SUMMER CHUM SALMON CONSERVATION INITIATIVE

An Implementation Plan To Recover Summer Chum Salmon in the Hood Canal and Strait of Juan de Fuca Region

Supplemental Report No. 8

Five-Year Review of the Summer Chum Salmon Conservation Initiative for the period 2005 through 2013

Point No Point Treaty Tribes

Washington Department of Fish and Wildlife

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1) INTRODUCTION

BACKGROUND

The Washington Department of Fish and Wildlife and Point No Point Treaty Tribes distributed the Summer Chum Salmon Conservation Initiative (SCSCI) in April 2000 (WDFW and PNPTT 2000). The initiative described a comprehensive plan for the implementation of summer chum salmon recovery in Hood Canal and eastern Strait of Juan de Fuca. The harvest and artificial production components of the SCSCI were subsequently approved by the National Marine Fisheries Service (NMFS) under Limits 6 and 5, respectively, of the Endangered Species Act 4(d) rule (NMFS 2001, 2002). The SCSCI's harvest and artificial production management provisions were also incorporated into the Summer Chum Recovery Plan prepared by the Hood Canal Coordinating Council (HCCC 2005). This Recovery Plan, which also addressed habitat protection and restoration, was formally adopted by NMFS under rule 4(f) of the Endangered Species Act in March 2007 (NMFS 2007a).

The present report is the second five-year plan review, covering the years 2005 through 2013. The first five year report covered the years 1999 through 2004 (WDFW and PNPTT 2007). These five year reports have been prepared consistent with the provisions under section 3.6.3 of the SCSCI. This report provides detailed information for the years 2005 through 2013 and also a review of progress through 2013, covering specific topics listed in section 3.6.3 of the SCSCI (p. 331). These topics are addressed in various sections of this report and also are summarily considered in the Concluding Remarks and Summary section.

This report is organized to cover, in order, the following subjects: stock assessment, harvest management, artificial production, ecological interactions and habitat. These subjects correspond to the major management areas required to address comprehensive recovery of the summer chum as described in the SCSCI. Additionally, a discussion of progress in meeting SCSCI performance standards and an update on recovery goals are included. Finally, concluding remarks with a summary is provided.

UPDATED INFORMATION

This report updates information and data for recent years through 2013. It also provides corrections where applicable, based on new information and found errors. For this reason, the historical information provided in this report takes precedence over that previously reported.

2) STOCK ASSESSMENT

This report provides detailed information for the years 2005 through 2013, consistent with what has been done in previous reports covering the years through 2004. The first two subsections of this Stock Assessment section address escapements and runsizes, respectively, and focus primarily on 2005 through 2013 (though brief summaries including prior years are included). The remaining subsections include detailed information for 2005 through 2013 but also incorporate new information and analyses applicable to prior years.

ESCAPEMENT

Spawning ground surveys were conducted throughout the summer chum return period to estimate the abundance of summer chum spawners for all known stocks in the Hood Canal and Strait of Juan de Fuca summer chum region during 2005 through 2013. In addition, the Co-managers conducted escapement surveys that will provide information to determine and monitor the status of Dungeness River summer chum salmon, whose status is currently unknown.

Summer chum escapement estimates based on spawner surveys, weir counts, and broodstock collection from 2005 through 2013 are summarized in Table 2-1 and regional summer chum escapement estimates for the period of 1974 to 2013 are presented in Table 2-2. Figure 2-1 and Figure 2-2 show escapement (and harvest) estimates for Hood Canal and the Strait of Juan de Fuca, respectively. Figure 2-3 shows estimates for the entire ESU. Escapement estimates include fish collected as broodstock for supplementation programs. Spawning escapement estimates by stream for the period 1968 through 2013 are provided for the Hood Canal and the Strait of Juan de Fuca regions in Appendix Tables 1 and 2, respectively. Information on the number of fish taken for broodstock by each supplementation program is also included in those tables. Also, see the below Mark Recovery subsection Table 2-10 and 2-12) for escapement estimates partitioned into natural origin and supplementation origin fish for the years 2001 through 2013.

The methods used to estimate escapements are the same as described in SCSCI Appendix Report 1.1 (WDFW and PNPTT 2000), and the current information is presented in the same format as in the appendices to Supplemental Report No. 1 of the SCSCI (Haymes 2000). Included here are summaries for the Big Beef, Chimacum, and Dungeness stocks that were absent in the SCSCI. Data from several small streams (e.g., Little Anderson, Seabeck, Stavis, Harding, Thomas, Eagle, Jorsted, Fulton, and Little Lilliwaup) are also presented here. Some of these streams were identified as possibly being part of the historic distribution of summer chum salmon based on evidence of former summer chum occurrence, but insufficient evidence to determine whether each represented a distinct stock (see SCSCI 1.7.2.3, WDFW and PNPTT 2000). These streams were also monitored to determine if summer chum are re-colonizing these streams and/or if summer chum adults returning from supplementation programs may be straying into these watersheds. A brief discussion of the 2005 through 2013 summer chum salmon escapements follows.

Table 2-1. Hood Canal summer chum escapement (including hatchery broodstock) by region and stream, 2005-2013.

Stock/stream	2005	2006	2007	2008	2009	2010	2011	2012	2013
Hood Canal Region									
Big Beef Creek	1,124	823	846	733	152	143	73	156	101
Anderson Creek	0	0	0	0	1	0	0	2	0
Dewatto River	23	69	21	26	50	9	37	187	186
Tahuya River	4	749	623	700	380	1,153	325	1,405	862
Skokomish River	5	8	22	23	33	61	107	524	977
Union River	1,987	2,836	1,967	1,130	611	963	296	2,246	1,949
Lilliwaup Creek	1,049	1,615	525	690	247	238	113	3,340	2,652
Hamma Hamma River	1,408	3,065	1,489	1,642	670	1,471	773	2,355	2,186
Duckabush River	821	3,135	1,294	2,668	2,661	4,110	1,538	5,241	4,129
Dosewallips River	2,658	2,577	1,468	3,930	1,128	2,521	1,130	2,862	1,815
Big Quilcene River	5,806	9,504	1,461	1,675	1,065	1,576	2,160	10,467	7,118
Little Quilcene River	866	2,372	1,065	2,186	425	497	420	1,272	832
Hood Canal Region Total	**15,751**	**26,753**	**10,781**	**15,403**	**7,423**	**12,742**	**6,972**	**30,057**	**22,807**
Strait of Juan de Fuca Region									
Chimacum Creek	1,396	2,026	926	727	1,020	1,968	640	894	3,066
Snow Creek	832	598	439	172	229	524	342	496	574
Salmon Creek	6,142	4,894	1,274	1,568	1,237	2,740	2,279	2,318	2,746
Jimmycomelately Creek	1,310	725	654	1,058	2,628	4,027	2,411	2,590	8,341
Dungness River	2	3	2	0	1	2	3	6	0
Strait of Juan de Fuca Total	**9,682**	**8,246**	**3,295**	**3,525**	**5,115**	**9,261**	**5,675**	**6,304**	**14,727**

Table 2-2. Escapement (including hatchery broodstock) for Hood Canal and the Strait of Juan de Fuca summer chum salmon stocks, 1974-2013.

Return year	Hood Canal escapement	Strait of Juan de Fuca escapement	HC/SJF combined
1974	12,281	1,768	14,049
1975	18,248	1,448	19,696
1976	27,715	1,494	29,209
1977	10,711	1,644	12,355
1978	19,709	3,080	22,789
1979	6,554	761	7,315
1980	3,777	5,109	8,886
1981	2,374	884	3,258
1982	2,623	2,751	5,374
1983	899	1,139	2,038
1984	1,414	1,579	2,993
1985	1,109	232	1,341
1986	2,552	1,087	3,639
1987	757	1,991	2,748
1988	2,967	3,690	6,657
1989	598	388	986
1990	429	341	770
1991	747	309	1,056
1992	2,377	1,070	3,447
1993	756	573	1,329
1994	2,429	178	2,607
1995	9,462	839	10,301
1996	20,490	1,084	21,574
1997	8,979	962	9,941
1998	4,001	1,269	5,270
1999	4,114	573	4,687
2000	8,649	983	9,632
2001	12,044	3,955	15,996
2002	11,454	6,955	18,409
2003	35,696	6,959	42,655
2004	69,995	9,341	79,336
2005	15,751	9,682	25,433
2006	26,753	8,246	34,999
2007	10,781	3,295	14,076
2008	15,403	3,525	18,928
2009	7,423	5,115	12,538
2010	12,742	9,261	22,003
2011	6,972	5,675	12,647
2012	30,057	6,304	36,361
2013	22,807	14,727	37,534

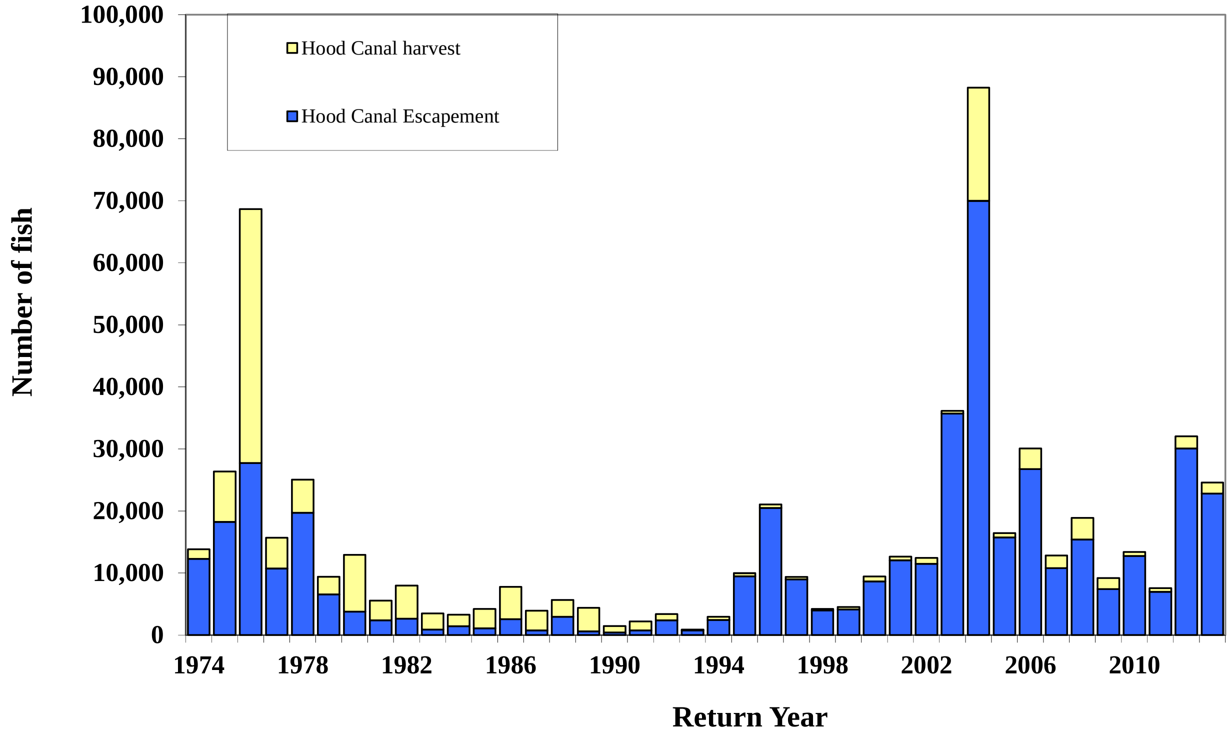

Figure 2-1. Hood Canal summer chum escapement and harvest, 1974-2013.

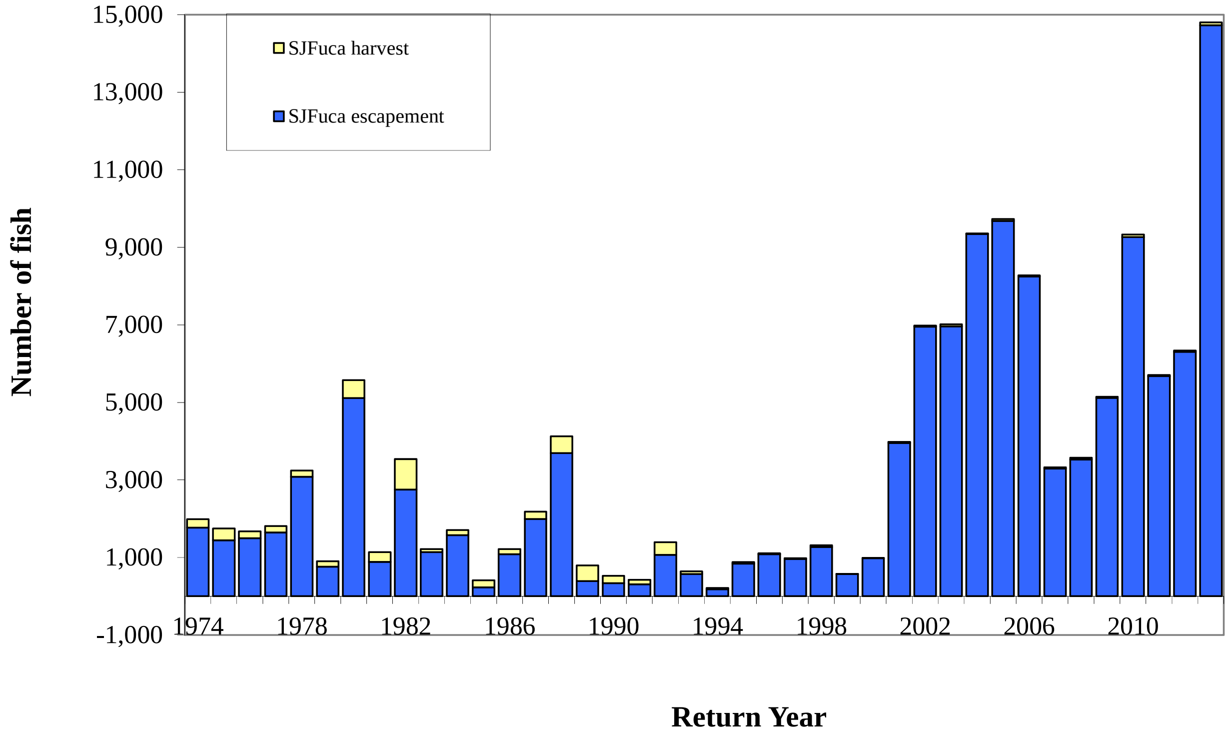

Figure 2-2. Strait of Juan de Fuca summer chum escapement and harvest, 1974-2013.

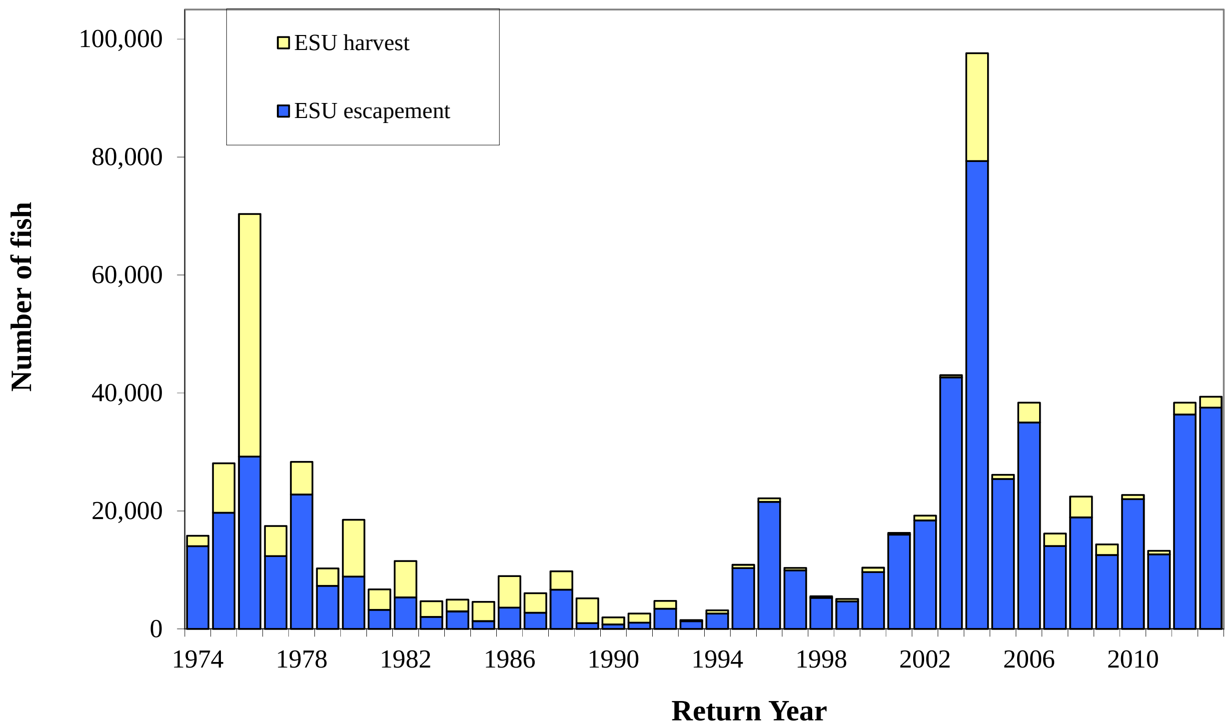

Figure 2-3. Hood Canal/Strait of Juan de Fuca summer chum ESU escapement and harvest, 1974-2013.

HOOD CANAL

During 2005 through 2013, Hood Canal summer chum spawner escapements declined substantially from the record high escapements of 35,696 fish in 2003 and 69,995 fish 2004. An escapement of 26,753 summer chum in 2006 was followed by five years of relatively low escapements (ranging from 6,792 to 15,403 fish) during 2007-2011, and an increase to 30,123 summer chum in 2012 and 22,807 summer chum in 2013 (Table 2-2). Each year the spawner escapements have been well distributed throughout the Hood Canal region (Table 2-3). The escapements across the region have been enhanced by the strong returns to the various supplementation and reintroduction programs, but the numbers of natural origin recruits (NORs) have far out-numbered hatchery origin recruits as several of these successful hatchery programs have been discontinued consistent with the SCSCI guidelines. One stream of concern is Big Beef Creek where escapements have declined from about 700 to 1100 summer chum during 2005-2008 to about 70 to 150 fish during 2009-2013. It is apparent that habitat productivity in Big Beef Creek may be limiting the production of summer chum now that adult returns from the reintroduction program have ended and only natural-origin fish are present. For more information on natural and supplementation origin returns, see the subsections below on Mark Recovery, Productivity, and Supplementation Returns/Straying.

STRAIT OF JUAN DE FUCA

During 2005 through 2013, Strait of Juan de Fuca summer chum spawner escapements remained high. A record high escapement of 14,727 was estimated in 2013 followed by the 2nd and 3rd highest escapements of 9,682 and 9,261summer chum in 2005 and 2010, respectively. Escapements mostly ranged from 3,295 fish in 2007 to 8,246 fish in 2006 (Table 2-2). Each year the spawner escapements have been well distributed throughout the Strait of Juan de Fuca region (Table 2-31). The escapements across the region have been enhanced by the strong returns to the various supplementation and reintroduction programs, but the numbers of natural origin recruits (NORs) have far out-numbered hatchery origin recruits as several of these successful hatchery programs have been discontinued consistent with the SCSCI guidelines. For more information on natural and supplementation origin returns, see the subsections below on Mark Recovery, Productivity, and Supplementation Returns/Straying.

RUNSIZES

To determine the total numbers of salmon returning to specific production areas, fish that are harvested in mixed stock and terminal fisheries must be allocated to the streams from which they originated. This allocation is done through a post-season process called "run re-construction," which splits the harvests in each catch area into the numbers of fish that were likely contributed by the individual stocks or management unit thought to be transiting the area. All estimated harvests for each stock or management unit are added to the escapement for that grouping to derive the estimated total return for each year.

Table 2-3 summarizes the estimates of runsize for Hood Canal and Strait of Juan de Fuca regions for 2005 through 2013. Table 2-4 shows regional total runsize from 1974 through 2013. Figure 2-1 and Figure 2-2 show runsize (escapement + harvest) estimates for Hood Canal and the Strait of Juan de Fuca, respectively. Figure 2-3 shows runsize (escapement + harvest) estimates for the entire ESU.

Run reconstruction tables for 2005 through 2013 are included in Appendix Report 1. Based on new information, harvest estimates reported in the first SCSCI 5-Year Review (WDFW and PNPTC 2007) were revised for the 2000 through 2004 return years and revised run reconstruction tables for these years are also included in Appendix Report 1. A discussion of the run re-construction methodology can be found in the SCSCI Appendix Report 1.3. Also, see the Mark Recovery subsection, below, for escapement and runsize partitioned into natural origin and supplementation origin fish for the years 2001 through 2013.

Table 2-3. Regional summer chum salmon runsize for the 2005 through 2013 return years.

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Hood Canal Region									
Escapement	15,757	26,753	10,781	15,403	7,423	12,742	6,972	30,057	22,807
Terminal runsize	16,325	29,950	12,710	18,609	9,138	13,288	7,519	31,850	24,448
Total runsize	16,418	30,073	12,838	18,870	9,200	13,396	7,558	32,017	24,570
Strait of Juan de Fuca Region									
Escapement	9,682	8,246	3,295	3,525	5,115	9,261	5,675	6,304	14,727
Terminal runsize	9,682	8,246	3,295	3,525	5,115	9,261	5,675	6,304	14,727
Total runsize	9,730	8,279	3,324	3,574	5,147	9,331	5,704	6,337	14,800

Table 2-4. Runsizes for Hood Canal and the Strait of Juan de Fuca summer chum salmon stocks, 1974-2013.

Return year	Hood Canal runsize	St. of Juan de Fuca runsize	HC/SJF combined
1974	14,220	1,986	16,206
1975	29,114	1,747	30,861
1976	74,219	1,673	75,892
1977	16,687	1,810	18,497
1978	25,344	3,241	28,585
1979	9,512	901	10,413
1980	13,026	5,574	18,600
1981	5,875	1,140	7,015
1982	8,331	3,540	11,871
1983	3,545	1,217	4,762
1984	3,372	1,707	5,079
1985	4,423	411	4,834
1986	7,843	1,216	9,059
1987	3,975	2,181	6,156
1988	5,699	4,128	9,827
1989	4,478	795	5,273
1990	1,564	528	2,092
1991	2,199	424	2,623
1992	3,377	1,394	4,771
1993	871	644	1,515
1994	2,959	214	3,173
1995	9,984	882	10,866
1996	21,057	1,106	22,163
1997	9,380	985	10,365
1998	4,275	1,316	5,591
1999	4,527	577	5,104
2000	9,443	987	10,430
2001	12,641	3,983	16,624
2002	12,428	6,982	19,410
2003	36,115	7,016	43,131
2004	88,236	9,361	97,597
2005	16,418	9,730	26,148
2006	30,073	8,279	38,352
2007	12,838	3,324	16,162
2008	18,870	3,574	22,444
2009	9,200	5,147	14,347
2010	13,396	9,331	22,727
2011	7,558	5,704	13,262
2012	32,017	6,337	38,354
2013	24,570	14,800	39,370

During the period from 2005 through 2013, harvest of summer chum was very limited and runsize generally tracked the trends in escapement (see Figures 2-1 through 2-3). Runsize in Hood Canal ranged from 7,558 summer chum in 2011 to 32,017 fish in 2012 (Table 2-3 and 2-4). Strait of Juan de Fuca runsize ranged from 3,324 summer chum in 2007 to 14,800 summer chum in 2013. The combined summer chum runsize for the Hood Canal/Strait of Juan de Fuca region ranged from 13,262 fish in 2011 to 39,370 fish in 2013. The 2011 runsize was the lowest since a return of 10,430 fish in 2000. The 2013 return was the fourth largest on record, with only 1976, 2003 and 2004 having larger returns of summer chum to the region (Table 2-4). For more information on harvest and runsize see the Harvest Management section below.

Genetic Stock Identification (GSI)

The Co-managers continued genetic stock identification allozyme and/or DNA collections of summer chum spawners throughout the region with from about 400 to 1300 fish sampled annually for DNA during 2005 through 2013 (see Appendix Table 3 through Appendix Table 10). In addition, many scale samples can be used to increase the number of fish analyzed for DNA. Analysis of the collected data, over time, will allow the comparison of recent and past collections with the goal of monitoring changes in allelic characteristics and of assessing whether the supplementation programs have negatively affected the genetic diversity of natural populations.

Recent genetic analyses of summer chum DNA collections have been completed. Kassler and Shaklee (2003) examined allozyme data for summer chum salmon populations in Hood Canal and Strait of Juan de Fuca and compared the new data with previously collected allozyme data. The results indicated that the eight currently recognized summer chum stocks (2 in Strait of Juan de Fuca and 6 in Hood Canal) generally are significantly different from each other (see Appendix Report 3 to SCSCI Supplemental Report No. 4 (WDFW and PNPTT 2003)). Small and Young (2003) reported on the genetic analysis of summer and early fall chum salmon populations in Hood Canal, Strait of Juan de Fuca, and South Puget Sound using microsatellite DNA. Summer chum of Hood Canal formed a group distinct but associated with summer chum of the Strait of Juan de Fuca and the study found that individual fish can be assigned to their region of origin (see Appendix Report 4 to SCSCI Supplemental Report No. 4 (WDFW and PNPTT 2003)) . Evaluating the genetic impacts of five to ten years of supplementation programs, Small et al. (2009, 2013) detected no effects on diversity or effective population size on most supplemented stocks (sub-populations) and suggest that supplementation minimally impacted population structure. Scale samples collected in 1978-79 from Big Beef Creek summer chum (before the stock was extirpated) were analyzed using microsatellite DNA. It was determined that Big Beef Creek summer chum were genetically more similar to other sub-populations from low elevation tributaries on the east side of Hood Canal than the geographically closer sub-populations in tributaries originating in the Olympic Mountains on the west side of Hood Canal (Small et al. 2013). Big Beef Creek were most similar genetically to Union River summer chum, which are about 80 km distant, and this supports an eco-regional association among summer chum on the Kitsap Peninsula as suggested by the Puget Sound Technical Recovery Team (PSTRT) (Sands et al. 2009).

The PSTRT is charged with identifying independent populations within the Hood Canal summer chum ESU that would be the focus of recovery activities under the ESA. Based on analysis of allozyme and microsatellite DNA data, historical and present geographical distribution, straying patterns, and life history variation information provided by the co-managers, the TRT identified two independent populations: one in the Strait of Juan de Fuca, and the other in Hood Canal (Sands et al. 2009). The TRT analyses indicated that the extant stocks identified by the co-managers in the SCSCI, as well as spawning aggregations that have disappeared from some streams, were important for viability of the Hood Canal and Strait of Juan de Fuca independent populations. In addition, genetic analyses suggested that genetic differences observed among some spawning aggregations might be partially explained by increased geographical isolation as a result of local extinctions in southern and eastern Hood Canal and Admiralty Inlet.

Finally, GSI analysis has been used to help resolve questions about program of origin for supplementation fish that could not be definitively identified by otolith techniques. Additional summer chum samples were recently added to improve the DNA baseline (Small et al. 2009, 2013) and the baseline was used to assign individual summer chum with "ambiguous" otolith marks to their region and stream of origin and/or to identify potential straying of hatchery-origin summer chum. This analysis is discussed below in the Mark Recovery section.

BIOLOGICAL DATA (AGE, SIZE, AND SEX DATA)

Biological sampling of summer chum adults remained high during 2005 through 2013 with about 300-1300 DNA samples, 1200-3400 otolith samples, and 1300-3900 scale samples collected each year in the Hood Canal and Strait of Juan de Fuca regions (Table 2-5). The genetic, otolith, and scale collections made from summer chum salmon in eastern Strait of Juan de Fuca and Hood Canal streams during 2005 through 2012 are shown in Appendix Tables 3 through 10. Age composition for each stream as determined from scale and/or otolith collections during 2005 through 2013 is presented in Appendix Tables 11 through 19. Although sample sizes were generally very good, estimates of age composition likely improved as the proportion of the total escapement sampled increased. In addition, with sample sizes of 200 to 400 fish per stream, for a confidence level of 0.80-0.90, the confidence interval half-width was +/- 5%-10% (Thompson 1987). Scale and otolith information are used as described in the Mark Recovery section of this report for estimating natural productivity and supplementation return rates. In addition to the collection of genetic, otolith, and scale samples taken, sampled fish were measured (fork length in mm) and identified to sex.

In the first SCSCI five-year review (WDFW and PNPTT 2007), a basic analysis of available length data was prepared, comparing the mean size of returning supplementation-origin fish from each program (including fish straying to other watersheds) vs. the mean size of natural-origin fish returning to the program stream, and comparing mean size of fish collected for broodstock in supplementation streams vs. mean size of fish spawning naturally in the same stream. For streams without supplementation programs, the mean lengths of natural-origin fish were compared to the mean lengths of stray supplementation-origin fish recovered in the stream. Means were calculated by sex and age class (data were only presented for age 3 and 4 fish, due to small sample sizes of age 2 and 5 fish). It appeared that summer chum collected for broodstock are representative of the summer chum returns and that supplementation programs have not affected the size of returning adults (WDFW and PNPTT 2007). No new analyses were done for data collected during 2005 through 2013, but we expect the results to be similar to those previously reported.

Table 2-5. Genetic, otolith, and scale collections made from adult summer chum salmon in Hood Canal and eastern Strait of Juan de Fuca streams, 2005 through 2013.

	Sample size		
Year	**DNA**	**Otolith**	**Scales**
2005	965	2,914	3,158
2006	1,065	3,430	3,990
2007	847	2,686	3,148
2008	1,335	2,354	3,267
2009	700	1,731	2,588
2010	758	2,027	2,149
2011	401	1,196	1,348
2012	491	1,753	2,193
2013	278	1,207	2,049

MARK RECOVERY

Summer chum fry from all supplementation and reintroduction programs are marked to allow for differentiation from natural-origin fish upon return as adults in fisheries, at broodstock traps, and on the spawning grounds. For the supplementation program on Big Quilcene River, all fry have been adipose-fin-clipped beginning with brood year 1997. The summer chum released from all other supplementation programs have their otoliths thermally mass-marked at the embryo stage; each program receives unique otolith marks. Due to the low rate of interception in fisheries, mark recovery has concentrated on spawning ground rather than fishery recoveries. Examination of otoliths recovered from spawned adults and checking adults for presence/ absence of adipose fins provides a method to separate the number of supplementation (hatchery) fish from the number of naturally spawning fish and assists in determining the contribution of the supplementation program to the summer chum population. In addition, adipose-fin-clipping and otolith-marking make it possible to determine the level of straying of supplementation program-origin fish to other drainages. This means that all adults sampled can be classified as natural or supplementation origin, and supplementation-origin fish can be identified to their stock of origin, allowing estimation of total returns for each group.

Marked summer chum adults produced by the supplementation or reintroduction programs began returning to streams mostly during 2000, 2001, and 2002; the exceptions are Salmon Creek and Union River which had marked adult returns beginning in 1996 and 2003, respectively, and Tahuya River which did not have program returns until 2006 (Table 2-6).

Table 2-6. Brood years that summer chum salmon supplementation or reintroduction programs and mass marking of fry releases (otolith marking or adipose clipping) were initiated and terminated in Hood Canal and eastern Strait of Juan de Fuca streams; and the first year marked adults from the program were expected to return.

Supplementation or reintroduction program	Brood year program initiated	Brood year mass marking initiated	First year marked adults to return[1]	Brood year Program terminated [4]
Salmon Creek	1992	1993	1996	2003
Big Quilcene River[2]	1992	1997	2000	2003
Lilliwaup Creek[3]	1992	1997	2000	[2014+]
Chimacum Creek (reintroduction)	1996	1999	2002	2003
Big Beef Creek (reintroduction)	1996	1998	2001	2004
Hamma Hamma River	1997	1997	2000	2008
Jimmycomelately Creek	1999	1999	2002	2010
Union River	2000	2000	2003	2003
Tahuya River (reintroduction)	2003	2003	2006	[2014]

[1] First year of returning age 3 fish is shown. Most adults return at age 3 and 4, with few returns at ages 2 and 5.
[2] Mass marked with adipose clip. All other programs use otolith marking.
[3] Attempts to initiate supplementation at Lilliwaup began in 1992, but broodstock collection efforts were largely unsuccessful until the 1998 brood.
[4] Projected termination dates shown in [brackets]

Otoliths were collected from adult summer chum salmon returning to spawn in Hood Canal and eastern Strait of Juan de Fuca streams and the fish were examined for adipose fin clips by WDFW, USFWS and tribal staffs, and staff or volunteers from Hood Canal Salmon Enhancement Group (HCSEG), Long Live The Kings (LLTK), North Olympic Salmon Coalition (NOSC) and Wild Olympic Salmon (WOS). Adult summer chum were sampled after spawning on the spawning grounds or after being spawned as broodstock for the supplementation/ reintroduction programs. Otolith analyses were conducted by WDFW's Fish Program Otolith Laboratory staff.

Both the number of fish and the number of streams sampled remained high from 2005 through 2013. The actual numbers of otolith-marked or adipose marked (AD-clipped) adults sampled were expanded based on the percentage of the total spawner escapement sampled for otolith marks or AD-clips in each stream. The last summer chum with AD-clips from the Big Quilcene supplementation program returned in 2008 as 5-year olds. The expanded estimates probably improve as the proportion of the total escapement sampled increases.

Data analysis

The analysis of mark recovery data was done in successive steps, but only the expanded results are presented and discussed in this report. The mark recovery analysis presented in WDFW and PNPTT (2007) for the years 2000-2004 is similar to that done for 2005-2013. The analysis calculates expansions based on age-specific otolith mark and AD-clip data since age composition of otolith and AD-clip sampled fish varied slightly from total stock age composition in most cases. The mark recovery data and results presented here should take precedence over those in previous reports.

Through a series of calculations and expansions, the total escapements of adipose-clipped fish, otolith marked fish, and unmarked fish (i.e., without adipose or otolith marks) were estimated for each stream. Using these numbers, it is possible to calculate total natural-origin returns and productivity, supplementation return rates, and to determine numbers of supplementation-origin fish straying to sampled streams other than their stream of origin. For productivity and supplementation return rate calculations, these escapement numbers were expanded to represent total runsize (using proportional escapement assumptions similar to those used by the run reconstruction model).

Interpretation of the mark recovery data is sound, but is complicated by several caveats. First, mass marking was not under way for all supplementation programs until brood year 1997. This means that not all supplementation-origin fish returning prior to 2002 were marked; the last unmarked supplementation-origin fish returned as 5-year olds in 2001. In addition, not all streams were sampled for otoliths every year although coverage was generally very good. For example, the Dosewallips and Duckabush were sampled for adipose clips, but were not sampled for otoliths in 2000 and 2001. This means that the actual number of natural-origin recruits (NORs) was likely smaller than the number calculated, and the actual number of supplementation-origin strays was likely higher in the Dosewallips and Duckabush in 2000 and 2001. For reintroduction programs at Big Beef and Chimacum creeks, supplementation fish were not marked for the first brood, as all returns were assumed to be of supplementation origin until natural-origin returns became a possibility. This means that any of these returning reintroduction-origin fish straying to other streams would have been classified as NORs, and that stray NORs from other streams entering these reintroduction streams would have been classified as supplementation-origin recruits (SORs).

The lack of reference collections for some mark groups, and ambiguous otolith marks placed on some groups (e.g., due to not strictly following the assigned otolith marking schedule at the hatchery) made assignment of some returning adults to a specific program impossible (although they were distinguishable as supplementation origin, and often could be narrowed to two or three likely programs of origin). This problem was substantial only with the 2003 and 2004 returns as discussed in the first 5-year review (WDFW and PNPTT 2007). DNA analysis was conducted on a portion of the samples with ambiguous otoliths, and the results of that analysis were used to assign program of origin to fish with the same combination of possible marks. If DNA and/or otolith analysis did not provide a conclusive result or if DNA analysis was not done due to lack of sufficient funding, the fish were assigned to the category 'marked, origin indefinite.' In some cases, this could represent a fish that was returning to its stream of origin, but whose release group was missing a reference collection, making assignment to the appropriate program impossible. Scale age was also used to resolve ambiguous marks whenever possible. Many of the data tables included in this section have footnotes explaining some, but not all of the issues discussed here.

Total Natural-Origin vs. Supplementation-Origin Returns

At the broadest level, this mark-recovery analysis yields estimates of total numbers of natural-origin and supplementation-origin summer chum returning each year. The natural-origin estimates are of particular interest for evaluation of the productivity of summer chum at a broad scale. The year 2001 was the first where the vast majority of returning summer chum of supplementation origin was marked. Table 2-7shows the total estimates of natural-origin recruits (NORs) and supplementation-origin recruits (SORs) escaping from 2001 through 2013, in Hood Canal and the Strait of Juan de Fuca. Table 2-8 shows similar estimates, expanded to total runsize. For the ESU, natural origin fish accounted for 54% to 88% of total escapement and total runsize between 2001 and 2013. Table 2-9 shows NOR and SOR escapement estimates at the Management Unit and stream levels and Table 2-10 shows NOR and SOR runsize estimates at the Management Unit level.

Prior to the initiation of the first supplementation programs in 1992, all summer chum adults returning to Hood Canal and Strait of Juan de Fuca were natural-origin fish. The first supplementation-origin adults returned in 1995. Runsize estimates of natural-origin and supplementation-origin summer chum for the period 1974 through 2013 are shown in Figure 2-4 for Strait of Juan de Fuca and in Figure 2-5 for Hood Canal. Escapement estimates of natural-origin and supplementation-origin summer chum for the period 1974-2013 are shown in Appendix Table 19 for Strait of Juan de Fuca and in Appendix Table 20 for Hood Canal. Runsize estimates of natural-origin and supplementation-origin summer chum for the period 1974-2013 are shown in Appendix Table 21 for Strait of Juan de Fuca and in Appendix Table 22 for Hood Canal.

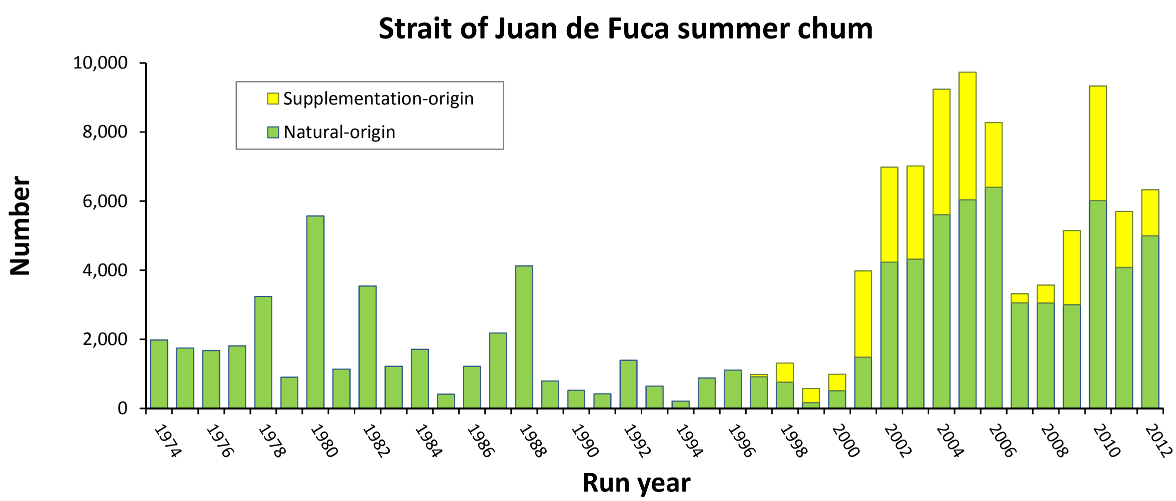

Figure 2-4**.**   Natural-origin and supplementation-origin runsize for Strait of Juan de Fuca summer chum salmon, 1974-2013.

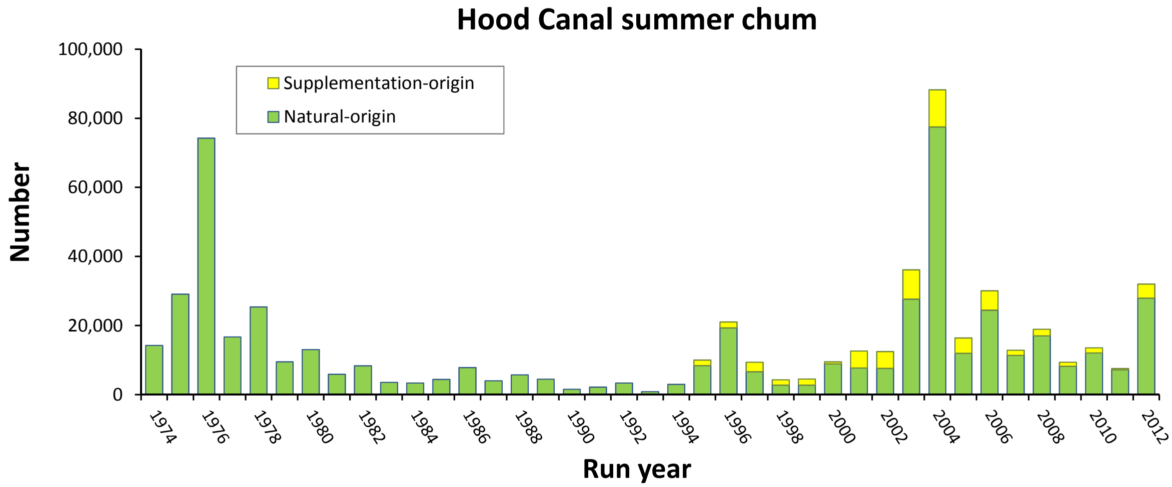

Figure 2-5. Natural-origin and supplementation-origin runsize for Hood Canal summer chum salmon, 1974-2013.

Table 2-7. Estimates of total escapement of natural and supplementation origin fish returning to streams in Hood Canal and Strait of Juan de Fuca, 2001-2013.

		2001		2002		2003		2004	
Region	Origin	Number	%	Number	%	Number	%	Number	%
	Natural origin	7,170	59.5%	6,850	59.8%	27,335	76.6%	60,341	86.2%
Hood Canal	Supp. origin	4,839	40.2%	4,594	40.1%	8,361	23.4%	9,621	13.7%
	Undetermined origin*	35	0.3%	10	0.1%	0	0.0%	33	0.0%
	Total	12,044		11,454		35,696		69,995	
Strait of Juan	Natural origin	1,473	37.2%	4,220	60.5%	4,281	61.5%	5,672	60.7%
de Fuca	Supp. origin	2,482	62.8%	2,750	39.5%	2,678	38.5%	3,546	38.0%
	Undetermined origin*	0	0.0%	0	0.0%	0	0.0%	123	1.3%
	Total	3,955		6,970		6,959		9,341	
Hood Canal ESU	Natural origin	8,643	54.0%	11,070	60.1%	31,616	74.1%	66,013	83.2%
	Supp. origin	7,321	45.8%	7,344	39.9%	11,039	25.9%	13,167	16.6%
	Undetermined origin*	35	0.2%	10	0.1%	0	0.0%	156	0.2%
	Total	15,999		18,424		42,655		79,336	

		2005		2006		2007		2008	
Region	Origin	Number	%	Number	%	Number	%	Number	%
	Natural origin	11,344	72.0%	21,381	79.9%	9,354	86.8%	13,550	88.0%
Hood Canal	Supp. origin	4,402	27.9%	5,364	20.1%	1,405	13.0%	1,830	11.9%
	Undetermined origin*	5	0.0%	8	0.0%	22	0.2%	23	0.1%
	Total	15,751		26,753		10,781		15,403	
Strait of Juan	Natural origin	5,999	62.0%	6,372	77.3%	3,017	91.6%	3,011	85.4%
de Fuca	Supp. origin	3,681	38.0%	1,871	22.7%	276	8.4%	514	14.6%
	Undetermined origin*	2	0.0%	3	0.0%	2	0.1%	0	0.0%
	Total	9,682		8,246		3,295		3,525	
Hood Canal ESU	Natural origin	17,342	68.2%	27,753	79.3%	12,370	87.9%	16,561	87.5%
	Supp. origin	8,084	31.8%	7,236	20.7%	1,682	11.9%	2,344	12.4%
	Undetermined origin*	7	0.0%	11	0.0%	24	0.2%	23	0.1%
	Total	25,433		34,999		14,076		18,928	

Table 2-7 (cont.). Estimates of total escapement of natural and supplementation origin fish returning to streams in Hood Canal and Strait of Juan de Fuca, 2001-2013.

		2009		2010		2011		2012		2013	
Region	Origin	Number	%	Number	%	Number	%	Number	%	Number	%
	Natural origin	6,545	88.3%	11,229	88.1%	6,461	92.7%	26,240	88.1%	19,485	87.3%
Hood Canal	Supp. origin	844	11.4%	1,451	11.4%	404	5.8%	3,291	11.0%	2,345	10.5%
	Undetermined origin*	25	0.3%	61	0.5%	107	1.5%	259	0.9%	481	2.2%
	Total	7,414		12,742		6,972		29,791		22,311	
Strait of Juan	Natural origin	2,659	52.0%	5,922	63.9%	4,060	71.5%	4,975	78.9%	12,042	81.8%
de Fuca	Supp. origin	2,455	48.0%	3,337	36.0%	1,612	28.4%	1,323	21.0%	2,685	18.2%
	Undetermined origin*	1	0.0%	2	0.0%	3	0.1%	6	0.1%	0	0.0%
	Total	5,115		9,261		5,675		6,304		14,727	
Hood Canal ESU	Natural origin	9,204	73.5%	17,152	78.0%	10,521	83.2%	31,216	86.5%	31,526	85.1%
	Supp. origin	3,299	26.3%	4,788	21.8%	2,016	15.9%	4,614	12.8%	5,031	13.6%
	Undetermined origin*	26	0.2%	63	0.3%	110	0.9%	265	0.7%	481	1.3%
	Total	12,529		22,003		12,647		36,095		37,038	

*Undetermined origin represents fish escaping to streams where no carcasses were sampled for marks

Table 2-8. Estimates of total runsizes of natural and supplementation origin fish returning to streams in Hood Canal and Strait of Juan de Fuca, 2001-2013.

		2001		2002		2003		2004	
Region	Origin	Number	%	Number	%	Number	%	Number	%
	Natural	7,825	58.6%	8,043	61.1%	27,760	76.6%	76,297	87.7%
Hood Canal	Supp. origin	5,504	41.2%	5,107	38.8%	8,467	23.4%	10,664	12.3%
	Undetermined origin*	35	0.3%	10	0.1%	0	0.0%	33	0.0%
	Total	13,364		13,160		36,227		86,993	
Strait of Juan	Natural	1,483	37.3%	4,234	60.7%	4,315	61.5%	5,682	60.7%
de Fuca	Supp. origin	2,499	62.7%	2,747	39.3%	2,700	38.5%	3,553	38.0%
	Undetermined origin*	0	0.0%	0	0.0%	0	0.0%	123	1.3%
	Total	3,982		6,981		7,014		9,358	
Hood Canal ESU	Natural origin	9,309	53.7%	12,277	61.0%	32,075	74.2%	81,979	85.1%
	Supp. origin	8,002	46.1%	7,854	39.0%	11,166	25.8%	14,217	14.8%
	Undetermined origin*	35	0.2%	10	0.0%	0	0.0%	156	0.2%
	Total	17,346		20,141		43,241		96,351	

		2005		2006		2007		2008	
Region	Origin	Number	%	Number	%	Number	%	Number	%
	Natural	11,807	71.9%	23,819	79.9%	11,121	87.5%	15,707	86.0%
Hood Canal	Supp. origin	4,486	27.3%	5,636	18.9%	1,502	11.8%	1,858	10.2%
	Undetermined origin*	126	0.8%	345	1.2%	90	0.7%	693	3.8%
	Total	16,417		29,798		12,712		18,257	
Strait of Juan	Natural	6,028	62.0%	6,397	77.3%	3,043	91.6%	3,053	85.4%
de Fuca	Supp. origin	3,700	38.0%	1,878	22.7%	279	8.4%	521	14.6%
	Undetermined origin*	2	0.0%	3	0.0%	2	0.1%	0	0.0%
	Total	9,730		8,279		3,324		3,575	
Hood Canal ESU	Natural origin	17,835	68.2%	30,216	79.4%	14,164	88.3%	18,761	85.9%
	Supp. origin	8,185	31.3%	7,514	19.7%	1,781	11.1%	2,380	10.9%
	Undetermined origin*	128	0.5%	348	0.9%	92	0.6%	693	3.2%
	Total	26,147		38,077		16,036		21,832	

Table 2-8 (cont.). Estimates of total runsizes of natural and supplementation origin fish returning to streams in Hood Canal and Strait of Juan de Fuca, 2001-2013.

		2009		2010		2011		2012		2013	
Region	Origin	Number	%	Number	%	Number	%	Number	%	Number	%
	Natural	7,611	88.0%	11,392	86.8%	6,650	91.9%	27,178	87.0%	20,541	86.5%
Hood Canal	Supp. origin	855	9.9%	1,472	11.2%	407	5.6%	3,331	10.7%	2,423	10.2%
	Undetermined origin*	181	2.1%	268	2.0%	178	2.5%	745	2.4%	791	3.3%
	Total	8,646		13,130		7,234		31,254		23,754	
Strait of Juan	Natural	2,676	52.0%	5,967	63.9%	4,081	71.5%	5,001	78.9%	12,102	81.8%
de Fuca	Supp. origin	2,471	48.0%	3,362	36.0%	1,621	28.4%	1,330	21.0%	2,699	18.2%
	Undetermined origin*	1	0.0%	2	0.0%	3	0.1%	6	0.1%	0	0.0%
	Total	5,148		9,332		5,705		6,337		14,800	
Hood Canal ESU	Natural origin	10,287	74.6%	17,359	77.3%	10,731	82.9%	32,179	85.6%	32,643	84.7%
	Supp. origin	3,326	24.1%	4,834	21.5%	2,028	15.7%	4,661	12.4%	5,122	13.3%
	Undetermined origin*	182	1.3%	270	1.2%	181	1.4%	752	2.0%	791	2.1%
	Total	13,794		22,462		12,939		37,591		38,555	

*Undetermined origin represents fish returning to streams where no carcasses were sampled for marks

Table 2-9. Estimates of natural-origin and supplementation-origin escapement for Hood Canal and Strait of Juan de Fuca summer chum management units and stocks from 2001 through 2013.

Management Unit (MU)	Stock	Origin	Return year 2001	2002	2003	2004	2005	2006
Sequim Bay	**Jimmycomelately**	Nat. origin	251	7	68	613	492	345
		Supp. origin	9	50	378	1,049	818	380
Discovery Bay	**Salmon/Snow**	Nat. origin	1,222	4,085	3,986	4,392	4,630	4,553
		Supp. origin	1,570	1,964	1,969	2,025	2,344	939
Port Townsend	**Chimacum**	Nat. origin	0	128	227	666	877	1,474
		Supp. origin	903	736	331	473	519	552
Quilcene/Dabob Bays	**Big/Little Quilcene**	Nat. origin	3,048	3,211	10,740	35,838	5,898	10,884
		Supp. origin	3,325	1,276	1,993	2,315	774	992
Mainstem Hood Canal	**Dosewallips**	Nat. origin	757*	1,313	6,510	10,325	2,498	2,457
		Supp. origin	233*	314	556	1,224	160	120
	Duckabush	Nat. origin	662*	355	1,600	7,850	749	2,963
		Supp. origin	280*	175	269	787	72	172
	Hamma	Nat. origin	1,155	1,050	535	2,409	1,176	2,709
		Supp. origin	72	1,278	319	282	232	356
	Lilliwaup	Nat. origin	41	36	27	136	256	426
		Supp. origin	51	822	326	881	793	1,189
	Dewatto	Nat. origin	N/A**	N/A**	0	6	12	17
		Supp. origin	N/A**	N/A**	9	17	12	52
	Big Beef	Nat. origin	15	12	0	174	36	200
		Supp. origin	879	730	896	1,742	1,088	623
	MU total	Nat. origin	1,212	2,767	8,672	20,900	4,726	8,772
		Supp. origin	1,001	3,318	2,375	4,933	2,357	2,512
SE Hood Canal	**Union**	Nat. origin	1,491	872	7,923	3,603	716	1,667
		Supp. origin	0	0	3,993	2,373	1,271	1,169
	Tahuya	Nat. origin	N/A	N/A	N/A	N/A	4	58
		Supp. origin	N/A	N/A	N/A	N/A	0	691
	MU total	Nat. origin	1,491	872	7,923	3,603	720	1,725
		Supp. origin	0	0	3,993	2,373	1,271	1,860

* Dosewallips and Duckabush were sampled for adipose clips but not for otoliths marks in 2001.
** Escapements to Dewatto of 32 fish in 2001 and 10 fish in 2002 were sampled for adipose clips, but not for otolith marks.

Table 2-9 (cont.).

Management Unit (MU)	Stock	Origin	Return year 2007	2008	2009	2010	2011	2012	2013
Sequim Bay	**Jimmycomelately**	Nat. origin	468	579	202	737	814	1,274	5,656
		Supp. origin	186	479	2,426	3,290	1,597	1,316	2,685
Discovery Bay	**Salmon/Snow**	Nat. origin	1,667	1,705	1,437	3,238	2,605	2,807	3,320
		Supp. origin	46	35	29	26	16	7	0
Port Townsend	**Chimacum**	Nat. origin	883	727	1,020	1,948	640	894	3,066
		Supp. origin	43	0	0	20	0	0	0
Quilcene/Dabob Bays	**Big/Little Quilcene**	Nat. origin	2,496	3,861	1,490	2,064	2,580	11,739	7,950
		Supp. origin	30	0	0	9	0	0	0
Mainstem Hood Canal	**Dosewallips**	Nat. origin	1,462	3,830	1,094	2,410	1,130	2,828	1,778
		Supp. origin	6	100	34	111	0	34	37
	Duckabush	Nat. origin	1,254	2,521	2,496	3,876	1,515	5,156	4,063
		Supp. origin	40	147	165	234	23	85	66
	Hamma	Nat. origin	1,416	1,384	597	1,370	685	2,206	2,186
		Supp. origin	73	258	73	101	88	149	0
	Lilliwaup	Nat. origin	153	177	60	188	77	1,631	1,233
		Supp. origin	372	513	187	50	36	1,709	1,419
	Dewatto	Nat. origin	18	12	50	9	37	153	155
		Supp. origin	4	14	0	0	0	34	31
	Big Beef	Nat. origin	704	705	152	143	73	156	101
		Supp. origin	142	28	0	0	0	0	0
	MU total	Nat. origin	5,006	8,629	4,450	7,995	3,517	12,131	9,517
		Supp. origin	637	1,060	458	497	147	2,011	1,552
SE Hood Canal	**Union**	Nat. origin	1,846	1,044	597	943	285	2,181	1,759
		Supp. origin	121	86	14	20	11	65	190
	Tahuya	Nat. origin	5	16	8	227	79	190	259
		Supp. origin	618	684	372	926	246	1,215	603
	MU total	Nat. origin	1,851	1,060	605	1,170	364	2,371	2,018
		Supp. origin	739	770	386	946	257	1,280	793

Table 2-10. Estimates of natural-origin and supplementation-origin runsize for Hood Canal and Strait of Juan de Fuca summer chum management units and stocks from 2001 through 2013.

Management Unit (MU)	Stock	Origin	Return year 2001	2002	2003	2004	2005	2006
Sequim Bay	**Jimmycomelately**	Nat. origin	253	5	69	615	494	346
		Supp. origin	9	37	381	1,050	822	381
Discovery Bay	**Salmon/Snow**	Nat. origin	1,230	4,100	4,018	4,401	4,653	4,571
		Supp. origin	1,581	1,972	1,985	2,029	2,356	943
Port Townsend	**Chimacum**	Nat. origin	0	129	229	667	881	1,480
		Supp. origin	909	738	334	473	522	554
Quilcene/Dabob Bays	**Big/Little Quilcene**	Nat. origin	3,632	4,330	11,026	51,737	6,314	13,172
		Supp. origin	3,964	1,720	2,046	3,342	829	1,201
Mainstem Hood Canal	**Dosewallips**	Nat. origin	770*	1,340	6,564	10,349	2,517	2,492
		Supp. origin	237*	320	561	1,227	161	122
	Duckabush	Nat. origin	673*	362	1,614	7,868	754	3,006
		Supp. origin	285*	179	271	789	73	174
	Hamma	Nat. origin	1,175	1,072	539	2,415	1,190	2,747
		Supp. origin	73	1,304	322	282	235	361
	Lilliwaup	Nat. origin	42	37	27	136	258	432
		Supp. origin	52	839	329	883	799	1,206
	Dewatto	Nat. origin	N/A**	N/A**	0	6	12	17
		Supp. origin	N/A**	N/A**	9	17	12	53
	Big Beef	Nat. origin	15	12	0	174	37	203
		Supp. origin	894	745	903	1,746	1,096	632
	MU total	Nat. origin	1,232	2,823	8,745	20,948	4,767	8,897
		Supp. origin	1,019	3,387	2,394	4,944	2,376	2,548
SE Hood Canal	**Union**	Nat. origin	1,517	890	7,990	3,611	721	1,690
		Supp. origin	0	0	4,026	2,379	1,281	1,186
	Tahuya	Nat. origin	N/A	N/A	N/A	N/A	4	59
		Supp. origin	N/A	N/A	N/A	N/A	0	701
	MU total	Nat. origin	1,517	890	7,990	3,611	725	1,749
		Supp. origin	0	0	4,026	2,379	1,281	1,887

* Dosewallips and Duckabush were sampled for adipose clips but not for otoliths marks in 2001.
** runsizes to Dewatto of 32 fish in 2001 and 10 fish in 2002 were sampled for adipose clips, but not for otolith marks.

Table 2-10 (cont.).

Management Unit (MU)	Stock	Origin	Return year 2007	2008	2009	2010	2011	2012	2013
Sequim Bay	**Jimmycomelately**	Nat. origin	472	587	203	742	819	1,281	5,684
		Supp. origin	188	486	2,442	3,315	1,605	1,323	2,699
Discovery Bay	**Salmon/Snow**	Nat. origin	1,681	1,729	1,446	3,262	2,619	2,822	3,337
		Supp. origin	47	35	29	26	16	7	0
Port Townsend	**Chimacum**	Nat. origin	890	737	1,027	1,962	643	899	3,081
		Supp. origin	44	0	0	21	0	0	0
Quilcene/Dabob Bays	**Big/Little Quilcene**	Nat. origin	3,860	5,868	2,508	2,097	2,736	12,500	8,723
		Supp. origin	46	0	0	9	0	0	0
Mainstem Hood Canal	**Dosewallips**	Nat. origin	1,548	3,889	1,103	2,444	1,139	2,862	1,815
		Supp. origin	6	101	34	113	0	34	37
	Duckabush	Nat. origin	1,327	2,560	2,517	3,930	1,528	5,219	4,148
		Supp. origin	43	150	167	238	23	86	67
	Hamma	Nat. origin	1,499	1,405	602	1,389	691	2,233	2,231
		Supp. origin	77	262	73	102	88	151	0
	Lilliwaup	Nat. origin	162	180	61	191	77	1,651	1,275
		Supp. origin	394	521	189	51	37	1,730	1,467
	Dewatto	Nat. origin	19	12	51	9	37	155	160
		Supp. origin	4	14	0	0	0	34	32
	Big Beef	Nat. origin	745	716	153	145	74	158	103
		Supp. origin	151	29	0	0	0	0	0
	MU total	Nat. origin	5,300	8,762	4,488	8,108	3,547	12,278	9,733
		Supp. origin	674	1,077	463	504	148	2,035	1,603
SE Hood Canal	**Union**	Nat. origin	1,955	1,061	606	956	287	2,207	1,818
		Supp. origin	128	87	14	20	11	66	197
	Tahuya	Nat. origin	5	16	9	230	79	192	268
		Supp. origin	655	695	377	939	249	1,230	623
	MU total	Nat. origin	1,960	1,077	615	1,187	367	2,399	2,086
		Supp. origin	782	782	392	959	260	1,296	820

PRODUCTIVITY

Productivity is a measurement of the number of adult salmon that are ultimately produced by each year's spawning escapement. Since the summer chum salmon from a given year's spawner population (brood year) return as 2-, 3-, 4-, and 5-year old fish, it is necessary to have reliable age composition data for each annual return, so that fish can be assigned to individual brood years. The compiled total return for each brood year is divided by the number of parent spawners to arrive at the brood year productivity, typically expressed as recruits per spawner (R/S). The SCSCI performance standards included a minimum value for mean R/S rates that would contribute to stability and recovery of summer chum, and the SCSCI interim recovery goals (PNPTT and WDFW 2003) include R/S threshold criteria that represent recovery.

Although previous reports in the SCSCI series recognized the importance of R/S rates as an indicator of stock performance, attempts to address brood productivity were not made, as age composition data were insufficient for estimating recruits by brood year. Increased scale and otolith data collection in recent years have made it possible to begin estimating productivity for a limited number of broods. When interpreting the productivity estimates, it is necessary to keep in mind the limitations of the mark recovery expansions discussed earlier. These estimates assume that all natural-origin recruits return to their home stream. Any exchanges (or straying) of natural origin recruits are not detectable, but are included in the stream-by-stream productivity estimates.

Productivity estimates of natural spawners are presented for the Hood Canal and Strait of Juan de Fuca regions, and for the Hood Canal summer chum ESU, in Table 2-11. Productivity estimates are not available prior to the 1996 brood in either region due to insufficient age data collected prior to the 1999 return year. An estimate is not available for the 1996 brood in Hood Canal because supplementation origin fish released prior to the 1997 brood were not marked. Brood returns are incomplete for the 2009 brood, but partial R/S estimates are presented here.

Total natural-origin R/S estimates for each management unit and stock are shown in Table 2-12 for each brood year with available data. Rates are highly variable from stock to stock and from year to year, although trends are visible for across stocks between years. Productivity for all regions was generally >1 R/S for the 1997 through 2002 brood years and <1 R/S for the 2003 through 2009 brood years. The reduced productivity from 2003 and 2004 brood years coincided with the highest spawning escapements in Hood Canal for the 14 year time series. However, low R/S rates continued through the 2006 brood year for all regions despite moderate to high spawning escapements. The R/S rates generally increased for the 2007-2009 brood years under low to moderate escapements more similar to those observed in the earlier years of the time series, despite 2009 being only a partial brood return. These observed trends may indicate density dependent responses for the populations (Table 2-6). For the Hood Canal population the change appears to occur at escapements greater than 10,000 to15,000 summer chum. Individual Hood Canal stocks exhibit varying degrees of density dependence with the exception of Big Beef Creek, which consistently has low productivity (<1 R/S) across the range of observed escapements. Although it is currently only a minor contributor to the overall Hood Canal MU abundance, the Big Beef Creek sub-population is essential to recovery (NMFS 2007a) so identifying the probable cause of consistently low productivity is important to recovery of the ESU.

The density dependent pattern is less clear for the Strait of Juan de Fuca population, however the Salmon/Snow stock shows density dependent trends across the time series. It is important to note that the majority of stocks in Hood Canal and Strait of Juan de Fuca all had extremely high production during the 1999 and 2000 brood years coming off of very low spawning escapements, contributing to the apparent density dependent trends. The cause of these density dependent trends across Strait of Juan de Fuca and Hood Canal stocks are currently unknown, but are likely caused by inherent and current habitat quality and quantity and the intrinsic production potential and capacity of each summer chum sub-population. In addition, caution is necessary in interpreting trends in the R/S values because of uncertainties in both escapement estimates and estimation of recruits. In particular, some of the highest R/S values for the smallest individual stocks are associated with very low escapements that likely have more associated uncertainties. A relatively minor underestimate in the actual escapement would significantly change the R/S value in several cases. Tables detailing the recruit/spawner estimates for each stock are included in Appendix Tables 24-36.

Table 2-11. Hood Canal summer chum brood-year based wild escapement, natural-origin brood return, and natural-origin recruit per spawner (R/S) estimates for the 1996 through 2009 broods for the Hood Canal region, Strait of Juan de Fuca region, and for the entire ESU. [1]

		Brood year													
Region		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hood Canal	Brood wild escapement	19,707	8,412	3,404	3,882	7,987	11,491	10,818	35,173	69,565	15,311	26,418	10,539	15,112	7,236
Region	Total NOR brood return	N/A**	7,051	3,771	12,056	83,320	17,211	21,862	14,136	21,265	7,283	9,796	11,373	11,644	14,489
	R/S	N/A**	**0.84**	**1.11**	**3.11**	**10.43**	**1.50**	**2.02**	**0.40**	**0.31**	**0.48**	**0.37**	**1.08**	**0.77**	**2.00**
Strait of	Brood wild escapement	975	852	1,148	502	801	3,733	6,791	6,752	9,280	9,619	8,181	3,219	3,449	5,029
Juan de Fuca	Total NOR brood return	171	1,135	1,297	5,048	6,714	4,002	7,829	3,066	5,864	3,040	3,378	7,567	4,399	1,267
Region	**R/S**	**0.18**	**1.33**	**1.13**	**10.05**	**8.38**	**1.07**	**1.15**	**0.45**	**0.63**	**0.32**	**0.41**	**2.35**	**1.28**	**0.25**
Hood Canal	Brood wild escapement	20,682	9,264	4,552	4,384	8,788	15,224	17,609	41,925	78,845	24,930	34,599	13,758	18,561	12,265
ESU	Total NOR brood return	N/A**	8,186	5,068	17,104	90,034	21,213	29,691	17,202	27,129	10,323	13,173	18,940	16,044	15,755
	R/S	N/A**	**0.88**	**1.11**	**3.90**	**10.25**	**1.39**	**1.69**	**0.41**	**0.34**	**0.41**	**0.38**	**1.38**	**0.86**	**1.28**

1. Partial brood returns: 2009 - does not include age 5 return

** Because 1996 brood Quilcene and Lilliwaup supplementation releases were not marked, natural-origin returns cannot be separated from supplementation-origin returns.

Table 2-12. Productivity estimates (natural-origin recruits/spawner) for Hood Canal and Strait of Juan de Fuca summer chum management units and stocks for the 1996 through 2009 broods. [1]

Management Unit (MU)	Stock	Brood year 1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Sequim Bay	**Jimmycomelately**	0.03	1.44	2.26	8.72	17.78	4.24	41.12	0.80	0.60	0.25	0.47	1.66	1.33	0.18
Discovery Bay	**Salmon/Snow**	0.18	1.32	1.02	10.47	8.24	0.95	1.00	0.34	0.39	0.22	0.31	2.69	1.40	0.85
Port Townsend	**Chimacum**	N/A[2]	N/A[2]	N/A[2]	74.82	62.16	4.58	5.09	6.19	3.74	3.41	1.90	5.08	7.86	1.08
Quilcene/Dabob Bays	**Big/Little Quilcene**	N/A[3]	0.44	0.57	2.26	8.62	2.26	2.82	0.71	0.18	0.37	0.14	1.75	1.88	7.19
Mainstem Hood Canal	**Dosewallips**	0.22	9.74	2.83	6.26	12.34	0.98	1.86	0.15	0.42	0.42	0.92	1.05	0.44	2.02
	Duckabush	0.17	0.99	1.37	7.81	18.36	0.79	4.30	0.81	0.40	2.33	1.18	2.16	0.89	2.06
	Hamma	0.57	8.72	6.35	4.41	13.36	0.59	1.36	1.16	0.87	0.59	0.37	0.87	0.62	3.63
	Lilliwaup	N/A[3]	3.15	10.57	N/A[4]	45.71	2.89	0.68	0.95	0.29	0.07	0.11	0.21	0.39	20.79
	Big Beef	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	0.23	0.22	0.11	0.64	0.31	0.15	0.13	0.23	0.30
	MU total	0.23	2.87	2.91	5.93	13.94	0.68	1.54	0.35	0.47	0.62	0.68	1.05	0.57	2.70
SE Hood Canal	**Union**	0.19	4.84	1.84	7.79	15.16	0.58	1.37	0.11	0.40	0.35	0.24	0.50	0.47	4.23
	Tahuya	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	1.30	2.67	0.03	0.43	0.15	0.64
	MU total	0.19	4.84	1.84	7.79	15.16	0.58	1.41	0.12	0.40	0.35	0.19	0.48	0.34	2.76

Estimates for early broods subject to caveats listed in text and appendix tables on mark recovery.

1. Partial brood returns: 2009 - does not include age 5 return
2. There were no wild spawners in Chimacum, Big Beef, and Tahuya prior to reintroduction programs, meaning there was no natural productivity.
3. Big Quilcene and Lilliwaup supplementation-origin fish were not marked until BY 1997, so estimation of natural-origin return is not possible for BY 1996.
4. Although 1999 brood year NOR's did return to Lilliwaup Creek, the 1999 natural spawning escapement estimate was 0, meaning that either some natural spawners were missed, or that the NOR's strayed from another system. A similar scenario arose with the 2000 brood, where a parent escapement of only 2 fish led to returns of 91 NOR's.

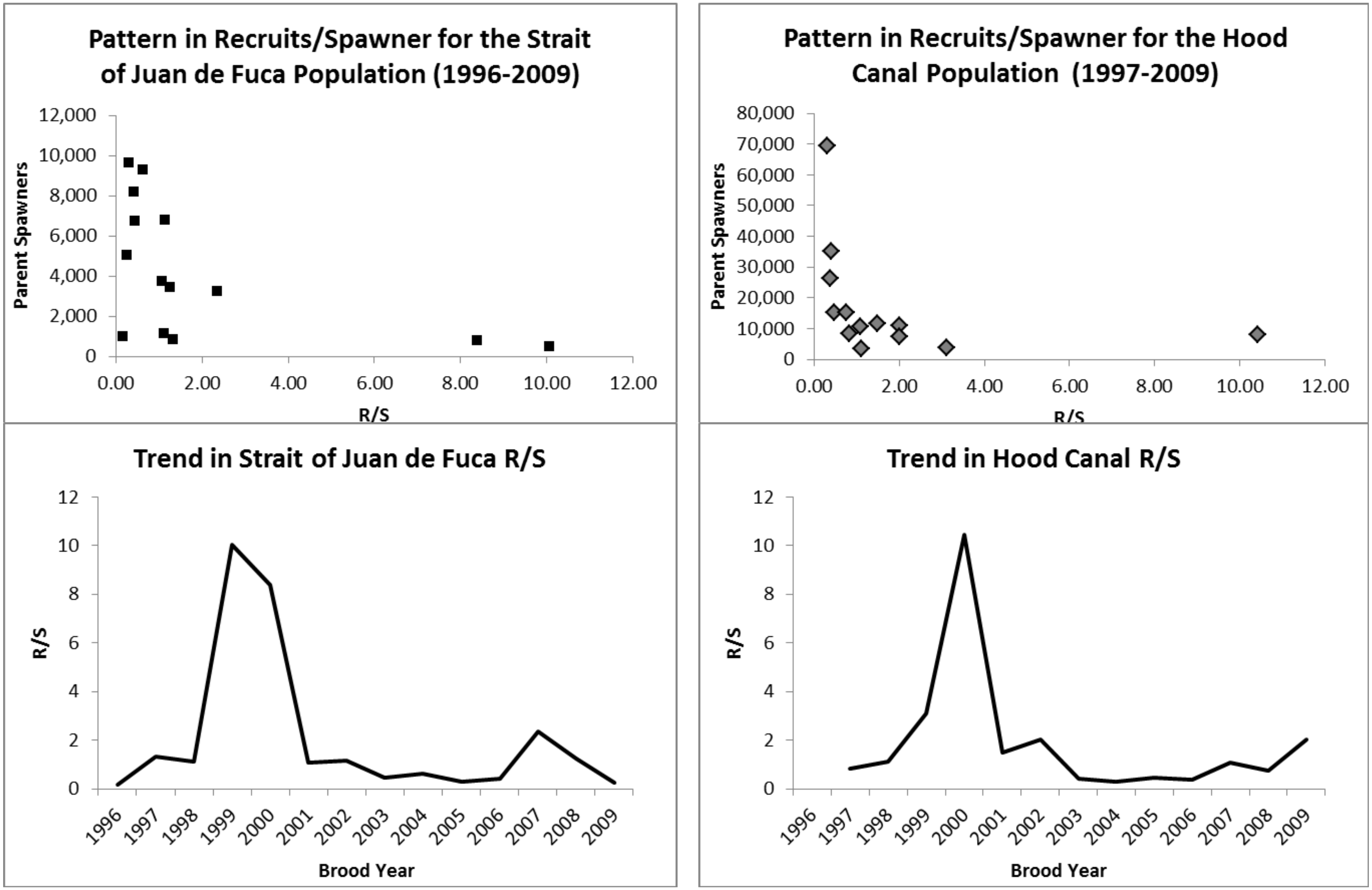

Figure 2-6. Trends in natural-origin recruits per spawner (productivity) for Strait of Juan de Fuca and Hood Canal summer chum salmon populations, 1996 through 2009 brood years (2009 is incomplete brood year)

SUPPLEMENTATION RETURNS/STRAYING

Most supplementation program adults have been recovered in their stock's own watersheds, however, some of the program adults have also been recovered in other streams each year. Most exchange (or straying) of supplementation-origin fish occurred between neighboring streams within the region of origin. The natural exchange (or stray) rate for Hood Canal and eastern Strait of Juan de Fuca summer chum stocks or populations is not known.

Return rates for supplementation programs, and brief discussion of straying of supplementation fish to other streams, are discussed in detail in section 4 (artificial production) under the individual project discussions. For year-by-year estimates of stray supplementation returns by program of origin and stream of recovery, see Appendix Table 34 through Appendix Table 41. The issue of straying of supplementation fish is difficult to interpret completely for some programs, due partially to the problems with definite assignment of some marked otoliths to programs.

