PACIFIC SALMON COMMISSION
JOINT CHINOOK TECHNICAL COMMITTEE

ANNUAL REPORT OF CATCH AND ESCAPEMENT FOR 2013

REPORT TCCHINOOK (14)-2

June 25, 2014

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List of Acronyms and Abbreviations

AABM	Aggregate Abundance Based Management
ADF&G	Alaska Department of Fish and Game
Agreement	June 30, 1999 PST Annex and the Related Agreement
AUC	Area-Under-the-Curve
BC	British Columbia
CBC	Central British Columbia (Kitimat to Cape Caution)
CDFO	Canadian Department of Fisheries and Oceans
CI	Confidence Interval
CNR	Chinook Nonretention
CR	Chinook Retention
CPUE	Catch per unit effort
CRITFC	Columbia River Intertribal Fish Commission
CTC	Chinook Technical Committee
CV	Coefficient of Variation
CWT	Coded Wire Tag
CY	Calendar Year
ESA	U.S. Endangered Species Act
FN	First Nations
FNC	First Nations Caucus
FR	Fraser River
FSC	Food, Social & Ceremonial
GH	Grease Harbor
GMR	Genetic Mark–Recapture
GSI	Genetic Stock Identification
GW	Gitwinksihlkw
IM	Incidental Mortality
ISBM	Individual Stock Based Management
JDF	Juan De Fuca
LAT	Low Abundance Threshold
LC	Landed Catch
LGS	Lower Strait of Georgia
LIM	Legal Incidental Mortality
MA	Management Agreement
MOC	Mid-Oregon Coast
MR	Mark–Recapture
MRE	Mature-Run Equivalent
MSY	Maximum Sustainable Yield for a stock, in adult equivalents
NA	Not Available
NC	North Coastal
NBC	Northern British Columbia (Dixon Entrance to Kitimat including Queen Charlotte Islands)
NMFS	National Marine Fisheries Service
NOC	North Oregon Coast
NWIFC	Northwest Indian Fisheries Commission
ODFW	Oregon Department of Fish and Wildlife
ORC	Oregon Coast
PS	Puget Sound
PSC	Pacific Salmon Commission
PST	Pacific Salmon Treaty
QIN	Quinault Nation
QCI	Haida Gwaii (Queen Charlotte Islands)
SE	Standard Error
SIM	Sublegal Incidental Mortality
SMSY	Escapement producing MSY
SEAK	Southeast Alaska Cape Suckling to Dixon Entrance
SSP	Sentinel Stocks Program
SUS	Southern U.S.
TBR	Transboundary Rivers (Alsek, Taku, Stikine)
TM	Total Mortality
UAF	University of Alaska Fairbanks
UGS	Upper Strait of Georgia
UMT	Upper Management Threshold
UMSY	Exploitation Rate at MSY
USFWS	U.S. Fish & Wildlife Service
U.S.	United States
WAC	Washington Coast
WCVI	West Coast Vancouver Island excluding Area 20
WDFW	Washington Department of Fish and Wildlife

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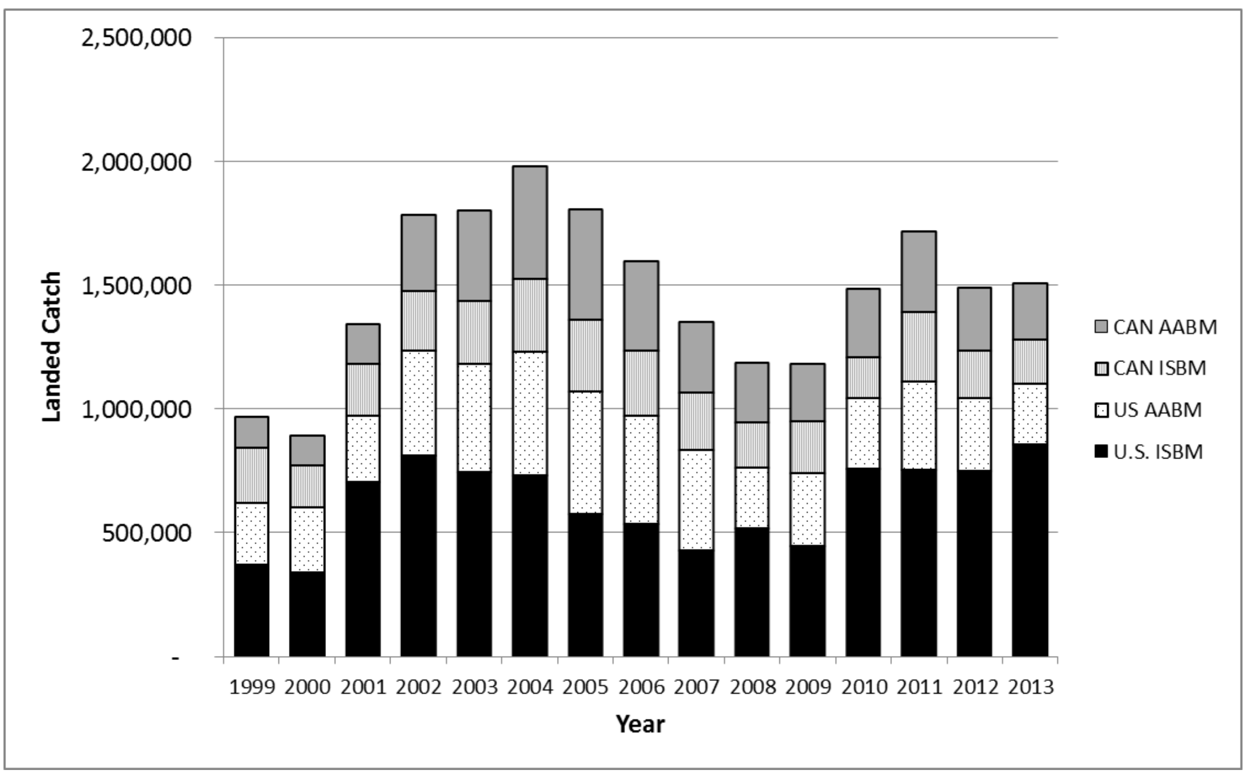
EXECUTIVE SUMMARY

The Pacific Salmon Treaty (PST) requires the Chinook Technical Committee (CTC) to report annual catch and escapement data for Chinook salmon stocks that are managed under the purview of the Treaty. The CTC provides an annual report to the Pacific Salmon Commission (PSC) to fulfill this obligation as agreed by Canada and the U.S. under Chapter 3 of the Treaty. This report contains four sections: Chinook salmon catches, escapements, stock status providing an indication of stock performance in the context of management objectives, and a summary of the Sentinel Stocks Program (SSP) for 2013.

Annual catch data are compiled by Canada and the U.S. for their respective jurisdictions within the PST area according to fishery regimes, regional locations, and gear type with estimates of incidental mortality (IM). Section 1 summarizes fishery catches by region and available estimates of IM by fishery in 2013, with accompanying commentary on the fisheries, management, and derivation of IM. Landed catch (LC) is fully reported in the appendices for each geographic area covered under the PST; a summary for all PSC Aggregate Abundance Based Management (AABM) and Individual Stock Based Management (ISBM) fisheries, from 1999 to 2013, is provided in the figure below. Time series of available IM estimates are provided in Appendix A for individual fisheries. Appendix A also includes a coastwide summary of the historical time series of LC, IM, and their sum, total mortality (TM), across all AABM and ISBM fisheries.

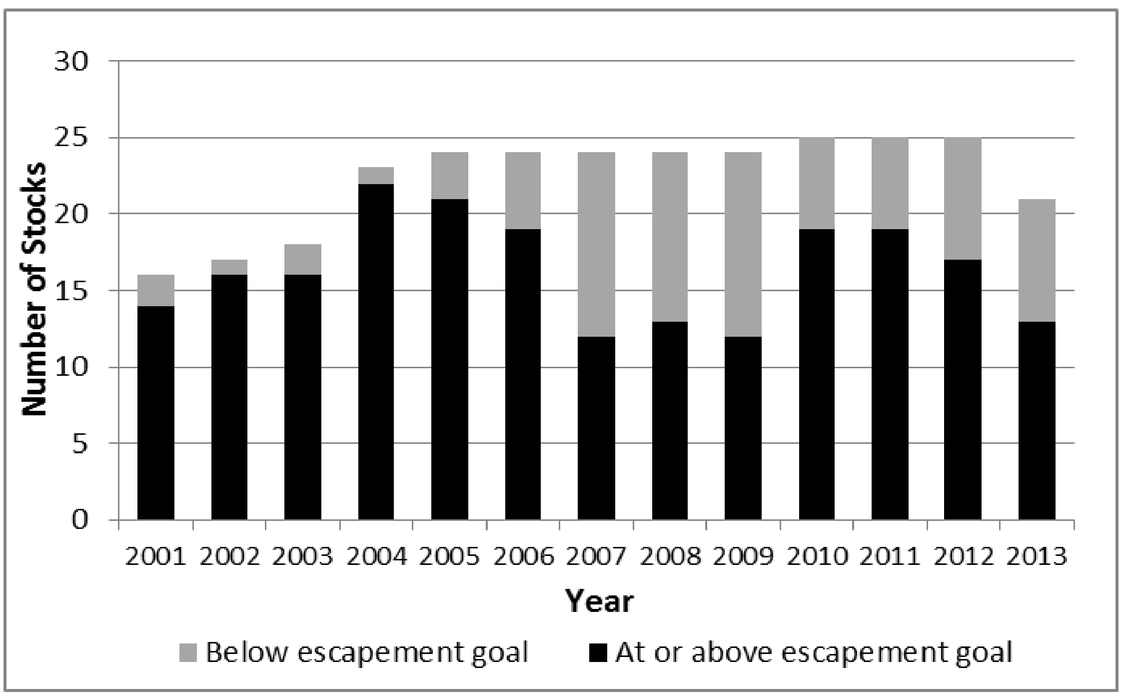


Estimates of landed catch for U.S. and Canada AABM and ISBM fisheries 1999–2013.

The preliminary estimate of total LC of Chinook salmon for all PSC fisheries in 2013 is 1,448,038 of which 1,104,311 were taken in U.S. fisheries and 405,727 were taken in Canadian fisheries. The estimated total IM associated with this harvest is 232,096 nominal Chinook salmon. The TM for all PSC fisheries in nominal fish was 1,680,134 Chinook salmon, of which 1,189,685 were taken in U.S. fisheries and 490,449 were taken in Canadian fisheries. For U.S. fisheries, 82% of the LC and 80% of TM occurred in ISBM fisheries; in Canada, 43% of the LC and 46% of TM occurred in ISBM fisheries. For some component sport fisheries, 2013 LC and IM estimates are not yet available.

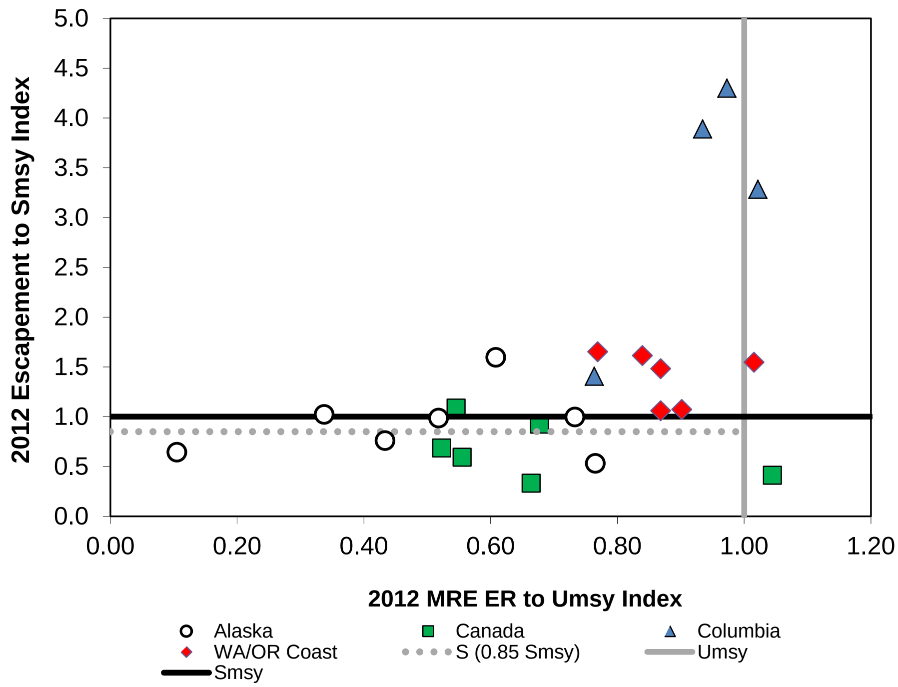
Section 2 includes an assessment of escapement for PST escapement indicator stocks/stock aggregates with CTC accepted biologically based goals (21 stocks) as well as escapement data for the other indicator stocks/stock aggregates (25 stocks). For eight of these, the escapement goal is defined as a range; for the remaining 13, the escapement goal is the point estimate of S_{MSY} (escapement producing maximum sustained yield). Annual escapements that are more than 15% below the lower end of the range or the S_{MSY} point estimate are noted. The CTC will continue to review escapement goals for stocks as they are provided by respective agencies.

From 1999 to 2012, the percentage of stocks that met or exceeded escapement goals or goal ranges has varied from 50% to 96%. In 2013, 13 of 21 stocks (62%) met or exceeded escapement objectives. Of the eight stocks below goal, three stocks (Chilkat, Taku, and Queets fall) were within 15% of the target goal. Five stocks were more than 15% below goal: Unuk, Harrison, Cowichan, Queets spring/summer, and Hoh spring/summer).



Number and status of stocks with CTC-accepted escapement goals for 1999–2013. The Keta, Blossom, and King Salmon rivers and Andrews Creek stocks have been dropped as escapement indicator stocks in 2013, bringing the total number of stocks with CTC-accepted escapement goals to 21 in 2013.

A synoptic evaluation of stock status that summarizes the performance of those stocks relative to established goals over time is presented in Section 3 for many of the escapement indicator stocks. This evaluation draws upon the catch information (Section 1), escapement information (Section 2), and exploitation rates and other information to evaluate the status of stocks. Synoptic plots present both the current status of stocks and the history of the stocks relative to PST management objectives; this information clearly summarizes the performance of fisheries management relative to stocks achieving established or potential goals. A synoptic summary figure for 20 stocks with 2012 data shows that the majority of stocks were in the safe zone. One stock (Cowichan) was in the high risk zone and six stocks (Situk, Alsek, Unuk, Harrison, Nicola, and Lower Shuswap) were in the low escapement and low exploitation zone. One stock (Columbia Upriver Brights) experienced high exploitation, but escapement exceeded the escapement goal objective. The Washington and Oregon coastal stocks clustered closer to the 1.0 index lines than the other regional groups. When stock status was examined by region there was not a strong regional pattern.



Synoptic summary by region of stock status for stocks with escapement and exploitation rate data in 2012 (escapement and exploitation rate data for each stock was standardized to the stock-specific escapement goal and U_{MSY} reference points).

A summary of the 2013 SSP is presented in Section 4. The goal of the SSP is to improve estimates of escapement for Chinook salmon stocks in the following five coastal areas: Northern British Columbia (NBC), Fraser River, West Coast Vancouver Island (WCVI), Puget Sound, and North Oregon Coast (NOC) to a level that meets or exceeds bilateral assessment accuracy and precision standards. The 2013 season is the fifth year of the program. In 2013, the PSC approved $1,947,600 in funding for 12 projects. Objectives of the funded projects were (1) to estimate escapements for stocks in the Nass and Skeena rivers (NBC), the Chilko and South

Thompson rivers (Fraser), the Burman, Marble, Sarita, and Tranquil rivers (WCVI), the Snohomish, Stillaguamish, and Green rivers (Puget Sound), and the Siletz and Nehalem rivers (NOC); and (2) to estimate the aggregate size of the terminal returns to the NOC and to WCVI. Escapement estimates and methods used to obtain those estimates are described in Section 4 and Appendix C for each of the funded programs.

In 2014, the CTC adopted an escapement goal for Grays Harbor fall Chinook salmon of 13,326 spawners (Appendix D).

1 CHINOOK SALMON CATCH

The 1999 and 2009 Agreements substantially changed the objectives and structure of the PSC Chinook salmon fisheries. The 1999 Agreement eliminated the previous ceiling and pass-through fisheries and replaced them with Aggregate Abundance Based Management (AABM) and Individual Stock Based Management (ISBM) fisheries. The 2009 Agreement defines catch limits based on aggregate abundance for Chinook salmon in AABM fisheries. The 2009 Agreement requires that ISBM fisheries be managed on a national basis to meet stock-specific agreed-to MSY or other biologically based escapement objectives (and/or exploitation rates for 4 of the 49 named stocks) or to limit adult equivalent mortality rates for these stocks to a portion of the 1979 to 1982 base period or the average 1991 to 1996 rate.

This report assesses landed catch (LC), incidental mortality (IM) and total fishing mortality (TM) among all fisheries, both those targeting Chinook salmon (Chinook Retention, CR) as well as those directed at other salmon species (Chinook Nonretention, CNR). The report includes all three AABM and the ISBM fisheries. For 2013, estimates for the three AABM fisheries are presented by gear sector in Table 1.6 and Table 1.7, and similar estimates for ISBM fisheries of Canada and the U.S. are summarized in Table 1.8 and Table 1.9. A summary of the estimated LC, IM, and TM for Chinook salmon in all PST AABM and ISBM fisheries is presented in Table 1.10.

The CTC started reporting IM within AABM fisheries in 2004 (CTC 2004a) and within most ISBM fisheries in 2005 (CTC 2005). The current reporting of LC and IM in all PST fisheries provides an opportunity to present a comprehensive overview across all PST fisheries that harvest Chinook salmon. Commentary is provided to explain fisheries, management, and derivation of estimates of IM. Historical LC, IM, and TM data are given in Appendix A.

1.1 Review of Aggregate Abundance Based Management Fisheries

AABM fisheries for Chinook salmon are managed to an allowable catch associated with each year's abundance index in Table 1 in Chapter 3 of the 2009 PST Agreement. AABM fisheries are mixed stock salmon fisheries that intercept and catch migratory Chinook salmon from many stocks. The AABM fisheries (PST, Annex IV, Chapter 3, paragraph 2) are listed below.

1) Southeast Alaska (SEAK) All Gear (Troll, Net, Sport)
2) Northern British Columbia (NBC) Troll and Queen Charlotte Islands (QCI) Sport
3) West Coast Vancouver Island (WCVI) Troll and Outside Sport

Catches for these three fisheries are reported in Table 1.1.

Table 1.1.–Annual catches and hatchery add-ons for AABM fisheries, expressed in thousands of Chinook salmon. The Treaty catches do not include the hatchery add-on or exclusions (see Appendix A.1).

Year	Southeast Alaska (T, N, S)			Northern British Columbia (T), Queen Charlotte Islands (S)		West Coast Vancouver Island (T, S)	
	Treaty Catch		Hatchery Add-on	Treaty Catch		Treaty Catch	
	Limit[1]	Observed		Limit[1]	Observed	Limit[1]	Observed
1999	184.2	198.8	47.7	126.1	86.7	107.0	38.5
2000	178.5	186.5	74.3	123.5	31.9	86.2	88.6
2001	250.3	186.9	77.3	158.9	43.5	145.5	120.3
2002	371.9	357.1	68.2	237.8	150.1	196.8	157.9
2003	439.6	380.2	57.2	277.2	191.7	268.9	173.6
2004	418.3	417.0	76.0	267.0	241.5	209.6	215.3
2005	387.4	388.1[2]	64.8[2]	240.7	243.6	179.7	199.5
2006	354.5	359.6[2]	48.9[2]	200.0	216.0	145.5	145.5
2007	259.2	327.7[2]	68.9[2]	143.0	144.2	121.9	140.6
2008	152.9	172.3[2]	66.6[2]	120.9	95.6	136.9	145.7
2009[3]	176.0	227.5[2]	62.4[2]	139.1	109.5	91.3	124.6
2010	215.8	230.3[2]	53.9[2]	160.4	136.6	142.3	139.0
2011	283.3	290.3[2]	66.0[2]	186.8	122.7	134.8	204.2
2012	205.1	242.0	51.9	149.5	120.3	113.8	134.5
2013	284.9	183.9	62.6	220.3	115.9	178.8	113.6
2014	439.4			290.3		205.4	

Note: T = Troll, N = Net and S = Sport fisheries.

[1] Allowable treaty catches correspond to the first post season abundance indices for 1999 to 2013 and the preseason abundance indices for 2014.

[2] Values changed because the method used to partition gillnet catch into large and nonlarge fish changed.

[3] 2009 was the first year of implementation of the 2009 Agreement.

1.1.1 Southeast Alaska Fisheries

The SEAK Chinook salmon fishery is managed to achieve the annual all-gear PSC allowable catch associated with the preseason abundance index generated by the CTC Chinook Model each spring. The catch is allocated through regulations established by the Alaska Board of Fisheries among troll, net, and sport fisheries. The current allocation plan reserves 4.3% of the total all-gear catch for purse seine, 2.9% for drift gillnet and 1,000 fish for set gillnet fisheries. After the net quotas are subtracted, 80% of the remainder is allocated for commercial troll and 20% for sport fisheries. The commercial troll and net fisheries are managed inseason according to procedures outlined in gear-specific management plans. Sport fishery bag and possession limits as well as annual limits are established prior to the season based on the preseason abundance index. The regulatory history of and maps for each SEAK fishery are presented in CTC 2004b.

In addition, the SEAK fisheries are managed for the following items.

1) An Alaska hatchery add-on estimated from CWT sampling. The add-on is the total estimated Alaska hatchery catch, minus 5,000 base period (pre-1985 contribution level) Alaska hatchery catch, and minus the risk adjustment. The risk adjustment is the product of the standard error (SE) for the total estimated Alaska hatchery catch and a risk factor (1.645).
2) An exclusion of wild Chinook salmon originating from the Situk, Stikine and Taku rivers, when appropriate according to Chapter 1 (Transboundary Rivers) of the 2009 Agreement.
3) Compliance with provisions established by the National Marine Fisheries Service (NMFS) in accordance with the U.S. Endangered Species Act (ESA).
4) Consistency with the provisions of the PST as required by the Salmon Fishery Management Plan of the North Pacific Fishery Management Council that was established by the U.S. Magnuson-Stevens Act.

The SEAK 2013 preseason AI of 1.20 provided for an all-gear PST allowable catch of 176,000 Chinook salmon. The preliminary total all-gear catch in 2013 was 246,727 with a PST catch of 183,891, an Alaska hatchery add-on of 62,570, and a terminal exclusion catch of 266 Chinook salmon. The postseason allowable catch for the all-gear SEAK AABM fishery was 284,900. Historical SEAK Chinook salmon catch numbers for 1975 to 2013 are included in Appendix A.1.

1.1.1.1 *Troll Fisheries Catch*

The troll fishery accounting year began with the start of the winter fishery on October 11, 2012, and ended with the summer fishery in September 2013. The winter troll fishery continues until 45,000 Chinook salmon are caught, or through April 30, whichever is earlier. In 2013, the winter troll fishery was open through April 30. The spring fishery, which targets Alaska hatchery-produced Chinook salmon, was conducted from May 1 to June 30 in a total of 32 spring areas and six terminal harvest areas. There is no cap on the number of Chinook salmon that can be harvested in the spring troll fisheries. However, the fisheries are managed to maximize the harvest of Alaska hatchery fish. The percentage of Alaska hatchery fish in each area is monitored on a weekly basis and only areas that meet predefined thresholds are left open. The 2013 summer troll fishery only included one Chinook salmon retention period, from July 1 to July 6. In recent years, a small but increasing portion of the troll fleet has targeted chum salmon from mid-June through August, resulting in a decrease in effort directed at Chinook and coho salmon (Skannes et al. 2013).

In 2013, the troll fishery harvested 149,615 Chinook salmon, which included 17,930 Alaska hatchery fish. There was an Alaska hatchery add-on of 14,410 and a Transboundary River (TBR) exclusion of 239 fish, and subtraction of these from the total harvest results in a total of 134,966 PST fish. The winter fishery harvested 26,587 fish, of which 3,374 were from Alaska hatcheries and 23,886 were PST fish. The spring fishery caught a total of 38,360 fish, of which 11,685 were Alaska hatchery fish and 28,710 were PST fish. The total summer catch was 84,668, of which 2,872 were from Alaska hatcheries and 82,369 were PST fish (Table 1.2).

Table 1.2.–Harvest of Chinook salmon in Southeast Alaska by gear type in 2013.

Gear	Total Catch	Alaska Hatchery Catch[1]	Alaska Hatchery Add-on[1]	Terminal Exclusion Catch[2]	AABM Catch[3]
Troll					
Winter	26,587	3,374	2,701	0	23,866
Spring	38,360	11,685	9,411	239	28,710
Summer	84,668	2,872	2,299	0	82,369
Troll subtotal	149,615	17,930	14,410	239	134,966
Sport[4]	45,787	12,504	10,488	0	35,299
Net					
Set Net	899			0	899
Drift gillnet	27,316	22,722	21,269	27	6,021
Seine	23,110	17,044	16,403	0	6,707
Net subtotal	51,325	39,766	37,672	27	13,626
Total	246,727	70,200	62,570	266	183,891

[1] The add-on is the total estimated Alaska hatchery catch, minus 5,000 base period Alaska hatchery catch, and minus the risk adjustment (product of standard error for the total estimated Alaska hatchery catch and a risk factor of 1.645).

[2] Terminal exclusion catch is a result of the harvest sharing arrangement on the Taku and Stikine rivers.

[3] Treaty catch is the total catch minus Alaska hatchery add-on minus terminal exclusion catch. Totals may not equal the sum of the individual values due to rounding.

[4] Preliminary values until mail-out survey results are available.

1.1.1.2 *Net Fisheries Catch*

There are three types of commercial net fisheries conducted in SEAK: purse seine, drift gillnet, and set gillnet. With the exception of directed gillnet harvests of Chinook salmon in SEAK terminal areas as provided in the Transboundary river chapter of the PST, harvests of Chinook salmon in the net fisheries are incidental to the harvest of other species. The 2013 total net catch was 51,325 Chinook salmon, including 39,766 Alaska hatchery fish. There was an Alaska hatchery add-on of 37,672 and a TBR exclusion of 27, resulting in a PST catch of 13,626 (Table 1.2).

The purse seine fishery is open from mid-June through early fall and is limited to specific areas and time periods established inseason by emergency order (Davidson et al. 2011b). In 2013, the purse seine fishery harvested a total of 23,110 Chinook salmon, which included 17,004 Alaska hatchery fish and an Alaska hatchery add-on of 16,403, resulting in a PST catch of 6,707.

The drift gillnet fishery usually opens in late June, unless directed fisheries are implemented in May to target surplus production of Chinook salmon bound for the Taku and Stikine rivers, (Davidson et al. 2011a) as detailed in Chapter 1 of the 2009 Agreement. In 2013, preseason terminal run forecasts for both the Taku and Stikine rivers did not provide for an allowable catch. Therefore, directed fisheries did not occur.

Overall, the drift gillnet fishery is limited to five traditional areas within the region and time periods are established inseason by emergency order. The 2013 drift gillnet fishery caught a total of 27,316 Chinook salmon, including 22,722 Alaska hatchery fish. There was an Alaska hatchery add-on of 21,269 and a TBR exclusion of 27, resulting in a PST catch of 6,021.

The set gillnet fishery is managed to catch no more than 1,000 PST Chinook salmon, a limit which is based on a historic average. This fishery is open during the late spring and summer in the Yakutat area. The 2013 set gillnet fishery caught 899 Chinook salmon, all of which were PST fish.

1.1.1.3 Sport Fishery Catch

Sport catches are monitored inseason by catch surveys throughout the region, and sampling programs are in place to recover coded wire tags (CWT) from tagged Chinook salmon. The number of Alaska hatchery fish caught is estimated from the CWTs collected by the sampling program. Preliminary sport catch estimates are computed from the catch surveys while final sport catch estimates are computed from a mail-out survey and are available one year after the fishery occurs. In 2013 with a preseason of abundance index 1.20, the management plan required a bag limit of one king salmon 71 cm (28 inches) or greater in length for all anglers. The nonresident harvest limit (annual limit that changes inseason) was three king salmon 28 inches in length from January 1 through June 30; two king salmon 28 inches or greater in length from July 1 through July 15; and one king salmon 28 inches or greater in length July 16 through December 31. In addition, residents were allowed to use two rods from October through March. In some designated harvest areas near hatchery release sites, bag and possession limits and annual limits were liberalized to provide increased catches of returning Alaska hatchery Chinook salmon. The preliminary 2013 total sport Chinook salmon catch was 45,787 with an estimate of 12,504 Alaska hatchery fish. There was an Alaska hatchery add-on of 10,488 fish, resulting in a PST catch of 35,299 Chinook salmon (Table 1.3).

Table 1.3.–Harvest of Chinook salmon by gear for Canadian AABM fisheries in 2013.

AABM Fishery	NBC	WCVI
NBC Troll (Area F)	69,264	
WCVI Troll (Area G)		35,166
Food, social, and ceremonial troll		5,000
Maanulth troll		1,710
T'aaq-wiihak troll		7,650
Sport	46,650	64,072
Total	**115,914**	**113,598**

1.1.2 British Columbia Fisheries

The NBC AABM fishery includes NBC troll catch in Statistical Areas 1–5 and QCI sport catch in Statistical Areas 1 and 2. The total NBC AABM catch in 2013 was 115,914. The WCVI AABM fishery includes the WCVI commercial and First Nations (FN) troll and a portion of the WCVI sport fishery (defined below). The total WCVI AABM catch in 2013 was 113,598 (Table 1.3). Troll catches from 1996 to 2004 have been updated with data from Canadian Department of Fisheries and Oceans (CDFO 2009; Appendix A).

1.1.2.1 *Northern British Columbia AABM*

The total NBC AABM catch (troll plus sport) between October 1, 2012 and September 30, 2013 was 115,914 Chinook salmon (Table 1.3).

1.1.2.1.1 Northern British Columbia Troll Fishery Catch

The NBC troll fishery landed 69,264 Chinook salmon in 2013. The NBC troll fishery was opened for Chinook salmon fishing from June 21 to July 7. The entire 2013 NBC troll fishery was conducted under a system of individual transferable quotas. All landings of Chinook salmon caught in the NBC troll fishery were made at designated landing sites and catches were validated by an independent contractor. Validation of landings has occurred since 2005. A total of 258 licenses were issued, but the total catch was landed by 125 vessels as much of the quota was transferred. Barbless hooks and revival boxes were mandatory in the troll fishery and the minimum size limit was 67 cm fork length (26.4 in). No troll test fisheries were conducted in 2013. A ribbon boundary around Langara Island and from Skonun Point to Cape Knox on Graham Island excluded the commercial troll fishery from areas within one nautical mile of the shore from June 21 to September 14, 2013.

1.1.2.1.2 Northern British Columbia Sport Fishery Catch

Sport caught Chinook salmon from QCI (Pacific Fishery Management Areas 1, 2, 101, 102 and 142) are included in the AABM totals. Catches in the QCI sport fisheries have been estimated since 1995 through lodge logbook programs, creel surveys and independent observations by Canadian Department of Fisheries and Oceans (CDFO) staff. The 2013 QCI sport catch was 46,650 Chinook salmon.

1.1.2.2 *West Coast Vancouver Island AABM*

Under the 2009 PST Agreement, the WCVI AABM fishery includes the WCVI troll and the outside WCVI sport fishery (defined below). The total AABM LC in the commercial troll, outside tidal sport, and FN troll in 2013 was 113,598 Chinook salmon (Table 1.3).

1.1.2.2.1 West Coast Vancouver Island Troll Fishery Catch

The AABM troll catch includes the commercial and FN troll caught Chinook salmon in Pacific Fishery Management Areas 21, 23–27, and 121–127. In the 2013 season (October 1, 2012 to September 30, 2013), WCVI troll fishing opportunities were consistent with a CDFO commitment to evaluate winter fisheries as a means to improve the economic base for the fishery and local communities while increasing flexibility in catch opportunities and reducing the exploitation on stocks encountered in summer fisheries (Table 1.4). Troll fishery openings were shaped by conservation concerns for Fraser River spring run age 1.2, Fraser River spring run age 1.3, Fraser River summer run age 1.3, WCVI, and Lower Strait of Georgia (LGS) Chinook salmon and interior Fraser River coho salmon.

Table 1.4.–Fishing periods and Chinook salmon caught and released during the 2013 catch year in the West Coast Vancouver Island (WCVI) commercial troll fishery.

Fishing Period[1]	Pacific Fishery Management Areas Open	Main Area Fished	LC	Legal Releases	Sub-legal releases
Oct 10–11	123, 124, 125, 126, 127	123	3,344	0	994
Nov 19–Dec 31	23, 24, 25, 26, 27, 123, 124, 125, 126, 127	23	542	0	162
Jan 1–31	23, 24, 25, 26, 27, 123, 124, 125, 126, 127	125/126	1,018	0	165
Feb 1–Mar 2	23, 24, 25, 26, 27, 123, 124, 125, 126, 127	126	361	0	47
Mar 3–15	23, 24, 25, 26, 27, 125, 126, 127	126	500	1	23
Apr 25–30	23, 24, 25, 26, 27, 125, 126, 127	126/127	1,204	2	38
May 1–6	23, 24, 25, 26, 27, 124, 125, 126, 127	124	2,626	1	57
May 7–15	23, 24, 25, 26, 27, 123, 124, 125, 126, 127	123	23,040	44	2,746
Sep 15–17	125, 126, 127	126/127	2,129	2	105
Sep 22–30	125, 126, 127	127	402	0	43
Total			35,166	50	4,380

[1] West Coast Vancouver Island (WCVI) troll fisheries were generally closed from mid-June to late August to avoid encounters of interior Fraser River and Thompson River coho and the WCVI Chinook salmon stock.

The annual WCVI commercial troll harvest was allocated by percent to the following periods: October 1 to March 15 (20%), March 16 to April 18 (Closed, 0%), April 19 to June 15 (40%), June 15 to July 23 (20%) and September (20% with adjustments for harvest by other fisheries). A full-time closure was maintained from March 16 to April 18 to avoid interception of Fraser River spring run age 1.2. During the April 19 to June 15 period, areas of Southwest Vancouver Island were closed until May 7 to avoid LGS, Fraser spring run age 1.2, Fraser River spring run age 1.3, and Fraser River summer run age 1.3 Chinook salmon. Full-time closures were also implemented from June 15 to July 23 in Areas 125–127 and from June 16 to July 31 in Areas 123 and 124. To minimize mortality of WCVI origin Chinook and wild coho salmon the mandatory use of six-inch plugs and a fishery limit on coho salmon encounters were implemented as well as time and area closures. Statistical Area 121 (Swiftsure Bank) remained closed in 2013. Selective fishing practices were mandatory, including single barbless hooks and revival tanks for resuscitating coho salmon prior to release, which affects the IM rates used for legal and sublegal Chinook salmon. The minimum size limit for commercial troll for all periods was 55 cm (21.6 in) fork length.

From April 19 to August 11, 2013, the T'aaq-wiihak demonstration fishery, a new fishery implemented in 2012, occurred in portions of Pacific Fishery Management Areas 24 and 124. The fishery eventually included portions of Pacific Fishery Management Area 125.

The catch for 2013 commercial troll fisheries was 35,166 Chinook salmon (Table 1.4). The WCVI FN caught an estimated 5,000 Chinook salmon in food, social, and ceremonial (FSC) fisheries, 1,710 Maanulth Treaty catch, and 7,650 in T'aaq-wiihak Demonstration fisheries. Therefore, the total WCVI AABM troll catch for 2013 was 49,526 with 50 legal and 4,380 sublegal Chinook salmon releases (not including releases from the WCVI FN troll fisheries, which are currently unknown).

1.1.2.2.2 West Coast Vancouver Island Sport Fishery Catch

The AABM sport fishery includes all catch in northwest WCVI (Areas 25–27, 125–127) from October 16 to June 30, and the catch outside of the surfline (about one nautical mile offshore) from July 1 to October 15, plus all the catch in southwest WCVI (Areas 21, 23, 24, 121, 123, and 124) from October 16 through July 31 and the catch outside one nautical mile offshore from August 1 to October 15. Catch inside the surf line and outside the AABM periods specified above is included in ISBM fishery catch.

The WCVI AABM sport fishery occurs primarily in the Barkley Sound, outer Clayoquot Sound, and Nootka Sound areas. The majority of fishing effort occurs from mid-July through August in northwest Vancouver Island and August through mid-September in the Southwest Vancouver Island. Creel surveys were conducted from early June to mid-September. The Chinook salmon daily bag limit was two fish greater than 45 cm fork length (17.7 in). Barbless hooks were mandatory.

The 2013 WCVI AABM sport LC estimate during the creel period was 64,072 (Table 1.5). Catch rates were determined from anglers interviewed from June 1 to September 15. No creel surveys occurred between October and May, when effort is relatively low.

Table 1.5.–West Coast Vancouver Island AABM sport fishery catches of Chinook salmon by Pacific Fishery Management Areas (PFMA) in 2013 representing catch from June 1 to September 15.

PFMA	21/121	23/123	24/124	25/125	26/126	27/127	Total
Catch	10,478	29,652	7,913	3,056	6,152	6,821	64,072

1.2 Estimates of Incidental Mortalities in AABM Fisheries

1.2.1 Southeast Alaska Fisheries

Estimates of encounters and IM in SEAK fisheries are shown for 2013 in Table 1.6 and in Appendix A for prior years. Estimates were converted from total IM into treaty IM by multiplying the total encounters by the ratio of treaty catch to LC for each respective fishery. The 2013 troll encounters were estimated from regressions of historical encounter estimates and troll effort. The regression predicts encounters from troll effort using encounter estimates obtained from direct fishery observation programs conducted during a series of years. The CR and CNR sublegal regressions use a data series from 1998 to 2006, while the CNR legal regression uses a data series from 1985 to 1988 and 1998 to 2006 (CTC 2011). Sport fishery releases were computed from the number of Chinook salmon caught and released as recorded on the annual Statewide Catch Survey (mail-in survey) forms. Legal and sublegal CNR purse seine encounters were calculated using a modified catch per landing approach that uses the relationship between the yearly catch and the magnitudes of legal and sublegal CNR encounters for years for which direct observational data are available (CTC 2011). For the gillnet fishery, drop-off mortality was estimated as a percentage of the LC using the regional-specific drop-off rate for SEAK (CTC 2004c). Encounter estimates are multiplied by the respective IM rate found in CTC (1997) to obtain estimates of IM. The estimated total in 2013 was 236,539 nominal Treaty fish, including 183,891 Treaty fish in the LC, and 52,647 incidental mortalities (Table 1.6).

Table 1.6.–Estimates of treaty and total (includes total treaty, terminal exclusion, and hatchery add-on catch and estimates of incidental mortality) landed catch (LC), incidental mortality (IM; in nominal numbers of fish), and total mortality (TM) in SEAK AABM fishery, 2013.

SEAK Fishery	LC	Legal Encounters	Sublegal Encounters	Total LIM[2]	Total SIM[2]	Total IM	Total Mortality
Treaty							
Troll CR	134,966	134,966	16,011	1,080	4,211	5,291	140,256
Troll CNR	0	61,643	40,824	13,500	10,737	24,236	24,236
Troll Total	134,966	196,608	56,835	14,579	14,948	29,527	164,493
Sport Total[1]	35,299	13,803	29,122	3,465	4,630	8,096	43,395
Gillnet	6,920	35,299	0	138	0	138	7,058
Seine CR	6,707	6,920	1,118	0	959	959	7,666
Seine CNR	0	5,657	15,023	2,885	11,042	13,927	13,927
Net Total	13,626	47,876	16,141	3,023	12,001	15,024	28,651
Treaty Total	183,891	258,288	102,098	21,068	31,579	52,647	236,539
Total SEAK							
Troll CR	149,615	149,615	17,749	1,197	4,668	5,865	155,480
Troll CNR	0	63,363	41,963	13,876	11,036	24,913	24,913
Troll Total	149,615	212,978	59,712	15,073	15,704	30,778	180,393
Sport Total[1]	45,787	17,904	37,775	4,495	6,006	10,501	56,288
Gillnet	28,215	28,215	0	564	0	564	28,780
Seine CR	23,110	23,110	3,853	0	3,306	3,306	26,416
Seine CNR	0	7,971	21,168	4,065	15,558	19,624	19,624
Net Total	51,325	59,296	25,021	4,630	18,864	23,494	74,819
SEAK Total	246,727	290,178	122,508	24,198	40,575	64,773	311,500

[1] Catch data are preliminary estimates from creel survey expansions; IM for the SEAK sport fishery is estimated from the preliminary LC and the previous year IM to LC ratios. Final estimates are available from mail-out surveys in October one year post fishing season and will be reported in Appendix A.2 and A.3 of the next annual Catch and Escapement Report.

[2] Includes dropoff mortality. LIM=Legal Incident Mortality, SIM=Sublegal Incident Mortality.

1.2.2 British Columbia Fisheries

1.2.2.1 *Northern British Columbia Fisheries*

Table 1.7 summarizes estimates of LC, encounters and associated incidental mortalities by size class during CR and CNR fishing periods in the 2013 NBC AABM fishery. Releases for the NBC troll fishery are based on logbook data. Encounters from the QCI sport fishery are based on creel survey and logbook programs. IM estimates were derived using gear and size-specific rates from the CTC (1997). The estimated TM for 2013 was 135,841 nominal fish, which included 115,914 in the LC and 19,927 incidental mortalities.

1.2.2.2 *West Coast Vancouver Island Fisheries*

The estimated TM of Chinook salmon that occurred within the WCVI AABM fishery in 2013 was 130,047 nominal fish, which included 113,598 in the LC and 16,449 from IM (Table 1.7). The estimated IM included 11,565 legal and 4,884 sublegal nominal Chinook salmon. Table 1.7 also summarizes encounters for these fisheries by size class during CR and CNR fisheries.

Table 1.7.–Estimates of treaty and total landed catch (LC), incidental mortality (IM; in nominal numbers of fish), and total mortality (TM) in NBC and WCVI AABM fisheries, 2013.

