC VIOLATION	Arrest	**7**	Warnings	**4**	Total	**11**
GEAR VIOLATION	Arrest	**48**	Warnings	**11**	Total	**59**
OVERLIMIT	Arrest	**1**	Warnings	**0**	Total	**1**
CHINOOK	Arrest	**1**	Warnings	**0**	Total	**1**
AREA /SEASON	Arrest	**1**	Warnings	**12**	Total	**13**
BOAT SAFE	Arrest	**0**	Warnings	**0**	Total	**0**

Total Citations: 58
Total Warnings: 27

Estimated compliance regarding overall salmon rules was 79.8%*
Estimated compliance regarding closed season chinook was 96.3%*

2003 / 2004 overall salmon rules compliance rate comparison: 67% / 79.8%
2003 / 2004 comparison of enforcement hours: 183 / 137 hours.
2003 / 2004 comparison of anglers contacted: 430 / 356 contacts.

* % compliance with overall salmon regulations = total rule violations associated with **salmon only** (license, gear, possession, season and area) / total contacts.

** % compliance for possession of unmarked coho = total unmarked fish violations / total contacts.

*** % compliance for possession of unmarked chinook = total unmarked fish violations / total contacts.