Several references have been made to ambiguous otolith marks, not assignable to a single program. This problem is primarily only seen with the 2003 and 2004 returns. To give some idea of the magnitude of the problem, in 2004 nearly 1,175 marked otoliths were recovered. Of those, 428 could not be attached to a specific supplementation program, even after using DNA analysis to assign many of the ambiguous otoliths (note: not all ambiguous otoliths were analyzed with DNA so more assignments may be possible). This large number of ambiguous marks expands to an escapement estimate of 3,097 supplementation fish not attributable to a specific program. However, DNA analysis was used and able to assign supplementation fish to the region of origin (i.e., either Hood Canal or Strait of Juan de Fuca) with a high level of confidence. The presence of ambiguous otolith marks must, however, be considered when interpreting supplementation return rate and straying data within each region.

As mentioned earlier, summer chum stocks from the Strait of Juan de Fuca and Hood Canal regions have been identified as independent populations within the ESU. While some straying of supplementation (and natural) origin fish between streams within each population's geographic region is expected, straying between regions should be much less common. In fact, recoveries of supplementation-origin fish in streams outside their region have been rare. Actual recoveries expand to estimates of from 0 to 61 supplementation-origin fish straying between regions for an estimated 0.0% to 0.12% stray rate (Table 2-13, see Appendix Tables 37 through 44 for details by program and stream).

Table 2-13. Total escapement, escapement of supplementation fish straying between regions, and percentage of total escapement represented by inter-region strays for Hood Canal and Strait of Juan de Fuca summer chum, 2001-2012.

	Return year											
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hood Canal												
Total escapement	12,044	11,454	35,696	69,995	15,751	26,753	10,781	15,403	7,423	12,742	6,972	30,123
Estimated strays from SJF supplementation programs	0	12	12	31	10	42	0	0	0	0	0	0
% of total escapement straying from SJF supp. programs	0.00%	0.10%	0.03%	0.04%	0.06%	0.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Strait of Juan de Fuca												
Total escapement	3,955	6,955	6,958	9,341	9,682	8,246	3,295	3,525	5,115	9,261	5,675	6,304
Estimated strays from HC supplementation programs	3	5	4	30	10	0	8	0	0	0	0	9
% of total escapement straying from HC supp. programs	0.08%	0.07%	0.06%	0.32%	0.10%	0.00%	0.24%	0.00%	0.00%	0.00%	0.00%	0.14%
Hood Canal/SJFuca ESU												
Total escapement	15,999	18,409	42,654	79,336	79,336	34,999	14,076	18,928	12,538	22,003	12,647	36,427
Estimated strays from supplementation programs	3	17	16	61	61	42	8	0	0	0	0	9
% of total escapement straying from out-of-region supp. programs	0.02%	0.09%	0.04%	0.08%	0.08%	0.12%	0.06%	0.00%	0.00%	0.00%	0.00%	0.02%

EXTINCTION RISK UPDATE

The extinction risk faced by individual summer chum stocks is assessed periodically based on the methodology proposed by Allendorf et al. (1997), and discussed in section 1.7.4 of SCSCI. The Allendorf et al. (1997) methodology consists of a set of procedures for rating extinction risk and for providing estimation of the possible consequences of extinction for Pacific salmon stocks. The methods for estimating extinction risk use either population viability analysis (PVA) or a set of surrogate measures that include current population size parameters and population trends.

The methods used to assess extinction risk result in the ranking of individual stocks into one of four categories: very high, high, moderate, and special concern (see SCSCI Table 1.11). For the purposes of assessment, a "low" category was added for defining stocks that did not fit any of the above categories and are not at risk of extinction. Hood Canal and Strait of Juan de Fuca summer chum stocks were first rated for extinction risk in the SCSCI (see SCSCI table 1.12). The original risk assessment was subsequently updated in the SCSCI Supplemental Report Nos. 3, 4, and 7 (WDFW and PNPTT 2001, WDFW and PNPTT 2003, WDFW and PNPTT 2007).

Abundances of summer chum in Hood Canal declined from the late 1970's through the early 1990's (Figure 2-1). All stocks of summer chum in Hood Canal except the Union River suffered declines in abundance during this period, with several stocks becoming extinct, and several others being classified at high risk of extinction based on methods of Allendorf et al. (1997). In the Strait of Juan de Fuca, the decline started approximately 10 years later, with a noticeable and lasting drop of abundance in 1989 (Figure 2-2). By 1992, six of the twelve summer chum stocks known to have inhabited Hood Canal were extinct, and six were rated at moderate or high risk of extinction; one of the four Strait of Juan de Fuca stocks was extinct, two were rated at high risk of extinction, and one was of unknown status.

Populations rebounded to higher levels quickly in the mid-1990's, after the initiation of harvest reductions and several supplementation programs. Larger escapements were seen from 1995-1997 for the major streams entering the west side of Hood Canal, including a new record escapement for Big Quilcene in 1996, although a significant portion of the Quilcene return was thought to be of supplementation origin (see Artificial Production section for details on supplementation programs and their evaluation). Abundances were down again in 1998 and 1999 (although still five times higher than abundances just prior to recovery efforts), but began to increase in 2000. The 2003 and 2004 escapements were the largest on record, with a total of over 79,000 fish escaping to the ESU in 2004. However, 2004 was the peak return year in a strong 4-year production cycle and production was expected to decline in 2005 as the run cycled down from the high year. From 2005 through 2012, total escapements (combined natural-origin and supplementation-origin fish) for the ESU of about 25,000 to 35,000 summer chum were followed by five years of relatively low escapements (ranging from about 12,000 to 22,000 fish) during 2007-2011, and an increase to about 36,000 summer chum in 2012 (Table 2-2).

The assessment of extinction risk in the first 5-year review (WDFW and PNTT 2007) used total escapements (comprised of natural-origin and supplementation-origin fish) for each stock. In this second 5-year review, Table 2-14 summarizes extinction risk criteria based only on natural-origin summer chum escapement data from the four year periods (one generation) before onset of recovery activities (1988-1991), at the time of the first 5-year review (2001-2004), and from a recent four years (2009-2012). Extinction risks for all stocks, except Lilliwaup, have decreased since the onset of recovery activities, with increases in population sizes, and effective population sizes per generation for all stocks. The extinction risk for Lilliwaup summer chum has remained high. In addition, three stocks have been reintroduced into watersheds where the indigenous stock was extinct, further reducing the extinction risk for the donor stocks and reinitiating natural summer chum production in these streams. Short discussions for each stock follow.

UNION RIVER

Estimated natural-origin escapements to the Union River show no declining trend over the period of record and, in fact, have increased somewhat since the 1970s, with a larger increase occurring since 2000. Escapements from 2009-2012 ranged from 285 to 2,245, averaging 1,018 natural-origin spawners. The effective population size *(N_e)* has increased and equals 733 fish for the 2009-12 return years, and total population size *(N)* is 3,663 for the same years. This stock has shown a stable escapement trend, and its risk of extinction is rated as low.

LILLIWAUP CREEK

Estimated natural-origin summer chum escapements to Lilliwaup Creek are 60, 188, 77, and 1,631 for 2009 through 2012, respectively, averaging 489 natural-origin spawners. The effective population size *(N_e)* has remained low and equals 352 fish for the 2009 through 2012 return years, and total population size *(N)* is 1,760 for the same years. The returns from 1995 through 2012 were enhanced by the supplementation program begun in 1992, but supplementation-origin fish are not included in the extinction risk assessment. Because Lilliwaup summer chum abundance does not exceed the high risk abundance criterion (population size, N_e < 500 or N < 2,500), the risk of extinction is judged to be high.

HAMMA HAMMA RIVER

The annual average estimated Hamma Hamma system escapement from 2009-12 is 1,215 summer chum, ranging from 597 to 2,206 natural-origin spawners. The effective population size *(N_e)* equals 874 fish for the 2009-12 return years, and total population size *(N)* is 4,372 for the same years. Because the population exceeds the high risk abundance criterion (population size, N_e < 500 or N < 2,500) and is currently increasing relative to the low years from 1987-1993 and stable relative to the years from 2001-2004, the risk of extinction is judged to be low.

DUCKABUSH RIVER

The estimated escapements to the Duckabush River ranges from 1,515 to 5,156 natural-origin summer chum from 2009-12, averaging 3,261 spawners. The effective population size *(N_e)* equals 2,348 fish for those return years, and total population size *(N)* is 11,739 for the same years. Previously rated as high risk of extinction, the increasing population size for this stock exceed the risk abundance criterion *(N_e* < 500 or N < 2,500), indicating that the risk of extinction for Duckabush summer chum is low.

DOSEWALLIPS RIVER

The 2009 through 2012 annual average escapement of summer chum salmon to the Dosewallips River was 1,910 natural-origin spawners, ranging from 1,094 to 2,828 fish. The effective population size *(N_e)* equals 1,343 fish for the 2009-12 return years, and total population size *(N)* is 6,716 for the same years. Escapements have increased substantially over the lows experienced in the 1980s and the recent population size for this stock exceeds the risk abundance criterion *(N_e* < 500 or N < 2,500), indicating that the current risk of extinction for Dosewallips summer chum is low.

BIG/LITTLE QUILCENE RIVERS

Escapement estimates averaged 4,468 natural-origin summer chum spawners (range of 1,490 to 11,739) for the Big/Little Quilcene summer chum stock for the 2009 through 2012 return years. The total effective population size *(N_e)* equals 3,218 fish for the 2009-2012 return years, and the total population size *(N)* is 16,086 for the same years. Based on a stable escapement trend and the large recent escapements, the current extinction risk for this stock is low.

SNOW/SALMON CREEKS

From 2009 through 2012, escapement estimates averaged 2,522 natural-origin spawners (range of 1,437 to 3,238) for the Snow/Salmon stock. The effective population size *(N_e)* equals 1,816 fish for the 2009-12 return years, and total population size *(N)* is 9,080 for the same years. Since the stock (with two streams combined) has experienced stable overall escapements in recent years and exceeds the risk abundance criteria, the current risk of extinction is judged to be low.

JIMMYCOMELATELY CREEK

Escapements for Jimmycomelately Creek from 2009 through 2012 averaged 757 natural-origin spawners (range of 202 to 1,274). The returns from 2002 through 2012 were enhanced by the supplementation program begun in 1999 and recently terminated in 2010, but supplementation-origin fish are not included in the extinction risk assessment. The effective population size *(N_e)* equals 545 fish for the 2009-12 return years, and total population size *(N)* is 2,724 for the same years. Because the population exceeds the high risk abundance criterion (population size, N_e < 500 or N < 2,500) and is currently increasing relative to the low years from 1987-1993, the risk of extinction is judged to be low.

DUNGENESS RIVER

Summer chum spawner information comes from observations made in the course of collecting data on Chinook and pink salmon as part of ongoing stock assessment and recovery efforts for these two species. More detailed information is needed before extinction risk can be evaluated and, in the interim, the Dungeness River stock risk is rated to be of special concern.

Table 2-14. Mean natural-origin escapement, effective population size, total population size, population trend, and extinction risk rating for Hood Canal and Strait of Juan de Fuca summer chum stocks for the four years preceeding onset of recovery actions, and recent four year periods. Extinction risk calculations are based on methodology proposed by Allendorf et al (1997).

Stock	Escapement (4-year mean)	Effective Population Size (Ne)	Total Population Size (N)	Population Trend	Risk Rating
Union					
1988-1991	391	281	1,406	Stable	Moderate
2001-2004*	3,472	2,500	12,500	Increasing	Low
2009-2012	1,018	733	3,663	Stable	Low
Lilliwaup					
1988-1991	88	63	315	Chronic decline/depression	High
2001-2004*	60	43	216	Chronic decline/depression	High
2009-2012	489	352	1,760	Increasing	High
Hamma Hamma					
1988-1991	154	111	555	Chronic decline/depression	High
2001-2004*	1,287	927	4,634	Increasing	Low
2009-2012	1,215	874	4,372	Stable	Low
Duckabush					
1988-1991	175	126	631	Chronic decline/depression	High
2001-2004*	2,617	1,884	9,420	Increasing	Low
2009-2012	3,261	2,348	11,739	Stable	Low
Dosewallips					
1988-1991	234	168	842	Chronic decline/depression	High
2001-2004*	4,726	3,403	17,015	Increasing	Low
2009-2012	1,866	1,343	6,716	Stable	Low
Big/Little Quilcene					
1988-1991	89	64	319	Chronic decline/depression	High
2001-2004*	13,212	9,512	47,562	Increasing	Low
2009-2012	4,468	3,218	16,086	Stable	Low
Snow/Salmon					
1989-1992**	283	204	1,018	Precipitous decline	High
2001-2004*	3,421	2,463	12,316	Increasing	Low
2009-2012	2,522	1,816	9,080	Stable	Low
Jimmycomelately					
1989-1992**	244	176	879	Precipitous decline	High
2001-2004*	235	169	845	Stable	High
2009-2012	757	545	2,724	Increasing	Low
Dungeness	No data	N/A	N/A	N/A	Special concern

* 2001-2004 data are updated from evaluation in first SCSCI 5-year review (WDFW and PNPTT 2007) which used natural-origin + supplementation-origin escapement

** 1989-1992 escapement values used due to later onset of decline of Strait of Juan de Fuca stocks.

STOCK ASSESSMENT INFORMATION NEEDS

As noted in section 3.5.12 of the SCSCI, success of the implementation plan is dependent on application of the best current data and data analysis to the management of the summer chum salmon resource. Several stock assessment information needs identified in the SCSCI section 3.5.12 have been addressed by the Co-managers since completion of the SCSCI, including the following:

- The frequency of escapement surveys continues to be excellent with surveys conducted on a weekly basis. This survey coverage provides very good escapement estimates.
- Age composition information is being collected for each management unit from summer chum carcasses on the spawning grounds and/or from broodstock used in the supplementation program. These data are being used to develop estimates of age-specific returns and productivity estimates for each management unit. No biological data were collected from the fisheries because of the general scarcity of summer chum catch and the impracticality of setting up sampling programs for expected very small numbers of fish. It may, however, be possible to sample catch in the Quilcene Bay fishery with some additional planning and effort.
- Contributions of supplementation-origin adults to natural spawning escapement and recovery of program adults in streams other than their streams of release are being determined through marking of all supplementation releases, and sampling for marks on all streams with returning adults.

The level of effort placed in escapement surveys and age/mark sampling must be continued, if the progress of summer chum towards recovery is to be evaluated. As more supplementation programs are terminated, mark sampling needs may become focused only on those streams with supplementation program returns expected and less funding may be required for analysis of otolith samples collected in the future. More funding will be needed, however, to analyze past and future genetic collections to help determine the impact of the supplementation programs on summer chum genetic diversity. DNA analyses have only been conducted to date on samples collected through 2009 (see Small et al, 2013).

3) HARVEST MANAGEMENT

INTRODUCTION

The SCSCI established an annual fishing regime (referred to as the Base Conservation Regime or BCR) designed to minimize incidental impacts to summer chum salmon beginning in 2000 for Canadian, Washington pre-terminal, and Washington terminal area fisheries. The intent of the BCR is to initiate rebuilding of the summer chum runs, from the critical or near critical levels of the late 1990s, by establishing ceiling exploitation rates, to provide incremental increases in escapements over time while allowing a limited opportunity to harvest other species. The BCR was constructed using a conservative approach that would pass through to spawning escapement, on average, in excess of 95% of the Hood Canal-Strait of Juan de Fuca summer chum recruitment entering U.S. waters, and nearly 90% of the total recruitment of the run of each management unit.

The SCSCI requires annual post-season abundance assessments for each management unit (MU). Where management units may contain more than one stock (Mainstem Hood Canal), it requires assessment of the abundance distribution among component populations. Critical abundance thresholds are defined for each MU, for both total run size and spawning escapement, and minimum escapement as well as escapement distribution “flags” are further defined for individual stocks within the Mainstem MU. An MU is considered to be in critical status when its run size or escapement in the most recent past return year is lower, or its forecast run size for the coming return year is projected to be lower, than the appropriate threshold value. Minimum escapement and escapement distribution flags are useful planning benchmarks to check for unbalanced performance of individual stocks of the Mainstem MU in years when the overall MU abundance exceeds the critical abundance threshold and help in assessing spatial structure and diversity for the Hood Canal population (see SCSCI Section 1.7.3).

This section summarizes the harvest management actions, and results of those actions, relative to summer chum salmon, in the years 2005 through 2013. The results from these nine years, under the Base Conservation Regime, can be generally described as very good.

PRESEASON FORECASTS AND POST SEASON ESTIMATES

Preseason forecasts were calculated as the mean of the preceding five years’ recruitment, as estimated by the current post-season run reconstruction. The forecasts include summer chum which are expected to return to a number of streams from supplementation and reintroduction projects. Age-specific information is now available and it may be possible to attempt forecasts based on age-specific or cohort returns. Forecasts were made annually for each management unit and these were summed into regional and ESU totals (Table 3-1). Forecasts for the Chimacum unit were made starting in 2002, once sufficient information from past returns was available. Details of the data and methods used in each year have been presented in the annual co-managers’ Hood Canal and Strait of Juan de Fuca Framework Management Plans (PNPTC et al. 2000 through 2012).

An overview of pre-season forecasts (Table 3-1) and postseason results (Table 3-2) compared to abundance thresholds that triggered the various management responses are provided for the entire ESU, and for the Strait of Juan de Fuca and Hood Canal. Table 3-3 shows estimated annual harvest of summer chum salmon by management unit and fishery.

Table 3-1. Pre-season abundance forecasts for Hood Canal and Strait of Juan de Fuca summer chum, 2005-2013.

Unit	Critical Abundance Threshold	Pre-Season Abundance Forecasts								
		2005	2006	2007	2008	2009	2010	2011	2012	2013
HC - SJF ESU	5,590	24,865	28,018	32,296	26,128	23,207	9,990	14,358	14,885	26,401
Strait of Juan de Fuca	1,010	6,804	8,238	8,566	5,969	5,198	3,991	5,308	5,915	6,603
Sequim Bay	220	605	868	1,040	1,090	943	1,460	2,102	2,540	2,922
Discovery Bay	790	5,329	6,377	6,240	3,912	3,252	1,642	2,047	2,282	2,547
Port Townsend (Chimacum)	na	870	993	1,286	967	1,003	889	1,159	1,093	1,134
Hood Canal	4,580	18,061	19,780	23,730	20,159	18,009	5,999	9,050	8,970	19,798
Quilcene/Dabob Bays	1,260	8,355	8,415	10,129	8,496	7,228	1,343	2,250	2,445	6,938
Mainstem Hood Canal	2,980	5,911	7,208	8,969	8,911	8,593	4,005	5,730	5,682	10,026
Southeast Hood Canal	340	3,795	4,157	4,632	2,752	2,188	651	1,070	843	2,834
Note: Boxed entries indicate abundance below critical threshold.										

Table 3-2. Post season abundance estimates for Hood Canal and Strait of Juan de Fuca summer chum, 2005-2013.

Unit	Critical Abundance Threshold	Post Season Abundance Estimates								
		2005	2006	2007	2008	2009	2010	2011	2012	2013
HC - SJF ESU	5,590	26,148	38,352	16,162	22,444	14,347	22,727	13,262	38,354	39,370
Strait of Juan de Fuca	1,010	9,730	8,279	3,324	3,574	5,147	9,331	5,704	6,337	14,800
Sequim Bay	220	1,316	728	660	1,073	2,645	4,057	2,423	2,603	8,383
Discovery Bay	790	7,009	5,514	1,728	1,764	1,475	3,289	2,634	2,829	3,337
Port Townsend (Chimacum)	na	1,403	2,034	934	737	1,026	1,983	643	899	3,081
Hood Canal	4,580	16,418	30,073	12,838	18,870	9,200	13,396	7,558	32,017	24,570
Quilcene/Dabob Bays	1,260	7,143	14,359	3,848	5,866	2,498	2,110	2,741	12,500	8,723
Mainstem Hood Canal	2,980	7,143	11,434	5,939	9,835	4,953	8,625	3,700	14,315	11,336
Southeast Hood Canal	340	2,006	3,633	2,726	1,858	1,000	2,149	627	3,695	2,906
Note: Boxed entries indicate abundance below critical threshold.										

Table 3-3. Distribution of harvest of Hood Canal and Strait of Juan de Fuca summer chum by management unit and fishery, 2005-2013.

		Harvest								
Management Unit	**Fishery**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
	Canada	3	1	3	6	12	8	7	7	10
Sequim Bay	U.S. Preterm.	3	2	3	8	4	23	5	7	31
	Terminal	0	0	0	0	0	0	0	0	0
	Canada	17	8	8	11	7	6	8	7	4
Discovery Bay	U.S. Preterm.	18	14	7	13	2	18	6	7	12
	Terminal	0	0	0	0	0	0	0	0	0
	Canada	3	3	5	4	5	4	2	2	4
Port Townsend (Chimacum)	U.S. Preterm.	4	5	4	6	2	11	1	2	11
	Terminal	0	0	0	0	0	0	0	0	0
	Canada	17	20	19	36	12	4	8	33	11
Quilcene/Dabob Bays	U.S. Preterm.	24	38	19	46	5	13	6	33	32
	Terminal	430	2,424	1,283	1,924	991	20	146	696	730
	Canada	17	16	29	60	23	16	11	37	14
Mainstem Hood Canal	U.S. Preterm.	24	31	30	77	10	53	8	37	42
	Terminal	13	103	237	10	11	64	17	97	211
	Canada	5	5	13	11	5	4	2	10	4
Southeast Hood Canal	U.S. Preterm.	7	10	14	14	2	13	1	10	11
	Terminal	4	33	109	2	2	16	3	25	80
Strait of Juan de Fuca	**Total**	**48**	**33**	**29**	**49**	**32**	**70**	**29**	**33**	**73**
Hood Canal	**Total**	**540**	**2,680**	**1,754**	**2,179**	**1,061**	**203**	**202**	**978**	**1,134**
Hood Canal / SJFuca ESU	**Total**	**588**	**2,714**	**1,783**	**2,227**	**1,093**	**273**	**231**	**1,011**	**1,208**

In most cases, the forecasts overestimated the annual recruit abundance (compare Table 3-1 and Table 3-2 entries). Exceptions were the Mainstem Hood Canal unit, in 2006, 2010 and 2012. The forecast was often underestimated for the Strait of Juan de Fuca. It was overestimated in 2007, 2008 and 2009. A significant reason for the variations is the forecasting method. Moving averages will generally result in underestimates, when the abundance trend is moving upwards. While in this case the forecasts were conservative, relative to the underlying abundance, the forecasting method could result in overestimates, should the abundance trend downwards for any significant period of years.

As shown in Table 3-1, the preseason forecasts for both the Strait of Juan de Fuca and Hood Canal did not indicate that any units would be below the critical threshold in any year during 2005 through 2013.

As part of preseason assessments, individual unit forecasts were compared to each unit's critical abundance threshold (Table 3-1) and if the abundance was lower, consideration is given to the need for additional harvest control measures. However, given the performance of the BCR, no specific additional measures were implemented. No unit's escapement was below its critical threshold (Table 3-4). Also, in the case of the Mainstem Hood Canal unit, if the critical threshold was exceeded, the component stocks' escapement flag thresholds were reviewed (see

Table AR2- 7) to see whether particular stocks of the unit merited special consideration. In 2009, Hamma Hamma was below both its minimum escapement flag (MEF) and escapement distribution flag (EDF) thresholds (Table 3-5). In 2011, Lilliwaup was below its MEF and EDF thresholds. Duckabush in 2005, Lilliwaup in 2010 and Hamma Hamma in 2008, 2010 and 2012 each failed the EDF but not the MEF test, meaning that while the overall escapement may not have been distributed according to the SCSCI targets, escapements were not critically low. In all cases, given the performance of the BCR, the extremely low catches and general nature of the fishery, further restrictions or shaping were not effective remedies and no additional protective steps were taken. A summary of the Mainstem MU flags' application, relative to escapement assessment, is provided in Table 3-5 and Table AR2-7.

In all cases, the co-managers used the provisions of the Base Conservation Regime (BCR) during the preseason planning process to formulate the season's plans. The BCR exploitation rate limits, for specific fisheries and fishery aggregates is outlined in Table 3-6 along with the post season estimated results of its application to each fishery for the years 2000 through 2013. Detailed descriptions of the co-managers' adopted measures can be found in each year's State/Tribal List of Agreed-to Fisheries document (recent years available at the Northwest Indian Fisheries Commission website http://files.nwifc.org/LOAFS/) and in the annual co-manager's Framework Management Plan for each region (available at http://www.pnptc.org).

For the last thirteen years of the BCR application, the resulting exploitation rates, as assessed after each season, were well below the BCR targets, for the Canadian fisheries, the U.S. preterminal fisheries, and the Hood Canal terminal area fisheries (Table 3-6). In Canadian fisheries, the lower than predicted level of exploitation has been the result of the absence of Canadian commercial fisheries for sockeye and pink salmon in most years. The same management considerations have also acted to reduce the U.S. preterminal exploitation to lower than anticipated levels. Terminal area interceptions are normally expected in the Hood Canal fisheries (Strait of Juan de Fuca has no applicable terminal fishing areas). However, again because of other factors, such as fishery restrictions to protect Chinook salmon, and a reduction in fishing effort for coho salmon, exploitation rates were lower than expected.

Finally, in the Quilcene Bay area there is an extreme terminal fishery, for hatchery coho salmon, which are commingled with returning summer chum. No fishery specific exploitation rate is defined for this fishery. Instead, management relies on a stepped fishing schedule based on an inseason assessment of natural escapement. Per the BCR, fisheries are controlled as to retention and gear types to achieve spawner escapement objectives for the Big and Little Quilcene rivers. At any escapement level, hook-and-line and beach seine fisheries can be scheduled, but regulations require the release of chum. For gillnet fisheries, closures are in effect if spawner escapement is < 1,500 summer chum, a 1 day per week fishery may be scheduled if escapement is >1,500 summer chum, and up to a 2 day per week fishery may be scheduled if escapement is > 2,500 summer chum (see SCSCI Table 3.33). A 1 day per week gillnet fishery in the Quilcene Bay area is expected to add 5% to the Hood Canal population exploitation rate (see SCSCI Table 3.35) and a higher exploitation rate is expected for a 2 day per week gillnet fishery. The expected exploitation rate is not the management objective, but rather the expected spawner escapement is the objective. During 2000 through 2008, pre-season and in-season information indicated that the escapement to the Quilcene unit would exceed 2,500 summer chum each year and 1 or 2 days per week of gillnet fishing for coho could be and were scheduled. Spawner escapements to Big and Little Quilcene rivers for these years exceeded 1,500 summer chum each year (ranging from

2,526 to 38,153 fish) and met the minimum BCR escapement objective (Table 3-6). In 2009, the pre-season forecast was 7,228 summer chum and one day per week of gillnet fishing was scheduled based on the forecast; but the return was much lower than forecast and the resulting escapement of 1,490 fish was slightly lower than the BCR minimum escapement objective. Consequently, beginning in 2010, a more conservative approach was implemented by the co-managers with no gill net fishing to be scheduled until an estimated 1,500 summer chum escapement was actually measured in the Big/Little Quilcene rivers. The results during the 2010, 2011, 2012, and 2013 extreme terminal fisheries in Quilcene Bay met the BCR escapement objectives (Table 3-6).

Table 3-4. Escapement estimates for Hood Canal and Strait of Juan de Fuca summer chum, 2005-2013.

	Critical Escapement	Escapement								
Unit	**Threshold**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
HC - SJF ESU	4,990	25,433	34,999	14,076	18,928	12,538	22,003	12,647	36,361	37,534
Strait of Juan de Fuca	920	9,682	8,246	3,295	3,525	5,115	9,261	5,675	6,304	14,727
Sequim Bay	200	1,310	725	654	1,058	2,628	4,027	2,411	2,590	8,341
Discovery Bay	720	6,974	5,492	1,713	1,740	1,466	3,264	2,621	2,814	3,320
Port Townsend (Chimacum)	na	1,396	2,026	926	727	1,020	1,968	640	894	3,066
Hood Canal	4,070	15,751	26,753	10,781	15,403	7,423	12,742	6,972	30,057	22,807
Quilcene/Dabob Bays	1,110	6,672	11,876	2,526	3,861	1,490	2,073	2,580	11,739	7,950
Mainstem Hood Canal	2,660	7,083	11,284	5,643	9,689	4,909	8,492	3,664	14,143	11,069
Southeast Hood Canal	300	1,991	3,585	2,590	1,830	991	2,116	621	3,651	2,811

Note: Boxed entries indicate escapement below critical threshold.

Table 3-5. Escapement and escapement proportions for the summer chum salmon stocks in the Hood Canal Mainstem Management Unit (MU) relative to the minimum escapement tag (MEF) and escapement distribution flag (EDF) critical thresholds established in the Base Conservation Regime of the Summer Chum Salmon Conservation Initiative (SCSCI).

	BCR Thresholds		Escapement and Escapement Proportions																	
			2005		2006		2007		2008		2009		2010		2011		2012		2013	
MU Escapement	2,660		7,083		11,284		5,643		9,689		4,909		8,492		3,664		14,143		11,069	
Escapement	**MEF**	**EDF**																		
Dosewallips	736	0.147	2,658	0.448	2,577	0.248	1,468	0.307	3,930	0.440	1,128	0.240	2,521	0.302	1,130	0.318	2,862	0.207	1,815	0.168
Duckabush	700	0.180	821	**0.138**	3,135	0.302	1,294	0.271	2,668	0.299	2,661	0.565	4,110	0.493	1,538	0.433	5,241	0.380	4,129	0.383
Hamma Hamma	1,042	0.193	1,408	0.237	3,065	0.295	1,489	0.312	1,642	**0.184**	**670**	**0.142**	1,471	**0.176**	**773**	0.218	2,355	**0.171**	2,186	0.203
Lilliwaup	182	0.043	1,049	0.177	1,615	0.155	525	0.110	690	0.077	247	0.052	238	**0.029**	**113**	**0.032**	3,340	0.242	2,652	0.246

Note: Entries in **bold** indicate values below the threshold. Boxed entries indicate when both MEF and EDF flags were triggered for critical response.

1/ See SCSCI section 1.7.3 and Appendix Report 1.5.

Table 3-6. Base Conservation Regime (BCR) exploitation rate limits and actual exploitation rates, 2000-2013.

Fishery	BCR Limits (Range)	Actual Exploitation Rates by Fishery [2]														Average
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Canada	6.3%	0.3%	0.4%	0.2%	0.1%	0.1%	0.2%	0.1%	0.5%	0.6%	0.5%	0.2%	0.3%	0.3%	0.1%	0.3%
	(2.3% - 8.3%)															
U.S. Preterminal Fisheries																
Juan de Fuca	2.5%	0.2%	0.4%	0.2%	0.8%	0.1%	0.3%	0.3%	0.5%	0.8%	0.2%	0.6%	0.2%	0.3%	0.4%	0.4%
Hood Canal	2.5%	0.2%	0.4%	0.2%	0.8%	0.1%	0.3%	0.3%	0.5%	0.8%	0.2%	0.6%	0.2%	0.3%	0.4%	0.4%
	(0.5% - 3.5%)															
Hood Canal Mixed Terminal Fisheries	2.1% (0.5% - 3.5%)	0.4%	0.9%	1.1%	0.0%	0.1%	0.2%	0.9%	***4.0%***	0.1%	0.2%	0.7%	0.4%	0.7%	1.6%	0.8%
Quilcene Extreme Terminal [1]																
Exploitation Rate	n/a	7.4%	0.6%	4.8%	0.0%	20.2%	2.5%	7.6%	8.8%	10.2%	10.7%	0.0%	1.8%	1.9%	2.4%	5.6%
Escapement Objective	1,500 (min.)	5,898	6,373	4,487	12,733	38,153	6,672	11,876	2,526	3,861	***1,490***	2,073	2,580	11,739	7,950	8,458
Regional Totals																
Juan de Fuca	8.8%	0.4%	0.7%	0.4%	0.8%	0.2%	0.5%	0.4%	0.9%	1.4%	0.6%	0.7%	0.5%	0.5%	0.5%	0.6%
	(2.8% - 11.8%)															
Hood Canal	15.9%	8.2%	2.1%	6.2%	0.8%	***20.5%***	3.3%	8.9%	13.7%	11.5%	11.5%	1.5%	2.7%	3.1%	4.6%	7.4%
	(8.3% - 20.3%)															
ESU	- - -	7.5%	3.8%	4.1%	0.8%	18.7%	2.7%	8.7%	12.9%	15.7%	12.6%	3.2%	4.6%	5.2%	4.7%	7.8%

[1] No fisheryspecific exploitation rate is defined for this fishery. Instead, management relies on a stepped fishing schedule based on an inseason assessment of natural escapement. Up to 2 days of gillnet fishing are allowed per week as expected escapement increases; a 1 day per week gillnet fishery is expected to add 5% to the Hood Canal population exploitation rate (see SCSCI Table 3.35) and a higher exploitation rate is expected for a 2 day per week gillnet fishery.

[2] Values in bold and italics indicate that the BCR exploitation rate limit or escapement objective was not met.

Performance assessments for the entire ESU and the Strait of Juan de Fuca and Hood Canal regions are outlined in Table 3-7, Table 3-8, and 3-9; also see Figure 2-1 through Figure 2-3 for display of annual abundance (escapement + harvest). Similarly, performance assessments for the individual management units are provided in Appendix Report Tables AR2-1 through AR2-6; also see Figures AR2-1 through AR2-5 for display of annual abundance (escapement + harvest).

Table 3-7. Pre-season forecasted versus actual abundances, escapements, and exploitation rates for the Hood Canal/Strait of Juan de Fuca summer chum salmon ESU, 2005-2013.

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Hood Canal/Strait of Juan de Fuca ESU									
Preseason Abundance Forecast	24,865	28,018	32,296	26,128	23,207	9,990	14,358	14,885	26,401
Post Season Estimate of Abundance	26,148	38,352	16,162	22,444	14,347	22,727	13,262	38,354	39,370
Forecast Error (Percent over / under observed)	-4.9%	-26.9%	99.8%	16.4%	61.8%	-56.0%	8.3%	-61.2%	-32.9%
Preseason Escapement Rate Target [1]	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%
Post Season Escapement Rate	97.3%	91.3%	87.1%	84.3%	87.4%	96.8%	95.4%	94.8%	92.4%
Preseason Expected Escapement	22,677	25,552	29,454	23,829	21,165	9,111	13,094	13,575	24,078
Post Season Escapement Estimate	25,433	34,999	14,076	18,928	12,538	22,003	12,647	36,361	36,361
Expected Preterminal & Terminal Exploitation	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Expected Additional Extreme Terminal Exploitation [2]	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Estimated Preterminal and Terminal Exploitation	0.9%	2.3%	4.7%	6.7%	5.6%	3.0%	3.4%	3.2%	15.3%
Estimated Additional Extreme Terminal Exploitation	1.8%	6.5%	8.2%	8.9%	7.0%	0.2%	1.2%	2.0%	-7.7%
Total Exploitation	2.7%	8.7%	12.9%	15.7%	12.6%	3.2%	4.6%	5.2%	7.6%
[1] Includes 5% Extreme Terminal Exploitation for Quilcene MU									
[2] Extreme Terminal Exploitation for Quilcene MU only									

Table 3-8. Preseason forecasted versus actual abundances, escapements, and exploitation rates for Hood Canal summer chum salmon, 2005-2013.

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Hood Canal									
Preseason Abundance Forecast	18,061	19,780	23,730	20,159	18,009	5,999	9,050	8,970	19,798
Post Season Estimate of Abundance	16,418	30,073	12,838	18,870	9,200	13,396	7,558	32,017	24,570
Forecast Error (Percent over / under observed)	10.0%	-34.2%	84.8%	6.8%	95.8%	-55.2%	19.7%	-72.0%	-19.4%
Preseason Escapement Rate Target [1]	86.9%	86.7%	87.6%	87.5%	87.7%	88.3%	87.3%	87.1%	87.3%
Post Season Escapement Rate	95.9%	89.0%	84.0%	81.6%	80.7%	95.1%	92.2%	93.9%	122.3%
Preseason Expected Escapement	15,699	17,152	20,788	17,648	15,802	5,298	7,899	7,817	17,289
Post Season Escapement Estimate	15,751	26,753	10,781	15,403	7,423	12,742	6,972	30,057	30,057
Expected Preterminal & Terminal Exploitation	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%
Expected Additional Extreme Terminal Exploitation [2]	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Estimated Preterminal and Terminal Exploitation	1.2%	2.8%	5.7%	7.7%	8.4%	4.6%	5.6%	3.7%	-10.1%
Estimated Additional Extreme Terminal Exploitation [2]	2.9%	8.3%	10.3%	10.6%	11.0%	0.3%	2.1%	2.4%	-12.3%
Total Exploitation	4.1%	11.0%	16.0%	18.4%	19.3%	4.9%	7.8%	6.1%	-22.3%
[1] Includes 5% Extreme Terminal Exploitation for Quilcene MU									
[2] Extreme Terminal Exploitation for Quilcene MU only									

Table 3-9. Pre-season forecasted versus actual abundances, escapements, and exploitation rates for Strait of Juan de Fuca summer chum salmon, 2005-2013.

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Strait of Juan de Fuca									
Preseason Abundance Forecast	6,804	8,238	8,566	5,969	5,198	3,991	5,308	5,915	6,603
Post Season Estimate of Abundance	9,730	8,279	3,324	3,574	5,147	9,331	5,704	6,337	14,800
Forecast Error (Percent over / under observed)	-30.1%	-0.5%	157.7%	67.0%	1.0%	-57.2%	-6.9%	-6.7%	-55.4%
Preseason Escapement Rate Target	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%
Post Season Escapement Rate	99.5%	99.6%	99.1%	98.6%	99.4%	99.3%	99.5%	99.5%	42.6%
Preseason Expected Escapement	6,205	7,513	7,812	5,444	4,741	3,640	4,841	5,394	6,022
Post Season Escapement Estimate	9,682	8,246	3,295	3,525	5,115	9,261	5,675	6,304	6,304
Expected Preterminal & Terminal Exploitation	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Expected Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Estimated Preterminal and Terminal Exploitation	0.5%	0.4%	0.9%	1.4%	0.6%	0.7%	0.5%	0.5%	57.4%
Estimated Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Exploitation	0.5%	0.4%	0.9%	1.4%	0.6%	0.7%	0.5%	0.5%	57.4%

In-season Actions and Estimates

During each season, the co-managers followed the preseason agreements regarding the application of the BCR to the various affected fisheries. With the exception of the Quilcene extreme terminal area fishery, no inseason actions were taken, except for the monitoring of bycatch numbers, as they became available, through established inseason reporting databases (soft data) and, for Canadian areas, the test fishery reports of the Pacific Salmon Commission.

In the Quilcene area, weekly spawner surveys were used to assess escapements throughout each season. During weekly conference calls, escapement data and catch and effort information from the previous weeks' fisheries were used to assess whether fisheries for other commingled species, in Quilcene Bay and the Quilcene River, could safely be opened or liberalized, without adverse impact to summer chum escapement targets. In all years, by mid-September, it was determined whether fisheries could be opened or liberalized and additional days per week of gillnet fishing for coho could be scheduled. In recent years, results of a new in-season abundance model based on catch of summer chum in Canadian test fisheries was developed, refined and used to augment this information.

NMFS is informed of inseason management and has expressed no significant concerns given the fisheries were managed consistent with the BCR.

Overall, during this period, there were no significant, or persistent, compliance or enforcement problems. Individual fishery events, which caused the co-managers to assess their enforcement emphasis, included, some recreational fishery induced mortality in the Big Quilcene River as well a couple instances of people fishing downstream of Rodgers Street (which is closed to fishing). These appear to have been relatively minor in nature and the issuing of citations and some shifting of enforcement efforts, along with efforts at fisher education, appear to have been effective.

In addition to catch record data, pre-terminal and terminal area commercial catches were sampled at buying stations, as part of CWT recovery efforts, and any chum salmon were recorded. In recreational fisheries, sampling was used primarily in Areas 5 and 12C to estimate encounters.

Over the last couple seasons, scale samples from summer chum salmon have been collected during CWT sampling of the Quilcene Bay coho fishery. The samples have been archived and are waiting to be processed. No other biological sampling programs have occurred due to the scarcity of summer chum catch. There are certain difficulties involved in preparing a biological sampling program for very small numbers of fish. Discussions are currently underway to investigate different approaches that could secure samples from future fisheries.

BASE CONSERVATION REGIME EVALUATION

The Base Conservation Regime (BCR) was formulated along with the rest of the SCSCI, using all available stock information, including timing and abundance profiles, and information regarding the conduct of fisheries directed at other species during times when summer chum salmon were likely to be intercepted. Fishing gear characteristics and effort intensity were also taken into consideration when designing appropriate closed periods and areas, as well as specific gear restrictions, to provide for summer chum protection, while maintaining a stable fishery regime to provide sufficient levels of opportunity directed at other species.

After the nine years of application during 2005 through 2013, it is still apparent that the BCR has been well chosen for its function and has resulted in the reduction of fishery related impacts to summer chum salmon to nearly insignificant levels.

The only location where additional inseason measures have become part of the BCR is the Quilcene extreme terminal area fishery. Major emphasis there has been placed on beach seines for the harvest of coho salmon. Gillnets, because of their high level of mortality impact to summer chum salmon were severely restricted during the initial design of the BCR. However, because of their catch volume and injury rate when fished at certain locations, beach seines have been found to potentially cause significant mortality as well. Such details were not available to the co-managers during the design of the BCR. It is recommended that the co-managers continue to adaptively manage and improve implementation of the BCR provisions.

After thirteen years of application, it appears that the BCR has indeed accomplished its major goal of controlling and reducing bycatch impacts to summer chum salmon. In fact, its performance far exceeded the co-managers' expectations. The BCR was designed to be particularly conservative, during its formulation, because a number of unknowns existed. These included the survival and recruitment rate of summer chum, the recovery potential or recovery goals for summer chum, the prospects for other species' fisheries, and the relative fishing effort levels, just to name a few.

In 1992, co-managers adopted a sustainable harvest rate for summer chum salmon followed by the formal implementation of the BCR in 2000. Under the harvest regime, harvest rates have declined from a range of about 50-70 percent to about 2-15 percent for Hood Canal summer chum and from a range of about 10-30 percent to less than 2 percent for Strait of Juan de Fuca summer chum. Harvest rates have been below the BCR harvest rate limits for all years in Strait of Juan de Fuca fisheries and for all years except 2004 in Hood Canal fisheries. From 2000 through 2013, the harvest rate for Hood Canal and Strait of Juan de Fuca summer chum combined has averaged about 8 percent (Table 3-6, Figure 3-1).

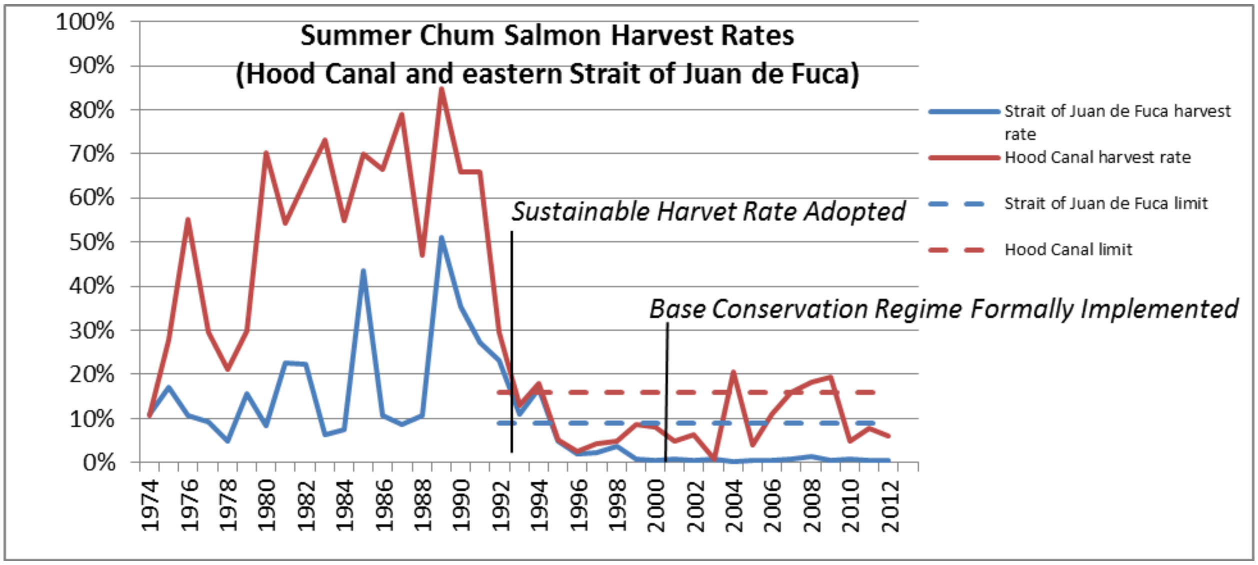

Figure 3-1. Base Conservation Regime (BCR) harvest rate limits established in the SCSCI and actual harvest rates, 1974-2013.

Given the current performance of the BCR, we recommend that it be retained as the primary harvest regulation tool. It is particularly well suited to address fishery risk when the summer chum populations are at low levels, as they had been, in the vicinity of their critical abundance thresholds. On the other hand, since a "Recovered" regime may not be formulated, or warranted, the co-managers should continue their development of the basic provisions and criteria for a "Recovering" regime. This new regime could be used when the status of summer chum, while not recovered, is sufficient to warrant departure from the strict application of the BCR in order to relieve some of the restrictions on fisheries for other stocks and species.

4) ARTIFICIAL PRODUCTION

Artificial production (hatchery) techniques may be used to supplement currently depressed wild summer chum populations or to reintroduce summer chum into streams where the original population no longer exists. When properly implemented, supplementation and reintroduction can be powerful tools which, in combination with harvest and habitat management actions, can contribute to the recovery or restoration of naturally-producing populations (Ames and Adicks, 2003; Johnson and Weller, 2003; Adicks et al. 2005). As described in section 3.2 of the SCSCI, the intent of supplementation of summer chum in the Hood Canal Region is to reduce the short term extinction risk to summer chum populations and to increase the likelihood of their recovery.

This section of the annual report is organized to provide background information for six supplementation and three reintroduction projects, including a brief history, an overview of the implementation of supplementation standards presented in the SCSCI, an overview of project monitoring and evaluation, and a perspective on the Hatchery and Genetic Management Plans prepared for each project. Individual reports are also provided for each project that include more detailed information on annual production and monitoring and evaluation, as well as a general program assessment.

BACKGROUND

HISTORY OF PROJECTS

Consistent with the SCSCI, supplementation has been applied as a strategy to help recover summer chum populations in Hood Canal and the eastern Strait of Juan de Fuca since 1992. Included in the SCSCI are rigorous standards that determine when and how hatchery supplementation will be applied as a recovery action. Based on the best scientific data and the collective salmon management experience of the plan authors, these standards were developed with the goal of using artificial propagation to preserve and expeditiously recover extant summer chum salmon populations, and re-establish returns where stocks have been extirpated, while minimizing the risk of deleterious genetic, ecological, and demographic effects to supplemented and un-supplemented stocks.

An over-riding understanding is that supplementation will be applied while other factors causing decreased summer chum abundances are addressed. This approach recognizes that supplementation measures alone will not lead to self-sustainability, or to the recovery of the ESA-listed summer chum populations. Commensurate, timely improvements in the condition of habitat critical for summer chum salmon survival, and implementation of protective harvest management measures, are also necessary to recover the listed populations to healthy levels.

Active supplementation of selected Hood Canal and Strait of Juan de Fuca summer chum stocks began in 1992, operating concurrently with the development of the principles contained in the SCSCI. From an initial start in 1992 with seven stocks at high risk of extinction, supplementation efforts have now contributed to increased returns to six of the eight extant stocks, and reintroduction projects have returned fish to three streams where summer chum salmon had become extinct (Figure 4-1). Programs initiated in 1992 include the Big Quilcene River, Lilliwaup Creek, and Salmon Creek supplementation projects. Re-introduction of summer chum into Chimacum and Big Beef creeks began in 1996; summer chum adults have returned to these streams since 1999. Supplementation programs were also initiated on Hamma Hamma River in 1997, on Jimmycomelately Creek in 1999, and on Union River in 2000. A reintroduction program was initiated on Tahuya River in 2003 and summer chum adults returned beginning in fall 2006 (Table 2-6).

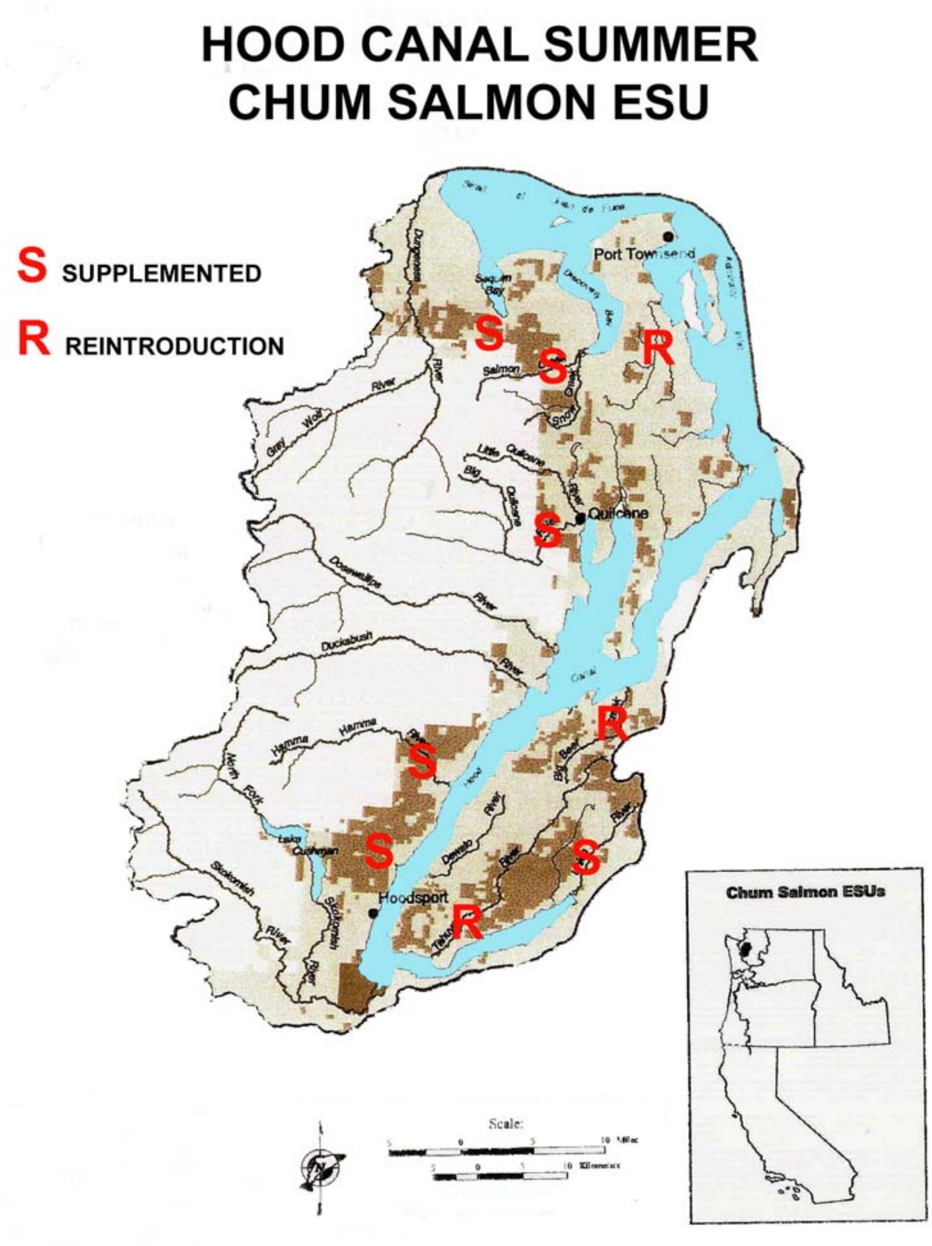

Figure 4-1. Map of Hood Canal summer chum Evolutionarily Significant Unit (ESU). Locations of supplementation programs indicated by "S", and locations of reintroduction programs by "R".

Cooperators who have participated in the projects with WDFW and the PNPT Tribes include Hood Canal Salmon Enhancement Group (HCSEG), Long Live the Kings (LLTK), North Olympic Salmon Coalition (NOSC), Wild Olympic Salmon (WOS), and the U.S. Fish and Wildlife Service (USFWS). Programs have been operated using WDFW and USFWS hatcheries, a private hatchery owned by LLTK, and remote site facilities operated by the cooperators. WDFW oversees operation of the cooperators' programs.

Hatchery and Genetic Management Plans

Hatchery and Genetic Management Plans (HGMPs) have been prepared by WDFW and the U.S. Fish and Wildlife Service (USFWS) and submitted to NMFS for each of the summer chum supplementation and reintroduction programs in the eastern Strait of Juan de Fuca and Hood Canal areas. Supported by information provided in the SCSCI, each HGMP provides a thorough description of each hatchery operation including the facilities used, methods employed to propagate and release fish, measures of performance, status of ESA-listed stocks that may be affected by the program, anticipated listed fish "take" levels, and descriptions of risk minimization measures applied to safeguard listed fish. Much of the information in the HGMPs was derived from the SCSCI. NMFS determined through ESA review that the hatchery programs were adequately conservative to prevent harm to the summer chum populations, and were likely to be beneficial to their recovery. The HGMPs were approved by NMFS in 2002 under Limit 5 of the ESA 4(d) Rule for a 12-year period (NMFS 2002, 2004). The summer chum programs have operated under the approved HGMPs since that time.

A copy of each HGMP is available on NMFS West Coast Region web site.

SCSCI Standards and Principles Guiding Artificial Production

In developing the hatchery component of the SCSCI, the co-managers identified objectives and the rationale for supplementation programs and reviewed their benefits and risks (see sections 3.2.2.2 and 3.2.2.3 of the SCSCI and Tynan et al. (2003)). Standards in the SCSCI defined when to modify or stop a supplementation or reintroduction program and how to supplement summer chum salmon populations to meet stock recovery, restoration, and ESA-listed wild stock protection objectives. We present or synopsize these SCSCI standards here and describe how these standards were applied to summer chum supplementation and reintroduction programs.

When to modify or stop a supplementation or reintroduction program

By definition, supplementation and reintroduction were proposed to be used as much as possible as short term means to preserve, rebuild, or restore a naturally producing summer chum salmon population through the use of artificial propagation. One intent is to limit the duration of the programs to minimize the risk that adverse effects on the natural-origin population would result from the use of artificial propagation. This intent is balanced by the need to allow the program to progress for a sufficient period of time to allow the target population for rebuilding or reintroduction to be sufficiently recovered or established. Also, as the program progresses there should be an allowance for adequate evaluation of whether the program is effective, and for adaptive management of the program as a result of evaluation findings.

The following six standards were developed and included in the SCSCI to determine when a supplementation or reintroduction program should be terminated or modified (see section 3.2.2.2 of the SCSCI).

1) The maximum duration of regional summer chum salmon supplementation programs will be based on criteria that minimize the likelihood that potentially deleterious genetic changes occur in the wild population.

This objective is met by applying a three generation maximum duration (12 years) for all summer chum salmon supplementation programs. Geneticists working with the co-managers advised that a three generation maximum duration limits the risk of adverse within and among population diversity reduction effects that could harm the target or conspecific wild populatios (S. Phelps, WDFW, pers. comm., April 1998). This limit also provides two generations (eight years) of adult returns to assess the program, prior to cessation of egg takes. An exception to this duration limit, leading to an increase in the duration of a program, may be acceptable if there have been catastrophic declines in habitat condition, or if other uncontrollable factors affecting summer chum survival emerge during the course of a supplementation effort, making sustainable natural production unlikely. In such a situation, the risk of continuing the project would be reevaluated and measured against jeopardy to the status of the target stock that is likely if the program were terminated. Extension of a project longer than three generations necessitates compliance with more rigorous genetic hazard reduction criteria included in the SCSCI.

All summer chum supplementation programs are scheduled with a maximum duration of three generations (12 years).

Four supplementation programs (Quilcene River, Salmon Creek, Hamma Hamma River, and Jimmycomelately Creek) met the 12 year operation limit and have been terminated (see Table 2-6).

The supplementation program on Lilliwaup also reached the 12 year limit with brood year 2003, but production targets (e.g., broodstock collections and release numbers) were not met for the Lilliwaup program through 1997. It was decided that the program should continue since the Lilliwaup summer chum stock remained at high risk of extinction and would be in jeopardy without a supplementation program. The co-managers provided increased involvement and oversight beginning in 1998 and program management and returns of summer chum have improved since then.

No other supplementation programs have reached the 12 year limit.

2) If adult return targets are met before the three generation maximum limit is reached, then the program may be reconsidered, and may be reduced or terminated.

Adult return targets defined specifically for each project were based on the magnitude of total adult escapements to consider program reductions, and on escapement of only natural origin recruits resulting from supplementation program and wild-origin fish to consider program termination. Program reduction or cessation determinations may therefore be made as follows:

- *When the total summer chum salmon adult escapement meets or exceeds 1974-78*

average escapement for the stock for four consecutive years, the desired number of juvenile hatchery-origin fish produced for the program will be reduced, after considering circumstances bearing on the sustainability of the population.
• When the total number of natural origin recruits (NORs) escaping to the production stream resulting from the supplementation program and wild-origin fish meets or exceeds 1974-78 average escapement for the stock for four consecutive brood years, the supplementation program may be terminated.
• When the adult return target used to indicate when a supplementation program should be reduced or terminated is based on another number that will assume precedence over 1974-78-derived goals.

The Union River supplementation program was terminated in brood year 2004 (see Table 2-6) after 4 years (one generation) of operation since adult return targets were met; e.g., the average escapement of 3,472 NORs during 2001-2004 exceeded the mean escapement of 82 NORs during 1974-1978 and 340 NORs during 1974-2000. In addition, supplementation program releases into Union River during 2000 through 2004 continued to contribute to Union River escapement through 2008 and boost the population. Union River broodstock continued as the source of eggs during brood years 2003-2012 to support the reintroduction program for Tahuya River summer chum; and, summer chum returns to Tahuya beginning in 2006 will be considered a range extension of Union River summer chum and further reduce its extinction risk.

The Chimacum Creek reintroduction program was terminated in brood year 2004 after 8 years (two generations) of operation (see Table 2-6). Good fry-to-adult return rates from program releases and favorable productivity (NOR recruits per spawner) from the first natural spawners in 1999 and 2000 led the co-managers to conclude that the stock would not be in jeopardy if the program was terminated. In addition, program releases of summer chum fry into Chimacum Creek through brood year 2003 continued to contribute to summer chum escapement through 2007 and boost the population. Chimacum Creek summer chum are considered a range extension of Snow/Salmon Creek summer chum and further reduce its extinction risk.

3) Supplementation and reintroduction programs may be terminated if they are no longer believed to be necessary for timely recovery, for reasons other than the success of supplementation or reintroduction, including improvements in ocean survival or habitat condition.
4) Supplementation programs will be modified or terminated if appreciable genetic or ecological differences between hatchery and wild fish have emerged during the recovery programs.
5) Supplementation programs will be modified or terminated if there is evidence that the programs are impeding recovery.
6) Supplementation or reintroduction programs will be modified or terminated if there is evidence that the programs are negatively impacting a non-target ESA-listed salmonid population.

There is no evidence that Standards 3) through 6), above, currently apply to any summer chum supplementation or reintroduction program.

How to supplement or reintroduce

In the SCSCI, general and specific guiding principles describe how supplementation and reintroduction programs will be conducted. These principles were applied to help address risks to natural origin fish, and to ensure the effectiveness of supplementation and reintroduction programs selected for implementation. A presentation of specific criteria, expanding on these general guidelines, is included in Appendix Report 3.1 of the SCSCI. Also, more recently a set of protocols for summer chum supplementation recovery projects has been developed (Schroeder and Ames 2005). General standards guiding how to supplement or reintroduce (see section 3.2.2.3 of the SCSCI) include

- *Phased implementation of individual programs and distribution of programs in the region rather than commencing selected programs at maximum levels at the same time*

Supplementation and reintroduction programs were phased in between 1992 and 2003 in the Hood Canal region and between 1992 and 1999 in the eastern Strait of Juan de Fuca region. The numbers of broodstock collected and fry released were often also phased in for each program (see Individual Project Reports, below), but with the overall intent to produce fish at consistent levels, at or near goals each year. Maximum fry release numbers set as goals in the SCSCI have not been achieved for Hamma Hamma, Lilliwaup, or Tahuya river programs due to limited remote hatchery rearing space and/or rearing flows in these watersheds.

- *Selection and maintenance of non-supplemented wild summer chum populations that comprise a representative spectrum of existing diversity*

Summer chum stocks in the Dosewallips and Duckabush rivers are being maintained in a natural state without assistance of supplementation to act as reference populations for tracking effects and benefits of supplementation programs implemented in adjacent watersheds. These unsupplemented wild populations may still be used as donor stocks (subject to risk assessments applied for all candidate programs) to reintroduce summer chum into watersheds where the original population has been extirpated to help maintain population diversity in the region.

- *Managing individual hatchery hazards and development of risk aversion and minimization methods addressing each hazard category, including*
  - *partial/total hatchery failure (e.g., propogation at more than one location (including reintroductions), hatchery siting guidelines, emergency response strategies, and back-up hatchery equipment)*
  - *predation and competition (e.g., determined to be low risk to wild summer chum due to size and number of program fish and time of release)*
  - *disease (e.g., application of Pacific Northwest and co-manager disease control policies and inspection/certification by co-manager fish pathologists prior to release)*
  - *loss of genetic variability between populations (e.g., diversity-based management measures are implemented to minimize likelihood for outbreeding depression and potential negative effects on wild stock fitness); key standards are*
    - *propagate and release only the indigenous population;*
    - *limit transfers of each donor stock for reintroduction to only one target watershed outside of the range of the donor stock*

- *supplemented and reintroduced populations will be acclimated to the watershed desired for outplanting*
- *for reintroduced populations, where feasible, local adaptation should be fostered by using returning spawners rather than the original donor population as broodstock*
- *all summer chum produced in hatchery programs will be marked to allow for monitoring and evaluation of adult returns.*
- *loss of genetic variability within populations ((e.g., diversity-based management measures are implemented to reduce the risk that within population genetic variability would be lost as a result of inbreeding depression, genetic drift, or domestication selection; key standards included*
- *limit duration of all supplementation programs to a maximum of three chum salmon generations (12 years);*
- *collect broodstock so that they represent an unbiased sample of the naturally spawning donor population with respect to run timing, size, age, sex ratio, and any other traits identified as important for long term fitness;*
- *use returning adults produced by a supplementation program, with natural origin fish, as broodstock over the duration of the program as a measure to increase the effective breeding population size;*
- *apply spawning protocols to ensure that hatchery broodstocks are*
- *representative of wild stock diversity (e.g., spawning of broodstock proportionately across the breadth of the natural return, randomizing matings with respect to size and phenotypic traits, application of factorial, or at least 1 : 1 male-female mating schemes, and avoidance of intentional selection for any life history or morphological trait.*
- *apply numerical broodstock collection objectives to help retain genetic diversity (e.g., minimize loss of some alleles and fixation of others; allow for at least 50% of escaping fish to spawn naturally each year);*
- *mimic the natural environment with hatchery incubation and rearing measures (e.g., limit hatchery rearing to a maximum of 75 days post swim-up to minimize the level of intervention into the natural chum life cycle; reduce domestication selection effects); and,*
- *mark all summer chum produced in hatchery programs to allow for monitoring and evaluation of adult returns.*

These key standards from the SCSCI and the specific criteria in Appendix Report 3.1 of the SCSCI are implemented for each supplementation or reintroduction program.

There have been hatchery failures in some years at some facilities that caused summer chum mortalities (see Individual Project Reports, below), but any problems have subsequently been assessed and remedied.

Although no specific studies have been conducted, there is no evidence of effects on wild summer chum by hatchery summer chum due to predation, competition, or disease.

There is no evidence of loss between or within population genetic variability for the summer chum populations. All genetically based management measures described above continue to be implemented. Analyses of GSI allozyme and microsatellite DNA collections made pre- and post-supplementation indicate that supplemented natural summer chum populations have remained significantly different from each other (Kassler and Shaklee 2003, Small and Young 2003, Small et al. 2009, Small et al. 2013). In addition, the co-managers continue to collect DNA samples from summer chum spawners throughout the ESU and plan to analyze DNA samples to monitor changes in allelic characteristics and assess whether the supplementation programs have negatively affected the genetic diversity of natural populations. A DNA baseline for Hood Canal and Strait of Juan de Fuca summer chum has been developed and refined and has been useful in this assessment (e.g., see Small et al. 2013).

- *The SCSCI provides standards for setting the scale of allowable fish release levels for each program, the disposition of excess individuals, and the maintenance of ecological and genetic characteristics of the natural population (e.g. broodstock collection, spawning, incubation, juvenile rearing, and smolt release procedures; see section 3.2.2.3 of the SCSCI.*

The release levels established for each program were generally not exceeded, but not all targets were met. Program releases for the Big Quilcene and Big Beef Creek programs exceeded the targets in some years (e.g., 1995 and 1996 prior to SCSCI), but were brought into compliance for levels of production each year.

All programs adhered to production targets and there has been no need for disposition of excess individuals (broodstock, eggs, or juveniles).

For all supplementation and reintroduction programs, the technologies used to propagate summer chum followed SCSCI standards and were designed to ensure that rearing units and procedures were as non-invasive into the natural life cycle of the fish as possible. The duration of rearing within the hatchery environment was short, extending from incubation through early fry rearing. Incubation and rearing structures and procedures used mimic natural processes, while maintaining the survival advantage anticipated for fish produced in a controlled environment.

Project Monitoring and Evaluation

Critical objectives of the SCSCI include the monitoring and evaluation of the effects of supplementation on the natural summer chum populations and of the effectiveness of the programs in the recovery of summer chum (see section 3.2.2.4 of the SCSCI). The basic approach is to collect information that will help determine 1) the degree of success of each project; 2) if a project is unsuccessful, why it was unsuccessful; 3) what measures can be implemented to adjust a program that is not meeting objectives for the project; and 4) when to stop a supplementation project.

Each project is to be fully consistent with the intent and implementation of the monitoring and evaluation component for supplementation programs identified in the SCSCI. The recommendations for monitoring and evaluation in the SCSCI respond to concerns regarding the uncertainty of summer chum supplementation and reintroduction effects by addressing the following four elements:

> *Element 1* - The estimated contribution of supplementation/reintroduction program-origin chum to the natural population during the recovery process;
>
> *Element 2* - Changes in the genetic, phenotypic, or ecological characteristics of populations (target and non-target) affected by the supplementation/reintroduction program;
>
> *Element 3* - The need and methods for improvement of supplementation/reintroduction activities in order to meet program objectives, or the need to discontinue a program because of failure to meet objectives; and
>
> *Element 4* - Determination of when supplementation has succeeded and is no longer necessary for recovery by collection and evaluation of information on adult returns.

Monitoring and evaluation were managed for each of the individual projects, consistent with the above four elements as follows:

Fish marking, mark recovery, and adult returns - The summer chum salmon juveniles (either embryos or fry) produced by each supplementation program are mass-marked (otolith-marked or fin-clipped) prior to release. Spawning ground surveys are conducted throughout the summer chum escapement period to enumerate spawners and to collect information on fish origin and age composition. Examination of otoliths or fin clip ratios from spawned adults (carcasses) is the method used to estimate the number of supplementation (hatchery) fish versus the number of natural origin (wild) fish and assists in determining the contribution of the supplementation program to the target population.

Genetic and age sampling - In order to detect any changes in genetic characteristics of populations, periodic allozyme and/or DNA samples have been collected from summer chum since most supplementation programs were started, for comparison to earlier collections. Analysis of allozyme samples has been completed (Kassler and Shaklee, 2003); see Appendix Report 3 of SCSCI Supplemental Report No. 4 (WDFW and PNPTT 2003). DNA samples have been analyzed to develop a baseline for summer chum (Small and Young 2003; see Appendix Report 4 of SCSCI Supplemental Report No. 4 (WDFW and PNPTT 2003)). Additional samples have been added to improve the DNA baseline and the baseline has been used to assign individual summer chum with “ambiguous” otolith marks to their region and stream of origin and/or to identify potential straying of hatchery-origin summer chum (e.g., see Small et al. 2006).

Analyses of GSI allozyme and microsatellite DNA collections made pre- and post-supplementation indicate that supplemented natural summer chum populations have remained significantly different from each other (Kassler and Shaklee 2003, Small and Young 2003, Small et al. 2009, Small et al. 2013). In addition, the co-managers continue to collect DNA samples from summer chum spawners throughout the ESU and plan to analyze DNA samples to monitor changes in allelic characteristics and assess whether the supplementation programs have negatively affected the genetic diversity of natural populations.

Several thousand scales are collected annually to age the adult summer chum throughout the Hood Canal and Strait of Juan de Fuca regions (e.g., see Table 2-5).

Broodstocking and egg sources - To fully represent the demographics of donor populations, summer chum broodstock are collected randomly as the fish arrive in Quilcene Bay (e.g., Quilcene River), at temporary fish traps operated by WDFW or project sponsors (e.g., Jimmycomelately Cr., Salmon Cr., Union River, Big Beef Cr., Lilliwaup), or by beach seining in the lower reaches of the stream (e.g., Lilliwaup R., Hamma Hamma R.) in proportion to the timing, weekly abundance, and duration of the total return. Fish not retained as broodstock are released upstream of trap sites or returned to the stream to spawn naturally.

Hatchery operations - Records of fish cultural operations are regularly maintained and compiled. Project sponsors in collaboration with WDFW, summarize protocols and procedures, temperature unit records by developmental stage, ponding dates, feeding, rearing and release methods, and production and survival data, and recommend facility or protocol improvements.

Fish health - Fish health is monitored by a WDFW or USFWS fish health specialist in accordance with procedures in the Co-managers' disease control policy (NWIFC and WDFW 2006). Summer chum broodstock are sampled for the incidence of viral pathogens, there has been no significant mortality of broodstock or juveniles from unknown causes, and the health of fry from all projects prior to release has been good.

Additional descriptions of monitoring and evaluation activities and/or results are provided below in individual project reports.

INDIVIDUAL PROJECT REPORTS

Individual project reports are presented for each supplementation and reintroduction project in the Hood Canal and Strait of Juan de Fuca regions. Updates for all projects were provided in previous SCSCI progress reports (WDFW and PNPTT 2001, WDFW and PNPTT 2003) and the first SCSCI 5-year review (WDFW and PNPTT 2007). Now information for all projects is updated for years 2005 through 2012 in the following reports.

HOOD CANAL REGION

Big Quilcene River

A supplementation program was started in 1992, in response to the critical condition of the stock and to take advantage of a year expected to be relatively strong in the Hood Canal summer chum return cycle. The program is operated by the USFWS at the Quilcene National Fish Hatchery (QNFH). The Quilcene program contributed eggs and fry to support the re-introduction program for summer chum at Big Beef Creek in its early years (from 1996 through 2000).

Annual Production

A summary of the production for each brood year of the project is presented in Table 4-1.

Table 4-1. Summary of Quilcene National Fish Hatchery summer chum supplementation program, brood years 1992-2003.

Brood year	Broodstock retained Males	Females	Total	Natural spawners	Percent removed	Fed fry released	Release size, g	Release dates(s)
1992	225	186	411	320	56%	216,441	1.05	4/13/93
1993	19	17	36	97	27%	24,784	1.46	3/30/94
1994	184	178	362	349	51%	343,550	1.06	3/27/95
1995	243	256	499	4,029	11%	441,167	1.06	3/27/96
1996	438	333	771	8,479	8%	612,598	1.34	4/10/97
1997	296	261	557	7,339	7%	340,744	1.62	4/2, 4/15/98
1998	313	231	544	2,244	20%	343,530	1.28	3/8, 3/22, 4/2/99
1999	81	89	170	2,982	5%	181,711	1.03	3/9, 3/24/00
2000	187	195	382	5,126	7%	414,353	1.01	3/5, 3/19/01
2001	134	172	306	5,868	5%	351,709	0.98	3/3, 3/22/02
2002	174	181	355	3,662	9%	272,017	0.79	3/7, 3/24/03
2003	46	52	98	11,745	0.8%	92,559	1.78	3/12/04

The transfers of summer chum eyed eggs and fry from the Quilcene NFH to Big Beef Creek for brood years 1996 through 2004 are summarized in Table 4-2.

Table 4-2. Summer chum transfers from Quilcene NFH to Big Beef Creek, 1996-2004.

Brood year	Fry	Eyed eggs
1996	40,000	168,000
1997	0	157,000
1998	0	217,465
1999	0	40,298
2000	0	55,500
2001	0	0
2002	0	0
2003	0	0
2004	0	0

Monitoring and Evaluation

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

Fish marking, mark recovery and adult returns - Beginning with brood year 1997 (3-year olds returning in 2000), the summer chum fry released at Quilcene NFH were adipose-clipped to identify returning adults as hatchery-origin fish. Broodstock were collected from Quilcene Bay and/or at Quilcene National Fish Hatchery. Spawning ground surveys were conducted throughout the summer chum return to enumerate spawners. Also, information on fish origin and age composition was collected from broodstock and natural spawners (see Section 2, Stock Assessment). Estimates of natural-origin and supplementation-origin runsize are shown in Table 2-10 and Figure 4-2 for through the 2013 return year.