Fishery	LC	Legal Releases	Sublegal Releases	LIM Drop-off	Total LIM	Total SIM	Total IM	Total Mortality
NBC								
Troll CR	69,264	-	9,982	1,177	1,177	2,366	3,543	72,807
Troll CNR	-	29,994	4,322	-	6,059	1,024	7,083	7,083
Troll Total	69,264	29,994	14,304	1,177	7,236	3,390	10,626	79,890
Sport Total	46,650	47,931	0	1,679	9,300	-	9,300	55,950
NBC Total	115,914	77,925	14,304	2,856	16,536	3,390	19,926	135,840
WCVI								-
Troll CR	35,166	50	4,380	598	608	1,734	2,342	37,508
Troll CNR	-	0	0	0	0	0	-	-
FN Troll[1]	14,360	-	-	244	244	-	244	14,604
Troll Total	49,526	50	4,380	842	852	1,734	2,586	52,112
Sport Total	64,072	32,777	17,221	4,421	10,714	3,306	14,020	78,092
WCVI Total	113,598	32,827	21,601	5,263	11,566	5,040	16,606	130,204

[1] FN troll includes FSC, Maanulth Treaty catch and T’aaq-wiihak catch.

1.3 Review of Individual Stock Based Management Fisheries

ISBM fisheries include all British Columbia Chinook salmon fisheries that are not included in the NBC and WCVI AABM fisheries, and all marine and freshwater Chinook salmon fisheries in Washington, Oregon, and Idaho. ISBM fisheries are managed with the intent of meeting management objectives for individual stocks listed in Attachments IV and V in Chapter 3, Annex IV to the PST.

1.3.1 Canadian Individual Stock Based Management Fisheries

The Canadian ISBM fisheries include all fisheries that catch or release Chinook salmon in British Columbia that are not AABM fisheries. In 2013, 176,215 Chinook salmon were caught in Canadian ISBM fisheries in British Columbia and Canadian sections of the Transboundary Rivers. Total estimated IM in 2013 was 26,038 legal and 22,306 sublegal Chinook salmon. The distribution of LC and estimated IM are presented in Table 1.8.

Table 1.8.–Landed catch and incidental mortalities in Canadian ISBM fisheries for 2013.

Region/Gear	Landed Catch	Release Legals	Release Sublegals	Total LIM	Total SIM	Total IM
Transboundary Rivers	6,472	198	38	340	58	398
Net	4,858	1	38	224	58	282
Freshwater Sport	160	197	0	49	0	49
FN-FSC	1,454	0	0	67	0	67
Northern British Columbia	23,513	3,583	1,098	3,476	464	3,940
Net	2,126	2,669	494	2,383	356	2,739
Tidal Sport	10,259	331	229	422	36	458
Freshwater Sport	2,024	583	375	252	72	324
FN-FSC	8,557	0	0	394	0	394
Tyee Test Fishery	547	0	0	25	0	25
Central British Columbia	15,209	1,545	929	1,608	657	2,266
Net	5,301	1,149	895	1,083	644	1,728
Tidal Sport	4,457	0	0	160	0	160
Freshwater Sport	1,506	-	-	104	0	104
FN-FSC	3,945	-	-	181	0	181
Troll	0	396	34	80	13	93
West Coast Vancouver Island	32,227	7,560	10,974	3,586	2,107	5,693
Net	8,854	259	0	597	0	597
Tidal Sport	22,272	7,301	10,974	2,939	2,107	5,046
Freshwater Sport	-	-	-	-	-	0
FN-FSC	1,101	-	-	51	0	51
Johnstone Strait	8,553	1,893	5,058	1,080	971	2,051
Net	35	241	0	181	0	181
Tidal Sport	8,260	1,652	5,058	887	971	1,858
Freshwater Sport	-	-	-	-	-	0
FN-FSC	258	-	-	12	0	12
Georgia Strait	25,883	3,315	71,290	2,505	13,688	16,193
Net	4	188	0	138	0	138
Tidal Sport	25,036	3,127	71,290	2,328	13,688	16,016
Freshwater Sport	-	-	-	-	-	0
FN-FSC	843	0	0	39	0	39
Troll	-	-	-	-	-	0
Juan de Fuca	32,636	8,816	17,145	4,116	3,931	6,947
Net	273	316	1,095	250	849	0
Tidal Sport	32,363	8,500	16,050	3,865	3,082	6,947
Fraser River	31,722	14,389	2,242	9,327	430	9,758
Commercial Net	5	21	0	20	0	20
FN-EO Net	229	6,202	0	5,878	0	5,878
FN-FSC Net	17,092	113	0	893	0	893
Mainstem Catch Sport	2,882	685	148	330	28	359
Test Fishery Net	2,890	84	0	212	0	212
Trib Catch Sport	8,624	7,284	2,094	1,994	402	2,396
Grand Total	176,215	41,299	108,774	26,038	22,306	47,247

1.3.2 Southern U.S. Individual Stock Based Management Fisheries

Southern U.S. fisheries of interest to the PSC, generally those north of Cape Falcon, Oregon, are managed in accordance with legal obligations stemming from treaties between Indian tribes and the U.S., and where relevant, the conservation constraints set by the ESA. In 1974, *U.S. v Washington* set forth sharing obligations to meet treaty fishing rights in western Washington. Treaty rights of Columbia River tribes were defined by *U.S. v Oregon*, and the Columbia River Fisheries Management Plan was implemented in 1977. In reporting these fisheries, fisheries are termed *treaty Indian* if they are fishing under the Native American Treaty fishing rights and *non-Indian* otherwise. As specified in the 2009 Agreement, all southern U.S. fisheries are ISBM fisheries. Historical catches in these fisheries are provided in Appendices A.16 through A.22.

1.3.2.1 *Strait of Juan de Fuca and the San Juan Islands*

The preliminary estimate of the 2013 Chinook salmon catch in Strait of Juan de Fuca net fisheries was 449 fish with the majority of these taken during fisheries targeting Fraser River sockeye salmon. There were 3,872 Chinook salmon harvested in the San Juan Islands net fisheries. The preliminary estimate of the 2013 Strait of Juan de Fuca treaty Indian troll fishery catch (through December 2013) is 3,295 Chinook salmon. The catch estimate does not include catches from Area 4B during the May to September Pacific Fisheries Management Council management period. Historic catch estimates are provided for the Strait of Juan de Fuca (Appendix A.16) and San Juan areas (Appendix A.17).

1.3.2.2 *Puget Sound*

The preliminary estimate of the net fishery harvest of Chinook salmon in Puget Sound marine areas in 2013 is 77,952 (68,916 treaty Indian, 9,036 non-Indian) for all marine areas excluding Strait of Juan de Fuca (Area 4B, 5, 6, 6A, 6B, and 6C) and San Juan Islands (Area 7 and 7A). Additional harvest occurred in treaty Indian freshwater net fisheries with a preliminary estimate of 27,077. Estimates of the sport catch in 2013 are not yet available from the Washington Department of Fish and Wildlife (WDFW) Catch Record Card accounting system; thus, the preliminary estimate of sport catch reported here for 2013 is an average of the previous three years. Historic catch tables for Puget Sound exclusive of the Strait of Juan de Fuca and San Juan Islands are provided in Appendix A.18.

1.3.2.3 *Washington Coast Terminal*

Treaty Indian commercial, ceremonial and subsistence fisheries harvested 14,351 Chinook salmon in north coastal rivers (Quinault, Queets, Hoh, and Quillayute) in 2013.

Harvest in Grays Harbor includes catch from both the Humptulips and Chehalis rivers. The 2013 treaty Indian net fisheries harvested an estimated 2,755 Chinook salmon. The 2013 non-Indian commercial net harvest in Grays Harbor was 39 Chinook salmon. An estimated 13,966 Chinook salmon were harvested by non-Indian commercial net fisheries in Willapa Bay in 2013.

From Grays Harbor north, sport fisheries were implemented based upon preseason state–tribal agreements and were subject to inseason adjustment. Estimates of sport fishery catches for Washington coastal terminal fishing areas in 2013 are not yet available from the Catch Record Card accounting system, but are approximated here based on the average catch from the previous three years. Historic catch estimates for Washington Coastal inside fisheries are shown in Appendix A.19.

1.3.2.4 *North of Cape Falcon*

Ocean fisheries off the coasts of Washington, Oregon, and California are managed under regulations recommended by the Pacific Fishery Management Council. The fisheries north of Cape Falcon also fall under the jurisdiction of the PST. For 2013, the estimated catch of Chinook salmon in commercial troll fisheries from Cape Falcon, Oregon to the U.S.-Canada border was 91,915 for non-Indian and treaty Indian fisheries combined. Estimated catch in the ocean sport fishery north of Cape Falcon in 2013 was 30,837 Chinook salmon. Historic catch estimates for U.S. ocean fisheries north of Cape Falcon are shown in Appendix A.20.

1.3.2.5 *Columbia River*

Chinook salmon from the Columbia River are divided into eight stock groups for management purposes. These groups are delineated by run timing and area of origin: (1) spring run originating below Bonneville Dam, (2) spring run originating above Bonneville Dam, (3) summer run originating above Bonneville Dam, (4) fall run returning to Spring Creek Hatchery, (5) fall run originating in hatchery complexes below Bonneville Dam, (6) wild fall run originating below Bonneville Dam, (7) Upriver Bright fall run, and (8) Mid-Columbia Bright fall hatchery fish.

When comparing the IM estimates in Table 1.9 and Appendix Table A.21 with IM from *US vs. Oregon* Technical Advisory Committee, WDFW, Oregon Department of Fish and Wildlife (ODFW), and Columbia River Intertribal Fish Commission (CRITFC) reports, readers should keep the following in mind.

1. The Columbia River fishery management agencies include release mortality in some of their catch estimates whereas the tables in this report show LC in terms of retained fish only.
2. Release mortality rates used by Columbia River fishery management agencies differ from those used by the CTC for this report.
3. The tables in this report include estimates of IM from net dropout and hook and line dropoff, whereas the Columbia River fishery management agencies do not estimate this type of fishery related mortality.

In 2013, the total annual harvest for all fisheries (spring, summer, and fall, both hatchery and wild) in the Columbia River basin was 500,376 Chinook salmon. This included non-Indian commercial net plus Wanapum and Colville tribal harvest of 130,816; sport harvest of 109,741; and treaty Indian commercial, ceremonial, and subsistence harvest of 259,820 (Appendix Table A.21). The 2013 total annual Columbia River combined net and sport harvest consisted of 50,651 spring Chinook, 19,715 summer Chinook and 430,011 fall Chinook (Table 1.9) salmon.

Table 1.9.–Estimated incidental mortality in Southern U.S. troll, net, and sport fisheries, 2011–2013.

Fishery	Gear	2013			2012			2011		
		LC	Releases	IM	LC	Releases	IM	LC	Releases	IM
Juan de Fuca	Net	449	NA	36	1,523	NA	122	352	NA	28
	Sport	11,622[1]	28,957[1]	9,446[1]	13,854	28,235	9,576	9,504	20,601	6,899
	Troll	3,295	NA	82	1,026	NA	26	4,090	NA	102
Total		15,366	28,957	9,564	16,403	28,235	9,723	13,946	20,601	7,029
San Juans	Net	3,872	12,065	9,962	441	218	210	5,810	11,893	9,979
	Sport	5,038[1]	4,898[1]	2,043[1]	5,764	5,688	2,360	6,193	6,603	2,668
Total		8,910	16,963	12,005	6,205	5,906	2,570	12,003	18,496	12,647
Puget Sound	Net	105,029	NA	8,402	115,917	NA	9,273	100,692	NA	8,055
	Sport	28,227[1]	77,777[1]	24,937[1]	22,036	115,056	34,030	29,829	78,760	25,433
Total		133,256	77,777	33,339	137,953	115,056	43,304	130,521	78,760	33,488
Wash. Inside Coastal	Net	31,111	NA	622	29,232	NA	585	39,034	NA	781
	Sport	10,143[1]	NA	700[1]	9,646	NA	666	13,951	NA	963
Total		41,254	-	1,322	38,878	-	1,250	52,985	-	1,743
Columbia River--Spring	Net	22,954	818	1,193	48,922	850	1,706	41,403	1,663	2,015
	Sport	27,697	3,064	2,521	66,516	4,222	5,429	71,888	4,229	5,801
Summer	Net	15,591	0	468	9,562	0	287	25,704	0	771
	Sport	4,124	1,514	471	6,151	7,180	1,308	10,403	4,493	1,270
Fall	Net	352,091	0	10,563	184,886	0	5,547	200,566	0	6,017
	Sport	77,920	39,070	12,878	75,656	11,760	7,478	67,868	4,770	5,599
Total		500,376	44,466	28,092	391,694	24,012	21,754	417,832	15,155	21,473
WA/OR North Falcon	Sport	30,837	32,048	5,640	35,428	42,874	7,388	30,826	55,050	9,090
	Troll	91,915	NA	2,298	99,792	NA	2,495	61,433	NA	1,536
Total		122,752	32,048	7,938	135,220	42,874	9,882	92,259	55,050	10,626
Oregon Inside	Sport	35,317[2]	NA	2,437[2]	26,272	NA	1,813	33,089	NA	2,283
	Troll[3]	1,188	NA	30	636	NA	16	1,954	NA	49
Total		36,505	NA	2,467	26,908	NA	1,829	35,043	NA	2,332
GRAND TOTAL		858,420	181,965	94,727	750,133	207,032	91,644	753,978	157,338	89,279

[1] WDFW Catch Record Card estimates of LC were not yet available; LC and releases for 2013 were computed using 2010–2012 mean values.

[2] Values for 2013 LC and IM are estimates based on averages, not actual observed values. These will become available after the timeframe required for this report.

[3] The value represented by Troll is the concentrated fishery off of the mouth of the Elk River which is designed to specifically exploit returning Elk River Chinook salmon.

1.3.2.6 *Oregon Coast Terminal*

Most harvest in ocean fisheries off Oregon's coast is comprised of a mixture of southern Oregon and California Chinook salmon stocks not included in the PSC agreement. These stocks do not migrate north into the PSC jurisdiction to any great extent. Chinook salmon originating from Oregon streams north of Cape Blanco migrate north, and a majority of these populations are designated as the NOC aggregate and are included in the CTC Chinook model. Chinook salmon originating from Mid-Oregon Coastal (MOC) streams are also caught in PSC fisheries. The NOC stocks are harvested only incidentally in Oregon ocean fisheries, while the contribution of MOC stocks to Oregon and Washington ocean fisheries is greater (based on CWT distribution data). On the mid-Oregon coast south of the NOC to Cape Blanco is a smaller population group designated as MOC. Catch statistics for this group are readily available only for one terminal ocean area troll fishery on a hatchery supplemented stock at the mouth of the Elk River. Late season (October to December) troll catch in the Elk River terminal troll fishery in 2013 was 1,188 Chinook salmon.

Sport catch of these two stock groups occurs primarily in estuary and freshwater areas as mature fish return to spawn, and catch is reported through a punch card accounting system. These estimates become available more than two years after the current season. Therefore, inriver and estuary sport catch punch card estimates are provided through 2011 only for the NOC. The 2012 punch card estimate of estuary and freshwater catch for the NOC group is 26,272 Chinook salmon. However, catch projections have been made for 2013 using correlations between escapement and punch card catch estimates for past years; these preliminary estimates of terminal sport catch for 2013 are presented in Table 1.9. Historical catch estimates for the troll fishery targeting Elk River and the estuary and freshwater sport fisheries targeting on NOC stocks are shown in Appendix A.22.

1.3.3 Estimates of Incidental Mortality for Southern U.S. Fisheries

Table 1.9 shows estimates of IMs for southern U.S. fisheries in marine and river fisheries in Puget Sound, on the Washington and Oregon coast north of Cape Falcon, Oregon coast terminal fisheries, and in the Columbia River fisheries. IM was calculated using the release mortality, drop-out, and drop-off mortality rates assigned for areas and gears in CTC (1997). Number of fish released is from creel interviews, voluntary trip reports, onwater monitoring, or extrapolated from similarly structured fisheries with known release information.

1.4 Summary of 2013 Coastwide Landed Catch, Incidental Mortality, and Total Mortality in Pacific Salmon Commission Fisheries

Table 1.10 provides a coastwide summary of Chinook salmon catches and estimates of IM and TM in PSC fisheries for 2013. It should be noted, for some component fisheries, that current 2013 LC and IM are not yet available; the preliminary estimates of LC and IM will be updated in future reports as observed data become available.

The preliminary estimate of total LC of Chinook salmon for all PSC fisheries in 2013 is 1,448,038; 1,104,311 were taken in U.S. fisheries and 405,727 were taken in Canadian fisheries (

Table 1.10). Total estimated IM associated with this harvest was 232,096 Chinook salmon (14% of the TM) in nominal fish. The TM for all PSC fisheries in nominal fish was 1,680,134 Chinook salmon which is approximately 44,000 more than recorded for 2012 (Appendix A.25). Of the 1,680,134 total PSC TM estimated for 2013, 1,189,685 occurred in U.S. fisheries and 490,449 occurred in Canadian fisheries. For U.S. fisheries, 82% of the LC and 80% of TM occurred in

ISBM fisheries; in Canada, 43% of the LC and 46% of TM occurred in ISBM fisheries. Data for calculating summary information contained in

Table 1.10 for 2013 and previous years can be found in Appendix A.23, A.24, and A.25.

Table 1.10.–Summary in nominal fish of preliminary estimates for landed catch (LC), incidental mortality (IM), and total mortality (TM) for U.S. and Canada AABM and ISBM fisheries in 2013.

Fishery	**2013**		
	LC	**IM**	**TM**
SEAK AABM	183,891	52,647	236,538
SEAK hatchery add-on and terminal exclusion	62,836	40,491	103,327
U.S. ISBM	858,420	94,727	953,147
U.S. TOTAL[1]	1,104,311	147,374	1,189,685
NBC AABM	115,914	19,926	135,840
WCVI AABM	113,598	16,449	130,047
CANADA ISBM	176,215	48,347	224,562
CANADA TOTAL	405,727	84,722	490,449
PST FISHERIES TOTAL[1]	1,448,038	232,096	1,680,134

[1] Does not include SEAK AABM fishery nontreaty catch from hatchery add-on and terminal exclusion.

2 CHINOOK SALMON ESCAPEMENTS

The Agreement established a Chinook salmon management program that

> *"introduces catch regimes that are based on estimates of Chinook salmon abundance, that are responsive to changes in Chinook salmon production, that take into account all fishery induced mortalities and that are designed to meet MSY or other agreed biologically based escapement objectives…"*

This chapter compares annual escapement estimates with MSY or other agreed biologically based escapement goals established for Chinook salmon stocks. The CTC has reviewed and accepted escapement goals for 21 stocks included in this report.

This annual report includes a section on the framework used for escapement assessments and narratives for each stock that includes a description of escapement methodology, escapement goal basis, and agency comments. Annual reports from 2006 to 2011 used an abbreviated narrative for each stock.

Escapement goals accepted by the CTC were based on analyses that followed the guidelines developed in the CTC escapement goal report (CTC 1999). In the stock-specific narratives presented with the escapement graphs, only CTC-accepted escapement goals and ranges (in gray shading) are shown on the escapement graphs and used for evaluation. Table 2.1 presents the status of escapement goal reviews by the CTC for stocks identified as escapement indicator stocks.

2.1 Escapement Goal Assessments

The Agreement (Annex IV, Chapter 3, Paragraph 1.b.iii) directs the CTC to

> *"report annually on the escapement of naturally spawning Chinook salmon stocks in relation to the agreed escapement objectives referred to below, evaluate trends in the status of stocks, and report on progress in the rebuilding of naturally spawning Chinook salmon stocks…"*

Stock-specific graphs of escapements and commentaries are presented in this report to provide a perspective on stock status and escapement trends through 2012.

The escapement goals and 2012 to 2013 escapements for the 21 stocks with CTC-accepted escapement goals are listed in Table 2.2. For eight of these stocks, the agency escapement goal is defined as a range; for the remaining 13 stocks, the escapement goal is defined as a point estimate. In 2013, escapements were within the goal range for four stocks, above the range or S_{MSY} point estimate for nine stocks, and below the goal for eight stocks.

The CTC has now assessed the status of stocks with CTC-accepted goals for return years 1999 to 2013. Over this time period, the number of stocks with CTC-accepted goals has increased from 15 to 21 (Figure 2.1). From 1999 to 2012, the percentage of stocks that met or exceeded escapement goals or goal ranges has varied from 50% to 96%. In 2013, the percentage of stocks that met or exceeded goal was 62%. Of the eight stocks below goal, three stocks (Chilkat, Taku, and Queets fall) were within 15% of the target goal. Five stocks were more than 15% below goal: Unuk, Harrison, Cowichan, Queets spring/summer, and Hoh spring/summer).

Table 2.1.–Pacific Salmon Commission Chinook salmon escapement indicator stocks.

Presence in Treaty Attachments					Stock Group in Attachment I–V	Escapement Indicator	Region[1]	Run
SEAK	NBC/ QCI	WCVI	BC ISBM	SUS ISBM				
						Situk	Yakutat	Spring
						Chilkat	N. Inside	Spring
						Unuk	S. Inside	Spring
						Chickamin	S. Inside	Spring
						Alsek	TBR	Spring
						Taku	TBR	Spring
						Stikine	TBR	Spring
✓	✓		✓		North/Central British Columbia	Yakoun	NBC-Area 1	Summer
✓	✓		✓		North/Central British Columbia	Nass	NBC-Area 3	Spring/Summer
✓	✓		✓		North/Central British Columbia	Skeena	NBC-Area 4	Spring/Summer
			✓		North/Central British Columbia	Dean	CBC-Area 8	Spring
						Rivers Inlet	CBC-Area 9	Spring/Summer
✓	✓		✓		WCVI Falls	Artlish, Burman, Kaouk, Tahsis, Tashish, Marble	WCVI	Fall
✓	✓		✓		UGS	Klinaklini , Kakwiekan, Wakeman, Kingcome, Nimpkish	UGS	Summer/Fall
			✓		LGS	Cowichan/Nanaimo[2]	LGS	Fall
✓	✓		✓		Fraser Early[3] (Spr/Sum)	Fraser Spring 1.3	FR	Spring
✓	✓		✓		Fraser Early[3] (Spr/Sum)	Fraser Spring 1.2	FR	Spring
✓	✓		✓		Fraser Early[3] (Spr/Sum)	Fraser Summer 1.3	FR	Summer
✓	✓		✓		Fraser Early[3] (Spr/Sum)	Fraser Summer 0.3	FR	Summer
		✓	✓	✓	Fraser Late	Harrison	FR	Fall
			✓	✓	North Puget Sound Natural springs	Nooksack	NC/PS	Spring
			✓	✓	North Puget Sound Natural Springs	Skagit Spring	NC/PS	Spring
		✓	✓	✓	Puget Sound Natural Summer/Falls	Skagit Summer/Fall	NC/PS	Summer/Fall
		✓	✓	✓	Puget Sound Natural Summer/Falls	Stillaguamish	NC/PS	Summer/Fall
		✓	✓	✓	Puget Sound Natural Summer/Falls	Snohomish	NC/PS	Summer/Fall
		✓	✓	✓	Puget Sound Natural Summer/Falls	Lake Washington	NC/PS	Summer/Fall
		✓	✓	✓	Puget Sound Natural Summer/Falls	Green	NC/PS	Summer/Fall
✓	✓			✓	Washington Coastal Fall Natural	Hoko	WAC/JDF	Fall
						Quillayute Summer	WAC/JDF	Summer
✓	✓			✓	Washington Coastal Fall Natural	Quillayute Fall	WAC/JDF	Fall
						Hoh Spring/Summer	WAC/JDF	Summer

–continued–

Table 2.1.–Page 2 of 2.

Presence in Treaty Attachments					Stock Group in Attachment I–V	Escapement Indicator	Region[1]	Run
SEAK	NBC/ QCI	WCVI	BC ISBM	SUS ISBM				
✓	✓			✓	Washington Coastal Fall Natural	Hoh Fall	WAC/JDF	Fall
						Queets Spring/Summer	WAC/JDF	Summer
✓	✓			✓	Washington Coastal Fall Natural	Queets Fall	WAC/JDF	Fall
						Grays Harbor Spring	WAC/JDF	Spring
✓	✓			✓	Washington Coastal Fall Natural	Grays Harbor Fall[4]	WAC/JDF	Fall
						COLR Upriver Spring	COLR	Spring
✓	✓	✓		✓	Columbia River Upriver Summers	Mid-COLR Summers	COLR	Summer
✓	✓	✓		✓	Columbia River Falls	COLR Upriver Bright	COLR	Fall
✓	✓	✓		✓	Columbia River Falls	Lewis	COLR	Fall
✓	✓	✓		✓	Columbia River Falls	Deschutes	COLR	Fall
✓	✓			✓	Far North Migrating Oregon Coastal	Nehalem	NOC	Fall
✓	✓			✓	Far North Migrating Oregon Coastal	Siletz	NOC	Fall
✓	✓			✓	Far North Migrating Oregon Coastal	Siuslaw	NOC	Fall
						South Umpqua	MOC	Fall
						Coquille	MOC	Fall

Note: Shading indicates that there is not a CTC-accepted escapement goal.

[1] Refer to List of Acronyms for definitions.

[2] An escapement goal was established for the Cowichan in 2005; a goal for Nanaimo is still pending.

[3] The escapement indicator stocks listed in the Annex tables for this group are Upper Fraser, Middle Fraser, and Thompson. The Fraser River spring/summer group is split into these four escapement indicators to represent the stock group by life history type rather than geographically.

[4] An escapement goal for Grays Harbor fall was provisionally accepted by the CTC in February, 2014.

Table 2.2.–Escapement goals, 2012–2013 escapements, and 2014 forecasts for stocks with CTC-agreed goals.

Stock	Region[1]	Stock Group	Escapement Goal	2012 Escapement[2]	2013 Escapement[2]	2014 Forecast[2]
Situk	SEAK	Yakutat	500–1,000	**322 (64%)**	912 (182%)	800
Chilkat[3]	SEAK	Northern Inside	1,750–3,500	1,627 (93%)	1,730 (99%)	2,100+
Unuk	SEAK	Southern Inside	1,800–3,800	**956 (53%)**	**1,135 (63%)**	2,600
Chickamin (survey index)	SEAK	Southern Inside	450–900	444 (99%)	**468 (104%)**	NA
Alsek	SEAK/ TBR	Transboundary Rivers	3,500–5,300	**2,660 (76%)**	5,044 (144%)	NA
Taku[3]	SEAK/ TBR	Transboundary Rivers	19,000–36,000	19,429 (102%)	18,002 (95%)	26,800
Stikine[3]	SEAK/ TBR	Transboundary Rivers	14,000–28,000	22,671 (162%)	16,737 (119%)	27,700
Harrison	BC	Fraser River	75,100–98,500	**44,467 (59%)**	**42,953 (57%)**	72,484 (97%)
Cowichan	BC	Lower Strait of Georgia	6,500	**3508 (54%)**	**2,388 (37%)**	NA
Columbia Upriver Summers	COLR	Colorado River	12,143	52,184 (430%)	68,386 (563%)	67,500 (556%)[4]
Columbia Upriver Brights	COLR	Colorado River	40,000	131,613 (329%)	371,154 (928%)	444,300 (1,110%)[5]
Deschutes Fall	COLR	Colorado River	4,532	17,624 (389%)	18,068 (399%)	NA
Lewis	COLR	Colorado River	5,700	8,143 (143%)	15,197 (267%)	22,900 (402%)[5]
Quillayute Fall	WAC	Washington Coast	3,000	3,181 (106%)	3,901 (130%)	6,649 (221%)[4]
Queets Spr/Sum	WAC	Washington Coast	700	764 (109%)	**520 (74%)**	**500 (71%)**
Queets Fall	WAC	Washington Coast	2,500	3,993 (160%)	2,413 (96%)	3,576 (143%)[4]
Hoh Spr/Sum	WAC	Washington Coast	900	915 (102%)	**750 (83%)**	876 (97%)
Hoh Fall	WAC	Washington Coast	1,200	1,937 (161%)	1,269 (106%)	2,447 (203%)[4]
Nehalem	ORC	Oregon Coast	6,989	7,515 (108%)	18,194 (260%)	15,998 (229%)
Siletz	ORC	Oregon Coast	2,944	4,871 (165%)	7,364 (250%)	7,584 (258%)
Siuslaw	ORC	Oregon Coast	12,925	20,018 (155%)	23,411 (181%)	24,838 (192%)

[1] Refer to List of Acronyms for definitions

[2] Percentages relative to goals are in parentheses. Escapements below the goal or lower bound of the escapement range are shaded; escapements or forecasts below the 85% threshold applicable to Attachment I–III are bold.

[3] The forecast for Chilkat River Chinook salmon is an inriver run forecast and not a forecast of escapement; the forecasts for Taku and Stikine river Chinook salmon are terminal run forecasts and not forecasts of escapement.

[4] Forecasts for terminal run rather than escapement.

[5] Projected escapement in 2014 based on estimated escapement in the final preseason inriver harvest model for 2014. Lewis River is calculated as 87% of the estimate of escapement for Lower River Wild management unit.

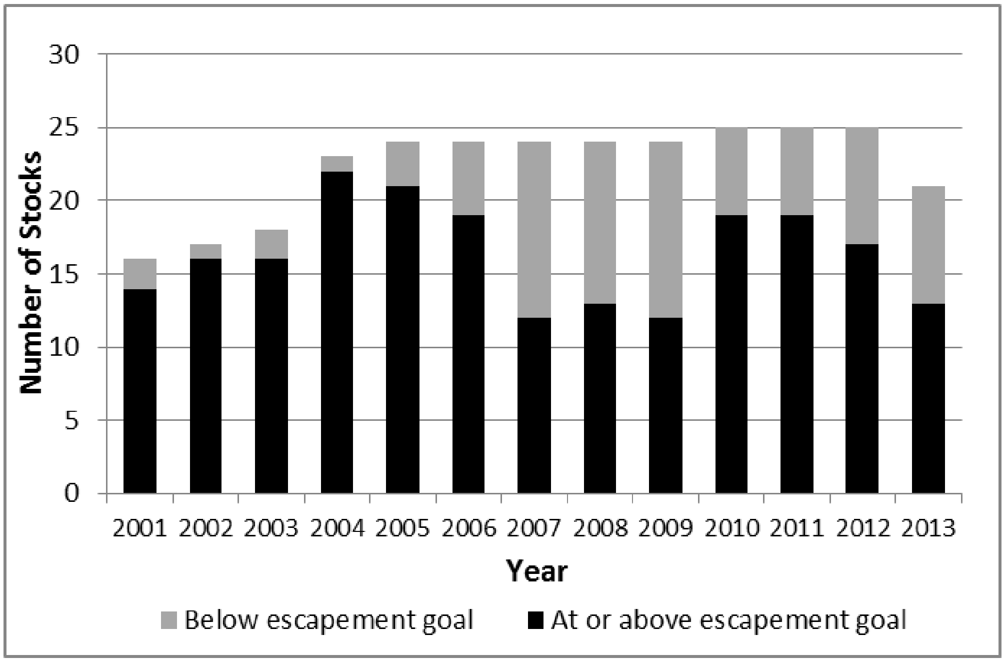


Figure 2.1.–Number and status of stocks with CTC-accepted escapement goals, 1999–2013.

Note: The Keta, Blossom, and King Salmon rivers and Andrews Creek stocks have been dropped as escapement indicator stocks, bringing the total number of stocks with CTC-accepted escapement goals to 21 in 2013.

2.2 Trends for Escapement Indicator Stocks

The evaluation of trends in Chinook salmon escapements was based on the 1999 to 2013 time series of escapements using a state-space exponential growth model (Dennis et al. 2006) parameterized through restricted maximum likelihood (Humbert et al. 2009), which produces rates of change estimates that are generally superior to those produced through maximum likelihood (Staples et al. 2004). This method assumes both observation error and process noise and therefore produces variances and confidence intervals (CIs) that represent the annual variability associated with environmental stochasticity and sampling or observation error (Humber et al. 2009). The start year of the time series was chosen to correspond with the start of the 1999 Agreement. For some stocks, however, the time series of escapement started later due to changes in escapement estimation methodology. Thus the analysis of trends is based on escapement estimates produced by the same methodology across the time period or a combination of estimated and calibrated estimates. Stock-specific escapement trends were characterized by the long-term mean rate of change (μ) and corresponding 95% CIs, where μ = 0.00 indicates equilibrium (i.e., escapement has been stable, on average, for the selected time period) and the CIs represent the interannual variability in escapement rates of change within the selected time period. For the purposes of presentation, stocks were grouped into four regions: Southeast Alaska/Transboundary, British Columbia, Washington, and Columbia River-Oregon.

2.2.1 Escapement Trends for Southeast Alaska/Transboundary Stocks

The analysis of escapement trends for the period 1999 to 2013 revealed that four of the seven SEAK/TBR stocks of Chinook salmon (Taku, Stikine, Chilkat and Chickamin) demonstrated variable escapement trends, with the average escapement change being near zero (Figure 2.2). Confidence intervals around the rate of change for the Alsek and Unuk stocks of Chinook salmon indicate that escapements have not trended consistently in either direction while the average rate is negative. Escapements have declined significantly for the Situk stock of Chinook salmon. Poor productivity was associated with SEAK/TBR Chinook salmon and especially with outside-rearing stocks. This started with the 2002 brood year and was manifested in the 2007 return year, which led to escapements less than goal for the Situk and Alsek stocks of Chinook salmon, and also with the Unuk stock of Chinook salmon.

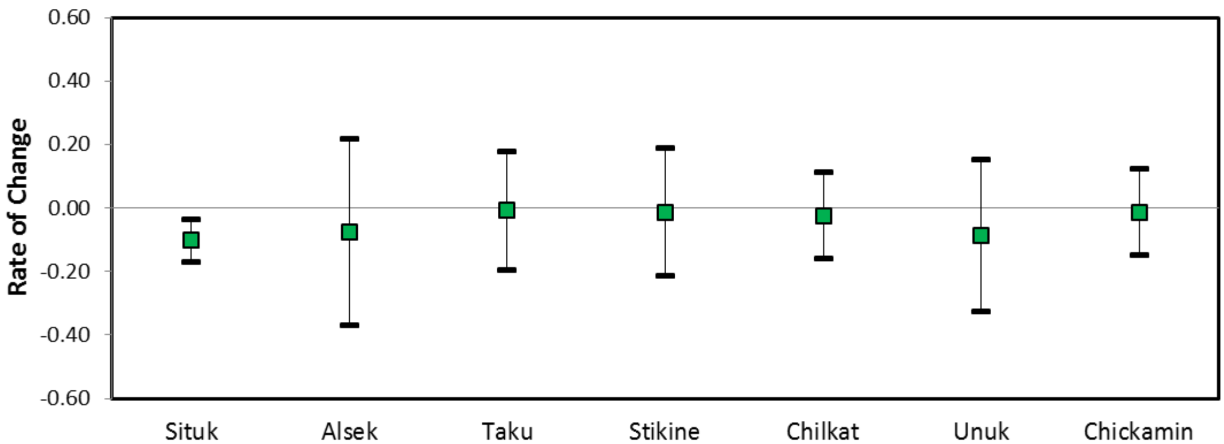


Figure 2.2.–Long-term annual rates of change in escapements for SEAK/TBR Chinook salmon stocks.

Note: Squares represent mean rate of change and bars represent 95% CIs. The color green in the squares indicate these stocks have CTC-accepted escapement goals.

2.2.2 Escapement Trends for Canadian Stocks

The long-term rates of change in escapement for Canadian stocks were based on the 1999 to 2013 time series of escapement for 15 of the 17 stocks evaluated. Due to changes in escapement estimation methodologies, the escapement time series started in Lower Shuswap in 2000 and started in Nanaimo in 2005. Few Canadian stocks exhibited unequivocal positive or negative tendencies in long-term rates of change in escapement. Most stocks, including those with CTC-accepted escapement goals (Cowichan and Harrison) showed negative mean rates of change and large variability in annual rates of change (as indicated by the 95% CIs), generally crossing the equilibrium line (Figure 2.3). Stocks that showed a positive long-term rate of change in escapement include Fraser River summer run age 0.3, Wannock, and the WCVI 6-Stream Index to a lesser extent, whereas stocks showing noticeable negative rates of change include Atnarko, Chuckwalla/Kilbella, Fraser River spring age 1.2, and Lower Shuswap. Chinook salmon from Atnarko, Chuckwalla/Kilbella, Fraser River summer run age 0.3, Wannock, and WCVI 6-Stream Index exhibited the lowest variability in annual rates of change in escapement, whereas Chinook salmon from Nanaimo exhibited much greater variability than all other Canadian stocks. The large 95% CI for Nanaimo is partly due to its short time series. The highest long-term mean rate of change in escapement for Canadian stocks was the 7.7% annual increase for Chinook salmon from the Wannock River, whereas, the lowest mean rate of change in escapement was characterized by a 17.7% annual decline for Chinook salmon from the Chuckwalla-Kilbella aggregate.

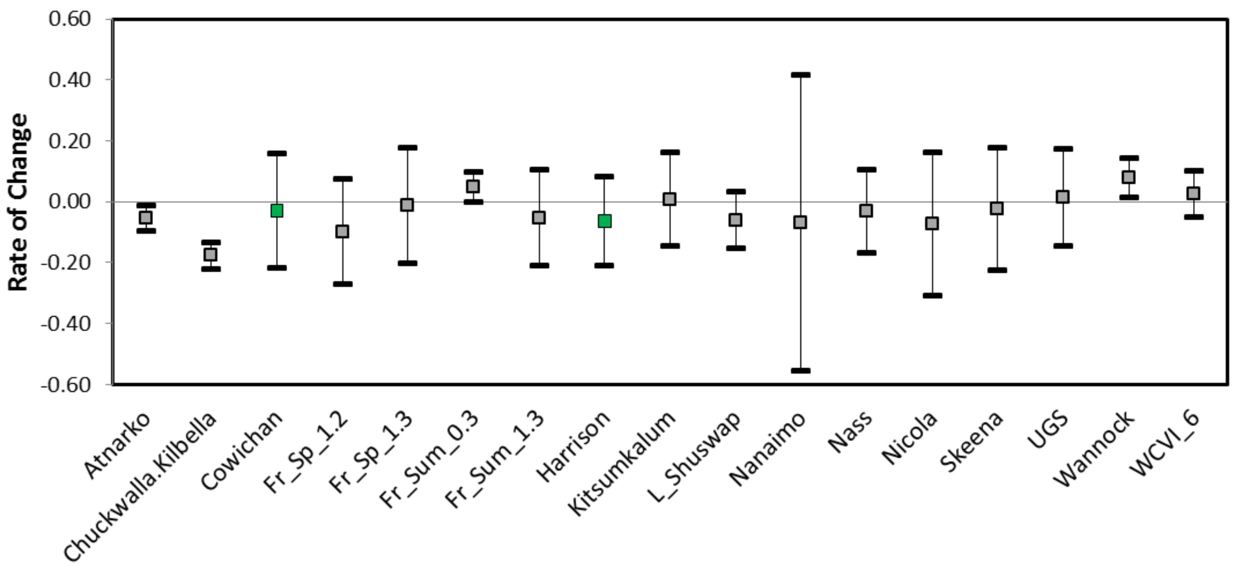


Figure 2.3.–Long-term annual rates of change in escapements for Canadian Chinook salmon stocks.

Note: Squares represent mean rate of change and bars represent 95% CIs. The color green in the squares indicate these stocks have CTC-accepted escapement goals, grey colored squares indicate the stocks do not have CTC-accepted escapement goals. Escapement time series for Nanaimo started in 2005 due to changes in escapement estimation methodologies.

2.2.3 Escapement Trends for Washington Stocks

The analysis of escapement trends for the period 1999–2013 revealed several noteworthy patterns for Puget Sound and Washington Coastal escapement indicator stocks (Figure 2.4). Firstly, of the seven Puget Sound indicators, escapements have declined significantly for two (average annual rate of change –6% for Snohomish, –11% for Green) and trended positively for one (+6% for Lake Washington). Confidence intervals around the rate of change, as well as point estimates, for the four remaining Puget Sound stocks indicate that escapements have not trended consistently in either direction. However, due to widely varying escapements, there is considerable uncertainty around rate of change estimates for Skagit River summer/fall Chinook and Nooksack spring Chinook salmon. Although Puget Sound stocks have largely met their agency management objectives (i.e., exploitation rate ceilings) for the time period under consideration, none of them have CTC-approved escapement goals against which trends can be considered. In contrast to Puget Sound, none of the nine Washington Coast indicators showed a significant trend in escapement for the 1999–2013 period (i.e., 95% CI inclusive of 0; absolute annual rate of change <5% for all). Six of the coastal indicators have CTC-approved goals , which have been consistently met for summer/fall (Queets, Quillayute, Hoh) but not spring/summer (Hoh, Queets) run timing groups. Thus, despite regularly missing goals and returning at levels consistently lower than what was seen historically, the abundance of Hoh and Queets spring/summer Chinook salmon stocks remains stable. In sum, this analysis provides a picture of escapement stability for the Washington Coast Chinook salmon stocks and a variable perspective for Puget Sound Chinook salmon stocks.