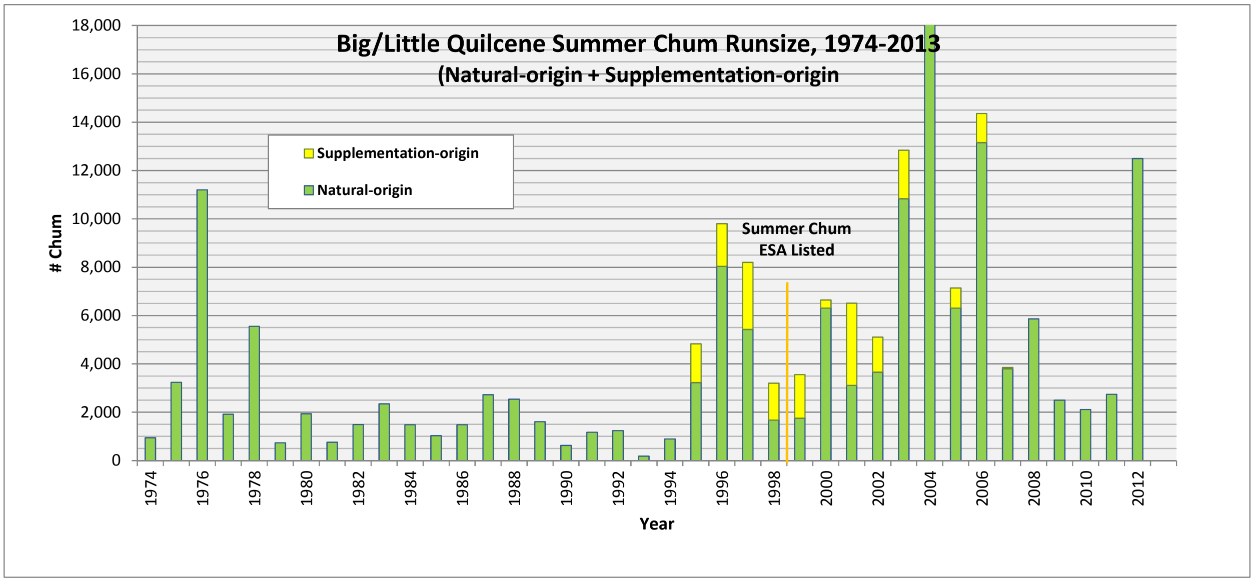

Figure 4-2. Big Quilcene/Little Quilcene rivers summer chum supplementation-origin and natural-origin runsize, 1974-2013. Runsize in 2004 is 55,079 summer chum, comprised of 51,737 natural-origin and 3,342 supplementation-origin recruits.

Most supplementation-origin summer chum from the Quilcene program returned to Big and Little Quilcene rivers; these streams support the same summer chum stock. For brood years 1996 through 2003, the percentage of Quilcene supplementation fish that returned to Big and Little Quilcene rivers averaged 87%, ranging from 82% to 93%. Strays from the Quilcene program were mostly recovered in Dosewallips, Duckabush, Hamma Hamma, and Lilliwaup. For year-by-year estimates of stray supplementation returns by program and stream of recovery, see Appendix Tables 37 to 44.

The Big Quilcene supplementation program has been very successful in contributing to the return of adult summer chum. Estimates of the number of adipose-marked adults, their ages and survival from release as fed fry to return as spawners are presented for the 1997 through 2001 brood years in Table 4-3. The supplementation program contributed an estimated 2956, 2452, 2005, 4147, 1338, 1666, and 601 adults during the 1997 through 2003 brood years, respectively; this includes strays to other streams.

Under the SCSCI, a fry to adult survival rate range of 0.83% to 1.66% was set as an objective for each supplementation and reintroduction program (WDFW and PNPTT 2000). For the Quilcene supplementation program, the return rate from fry release to adult return was 0.9%, 0.7%, 1.1%, 1.0%, 0.4%, 0.6%, and 0.6% for the 1997 and through 2003 brood years, respectively (Table 4-3).

Table 4-3. Return from fry to adult for summer chum salmon reared in supplementation program at Quilcene River, as determined from adipose-clips for the 1997 through 2003 brood years; this includes strays to other streams.

Brood year	No. fry released	Return year	Age	Adult return	Return rate
1997	340,744	1999	2	N/A	N/A
		2000	3	380	0.11%
		2001	4	2,548	0.75%
		2002	5	29	0.01%
			Total	2,956	0.87%
1998	343,530	2000	2	4	0.00%
		2001	3	1,707	0.50%
		2002	4	745	0.22%
		2003	5	0	0.00%
			Total	2,452	0.71%
1999	181,711	2001	2	0	0.00%
		2002	3	1,359	0.75%
		2003	4	624	0.34%
		2004	5	22	0.01%
			Total	2,005	1.10%
2000	414,353	2002	2	0	0.00%
		2003	3	1,626	0.39%
		2004	4	2,497	0.60%
		2005	5	24	0.01%
			Total	4,147	1.00%
2001	351,709	2003	2	7	0.00%
		2004	3	1,124	0.32%
		2005	4	193	0.05%
		2006	5	20	0.01%
			Total	1,338	0.38%
2002	272,017	2004	2	0	0.00%
		2005	3	735	0.27%
		2006	4	932	0.34%
		2007	5	0	0.00%
			Total	1,666	0.61%
2003	92,559	2005	2	0	0.00%
		2006	3	566	0.61%
		2007	4	35	0.04%
		2008	5	0	0.00%
			Total	601	0.65%

Broodstocking and egg sources - To represent the demographics of the donor population, Quilcene broodstock were collected as the fish arrived in Quilcene Bay and/or at the permanent trap operated by US Fish and Wildlife Service at QNFH.

Additional information on the Big Quilcene supplementation program is reported in WDFW and PNPTT (2007).

General Program Assessment

The Quilcene supplementation program resulted in substantial increases in the total number of summer chum salmon adults returning to spawn in the watershed. The escapement of natural-origin spawners in the Big/Little Quilcene stock has increased from a mean of 89 adults during 1988-1991 (just prior to initiation of supplementation) to a mean of 15,437 adults during 2001-2004, and a mean of 4,471 adults during 2009-2012. The Quilcene program also contributed eggs and fry to support the reintroduction program for summer chum at Big Beef Creek from 1996 through 2004.

The Quilcene supplementation project has addressed the program objectives described in section 3.2.3.4 of the SCSCI.

Consistent with the standards set in the SCSCI and HGMP, the intended maximum duration of the program is 12 years (3 generations) beginning with brood year 1992. Accordingly, the program has been terminated and the last brood year of the Big Quilcene River program was 2003, with the last returns of supplementation program adults in 2008.

Although it appears that impacts to natural processes in freshwater and/or estuarine habitats have likely limited natural summer chum production in the stream in some years, habitat restoration actions implemented in recent years are expected to improve survival and productivity conditions for natural fish. Commensurate with the summer chum salmon supplementation program, Hood Canal Salmon Enhancement Group, Jefferson County, the Skokomish Tribe, and WDFW have implemented habitat restoration projects designed to restore floodplain connectivity and reduce other channel degradation factors. Restoration projects have also been completed in the Big Quilcene, Little Quilcene, and Donovan Creek estuaries and additional restoration actions are being planned. These restoration actions have been designed to improve prospects for the survival and productivity of naturally spawning summer chum salmon, including adults produced through the hatchery effort.

Big Beef Creek

The Big Beef Creek project began with brood year 1996 when eyed eggs of Quilcene stock were transferred from Quilcene National Fish Hatchery (QNFH) to Big Beef Creek to initiate and support the reintroduction of a summer chum population there. WDFW operates an adult trap and hatchery facilities at the University of Washington's Big Beef Creek Research Station.

Annual Production

A summary of the production for each brood year of the project is provided in Table 4-4.

Table 4-4. Big Beef Creek summer chum reintroduction program, brood years 1996-2004.

Brood year	Broodstock Males	Broodstock Females	Total spawners	Natural spawners	Percent removed	No. eyed eggs from QNFH [1]	No. fed fry released	Release size (gm)	Release date
1996	-- [1]	-- [1]	-- [1]	0	--	168,000 [2]	204,000	0.5-0.7	2/7, 3/7/97
1997	-- [1]	-- [1]	-- [1]	0	--	157,000	100,280	0.8	2/9/98
1998	-- [1]	-- [1]	-- [1]	0	--	217,465	214,936	1.1-1.6	2/23, 3/15, 3/29/99
1999	-- [1]	-- [1]	-- [1]	4	--	40,298	39,800	1.4	3/10/00
2000	9	11	20	0	100%	81,672 [3]	80,550	1.4-1.8	2/26, 3/13/01
2001	34	34	68 [4]	826	7.6%	--	80,925	1.4-1.7	3/4, 3/14, 3/25/02
2002	32	33	65 [4]	677	8.8%	--	72,622	1.2-1.8	3/4, 3/18, 3/27/03
2003	38	34	72	824	8.0%	--	76,353	1.6-1.8	3/9, 3/22, 4/1/04
2004	33	31	64	1852	3.3%	--	14,814	1.8	2/28, 3/11, 3/25/05

[1] Eyed eggs received from Quilcene National Fish Hatchery (QNFH).
[2] Also received 40,000 swim-up fry from QNFH for BY 1996.
[3] Includes 26,172 eyed eggs from Big Beef Cr. fish and 55,500 eyed eggs from QNFH.
[4] Includes 2, 2, 4, and 0 broodstock mortalities in 2001, 2002, 2003, and 2004, respectively.

Monitoring and Evaluation

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

Fish marking and mark recovery - Beginning with brood year 1998, the otoliths of summer chum salmon embryos produced in the reintroduction program on Big Beef Creek were thermally mass-marked (otolith-marked) prior to release as fry to distinguish them from other summer chum. Since 1999, a permanent trap was operated each season throughout the summer chum return to collect broodstock, enumerate spawners, and to complement information on fish origin and age composition collected during spawner surveys (see Section 2, Stock Assessment).

For brood years 1996 through 2003, nearly all (range = 94% to 100%) of supplementation-origin summer chum from the Big Beef program returned to Big Beef Creek. A few strays from the Big Beef Creek program were recovered in Dosewallips, Hamma Hamma, Lilliwaup, Union, and Little Quilcene. For year-by-year estimates of stray supplementation returns by program and stream of recovery, see Appendix Tables 37 to 44.

Adult returns - The Big Beef Creek reintroduction program has been very successful in generating new returns of adult summer chum to a watershed where the original population had become extinct. The first natural spawning by summer chum in Big Beef Creek since the early-1980's occurred during 2001 and 2002 (excepting the four spawners of 1999). Estimates of natural-origin and supplementation-origin runsize are shown in Table 2-10 and Figure 4-3 through the 2013 return year.

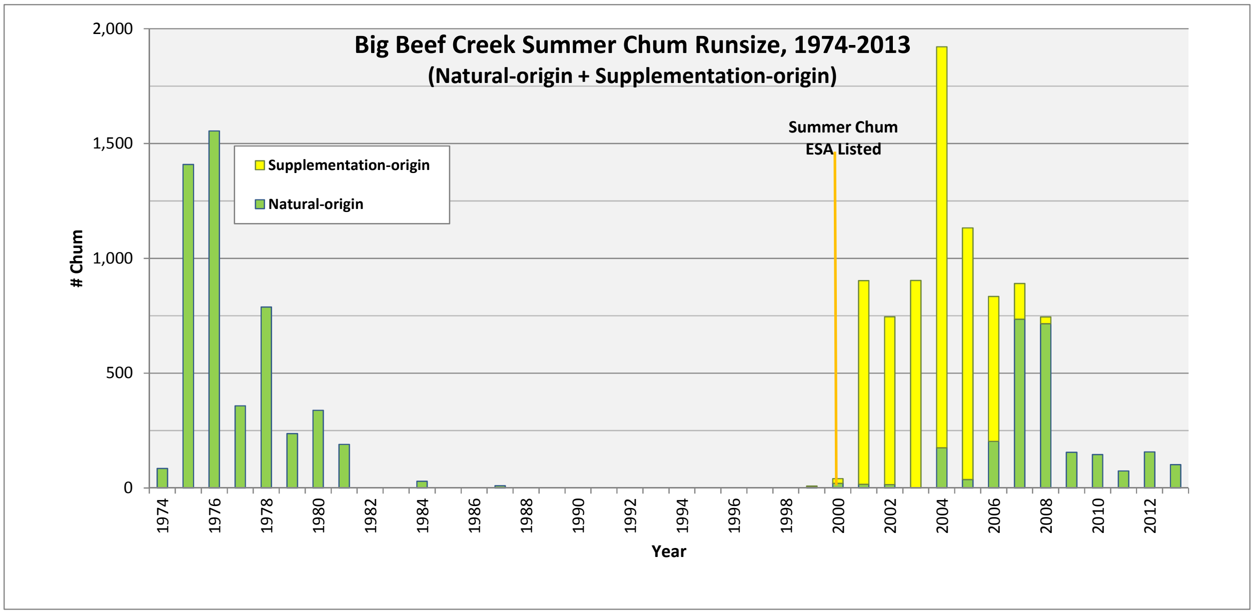

Figure 4-3. Big Beef Creek summer chum supplementation-origin and natural-origin runsize, 1974-2013.

Estimates of the number of otolith-marked adults and survival from fed fry to spawner for summer chum reared in the supplementation program at Big Beef Creek are presented for the 1996 through 2004 brood years in Table 4-5. The reintroduction program contributed an estimated 4, 142, 1063, 778, 1475, 1563, 1098, 644, and 122 summer chum adults during the 1996 through 2004 brood years, respectively; this includes strays to other streams.

Under the SCSCI, a fry to adult survival rate range of 0.83% to 1.66% was set as an objective for each supplementation and reintroduction program (WDFW and PNPTT 2000). For the Big Beef Creek reintroduction program, the return rate from fry release to adult return was 0.1%, 0.5%, 0.4%, 1.8%, 1.9%, 1.5%, 0.8%, and 0.8% for the 1997 and through 2004 brood years, respectively (Table 4-5).

Table 4-5. Return from fry to adult for summer chum salmon reared in supplementation program at Big Beef Creek, as determined from otolith marks for the 1996 through 2001 brood years; this includes strays to other streams.

Brood year	No. fry released	Return year	Age	Adult return	Return rate
1996	204,000	1998	2	N/A	N/A
		1999	3	4	0.00%
		2000	4	0	0.00%
		2001	5	0	0.00%
			Total	4	0.00%
1997	100,280	1999	2	0	0.00%
		2000	3	0	0.00%
		2001	4	142	0.14%
		2002	5	0	0.00%
			Total	142	0.14%
1998	214,936	2000	2	0	0.00%
		2001	3	807	0.38%
		2002	4	256	0.12%
		2002	5	0	0.00%
			Total	1,063	0.49%
1999	39,800	2001	2	5	0.01%
		2002	3	654	0.30%
		2003	4	111	0.05%
		2004	5	8	0.00%
			Total	778	0.37%
2000	80,550	2002	2	11	0.01%
		2003	3	914	1.14%
		2004	4	546	0.68%
		2005	5	3	0.00%
			Total	1,475	1.83%
2001	80,925	2003	2	17	0.02%
		2004	3	1,342	1.66%
		2005	4	204	0.25%
		2006	5	1	0.00%
			Total	1,563	1.93%
2002	72,622	2004	2	0	0.00%
		2005	3	894	1.23%
		2006	4	204	0.28%
		2007	5	0	0.00%
			Total	1,098	1.51%

Table 4-5. (continued)

Brood year	No. fry released	Return year	Age	Adult return	Return rate
2003	76,353	2005	2	25	0.03%
		2006	3	555	0.73%
		2007	4	63	0.08%
		2008	5	0	0.00%
				644	0.84%
2004	14,814	2006	2	0	0.00%
		2007	3	90	0.61%
		2008	4	32	0.21%
		2009	5	0	0.00%
				122	0.82%

Hatchery survival rates - The Big Beef Creek summer chum program has generally been successful in meeting the survival rate objectives. The number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum reared at Big Beef Creek from 2001 through 2004 are presented in Table 4-6.

Table 4-6. Number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum salmon reared in the Big Beef Creek reintroduction program, brood years 2001 through 2004.

					% Survival by life stage			Cumulative % survival		
Brood Year	**Green eggs**	**Eyed eggs**	**Swim-up fry**	**Fry released**	**Green egg to eyed egg**	**Eyed egg to swim-up**	**Swim-up to release**	**Green egg to eyed egg**	**Green egg to swim-up**	**Green egg to release**
2001	93,398	87,951	81,214	80,919	94.2%	92.3%	99.6%	94.2%	87.0%	86.6%
2002	93,018	74,039	73,235	72,622	79.6%	98.9%	99.2%	79.6%	78.7%	78.1%
2003	83,329	78,350	77,603	76,353	94.0%	99.0%	98.4%	94.0%	93.1%	91.6%
2004	87,884	80,561	16,350	14,814	91.7%	20.3%	90.6%	91.7%	18.6%	16.9%

For brood year 2004, there was substantial mortality of eyed eggs when a water valve was found closed following an otolith marking event. Consequently, the survival from eyed egg to swim-up was only about 20% and survival from green egg to release was only about 17% (compared to the program objective of 85%).

Broodstocking and egg sources - From 1996 through 1999, all summer chum eggs incubated and released at Big Beef Creek were transferred from QNFH (Table 4-4). During 2000, a total of

26,890 green eggs (which resulted in 26,172 eyed eggs) were obtained from summer chum returning to Big Beef Creek and 55,500 eyed eggs were transferred from QNFH. To foster local adaptation of the reintroduced population, adults returning to Big Beef Creek during 2001 through 2004 were used as broodstock, and no eggs were transferred from QNFH. Broodstock are collected randomly as the fish arrive at the trap location, proportional to the timing, weekly abundance, and duration of the total return to the creek. Since the trap is located near the most downstream point of observed natural spawning activity, nearly the entire run is available for trapping, decreasing the risk that fish trapped through the program are not representative of the total run. Trap data for 2005 through 2012 are presented in Appendix Report 1.

General Program Assessment

The Big Beef Creek summer chum reintroduction program has generally been successful in collecting a representative sample of brood stock from the donor Quilcene River stock (1996-2000) and from Big Beef Creek returns (2001-2004). The numbers of summer chum adults that returned during 2001 through 2008 are encouraging with a total of 733 to 1,916 fish escaping to spawn. From 2001 through 2006, most (>75%-90%) fish each year were produced from the supplementation program. The program ended with brood year 2004 and as returns from the program were phased out, the proportion of natural-origin spawners increased to 83% in 2007, 96% in 2008, and 100% since 2009 (Table 2-9). However, the number of natural-origin spawners has decreased to < 150 fish each year since 2007. In addition, natural-origin productivity estimates are consistently < 1 R/S (Table 2-11), likely indicating that habitat productivity is low. There is some concern whether Big Beef Creek summer chum will become self-supporting unless substantial habitat restoration is completed. Habitat restoration projects are planned and some may be funded and implemented during summer 2015. The Co-managers will continue to monitor the adult returns.

The Big Beef reintroduction project has addressed the program objectives described in section 3.2.3.4 of the SCSCI. In compliance with planned research objectives for the program, NMFS, in cooperation with the co-managers, conducted a study during the 2004 and 2005 spawning seasons comparing the relative reproductive success of hatchery and natural-origin summer chum spawners using the Big Beef Creek spawning channel. Berejikian et al. (2009) reported that the overall adult-to-fry reproductive success of hatchery females was not significantly different from that of natural-origin females.

Lilliwaup Creek

A supplementation program began on Lilliwaup Creek in 1992 as a cooperative project between HCSEG and WDFW. In 1994, LLTK assumed the role of the primary project operator. Through 1997, there were difficulties in collecting adequate numbers of brood stock from Lilliwaup Creek. Attempts in this regard were complicated by the lack of a fish collection trap, low overall summer chum return levels, and the presence (in odd-numbered years) of pink salmon in the same stream areas as summer chum. Beginning in 1998, WDFW was able to provide limited funding for this project, allowing for the installation of a trap in the lower creek (through 2001), increased agency assistance during fish spawning, and increased monitoring and evaluation of the supplementation program. Since 2002, LLTK staff has successfully resumed collection of broodstock from Lilliwaup Creek without the use of a trap.

Annual Production

A summary of the production for each brood year of the project is provided in Table 4-7.

Table 4-7. Lilliwaup Creek summer chum supplementation program, brood years 1992-2012.

Brood year	Broodstock Males	Females	Total	Natural spawners	Percent removed	Fed fry released	Release size (gms)	Release date
1992	--	--	18	81	18.2%	20,000	0.4	March
1993	--	--	10	67	13.0%	12,000	fed	March
1994	--	--	12	99	10.8%	15,000	fed	March
1995	--	--	0	79	0.0%	0	--	--
1996	--	--	12	64	15.8%	15,000	fed	March
1997	11	7	18	9	66.7%	14,200	1.0	03/01/98
1998	9	12	21	3	87.5%	17,200	0.7	02/24/99
1999	7	6	13	0	100.0%	17,400	1.5	03/11/00
2000	13	7	20	2	90.9%	14,800	1.4	03/12/01
2001 [1]	42	18	60	32	65.2%	38,000	1.1	03/15/02
2002	43	40	83	775	9.7%	96,000	1.2	03/21/03
2003 [1]	91	69	160	194	45.2%	103,913	1.3	03/25/04
2004	49	48	97	922	9.5%	99,500	0.8	04/01/05
2005	49	49	98	951	9.3%	106,466	1.2	2/27, 2/29, 3/3/06
2006	45	46	91	1523	5.6%	88,800	1.16	2/24, 3/9/07
2007 [2]	20	20	40	485	7.6%	0	- -	- -
2008	34	34	68	638	9.6%	68,810	1.2	2/9, 2/18/09
2009	62	62	124	123	50.2%	140,210	1.08	2/1, 2/22, 2/23/10
2010	64	64	128	95	57.4%	139,816	1.74	2/24/2011
2011	19	19	38	75	33.6%	41,006	1.0	2/27/2012
2012	68	68	136	3204	4.1%	157,760	1.0	2/20/2013

[1] Includes 20 broodstock mortalities (all males due to lack of females) in 2001 and 50 broodstock mortalities (36 males and 14 females) in 2003.

[2] Water line to hatchery destroyed by flood in December; 100% mortality for eggs and fry

Monitoring and Evaluation

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

Fish marking and mark recovery - Beginning with brood year 1997, the otoliths of summer chum salmon embryos produced in the supplementation program on Lilliwaup Creek were thermally mass-marked (otolith-marked) prior to release as fry to distinguish them from other summer chum. From 1998 through 2001, a temporary fish trap was operated each season throughout the summer chum return to collect broodstock, enumerate spawners and to complement information on fish origin and age composition collected during spawner surveys (see Section 2, Stock Assessment).

For brood years 1997, 1998, and 1999, nearly all (range = 93% to 100%) of supplementation-origin summer chum from the Lilliwaup program returned to Lilliwaup, with a few strays from Lilliwaup Creek recovered in Hamma Hamma and Duckabush. Brood years 2000 and 2001 are more difficult to assess since, as with the Hamma Hamma program (see below), ambiguous otolith marks became prevalent and definite assignment of otolith-marked adults to a specific program was not always possible. DNA analysis was used to identify some fish with ambiguous otoliths to a program of origin, and this helped, but many fish were not analyzed due to budget constraints. Consequently, estimates of supplementation program returns, including strays, for brood years 2000 and 2001 are of limited value (WDFW and PNPTT 2007). During return years 2005 through 2013, most fish from the Lilliwaup program returned to Lilliwaup, most strays were recovered in nearby west Hood Canal watersheds (e.g., Hamma Hamma, Duckabush, Dosewallips), but some were recovered in east Hood Canal watersheds (e.g., Union and Dewatto). For year-by-year estimates of stray supplementation returns by program and stream of recovery, see Appendix Tables 37 to 44.

Adult returns - The Lilliwaup Creek supplementation program contributed to the returns of adult summer chum each year from 2001 through 2012. Few summer chum returned to Lilliwaup Creek through 2000, but total (natural + supplementation) adult returns increased to 97 to 3,381 fish for years 2001 through 2013. Estimates of natural-origin and supplementation-origin runsize are shown in Table 2-10 and Figure 4-4 through the 2013 return year.

Otolith-marked summer chum adults originating from the supplementation program first returned in 2001, as 3 years olds from brood year 1998 and 4 year olds from brood year 1997. Estimates of the number of otolith-marked adults, their ages, and survival from fed fry to spawner for summer chum reared in the supplementation program at Lilliwaup Creek are presented for the 1997 through 2009 brood years in Table 4-8. The supplementation program contributed an estimated 7, 84, 711, 379, 612, 745, 765, 393, 467, 119, 30, 28, and 2679 adults during the 1997 through 2009 brood years, respectively; this includes strays to other streams. As noted above, estimates of supplementation program returns for brood years 2000 and 2001 are of limited value.

Under the SCSCI, a fry to adult survival rate range of 0.83% to 1.66% was set as an objective for each supplementation and reintroduction program (WDFW and PNPTT 2000). For the Lilliwaup River supplementation program, the return rate from fry release to adult return was 0.05%, 0.5%, 4.1%, 2.5%, 1.6%, 0.8%, 0.7%, 0.4%, 0.4%, 0.1%, 0%, 0.4%, and 1.9% for the 1997 through 2009 brood years, respectively (Table 4-8).

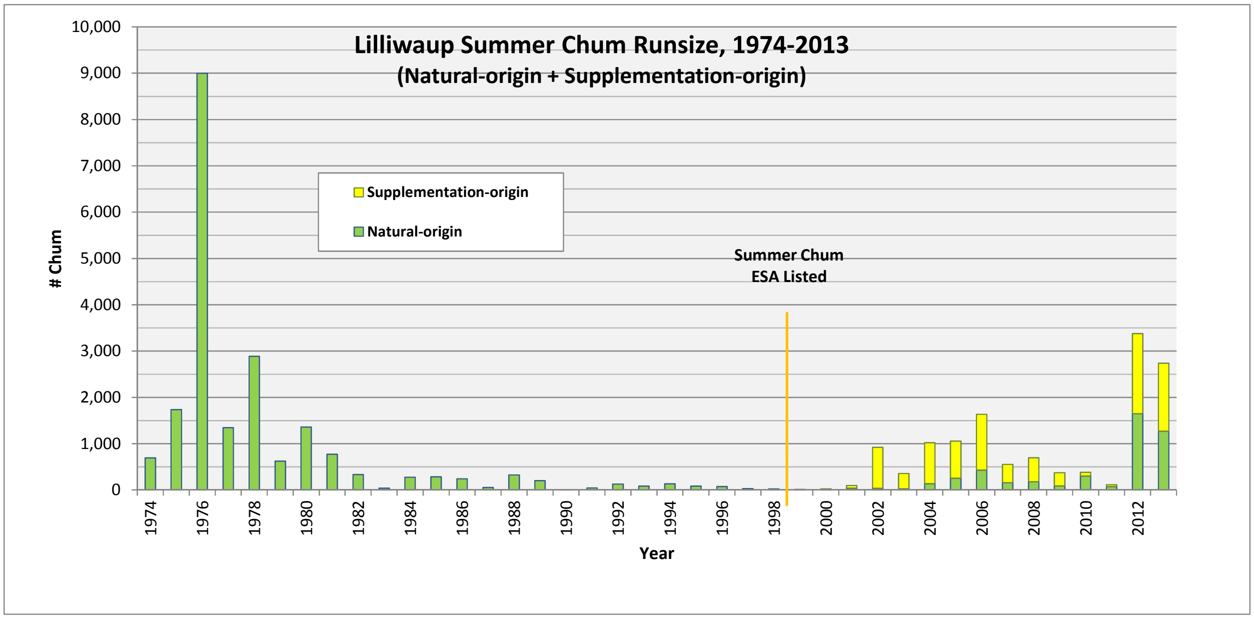

Figure 4-4. Lilliwaup Creek summer chum supplementation-origin and natural-origin runsize, 1974-2013.

Table 4-8. Return from fry to adult for summer chum salmon reared in supplementation program at Lilliwaup Creek, as determined from otolith marks for the 1997 through 2009 brood years; this includes strays to other streams.

Brood year	No. fry released	Return year	Age	Adult return	Return rate
1997	14,200	1999	2		0.00%
		2000	3	0	0.00%
		2001	4	7	0.05%
		2002	5	0	0.00%
			Total	7	0.05%
1998	17,200	2000	2	0	0.00%
		2001	3	21	0.12%
		2002	4	64	0.37%
		2003	5	0	0.00%
			Total	84	0.49%
1999	17,400	2001	2	0	0.00%
		2002	3	710	4.08%
		2003	4	2	0.01%
		2004	5	0	0.00%
			Total	711	4.09%
2000	14,800	2002	2	0	0.00%
		2003	3	160	1.08%
		2004	4	219	1.48%
		2005	5	0	0.00%
			Total	379	2.56%
2001	38,000	2003	2	0	0.00%
		2004	3	609	1.60%
		2005	4	0	0.00%
		2006	5	3	0.01%
			Total	612	1.61%
2002	96,000	2004	2	0	0.00%
		2005	3	350	0.36%
		2006	4	390	0.41%
		2007	5	5	0.01%
				745	0.78%
2003	103,913	2005	2	0	0.00%
		2006	3	590	0.57%
		2007	4	164	0.16%
		2008	5	11	0.01%
				765	0.74%

Table 4-8. (continued)

Brood year	No. fry released	Return year	Age	Adult return	Return rate
2004	99,500	2006	2	3	0.00%
		2007	3	217	0.22%
		2008	4	170	0.17%
		2009	5	3	0.00%
				393	0.39%
2005	106,466	2007	2	14	0.01%
		2008	3	337	0.32%
		2009	4	115	0.11%
		2010	5	1	0.00%
				467	0.44%
2006	88,800	2008	2	3	0.00%
		2009	3	70	0.08%
		2010	4	46	0.05%
		2011	5	0	0.00%
				119	0.13%
2007	0	2009	2	0	- -
		2010	3	2	- -
		2011	4	11	- -
		2012	5	17	- -
				30	- -
2008	68,810	2010	2	0	0.00%
		2011	3	10	0.01%
		2012	4	18	0.03%
		2013	5	0	NA
				28	0.04%
2009	140,210	2011	2	15	0.01%
		2012	3	1,695	1.21%
		2013	4	969	0.69%
		2014	5	NA	NA
				2,679	1.91%

Hatchery survival rates – Sufficient data have not been collected and/or recorded to be able to fully assess survival rates by life stage for summer chum reared in the supplementation program at Lilliwaup. There were improvements in the data collecting and recording during brood years 2003 and 2004 and subsequent years. The estimated survival rate from green egg to fry release was about 92% for brood year 2003 and about 85% for brood year 2004 (compared to the program objective of 85% survival).

Broodstocking and egg sources - The Lilliwaup Creek summer chum supplementation program has generally been successful in collecting a representative sample of brood stock. To represent the demographics of the donor population, broodstock are collected proportional to the timing, weekly abundance, and duration of the entire return to Lilliwaup Creek. Broodstock are collected near the most downstream point of observed spawning activity in Lilliwaup, so nearly the entire run is available for broodstock and the probability is increased that broodstock are representative of the total run. To represent the demographics of the donor population at low population levels, up to 100% of the summer chum returning to Lilliwaup Creek may be used as broodstock. During 1998 through 2001, all or nearly all summer chum returning to Lilliwaup Creek were included in the supplementation program. During 2002 through 2013, the return of summer chum increased substantially, more broodstock were collected for the program, and more summer chum spawned naturally in Lilliwaup Creek (Table 4-11).

General Program Assessment

Until 2001 and 2002, adult return levels had not improved since the program began. Program operational improvements were made beginning in 1998 and the supplementation program has contributed to increased adult returns each year (see Table 2-10). According to the standards set in the SCSCI and HGMP, the expected duration of the program is a maximum of 12 years (3 generations). The original program began in 1992, however, due to the lack of adequate broodstock collection until 1998 and only recent indications of stock recovery, the Co-managers have established 1998 as the first effective year of the program and will extend the program beyond the original 12-year maximum. The number of natural-origin spawners has been < 200 fish in most years in Lilliwaup (Table 2-9). In addition, since brood year 2002, natural-origin productivity estimates are consistently < 1 R/S (Table 2-11), likely indicating that freshwater and estuary habitat productivity is low. There is some concern whether Lilliwaup Creek summer chum will become self-supporting unless substantial habitat restoration is completed. Habitat restoration projects are planned and funded and some may be implemented during summer 2015. Consequently, the co-managers will assess the situation and consider whether to continue, and possibly extend, the supplementation program for additional years while habitat restoration actions are planned and implemented. The Co-managers will continue to monitor the adult returns.

The Lilliwaup supplementation project has generally addressed the program objectives described in section 3.2.3.4 of the SCSCI.

Hamma Hamma River

The Hamma Hamma multi-species salmonid recovery project was developed by HCSEG with support from others. Out of this effort evolved the Hamma Hamma summer chum supplementation project on John Creek, a Hamma Hamma River tributary. A review of freshwater habitat conditions, summer chum escapements, potential causes for decline in escapement, and current restoration efforts in Hood Canal by the Co-managers and cooperators, led to the recommendation to initiate the summer chum supplementation project, beginning with brood year 1997.

Annual Production

A summary of the production for each brood year of the project is provided in Table 4-9.

Table 4-9. Hamma Hamma River summer chum supplementation program, brood years 1997-2008.

Brood	Broodstock			Natural	Percent	Fed fry	Release	
year	Males	Females	Total	spawners	removed	released	size (gms)	Release date
1997	9	5	14	97	12.6%	12,000	1	3/1/98
1998	15	17	32	95	25.2%	2,800	1	3/15/99
1999	21	22	43	212	16.9%	51,600	1.1-1.5	3/11, 3/25/00
2000	30	26	56	173	24.5%	55,400	1.1-1.2	3/12, 3/20/01
2001	27	27	54	1,173	4.4%	49,500	1	3/4, 3/7, 3/15/02
2002	34	34	68	2,260	2.9%	61,000	1.0-1.2	2/26, 3/5, 3/20/03
2003	28	30	58	796	6.8%	75,356	1.1-1.3	2/27, 3/4, 3/20/04
2004	32	32	64	2,628	2.4%	57,000	0.9	3/27/05
2005	64	70	134	1,272	9.5%	117,837	1.12	2/27, 2/29, 3/3/06
2006	69	74	143	2,922	4.7%	151,550	1.1	2/13, 2/24, 2/27, 3/5, 3/9, 3/13, 3/20/07
2007	48	54	102	1,387	6.9%	48,530	1.2	2/25, 3/5, 3/20, 4/1, 4/4/08
2008	70	71	141	1,503	8.6%	208,450	1.2	2/2, 2/9, 2/16, 2/23/09

Monitoring and Evaluation

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

Fish marking and mark recovery - Beginning with brood year 1997, the otoliths of summer chum salmon embryos produced in the supplementation program on Hamma Hamma River were thermally mass-marked (otolith-marked) prior to release as fry to distinguish them from other summer chum. Spawning ground surveys were conducted throughout the summer chum return to enumerate spawners and to collect information on fish origin and age composition (see Section 2, Stock Assessment).

Evaluation of the Hamma Hamma supplementation program is difficult. The Hamma Hamma and Lilliwaup supplementation programs are both otolith-marked at LLTK's Lilliwaup Hatchery and apparently, for some brood years (e.g., 2000-2003), otolith marking schedules were not closely followed and/or reference collections of otolith marks applied were not representative of fed fry released from the program. Consequently, ambiguous otolith marks were common from summer chum adults recovered in the Hamma Hamma River and in some other streams, with Hamma Hamma supplementation program being one of the possibilities. These otolith-marked adults could be identified as being produced from a supplementation program, but definite assignment to a specific program was not always possible. DNA analysis was used to identify some fish with ambiguous otoliths to a program of origin, and this helped, but many fish were not analyzed due to budget constraints. In addition, although sampling rates were generally good, expansion rates applied to the actual number of fish sampled to obtain total mark rates in the estimated total escapement could be a source of error.

As described earlier (see Section 2, Stock Assessment), most straying of supplementation-origin fish occurred between neighboring streams within the region of origin. Strays from Hamma Hamma River were most commonly recovered in Duckabush, Dosewallips, and Lilliwaup (which are adjacent west Hood Canal streams) and Union River. Smaller numbers of strays were recovered in Little Quilcene, Big Beef, Dewatto, and Chimacum. For year-by-year estimates of stray supplementation returns by program and stream of recovery during 2005 through 2012, see Appendix Tables 37 to 44.

Adult returns - The Hamma Hamma River supplementation program has contributed to the return of adult summer chum each year of the program. Estimates of natural-origin and supplementation-origin runsize are shown in Table 2-10 and Figure 4-5 through the 2013 return year.

Summer chum adults originating from the supplementation program first returned in 2000, as three year olds. Estimates of the number of otolith-marked adults, their ages, and survival from fed fry to spawner for summer chum reared in the supplementation program at Hamma Hamma River are presented for the 1997 through 2008 brood years in Table 4-10. The supplementation program contributed an estimated 22, 14, 1562, 934, 596, 747, 58, 197, 637, 444, 272, and 92, and 150 adults during the 1997 through 2008 brood years, respectively; this includes apparent strays to other streams.

Under the SCSCI, a fry to adult survival rate range of 0.83% to 1.66% was set as an objective for each supplementation and reintroduction program (WDFW and PNPTT 2000). For the Hamma Hamma River supplementation program, the return rate from fry release to adult return was 0.2%, 0.5%, 3.0%, 1.7%, 1.2%, 1.2%, 0.1%, 0.3%, 0.5%, 0.3%, 0.6%, and 0.04% for the 1997 through 2008 brood years, respectively (Table 4-10).

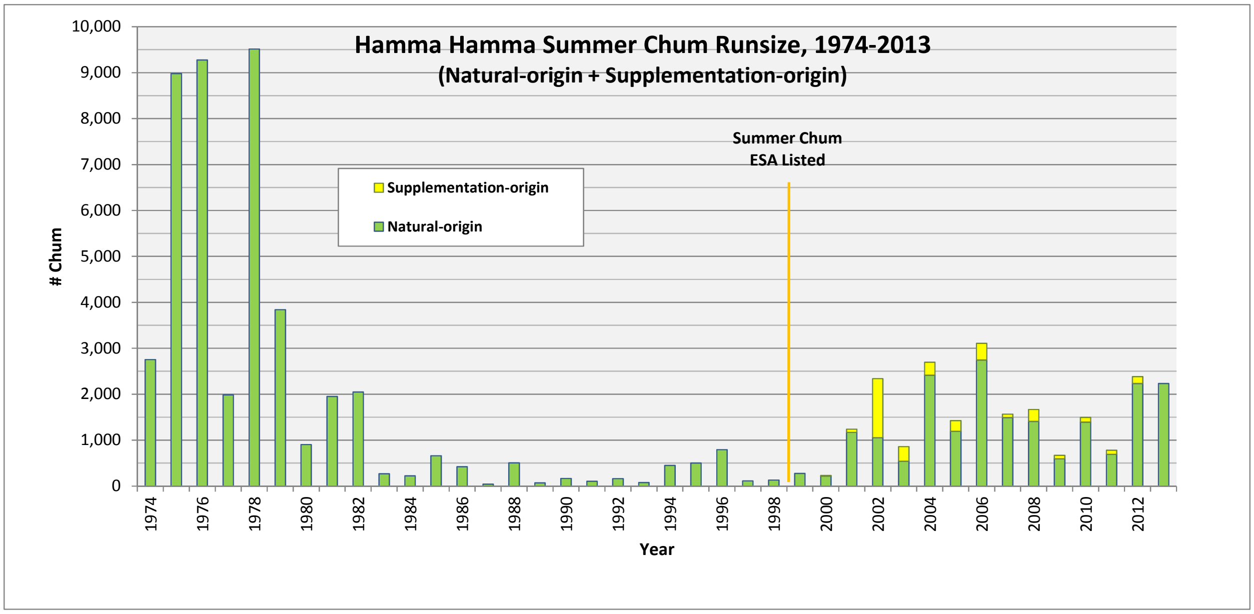

Figure 4-5. Hamma Hamma River summer chum supplementation-origin and natural-origin runsize, 1974-2013.

Table 4-10. Return from fry to adult for summer chum salmon reared in supplementation program at Hamma Hamma River, as determined from otolith marks for the 1997 through 2008 brood years; this includes strays to other streams.

Brood year	No. fry released	Return year	Age	Adult return	Return rate
1997	12,000	1999	2	0	0.00%
		2000	3	10	0.08%
		2001	4	0	0.00%
		2002	5	13	0.10%
			Total	22	0.18%
1998	2,800	2000	2	0	0.00%
		2001	3	0	0.00%
		2002	4	14	0.50%
		2003	5	0	0.00%
			Total	14	0.50%
1999	51,600	2001	2	0	0.00%
		2002	3	1,245	2.41%
		2003	4	317	0.61%
		2004	5	0	0.00%
			Total	1,562	3.03%
2000	55,400	2002	2	0	0.00%
		2003	3	663	1.20%
		2004	4	260	0.47%
		2005	5	10	0.02%
			Total	934	1.69%
2001	49,500	2003	2	6	0.01%
		2004	3	224	0.45%
		2005	4	224	0.45%
		2006	5	142	0.29%
			Total	596	1.20%
2002	61,000	2004	2	0	0.00%
		2005	3	468	0.77%
		2006	4	279	0.46%
		2007	5	0	0.00%
			Total	747	1.22%
2003	75,356	2005	2	0	0.00%
		2006	3	34	0.05%
		2007	4	22	0.03%
		2008	5	2	0.00%
			Total	58	0.08%

Table 4-10 (continued)

Brood year	No. fry released	Return year	Age	Adult return	Return rate
2004	57,000	2006	2	0	0.00%
		2007	3	78	0.14%
		2008	4	118	0.21%
		2009	5	0	0.00%
			Total	197	0.34%
2005	117,837	2007	2	26	0.02%
		2008	3	467	0.40%
		2009	4	143	0.12%
		2010	5	1	0.00%
			Total	637	0.54%
2006	151,550	2008	2	0	0.00%
		2009	3	182	0.12%
		2010	4	262	0.17%
		2011	5	0	0.00%
			Total	444	0.29%
2007	48,530	2009	2	8	0.02%
		2010	3	165	0.34%
		2011	4	98	0.20%
		2012	5	0	0.00%
			Total	272	0.56%
2008	208,450	2010	2	0	0.00%
		2011	3	0	0.00%
		2012	4	92	0.04%
		2013	5	0	0.00%
			Total	92	0.04%

Hatchery survival rates – Sufficient data have not been collected and/or recorded to be able to fully assess survival rates by life stage for summer chum reared in the supplementation program at Hamma Hamma. There were improvements in the collecting and recording of data during brood years 2001 through 2004. The estimated survival rate from green egg to fry release was about 77%, 68%, 92%, and 74% for brood year 2001, 2002, 2003, and 2004, respectively (compared to the program objective of 85% survival). Measures to increase hatchery survival rates have been discussed and implemented.

Broodstocking and egg sources - To represent the demographics of the donor population, broodstock are collected proportional to the timing, weekly abundance, and duration of the entire return to the Hamma Hamma. Broodstock are collected near the most downstream point of observed spawning activity in the Hamma Hamma, so nearly the entire run is available for broodstock and the probability is increased that broodstock are representative of the total run.

General Program Assessment

It appears that the Hamma Hamma River summer chum supplementation program was generally successful in collecting a representative sample of broodstock from the natural Hamma Hamma River summer chum stock. Consistent with the standards set in the SCSCI and HGMP, the duration of the program is a maximum of 12 years (3 generations) and the program was operated from brood year 1997 through brood year 2008. The program was successful in contributing adult returns to the Hamma Hamma River. The Co-managers will continue to monitor the returns.

The Hamma Hamma supplementation project has addressed the program objectives described in section 3.2.3.4 of the SCSCI.

Union River/Tahuya River

The Union River supplementation program is a cooperative effort between the Hood Canal Salmon Enhancement Group and WDFW and was initiated in brood year 2000. The goal is to reintroduce a healthy, natural, self-sustaining population of summer chum into the Tahuya River. The strategy is to boost the abundance of the Union River population to allow for transfers of surplus fish for a reintroduction of summer chum on the Tahuya River using Union River stock. The supplementation program, its goal, objectives, and guidelines are presented in an HGMP consistent with the SCSCI.

Annual Production

A summary of the production for each brood year of the project is provided in Table 4-11 for Union River and Table 4-12 for Tahuya River.

All eggs are incubated to eyed egg at WDFW's George Adams Hatchery, eyed eggs were transferred to remote hatchery facilities, and fry were reared to target size at the remote hatchery facilities and released during February and March each year. Some fish were also reared to swim-up at George Adams Hatchery prior to transfer; this rearing strategy reduced the risk of catastrophic hatchery failure at the remote sites. Fry reared at George Adams Hatchery and at each remote site (Huson springs and Tahuya) received different otolith marks so the rearing strategies can be evaluated.

Table 4-11. Union River summer chum supplementation program, brood years 2000 through 2012. Beginning in 2004, broodstock were collected from Union River for Tahuya River reintroduction program (with no fry releases into Union River).

Brood year	Broodstock Males	Broodstock Females	Broodstock Total	Natural spawners	Percent removed	No. fed fry released	Release size (gm)	Release date
2000	30	32	62	682	8.3%	75,876	1.0	2/21, 2/27/01
2001	32	32	64	1,426	4.3%	73,472	1.0	2/21, 2/27/02
2002	32	33	65	807	7.5%	82,636	1.0	3/3, 3/10, 3/20/03
2003	68	68	136	11,780	1.1%	35,343 [1/]	1.0-1.1	03/10/04
2004	49	51	100	5,876	1.7%	- -	- -	- -
2005	51	51	102	1,885	5.1%	- -	- -	- -
2006	50	50	100	2,736	3.5%	- -	- -	- -
2007	50	50	100	1,867	5.1%	- -	- -	- -
2008	50	50	100	1,030	8.8%	- -	- -	- -
2009	33	30	63	548	10.3%	- -	- -	- -
2010	50	50	100	897	10.0%	- -	- -	- -
2011	10	10	20	276	6.8%	- -	- -	- -
2012	33	33	66	2,246	2.9%	- -	- -	- -

[1/] In addition, for BY 2003, a total of 111,232 fed fry were released from a remote rearing site on the Tahuya River

Table 4-12. Tahuya River summer chum reintroduction program, brood years 2003 through 2012.

Brood year	Broodstock Males	Broodstock Females	Broodstock Total	Natural spawners	Percent removed	No. fed fry released	Release size (gm)	Release date
2003	[1/]	[1/]	[1/]	0	--	111,232	1.4	3/8, 3/17, 3/22, 3/29/04
2004	[1/]	[1/]	[1/]	8	--	118,872	1.0-1.1	2/16, 3/10/05
2005	[1/]	[1/]	[1/]	4	--	119,260	1.05, 1.03	2/27, 3/9, 3/16/2006
2006	[1/]	[1/]	[1/]	749	--	133,826	1.12, 1.13	2/14, 2/28,3/7, 3/14/2007
2007	[1/]	[1/]	[1/]	623	--	53,632 [2/]	1.03	2/29/2008
2008	[1/]	[1/]	[1/]	700	--	97,145 [2/]	1.16, 1.00	02/11, 3/10/2009
2009	[1/]	[1/]	[1/]	380	--	69,711 [3/]	1.07, 1.00	2/16, 3/9/2010
2010	[1/]	[1/]	[1/]	1153	--	27,706 [4/]	1.02	3/14/2011
2011	[1/]	[1/]	[1/]	325	--	19,600 [3/]	1.0	3/15/2012
2012	[1/]	[1/]	[1/]	1405	--	110,000	1.0, 0.97	2/22, 3/1/2013

[1/] For BY 2003 through BY 2012, broodstock were collected from Union River and eggs were eyed and otolith marked at George Adams Hatchery.

[2/] Fish loss at Tahuya rearing site due to flood event
[3/] Short of egg take goal
[4/] Fish loss at George Adams due to blocked water supply pipe, fish loss at Tahuya due to flood event

Monitoring and Evaluation

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

Fish marking and mark recovery - Brood year 2000 was the first year of the Union River supplementation program. The otoliths of summer chum salmon embryos produced in the program were thermally mass-marked (otolith-marked) prior to release as fry to distinguish them from naturally-spawned summer chum in the Union River and from summer chum fry released from other supplementation programs. During 2000 through 2013, a permanent trap was operated throughout the summer chum return to collect broodstock, enumerate spawners and to complement information on fish origin and age composition collected during spawner surveys (see Section 2, Stock Assessment).

For brood years 2000 through 2003, nearly all supplementation-origin summer chum from the Union River program returned to the Union River. A few strays from Union River were recovered in Lilliwaup and Chimacum creeks. For year-by-year estimates of stray supplementation returns by program and stream of recovery during 2005 through 2012, see Appendix Tables 37 to 44.

Adult returns - The Union River supplementation program has been very successful in contributing to the return of adult summer chum. Estimates of natural-origin and supplementation-origin runsize are shown in Table 2-10 and Figure 4-6 through the 2013 return year.

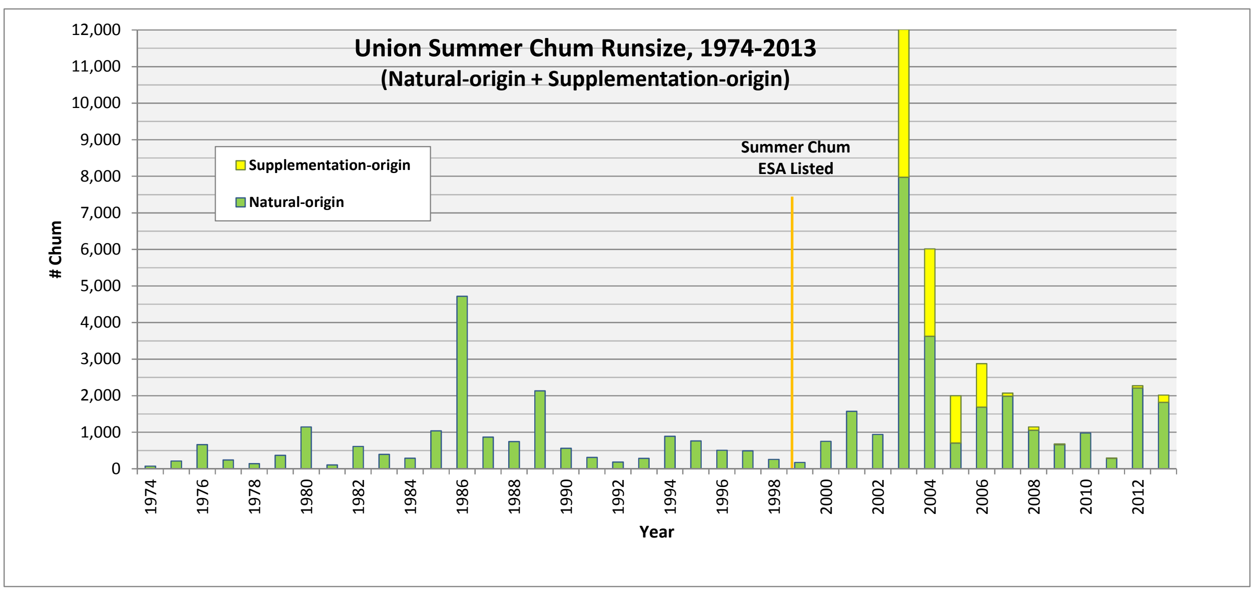

Figure 4-6. Union River summer chum supplementation-origin and natural-origin runsize, 1974-2013. Runsize in 2003 is 12,018 summer chum, comprised of 7,991 natural-origin and 4,027 supplementation-origin recruits.

Summer chum adults originating from the supplementation program first returned in 2003, as three year olds. Estimates of the number of otolith-marked adults, their ages, and survival from fed fry to spawner for summer chum reared in the supplementation program at Union River are presented for the 2000 through 2003 brood years in Table 4-13. The supplementation program contributed an estimated 3434, 2033, 1438, and 691 adults from the 2000 through 2003 brood years, respectively; this includes strays to other streams.

Under the SCSCI, a fry to adult survival rate range of 0.83% to 1.66% was set as an objective for each supplementation and reintroduction program (WDFW and PNPTT 2000). For the Union River supplementation program, the return rate from fry release to adult return ranged from 1.7% to 4.5% for the 2000 and 2003 brood years (Table 4-13).

Table 4-13. Return from fry to adult for summer chum salmon reared in supplementation program at Union River, as determined from otolith marks for the 2000 through 2003 brood years; this includes strays to other streams.

Brood year	No. fry released	Return year	Age	Adult return	Return rate
2000	75,876	2002	2	0	0.00%
		2003	3	3,082	4.06%
		2004	4	341	0.45%
		2005	5	11	0.01%
			Total	3,434	4.53%
2001	73,472	2003	2	54	0.07%
		2004	3	1,697	2.31%
		2005	4	283	0.39%
		2006	5	0	0.00%
			Total	2,033	2.77%
2002	82,636	2004	2	0	0.00%
		2005	3	900	1.09%
		2006	4	530	0.64%
		2007	5	9	0.01%
			Total	1,438	1.74%
2003	35,343	2005	2	0	0.00%
		2006	3	630	1.78%
		2007	4	61	0.17%
		2008	5	0	0.00%
			Total	691	1.95%

The Tahuya River reintroduction program has been very successful in contributing to the return of adult summer chum. In addition, fair numbers of natural-origin spawners have been observed in the Tahuya River for the first time since 1988, with 227, 79, and 190 spawners estimated during 2010 through 2012, respectively. Estimates of natural-origin and supplementation-origin runsize are shown in Table 2-10 and Figure 4-7 through the 2013 return year.

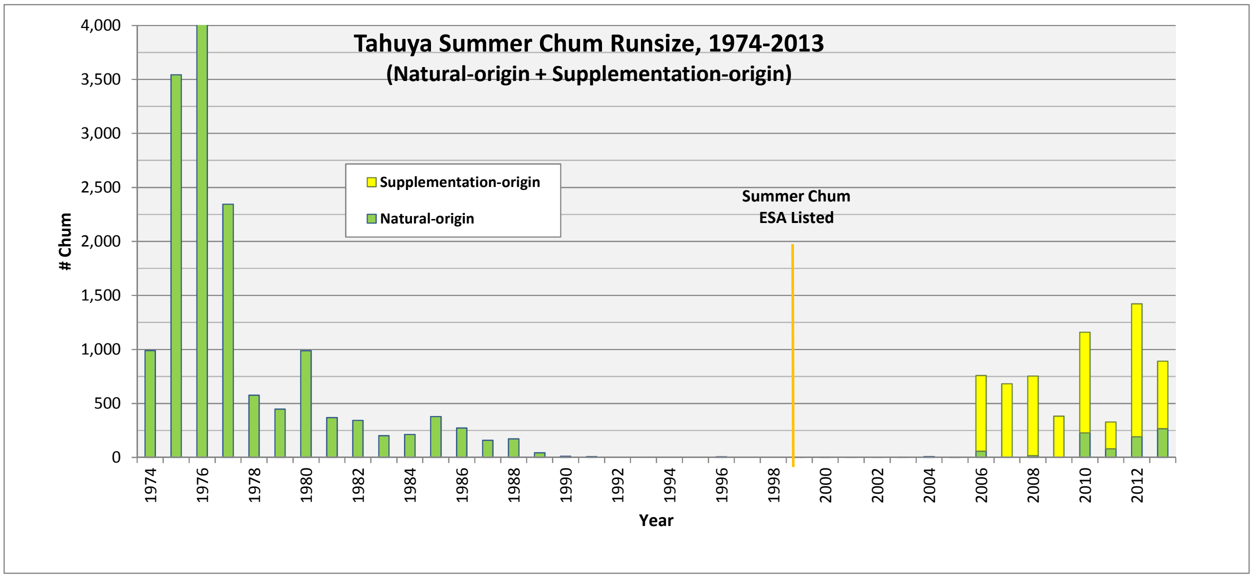

Figure 4-7. Tahuya River summer chum supplementation-origin and natural-origin runsize, 1974-2013.

Summer chum adults originating from the reintroduction program first returned in 2006, as three year olds. Estimates of the number of otolith-marked adults, their ages, and survival from fed fry to spawner for summer chum reared in the supplementation program at Tahuya River are presented for the 2004 and 2009 brood years in Table 4-14. The supplementation program contributed an estimated 915, 680, 390, 1091, 169, and 1621 adults from the 2004 through 2009 brood years, respectively; this includes strays to other streams.

Under the SCSCI, a fry to adult survival rate range of 0.83% to 1.66% was set as an objective for each supplementation and reintroduction program (WDFW and PNPTT 2000). For the Tahuya River reintroduction program, the return rate from fry release to adult return is estimated at 0.5%, 0.6%, 0.3%, 2.0%, 0.2%, and 2.3% for the 2004 through 2009 brood years, respectively (Table 4-14).

Table 4-14. Return from fry to adult for summer chum salmon reared in supplementation program at Tahuya River, as determined from otolith marks for the 2004 through 2009 brood years; this includes strays to other streams.

Brood year	No. fry released	Return year	Age	Adult return	Return rate
2004	188,872	2006	2	19	0.01%
		2007	3	608	0.32%
		2008	4	287	0.15%
		2009	5	0	0.00%
			Total	915	0.48%
2005	119,260	2007	2	5	0.00%
		2008	3	499	0.42%
		2009	4	167	0.14%
		2010	5	9	0.01%
			Total	680	0.57%
2006	133,826	2008	2	0	0.00%
		2009	3	215	0.16%
		2010	4	175	0.13%
		2011	5	0	0.00%
			Total	390	0.29%
2007	53,632	2009	2	0	0.00%
		2010	3	802	1.50%
		2011	4	226	0.42%
		2012	5	63	0.12%
			Total	1,091	2.03%
2008	97,142	2010	2	0	0.00%
		2011	3	23	0.02%
		2012	4	146	0.15%
		2013	5	0	NA
			Total	169	0.17%
2009	69,711	2011	2	0	0.00%
		2012	3	1,021	1.46%
		2013	4	600	0.86%
		2014	5	NA	NA
			Total	1,621	2.33%

Hatchery survival rates - The Union River/Tahuya River summer chum program has generally been successful in meeting the hatchery survival rate objectives. The number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum reared in the supplementation program at Huson Springs site, Tahuya site, and George Adams Hatchery from 2000 through 2010 are presented in Table 4-15.

Table 4-15. Number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum salmon reared in the Union/Tahuya reintroduction program, brood years 2000 through 2010.

						% Survival by life stage			Cumulative % survival		
Brood Year	Facility	Green eggs [1]	Eyed eggs	Swim-up fry	Fry released	Green egg to eyed egg	Eyed egg to swim-up	Swim-up to release	Green egg to eyed egg	Green egg to swim-up	Green egg to release
2000	G. Adams	85,077	--	--	--	94.9%	--	--	94.9%	--	--
	Huson site	--	80,717	80,127	75,876	--	99.3%	94.7%	--	94.2%	89.2%
2001	G. Adams	83,648	--	--	--	90.6%	--	--	90.6%	--	--
	Huson site	--	75,812	75,517	73,472	--	99.6%	97.3%	--	90.3%	87.8%
2002	G. Adams	89,397	--	--	--	96.6%	--	--	96.6%	--	--
	Huson site	--	86,390	85,859	82,636	--	99.4%	96.2%	--	96.0%	92.4%
2003	G. Adams	169,802	--	--	--	91.7%	--	--	91.7%	--	--
	Huson site	--	38,936	38,515	35,343	--	98.9%	91.8%	--	90.7%	83.2%
	Tahuya site	--	116,704	115,601	111,232	--	99.1%	96.2%	--	90.8%	87.4%
2004	G. Adams	130,249	--	--	--	93.2%	--	--	93.2%	--	--
	Huson site	--	--	--	--	--	--	--	--	--	--
	Tahuya site	--	121,413	120,080	118,872	--	98.9%	99.0%	--	92.2%	91.3%
2005	G. Adams	128,231	122,175	43,232	119,260	97.30%	99.80%	97.80%	97.30%	95.12%	93.00%
	Tahuya	--		78,738							
2006	G. Adams	143,856	137,827	50,686	133,826	95.80%	99.10%	98.00%	95.80%	94.91%	93.03%
	Tahuya	--		85,847							
2007	G. Adams	124,531	115,561	54,495	53,632	92.80%	94.00%	49.40%	92.80%	87.27%	43.07%
	Tahuya	--		54,177							
2008	G. Adams	138,430	133,793	74,353	97,145	96.60%	99.50%	73.00%	96.60%	96.17%	70.18%
	Tahuya	--		58,778							
2009	G. Adams	75,856	72,099	47,646	69,711	95.05%	96.70%	98.80%	95.05%	93.03%	91.90%
	Tahuya	--		22,921							
2010	G. Adams	132,024	127,697	1,000	27,706	96.70%	98.80%	91.40%	96.70%	23.72%	20.99%
	Tahuya	--		30,316							

[1] All green eggs are incubated at WDFW George Adams Hatchery and are shipped as eyed eggs to the Huson and Tahuya remote sites.

The average weight of female summer chum salmon, egg size, fecundity, egg loss, and sex ratio for broodstock used in the Union/Tahuya River supplementation/reintroduction program, 2000 through 2010, are shown in Table 4-16.

Table 4-16. Average summer chum salmon female weight, egg size, fecundity, egg loss, and sex ratio for broodstock used in the Union/Tahuya River supplementation/reintroduction program, 2000 through 2010.

Brood Year	Average adult female weight (lbs.)	Average green egg sample (#lb.)	Average eyed egg samble (#lb.)	Average fecundity (eggs/female)	Average % egg loss	Male:: female ratio (%) in trap
2000	7.11	1,990	1,774	2,659	5.1%	42.9::57.1
2001	6.95	2,050	1,827	2,614	9.4%	47.5::52.5
2002	6.90	2,082	1,842	2,798	3.5%	53.0::47.0
2003	6.20	2,090	1,903	2,121	8.3%	47.4::52.6
2004	7.60	1,848	1,673	2,546	6.8%	50.9::49.1
2005	6.30	2,131	2,396	2,514	4.7%	52.0::48.0
2006	7.18	2,099	1,927	2,946	6.4%	54.3: 45.7
2007	6.46	2,166	1,971	2,494	7.3%	49.0: 51.0
2008	7.31	1,982	1,792	2,861	3.3%	51.7::48.3
2009	6.31	2,005	1,823	2,371	5.0%	47.1: 52.9
2010	6.76	2,024	1,850	2,640	3.3%	49.2: 50.8

Fish Health - Fish health exams found bacterial gill disease in fry at the Huson Springs site during 2001, 2002, and 2003 and at the Tahuya site during 2003 and 2004; treatment was successful. To reduce the risk of bacterial gill disease at Huson Springs and Tahuya, changes to the incubation and rearing systems were designed and implemented for the 2003 and 2004 brood years. To date, this is the only fish health issue that has arisen among all of the summer chum fish culture facilities.

General Program Assessment

It appears that the Union River summer chum supplementation program was generally successful in collecting a representative sample of broodstock from the natural Union River summer chum stock. The Union River supplementation project has addressed the program objectives described in section 3.2.3.4 of the SCSCI.

Consistent with the standards set in the SCSCI, the co-managers decided that the Union River supplementation program could be terminated since adult return targets were met before the three-generation (12 year) maximum limit. Based on an increased abundance of adult returns in recent years (2001-2004 average of 5,064 adults) relative to post population decline years (1988-1991 average of 391 adults), indications that the supplementation program had successfully bolstered total return levels (e.g., by contributing 4,026 hatchery adults in 2003 and 2,379 hatchery adults in 2004 (see Table 2-10)), and indications that natural-origin summer chum productivity is good (see Table 2-12), the decision was made that supplementation program fry releases into the Union River in 2004 (brood year 2003) would be the final releases. The returns of supplementation program adults from this last brood year returned in 2008 (as 5-year olds).

The phase of the project to reintroduce summer chum into the Tahuya River began with brood year 2003 and is planned to continue through brood year 2014, with fry releases into the Tahuya from 2004 through 2015. Broodstock will continue to be collected from the Union River to support the Tahuya River program.

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Salmon Creek

Wild Olympic Salmon initiated a project to boost the number of summer chum in the Snow/Salmon Creek stock so it could be used as a donor stock to reintroduce summer chum into Chimacum Creek. The supplementation program, begun on Salmon Creek in 1992, was originally conceived with the objectives to rebuild and stabilize the Snow/Salmon Creek stock and to allow for the transfer of surplus eggs or fry to reintroduce summer chum to Chimacum Creek. The supplementation project is a cooperative effort between WDFW, North Olympic Salmon Coalition, and Wild Olympic Salmon.

The Salmon Creek supplementation program has met the program objectives and brood year 2003 was the last year of operation. The program has resulted in substantial increases in the total number of summer chum salmon adults returning to spawn in the watershed. The abundance of natural-origin spawners in Salmon Creek has increased from a mean of 261 adults (283 adults for Salmon/Snow stock) during 1989-1992 (just prior to initiation of supplementation) to a mean of 3,198 adults (2,541 adults for Salmon/Snow stock) during 2009-2012. In addition, the hatchery program succeeded as a donor stock for reintroduction of a summer chum return in Chimacum Creek. Adult returns to Chimacum Creek have been re-established to the level that transfers of Salmon Creek stock were no longer necessary beginning with brood year 2004.

Annual Production

A summary of the production for each brood year of the project is provided in Table 4-17.

Table 4-17. Salmon Creek summer chum supplementation program, brood years 1992-2003.

Brood year	**Broodstock**			**Natural spawners**	**Percent removed**	**Fed fry [1] released**	**Release size[1] (gms)**	**Release date**
	Males	**Females**	**Total**					
1992	35	27	62	371	14.3%	19,200	1.1	5/7/93
1993	29	23	52	400	11.5%	44,000	1.8	4/27/94
1994	12	12	24	137	14.9%	2,000	1.3	3/31/95
1995	35	18	53	538	9.0%	38,808	1.3	4/23/96
1996	59	50	109	785	12.2%	62,000 [2]	1.3	4/8, 4/24/97
1997	60	50	110	724	13.2%	71,821 [2]	1.0-1.3	3/31, 4/16/98
1998	65	56	121	1,023	10.6%	67,832 [2]	1.0-1.3	3/31, 4/21, 5/4/99
1999	34	31	65	434	13.0%	34,680 [2]	1.3-2.6	4/23, 6/12/00
2000	71	65	136	710	16.1%	90,435 [2]	0.6-1.1	4/14, 4/26/01
2001	77	77	154	2,484	5.8%	18,110 [2]	1.0-1.1	4/18, 4/27/02
						72,870 [3]	0.35	3/1/02-4/18/02
2002	64	64	128	5,389	2.3%	118,347 [2,3]	0.35	2/19/03-3/28/03
2003	65	65	130	5,521	2.3%	88,610 [2,3]	0.35	2/1/04-3/18/04

[1] Release number and size data from Wild Olympic Salmon (1997; 1998) and WDFW files.
[2] Release numbers do not include 28,788; 36,840; 70,050; 39,170; 73,200; 79,500; 57,300; and 57,435 fry of Salmon Creek-origin, released into Chimacum Creek in 1997, 1998, 1999, 2000, 2001, 2002, 2003, and 2004, respectively.
[3] Unfed fry release from remote site incubators; for BY 2002, includes 33,880 unfed fry transferred from Hurd Creek Hatchery and released directly into Salmon Creek.

Monitoring and Evaluation

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

Fish marking and mark recovery - The otoliths of summer chum salmon embryos produced in the supplementation program on Salmon Creek are thermally mass-marked (otolith-marked) prior to release. An adult trap was operated and spawning ground surveys were conducted throughout the summer chum return to enumerate spawners and to collect information on fish origin and age composition (see Section 2, Stock Assessment).

Most supplementation-origin summer chum from the Salmon Creek program returned to Salmon Creek or Snow Creek; these two streams support the same summer chum stock. For brood years 1996 through 2001, the percentage of Salmon Creek supplementation fish that returned to Salmon and/or Snow creeks averaged 95%, ranging from 89% to 99%.

As noted earlier (see Section 2, Stock Assessment), most straying of supplementation-origin fish occurred between neighboring streams within the region of origin. Strays from Salmon Creek were recovered in Jimmycomelately, Little Quilcene, Duckabush, Hamma Hamma, Lilliwaup, and Big Beef Creek in small numbers. Recoveries occurred in more substantial numbers in Chimacum Creek, the recipient of the Salmon Creek stock as the donor for the reintroduction program there. For year-by-year estimates of stray supplementation returns by program and stream of recovery during 2005 through 2012, see Appendix Tables 37 to 44.

Adult returns - The Salmon Creek supplementation program has been very successful in contributing to the return of adult summer chum. Estimates of natural-origin and supplementation-origin runsize are shown in Table 2-10 and Figure 4-8 through the 2013 return year. The number of supplementation-origin recruits and natural-origin recruits to Salmon Creek increased substantially since 2001. The number of natural-origin recruits in Salmon Creek during 2002 through 2006 each exceeded the previous recorded high of 3,074 natural-origin recruits in 1980.

Estimates of the number of otolith-marked adults, their ages and survival from fed fry to spawner for summer chum reared in the supplementation program at Salmon Creek are presented for the 1994 through 2003 brood years in Table 4-18. The supplementation program contributed an estimated 96, 648, 422, 1057, 1678, 1536, 1520, 1845, 2059, and 403 adults during the 1994 through 2003 brood years, respectively; this includes strays to other streams.

Under the SCSCI, a fry to adult survival rate range of 0.83% to 1.66% was set as an objective for each supplementation and reintroduction program (WDFW and PNPTT 2000). For the Salmon

Creek supplementation program, the return rate from fry release to adult return was 4.8%, 1.7%, 0.7%, 1.5%, 2.5%, 4.4%, 1.7%, 2.0%, 1.7% and 0.4% for the 1994 through 2003 brood years, respectively (Table 4-18).

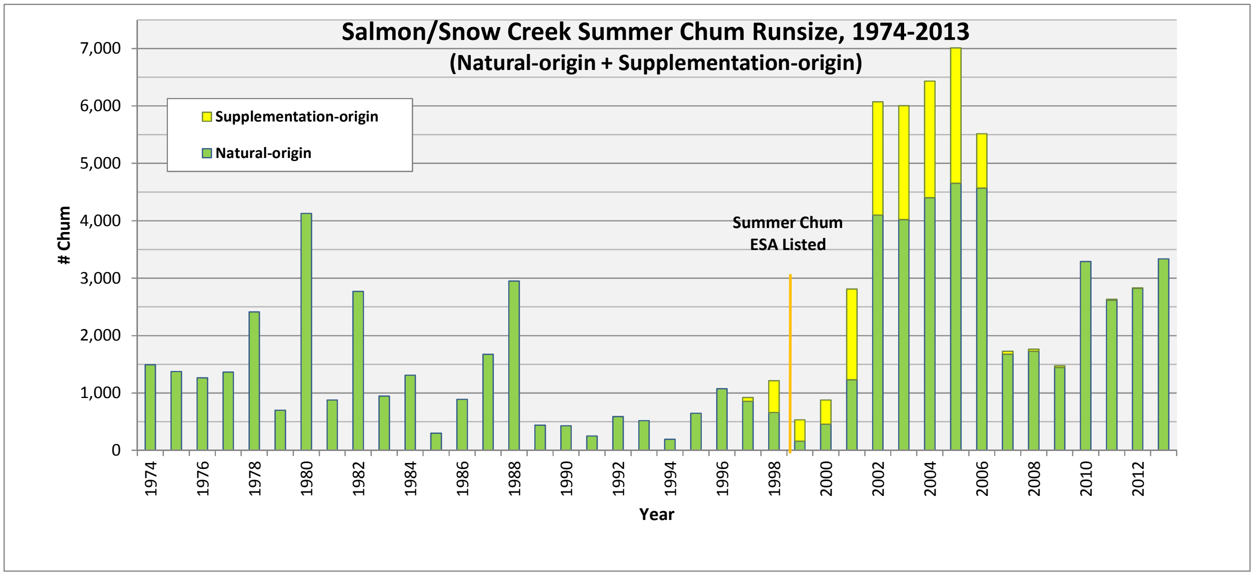

Figure 4-8. Salmon/Snow Creek summer chum supplementation-origin and natural-origin runsize, 1974-2013.

Table 4-18. Return from fry to adult for summer chum salmon reared in supplementation program at Salmon Creek, as determined from otolith marks for the 1994 through 2003 brood years; this includes strays to other streams.

Brood year	No. fry released	Return year	Age	Adult return	Return rate
1994	2,000	1996	2	N/A	N/A
		1997	3	46	2.30%
		1998	4	50	2.50%
		1999	5	0	0.00%
			Total	96	4.80%
1995	38,808	1997	2	13	0.03%
		1998	3	471	1.21%
		1999	4	164	0.42%
		2000	5	0	0.00%
			Total	648	1.67%
1996	62,000	1998	2	8	0.01%
		1999	3	220	0.36%
		2000	4	194	0.31%
		2001	5	0	0.00%
			Total	422	0.68%
1997	71,821	1999	2	0	0.00%
		2000	3	235	0.33%
		2001	4	822	1.14%
		2002	5	0	0.00%
			Total	1,057	1.47%
1998	67,832	2000	2	14	0.02%
		2001	3	856	1.26%
		2002	4	788	1.16%
		2003	5	21	0.03%
			Total	1,678	2.47%
1999	34,680	2001	2	47	0.14%
		2002	3	1,332	3.84%
		2003	4	156	0.45%
		2004	5	0	0.00%
			Total	1,536	4.43%
2000	90,435	2002	2	0	0.00%
		2003	3	1,365	1.51%
		2004	4	156	0.17%
		2005	5	0	0.00%
			Total	1,520	1.68%

Table 4-18 (continued)

Brood year	No. fry released	Return year	Age	Adult return	Return rate
2001	92,415	2003	2	34	0.04%
		2004	3	1,057	1.14%
		2005	4	717	0.78%
		2006	5	37	0.04%
			Total	1,845	2.00%
2002	117,797	2004	2	15	0.01%
		2005	3	1,545	1.31%
		2006	4	499	0.42%
		2007	5	0	0.00%
			Total	2,059	1.75%
2003	88,610	2005	2	15	0.02%
		2006	3	373	0.42%
		2007	4	14	0.02%
		2008	5	0	0.00%
			Total	403	0.45%

Hatchery survival rates - The Salmon Creek summer chum program has generally been successful in meeting the hatchery survival rate objectives. The number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum reared in the supplementation program at Salmon Creek Hatchery for 1992 through 2003 brood years are presented in Table 4-19.

Table 4-19. Number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum salmon reared in the supplementation program at Salmon Creek Hatchery, 1992 through 2003 brood years.

	Number of eggs or fry					% Survival by life stage			Cumulative % survival	
	Total		Salmon Cr. Hatchery			Salmon Cr. Hatchery			Salmon Cr. Hatchery	
Brood year	Green eggs	Eyed eggs	Eyed eggs	Swim-up fry	Fry released	Green egg to eyed egg	Eyed egg to swim-up	Swim-up to release	Green egg to swim-up	Green egg to release
1992	46,980	44,280	44,280	18,684	19,200	94.3	42.2	100.0	39.8	39.8
1993	--	46,300	46,300	26,837	44,000	--	58.0	100.0	--	--
1994	--	24,200	24,200	2,000	2,000	--	8.3	100.0	--	--
1995	41,750	39,200	39,200	38,808	38,808	93.9	99.0	100.0	93.0	93.0
1996	--	114,900 [1]	64,900	62,300	62,000	--	96.0	99.5	--	--
1997	133,340	112,900 [1]	72,900	71,011	71,821	87.7	97.4	100.0	85.4	85.4
1998	164,300	149,100 [1]	69,100	68,423	67,807	90.7	99.0	99.1	89.8	89.0
1999	87,350	78,300 [1]	29,200	28,950	28,400 [2]	89.6	99.1	98.1	88.8	87.1
2000	174,550	165,400 [1]	91,350	90,755	90,435	94.8	99.3	99.6	94.1	93.8
2001	198,685	177,150 [1]	93,309	92,644	92,415	89.2	99.3	99.7	88.6	88.3
2002	184,450	177,150 [1]	119,150	--	117,797 [3]	96.0	--	98.9	--	94.9
2003	154,200	150,300 [1]	90,225	--	88,610	97.5	--	98.2	--	95.8

[1] Total includes eggs taken for both Salmon Creek supplementation and Chimacum Creek reintroduction programs; all green eggs are incubated at Dungeness Hatchery and shipped as eyed eggs to Salmon Creek Hatchery and Chimacum Creek Hatchery.
[2] Does not include 6,300 fish transferred June 1 at 256 fish per pound (fpp) from Dungeness Hatchery and 6,280 released June 12 at 175 fpp at RM 0.1 in Salmon Creek after rearing in freshwater there; total release was 34,680 fish for BY 1999.
[3] Includes 33,580 fish incubated at Hurd Creek and transferred and released upon swim-up at Salmon Creek RM 0.8.

Broodstocking and egg sources - To represent the demographics of the donor stock, summer chum broodstock are collected randomly as the fish arrive at a temporary fish trap operated by WDFW, Wild Olympic Salmon, and North Olympic Salmon Coalition, proportional to the timing, weekly abundance, and duration of the total return to the creek. Fish not retained for use as broodstock are released upstream of the trap site to spawn naturally.

General Program Assessment

The Salmon Creek supplementation program has resulted in substantial increases in the total number of summer chum salmon adults returning to spawn in the watershed. The abundance of natural-origin spawners in Salmon Creek has increased from a mean of 261 adults (283 adults for Salmon/Snow stock) during 1989-1992 (just prior to initiation of supplementation) to a mean of 3,198 adults (2,541 adults for Salmon/Snow stock) during 2009-2012. In addition, the hatchery program succeeded as a donor stock for reintroduction of a summer chum return in Chimacum Creek. Adult returns to Chimacum Creek have been re-established to the level that transfers of Salmon Creek stock were no longer necessary beginning in 2004.

It appears that the Salmon Creek summer chum supplementation program was generally successful in collecting a representative sample of broodstock from the natural Snow/Salmon summer chum stock. The Salmon Creek supplementation project has addressed the program objectives described in section 3.2.3.4 of the SCSCI.

Consistent with the standards set in the SCSCI and HGMP, the intended maximum duration of the program is 12 years (3 generations) beginning with brood year 1992. Accordingly, the last brood year of the Salmon Creek program was 2003, with the returns of adults of this brood year occurring through 2008.

Although it appears that impacts to natural processes in freshwater and/or estuarine habitats have likely limited natural summer chum production in the stream in some years, habitat restoration actions implemented in recent years are expected to improve survival and productivity conditions for natural fish. Commensurate with the summer chum salmon supplementation program, WDFW and Jefferson Land Trust purchased properties in the lower freshwater reaches and along the Salmon/Snow creek estuary and North Olympic Salmon Coalition, Jefferson County Conservation District, and WDFW have implemented habitat restoration projects designed to remedy major sediment input and lower channel degradation factors. Restoration projects have been implemented in the Salmon/Snow estuary and more are planned and funded for 2014 and 2015. These restoration actions were designed to improve prospects for the survival and productivity of naturally spawning summer chum salmon, including adults produced through the hatchery effort.

Chimacum Creek

Chimacum Creek supported an indigenous summer chum population until the mid-1980s, when a combination of habitat degradation and poaching evidently led to its demise (WDFW and PNPTT 2000). In 1992, Wild Olympic Salmon initiated a project to boost the number of summer chum in the Salmon Creek stock so it could be used as a donor stock to reintroduce summer chum into Chimacum Creek. Beginning with brood year 1996, eyed eggs from the Salmon Creek broodstock were transferred to, and released from, Chimacum Creek hatchery facilities to reintroduce summer chum to formerly occupied habitat. The reintroduction project is a cooperative effort between WDFW, North Olympic Salmon Coalition, and Wild Olympic Salmon.

Annual Production

A summary of the production for each brood year of the project is provided in Table 4-20.

Table 4-20. Chimacum Creek summer chum reintroduction program, brood years 1996-2003.

Brood year	No. eggs received	No. fed fry released	Release size (gm)	Release date
1996	50,000	28,788	0.4-1.5	3/23, 5/9/97
1997	40,000	36,840	0.7	3/27, 4/11, 4/19/98
1998	80,000	70,050	0.6-0.8	3/26, 3/28, 4/21/99
1999	41,300	39,170	0.4-0.8	3/20, 3/31, 4/7, 4/24/00
2000	74,050	73,300	0.8-1.2	4/5, 4/17, 4/18, 4/23, 5/3, 5/10/01
2001	82,490	71,500	0.9-1.8	4/18, 4/27, 4/30, 5/2/02
		8,000 [1]	0.35	3/12/02
2002	58,000	57,300	0.9-1.0	3/4, 3/15, 3/19, 3/23/03
2003	60,075	57,435	0.7-1.0	4/6, 4/15, 4/27/04

[1] Unfed fry released accidentally into tributary to Chimacum Creek due to tank overflow.

Fry were successfully reared to target size in freshwater and saltwater facilities and released during March, April and May. Fry reared at the freshwater and saltwater sites received different otolith marks so the rearing and release strategies could be evaluated.

Monitoring and Evaluation

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

Fish marking and mark recovery - Beginning with brood year 1999, the otoliths of summer chum salmon embryos produced in the supplementation program on Chimacum Creek were thermally mass-marked (otolith-marked) prior to release to distinguish them from naturally-spawned summer chum in Chimacum Creek and from summer chum fry released from other supplementation programs. Spawning ground surveys were conducted throughout the summer chum return to enumerate spawners and to collect information on fish origin and age composition (see Section 2, Stock Assessment).

As noted earlier (see Section 2, Stock Assessment), most straying of supplementation-origin fish occurred between neighboring streams within the region of origin. Strays from Chimacum Creek were recovered most commonly in Salmon Creek (the donor stock), with small numbers of recoveries in Jimmycomelately, Snow, Duckabush, and Lilliwaup. For year-by-year estimates of stray supplementation returns by program and stream of recovery during 2005 through 2012, see Appendix Tables 37 to 44.

Adult returns - The Chimacum Creek reintroduction program has been successful in contributing to the re-establishment of adult summer chum to a stream previously occupied by summer chum. Estimates of natural-origin and supplementation-origin runsize are shown in Table 2-10 and Figure 4-9 through the 2013 return year. The number of supplementation-origin recruits and natural-origin recruits to Chimacum Creek has increased substantially since the first 38 fish returned in 1999 with a record high of 3,081 natural-origin summer chum returning in 2013.

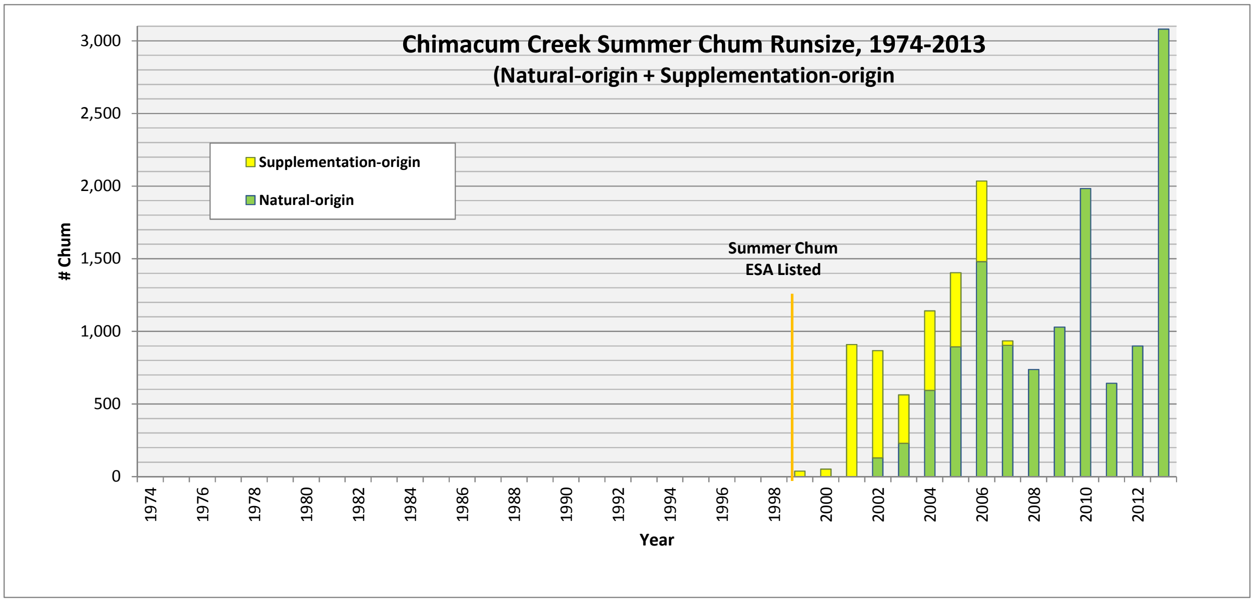

Figure 4-9. Chimacum Creek summer chum supplementation-origin and natural-origin runsize, 1974-2013.

Estimates of the number of reintroduction program adults, their ages and survival from fed fry to spawner for summer chum reared in the reintroduction program at Chimacum Creek are presented for the 1996 through 2003 brood years in Table 4-21. The reintroduction program contributed an estimated 38, 428, 912, 483, 501, 506, 530, and 357 summer chum adults from brood years 1996 through 2003, respectively; this includes strays to other streams.

Under the SCSCI, a fry to adult survival rate range of 0.83% to 1.66% was set as an objective for each supplementation and reintroduction program (WDFW and PNPTT 2000). For the Chimacum reintroduction program, the return rate from fry release to adult return was 0.1%, 1.2%, 1.3%, 0.7%, 0.7%, 0.7%, 0.9% and 0.6% for the 1996 through 2003 brood years, respectively (Table 4-21).

Table 4-21. Return from fry to adult for summer chum salmon reared in reintroduction program at Chimacum Creek, as determined from otolith marks for the 1996 through 2003 brood years; this includes strays to other streams.

Brood year	No. fry released	Return year	Age	Adult return	Return rate
1996	28,788	1998	2	N/A	N/A
		1999	3	38	0.13%
		2000	4	0	0.00%
		2001	5	0	0.00%
			Total	38	0.13%
1997	36,840	1999	2	0	0.00%
		2000	3	0	0.00%
		2001	4	404	1.10%
		2002	5	24	0.07%
			Total	428	1.16%
1998	70,050	2000	2	0	0.00%
		2001	3	419	0.60%
		2002	4	488	0.70%
		2002	5	5	0.01%
			Total	912	1.30%
1999	39,170	2001	2	0	0.00%
		2002	3	60	0.09%
		2003	4	419	0.60%
		2004	5	4	0.01%
			Total	483	0.69%
2000	73,300	2002	2	0	0.00%
		2003	3	152	0.21%
		2004	4	349	0.48%
		2005	5	0	N/A
			Total	501	0.68%
2001	71,750	2003	2	4	0.01%
	8000	2004	3	164	0.23%
		2005	4	315	0.44%
		2006	5	23	0.03%
			Total	506	0.71%
2002	57,300	2004	2	0	0.00%
		2005	3	297	0.52%
		2006	4	233	0.41%
		2007	5	0	0.00%
			Total	530	0.92%
2003	57,435	2005	2	0	0.00%
		2006	3	315	0.55%
		2007	4	42	0.07%
		2008	5	0	0.00%
			Total	357	0.62%

Hatchery survival rates - The Chimacum Creek summer chum program has generally been successful in meeting the survival rate objectives. The number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum reared in the supplementation program at Chimacum Creek Hatchery from 1996 through 2003 are presented in Table 4-22.

Table 4-22. Number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum salmon reared in the reintroduction program at Chimacum Creek Hatchery, 1996 through 2003 brood years.

	Number of eggs or fry					% Survival by life stage				
	Total [1]		Chimacum Cr. Hatchery			Chimacum Cr. Hatchery				
Brood year	**Green eggs**	**Eyed eggs**	**Eyed eggs**	**Swim-up fry**	**Fry released**	**Green eggs to eyed eggs**	**Eyed egg to swim-up**	**Swim-up to release**	**Green egg to release**	**Eyed egg to release**
1996	--	114,900	50,000	31,243	28,788	--	62.5	92.1	--	57.6
1997	133,340	112,900	40,000	38,000	36,840	84.7	95.0	96.9	78.0	92.1
1998	164,300	149,100	80,000	73,750	70,050	90.7	92.2	95.0	79.5	87.6
1999	87,350	78,300	41,300	40,880	39,170	89.6	99.0	95.8	85.0	94.8
2000	174,550	165,400	74,050	--	73,300	94.8	--	--	93.8	99.0
2001	198,685	177,150	83,841	--	71,750	89.2	--	--	76.3	85.6
2002	184,450	177,150	58,000	--	57,300	96.0	--	--	94.9	98.8
2003	154,200	150,300	60,075	--	57,435	97.5	--	--	93.1	95.6

[1] Total includes eggs taken for both Salmon Creek supplementation and Chimacum Creek reintroduction programs; all green eggs are incubated at Dungeness Hatchery and shipped as eyed eggs to Salmon Creek Hatchery and Chimacum Creek Hatchery.

Broodstocking and egg sources - Summer chum broodstock were collected randomly as the fish arrived at a temporary fish trap operated by WDFW, Wild Olympic Salmon, and North Olympic Salmon Coalition on Salmon Creek, proportional to the timing, weekly abundance, and duration of the total return to the creek. Trap data are presented in Appendix Report 1. Eggs from each female used as broodstock were represented in the Chimacum Creek reintroduction program.

General Program Assessment

It appears that the Chimacum Creek summer chum reintroduction program has generally been successful in collecting a representative sample of broodstock from the natural Snow/Salmon Creek summer chum stock and successful in contributing to the return of adult summer chum to Chimacum Creek. Consistent with the standards set in the SCSCI and HGMP for the program, the expected duration of the program is a maximum of 12 years (3 generations) beginning with brood year 1996. Substantial numbers of returning adults to the creek, and data showing that the reintroduction program had led to the production, return, and spawning of natural-origin fish that were the progeny of naturally spawning hatchery fish, drove the decision to terminate the reintroduction program with brood year 2003; this was four years in advance of the 12-year duration limit. The Co-managers will continue to monitor the adult returns from fry released from the reintroduction program, with returns of supplementation program adults occurring through 2008.

The Chimacum Creek reintroduction project has addressed the program objectives described in section 3.2.3.4 of the SCSCI.

Habitat protection and restoration actions implemented in recent years are expected to improve survival and productivity conditions for natural fish. Commensurate with the summer chum salmon reintroduction program, North Olympic Salmon Coalition, Wild Olympic Salmon, Jefferson County, Jefferson Land Trust and WDFW implemented habitat restoration projects and purchased properties in the lower freshwater reaches and along the estuary. The projects are designed to protect lands adjacent to summer chum spawning and rearing areas from development impacts and to restore habitat function to freshwater and estuarine habitats. These restoration actions were designed to improve prospects for the survival and productivity of naturally spawning summer chum salmon, including adults produced through the hatchery program.

Jimmycomelately Creek

Summer chum in Jimmycomelately (JCL) Creek were identified as at high risk of extinction in the SCSCI and a supplementation project was initiated with the 1999 brood year. The supplementation project is a cooperative effort between WDFW and North Olympic Salmon Coalition. The supplementation program was terminated with brood year 2010 after 12 years of operation and after accomplishing the program objectives.

Annual Production

A summary of the production for each brood year of the project is provided in Table 4-23.

Table 4-23. Jimmycomelately Creek summer chum supplementation program, brood years 1999-2010.

Brood year	Broodstock			Natural spawners	Percent removed	Fed fry released	Release size (gms)	Release date
	Males	Females	Total					
1999	2	4	6	1	85.7%	3,880	1.0	4/8/2000
2000	33	13	46	9	83.6%	25,900	1.0	4/20, 4/28/01
2001	36	32	68	192	26.2%	54,515	0.9-1.2	4/17, 4/26/02
2002	21	15	36	6	85.7%	20,887	0.8-1.1	4/7, 4/21/03
2003	37	39	76	369	17.1%	50,307	0.9-1.2	3/26, 4/7, 4/16, 4/22, 4/26/04
2004	30	31	61	1,601	3.7%	76,982	0.7-1.0	3/25, 3/30, 4/1, 4/8, 4/15/05
2005	31	30	61	1,247	4.7%	57,300	0.9-1.1	3/27, 4/3, 4/14/06
2006	33	32	65	660	9.0%	79,428	1.0-1.2	3/21, 3/30, 4/4, 4/10/07
2007	39	37	76	578	11.6%	73,811	1.0-1.2	4/3, 4/10, 4/17, 4/24/08
2008	37	35	72	982	6.8%	88,766	1.0-1.3	3/16, 3/24, 3/30, 4/6,4/18/09
2009	43	43	86	2,542	3.3%	92,200	1.0-1.5	3/13, 3/24, 3/27, 3/31, 4/7/10
2010	41	41	82	3,945	2.0%	85,630	1.1-1.6	3/29, 3/31, 4/5, 4/16, 4/14/11

Fry are reared to target size in two freshwater remote hatchery facilities and released during March and April each year. Incubation and rearing at multiple sites is intended to reduce the risk of catastrophic hatchery failure. Fry reared at the Woods and Valhalla remote sites received different otolith marks so the two rearing strategies can be evaluated.

Monitoring and Evaluation

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation**)**. Following are additional details of monitoring and evaluation activities applicable to this project.

Fish marking and mark recovery - Beginning with brood year 1999, the otoliths of summer chum salmon embryos produced in the supplementation program on Jimmycomelately (JCL) Creek were thermally mass-marked prior to release to distinguish them from naturally-spawned summer chum in JCL Creek and from summer chum fry released from other supplementation programs. An adult trap was operated and spawning ground surveys were conducted throughout the summer chum return to enumerate spawners and to collect information on fish origin and age composition (see Section 2, Stock Assessment).

As noted earlier (see Section 2, Stock Assessment), most straying of supplementation-origin fish occurred between neighboring streams within the region of origin. Small numbers of strays from the JCL Creek program were recovered in Salmon, Snow, Duckabush, Hamma Hamma, and Lilliwaup. For year-by-year estimates of stray supplementation returns by program and stream of recovery during 2005 through 2012, see Appendix Tables 37 to 44.

Adult returns - The JCL Creek supplementation program has been very successful in contributing to the return of adult summer chum. Estimates of natural-origin and supplementation-origin runsize are shown in Table 2-10 and Figure 4-10 through the 2013 return year. The number of supplementation-origin recruits and natural-origin recruits to JCL Creek has increased substantially since 2004 with record highs of 4,027 in 2010 and 8,383 in 2013. The previous high of 1,447 total recruits has been exceeded six times since 2004 (Figure 4-10).

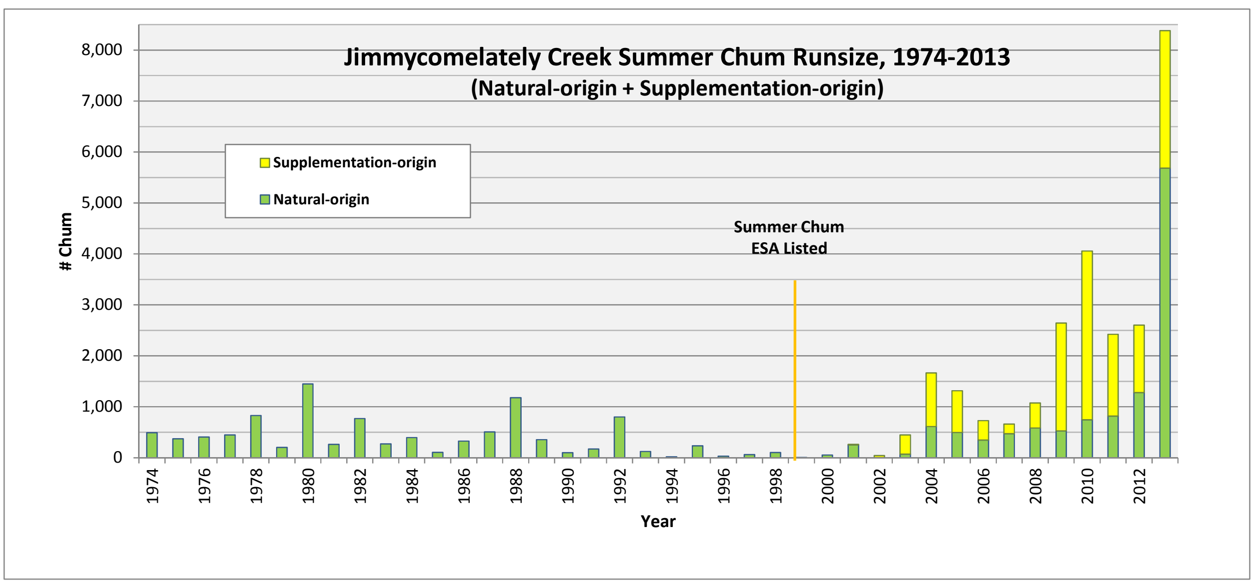

Figure 4-10. Jimmycomelately Creek summer chum supplementation-origin and natural-origin runsize, 1974-2013.

Estimates of the number of otolith-marked adults, their ages and survival from fed fry to spawner for summer chum reared in the supplementation program at JCL Creek are presented for the 1999 through 2009 brood years in Table 4-24. The supplementation program contributed an estimated 219, 593, 1322, 469, 247, 274, 825, 2743, 3704, 991, 1533, and 2027 adults from the 1999 through 2010 brood years, respectively; this includes strays to other streams.

Under the SCSCI, a fry to adult survival rate range of 0.83% to 1.66% was set as an objective for each supplementation and reintroduction program (WDFW and PNPTT 2000). For the JCL supplementation program, the return rate from fry release to adult return was 5.6%, 2.3%, 2.4%, 0.5%, 0.4%, 1.4%, 3.5%, 5.0%, 1.1%, 1.7%, and 2.4% for the 1999 through 2010 brood years, respectively (Table 4-24). Note that for 2009 and 2010 broods, these represent incomplete brood returns.

Table 4-24. Return from fry to adult for summer chum salmon reared in reintroduction program at Jimmycomelately Creek, as determined from otolith marks for the 1999 through 2010 brood years; this includes strays to other streams.

Brood year	No. fry released	Return year	Age	Adult return	Return rate
1999	3,880	2001	2	2	0.05%
		2002	3	62	1.60%
		2003	4	149	3.83%
		2004	5	6	0.15%
			Total	219	5.64%
2000	25,900	2002	2	0	0.00%
		2003	3	342	1.32%
		2004	4	251	0.97%
		2005	5	0	0.00%
			Total	593	2.29%
2001	54,515	2003	2	9	0.02%
		2004	3	839	1.54%
		2005	4	462	0.85%
		2006	5	13	0.02%
			Total	1,322	2.43%
2002	20,887	2004	2	0	0.00%
		2005	3	296	1.42%
		2006	4	173	0.83%
		2007	5	0	0.00%
			Total	469	2.25%
2003	50,307	2005	2	9	0.02%
		2006	3	214	0.43%
		2007	4	24	0.05%
		2008	5	0	0.00%
			Total	247	0.49%
2004	76,982	2006	2	14	0.02%
		2007	3	177	0.23%
		2008	4	83	0.11%
		2009	5	0	0.00%
			Total	274	0.36%
2005	57,300	2007	2	3	0.01%
		2008	3	338	0.59%
		2009	4	483	0.84%
		2010	5	0	0.00%
			Total	825	1.44%

Table 4-24 (continued)

2006	79,428	2008	2	70	0.09%
		2009	3	1,934	2.43%
		2010	4	698	0.88%
		2011	5	41	0.05%
			Total	2,743	3.45%
2007	73,840	2009	2	63	0.09%
		2010	3	2,631	3.56%
		2011	4	1,010	1.37%
		2012	5	0	0.00%
			Total	3,704	5.02%
2008	88,766	2010	2	21	0.02%
		2011	3	544	0.61%
		2012	4	426	0.48%
		2013	5	0	0.00%
			Total	991	1.12%
2009	92,200	2011	2	24	0.03%
		2012	3	861	0.93%
		2013	4	672	0.73%
		2014	5	NA	NA
			Total	885	1.69%
2010	85,630	2012	2	35	0.04%
		2013	3	2027	2.37%
		2014	4	NA	NA
		2015	5	NA	NA
			Total	35	2.41%

Hatchery survival rates - The Jimmycomelately Creek summer chum program has generally been successful in meeting the hatchery survival rate objectives. Survival rates are presented in Table 4-25. For brood years 2001 and 2003 the egg to swim-up goals for the Woods site were not met. In April of 2002 several thousand dead and live fry were found trapped beneath a screen in the barrel incubator, and there were approximately 5,000 fry mortalities. In January of 2004 approximately 28,000 alevin were killed when the water intake line froze up. In both cases modifications were made to the facilities to minimize potential future losses.

Table 4-25. Number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum salmon reared in the Jimmycomelately Creek supplementation program, 2000 through 2010 brood years.

						% Survival by life stage			Cumulative % survival		
Brood Year	Facility	Green eggs	Eyed eggs	Swim-up fry	Fry released	Green egg to eyed egg	Eyed egg to swim-up	Swim-up to release	Green egg to eyed egg	Green egg to swim-up	Green egg to release
2000	Woods site Incubation & rearing	13,783	13,104	13,059	12,900	95.1%	99.7%	98.8%	95.1%	94.7%	93.6%
	Woods site Rearing only	13,783	13,134	13,050	13,000	95.3%	99.4%	99.6%	95.3%	94.7%	94.3%
2001	Valhalla site	35,181	30,517	30,360	29,690	86.7%	99.5%	97.8%	86.7%	86.3%	84.4%
	Woods site	35,182	30,517	25,415	24,825	86.7%	83.3%	97.7%	86.7%	72.2%	70.6%
2002	Valhalla site	14,120	12,442	11,642	11,095	88.1%	93.6%	95.3%	88.1%	82.5%	78.6%
	Woods site	14,120	12,442	10,598	9,792	88.1%	85.2%	92.4%	88.1%	75.1%	69.3%
2003	Valhalla site	53,787	48,930	48,150	47,740	91.0%	98.4%	99.1%	91.0%	89.5%	88.8%
	Woods site	32,966	29,989	2,170	2,157	91.0%	7.2%	99.4%	91.0%	6.6%	6.5%
2004	Valhalla site	53,966	52,000	51,695	51,510	96.4%	99.4%	99.6%	96.4%	95.8%	95.4%
	Woods site	31,414	30,276	26,216	25,472	96.4%	86.6%	97.2%	96.4%	83.5%	81.1%
2005	Valhalla site	59,125	54,000	53,230	53,000	91.3%	98.6%	99.6%	91.3%	90.0%	89.6%
	Woods site	28,003	26,027	4,422	4,310	92.9%	17.0%	97.5%	92.9%	15.8%	15.4%
2006	Valhalla site	63,276	55,001	54,552	54,305	86.9%	99.2%	99.5%	86.9%	86.2%	85.8%
	Woods site	29,136	25,850	25,383	25,123	88.7%	98.2%	99.0%	88.7%	87.1%	86.2%
2007	Valhalla site	64,209	50,757	50,091	49,670	79.0%	98.7%	99.2%	79.0%	78.0%	77.4%
	Woods site	31,908	25,000	24,750	24,141	78.4%	99.0%	97.5%	78.4%	77.6%	75.7%
2008	Valhalla site	72,785	62,652	62,133	61,467	86.1%	99.2%	98.9%	86.1%	85.4%	84.5%
	Woods site	30,765	28,045	27,903	27,299	91.2%	99.5%	97.8%	91.2%	90.7%	88.7%
2009	Valhalla site	69,204	60,089	59,205	58,966	86.8%	98.5%	99.6%	86.8%	85.6%	85.2%
	Woods site	39,903	34,029	33,472	33,234	85.3%	98.4%	99.3%	85.3%	83.9%	83.3%
2010	Valhalla site	71,465	57,373	56,645	56,580	80.3%	98.7%	99.9%	80.3%	79.3%	79.2%
	Woods site	38,531	30,000	29,050	29,050	77.9%	96.8%	100.0%	77.9%	75.4%	75.4%

[1] All green eggs are incubated at WDFW Hurd Creek Hatchery; eyed eggs are shipped to the Valhalla and Woods remote sites.

Broodstocking and egg sources - To represent the demographics of the donor population at the initial extremely low population levels, the intent was to use 100% of the summer chum returning to Jimmycomelately Creek as broodstock. A temporary adult trap (operated by WDFW and volunteers of North Olympic Salmon Coalition) was located near the most downstream point of observed natural spawning activity; nearly the entire run was available for trapping, decreasing the risk that fish trapped through the program were not representative of the total run. During 1999, 2000, and 2002, approximately 85% of the summer chum returning to Jimmycomelately Creek were included in the supplementation program. Since 2004, the escapements of summer chum were larger, less than about 10% of the return was used for broodstock, adequate numbers of broodstock were collected for the program throughout the run timing, and the remainder of the summer chum were passed upstream to spawn naturally in Jimmycomelately Creek.

General Program Assessment

It appears that the JCL Creek summer chum supplementation program has been generally successful in collecting a representative sample of broodstock from the natural JCL Creek summer chum stock. The supplementation program has contributed to the increase of adult returns from the post population decline (1989-1991) average escapement of 88 fish to an average escapement of 2,914 fish during 2009-2012. Supplementation program adults comprised about 30% to 90% of the total escapement during 2005 through 2013 (see Table 2-9, Figure 4-9,). The Co-managers will continue to monitor the adult returns from natural spawners and from fry released from the supplementation program.

Consistent with the standards set in the SCSCI and HGMP, the expected duration of the program is a maximum of 12 years (3 generations) beginning with brood year 1999. The program was terminated with brood year 2010 after 12 years of operation and after accomplishing the program objectives.

The Jimmycomelately Creek supplementation project has addressed the program objectives described in section 3.2.3.4 of the SCSCI.

The SCSCI noted that habitat impacts are high in JCL Creek and may be contributing to the risk to summer chum, and recommended that habitat protection and recovery measures should be addressed concurrent with supplementation project development. The Jamestown S'Klallam Tribe, WDFW, and numerous other partners have implemented habitat restoration projects in freshwater and estuarine areas of JCL Creek. In particular, the restoration and improvement of lower creek and upper estuarine habitat in the watershed now provides improved access to spawning areas, and improved spawning and incubation conditions, for adult summer chum salmon returning as a result of the supplementation program. The integration of these habitat restoration actions with the supplementation program is designed to improve prospects for supporting a self-sustaining, viable natural summer chum salmon population in the watershed after the supplementation program terminates.

PROGRAM RECOMMENDATIONS

The summer chum supplementation and reintroduction programs have been effective and SCSCI standards should continue to be implemented for ongoing programs.

The monitoring and evaluation of the supplementation programs and naturally spawning populations is being done well and should continue to adhere to the guidelines in the SCSCI. To assess whether the natural populations are self-sustaining, it will be important to monitor population trends and reproductive success of natural populations in years following the termination of each hatchery program.

It is important to continue to integrate hatchery, habitat, and harvest management actions consistent with the SCSCI. An overarching premise assumed in implementing these conservation hatchery programs in the region is that summer chum salmon populations threatened with extinction cannot be recovered to viable population levels with harvest and hatchery measures alone. Commensurate, timely improvements in the condition of habitat critical for summer chum salmon survival are necessary to recover the listed populations to healthy levels.

SELECTION OF NEW PROJECTS

Consistent with the SCSCI, it is possible to consider new projects, but the selection process will not be implemented at this time lacking new at risk populations and pending completion of assessments of ongoing projects. To fully meet the recovery criterion for spatial distribution, a program may be need to reintroduce one or more spawning aggregations between Big Beef Creek and Tahuya River on the eastern shore of Hood Canal (see Puget Sound TRT Long-term Viability Criteria section, below).

OTHER SCSCI HATCHERY PROGRAM REVIEWS

HATCHERY SCIENTIFIC REVIEW GROUP

The Hatchery Scientific Review Group (HSRG 2002, 2004) favorably reviewed the SCSCI summer chum hatchery programs and provided recommendations and comments, including:

- *"Continue the existing programs consistent with the SCSCI, including collecting and analyzing all data necessary to evaluate the programs' success"*

- *"The SCSCI is a well-designed, well-conducted program that appears to be achieving its goals. It is an example of a successful conservation program and partnership among state, tribal, private, and federal entities"*

- *"The program, which may serve as a prototype for similar efforts in the future, has met the HSRG's first key principle of beginning with a solid goal setting process. Ensuring* *complete monitoring and evaluation of this program will be crucial to meeting the second and third principles -- scientific defensibility and informed decision-making"*

- *"Like all integrated hatchery programs, success will depend on good habitat being available to both and hatchery- and natural-origin components of the integrated population".*

RECOVERY SCIENCE REVIEW PANEL

The Recovery Science Review Panel (RSRP) was convened by NOAA Fisheries to guide the scientific and technical aspects of recovery planning for listed salmon and steelhead species throughout the West Coast. The co-managers made a presentation to the RSRP on August 31, 2004 on the development and implementation of artificial production (hatchery) approaches presented in the SCSCI to assist in the recovery of summer chum. The RSRP (2004) reviewed and commented on the SCSCI program, as follows:

- "*This program is especially notable for its dual commitment not only to hatchery and management measures but also to habitat improvement to follow the ESA mandate of restoring numbers of fish and the ability of the natural environment to sustain fish"*
- *"This program has developed a rigorous set of protocols for conservation-driven hatchery programs so as to limit risk of predation on wild stock fish, limit potential competition between hatchery and wild fish, minimize potential disease introduction from hatcheries to the natural system, and maintain genetic variability among and within wild populations. In cases where recovery objectives have been met, hatchery augmentation has ceased. Thus the focus of the restoration program falls unambiguously on promoting recovery of wild stocks and the habitat required to sustain them"*
- *"This work is so important, and is of such high quality, that its results deserve wide dissemination in the scientific community".*

NMFS SALMON RECOVERY DIVISION

The NMFS Salmon Recovery Division has also reviewed the Hood Canal summer chum ESU hatchery programs (NMFS 2005). The report discussed summer chum stocks included in the ESU populations, status of natural populations, broodstock/program history, similarity between hatchery origin and natural origin fish, program design, program performance, and an assessment of viable salmonid population (VSP) parameters.

The summary of the VSP assessment in NMFS (2005) concluded that (1) hatchery populations produced by the eight programs have benefited the abundance, diversity, and spatial structure of the Hood Canal summer chum ESU; (2) hatchery program effects on the productivity of the natural summer chum populations are as yet unknown; and (3) monitoring of summer chum salmon population trends and reproductive success in years following the last hatchery origin adult returns is needed to assess whether the natural populations are self-sustaining. In addition, it was stated that the eight hatchery programs have benefited the diversity of the ESU by preserving populations threatened with extinction (preventing extirpations), bolstering total population sizes (retaining within population genetic diversity), and creating genetic reserves (through reintroductions of transplanted stocks into historical summer chum streams where the native populations were extirpated).

Also, it was noted that the ESU spatial structure has benefited through summer chum spawning range extensions resulting from reintroduction efforts at Big Beef Creek, Chimacum Creek, and (in 2006) the Tahuya River. And finally, the increased summer chum spawner abundances and densities in supplemented watersheds has led to increased areal distribution of spawners in the Big Quilcene and Salmon Creek watersheds, relative to pre-supplementation years.

5) ECOLOGICAL INTERACTIONS

The SCSCI addressed two specific areas of potentially adverse effects on summer chum from ecological interactions: artificial production and marine mammal predation. Recommendations were made to address negative interactions associated with artificial production and there was acknowledgment that further study was needed to help identify possible future actions to mitigate predation impacts of marine mammals. Following are updates of progress in these two areas of concern.

HATCHERIES

The SCSCI assessed potential effects of existing hatchery programs upon summer chum in four categories: hatchery operations, predation, competition/behavior modification, and fish disease (SCSCI, section 3.3.2.1). Hatchery programs for individual salmonid species (other than summer chum) were rated as high, medium or low risk for designated hazards within each category. Those programs with hazards of high or medium risk were assigned specific risk aversion and monitoring/evaluation mitigation measures that if implemented would reduce the hazards to low risk.

Table 5-1 shows the programs that were in existence in 1998. The table duplicates Table 3.15 of the SCSCI, except that strikethroughs indicate the programs that have been discontinued through 2004 as reported in first 5-year review (program terminations and reductions since 2004 are noted in table footnotes). In addition, any changes made since the first 5-year review are shown in Table 5-1 in red font and strikeout. For example, there have been terminations of the Skokomish yearling Chinook (Rick's Pond) program, the Snow Creek coho supplementation program, and WDFW and Hamma steelhead yearling programs. Also, new programs include steelhead integrated conservation (supplementation) programs started on S.F. Skokomish, Duckabush, and Dewatto rivers using indigenous stocks and a fall chum program at Rick's Pond.

Also shown in the table are the risk aversion and monitoring/evaluation mitigation measures to be met by each program that was determined to have one or more hazards of high or medium risk (the table describes the measures in abbreviated form; complete descriptions are available in section 3.3.2.1 of the SCSCI). Finally, Table 5-1 indicates the status of implementing the mitigation measures by the accompanying symbols: **Y** = yes, measure(s) was implemented, **N** = no, measure(s) was not implemented, **Y/N** = partial implementation of the measure(s), or **NA** = not applicable.

The vast majority of the mitigation measures have been implemented since they were identified. The only exceptions have been for several relatively small citizen group projects; these fall into two categories – monitoring and reporting project operations, and on-site health monitoring and certification of juvenile fish by a pathologist before release.

Overall, since implementation of the hatchery ecological interactions mitigation measures, there has been good compliance within the Hood Canal summer chum ESU. Moreover, the risk of such interactions has decreased with the substantial reduction of total production and number of non-summer chum hatchery programs.

Table 5-1. Summary description of Risk Aversion (r.a.) and Monitoring and Evaluation measures planned for artificial propagation programs in the Hood Canal summer chum region as reported in WDFW and PNPTT (2007) and for the years since 2004 (indicated in red font). Abbreviations "Y", "N", or "Y/N" shown in parentheses next to each measure indicate: "yes", the measure was implemented, "no" the measure was not implemented, or "yes and no" the measure was partially implemented (see specific comments in Appendix Report 3 of WDFW and PNPTT (2007)). "NA" means the measure was not applicable. Strikethroughs indicate the project was discontinued. Program terminations and reductions after 2004 are described in footnotes.

			Hazard Categories and Assigned Risk Control Measures /1			
Agency	**Species** **Project**	**Release Class**	**Hatchery Operations**	**Predation**	**Competition and Behavior Modification**	**Disease Transfer**
	Fall Chinook					
WDFW	Hoodsport FH /2	Fingerling	--	--	--	--
		Yearling	--	--	--	--
	George Adams FH	Fingerling	--	--	--	--
	~~Sund Rock Net Pens~~	~~Yearling~~	--	--	~~r.a. #7, m&e#1~~	--
Skokomish Tribe	~~Enetai~~	~~Fingerling~~	--	--	~~m&e#1~~	--
Port Gamble Tribe	~~Little Boston~~	~~Fingerling~~	--	--	--	--
Citizen Groups	~~Union River~~	~~Fingerling~~	~~m&e#3-5~~	~~m&e#1~~	~~r.a.#4, m&e#1, 2~~	~~r.a.#4, m&e#1, 2~~
	~~Tahuya River~~	~~Fingerling~~	~~m&e#3-5~~	~~m&e#1~~	~~r.a.#4, m&e#1, 2~~	~~r.a.#4, m&e#1, 2~~
		~~Unfed fry~~	~~m&e#3-5~~	~~m&e#1~~	~~r.a.#4, m&e#1, 2~~	~~r.a.#4, m&e#1, 2~~
	~~Dewatto River~~	~~Fingerling~~	~~m&e#3-5~~	~~m&e#1~~	~~r.a.#4, m&e#1, 2~~	~~r.a.#4, m&e#1, 2~~
	~~Big Beef Creek~~	~~Fingerling~~	~~m&e#3 (Y/N),4 (Y), 5 (NA)~~	~~m&e#1 (Y)~~	~~r.a.#4 (Y); m&e#1 (Y)~~	~~r.a. #1 (Y/N), 2 (Y), 3 (N), 4 (Y), m&e#1 Y/N), 2 (Y)~~
	~~Skokomish River~~ /12	~~Yearling~~	~~m&e#3 (Y), 4 (Y), 5 (NA)~~	~~m&e#1 (Y)~~	~~m&e#1 (Y)~~	~~m&e#1 (Y), 2 (Y)~~
		~~Fingerling~~	~~r.a.#4,6; m&e#1-5~~	~~m&e#1~~	~~m&e#1~~	~~m&e#1, 2~~
	Hamma Hamma River	Fingerling	r.a.#4 (Y),#6 (Y); m&e#1-2, (Y), 3 (Y/N), 4 (Y), 5 (NA)	m&e#1 (Y)	m&e#1 (Y)	m&e#1 (Y/N), 2 (Y)
	~~Johnson Creek (Duckabush)~~	~~Fingerling~~	~~m&e#3-5~~	~~m&e#1~~	~~m&e#1~~	~~r.a.#1-3; m&e#1, 2~~
	~~Unnamed tribs.~~	~~Unfed fry~~	~~m&e#3-5~~	~~m&e#1~~	~~m&e#1, 2~~	~~r.a.#1-4, m&e#1,2~~
	~~Pleasant Harbor Net Pens~~	~~Yearling~~	~~m&e#3-5~~	~~m&e#1~~	~~r.a.#7, m&e#1~~	~~m&e#1,2~~
	~~HC Marina Net Pens~~	~~Yearling~~	~~m&e#3-5~~	~~m&e#1~~	~~r.a.#7, m&e#1~~	~~m&e#1,2~~

(Table continues on next page)

Table 5-1 (continued)

Species Agency	Project	Release Class	Hazard Categories and Assigned Risk Control Measures[1] Hatchery Operations	Predation	Competition and Behavior Modification	Disease Transfer
Chinook						
WDFW	Dungeness FH	~~Fry~~	--	~~m&e#2 (Y)~~	--	--
		Fingerling	--	m&e#2 (Y)	--	--
		Yearling	--	m&e#2 (Y)	--	--
Coho						
WDFW	Dungeness FH	Yearling	--	--	--	--
	Pt. Gamble Net pens	Yearling	--	--	r.a.#7 (Y)	--
	Quilcene Net pens	Yearling	--	--	r.a.#7 (Y)	--
	George Adams FH /3	Yearling	--	--	--	--
	~~Tarboo Creek~~	~~Fingerling~~	--	--	--	--
	~~Snow Creek~~	~~Unfed fry~~	--	~~m&e#2 (Y)~~	~~m&e#3 (Y)~~	--
		~~Presmolts~~	--	~~m&e#2 (Y)~~	~~m&e#3 (Y)~~	--
USFWS	Quilcene NFH /4	Yearling	--	--	--	--
		~~Fingerling~~	--	~~r,a#2, 3~~	--	--
Pink						
WDFW	Hoodsport FH /5	Fed fry	--	r.a.#4 (Y)	r.a.#1, 2 (Y)	--
	~~Dungeness FH~~	~~Fed fry~~	~~r.a.#1-5~~	--	~~r.a.#6~~	--
Fall Chum						
WDFW	Hoodsport FH /6	Fed fry	--	r.a.#4 (Y)	r.a.#1, 2 (Y)	--
	George Adams FH /7	Fed fry	--	--	--	--
	McKernan FH	Fed fry	--	r.a.#4 (Y)	r.a.#1, 2 (Y)	--
Skokomish Tribe	Enetai	Fed fry	--	--	--	--
Pt. Gamble Tribes	Port Gamble FH /8	Fed fry	--	--	--	--
USFWS	~~Quilcene NFH~~	~~Fed fry~~	--	--	--	--

(Table continues on next page)

Table 5-1 (continued)

Agency	*Species* Project	Release Class	Hazard Categories and Assigned Risk Control Measures[1] Hatchery Operations	Predation	Competition and Behavior Modification	Disease Transfer
	Fall Chum (continued)					
Citizen Groups	~~Mills Creek~~	~~Unfed fry~~	~~m&e#3-5~~	~~m&e#1~~	~~r.a.#3, m&e#1-2~~	~~r.a.#1; m&e#1,2~~
	~~Tahuya River~~	~~Unfed fry~~	~~m&e#3-5~~	~~r.a.#4, m&e#1~~	~~r.a.#3, m&e#1-2~~	~~r.a.#1; m&e#1,2~~
	~~Union River~~	~~Unfed fry~~	~~m&e#3-5~~	~~r.a.#4, m&e#1~~	~~r.a.#2, 3; m&e#2~~	~~r.a.#1; m&e#1,2~~
	~~L. Mission Creek~~	~~Unfed fry~~	~~m&e#3-5~~	~~m&e#1~~	~~r.a.#2, m&e#2~~	~~r.a.#1; m&e#1,2~~
	~~Skull Creek~~	~~Unfed fry~~	~~m&e#3-5~~	~~m&e#1~~	~~r.a.#2; m&e#2~~	~~r.a.#1; m&e#1,2~~
	Sweetwater Creek	Unfed fry	m&e#3 (Y/N), 4 (Y), 5 (NA)	m&e#1 (Y)	r.a.#2 (Y); m&e#2 (Y)	r.a.#1 (Y/N), 2,4 (Y) 3 (N); m&e1 (Y/N), 2 (Y)
	Unnamed 14.01xx (Grimm)	Unfed fry	m&e#3 (Y/N), 4 (Y), 5 (NA)	m&e#1 (Y)	r.a.#2 (Y); m&e#2 (Y)	r.a.#1 (Y/N), 2,4 (Y) 3 (N); m&e1 (Y/N), 2 (Y)
	~~Chinom Pt. (Ck)~~	~~Unfed fry~~	~~m&e#3-5~~	~~m&e#1~~	~~r.a.#2;m&e#2~~	~~r.a.#1-4; m&e 1,2~~
	Unnamed 14.0136 (Hood Canal Schools, formerly Adams)	Unfed fry	m&e#3 (Y/N), 4 (Y), 5 (NA)	m&e#1 (Y)	r.a.#2 (Y); m&e#2 (Y)	r.a.#1 (Y/N), 2,4 (Y) 3 (N); m&e1 (Y/N), 2 (Y)
	~~Skokomish River~~	~~Unfed fry~~	~~m&e#3-5~~	~~r.a.#4; m&e#1~~	~~r.a.#2; m&e#2~~	~~r.a.#1-4; m&e 1,2~~
	~~Jump-off Joe Creek~~	~~Unfed fry~~	~~m&e#3-5~~	~~m&e#1~~	~~r.a.#2; m&e#2~~	~~r.a.#1-4; m&e 1,2~~
	Unnamed 14.01xx (Mulberg, formerly Koopman)	Unfed fry	m&e#3 (Y/N), 4 (Y), 5 (NA)	m&e #1 (Y)	r.a.#2 (Y); m&e#2 (Y)	r.a.#1 (Y/N), 2, 4 (Y), 3 (N); m&e 1 (Y/N) 2 (Y)
	Skokomish River /12	Fed fry	--	r.a.#4 (Y)	r.a.#1, 2 (Y)	--
	Steelhead					
WDFW	~~Skokomish River /9~~	~~Yearling~~	~~--~~	~~r.a.#1-3 (Y)~~	--	--
	~~Dosewallips River /9~~	~~Yearling~~	~~--~~	~~r.a.#1,2 (Y), 3 (Y/N)~~	--	--
	~~Duckabush River /9~~	~~Yearling~~	~~--~~	~~r.a.#1,2 (Y), 3 (Y/N)~~	--	--
	S.F. Skokomish /13	2+ yr old, 4+ yr old adult releases	r.a.#4, 6 (Y); m&e#1,2,4 (Y), 3 (Y/N), 5 (NA)	r.a.#1,2 (Y/N), 3 (Y); m&e#1 (Y)	m&e#3 (NA)	m&e#1 (Y/N), 2 (Y)
	Dungeness FH	Yearling		r.a.#1-3 (Y)	--	--
Citizen Groups	~~Hamma Hamma River /10~~	~~2+ Yearling~~	~~r.a.#4, 6 (Y); m&e#1,2,4 (Y), 3 (Y/N), 5 (NA)~~	~~r.a.#1,2 (Y/N), 3 (Y); m&e#1 (Y)~~	~~m&e#3 (NA)~~	~~m&e#1 (Y/N), 2 (Y)~~
	Duckabush River /13	2+ yr old, 4+ yr old adult releases	r.a.#4, 6 (Y); m&e#1,2,4 (Y), 3 (Y/N), 5 (NA)	r.a.#1,2 (Y/N), 3 (Y); m&e#1 (Y)	m&e#3 (NA)	m&e#1 (Y/N), 2 (Y)
	Dewatto River /13	2+ yr old, 4+ yr old adult releases	r.a.#4, 6 (Y); m&e#1,2,4 (Y), 3 (Y/N), 5 (NA)	r.a.#1,2 (Y/N), 3 (Y); m&e#1 (Y)	m&e#3 (NA)	m&e#1 (Y/N), 2 (Y)

Table 5-1 (continued)

1 Risk aversion ("r.a.") and monitoring and evaluation ("m&e") measures indicated as required for each project are keyed by number to measure applicable to each hazard described in section 3.3.2.1 of the Summer Chum Salmon Conservation Initiative.

2 At Hoodsport Hatchery following release year 2005, Chinook fingerling production was reduced from 3.0 million 2.8 million and Chinook yearling production was reduced from 250 thousand to 120 thousand.

3 At George Adams Hatchery following release year 2004, coho yearling production was reduced from 500 thousand to 300 thousand.

4 At Quilcene National Fish Hatchery following release year 2006, coho production will be reduced from 450 thousand to 400 thousand.

5 At Hoodsport Hatchery following release year 2004, pink salmon production was reduced from 1.0 million to 500 thousand.

6 At Hoodsport Hatchery, fall chum production was reduced from 15 million to 12 million following release year 2004.

7 At George Adams Hatchery following release year 2004, the fall chum program was terminated.

8 At Port Gamble (Little Boston) Hatchery following release year 2005, fall chum production was reduced from 900 thousand to 500 thousand.

9 Following the 2004 release year, steelhead plants in the Skokomish, Dosewallips and Duckabush rivers were terminated.

10 Hamma Hamma River steelhead releases occurred in 2003 but not 2004. The program was discontinued in 2006.

11 Snow Creek coho supplementation program was discontinued in Brood Year 2003 with final releases in 2005; monitoring is ongoing.

12 At Skokomish River (Rick's Pond), Chinook yearling program was discontinued in BY 2010 and new 1.1 million fall chum program was added beginning BY 2011.

13 New steelhead integrated conservation (supplementation) programs on S.F. Skokomish, Duckabush, and Dewatto rivers using indigenous stocks. The Hood Canal Steelhead Project (Berejikian et al. 2007) is a collaborative effort between National Marine Fisheries Service, Washington Department of Fish and Wildlife, Skokomish Tribe, the Port Gamble S'Klallam Tribe, the Point No Point Treaty Council, Long Live the Kings, and the Hood Canal Salmon Enhancement Group.

MARINE MAMMALS

Besides those reported in the first SCSCI 5-year review (WDFW and PNPTT 2007), there have been no studies or developments with respect to marine mammal impacts on summer chum populations.

6) HABITAT

The Co-managers recognize the critical importance of habitat management to the protection and recovery of summer chum salmon. However, habitat management is usually a shared responsibility with local jurisdictions, private landowners, and other state and federal agencies. Except for management of lands in their possession and the issuing of restrictions through Hydraulic Project Approvals, the Co-managers generally have no jurisdiction over land and water resources, and therefore do not directly regulate land or water use for protection of the habitat. We therefore work with the aforementioned jurisdictions and others to effect habitat protection. Most recently, in particular, we have been working with the counties and agencies that do have jurisdiction, to provide information and support that is consistent with habitat management recommendations contained in the SCSCI. Section 3.4 of the SCSCI provides guidance and direction for pursuit of habitat protection and recovery measures with 1) an initial analysis of factors limiting summer chum habitat in the watersheds and sub-estuaries, 2) descriptions of habitat protection and restoration strategies, 3) recommendations for monitoring and research, and 4) a discussion of implementation focusing on what participants and what their roles need to be for effective habitat protection and improvement. The SCSCI's Appendix Report 3.6 shows detailed results of habitat analysis and provides recommendations for recovery actions specific to individual watersheds. More recent habitat protection and restoration planning efforts that update, extend and even supersede those of the SCSCI are described below.

Since the SCSCI was completed in 2000, considerable activity promoting habitat protection and improvement has occurred in Hood Canal and the eastern Strait. The following outline briefly describes major actions implemented over the past five years and currently in process. No priority is implied by the order of items in the outline. However, the below described Hood Canal and Eastern Strait of Juan de Fuca Summer Chum Recovery Plan (item # 10) has been adopted by NMFS as the recovery plan required under ESA for a listed species; this plan is intended to incorporate all summer chum related habitat planning efforts and direct future summer chum habitat recovery activities.

1) The Washington State Conservation Commission led a joint effort to identify habitat limiting factors for all salmonids in the Watershed Resource Inventory Areas (WRIAs) within Hood Canal and the eastern Strait (Correa 2002 – WRIA 17, Correa 2003 – WRIA 16, Haring 1999 – WRIA 18, Kuttel 2003 – WRIAs 15[west] and 14[north]). These limiting factors analyses addressed all salmon species, including Hood Canal summer chum, and were useful sources of information for various recovery planning forums (see below). The analyses addressed estuarine and nearshore as well as freshwater habitats.

2) Within Hood Canal and the eastern Strait, watershed planning has been under way that addresses water issues (water quality and flow), accounting for effects on salmonid habitat (as provided under Washington State RCW 90.82 [HB 2514]). Planning groups addressing WRIAs 16, 15, 14 (the northern portion that drains into Hood Canal), and 17 are nearing completion of the watershed plans. As explained within the HCCC summer chum salmon recovery plan (HCCC 2005):

    Chapter 90.82 RCW provides a process to plan and manage water resources in designated water resource inventory areas (WRIA). Each WRIA under this process *has established Planning Units, comprised of councils of governmental and non-governmental entities to perform two tasks: 1) determine the status of water resources in a watershed and 2) resolve the often conflicting demands for the water, including ensuring adequate supplies for salmon (WRIA 17, 2003). The WRIA Planning Units are to develop a watershed plan that accomplishes these tasks. RCW 90.82 further states that the watershed plan shall be coordinated or developed to protect or enhance fish habitat in the management area. Watershed plans are to be integrated with strategies, developed under other processes, to respond to potential and actual ESA listings of salmon and other fish species*

Water issues are particularly relevant to summer chum recovery as adult fish enter the rivers during late summer and early fall. Low flow conditions at that time can limit fish access, affect spawning distribution, and impact survival of eggs and alevins in the gravel.

3) Dissolved oxygen levels in Hood Canal marine areas recently reached historic lows, triggering a strong response at all levels of government. The Puget Sound Action Team and the Hood Canal Coordinating Council developed a Preliminary Assessment and Corrective Action Plan that provided an initial assessment of human contributions to the problem and proposed some initial actions to address problem areas (PSAT and HCCC 2004).

   Salmon are thought to be mobile enough to avoid most of the effects of low dissolved oxygen but more study is needed. The long-term consequences of low dissolved oxygen levels to marine life are not well understood. Local groups and county, state and federal entities are joining forces to study and identify the potential causes through the newly formed Hood Canal Dissolved Oxygen Program. Several remedial projects to address likely causative factors, including new sewage treatment programs, have been initiated or soon will be. Updated information can be found at the website, http://www.hoodcanal.washington.edu/.

4) The counties (Jefferson, Kitsap and Mason) contracted for studies, now completed, to identify habitat refugia important for the support of salmonids at different stages of their life histories (Kitsap County 2000, May and Peterson 2003). These studies help inform recovery planning and regulatory actions by accounting for the value of refugia and connections between salmonid habitats.

5) The SCSCI recognized the importance of nearshore habitat (see SCSCI Appendix Report 3.5) and influenced the ongoing pursuit of nearshore habitat assessments within Hood Canal and the Eastern Strait[1]. A major federal habitat initiative for Puget Sound, the Puget Sound Nearshore Ecosystem Recovery Project (PSNERP) has been created and hopefully will assist in making federal funding available for large scale projects (e.g. Highway 101 causeway retrofits) relevant to summer chum recovery. Early action nearshore habitat projects funded by the U.S. Army Corps of Engineers program, Puget Sound and Adjacent Waters, may focus on the Skokomish estuary restoration.

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[1] Relevant studies in Hood Canal and the eastern Strait include an inventory of anthropogenic shoreline modifications (Hirschi et al. 2003), an assessment of intertidal eelgrass landscapes (Simenstad et al. In prep.), and an evaluation of historical changes to estuaries, spits and tidal wetlands (Todd et al. 2006).

6) Counties within the ESU have been or will soon be in the process of updating shoreline management plans, critical area ordinances and comprehensive plans that regulate land use activities. We anticipate the planning processes described here will positively influence these updates leading to continuing and improved measures to protect summer chum habitat.

   Funding for salmon habitat projects became available through the Washington State Salmon Recovery Funding Board (SRFB) in 2000, leading to coordination and implementation of many habitat projects in the Hood Canal and eastern Strait of Juan de Fuca watersheds. The Hood Canal Coordinating Council and North Olympic Peninsula Lead Entity have served as the lead entities (under House Bill 2496 and Senate Bill 5595) in Hood Canal and the Strait of Juan de Fuca to coordinate local project proposals for funding by the SRFB. These two organizations have developed procedures for prioritizing project proposals within their respective areas, in cooperation with tribes, local and state agencies, and non-governmental organizations. The SCSCI has been used in developing strategies for recovery planning; for example, see below item #9. The co-managers and many partners have also been active in implementing studies and habitat protection and restoration projects throughout the Hood Canal and Strait of Juan de Fuca regions. Details on many of these efforts can be found in the Habitat Work Schedule for each Lead Entity (see http://hws.ekosystem.us/).

7) The Washington State SRF Board has funded numerous salmon habitat recovery assessments and recovery projects within the Hood Canal summer chum ESU over the last five years. Other funding sources have also contributed to the recovery effort.

8) The Hood Canal Coordinating Council (HCCC), working with agencies, tribes, non-governmental organizations and other local parties, prepared a Hood Canal / Eastern Strait of Juan de Fuca Salmon Habitat Recovery Strategy to serve as the basis for planning and funding salmon recovery projects (HCCC 2004). The SCSCI, along with other information sources described above, was used in developing this Salmon Habitat Recovery Strategy. The Strategy applied to all salmonid species but emphasized Hood Canal summer chum (and Puget Sound Chinook) because of ESA threatened listing status. It was the basis for prioritizing and selecting recovery projects for funding by the Washington State Salmon Recovery Funding (SRF) Board in Hood Canal and the Eastern Strait (extending to and including Sequim Bay). Recently, this strategy was incorporated into the Hood Canal summer chum recovery plan described below.

9) The HCCC, working with counties of the ESU (Jefferson, Kitsap and Mason), has prepared a Hood Canal and Eastern Strait of Juan de Fuca Summer Chum Salmon Recovery Plan that assessed potential development effects on summer chum habitat relative to county land use management and identifies habitat recovery projects within summer chum watersheds and the stream deltas (HCCC 2005). The plan also incorporated the Co-mangers' approach to harvest and hatchery management (based on SCSCI provisions, approved by NMFS under the ESA 4(d) rule). The HCCC plan was reviewed by agencies, tribes and others. Following public review, NMFS adopted it as the Recovery Plan for the listed summer chum ESU as required under rule 4(f) of the ESA (NMFS 2007a, 2007b).

10) A major salmon recovery effort, focusing primarily on Puget Sound Chinook but also including bull trout, recently produced a Puget Sound Salmon Management Plan (PSSS 2005). The Puget Sound Shared Salmon Strategy, a Washington State designated salmon recovery planning group for the region, led this effort that included the participation of local watershed planning groups throughout Puget Sound. The plan has been adopted by NMFS as the Puget Sound Chinook ESU Recovery Plan, consistent with rule 4(f) of the ESA (NMFS 2007c). This Chinook recovery effort overlaps with that for Hood Canal summer chum, specifically in the Hood Canal watersheds of Dosewallips, Duckabush, Hamma Hamma and Skokomish, and the eastern Strait Dungeness watershed, but also in the nearshore and marine areas. Potential for implementation of habitat actions by local, state, federal and tribal governments is strengthened when benefits are obtained for more than one species and under two ESA Recovery Plans.

11) The treaty tribes prepared the State of Our Watersheds report (see http://nwifc.org/publications/sow/) to provide a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. The report serves as a bellwether – both and indicator and a warning – that the tide of habitat loss and degradation must be turned if we are to restore the salmon resource. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at http://treatyrightsatrisk.org/ .

12) The HCCC Business Plan for Hood Canal/Eastern Strait of Juan de Fuca Summer Chum Salmon (HCCC 2013) identifies the conservation outcomes needed, an implementation plan with strategic priorities and performance measures, and funding and resources needed to recover summer chum salmon. Efforts are focused on three strategies for habitat: habitat conservation, habitat restoration, and habitat management. Details are provided on the basis for each strategy and specific projects are identified. In addition, the HCCC, in partnership with the co-managers and NMFS, has just completed an update to the PSTRT's population viability analysis (Sands et al. 2009) by incorporating additional years of abundance and productivity data and considering variation associated with ocean production regimes and potential climate change. A guidance document (Lestelle et al. 2014) supporting the Business Plan incorporates the new data and also presents an analysis that determines how much habitat performance is necessary to bring each watershed to a functional condition associated with a threshold for viability with low risk. Once the 'gap' between 2013 baseline conditions and recovery has been identified, the HCCC and partners will update and refine the overall Hood Canal/Strait of Juan de Fuca summer chum recovery goals, as well as finalize and adopt the habitat goals necessary for each watershed. These habitat goals are currently expressed as 10 year habitat goals and align with the Business Plan timeline. Whether they will be implemented in 10 years depends on operational and capital funding availability.

13) The HCCC has additional excellent information on their website. For example, a 2011 Habitat Implementation report is available that summarizes the number, categories, and metrics for habitat projects that have been implemented as a part of the Summer Chum Salmon Recovery Plan (HCCC, 2005) between 1983 and 2011 and also provides a set of recommended next steps for future program development (see

http://hccc.wa.gov/Salmon+Recovery/Summer+Chum+Salmon/default.aspx).

The HCCC and its partners are working with the broader community to create a strategic action plan that will set priorities to ensure a future in which the Hood Canal remains a special place. The Hood Canal Integrated Watershed Plan (IWP) is an organizational concept for integrating existing plans and programs, as well as identified gaps, through a strategic planning framework in order to meet the Plan goals. The ultimate purpose of the IWP is to provide a set of prioritized actions and strategies to be implemented by and for the Hood Canal community (see http://hccc.wa.gov/).

Additional information on habitat protection and restoration efforts is presented at the biannual HCCC Summer Chum Salmon Recovery Symposia (see http://hccc.wa.gov/Salmon+Recovery/Summer+Chum+Salmon/Summer+Chum+Salmon+Recovery+Symposia/2013+Recovery+Symposium/default.aspx).

In conclusion, implementation of habitat elements of the recovery plan is progressing well. After 13 years of implementing habitat recovery projects made possible by dedicated federal and state funding, and eight years of implementing programmatic habitat actions through federal, state, and local regulatory programs, physical improvements on the ground and biological improvements in fish returns can be measured. After compiling all known, significant habitat projects into the Habitat Work Schedule for the eight watersheds with extant summer chum subpopulations, the HCCC estimates that about 34 percent of projects needed have been implemented (HCCC 2013) and that we are one-third of the way to meeting habitat project goals.

New information has been gained to help direct management actions and habitat management planning has continued, incorporating participation at all levels, including local governments, nongovernmental organizations, tribes, and state and federal agencies. Considerable investment has been made in habitat protection and recovery projects that have been selected in planning processes that account for priorities arrived at through joint local planning efforts. Progress with land use management has been slower, but local governments have been updating or are about to update shoreline management plans, critical area ordinances and comprehensive plans. A summer chum recovery plan has been developed by the Hood Canal Coordinating Council and has been adopted by NMFS as the listed species Recovery Plan required under the ESA. This new plan provides direction for current and future actions to protect and restore summer chum habitat.

The co-managers remain concerned, however, that with the pressures of population growth, existing land use management measures may be compromised or not enforced. The Co-managers advocate a strong habitat adaptive management program be developed under the new summer chum Recovery Plan and that it be integrated with the existing SCSCI harvest and hatchery management programs. After all, “Habitat is where it’s at!”.

7) SCSCI PERFORMANCE STANDARDS

Section 3.6.4 of the SCSCI describes performance standards "…meant to provide immediate criteria upon which to measure progress toward recovery of summer chum populations". The standards are described within four categories: abundance, productivity, escapement, and management actions. Following is a review and discussion of how well these standards have been met. Each performance standard is listed below, followed by a discussion of how the standard has been addressed.

ABUNDANCE

Abundance refers to the annual total number of adult recruits or the adult run size prior to any fishing related mortality.

1. *Annual post-season estimated abundance must be equal to, or greater than that of the parent brood abundance. When this is not the case, an investigation of the causes shall be made and remedial measures shall be formulated when appropriate*.

The comparison of the post-season annual abundance estimate to the parent brood abundance estimate was intended as a simple, short-term means of alerting managers of a potential downturn in abundance. With such an alert, managers were to proceed with caution, taking appropriate remedial measures. At the time this standard was developed, we lacked the information needed to track returns by age directly to the brood year source; the standard was supposed to provide a rough approximation of performance relative to brood abundance based on annual abundance estimates. The brood year abundance was to be calculated as the average of the annual abundances estimated three and four years prior to the indicated year of annual post-season abundance.

As reported in the first five-year review of the SCSCI (WDFW and PNPTT 2007), this well-intentioned but crude standard of abundance comparison is not a very useful management tool. Given the success of recent data collection and analysis, a more direct approach now exists to relate fish returns to parent brood year; that is, we have generated estimates of NOR productivity (recruits per spawner) that are more effective in addressing the brood year performance implied by this standard.

NOR productivity results are described in Table 2-11 and Table 2-12 of the Stock Assessment section for brood years 1996 through 2009. Also see the section on productivity performance standards, below.

2. *Annual abundance should be stable or increasing and the 5 year average abundance must be higher than the threshold. Annual abundances shall not fall below the critical threshold in more than two out of five consecutive years. Information concerning the productivity and productive capacity of the stocks(s) shall be pursued to further refine the thresholds themselves.*

Post season natural-origin abundance estimates for the five years, 2009 through 2013, are provided in Table 7-1. Annual abundance appears to be stable or increasing for each management unit. The five-year average abundance exceeded the critical threshold for each management unit. In 2009, the Sequim Bay management unit natural-origin abundance was lower than the critical threshold. In 2011, the Southeast Hood Canal management unit natural-origin abundance was lower than the critical threshold. In all other years, the natural-origin abundance of each management unit exceeded the critical threshold each year.

Table 7-1. Critical thresholds and annual and five-year mean natural-origin abundance estimates for Hood Canal summer chum, 2009-2013.[1]

Management Unit	Critical Threshold[2]	2009	2010	2011	2012	2013	Mean
Sequim Bay	220	***203***	742	819	1,281	5,684	1,746
Discovery Bay	790	1,446	3,262	2,619	2,822	3,337	2,697
Quilcene	1,260	2,508	2,097	2,736	12,500	8,723	5,713
Mainstem Hood Canal [3]	2,980	4,537	8,034	4,284	7,954	3,436	5,649
S.E. Hood Canal [3]	340	606	956	**287**	2,207	1,818	1,175

[1] NOR abundance estimates are from Table 2-10 in the Stock Assessment section.

[2] Values that fall below the applicable threshold/flag are shown with bold and italicized font.

[3] Note that for the purpose of this table, the Mainstem Hood Canal management unit includes only the Dosewallips, Duckabush, Hamma Hamma, and Lilliwaup stocks and SE Hood Canal MU only includes Union River.

3. *Liberalization of actions under the Base Conservation Regime shall not be considered unless number 2 above is met.*

As shown above, the performance standards of number 2 have been met and, as noted at the end of the Harvest Management section, the co-managers intend to begin developing criteria and provisions for a “Recovering” regime. These criteria would describe the conditions under which the Base Conservation Regime restrictions could be relaxed and these provisions would describe the specific management measures under a “Recovering” regime. See also discussion in Harvest Management section.

PRODUCTIVITY

The following standards apply to productivity of management units and stocks. Productivity refers to the ratio of maturing natural-origin recruits per parent brood spawner.

1. *Five year estimated mean productivity shall be greater than 1.2 recruits per spawner.*

As shown in Table 7-2, mean productivity for the five recent complete brood years, 2004 – 2008 exceeded 1.2 natural-origin recruits per spawner for 2 of the 11 stocks including Chimacum and Duckabush. For the remaining 9 stocks, the average recruits per spawner is 48% below the 1.2 R/S goal at 0.62. Lilliwaup, Big Beef and Union have the lowest productivity rates for the time period, rarely exceeding 0.50 R/S on a given year. When the time period is shifted to include the partial 2009 brood year, 4 of the 11 stocks exceed 1.2 R/S due to increased returns largely in 2009. Only the Port Townsend Management Unit exceeds the 1.2 criteria, even without inclusion of the 2009 brood year. The table results are based on analysis of collected age data for adult return years 2006 through 2013.

Table 7-2. Productivity estimates (natural-origin recruits/spawner) for Hood Canal and Strait of Juan de Fuca summer chum management units and stocks, brood years 2004-2008.

Management Unit (MU)	Stock	Brood year 2004	2005	2006	2007	2008	Mean productivity BYs 2004-2008
Sequim Bay	**Jimmycomelately**	0.60	0.25	0.47	1.66	1.33	0.86
Discovery Bay	**Salmon/Snow**	0.39	0.22	0.31	2.69	1.40	1.00
Port Townsend	**Chimacum**	3.74	3.41	1.90	5.08	7.86	4.40
Quilcene/Dabob Bays	**Big/Little Quilcene**	0.18	0.37	0.14	1.75	1.88	0.86
Mainstem Hood Canal	**Dosewallips**	0.42	0.42	0.92	1.05	0.44	0.65
	Duckabush	0.40	2.33	1.18	2.16	0.89	1.39
	Hamma	0.87	0.59	0.37	0.87	0.62	0.66
	Lilliwaup	0.29	0.07	0.11	0.21	0.39	0.21
	Big Beef	0.64	0.31	0.15	0.13	0.23	0.29
	MU total	0.47	0.62	0.68	1.05	0.57	0.68
SE Hood Canal	**Union**	0.40	0.35	0.24	0.50	0.47	0.39
	Tahuya	1.30	2.67	0.03	0.43	0.15	0.92
	MU total	0.40	0.35	0.19	0.48	0.34	0.35

2. *The number of recruits per spawner when management units are at or near critical threshold abundances must be stable or increasing.*

All management units (MU) exceed the critical threshold abundances outlined in Table 7-1. Despite meeting critical thresholds, MU productivity trends are discussed hereafter. The R/S rates of all MU's are highly variable for brood years 2004 through 2008 (Table 7-2). When the time period is expanded to include 2008 and 2009 (see Table 2-12 in Stock Assessment section), several trends become apparent across MU's. Mainstem Hood Canal and SE Hood Canal stocks had variable productivity from 2003-2008 but consistently showed increased productivity in 2009, with the exception of Tahuya. Strait of Juan de Fuca and Port Townsend stocks show increasing productivity from 2003-2008. However, conversely to Hood Canal stocks, productivity for the 2009 brood year was significantly reduced for 3 of the 4 Straits and Port Townsend stocks. This may change as the remaining 2009 brood return data is incorporated.

ESCAPEMENT

Escapement refers to the portion of the abundance that has "escaped" through the various fisheries and arrived on the spawning grounds.