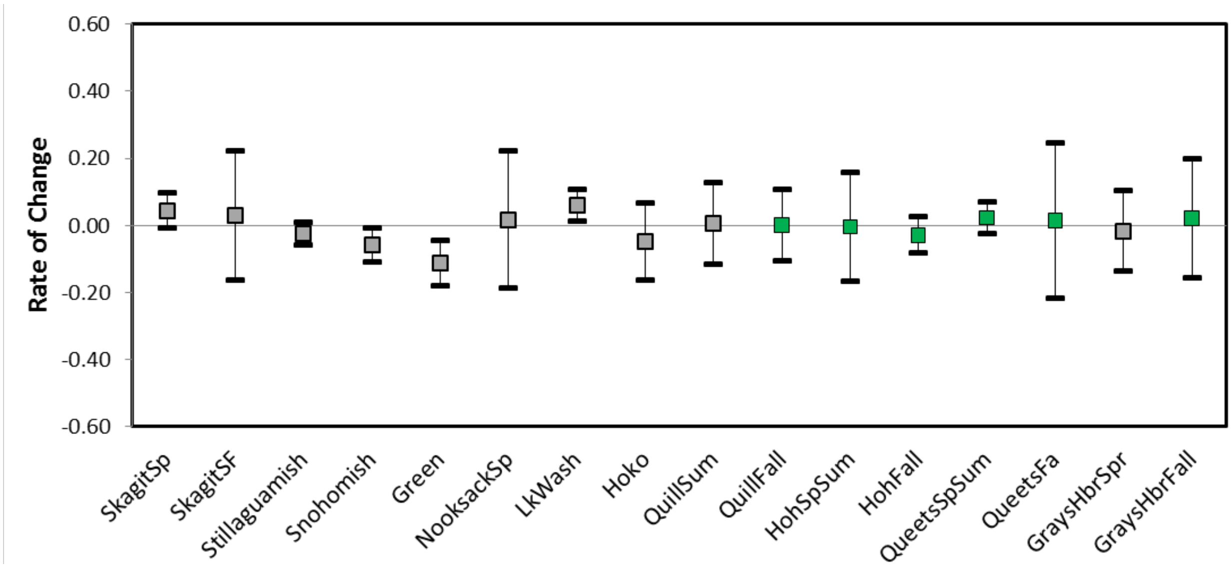


Figure 2.4.–Long-term annual rates of change in escapements for Washington Chinook salmon stocks.

Note: Squares represent mean rate of change and bars represent 95% CIs. The color green in the squares indicate these stocks have CTC-accepted escapement goals, grey colored squares indicate the stocks do not have CTC-accepted escapement goals. The 2013 Nooksack spring escapement estimate was not available for this analysis.

2.2.4 Escapement Trends for Columbia River/Oregon Stocks

Across all of the PSC stock groups assessed, rates of change for Columbia River stocks showed the highest degree of within-region consistency, with all but one stock trending positively (Figure 2.5). Annual rates of change averaged 14% for the five Columbia River stocks and ranged from a low of 7% (Deschutes) to a high of 17% Columbia Upriver Brights) experienced met their objectives in most years when goals applied. During the same period, escapements have varied widely for each of the five Oregon Coast stocks, encompassing two escapement peaks (early 2000s, early 2010s) and one major valley (2005–2008). Consequently, rates of change did not differ from zero in any case and averaged 4% for the five Oregon stocks (Figure 2.5). Outside of the mid-2000s low escapement period, goals were generally met for the three Oregon Coastal indicator stocks with CTC-approved goals (Nehalem, Siletz, Siuslaw).

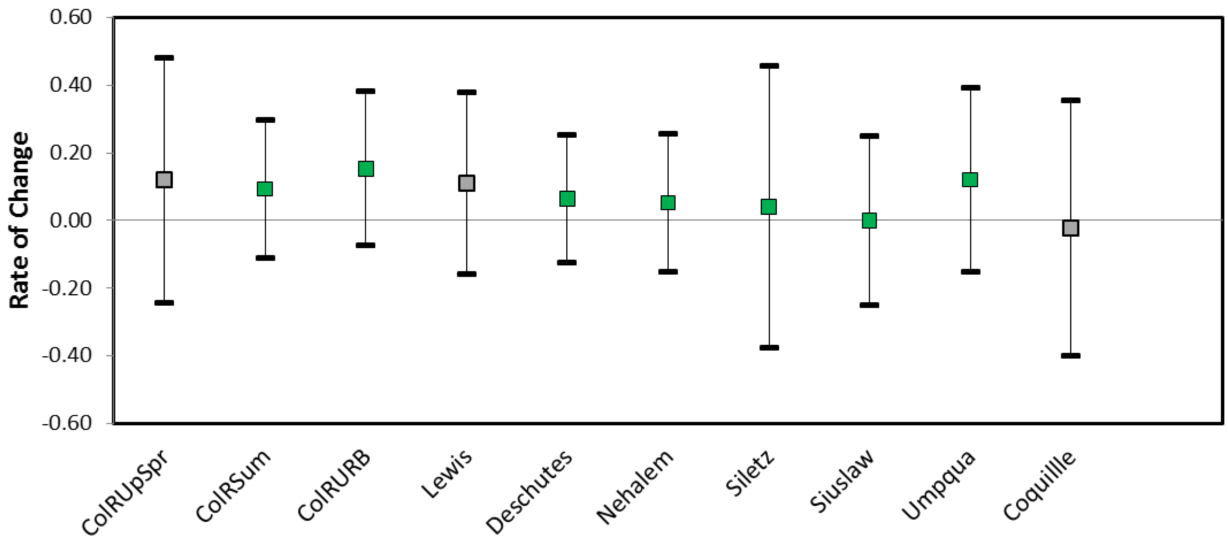


Figure 2.5.–Long-term annual rates of change in escapements for Columbia River/Oregon Chinook salmon stocks.

Note: Squares represent mean rate of change and bars represent 95% CIs. The color green in the squares indicate these stocks have CTC-accepted escapement goals, grey colored squares indicate the stocks do not have CTC-accepted escapement goals.

2.3 Profiles for Escapement Indicator Stocks

Graphs of time series of escapements for Chinook salmon stocks are included in sections for Alaska, Canada, Puget Sound, Coastal Washington, Columbia River, and Oregon Coast. For each stock, there is a commentary describing the escapement methodology, escapement goal basis, escapement evaluation and agency comments. Escapement is usually reported in adults by calendar year (CY). All escapement goals accepted by the CTC are shown. Historical escapement and terminal run data are provided in the appendices for SEAK stocks (Appendix B.1), Canadian stocks (Appendix B.2–B.5), Puget Sound (Appendix B.6), Washington Coastal stocks (Appendix B.7), Columbia River stocks (Appendix B.8 and B.9) and Oregon Coastal stocks (Appendix B.10 and B.11).

2.3.1 Southeast Alaska and Transboundary River Stocks

There are seven SEAK and TBR escapement indicator stocks. The Situk, Chilkat, Taku, Stikine, and Unuk rivers include estimates of total escapement of large fish, Chinook salmon equal to or greater than 660 mm length from mid eye to tail fork. Escapement estimates for the Chickamin River are index observer counts of large fish. These indices are enumerated from aerial helicopter surveys that represent a fraction (one-fifth) of the total number of large spawners. Estimates of large fish include ocean age-3, -4, and -5 fish, which includes virtually all of the females in the population, essentially no ocean age-1 males, and only ocean age-2 fish greater than 659 mm length from mid eye to tail fork. Escapement estimates for the Alsek River are germane to ocean age-2 fish and older. Survey methods have been standardized for all systems since 1975 except for the Chilkat River which was standardized in 1991 as an annual MR estimate of escapement. Escapement goals have been defined as a range for the SEAK/TBR stocks.

The SEAK and TBR stocks can be classified into two broad categories, inside rearing and outside rearing, based on ocean migrations. Outside-rearing stocks have limited marine rearing in SEAK and are caught primarily during their return spawning migrations in the spring; these stocks include Chinook salmon returning to the Situk, Alsek, Taku, and Stikine rivers. Inside-rearing stocks are vulnerable to SEAK and NBC fisheries as immature fish as well as during their spawning migrations and include the other three SEAK indicator stocks (Chilkat, Unuk, and Chickamin). There is some overlap within these two broad classifications. All SEAK and TBR indicator stocks produce primarily yearling smolt except the Situk River, which presently produces around 90% subyearling smolt.

A 15-year rebuilding program was established by the ADF&G in 1981 (ADF&G 1981). At the same time, ADF&G established interim point escapement goals for all seven systems, based on the highest observed escapement count prior to 1981. ADF&G and CDFO have subsequently revised escapement goals for the three TBR stocks which have been reviewed and accepted by the CTC. ADF&G has revised escapement goals for the other four stocks that have been reviewed and accepted by the CTC, some more than once. ADF&G uses escapement goal ranges in conformance with the ADF&G Salmon Escapement Goal Policy and Sustainable Salmon Fisheries Policy.

2.3.1.1 *Southeast Alaska Stocks*

2.3.1.1.1 Situk River

The Situk River is a nonglacial system located near Yakutat, Alaska, that supports a moderate-sized, outside-rearing stock of Chinook salmon. Few Situk-origin Chinook salmon are caught in PSC fisheries other than in directed sport, commercial and subsistence fisheries located inriver, in the estuary, and in nearby surf waters. The fisheries that target this stock fall under a management plan directed to achieve escapements within the range.

Escapement Methodology: Escapements are based on weir counts minus upstream sport fishery harvests (if any), which are estimated from an onsite creel survey and a postseason mail-out survey. The weir has been operated annually since 1976, and was also operated from 1928 to 1955. Counts of large Chinook salmon are reported as the spawning stock. Jacks (ocean-age-1 and -2 fish) are also counted and, since 1989, jack counts (not included in the graph above) have ranged between 1,200 and 4,000. ADF&G assessments of the Situk River escapements of Chinook salmon meet U.S. and Bilateral CTC data standards and have continuously done so since 1976.

Escapement Goal Basis: In 1991, ADF&G revised the Situk River Chinook salmon escapement goal to 600 large spawners based upon a spawner–recruit analysis,[1] which was reviewed and adopted by the CTC. In 1997, ADF&G revised the Situk River escapement goal range to 500 to

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[1] Scott A. McPherson, ADF&G, to Keith Weiland, ADF&G. 1991 memorandum. Available from author, Douglas Island Center Building, 802 3rd Street, P. O. Box 240020, Douglas, AK 99824-0020.

1,000 large spawners to conform to the department's escapement goal policy. The CTC reviewed and accepted this change in 1998. ADF&G changed the goal range from 450 to 1,050 large spawners in 2003; this range was reviewed by the CTC in 2004 but not accepted.

Escapement Evaluation: Productivity of the Situk River stock has significantly declined over the last decade. Annual escapements less than 85% of the goal have occurred in five of the last eight years. The 2013 escapement was 912 fish, a level within the goal range, and significant management action was taken to ensure this goal was met. All terminal fisheries were closed until late in the run when it was apparent the lower bound of the escapement goal would be met. The 2013 escapement is an improvement over the levels seen 2010 through 2012. There were no estimated harvests above the weir and this is an exact count of escapement (Figure 2.6).

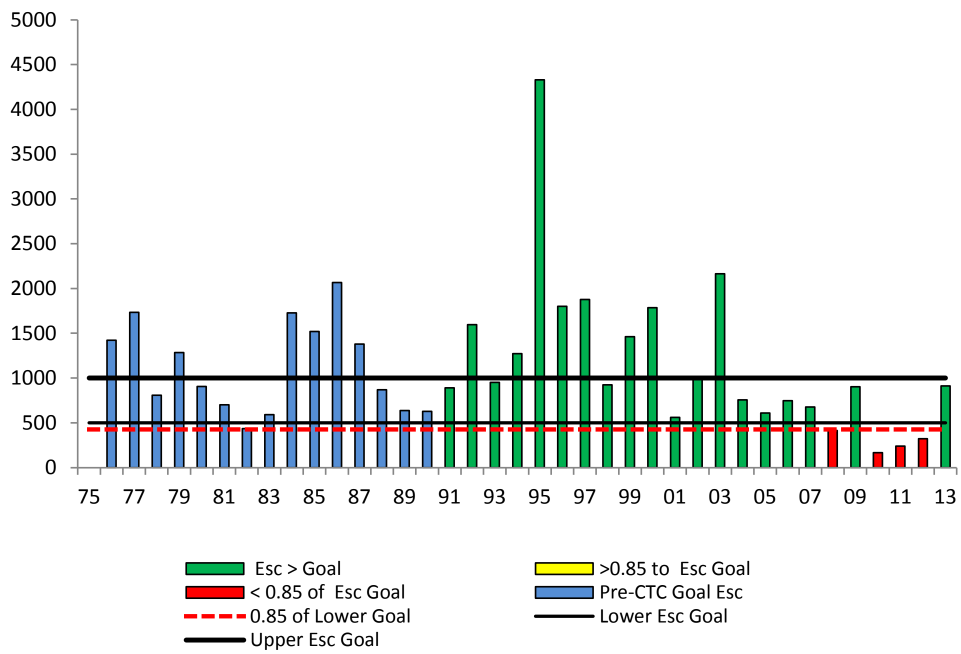

Figure 2.6.–Situk River escapements of Chinook salmon, 1976–2013.

Agency Comments: Total annual terminal harvest rates (and all harvests within the PSC area) for all gear groups combined averaged about 60% from 1990 to 2003. Harvest rates have been substantially lower since 2004 because this stock has experienced poor natural survival for recent brood years. Terminal directed fisheries have been curtailed while incidental catches of this stock in sport and commercial fisheries were restricted to nonretention of Chinook salmon from 2010 to 2012 and during most of 2013.

2.3.1.1.2 Chilkat River

The Chilkat River is a moderate-sized glacial system located near Haines, Alaska which supports an inside-rearing stock of Chinook salmon. Smolts from this stock have had CWTs applied at relatively high rates (8–10%) beginning with the 1999 brood year; additional wild stock tagging occurred for three broods prior to that time. Relatively small terminal U.S. marine sport and subsistence fisheries target this stock. This stock is also caught incidentally in sport, commercial drift gillnet and troll fisheries in northern SEAK.

Escapement Methodology: Escapements are based on estimates of large spawners from a MR program conducted annually since 1991 (Ericksen and McPherson 2003). The escapement data are relatively precise with CVs for annual escapements averaging about 15% since 1991. Since 1991, escapement assessments for Chilkat River Chinook salmon have continuously met U.S. CTC data standards and in most years have met CTC Bilateral data standards. In 10 of the last 23 years the CV was 15% or less, with the highest CV being 21% in 1995. From 1975 to 1992, aerial survey counts were conducted on two small tributaries with relatively clear water; results from these estimates were inconsistent. Radio telemetry studies conducted in 1991 and 1992 found that spawners in these two tributaries represented less than 5% of the total escapement, and did not represent trends in abundance and the aerial surveys were discontinued.

Escapement Goal Basis: The 1981 escapement goal was set at 2,000 large fish, based on an assumed fraction of the total escapement represented by discontinued survey counts. Ericksen and McPherson (2003) recommended a revised escapement goal range of 1,750 to 3,500 large Chinook salmon spawners, based on the MR estimates of escapement and limited CWT information available for this stock. This goal range was reviewed and adopted by ADF&G and the Alaska Board of Fish in 2003 and subsequently reviewed and accepted by the CTC in 2004.

Escapement Evaluation: The Chilkat River stock is reasonably healthy with annual escapements of at least 85% of the goal in all years except in 2007. The 2013 escapement was 1,730 (CV = 20%) Chinook salmon, 99% of the lower bound of the escapement goal range. This stock, like others in Alaska, has recently experienced a decline in productivity (Figure 2.7).

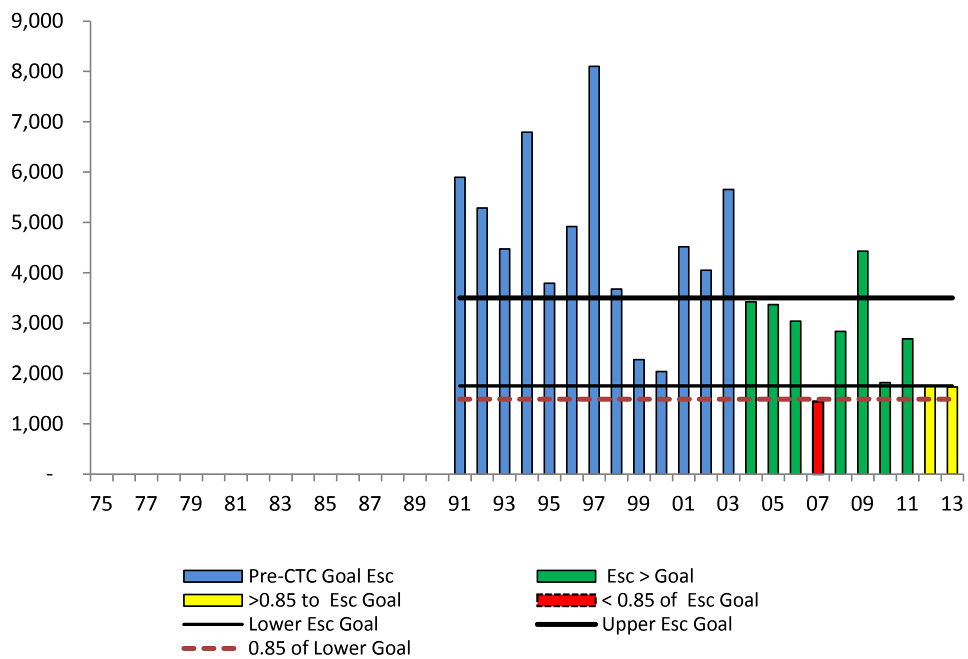

Figure 2.7.–Chilkat River escapements of Chinook salmon, 1991–2013.

Agency Comments: Available CWT information on this stock suggests that exploitation is about 20% for recent brood years from the CTC exploitation rate analysis. Escapements since 1991 have been within or above the escapement goal range in all years except 2007, 2012 and 2013.

2.3.1.1.3 Unuk River

The Unuk River is a moderate-sized glacial system that supports an inside-rearing stock of Chinook salmon. Escapements are estimates of total escapement of large spawners. Harvests of immature and mature fish occur in SEAK and NBC fisheries. On average, for the 1992 to 2001 broods, harvest by gear sector was 47% SEAK troll, 36% SEAK sport, 10% SEAK net and most of the remainder caught in NBC. About 55% of the harvest is taken in the southern inside area of SEAK (mostly troll and sport). Estimated annual harvest rates averaged about 27% in nominal numbers and 24% in adult equivalents from 1985 to 1998 (Hendrich et al. 2008). Coded-wire tagging of this stock was conducted for the 1982 to 1986 (Pahlke 1995) and the 1992 to present broods; this stock is now an exploitation rate indicator stock.

Escapement Methodology: Escapements of large spawners are MR estimates of total escapement from 1997 to 2011 and expanded survey counts from 1977 to 1996 and 2012 to 2013. Radio telemetry studies in 1994 and 2007 showed that the surveys are conducted in stream reaches where 80% of the spawning occurs; the expansion factor for survey counts is 4.83 (Hendrich et al. 2008). Escapement assessments for Unuk River Chinook salmon meet U.S. CTC data standards. Since 1997, CVs of estimates have averaged 11%; in those 17 years, 14 of the annual estimates had CVs of 15% or less; the three annual estimates with CVs exceeding 15% were 16% in 2010, 16% in 2012, and 21% in 2011.

Escapement Goal Basis: In 1994, ADF&G revised the Unuk escapement goal to 875 large spawners in survey (index) counts, based upon the spawner–recruit analysis reported by McPherson and Carlile (1997), which the CTC reviewed and accepted in 1994. In 1997, ADF&G revised the goal to a range of 650 to 1,400 large index spawners as recommended in the McPherson and Carlile (1997) report and in compliance with the ADF&G Escapement Goal Policy. The CTC reviewed and accepted this change in 1998. Since the expansion factor for surveys was unknown at that time, the goal was expressed as an index peak survey count. In 2008, a more extensive analysis was done with spawners, recruitment, and fishing mortality expressed in total numbers of fish because of the extensive number of MR estimates of escapement and CWT data available (Hendrich et al. 2008). The analysis included the 1982 to 2001 brood years. The CTC-accepted a range of 1,800 to 3,800 large spawners, with a point estimate of 2,764 in 2009.

Escapement Evaluation: The Unuk River stock has demonstrated a healthy status with annual escapements from 1977 to 2011 within or above the escapement goal range in all years. However, productivity of the stock has declined in recent years and the 2012 and 2013 escapements were only 956 (CV = 0.16) and 1,135 (CV = 0.12) large Chinook salmon. The 2013 escapement was 63% of the lower end of the goal range (Figure 2.8).

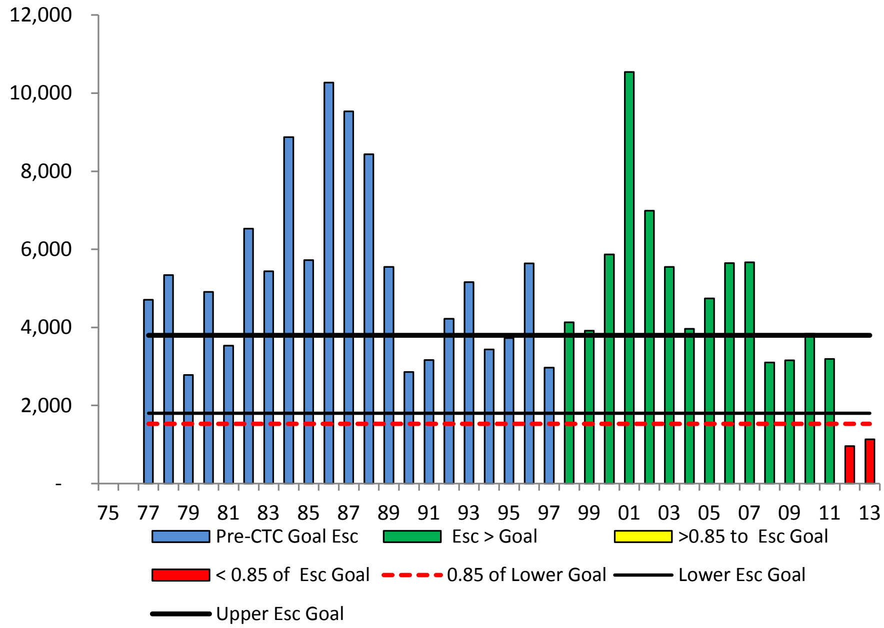

Figure 2.8.–Unuk River escapements of Chinook salmon, 1977–2013.

Agency Comments: The recent reduction in productivity of Chinook salmon stocks in Alaska has been recognized and ADF&G as the management agency is being challenged to respond to reduced run strength in many parts of the State. The large reduction in run strength of the Unuk stock in 2012 and 2013 was unexpected, given its past history. There are no directed fisheries that target this stock; sport fishing in freshwater is closed, marine sport fishing in East Behm Canal is closed during the spring and summer, and commercial fishing in nearby marine waters is closed. Additional management measures to reduce exploitation of this stock in the SEAK fishery are being implemented in 2014.

2.3.1.1.4 Chickamin River

The Chickamin River is a moderate-sized glacial system that supports a run of inside-rearing Chinook salmon, based on wild stock CWTs. There is no terminal fishery targeting this stock; harvests of immature and mature fish occur in marine SEAK and NBC fisheries, with the majority of harvests taken in the southern inside quadrant of SEAK by troll and sport gear sectors. There is no subsistence or freshwater fisheries on any of the Behm Canal Chinook salmon stocks. Coded wire tagging on the Chickamin River was conducted for the 1982 to 1986 broods (Pahlke 1995) and resumed for the 2000 to 2006 broods. Total exploitation rates for recent broods were about 28% to 30% in adult equivalents under the current management regime.

Escapement Methodology: The escapements shown in Figure 2.9 are survey counts (unexpanded highest single-day counts) of large fish in eight tributaries of the Chickamin River using standardized methodology (Pahlke 2003).

Studies in 1995, 1996 and 2001 to 2005 using MR and survey counts found that about 21% of the total escapement is counted during peak surveys on average (Weller et al. 2007). A radio telemetry study in 1996 indicated that the annual surveys are conducted in stream reaches where over 80% of all spawning occurs. The expansion factor is estimated at 4.75 for survey counts using the results from the 1996 and 2001 to 2005 studies. Because total escapements for Chickamin River Chinook salmon are not reported, the assessments do not meet U.S. CTC nor Bilateral CTC data standards.

Escapement Goal Basis: In 1994, ADF&G revised the goal to 525 large index spawners based upon a spawner–recruit analysis (McPherson and Carlile 1997), which the CTC reviewed and accepted. In 1997, ADF&G revised the goal to 450–900 large index spawners as recommended in the McPherson and Carlile (1997) report and in compliance with the ADF&G Escapement Goal Policy (5 AAC 39.223). The CTC reviewed and accepted this change in 1998.

Escapement Evaluation: The Chickamin River stock is reasonably healthy while showing a cyclic pattern of escapement since 1975. Annual escapements less than 85% of the goal have occurred eight times since 1975, all of which occurred before 1998. The 2013 escapement index was 468 large spawning Chinook salmon, within the escapement goal range. This index count is not expanded to an estimate of total escapement and has no associated variance, accordingly (Figure 2.9).

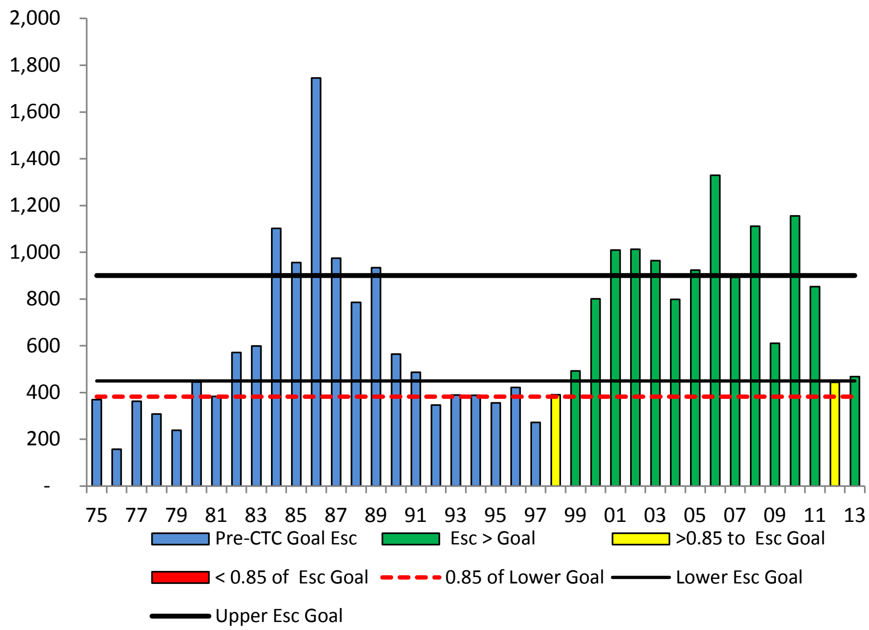

Figure 2.9.–Chickamin River peak index counts of Chinook salmon, 1975–2013.

Agency Comments: By size, these are the largest Chinook salmon of the seven escapement indicator stocks. The time series of survey counts follows two cycles: counts from 1975 to 1981 and 1992 to 1998 were below the goal range, and those from 1982 to 1991 and 1999 to 2011 were all within or slightly above the range. The 2013 escapement for this stock was slightly higher than the escapement seen in 2012 and is indicative of reduced productivity seen recently throughout SEAK.

2.3.1.2 *Transboundary River Stocks*

2.3.1.2.1 Alsek River

The Alsek River is large transboundary glacial system that originates in the SW Yukon Territory and NW British Columbia and flows into the Gulf of Alaska about 50 miles east of Yakutat. This river supports a run of outside-rearing Chinook salmon.

Escapement Methodology: Since 1976, escapements have been principally monitored by a weir operated at the Klukshu River, one of 51 tributaries of the Tatshenshini River, the principal salmon-producing branch of the Alsek River. Index escapements were estimated using a weir at the Klukshu River. These have been replaced with estimates of total escapement, drainagewide, including direct MR estimates for years 1998 to 2004. All other years are Klukshu River weir counts expanded by the average expansion factor (4.00) from 1998 to 2004. The Alsek Chinook salmon escapement assessments meet U.S. CTC data standards; however, they fail to meet Bilateral CTC data standards due to the CVs ranging from 24% to 61%.

Escapement Goal Basis: A revised goal of 3,500 to 5,300 total spawners (fish age 1.2 and older) was accepted by the CTC, ADF&G, and Canadian Science Advisory Pacific, based on analysis in Bernard and Jones (2010). Prior to this, the goal was based on the escapement counted through the Klukshu River weir (McPherson et al. 1998).Escapement Evaluation: Annual escapements of less than 85% of the goal have occurred four times since 1976, and all have been recent. These poor escapements appear to be the result of reduced productivity that has occurred in most of the last eight years, because known harvest rates exerted on the stock are very small. If no harvest had occurred in 2006, 2007, 2008, and 2012, the stock would still have failed to achieve the lower bound of the escapement goal range. The 2013 escapement was only 5,044 (CV = 0.30) large Chinook salmon, within the escapement goal range (Figure 2.10).

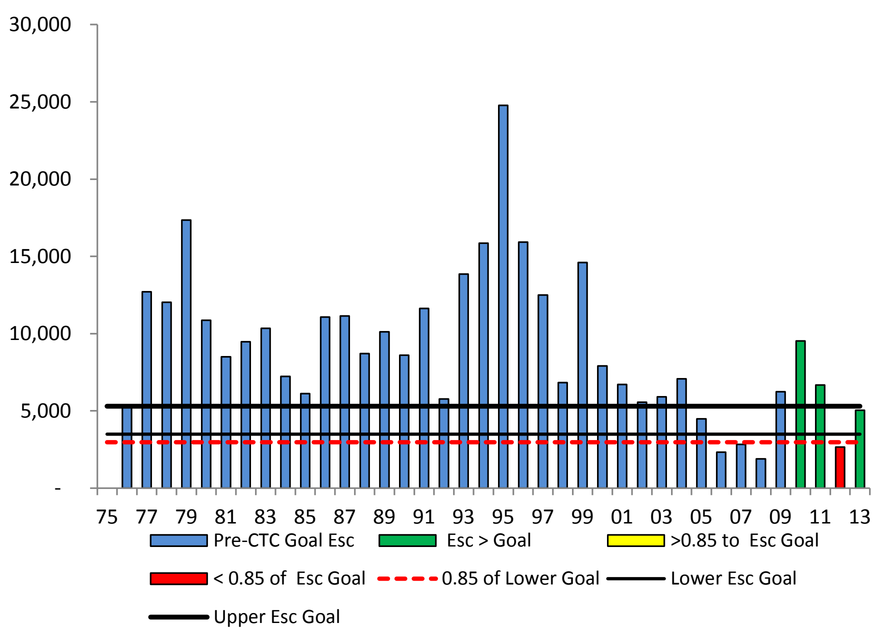

Figure 2.10.–Alsek River escapements of Chinook salmon, 1976–2013.

Agency Comments: Directed Canadian sport and aboriginal fisheries occur in various upriver sections of the Alsek River. Some Chinook salmon are caught as bycatch in the U.S. sockeye salmon directed fishery that takes place inriver near the estuary and within the estuary. A few Chinook salmon are also caught in a U.S. subsistence fishery that takes place in the same area as the U.S. sockeye fishery. Total annual harvest rates have averaged 12% since 1976 (Bernard and Jones 2010).

2.3.1.2.2 Taku River

The Taku River is a large Transboundary glacial system that supports a run of outside-rearing Chinook salmon. Few Taku River origin Chinook salmon are caught in PSC fisheries other than in terminal areas including District 11 of Southeast Alaska and in the Canadian portion of the lower river itself. Directed gillnet fisheries by both Parties to the Agreement take place in terminal areas in years when abundance exceeds predetermined levels as described in the Agreement under Chapter One, Transboundary Rivers 3(b)(3). In other years, Taku River origin Chinook salmon are caught as bycatch in directed gillnet fisheries for sockeye salmon in terminal waters (District 11 of Southeast Alaska and inriver in Canada), in sport fisheries near Juneau Alaska, and in inriver First Nation fisheries in Canada.

Escapement Methodology: Total escapements of large fish were estimated with MR experiments in 1989, 1990, and 1995 to the present. The MR estimates are unbiased and have an average CV of 15%. Taku Chinook salmon escapement assessments meet the U.S. CTC data standards. Annual estimates since 1995 have CVS that range from 9% to 38% with 80% of the annual estimates meeting Bilateral CTC standards. Aerial survey counts prior to 1989, from 1991 to 1995, and in 2013 were expanded by a factor of 5.2, which is the average of the ratio of the MR estimates to aerial survey counts. Aerial survey methods for stock assessment were standardized in 1975. Estimates of escapement based upon expanded aerial survey counts are assumed unbiased and have a CV of about 25%.

Escapement Goal Basis: Prior to 1999, several systemwide or index goals were developed by the U.S. and Canada based upon limited data. A goal based upon maximizing smolt production was in place from 1999 to 2009 (McPherson et al. 2000). In 2009, an escapement goal of 19,000 to 36,000 large Chinook salmon based upon stock–recruit analysis (McPherson et al. 2010) was accepted by the CTC.

Escapement Evaluation: The Taku River stock is reasonably healthy with annual escapements of less than 85% of the goal occurring only three times since 1975 (1975, 1983, and 2007). Exploitation rates on the stock have never exceeded the MSY exploitation rate level. The 2013 escapement was estimated to be 18,002 (CV = 0.38) large Chinook salmon, below the lower bound of the escapement goal range (Figure 2.11).

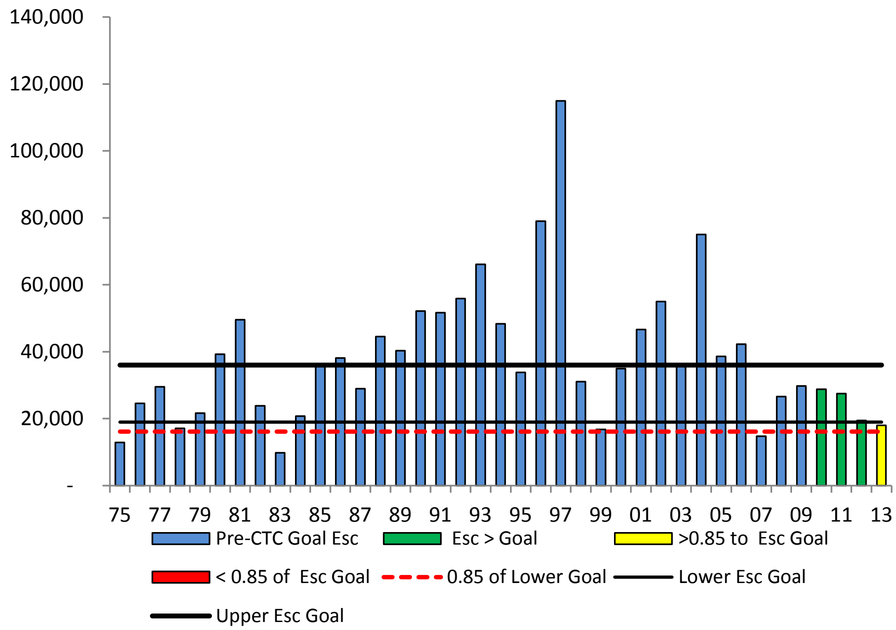

Figure 2.11.–Taku River escapements of Chinook salmon, 1975–2013.

Agency Comments: The Taku River is both an escapement indicator stock and an exploitation rate indicator stock. Wild smolts have been marked with CWTs (1976–1981 and 1993–present), and CWT recoveries from fisheries and escapements are used to estimate exploitation rates and production. Historically, a significant terminal marine gillnet fishery occurred, but stock assessment was not adequate for management. In 2005, the Parties developed an abundance-based management regime for Taku River origin Chinook salmon with harvest sharing. The abundance-based management regime includes preseason forecasts, inseason run projections, and postseason assessments which, when coupled with carefully controlled weekly openings of gillnet fisheries on both sides of the border, has allowed sustained harvest while ensuring escapement needs are not jeopardized by fishing. The Taku River stock of Chinook salmon has demonstrated declining productivity over the past few years; the issue appears to be reduced marine survival. Until these conditions improve, it is unlikely that directed fisheries will be prosecuted and it may be that escapements will fall below the goal range, even with reduced but minor levels of indirect fishing.

2.3.1.2.3 Stikine River

The Stikine River originates in British Columbia and flows into central Southeast Alaska near the towns of Petersburg and Wrangell. This is the largest river emptying into SEAK, glacial in origin, and supports an outside-rearing stock of Chinook salmon. Starting in 2005, during years of surplus production to the Stikine River, directed Chinook salmon fisheries were allowed in the marine waters in District 108 near Petersburg and Wrangell and inriver in Canada.

Escapement Methodology: From 1975 to 1984, index escapements were conducted using survey counts, and since 1985 counts were conducted using a weir at the Little Tahltan River. Since 1996, MR experiments were conducted annually to estimate total escapement. These studies indicate the weir counts represented 17% to 20% of the total escapement (Pahlke and Etherton 1999). The Stikine Chinook salmon escapement assessments have met U.S. CTC data standards since 1996 with annual CVs averaging 14%. In those 18 years, 33% had CVs that exceeded the Bilateral CTC data standard ranging from 16% to 28%.

Escapement Goal Basis: An escapement goal of 14,000 to 28,000 large Chinook salmon (age-.3 to age-.5 fish) was established in 1999 after review and acceptance by the CTC, ADF&G, TBR Panel, and Canadian Science Advisory Pacific, based on the analysis in Bernard et al. (2000). Previously, several systemwide or index goals were developed by the U.S. and Canada, and were based on limited data.

Escapement Evaluation: The Stikine River stock is reasonably healthy with annual escapements of less than 85% of the goal six times since 1975; however, this has only occurred once in the past 28 years (2009). The 2013 escapement was estimated to be 16,735 (CV = 17%) large Chinook salmon, within the goal range (Figure 2.12).

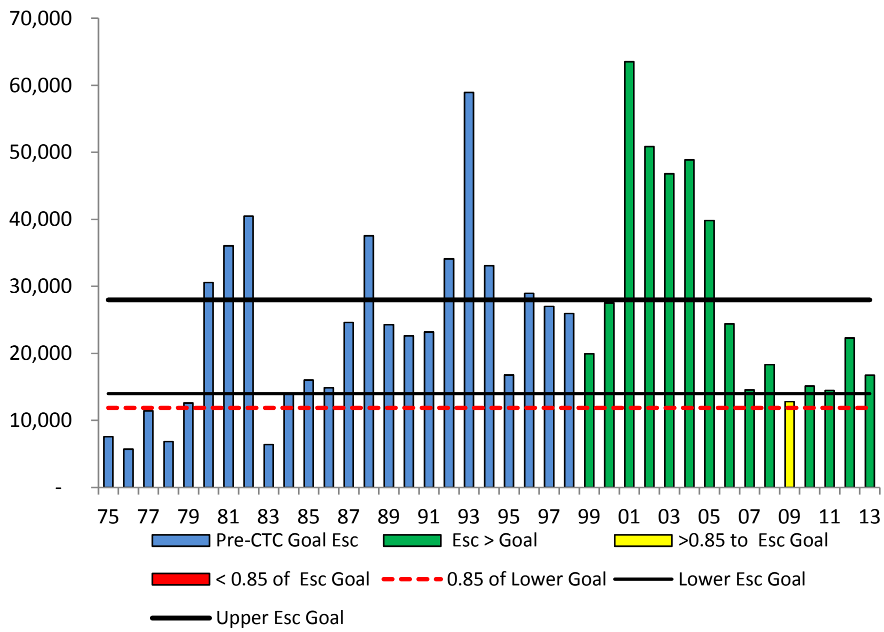

Figure 2.12.–Stikine River escapements of Chinook salmon, 1975–2013.

Agency Comments: In recent years of directed Chinook salmon fishing, total harvest rates on Stikine River Chinook salmon are believed to have ranged between 50% and 70%. Most harvests occur in the U.S. commercial gillnet and sport fisheries in District 108 near Petersburg and Wrangell and inriver in the Canadian gillnet and aboriginal fisheries. Currently CDFO and ADF&G operate joint programs to CWT smolt in order to estimate smolt and adult production, as well as exploitation. Since 1985, escapements to the Stikine River were within or above the escapement goal range except in 2009. Like the Taku River stock of Chinook salmon, the Stikine River stock has demonstrated declining productivity over the past few years. The issue appears to be reduced marine survival. Until these conditions improve, it is unlikely that directed fisheries will be prosecuted and it may be that escapements will fall below the goal range, even with reduced, but minor levels of indirect fishing.

2.3.2 Canadian Stocks

Since the beginning of the Chinook salmon rebuilding program of the 1985 PST, escapement goals for Canadian Chinook salmon stocks were generally based on doubling the average escapements recorded from 1979 to 1982. The doubling was based on the premise that Canadian Chinook salmon stocks were overfished and that doubling the escapement would still be less than the optimal escapement estimated for the aggregate of all Canadian Chinook salmon populations (PSC 1991). Doubling was also expected to be a large enough change in escapements to allow detection of the change in numbers of spawners and the subsequent production. The escapement goals of most Canadian stocks are currently being reviewed; two stocks (Harrison and Cowichan) have CTC-agreed escapement goals.

2.3.2.1 *Northern British Columbia*

2.3.2.1.1 Yakoun River

The CTC was unable to assess stock performance because Yakoun River Chinook salmon escapements have not been estimated since 2005. See Appendix Table B.2 for escapements up to 2005.

2.3.2.1.2 Nass River

The Nass River is the largest river in Area 3, representing a group of approximately 25 streams. It flows southwest from the British Columbia interior into Portland Inlet and the estuary is only 30 km from the Alaska/British Columbia border. The Nass River drains an area of approximately 18,000 km^2 and is constrained by a canyon at Gitwinksihlkw (GW). The canyon was formed by the Tseax Volcano in 1775 and is approximately 40 km upstream from the estuary. The mainstem of the Nass River is extremely turbid with visibility near zero for most of the year. Among the major Chinook salmon producing tributaries, the Bell Irving River is glacially turbid while the Meziadin, Cranberry/Kiteen, Kwinageese and Damdochax rivers are relatively clear. Nass River Chinook salmon are primarily stream-type salmon and are thought to be far north migrating

Escapement Methodology: Prior to 1992, CDFO observations of Nass River Chinook salmon escapement were based on visual counts. Programs using MR have been conducted since 1992 by the Nisga'a Fisheries to estimate total spawning escapement in the Nass River. The Nass MR program uses two fish wheels at GW in the Lower Nass canyon and occasionally two wheels at Grease Harbor further upstream to apply tags. The Meziadin River fishway, a weir on the Kwinageese River and a deadpitch program on the Damdochax River are used for tag recovery. Tags were also recovered in upriver fisheries and on the spawning grounds. A modified Petersen model was used to estimate the total population of Chinook salmon past the tagging location. Spawning escapements were calculated as the estimated Chinook salmon population past GW from the MR studies, less upriver catches in sport and FN fisheries. Three tributaries with Chinook salmon populations—the Kincolith, Ishkeenickh and the Iknouk—enter the Nass River below GW. Visual estimates of these systems were augmented by fence counts of the Kincolith River in 2001, 2002, 2005, and 2007 to estimate escapements below the fish wheels.