1. *The annual post-season estimated NOR escapement rate of each run must be within or above the range specified by the Base Conservation Regime.*

Table 7-3 provides NOR escapement rate information by stock and management unit, for the years 2008 through 2012. The table results are based on annual run reconstructions (for example, see Appendix Report 1). It is assumed that NOR and HOR escapement rates are the same. In all cases, the escapement rate has exceeded the upper end of the range. The Quilcene/Dabob management unit is managed for a flexible escapement range linked to achieving minimum escapements and the minimum escapement of 1,500 summer chum has been met every year since 2000, except during 2009 when escapement was 1,490 summer chum (see Table 3-6 in Stock Assessment section).

Table 7-3. BCR Target, actual annual, and mean escapement rates by management unit and stock for Hood Canal summer chum, 2008-2012[1]

Table 7 – 3. BCR Target, actual annual, and mean escapement rates by management unit and stock for Hood Canal summer chum, 2008-2012.

Management Unit Stock	**BCR Target (Range)**	**2008**	**2009**	**2010**	**2011**	**2012**	**Mean**
Sequim Bay Jimmycomelately	91.20% (88.2%-97.2%)	98.6%	99.4%	99.3%	99.5%	99.5%	99.3%
Discovery Bay Salmon/Snow	91.20% (88.2%-97.2%)	98.6%	99.4%	99.3%	99.5%	99.8%	99.3%
Port Townsend Chimacum	91.20% (88.2%-97.2%)	98.6%	99.4%	99.3%	99.5%	99.5%	99.3%
Quilcene/Dabob Big/Little Quilcene	1	65.8%	59.6%	98.3%	94.1%	93.9%	82.3%
Mainstem Hood Canal	89.10%	98.5%	99.1%	98.5%	99.0%	98.8%	98.8%
Dosewallips	(84.7%-96.7%)	98.5%	99.2%	98.6%	99.2%	98.8%	98.9%
Duckabush		98.5%	99.2%	98.6%	99.2%	98.8%	98.9%
Hamma Hamma		98.5%	99.2%	98.6%	99.2%	98.8%	98.9%
Lilliwaup		98.5%	98.4%	98.6%	99.2%	98.6%	98.7%
Big Beef		98.5%	98.2%	98.6%	99.2%	98.8%	98.7%
Southeast Hood Canal Union/Tahuya	89.10% (84.7%-96.7%)	98.5%	99.1%	98.5%	99.0%	98.8%	98.8%

1. No fisheryspecific exploitation rate is defined for this fishery. Instead, management relies on a stepped fishing schedule based on an inseason assessment of natural escapement.

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2. *Annual NOR escapements shall be stable or increasing and 5 year average escapements must be higher than the critical thresholds. Information concerning the productivity and productive capacity of the stock(s) shall be used to further refine the thresholds themselves.*

Table 7-4 describes estimated NOR post season escapements for the years 2009 through 2013 and five-year mean escapements for each management unit and stock.

Annual NOR escapements appear to be stable or increasing for each management unit. However, the Hamma Hamma and Lilliwaup stocks are at levels close to the critical threshold flags, so caution is warranted in determining that this criterion has been met for the Mainstem Hood Canal Management Unit. The five-year mean NOR escapements exceeded the critical threshold for all management units and stocks. However, the Hamma Hamma stock fell below the minimum escapement flag in 2009 and 2011. The Lilliwaup stock fell below the minimum escapement flag in 2008, 2009, and 2011. The South East Hood Canal management unit fell below the critical escapement threshold in 2011.

Table 7-4. Critical thresholds and annual and five-year mean NOR escapement estimates for Hood Canal summer chum, 2009-2013.[1]

Management Unit/ Stock	Critical Thresh./ Flag[2]	2009	2010	2011	2012	2013	Mean
Sequim Bay	200	202	737	814	1,274	5,656	1,737
Discovery Bay	720	1,437	3,238	2,605	2,807	3,320	2,681
Quilcene	1,110	1,490	2,064	2,580	11,739	7,950	5,165
Mainstem H.C.[3]	2,660	4,248	7,843	3,407	11,822	9,261	7,316
Dosewallips	736	1,094	2,410	1,130	2,828	1,778	1,848
Duckabush	700	2,496	3,876	1,515	5,156	4,063	3,421
Hamma	1042	***597***	1,370	***685***	2,206	2,186	1,409
Lilliwaup	182	***60***	188	***77***	1,631	1,233	638
S.E. Hood Canal	300	597	943	***285***	2,181	1,759	1,153

1. NOR escapement estimates are from Table 2-9 in the Stock Assessment section.

2. Shown are critical thresholds that apply to management units and minimum escapement flags that apply to stocks within the Mainstem Hood Canal management unit (SCSCI 2000). Values that fall below the applicable threshold/flag are shown with bold and italicized font.

3. Note that for the purpose of this table, the Mainstem Hood Canal management unit includes only the stocks shown and SE Hood Canal MU includes only Union River.

3. *Expected escapement rates are based on numerous assumptions made during the formulation of the Base Conservation Regime. Annually estimated rates, for the period to be evaluated, must be normally distributed across the Base Conservation Regime's anticipated range. If this does not occur, the Base Conservation Regime, its underlying assumptions, and the application of the Regime shall be reevaluated and remedial measures shall be formulated.*

The escapement rates are tightly bunched within the range of 98.5 to 99.5% (Table 7-3). The exception is for the Quilcene management unit where management of terminal fisheries (that are directed at co-occurring coho salmon) is designed to accommodate a lower escapement rate (and higher harvest rate) by meeting a minimum summer chum escapement number. The escapement rates are thus at the high end of the expected ranges. Therefore, they are not normally distributed across the Base Conservation Regime's anticipated range and the underlying assumptions for the anticipated range have not been borne out so far. It is important to note that not meeting the criterion is not a conservation concern since it has resulted in more of the returning fish escaping to spawn than originally anticipated. As a result, the co-managers don't anticipate formally changing the anticipated range under the Base Conservation Regime. The co-managers plan to explore development of a set of escapement rate (and exploitation rate) criteria and provisions that would apply under conditions of a “recovering” regime and would accommodate relaxing the current Base Conservation Regime restrictions.

MANAGEMENT ACTIONS

1. *At a minimum the plan (conservation initiative) strategies and actions shall result in stable recruit abundances at current levels, while ensuring that escapement rates are high. The plan’s strategies shall be considered successful if progress toward recovery is demonstrated by positive trends in NOR abundance.*

Escapement rates for all Hood Canal and Strait of Juan de Fuca management units remain high (Table 7-3). During 2005 through 2013, Hood Canal summer chum NOR abundance declined from the record highs during 2003 and 2004, but remained much improved over abundances during the 1990’s when management actions were initiated to recover summer chum. Abundance of summer chum remained high, and reached new record highs, in the Strait of Juan de Fuca during 2005 through 2013.

2. *Strategies and actions directed at management units or stocks, whose abundance is below their currently estimated critical threshold, will be considered successful if they stop and reverse the decline in productivity and/or abundance.*

For each management unit, the most recent five-year averages of natural-origin abundance and natural-origin escapement each exceeded their critical thresholds. The only stocks where improvement is still in question based on results through 2013 are the Hamma Hamma and Lilliwaup stocks (within the Hood Canal Mainstem management unit) which fell below their minimum escapement flags during several years of the last five years. All stocks and management units are being closely monitored.

3. *Plan (conservation initiative) strategies and actions shall be considered successful when all management units are maintained on average, above their critical abundance and escapement thresholds.*

All management units and stocks are on average above their critical abundance and escapement thresholds (Table 7-4). The averages for the Hamma Hamma and Lilliwaup stocks have been boosted by the relatively high abundances and escapements during 2012 and 2013 (Table 7-4).

8) RECOVERY GOALS

In 2003, the Co-managers identified interim recovery goals for individual stocks that addressed annual abundance (run size) and escapement, productivity and diversity (PNPTT and WDFW 2003). More recently, the Puget Sound Technical Recovery Team (PSTRT) has identified two independent summer chum populations (Strait and Hood Canal) within the ESU (PSTRT 2007) and viable salmonid population criteria providing for low extinction risk for these two populations. In adopting the Hood Canal Summer Chum recovery plan under the ESA, NMFS (2007a) stated its support managing for recovery at the level of the Co-managers' individual stocks (or what may be described as sub-populations of the PSTRT's two independent populations) as compatible with and a reasonable intermediate step toward the PSTRT's long-term population viability criteria. For the present, the Co-managers will continue to measure progress toward recovery by the individual stock recovery goals. What follows is a description of current stock status relative to the interim co-manager recovery goals and PSTRT long-term viability criteria.

CO-MANAGER INTERIM RECOVERY GOALS

ABUNDANCE AND ESCAPEMENT

Individual Stocks

To meet the abundance and escapement recovery goal criteria, a summer chum stock must, over the most recent 12 years, (1) have a mean abundance and a mean escapement of natural-origin recruits (NORs) that respectively meets or exceeds its abundance and escapement recovery goal thresholds and (2) have the natural-origin abundance and escapement fall below the respective stock's critical thresholds (or where applicable, minimum escapement flags) in no more than two of the most recent eight years and, additionally, in no more than one of the most recent four years.

Table 8-1 describes the most recent 12 year (2002-2013) annual mean NOR abundance and mean NOR escapement by stock in comparison to the stock's interim abundance and escapement recovery goal thresholds. Six of the eight stocks, Quilcene, Dosewallips, Duckabush, Union, Salmon/Snow, and Jimmycomelately, each meet or exceed their escapement recovery goal thresholds. Hamma Hamma and Lilliwaup were far below their respective escapement recovery goal thresholds. In addition, only four of the eight stocks, Quilcene, Dosewallips, Union, and Salmon/Snow also meet or exceed their abundance recovery goal thresholds. While Duckabush and Jimmycomelately nearly achieved the abundance recovery goal thresholds, Hamma Hamma and Lilliwaup were far below them (Table 8-1).

Table 8-1. Mean natural-origin recruit (NOR) stock abundances and escapements over most recent 12 years compared to interim recovery goal thresholds[1].

Stock	2002-2013 Mean Abundance	Recovery Abundance Threshold	2002-2013 Mean Escapement	Recovery Escapement Threshold
Hood Canal				
Quilcene	9,845	4,570	7,465	2,860
Dosewallips	3,339	3,080	3,303	1,930
Duckabush	***2,547***	3,290	2,518	2,060
Hamma Hamma	***1,339***	6,060	***1,317***	3,790
Lilliwaup	***146***	3,130	***143***	1,960
Union	1,936	550	1,908	340
Strait				
Salmon/Snow	3,065	1,560	3,047	970
Jimmycomelately	***419***	520	416	330

[1] Interim recovery goals include NORs only. Twelve year mean values that are less than the recovery thresholds are indicated by italics with bold font.

Table 8-2 describes natural-origin summer chum abundance and escapement values for the most recent eight years by stock and each stock's critical abundance and escapement thresholds or, where applicable, minimum escapement flags. Seven of the eight stocks, Quilcene, Dosewallips, Duckabush, Hamma Hamma, Union, Salmon/Snow and Jimmycomelately, have met the criteria and have had the natural-origin abundance and/or escapement fall below the respective stock's critical thresholds (or where applicable, minimum escapement flags) in no more than two of the most recent eight years and, additionally, in no more than one of the most recent four years. Lilliwaup was below the minimum escapement flag four times in the most recent eight years and once in the most recent four years (Table 8-2).

ESU

The recovery goal criterion for the ESU is that all six Hood Canal stocks and two Strait stocks meet the individual abundance and escapement criteria. Since only five of the Hood Canal stocks (Quilcene, Dosewallips, Duckabush, Hamma Hamma, and Union) and each of the Strait of Juan de Fuca stocks (Salmon/Snow and Jimmycomelately) are currently meeting its individual stock criteria, the ESU falls just short of its criterion for recovery under the co-managers' interim recovery goals.

Table 8-2. Annual natural-origin stock abundance and escapement over the most recent eight years compared to critical thresholds.[1]

Hood Canal	Critical Thresh.[2]	2006	2007	2008	2009	2010	2011	2012	2013
Quilcene									
Abundance	1,260	13,172	3,860	5,868	2,508	2,097	2,736	12,500	8,723
Escapement	1,110	10,884	2,496	3,861	1,490	2,064	2,580	11,739	7,950
Dosewallips									
Escapement	736	2,457	1,462	3,830	1,094	2,410	1,130	2,828	1,778
Duckabush									
Escapement	700	2,963	1,254	2,521	2,496	3,876	1,515	5,156	4,063
Hamma Hamma									
Escapement	1,042	2,709	1,416	1,384	**597**	1,370	**685**	2,206	2,186
Lilliwaup									
Escapement	182	426	**153**	**177**	**60**	188	**77**	1,631	1,233
Union									
Abundance	340	1,690	1,955	1,061	606	956	**287**	2,207	1,818
Escapement	300	1,667	1,846	1,044	597	943	**285**	2,181	1,759
Strait									
Salmon/Snow									
Abundance	790	4,571	1,681	1,729	1,446	3,262	2,619	2,822	3,337
Escapement	720	4,553	1,667	1,705	1,437	3,238	2,605	2,807	3,320
Jimmycomelately									
Abundance	220	346	472	587	**203**	742	819	1,281	5,684
Escapement	200	345	468	579	202	737	814	1,274	5,656

[1] Annual values that are less than the critical thresholds or minimum escapement flags are indicated

[2] Critical abundance and escapement thresholds have been defined for all management units in the SCSCI that are equivalent to individual stocks. Minimum escapement flags, but no critical abundance thresholds, have been described for individual stocks of the mainstem Hood Canal management unit (see Appendix 1.5 of SCSCI for description of thresholds and flags and their derivation).

PRODUCTIVITY

The productivity recovery goal criteria for each stock are (1) that natural recruits per spawner average at least 1.6 over the most recent eight brood years and (2) that no more than two of these eight years fall below 1.2 recruits per spawner. The first SCSCI 5-year review (WDFW and PNPTT 2007) had insufficient brood years to determine the recovery status of stocks, since the productivity recovery goal criteria requires measurements extending over 8 brood years and only 5 brood years were available at the time. Productivity estimates for brood years 2001 through 2008 are shown in Table 8-3. The 8-year mean productivity exceeds the mean productivity recovery goal criterion of 1.6 recruits per spawner for 3 of the 11 stocks and two MU's (Sequim Bay and Port Townsend) exceed that goal. In addition, Chimacum is the only stock to have R/S rates fall below 1.2 for no more than 2 of the 8 years. The remaining 10 stocks fall below 1.2 R/S approximately most of the time.

Table 8-3. Productivity estimates (natural-origin recruits/spawner) for Hood Canal and Strait of Juan de Fuca summer chum management units and stocks for the 2001 through 2008 broods. [1]

Management Unit (MU)	Stock	Brood year 2001	2002	2003	2004	2005	2006	2007	2008	Mean
Sequim Bay	Jimmycomelately	4.24	41.12	***0.80***	***0.60***	***0.25***	***0.47***	1.66	1.33	6.31
Discovery Bay	Salmon/Snow	***0.95***	***1.00***	***0.34***	***0.39***	***0.22***	***0.31***	2.69	1.40	0.91
Port Townsend	Chimacum	4.58	5.09	6.19	3.74	3.41	1.90	5.08	7.86	4.73
Quilcene/Dabob Bays	Big/Little Quilcene	2.30	2.82	***0.71***	***0.18***	***0.37***	***0.14***	1.75	1.88	1.27
Mainstem Hood Canal	Dosewallips	***0.98***	1.86	***0.15***	***0.42***	***0.42***	***0.92***	***1.05***	***0.44***	0.78
	Duckabush	***0.79***	4.30	**0.81**	**0.40**	2.33	**1.18**	2.16	**0.89**	1.61
	Hamma	***0.59***	1.36	***1.16***	***0.87***	***0.59***	***0.37***	***0.87***	***0.62***	0.80
	Lilliwaup	2.9	***0.68***	***0.95***	***0.29***	***0.07***	***0.11***	***0.21***	***0.39***	0.70
	Big Beef	***0.23***	***0.22***	***0.11***	***0.64***	***0.31***	***0.15***	***0.13***	***0.23***	0.25
	MU total	0.68	1.54	0.35	0.47	0.62	0.68	1.05	0.57	0.74
SE Hood Canal	Union	***0.58***	1.37	***0.11***	***0.40***	***0.35***	***0.24***	***0.50***	***0.47***	0.50
	Tahuya	N/A	N/A	N/A	1.30	2.67	***0.03***	***0.43***	***0.15***	0.92
	MU total	0.59	1.41	0.12	0.40	0.35	0.19	0.48	0.34	0.49

[1] Values that fall below the recovery criteria for each MU or stock are shown in bold and italics.

DIVERSITY

Goals to protect and increase summer chum population diversity are listed below along with a brief description of the co-managers' current efforts to meet these goals:

1. *Support planning and implementation of effective habitat protection and recovery actions by agencies and local governments that have jurisdiction.*
   The co-managers have actively supported planning efforts including the State Conservation Commission's limiting factors analyses within the ESU, the Hood Canal Coordinating Council Lead Entity and North Olympic Peninsula Lead Entity for Salmon effort to develop recovery strategies to guide selection of habitat protection and restoration projects funded under the State's Salmon Recovery Funding Board and other funding sources, and development of the Hood Canal Summer Chum Salmon Recovery Plan by the Hood Canal Coordinating Council adopted by NMFS as the formal summer chum recovery plan under the Endangered Species Act. The co-managers and many partners have also been active in implementing studies and habitat protection and restoration projects throughout the Hood Canal and Strait of Juan de Fuca regions. Details on many of these efforts can be found in the Habitat Work Schedule for each Lead Entity (see http://hws.ekosystem.us/).

   The treaty tribes prepared the 2012 State of Our Watersheds report (NWIFC 2012) to provide a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. The report serves as a bellwether – both and indicator and a warning – that the tide of habitat loss and degradation must be turned if we are to restore the salmon resource (see http://nwifc.org/publications/sow/). This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at http://treatyrightsatrisk.org/ .

2. *Rebuild by natural or artificial means the existing summer chum stocks to meet their abundance and recovery goals.*
   As described in the Artificial Production section of this report, the co-managers have successfully implemented hatchery supplementation programs that have contributed substantially to the rebuilding of many of the extant natural stocks. These programs have been consistent with guidelines described in the SCSCI to help ensure genetic diversity of the natural populations. For example, five of the six supplementation programs were terminated after 12 years or less to limit potential hatchery domestication effects, after rebuilding the populations to relatively strong numbers of naturally reproducing salmon.
   Recovery by natural means is also being facilitated by habitat protection and restoration projects that have been developed through processes to which the co-managers have provided support. See the Habitat section of this report.

3. *Re-establish by natural and artificial (i.e., reintroduction) means the selected extinct summer chum stocks.*
   Hatchery programs to reintroduce summer chum in watersheds where the stock had become extinct (Chimacum, Big Beef, Tahuya) have also been successful as described in the Artificial Production section. These programs have operated consistent with guidelines described in the SCSCI to help ensure genetic diversity of the natural populations. For example, two of the three supplementation programs were terminated

after 12 years or less (Big Beef, Chimacum). The current plan is to terminate the reintroduction program in the Tahuya after the 2014 brood year and 12 years of operation. Habitat projects have also helped to reestablish the populations by protecting and improving natural habitat in the watersheds (see Habitat section), but more work needs to be done to ensure that the stocks are productive and self-sustaining.

UPDATING RECOVERY GOALS

When the current interim recovery goals were developed, the co-managers acknowledged that the goals preferably should be "based on knowledge and assessment of how the habitat affects potential production, productivity and diversity of the stocks" (p. 3, PNPTT and WDFW 2003). But lacking that knowledge, the co-managers estimated interim goals based on available historic population data. The hope and anticipation was that future studies would lead to developing quantitative relationships between habitat conditions and summer chum performance that would provide the desired knowledge to improve the goals.

Also, at the time, a question was raised about the accuracy of the population based estimates of abundance and escapement thresholds for two stocks, Quilcene and Lilliwaup, owing to uncertainty about interpretation of the historical population data (p. 5, PNPTT and WDFW 2003). The co-managers decided then that productivity and capacity of summer chum would be assessed for these two watersheds and their estuaries so that these stocks' interim recovery goals could be reevaluated during the first five year review of the SCSCI. The recent and ongoing efforts by the HCCC, co-managers, and NMFS (Lestelle et al. 2014) to identify habitat-based recovery goals for each stock should provide information needed to do so for each extant summer chum stock. In addition, the HCCC Business Plan (HCCC 2013) identifies the conservation outcomes needed, an implementation plan with strategic priorities and performance measures, and funding and resources needed over a 10 year period to recover summer chum salmon (see Habitat section).

Summer chum salmon are on the rebound in Hood Canal and the Strait of Juan de Fuca and there is reason to believe that they can be recovered. Scores of organizations are working together for the sake of the salmon, the Hood Canal/Strait of Juan de Fuca regions, and our communities. Our focus is on maintaining effective harvest and hatchery practices while increasing and aligning habitat protection and restoration where we know we can make a difference. We are also working to better understand what other actions must be taken now and in the future as we adaptively manage the resources.

PUGET SOUND TECHNICAL RECOVERY TEAM LONG-TERM VIABILITY CRITERIA

NMFS' TRTs have identified the biological characteristics of viable ESUs and viable salmonid populations (VSP) (McElhany et al., 2000). While the ESU is the listed entity under the ESA, the ESU-level viability criteria are based on the collective viability of the individual populations that make up the ESU -- their characteristics, and their distribution throughout the ESU's geographic range.

In early 2007, the NMFS Puget Sound Technical Recovery Team (PSTRT) identified two independent populations within the Hood Canal summer chum ESU: a Hood Canal population and a Strait of Juan de Fuca population. The PSTRT provided viability criteria for the two summer chum populations in 2009 (Sands et al. 2009); these criteria describe characteristics predicted to result in a negligible risk of extinction in the long term (100 years). NMFS considers the co-managers' interim stock recovery goals as compatible with these long-term criteria as appropriate short-term targets and a reasonable intermediate step toward the PSTRT's long-term viability criteria (NMFS 2007a).

The PSTRT provides recommendations for viable summer chum population abundance, productivity, spatial structure, and diversity and describes the rationale used and any associated uncertainties. Current information about the viable salmonid population (VSP) parameters of abundance, productivity, spatial distribution and diversity (McElhany et al. 2000) and the factors affecting them is contained in this 5 year review. Each PSTRT recommendation is listed below (in italics) followed by a discussion applicable to each of the NMFS' VSP parameters and considered in the context of the two summer chum populations and the ESU. Each of the PSTRT recommendations was adopted into the Federal summer chum recovery plan (NMFS 2007a).

ABUNDANCE AND PRODUCTIVITY

PSTRT Recommendation: Abundance and productivity

A viable population of summer chum salmon in the Strait of Juan de Fuca population has 12,500 spawners, assuming a 1:1 replacement rate and density-independent dynamics at low population sizes. Spawner escapement numbers for a viable Strait of Juan de Fuca population could be as low as 4,500 adults if we can assume that the population is driven by density-dependent dynamics and the intrinsic α and β parameters of the population's viable spawner-recruit curve can be estimated and achieved (i.e., for escapement = 4,500, then α = 5 and β = 3,300). Similarly, a viable population of summer chum in the Hood Canal population has 24,700 spawners, assuming a 1:1 replacement rate and density-independent dynamics at low population sizes. Spawner escapement numbers for a viable Hood Canal population could be as low as 18,300 adults if we can assume that the population is driven by density-dependent dynamics and the corresponding intrinsic α and β parameters of the population's viable spawner-recruit curve can be estimated and achieved (i.e., for escapement = 18,300, then α = 5 and β = 13,500). Estimates of spawner escapement consistent with viable summer chum populations under different assumptions of intrinsic productivity, capacity, and persistence probability are presented in Table 5 and Tables 7–9 of Sands et al. (2009).

Before the population achieves its viable state (where the population abundance is stable, or λ = 1), a useful benchmark for tracking progress in recovery is for the population growth rate for spawners (λ) to be greater than 1.

A population will have a low risk of extinction if it has sufficient abundance and productivity to persist in the face of natural variability in returns caused by environmental and anthropogenic factors. The PSTRT investigated the question of population viability for the two summer chum populations using data for return years 1974 through 2004 (Sands et al. 2009). The PSTRT concluded that neither the Strait of Juan de Fuca nor Hood Canal populations were viable.

The viability analysis done by Sands et al. (2009) was incorporated into the Summer Chum Recovery Plan (NMFS 2007a). The Hood Canal Coordinating Council, in partnership with the co-managers and NMFS, has just completed an update to viability analysis. The updated analysis incorporates additional years of abundance and productivity data and considers variation associated with ocean production regimes (PDO) and potential climate change. The incorporation of updated empirical data in this analysis, as presented in a guidance document (Lestelle et al. 2014), will have an effect on the abundance and productivity goals needed for summer chum recovery.

It is recognized that recovery goals and population viability criteria are to be an adaptively managed part of the recovery plan and that as new data and modeling results become available, the recovery goals and population viability criteria would be refined over time (WDFW and PNPTT 2000; PNPTT and WDFW 2003; HCCC 2005; NMFS 2007a). Further technical and policy review should be completed before finalizing recommended updates to the existing goals outlined in the Summer Chum Recovery Plan (HCCC 2005) and the NMFS supplement to the Recovery Plan (NMFS 2007a).

We provide some background and a synopsis of the updated viability analysis presented and discussed in Lestelle et al. (2014), below.

Sands et al. (2009) used two different quantitative population viability analysis (PVA) approaches to assess viability thresholds for the two populations belonging to the Hood Canal ESU. One approach employed a density-independent model, assuming that the population time series approximates a Brownian motion (Dennis et al. 1991). Under this model, there is no underlying relationship between spawners and recruits; production is assumed in this case to be driven entirely by random processes. The computer program SimSalmon was used to model this approach. The second approach assumes that some form of a density-dependent underlying relationship exists between spawners and recruits. For this approach, the Viability and Risk Assessment Procedure (VRAP) was employed (Sands 2009).

Sands et al. (2009) presented numeric recovery goals for abundance (using capacity) and productivity with both modeling approaches. They did not recommend one approach over the other, suggesting that additional data was needed to arrive at a conclusion about the most appropriate type of assessment. An abbreviated summary of results is shown in Table 8-4 for both populations under each modeling approach. The results using the VRAP model are given as a range in capacity (incorporating a reasonable range of productivities) and a range in expected spawning escapement associated with a specific pair of capacity and productivity values. The viability target is not the escapement, but it is the combination of the productivity and capacity parameters. When the population reaches that viability condition, one would expect to see escapements averaging the given corresponding escapement levels.

Table 8-4. Minimum abundance viability thresholds for the Strait of Juan de Fuca and Hood Canal populations of summer chum as given in Sands et al. (2009) derived with two modeling approaches. The density-independent model (SimSalmon) did not explicitly incorporate exploitation rate (ER), whereas an ER was incorporated explicitly in the density-dependent model (VRAP). The results from VRAP are shown as a range, based on different values for productivity that bracket a reasonable range of values for each population. Note: this is Table 3 in Lestelle et al. 2014.

Population	Model	ER	Escapement range		Capacity range	
			Low	High	Low	High
Strait of Juan de Fuca	Density-independent	0%	5,600			
			P=6	P=3	P=6	P=3
	Density-dependent	0%	4,700	5,100	3,300	4,300
		10%	4,600	5,400	3,700	5,300
Hood Canal	Density-independent	0%	24,700			
			P=9	P=5	P=9	P=5
	Density-dependent	0%	17,900	20,600	13,000	17,000
		10%	18,600	21,500	15,500	20,500

Lestelle et al. (2014) updated the analysis presented in Sands et al. (2009) by incorporating additional years of spawner and adult recruitment abundance data. The assessment by Sands et al. (2009) was made using spawner and adult recruit data for brood years 1974 to 2001 for both the Strait of Juan de Fuca and Hood Canal populations. The updated analysis encompassed brood years 1974 to 2006, or five more brood years (2002-2006) than used by Sands et al. (2009). Age composition and natural-origin and supplementation-origin spawning escapement and runsize estimates were provided by the co-managers (as in this SCSCI 5-year review and WDFW and PNPTT 2007). Some of the escapement and harvest data from 2001 and later had been updated, as well as some older data. Age data were also revised for some years and some earlier data became available for the Strait of Juan de Fuca population.

The updated assessment by Lestelle et al. (2014) employed only VRAP for the viability analysis, since it is clear that the populations exhibit obvious patterns of density-dependence. The same procedures were applied in using VRAP as described in Sands et al. (2009). As in Sands et al. (2009), the data best fit S-R relationships using the Beverton-Holt function.

A comparison of the estimates of the coefficients of variation (CVs) associated with process error presented in Sands et al (2009) versus Lestelle et al. (2014) is provided in Table 8-5 (note that data in this table is from Table 4 in Lestelle et al. (2014)). While the CV increased modestly from the earlier assessment for the Strait of Juan de Fuca population (from 107% to 111% for approximately a 4% change), it declined by a larger amount for the Hood Canal population (from 134% to 120% for approximately a 10% change).

The changes in the CVs are due mainly to longer data sets (i.e., the inclusion of new data for five additional brood years) used in the analysis, which produced revised and, perhaps, more precise estimates of CV. For the analysis reported in Sands et al. (2009), high variability in the data set (CV=134%, Table 8-5) for the Hood Canal population was largely due to the extremely high return from the 2000 brood year (3.5 times as high as the next highest return). The new brood year data added to the Hood Canal analysis by Lestelle et al. (2014) were within the usual range of escapements, so this reduced the effect of the 2000 brood year on the estimate of CV. In contrast, for Strait of Juan de Fuca, the new data added a series of brood years with escapements higher than those analyzed in Sands et al. (2009) and resulted in a higher estimate of CV (more variation).

Table 8-5. The coefficient of variation (CV) related to process error for the Strait of Juan de Fuca and Hood Canal populations of summer chum for the analysis based on 1974-2005 data (brood years 1974-2001) in Sands et al. 2009 and the analysis based on 1974-2010 data (brood years 1974-2006) in Lestelle et al. 2014. Note: modified from Table 4 in Lestelle et al. 2014.

Population	Assessment	BY	CV
Strait of Juan de Fuca	Sands et al. 2009	1974-2001	107%
	Lestelle et al. 2014	1974-2006	111%
Hood Canal	Sands et al. 2009	1974-2001	134%
	Lestelle et al. 2014	1974-2006	120%

The changes in viability thresholds for each population are directly affected by the changes in the amount of variation in the stock-recruit relationship for each population derived using VRAP in the two assessments. The ranges of viability thresholds for the Strait of Juan de Fuca and Hood Canal populations derived from each assessment are shown in Table 8-6 for the same range of intrinsic productivities (i.e., from 4 to 6 for Strait of Juan de Fuca and from 6 to 8 for Hood Canal). Due to the larger CV (greater variation), the updated assessment by Lestelle et al. (2014) produces viability thresholds for the Strait of Juan de Fuca population with a range in escapements from 5,600 to 6,200 summer chum which are approximately 20% higher than the range of 4,600 to 5,100 summer chum reported in Sands et al. (2009). For the Hood Canal population, the thresholds were lowered by approximately 50% of those reported by Sands et al. (2009) due to a substantially reduced CV. The updated assessment derives viability thresholds with a range in escapements from 8,700 to 9,600 summer chum (Lestelle et al. 2014) compared to a range of 18,300 to 20,400 summer chum derived by Sands et al. (2009). Note that data in Table 8-6 is modified from Table 5 in Lestelle et al. (2014) and that escapement values are arithmetic means as in Sands et al. (2009) so that the values are directly comparable.

Lestelle et al. (2014) recommend that the equilibrium abundance (i.e., geometric mean) values for minimum average spawning escapements be used as a measure of whether the revised viability thresholds (recovery goals) have been achieved for the Hood Canal and Strait of Juan de Fuca summer chum populations. Reporting the results with equilibrium abundance instead of capacity provides a simpler, less abstract metric for managers and planners to use in comparing modeling results to empirical data on observed run sizes. Other TRTs, e.g., the Interior Columbia Basin TRT (ICTRT 2003), have expressed equilibrium abundance viability criteria for salmonids as geometric means.

Table 8-6. Minimum abundance viability thresholds for the Strait of Juan de Fuca and Hood Canal populations of summer chum as given in Sands et al. (2009) derived using the VRAP model and as updated in Lestelle et al. (2014). P is intrinsic productivity. Escapement values are arithmetic means as in Sands et al. (2009). Note: modified from Table 5 in Lestelle et al. 2014.

Population	ER	Assessment	Escapement range		Capacity range	
			Low	High	Low	High
			P=6	P=4	P=6	P=4
Strait of Juan de Fuca	0%	Sands et al. 2009	4,700	4,800	3,300	3,700
		Lestelle et al. 2014	5,700	6,200	5,100	6,300
	10%	Sands et al. 2009	4,600	5,100	3,700	4,500
		Lestelle et al. 2014	5,600	6,100	5,800	7,100
			P=8	P=6	P=8	P=6
Hood Canal	0%	Sands et al. 2009	18,300	19,100	13,500	15,000
		Lestelle et al. 2014	8,700	9,100	7,000	7,800
	10%	Sands et al. 2009	18,300	20,400	15,500	18,500
		Lestelle et al. 2014	8,700	9,600	8,000	9,300

For each population, approximate values for capacity and the corresponding productivity associated with average spawning escapement viability thresholds are shown in Table 8-7 at three exploitation rates (0, 10, and 20%). Two averages are shown for each case, the arithmetic mean (AM), which is skewed high (by approximately 35% to 40%) due to the lognormal distribution of observed escapements, and the geometric mean (GM), which is equivalent to what Lestelle et al. (2014) refer to as equilibrium abundance. Again, Sands et al. (2009) reported the viability thresholds are arithmetic means, but geometric means are more appropriate and are recommended here.

For each population, one reasonable set of geometric mean escapements (or viability thresholds) are shown in Table 8-7; an intrinsic productivity of 14 and the corresponding estimates of capacity were used. For Hood Canal, the viability threshold is an equilibrium escapement from 5,700 to 6,200 summer chum, depending on the exploitation rate. For Strait of Juan de Fuca, the viability threshold is an equilibrium escapement from 3,700 to 4,000 summer chum (Table 8-7).

Using other reasonable combinations of intrinsic productivity and capacity, though, would provide other reasonable estimates of equilibrium abundance and viability thresholds. For the range of intrinsic productivity and capacity values in Table 8-6, for example, the arithmetic mean spawner escapements from Lestelle et al. 2014 could be reduced by 35%-40% to provide estimates of geometric mean spawning escapements as viability thresholds. In fact, the relationship between intrinsic productivity and capacity are plotted as viability curves in Figure 8-1and any pairing of intrinsic productivity and capacity values for a population that is above the viability curve would achieve the viability threshold. However, the use of VRAP would be needed to provide the corresponding estimate of equilibrium abundance (i.e., geometric mean spawning escapement).

Table 8-7. Estimated values for capacity (Cap) of the Hood Canal and Strait of Juan de Fuca (SJDF) summer chum populations associated with a productivity of 14 that define viability thresholds (5% risk) for three exploitation rates (0, 10, and 20%), and expected average spawning escapements that would be observed at those thresholds. All of the values shown are derived with the VRAP model as in Sands et al. (2009). Minimum average spawning escapements are presented both as the arithmetic mean (AM), which was used in Sands et al. (2009) and the geometric mean (GM), which is equivalent to equilibrium abundance as used in this paper. Note: same as Table 9 in Lestelle et al. 2014.

Population	ER = 0%			ER = 10%			ER = 20%		
	Cap	AM esc	GM esc	Cap	AM esc	GM esc	Cap	AM esc	GM esc
Hood Canal	6,100	8,100	5,700	7,500	8,900	6,200	8,500	8,800	6,200
SJDF	4,000	5,000	3,700	4,800	5,400	4,000	5,400	5,300	3,900

Viability curves for the two populations using the updated assessment with exploitation rates of 0 and 30 percent are provided in Figure 8-1. For return years 2000 through 2013, exploitation rates have been low and have averaged about 7.6% for Hood Canal and about 0.6% for Strait of Juan de Fuca (see Table 3-6). Estimates of productivity and capacity for each population using all data for brood years 1974 to 2006 are also shown plotted. These results signal that the Hood Canal population would be considered viable or at negligible risk of extinction with current biological performance, provided that the exploitation rate is held to a very low level. In contrast, the analysis signals that the Strait of Juan de Fuca population would not be considered viable based on data for these brood years, even with the exploitation rate set to 0 percent.

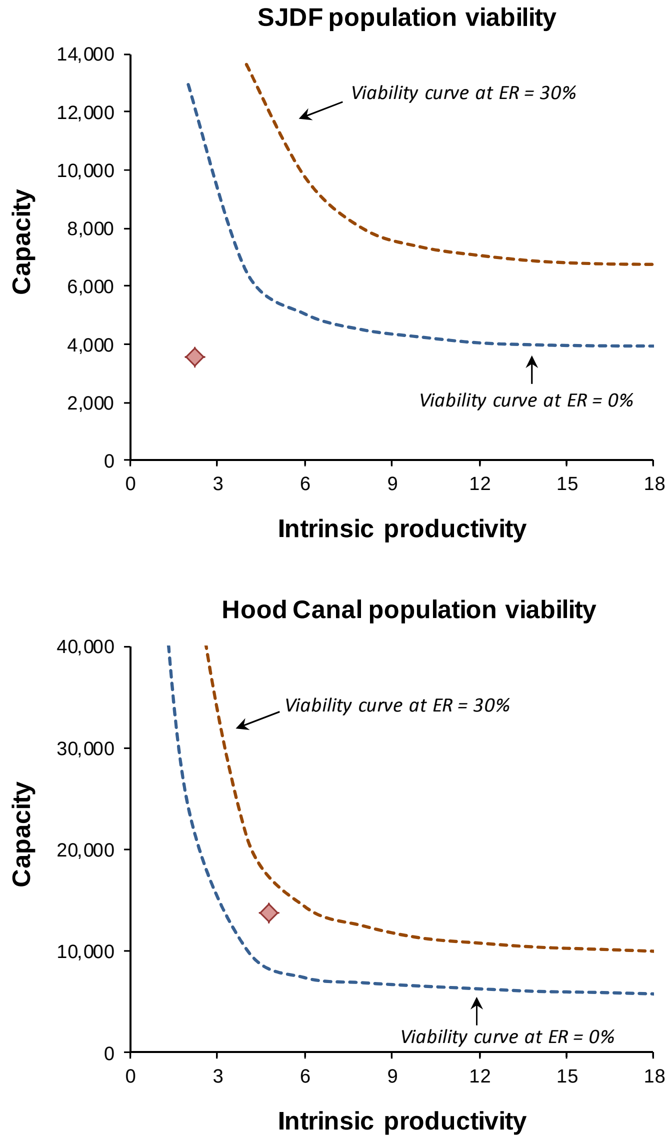

Figure 8-1. Updated viability curves with a 5 percent extinction risk for the Hood Canal and Strait of Juan de Fuca (SJDF) summer chum populations with associated exploitation rates of 0% and 30%, as well as population performance parameters plotted for brood years 1974 to 2006. Note: same as Figure 18 in Lestelle et al. 2014.

<u>Decadal-scale Climate and Ocean Regimes</u>: The potential role of shifts in decadal-scale climate and ocean regimes to summer chum performance was also examined in Lestelle et al. (2014) and the implications of such shifts to recovery were considered. The analysis apportioned performance and variation between low and high ocean production (Pacific Decadal Oscillation or PDO) regimes and showed that significant differences existed between them. Brood years 1979 to 1998 represent a low (warm) PDO regime and low ocean production and brood years 1999 to 2006 represent a high (cool) PDO regime and high ocean production. The conclusion from this analysis is that ocean regimes are extremely important to setting both summer chum viability thresholds and habitat goals.

Lestelle et al. (2014) recommends that whether a population's performance is meeting the low risk viability threshold should be primarily determined during the PDO regime when summer chum performance is low, consistent with recommendations of Lawson (1993). Lawson (1993) stated that during a period when marine survival is high that managers and politicians will naturally have a tendency to relax restoration efforts and claim success for their projects. He concluded that the true measure of success for salmon recovery will be when populations perform at a level needed to survive through episodes of low marine survival and reduced abundance. Similarly, NMFS (2010) reviewed the PDO index pattern with regard to salmon survival and concluded: "The survival and recovery of these species will depend on their ability to persist through periods of unfavorable hydrologic and oceanographic conditions." Ocean conditions can essentially overcome the negative effects of poor freshwater and nearshore during the productive ocean PDO regime. The importance of achieving productive freshwater and nearshore habitats becomes most obvious during the ocean regime when summer chum survival is poor. An ocean regime associated with a phase of the PDO can last upwards to 20 to 35 years (Lestelle et al. 2014) and we may remain in the current cool phase of the PDO for several more years.

The effect of the ocean production regime shift on the viability of the Strait of Juan de Fuca and Hood Canal populations is seen by plotting estimates for productivity and capacity for each population unit with their viability curves for the low (warm) PDO and high (cool) PDO regimes beginning with brood year 1979 (Figure 8-2). The results show that population viability is very strongly affected by the ocean/climate regime for the brood years analyzed.

Neither population is shown to exceed the 5 percent risk threshold curve with a 0 percent exploitation rate during the regime associated with the warm PDO regime brood years (1979-1998), though the Hood Canal population is only slightly below the threshold. With the shift after 1998 to a cool PDO regime, the Hood Canal population exceeds even the threshold associated with a 30 percent exploitation rate by a large margin, while the Strait of Juan de Fuca population is only slightly above the threshold with a 0 percent exploitation rate. The Strait of Juan de Fuca population is shown to have been at very high risk of extinction during the warm PDO regime (brood years 1979-1998) (Figure 8-2).

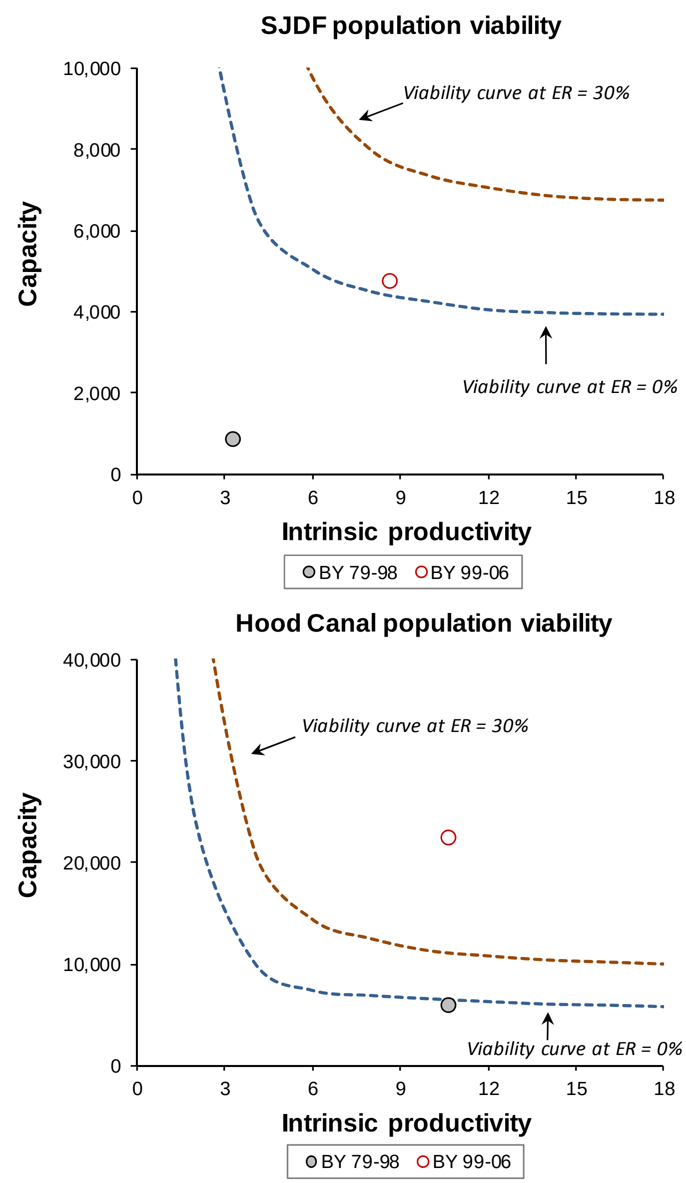

Figure 8-2. Population performance parameters for brood years (BY) 1979 to 1998 (warm PDO regime) and 1999 to 2006 (cool PDO regime) plotted relative to viability curves (5 percent extinction risk) for the Strait of Juan de Fuca and Hood Canal summer chum populations. Viability curves associated with both 0% and 30% exploitation rates are shown. Note: same as Figure 29 in Lestelle et al. 2014.

Climate Change: Climate change is expected to increase environmental variation, which in turn will likely increase variability in biological performance. NMFS urges salmon recovery planners to consider the effects of climate change patterns on future recovery (Ford ed. 2011). To consider how increased environmental variation associated with climate change might reasonably affect the viability of summer chum, Lestelle et al. (2014) used VRAP, with greater variation in population performance incorporated, to estimate viability thresholds under climate change scenarios for the Strait of Juan de Fuca and Hood Canal populations.

Lestelle et al (2014) assumed that variation in performance for each population will increase by 5, 10, or 15 percent with climate change over the next several decades. It is recognized that there is considerable uncertainty about how much environmental variation might increase in the Puget Sound region; this approach provides a first step in examining this issue, which can be expanded upon at a future date.

Figure 8-3 provides the updated viability curves with 5 and 10 percent climate change effects for each population, shown with performance parameters plotted separately for brood years 1979-1998 (warm PDO regime) and 1999-2006 (cool PDO regime). The viability curves are shifted up and to the right, setting a higher threshold in each case for viability to be achieved. During the warm phase of the PDO, neither population would be viable with a 5 percent increase in variation. During the cool phase of the PDO, the Strait of Juan de Fuca population is not viable with a 5% increase in variation, while the Hood Canal population is viable with a 10% increase in variation. The results illustrate that the beneficial effects of restoration and protection actions will become more important to achieve recovery with climate change.

Habitat Goals: A viability analysis was completed using VRAP for each of the 8 extant subpopulations in Hood Canal and Strait of Juan de Fuca by Lestelle et al. (2014). An objective was to estimate habitat goals for each subpopulation. The habitat goals for each population would then be the sum of the habitat goals for each of its subpopulations. The subpopulation viability curves and habitat goals are presented in Lestelle et al. (2014), but are still under review and are being developed for use as the basis for modifying recovery goals (HCCC 2013).

Since actual outcomes on subpopulation performance from habitat actions will only be measured or realized many decades after habitat restoration projects are completed, planning can benefit by using modeling projections to assess expected outcomes. The Ecosystem Diagnosis and Treatment (EDT) model was used to assess habitat characteristics in the natal watersheds, their subestuaries, and for the nearshore environment within Hood Canal and adjacent areas of the Puget Sound complex (Lestelle et al. 2005a and 2005b). Four relevant baseline time periods and scenarios were assessed: (1) the historic condition, (2) a 2001 baseline, (3) a 2001 baseline with projected future watershed buildout, and (4) a 2014 baseline which is a projection of what would be expected 100 years into the future for all habitat protection or restoration actions completed or planned by 2014; see Lestelle et al. (2014) for complete description of baselines.

Modeling was done to represent what would be expected under both the warm and cool phases of the PDO. These results were used to compare to viability curves for each subpopulation under a no climate change scenario and 5 and 10 percent increases in variability associated with climate change.

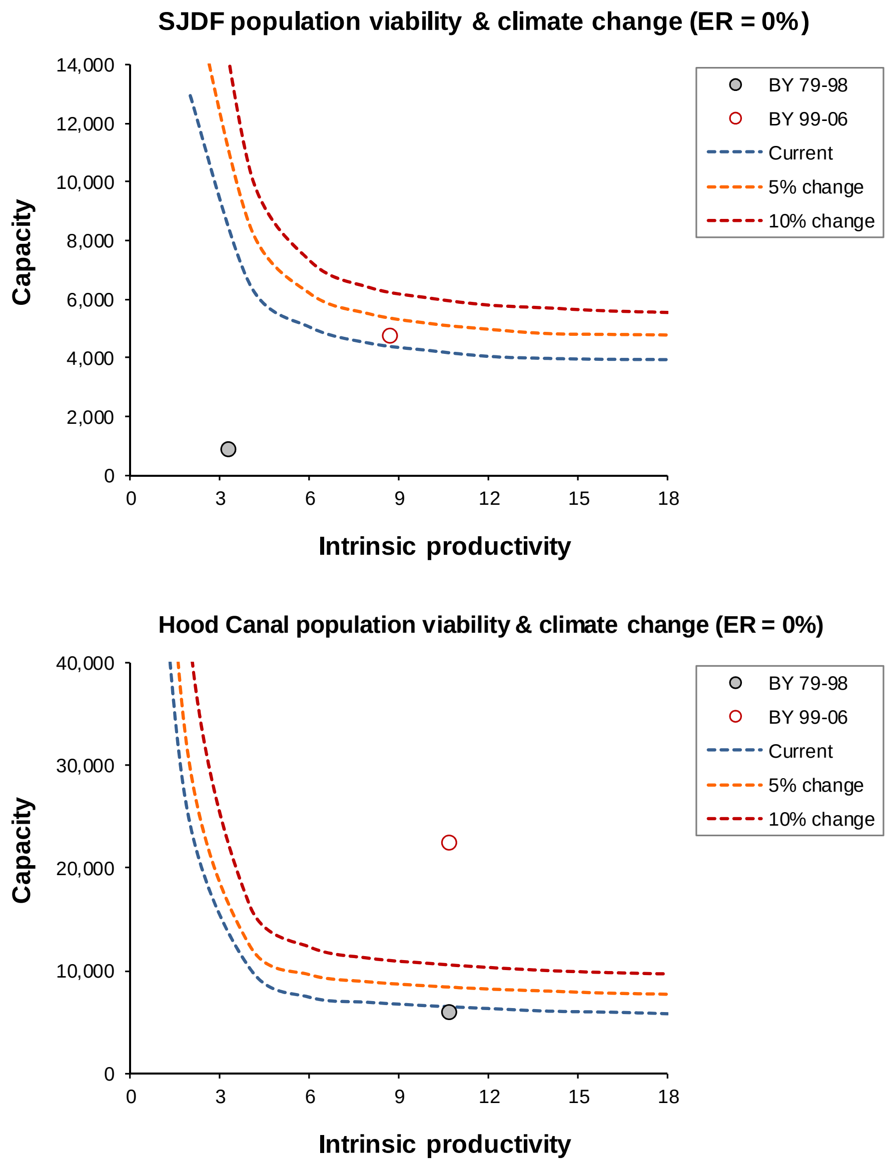

Figure 8-3. Population performance parameters for brood years (BY) 1979 to 1998 (warm PDO regime) and 1999 to 2006 (cool PDO regime) plotted relative to viability curves (5 percent extinction risk) for the Strait of Juan de Fuca (SJDF) and Hood Canal summer chum populations with variation increased by 5 and 10 percent to reflect future climate change. Note: same as Figure 32 in Lestelle et al. 2014.

Table 8-8 provides estimates of intrinsic productivity and equilibrium abundance for the Hood Canal and Strait of Juan de Fuca summer chum populations for each of the four baseline scenarios described above, together with viability abundance thresholds (with and without climate change) to achieve negligible risk of extinction. Table 8-8 also shows the results for equilibrium abundance for both the warm and cool phases of the PDO. A comparison of the equilibrium abundance (NEQ) during the warm or cool PDO phase for each scenario (2001 Base, 2001BaseBO, and 2014 BaseBO) versus the viability abundance threshold provides a measure of the estimated gap between the current performance during the warm or cool PDO phase and viability for a population. Plots of the population parameters (intrinsic productivity and capacity) with the viability curves for the warm and cool PDO regimes and three climate change conditions and are shown in Figures 8-4 and 8-5.

Table 8-8. Modeled results for four baseline scenarios for performance of the Hood Canal and Strait of Juan de Fuca summer chum populations. Prod is the estimated intrinsic productivity and NEQ is equilibrium abundance for warm and cool PDO regimes. Abundance thresholds expressed as geometric mean of minimum spawning escapements associated with the given productivity level for negligible risk (<5%) of extinction under three climate conditions are also shown. Note: modified from Table 6 in Lestelle et al. 2014.

Population	Scenario	Prod	NEQ in PDO phase		Viability abundance threshold with climate change		
			Warm	Cool	0% chg	5% chg	10% chg
Hood Canal	Historic	28.3	17,693	62,155	5,478	7,272	9,137
	2001 Base	15.4	5,152	18,484	5,591	7,350	9,204
	2001 BaseBO	11.4	3,677	13,440	5,817	7,556	9,487
	2014 BaseBO	19.8	8,012	28,204	5,478	7,272	9,137
Strait Juan de Fuca	Historic	29.5	4,386	17,402	3,721	4,514	5,242
	2001 Base	4.8	775	2,711	4,609	5,892	7,121
	2001 BaseBO	2.9	401	2,420	4,353	5,429	6,469
	2014 BaseBO	17.6	2,644	10,029	3,721	4,514	5,242

For the Hood Canal population under the warm phase of the PDO, the equilibrium abundance (NEQ) for the 2001 baseline with buildout (NEQ = 3,677) was projected to be substantially below the viability threshold for all three climate change conditions (NEQ = 5,817; 7,556; or 9,487). However, as a result of the habitat protection and restoration actions that have taken place in Hood Canal watersheds, the 2014 baseline with buildout (NEQ = 8,012) was projected to be higher than the threshold for both no climate change (NEQ = 5,478) and a 5 percent climate change condition (NEQ = 7,272). The 2014 scenario does not, however, achieve the viability threshold with a 10 percent climate change condition (NEQ = 9,137) (Table 8-8, Figure 8-4).

The Hood Canal summer chum population is performing much better under the cool phase versus the warm phase of the PDO (Table 8-8, Figure 8-4). During the cool phase of the PDO, equilibrium abundance (NEQ) for each of the four scenarios in Table 8-8 exceeds the viability thresholds for the Hood Canal population. The 2014 baseline with buildout (NEQ = 28,204) was projected to be substantially higher than the viability threshold for each of the climate change (NEQ = 5,478; 7,272; and 9,137).

For the Strait of Juan de Fuca population and with the warm phase of the PDO in effect, the gap between the viability thresholds compared to the equilibrium abundance (NEQ) for the 2001 baseline with buildout and the 2014 baseline with buildout is much greater than it was for the Hood Canal population under all three climate conditions. The 2001 baseline with buildout for the Strait of Juan de Fuca population (NEQ = 401) was projected to be substantially below the viability threshold for all three climate change conditions (NEQ = 4,353; 5,429; or 6,469). The 2014 baseline with buildout (NEQ = 2,644) is improved, but was also projected to be lower than the viability thresholds (Table 8-8, Figure 8-5). We will note that if natural-origin summer chum that are now spawning in Chimacum Creek after being reintroduced there are incorporated into the numbers (see Figure 4-9), the Strait of Juan de Fuca population during the warm phase of the PDO more closely approaches the viability thresholds.

The Strait of Juan de Fuca summer chum population is also performing better under the cool phase versus the warm phase of the PDO (Figure 8-5). During the cool phase of the PDO, for the 2014 baseline with buildout scenario, equilibrium abundance (NEQ = 10,029) was projected to be substantially higher than the viability threshold for each of the climate change conditions (NEQ = 3,721; 4,514, and 5,242) (Table 8-8). As a result Strait of Juan de Fuca watersheds, there has been a marked improvement over the 2001 baseline (NEQ = 2,711) or 2001 baseline with buildout (NEQ = 2,420) scenarios which did not achieve the viability thresholds.

Once these updated viability curves are finalized and the "gap" between 2014 baseline conditions and recovery has been identified, the HCCC, in collaboration with the co-managers, NMFS and other partners, will be able to update and refine the overall Hood Canal summer chum salmon recovery goals. It will also be possible to finalize and adopt the habitat goals necessary to bring each watershed to a functional level for summer chum salmon recovery. These habitat goals are currently expressed as 10 year habitat goals and align with the HCCC Business Plan (HCCC 2013) timeline. Whether they can and will be implemented in 10 years depends on operational and capital funding availability.

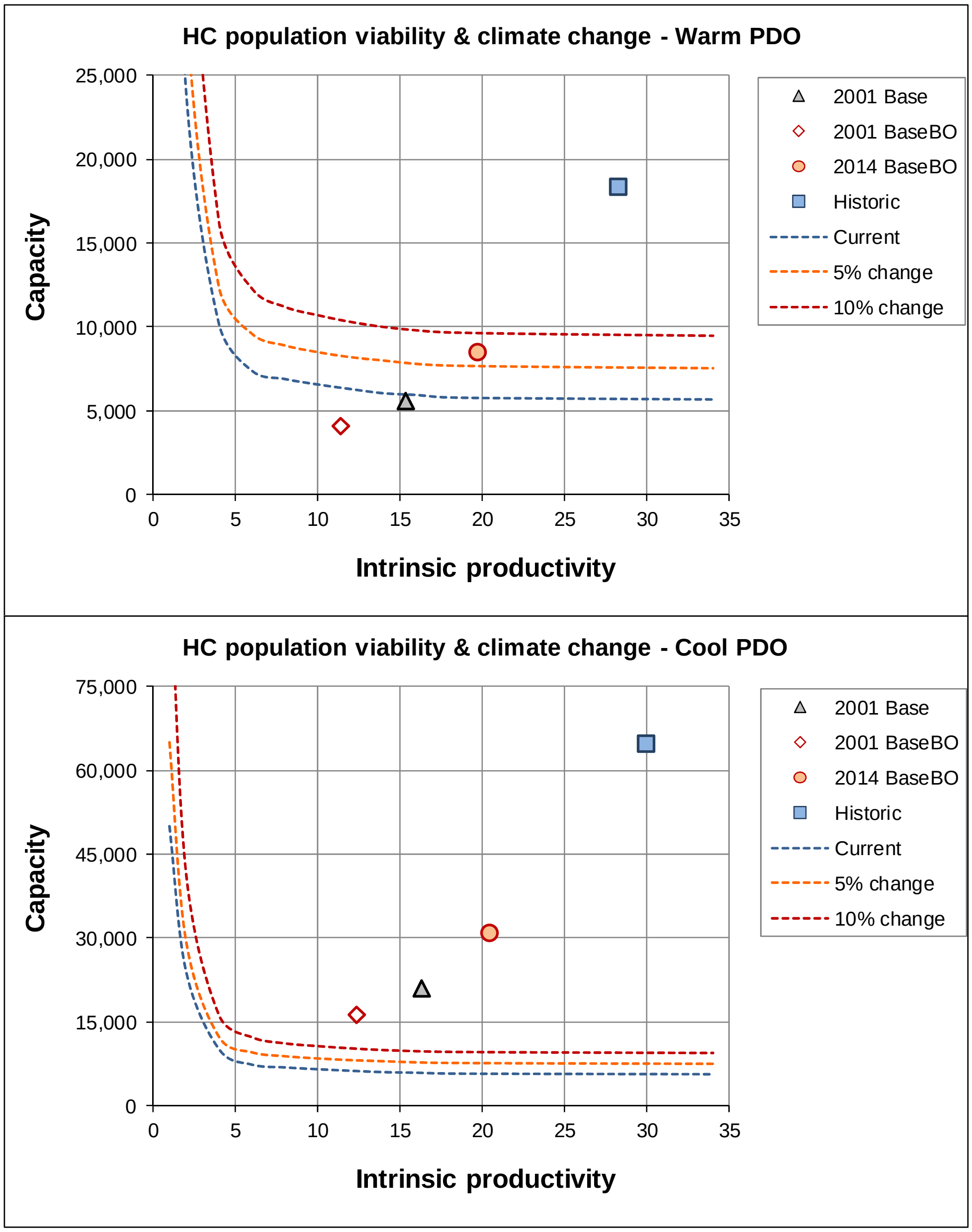

Figure 8-4. Modeled results for four baseline scenarios (described in Lestelle et al. 2014) showing population performance parameters (intrinsic productivity and capacity) relative to viability curves (5 percent extinction risk) for the Hood Canal summer chum population with variation increased by 5 and 10 percent to reflect future climate change under the warm (top) and cool (bottom) phases of the PDO. Note: same as Figure 34 in Lestelle et al. 2014

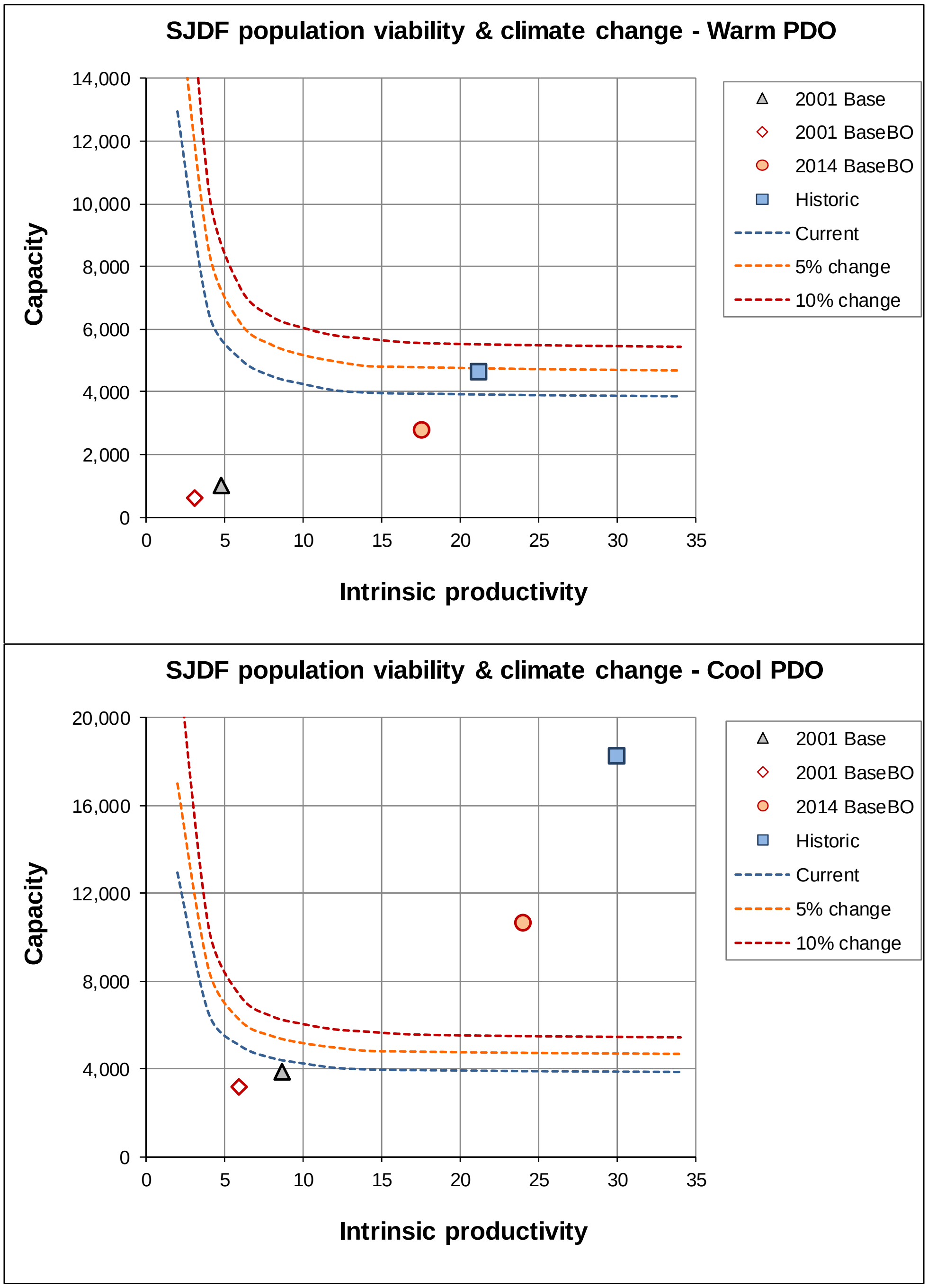

Figure 8-5. Modeled results for four baseline scenarios (described in Lestelle et al. 2014) showing population performance parameters (intrinsic productivity and capacity) relative to viability curves (5 percent extinction risk) for the Strait of Juan de Fuca (SJDF) summer chum population with variation increased by 5 and 10 percent to reflect future climate change under the warm (top) and cool (bottom) phases of the PDO. Note: same as Figure 35 in Lestelle et al. 2014.

SPATIAL STRUCTURE

PSTRT Recommendation: Spatial structure

A viable population contains multiple persistent spawning aggregations. The number of persistent aggregations needed for viability depends on the historical biological characteristics of the population and the historical distribution of spawning aggregations of the population. A population that meets the criteria below is likely to have a negligible risk of extinction over a 100-year period (i.e., be viable):

Spawning aggregations are distributed across the historical range of the population.

Most spawning aggregations are within 20 km of adjacent aggregations.

Major spawning aggregations (spawning aggregations in rivers and creeks that have historically provided the most persistent habitat) are distributed across the historical range of the population and are not more than approximately 40 km apart.

Currently, the criteria for spatial structure, above, are nearly met for Strait of Juan de Fuca and Hood Canal summer chum. Spawning aggregations are distributed across the historical range of the populations, major spawning aggregations are not more than 40 km apart, and nearly all spawning aggregations are within 20 km of adjacent aggregations. An exception to meeting the criteria can be found along east Hood Canal (west Kitsap) where spawning aggregations in Big Beef Creek and Tahuya River are about 60 km apart. To fully meet this criterion, one or more spawning aggregations would be needed between these two streams and the most likely candidates seem to be Dewatto River and/or Anderson Creek.

In addition, the increased summer chum spawner abundances and densities in supplemented watersheds have led to increased areal distribution of spawners in the Union, Big Quilcene, Little Quilcene, Salmon Creek and Jimmycomelately Creek watersheds, relative to pre-supplementation years (WDFW and PNPTT 2007).

The spatial distribution within the summer chum ESU is increasing through efforts to reintroduce summer chum to streams where they had become extinct. Summer chum have been successfully reintroduced to Chimacum Creek (within the Strait of Juan de Fuca population) and Big Beef Creek and Tahuya River (within the Hood Canal population). These reintroductions have been implemented through use of artificial production (see section 2, Artificial Production). The successful hatchery effort on Chimacum Creek began with brood year 1996 and was terminated following brood year 2003 after eight years of operation (see information on returning spawners in Tables 2-9 and 2-10). The Big Beef Creek hatchery program began with brood year 1996 and was terminated following brood year 2004 (Tables 2-9 and 2-10). The Tahuya River program began with brood year 2003 and is ongoing with adult returns to Tahuya River from the hatchery program since 2006 (Tables 2-9 and 2-10). Besides these streams, there have been no indications of reestablishment of a sustainable natural population to other streams where summer chum had become extinct (e.g., through straying of hatchery-origin or natural-origin adults). Additional reintroduction programs may be need to be implemented to fully meet this criterion.

DIVERSITY

PSTRT Recommendation: Diversity

Depending on the geographic extent and ecological context of the population, a viable population includes one or more persistent spawning aggregations from each of the two to four major ecological diversity groups historically present within the two populations.

The PSTRT identified six major ecological diversity groups (based on EPA level IV eco-regional units and sixth level hydrologic units) within the summer chum ESU, two for the Strait of Juan de Fuca population and four for the Hood Canal population. For the Strait of Juan de Fuca population, these were the Dungeness and Sequim-Admiralty major ecological diversity groups. For the Hood Canal population, the Quilcene, mid-west Hood Canal, west Kitsap, and lower-west Hood Canal major ecological diversity groups were identified.

At least one persistent spawning aggregation is currently present within five of the six major ecological diversity groups identified by the PSTRT. The possible exception is for the Dungeness major ecological diversity group, but there is uncertainty whether a summer chum stock was historically present in the Dungeness River (see WDFW and PNPTT 2000). For the Strait of Juan de Fuca population, spawning aggregations in the Sequim-Admiralty major ecological diversity group currently include Jimmycomelately, Salmon/Snow and Chimacum creeks. For the Hood Canal population, spawning aggregations in the Quilcene major ecological diversity group currently include Big and Little Quilcene rivers, spawning aggregations in the mid-west Hood Canal major ecological diversity group currently include Dosewallips and Duckabush rivers, and spawning aggregations in the west Kitsap major ecological diversity group currently include Union and Tahuya rivers and Big Beef Creek. Spawning aggregations in the lower-west Hood Canal major ecological diversity group currently include Hamma Hamma River and Lilliwaup Creek, but previous discussion related to performance standards for Lilliwaup may add some uncertainty as to its persistence.

The PSTRT identified other measures of spatial structure and diversity, but did not make specific recommendations regarding their application to the assessment of population viability. Rather, a quantitative analysis of spatial distribution and diversity was conducted to help further guide evaluations of the viability of the populations. The Shannon diversity index is a single statistic that describes the number of components in a group and their relative abundance or evenness. Diversity is high when there are many components and their abundances are fairly even. In the PSTRT analysis, spawning aggregations are the components and estimates of natural spawning escapements are the measure of abundance. Since spawning aggregations are spatially separated units, the spatial structure of the population is also described. The PSTRT noted that a good initial target level for spatial distribution and the Shannon diversity index, and thus for viability, would be the early year (1974-1978) average, as this was known to be attainable by each population (Sands et al. 2009). The average Shannon diversity index values for 1974-1978 are 1.84 for the Hood Canal population and 1.05 for the Strait of Juan population. The highest Shannon diversity index values possible (achieved if all aggregations were equally abundant) would be 2.48 and 1.61 for the Hood Canal and Strait of Juan de Fuca populations, respectively. However, since equal abundance for each spawning aggregation is not likely to occur due to differences in sub-population capacity and intrinsic productivity and habitat production potential, these Shannon diversity index values are theoretical maxima and likely not achievable.

Since 1974, the annual spawning escapement for the Hood Canal summer chum population has been monitored for eleven component spawning aggregations in Little Quilcene, Big Quilcene, Dosewallips, Duckabush, Hamma Hamma, Lilliwaup, Union, Tahuya, and Dewatto rivers and Anderson and Big Beef creeks. Summer chum were reintroduced into Big Beef Creek and the Tahuya River with the first summer chum adult returns beginning in 1996 and 2006, respectively. For the Strait of Juan de Fuca population, the annual spawning escapement has been monitored since 1974 for three component spawning aggregations in Jimmycomelately, Salmon, and Snow creeks. Summer chum were reintroduced into Chimacum Creek beginning in 1996 with the first returning adults in 1999 and spawning escapement has been regularly monitored in the Dungeness since 1986.

The composition and distribution of summer chum spawning escapement in Hood Canal and Strait of Juan de Fuca have changed over time. In general, the baseline Shannon diversity indices for Hood Canal and Strait of Juan de Fuca summer chum were high initially in 1974-1978, declined in the 1980's and remained low through the 1990's, and have rebounded in recent years to exceed the 1974-1978 levels (Figures 8-6 and 8-7). Higher diversity values indicate a more uniform distribution of the population among spawning aggregations which provides more robustness to the population. The change in diversity indices is also partly the result of the reintroduction of spawning aggregations into Big Beef Creek and Tahuya River (Hood Canal) and Chimacum Creek (Strait of Juan de Fuca) where summer chum had been extirpated.

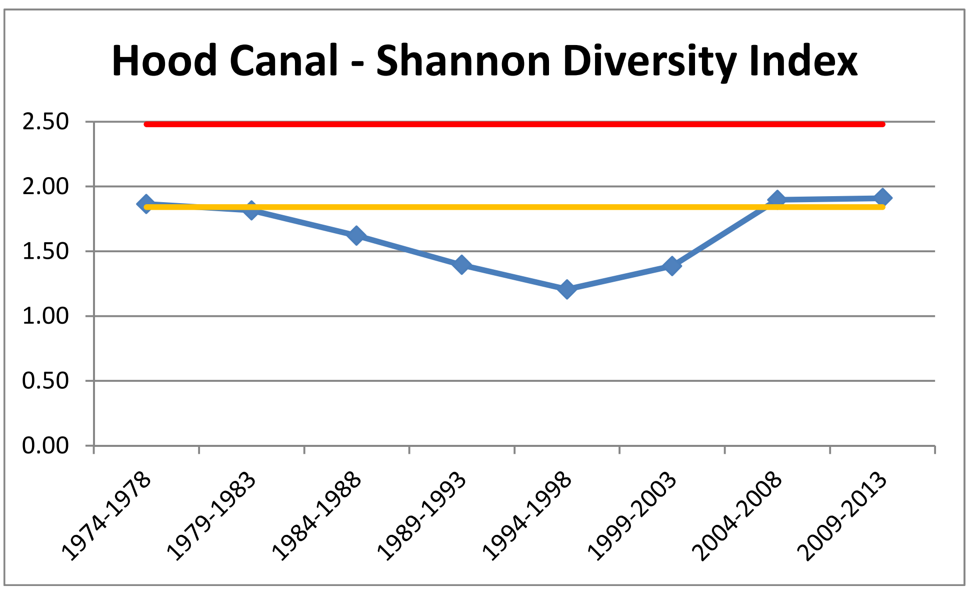

Figure 8-6. Mean Shannon diversity indices for the Hood Canal summer chum population for five-year periods from 1974 through 2012. The Puget Sound TRT (Sands et al. 2009) stated that the 1974-1978 mean value of 1.86 (yellow line) is a good initial viability target and that the highest value possible (achieved if all aggregations were equally abundant) is 2.48 (red line).

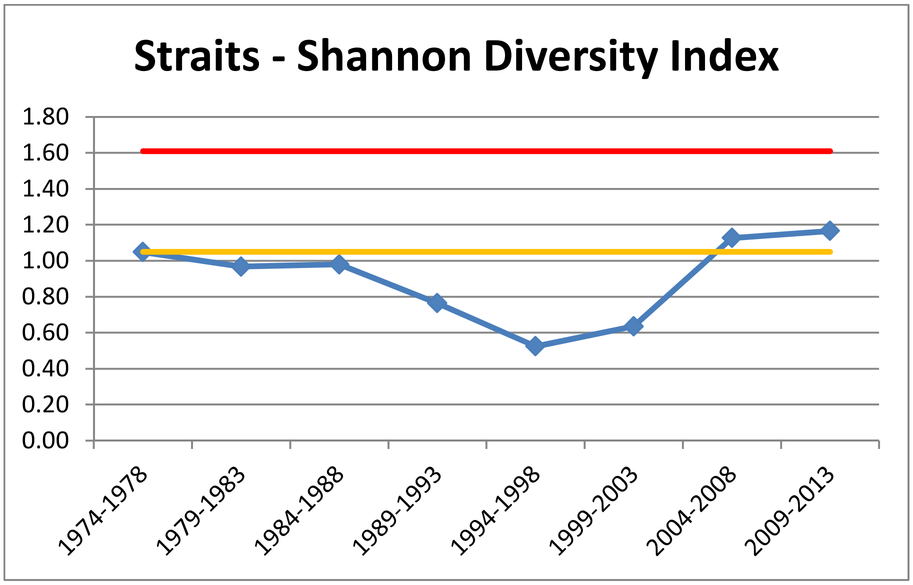

Figure 8-7. Mean Shannon diversity indices for the Strait of Juan de Fuca summer chum population for five-year periods from 1974 through 2013. The Puget Sound TRT (Sands et al. 2009) stated that the 1974-1978 mean value of 1.05 (yellow line) is a good initial viability target and that the highest value possible (achieved if all aggregations were equally abundant) is 1.61 (red line).

We also examined the distribution of NOR escapement for the spawning aggregations within the Hood Canal and Strait of Juan de Fuca summer chum populations for three five-year periods: 1974-1978 (prior to decline of summer chum abundance), 1990-1994 (prior to any supplementation program adult returns), and 2009-2013 (the most recent five years). The pie sections in Figure 8-8 (Hood Canal) and Figure 8-9 (Strait of Juan de Fuca) represent the average annual percentage of total population represented by each spawning aggregation over the given time period. Diversity is high when there are many components and their abundances are fairly even.

In Hood Canal, from 1974 to 1978, most spawning occurred in nine aggregations with three spawning aggregations in the Dosewallips, Duckabush and Hamma Hamma rivers comprising nearly 70% of the NOR escapement. By 1990-1994, nearly all spawning occurred in six aggregations with the Dosewallips, Duckabush and Hamma Hamma rivers comprising nearly 50% of the escapement and Union River accounting for about 30% of the spawners. During 2009-2013, spawning escapement was more widely and evenly distributed in eleven aggregations (Figure 8-8). The Shannon diversity indices associated with the 1974-1978, 1990-1994, and 2009-2013 periods are 1.86, 1.54, and 1.91, respectively.

In Strait of Juan de Fuca, from 1974 to 1978, three spawning aggregations in Salmon, Snow, and Jimmycomelately creeks were relatively evenly distributed. By 1990-1994, about 70% of all NOR spawning occurred in Salmon Creek and <10% of spawning was in Snow Creek. During 2009-2013, spawning escapement was more widely and evenly distributed in four aggregations (Table 8-9). The Shannon diversity indices associated with the 1974-1978, 1990-1994, and 2009-2013 periods are 1.05, 0.67, and 1.17, respectively.

Again, the change in the distribution of escapement is also partly the result of the reintroduction of spawning aggregations into Big Beef Creek and Tahuya River (Hood Canal) and Chimacum Creek (Strait of Juan de Fuca) where summer chum had been extirpated.

The Shannon diversity indices in recent years (2004-2008 and 2009-2013) are now about the same as the diversity indices during 1974-1978 for the Hood Canal and Strait of Juan de Fuca populations. This indicates that each population currently meets the initial target level for spatial distribution and, thus, each population is approaching viability under this criterion.

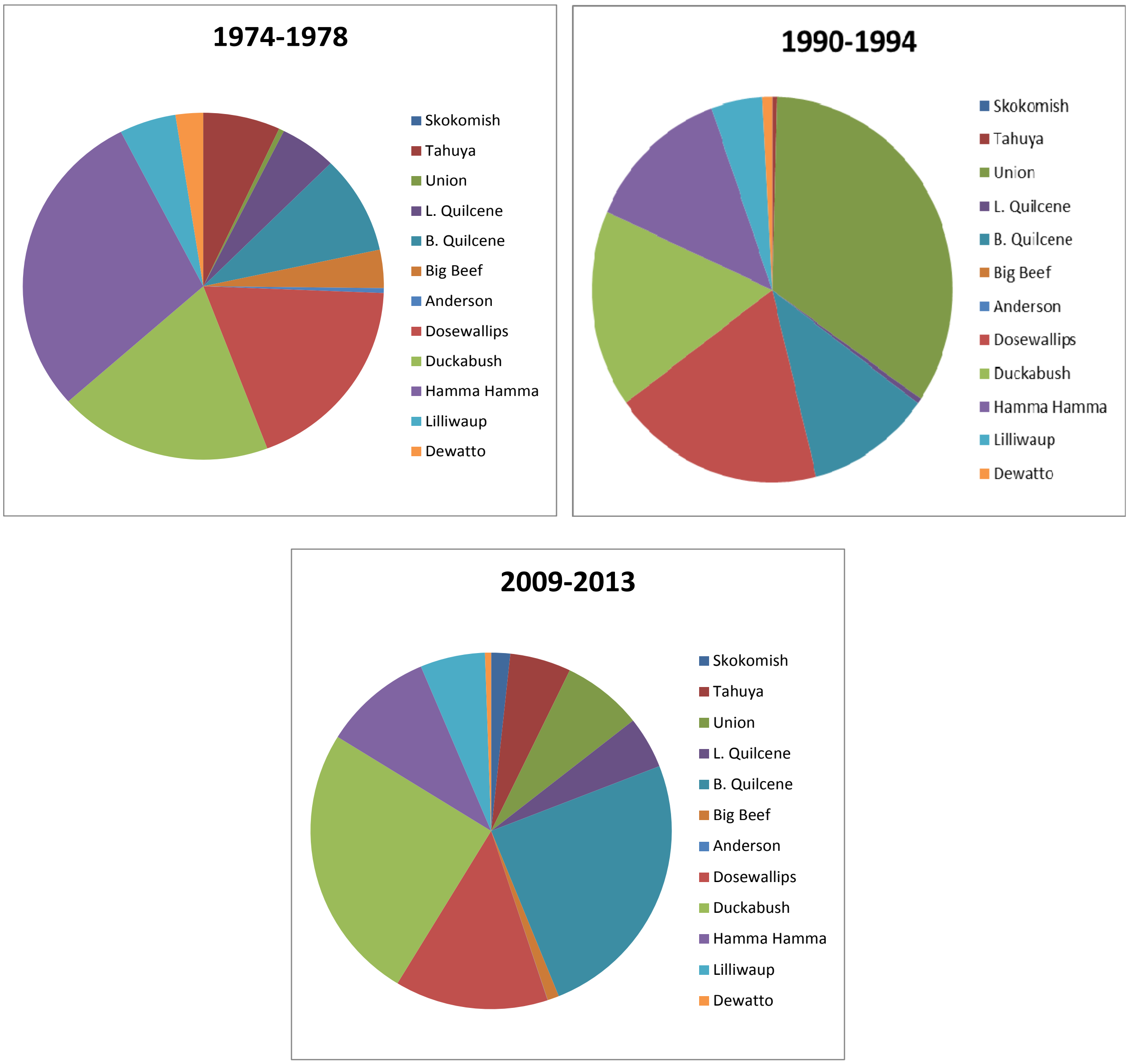

Figure 8-8. Distribution of NOR escapement for the spawning aggregations within the Hood Canal summer chum population for periods from 1974-1978 (pre-decline), 1990-1994 (prior to any supplementation program adult returns), and 2009-2013 (most recent five years). The pie sections represent the average annual percentage of total population represented by each spawning aggregation over the given time period. The Shannon diversity indices associated with 1974-1978, 1990-1994, and 2009-2013 are 1.86, 1.54, and 1.89 respectively.

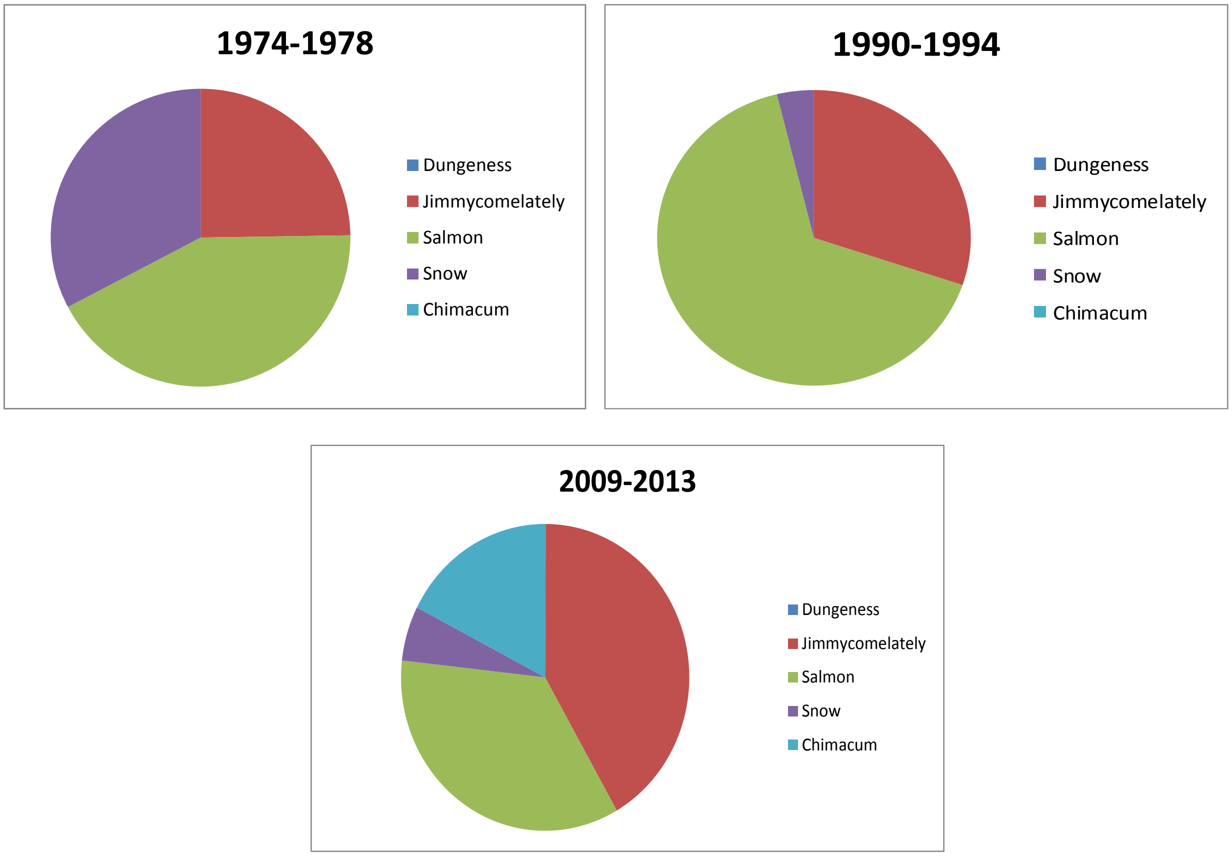

Figure 8-9. Distribution of NOR escapement for the spawning aggregations within the Strait of Juan de Fuca summer chum population for 1974-1978, 1990-1994, and 2009-2013. The pie sections represent the average annual percentage of total population represented by each spawning aggregation over the given time period. The Shannon index associated with 1974-1978, 1990-1994, and 2009-2013 are 1.05, 0.67, and 1.19, respectively.

The Co-managers have been collecting genetic stock information and analysis of the data by WDFW scientists and others has demonstrated genetic differences exist among stocks and populations (Kassler and Shaklee 2003, Small and Young 2003, PSTRT 2007, Small et al. 2009 and 2013). Genetic data baselines have been established and monitoring continues (see extent of monitoring in Appendix Tables 3 through 10 for 2005 through 2012, respectively, and similar tables in the earlier SCSCI Supplemental Reports WDFW and PNPTT 2001, 2003, 2007) and progress reports (WDFW and PNPTT 2006, 2007). There is no evidence of loss between or within population genetic variability for the summer chum populations. When comparisons were made before and after the implementation of supplementation programs, Small et al. (2009 and 2013) concluded that there was no impact to the genetic structure of summer chum and recent analyses show no long-term change in the effective population size (Ne). There were no significant differences in the reproductive success of supplementation-origin vs. natural-origin summer chum in a study done in artificial spawning channels at Big Beef Creek (Berejikian et al. 2008). In the future, the co-managers expect to continue tracking genetic diversity, analyzing the data and reporting the results. In particular, our interest will be with indications of any change in diversity that may be associated with recovery actions (e.g., artificial production) or environmental effects (e.g., climate change or loss/degradation of habitat).

ESU VIABILITY

PSTRT Recommendation: ESU viability

The Hood Canal Summer Chum Salmon ESU would have a negligible risk of extinction if both of the historical populations of summer chum achieve a low risk (i.e., viable) status.

Since neither the Hood Canal population nor Strait of Juan de Fuca summer chum population meet the PSTRT criteria for population viability at this time, the ESU is not viable. Viable in this sense refers to naturally self-sustaining populations, and ESU, that have a negligible risk of extinction over a 100-year time frame.

9) CONCLUDING REMARKS & SUMMARY

The Washington Department of Fish and Wildlife and Point No Point Treaty Tribes, as Co-managers within Hood Canal and the Strait of Juan de Fuca, started to actively pursue recovery of Hood Canal summer chum in 1992. At that time, the Co-managers began implementing terminal area harvest restrictions to protect summer chum escapements and initiated several hatchery conservation programs to help rebuild summer chum spawning populations. These efforts were expanded and refined as work progressed on preparation of a recovery initiative. The initiative, titled the "Summer Chum Salmon Conservation Initiative" or SCSCI was completed in April 2000, at which time the provisions of the initiative were already being fully implemented.

The Co-managers' have continued to carry out the SCSCI's provisions to the present day. Our focus has been primarily on the harvest management and artificial production components of the SCSCI. We recognize, however, that without habitat protection and restoration, which requires participation of land use managers and other entities, summer chum recovery cannot be accomplished. Support of habitat management actions is a major part of the Co-managers' SCSCI and is key to the overall integrated management approach necessary for recovery to be successful (see section 6, Habitat).

Critical to the success of the recovery efforts is effective monitoring of summer chum, so that we may know the status and trends of the spawning populations or stocks over time, evaluate the effects of protection and recovery actions, and make adjustments as appropriate. The Co-managers have closely monitored the individual stocks and management actions associated with them. Stock specific data and analyses have been collected pertaining to spawning escapements, harvests, runsizes, hatchery effects, straying, and biological and genetic characteristics. This information is presented in detail within the sections and appendices of the current report that address stock assessment (section 2), harvest (section 3) and artificial production (section 4). How well the Co-managers' recovery actions have met performance standards identified in the SCSCI is described in section 7. Section 6 describes progress with habitat protection and recovery. Also, the Co-managers' efforts to address ecological interactions and the current status of the summer chum stocks relative to the Co-managers' recovery goals are described in sections 5 and 8, respectively.

Below are sub-sections with (1) summaries of each previous section of this 5 year review report, (2) a commentary addressing the SCSCI's specific five year plan review requirements, and (3) a brief description of the future needs and direction of summer chum recovery.

5-YEAR REVIEW SECTION SUMMARIES

Following are brief summaries of progress in the implementation of the SCSCI, organized to follow the above sections of the report.

STOCK ASSESSMENT

Updates of escapement and runsize estimates are provided including details for the years 2005 through 2013. Abundance remained high for the Strait of Juan de Fuca population with several all-time high abundances recorded during this period. In Hood Canal, abundance declined during 2005 through 2011from the record highs observed there during 2003 and 2004, but then increased during 2012 and 2013.

The continued collection of data is reported for genetics (from DNA), hatchery vs. natural stock origin (from otoliths), and age (from fish scales and otoliths). Sampling is done from streams (carcasses during spawner surveys) and/or during collection of broodstock (by trap or seine). Age analysis has been updated through 2013 and used for estimates of productivity (see below).

Mark recovery data for the adult return years are available for 2001 through 2013 and have been analyzed to differentiate natural-origin from supplementation-origin fish. Proportions of natural and supplementation origin fish are described for the Hood Canal and Strait regions and for the ESU (Table 2-7 and Table 2-88). After 2005, natural-origin recruits generally comprise 80% or more (Hood Canal), 60% or more (Strait of Juan de Fuca), and 70% or more (ESU) of escapements and runsizes. Specific numbers of natural and supplementation origin recruits are provided for each stream and/or management unit in Table 2-9 and Table 2-10 and in Appendix Tables 20 through 23. These data allow us to evaluate the effects of the artificial production programs (see below) and measure progress with natural production (see SCSCI performance standards below).

The collection of age data and its analysis currently allow estimates of productivity (natural-origin recruits per spawner) for 9 brood years for most stocks and up to 14 brood years for some stocks (Table 2-12). For the ESU as a whole, productivity has ranged from 0.34 (BY 2004) to 10.25 (BY2000) (Table 2-11). Rates are highly variable from stock to stock and from year to year, although trends are visible for across stocks between years. Productivity for all regions was generally >1 R/S for the 1997 through 2002 brood years and <1 R/S for the 2003 through 2008 brood years. The reduced productivity from 2003 and 2004 brood years coincided with the highest spawning escapements in Hood Canal for the 14 year time series. However, low R/S rates continued through the 2006 brood year for all regions despite moderate to high spawning escapements. The R/S rates generally increased for the 2007-2009 brood years under low to moderate escapements more similar to those observed in the earlier years of the time series, despite 2009 being only a partial brood return. These observed trends may indicate density dependent responses for the populations. In addition, the existing productivity results are useful in assessing recent summer chum performance (see SCSCI performance standards below).

An updated assessment of extinction risk has been provided using the methodology of Allendorf et al. (1997). The assessment of extinction risk in the first 5-year review (WDFW and PNTT 2007) used total escapements (comprised of natural-origin and supplementation-origin fish) for each stock. In this second 5-year review, extinction risk criteria were based only on natural-origin summer chum escapement data from the four year periods (one generation) before onset of recovery activities (1988-1991 for Hood Canal stocks and 1989-1992 for Strait stocks), at the time of the first 5-year review (2001-2004), and from a recent four years (2009-2012). Extinction risks for all stocks, except Lilliwaup, have decreased since the onset of recovery activities, with increases in population sizes, and effective population sizes per generation for all stocks. The extinction risk for Lilliwaup summer chum has remained high.

HARVEST MANAGEMENT

Harvest management is reviewed over the nine year time span, 2005 through 2013. Presented and discussed are results of forecasting runs and of managing for harvest and escapement under provisions of the Base Conservation Regime (BCR).

Forecasts have been made using moving averages of post season annual runsize estimates. Generally, the forecasts have overestimated runsizes, with the exception of the Mainstem Hood Canal in 2006, 2010 and 2012. However, the Strait of Juan de Fuca abundance was typically underestimated during the eight year period. The only exceptions were in 2007, 2008 and 2009 (Table 3-1 and Table 3-2). When the abundance trend is moving upward, moving averages will typically result in underestimates. However, in this case forecasts were conservative and the forecasting method could result in overestimates should the abundance trend downward for any significant period. The BCR calls for checking forecasts against specified critical thresholds as an alert to potential risks of low returns in a given year. We evaluated those cases where the population forecast fell below the threshold, triggering our consideration of possible further protective measures; however, in every case we found a prior pattern of extremely low exploitation rates suggesting current protective measures were adequate. Also, there were no practical additional protective actions to take. Subsequent evaluation of post season abundance estimates showed almost no effects of harvest within Washington on these groups of fish. Given the performance of the BCR, no specific additional measures were implemented.

Annual estimates of forecast runsizes, post season runsizes, harvests and escapements, and of harvest exploitation rates are provided in Tables 3-1 through 3-9. Exploitation rates in every year are shown to fall well below the expected rates under the BCR, with the exception of the Quilcene extreme terminal fishery where provisions accommodate alternative management for escapement. In the latter case, fisheries are controlled to limit exploitation rates to 5% of Hood Canal runsize unless inseason information indicates that escapement will exceed preset levels. In that case, fishing limitations can be lifted. From 2000-2008, pre-season and inseason information indicated that summer chum escapement would exceed 2,500 and additional gillnet days for coho could be added. As a result, exploitation rates ranged from 0.00% to 33.2% (Table 3-6). In 2009 and 2010, the escapement range was below 2,500 chum, which prevented the scheduling of additional fishing days. Starting in 2010, a more conservative approach was implemented with no gillnet fisheries to be scheduled until an estimated 1,500 summer chum escapement was actually measured during spawner surveys. The results of this conservative approach during 2010, 2011, 2012, and 2013 were consistent with BCR limits. The Co-managers did not take any in-season actions that differed from the provisions of the BCR.

Over the nine years, a few incidents occurred, but overall there were no significant, or persistent, compliance or enforcement problems with the fisheries. Catch and escapement data were collected, recorded and later analyzed each year. Scale samples from summer chum have been collected during CWT sampling from the Quilcene Bay coho fishery. The samples have been archived for processing. No other biological data has been collected.

Though the harvest management provisions of the BCR were set up to provide considerable protection, harvest management performance has far exceeded the co-managers' expectations. Given the current performance of the BCR provisions, the co-managers recommend continuing these provisions in the interim. It is recommended, though, that the co-managers continue to monitor the implementation of BCR provisions in the Quilcene extreme terminal fishery. In addition, the co-managers plan to continue to develop new provisions and criteria for a "Recovering" regime that in the future may be implemented as an alternative to the BCR. To be applied only after sufficient summer chum status improvement, this new regime would relieve at least some of the BCR's harvest restrictions on other species.

ARTIFICIAL PRODUCTION

There have been a total of nine artificial production projects, six of these for supplementation (to rebuild existing stocks) and three for reintroduction (to reintroduce summer chum to a stream where the spawning population was extirpated). Seven of the projects have been terminated (see Table 2-6) consistent with the limit on project duration specified in SCSCI operations guidelines.

Individual detailed project reports have been provided for each artificial production project. These reports update project information through 2012 and include annual production numbers (e.g., adult returns, number of fish spawned, and number, size and date of fry releases), additional monitoring and evaluation (e.g., fish marking information, hatchery survival rates, fish health), and general program assessment. The reports vary somewhat, accommodating each project's specific situation. All of the supplementation and reintroduction projects have been effective and have followed the standards and guidelines of the SCSCI. The overall summer chum artificial production program has been reviewed by the Hatchery Scientific Review Group, the NOAA Fisheries Recovery Science Review Panel, and the NMFS Salmon Recovery Division. All three groups gave positive reviews of the way the program was designed and being implemented.

ECOLOGICAL INTERACTIONS

Two areas of potential adverse ecological interactions effects on summer chum are identified in the SCSCI: artificial production (or hatchery) programs of other species and marine mammal predation. The SCSCI contains an assessment of other species' hatchery programs, which identifies risks within four categories: hatchery operations, predation, competition/behavior modification and fish disease. The SCSCI also specifies risk aversion and monitoring/evaluation measures within these categories for those hatchery programs evaluated to be at risk of negatively impacting summer chum. As of 2013, the co-managers have implemented virtually all of these mitigation measures as described in Table 5-1. Another factor in reducing the risk of ecological interactions from this source has been the substantial reduction of the total production and number of hatchery programs for other species, also described in Table 5-1.

There have been no new studies or assessments of the potential impact marine mammals may have on recovering populations of summer chum salmon.

HABITAT

The Co-managers recognized within the SCSCI that habitat is the key to long term recovery and sustainability of summer chum. The SCSCI provided assessments and recommendations for protection of summer chum habitat that have since been built upon and, in large part, superseded by subsequent planning efforts. The Co-managers saw their role to be participants in collaborative actions with local jurisdictions, private landowners and other state and federal agencies in protecting and restoring land and water resources important in the life history of summer chum. For example, since the SCSCI was issued, the Co-managers have been involved (1) in a comprehensive effort to identify habitat limiting factors in watersheds of Hood Canal and the Strait of Juan de Fuca; (2) with watershed planning groups working on water issues and accounting for effects on salmonid habitat; (3) with the task force addressing low dissolved oxygen levels in Hood Canal; (4) in updating county shoreline master programs and critical area ordinances; (5) in researching nearshore habitat; (6) in recommending and reviewing habitat restoration projects for funding by the State's Salmon Recovery Funding Board and other sources; and (7) with other actions to benefit summer chum habitat as described in the above Habitat section.

Perhaps the most important recent development is the Hood Canal and Eastern Strait of Juan de Fuca Summer Chum Salmon Recovery Plan prepared by the Hood Canal Coordinating Council in cooperation with local counties of the ESU and the Co-managers. This plan includes assessments of the effects of land use management on summer chum habitat and identifies habitat recovery projects within the ESU. The plan, approved by NMFS consistent with section 4(f) of the Endangered Species Act, will guide summer chum habitat protection and restoration. The Co-managers remain concerned that, with the pressures of population growth, existing land use management measures may be compromised or not enforced. To help mitigate against loss of effective habitat protection and ensure proper habitat restoration, we advocate completion of a yet to be developed habitat adaptive management program as part of the recovery plan and also recommend that this program be integrated with the existing harvest and hatchery management programs.

SCSCI PERFORMANCE STANDARDS

Specific standards of performance were identified in the SCSCI that were "…meant to provide immediate criteria upon which to measure progress toward recovery of summer chum populations". These standards were expressed relative to measurements affecting abundance (runsize), productivity and escapement, and also relative to trends affected by management actions.

Generally, the extant summer chum stocks identified in the SCSCI have met performance standards as is described in detail within section 7 of this report. The exceptions are Lilliwaup and Hamma Hamma, which had natural origin escapements below the critical threshold during several years.

RECOVERY GOALS

The Co-managers developed interim recovery goal criteria for summer chum that addressed abundance (runsize) and escapement, productivity and diversity (PNPTT and WDFW 2003). The status of each of the eight extant summer chum stocks relative to the goal criteria has been assessed in this report (section 8).

Though there have been improvements in the abundance, escapement and productivity of the stocks in recent years, no stocks have met all the applicable recovery goal criteria for these parameters. Seven of the eight stocks, Quilcene, Dosewallips, Duckabush, Hamma Hamma, Union, Salmon/Snow, and Jimmycomelately, each meet or exceed their escapement recovery goal thresholds. However, only four of the eight stocks, Quilcene, Dosewallips, Union, and Salmon/Snow also meet or exceed their abundance recovery goal thresholds (Table 8-1). Two extant stocks (Duckabush and Jimmycomelately) currently meet the productivity recovery goal criteria.

The interim recovery goals for diversity include: support of planning and implementation of habitat protection and restoration measures (where strong co-managers support exists – see Habitat, section 6), rebuilding existing stocks, and reintroduction of extinct stocks. The latter two goals are to be accomplished by natural and artificial means. The Co-managers are actively involved in using artificial production to build and reintroduce summer chum stocks (see Artificial Production, section 4) and, again, have been supporting habitat protection and restoration to augment stock recovery by natural means.

In setting up the interim recovery goals, the Co-managers recognized that over time, with new information and analyses, the goals should be updated. We had hoped to be able to reconsider the goals in time for this five year report. The recent and ongoing efforts by the HCCC, co-managers, and NMFS (Lestelle et al. 2014) to identify habitat-based recovery goals for each stock should provide information needed to do so for each extant summer chum stock. In addition, the HCCC Business Plan (HCCC 2013) identifies the conservation outcomes needed, an implementation plan with strategic priorities and performance measures, and funding and resources needed over a 10 year period to recover summer chum salmon (see Habitat section). The interim goals do, however, continue to provide tangible objectives that point toward summer chum recovery.

SCSCI Five-Year Plan Review Requirements

Section 3.6.3 of the SCSCI specifies steps required for the five year plan reviews. These steps have been addressed within the previous sections of this report. However, following is a listing of the steps, including brief commentary on how they have been addressed.

1. *Review and describe performance of each element of the plan in meeting their specific compliance and effectiveness standards, as provided in previous sections (SCSCI sections 3.2 - 3.5), by management unit and stock, since the last review period and since adoption of the plan.*

   The SCSCI sections 3.2 – 3.5 correspond in subject matter to the artificial production, ecological interactions, habitat and harvest sections in the present report. Performance in each of these areas is reviewed within these sections of the report.

2. *Evaluate management unit and stock performance relative to the standards provided in section 3.6.4 of the SCSCI.*

   The review of these standards is provided in Section 7, SCSCI Performance Standards, of the present report.

3. *Determine which strategies and actions and conservation objectives were most effective and least effective and which management unit and stock did or did not see the desired improvement. Document the findings by management unit and stock and at the region-wide level, i.e., were successes concentrated geographically or were certain units chronically falling short of objectives.*

   Generally, within the scope of this 5 year review report, all of the strategies, actions and objectives have been shown to be effective. See the above individual sections 2 through 6, addressing stock assessment, harvest management, artificial production, ecological interactions and habitat, and also section 7 regarding SCSCI performance standards. Recovery effort results have been documented by stock, management unit and region. Through 2013, only the performance of the Lilliwaup stock has fallen below performance standards in that their average escapements were below the critical thresholds.

4. *Identify causes of successes and failures and categorize them according to type:*

   <u>Compliance:</u> *Actions were not implemented correctly or had a significant degree of non-compliance by user groups or governments.*

   Initially, there were problems with monitoring, record keeping and reporting of some non-summer chum volunteer/citizen hatchery project operations. This problem was corrected over time. Some relatively minor harvest compliance issues arose and were addressed in the extreme terminal Quilcene fishery. The co-managers will continue to monitor, evaluate, and improve implementation of the BCR provisions for this fishery (see also the below subsection describing future needs and direction).

   <u>Effectiveness:</u> *Actions were implemented correctly and had high degrees of compliance but did not have the intended effect(s).*

   The Lilliwaup artificial production project had not as of 2004 produced expected adult return rates based on experience with other summer chum artificial production projects. Needed improvements to project operations were made beginning with brood year 1998 and now appear to be contributing to increased returns (see section 4, Artificial Production). The Lilliwaup stock had not met its escapement performance standard through 2013. However, since the Lilliwaup stock has consistently had very low natural-origin returns (except for increases during 2012 and 2013) and is currently rated as at high risk of extinction, it appears that the supplementation returns has played an important role and is largely responsible for maintaining the summer chum stock in Lilliwaup.

<u>Assumptions:</u> *Assessment methods or parameters were accurately or inaccurately estimated and applied.*

Observed summer chum exploitation rates under the harvest management base conservation regime have been substantially lower than what was expected (see section 3, Harvest Management). Since this result does not imply any increased risk to summer chum (in fact, lower risk is indicated), the Co-managers will continue to conservatively manage harvest under the provisions of the base conservation regime. The Co-managers plan to develop new provisions and criteria for a "Recovering" regime that in the future may be implemented as an alternative to the base conservation regime.

5. *Make adjustments to plan elements as provided in sections 3.2 - 3.5. Co-managers will incorporate new information from monitoring, evaluation and research studies in making adjustments as prescribed.*

   Based on new information through 2013, there are no compelling reasons for making any adjustments.

6. *Make recommendations for plan changes or amendments. This information should be as specific as possible, including the watersheds, river systems, estuaries, management units, stocks, programs or projects, and fisheries affected, the type of suggested change and the time frame over which it should be implemented.*

   Owing to the generally successful implementation of the recovery strategies and actions, and to the generally positive results with respect to the summer chum populations, the Co-managers are not recommending any major changes at this time. However, see the following subsection describing future needs and direction of summer chum recovery.

FUTURE NEEDS AND DIRECTION

The Co-managers intend to continue to follow the provisions and guidelines of the SCSCI for managing recovery of summer chum, essentially in the same manner as is described in this report. It should be emphasized, however, that resources to maintain the current levels of performance are being stretched. The situation is especially tenuous with regard to the ongoing extensive monitoring effort, including data analysis. Of most immediate concern is that funding for reading otolith marks and analyzing genetic samples is not secure. Each year, it has been a challenge to find complete support for these analyses. Any future breakdowns in funding support could result in delays or even gaps in results of the monitoring efforts that are critical to the evaluation and support of recovery.

The Co-managers emphasize and will strive in the future to accommodate the following tasks:

1) Continue effective population, biological and genetic monitoring of summer chum.
2) As data become available, review options for improving forecasts of summer chum

runsizes used in preseason (and potentially in-season) harvest management planning

3) Continue to monitor, evaluate and improve implementation of the provisions of the Base Conservation Regime for the Quilcene extreme terminal fishery.
4) Develop a "Recovering" regime for harvest management of summer chum.
5) Continue monitoring and adaptively managing artificial production operations of summer chum and other species within the ESU.
6) Continue to support and advocate for habitat protection and restoration actions.
7) Support and advocate for development of a strong and effective habitat adaptive management program that is integrated with the programs for harvest and hatcheries.
8) Review new information and revise as appropriate the Co-managers' interim recovery goals.
9) Continue to report on progress of summer chum recovery actions, consistent with the guidelines of the SCSCI.
10) Continue to assess progress towards achieving the long-term viability criteria established in the Federal recovery plan. Incorporate the need to address ocean climate regimes and climate change into revised recovery goals.
11) The recent and ongoing efforts by the HCCC, co-managers, and NMFS (Lestelle et al. 2014) to identify habitat-based recovery goals for each extant stock should be further developed and finalized. In addition, the HCCC Business Plan (HCCC 2013) should be implemented over a 10 year period to recover summer chum salmon (see Habitat section).

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APPENDIX

APPENDIX TABLES

Appendix Table 1. Summer chum salmon spawning escapement estimates in the Hood Canal Region, 1968-2013.

Appendix Table 2. Summer chum salmon spawning escapement estimates in the Strait of Juan de Fuca Region, 1968-2013.

Appendix Tables 3 through 10. Genetic, otolith, and scale collections made from adult summer chum salmon in Hood Canal and eastern Strait of Juan de Fuca streams, 2005-2012.

Appendix Tables 11 through 19. Strait of Juan de Fuca and Hood Canal summer chum salmon age composition, 2005-2013.

Appendix Tables 20 and 21. Natural-origin and hatchery-origin summer chum escapement estimates in Strait of Juan de Fuca and Hood Canal regions, 1974-2013.

Appendix Tables 22 and 23. Natural-origin and hatchery-origin summer chum runsize estimates in Strait of Juan de Fuca and Hood Canal regions, 1974-2013.

Appendix Tables 24 through 36. Recruit per spawner worksheets for natural-origin summer chum returning to individual streams in the Hood Canal and Strait of Juan de Fuca.

Appendix Tables 37 through 44. Estimated numbers of supplementation-origin Hood Canal summer chum escaping to streams other than their stream of origin, 2005-2012.

Appendix Table 1. Summer chum escapement estimates in Hood Canal region, 1968-2013. (Excluded values = no estimates; Italicized = estimates based on regression or extrapolation. Excluded values in brood column = no broodstock collected).

Return		Big Beef						Union		
Year	Skokomish	Wild	Brood	Total	Anderson	Dewatto	Tahuya	Wild	Brood	Total
1968		100				2,275				
1969		100				280				
1970		178			65	2,666				
1971		159			125	2,012				
1972		177			225	1,403	4,487			
1973		244				691				
1974		75			0	181	880	68		
1975		1,152			195	613	1,389	*84*		
1976		1,281			234	741	3,200	100		
1977		302			*26*	225	726	75		
1978		680			16	544	266	64		
1979		191			6	49	117	*97*		
1980		123			2	117	179	208		
1981		90			1	41	140	41		
1982		0			0	21	86	*153*		
1983		0			0	15	86	170		
1984		22			1	44	142	194		
1985		0			0	19	122	334		
1986		0			0	20	109	1,892		
1987		6			0	5	91	497		
1988		0			0	23	145	629		
1989		0			0	2	9	450		
1990		0			0	0	6	275		
1991		0			0	31	5	208		
1992		0			0	0	0	140		
1993		0			0	1	0	251		
1994		0			0	0	0	738		
1995		0			0	0	0	721		
1996		0			0	0	5	494		
1997		0			0	6	0	410		
1998		0			0	12	0	223		
1999		0	4	4	0	2	1	159		
2000		0	20	20	0	10	2	682	62	744
2001	3	826	68	894	0	32	0	1,426	65	1,491
2002	0	677	65	742	0	10	0	807	65	872
2003	0	824	72	896	0	9	0	11,780	136	11,916
2004	24	1,852	64	1,916	1	23	8	5,876	100	5,976
2005	5	1,124	0	1,124	0	23	4	1,885	102	1,987
2006	8	823	0	823	0	69	749	2,736	100	2,836
2007	22	846	0	846	0	21	623	1,867	100	1,967
2008	23	733	0	733	0	26	700	1,030	100	1,130
2009	33	152	0	152	1	50	380	548	63	611
2010	61	143	0	143	0	9	1,153	897	66	963
2011	107	73	0	73	0	37	325	276	20	296
2012	524	156	0	156	2	187	1,405	2,180	66	2,246
2013	977	101	0	101	0	186	862	1,892	57	1,949

Appendix Table 1 (continued)

Return	Lilliwaup			Hamma Hamma			Duckab	Dosew	Quilcene			
Year	Wild	Brood	Total	Wild	Brood	Total	ush	allips	Big Quil	Little Quil	Brood	Total
1968				13,548			4,693		5,797	897		6,694
1969				3,104			3,802		1,307			
1970				1,390			2,301		655	12		667
1971	318			4,282			3,904		1,798	71		1,869
1972	716			5,346			13,546	1,733	2,067	300		2,367
1973							5,761	623	3,107	238		3,345
1974	616			*2,448*			3,581	*3,593*	795	44		839
1975	706			*7,341*			2,245	*2,250*	1,405	868		2,273
1976	1,612			*7,648*			6,095	3,271	2,445	1,088		3,533
1977	420			*1,675*			2,453	3,215	821	773		1,594
1978	1,331			*8,215*			1,898	*1,901*	2,978	1,816		4,794
1979	163			*3,096*			1,190	*1,190*	345	110		455
1980	247			329			827	1,216	375	154		529
1981	293			926			557	63	138	84		222
1982	84			801			690	507	156	125		281
1983	18			190			80	64	100	176		276
1984	187			*170*			299	212	60	83		143
1985	92			*231*			30	236	44	1		45
1986	97			173			177	57	15	12		27
1987	32			26			12	9	8	71		79
1988	275			440			497	661	120	177		297
1989	43			16			60	16	1	1		2
1990	2			90			42	8	6	0		6
1991	30			71			102	250	49	1		50
1992	81	18	99	123			617	655	320	9	414	743
1993	67	10	77	69			105	105	97	12	39	148
1994	99	12	111	370			263	225	349	0	373	722
1995	79	0	79	476			825	2,787	4,029	54	491	4,574
1996	64	12	76	774			2,650	6,976	8,479	265	771	9,515
1997	9	18	27	97	14	111	475	47	7,339	29	535	7,903
1998	3	21	24	95	32	127	226	336	2,244	265	544	3,053
1999	0	13	13	212	43	255	92	351	2,981	84	172	3,237
2000	2	20	22	173	56	229	464	1,260	5,126	268	504	5,898
2001	32	60	92	1,173	54	1,227	942	990	5,868	199	306	6,373
2002	775	83	858	2,260	68	2,328	530	1,627	3,662	470	355	4,487
2003	194	159	353	796	58	854	1,869	7,066	11,745	890	98	12,733
2004	922	95	1,017	2,628	63	2,691	8,637	11,549	35,000	3,045	108	38,153
2005	951	98	1,049	1,272	136	1,408	821	2,658	5,702	866	104	6,672
2006	1,523	92	1,615	2,922	143	3,065	3,135	2,577	9,504	2,372	0	11,876
2007	485	40	525	1,387	102	1,489	1,294	1,468	1,461	1,065	0	2,526
2008	638	52	690	1,503	139	1,642	2,668	3,930	1,675	2,186	0	3,861
2009	123	124	247	670	0	670	2,661	1,128	1,065	425	0	1,490
2010	95	143	238	1,471	0	1,471	4,110	2,521	1,576	497	0	2,073
2011	75	38	113	773	0	773	1,538	1,130	2,160	420	0	2,580
2012	3,204	136	3,340	2,355	0	2,355	5,241	2,862	10,467	1,272	0	11,739
2013	2,520	132	2,652	2,186	0	2,186	4,129	1,815	7,118	832	0	7,950

Appendix Table 2. Summer chum escapement estimates in Strait of Juan de Fuca region, 1968-2013. (*Excluded values = no estimates; Italicized = estimates based on regression or extrapolation. Excluded values in brood column = no broodstock collected).*

Return	Jimmycomelately				Salmon			
Year	Wild	Brood	Total	Snow	Wild	Brood	Total	Chimacum
1968								
1969								
1970								
1971					249			
1972				435	534			
1973					636			
1974	*438*			818	512			0
1975	*353*			340	755			0
1976	*365*			608	521			0
1977	*405*			538	701			0
1978	*787*			629	1,664			0
1979	*170*			133	458			0
1980	*1,326*			709	3,074			0
1981	*203*			242	439			0
1982	599			766	1,386			0
1983	254			154	731			0
1984	367			384	828			0
1985	61			20	151			0
1986	292			213	582			0
1987	464			465	1,062			0
1988	1,052			723	1,915			0
1989	173			21	194			0
1990	63			33	245			0
1991	125			12	172			0
1992	616			21	371	62	433	0
1993	110			11	400	52	452	0
1994	15			2	137	24	161	0
1995	223			25	538	53	591	0
1996	30			160	785	109	894	0
1997	61			67	724	110	834	0
1998	98			27	1,023	121	1,144	0
1999	1	6	7	29	434	65	499	38
2000	9	46	55	30	710	136	846	52
2001	192	68	260	154	2,484	154	2,638	903
2002	6	36	42	532	5,389	128	5,517	864
2003	369	77	446	304	5,521	130	5,651	558
2004	1,601	61	1,662	396	6,021	0	6,021	1,139
2005	1,247	63	1,310	832	6,142	0	6,142	1,396
2006	660	65	725	598	4,894	0	4,894	2,026
2007	578	76	654	439	1,274	0	1,274	926
2008	982	76	1,058	172	1,568	0	1,568	727
2009	2,542	86	2,628	229	1,237	0	1,237	1,020
2010	3,945	82	4,027	524	2,740	0	2,740	1,968
2011	2,411	0	2,411	342	2,279	0	2,279	640
2012	2,590	0	2,590	496	2,318	0	2,318	894
2013	8,341	0	8,341	574	2,746	0	2,746	3,066

Appendix Table 3. Genetic, otolith, and scale collections made from adult summer chum salmon in Hood Canal and eastern Strait of Juan de Fuca streams, 2005.

			Sample size			
Stream	**WRIA**	**GSI code**	**DNA**	**Otolith**	**Scales**	**Collection method**
Dungeness River	18.0018	--	--	--	--	Spawner survey
Jimmycomelately [1]	17.0285	05IH	63	300	300	Trap, foot survey
Salmon Cr.[1]	17.0245	05II	11	400	400	Trap, foot survey
Snow Cr.	17.0219	05IJ	0	169	176	Trap, foot survey
Chimacum Cr.[1]	17.0203	05IK	1	250	253	Foot survey
Thorndyke Cr.	17.0170	--	--	--	--	Foot survey
Little Quilcene R.	17.0076	05IL	34	199	233	Foot survey
Big Quilcene R.[1]	17.0012	--	103	103	103	Foot survey
Dosewallips R.	16.0442	05IM	115	287	355	Foot survey
Duckabush R.	16.0351	05IN	55	167	173	Foot survey
Fulton Cr.	16.0332	--	0	1	0	Foot survey
Hamma Hamma R.[1]	16.0251	05IO	246	377	455	Seine, foot survey
Lilliwaup R.[1]	16.0230	05IP	192	318	331	Trap, foot survey
Little Lilliwaup	16.0228	--	0	1	1	Foot survey
Skokomish R.	16.0001	--	--	--	--	Foot survey
Union R.[1]	15.0503	05IR	107	184	184	Trap, foot survey
Tahuya R. [1]	15.0446	--	--	--	--	Foot survey
Stavis Cr.	15.0404	--	--	--	--	Foot survey
Dewatto R.	15.0420	05LY	0	12	12	Foot survey
Big Beef Cr.[1]	15.0389	05IQ	38	146	182	Trap, foot survey
Little Anderson	15.0377	--	--	--	--	Foot survey
Totals			**965**	**2,914**	**3,158**	

[1] Stream has supplementation or reintroduction program adult returns.

Appendix Table 4. Genetic, otolith, and scale collections made from adult summer chum salmon in Hood Canal and eastern Strait of Juan de Fuca streams, 2006.

Stream	WRIA	GSI code	DNA	Otolith	Scales	Collection method
			Sample size			
Dungeness River	18.0018		0	0	0	Spawner survey
Jimmycomelately [1]	17.0285		65	253	254	Trap, foot survey
Salmon Cr.[1]	17.0245		0	400	400	Trap, foot survey
Snow Cr.	17.0219		0	160	160	Trap, foot survey
Chimacum Cr.[1]	17.0203		0	250	255	Foot survey
Thorndyke Cr.	17.0170		0	0	0	Foot survey
Little Quilcene R.	17.0076		0	175	229	Foot survey
Big Quilcene R.[1]	17.0012		0	0	213	Foot survey
Dosewallips R.	16.0442		110	309	333	Foot survey
Duckabush R.	16.0351		146	343	411	Foot survey
Fulton Cr.	16.0332		0	0	0	Foot survey
Hamma Hamma R.[1]	16.0251		336	508	579	Seine, foot survey
Lilliwaup R.[1]	16.0230		308	504	534	Trap, foot survey
Little Lilliwaup	16.0228		0	0	0	Foot survey
Skokomish R.	16.0001		0	10	14	Foot survey
Union R.[1]	15.0503		100	192	226	Trap, foot survey
Tahuya R. [1]	15.0446		0	141	157	
Stavis Cr.	15.0404		0	0	0	Foot survey
Dewatto R.	15.0420		0	25	25	Foot survey
Big Beef Cr.[1]	15.0389		0	160	200	Trap, foot survey
Little Anderson	15.0377		0	0	0	Foot survey
Totals			**1,065**	**3,430**	**3,990**	

[1] Stream has supplementation or reintroduction program adult returns.

Appendix Table 5. Genetic, otolith, and scale collections made from adult summer chum salmon in Hood Canal and eastern Strait of Juan de Fuca streams, 2007.

Stream	WRIA	GSI code	Sample size			Collection method
			DNA	Otolith	Scales	
Dungeness River	18.0018	--	--	--	--	Spawner survey
Jimmycomelately [1]	17.0285	07GO	90	200	200	Trap, foot survey
Salmon Cr.[1]	17.0245	07GP	32	250	250	Trap, foot survey
Snow Cr.	17.0219	07GQ	35	102	132	Trap, foot survey
Chimacum Cr.[1]	17.0203	07GR	21	296	305	Foot survey
Thorndyke Cr.	17.0170	--	--	--	--	Foot survey
Little Quilcene R.	17.0076	07GS	0	180	187	Foot survey
Big Quilcene R.[1]	17.0012	--	0	0	330	Foot survey
Dosewallips R.	16.0442	07GT	60	250	250	Foot survey
Duckabush R.	16.0351	07GU	129	265	320	Foot survey
Fulton Cr.	16.0332	--	--	--	--	Foot survey
Hamma Hamma R.[1]	16.0251	07GV	206	349	349	Seine, foot survey
Eagle Cr.	16.0243	--	0	1	1	Foot survey
Lilliwaup R.[1]	16.0230	07GW	109	233	235	Trap, foot survey
Little Lilliwaup	16.0228	--	--	--	--	Foot survey
Skokomish R.	16.0001	--	0	3	3	Foot survey
Union R.[1]	15.0503	07GF	160	240	250	Trap, foot survey
Tahuya R. [1]	15.0446	07GG	5	133	143	Foot survey
Stavis Cr.	15.0404	--	--	--	--	Foot survey
Dewatto R.	15.0420	--	0	6	6	Foot survey
Big Beef Cr.[1]	15.0389	07GX	0	172	185	Trap, foot survey
Little Anderson	15.0377	07LA	0	6	2	Foot survey
Totals			**847**	**2,686**	**3,148**	

[1] Stream has supplementation or reintroduction program adult returns.

Appendix Table 6. Genetic, otolith, and scale collections made from adult summer chum salmon in Hood Canal and eastern Strait of Juan de Fuca streams, 2008.

Stream	WRIA	GSI code	Sample size DNA	Otolith	Scales	Collection method
Dungeness River	18.0018	--	--	--	--	Spawner survey
Jimmycomelately [1]	17.0285	08GO	83	233	253	Trap, foot survey
Salmon Cr.[1]	17.0245	08GP	30	271	271	Trap, foot survey
Snow Cr.	17.0219	08GQ	22	58	59	Trap, foot survey
Chimacum Cr.[1]	17.0203	08GR	15	193	195	Foot survey
Thorndyke Cr.	17.0170	--	--	--	--	Foot survey
Little Quilcene R.	17.0076	08GS	0	186	327	Foot survey
Big Quilcene R.[1]	17.0012	--	0	0	269	Foot survey
Dosewallips R.	16.0442	08GT	198	198	379	Foot survey
Duckabush R.	16.0351	08GU	200	200	347	Foot survey
Fulton Cr.	16.0332	--	--	--	--	Foot survey
Hamma Hamma R.[1]	16.0251	08GV,HT	311	337	399	Seine, foot survey
Lilliwaup R.[1]	16.0230	08GW,HU	260	260	327	Trap, foot survey
Little Lilliwaup	16.0228	--	--	--	--	Foot survey
Skokomish R.	16.0001	--	--	--	--	Foot survey
Union R.[1]	15.0503	08GY	110	198	209	Trap, foot survey
Tahuya R. [1]	15.0446	08GZ	25	130	136	Foot survey
Stavis Cr.	15.0404	--	--	--	--	Foot survey
Dewatto R.	15.0420	08HB	2	11	12	Foot survey
Big Beef Cr.[1]	15.0389	08GX	79	79	84	Trap, foot survey
Little Anderson	15.0377	--	--	--	--	Foot survey
Totals			**1,335**	**2,354**	**3,267**	

[1] Stream has supplementation or reintroduction program adult returns.

Appendix Table 7. Genetic, otolith, and scale collections made from adult summer chum salmon in Hood Canal and eastern Strait of Juan de Fuca streams, 2009.

			Sample size			
Stream	**WRIA**	**GSI code**	**DNA**	**Otolith**	**Scales**	**Collection method**
Dungeness River	18.0018	--	--	--	--	Spawner survey
Jimmycomelately [1]	17.0285	09HH	106	300	300	Trap, foot survey
Salmon Cr.	17.0245	09HI	52	200	245	Trap, foot survey
Snow Cr.	17.0219	09HJ	27	73	73	Trap, foot survey
Chimacum Cr.	17.0203	09HK	25	173	241	Foot survey
Thorndyke Cr.	17.0170	--	--	--	--	Foot survey
Little Quilcene R.	17.0076	09HL	35	35	46	Foot survey
Big Quilcene R.	17.0012	09HM	61	61	289	Foot survey
Dosewallips R.	16.0442	09HN	42	156	387	Foot survey
Duckabush R.	16.0351	09HO	41	100	344	Foot survey
Fulton Cr.	16.0332	--	--	--	--	Foot survey
Hamma Hamma R.[1]	16.0251	09HP	27	205	208	Seine, foot survey
Lilliwaup R.[1]	16.0230	09HQ	207	205	207	Trap, foot survey
Little Lilliwaup	16.0228	--	--	--	--	Foot survey
Skokomish R.	16.0001	--	0	13	20	Foot survey
Union R.	15.0503	09HS	73	130	137	Trap, foot survey
Tahuya R. [1]	15.0446	09HT	4	43	47	Foot survey
Stavis Cr.	15.0404	--	0	0	1	Foot survey
Dewatto R.	15.0420	09HU	0	5	8	Foot survey
Big Beef Cr.	15.0389	09HR	0	32	35	Trap, foot survey
Little Anderson	15.0377	--	--	--	--	Foot survey
Totals			**700**	**1,731**	**2,588**	

[1] Stream has supplementation or reintroduction program adult returns.

Appendix Table 8. Genetic, otolith, and scale collections made from adult summer chum salmon in Hood Canal and eastern Strait of Juan de Fuca streams, 2010.

Stream	WRIA	GSI code	Sample size DNA	Otolith	Scales	Collection method
Dungeness River	18.0018	--	--	--	--	Spawner survey
Jimmycomelately [1]	17.0285	10HV	105	401	401	Trap, foot survey
Salmon Cr.	17.0245	10HW	18	200	213	Trap, foot survey
Snow Cr.	17.0219	10HX	17	59	76	Trap, foot survey
Chimacum Cr.	17.0203	10HY	37	198	219	Foot survey
Thorndyke Cr.	17.0170	--	--	--	--	Foot survey
Little Quilcene R.	17.0076	10HZ	60	84	102	Foot survey
Big Quilcene R.	17.0012	10IA	76	107	157	Foot survey
Dosewallips R.	16.0442	10IB	31	136	136	Foot survey
Duckabush R.	16.0351	10IC	61	194	194	Foot survey
Fulton Cr.	16.0332	--	--	--	--	Foot survey
Hamma Hamma R.[1]	16.0251	10ID	58	131	132	Seine, foot survey
Lilliwaup R.[1]	16.0230	10IE	175	182	182	Trap, foot survey
Little Lilliwaup	16.0228	--	--	--	--	Foot survey
Skokomish R.	16.0001	--	--	--	--	Foot survey
Union R.	15.0503	10IG	113	195	196	Trap, foot survey
Tahuya R. [1]	15.0446	10IH	7	138	139	Foot survey
Stavis Cr.	15.0404	--	--	--	--	Foot survey
Dewatto R.	15.0420	--	0	2	2	Foot survey
Big Beef Cr.	15.0389	10IF		0	0	Trap, foot survey
Little Anderson	15.0377	--	--	--	--	Foot survey
Totals			**758**	**2,027**	**2,149**	

[1] Stream has supplementation or reintroduction program adult returns.

Appendix Table 9. Genetic, otolith, and scale collections made from adult summer chum salmon in Hood Canal and eastern Strait of Juan de Fuca streams, 2011.

Stream	WRIA	GSI code	DNA	Otolith	Scales	Collection method
			Sample size			
Dungeness River	18.0018	--	--	--	--	Spawner survey
Jimmycomelately [1]	17.0285	11GY	55	300	300	Trap, foot survey
Salmon Cr.	17.0245	11GZ	60	200	202	Trap, foot survey
Snow Cr.	17.0219	11HA	27	80	80	Trap, foot survey
Chimacum Cr.	17.0203	11HB	18	118	124	Foot survey
Thorndyke Cr.	17.0170	--	--	--	--	Foot survey
Little Quilcene R.	17.0076	11HC	37	37	105	Foot survey
Big Quilcene R.	17.0012	11HD	63	63	130	Foot survey
Dosewallips R.	16.0442	11HE	8	42	42	Foot survey
Duckabush R.	16.0351	11HF	37	137	137	Foot survey
Fulton Cr.	16.0332	--	--	--	--	Foot survey
Hamma Hamma R.	16.0251	11HG	17	53	53	Seine, foot survey
Lilliwaup R.[1]	16.0230	11HH	40	81	81	Trap, foot survey
Little Lilliwaup	16.0228	--	--	--	--	Foot survey
Skokomish R.	16.0001	--	0	0	2	Foot survey
Union R.	15.0503	11HJ	39	56	56	Trap, foot survey
Tahuya R. [1]	15.0446	11HK	0	29	36	Foot survey
Stavis Cr.	15.0404	--	--	--	--	Foot survey
Dewatto R.	15.0420	11HL	--	--	--	Foot survey
Big Beef Cr.	15.0389	11HI	--	--	--	Trap, foot survey
Little Anderson	15.0377	--	--	--	--	Foot survey
Totals			**401**	**1,196**	**1,348**	

[1] Stream has supplementation or reintroduction program adult returns.

Appendix Table 10. Genetic, otolith, and scale collections made from adult summer chum salmon in Hood Canal and eastern Strait of Juan de Fuca streams, 2012.

			Sample size			
Stream	**WRIA**	**GSI code**	**DNA**	**Otolith**	**Scales**	**Collection method**
Dungeness River	18.0018	--	0	2	2	Spawner survey
Jimmycomelately [1]	17.0285	12HL	50	300	300	Trap, foot survey
Salmon Cr.[1]	17.0245	12HM	47	200	200	Trap, foot survey
Snow Cr.	17.0219	12HN	17	72	72	Trap, foot survey
Chimacum Cr.[1]	17.0203	12HO	19	200	216	Foot survey
Thorndyke Cr.	17.0170	--	--	--	--	Foot survey
Little Quilcene R.	17.0076	12HP	48	49	106	Foot survey
Big Quilcene R.[1]	17.0012	12HQ	57	100	234	Foot survey
Dosewallips R.	16.0442	12HR	31	163	180	Foot survey
Duckabush R.	16.0351	12HS	49	119	243	Foot survey
Fulton Cr.	16.0332	--	--	--	--	Foot survey
Hamma Hamma R.[1]	16.0251	12HT	20	80	143	Seine, foot survey
Lilliwaup R.[1]	16.0230	12HU	0	200	200	Trap, foot survey
Little Lilliwaup	16.0228	--	--	--	--	Foot survey
Skokomish R.	16.0001	12LL	28	50	58	Foot survey
Union R.[1]	15.0503	12HW	117	140	140	Trap, foot survey
Tahuya R. [1]	15.0446	12HX	6	68	68	Foot survey
Stavis Cr.	15.0404	--	--	--	--	Foot survey
Dewatto R.	15.0420	12HY	2	10	10	Foot survey
Big Beef Cr.[1]	15.0389	12HZ	--	--	21	Trap, foot survey
Little Anderson	15.0377	--	--	--	--	Foot survey
Totals			**491**	**1,753**	**2,193**	

[1] Stream has current or past supplementation or reintroduction program.

Appendix Table 11. Strait of Juan de Fuca and Hood Canal summer chum salmon age composition, 2005.

Stream	Total escapement	Escapement by age 2	3	4	5	Age composition 2	3	4	5
Dungeness	2	0	2	0	0	0.0%	100.0%	0.0%	0.0%
JCL	1,310	35	528	742	4	2.7%	40.3%	56.7%	0.3%
Salmon	6,142	46	4,069	1,950	77	0.8%	66.3%	31.8%	1.3%
Snow	832	5	649	172	5	0.6%	78.0%	20.7%	0.6%
Chimacum	1,396	17	996	372	11	1.2%	71.4%	26.6%	0.8%
L. Quilcene	866	4	552	179	131	0.4%	63.8%	20.7%	15.1%
B. Quilcene	5,806	0	4,989	817	0	0.0%	85.9%	14.1%	0.0%
Dosewallips	2,658	0	1,439	305	914	0.0%	54.2%	11.5%	34.4%
Duckabush	821	0	558	119	143	0.0%	68.0%	14.5%	17.4%
Hamma	1,408	0	1,108	194	107	0.0%	78.7%	13.8%	7.6%
Lilliwaup	1,049	0	911	131	6	0.0%	86.9%	12.5%	0.6%
Skokomish	5	0	5	0	0	0.0%	100.0%	0.0%	0.0%
Union	1,987	23	1,535	373	56	1.1%	77.3%	18.8%	2.8%
Tahuya	4	0	4	0	0	0.0%	100.0%	4.8%	0.0%
Dewatto	23	0	19	4	0	0.0%	83.3%	16.7%	0.0%
Big Beef	1,124	25	898	201	0	2.2%	79.9%	17.9%	0.0%
Strait of Juan de Fuca	9,682	103	6,245	3,236	97	1.1%	64.5%	33.4%	1.0%
Hood Canal	15,751	51	12,020	2,322	1,357	0.3%	76.3%	14.7%	8.6%
Total	25,433	154	18,266	5,559	1,455	0.6%	71.8%	21.9%	5.7%

Appendix Table 12. Strait of Juan de Fuca and Hood Canal summer chum salmon age composition, 2006.

Stream	Total escapement	Escapement by age 2	3	4	5	Age composition 2	3	4	5
Dungeness	3	0	3	0	0	0.0%	100.0%	0.0%	0.0%
JCL	725	34	462	214	14	4.7%	63.8%	29.5%	2.0%
Salmon	4,894	61	1,852	2,833	147	1.3%	37.8%	57.9%	3.0%
Snow	598	8	276	307	8	1.3%	46.2%	51.3%	1.3%
Chimacum	2,026	32	949	1,037	8	1.6%	46.9%	51.2%	0.4%
L. Quilcene	2,372	0	1,678	663	31	0.0%	70.7%	27.9%	1.3%
B. Quilcene	9,504	0	4,318	5,186	0	0.0%	45.4%	54.6%	0.0%
Dosewallips	2,577	0	869	1,699	10	0.0%	33.7%	65.9%	0.4%
Duckabush	3,135	9	1,295	1,813	18	0.3%	41.3%	57.8%	0.6%
Hamma	3,065	13	614	2,432	6	0.4%	20.0%	79.3%	0.2%
Lilliwaup	1,615	3	810	793	9	0.2%	50.1%	49.1%	0.6%
Skokomish	8	0	1	6	1	0.0%	14.3%	78.6%	7.1%
Union	2,836	26	1,728	1,068	13	0.9%	60.9%	37.7%	0.5%
Tahuya	749	19	687	38	5	2.5%	91.8%	5.1%	0.6%
Dewatto	69	0	52	17	0	0.0%	76.0%	24.0%	0.0%
Big Beef	823	12	550	261	0	1.5%	66.8%	31.7%	0.0%
Strait of Juan de Fuca	8,246	135	3,543	4,391	177	1.6%	43.0%	53.3%	2.1%
Hood Canal	26,753	83	12,602	13,975	93	0.3%	47.1%	52.2%	0.3%
Total	34,999	218	16,145	18,366	270	0.6%	46.1%	52.5%	0.8%

Appendix Table 13. Strait of Juan de Fuca and Hood Canal summer chum salmon age composition, 2007.

	Total	Escapement by age				Age composition			
Stream	escapement	2	3	4	5	2	3	4	5
Dungeness	2	0	2	0	0	0.0%	100.0%	0.0%	0.0%
JCL	654	3	624	27	0	0.5%	95.3%	4.1%	0.0%
Salmon	1,274	5	1,109	154	5	0.4%	87.1%	12.1%	0.4%
Snow	439	0	370	69	0	0.0%	84.4%	15.6%	0.0%
Chimacum	926	3	828	92	3	0.3%	89.4%	9.9%	0.3%
L. Quilcene	1,065	0	656	397	13	0.0%	61.6%	37.2%	1.2%
B. Quilcene	1,461	5	467	975	14	0.3%	32.0%	66.8%	1.0%
Dosewallips	1,468	0	1,237	213	18	0.0%	84.3%	14.5%	1.2%
Duckabush	1,294	4	995	283	12	0.3%	76.9%	21.8%	0.9%
Hamma	1,489	22	1,159	295	13	1.5%	77.8%	19.8%	0.9%
Lilliwaup	525	13	316	188	7	2.6%	60.3%	35.9%	1.3%
Skokomish	22	0	22	0	0	0.0%	100.0%	0.0%	0.0%
Union	1,967	41	1,686	231	8	2.1%	85.7%	11.8%	0.4%
Tahuya	623	5	560	59	0	0.7%	89.9%	9.4%	0.0%
Dewatto	21	0	14	7	0	0.0%	66.7%	33.3%	0.0%
Big Beef	846	0	767	79	0	0.0%	90.7%	9.3%	0.0%
Strait of Juan de Fuca	3,295	12	2,933	341	9	0.4%	89.0%	10.4%	0.3%
Hood Canal	10,781	90	7,879	2,727	85	0.8%	73.1%	25.3%	0.8%
Total	14,076	102	10,813	3,068	93	0.7%	76.8%	21.8%	0.7%

Appendix Table 14. Strait of Juan de Fuca and Hood Canal summer chum salmon age composition, 2008.

Stream	escapement	2	3	4	5	2	3	4	5
Dungeness	0	0	0	0	0	- -	- -	- -	- -
JCL	1,058	69	442	547	0	6.5%	41.7%	51.7%	0.0%
Salmon	1,568	12	703	847	6	0.8%	44.8%	54.0%	0.4%
Snow	172	0	80	92	0	0.0%	46.6%	53.4%	0.0%
Chimacum	727	0	373	354	0	0.0%	51.3%	48.7%	0.0%
L. Quilcene	2,186	0	216	1,970	0	0.0%	9.9%	90.1%	0.0%
B. Quilcene	1,675	0	281	1,317	77	0.0%	16.8%	78.6%	4.6%
Dosewallips	3,930	20	489	3,421	0	0.5%	12.4%	87.0%	0.0%
Duckabush	2,668	0	424	2,230	14	0.0%	15.9%	83.6%	0.5%
Hamma	1,642	0	527	1,100	15	0.0%	32.1%	67.0%	0.9%
Lilliwaup	690	3	365	312	10	0.5%	52.9%	45.1%	1.5%
Skokomish	23	0	12	12	0	0.0%	50.0%	50.0%	0.0%
Union	1,130	0	527	597	6	0.0%	46.7%	52.8%	0.5%
Tahuya	700	0	479	221	0	0.0%	68.4%	31.6%	0.0%
Dewatto	26	0	17	7	2	0.0%	66.7%	25.0%	8.3%
Big Beef	733	0	254	479	0	0.0%	34.6%	65.4%	0.0%
Strait of Juan de Fuca	3,525	81	1,598	1,840	6	2.3%	45.3%	52.2%	0.2%
Hood Canal	15,403	24	3,592	11,664	123	0.2%	23.3%	75.7%	0.8%
Total	18,928	105	5,189	13,504	129	0.6%	27.4%	71.3%	0.7%

Appendix Table 15. Strait of Juan de Fuca and Hood Canal summer chum salmon age composition, 2009.

	Total	Escapement by age				Age composition			
Stream	escapement	2	3	4	5	2	3	4	5
Dungeness	1	0	1	0	0	0.0%	100.0%	0.0%	0.0%
JCL	2,628	62	1,889	668	9	2.4%	71.9%	25.4%	0.3%
Salmon	1,237	26	557	649	5	2.1%	45.0%	52.5%	0.4%
Snow	229	6	119	100	3	2.7%	52.1%	43.8%	1.4%
Chimacum	1,020	62	541	417	0	6.1%	53.1%	40.8%	0.0%
L. Quilcene	425	0	148	259	18	0.0%	34.8%	60.9%	4.3%
B. Quilcene	1,065	0	306	680	79	0.0%	28.7%	63.8%	7.4%
Dosewallips	1,128	0	412	616	100	0.0%	36.5%	54.6%	8.9%
Duckabush	2,661	8	943	1,535	175	0.3%	35.4%	57.7%	6.6%
Hamma	670	3	222	417	27	0.5%	33.2%	62.2%	4.1%
Lilliwaup	247	1	102	141	3	0.5%	41.3%	57.1%	1.0%
Skokomish	33	0	14	17	2	0.0%	42.9%	52.4%	4.8%
Union	611	28	447	127	9	4.6%	73.1%	20.8%	1.5%
Tahuya	380	8	211	160	0	2.2%	55.6%	42.2%	0.0%
Dewatto	50	0	20	30	0	0.0%	40.0%	60.0%	0.0%
Big Beef	152	0	52	95	5	0.0%	34.4%	62.5%	3.1%
Strait of Juan de Fuca	5,115	156	3,107	1,834	17	3.1%	60.7%	35.9%	0.3%
Hood Canal	7,422	50	2,876	4,077	419	0.7%	38.8%	54.9%	5.6%
Total	12,537	206	5,983	5,911	436	1.6%	47.7%	47.2%	3.5%

Appendix Table 16. Strait of Juan de Fuca and Hood Canal summer chum salmon age composition, 2010.

	Total	Escapement by age				Age composition			
Stream	escapement	2	3	4	5	2	3	4	5
Dungeness	2	0	2	0	0	0.0%	100.0%	0.0%	0.0%
JCL	4,027	20	3,043	963	0	0.5%	75.6%	23.9%	0.0%
Salmon	2,740	0	1,921	791	28	0.0%	70.1%	28.9%	1.0%
Snow	524	0	311	213	0	0.0%	59.3%	40.7%	0.0%
Chimacum	1,968	0	1,267	686	15	0.0%	64.4%	34.8%	0.8%
L. Quilcene	497	0	209	264	25	0.0%	42.0%	53.1%	4.9%
B. Quilcene	1,576	0	964	567	45	0.0%	61.1%	36.0%	2.9%
Dosewallips	2,521	0	512	1,933	76	0.0%	20.3%	76.7%	3.0%
Duckabush	4,110	0	1,215	2,784	110	0.0%	29.6%	67.7%	2.7%
Hamma	1,471	0	530	906	35	0.0%	36.0%	61.6%	2.4%
Lilliwaup	238	1	60	172	5	0.6%	25.0%	72.2%	2.3%
Skokomish	61	0	31	31	0	0.0%	50.0%	50.0%	0.0%
Union	963	0	748	210	5	0.0%	77.7%	21.8%	0.5%
Tahuya	1,153	0	991	154	9	0.0%	85.9%	13.3%	0.7%
Dewatto	9	0	9	0	0	0.0%	100.0%	0.0%	0.0%
Big Beef	143	0	72	72	0	0.0%	50.0%	50.0%	0.0%
Strait of Juan de Fuca	9,261	20	6,544	2,653	43	0.2%	70.7%	28.6%	0.5%
Hood Canal	12,742	1	5,338	7,092	310	0.0%	41.9%	55.7%	2.4%
Total	22,003	22	11,882	9,746	353	0.1%	54.0%	44.3%	1.6%

Appendix Table 17. Strait of Juan de Fuca and Hood Canal summer chum salmon age composition, 2011.

Stream	Total escapement	Escapement by age				Age composition			
		2	3	4	5	2	3	4	5
Dungeness	3	0	2	2	0	0.0%	50.0%	50.0%	0.0%
JCL	2,411	49	812	1,502	49	2.0%	33.7%	62.3%	2.0%
Salmon	2,279	12	242	1,980	46	0.5%	10.6%	86.9%	2.0%
Snow	342	0	98	239	4	0.0%	28.8%	70.0%	1.3%
Chimacum	640	0	127	497	17	0.0%	19.8%	77.6%	2.6%
L. Quilcene	420	0	4	412	4	0.0%	1.0%	98.1%	1.0%
B. Quilcene	2,160	0	66	2,010	83	0.0%	3.1%	93.1%	3.8%
Dosewallips	1,130	0	30	1,011	89	0.0%	2.6%	89.5%	7.9%
Duckabush	1,538	12	23	1,352	151	0.8%	1.5%	87.9%	9.8%
Hamma	773	0	29	715	29	0.0%	3.8%	92.5%	3.8%
Lilliwaup	113	36	37	37	3	31.4%	32.9%	32.9%	2.9%
Skokomish	107	0	0	54	54	0.0%	0.0%	50.0%	50.0%
Union	296	61	73	162	0	20.8%	24.5%	54.7%	0.0%
Tahuya	325	0	45	280	0	0.0%	13.9%	86.1%	0.0%
Dewatto	37	0	19	19	0	0.0%	50.0%	50.0%	0.0%
Big Beef	73	0	37	37	0	0.0%	50.0%	50.0%	0.0%
Strait of Juan de Fuca	5,675	60	1,280	4,219	116	1.1%	22.6%	74.3%	2.0%
Hood Canal	6,972	109	363	6,087	414	1.6%	5.2%	87.3%	5.9%
Total	12,647	169	1,643	10,306	529	1.3%	13.0%	81.5%	4.2%

Appendix Table 18. Strait of Juan de Fuca and Hood Canal summer chum salmon age composition, 2012.

Stream	Total escapement	Escapement by age				Age composition			
		2	3	4	5	2	3	4	5
Dungeness	6	0	0	6	0	0.0%	0.0%	100.0%	0.0%
JCL	2,590	95	1,100	1,386	9	3.7%	42.5%	53.5%	0.3%
Salmon	2,318	35	568	1,623	93	1.5%	24.5%	70.0%	4.0%
Snow	496	0	77	384	35	0.0%	15.5%	77.5%	7.0%
Chimacum	894	26	321	505	43	2.9%	35.9%	56.5%	4.8%
L. Quilcene	1,272	37	247	902	86	2.9%	19.4%	70.9%	6.8%
B. Quilcene	10,467	0	5,143	4,782	541	0.0%	49.1%	45.7%	5.2%
Dosewallips	2,862	33	1,322	1,490	17	1.2%	46.2%	52.0%	0.6%
Duckabush	5,241	66	2,708	2,140	328	1.3%	51.7%	40.8%	6.3%
Hamma	2,355	0	1,334	922	99	0.0%	56.6%	39.2%	4.2%
Lilliwaup	3,340	0	3,083	223	35	0.0%	92.3%	6.7%	1.0%
Skokomish	524	9	496	18	0	1.8%	94.7%	3.5%	0.0%
Union	2,312	68	1,873	371	0	2.9%	81.0%	16.1%	0.0%
Tahuya	1,405	0	1,116	227	62	0.0%	79.4%	16.2%	4.4%
Dewatto	187	0	150	37	0	0.0%	80.0%	20.0%	0.0%
Big Beef	156	8	23	125	0	5.0%	15.0%	80.0%	0.0%
Strait of Juan de Fuca	6,304	156	2,066	3,904	179	2.5%	32.8%	61.9%	2.8%
Hood Canal	30,121	221	17,496	11,238	1,168	0.7%	58.1%	37.3%	3.9%
Total	36,425	376	19,561	15,141	1,347	1.0%	53.7%	41.6%	3.7%

Appendix Table 19. Strait of Juan de Fuca and Hood Canal summer chum salmon age composition, 2013.