Escapement Goal Basis: There is no CTC-accepted escapement goal for this stock. The Fisheries Operational Guidelines define two goals for managing Chinook salmon fisheries: an operational escapement target of 20,000 fish, and a minimum escapement target of 10,000 fish. If escapements are projected to be below 10,000 fish, then no fishing on Nass River Chinook salmon would be recommended. The median estimate of S_{MSY} for the Nass River upstream of GW using the habitat model was 16,422 (CV = 23%) Chinook salmon based on a watershed area of 15,244 km^2 (Parken et al. 2006; Figure 2.13).

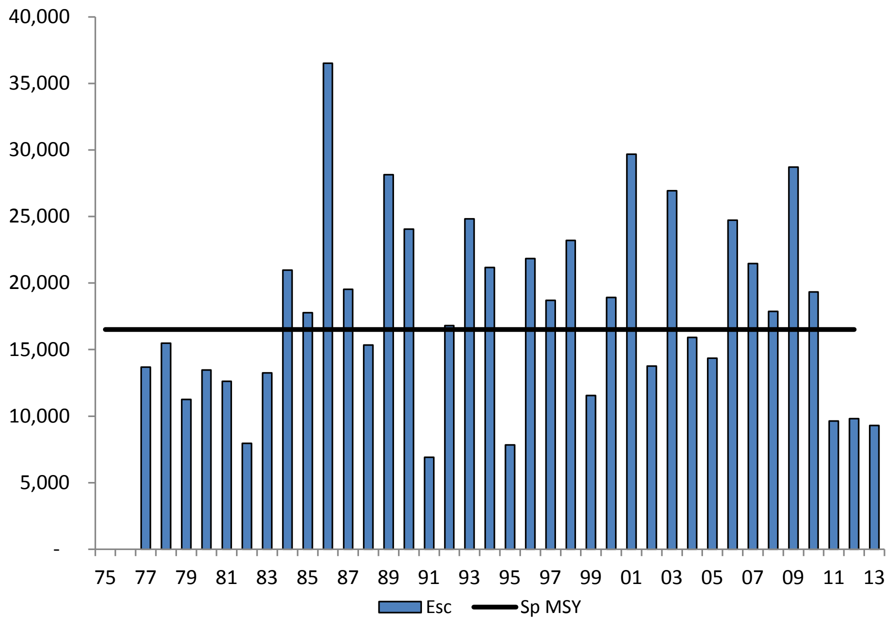

Figure 2.13.–Nass River escapements of Chinook salmon, 1977–2013.

Agency Comments: Chinook salmon escapement estimates produced before 1992 have been calibrated to the MR estimates. The Nisga'a Fisheries Working group, including CDFO, has accepted the historical escapement and terminal run values (Appendix B.2). An SSP-funded project on the Kwinageese River and Damdochax Creek (Section 4.53 and Appendix C.11) is designed to increase recoveries and improve the escapement estimates for the Nass Chinook salmon aggregate.

2.3.2.1.3 Skeena River

The Skeena River is the second largest river in British Columbia and drains an area of approximately 54,400 km^2. It supports the second largest aggregate of Chinook salmon stocks in British Columbia with over 75 separate spawning populations. Four large-lake stabilized tributaries, the Kitsumkalum, Morice, Babine and Bear rivers, account for 65% of the total Chinook salmon abundance in the Skeena River. The Kitsumkalum River is glacially turbid and visual methods for enumerating salmon are not appropriate. By comparison, other major Chinook salmon producing tributaries like the Morice, Bear, Babine and Kispiox rivers run relatively clear, especially in late summer when most of the Chinook salmon spawning occurs. Skeena River Chinook salmon are primarily stream-type salmon (approximately 97%), and are far north migrating. Most of the Skeena River Chinook salmon populations are summer run, but spring run fish occur in the Cedar River and the Upper Bulkley River.

Escapement Methodology: Historically, Chinook salmon escapements to the Skeena River have been represented by an index that includes approximately 40 populations surveyed annually using a variety of techniques (Figure 2.14 solid bars). Most of the escapement estimates are based on visual observations from helicopter, fixed wing aircraft and/or from stream walking surveys. Fish counting weirs are present on the Babine, Sustut and Kitwanga rivers. The Kitsumkalum River is the exploitation rate indicator stock for the Skeena Chinook salmon aggregate; and escapements have been estimated using a MR program since 1984. The Kitsumkalum represents approximately 30% of the spawners measured by the escapement index. The Bear and Morice river populations have contributed 20% (Bear) and 26% (Morice) to the escapement index since 1984. The visual estimates for these systems tend to underestimate their actual contribution to the total escapement in the Skeena aggregate.

Chinook salmon returns to the Skeena River have also been estimated using the proportion of Kitsumkalum River fish measured from genetic samples collected at the Tyee test fishery and estimates of the Kitsumkalum Chinook salmon escapement from independent MR programs (Figure 2.14 checkered bars). Preliminary estimates are available from 1984 to 2013 as a result of SSP funded projects (Sections 4.5.1, Appendix C.11). The genetic-based estimates represent an improvement over the historic indices since they include estimates of variance which cannot be produced for the historic indices. Also, comparisons between years are valid since the method is consistent across the time series whereas methods used for the historic indices varied through time.

The genetic studies found that the Kitsumkalum River conservation unit contributes, on average, 18% to the Skeena River aggregate. The Morice, Bear and Babine populations make up the Skeena Large Lake conservation unit and contribute 31% (Morice), 7.4% (Bear) and 6.6% (Babine) to the aggregate. An average contribution of 45% makes the Skeena Large Lake conservation unit the largest in the watershed.

Escapement Goal Basis: There is no CTC-accepted escapement goal for the Skeena River aggregate. The estimate of S_{MSY} for the Kitsumkalum indicator stock is 8,621 Chinook salmon based on stock–recruitment analyses (McNicol 1999; updated in Parken et al. 2006). Habitat-based estimates of S_{MSY} and other reference points are available for stocks within the Skeena River, but estimates of total escapement (or calibration of the visual indices) are needed to make them effective (Parken et al. 2006). Future assessments will partition this large aggregate into stocks by run timing, life history, and geographic areas.

Agency Comments: Terminal fisheries in the Skeena River normally include commercial gillnet in the terminal exclusion area (River Gap Slough, Area 4), inriver sport, and aboriginal fisheries. Estimates of inriver sport catch were not available from 1997 to 2002 but creel surveys were conducted on the Lower Skeena in 2003 and in 2010 through 2013. Consequently, the total terminal run estimates in these years include lower-river sport catch but no estimate of upper-river sport catch. Spawning escapements to the Kitsumkalum River have exceeded the point estimate of S_{MSY} in every year since 1998 (Figure 2.15).

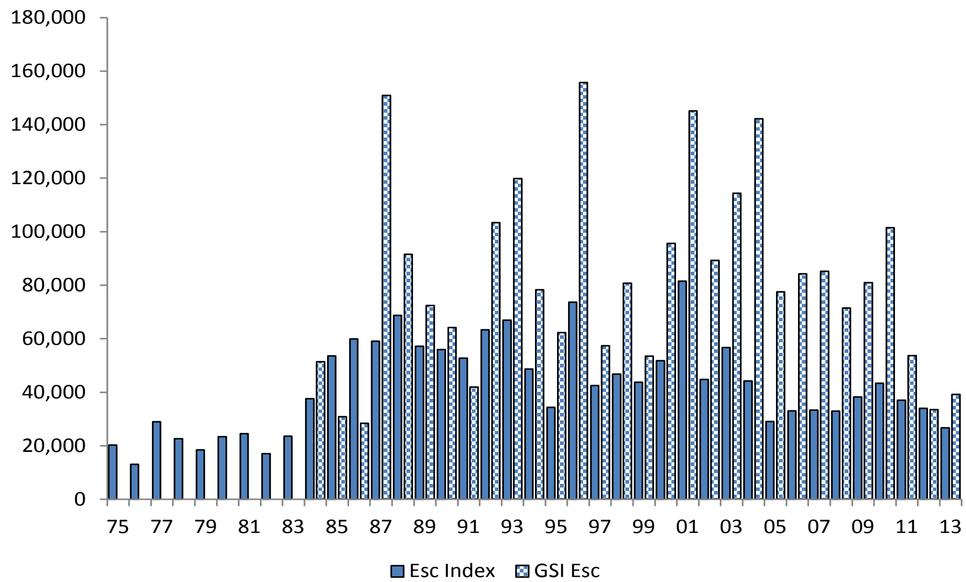

Figure 2.14.–Skeena River escapements of Chinook salmon, 1975–2013.

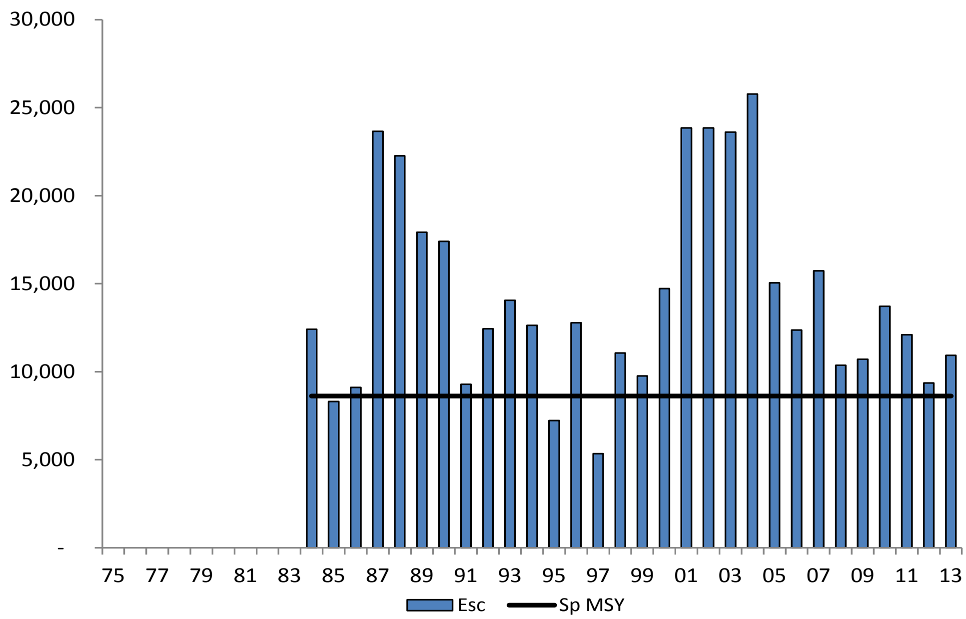

Figure 2.15.–Kitsumkalum River escapements of Chinook salmon, 1984–2013.

2.3.2.2 *Central British Columbia*

2.3.2.2.1 Dean River

The CTC was unable to assess stock performance because Dean River Chinook salmon escapements have not been estimated since 2011 due to insufficient resources. See Appendix Table B.2 for escapements up to 2011.

2.3.2.2.2 Rivers Inlet

The Rivers Inlet escapement index consists of an aggregate of Chinook salmon escapements to the Wannock, Kilbella and Chuckwalla rivers (Figure 2.16). The Wannock River drains Owikeno Lake into the head of Rivers Inlet. It is about 6 km long, over 100 m wide, and is glacially turbid. Wannock Chinook salmon are genetically distinct from other Chinook salmon populations in the central coast of British Columbia. This ocean-type stock exhibits fall run timing and is renowned for its large body size, due to ocean age-4 and ocean age-5 year components in the return. The Kilbella and Chuckwalla river systems share an estuary on the north shore of Rivers Inlet. These systems are relatively small and can run clear but are often turbid as a result of precipitation. The Chinook salmon populations in the Chuckwalla and Kilbella rivers have summer run timing and are stream-type salmon. The largest contributor to the index is the Wannock River which represents an average of 76% of the production for this index over the past decade, and over 95% since 2010.

Escapement Methodology: Chinook salmon escapement estimates for the Wannock River are produced from an annual carcass recovery program. Estimates are derived by expanding the number of carcasses pitched based on historical recovery rate assumptions. Expansion factors are somewhat subjective and take into consideration water clarity, river height, and recovery effort. The visual index estimate for Wannock Chinook salmon in 2013 was 4000 based on expansion of carcass recoveries during the traditional deadpitch program. Programs to calibrate carcass recoveries with population estimates from MR experiments were conducted from 1991 to 1994 and again in 2000. Results suggest the estimates based on the subjective expansions of carcass recoveries underestimate the Wannock Chinook salmon population by approximately half. Inherent bias as well as imprecision in the MR estimates leads to uncertainty in calibration of the carcass estimates.

Chinook salmon escapements for the Chuckwalla and Kilbella rivers are estimated using area-under-the-curve (AUC) methods applied to visual counts from helicopter surveys. Typically four flights are made during the spawning period, but only two flights were completed in 2013. Few Chinook salmon were observed in the Chuckwalla River, and the escapement was based on the Kilbella River estimate. The estimates are preliminary and any revisions will be presented in next year's report. The estimated escapement to the Kilbella River was 500 and to Chuckwalla River was 172.

Escapement Goal Basis: There is no CTC-accepted escapement goal for these stocks. Habitat-based estimates of S_{MSY} and other stock–recruitment reference points are available but estimates of total escapement are needed to make them effective. Habitat-based escapement goals were thought to overestimate S_{MSY} for the Wannock River because the stock may be limited by the relatively small amount of spawning area available (Parken et al. 2006).

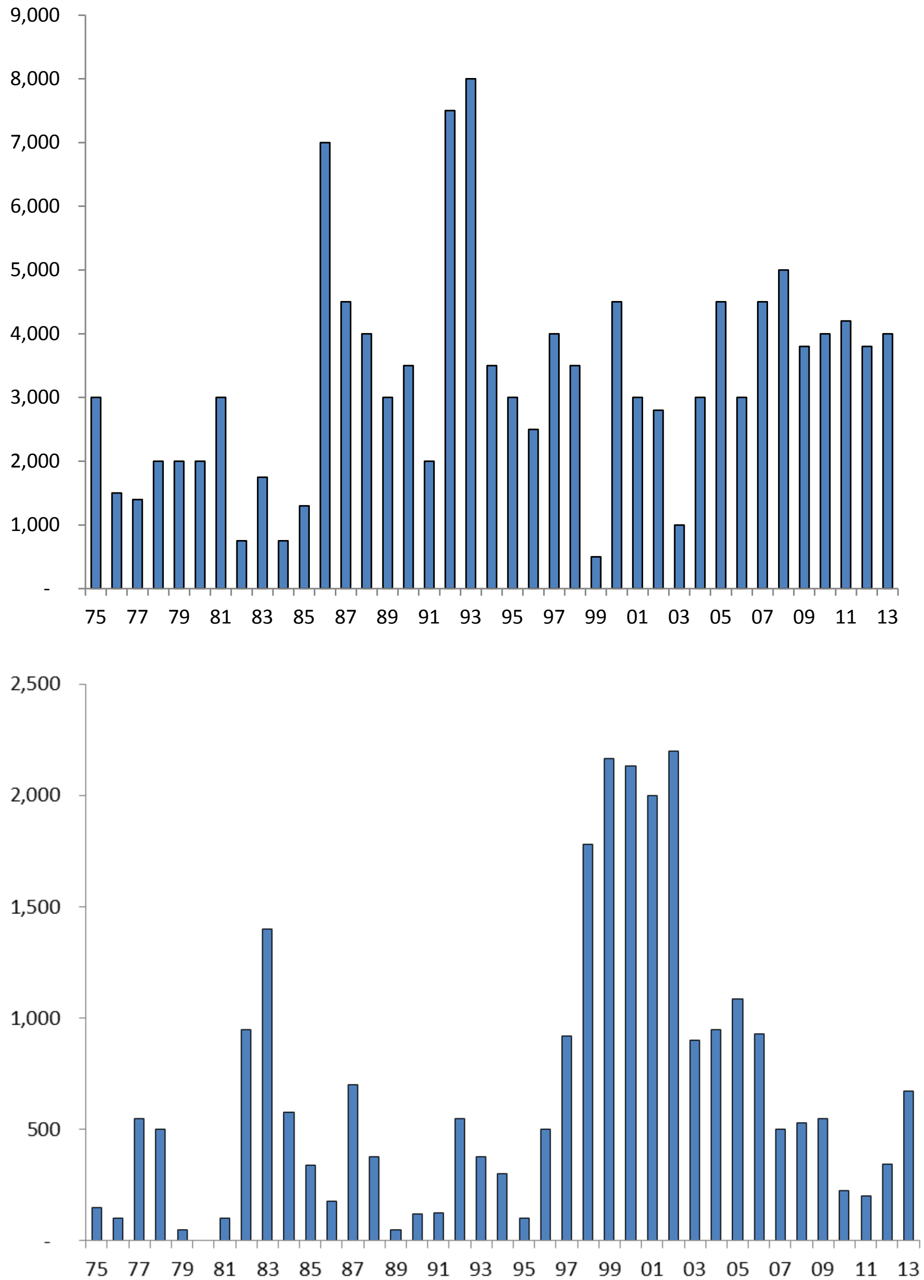

Figure 2.16.–Rivers Inlet escapement index of Chinook salmon, 1975–2013, including Wannock River (upper) and Kilbella and Chuckwalla rivers (lower).

Agency Comments: A small hatchery enhancement program occurs on the Wannock River but the contribution to the total population is unknown. Production from enhancement of the Kilbella and Chuckwalla rivers from 1990 to 1998 is thought to have had significant influence on escapements from 1994 to 2003, but estimates of the enhanced component are not available. Estimated returns to the Chuckwalla and Kilbella averaged 1300 Chinook salmon during the period of enhancement. Recent returns have averaged less than 500 Chinook salmon for both rivers combined and it is unclear if these populations have returned to pre-enhancement levels or are experiencing an unrelated decline.

2.3.2.2.3 Atnarko River

Following the 2009 Agreement, the CWT Improvement Program highlighted the lack of a Chinook salmon indicator in the Central British Columbia region. In order to convert the existing Atnarko Chinook Assessment program into an exploitation rate indicator, a series of objectives were identified including the application of 250,000 additional CWTs, sampling of the terminal commercial, sport, and FN fisheries, and reintroduction of a MR program to improve escapement estimates (Velez-Espino et al. 2011). Implementation of these changes began in 2009 (Velez-Espino et al. 2010) and subsequent MR programs have yielded escapement estimates with corresponding CVs of less than 15% for all years (Velez-Espino et al. 2014).

The NBC CTC model stock group is represented by Kitsumkalum River which is a stream-type stock, while the Atnarko River which feeds the Bella Coola River and is situated in Statistical Area 8 on the Central Coast of British Columbia is predominantly an ocean-type stock. It constitutes the largest complex of Chinook salmon in Central British Columbia. Hatchery releases of Atnarko Chinook salmon have averaged around 2 million annually with recent CWT releases in excess of 400,000. Atnarko CWT recoveries occur in both U.S. and Canadian AABM fisheries as well as coastal British Columbia ISBM fisheries.

Three methods have been used since 1990 to generate independent estimates of Chinook salmon escapement in the Atnarko River. These methods are based on (1) CPUE during broodstock collection, (2) carcass counts during dead pitching, and (3) the number of spawners observed during drift boat surveys. The simplicity and low cost of these three methods has allowed the continuous monitoring of Atnarko escapement, and the average of these three population estimates (3MA method) has been used as escapement estimate in years without MR studies. A serious flood event in the fall of 2010 impacted the Atnarko by altering flow dynamics and creating a sequence of obstructive log jams. As a result, the use of rafts to obtain drift counts was no longer feasible. Robust maximum likelihood estimates within a model selection framework have been developed for escapement of total and wild Atnarko Chinook salmon based on MR data for years 2001 to 2003 and 2009 to 2013. The 1990 to 2013 time series of Atnarko Chinook salmon escapement was calibrated using Generalized Linear Models based on these high-quality escapement estimates and data routinely collected for the 3MA method (Vélez-Espino et al. 2014). The estimation model used for time series calibration also serves as a tool to generate reliable escapement estimates based on broodstock CPUE and carcass counts. The calibrated escapement estimates have yielded escapement estimates with corresponding CVs of less than 15% for all years, except 1995 (17.9%) and 2006 (15.6%; Velez-Espino et al. 2014).

Escapement Goal Basis: There is no CTC-accepted escapement goal for Atnarko Chinook salmon. A habitat-based escapement goal (Parken et al. 2006) of 5,009 wild fish has been developed for Atnarko Chinook salmon (Vélez-Espino et al. 2014). This habitat-based escapement goal represents a first iteration in the process of refinement required to quantify the spawning escapement at maximum sustainable yield (S_{MSY}) for this stock (Figure 2.17).

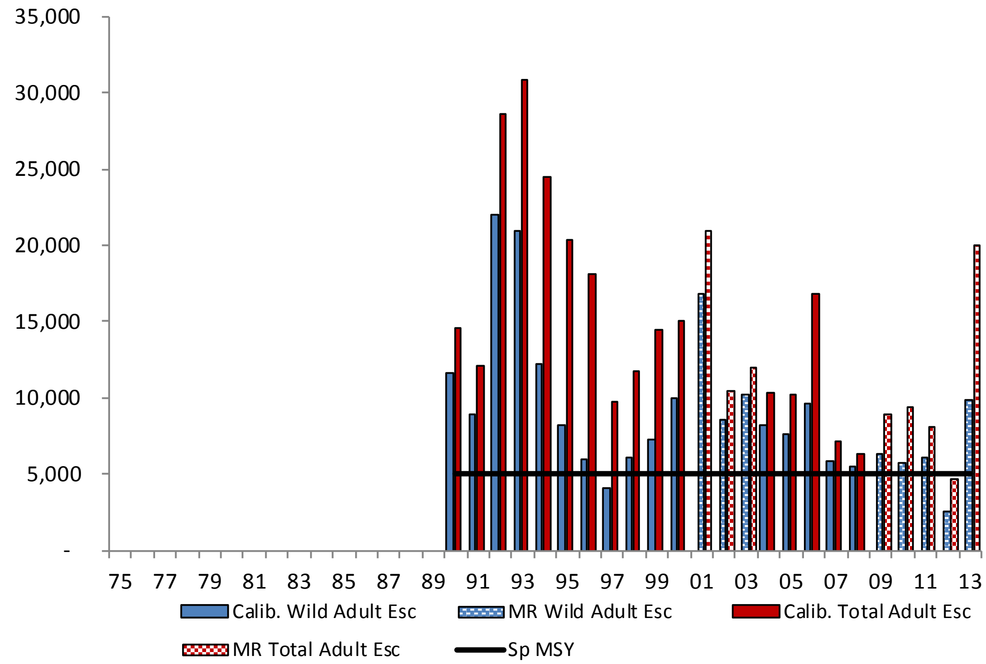

Figure 2.17.–Atnarko River escapements of wild adult (excluding jacks) and total adult (hatchery and wild, excluding jacks) Chinook salmon, 1990–2013.

Note: Estimates for 2001–2003 and 2009–2013 are based on MR data. Estimates for all remaining years are based on time series calibration via Generalized Linear Models parameterized with MR data, carcass counts and broodstock capture per unit effort (CPUE; Vélez-Espino et al. 2014).

Agency Comments: The Atnarko River has been developed as an exploitation rate indicator stock (Velez-Espino et al. 2011). MR estimates with corresponding CVs less than 15% have been attained in eight program years (2001–2003 and 2009–2013). The estimation model used for the 1990 to 2013 time series calibration can also generate reliable escapement estimates based on broodstock CPUE and carcass counts. Counting with a calibrated time series of escapement and an estimation method provides the ability to produce escapement estimates in the future even in the absence of MR data.

2.3.2.3 *West Coast Vancouver Island and Georgia Strait*

2.3.2.3.1 West Coast Vancouver Island

Escapement Methodology: The WCVI index represents the sum of escapements for six rivers (Marble, Tahsis, Burman, Artlish, Kaouk, and Tahsish), which were chosen to provide an index of escapement for wild WCVI stocks in general. These stocks were chosen based on historical consistency of data quality, although the escapement methodology changed in 1995 and prior estimates have not been calibrated to the new methodology. CDFO has developed a 14-stream expanded index which includes escapements to the 6-stream index plus the following WCVI streams: Colonial and Cayegle creeks (Area 26), Leiner (Area 25), Megin, Bedwell/Ursus, Moyeha (Area 24) and Sarita, Nahmint (Area 23), and San Juan (Area 21). In 2005, the Colonial/Cayegle escapement was not available, and was therefore not included in the 14-stream index (Figure 2.18). Since 2007, a MR program has been conducted on the Burman

River, a SSP-funded project (Section 4.3.2 and Appendix C.6), in addition to the regular swim and foot surveys. The Burman River escapement estimate used for the index has used the swim and foot survey methodology since 2005. The escapements in 2013 were 11,900 Chinook salmon for the 6-stream index and 15,255 for the 14-stream index.

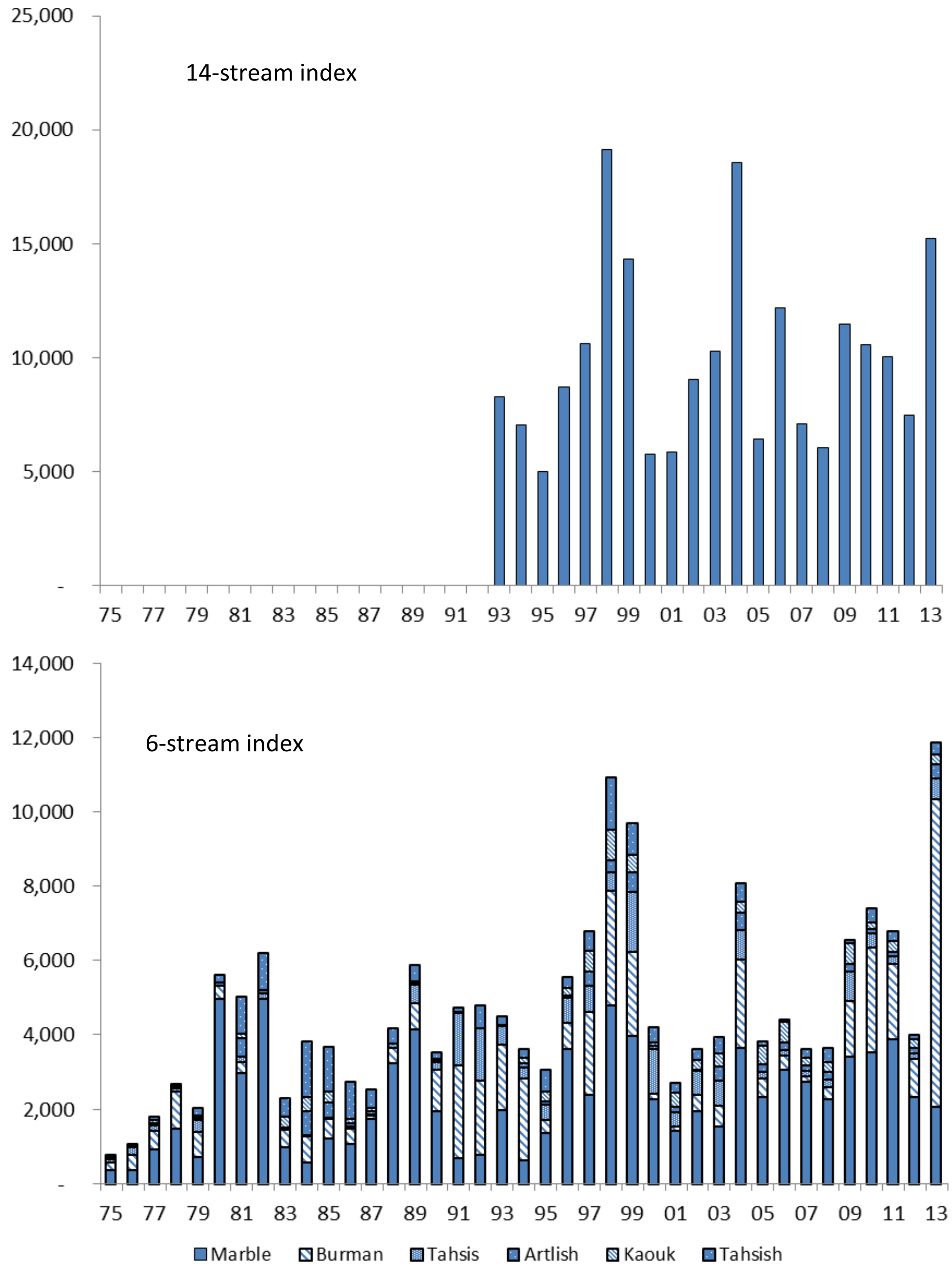

Figure 2.18.–WCVI 14-stream and 6-stream indexes of escapement of Chinook salmon, 1975–2013.

Note: The escapement methodology changed for the 6-stream index in 1995 and prior estimates have not been calibrated to the new methodology.

Over the last decade, the PSC Sentinel Stocks and Endowment Fund programs have conducted several studies aimed at producing high quality escapement estimates that are consistent with the CTC data quality standards (CTC 2013). In 2013, CDFO held a Canadian Science Advisory Process workshop with an objective of evaluating the escapement estimation methodology used to assess the abundance of WCVI extensive indicator stocks relative to escapement targets. The review produced several recommendations for further work and another workshop meeting is planned. It is anticipated that this work will result in revised escapement data, with measures of precision, which are better quality than the estimates presented here (Figure 2.19).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock group.

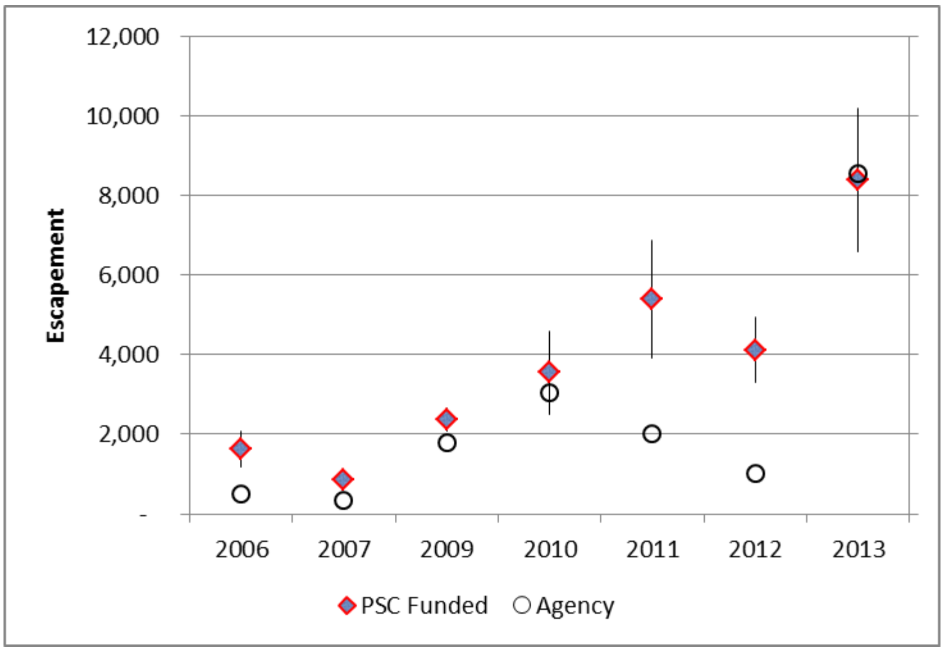

Figure 2.19.–Burman River escapements of Chinook salmon in years when both agency AUC swim surveys expanded by AUC methods were used (circles) and when MR estimates (diamonds are point estimates and the bars are 95% CIs) were conducted with funding from the PST.

Agency Comments: Habitat-based estimates of S_{MSY} and other stock–recruitment reference points are available for these stocks (Parken et al. 2006), but estimates of total escapement are needed to make them effective. Work is currently underway to estimate total escapements as part of the SSP-funded projects since 2009, and in 2013 projects occurred at the Burman, Marble, Tahsis and Leiner rivers (Section 4.3.2 and Appendix C.6). Escapements have remained low at nonenhanced streams since 1999 despite terminal fishing restrictions in effect in Areas 24–26 from July to September each year. Escapements to all nonenhanced Clayoquot Sound and Kyuquot Sound Chinook salmon streams in the indices remain below 500 fish.

2.3.2.3.2 Upper Strait of Georgia

The Upper Strait of Georgia (UGS) stock index consists of five rivers (Klinaklini, Kakweiken, Wakeman, Kingcome, Nimpkish). Four are in Johnstone Strait mainland inlets and the Nimpkish River is on northeast Vancouver Island.

Escapement Methodology: The accuracy of escapement estimates in the mainland inlet systems is likely poor due to low visibility of glacial systems, remote access, and timing of surveys. Escapement estimates have primarily been based on aerial counts targeting other salmon species, which may not coincide with the main spawning period for Chinook salmon. Swim surveys and stream walks have been conducted in the Nimpkish River. A fish wheel program occurred on the Klinaklini River from 1997 to 2004. The escapement time series for the UGS stock includes estimates based on consistent methods within each river, and escapements to rivers missing escapement data for some years (i.e., no surveys) were estimated using the procedures described by English et al. (2007). The estimated escapement for the UGS in 2013 was 20,954 (Figure 2.20).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock group.

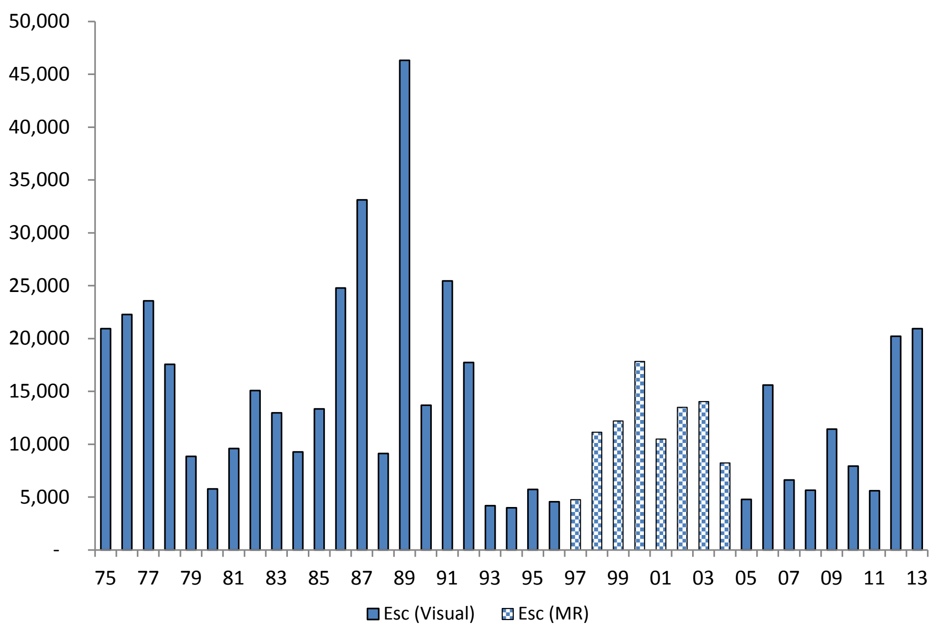

Figure 2.20.–Upper Georgia Strait stock group escapements of Chinook salmon, 1975–2013.

Note: The hatched bars in the histogram represent years when escapements to the Klinaklini River were estimated using Fishwheel MR methods while the solid bars indicate estimates based on visual surveys.

Agency Comments: Assessment of stock status is highly uncertain and the escapement time series requires standardization to better represent this stock group in the PSC Chinook Model. Differences in ocean distributions, run timing, and life history indicate that future assessments should separate the stock group into conservation units.

2.3.2.3.3 Lower Strait of Georgia

The Lower Strait of Georgia (LGS) natural rivers monitored for naturally spawning fall Chinook salmon escapement are the Cowichan and Nanaimo rivers (Figure 2.21 and Figure 2.22).

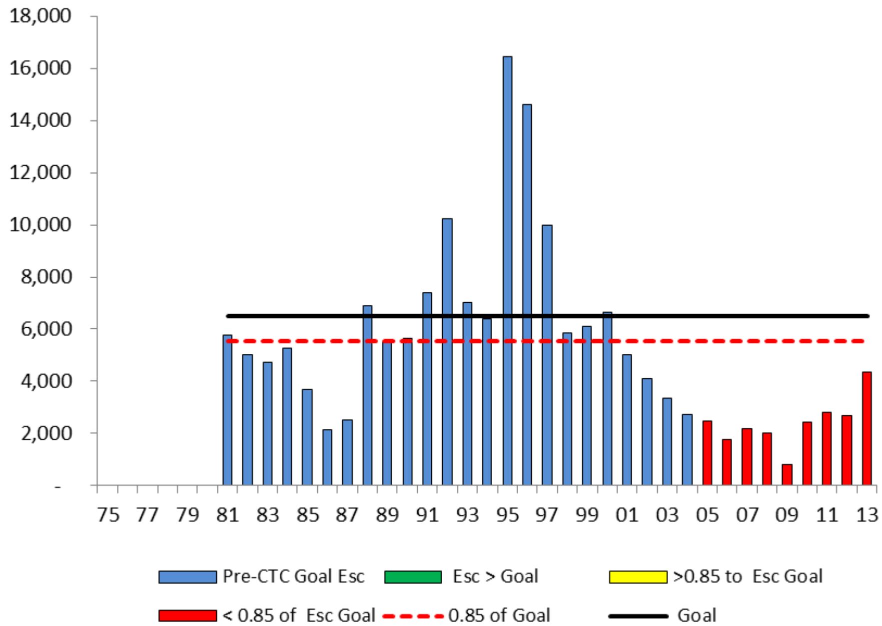

Figure 2.21.–Cowichan River escapements of Chinook salmon, 1981–2013.

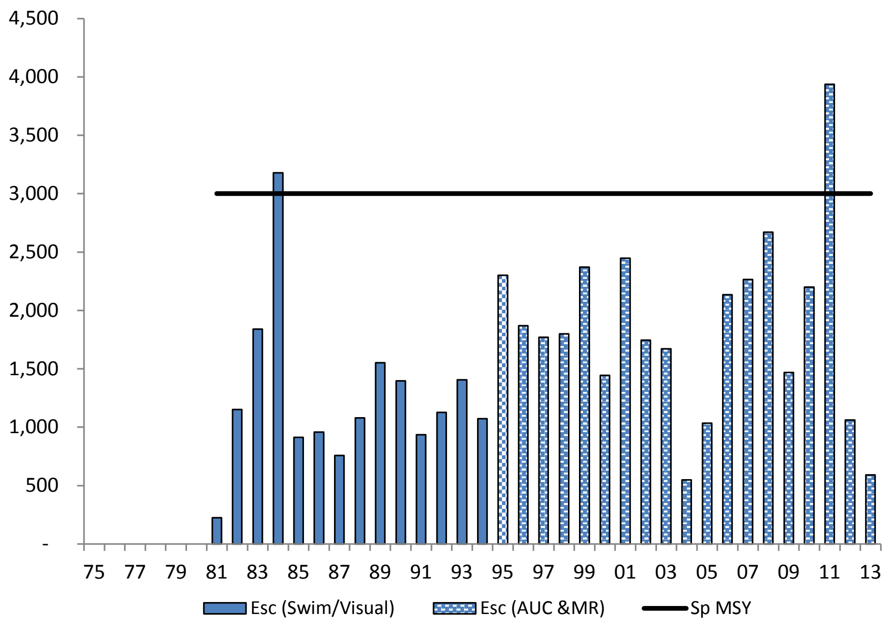

Figure 2.22.–Nanaimo River escapements of Chinook salmon, 1981–2013.

Escapement Methodology: Total Chinook salmon returns have been estimated since 1975. Prior to 1988, escapement estimates from the Cowichan River were derived from swim and aerial surveys. This approach was also used for the Nanaimo River prior to 1995. Since 1988, a counting fence has been used in the Cowichan River. Between 1995 and 2004, carcass MR surveys were used in the Nanaimo River, and since 2005, AUC methods have been used. Survey life is based on a tagging study in 2006. The estimated escapement in 2013 was 4,590 Chinook salmon for the Cowichan River and 593 for the Nanaimo River.

Escapement Goal Basis: An escapement goal of 6,500 (CV = 33%) for the Cowichan River was accepted by the CTC in 2005 (Tompkins et al. 2005). There is currently no CTC-accepted escapement goal for the Nanaimo River; however, it has a habitat-based estimate for S_{MSY} of 3,000 spawners (median; CV = 14%; Parken et al. 2006).

Agency Comments: The Cowichan River stock showed considerable increase in 1995 and 1996, followed by a rapid decline to conservation concern levels more than 15% below the escapement goal. Significant Canadian fishery management actions are used to reduce exploitation levels on the LGS natural stock group.

2.3.2.4 *Fraser River Stocks*

The Fraser River watershed is the largest Canadian producer of Chinook salmon. Fraser Chinook salmon consist of many local populations as described in CTC (2002b).

Much of the knowledge about the status of Fraser River Chinook salmon is based on spawner escapement data. Most data are from visual surveys, which are generally biased low, although many estimates are considered to be reasonably precise. Visual survey data are generated from aerial surveys and the escapement estimate is usually obtained by dividing the peak count by 0.65 (Farwell et al. 1999). The CDFO continues to evaluate the appropriateness of this expansion factor and AUC methodology through calibration studies. MR projects exist for some systems, and fishways or resistivity counters are being employed in a few others, but most of the time series of escapement data from these projects are relatively short compared to the aerial estimates.

Currently, Fraser River Chinook salmon are assessed as five aggregates for PSC management, (Fraser River spring run age 1.2, Fraser River spring run age 1.3, Fraser River summer run age 1.3, Fraser River summer run age 0.3, and Fraser late) however Fraser River Chinook salmon are only represented by two stocks in the CTC model, Fraser early and Fraser late. Work is underway to upgrade Fraser representation in the model by parsing Fraser early into the four constituent life history based populations.

Within the Fraser, there are four current CWT indicator stocks: Nicola River (Fraser River spring run age 1.2), Lower Shuswap (Fraser River summer run age 0.3), and Harrison River and Chilliwack River for Fraser late. Dome Creek (Fraser River spring run age 1.3) CWT application and recovery (Fraser River spring run age 1.3) was discontinued in 2005. Of the four aggregate populations comprising the Fraser early model stock, three are thought to be dominated by offshore migrant yearling Chinook salmon, while the fourth, Fraser River summer run age 0.3, are far north migrating, and contribute significantly to fisheries in NBC and SEAK.

Only the Harrison River has a CTC-approved escapement goal. For populations other than the Harrison River, habitat-based models are being developed to estimate spawning capacity and spawner abundance producing MSY (Parken et al. 2006). This habitat-based assessment will initially focus on predictive models based on Chinook salmon stock–recruitment relationships, although other habitat-based approaches will also be considered.

Escapements to the three yearling aggregates declined steeply between 2003 and 2009, and yearling smolts that entered the ocean in 2005 and 2007 faired particularly poorly. Recent returns indicate that the decline may have been halted; however, rebuilding progress has been particularly slow, especially in the spring run age 1.2. In contrast, escapements to the Fraser River summer run age 0.3 have increased and remained very strong until 2012, when a low escapement occurred.

Returns to the Fraser late stock failed to meet the escapement goal again in 2013.

2.3.2.4.1 Fraser River Spring Run: Age 1.3

The Fraser River spring run age-1.3 aggregate includes the Upper Pitt and Birkenhead river stocks in the Lower Fraser, and the spring run stocks of the Mid- and Upper Fraser, North Thompson, and South Thompson, but excluding those of the Lower Thompson tributaries (CTC 2002b).

Commentary: Escapements are mostly estimated by expanded peak counts of spawners, holders and carcasses, surveyed from helicopters or on foot. Escapements improved in 2013, and also slightly exceeded the parental brood escapement levels in 2008. Escapement to the aggregate was estimated at 17,582 in 2013 (Figure 2.23).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this aggregate. Habitat-based estimates of S_{MSY} and other stock–recruitment reference points are available for this stock group, but estimates of total escapement are needed to make them effective. Work is currently underway to estimate total escapements by developing factors that calibrate the visual survey indices to total escapements estimated by MR and electronic resistivity counter methods.

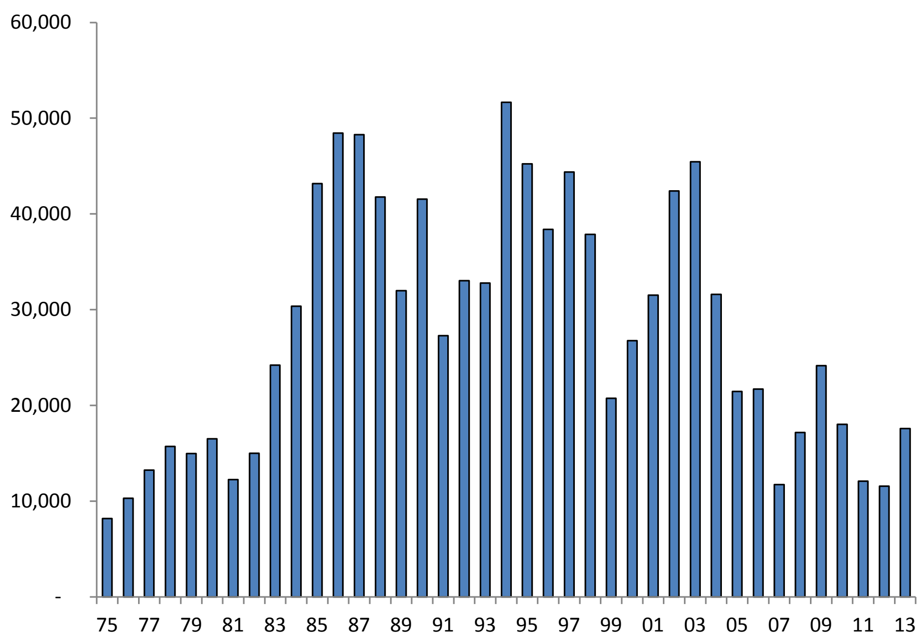

Figure 2.23.–Fraser River spring run age-1.3 stock group escapements of Chinook salmon, 1975–2013.

Agency Comments: The stock group has declined substantially over the last decade and is a stock of conservation concern.

2.3.2.4.2 Fraser River Spring Run: Age 1.2

The Fraser River spring run age-1.2 aggregate includes six populations that spawn in the Lower Thompson River tributaries, Louis Creek of the North Thompson and the spring-run fish of Bessette Creek in the South Thompson (CTC 2002b). This stock group has an early maturation schedule for a stream-type life history, with an average generation time of 4.1 years (brood years 1985–1986), which results in smaller body size and lower fecundity compared to many other stock groups.

Escapement Methodology: For the CTC time series, escapements are estimated visually using expanded peak counts of spawners, holders and carcasses in the Nicola River, Spius Creek, Coldwater River, Louis Creek and Bessette Creek. Escapements to the Deadman River are estimated by resistivity counter. Escapements declined in 2013 from levels observed in 2012; however, escapements exceeded those of the 2009 parental brood. Aggregate escapement was estimated at 3,157.

The Nicola River is the exploitation rate indicator stock for the Fraser River spring run age-1.2 stock group. A MR program provides the high precision estimates of escapement by age and sex, and since 1995, Petersen disk tags have been applied by angling and postspawned salmon carcasses examined for the presence of marks. Estimates of escapement have been generated using pooled Petersen methods. The expanded peak count time series for the Nicola River is generally less than the MR estimates (Parken et al. 2003), and calibration of the complete time series of peak count estimates is in progress. The Nicola peak count series is included in the Fraser River spring run age-1.2 aggregate time series (Figure 2.24 and Figure 2.25).

The Nicola 2013 MR escapement (3,445) is less than the 2012 escapement (5,702), however the 2013 escapement exceeded that of the 2009 parental brood (538). Since 1995 hatchery origin fish averaged 25% of the spawning escapement (range: 4–62%).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this aggregate. Habitat-based estimates of S_{MSY} and other stock–recruitment reference points are available for this stock group (Parken et al. 2006), but estimates of total escapement are needed to make them effective. Work is currently underway to estimate total escapements by developing factors that calibrate the visual survey indices to total escapements estimated by MR and electronic resistivity counter methods. Since 2004, the Nicola River escapements have been less than the median estimate of S_{MSY} (9,300; CV = 21%).

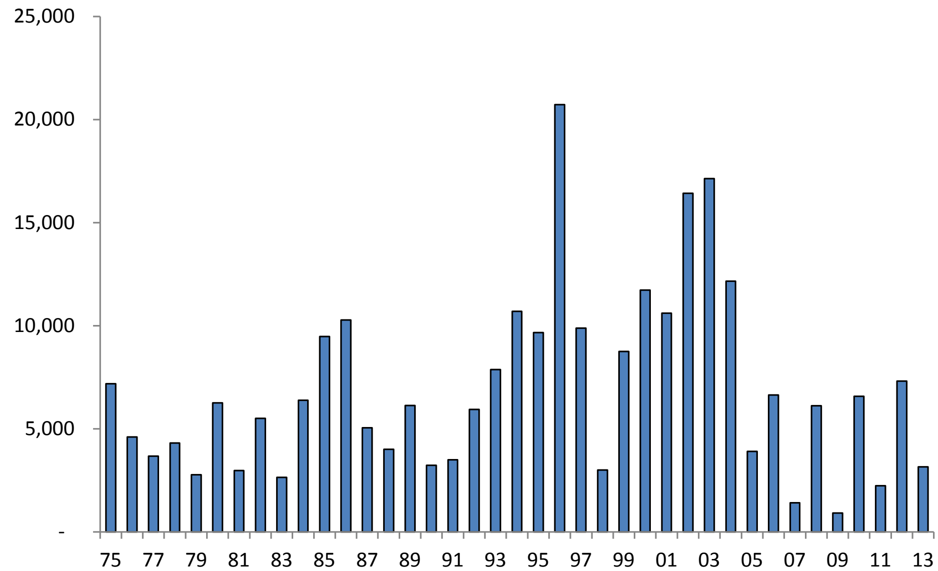

Figure 2.24.–Fraser River spring run age-1.2 stock group escapements of Chinook salmon, 1975–2013.

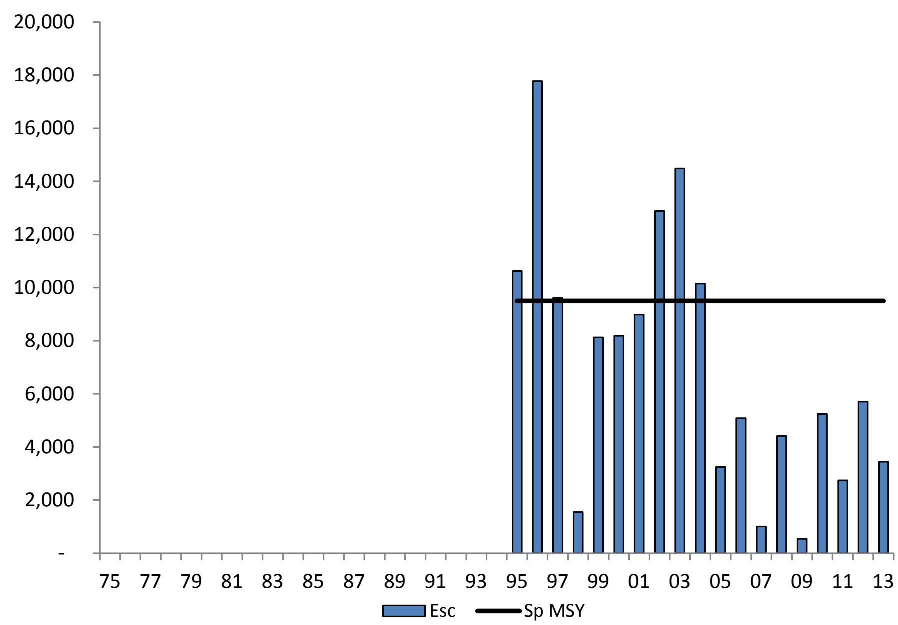

Figure 2.25.–Nicola River escapements of Chinook salmon, 1995–2013.

Agency Comments: The stock group has declined substantially over the last decade and is a stock of conservation concern.

2.3.2.4.3 Fraser River Summer Run: Age 1.3

The Fraser River summer run age-1.3 aggregate includes 10 populations spawning in large rivers, mostly below the outlets of large lakes. These include the Nechako, Chilko and Quesnel rivers in the Mid-Fraser and the Clearwater River in the North Thompson watershed (CTC 2002b).

Escapement Methodology: Escapements are estimated by expanded peak counts of spawners, holders and carcasses surveyed from helicopters. Surveys of the Stuart River and North Thompson River were discontinued in 2004 due to unreliable counting conditions and have been removed completely from the time series. Escapements in 2013 improved slightly from those observed in 2012; however, they failed to attain levels estimated in the parental brood year in 2008. Aggregate escapement was estimated at 12,573 (Figure 2.26).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for the aggregate. Habitat-based estimates of S_{MSY} and other stock–recruitment reference points are available for this stock group, but estimates of total escapement are needed to make them effective. Work is currently underway to estimate total escapements by developing factors that calibrate the visual survey indices to total escapements estimated by MR and AUC methods.

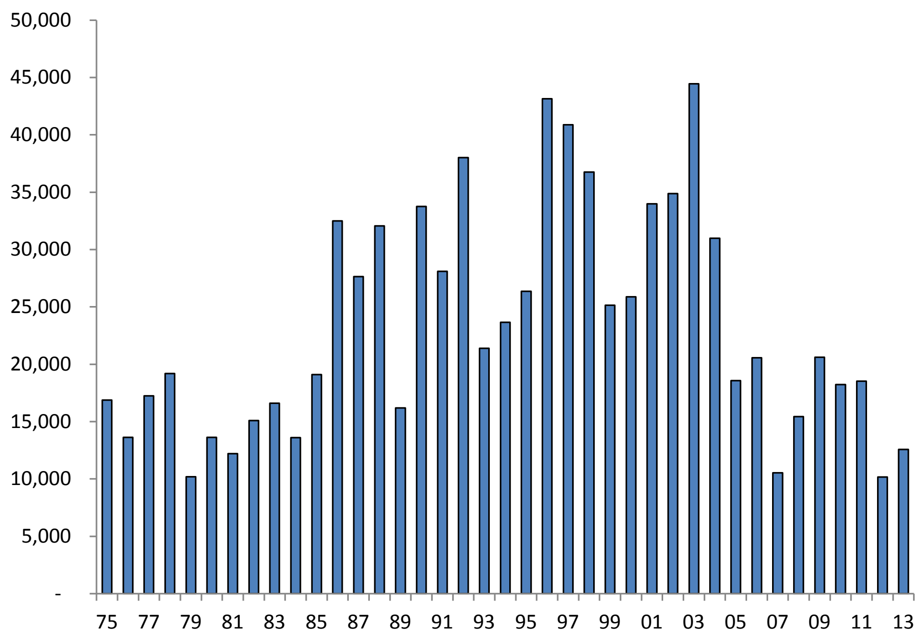

Figure 2.26.–Fraser River summer run age-1.3 stock group escapements of Chinook salmon, 1975–2013.

Agency Comments: The stock group has declined over the last decade and is a stock of conservation concern.

2.3.2.4.4 Fraser River Summer Run: Age 0.3

The Fraser River summer run age-0.3 aggregate includes six populations spawning in the South Thompson watershed and one in the Lower Fraser. These include the Middle Shuswap, Lower Shuswap, Lower Adams, Little River and the South Thompson River mainstem in interior British Columbia, and Maria Slough in the Lower Fraser River (CTC 2002b).

Escapement Methodology: Escapements are estimated using peak count visual survey methods. Escapements to the Frasier River summer run age 0.3 aggregate rebounded from the steep decline observed in 2012 (Figure 2.27). Escapements to the aggregate in 2013 (130,617) exceeded the parental brood year escapements in 2009 (86,377).

The Lower Shuswap River is the exploitation rate indicator stock for the Fraser River summer run age-0.3 stock group, and a MR program provides the high precision estimates of escapement by age and sex. Since 2000 (with the exception of 2003), tags have been applied to live fish by seining, and salmon carcasses were examined later for the presence of marks.

The estimated escapement of 28,797 is substantially greater than that observed in 2012 (3,958). The 2013 escapement represents 113% of the 2009 parental brood of 25,288. Since 2000, hatchery origin fish averaged 6% of the spawning escapement (range: 2–13%). See Figure 2.28.

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for the aggregate. Habitat-based estimates of S_{MSY} and other stock–recruitment reference points are available for this stock group (Parken et al. 2006), but estimates of total escapement are needed to make them effective. Work is currently underway to estimate total escapements by developing factors that calibrate the visual survey indices to total escapements estimated by MR methods and novel methods via the SSP. With the exception of 2012, Lower Shuswap River escapements have exceeded the median estimate of S_{MSY} (12,800; CV=37%).

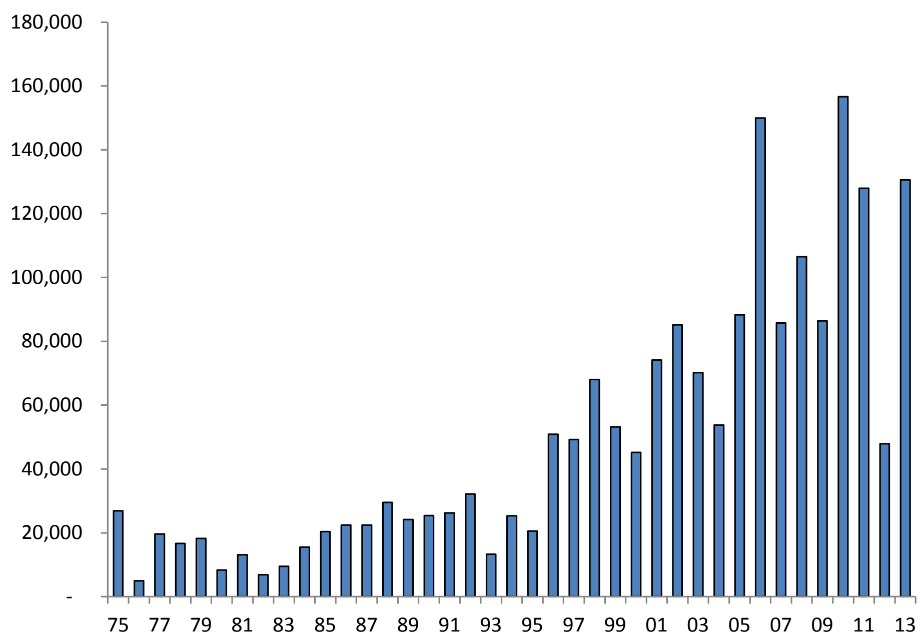

Figure 2.27.–Fraser River summer run age-0.3 stock group escapements of Chinook salmon, 1975–2013.

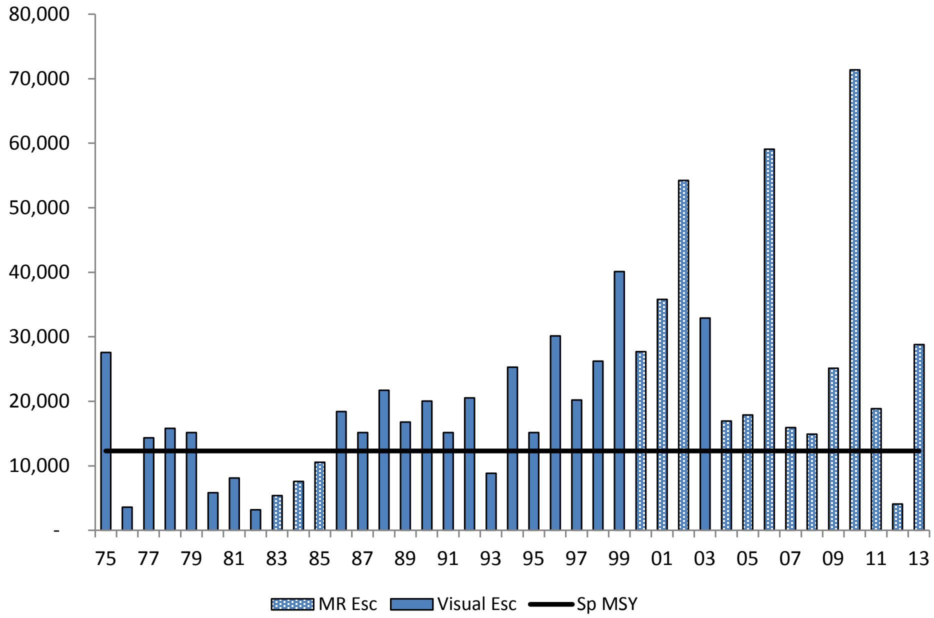

Figure 2.28.–Lower Shuswap River escapements of Chinook salmon, 1975–2013. The visual escapement estimates have been calibrated with the MR estimates.

Agency Comments: Escapements had been increasing for this stock group over the last decade and the stock group has been healthy and abundant.

2.3.2.4.5 Fraser River Late Run (Harrison River)

Escapement Methodology: Since 1984, MR studies have been conducted annually on the Harrison River to obtain reliable estimates of spawning escapements. Spawning escapements to the Harrison River have varied widely from a low of 28,616 adults in 1995 to a high of 247,121 adults in 2003 (Figure 2.29). The 2013 escapements were estimated to be 42,953 adult Chinook salmon, and 40,155 jacks.

Escapement Goal Basis: Due to their natural abundance and importance in numerous British Columbia and Washington State fisheries, Harrison River Chinook salmon were designated as an escapement indicator stock (i.e., key stream indicator) to aid in fulfilling commitments under the 1985 PST. In 1986, an interim escapement goal for Harrison River Chinook salmon was established at 241,700 fish, based on doubling of the escapement estimate obtained from a MR program in 1984. In 2001, an escapement goal range was developed for Harrison Chinook salmon using a Ricker stock–recruit approach and is described in CTC (2002b).

The escapement goal range that was proposed was 75,100 to 98,500 (CV = 15%) with the upper bound equal to the upper 75% confidence limit derived from a bootstrap procedure. This range was reviewed and accepted by the CTC. Estimated spawning escapements in the Harrison have exceeded this escapement goal range in nine years from 1984 to the present. Escapements have fluctuated substantially with no apparent trend in the time series.

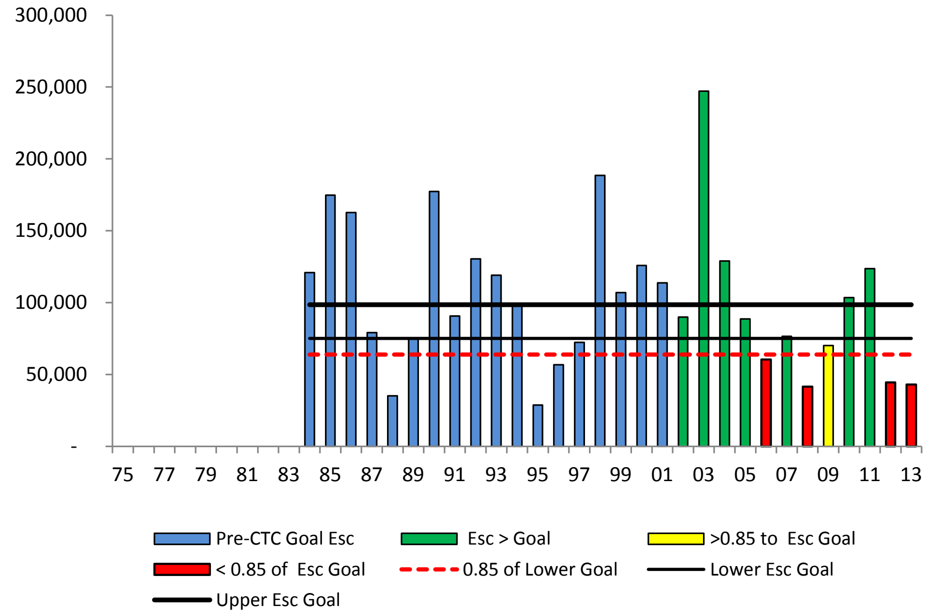

Figure 2.29.–Harrison River escapements of Chinook salmon, 1984–2013.

Agency Comments: Harrison River Chinook salmon are white-fleshed fish that return to spawn during the fall. They are unusual in that fry migrate into the Lower Fraser River and estuary shortly after emergence. This stock spends two to four years in the coastal marine environment before returning to spawn. The Harrison River stock is one of the largest naturally spawning Chinook salmon populations in the world and makes important contributions to fisheries in southern British Columbia and Washington State. The stock has been more than 15% below the lower bound of the escapement goal for two consecutive years.

2.3.3 Puget Sound, Coastal Washington, Columbia River, and Coastal Oregon Stocks

The PSC escapement indicator stocks in Washington and Oregon are currently separated into four regional groups: Puget Sound, Washington Coastal, Columbia River, and North Oregon Coastal. Far north migrating Chinook salmon from the mid-Oregon Coast are not currently included in the PSC Chinook model and thus do not yet have escapement indicator stocks, although there have been two proposed. The indicator stocks include a variety of run timings and ocean distributions. Some of these indictor stocks are components in the different stock groups listed in Attachment I–V tables in the 2009 Agreement.

Biologically based escapement goals have been reviewed and accepted by the CTC for three fall stocks (Queets, Quillayute, Hoh as part of the Washington Coastal fall natural stock group), two spring/summer stocks (Queets, Hoh), four Columbia River stocks (Lewis, Upriver Brights and Deschutes as the Columbia River fall stock group and the Columbia River summer stock group), and three Oregon coastal stocks (Nehalem, Siletz and Siuslaw as the far north migrating Oregon Coastal falls stock group).

2.3.3.1 *Puget Sound*

Puget Sound escapement indicator stocks include spring, summer/fall and fall Chinook salmon stocks from the Nooksack, Skagit, Stillaguamish, Snohomish, Lake Washington, and Green river systems. They tend to have a more local distribution than most coastal and Columbia River stocks and are caught primarily in WCVI AABM fisheries, and Canadian and U.S. ISBM fisheries. Escapement for these stocks is assessed as the total number of natural- and hatchery-origin fish spawning naturally on the spawning grounds.

2.3.3.1.1 Nooksack River

The Nooksack River drains into Puget Sound just north of Bellingham. The Nooksack spring Chinook salmon stock includes early timed populations returning to the north and south forks of the Nooksack River.

Escapement Methodology: Estimates of the escapement in the south fork have traditionally been based on the number of redds observed prior to the first of October expanded by 2.5 redds per spawner. Since 1999, this estimate has been further refined by separating hatchery-origin strays (north/middle fork and summer/fall Chinook salmon) based on CWTs, otolith marks or adipose fin clips, and also by assigning the natural-origin spawners to the south fork, north/middle fork and summer/fall hatchery stocks. The latter step is based on the expansion of the microsatellite DNA stock assignment of carcasses collected through the first week of October applied to the total estimated natural-origin spawners. The majority of the run and the escapement to the spawning grounds is composed of hatchery-origin returns from the supplementation program. Owing to the influence of glacial runoff, estimates of escapement in the north and middle forks are based on a combination of field methods, including carcass and redd counts (i.e., in clear tributaries and during clear/low-flow mainstem conditions). Due to spawn timing differences, north fork/middle fork escapement estimates are assumed to be spring Chinook salmon only, and natural- and hatchery-origin fish are identified based on carcass marks (CWT, otolith thermal marks, adipose clips). Escapement estimates are not yet available for either population for 2013, nor are 2012 stock ID details for the South Fork population (Figure 2.30).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock.

Agency Comments: The state–tribal escapement goal established for this Chinook salmon management unit is an upper management threshold (UMT) of 4,000 spawners and a low abundance threshold (LAT) of 2,000 natural-origin fish (CCMP 2010). The UMT as established by the state–tribal managers is generally considered as the adult (age 3+) escapement level associated with maximum sustained harvest. The LAT is the escapement level below which dramatic declines in long-term productivity could occur. Since listing in 1999 as threatened under the ESA, annual fishery management for this stock has been for a ceiling exploitation rate rather than for a UMT or LAT escapement.

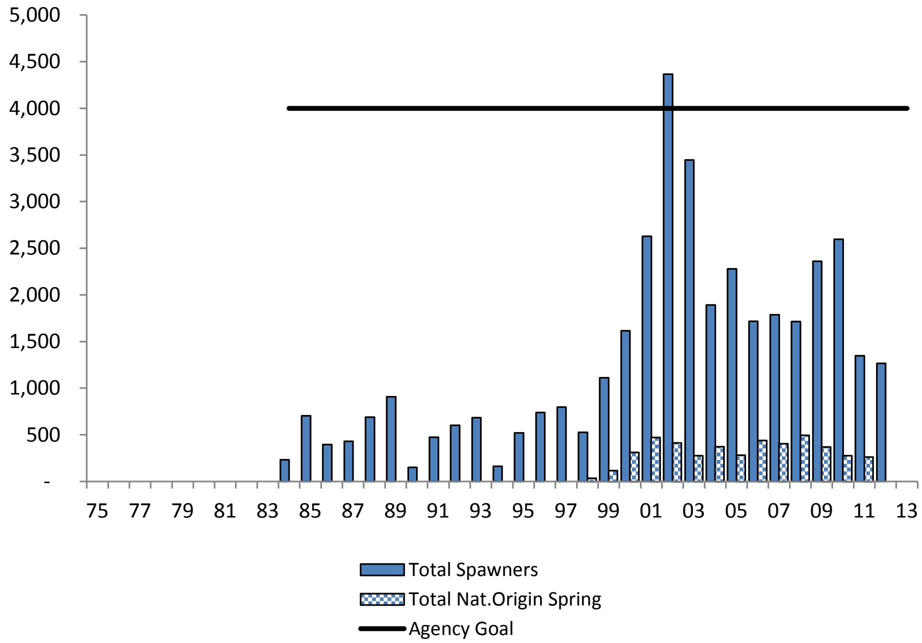

Figure 2.30.–Nooksack River escapement of total (natural- and hatchery-origin) and natural-origin spring Chinook salmon, 1980–2013.

2.3.3.1.2 Skagit River Spring

The Skagit River drains into northern Puget Sound near Mount Vernon, and is the largest drainage basin in Puget Sound. The Skagit River spring Chinook salmon stock includes early-timed populations returning to the Upper Sauk, Cascade, and Suiattle rivers.

Escapement Methodology: Due to changes in spawning index areas, beginning in 1992 for the Cascade stock and 1994 for the Sauk and Suiattle stocks, escapements are not directly comparable to previous numbers. In the Upper Sauk, redds are counted from river mile 21.2 to 39.7 (Darrington to the confluence of the North and South Fork Sauk), in the North Fork Sauk from the mouth to the falls, and in the South Fork Sauk (river mile 0 to 2.5). This method replaced the peak live and dead count approach in 1994. A redd life value of 30.2 days is used and is based on the average of a foot survey-based estimate of 22.9 days and an AUC back calculated estimate of 37.5 days. In the Cascade River, redds are counted in the mainstem upstream of river mile 7.8 and in the lower north fork and south fork, and Found, Kindy, and Sonny Boy creeks. Two helicopter flights and five foot surveys occurred over river mile 7.8 to 18.6. In the Suiattle basin, redds are counted in mainstem Suiattle, and in Big, Tenas, Straight, Circle, Buck, Lime, Downey, Sulphur, and Milk creeks. Prior to 1994, peak live and dead fish counts in Big, Tenas, Buck, and Sulphur creeks were used. Escapement may include very small numbers of hatchery strays in these natural production areas. Past PSC-funded studies on straying of Marblemount Hatchery spring Chinook salmon focused on the area immediately adjacent to the hatchery which is outside the survey reach for natural production. The 2013 escapement estimate was 2,010 natural spawners (Figure 2.31).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock.

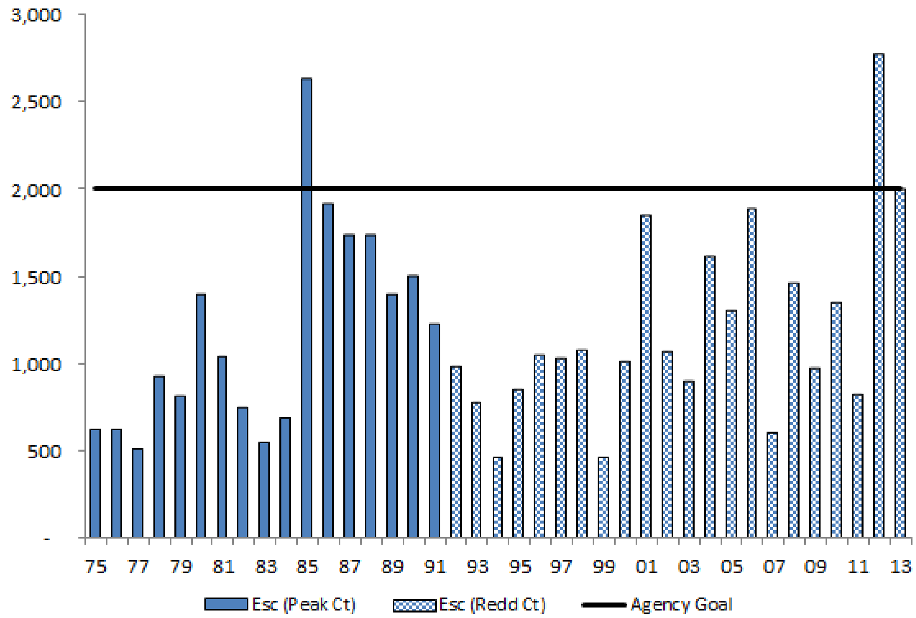

Figure 2.31.–Skagit River escapement of spring Chinook salmon to the spawning grounds, 1975–2013.

Agency Comments: The current UMT used by the state and tribal comanagers for the Skagit River spring Chinook salmon management unit is 2,000 with a LAT of 576 (CCMP 2010). Since listing in 1999 as threatened under the ESA, annual fishery management for this stock has been for a total exploitation rate ceiling rather than for a UMT or LAT escapement.

2.3.3.1.3 Skagit River Summer/Fall

The Skagit River summer/fall Chinook salmon stock includes the Upper Skagit River summer, Sauk summer, and Lower Skagit River fall run populations.

Escapement Methodology: Escapement of Skagit River summer/fall Chinook salmon was estimated using expansion of redd counts from helicopter surveys of mainstem areas and foot surveys of smaller tributaries. The counts are expanded by the AUC method (Smith and Castle 1994). This method assumes a 21-day redd life and 2.5 adult spawners for each estimated redd. The estimate is then reduced by 5% to account for false redds counted during aerial surveys. Natural escapement is predominantly offspring from natural-origin parent spawners; the remainder is hatchery origin fish from the wild stock tagging program that started in 1994. Natural escapement does not include the brood stock collected for this program. The 2013 escapement estimate was 10,882 (Figure 2.32).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock group.

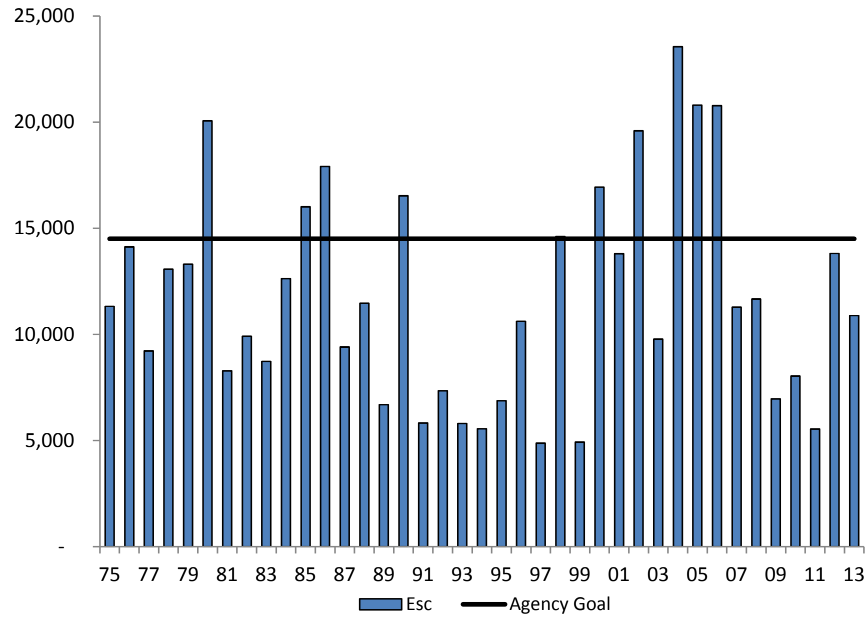

Figure 2.32.–Skagit River escapement of summer/fall Chinook salmon to the spawning grounds, 1975–2013.

Agency Comments: The UMT used by the state–tribal comanagers for the Skagit River summer/fall Chinook salmon management unit is 14,500, based on a recent assessment of freshwater productivity and accounting for variability and biases in management error (CCMP 2010). The LAT is 4,800 spawners. Since listing in 1999 as threatened under the ESA, annual fishery management for this stock has been for a total exploitation rate rather than for a UMT or LAT escapement. In years when the UMT is expected to be exceeded, terminal fisheries can be expanded subject to the overall ceiling exploitation rate.

2.3.3.1.4 Stillaguamish River

The Stillaguamish River drains into northern Puget Sound between Everett and Mount Vernon. The Stillaguamish River has two populations of Chinook salmon distinguished by genetic characteristics, a summer-timed run, and a fall-timed run. These two populations overlap in spawn timing and distribution with both populations spawning in both forks of the river. The summer-timed run is a composite of natural and hatchery-origin supplemental production, with the majority of spawning occurring in the North Fork and its major tributaries, including Boulder River, Deer, Grant, French, and Squire creeks. A much smaller, natural-origin fall stock spawns primarily in the mainstem and South Fork Stillaguamish, and in Pilchuck, Jim and Canyon creeks and in the North Fork Stillaguamish. Escapement is currently estimated for South Fork and North Fork Stillaguamish rather than summer and fall populations of Chinook salmon.

Escapement Methodology: Escapement estimates for Stillaguamish Chinook salmon were based on redd count expansions, assuming a 21-day redd life. The north fork of the Stillaguamish River is surveyed more extensively, with one to three aerial surveys and AUC redd estimates. The escapement estimates for the south fork of the Stillaguamish River uses a peak redd count and assumes 2.5 fish per redd. Boulder and Squire creeks on the north fork of the Stillaguamish River and Jim Creek on the south fork of the Stillaguamish River are also surveyed.

Spawning escapement estimates of fall Chinook salmon may be biased low due to incomplete redd counts using visual sampling methods (Figure 2.33). Evidence of this is supported by MR studies in 2007 through 2012 funded through the SSP where escapement estimates were 1.1 times to 3.1 times higher than those from redd counts (Figure 2.34). Natural escapement excludes brood stock taken for the wild stock indicator program after 1987 but does include spawning hatchery fish from this production. Total natural spawning escapement in 2013 was estimated at 854 (521 natural- and 333 hatchery-origin fish).

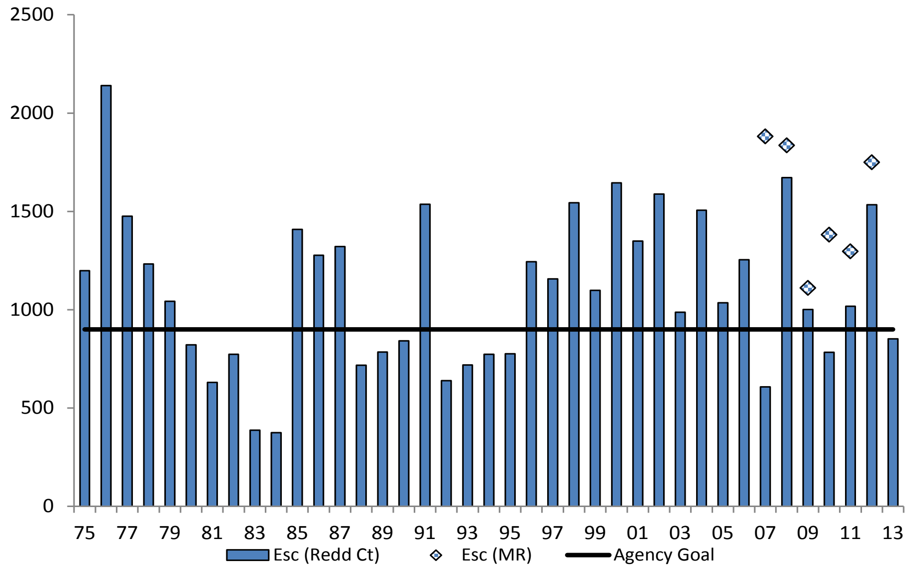

Figure 2.33.–Stillaguamish River escapement of Chinook salmon to the spawning grounds, 1975–2013.

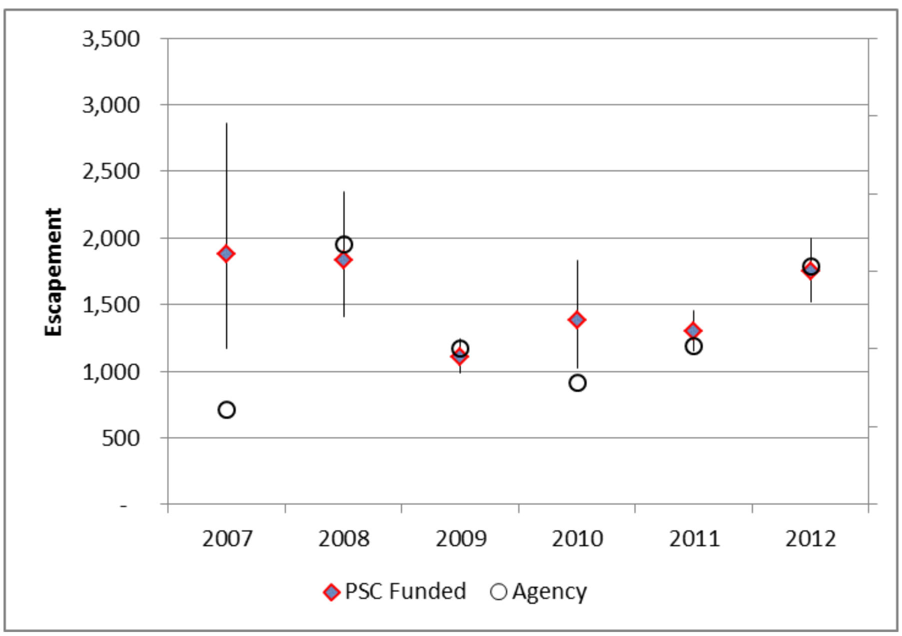

Figure 2.34.–Stillaguamish River escapements of Chinook salmon to the spawning grounds in years when both agency expanded redd counts were used (circles) and when genetic mark–recapture (GMR) estimates (diamonds are point estimates and the bars are 95% CIs) were conducted with SSP funding from the PST.

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock group.

Agency Comments: State–tribal comanagers have established a UMT for this management unit of 900 natural-origin spawners (600 from the North Fork of the Stillaguamish River and 300 from the South Fork of the Stillaguamish River and mainstem) with a LAT of 700 (CCMP 2010). The summer Chinook salmon supplementation program, which collects brood stock from the North Fork of the Stillaguamish River return, was initiated in 1986 as a PST indicator stock program, and its current objective is to release 200,000 tagged fingerling smolts per year. Since 2000, an average of approximately 140 adults has been collected annually from the spawning population for this program. Most releases into the North Fork are from acclimation sites. Relatively small numbers of smolts have been released into the South Fork of the Stillaguamish River. Since listing in 1999 as threatened under the ESA, annual fishery management for this stock has been for a ceiling exploitation rate rather than for a UMT or LAT escapement.

2.3.3.1.5 Snohomish River

The Snohomish River is located in northern Puget Sound near Everett. The Snohomish Chinook salmon stock includes the Skykomish and Snoqualmie summer/fall run populations. Skykomish Chinook salmon spawn in the mainstem of the Skykomish River, and its tributaries including the Wallace and Sultan rivers, in Bridal Veil Creek, the south fork of the Skykomish River between river mile 49.6 and river mile 51.1 and above Sunset Falls (fish have been transported around the falls since 1958), and the north fork of the Skykomish River up to Bear Creek Falls (river mile 13.1). Snoqualmie Chinook salmon spawn in the Snoqualmie River and its tributaries, including the Tolt River, Raging River, and Tokul Creek.