	Total	Escapement by age					Age composition			
Stream	escapement	2	3	4	5		2	3	4	5
Dungeness	0	0	0	0	0		- -	- -	- -	- -
JCL	8,341	56	7,365	865	56		0.7%	88.3%	10.4%	0.7%
Salmon	2,746	41	2,238	426	41		1.5%	81.5%	15.5%	1.5%
Snow	574	0	380	154	40		0.0%	66.2%	26.8%	7.0%
Chimacum	3,066	53	2,226	773	13		1.7%	72.6%	25.2%	0.4%
L. Quilcene	832	0	363	203	267		0.0%	43.6%	24.4%	32.1%
B. Quilcene	7,118	0	2,043	4,325	749		0.0%	28.7%	60.8%	10.5%
Dosewallips	1,815	0	685	950	180		0.0%	37.7%	52.3%	9.9%
Duckabush	4,129	0	1,194	2,670	265		0.0%	28.9%	64.7%	6.4%
Hamma	2,186	0	1,041	1,145	0		0.0%	47.6%	52.4%	0.0%
Lilliwaup	2,652	10	620	2,012	10		0.4%	23.4%	75.9%	0.4%
Skokomish	977	0	373	604	0		0.0%	38.2%	61.8%	0.0%
Union	1,949	23	1,338	517	71		1.2%	68.7%	26.5%	3.6%
Tahuya	862	0	152	710	0		0.0%	17.6%	82.4%	0.0%
Dewatto	186	0	62	124	0		0.0%	33.3%	66.7%	0.0%
Big Beef	101	0	72	21	8		0.0%	70.8%	20.8%	8.3%
Strait of Juan de Fuca	14,727	150	12,209	2,217	151		1.0%	82.9%	15.1%	1.0%
Hood Canal	22,807	34	7,943	13,280	1,551		0.1%	34.8%	58.2%	6.8%
Total	37,534	184	20,152	15,497	1,702		0.5%	53.7%	41.3%	4.5%

Appendix Table 20. Natural-origin and hatchery-origin summer chum spawner escapement estimates in Strait of Juan de Fuca region, 1974-2013.

Return year	Spawner Escapement																	
	Dungeness			Jimmycomelately			Salmon			Snow			Chimacum			Strait of Juan de Fuca Total		
	NOR [1/]	HOR [1/]	Total	NOR [1/]	HOR [1/]	Total	NOR [1/]	HOR [1/]	Total	NOR [1/]	HOR [1/]	Total	NOR [1/]	HOR [1/]	Total	NOR [1/]	HOR [1/]	Total
1974	0	0	0	438	0	438	512	0	512	818	0	818				1,768	0	1,768
1975	0	0	0	353	0	353	755	0	755	340	0	340				1,448	0	1,448
1976	0	0	0	365	0	365	521	0	521	608	0	608				1,494	0	1,494
1977	0	0	0	405	0	405	701	0	701	538	0	538				1,644	0	1,644
1978	0	0	0	787	0	787	1,664	0	1,664	629	0	629				3,080	0	3,080
1979	0	0	0	170	0	170	458	0	458	133	0	133				761	0	761
1980	0	0	0	1,326	0	1,326	3,074	0	3,074	709	0	709				5,109	0	5,109
1981	0	0	0	203	0	203	439	0	439	242	0	242				884	0	884
1982	0	0	0	599	0	599	1,386	0	1,386	766	0	766				2,751	0	2,751
1983	0	0	0	254	0	254	731	0	731	154	0	154				1,139	0	1,139
1984	0	0	0	367	0	367	828	0	828	384	0	384				1,579	0	1,579
1985	0	0	0	61	0	61	151	0	151	20	0	20				232	0	232
1986	0	0	0	292	0	292	582	0	582	213	0	213				1,087	0	1,087
1987	0	0	0	464	0	464	1,062	0	1,062	465	0	465				1,991	0	1,991
1988	0	0	0	1,052	0	1,052	1,915	0	1,915	723	0	723				3,690	0	3,690
1989	0	0	0	173	0	173	194	0	194	21	0	21				388	0	388
1990	0	0	0	63	0	63	245	0	245	33	0	33				341	0	341
1991	0	0	0	125	0	125	172	0	172	12	0	12				309	0	309
1992	0	0	0	616	0	616	433	0	433	21	0	21				1,070	0	1,070
1993	0	0	0	110	0	110	452	0	452	11	0	11				573	0	573
1994	0	0	0	15	0	15	161	0	161	2	0	2				178	0	178
1995	0	0	0	223	0	223	591	0	591	25	0	25				839	0	839
1996	0	0	0	30	0	30	894	0	894	160	0	160				1,084	0	1,084
1997	0	0	0	61	0	61	768	66	834	67	0	67				896	66	962
1998	0	0	0	98	0	98	605	529	1,134	27	0	27	0	0	0	730	529	1,259
1999	0	0	0	7	0	7	133	366	499	15	15	30	0	38	38	155	419	574
2000	0	0	0	55	0	55	437	409	846	15	15	30	0	52	52	507	476	983
2001	0	0	0	251	9	260	1,168	1,470	2,638	54	100	154	0	903	903	1,473	2,482	3,955
2002	0	0	0	7	50	57	3,745	1,772	5,517	340	192	532	128	736	864	4,220	2,750	6,970
2003	0	0	0	68	378	446	3,785	1,866	5,651	203	101	304	227	331	558	4,283	2,676	6,959
2004	123	0	123	613	1,049	1,662	4,103	1,918	6,021	289	107	396	666	473	1,139	5,794	3,670	9,464
2005	2	0	2	492	818	1,310	3,857	2,285	6,142	773	59	832	877	519	1,396	6,001	3,683	9,684
2006	3	0	3	345	380	725	3,989	905	4,894	564	34	598	1,474	552	2,026	6,375	1,874	8,249
2007	2	0	2	468	186	654	1,236	38	1,274	430	9	439	883	43	926	3,019	278	3,297
2008	0	0	0	579	479	1,058	1,539	29	1,568	166	6	172	727	0	727	3,011	514	3,525
2009	1	0	1	202	2,426	2,628	1,217	20	1,237	220	9	229	1,020	0	1,020	2,660	2,456	5,116
2010	2	0	2	737	3,290	4,027	2,740	0	2,740	498	26	524	1,948	20	1,968	5,925	3,338	9,263
2011	3	0	3	814	1,597	2,411	2,268	11	2,279	338	4	342	640	0	640	4,063	1,615	5,678
2012	6	0	6	1,274	1,316	2,590	2,318	0	2,318	489	7	496	894	0	894	4,981	1,329	6,310
2013	0	0	0	5,656	2,685	8,341	2,746	0	2,746	574	0	574	3,066	0	3,066	12,042	2,685	14,727

1/ NOR = natural-origin (wild); HOR = hatchery-origin

Appendix Table 21. Natural-origin and hatchery-origin summer chum spawner escapement estimates in Hood Canal region, 1974-2013.

	Spawner Escapement																	
Return year	**Little Quilcene**			**Big Quilcene**			**Dosewallips**			**Duckabush**			**Hamma Hamma**			**Lilliwaup**		
	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total
1974	44	0	44	795	0	795	3,593	0	3,593	3,581	0	3,581	2,448	0	2,448	616	0	616
1975	868	0	868	1,405	0	1,405	2,250	0	2,250	2,245	0	2,245	7,341	0	7,341	706	0	706
1976	1,088	0	1,088	2,445	0	2,445	3,271	0	3,271	6,095	0	6,095	7,648	0	7,648	1,612	0	1,612
1977	773	0	773	821	0	821	3,215	0	3,215	2,453	0	2,453	1,675	0	1,675	420	0	420
1978	1,816	0	1,816	2,978	0	2,978	1,901	0	1,901	1,898	0	1,898	8,215	0	8,215	1,331	0	1,331
1979	110	0	110	345	0	345	1,190	0	1,190	1,190	0	1,190	3,096	0	3,096	163	0	163
1980	154	0	154	375	0	375	1,216	0	1,216	827	0	827	329	0	329	247	0	247
1981	84	0	84	138	0	138	63	0	63	557	0	557	926	0	926	293	0	293
1982	125	0	125	156	0	156	507	0	507	690	0	690	801	0	801	84	0	84
1983	176	0	176	100	0	100	64	0	64	80	0	80	190	0	190	18	0	18
1984	83	0	83	60	0	60	212	0	212	299	0	299	170	0	170	187	0	187
1985	1	0	1	44	0	44	236	0	236	30	0	30	231	0	231	92	0	92
1986	12	0	12	15	0	15	57	0	57	177	0	177	173	0	173	97	0	97
1987	71	0	71	8	0	8	9	0	9	12	0	12	26	0	26	32	0	32
1988	177	0	177	120	0	120	661	0	661	497	0	497	440	0	440	275	0	275
1989	1	0	1	1	0	1	16	0	16	60	0	60	16	0	16	43	0	43
1990	0	0	0	6	0	6	8	0	8	42	0	42	90	0	90	2	0	2
1991	1	0	1	49	0	49	250	0	250	102	0	102	71	0	71	30	0	30
1992	9	0	9	734	0	734	655	0	655	617	0	617	123	0	123	99	0	99
1993	12	0	12	136	0	136	105	0	105	105	0	105	69	0	69	77	0	77
1994	0	0	0	722	0	722	225	0	225	263	0	263	370	0	370	111	0	111
1995	52	2	54	3,005	1,515	4,520	2,787	0	2,787	825	0	825	476	0	476	79	0	79
1996	257	8	265	7,548	1,702	9,250	6,976	0	6,976	2,650	0	2,650	774	0	774	76	0	76
1997	28	1	29	5,203	2,671	7,874	47	0	47	475	0	475	111	0	111	27	0	27
1998	257	8	265	1,338	1,450	2,788	336	0	336	226	0	226	127	0	127	24	0	24
1999	84	0	84	1,513	1,640	3,153	351	0	351	92	0	92	255	0	255	13	0	13
2000	244	24	268	5,349	281	5,630	1,249	11	1,260	428	36	464	215	14	229	20	2	22
2001	143	56	199	2,905	3,269	6,174	757	233	990	662	280	942	1,155	72	1,227	41	51	92
2002	393	77	470	2,818	1,199	4,017	1,313	314	1,627	355	175	530	1,050	1,278	2,328	36	822	858
2003	780	110	890	9,960	1,883	11,843	6,510	556	7,066	1,600	269	1,869	535	319	854	27	326	353
2004	2,971	74	3,045	32,867	2,241	35,108	10,325	1,224	11,549	7,850	787	8,637	2,409	282	2,691	136	881	1,017
2005	786	80	866	5,111	695	5,806	2,498	160	2,658	749	72	821	1,176	232	1,408	256	793	1,049
2006	2,262	110	2,372	8,622	882	9,504	2,457	120	2,577	2,963	147	3,110	2,709	356	3,065	426	1,189	1,615
2007	1,053	12	1,065	1,443	18	1,461	1,462	6	1,468	1,254	40	1,294	1,416	73	1,489	153	372	525
2008	2,186	0	2,186	1,675	0	1,675	3,830	100	3,930	2,521	147	2,668	1,384	258	1,642	177	513	690
2009	425	0	425	1,065	0	1,065	1,094	34	1,128	2,496	165	2,661	597	73	670	60	187	247
2010	497	0	497	1,567	0	1,567	2,410	111	2,521	3,876	234	4,110	1,370	101	1,471	188	50	238
2011	420	0	420	2,160	0	2,160	1,130	0	1,130	1,515	23	1,538	685	88	773	77	36	113
2012	1,272	0	1,272	10,467	0	10,467	2,828	34	2,862	5,156	85	5,241	2,206	149	2,355	1,631	1,709	3,340
2013	832	0	832	7,118	0	7,118	1,778	37	1,815	4,063	66	4,129	2,186	0	2,186	1,233	1,419	2,652

1/ NOR = natural-origin (wild); HOR = hatchery-origin

Appendix Table 21 (continued).

Return year	Spawner Escapement																				
	Union			Tahuya			Dewatto			Anderson			Big Beef			Skokomish			Hood Canal Total		
	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total
1974	68	0	68	880	0	880	181	0	181	0		0	75	0	75			0	12,281	0	12,281
1975	84	0	84	1,389	0	1,389	613	0	613	195		195	1,152	0	1,152			0	18,248	0	18,248
1976	100	0	100	3,200	0	3,200	741	0	741	234		234	1,281	0	1,281			0	27,715	0	27,715
1977	75	0	75	726	0	726	225	0	225	26		26	302	0	302			0	10,711	0	10,711
1978	64	0	64	266	0	266	544	0	544	16		16	680	0	680			0	19,709	0	19,709
1979	97	0	97	117	0	117	49	0	49	6		6	191	0	191			0	6,554	0	6,554
1980	208	0	208	179	0	179	117	0	117	2		2	123	0	123			0	3,777	0	3,777
1981	41	0	41	140	0	140	41	0	41	1		1	90	0	90			0	2,374	0	2,374
1982	153	0	153	86	0	86	21	0	21	0		0	0	0	0			0	2,623	0	2,623
1983	170	0	170	86	0	86	15	0	15	0		0	0	0	0			0	899	0	899
1984	194	0	194	142	0	142	44	0	44	1		1	22	0	22			0	1,414	0	1,414
1985	334	0	334	122	0	122	19	0	19	0		0	0	0	0			0	1,109	0	1,109
1986	1,892	0	1,892	109	0	109	20	0	20	0		0	0	0	0			0	2,552	0	2,552
1987	497	0	497	91	0	91	5	0	5	0		0	6	0	6			0	757	0	757
1988	629	0	629	145	0	145	23	0	23	0		0	0	0	0			0	2,967	0	2,967
1989	450	0	450	9	0	9	2	0	2	0		0	0	0	0			0	598	0	598
1990	275	0	275	6	0	6	0	0	0	0		0	0	0	0			0	429	0	429
1991	208	0	208	5	0	5	31	0	31	0		0	0	0	0			0	747	0	747
1992	140	0	140	0	0	0	0	0	0	0		0	0	0	0			0	2,377	0	2,377
1993	251	0	251	0	0	0	1	0	1	0		0	0	0	0			0	756	0	756
1994	738	0	738	0	0	0	0	0	0	0		0	0	0	0			0	2,429	0	2,429
1995	721	0	721	0	0	0	0	0	0	0		0	0	0	0			0	7,945	1,517	9,462
1996	494	0	494	5	0	5	0	0	0	0		0	0	0	0			0	18,780	1,710	20,490
1997	410	0	410	0	0	0	6	0	6	0		0	0	0	0			0	6,307	2,672	8,979
1998	223	0	223	0	0	0	12	0	12	0		0	0	0	0			0	2,543	1,458	4,001
1999	159	0	159	1	0	1	2	0	2	0		0	0	4	4			0	2,470	1,644	4,114
2000	744	0	744	2	0	2	10	0	10	0		0	20	0	20			0	8,281	368	8,649
2001	1,491	0	1,491	0	0	0	32	0	32	0		0	15	879	894	3	0	3	7,204	4,840	12,044
2002	872	0	872	0	0	0	10	0	10	0		0	12	730	742	0	0	0	6,859	4,595	11,454
2003	7,923	3,993	11,916	0	0	0	0	9	9	0		0	0	896	896	0	0	0	27,335	8,361	35,696
2004	3,603	2,373	5,976	8	0	8	6	17	23	1		1	174	1,742	1,916	24	0	24	60,374	9,621	69,995
2005	716	1,271	1,987	4	0	4	11	12	23	0		0	36	1,088	1,124	5	0	5	11,348	4,403	15,751
2006	1,667	1,169	2,836	58	691	749	17	52	69	0		0	200	623	823	8	0	8	21,389	5,339	26,728
2007	1,846	121	1,967	5	618	623	18	3	21	0		0	704	142	846	22	0	22	9,376	1,405	10,781
2008	1,044	86	1,130	16	684	700	12	14	26	0		0	705	28	733	23	0	23	13,573	1,830	15,403
2009	597	14	611	8	372	380	50	0	50	1		1	152	0	152	25	8	33	6,570	853	7,423
2010	943	20	963	227	926	1,153	9	0	9	0		0	143	0	143	64	0	64	11,294	1,442	12,736
2011	285	11	296	79	246	325	37	0	37	0		0	73	0	73	107	0	107	6,568	404	6,972
2012	2,181	65	2,246	190	1,215	1,405	153	34	187	2		2	156	0	156	259	265	524	26,501	3,556	30,057
2013	1,759	190	1,949	259	603	862	155	31	186	0		0	101	0	101	481	496	977	19,965	2,842	22,807

1/ NOR = natural-origin (wild); HOR = hatchery-origin

Appendix Table 22. Natural-origin and hatchery-origin summer chum runsize estimates in Strait of Juan de Fuca region, 1974-2013.

	Runsize																	
Return year	Dungeness			Jimmycomelately			Salmon			Snow			Chimacum			Strait of Juan de Fuca Total		
	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total
1974	0	0	0	492	0	492	575	0	575	919	0	919				1,986	0	1,986
1975	0	0	0	373	0	373	947	0	947	427	0	427				1,747	0	1,747
1976	0	0	0	409	0	409	583	0	583	681	0	681				1,673	0	1,673
1977	0	0	0	446	0	446	772	0	772	592	0	592				1,810	0	1,810
1978	0	0	0	828	0	828	1,751	0	1,751	662	0	662				3,241	0	3,241
1979	0	0	0	201	0	201	542	0	542	157	0	157				901	0	901
1980	0	0	0	1,447	0	1,447	3,354	0	3,354	773	0	773				5,574	0	5,574
1981	0	0	0	262	0	262	566	0	566	312	0	312				1,140	0	1,140
1982	0	0	0	771	0	771	1,784	0	1,784	986	0	986				3,540	0	3,540
1983	0	0	0	271	0	271	781	0	781	165	0	165				1,217	0	1,217
1984	0	0	0	397	0	397	895	0	895	415	0	415				1,707	0	1,707
1985	0	0	0	108	0	108	267	0	267	35	0	35				411	0	411
1986	0	0	0	327	0	327	651	0	651	238	0	238				1,216	0	1,216
1987	0	0	0	508	0	508	1,163	0	1,163	509	0	509				2,181	0	2,181
1988	0	0	0	1,177	0	1,177	2,142	0	2,142	809	0	809				4,128	0	4,128
1989	0	0	0	354	0	354	397	0	397	43	0	43				795	0	795
1990	0	0	0	98	0	98	379	0	379	51	0	51				528	0	528
1991	0	0	0	172	0	172	236	0	236	16	0	16				424	0	424
1992	0	0	0	802	0	802	564	0	564	27	0	27				1,394	0	1,394
1993	0	0	0	124	0	124	508	0	508	12	0	12				644	0	644
1994	0	0	0	18	0	18	193	0	193	2	0	2				214	0	214
1995	0	0	0	234	0	234	621	0	621	26	0	26				882	0	882
1996	0	0	0	31	0	31	912	0	912	163	0	163				1,106	0	1,106
1997	0	0	0	62	0	62	786	68	854	69	0	69				917	68	985
1998	0	0	0	102	0	102	633	554	1,187	28	0	28	0	0	0	763	554	1,317
1999	0	0	0	7	0	7	134	369	503	15	14	29	0	38	38	156	421	577
2000	0	0	0	55	0	55	439	410	849	15	15	30	0	52	52	509	477	986
2001	0	0	0	253	9	262	1,177	1,480	2,657	54	101	155	0	909	909	1,484	2,499	3,983
2002	0	0	0	5	37	42	3,759	1,779	5,538	341	193	534	129	738	867	4,234	2,747	6,981
2003	0	0	0	69	381	450	3,814	1,883	5,697	204	102	306	229	334	563	4,316	2,701	7,017
2004	123	0	123	615	1,051	1,666	4,112	1,922	6,034	290	107	397	667	474	1,141	5,807	3,677	9,484
2005	2	0	2	494	822	1,316	3,877	2,296	6,172	776	60	836	881	522	1,403	6,030	3,702	9,732
2006	3	0	3	346	381	728	4,005	909	4,914	566	34	600	1,480	554	2,034	6,401	1,882	8,282
2007	2	0	2	472	188	660	1,247	38	1,285	434	9	443	891	44	934	3,046	281	3,326
2008	0	0	0	587	486	1,073	1,560	29	1,590	169	6	174	737	0	737	3,052	521	3,574
2009	1	0	1	203	2,442	2,645	1,225	20	1,245	221	9	230	1,026	0	1,026	2,676	2,472	5,148
2010	2	0	2	742	3,315	4,057	2,761	0	2,761	502	26	528	1,962	21	1,983	5,969	3,364	9,333
2011	3	0	3	819	1,605	2,424	2,279	11	2,291	339	4	344	643	0	643	4,084	1,624	5,708
2012	6	0	6	1,281	1,323	2,603	2,330	0	2,330	492	7	499	899	0	899	5,007	1,336	6,343
2013	0	0	0	5,684	2,699	8,383	2,760	0	2,760	577	0	577	3,081	0	3,081	12,102	2,699	14,800

1/ NOR = natural-origin (wild); HOR = hatchery-origin

Appendix Table 23. Natural-origin and hatchery-origin summer chum runsize estimates in Hood Canal region, 1974-2013.

	Runsize																	
Return year	Little Quilcene			Big Quilcene			Dosewallips			Duckabush			Hamma Hamma			Lilliwaup		
	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total
1974	50	0	50	895	0	895	4,043	0	4,043	4,030	0	4,030	2,755	0	2,755	693	0	693
1975	1,235	0	1,235	2,000	0	2,000	2,752	0	2,752	2,746	0	2,746	8,979	0	8,979	1,737	0	1,737
1976	3,451	0	3,451	7,755	0	7,755	3,968	0	3,968	7,394	0	7,394	9,278	0	9,278	8,998	0	8,998
1977	930	0	930	988	0	988	3,811	0	3,811	2,908	0	2,908	1,986	0	1,986	1,345	0	1,345
1978	2,104	0	2,104	3,451	0	3,451	2,202	0	2,202	2,199	0	2,199	9,517	0	9,517	2,887	0	2,887
1979	177	0	177	557	0	557	1,475	0	1,475	1,475	0	1,475	3,839	0	3,839	622	0	622
1980	544	0	544	1,388	0	1,388	3,341	0	3,341	2,272	0	2,272	904	0	904	1,362	0	1,362
1981	285	0	285	476	0	476	133	0	133	1,174	0	1,174	1,952	0	1,952	772	0	772
1982	665	0	665	829	0	829	1,295	0	1,295	1,762	0	1,762	2,046	0	2,046	336	0	336
1983	750	0	750	1,601	0	1,601	89	0	89	112	0	112	265	0	265	42	0	42
1984	566	0	566	920	0	920	281	0	281	397	0	397	226	0	226	279	0	279
1985	12	0	12	1,013	0	1,013	674	0	674	86	0	86	660	0	660	286	0	286
1986	363	0	363	1,120	0	1,120	139	0	139	430	0	430	421	0	421	242	0	242
1987	2,355	0	2,355	365	0	365	15	0	15	19	0	19	42	0	42	56	0	56
1988	1,434	0	1,434	1,110	0	1,110	760	0	760	572	0	572	506	0	506	325	0	325
1989	52	0	52	1,552	0	1,552	69	0	69	260	0	260	69	0	69	204	0	204
1990	0	0	0	623	0	623	15	0	15	76	0	76	164	0	164	4	0	4
1991	18	0	18	1,155	0	1,155	359	0	359	147	0	147	102	0	102	45	0	45
1992	15	0	15	1,223	0	1,223	856	0	856	806	0	806	161	0	161	129	0	129
1993	15	0	15	169	0	169	118	0	118	118	0	118	78	0	78	87	0	87
1994	0	0	0	896	0	896	272	0	272	318	0	318	447	0	447	134	0	134
1995	55	2	57	3,173	1,600	4,773	2,939	0	2,939	870	0	870	502	0	502	83	0	83
1996	265	8	273	7,776	1,753	9,529	7,148	0	7,148	2,715	0	2,715	793	0	793	78	0	78
1997	29	1	30	5,398	2,771	8,169	48	0	48	487	0	487	114	0	114	32	0	32
1998	270	8	278	1,403	1,521	2,924	351	0	351	236	0	236	133	0	133	25	0	25
1999	91	0	91	1,661	1,801	3,462	381	0	381	100	0	100	277	0	277	14	0	14
2000	275	27	302	6,030	317	6,347	1,259	11	1,270	432	36	468	217	14	231	20	2	22
2001	146	57	203	2,968	3,340	6,309	765	235	1,000	669	283	952	1,167	73	1,240	43	54	97
2002	448	87	535	3,209	1,365	4,574	1,319	315	1,634	356	176	532	1,055	1,283	2,338	39	884	923
2003	787	111	898	10,045	1,899	11,944	6,565	561	7,126	1,614	271	1,885	539	322	861	27	329	356
2004	4,374	108	4,482	48,382	3,299	51,681	10,352	1,227	11,579	7,870	789	8,659	2,416	282	2,698	137	887	1,024
2005	842	85	927	5,472	744	6,216	2,517	161	2,678	754	73	827	1,190	235	1,425	258	799	1,057
2006	2,735	133	2,868	10,425	1,066	11,491	2,490	122	2,611	3,003	174	3,177	2,745	361	3,106	432	1,205	1,636
2007	1,604	18	1,622	2,198	28	2,225	1,539	6	1,545	1,320	42	1,362	1,490	77	1,567	161	391	553
2008	3,321	0	3,321	2,545	0	2,545	3,888	101	3,989	2,559	149	2,708	1,405	262	1,667	180	521	700
2009	713	0	713	1,786	0	1,786	1,104	34	1,138	2,518	167	2,685	603	73	676	61	188	249
2010	506	0	506	1,595	9	1,604	2,448	113	2,561	3,937	238	4,175	1,391	103	1,494	191	51	242
2011	444	0	444	2,292	0	2,292	1,139	0	1,139	1,528	23	1,551	691	88	779	77	37	114
2012	1,355	0	1,355	11,146	0	11,146	2,862	34	2,897	5,219	86	5,305	2,233	151	2,384	1,651	1,730	3,381
2013	913	0	913	7,810	0	7,810	1,815	37	1,853	4,148	67	4,215	2,231	0	2,231	1,275	1,467	2,741

1/ NOR = natural-origin (wild); HOR = hatchery-origin

Appendix Table 23 (continued).

Return year	Runsize																				
	Union			Tahuya			Dewatto			Anderson			Big Beef			Skokomish			Hood Canal Total		
	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total	NOR 1/	HOR 1/	Total
1974	77	0	77	990	0	990	204	0	204	0	0	0	84	0	84	401	0	401	14,220	0	14,220
1975	214	0	214	3,543	0	3,543	1,508	0	1,508	239	0	239	1,409	0	1,409	2,751	0	2,751	29,114	0	29,114
1976	663	0	663	21,206	0	21,206	4,136	0	4,136	284	0	284	1,554	0	1,554	5,531	0	5,531	74,219	0	74,219
1977	242	0	242	2,344	0	2,344	720	0	720	31	0	31	358	0	358	1,024	0	1,024	16,687	0	16,687
1978	139	0	139	577	0	577	1,180	0	1,180	19	0	19	788	0	788	282	0	282	25,344	0	25,344
1979	370	0	370	447	0	447	187	0	187	7	0	7	237	0	237	118	0	118	9,512	0	9,512
1980	1,147	0	1,147	987	0	987	645	0	645	5	0	5	338	0	338	94	0	94	13,026	0	13,026
1981	108	0	108	369	0	369	108	0	108	2	0	2	190	0	190	306	0	306	5,875	0	5,875
1982	611	0	611	344	0	344	84	0	84	0	0	0	0	0	0	360	0	360	8,331	0	8,331
1983	397	0	397	201	0	201	35	0	35	0	0	0	0	0	0	54	0	54	3,545	0	3,545
1984	290	0	290	212	0	212	66	0	66	1	0	1	29	0	29	105	0	105	3,372	0	3,372
1985	1,038	0	1,038	379	0	379	59	0	59	0	0	0	0	0	0	217	0	217	4,423	0	4,423
1986	4,719	0	4,719	272	0	272	50	0	50	0	0	0	0	0	0	87	0	87	7,843	0	7,843
1987	870	0	870	159	0	159	9	0	9	0	0	0	10	0	10	75	0	75	3,975	0	3,975
1988	743	0	743	171	0	171	27	0	27	0	0	0	0	0	0	51	0	51	5,699	0	5,699
1989	2,134	0	2,134	43	0	43	9	0	9	0	0	0	0	0	0	85	0	85	4,478	0	4,478
1990	565	0	565	12	0	12	0	0	0	0	0	0	0	0	0	105	0	105	1,564	0	1,564
1991	313	0	313	8	0	8	47	0	47	0	0	0	0	0	0	5	0	5	2,199	0	2,199
1992	183	0	183	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4	3,377	0	3,377
1993	283	0	283	0	0	0	1	0	1	0	0	0	0	0	0	2	0	2	871	0	871
1994	891	0	891	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2,959	0	2,959
1995	760	0	760	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8,382	1,602	9,984
1996	506	0	506	5	0	5	0	0	0	0	0	0	0	0	0	9	0	9	19,296	1,761	21,057
1997	493	0	493	0	0	0	7	0	7	0	0	0	0	0	0	0	0	0	6,608	2,772	9,380
1998	255	0	255	0	0	0	13	0	13	0	0	0	0	0	0	60	0	60	2,746	1,529	4,275
1999	173	0	173	1	0	1	2	0	2	0	0	0	4	4	8	22	0	22	2,726	1,805	4,530
2000	750	0	750	2	0	2	10	0	10	0	0	0	20	0	20	20	0	20	9,036	407	9,442
2001	1,575	0	1,575	0	0	0	34	0	34	0	0	0	15	879	894	329	0	329	7,711	4,921	12,633
2002	938	0	938	0	0	0	11	0	11	0	0	0	12	733	745	198	0	198	7,584	4,844	12,427
2003	7,991	4,027	12,018	0	0	0	0	9	9	0	0	0	0	904	904	114	0	114	27,683	8,432	36,115
2004	3,627	2,389	6,016	8	0	8	6	17	23	1	0	1	174	1,747	1,921	143	0	143	77,489	10,746	88,235
2005	721	1,281	2,002	4	0	4	12	12	23	0	0	0	37	1,096	1,133	126	0	126	11,933	4,486	16,418
2006	1,689	1,185	2,874	59	700	759	17	53	70	0	0	0	203	631	834	647	0	647	24,443	5,630	30,073
2007	1,943	127	2,070	5	651	656	18	4	22	0	0	0	741	150	890	325	0	325	11,345	1,493	12,838
2008	1,060	87	1,147	16	695	711	12	14	26	0	0	0	715	29	744	1,311	0	1,311	17,013	1,858	18,870
2009	602	14	616	9	375	383	50	0	50	1	0	1	153	0	153	570	178	749	8,170	1,030	9,200
2010	958	20	978	231	940	1,171	9	0	9	0	0	0	145	0	145	512	0	512	11,922	1,474	13,396
2011	287	11	298	79	249	328	37	0	37	0	0	0	74	0	74	178	0	178	6,828	407	7,235
2012	2,207	66	2,273	192	1,230	1,422	155	34	189	2	0	2	158	0	158	745	761	1,506	27,926	4,092	32,018
2013	1,818	197	2,015	268	623	891	160	32	192	0	0	0	103	0	103	791	815	1,605	21,332	3,238	24,570

1/ NOR = natural-origin (wild); HOR = hatchery-origin

Appendix Table 24. Recruit per spawner worksheet for summer chum salmon returning to Jimmycomelately Creek.

Return year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Age 2 NOR's	0	29	2	0	5	0	26	17	0	0	0	0	25	61
Age 3 NOR's	0	25	191	1	57	516	174	254	458	114	0	433	275	236
Age 4 NOR's	7	1	60	1	6	98	290	73	14	472	194	309	519	975
Age 5 NOR's	0	0	0	3	0	0	4	3	0	0	9	0	0	9
Total NOR's	**7**	**55**	**253**	**5**	**69**	**615**	**494**	**346**	**472**	**587**	**203**	**742**	**819**	**1,281**

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Age 2 return year			*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Age 2 return			**0**	**29**	**2**	**0**	**5**	**0**	**26**	**17**	**0**	**0**	**0**	**0**	**25**	**61**
% total brood return			0.0%	13.1%	24.4%	0.0%	0.7%	0.0%	9.0%	1.8%	0.0%	0.0%	0.0%	0.0%	9.4%	100.0%
Age 3 return year		*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 3 return		**0**	**25**	**191**	**1**	**57**	**516**	**174**	**254**	**458**	**114**	**0**	**433**	**275**	**236**	
% total brood return		0.0%	28.5%	86.5%	8.9%	35.9%	63.4%	70.6%	86.3%	47.9%	37.1%	0.0%	45.1%	22.0%	90.6%	
Age 4 return year	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 4 return	**7**	**1**	**60**	**1**	**6**	**98**	**290**	**73**	**14**	**472**	**194**	**309**	**519**	**975**		
% total brood return		100.0%	67.8%	0.4%	66.7%	61.4%	35.6%	29.4%	4.7%	49.4%	62.9%	100.0%	54.0%	78.0%		
Age 5 return year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*		
Age 5 return	**0**	**0**	**3**	**0**	**0**	**4**	**3**	**0**	**0**	**9**	**0**	**0**	**9**			
% total brood return		0.0%	3.7%	0.0%	0.0%	2.7%	0.4%	0.0%	0.0%	0.9%	0.0%	0.0%	0.9%			
Total brood return	7	1	88	221	9	160	814	247	294	956	308	309	961	1,249	261	61

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Parent wild escapement	223	30	61	98	1	9	192	6	369	1,601	1,247	660	578	982	2,542	3,945	2,411	2,590
Age 2 R/S			0.00	0.30	2.13	0.00	0.03	0.00	0.07	0.01	0.00	0.00	0.00	0.00	0.01	0.02		
Age 3 R/S		0.00	0.41	1.95	0.77	6.38	2.69	29.01	0.69	0.29	0.09	0.00	0.75	0.28	0.09			
Age 4 R/S	0.03	0.03	0.98	0.01	5.81	10.92	1.51	12.10	0.04	0.30	0.16	0.47	0.90	0.99				
Age 5 R/S	0.00	0.00	0.05	0.00	0.00	0.49	0.01	0.00	0.00	0.01	0.00	0.00	0.02					
Total R/S	0.03	0.03	1.44	2.26	8.72	17.78	4.24	41.12	0.80	0.60	0.25	0.47	1.66	1.27	0.10	0.02		

Appendix Table 25. Recruit per spawner worksheet for summer chum salmon returning to Salmon and Snow creeks.

Return year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Age 2 NOR's	0	37	79	0	0	0	36	69	6	12	32	0	12	35
Age 3 NOR's	87	329	446	3,517	2,818	1,129	3,262	1,744	1,484	776	655	2,240	342	648
Age 4 NOR's	56	83	706	572	1,178	3,197	1,273	2,654	186	935	751	994	2,215	2,010
Age 5 NOR's	6	5	0	12	21	75	82	103	6	6	8	28	51	128
Total NOR's	**148**	**454**	**1,230**	**4,100**	**4,018**	**4,401**	**4,653**	**4,571**	**1,681**	**1,729**	**1,446**	**3,262**	**2,619**	**2,822**

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Age 2 return year			*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Age 2 return			**0**	**37**	**79**	**0**	**0**	**0**	**36**	**69**	**6**	**12**	**32**	**0**	**12**	**35**
% total brood return			0.0%	3.4%	1.6%	0.0%	0.0%	0.0%	1.8%	2.8%	0.4%	0.7%	0.7%	0.0%	1.8%	100.0%
Age 3 return year		*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 3 return		**87**	**329**	**446**	**3,517**	**2,818**	**1,129**	**3,262**	**1,744**	**1,484**	**776**	**655**	**2,240**	**342**	**648**	
% total brood return		51.2%	31.4%	41.4%	72.5%	46.2%	45.1%	55.1%	88.4%	59.4%	49.7%	38.3%	48.5%	14.5%		
Age 4 return year	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 4 return	**56**	**83**	**706**	**572**	**1,178**	**3,197**	**1,273**	**2,654**	**186**	**935**	**751**	**994**	**2,215**	**2,010**		
% total brood return		48.8%	67.4%	53.1%	24.3%	52.4%	50.8%	44.8%	9.4%	37.4%	48.1%	58.1%	48.0%	85.5%		
Age 5 return year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*		
Age 5 return	**5**	**0**	**12**	**21**	**75**	**82**	**103**	**6**	**6**	**8**	**28**	**51**	**128**			
% total brood return		0.0%	1.2%	2.0%	1.6%	1.3%	4.1%	0.1%	0.3%	0.3%	1.8%	3.0%	2.8%			
Total brood return	60	170	1,047	1,075	4,849	6,097	2,504	5,922	1,973	2,496	1,562	1,712	4,615	2,352	660	35

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Parent wild escapement	563	945	791	1,050	463	740	2,638	5,921	5,825	6,417	6,974	5,492	1,713	1,740	1,466	3,264	2,621	2,814
Age 2 R/S			0.00	0.04	0.17	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.02	0.00	0.01	0.01		
Age 3 R/S		0.09	0.42	0.42	7.60	3.81	0.43	0.55	0.30	0.23	0.11	0.12	1.31	0.20	0.44			
Age 4 R/S	0.10	0.09	0.89	0.54	2.54	4.32	0.48	0.45	0.03	0.15	0.11	0.18	1.29	1.16				
Age 5 R/S	0.01	0.00	0.02	0.02	0.16	0.11	0.04	0.00	0.00	0.00	0.00	0.01	0.07					
Total R/S	0.11	0.18	1.32	1.02	10.47	8.24	0.95	1.00	0.34	0.39	0.22	0.31	2.69	1.35	0.45	0.01		

Appendix Table 26. Recruit per spawner worksheet for summer chum salmon returning to Chimacum Creek.

Return year	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Age 2 NOR's	5	0	17	32	3	0	63	0	0	26
Age 3 NOR's	176	490	697	637	829	378	545	1,277	128	322
Age 4 NOR's	48	177	156	811	55	359	419	670	499	507
Age 5 NOR's	[redacted]	**2,671**	**2,875**	**3,486**	**2,894**	**2,745**	**3,036**	**3,957**	**2,638**	**2,868**
Total NOR's	**229**	**3,337**	**3,744**	**4,966**	**3,782**	**3,483**	**4,062**	**5,905**	**3,264**	**3,723**

Brood year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Age 2 return year	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Age 2 return	**0**	**5**	**5**	**0**	**17**	**32**	**3**	**0**	**63**	**0**	**0**	**26**
% total brood return	0.0%	0.1%	0.1%	0.0%	0.5%	0.8%	0.1%	0.0%	1.3%	0.0%	0.0%	100.0%
Age 3 return year	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 3 return	**124**	**176**	**490**	**697**	**637**	**829**	**378**	**545**	**1,277**	**128**	**322**	
% total brood return	4.4%	5.4%	11.8%	15.8%	18.4%	19.5%	8.0%	14.1%	27.1%	20.1%		
Age 4 return year	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 4 return	**48**	**177**	**156**	**811**	**55**	**359**	**419**	**670**	**499**	**507**		
% total brood return	1.7%	5.5%	3.8%	18.4%	1.6%	8.4%	8.8%	17.4%	10.6%	79.9%		
Age 5 return year	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*			
Age 5 return	**2,671**	**2,875**	**3,486**	**2,894**	**2,745**	**3,036**	**3,957**	**2,638**	**2,868**			
% total brood return	93.9%	88.9%	84.3%	65.7%	79.5%	71.3%	83.2%	68.5%	60.9%			
Total brood return	2,843	3,232	4,136	4,402	3,455	4,255	4,758	3,853	4,706	635	322	26

Brood year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Parent wild escapement	38	52	903	864	558	1,139	1,396	2,026	926	727	1,020	1,968	640	894
Age 2 R/S	0.00	0.09	0.01	0.00	0.03	0.03	0.00	0.00	0.07	0.00	0.00	0.01		
Age 3 R/S	3.26	3.38	0.54	0.81	1.14	0.73	0.27	0.27	1.38	0.18	0.32			
Age 4 R/S	1.27	3.41	0.17	0.94	0.10	0.31	0.30	0.33	0.54	0.70				
Age 5 R/S	70.28	55.28	3.86	3.35	4.92	2.67	2.83	1.30	3.10					
Total R/S	74.82	62.16	4.58	5.09	6.19	3.74	3.41	1.90	5.08	0.87	0.32	0.01	0.00	0.00

Appendix Table 27. Recruit per spawner worksheet for summer chum salmon returning to Big and Little Quilcene rivers.

Return year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Age 2 NOR's		0	3	0	0	0	4	0	7	0	0	0	0	39
Age 3 NOR's		241	517	3,391	7,869	12,774	5,275	6,797	1,720	756	764	1,191	75	5,740
Age 4 NOR's			2,936	850	3,085	38,506	896	6,351	2,092	4,996	1,580	835	2,569	6,053
Age 5 NOR's				88	72	457	139	24	41	117	165	71	92	669
Total NOR's	**N/A**	**241**	**3,456**	**4,330**	**11,026**	**51,737**	**6,314**	**13,172**	**3,860**	**5,868**	**2,508**	**2,097**	**2,736**	**12,500**

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Age 2 return year			*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Age 2 return			**0**	**0**	**3**	**0**	**0**	**0**	**4**	**0**	**7**	**0**	**0**	**0**	**0**	**39**
% total brood return			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	100.0%
Age 3 return year		*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 3 return		**0**	**241**	**517**	**3,391**	**7,869**	**12,774**	**5,275**	**6,797**	**1,720**	**756**	**764**	**1,191**	**75**	**5,740**	
% total brood return		0.0%	7.4%	35.9%	48.9%	16.9%	93.3%	45.2%	75.4%	25.0%	31.3%	45.1%	26.9%	1.2%		
Age 4 return year	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 4 return	**0**	**0**	**2,936**	**850**	**3,085**	**38,506**	**896**	**6,351**	**2,092**	**4,996**	**1,580**	**835**	**2,569**	**6,053**		
% total brood return		0.0%	89.9%	59.1%	44.5%	82.8%	6.5%	54.4%	23.2%	72.6%	65.4%	49.4%	58.0%	98.8%		
Age 5 return year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*		
Age 5 return	**0**	**0**	**88**	**72**	**457**	**139**	**24**	**41**	**117**	**165**	**71**	**92**	**669**			
% total brood return		0.0%	2.7%	5.0%	6.6%	0.3%	0.2%	0.4%	1.3%	2.4%	2.9%	5.5%	15.1%			
Total brood return	0	0	3,266	1,439	6,937	46,514	13,694	11,667	9,010	6,880	2,414	1,692	4,429	6,127	5,740	39

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Parent wild escapement	4,083	8,744	7,368	2,509	3,065	5,394	6,067	4,132	12,635	38,045	6,568	11,876	2,526	3,861	1,490	2,073	2,580	11,739
Age 2 R/S			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02		
Age 3 R/S		0.00	0.03	0.21	1.11	1.46	2.11	1.28	0.54	0.05	0.12	0.06	0.47	0.02	3.85			
Age 4 R/S	0.00	0.00	0.40	0.34	1.01	7.14	0.15	1.54	0.17	0.13	0.24	0.07	1.02	1.57				
Age 5 R/S	0.00	0.00	0.01	0.03	0.15	0.03	0.00	0.01	0.01	0.00	0.01	0.01	0.26					
Total R/S	0.00	0.00	0.44	0.57	2.26	8.62	2.26	2.82	0.71	0.18	0.37	0.14	1.75	1.59	3.85	0.02	0.00	0.00

Appendix Table 28. Recruit per spawner worksheet for summer chum salmon returning to Dosewallips River.

Return year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Age 2 NOR's	0	0	0	0	60	0	0	0	0	21	0	0	0	17
Age 3 NOR's	173	32	358	634	4,948	622	1,350	818	1,304	435	393	500	30	1,321
Age 4 NOR's	199	1,236	297	577	1,542	9,708	279	1,665	226	3,433	609	1,867	1,019	1,508
Age 5 NOR's	9	0	115	129	15	19	888	10	19	0	101	77	90	17
Total NOR's	**381**	**1,267**	**770**	**1,340**	**6,564**	**10,349**	**2,517**	**2,492**	**1,548**	**3,889**	**1,103**	**2,444**	**1,139**	**2,862**

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Age 2 return year			*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Age 2 return			**0**	**0**	**0**	**0**	**60**	**0**	**0**	**0**	**0**	**21**	**0**	**0**	**0**	**17**
% total brood return			0.0%	0.0%	0.0%	0.0%	6.2%	0.0%	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%	0.0%	100.0%
Age 3 return year		*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 3 return		**173**	**32**	**358**	**634**	**4,948**	**622**	**1,350**	**818**	**1,304**	**435**	**393**	**500**	**30**	**1,321**	
% total brood return		11.4%	7.0%	37.7%	28.9%	31.8%	64.1%	44.5%	78.4%	26.9%	38.8%	16.6%	32.6%	1.9%		
Age 4 return year	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 4 return	**199**	**1,236**	**297**	**577**	**1,542**	**9,708**	**279**	**1,665**	**226**	**3,433**	**609**	**1,867**	**1,019**	**1,508**		
% total brood return		81.1%	64.8%	60.7%	70.2%	62.5%	28.8%	54.9%	21.6%	71.0%	54.3%	78.8%	66.3%	98.1%		
Age 5 return year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*			
Age 5 return	**0**	**115**	**129**	**15**	**19**	**888**	**10**	**19**	**0**	**101**	**77**	**90**	**17**			
% total brood return		7.6%	28.2%	1.6%	0.9%	5.7%	1.0%	0.6%	0.0%	2.1%	6.9%	3.8%	1.1%			
Total brood return	199	1,524	458	950	2,196	15,543	970	3,034	1,043	4,838	1,121	2,370	1,537	1,538	1,321	17

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Parent wild escapement	2787	6976	47	336	351	1260	990	1627	7066	11549	2658	2577	1468	3930	1128	2521	1130	2862
Age 2 R/S			0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01		
Age 3 R/S		0.02	0.68	1.07	1.81	3.93	0.63	0.83	0.12	0.11	0.16	0.15	0.34	0.01	1.17			
Age 4 R/S	0.07	0.18	6.32	1.72	4.39	7.70	0.28	1.02	0.03	0.30	0.23	0.72	0.69	0.38				
Age 5 R/S	0.00	0.02	2.75	0.04	0.06	0.70	0.01	0.01	0.00	0.01	0.03	0.03	0.01					
Total R/S	0.07	0.22	9.74	2.83	6.26	12.34	0.98	1.86	0.15	0.42	0.42	0.92	1.05	0.39	1.17	0.01	0.00	0.00

Appendix Table 29. Recruit per spawner worksheet for summer chum salmon returning to Duckabush River.

Return year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Age 2 NOR's	0	0	0	0	0	0	0	9	0	0	0	0	12	66.31075
Age 3 NOR's	25	37	203	241	1,136	628	512	1,225	1,030	322	857	1,124	23	2,741
Age 4 NOR's	75	384	417	106	478	7,240	98	1,753	284	2,224	1,483	2,694	1,340	2,080
Age 5 NOR's	0	13	53	15	0	0	144	18	13	14	177	112	153	332
Total NOR's	**100**	**435**	**673**	**362**	**1,614**	**7,868**	**754**	**3,006**	**1,327**	**2,560**	**2,517**	**3,930**	**1,528**	**5,219**

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Age 2 return year			*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Age 2 return			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**0**	**0**	**0**	**0**	**12**	**66**
% total brood return			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.4%	100.0%
Age 3 return year		*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 3 return		**25**	**37**	**203**	**241**	**1,136**	**628**	**512**	**1,225**	**1,030**	**322**	**857**	**1,124**	**23**	**2,741**	
% total brood return		5.4%	8.0%	65.6%	33.5%	13.3%	84.4%	22.5%	80.4%	30.0%	16.8%	23.1%	40.2%	1.1%		
Age 4 return year	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 4 return	**75**	**384**	**417**	**106**	**478**	**7,240**	**98**	**1,753**	**284**	**2,224**	**1,483**	**2,694**	**1,340**	**2,080**		
% total brood return		83.1%	88.8%	34.4%	66.5%	85.0%	13.2%	76.9%	18.6%	64.6%	77.4%	72.7%	47.9%	98.9%		
Age 5 return year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*		
Age 5 return	**13**	**53**	**15**	**0**	**0**	**144**	**18**	**13**	**14**	**177**	**112**	**153**	**332**			
% total brood return		11.5%	3.2%	0.0%	0.0%	1.7%	2.5%	0.6%	0.9%	5.1%	5.8%	4.1%	11.9%			
Total brood return	88	462	470	309	718	8,521	745	2,278	1,523	3,440	1,917	3,704	2,796	2,104	2,753	66

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Parent wild escapement	476	774	97	95	212	173	1173	2260	796	2628	1272	2922	1387	1503	670	1471	773	2355
Age 2 R/S			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05		
Age 3 R/S		0.03	0.39	2.13	1.14	6.57	0.54	0.23	1.54	0.39	0.25	0.29	0.81	0.02	4.09			
Age 4 R/S	0.16	0.50	4.30	1.12	2.25	41.85	0.08	0.78	0.36	0.85	1.17	0.92	0.97	1.38				
Age 5 R/S	0.03	0.07	0.16	0.00	0.00	0.83	0.02	0.01	0.02	0.07	0.09	0.05	0.24					
Total R/S	0.19	0.60	4.84	3.26	3.39	49.25	0.64	1.01	1.91	1.31	1.51	1.27	2.02	1.40	4.11	0.05	0.00	0.00

Appendix Table 30. Recruit per spawner worksheet for summer chum salmon returning to Hamma Hamma River.

Return year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Age 2 NOR's	0	8	13	0	8	0	0	13	0	0	3	0	0	0
Age 3 NOR's	135	39	267	697	301	513	923	596	1,177	324	184	499	29	1,264
Age 4 NOR's	142	171	756	324	226	1,901	159	2,132	308	1,066	387	855	632	902
Age 5 NOR's	0	0	139	51	4	0	108	6	14	15	28	36	29	67
Total NOR's	**277**	**218**	**1,175**	**1,072**	**539**	**2,415**	**1,190**	**2,747**	**1,499**	**1,405**	**602**	**1,389**	**691**	**2,233**

Brood year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Age 2 return year			*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Age 2 return			**0**	**8**	**13**	**0**	**8**	**0**	**0**	**13**	**0**	**0**	**3**	**0**	**0**	**0**
% total brood return			0.0%	1.4%	1.3%	0.0%	1.2%	0.0%	0.0%	0.6%	0.0%	0.0%	0.3%	0.0%	0.0%	
Age 3 return year		*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 3 return		**135**	**39**	**267**	**697**	**301**	**513**	**923**	**596**	**1,177**	**324**	**184**	**499**	**29**	**1,264**	
% total brood return		30.4%	4.6%	44.3%	74.5%	13.0%	74.7%	30.1%	64.8%	51.5%	43.3%	17.2%	41.5%	3.2%		
Age 4 return year	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 4 return	**142**	**171**	**756**	**324**	**226**	**1,901**	**159**	**2,132**	**308**	**1,066**	**387**	**855**	**632**	**902**		
% total brood return		38.4%	89.4%	53.7%	24.1%	82.3%	23.2%	69.5%	33.5%	46.7%	51.9%	80.0%	52.6%	96.8%		
Age 5 return year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*		
Age 5 return	**0**	**139**	**51**	**4**	**0**	**108**	**6**	**14**	**15**	**28**	**36**	**29**	**67**			
% total brood return		31.2%	6.0%	0.7%	0.0%	4.7%	0.9%	0.4%	1.7%	1.2%	4.8%	2.8%	5.6%			
Total brood return	142	445	846	603	936	2,311	687	3,068	920	2,284	747	1,068	1,201	932	1,264	0

Brood year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Parent wild escapement	476	774	97	95	212	173	1173	2260	796	2628	1272	2922	1387	1503	670	1471	773	2355
Age 2 R/S			0.00	0.09	0.06	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Age 3 R/S		0.17	0.40	2.81	3.29	1.74	0.44	0.41	0.75	0.45	0.25	0.06	0.36	0.02	1.89			
Age 4 R/S	0.30	0.22	7.80	3.41	1.06	10.99	0.14	0.94	0.39	0.41	0.30	0.29	0.46	0.60				
Age 5 R/S	0.00	0.18	0.52	0.04	0.00	0.62	0.01	0.01	0.02	0.01	0.03	0.01	0.05					
Total R/S	0.30	0.57	8.72	6.35	4.41	13.36	0.59	1.36	1.16	0.87	0.59	0.37	0.87	0.62	1.89	0.00	0.00	0.00

Appendix Table 31. Recruit per spawner worksheet for summer chum salmon returning to Lilliwaup Creek.

Return year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Age 2 NOR's	0	0	0	0	0	0	0	0	1	1	21	0
Age 3 NOR's	20	25	20	65	231	141	117	33	33	58	27	1,428
Age 4 NOR's	21	12	7	71	27	292	43	146	28	128	26	208
Age 5 NOR's	[redacted]	0	0	0	0	0	2	0	0	4	3	18
Total NOR's	**41**	**37**	**27**	**136**	**259**	**433**	**162**	**180**	**61**	**191**	**77**	**1,653**

Brood year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Age 2 return year	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Age 2 return	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**21**	**0**
% total brood return	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%	0.6%	1.4%	
Age 3 return year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 3 return	**7**	**20**	**25**	**20**	**65**	**231**	**141**	**117**	**33**	**33**	**58**	**27**	**1,428**	
% total brood return	25.9%	62.7%	79.0%	22.3%	70.7%	44.0%	76.6%	44.4%	51.5%	20.0%	56.0%	11.5%	98.6%	
Age 4 return year	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 4 return	**21**	**12**	**7**	**71**	**27**	**292**	**43**	**146**	**28**	**128**	**26**	**208**		
% total brood return	74.1%	37.3%	21.0%	77.7%	29.3%	55.5%	23.4%	55.6%	42.3%	78.1%	25.5%	87.9%		
Age 5 return year	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*		
Age 5 return	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**4**	**3**	**18**			
% total brood return	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	6.3%	2.0%	17.2%			
Total brood return	28	32	32	91	93	526	184	263	65	164	103	236	1,448	0

Brood year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Parent wild escapement	9	3	0	2	32	775	194	922	951	1523	485	638	123	95	75	3204
Age 2 R/S	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00		
Age 3 R/S	0.81	6.62		10.19	2.04	0.30	0.73	0.13	0.04	0.02	0.12	0.04	11.61			
Age 4 R/S	2.33	3.95		35.52	0.85	0.38	0.22	0.16	0.03	0.08	0.05	0.33				
Age 5 R/S	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04					
Total R/S	3.15	10.57		45.71	2.89	0.68	0.95	0.29	0.07	0.11	0.21	0.37	11.78	0.00		

Appendix Table 32. Recruit per spawner worksheet for summer chum salmon returning to Big Beef Creek.

Return year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Age 2 NOR's	0	13	0	0	0	0	0	0
Age 3 NOR's	21	62	716	258	53	73	37	79
Age 4 NOR's	15	129	29	458	96	73	37	79
Age 5 NOR's	0	0	0	0	5	0	0	0
Total NOR's	**37**	**203**	**745**	**716**	**153**	**145**	**74**	**158**

Brood year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Age 2 return year	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Age 2 return	**0**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**0**
% total brood return	0.0%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
Age 3 return year	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 3 return	**174**	**21**	**62**	**716**	**258**	**53**	**73**	**37**	**79**	
% total brood return	91.9%	14.1%	68.2%	60.1%	72.9%	42.1%	66.3%	31.8%		
Age 4 return year	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 4 return	**15**	**129**	**29**	**458**	**96**	**73**	**37**	**79**		
% total brood return	8.1%	85.9%	31.8%	38.4%	27.1%	57.9%	33.7%	68.2%		
Age 5 return year	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*		
Age 5 return	**0**	**0**	**0**	**5**	**0**	**0**	**0**			
% total brood return	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%			
Total brood return	190	150	90	1,192	353	125	109	116	79	0

Brood year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Parent wild escapement	826	677	824	1852	1124	823	846	733	152	143	73	156
Age 2 R/S	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00		
Age 3 R/S	0.21	0.03	0.07	0.39	0.23	0.06	0.09	0.05	0.52			
Age 4 R/S	0.02	0.19	0.03	0.25	0.09	0.09	0.04	0.11				
Age 5 R/S	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
Total R/S	0.23	0.22	0.11	0.64	0.31	0.15	0.13	0.16	0.52	0.00	0.00	0.00

Appendix Table 33. Recruit per spawner worksheet for summer chum salmon returning to Mainstem Hood Canal management unit.

Return year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Age 2 NOR's	0	8	13	0	68	0	0	35	0	21	5	1	32	83
Age 3 NOR's	333	116	864	1,598	6,406	2,003	3,037	2,842	4,345	1,372	1,519	2,253	147	6,832
Age 4 NOR's	416	1,790	1,492	1,031	2,252	18,920	579	5,970	889	7,328	2,603	5,616	3,055	4,777
Age 5 NOR's	9	13	307	195	19	19	1,140	34	48	29	310	229	275	433
Total NOR's	**758**	**1,928**	**2,675**	**2,823**	**8,745**	**20,943**	**4,756**	**8,880**	**5,282**	**8,750**	**4,437**	**8,099**	**3,509**	**12,125**

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	
Age 2 return year			*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 2 return			**0**	**8**	**13**	**0**	**68**	**0**	**0**	**35**	**0**	**21**	**5**	**1**	**32**	**83**	
% total brood return			0.0%	0.4%	0.3%	0.0%	2.5%	0.0%	0.0%	0.3%	0.0%	0.3%	0.1%	0.0%	0.5%	100.0%	
Age 3 return year		*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 3 return		**333**	**116**	**864**	**1,598**	**6,406**	**2,003**	**3,037**	**2,842**	**4,345**	**1,372**	**1,519**	**2,253**	**147**	**6,832**		
% total brood return		13.7%	6.4%	44.9%	41.2%	24.2%	74.6%	33.5%	75.6%	36.2%	32.6%	20.4%	39.2%	3.0%	99.5%		
Age 4 return year	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*			
Age 4 return		**1,790**	**1,492**	**1,031**	**2,252**	**18,920**	**579**	**5,970**	**889**	**7,328**	**2,603**	**5,616**	**3,055**	**4,777**			
% total brood return		73.7%	82.8%	53.6%	58.0%	71.5%	21.6%	65.9%	23.7%	61.0%	61.9%	75.6%	53.2%	97.0%			
Age 5 return year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*				
Age 5 return	**13**	**307**	**195**	**19**	**19**	**1,140**	**34**	**48**	**29**	**310**	**229**	**275**	**433**				
% total brood return		12.6%	10.8%	1.0%	0.5%	4.3%	1.3%	0.5%	0.8%	2.6%	5.4%	3.7%	7.5%				
Total brood return	13	2,431	1,802	1,922	3,881	26,466	2,684	9,055	3,760	12,018	4,203	7,431	5,745	4,925	6,865	83	0

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Parent wild escapement	3739	8524	250	529	775	1608	4194	7599	9676	19579	7277	10767	5573	8307	2743	5701	2824	10932
Age 2 R/S			0.00	0.02	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01		
Age 3 R/S		0.04	0.46	1.63	2.06	3.98	0.48	0.40	0.29	0.22	0.19	0.14	0.40	0.02	2.49			
Age 4 R/S	0.00	0.21	5.97	1.95	2.91	11.77	0.14	0.79	0.09	0.37	0.36	0.52	0.55	0.58				
Age 5 R/S	0.00	0.04	0.78	0.04	0.03	0.71	0.01	0.01	0.00	0.02	0.03	0.03	0.08					
Total R/S	0.00	0.29	7.21	3.63	5.01	16.46	0.64	1.19	0.39	0.61	0.58	0.69	1.03	0.59	2.50	0.01		

Appendix Table 34. Recruit per spawner worksheet for summer chum salmon returning to Union River.

Return year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Age 2 NOR's	0	19	11	85	0	17	23	27	44	0	29	0	57	68
Age 3 NOR's	20	662	214	625	7,378	745	583	1,143	1,743	478	439	743	73	1,830
Age 4 NOR's	153	75	1293	151	585	2,832	70	508	168	577	129	208	158	376
Age 5 NOR's	0	0	0	28	27	17	46	13	0	6	10	5	0	0
Total NOR's	**173**	**755**	**1,518**	**890**	**7,990**	**3,611**	**721**	**1,690**	**1,955**	**1,061**	**606**	**956**	**287**	**2,275**

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Age 2 return year			*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Age 2 return			**0**	**19**	**11**	**85**	**0**	**17**	**23**	**27**	**44**	**0**	**29**	**0**	**57**	**68**
% total brood return			0.0%	4.5%	0.9%	0.8%	0.0%	1.6%	1.7%	1.1%	6.7%	0.0%	3.1%	0.0%	3.0%	100.0%
Age 3 return year		*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 3 return		**20**	**662**	**214**	**625**	**7,378**	**745**	**583**	**1,143**	**1,743**	**478**	**439**	**743**	**73**	**1,830**	
% total brood return		21.4%	33.4%	52.1%	50.5%	71.4%	90.0%	52.6%	85.3%	74.0%	72.9%	67.9%	80.0%	16.3%	97.0%	
Age 4 return year	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 4 return	**153**	**75**	**1,293**	**151**	**585**	**2,832**	**70**	**508**	**168**	**577**	**129**	**208**	**158**	**376**		
% total brood return		78.6%	65.2%	36.9%	47.2%	27.4%	8.4%	45.8%	12.6%	24.5%	19.7%	32.1%	17.0%	83.7%		
Age 5 return year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*			
Age 5 return	**0**	**0**	**28**	**27**	**17**	**46**	**13**	**0**	**6**	**10**	**5**	**0**	**0**			
% total brood return		0.0%	1.4%	6.5%	1.4%	0.4%	1.6%	0.0%	0.4%	0.4%	0.8%	0.0%	0.0%			
Total brood return	153	95	1,983	411	1,238	10,341	828	1,108	1,339	2,356	655	647	929	449	1,887	68

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Parent wild escapement	721	494	410	223	159	682	1426	807	11780	5876	1885	2736	1867	1030	548	897	276	2246
Age 2 R/S			0.00	0.08	0.07	0.12	0.00	0.02	0.00	0.00	0.02	0.00	0.02	0.00	0.10	0.08		
Age 3 R/S		0.04	1.61	0.96	3.93	10.82	0.52	0.72	0.10	0.30	0.25	0.16	0.40	0.07	3.34			
Age 4 R/S	0.21	0.15	3.15	0.68	3.68	4.15	0.05	0.63	0.01	0.10	0.07	0.08	0.08	0.37				
Age 5 R/S	0.00	0.00	0.07	0.12	0.11	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00					
Total R/S	0.21	0.19	4.84	1.84	7.79	15.16	0.58	1.37	0.11	0.40	0.35	0.24	0.50	0.44	3.44	0.08		

Appendix Table 35. Recruit per spawner worksheet for summer chum salmon returning to Tahuya River.

Return year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Age 2 NOR's	0	0	0	0	9	0	0	0
Age 3 NOR's	4	27	5	11	0	204	23	109
Age 4 NOR's	0	27	0	5	0	26	56	84
Age 5 NOR's	0	5	0	0	0	0	0	0
Total NOR's	**4**	**59**	**5**	**16**	**9**	**230**	**79**	**192**

Brood year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**		
Age 2 return year			*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 2 return			**0**	**0**	**0**	**0**	**9**	**0**	**0**	**0**		
% total brood return			0.0%	0.0%	0.0%	0.0%	3.2%	0.0%	0.0%			
Age 3 return year		*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*			
Age 3 return		**4**	**27**	**5**	**11**	**0**	**204**	**23**	**109**			
% total brood return		12.2%	100.0%	48.5%	100.0%	0.0%	75.9%	21.4%	100.0%			
Age 4 return year	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*				
Age 4 return	**0**	**27**	**0**	**5**	**0**	**26**	**56**	**84**				
% total brood return		87.8%	0.0%	51.5%	0.0%	100.0%	21.0%	78.6%				
Age 5 return year	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*					
Age 5 return	**5**	**0**	**0**	**0**	**0**	**0**	**0**					
% total brood return		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%					
Total brood return	5	31	27	10	11	26	269	107	109	0	0	0

Brood year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Parent wild escapement	0	0	0	8	4	749	623	700	380	1153	325	1405
Age 2 R/S				0.00	0.00	0.00	0.01	0.00	0.00	0.00		
Age 3 R/S				0.63	2.67	0.00	0.33	0.03	0.29			
Age 4 R/S				0.67	0.00	0.03	0.09	0.12				
Age 5 R/S				0.00	0.00	0.00	0.00					
Total R/S				1.30	2.67	0.03	0.43	0.15	0.29	0.00		

Appendix Table 36. Recruit per spawner worksheet for summer chum salmon returning to Southeast Hood Canal management unit.

Return year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Age 2 NOR's	0	19	11	85	0	17	23	27	44	0	37	0	57	68
Age 3 NOR's	20	662	214	625	7,378	745	587	1,169	1,748	488	439	947	96	1,939
Age 4 NOR's	153	75	1293	151	585	2,832	70	535	168	582	129	234	214	460
Age 5 NOR's	0	0	0	28	27	17	46	18	0	6	10	5	0	0
Total NOR's	**173**	**755**	**1,518**	**890**	**7,990**	**3,611**	**725**	**1,749**	**1,960**	**1,077**	**615**	**1,187**	**367**	**2,467**

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Age 2 return year			*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Age 2 return			**0**	**19**	**11**	**85**	**0**	**17**	**23**	**27**	**44**	**0**	**37**	**0**	**57**	**68**
% total brood return			0.0%	4.5%	0.9%	0.8%	0.0%	1.5%	1.7%	1.1%	6.6%	0.0%	3.1%	0.0%	2.8%	100.0%
Age 3 return year		*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	
Age 3 return		**20**	**662**	**214**	**625**	**7,378**	**745**	**587**	**1,169**	**1,748**	**488**	**439**	**947**	**96**	**1,939**	
% total brood return		21.4%	33.4%	52.1%	50.5%	71.4%	89.4%	51.5%	85.6%	73.9%	73.3%	65.3%	79.0%	17.3%	97.2%	
Age 4 return year	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*		
Age 4 return	**153**	**75**	**1,293**	**151**	**585**	**2,832**	**70**	**535**	**168**	**582**	**129**	**234**	**214**	**460**		
% total brood return		78.6%	65.2%	36.9%	47.2%	27.4%	8.4%	47.0%	12.3%	24.6%	19.4%	34.7%	17.9%	82.7%		
Age 5 return year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*			
Age 5 return	**0**	**0**	**28**	**27**	**17**	**46**	**18**	**0**	**6**	**10**	**5**	**0**	**0**			
% total brood return		0.0%	1.4%	6.5%	1.4%	0.4%	2.2%	0.0%	0.4%	0.4%	0.8%	0.0%	0.0%			
Total brood return	153	95	1,983	411	1,238	10,341	833	1,139	1,366	2,367	666	673	1,199	556	1,995	68

Brood year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Parent wild escapement	721	494	410	223	159	682	1426	807	11780	5884	1889	3485	2490	1730	928	2050	601	3651
Age 2 R/S			0.00	0.08	0.07	0.12	0.00	0.02	0.00	0.00	0.02	0.00	0.01	0.00	0.06	0.03		
Age 3 R/S		0.04	1.61	0.96	3.93	10.82	0.52	0.73	0.10	0.30	0.26	0.13	0.38	0.06	2.09			
Age 4 R/S	0.21	0.15	3.15	0.68	3.68	4.15	0.05	0.66	0.01	0.10	0.07	0.07	0.09	0.27				
Age 5 R/S	0.00	0.00	0.07	0.12	0.11	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00					
Total R/S	0.21	0.19	4.84	1.84	7.79	15.16	0.58	1.41	0.12	0.40	0.35	0.19	0.48	0.32	2.15			

Appendix Table 37. Estimated numbers of supplementation-origin summer chum escaping to streams other than their streams of origin in 2005.

Program of origin — Age 2

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness											0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush											0
Hamma											0
Lilliwaup											0
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish											0

Program of origin — Age 3

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness											0
JCL		52							4	4	60
Salmon			21							41	62
Snow			6								6
Chimacum		33							6		39
L. Quilcene			4							8	
B. Quilcene											
Dosewallips				44					38	17	99
Duckabush		6			6	17		6	16		51
Hamma								17	32	34	83
Lilliwaup				244		17			3	109	373
Union				65	33						98
Tahuya									0		0
Dewatto						2		10			12
Big Beef					10					10	20
Skokomish											0

Program of origin — Age 4

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness											0
JCL											0
Salmon			136							34	170
Snow	5		5								10
Chimacum		4									4
L. Quilcene											0
B. Quilcene											0
Dosewallips				26					1		27
Duckabush				5					12	5	22
Hamma								14	12		26
Lilliwaup				79				3	1	21	104
Union				22							22
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish											0

Program of origin — Age 5

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness										0	0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips				10					22		32
Duckabush											0
Hamma											0
Lilliwaup								3	0	3	6
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish											0

Appendix Table 38. Estimated numbers of supplementation-origin summer chum escaping to streams other than their streams of origin in 2006.

Program of origin — Age 2

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness											0
JCL		3									3
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush											0
Hamma											0
Lilliwaup											0
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish											0

Program of origin — Age 3

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness											0
JCL										9	9
Salmon	12									12	24
Snow										7	7
Chimacum		1				0				7	8
L. Quilcene										12	
B. Quilcene											
Dosewallips									53	10	63
Duckabush									70	17	87
Hamma						5		13			18
Lilliwaup			7	27		10		43		7	94
Union										19	19
Tahuya									10		10
Dewatto					6	25		3		14	48
Big Beef					0						0
Skokomish											0

Program of origin — Age 4

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness											0
JCL		3									3
Salmon	12										12
Snow	4									4	8
Chimacum		8									8
L. Quilcene											0
B. Quilcene											0
Dosewallips				10	10				27	10	57
Duckabush	18			18					48		84
Hamma		6			6	12		21	117	6	168
Lilliwaup				64		4		55	13		136
Union				22						22	44
Tahuya			11								11
Dewatto						3		3			6
Big Beef						11					11
Skokomish											0

Program of origin — Age 5

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness										0	0
JCL			3								3
Salmon			12							12	24
Snow	4										4
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush											0
Hamma											0
Lilliwaup									7		7
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish											0

Appendix Table 39. Estimated numbers of supplementation-origin summer chum escaping to streams other than their streams of origin in 2007.

Program of origin — Age 2

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush				4							4
Hamma					4						4
Lilliwaup				4							4
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish			0					0			0

Program of origin — Age 3

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL		3									3
Salmon											0
Snow	9										9
Chimacum						3			3		6
L. Quilcene				9							
B. Quilcene											
Dosewallips					6						6
Duckabush					10				13		23
Hamma											0
Lilliwaup				19		7		5			31
Union											0
Tahuya											0
Dewatto											0
Big Beef				2	2	2				2	8
Skokomish								0			0

Program of origin — Age 4

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL						3					3
Salmon	14		5			5					24
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush				3	3	3			4		13
Hamma											0
Lilliwaup				5							5
Union				8				8			16
Tahuya											0
Dewatto					4						4
Big Beef											0
Skokomish								0			0

Program of origin — Age 5

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush											0
Hamma											0
Lilliwaup											0
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish								0			0

Appendix Table 40. Estimated numbers of supplementation-origin summer chum escaping to streams other than their streams of origin in 2008.

Program of origin – Age 2

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness											0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush											0
Hamma											0
Lilliwaup											0
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish											0

Program of origin – Age 3

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness											0
JCL										0	0
Salmon											0
Snow	6										6
Chimacum											0
L. Quilcene											
B. Quilcene											
Dosewallips				60							60
Duckabush				94	13						107
Hamma					45						45
Lilliwaup				128			14			2	144
Union					57						57
Tahuya				5							5
Dewatto				2	5						7
Big Beef											0
Skokomish											0

Program of origin – Age 4

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness											0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips				20			20				40
Duckabush				27	13						40
Hamma					3			3		3	9
Lilliwaup				29			6				35
Union					6		23				29
Tahuya											0
Dewatto							4				4
Big Beef											0
Skokomish											0

Program of origin – Age 5

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness										0	0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush											0
Hamma											0
Lilliwaup											0
Union											0
Tahuya											0
Dewatto				2							2
Big Beef											0
Skokomish											0

Appendix Table 41. Estimated numbers of supplementation-origin summer chum escaping to streams other than their streams of origin in 2009.

	Program of origin																																											
	Age 2											Age 3											Age 4											Age 5										
Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0								0			0								0			0								0			0
JCL											0											0											0											0
Salmon											0	20										20											0											0
Snow											0	6										6	3										3											0
Chimacum											0											0											0											0
L. Quilcene											0																						0											0
B. Quilcene											0																						0											0
Dosewallips											0				22							22				12							12											0
Duckabush				8							8				94							94				65							65											0
Hamma											0							3				3							3				3											0
Lilliwaup											0				29			1				30				36			1				37											0
Union											0											0											0											0
Tahuya											0											0											0											0
Dewatto											0											0											0											0
Big Beef											0											0											0											0
Skokomish			0					0			0				14			14	0			28				14			22	0			36								0			0

Appendix Table 42. Estimated numbers of supplementation-origin summer chum escaping to streams other than their streams of origin in 2010.