Escapement Methodology: Escapement was estimated using expansion of redd counts conducted by a combination of helicopter, float, and foot surveys, and from fish counts at the Sunset Falls fishway. The natural escapement estimate includes a significant contribution of hatchery strays from the Wallace and Bernie Kai-Kai Gobin (Tulalip Tribe) facilities. A MR study funded under the SSP yielded an estimated spawning escapement of 10,399 (2011) and 7,763 (2012), compared to the redd-based estimate of 1,880 (2011) and 5,123 (2012). See Figure 2.35 and Figure 2.36. The 2013 escapement was estimated at 3,244 natural spawners using redd counts.

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock.

Agency Comments: The state–tribal comanagers have a UMT for this stock of 4,600 natural-origin spawners (CCMP 2010). The LAT for Snohomish River summer/fall Chinook salmon is 2,800. Since listing in 1999 as threatened under the ESA, annual fishery management for this stock has been for a ceiling exploitation rate rather than for a UMT or LAT escapement. In 2014, WDFW and the Tulalip Tribe reviewed, reconciled, and updated the historic escapement time series for the Snohomish Basin; this resulted in minor changes to the data series.

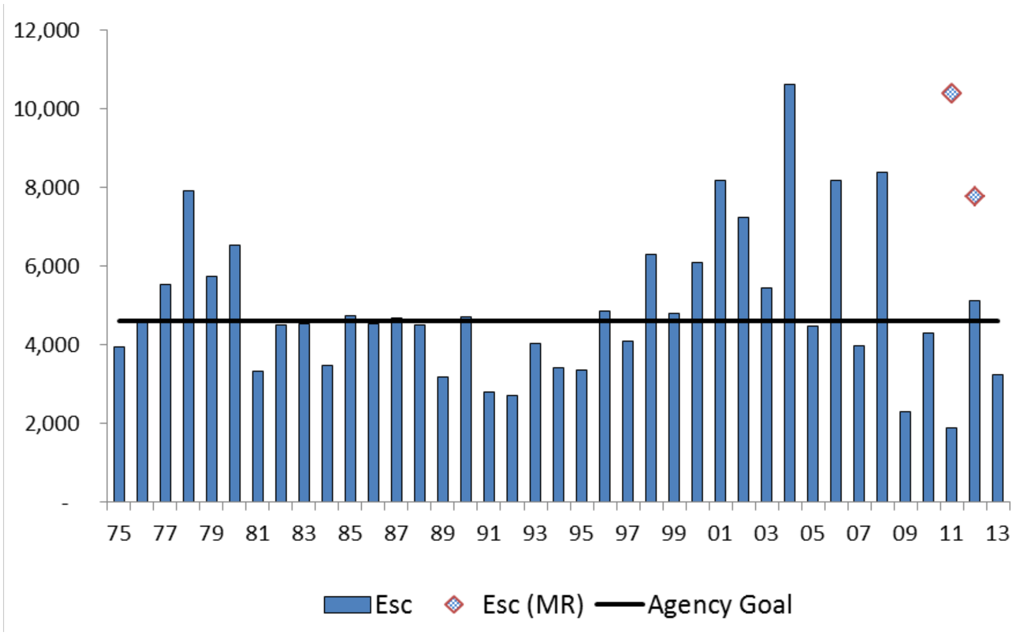

Figure 2.35.–Snohomish River escapement of Chinook salmon to the spawning grounds, 1975–2013.

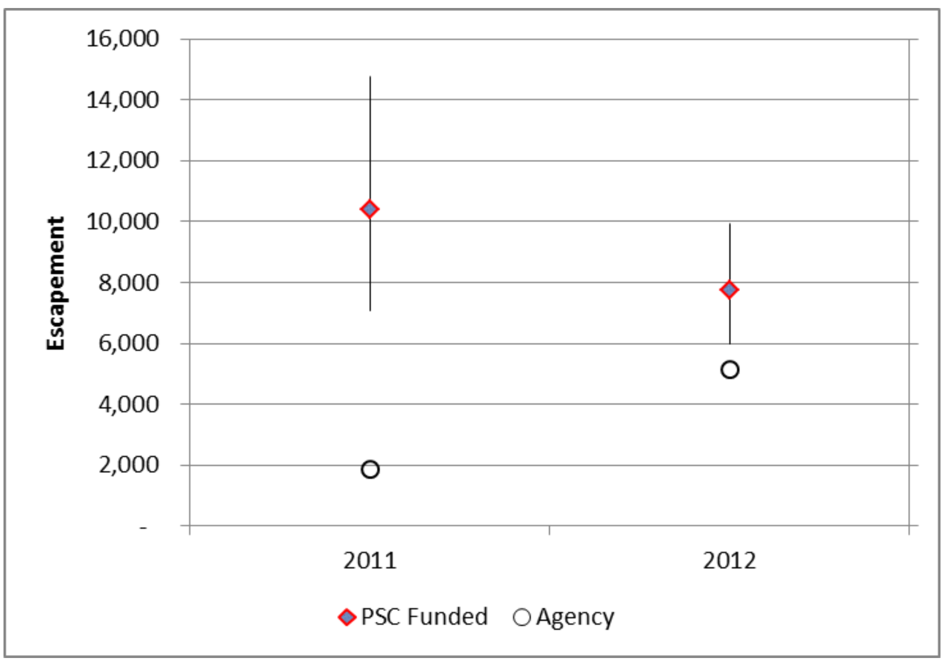

Figure 2.36.–Snohomish River escapements of Chinook salmon to the spawning grounds in years when both agency expanded redd counts were used (circles) and when genetic mark–recapture (GMR) estimates (diamonds are point estimates and the bars are 95% CIs) were conducted with SSP funding from the PST.

2.3.3.1.6 Lake Washington

The Lake Washington Chinook salmon stock includes the fall run populations in the Cedar River and in the North Lake Washington tributaries of Bear, Cottage, and Issaquah creeks. A hatchery is located on Issaquah Creek and Chinook salmon spawning in Issaquah Creek are not included in the natural escapement for Lake Washington.

Escapement Methodology: Natural spawners in Issaquah Creek that spawn below the Issaquah Hatchery are not included in the graph. It should be noted that although there are no hatchery fish released into the Cedar River, an average of 23% of the spawners from 2003 to 2008 were adipose clipped from mass-marked hatchery production, presumably from Issaquah Hatchery (CCMP 2010). Escapement in the Cedar River is estimated using expansion of total redd counts. In recent years, estimates of spawner abundance have also been made using redd counts performed over the entirety of the spawning area downstream of Landsburg Dam (CCMP 2010). These data were used to convert previous estimates of escapement within the index reach to estimates of spawner abundance (as would be derived through redd counts) for the entirety of the river (below the dam) using simple linear regression. Escapement to the North Lake Tributaries is estimated using live counts and AUC methods. The 2013 escapement for Lake Washington was 2,098 spawners, including 248 primarily hatchery-origin fish in Bear and Cottage creeks (Figure 2.37).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock.

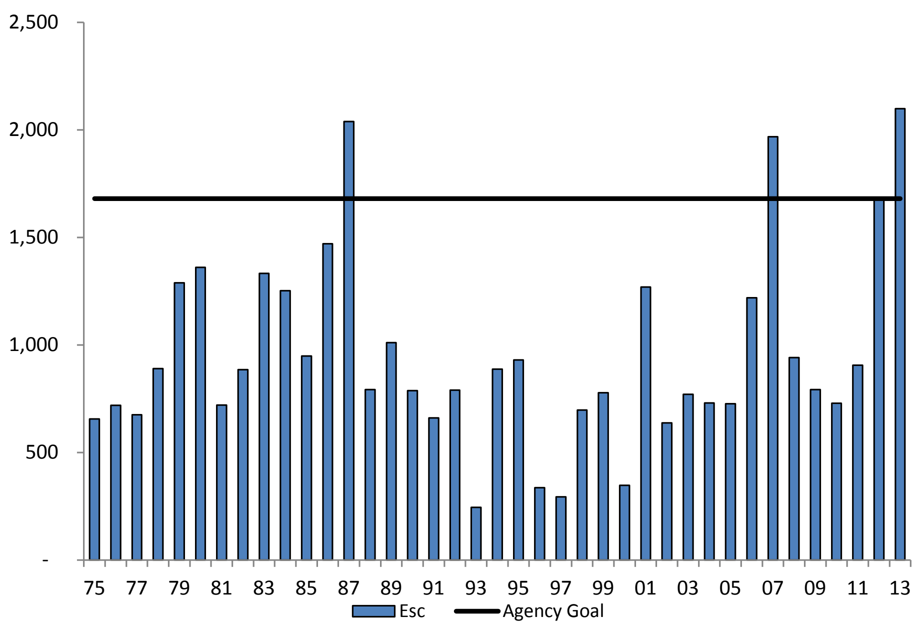

Figure 2.37.–Escapement of Chinook salmon to the spawning grounds in the tributaries of Lake Washington (Cedar River and Bear and Cottage creeks), 1975–2013.

Agency Comments: A state–tribal interim UMT escapement goal of 1,200 Chinook salmon for an index reach in the Cedar River was established in 1993 based on average escapements from 1965 to 1969. This goal for the index reach was converted to 1,680 Chinook salmon for the entirety of the river downstream of the dam and reflects a redd-based escapement value consistent with the interim escapement goal derived using AUC methodology. Since listing in

1999 as threatened under the ESA, annual fishery management for this stock has been for a ceiling exploitation rate rather than for a UMT or LAT escapement in the Cedar River; however, when the UMT is expected to be exceeded, some additional fishing in Lake Washington is considered.

2.3.3.1.7 Green River

The Green River fall Chinook salmon stock consists of a single population spawning in the mainstem Green River and two of its major tributaries, Newaukum and Soos creeks.

Escapement Methodology: Escapement is estimated from a redd count expansion method that has varied over the time series by the extent of spawning survey coverage. The method used until about 1996 involved an index area redd count multiplied by 2.6 to estimate total redds, then multiplied by 2.5 fish per redd to produce estimated escapement. The 2.6 index to total redd expansion factor was based on a 1976 to 1977 U.S. Fish and Wildlife Service MR study. Since 1996, the survey areas have broadened and the associated expansion factor of 2.6 has been reduced to the point that the redd counts in 2009 have complete spawning reach coverage. The method used in recent years provides natural escapement estimates for the mainstem Green River and Newaukum Creek. Newaukum Creek redds are counted during foot surveys. The mainstem Green River is surveyed by boat and by air. Some parts of the river (i.e., the Gorge) are only surveyed by air. Boat surveys are generally done once a week, or twice a week in years with a large numbers of pink salmon. One aerial survey is made during the peak of spawning, more if budgets permit. Certain index reaches of the river are surveyed every week by boat to develop a cumulative redd count total for those reaches. These index reaches are distributed throughout the river. Visible redds are counted for the entire floatable part of the river by boat each week and for the entire river by helicopter during the peak. The ratio of visible redds seen by boat to those seen by air (boat surveys assumed to be best) is used to estimate how many redds would be seen by boat in the unfloated reaches. This provides an estimate of how many visible redds exist during the peak of spawning. To get from peak redds to cumulative total redds, the visible redds in the index reaches during the peak are compared to the season total for those index reaches. Different areas of the river have different ratios of peak visible redds to season totals. Expansion of nonindex visible redds to season total redds uses the ratio from nearby index reaches of the same general character. The CTC considers these estimates from redd counts as index values rather than estimates of total escapement. Estimates of total escapement from MR studies in 2000, 2001, and 2002 funded through the U.S. Letter of Agreement were about 2.5 times higher than the escapement estimate from redd count expansion. In 2010, 2011 and 2012, the MR-based escapements from studies funded under the SSP were once again more than twice as high as the redd count expansion estimates (Figure 2.38 and Figure 2.39). There is a large hatchery program in this basin and these fish comprise a large portion of the return. Hatchery fish contribution to the natural escapement ranged from 53% to 65% for the years 2004 to 2007. The escapement in 2013 from redd count expansion was 2,041 Chinook salmon of mixed hatchery and natural origin.

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock.

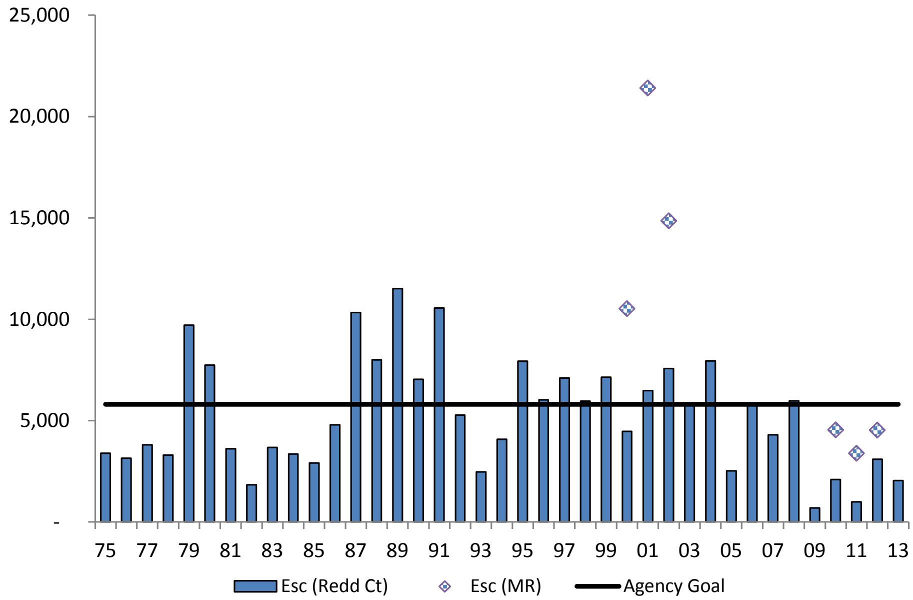

Figure 2.38.–Green River escapement of Chinook salmon to the spawning grounds, 1975–2013.

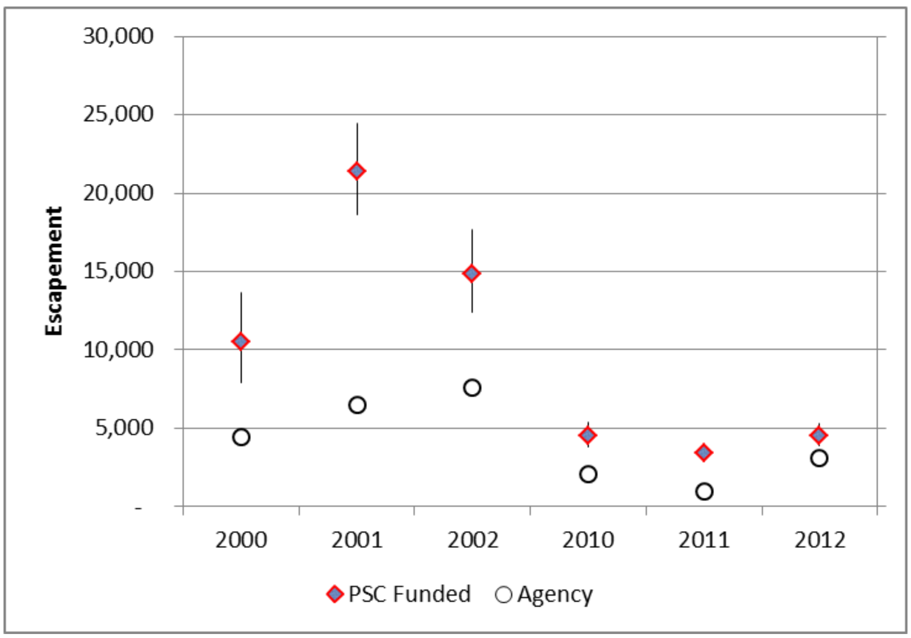

Figure 2.39.–Green River escapements of Chinook salmon to the spawning grounds in years when both agency expanded redd counts were used (circles) and when conventional (2001–2002) and genetic (2010–2012) MR estimates (diamonds are point estimates and the bars are 95% CIs) were conducted with LOA or SSP funding from the PST.

Agency Comments: The state–tribal UMT escapement goal of 5,800 naturally spawning adults is the average of the 1965 to 1976 escapements (Ames and Phinney 1977). The LAT is 1,800 fish. Since listing in 1999 as threatened under the ESA, annual fishery management for this stock has been on a ceiling exploitation rate in the southern U.S. preterminal fisheries and for the UMT in the terminal fisheries.

2.3.3.2 Coastal Washington

Coastal Washington stocks include spring, summer, and fall Chinook salmon from the Hoko, Quillayute, Hoh, and Queets rivers, and from Grays Harbor. Coastal Washington stocks have a northerly distribution and are vulnerable to southern U.S. fisheries primarily as mature fish during their spawning migrations. They are caught primarily in SEAK and NBC AABM fisheries and in terminal net fisheries.

2.3.3.2.1 Hoko River

The Hoko River is located at the extreme western end of the Strait of Juan de Fuca and is not a population listed under the ESA as part of the Puget Sound Chinook Salmon Endangered Species Unit. Hoko River Chinook salmon spawn primarily in the mainstem of the Hoko River, with limited spawning in larger tributaries.

Escapement Methodology: The Makah Tribe and WDFW conduct ground surveys using cumulative redd counts for the mainstem (Hoko) and tributaries found between river mile 1.5 and 21.7, which represents the entire range of spawning habitat utilized by Chinook salmon. Redd counts are multiplied by 2.5 adults per redd. There are 10 mainstem reaches plus 13 tributary reaches, including Little Hoko, Browne's, Herman, North Fork Herman, Ellis, Bear, and Cub rivers, which are all upper mainstem tributaries. The tribe also surveys the mainstem Sekiu and Carpenter, SF Carpenter, Sunnybrook, and unnamed creeks 19.0215, 19.0216, and 19.0218. Escapement excludes brood stock collected from the spawning grounds for the supplementation program which started in 1988 and has collected an average of 149 fish annually through 2011. In 2013, 750 fish were retained for the supplementation program leaving a total natural spawning escapement estimate of 656 of mixed natural origin and returns from the supplementation program (Figure 2.40).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock.

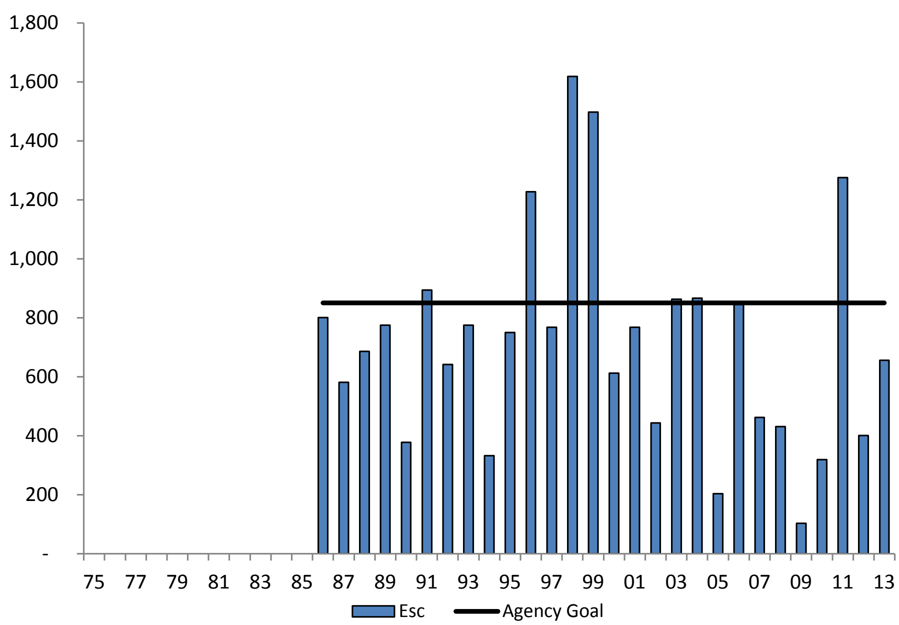

Figure 2.40.–Hoko River escapement of Chinook salmon to the spawning grounds, 1986–2013.

Agency Comments: The UMT escapement goal established by state and tribal comanagers is 850 naturally spawning adults. This goal was developed as a proxy for the spawning escapement for MSY. The escapement goal was calculated using a habitat-based approach rather than a stock–recruitment analysis by estimating the amount of available spawning habitat, then expanded utilizing assumed optimal redds per mile and fish per redd values (Ames and Phinney 1977).

2.3.3.2.2 Quillayute River Summer

The Quillayute River drains from the northwest side of the Olympic Mountains into the Pacific Ocean, south of Cape Alava on the north Washington coast.

Escapement Methodology: Escapement estimates are based on redd counts in index areas and from supplemental surveys on the Bogachiel, mainstem Calawah, North Fork Calawah and Sitkum rivers. This has been used consistently in the Quillayute River System since the 1970s. Surveys are conducted by foot, raft, drift boat and helicopter. Surveys in index areas are examined either weekly or biweekly as conditions allow. Supplemental surveys are done once a season during the peak spawning period. Redd counts from these supplemental surveys are then expanded by the index surveys to estimate redd construction within the supplemental survey areas for the entire season. Using an appropriate redds per mile assignment, the information from index and supplemental surveys is then applied to other streams and segments that have historically had fish presence, but were not surveyed. These areas comprise the Quillayute River system stream mileage base that is consistently calculated to estimate escapement numbers. The number of redds is multiplied by 2.5 to estimate fish escapement. The 2013 escapement estimate for summer Chinook salmon was 968 (Figure 2.41).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock.

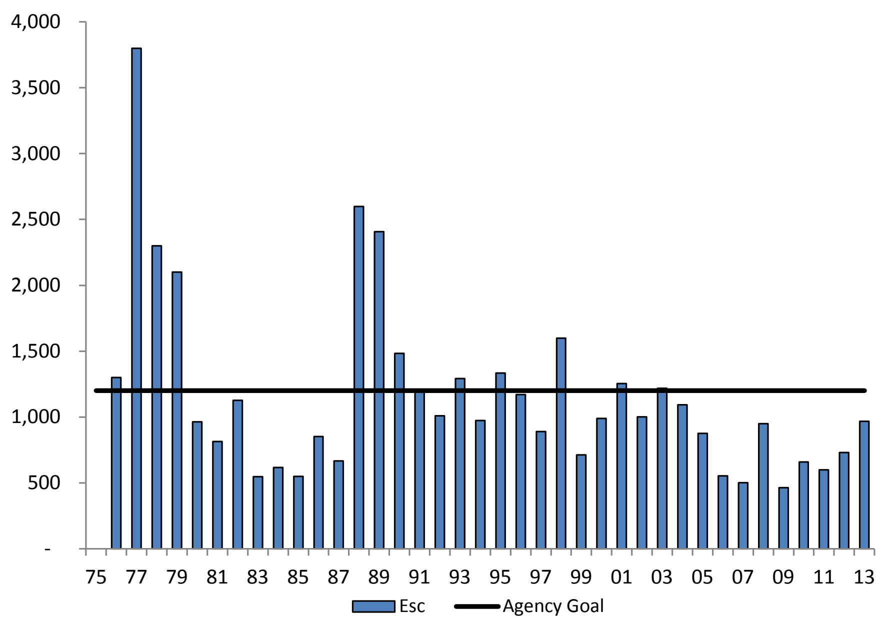

Figure 2.41.–Quillayute River escapement of summer Chinook salmon to the spawning grounds, 1976–2013.

Agency Comments: The state–tribal management goal for this stock is 1,200 adults and jacks combined (PFMC 2003).

2.3.3.2.3 Quillayute River Fall

The Quillayute River drains from the northwest side of the Olympic Mountains into the Pacific Ocean, south of Cape Alava on the north Washington coast. It is one of three Washington coast river systems that contain fall Chinook salmon with CTC-approved escapement goals.

Escapement Methodology: Escapement estimates are based on redd counts in index areas and from supplemental surveys on the Bogachiel, Sol Duc, Dickey, Calawah rivers and several other smaller tributaries in the basin. This has been used consistently in the Quillayute River System since the 1970s. Surveys are conducted by foot, raft, drift boat and helicopter. Surveys in index areas are examined either weekly or biweekly as conditions allow. Supplemental surveys are done once a season during the peak spawning period. Redd counts from these supplemental surveys are then expanded by the index surveys to estimate redd construction within the supplemental survey areas for the entire season. Using an appropriate redds per mile assignment, the information from index and supplemental surveys is then applied to other streams and segments that have historically had fish presence, but were not surveyed. These areas comprise the Quillayute River system stream mileage base that is consistently calculated to estimate escapement numbers. The number of redds is multiplied by 2.5 to estimate fish escapement. The 2013 escapement estimate was 3,901 (Figure 2.42).

Escapement Goal Basis: In 2004, the CTC-approved an escapement goal for Quillayute fall Chinook salmon of 3,000 natural spawners based on a spawner–recruit analysis developed by Cooney (1984) and QDNR (1982).

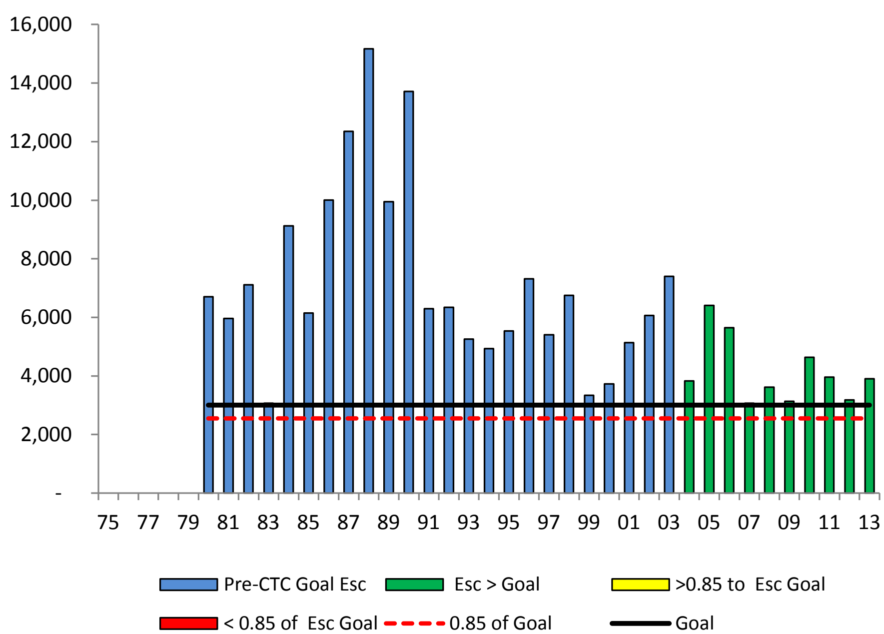

Figure 2.42.–Quillayute River escapement of fall Chinook salmon to the spawning grounds, 1980–2013.

Agency Comments: Terminal fisheries are managed for a harvest rate of 40%, with an escapement floor of 3,000 fish (PFMC 2003). This objective is designed to actively probe at and above estimates of escapements that produce maximum sustained harvest, while minimizing potential detrimental effects of existing fisheries. Stock production analyses of spawning escapements from 1968 to 1982 were used to determine the initial escapement floor.

2.3.3.2.4 Hoh River Spring/Summer

The Hoh River drains from the western side of the Olympic Mountains on the north Washington coast between the Quillayute River to the north and the Queets River to the south.

Escapement Methodology: Escapement is estimated from redd counts in index areas and supplemental surveys in the mainstem and south fork of the Hoh River and in tributaries with spawning habitat. Surveys are conducted by foot, boat, and helicopter. Intensively monitored index reaches are surveyed each week where surveyors record new and visible redds. Cumulative redd counts for each index reach represents the total spawner abundance for that particular spawning area. Weekly visible redd counts in index reaches are used to estimate spawning timing curves by calculating the proportion of season cumulative redds that are visible on each weekly survey date. Surveys are also conducted in reaches too large or remote to intensively monitor throughout the season. These surveys are timed as close as possible to peak spawning activity and spawner abundance estimates are derived using index timing curves. For areas with suitable habitat but not regularly surveyed, redd densities (cumulative redds per river mile) from surveyed reaches with similar habitat type are used to estimate escapement into these reaches of known stream length. The total natural spawning escapement is calculated assuming 2.5 fish per redd. There is no hatchery program in this system. The 2013 natural escapement estimate was 750 fish (Figure 2.43).

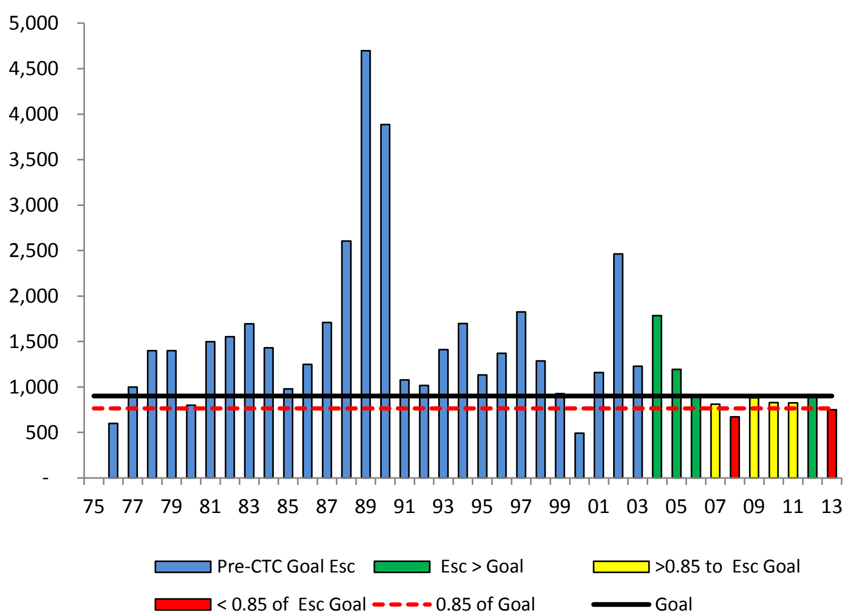

Figure 2.43.–Hoh River escapement of spring/summer Chinook salmon to the spawning grounds, 1976–2013.

Escapement Goal Basis: Escapement floor policy of 900 for the Hoh spring/summer Chinook salmon was developed by Cooney (1984) and QDNR (1982), based on spawner–recruit analyses, and was accepted by the CTC in 2004.

Agency Comments: Similar to many of the other Washington coastal stocks, Hoh River spring/summer escapements have been relatively stable except for much larger returns in 1988, 1989, and 1990. The terminal return for this stock declined from 1997 to 2000, had rebounded in 2001 before declining again since 2005. Terminal fisheries are managed to catch 31% of the river run, with an escapement floor of 900 fish (PFMC 2003). This objective is designed to allow a wide range of spawner escapements from which to eventually develop an MSY objective or proxy while protecting the long-term productivity of the stock. Stock production analysis of spawning escapement for brood years 1969 to 1976 was utilized to determine the initial escapement floor.

2.3.3.2.5 Hoh River Fall

The Hoh River drains from the western side of the Olympic Mountains on the north Washington coast between the Quillayute River to the north and the Queets River to the south. It is one of three Washington coast river systems that contain fall Chinook salmon with CTC-approved escapement goals.

Escapement Methodology: Escapement is estimated from redd counts in index areas and supplemental surveys in the mainstem and south fork Hoh River and in tributaries with spawning habitat. Surveys are conducted by foot, boat, and helicopter. Intensively monitored index reaches are surveyed each week where surveyors record total new and visible redds observed each week. Cumulative redd counts for each index reach represents the total spawner abundance for that particular spawning area. Weekly visible redd counts in index reaches are used to estimate spawning timing curves by calculating the proportion of season cumulative redds that are visible on each weekly survey date. Extensive surveys are also conducted in nonintensively monitored stream areas utilized by spawning Chinook salmon. These extensive reaches encompass areas too large or remote to intensively monitor throughout the season. Extensive surveys are timed as close as possible to peak spawning activity. Extensive reach spawner abundance estimates are derived using index timing curves. For areas with suitable habitat but not regularly surveyed, redd densities (cumulative redds per river mile) from surveyed reaches with similar habitat type are used to estimate escapement into these reaches of known stream length. The total natural spawning escapement is calculated assuming 2.5 fish per redd. The natural escapement estimates for Hoh River fall Chinook salmon include a small number of fish taken for an experimental hatchery program from 1983 to 1986, but otherwise should be considered natural-origin fish. The 2013 escapement estimate was 1,269 fish (Figure 2.44).

Escapement Goal Basis: The escapement floor of 1,200 for the Hoh fall Chinook salmon was developed by Cooney (1984) and QDNR (1982), based on spawner–recruit analyses, and was accepted by the CTC in 2004 as the escapement goal.

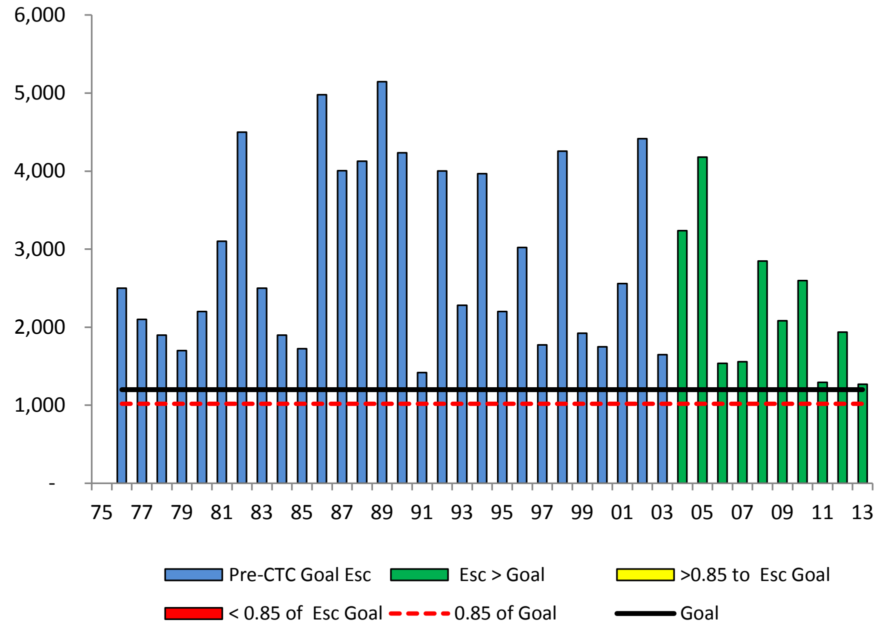

Figure 2.44.–Hoh River escapement of fall Chinook salmon to the spawning grounds, 1976–2013.

Agency Comments: The state–tribal management plan for this stock includes a harvest rate of 40% of the terminal run, with an escapement floor of 1,200 spawners (PFMC 2003). This objective is designed to actively probe at and above estimates of the escapements that produce maximum sustained harvest, while minimizing potential detrimental effects of existing fisheries. Stock production analyses of spawning escapements from 1968 to 1982 were utilized to determine the initial escapement floor.

2.3.3.2.6 Queets River Spring/Summer

The Queets River drains from the western side of the Olympic Mountains on the north Washington coast and is south of the Hoh River.

Escapement Methodology: Escapement is estimated from redd counts from August 15 to October 15 for spring/summer Chinook salmon. Surveys are conducted by foot, boat, and helicopter. Intensively monitored index reaches are surveyed each week where surveyors record total new and visible redds observed each week. Cumulative redd counts for each index reach represents the total spawner abundance for that particular spawning area. Weekly visible redd counts in index reaches are used to estimate spawning timing curves by calculating the proportion of season cumulative redds that are visible on each weekly survey date. Extensive surveys are also conducted in nonintensively monitored stream areas utilized by spawning Chinook salmon. These extensive reaches encompass areas too large or remote to intensively monitor throughout the season. Extensive surveys are timed as close as possible to peak spawning activity. Extensive reach spawner abundance estimates are derived using index timing curves. For areas with suitable habitat but not regularly surveyed, redd densities (cumulative redds per river mile) from surveyed reaches with similar habitat type are used to estimate escapement into these reaches of known stream length. The total natural spawning escapement is calculated under the assumption of 2.5 fish per redd. The 2013 estimate of natural escapement was 520 fish (Figure 2.45).

Escapement Goal Basis: Escapement floor policy of 700 for Queets spring/summer Chinook salmon was developed by Cooney (1984) and QDNR (1982), based on spawner–recruit analyses, and was accepted by the CTC in 2004 as the escapement goal. Stock production analysis of spawning escapements for brood years 1969 to 1976 were used to determine the initial escapement floor.

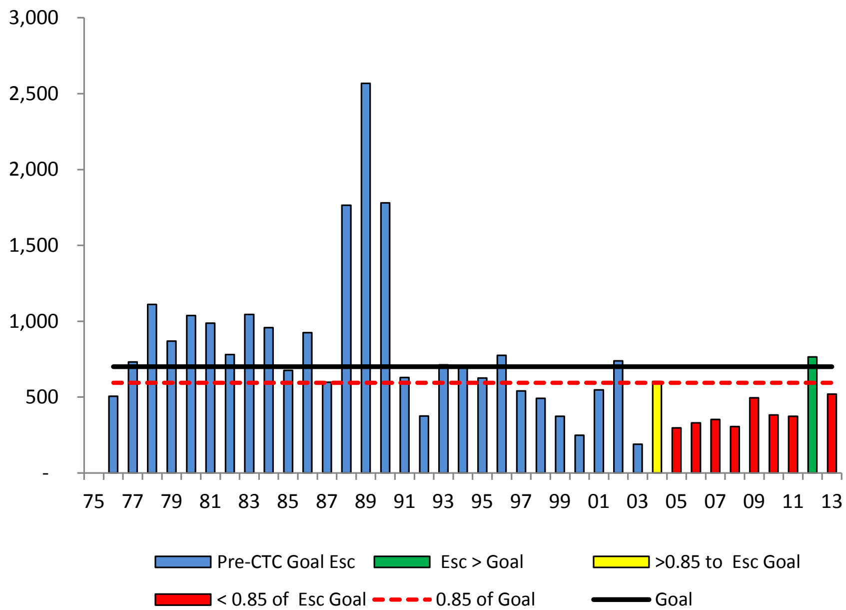

Figure 2.45.–Queets River escapement of spring/summer Chinook salmon to the spawning grounds, 1976–2013.

Agency Comments: Terminal fisheries are managed by the state and tribes to catch 30% of the river run size, with an escapement floor of 700 fish (PFMC 2003). This objective is designed to actively probe at and above the estimates of escapement that produce MSY. Since 1990, terminal fisheries have had minimal impact on this stock as returns to the river have rarely exceeded the escapement floor. Since 2000, sport anglers have been required to release all Chinook salmon during the summer, and tribal fisheries have been limited to one tribal netting day for ceremonial and subsistence purposes.

2.3.3.2.7 Queets River Fall

The Queets River drains from the western side of the Olympic Mountains on the north Washington coast and is south of the Hoh River. It is one of three Washington coast river systems that contain fall Chinook salmon with CTC-approved escapement goals.

Escapement Methodology: Escapement is estimated from redd counts from October 15 to December 1 for fall Chinook salmon. Surveys are conducted by foot, boat, and helicopter. Intensively monitored index reaches are surveyed each week where surveyors record total new and visible redds observed. Cumulative redd counts for each index reach represents the total spawner abundance for that particular spawning area. Weekly visible redd counts in index reaches are used to estimate spawning timing curves by calculating the proportion of season cumulative redds that are visible on each weekly survey date. Extensive surveys are also conducted in nonintensively monitored stream areas utilized by spawning Chinook salmon. These extensive reaches encompass areas too large or remote to intensively monitor throughout the season. Extensive surveys are timed as close as possible to peak spawning activity. Extensive reach spawner abundance estimates are derived using index timing curves. For areas with suitable habitat but not regularly surveyed, redd densities (cumulative redds per river mile) from surveyed reaches with similar habitat type are used to estimate escapement into these reaches of known stream length. The total natural spawning escapement is calculated under the assumption of 2.5 fish per redd. The natural escapement of Queets River fall Chinook salmon was 2,403 in 2013 (Figure 2.46).

Escapement Goal Basis: The escapement floor policy of 2,500 for the Queets fall Chinook salmon was developed by Cooney (1984) and QDNR (1982), and was based on spawner–recruit analyses, and was accepted by the CTC in 2004 as the escapement goal.

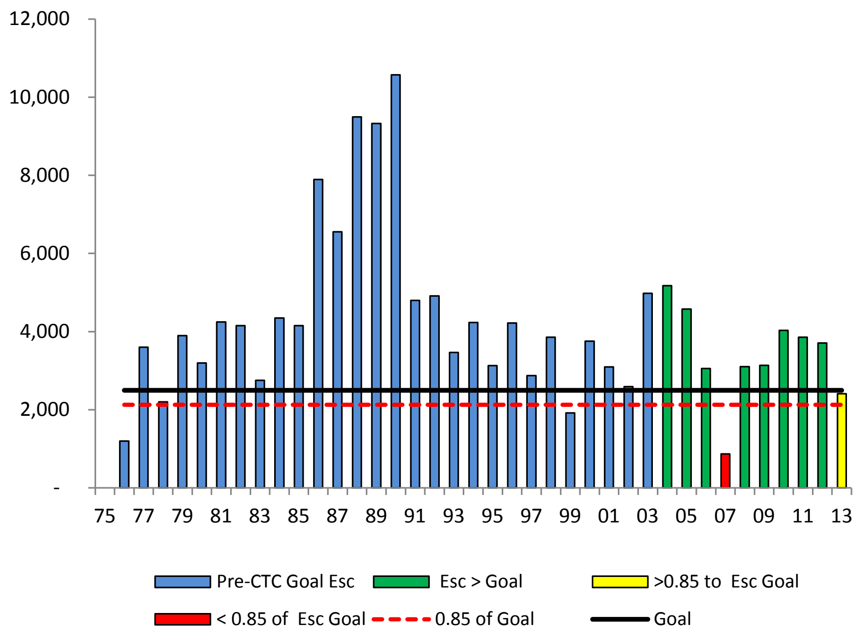

Figure 2.46.–Queets River escapement of fall Chinook salmon to the spawning grounds, 1976–2013.

Agency Comments: Terminal fisheries are managed by the state and tribes to catch 40% of the river return, with an escapement floor of 2,500 spawners (PFMC 2003). This objective is designed to actively probe at and above estimates of the escapements that produce maximum sustained harvest. Stock production analyses of spawning escapements from 1967 to 1982 were used to determine the initial escapement floor.

2.3.3.2.8 Grays Harbor Spring

Grays Harbor spring Chinook salmon spawn primarily in the upper reaches of mainstem Chehalis River and its tributaries.

Escapement Methodology: Escapement is estimated by redd counts from August 15 to October 15 for spring/summer Chinook salmon. Surveys are conducted by foot, boat, and helicopter. Intensively monitored index reaches are surveyed each week where surveyors record total new and visible redds observed. Cumulative redd counts for each index reach represents the total spawner abundance for that particular spawning area. Weekly visible redd counts in index reaches are used to estimate spawning timing curves by calculating the proportion of season cumulative redds that are visible on each weekly survey date. Extensive surveys are also conducted in nonintensively monitored stream areas utilized by spawning Chinook salmon. These extensive reaches encompass areas too large or remote to intensively monitor throughout the season. Extensive surveys are timed as close as possible to peak spawning activity. Extensive reach spawner abundance estimates are derived using index timing curves. For areas with suitable habitat but not regularly surveyed, redd densities (cumulative redds per river mile) from surveyed reaches with similar habitat type are used to estimate escapement into these reaches of known stream length. The total natural spawning escapement is calculated under the assumption of 2.5 fish per redd. The 2013 escapement was 2,459 Chinook salmon (Figure 2.47).

Escapement Goal Basis: There is currently no CTC-accepted escapement goal for this stock group.

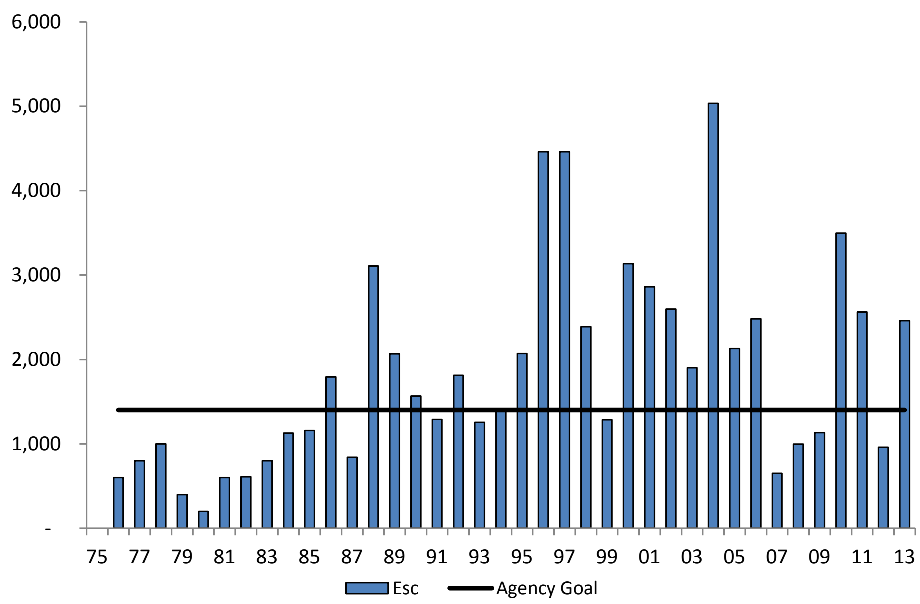

Figure 2.47.–Grays Harbor escapement of spring Chinook salmon to the spawning grounds, 1976–2013.

Agency Comments: The natural spawning escapement goal established by the state–tribal comanagers for Grays Harbor spring Chinook salmon is 1,400 adult fish (PFMC 2003). This single targeted goal was developed as a MSY proxy. This objective was derived from actual spawning data from the mid- to late 1970s, and expanded to include additional habitat not covered by spawner surveys.

2.3.3.2.9 Grays Harbor Fall

Grays Harbor fall Chinook salmon spawn primarily in the mainstem Chehalis River, in the Humptulips and Satsop rivers where fall Chinook salmon hatchery facilities are located, and in smaller tributaries such as the Wishkah and Hoquiam rivers that flow directly into the harbor.

Escapement Methodology: Escapement is estimated from redd counts from October 15 to December 1 for fall Chinook salmon. Surveys are conducted by foot, boat, and helicopter. Intensively monitored index reaches are surveyed each week where surveyors record total new and visible redds observed. Cumulative redd counts for each index reach represents the total spawner abundance for that particular spawning area. Weekly visible redd counts in index reaches are used to estimate spawning timing curves by calculating the proportion of season cumulative redds that are visible on each weekly survey date. Extensive surveys are also conducted in nonintensively monitored stream areas utilized by spawning Chinook salmon. These extensive reaches encompass areas too large or remote to intensively monitor throughout the season. Extensive surveys are timed as close as possible to peak spawning activity. Extensive reach spawner abundance estimates are derived using index timing curves. For areas with suitable habitat but not regularly surveyed, redd densities (cumulative redds per river mile) from surveyed reaches with similar habitat type are used to estimate escapement into these reaches of known stream length. The total natural spawning escapement is calculated under the assumption of 2.5 fish per redd. The 2013 escapement was 12,153 spawners (

Figure 2.48).

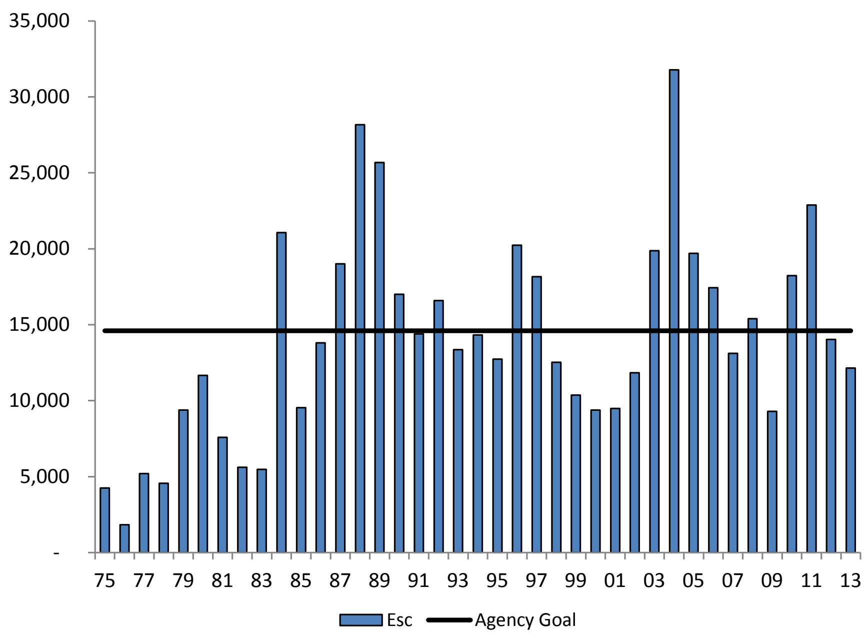

Figure 2.48.–Grays Harbor escapement of fall Chinook salmon to the spawning grounds, 1976–2013.

Note: The displayed agency goal line (14,600) relates to the agency goal in effect through 2013; the newly CTC-approved escapement goal (13,326) will be used in assessments from 2014 onward.

Escapement Goal Basis: In February, 2014 the CTC reviewed a spawner–recruit analysis by Quinalt Department of Natural Resources and WDFW that identified a biologically based spawning escapement goal. The CTC provisionally accepted the presented goal (13,500) and provided comments necessitating minor re-analysis and report revision. The final adopted goal is 13,326 (QDNR and WDFW 2014; Appendix D).

Agency Comments: Consistent with the stock group in Attachments I, II and V of the 2009 Agreement, the Grays Harbor fall Chinook salmon escapement goal will be applied in CTC stock-performance evaluations on a stock aggregate basis. This goal, however, is the sum of tributary-specific goals that were derived separately for the Chehalis and Humptulips rivers.

2.3.3.3 *Columbia River*

Columbia River stocks include spring, summer, and fall Chinook salmon from the Columbia River and its tributaries. Runs may have markedly different marine distributions with different vulnerabilities to ocean fisheries. Upriver spring stocks generally migrate offshore and are rarely retained in ocean salmon fisheries. As a result, they are not identified in Attachments I–V of the PST. Most summer and fall stocks have a northern distribution. Lower Columbia River tule fall Chinook salmon have a more local distribution and are caught mainly in the WCVI AABM fishery and U.S. ISBM fisheries.

2.3.3.3.1 Columbia Upriver Spring

Escapement Methodology: To provide consistency with the Technical Advisory Committee's annual Joint Staffs Reports, escapement graphs include the sum of wild adult upper Columbia spring Chinook salmon passing Rock Island Dam (Joint Staff Report, Table 8) and wild adult Snake River spring/summer Chinook salmon passing Lower Granite Dam (plus Tucannon escapements below; Joint Staff Report, Table 9). However, for purposes of fishery management and allocation under *US v. OR*, Columbia Upriver spring stock includes all hatchery and wild fish destined to return past Bonneville from January 1 through June 15. There are additional tributary spawning escapements (e.g., Deschutes and John Day rivers) that comprise the Columbia Upriver spring management unit that are not included in the graph. Although it is not a completely comprehensive estimate of the naturally spawning Columbia Upriver spring escapement past Bonneville, this times series provides a consistent and annually documented index of the abundance trend of naturally spawning fish (Figure 2.49).

Escapement Goal Basis: Under the 2008–2017 *U.S. v. Oregon* Management Agreement (MA), this stock is not managed for an escapement goal. Fishery impacts are managed using harvest rate schedules based on total river mouth abundance of upriver spring Chinook salmon or the Snake River natural spring/summer run size if it is less than 10% of the total run size (2008–2017 *U.S. v. Oregon* MA, Appendix A, Table A1). The harvest rate schedule ranges from less than 5.5% at run sizes less than 27,000 up to 17% at run sizes exceeding 488,000.

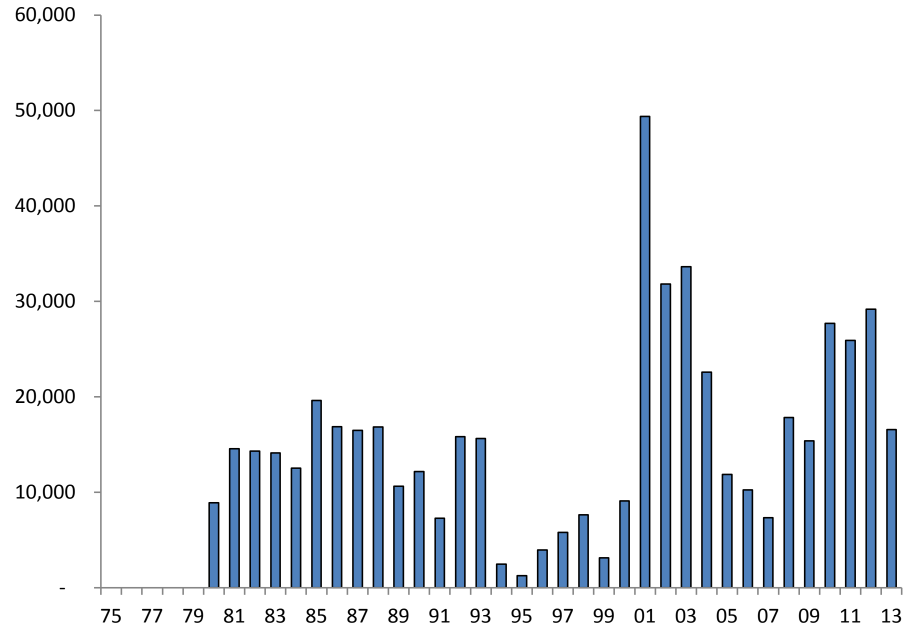

Figure 2.49.–Escapement of Columbia upriver spring Chinook salmon, 1980–2013.

Agency Comments: The 2008–2017 *U.S. v. Oregon* MA provides for a minimum annual mainstem treaty Indian ceremonial and subsistence entitlement of 10,000 spring and summer Chinook salmon. Beginning in 2010, modifications to Table A1 (2008–2017 *U.S. v. Oregon* MA) were implemented requiring non-Indian fisheries to meet catch balance provisions in the MA for upriver spring Chinook salmon. Under these provisions, non-Indian fisheries are managed to remain within ESA impacts, and to not exceed the total allowable catch available for treaty fisheries.

2.3.3.3.2 Columbia Upriver Summer

Escapement Methodology: This graph represents the counts of all adult Chinook salmon past Rock Island Dam during the summer counting period (June 18 to August 17), for consistency with escapements used to develop the interim escapement goal (Figure 2.50).

Escapement Goal Basis: The CTC (1999) developed an interim escapement goal of 12,143 adult summer Chinook salmon past Rock Island Dam, using PSC Chinook model predictions of escapement and recruitment. Because the model data included both hatchery and wild fish, the goal is compared to total escapement past Rock Island Dam. An analysis in 2008 using actual escapement data resulted in a similar goal, but modifications to the analysis were requested by the CTC and no further action was taken.

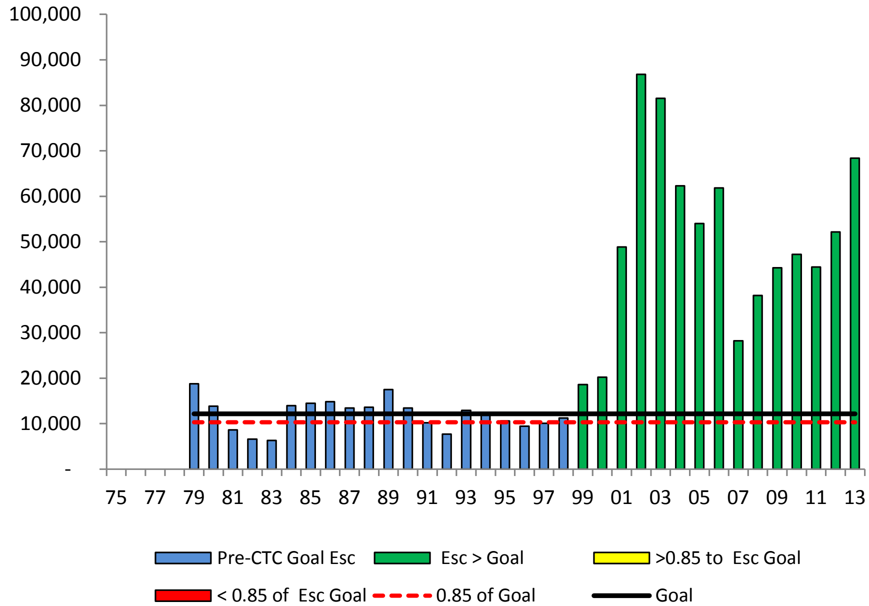

Figure 2.50.–Adult passage of Columbia upriver summer Chinook salmon at Rock Island Dam, 1979–2013.

Agency Comments: The summer management period is from June 16 to July 31. Catches of Chinook salmon during this period are in accord with a harvest rate schedule that varies based on expected river mouth abundance (2008–2017 *U.S. v. Oregon* MA, Table A2). Harvest rates vary from about 5 % to 7% for run sizes up to 16,000, 15% to 17% up to a run size of 36,250, and catch sharing formulas for harvestable surpluses above that. In addition, Columbia upriver summer Chinook salmon are managed for a goal of 29,000 hatchery- and natural-origin adults at the Columbia River mouth, to provide 20,000 adults above Priest Rapids Dam, including 13,500 Wenatchee/Entiat/Chelan natural fish, 3,500 Methow/Okanogan natural fish and 3,000 hatchery fish.

2.3.3.3.3 Coweeman River Tules

The Coweeman River is a third-order tributary to the Cowlitz River located in Cowlitz County, Washington and drains approximately 329 km^2. This watershed supports a small population of mostly natural origin age-3 and -4 tule fall Chinook salmon. The Coweeman stock is a newly added (effective this year) CTC escapement indicator representing natural tule fall Chinook salmon production for the Lower Columbia River.

Escapement Methodology: The Coweeman Chinook salmon stock has been monitored on a long-term basis using a peak live plus dead count from a single survey pass through a portion of the spawning habitat. This provides an index of escapement, not a basin-total estimate. Since 2002, Chinook salmon escapement (>59 cm) for the entire basin has been estimated annually through intensive studies based on a variety of methods. The preferred method for estimating escapement in the Coweeman River is MR, which was successfully implemented from 2002 to 2004, 2011 (physical MR), and 2009 to 2010 (GMR). Redd-based escapement estimates were generated for 2007 and 2008 using the results from a basin- and seasonwide redd census and sampling estimates of mean females per redd and sex ratio. In 2005 and 2006, live-count AUC estimates were produced using a trapezoidal AUC estimator and weekly counts of spawners in the index section; index AUC escapement was expanded to the entire spawning area based on the proportion of total spawners observed in the index reach during a basinwide survey near peak spawning time. See Figure 2.51 for Coweeman River escapements of tule fall Chinook salmon, 1975 to 2013.

Escapement Goal Basis: The Coweeman stock has no CTC-agreed or agency escapement goal(s). However, it is managed according to an abundance-based exploitation rate ceiling schedule for Lower Columbia River Tule Chinook salmon under ESA fishery consultation standards.

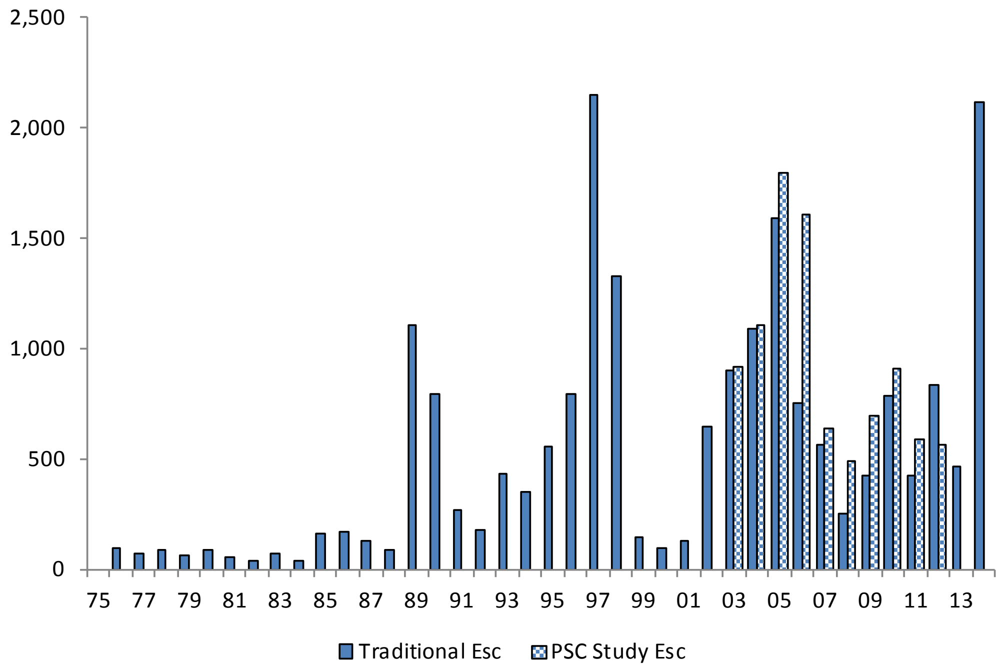

Figure 2.51.–Coweeman River escapements of tule fall Chinook salmon, 1975–2013.

Agency Comments: GMR studies were also conducted in 2012 and 2013; however, estimates are not yet available. In 2013 surveyors observed a peak count (index) of 2,118 fish. Future efforts will focus on calibrating the long-term index time series to basin-total escapement.

2.3.3.3.4 Lewis River Fall

Escapement Methodology: Most natural bright fall Chinook salmon production below Bonneville Dam occurs in the North Fork Lewis River. The Lewis River Wild stock is the main component of the Lower River Wild management unit for fall Chinook salmon, which also includes small amounts of wild production from the Cowlitz and Sandy river basins. In this report, the escapements and goal are for the Lewis River component. Annual escapement estimates are obtained by expanding peak counts from weekly counts of live and dead fish in the 6.4 km area below Merwin Dam (river km 31.4) by a factor of 5.29 (total spawners per peak count). This factor was derived from a carcass tagging and recapture study performed in 1976 (McIsaac 1990). From 1999 to 2001, a Letter of Agreement funded study estimated and verified the expansion factor. A CWT program for wild fish has been in place since the 1977 brood.

Methods of CWT recovery, escapement counting, and expansion of the index area fish counts have been consistent since 1964. All naturally spawning adult fish, both from hatchery and natural production, are included in the escapement (Figure 2.52).

Escapement Goal Basis: The escapement goal of 5,700 fall Chinook salmon in the Lewis River was developed by McIsaac (1990), based on spawner–recruit analysis of the 1964 to 1982 broods and CWT recoveries from the 1977 to 1979 broods. This analysis was updated by the CTC (1999) using brood years 1964 to 1991 and the goal of 5,700 was accepted as a biologically based goal.

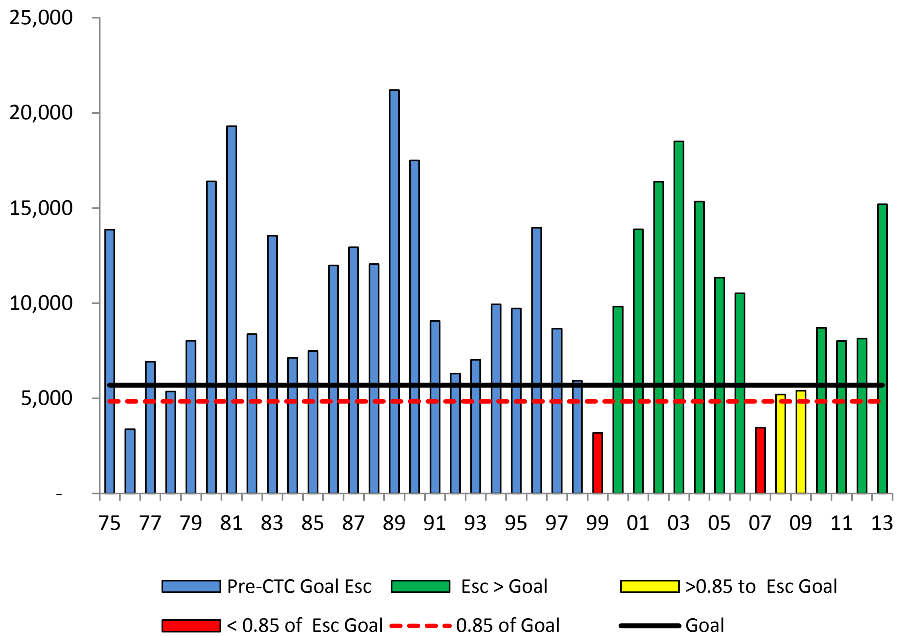

Figure 2.52.–Lewis River escapements of fall Chinook salmon, 1975–2013.

Agency Comments: Lewis River escapements have been above their escapement goal since 1979, with the exception of 1999 and 2007 to 2009.

2.3.3.3.5 Deschutes River

Escapement Methodology: Escapement data are based on a MR estimate for the area above Sherars Falls and expanded for redd counts below Sherars Falls. From 2000 to 2007, Confederated Tribes of the Warm Springs Reservation of Oregon performed an entire river MR experiment to validate the Deschutes River fall Chinook salmon escapement estimates. Results of these MR studies confirm the validity of the historical estimation methodology. For historic years where the entire river was not surveyed for redd counts, the time series was updated based on a comprehensive analysis done by Warm Springs, ODFW, and Columbia River Intertribal Fish Commission (CRITFC) staff (Sharma et al. unpublished). See Figure 2.53 for Deschutes River escapements of fall Chinook salmon, 1977 to 2013.

Escapement Goal Basis: An escapement goal was derived from the updated time series and approved by the CTC. The metric reported (Figure 2.54) is the ODFW MR estimate based on expanding the Sherars Falls MR estimate for redds below Sherars Falls. The CTC-agreed escapement goal is 4,532 fish (Sharma et al. unpublished).

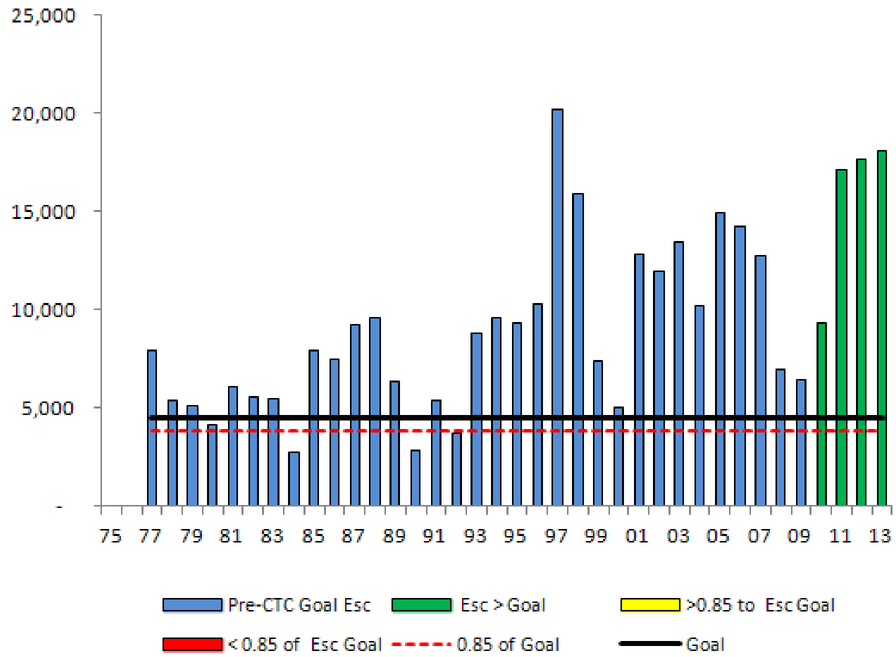

Figure 2.53.–Deschutes River escapements of fall Chinook salmon, 1977–2013.

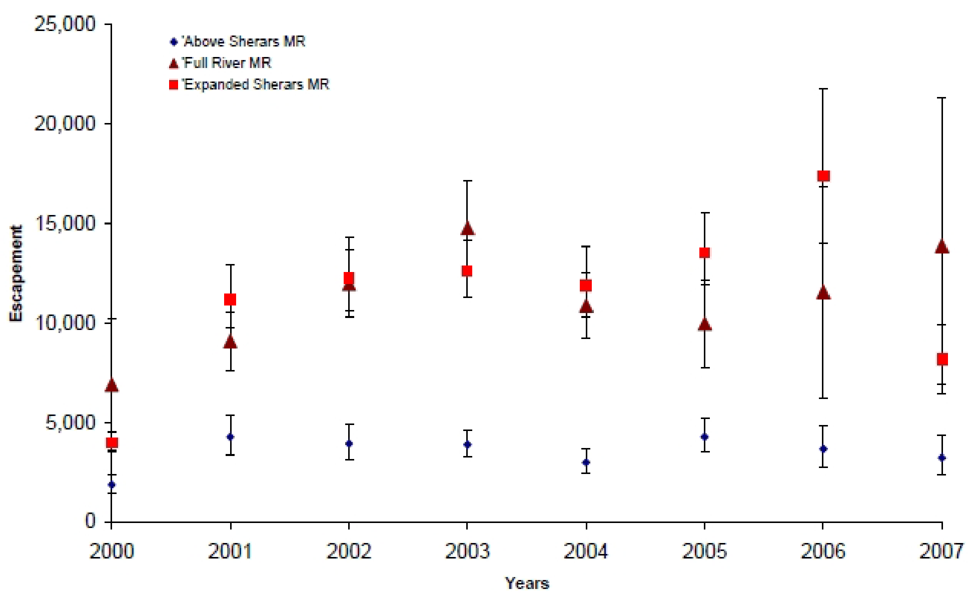

Figure 2.54.–MR method for the entire river as compared to above Sherars Falls (ODFW method) expanded for redd ratios above and below the falls (with 90% CIs).

Agency Comments: Deschutes River fall Chinook salmon escapements have been maintained above the goal since 1992.

2.3.3.3.6 Columbia Upriver Bright

Escapement Methodology: Escapement estimates are calculated as the McNary Dam count minus Hanford Reach adult sport, Wanapum tribal catches, and brood stocks taken by Priest Rapids, Ringold and Snake River hatcheries.

Escapement Goal Basis: The CTC agreed escapement goal for Columbia Upriver Bright Chinook salmon is 40,000 naturally spawning fish past McNary Dam based on stock–recruitment analyses (Figure 2.55).

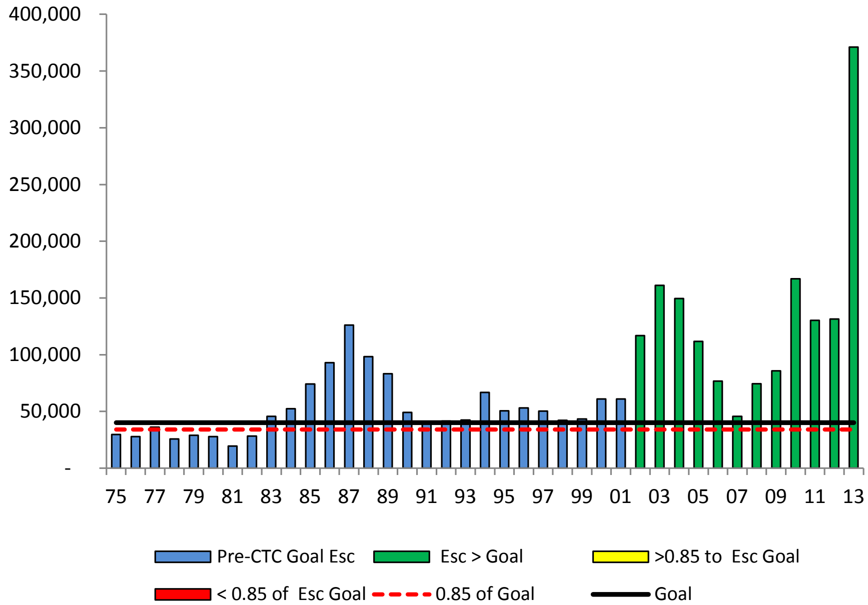

Figure 2.55.–Escapement of Columbia Upriver Bright Chinook salmon, 1975–2013.

Agency Comments: Under the 2008–2017 *U.S. v. Oregon* MA, the minimum combined Columbia River and Snake River Upriver Bright management goal at McNary Dam is 60,000 adult fall Chinook salmon, which includes both hatchery and natural production for all areas above McNary Dam. The Parties also agreed to 43,500 as the minimum Upriver Bright escapement to meet the combined Hanford Reach, Lower Yakima River, and mainstem Columbia River above Priest Rapids Dam natural spawning goal, as well as the current Priest Rapids Hatchery production (this historically included a minimal run to the Snake River). Fall Chinook salmon fisheries are managed according to a harvest rate schedule ranging from 21.5% to 45%, depending on either (1) the expected river mouth run size of the aggregate fall Chinook salmon run, or (2) the Snake River natural origin Chinook salmon run—if that run size is associated with a lower harvest rate. The terminal run forecast for Upriver Brights in 2013 was 432,500, and the actual terminal run of 764,029 was one of the largest returns since Bonneville Dam was constructed in 1938. Fall Chinook salmon fisheries were managed for the maximum harvest rate of 45%, but only obtained 34.8%. The primary management constraint for achieving higher harvest rates on Columbia Upriver Bright production is the 15% harvest rate limit on commingled ESA listed summer B steelhead (>78 cm) for forecast runs of less than 20,000. In some years, other constraints include ESA listed Snake River wild fall Chinook salmon impacts, and providing the escapement goal of 7,000 adults to Spring Creek Hatchery for tule fall Chinook salmon production.

2.3.3.4 *Coastal Oregon*

2.3.3.4.1 Oregon Coastal North Migrating

North migrating Chinook salmon originate from rivers on the NOC and the MOC. Chinook salmon production in the NOC occurs mostly from naturally spawned, fall-returning, ocean-type life histories of fish. Adult spawning escapement is dominated by 4- and 5-year-old fish with smaller proportions of 3- and 6-year-old fish. These Chinook salmon from the NOC aggregate stock are caught primarily in SEAK, NBC and in terminal fisheries.

Currently, only NOC fall Chinook salmon are accounted for in PSC management, while work is underway to include MOC production in the PST. Stocks in the NOC aggregate are those salmon spawning from the Necanicum River in the north through the Siuslaw Basin in the south. Three escapement indicator stocks represent the production of NOC Chinook salmon: the Nehalem, Siletz, and Siuslaw stocks. Other stocks in the NOC aggregate include the Nestucca, Yaquina, Alsea, and Tillamook stocks. The Tillamook stock includes substocks in the Kilchis, Miami, Trask, Tillamook and Wilson rivers.

Forecasts for the NOC aggregate are based on sibling regression relationships developed for each discrete stock, both indicator and nonindicator stocks. The aggregated forecast for the NOC is the sum of the forecasts for the individual basins within the geographic range. Forecasting methods were developed in 2008 and are continually refined with each year's additional information. Prior to 2008, the aggregate forecast (and each of the indicator stock's forecasts) was based on a running three-year average.

2.3.3.4.1.1 **Nehalem River**

Escapement Methodology: Both directed MR studies and historically conducted surveys were used to estimate escapement in the Nehalem during 2013. Standard estimates were generated from peak abundance observed during surveys of historically walked, standard index areas of known spawning habitat within the basin. These observations were then adjusted by estimates of the total available habitat, estimated observer bias, the total run encountered during the peak count, and the bias observed between these predefined surveys and other survey areas that were randomly selected. Figure 2.56 represents escapement estimates generated using normative agency methodologies, which are directly comparable to the established escapement goal. Comparison between those standard estimates and MR estimates of adult spawning escapement funded by the PSC indicates that in most years (6 out of 9) standard agency escapement estimates fall within the CIs around the comparable MR point estimates for the Nehalem stock (Figure 2.57).

Escapement Goal Basis: The current point goal of 6,989 spawners was derived by Zhou and Williams in 1999 and was based on assessments of escapement made through standard survey methodology.

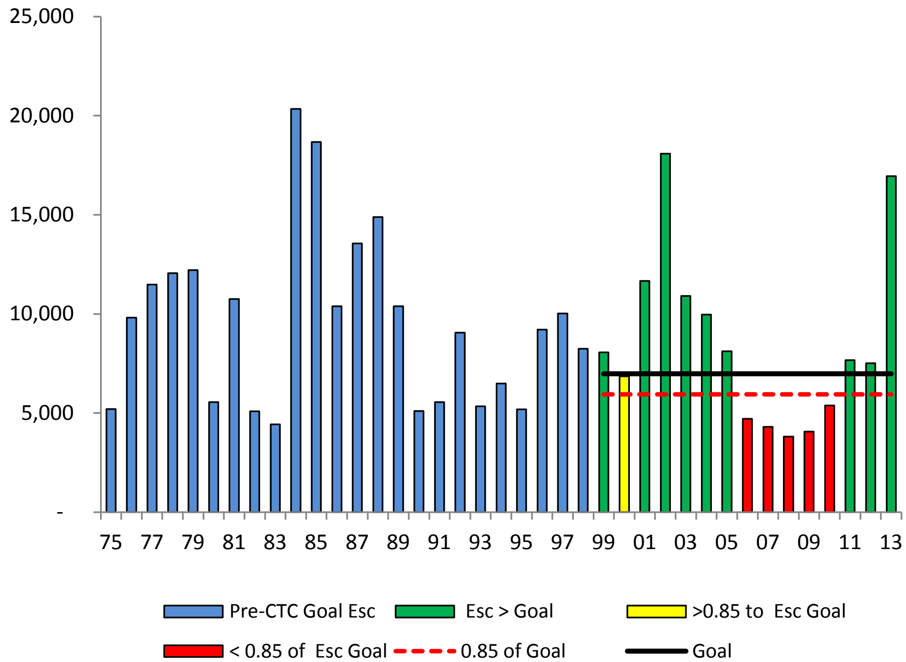

Figure 2.56.–Nehalem River escapements of Chinook salmon, 1975–2013.

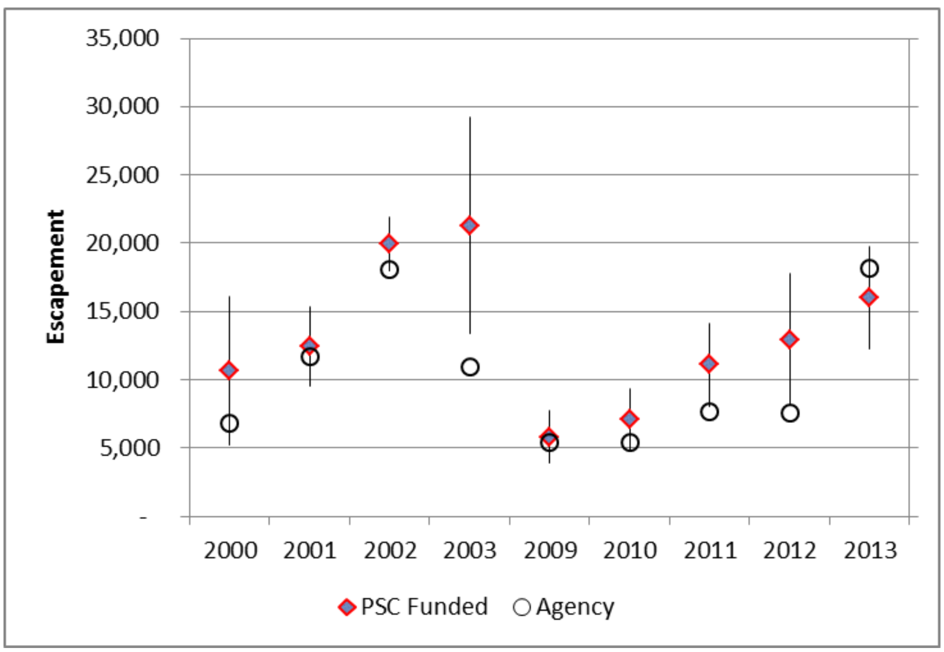

Figure 2.57.–Nehalem River escapements of Chinook salmon in years when both agency historical expanded surveys were used (circles) and when MR estimates (diamonds are point estimates and the bars are 95% CIs) were conducted with LOA or SSP funding from the PST.

Agency Comments: This stock was being studied with funds from the SSP to improve escapement estimation. The MR estimate of adult spawning escapement in 2013 was 15,989. Methods comparable to those used to generate the agreed to escapement goal for the Nehalem indicate a 2013 escapement of 18,194 adult spawners. This is 260% of the current escapement goal. This is the third return year since 2005 that the escapement goal has been met for the Nehalem stock. The terminal fishery was closed in 2009. While a terminal sport fishery was conducted from 2010 to 2012 return years, significant area closures, and daily and seasonal bag restrictions were deployed to assist in the rebuilding of this stock. While limited area closures were again in place for the 2013 terminal sport fishing season, the fishery was structured similarly to those prior to 2009. Based on sibling regression forecasting methods, the Nehalem stock is forecasted to meet the escapement goal in 2014. ODFW is engaged in analysis to best use results from recent MR experiments to reconstruct historic estimates from peak counts observed in standard surveys.

2.3.3.4.1.2 **Siletz River Fall**

Escapement Methodology: Both directed MR studies and historically conducted surveys were used to measure escapement in the Siletz during 2013. Standard estimates were generated from peak abundance observed in historically walked, predefined areas of known spawning habitat within the basin. These observations were then adjusted by estimates of the total available habitat, estimated observer bias, the total run encountered during the peak, and the bias seen between these predefined surveys and other survey areas that are randomly selected. Escapement estimates generated using standard agency methodologies were used to develop the current escapement goal, and are presented for comparison with that goal (Figure 2.58).

Escapement Goal Basis: The current point goal of 2,944 spawners was derived by Zhou and Williams (2000) and was based on assessments of escapement made through standard survey methodology.

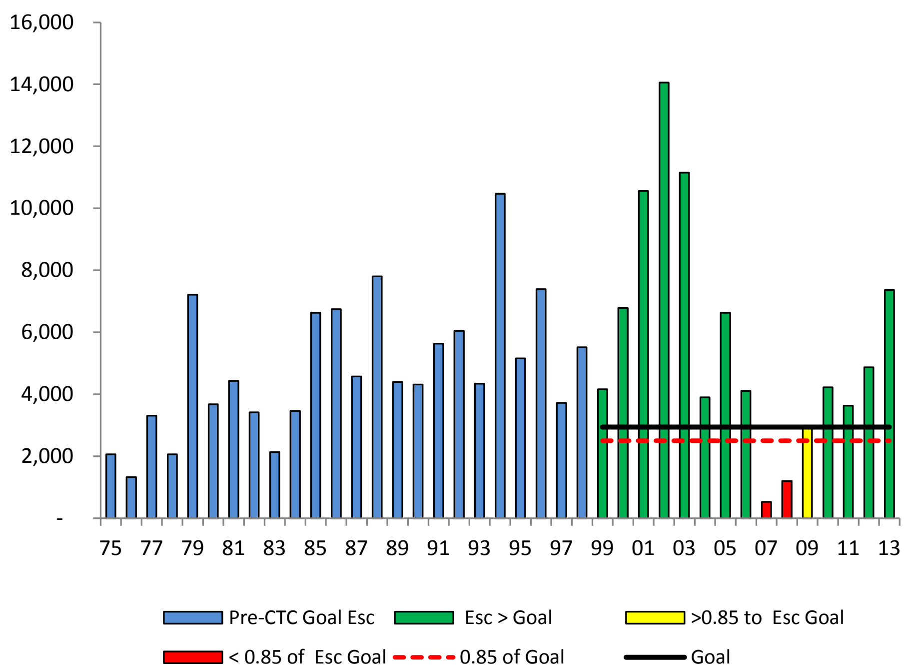

Figure 2.58.–Siletz River fall escapements of Chinook salmon, 1975–2013.

Comparison between standard estimates and estimates from MR studies funded by the PSC reveals that for those MR-based estimates with CVs less than 30%, two standard estimates are within the CI around the MR-based estimate; in 2008 the different estimates were nearly identical (Figure 2.59), and again in 2009, both estimates were quite similar.