Program of origin — Age 2

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush											0
Hamma											0
Lilliwaup											0
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish			0					0			0

Program of origin — Age 3

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL											0
Salmon											0
Snow	9										9
Chimacum											0
L. Quilcene											
B. Quilcene											
Dosewallips				19							19
Duckabush				109							109
Hamma											0
Lilliwaup							1				1
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish								0			0

Program of origin — Age 4

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL											0
Salmon											0
Snow	17										17
Chimacum	20										20
L. Quilcene											0
B. Quilcene											0
Dosewallips				75			19				94
Duckabush				##			21				128
Hamma											0
Lilliwaup				16			5				21
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish								0			0

Program of origin — Age 5

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush											0
Hamma											0
Lilliwaup				1							1
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish								0			0

Appendix Table 43. Estimated numbers of supplementation-origin summer chum escaping to streams other than their streams of origin in 2011.

Program of origin — Age 2

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush											0
Hamma											0
Lilliwaup											0
Union							5				5
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish			0					0			0

Program of origin — Age 3

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											
B. Quilcene											
Dosewallips											0
Duckabush											0
Hamma											0
Lilliwaup											0
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish								0			0

Program of origin — Age 4

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL											0
Salmon	11										11
Snow	4										4
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush				23							23
Hamma											0
Lilliwaup				1			3				4
Union							6				6
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish								0			0

Program of origin — Age 5

Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness								0			0
JCL											0
Salmon											0
Snow											0
Chimacum											0
L. Quilcene											0
B. Quilcene											0
Dosewallips											0
Duckabush											0
Hamma											0
Lilliwaup											0
Union											0
Tahuya											0
Dewatto											0
Big Beef											0
Skokomish								0			0

Appendix Table 44. Estimated numbers of supplementation-origin summer chum escaping to streams other than their streams of origin in 2012.

	Program of origin																																											
	Age 2											Age 3											Age 4											Age 5										
Stream of escapement	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total	JCL	Salmon	Chimacum	Hamma	Lilliwaup	Union	Tahuya	Big Beef	Big Quilcene	Marked, origin indefinite	Total
Dungeness											0											0											0										0	0
JCL											0					9						9											0											0
Salmon											0											0											0											0
Snow											0											0	7										7											0
Chimacum											0											0											0											0
L. Quilcene											0																						0											0
B. Quilcene											0																						0											0
Dosewallips					17						17					17						17											0											0
Duckabush											0											0				42						42	84											0
Hamma											0					57		28				85											0							33				33
Lilliwaup											0											0				18							18							17				17
Union											0					67						67											0											0
Tahuya											0					21						21											0											0
Dewatto											0					21						21											0											0
Big Beef											0											0											0											0
Skokomish							9				9					71		172				243				12							12											0

APPENDIX REPORT 1

Summer Chum Salmon Run Reconstruction, 2000-2013 Return Years

2000		Harvest		20		0	0	696	0	35	0	0	0		5	2	13	27	798
		ERs by Area Fisheries		0.0021	0.0000	0.0000		0.0737	0.0000	0.0037	0.0000	0.0000	0.0000	0.0000	0.00048	0.00019	0.00125	0.00259	
															Seattle	Admiralty	US	Canadian	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term			Conv	Area	
Skokomish	Skokomish	N/A		20		20			20	20	20			20	20	20	20	20	
12D	Tahuya	2			2	2			2	2	2			749	749	749	750	752	
	Union	682	62		744	744			744	747	747								
12A	L. Quilcene	268						300	300	301	301			6,619	6,622	6,623	6,632	6,649	
	B. Quilcene	5,126	504				5,630	6,294	6,294	6,318	6,318								
12-12B-12C	Big Beef	0	20						20	20	20			2,012	2,014	2,014	2,016	2,022	
	Anderson	0							0	0	0								
	Dosewallips	1,260							1,260	1,265	1,265								
	Duckabush	464							464	466	466								
	Hamma Hamma	173	56						229	230	230								
	Lilliwaup	2	20			22			22	22	22								
	Dewatto	10				10			10	10	10								
Chimacum	Chimacum	52												52		52	52	52	
Discovery	Snow	30										30		876		876	877	880	
	Salmon	710	136									846							
Sequim	Jimmycomelatel	9	46										55	55		55	55	55	
Totals		**8,788**	844	20	746	798	5,630	6,594	9,365	9,400	9,400	876	55	10,383	9,405	10,390	10,403	**10,430**	
Hood Canal		7,987	662											**9,400**	9,405	9,407	9,419	**9,443**	
E. Strait		801	182											**983**		983	984	**987**	

2000						
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	N/A	20			
12D	Tahuya	2	2	0	0.091	
	Union	744	750	6	0.008	
12A	L. Quilcene	268	302	34	0.113	
	B. Quilcene	5,630	6,347	717	0.113	
12-12B-12C	Big Beef	20	20	0	0.008	
	Anderson	0	0	0	0.000	
	Dosewallips	1,260	1,270	10	0.008	
	Duckabush	464	468	4	0.008	
	Hamma Hamma	229	231	2	0.008	
	Lilliwaup	22	22	0	0.008	
	Dewatto	10	10	0	0.008	
Chimacum	Chimacum	52	52	0	0.004	
Discovery	Snow	30	30	0	0.004	
	Salmon	846	849	3	0.004	
Sequim	Jimmycomelatel	55	55	0	0.004	
						HC Tot. - Skok
Hood Canal		8,649	9,443	774	0.082	**0.082**
SJFuca		983	987	4	0.004	
ESU		9,632	10,430	778	0.075	

2001		Harvest		309	0	88	0	75	13	12	0	0	0		10	17	36	65	625
		ERs by Area Fisheries		0.0244	0.0000	0.0070		0.0059	0.0010	0.0009	0.0000	0.0000	0.0000	0.0000	0.00060	0.00102	0.00217	0.00391	
															Seattle	Admiralty	US	Canadian	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term			Conv	Area	
Skokomish	Skokomish	3		312		326			327	327	327			327	327	327	328	329	
12D	Tahuya	0			0	0			0	0	0			1,562	1,563	1,565	1,568	1,575	
	Union	1,426	65		1,491	1,559			1,561	1,562	1,562								
12A	L. Quilcene	199						201	202	202	202			6,461	6,466	6,473	6,487	6,512	
	B. Quilcene	5,868	306				6,174	6,247	6,253	6,259	6,259								
12-12B-12C	Big Beef	826	68						895	896	896			4,191	4,194	4,199	4,208	4,224	
	Anderson	0							0	0	0								
	Dosewallips	990							991	992	992								
	Duckabush	942							943	944	944								
	Hamma Hamma	1,173	54						1,228	1,229	1,229								
	Lilliwaup	32	60			96			96	96	96								
	Dewatto	32				33			33	34	34								
Chimacum	Chimacum	903												903		904	906	909	
Discovery	Snow	154										154		2,792		2,795	2,801	2,812	
	Salmon	2,484	154									2,638							
Sequim	Jimmycomelately	192	68										260	260		260	261	262	
Totals		**15,224**	775	312	1,491	2,015	6,174	6,448	12,529	12,541	12,541	2,792	260	16,496	12,551	16,523	16,559	**16,624**	
Hood Canal		11,491	553											12,541	12,551	12,564	12,591	**12,641**	
E. Strait		3,733	222		6,174									3,955		3,959	3,968	**3,983**	

2001						
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	3	329	326	0.991	
12D	Tahuya	0	0	0	0.000	
	Union	1,491	1,575	84	0.053	
12A	L. Quilcene	199	203	4	0.021	
	B. Quilcene	6,174	6,309	135	0.021	
12-12B-12C	Big Beef	894	903	9	0.010	
	Anderson	0	0	0	0.000	
	Dosewallips	990	1,000	10	0.010	
	Duckabush	942	951	9	0.010	
	Hamma Hamma	1,227	1,239	12	0.010	
	Lilliwaup	92	97	5	0.053	
	Dewatto	32	34	2	0.053	
Chimacum	Chimacum	903	909	6	0.007	
Discovery	Snow	154	155	1	0.007	
	Salmon	2,638	2,657	19	0.007	
Sequim	Jimmycomelately	260	262	2	0.007	
						HC Tot. - Skok
Hood Canal		12,044	12,641	597	0.047	**0.021**
SJFuca		3,955	3,983	28	0.007	
ESU		15,999	16,624	625	0.038	

2002		Harvest		184		136	0	600	0	0	0	0	0		6	4	30	41	1,001
		ERs by Area Fisheries		0.0148	0.0000	0.0109	0.0483		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00031	0.00021	0.00155	0.00211	
															Seattle	Admiralty	US	Canadian	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term			Conv	Area	
Skokomish	Skokomish	N/A		184		197			197	197	197			197	197	197	197	198	
12D	Tahuya	0			0	0			0	0	0			934	934	934	936	938	
	Union	807	65		872	934			934	934	934								
12A	L. Quilcene	470						533	533	533	533			5,087	5,089	5,091	5,098	5,109	
	B. Quilcene	3,662	355				4,017	4,554	4,554	4,554	4,554								
12-12B-12C	Big Beef	677	65						742	742	742			6,156	6,159	6,161	6,170	6,183	
	Anderson	0							0	0	0								
	Dosewallips	1,627							1,627	1,627	1,627								
	Duckabush	530							530	530	530								
	Hamma Hamma	2,260	68						2,328	2,328	2,328								
	Lilliwaup	775	83			919			919	919	919								
	Dewatto	10				11			11	11	11								
Chimacum	Chimacum	864												864		864	866	867	
Discovery	Snow	532										532		6,049		6,050	6,060	6,072	
	Salmon	5,389	128									5,517							
Sequim	Jimmycomelately	6	36										42	42		42	42	42	
Totals		**17,609**	800	184	872	2,060	4,017	5,087	12,374	12,374	12,374	6,049	42	19,329	12,380	19,339	19,369	**19,410**	
Hood Canal		10,818	636											12,374	12,380	12,383	12,402	**12,428**	
E. Strait		6,791	164											6,955		6,956	6,967	**6,982**	

2002						
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	N/A	198			
12D	Tahuya	0	0	0	0.000	
	Union	872	938	66	0.070	
12A	L. Quilcene	470	535	65	0.122	
	B. Quilcene	4,017	4,574	557	0.122	
12-12B-12C	Big Beef	742	745	3	0.004	
	Anderson	0	0	0	0.000	
	Dosewallips	1,627	1,634	7	0.004	
	Duckabush	530	532	2	0.004	
	Hamma Hamma	2,328	2,338	10	0.004	
	Lilliwaup	858	923	65	0.070	
	Dewatto	10	11	1	0.070	
Chimacum	Chimacum	864	867	3	0.00386	
Discovery	Snow	532	534	2	0.004	
	Salmon	5,517	5,538	21	0.004	
Sequim	Jimmycomelately	42	42	0	0.004	
						HC Tot. - Skok
Hood Canal		11,454	12,428	776	0.062	**0.062**
SJFuca		6,955	6,982	27	0.004	
ESU		18,409	19,410	803	0.041	

2003		Harvest		113	0	0	0	0	0	0	0	0	0	0	14	53	263	33	476
		ERs by Area Fisheries		0.0031	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00032	0.00123	0.00610	0.00077	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term	Seattle	Admiralty	US Conv	Canadian Area	
Skokomish	Skokomish	0		113		113			113	113	113			113	113	113	114	114	
12D	Tahuya	0			0	0			0	0	0			11,916	11,921	11,935	12,009	12,018	
	Union	11,780	136		11,916	11,916			11,916	11,916	11,916								
12A	L. Quilcene	890						890	890	890	890			12,733	12,738	12,754	12,832	12,842	
	B. Quilcene	11,745	98				11,843	11,843	11,843	11,843	11,843								
12-12B-12C	Big Beef	824	72						896	896	896			11,047	11,051	11,065	11,133	11,141	
	Anderson	0							0	0	0								
	Dosewallips	7,066							7,066	7,066	7,066								
	Duckabush	1,869							1,869	1,869	1,869								
	Hamma Hamma	796	58						854	854	854								
	Lilliwaup	194	159			353			353	353	353								
	Dewatto	9				9			9	9	9								
Chimacum	Chimacum	558												558		559	562	563	
Discovery	Snow	304										304		5,955		5,962	5,999	6,004	
	Salmon	5,521	130									5,651							
Sequim	Jimmycomelately	369	77										446	446		447	449	450	
Totals		**41,925**	730	113	11,916	12,391	11,843	12,733	35,809	35,809	35,809	5,955	446	42,768	35,823	42,835	43,098	**43,131**	
Hood Canal		35,173	523											35,809	35,823	35,867	36,088	**36,115**	
E. Strait		6,752	207											6,959		6,968	7,010	**7,016**	

2003						
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	0	114			
12D	Tahuya	0	0	0	0.000	
	Union	11,916	12,018	102	0.008	
12A	L. Quilcene	890	898	8	0.008	
	B. Quilcene	11,843	11,944	101	0.008	
12-12B-12C	Big Beef	896	904	8	0.008	
	Anderson	0	0	0	0.000	
	Dosewallips	7,066	7,126	60	0.008	
	Duckabush	1,869	1,885	16	0.008	
	Hamma Hamma	854	861	7	0.008	
	Lilliwaup	353	356	3	0.008	
	Dewatto	9	9	0	0.008	
Chimacum	Chimacum	558	563	5	0.008	
Discovery	Snow	304	306	2	0.008	
	Salmon	5,651	5,697	46	0.008	
Sequim	Jimmycomelately	446	450	4	0.008	
						HC Tot. - Skok
Hood Canal		35,696	36,115	305	0.008	**0.008**
SJFuca		6,959	7,016	57	0.008	
ESU		42,655	43,131	362	0.008	

2004		Harvest		118		30	0	17,866	0	28	0				6	13	124	76	18,261
		ERs by Area Fisheries		0.0013	0.0000	0.0003		0.2025	0.0000	0.0003	0.0000	0.0000	0.0000	0.0000	0.00006	0.00013	0.00127	0.00078	
															Seattle	Admiralty	US	Canadian	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term			Conv	Area	
Skokomish	Skokomish	24		142		143			143	143	143			143	143	143	143	143	
12D	Tahuya	8			8	8			8	8	8			6,011	6,011	6,012	6,020	6,025	
	Union	5,876	100		5,976	6,001			6,001	6,003	6,003								
12A	L. Quilcene	3,045						4,471	4,471	4,472	4,472			56,037	56,041	56,048	56,119	56,163	
	B. Quilcene	35,000	108				35,108	51,548	51,548	51,565	51,565								
12-12B-12C	Big Beef	1,852	64						1,916	1,917	1,917			25,847	25,848	25,852	25,885	25,905	
	Anderson	1							1	1	1								
	Dosewallips	11,549							11,549	11,553	11,553								
	Duckabush	8,637							8,637	8,640	8,640								
	Hamma Hamma	2,628	63						2,691	2,692	2,692								
	Lilliwaup	922	95			1,021			1,021	1,022	1,022								
	Dewatto	23				23			23	23	23								
Chimacum	Chimacum	1,139												1,139		1,139	1,141	1,141	
Discovery	Snow	396										396		6,417		6,418	6,426	6,431	
	Salmon	6,021	0									6,021							
Sequim	Jimmycomelately	1,601	61										1,662	1,662		1,662	1,664	1,666	
Dungeness	Dungeness	123												123		123	123	123	
Totals		**78,845**	491	142	5,984	7,196	35,108	56,019	88,009	88,037	88,037	12,834	1,662	97,378	88,043	97,397	97,521	**97,597**	
Hood Canal		69,565	430											88,037	88,043	88,055	88,167	**88,236**	
E. Strait		9,280	61											9,341		9,342	9,354	**9,361**	

2004						
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	24	143	119	0.832	
12D	Tahuya	8	8	0	0.007	
	Union	5,976	6,016	40	0.007	
12A	L. Quilcene	3,045	4,482	1,437	0.321	
	B. Quilcene	35,108	51,681	16,573	0.321	
12-12B-12C	Big Beef	1,916	1,921	5	0.003	
	Anderson	1	1	0	0.003	
	Dosewallips	11,549	11,579	30	0.003	
	Duckabush	8,637	8,659	22	0.003	
	Hamma Hamma	2,691	2,698	7	0.003	
	Lilliwaup	1,017	1,024	7	0.007	
	Dewatto	23	23	0	0.007	
Chimacum	Chimacum	1,139	1,141	2	0.002	
Discovery	Snow	396	397	1	0.002	
	Salmon	6,021	6,034	13	0.002	
Sequim	Jimmycomelately	1,662	1,666	4	0.002	
Dungeness	Dungeness	123	123	0	0.002	
				18,261		**HC Tot. - Skok**
Hood Canal		69,995	88,236	18,241	0.207	**0.205**
SJFuca		9,341	9,361	20	0.002	
ESU		79,336	97,597	18,261	0.187	

2005		Harvest		120		0	0	417	0	31	0				12	11	56	62	709
		ERs by Area Fisheries		0.0073	0.0000	0.0000	0.0254		0.0000	0.0019	0.0000	0.0000	0.0000	0.0000	0.00046	0.00042	0.00214	0.00237	
															Seattle	Admiralty	US	Canadian	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term			Conv	Area	
Skokomish	Skokomish	5		125		125			125	125	125			125	125	125	126	126	
12D	Tahuya	4			4	4			4	4	4			1,995	1,996	1,997	2,001	2,006	
	Union	1,885	102		1,987	1,987			1,987	1,991	1,991								
12A	L. Quilcene	866						920	920	922	922			7,102	7,108	7,111	7,126	7,143	
	B. Quilcene	5,702	104				5,806	6,169	6,169	6,181	6,181								
12-12B-12C	Big Beef	1,124	0						1,124	1,126	1,126			7,102	7,108	7,111	7,126	7,143	
	Anderson	0							0	0	0								
	Dosewallips	2,658							2,658	2,663	2,663								
	Duckabush	821							821	823	823								
	Hamma Hamma	1,272	142						1,414	1,417	1,417								
	Lilliwaup	951	98			1,049			1,049	1,051	1,051								
	Dewatto	23				23			23	23	23								
Chimacum	Chimacum	1,396												1,396		1,397	1,400	1,403	
Discovery	Snow	832										832		6,974		6,977	6,992	7,009	
	Salmon	6,142	0									6,142							
Sequim	Jimmycomelately	1,247	63										1,310	1,310		1,311	1,313	1,316	
Dungeness	Dungeness	2												2		2	2	2	
Totals		**24,930**	509	125	1,991	3,188	5,806	7,089	16,294	16,325	16,325	6,974	1,310	26,007	16,337	26,030	26,086	**26,148**	
Hood Canal		15,311	446											16,325	16,337	16,344	16,379	**16,418**	
E. Strait		9,619	63											9,682		9,686	9,707	**9,730**	

2005						
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	5	126	121	0.960	
12D	Tahuya	4	4	0	0.008	
	Union	1,987	2,002	15	0.008	
12A	L. Quilcene	866	927	61	0.066	
	B. Quilcene	5,806	6,216	410	0.066	
12-12B-12C	Big Beef	1,124	1,133	9	0.008	
	Anderson	0	0	0		
	Dosewallips	2,658	2,678	20	0.008	
	Duckabush	821	827	6	0.008	
	Hamma Hamma	1,414	1,425	11	0.008	
	Lilliwaup	1,049	1,057	8	0.008	
	Dewatto	23	23	0	0.008	
Chimacum	Chimacum	1,396	1,403	7	0.005	
Discovery	Snow	832	836	4	0.005	
	Salmon	6,142	6,172	30	0.005	
Sequim	Jimmycomelately	1,310	1,316	6	0.005	
Dungness	Dungness	2	2	0	0.005	
				709		**HC Tot. - Skok**
Hood Canal		15,757	16,418	661	0.040	**0.033**
SJFuca		9,682	9,730	48	0.005	
ESU		25,439	26,148	709	0.027	

2006		Harvest		631		0		2,295	0	233	38				2	4	96	54	3,353
		ERs by Area Fisheries		0.0210	0.0000	0.0000	0.0763		0.0000	0.0077	0.0013	0.0000	0.0000	0.0000	0.00005	0.00010	0.00250	0.00141	
															Seattle	Admiralty	US	Canadian	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term			Conv	Area	
Skokomish	Skokomish	8		639		639			639	644	645			645	645	645	647	647	
12D	Tahuya	749			749	749			749	755	756			3,618	3,618	3,618	3,627	3,633	
	Union	2,736	100		2,836	2,836			2,836	2,858	2,862								
12A	L. Quilcene	2,372						2,830	2,830	2,853	2,856			14,300	14,301	14,303	14,339	14,359	
	B. Quilcene	9,504	0				9,504	11,341	11,341	11,430	11,444								
12-12B-12C	Big Beef	823	0						823	829	831			11,387	11,388	11,389	11,418	11,434	
	Anderson	0							0	0	0								
	Dosewallips	2,577							2,577	2,597	2,601								
	Duckabush	3,135							3,135	3,160	3,164								
	Hamma Hamma	2,922	143						3,065	3,089	3,093								
	Lilliwaup	1,523	92			1,615			1,615	1,628	1,630								
	Dewatto	69				69			69	70	70								
Chimacum	Chimacum	2,026												2,026		2,026	2,031	2,034	
Discovery	Snow	598										598		5,492		5,493	5,506	5,514	
	Salmon	4,894	0									4,894							
Sequim	Jimmycomelately	660	65										725	725		725	727	728	
Dungeness	Dungeness	3												3		3	3	3	
Totals		**34,599**	400	639	3,585	5,908	9,504	14,171	29,679	29,912	29,950	5,492	725	38,196	29,952	38,202	38,298	**38,352**	
Hood Canal		26,418	335											29,950	29,952	29,955	30,030	**30,073**	
E. Strait		8,181	65											8,246		8,247	8,268	**8,279**	

2006						
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	8	647	639	0.988	
12D	Tahuya	749	759	10	0.013	
	Union	2,836	2,874	38	0.013	
12A	L. Quilcene	2,372	2,868	496	0.173	
	B. Quilcene	9,504	11,491	1,987	0.173	
12-12B-12C	Big Beef	823	834	11	0.013	
	Anderson	0	0	0		
	Dosewallips	2,577	2,611	34	0.013	
	Duckabush	3,135	3,177	42	0.013	
	Hamma Hamma	3,065	3,106	41	0.013	
	Lilliwaup	1,615	1,636	21	0.013	
	Dewatto	69	70	1	0.013	
Chimacum	Chimacum	2,026	2,034	8	0.004	
Discovery	Snow	598	600	2	0.004	
	Salmon	4,894	4,914	20	0.004	
Sequim	Jimmycomelately	725	728	3	0.004	
Dungness	Dungness	3	3	0	0.004	
				3,353		**HC Tot. - Skok**
Hood Canal		26,753	30,073	3,320	0.110	**0.089**
SJFuca		8,246	8,279	33	0.004	
ESU		34,999	38,352	3,353	0.087	

2007		Harvest		287	0	0	0	1,130	310	11	191	0	0		15	14	49	79	2,086
		ERs by Area Fisheries		0.0224	0.0000	0.0000	0.0880		0.0241	0.0009	0.0149	0.0000	0.0000	0.0000	0.00093	0.00087	0.00303	0.00489	
															Seattle	Admiralty	US	Canadian	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term			Conv	Area	
Skokomish	Skokomish	22		309		309			317	317	322			322	322	323	324	325	
12D	Tahuya	623			623	623			639	639	649			2,699	2,702	2,704	2,713	2,726	
	Union	1,867	100		1,967	1,967			2,017	2,019	2,050								
12A	L. Quilcene	1,065						1,541	1,581	1,582	1,606			3,809	3,814	3,817	3,829	3,848	
	B. Quilcene	1,461	0				1,461	2,115	2,168	2,170	2,203								
12-12B-12C	Big Beef	846	0						868	868	882			5,880	5,887	5,892	5,910	5,939	
	Anderson	0							0	0	0								
	Dosewallips	1,468							1,505	1,507	1,530								
	Duckabush	1,294							1,327	1,328	1,348								
	Hamma Hamma	1,387	102						1,527	1,528	1,551								
	Lilliwaup	485	40			525			538	539	547								
	Dewatto	21				21			22	22	22								
Chimacum	Chimacum	926												926		927	930	934	
Discovery	Snow	439										439		1,713		1,714	1,720	1,728	
	Salmon	1,274	0									1,274							
Sequim	Jimmycomelatel	578	76										654	654		655	657	660	
Dungeness	Dungeness	2												2		2	2	2	
Totals		**13,758**	318	309	2,590	3,445	1,461	3,656	12,508	12,519	12,710	1,713	654	16,005	12,725	16,034	16,083	**16,162**	
Hood Canal		10,539	242											12,710	12,725	12,736	12,775	**12,838**	
E. Strait		3,219	76											3,295		3,298	3,308	**3,324**	

2007						
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	22	325	303	0.932	
12D	Tahuya	623	656	33	0.050	
	Union	1,967	2,070	103	0.050	
12A	L. Quilcene	1,065	1,622	557	0.344	
	B. Quilcene	1,461	2,225	764	0.344	
12-12B-12C	Big Beef	846	890	44	0.050	
	Anderson	0	0	0		
	Dosewallips	1,468	1,545	77	0.050	
	Duckabush	1,294	1,362	68	0.050	
	Hamma Hamma	1,489	1,567	78	0.050	
	Lilliwaup	525	553	28	0.050	
	Dewatto	21	22	1	0.050	
Chimacum	Chimacum	926	934	8	0.009	
Discovery	Snow	439	443	4	0.009	
	Salmon	1,274	1,285	11	0.009	
Sequim	Jimmycomelatel	654	660	6	0.009	
Dungness	Dungness	2	2	0	0.009	
				2,086		**HC Tot.**
						- Skok
Hood Canal		10,781	12,838	2,057	0.160	**0.137**
SJFuca		3,295	3,324	29	0.009	
ESU		14,076	16,162	2,086	0.129	

2008		Harvest		1,269	0	0	0	1,918	0	1	18	0	0		5	3	166	136	3,516
		ERs by Area Fisheries		0.0672	0.0000	0.0000		0.1016	0.0000	0.0001	0.0010	0.0000	0.0000	0.0000	0.00022	0.00013	0.00740	0.00606	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term	Seattle	Admiralty	US Conv	Canadian Area	
Skokomish	Skokomish	23		1,292		1,292			1,292	1,292	1,293			1,293	1,294	1,294	1,304	1,311	
12D	Tahuya	700			700	700			700	700	701			1,832	1,832	1,833	1,846	1,858	
	Union	1,030	100		1,130	1,130			1,130	1,130	1,131								
12A	L. Quilcene	2,186						3,272	3,272	3,272	3,275			5,785	5,786	5,787	5,831	5,866	
	B. Quilcene	1,675	0				1,675	2,507	2,507	2,507	2,510								
12-12B-12C	Big Beef	733	0						733	733	734			9,699	9,702	9,703	9,776	9,835	
	Anderson	0							0	0	0								
	Dosewallips	3,930							3,930	3,930	3,934								
	Duckabush	2,668							2,668	2,668	2,671								
	Hamma Hamma	1,503	139						1,642	1,642	1,644								
	Lilliwaup	638	52			690			690	690	691								
	Dewatto	26				26			26	26	26								
Chimacum	Chimacum	727												727		727	733	737	
Discovery	Snow	172										172		1,740		1,740	1,753	1,764	
	Salmon	1,568	0									1,568							
Sequim	Jimmycomelately	982	76										1,058	1,058		1,058	1,066	1,073	
Dungeness	Dungeness	0												0		0	0	0	
Totals		**18,561**	367	1,292	1,830	3,838	1,675	5,779	18,590	18,591	18,609	1,740	1,058	22,134	18,614	22,142	22,308	**22,444**	
Hood Canal		15,112	291											18,609	18,614	18,617	18,756	**18,870**	
E. Strait		3,449	76											3,525		3,525	3,552	**3,574**	

2008						
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	23	1,311	1,288	0.982	
12D	Tahuya	700	711	11	0.015	
	Union	1,130	1,147	17	0.015	
12A	L. Quilcene	2,186	3,321	1,135	0.342	
	B. Quilcene	1,675	2,545	870	0.342	
12-12B-12C	Big Beef	733	744	11	0.015	
	Anderson	0	0	0		
	Dosewallips	3,930	3,989	59	0.015	
	Duckabush	2,668	2,708	40	0.015	
	Hamma Hamma	1,642	1,667	25	0.015	
	Lilliwaup	690	700	10	0.015	
	Dewatto	26	26	0	0.015	
Chimacum	Chimacum	727	737	10	0.014	
Discovery	Snow	172	174	2	0.014	
	Salmon	1,568	1,590	22	0.014	
Sequim	Jimmycomelately	1,058	1,073	15	0.014	
Dungness	Dungness	0	0	0		
				3,516		**HC Tot. - Skok**
Hood Canal		15,403	18,870	3,467	0.184	**0.115**
SJFuca		3,525	3,574	49	0.014	
ESU		18,928	22,444	3,516	0.157	

2009		Harvest		709		0		986	11	9	0				4	3	20	67	1,809
		ERs by Area Fisheries		0.0771	0.0000	0.0000		0.1072	0.0012	0.0010	0.0000	0.0000	0.0000	0.0000	0.00028	0.00021	0.00139	0.00467	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term	Seattle	Admiralty	US Conv	Canadian Area	
Skokomish	Skokomish	33		742		742			743	744	744			744	744	744	745	749	
12D	Tahuya	380			380	380			380	381	381			993	994	994	995	1,000	
	Union	548	63		611	611			612	612	612								
12A	L. Quilcene	425						706	707	708	708			2,481	2,483	2,483	2,487	2,498	
	B. Quilcene	1,065	0				1,065	1,770	1,772	1,774	1,774								
12-12B-12C	Big Beef	152	0						152	152	152			4,920	4,922	4,923	4,930	4,953	
	Anderson	1							1	1	1								
	Dosewallips	1,128							1,129	1,130	1,130								
	Duckabush	2,661							2,664	2,667	2,667								
	Hamma Hamma	670	0						671	671	671								
	Lilliwaup	123	124			247			247	248	248								
	Dewatto	50				50			50	50	50								
Chimacum	Chimacum	1,020												1,020		1,020	1,022	1,026	
Discovery	Snow	229										229		1,466		1,466	1,468	1,475	
	Salmon	1,237	0									1,237							
Sequim	Jimmycomelatel	2,542	86										2,628	2,628		2,629	2,632	2,645	
Dungeness	Dungeness	1												1		1	1	1	
Totals		**12,265**	273	742	991	2,030	1,065	2,476	9,129	9,138	9,138	1,466	2,628	14,253	9,142	14,260	14,280	**14,347**	
Hood Canal		7,236	187											9,138	9,142	9,144	9,157	**9,200**	
E. Strait		5,029	86											5,115		5,116	5,123	**5,147**	

2009 Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	33	749	716	0.956	
12D	Tahuya	380	383	3	0.009	
	Union	611	616	5	0.009	
12A	L. Quilcene	425	713	288	0.404	
	B. Quilcene	1,065	1,786	721	0.404	
12-12B-12C	Big Beef	152	153	1	0.009	
	Anderson	1	1	0		
	Dosewallips	1,128	1,138	10	0.009	
	Duckabush	2,661	2,685	24	0.009	
	Hamma Hamma	670	676	6	0.009	
	Lilliwaup	247	249	2	0.009	
	Dewatto	50	50	0	0.009	
Chimacum	Chimacum	1,020	1,026	6	0.006	
Discovery	Snow	229	230	1	0.006	
	Salmon	1,237	1,245	8	0.006	
Sequim	Jimmycomelatel	2,628	2,645	17	0.006	
Dungness	Dungness	1	1	0	0.006	
				1,809		**HC Tot. - Skok**
Hood Canal		7,423	9,200	1,777	0.193	**0.115**
SJFuca		5,115	5,147	32	0.006	
ESU		12,538	14,347	1,809	0.126	

2010		Harvest		443	0	0	0	4	0	22	77				8	0	127	43	724
		ERs by Area Fisheries		0.0331	0.0000	0.0000		0.0003	0.0000	0.0016	0.0057	0.0000	0.0000	0.0000	0.00035	0.00000	0.00559	0.00189	
															Seattle	Admiralty	US	Canadian	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term			Conv	Area	
Skokomish	Skokomish	61		504		504			504	505	508			508	508	508	511	512	
12D	Tahuya	1,153			1,153	1,153			1,153	1,155	1,162			2,132	2,133	2,133	2,145	2,149	
	Union	897	66		963	963			963	965	970								
12A	L. Quilcene	497						498	498	499	502			2,093	2,094	2,094	2,106	2,110	
	B. Quilcene	1,576	0				1,576	1,579	1,579	1,582	1,591								
12-12B-12C	Big Beef	143	0						143	143	144			8,556	8,561	8,561	8,609	8,625	
	Anderson	0							0	0	0								
	Dosewallips	2,521							2,521	2,525	2,540								
	Duckabush	4,110							4,110	4,117	4,141								
	Hamma Hamma	1,471	0						1,471	1,473	1,482								
	Lilliwaup	95	143			238			238	238	240								
	Dewatto	9				9			9	9	9								
Chimacum	Chimacum	1,968												1,968		1,968	1,979	1,983	
Discovery	Snow	524										524		3,264		3,264	3,282	3,289	
	Salmon	2,740	0									2,740							
Sequim	Jimmycomelately	3,945	82										4,027	4,027		4,027	4,050	4,057	
Dungeness	Dungeness	2												2		2	2	2	
Totals		**21,712**	291	504	2,116	2,867	1,576	2,077	13,189	13,211	13,288	3,264	4,027	22,549	13,296	22,557	22,684	**22,727**	
Hood Canal		12,533	209											13,288	13,296	13,296	13,371	**13,396**	
E. Strait		9,179	82											9,261		9,261	9,313	**9,331**	

2010						
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	61	512	451	0.881	
12D	Tahuya	1,153	1,171	18	0.015	
	Union	963	978	15	0.015	
12A	L. Quilcene	497	506	9	0.017	
	B. Quilcene	1,576	1,604	28	0.017	
12-12B-12C	Big Beef	143	145	2	0.015	
	Anderson	0	0	0		
	Dosewallips	2,521	2,561	40	0.015	
	Duckabush	4,110	4,175	65	0.015	
	Hamma Hamma	1,471	1,494	23	0.015	
	Lilliwaup	238	242	4	0.015	
	Dewatto	9	9	0	0.015	
Chimacum	Chimacum	1,968	1,983	15	0.007	
Discovery	Snow	524	528	4	0.007	
	Salmon	2,740	2,761	21	0.007	
Sequim	Jimmycomelately	4,027	4,057	30	0.007	
Dungness	Dungness	2	2	0	0.007	
				724		**HC Tot. - Skok**
Hood Canal		12,742	13,396	654	0.049	**0.015**
SJFuca		9,261	9,331	70	0.007	
ESU		22,003	22,727	724	0.032	

2011		Harvest		379	0	0	7	127	0	19	15	0			1	0	28	39	615
		ERs by Area Fisheries		0.0501	0.0000	0.0000	0.0177		0.0000	0.0025	0.0020	0.0000	0.0000	0.0000	0.00008	0.00000	0.00211	0.00294	
															Seattle	Admiralty	US	Canadian	
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term			Conv	Area	
Skokomish	Skokomish	107		486		486			486	487	488			488	488	488	489	491	
12D	Tahuya	325			325	325			325	326	326			624	624	624	625	627	
	Union	276	20		296	296			296	297	297								
12A	L. Quilcene	420						441	441	442	443			2,726	2,727	2,727	2,732	2,741	
	B. Quilcene	2,160	0				2,167	2,273	2,273	2,279	2,284								
12-12B-12C	Big Beef	73	0						73	73	73			3,681	3,681	3,681	3,689	3,700	
	Anderson	0							0	0	0								
	Dosewallips	1,130							1,130	1,133	1,135								
	Duckabush	1,538							1,538	1,542	1,545								
	Hamma Hamma	773	0						773	775	777								
	Lilliwaup	75	38			113			113	113	114								
	Dewatto	37				37			37	37	37								
Chimacum	Chimacum	640												640		640	641	643	
Discovery	Snow	342										342		2,621		2,621	2,627	2,634	
	Salmon	2,279	0									2,279							
Sequim	Jimmycomelatel	2,411	0										2,411	2,411		2,411	2,416	2,423	
Dungeness	Dungeness	3												3		3	3	3	
Totals		**12,589**	58	486	621	1,257	2,167	2,714	7,485	7,504	7,519	2,621	2,411	13,194	7,520	13,195	13,223	**13,262**	
Hood Canal		6,914	58											7,519	7,520	7,520	7,536	**7,558**	
E. Strait		5,675	0											5,675		5,675	5,687	**5,704**	

2011						
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	107	491	384	0.782	
12D	Tahuya	325	328	3	0.010	
	Union	296	299	3	0.010	
12A	L. Quilcene	420	445	25	0.056	
	B. Quilcene	2,160	2,296	136	0.059	
12-12B-12C	Big Beef	73	74	1	0.010	
	Anderson	0	0	0		
	Dosewallips	1,130	1,141	11	0.010	
	Duckabush	1,538	1,553	15	0.010	
	Hamma Hamma	773	781	8	0.010	
	Lilliwaup	113	114	1	0.010	
	Dewatto	37	37	0	0.010	
Chimacum	Chimacum	640	643	3	0.005	
Discovery	Snow	342	344	2	0.005	
	Salmon	2,279	2,291	12	0.005	
Sequim	Jimmycomelatel	2,411	2,423	12	0.005	
Dungness	Dungness	3	3	0	0.005	
				615		**HC Tot. - Skok**
Hood Canal		6,972	7,558	586	0.078	**0.027**
SJFuca		5,675	5,704	29	0.005	
ESU		12,647	13,262	615	0.046	

Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term	Seattle	Admiralty	US Conv	Canadian Area	
2012		Harvest		964	0	0	0	611	0	67	151	0	0		2	0	98	100	1,993
		ERs by Area Fisheries		0.0301	0.0000	0.0000	0.0191		0.0000	0.0021	0.0047	0.0000	0.0000	0.0000	0.00005	0.00000	0.00256	0.00261	
						8,666			31,632	31,632	31,699				31,850	38,156	38,156	38,254	
Skokomish	Skokomish	524		1,488		1,488			1,488	1,491	1,498			1,498	1,498	1,498	1,502	1,506	
12D	Tahuya	1,405			1,405	1,405			1,405	1,408	1,415			3,676	3,676	3,676	3,686	3,695	
	Union	2,180	66		2,246	2,246			2,246	2,251	2,261								
								11,739											
12A	L. Quilcene	1,272						1,338	1,338	1,341	1,347			12,435	12,436	12,436	12,468	12,500	
	B. Quilcene	10,467	0				10,467	11,012	11,012	11,035	11,088								
12-12B-12C	Big Beef	156	0						156	156	157			14,240	14,241	14,241	14,278	14,315	
	Anderson	2							2	2	2								
	Dosewallips	2,862							2,862	2,868	2,882								
	Duckabush	5,241							5,241	5,252	5,277								
	Hamma Hamma	2,355	0						2,355	2,360	2,371								
	Lilliwaup	3,204	136			3,340			3,340	3,347	3,363								
	Dewatto	187				187			187	187	188								
Chimacum	Chimacum	894												894		894	896	899	
												2,814							
Discovery	Snow	496										496		2,814		2,814	2,821	2,829	
	Salmon	2,318	0									2,318							
Sequim	Jimmycomelatel	2,590	0										2,590	2,590		2,590	2,597	2,603	
Dungeness	Dungeness	6												6		6	6	6	
														Term RS				**4B RS**	
Totals		**36,159**	202	1,488	3,651	8,666	10,467	12,350	31,632	31,699	31,850	2,814	2,590	**38,154**	31,852	38,156	38,254	**38,354**	
Hood Canal		29,855	202											**31,850**	31,852	31,852	31,934	**32,017**	
E. Strait		6,304	0											**6,304**		6,304	6,320	**6,337**	

2012 Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	MU Harvest Rate	
Skokomish	Skokomish	524	1,506	982	0.652	
12D	Tahuya	1,405	1,422	17	0.012	
	Union	2,246	2,273	27	0.012	
12A	L. Quilcene	1,272	1,355	83	0.061	
	B. Quilcene	10,467	11,146	679	0.061	
12-12B-12C	Big Beef	156	158	2	0.012	
	Anderson	2	2	0	0.012	
	Dosewallips	2,862	2,897	35	0.012	
	Duckabush	5,241	5,305	64	0.012	
	Hamma Hamma	2,355	2,384	29	0.012	
	Lilliwaup	3,340	3,381	41	0.012	
	Dewatto	187	189	2	0.012	
Chimacum	Chimacum	894	899	5	0.005	
Discovery	Snow	496	499	3	0.005	
	Salmon	2,318	2,330	12	0.005	
Sequim	Jimmycomelatel	2,590	2,603	13	0.005	
Dungness	Dungness	6	6	0	0.005	
				1,993		**HC Tot. - Skok**
Hood Canal		30,057	32,017	1,960	0.061	**0.031**
SJFuca		6,304	6,337	33	0.00516	
ESU		36,361	38,354	1,993	0.052	

2013		Harvest		576	0	91	0	595	0	38	341	0	0		0	0	146	49
		ERs by Area Fisheries		0.0234	0.0000	0.0037	0.0242		0.0000	0.0015	0.0139	0.0000	0.0000	0.0000	0.00000	0.00000	0.00371	0.00124
															Seattle	Admiralty	US	Canadian
Mgmt Unit	Prod. Unit	Escapement	Broodstock	82G/J	12D	12C	82F	12A	12B	12	9A	Discov	Sequim	Term			Conv	Area
						7,202			24,069	24,069	24,107				24,448	39,175	39,175	39,321
Skokomish	Skokomish	977		1,553		1,573			1,573	1,575	1,597			1,597	1,597	1,597	1,603	1,605
12D	Tahuya	862			862	873			873	874	887			2,891	2,891	2,891	2,902	2,906
	Union	1,892	57		1,949	1,974			1,974	1,977	2,005							
								7,950										
12A	L. Quilcene	832						894	894	896	908			8,680	8,680	8,680	8,712	8,723
	B. Quilcene	7,118	0				7,118	7,651	7,651	7,663	7,771							
12-12B-12C	Big Beef	101	0						101	101	103			11,280	11,280	11,280	11,322	11,336
	Anderson	0							0	0	0							
	Dosewallips	1,815							1,815	1,818	1,844							
	Duckabush	4,129							4,129	4,136	4,194							
	Hamma Hamma	2,186	0						2,186	2,189	2,220							
	Lilliwaup	2,520	132			2,686			2,686	2,690	2,728							
	Dewatto	186				188			188	189	191							
Chimacum	Chimacum	3,066												3,066		3,066	3,077	3,081
												3,320						
Discovery	Snow	574										574		3,320		3,320	3,332	3,337
	Salmon	2,746	0									2,746						
Sequim	Jimmycomelately	8,341	0										8,341	8,341		8,341	8,372	8,383
Dungeness	Dungeness	0												0		0	0	0
														Term RS				**4B RS**
Totals		**37,345**	189	1,553	2,811	7,293	7,118	8,545	24,069	24,107	24,448	3,320	8,341	**39,175**	24,448	39,175	39,321	**39,370**
Hood Canal		22,618	189											**24,448**	24,448	24,448	24,539	**24,570**
E. Strait		14,727	0											**14,727**		14,727	14,782	**14,800**

2013					MU	
Mgmt Unit	Prod. Unit	Escapement	Runsize	Harvest	Harvest Rate	
Skokomish	Skokomish	977	1,605	628	0.391	
12D	Tahuya	862	891	29	0.033	
	Union	1,949	2,015	66	0.033	
12A	L. Quilcene	832	913	81	0.089	
	B. Quilcene	7,118	7,810	692	0.089	
12-12B-12C	Big Beef	101	103	2	0.020	
	Anderson	0	0	0	0.000	
	Dosewallips	1,815	1,853	38	0.020	
	Duckabush	4,129	4,215	86	0.020	
	Hamma Hamma	2,186	2,231	45	0.020	
	Lilliwaup	2,652	2,741	89	0.033	
	Dewatto	186	192	6	0.033	
Chimacum	Chimacum	3,066	3,081	15	0.005	
Discovery	Snow	574	577	3	0.005	
	Salmon	2,746	2,760	14	0.005	
Sequim	Jimmycomelately	8,341	8,383	42	0.005	
Dungeness	Dungeness	0	0	0	0.000	
				1,836		**HC Tot. - Skok**
Hood Canal		22,807	24,570	1,763	0.072	**0.046**
SJFuca		14,727	14,800	73	0.00495	
ESU		37,534	39,370	1,836	0.047	

APPENDIX REPORT 2

Summer Chum Harvest Management Performance Assessments for Individual Management Units, 2005-2013 Return Years

Table AR2- 1. Pre-season forecasted versus actual abundances, escapements, and exploitation rates for summer chum salmon from the Sequim Bay Management Unit, 2005 through 2013.

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Sequim Bay Management Unit									
Preseason Abundance Forecast	605	868	1,040	1,090	943	1,460	2,102	2,540	2,922
Post Season Estimate of Abundance	1,316	728	660	1,073	2,645	4,057	2,423	2,603	8,383
Forecast Error (Percent over / under observed)	-54.0%	19.2%	57.6%	1.6%	-64.3%	-64.0%	-13.3%	-2.4%	-65.1%
Preseason Escapement Rate Target	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%
Post Season Escapement Rate	99.5%	99.6%	99.1%	98.6%	99.4%	99.3%	99.5%	99.5%	99.5%
Preseason Expected Escapement	552	792	948	994	860	1,332	1,917	2,316	2,665
Post Season Escapement Estimate	1,310	725	654	1,058	2,628	4,027	2,411	2,590	8,341
Expected Preterminal & Terminal Exploitation	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Expected Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Estimated Preterminal and Terminal Exploitation	0.5%	0.4%	0.9%	1.4%	0.6%	0.7%	0.5%	0.5%	0.5%
Estimated Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Exploitation	0.5%	0.4%	0.9%	1.4%	0.6%	0.7%	0.5%	0.5%	0.5%

Table AR2- 2. Pre-season forecasted versus actual abundances, escapements, and exploitation rates for summer chum salmon from the Discovery Bay Management Unit, 2005 through 2013.

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Discovery Bay Management Unit									
Preseason Abundance Forecast	5,329	6,377	6,240	3,912	3,252	1,642	2,047	2,282	2,547
Post Season Estimate of Abundance	7,009	5,514	1,728	1,764	1,475	3,289	2,634	2,829	3,337
Forecast Error (Percent over / under observed)	-24.0%	15.6%	261.1%	121.8%	120.4%	-50.1%	-22.3%	-19.3%	-23.7%
Preseason Escapement Rate Target	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%
Post Season Escapement Rate	99.5%	99.6%	99.1%	98.6%	99.4%	99.3%	99.5%	99.5%	99.5%
Preseason Expected Escapement	4,860	5,816	5,691	3,568	2,966	1,498	1,867	2,081	2,323
Post Season Escapement Estimate	6,974	5,492	1,713	1,740	1,466	3,264	2,621	2,814	3,320
Expected Preterminal & Terminal Exploitation	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Expected Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Estimated Preterminal and Terminal Exploitation	0.5%	0.4%	0.9%	1.4%	0.6%	0.7%	0.5%	0.5%	0.5%
Estimated Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Exploitation	0.5%	0.4%	0.9%	1.4%	0.6%	0.7%	0.5%	0.5%	0.5%

Table AR2- 3. Pre-season forecasted versus actual abundances, escapements, and exploitation rates for summer chum salmon from the Port Townsend (Chimacum) Management Unit, 2005 through 2013.

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Port Townsend (Chimacum) Management Unit									
Preseason Abundance Forecast	870	993	1,286	967	1,003	889	1,159	1,093	1,134
Post Season Estimate of Abundance	1,403	2,034	934	737	1,026	1,983	643	899	3,081
Forecast Error (Percent over / under observed)	-38.0%	-51.2%	37.7%	31.2%	-2.3%	-55.2%	80.2%	21.6%	-63.2%
Preseason Escapement Rate Target	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%	91.2%
Post Season Escapement Rate	99.5%	99.6%	99.1%	98.6%	99.4%	99.3%	99.5%	99.5%	99.5%
Preseason Expected Escapement	793	906	1,173	882	915	811	1,057	997	1,034
Post Season Escapement Estimate	1,396	2,026	926	727	1,020	1,968	640	894	3,066
Expected Preterminal & Terminal Exploitation	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Expected Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Estimated Preterminal and Terminal Exploitation	0.5%	0.4%	0.9%	1.4%	0.6%	0.7%	0.5%	0.5%	0.5%
Estimated Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Exploitation	0.5%	0.4%	0.9%	1.4%	0.6%	0.7%	0.5%	0.5%	0.5%

Table AR2- 4. Pre-season forecasted versus actual abundances, escapements, and exploitation rates for summer chum salmon from the Quilcene/Dabob Bays Management Unit, 2005 through 2013.

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Quilcene/Dabob Bays Management Unit									
Preseason Abundance Forecast	8,355	8,415	10,129	8,496	7,228	1,343	2,250	2,445	6,938
Post Season Estimate of Abundance	7,143	14,359	3,848	5,866	2,498	2,110	2,741	12,500	8,723
Forecast Error (Percent over / under observed)	17.0%	-41.4%	163.2%	44.8%	189.3%	-36.3%	-17.9%	-80.4%	-20.5%
Preseason Escapement Rate Target	84.1%	84.1%	84.1%	84.1%	84.1%	84.1%	84.1%	84.1%	84.1%
Post Season Escapement Rate	93.4%	82.7%	65.6%	65.8%	59.6%	98.3%	94.1%	93.9%	91.1%
Preseason Expected Escapement	7,027	7,077	8,518	7,145	6,079	1,129	1,892	2,056	5,835
Post Season Escapement Estimate	6,672	11,876	2,526	3,861	1,490	2,073	2,580	11,739	7,950
Expected Preterminal & Terminal Exploitation	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%
Expected Additional Extreme Terminal Exploitation	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Estimated Preterminal and Terminal Exploitation	0.8%	1.3%	5.0%	1.5%	0.9%	1.5%	1.0%	1.2%	2.4%
Estimated Additional Extreme Terminal Exploitation	5.8%	16.0%	29.4%	32.7%	39.5%	0.2%	4.9%	4.9%	6.5%
Total Exploitation	6.6%	17.3%	34.4%	34.2%	40.4%	1.7%	5.9%	6.1%	8.9%

Table AR2- 5. Pre-season forecasted versus actual abundances, escapements, and exploitation rates for summer chum salmon from the Mainstem Hood Canal Management Unit, 2005 through 2013.

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Mainstem Hood Canal Management Unit									
Preseason Abundance Forecast	5,911	7,208	8,969	8,911	8,593	4,005	5,730	5,682	10,026
Post Season Estimate of Abundance	7,143	11,434	5,939	9,835	4,953	8,625	3,700	14,315	11,336
Forecast Error (Percent over / under observed)	-17.2%	-37.0%	51.0%	-9.4%	73.5%	-53.6%	54.9%	-60.3%	-11.6%
Preseason Escapement Rate Target	89.1%	89.1%	89.1%	89.1%	89.1%	89.1%	89.1%	89.1%	89.1%
Post Season Escapement Rate	99.2%	98.7%	95.0%	98.5%	99.1%	98.5%	99.0%	98.8%	97.6%
Preseason Expected Escapement	5,267	6,422	7,991	7,940	7,656	3,568	5,105	5,063	8,933
Post Season Escapement Estimate	7,083	11,284	5,643	9,689	4,909	8,492	3,664	14,143	11,069
Expected Preterminal & Terminal Exploitation	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%
Expected Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Estimated Preterminal and Terminal Exploitation	0.8%	1.3%	5.0%	1.5%	0.9%	1.5%	1.0%	1.2%	2.4%
Estimated Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Exploitation	0.8%	1.3%	5.0%	1.5%	0.9%	1.5%	1.0%	1.2%	2.4%

Table AR2- 6. Pre-season forecasted versus actual abundances, escapements, and exploitation rates for summer chum salmon from the Southeast Hood Canal Management Unit, 2005 through 2013.

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Southeast Hood Canal Management Unit									
Preseason Abundance Forecast	3,795	4,157	4,632	2,752	2,188	651	1,070	843	2,834
Post Season Estimate of Abundance	2,006	3,633	2,726	1,858	1,000	2,149	627	3,695	2,906
Forecast Error (Percent over / under observed)	89.2%	14.4%	69.9%	48.1%	118.8%	-69.7%	70.6%	-77.2%	-2.5%
Preseason Escapement Rate Target	89.1%	89.1%	89.1%	89.1%	89.1%	89.1%	89.1%	89.1%	89.1%
Post Season Escapement Rate	99.2%	98.7%	95.0%	98.5%	99.1%	98.5%	99.0%	98.8%	96.7%
Preseason Expected Escapement	3,381	3,704	4,127	2,452	1,950	580	953	751	2,525
Post Season Escapement Estimate	1,991	3,585	2,590	1,830	991	2,116	621	3,651	2,811
Expected Preterminal & Terminal Exploitation	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%	10.9%
Expected Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Estimated Preterminal and Terminal Exploitation	0.8%	1.3%	5.0%	1.5%	0.9%	1.5%	1.0%	1.2%	3.3%
Estimated Additional Extreme Terminal Exploitation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Exploitation	0.8%	1.3%	5.0%	1.5%	0.9%	1.5%	1.0%	1.2%	3.3%

Table AR2- 7. Escapement and escapement proportions for the summer chum salmon stocks in the Hood Canal Mainstem Management Unit (MU) with the MU status and the escapement distribution flag status relative to critical thresholds established in the Base Conservation Regime of the Summer Chum Salmon Conservation Initiative (SCSCI).

	Escapement					Escapement Proportions				MU Status and Escapement Distribution Flag Status				
										MU Status		Hamma		
		Hamma					Hamma			Threshold	Lilliwaup	Hamma	Duckabush	Dosewallips
Year	Lilliwaup	Hamma	Duckabush	Dosewallips	MU Total	Lilliwaup	Hamma	Duckabush	Dosewallips	2,660	0.043	0.193	0.180	0.147
1999	13	255	92	351	711	0.018	0.359	0.129	0.494	Critical	Check	Ok	Check	Ok
2000	22	229	464	1,260	1,975	0.011	0.116	0.235	0.638	Critical	Check	Check	Ok	Ok
2001	92	1,227	942	990	3,251	0.028	0.377	0.290	0.305	Above Crit.	Check	Ok	Ok	Ok
2002	858	2,328	530	1,627	5,343	0.161	0.436	0.099	0.305	Above Crit.	Ok	Ok	Check	Ok
2003	353	854	1,869	7,066	10,142	0.035	0.084	0.184	0.697	Above Crit.	Check	Check	Ok	Ok
2004	1,017	2,691	8,637	11,549	23,894	0.043	0.113	0.361	0.483	Above Crit.	Check	Check	Ok	Ok
2005	1,049	1,408	821	2,658	5,936	0.177	0.237	0.138	0.448	Above Crit.	Ok	Ok	Check	Ok
2006	1,615	3,065	3,135	2,577	10,392	0.155	0.295	0.302	0.248	Above Crit.	Ok	Ok	Ok	Ok
2007	525	1,489	1,294	1,468	4,776	0.110	0.312	0.271	0.307	Above Crit.	Ok	Ok	Ok	Ok
2008	690	1,642	2,668	3,930	8,930	0.077	0.184	0.299	0.440	Above Crit.	Ok	Check	Ok	Ok
2009	247	670	2,661	1,128	4,706	0.052	0.142	0.565	0.240	Above Crit.	Ok	Check	Ok	Ok
2010	238	1,471	4,110	2,521	8,340	0.029	0.176	0.493	0.302	Above Crit.	Check	Check	Ok	Ok
2011	113	773	1,538	1,130	3,554	0.032	0.218	0.433	0.318	Above Crit.	Check	Ok	Ok	Ok
2012	3,340	2,355	5,241	2,862	13,798	0.242	0.171	0.380	0.207	Above Crit.	Ok	Check	Ok	Ok
2013	2,652	2,186	4,129	1,815	10,782	0.246	0.203	0.383	0.168	Above Crit.	Ok	Ok	Ok	Ok

1/ See SCSCI section 1.7.3 and Appendix Report 1.5.

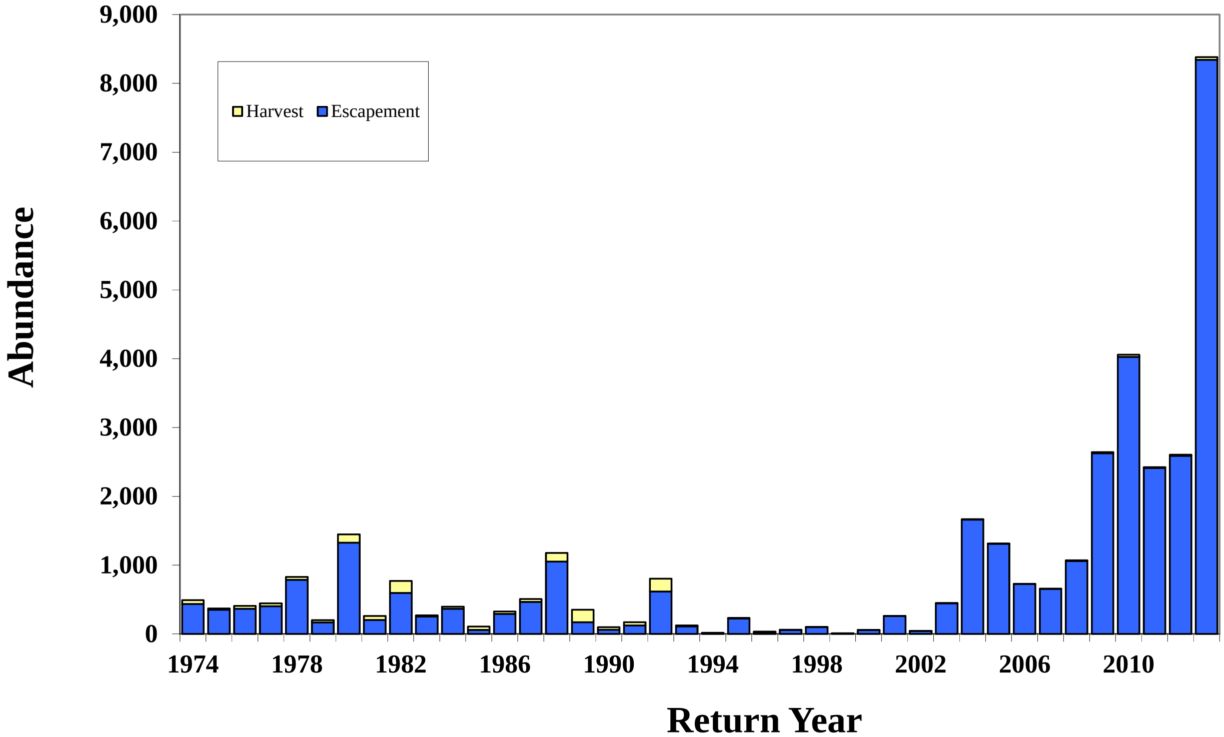

Figure AR2-1. Summer chum annual abundance (escapement + harvest) for the Sequim Bay management unit, 1974-2013.

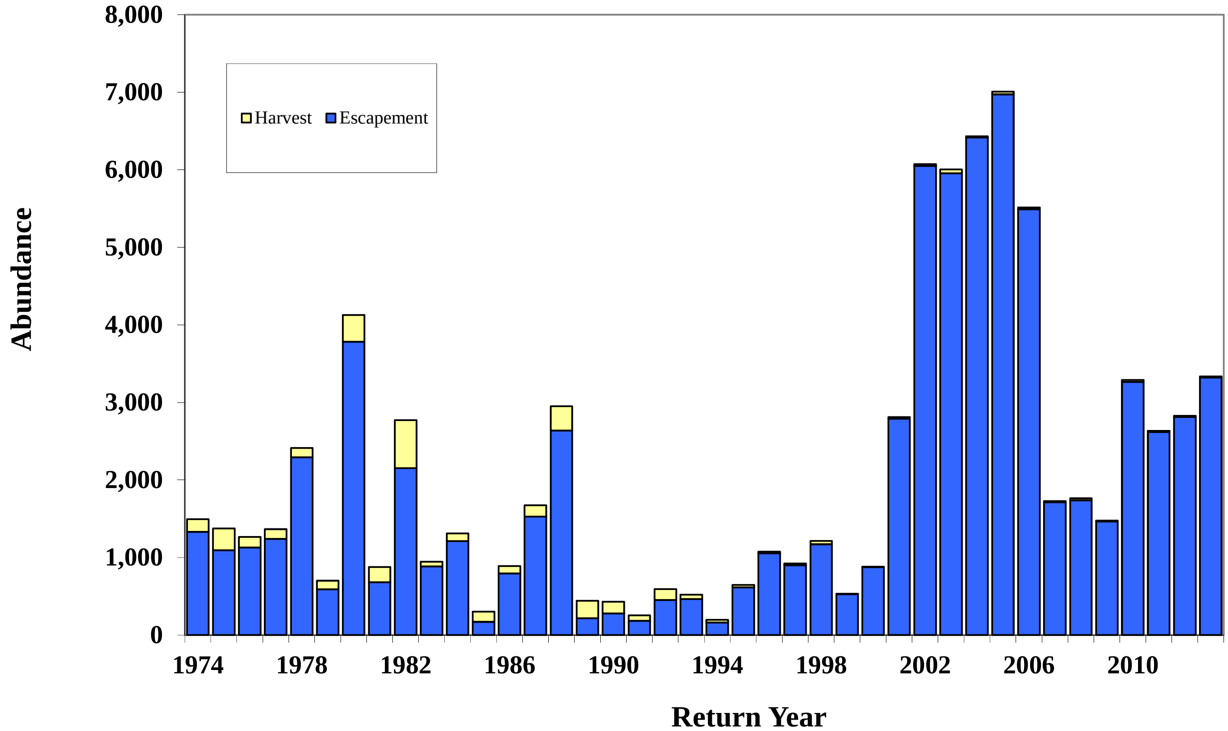

Figure AR2-2. Summer chum annual abundance (escapement + harvest) for the Discovery Bay management unit, 1974-2013.

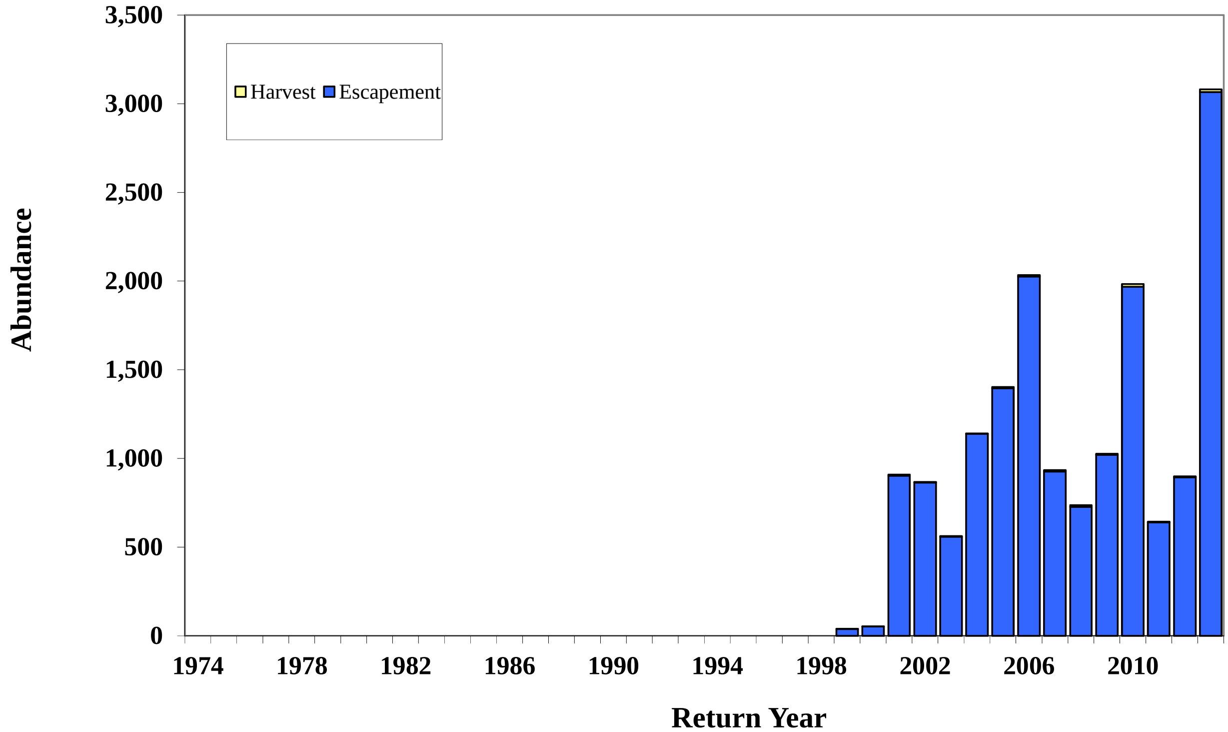

Figure AR2- 3. Summer chum annual abundance (escapement + harvest) for the Port Townsend (Chimacum) management unit, 1974-2013.

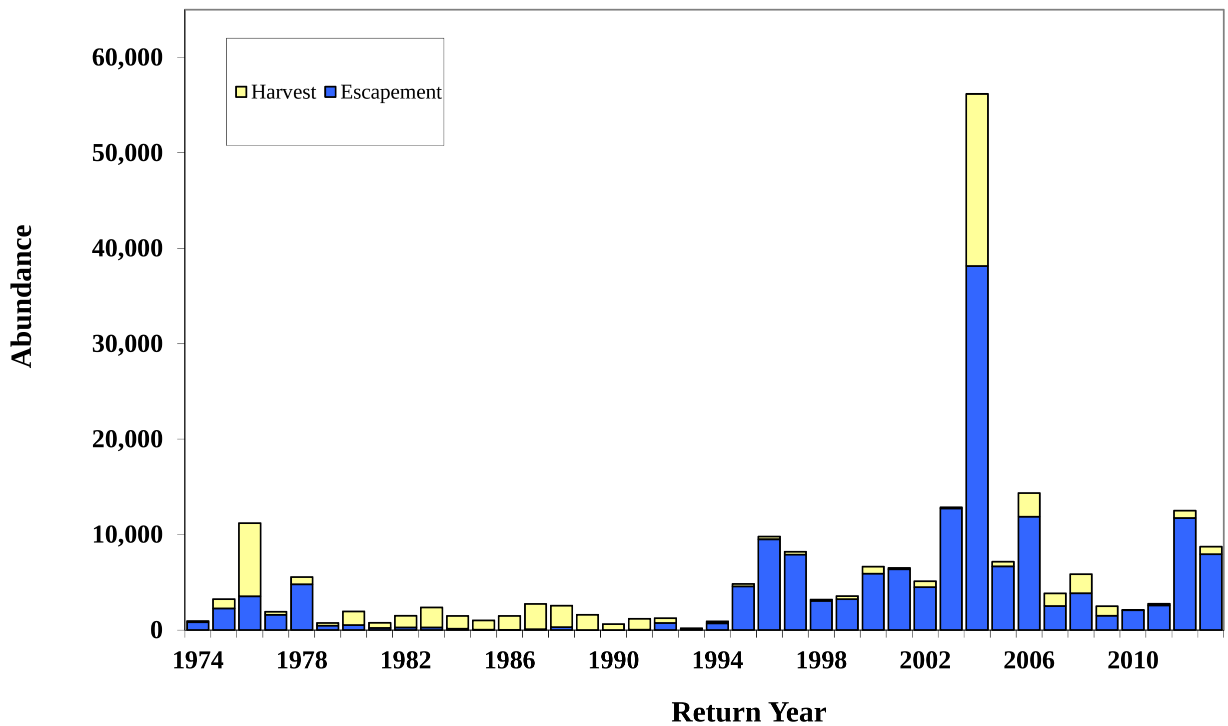

Figure AR2- 4. Summer chum annual abundance (escapement + harvest) for the Quilcene/Dabob Bays management unit, 1974-2013.

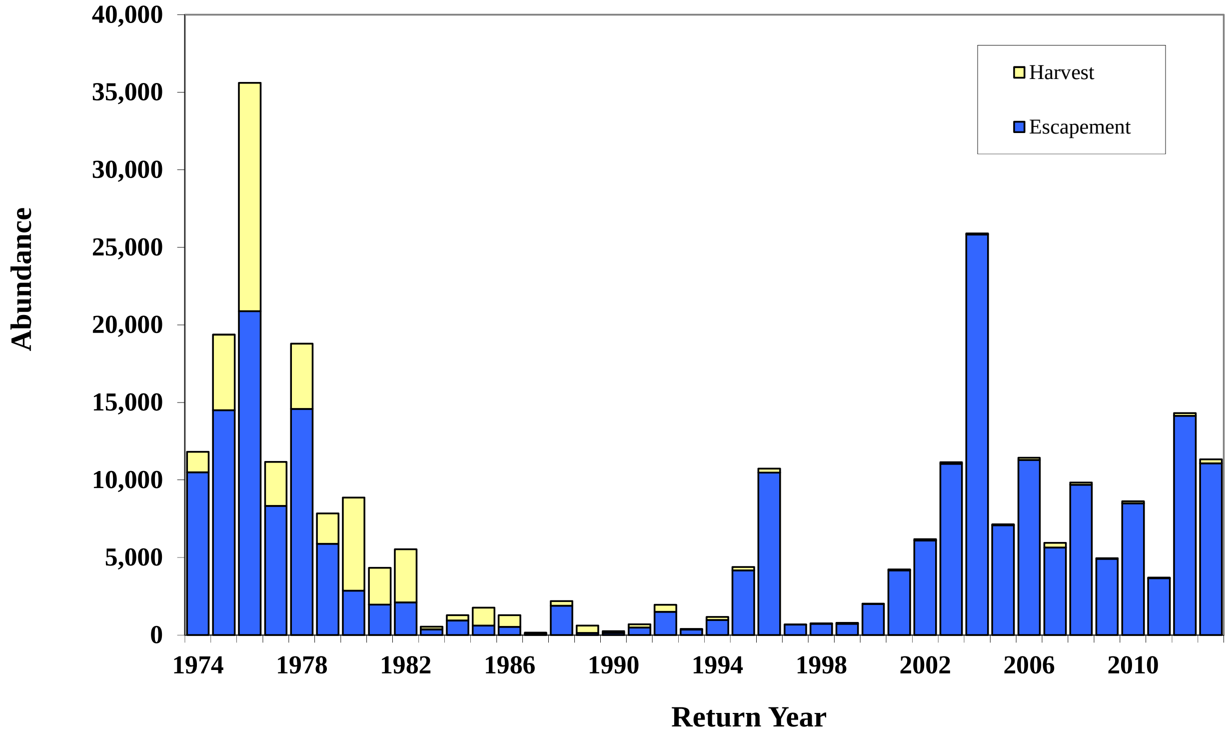

Figure AR2- 5. Summer chum annual abundance (escapement + harvest) for the Mainstem Hood Canal management unit, 1974-2013.

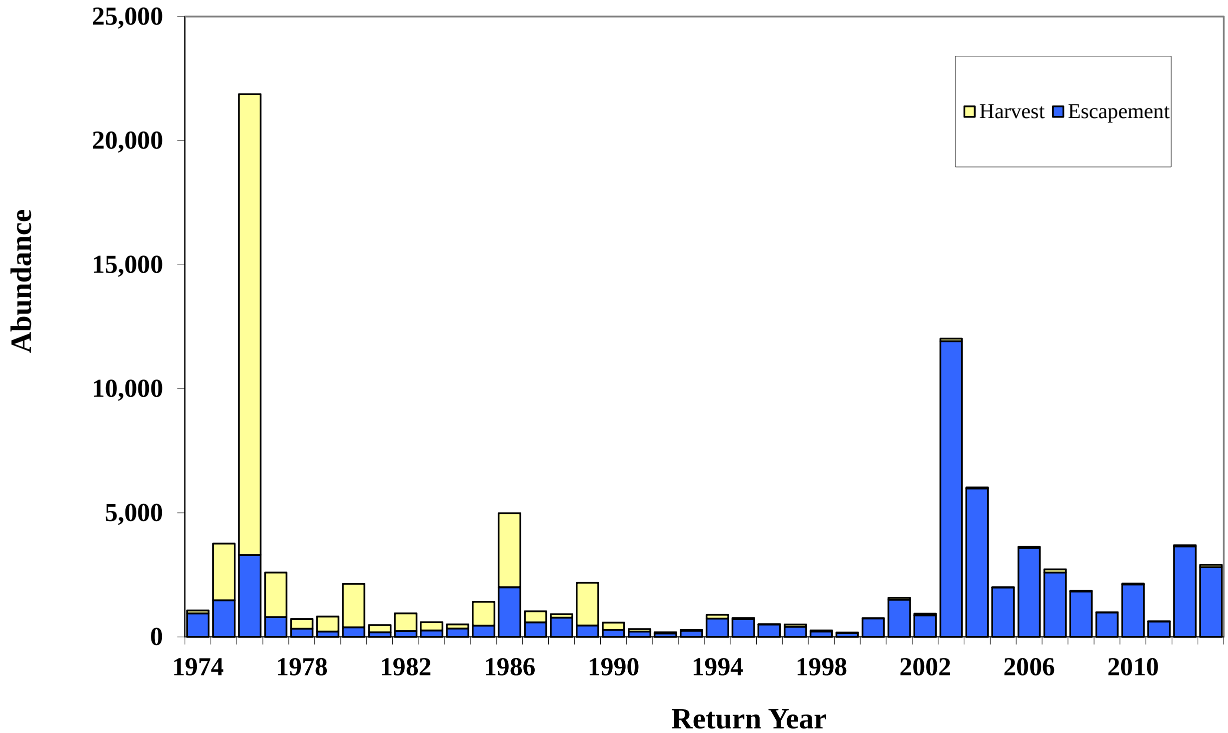

Figure AR2- 6. Summer chum annual abundance (escapement + harvest) for the Southeast Hood Canal management unit, 1974-2013.