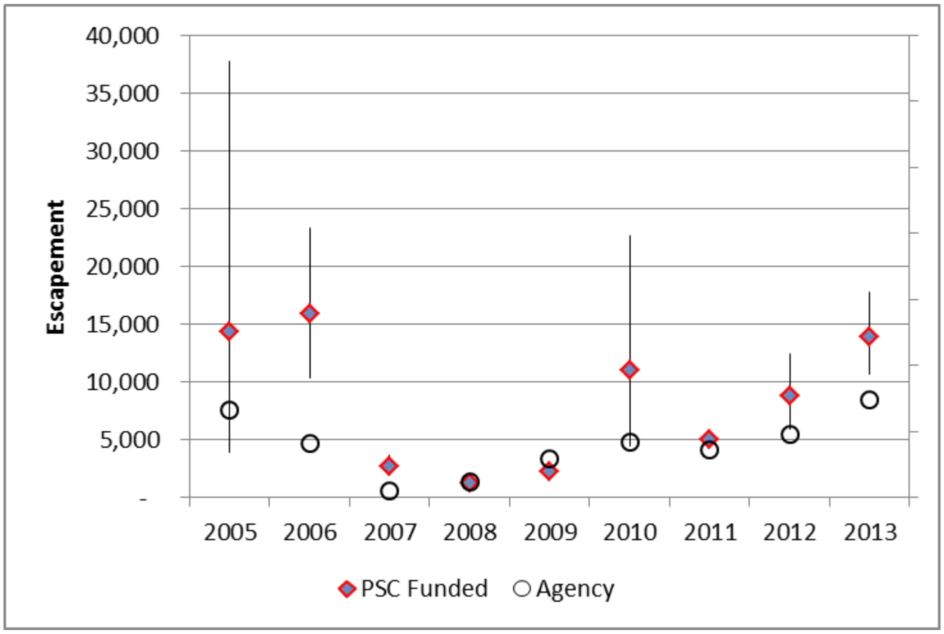

Figure 2.59.–Siletz River escapements of Chinook salmon in years when both agency historical expanded surveys were used (circles) and when MR estimates (diamonds are point estimates and the bars are 95% CIs) were conducted with LOA or SSP funding from the PST.

Agency Comments: This stock has been studied with funds from the SSP to improve escapement estimation. Studies were initiated in the 2009 spawning year to calibrate the standard escapement estimates using MR methods. However, traditional methods of escapement estimation remain in place until MR experiment-based estimation is complete. The MR estimate of escapement in the Siletz was 13,878 adult spawners in 2013. Data used to derive the escapement goal are not directly comparable to MR-based estimates of escapement. The estimate derived from standard methods was 7,364 fall Chinook salmon (250% of goal) in 2013. Significant restrictions of the terminal area sport fishery including substantial area closures, restrictive daily and seasonal bag limits are believed to have assisted in the achievement of the escapement goal in recent years. Those restrictions which had been in effect between 2009 and 2012 were relaxed to some extent for 2013. This stock is forecasted to exceed its escapement goal in 2014.

2.3.3.4.1.3 **Siuslaw River Fall**

Escapement Methodology: Both MR-based methods and historically conducted standard surveys were used to measure escapement in the Siuslaw basin during 2013. Standard estimates were generated from observation of peak abundance in historically walked, predefined areas of known spawning habitat within the basin. These observations were then adjusted by estimates of the total available habitat, estimated observer bias, the total run encountered during the peak, and the bias observed between these predefined surveys and those that are randomly selected. These standard estimates were used to derive the current escapement goal, and are used for comparison with that goal (Figure 2.60). Comparison of the standard agency escapement estimates with PSC-funded MR estimates reveals a clear pattern with the standard estimates being consistently higher that the MR estimates (Figure 2.61). This bias in the agency based estimate that will need to be addressed in upcoming revisions of the escapement goal for the Siuslaw River.

Escapement Goal Basis: The current point goal of 12,925 spawners was derived in 2000 by Zhou and Williams (2000) and was based on assessments of escapement made through standard survey methodology.

Agency Comments: Escapement in 2013 for the Siuslaw stock, estimated based on standard habitat expansion methods, was 23,411 adult spawners. Calibration of that estimate, using the ratio of MR estimates to standard estimates from 2002 to 2006, results in an estimate of 17,452 adult spawners. The current escapement goal estimate was based on the standard escapement estimates, as used in other basins on the Oregon coast. Ultimately, a new goal should be developed from a calibrated historical data series. This stock is forecast to exceed the current escapement goal in 2014.

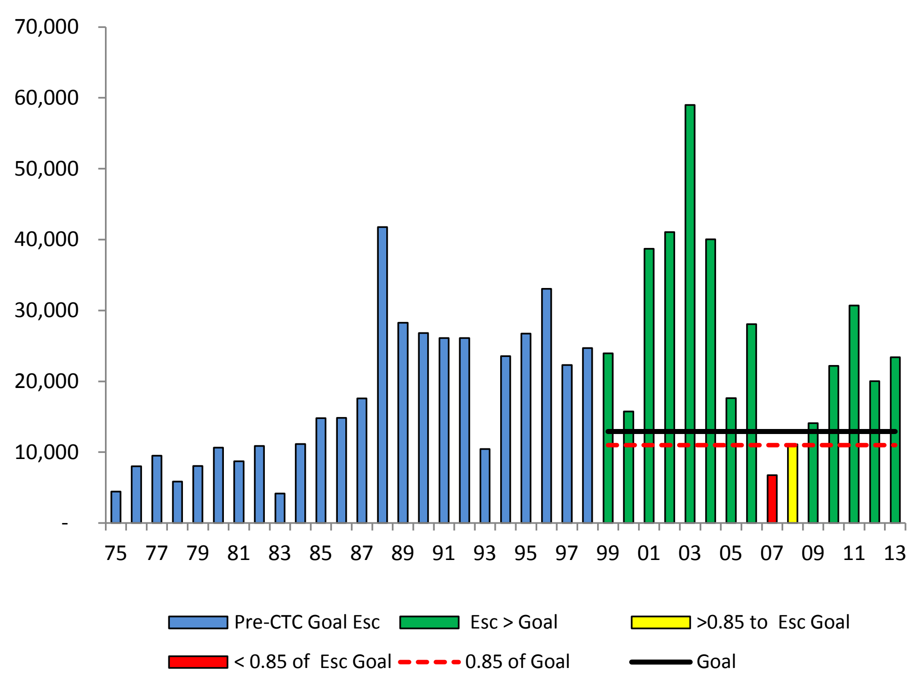

Figure 2.60.–Siuslaw River fall escapements of Chinook salmon, 1975–2013.

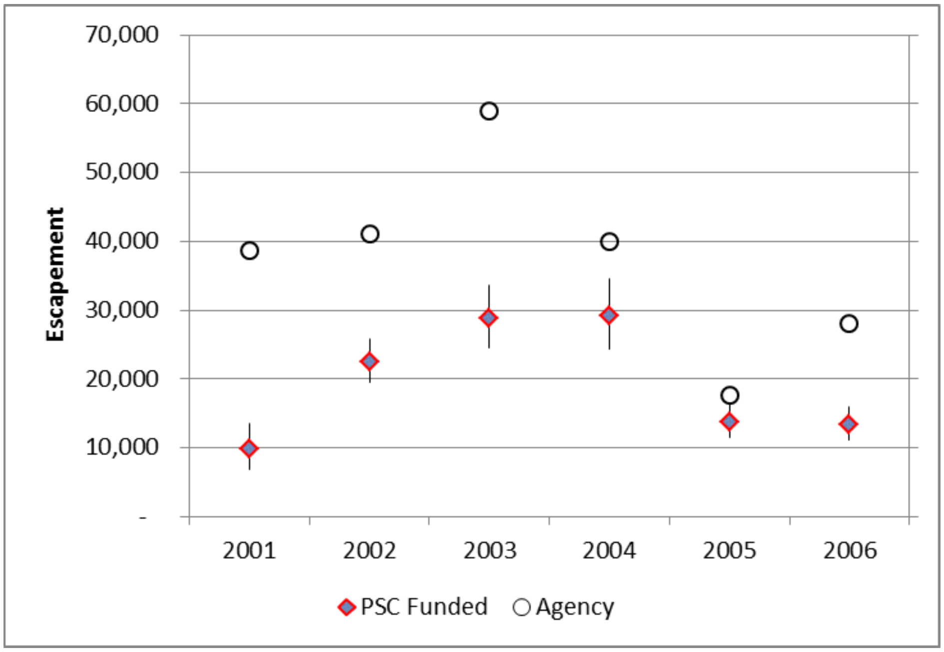

Figure 2.61.–Siuslaw River escapements of Chinook salmon in years when both agency historical expanded surveys were used (circles) and when MR estimates (diamonds are point estimates and the bars are 95% CIs) were conducted with LOA funding from the PST.

2.3.3.4.2 Mid-Oregon Coast

Populations of the MOC have been proposed for inclusion in PSC management, and there are two proposed escapement indicator stocks, the South Umpqua and the Coquille stocks. This area is bounded by the Umpqua River on the north and the Elk River Basin on the south, and includes two additional major basins, the Coos and Coquille, and two small basins, Floras Creek and the Sixes River.

There is a mixture of natural and hatchery-produced salmon originating from the MOC, both of which return in the fall and follow an ocean-type life history. The largest age classes which normally contribute to spawning escapement are 4- and 5-year-old fish; however, there are smaller proportions of spawning escapement that are observed each return year that are both 3- and 6-year-old fish. These Chinook salmon are caught primarily in SEAK, NBC, and PFMC fisheries and in terminal fisheries.

Forecasts for MOC stocks, except for the Elk River stock, are based on sibling regression relationships developed for each discrete population in 2008 and updated with each year's additional information. Forecasts for the Elk River stock are based on projected survival rates of hatchery releases and recent proportions of wild adults in the aggregate return.

2.3.3.4.2.1 **South Umpqua River Fall**

Escapement Methodology: Indices of Chinook salmon spawner abundance in the South Umpqua/Cow Creek subbasin were derived from aerial surveys of redds calibrated to six years of MR estimates. The aerial surveys are funded by Douglas County and were conducted twice during each spawning season. Surveys were flown on the lower 69 miles of the South Umpqua and the lower 60 miles of Cow Creek. These surveys cover all mainstem spawning areas for fall

Chinook salmon in the South Umpqua Basin. The South Umpqua is broken up into three reaches (Forks to Happy Valley, Happy Valley to Cow Creek, Cow Creek to Milo) and Cow Creek is considered as one reach from the confluence with the Umpqua River to Galesville Dam.

Aerial surveys are conducted using a Bell Ranger 3 helicopter; at least two flights are typically scheduled to encompass the peak spawning period. Two biologists simultaneously count redds for each reach using hand tally counters. At the end of the reach, each biologist records the number of redds identified and counters are reset for the next reach. The average of the two observers' Chinook salmon redd counts from each reach is used. The index is defined as the sum of the observed average of the peak counts for each reach between the two flights. Expansions are sometimes made to account for portions of reaches that were not completed due to visibility or mechanical problems. During the aerial surveys of the South Umpqua in 2013, the surveying helicopter crashed midway in the historically surveyed sections. The 2013 return year estimate is based on partially completed survey peaks and a regression between what had been completed and what would have been expected in unfinished sections of this basin's survey. Due to ongoing agency reevaluation of the safety of conducting these aerial surveys, it is unlikely that aerial surveys will be continued. ODFW is currently engaged in a discussion as to how best to generate estimates in the coming years. Newer technologies are being considered, including the utilization of unmanned aerial vehicles to gather photographic data. Figure 2.62 shows South Umpqua River escapement of fall Chinook salmon, 1978 to 2013.

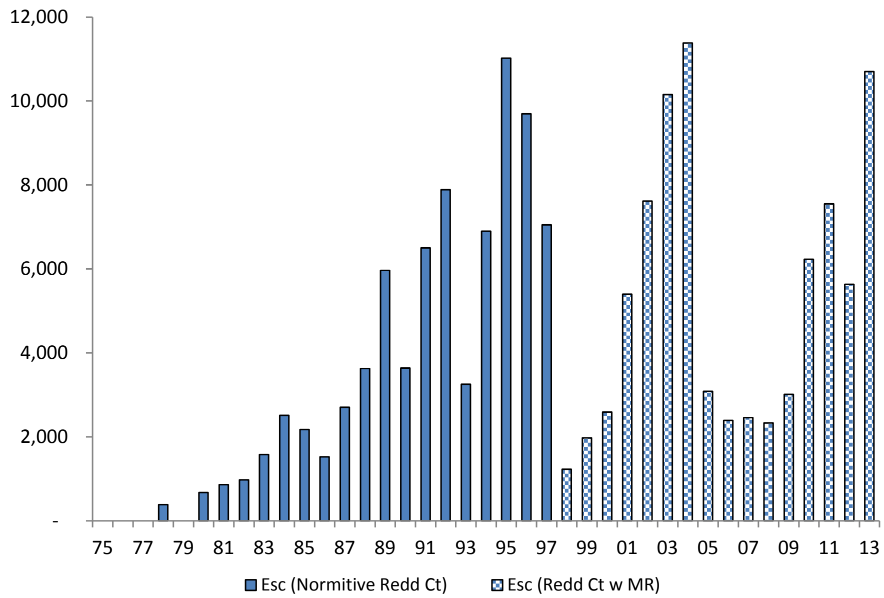

Figure 2.62.–South Umpqua River escapement of fall Chinook salmon, 1978–2013.

Escapement Goal Basis: ODFW is currently engaged in analysis which will produce an escapement goal for this stock.

Agency Comments: Recoveries of coded wire tagged fall run Chinook salmon from the Umpqua River indicate that they are caught in PSC fisheries. Four years of U.S. CTC-funded research has allowed the calibration of redd counts to derive a fish per redd expansion factor to estimate annual escapements. The average expansion factor from these studies is 3.64 fish per redd. The CV of the expansion factor was found to be 29%, which indicates that the average expansion factor is a reasonably reliable statistic to use for annual estimates of escapement. The escapement estimate for 2013 was 10,704 adults based on redd count expansions.

2.3.3.4.2.2 **Coquille River Fall**

Escapement Methodology: Both MR study based calibration factors (Figure 2.63) and historically conducted surveys were used to measure escapement during the past return year. Standard survey methods are identical to those described in the Siuslaw, Siletz and Nehalem basins. Values presented in Figure 2.63 are based on standard habitat survey estimations along with values calibrated to MR estimates. Both standard and MR calibrated estimates may be found in the appendix tables.

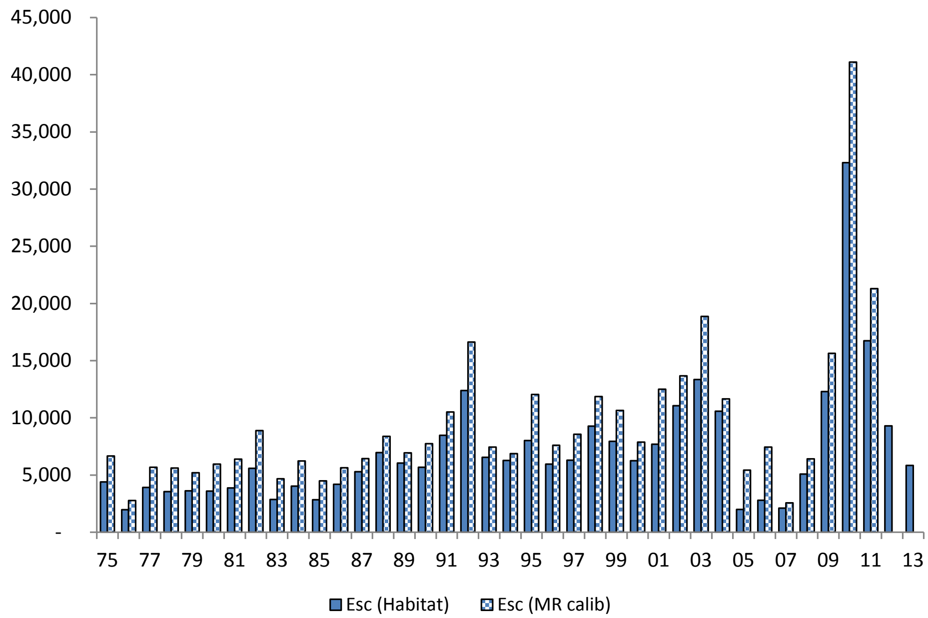

Figure 2.63.–Coquille River escapement of fall Chinook salmon, 1975–2013.

Escapement Goal Basis: ODFW is currently engaged in analysis which will produce an escapement goal for this stock.

Agency Comments: Methods based on MR-calibrated analysis yield a preliminary adult Chinook salmon escapement estimate for the Coquille Basin of 7,423 spawners in 2013. The traditional habitat expansion-based estimate is 5,836 fish. Analysis funded by the CTC is underway that will provide information to designate Coquille fall Chinook salmon as an escapement indicator stock for the MOC. An index of peak counts from standard surveys calibrated to MR abundance estimates has been selected as an efficient and cost-effective means to measure spawner escapement of Chinook salmon for use in PST fisheries management.

Improvements in applying those calibrated values towards the estimation of this and other Oregon Coastal stocks are currently being reviewed and discussed within the agency. It is anticipated that historical time series for each of the basins which have MR calibration studies (Nehalem, Siletz, Siuslaw, S. Umpqua and Coquille rivers) will be updated in a subsequent reporting cycle.

3 STOCK STATUS

3.1 Synoptic Evaluation of Stock Status

The following sections include graphics to display stock status information consisting of escapement and exploitation with spawning escapement on one axis and exploitation rate on the other. These synoptic plots display summary information for individual escapement indicator stocks. The figures present both the current status of stocks and the history of the stocks relative to PST management objectives using escapement data, CTC accepted MSY management objectives (or, in some cases, habitat model or agency stock–recruitment-based escapement objectives that have yet to be submitted to the CTC or agreed upon by the CTC), and exploitation rates from CWT indicator stocks to clearly summarize the performance of the stocks and fisheries management relative to established or potential goals.

The plots resemble those presented for groundfish in Garcia and De Leiva Moreno (2005). A general depiction of the plots with three reference lines is provided in Figure 3.1. The plots show the annual observations of a stock with regard to fishing rate (x-axis) and escapement abundance (y-axis) from one year to the next. There are three reference lines, one for fishing mortality (U_{MSY}) and two for escapement abundance (S_{MSY}, $0.85*S_{MSY}$) that define five zones on the plots. The definition of reference points for PST Chinook salmon stocks is based on the management objectives (escapement and exploitation rate) identified in the 2009 Agreement. The lower reference line for escapement on the synoptic plots is set at $0.85*S_{MSY}$ due to language in Paragraph 13 of the 2009 Agreement. For stocks with escapement objectives defined as ranges (SEAK, TBR, and the Harrison River), the lower reference line has been defined as 85% of the lower bound of the escapement range and the upper reference line has been set as the lower bound of the escapement range. The exploitation rate reference line (U_{SMSY}) is the exploitation rate at S_{MSY} for stocks with escapement objectives.

The three reference lines produce five zones in the synoptic plots. The green area (Safe Zone) in Figure 3.1 represents a healthy stock status where fishing is below U_{MSY} and the concurrent stock spawning abundance is above the specified escapement goal. The area of high risk (High Risk) is shaded red, and represents an area where a higher-than-prescribed fishing mortality is occurring concurrent with low escapement abundance. The two yellow zones (High Escapement High Exploitation, Low Escapement Low Exploitation) represent situations in which the stock could be in danger of falling into an area of conservation concern; in the upper right (High Escapement High Exploitation), escapement is at a healthy level, but fishing mortality is above the U_{MSY} limit, and in the lower left (Low Escapement Low Exploitation), fishing is occurring below the U_{MSY} limit but the population failed to attain a desired minimum escapement. The cross-hatched region is the PSC buffer zone, indicating problems may arise in the future.

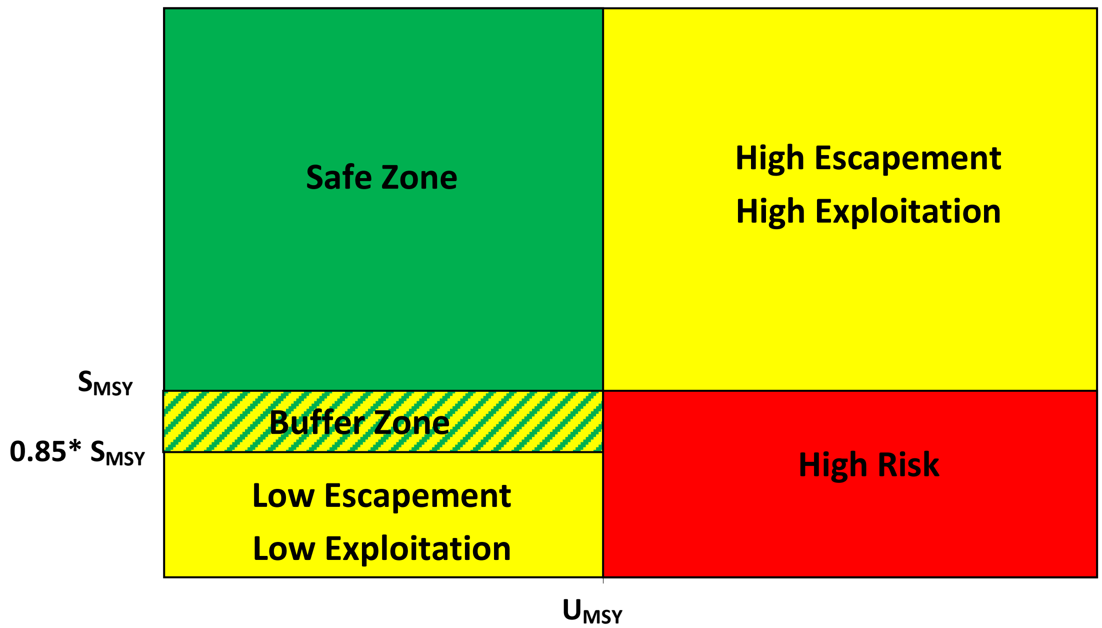

Figure 3.1.–Precautionary plot for synoptic evaluations of PST Chinook salmon stocks.

Exploitation rates used in the synoptic plots are one of the following: CY exploitation rates, preterminal cumulative mature-run equivalent (MRE) exploitation rates, or total (preterminal and terminal) cumulative MRE exploitation rates. Total cumulative MRE exploitation rates cannot be used when there is a terminal fishery that is directed on the hatchery indicator stock because the terminal exploitation will differ from that on the wild stock being represented. The ages used in the escapement and exploitation rate calculations are not the same for each stock presented in the synoptic charts below, and typically exclude age 2 for ocean-type stocks and age 3 for stream-type stocks. See Table 3.1 for more detail.

Calendar year exploitation rates are computed as

$$CYER_{CY} = \frac{OceanMorts_{CY} + TermMorts_{CY}}{(OceanMorts_{CY} + TermMorts_{CY} + OESC_{CY})}$$

Cumulative MRE exploitation rates are computed as

$$CMREER_{CY} = 1 - \left(\frac{OESC_{CY}}{PESC_{CY}}\right)$$

where

$$OESC_{CY} = \sum_{a=startage}^{maxage} OESC_{CY,a}$$

$$PESC_{CY} = \sum_{a=startage}^{maxage} PESC_{CY,a}$$

and

$$PESC_{CY,a} = \frac{OESC_{CY,a}}{CumSurvRte_{CY-a,a}}$$

When computing total (preterminal and terminal) MRE exploitation rates, the cumulative survival rate is computed for each age in a brood year as

$$CumSurvRte_{BY,a} = TermSurvRte_{BY,a} * \prod_{i=startage}^{a} PreTermSurvRte_{BY,i}$$

When computing preterminal MRE exploitation rates the cumulative survival rate is computed for each age in a brood year as

$$CumSurvRte_{BY,a} = \prod_{i=startage}^{a} PreTermSurvRte_{BY,i}$$

The preterminal harvest rates for each age in a brood year are computed as

$$PreTermHR_{BY,a} = \frac{OceanMorts_{BY,a}}{CohortSizeANM_{BY,a}}$$

The preterminal survival rates for each age in a brood year are computed as

$$PreTermSurvRte_{BY,a} = 1 - PreTermHR_{BY,a}$$

Table 3.1.–Parameter definitions for all equations used to estimate CY exploitation rates and cumulative mature-run exploitation rates.

Parameter	Description
$a =$	age
$BY =$	Brood year
$CY =$	Calendar year
$CMREER_{CY} =$	Cumulative MRE exploitation rate for calendar year *CY*
$CohortSizeANM_{BY,a} =$	Cohort size after natural mortality for brood year *BY* and age *a*
$CumSurvRte_{BY,a} =$	Cumulative survival rate for brood year *BY* and age *a*
$CYER_{CY} =$	Calendar year exploitation rate for calendar year *CY*
$OceanMorts_{BY,a} =$	Ocean mortalities for brood year *BY* and age *a*
$OESC_{CY} =$	Observed escapement for calendar year *CY*
$OESC_{CY,a} =$	Observed escapement for calendar year *CY* and age *a*
$PESC_{CY} =$	Potential escapement for calendar year *CY*
$PESC_{CY,a} =$	Potential escapement for calendar year *CY* and age *a*
$PreTermHR_{BY,a}$=	Pre-terminal harvest rate for brood year *BY* and age *a*
$PreTermSurvRte_{BY,a} =$	Pre-terminal survival rate for brood year *BY* and age *a*
$TermMorts_{CY} =$	Terminal mortalities for calendar year *CY*
$TermSurvRte_{BY,a} =$	Terminal survival rate for brood year *BY* and age *a*

For many escapement indicator stocks, data necessary to plot the stock trajectories are available (Table 3.2). Most escapement indicator stocks have companion exploitation rate indicator stocks that are assumed capable of reflecting the exploitation rates in preterminal areas. With suitable assumptions about terminal area fisheries, the total exploitation rates on stocks can be estimated. Most areas along the coast have escapement indicator stocks. Notable exceptions are the UGS area, the WCVI area and the Fraser River early stocks (spring and summer). For UGS, the CTC in the past has reported escapement for an aggregate. In future catch and escapement reports, the CTC will provide the individual metrics in addition to the aggregate numbers. The Fraser early stock consists of additional complexities for escapement indicator stocks, which are delineated on the basis of life history, and the stocks listed in Attachments I, II, and IV, which are based on geography. Region-specific synoptic evaluations of Chinook salmon stocks are presented in Section 3.2.

Table 3.2.–Summary of information available for synoptic stock evaluations.

Region[1]	Escapement Indicator	S_{MSY}	85% of S_{MSY}[2]	Exploitation Rate Indicator	U_{MSY}	Type of Exp. Rate[3]
SEAK	Situk	600	425	Situk wild	0.81	CY
SEAK	Chilkat	2,200	1,488	Chilkat wild	0.40	CY
SEAK	Unuk	2,764	1,530	Unuk wild	0.60	CMRE
SEAK	Chickamin (survey index)	525	383	Alaska Hatchery (Neets, Whitman, Deer) and Unuk wild	0.72	CMRE
SEAK/TBR	Alsek	4,677	2,975	Alsek wild	0.58	CY
SEAK/TBR	Taku	25,500	16,150	Taku wild	0.59	CY
SEAK/TBR	Stikine	17,400	11,900	Stikine wild	0.42	CY
BC	Harrison	75,072	63,811	Chilliwack	0.57	CMRE
BC	Cowichan	6,514	5,537	Cowichan	0.69	CMRE
BC	Kitsumkalum	8,621	7,328	Kitsumkalum	0.61	CMRE
BC	Atnarko	5,009	4,258	Atnarko	0.77	CMRE
BC	Nicola	8,337	7,86	Nicola	0.59	CMRE
BC	Lower Shuswap	12,339	10,488	Lower Shuswap	0.73	CMRE
COLR	Columbia Upriver Summer	12,143	10,322	Columbia Summers	0.75	CMRE
COLR	Columbia Upriver Brights	40,000	34,000	Upriver Brights	0.56	CMRE
COLR	Deschutes River Fall	4,532	3,852	Lewis River Wild	0.79	CMRE
COLR	Lewis River Fall	5,791	4,922	Lewis River Wild	0.79	CMRE
WAC	Quillayute Fall	3,000	2,550	NA		NA
WAC	Queets Spring/Summer	700	595	NA		NA
WAC	Queets Fall	3,000	2,550	Queets Fall Fingerlings	0.74	CMRE
WAC	Hoh Spring/Summer	900	765	NA		NA
WAC	Hoh Fall	1,200	1,020	NA		NA
ORC	Nehalem	6,989	5,941	Salmon River	0.69	CMRE
ORC	Siletz	2,944	2,502	Salmon River	0.81	CMRE
ORC	Siuslaw	12,925	10,986	Salmon River	0.61	CMRE

[1] See List of Acronyms for definitions.

[2] Stocks with an escapement goal range use 85% of the lower bound.

[3] Two types of exploitation rates were used: cumulative mature-run equivalents (CMRE) and calendar year (CY) which are based off of actual stock assessment data gathered annually for each stock.

A synoptic summary figure for 23 stocks for 2012 data shows that the majority were in the safe zone (Figure 3.2). One stock (Cowichan) was in the high risk zone and six stocks (Situk, Alsek, Unuk, Harrison, Nicola, and Lower Shuswap) were in the low escapement and low exploitation zone. One stock (Columbia Upriver Brights) experienced high exploitation, but escapement exceeded the escapement goal objective. The Washington and Oregon coastal stocks clustered closer to the 1.0 index lines than the other regional groups. When stock status was examined by region there was not a strong regional pattern.

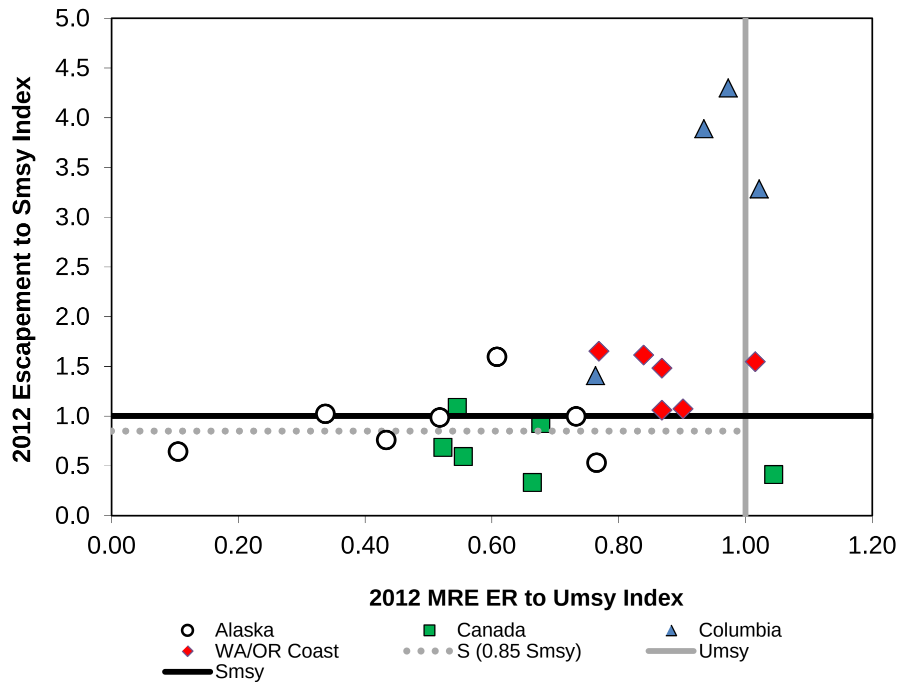

Figure 3.2.–A synoptic summary by region of stock status for stocks with escapement and exploitation rate data in 2012.

Note: Escapement and exploitation rate data were standardized to the stock-specific escapement goal and U_{MSY} reference points.

3.2 Regional Trends and Profiles

3.2.1 Southeast Alaska and Transboundary River Stocks

Recent declines in Chinook salmon productivity and abundance are widespread and persistent throughout Alaska, particularly in western and northern Alaska. Analysis of productivity of Chinook salmon stocks throughout Alaska using stock–recruit relationships reveals that temporal patterns in residuals differed considerably prior to 2001. Beginning with brood year 2001, residuals for most of these stocks are consistently negative (Figure 3.3; ADF&G 2013). This pattern indicates that since brood year 2001, productivity was consistently lower than would be expected given the density-dependent effect of abundance of spawning adults. These declines in productivity would have begun to negatively affect run abundances during 2005 when age-4 fish returned to spawn, but would have fully affected all age classes from 2007 to present. For more than half of the stocks included in Figure 3.4, recent productivity values are the lowest observed since data collection began in the 1970s. Available run abundance data for Chinook salmon in Alaska indicate significant declines were first fully detected in 2007—as expected—from a persistent decline in productivity that began with returns from brood year 2001. Run abundance data available from 21 stocks in Alaska show substantial variability and moderate to no coherence among stocks prior to 2004 (Figure 3.4). This was followed by consistent declines in run abundance across the state from 2007 to present. This is consistent with a downward trend in productivity and similar declines have been seen in the SEAK Chinook salmon stocks.

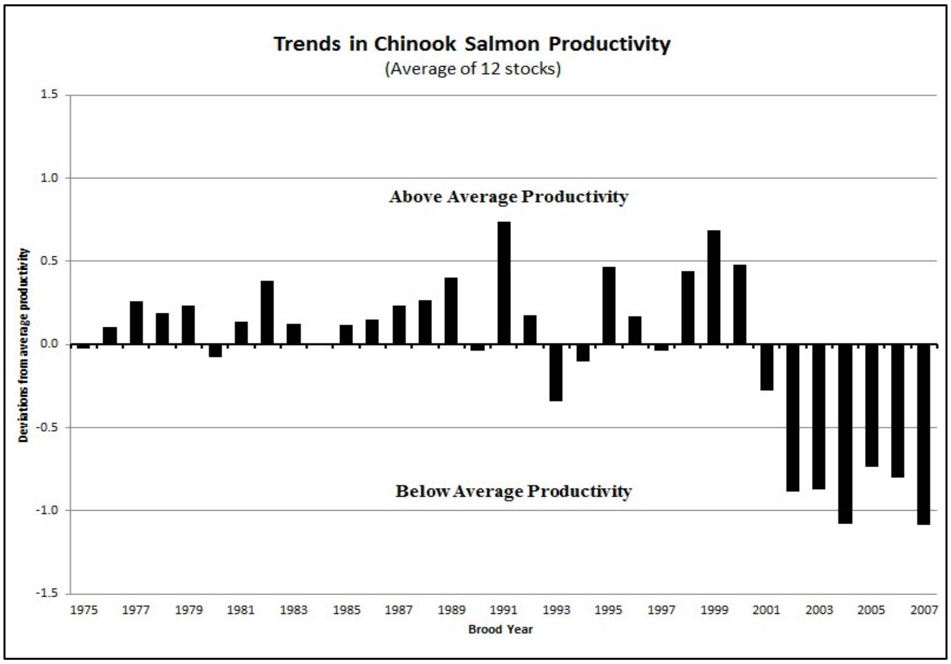

Figure 3.3.–Average of standardized deviations from average productivity for 12 stocks of Chinook salmon in Alaska (the Kuskokwim, Canadian Yukon, and Nelson on the Alaska Peninsula; the Ayakulik and Karluk on Kodiak Island; the Anchor and Deshka in Cook Inlet; and the Situk, Alsek, Taku, Stikine, and Blossom in Southeast Alaska).

The SEAK stocks have two main rearing behaviors that are consistent and predictable annually. One rearing behavior, outside rearing, is to rear in the Gulf of Alaska and Bering Sea after leaving the freshwater environment. The other behavior, inside rearing, is to rear in the nearshore environment of SEAK. Outside rearing stocks include the Situk, Alsek, Taku, and Stikine rivers stocks of Chinook salmon, and for the most part these fish strictly adhere to this behavior. Inside rearing stocks include the Chilkat, Unuk, and Chickamin rivers stocks and although the vast majority rear in the nearshore environment, CWT information suggests at least a small proportion of these fish exhibit outside-rearing behavior. Productivity has decreased for both outside- and inside-rearing stocks; however, information suggests that some of the inside-rearing stocks may have avoided the more prevalent declines in production associated with other SEAK and Alaska Chinook salmon stocks.

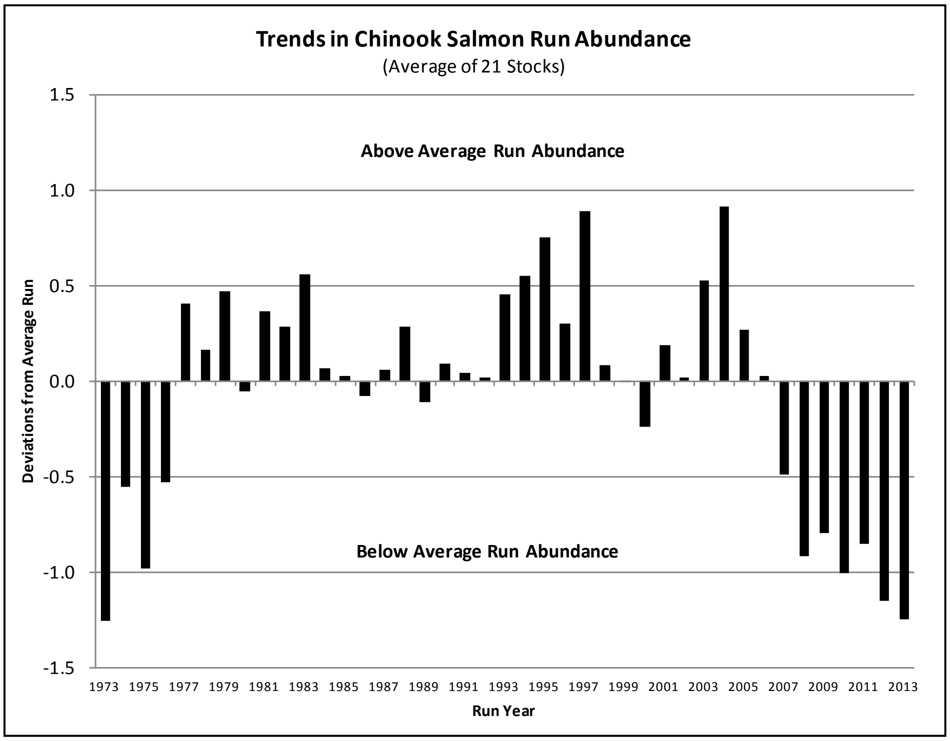

Figure 3.4.–Average of standardized deviations from average run abundance for 21 stocks of Chinook salmon in Alaska (the Unalakleet, Nushagak, Goodnews and Kuskokwim in western Alaska; the Chena and Salcha on the Yukon River; the Canadian Yukon, the Chignik and Nelson on the Alaska Peninsula; the Karluk and Ayakulik on Kodiak Island; the Deshka, Anchor and late run Kenai in Cook Inlet, the Copper in the northeastern Gulf of Alaska, and the Situk, Alsek, Chilkat, Taku, Stikine, and Unuk in Southeastern Alaska).

3.2.1.1 *Situk, Alsek, Taku, and Stikine Rivers Chinook Salmon Stock Status: Outside Rearing (Northern Gulf of Alaska and Transboundary Rivers)*

The Situk River stock has failed to meet the escapement goal in four of the last six years and the Alsek River stock has failed to achieve the goal in four of the last eight years. Over the past decade, these two stocks demonstrated the poorest performance in meeting escapement goals among the seven SEAK and TBR stocks, yet harvest rates exerted in recent years were very low, and among the lowest in the region. MRE exploitation rates are not described for these two stocks since neither has a CWT program to estimate harvest. However, because harvests are mostly inriver or in the estuary, detailed catch accounting programs enumerate the vast majority of any SEAK harvest and CY exploitation rates are available. These fish are also outside rearing; thus, they are unavailable for harvest as rearing fish in SEAK. Exploitation rates for both stocks have been below—and have never exceeded—the threshold reference value rates. In 2011 and 2012, exploitation rates for the Situk River stock were around 8%, and increased to 31% in 2013 with improved run abundance. Rates exerted on the Alsek River stock have never approached 50% of the U_{msy} rate and were about 10% in 2013 (Figure 3.5, Figure 3.6). The poor runs and escapement performance result from decreased productivity and mirror the very low productivity of other Alaska stocks that rear in the Gulf of Alaska/Bering Sea. Management measures have been in place for both of these stocks to reduce harvests and increase escapement.

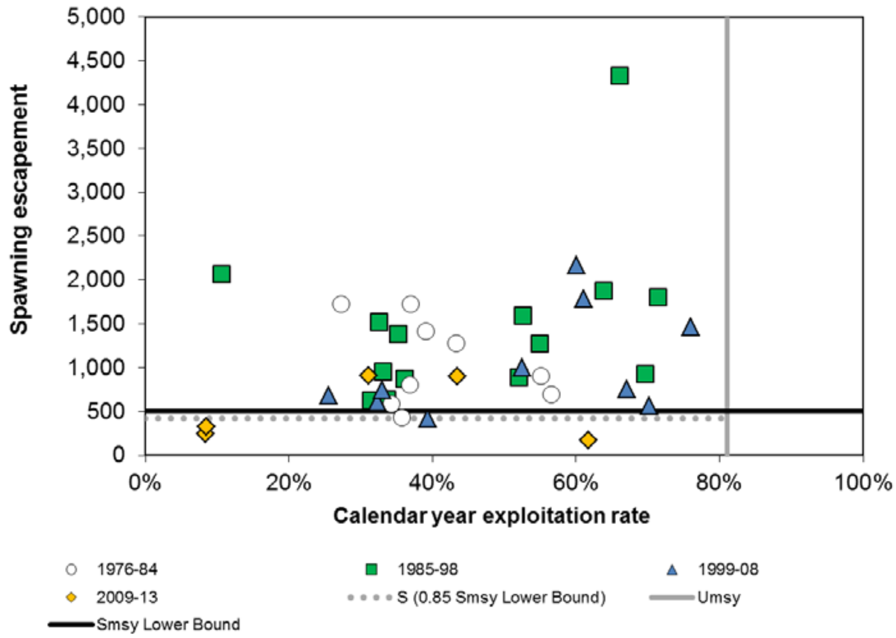

Figure 3.5.–Calendar year exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Situk River stock of Chinook salmon, 1976–2013.

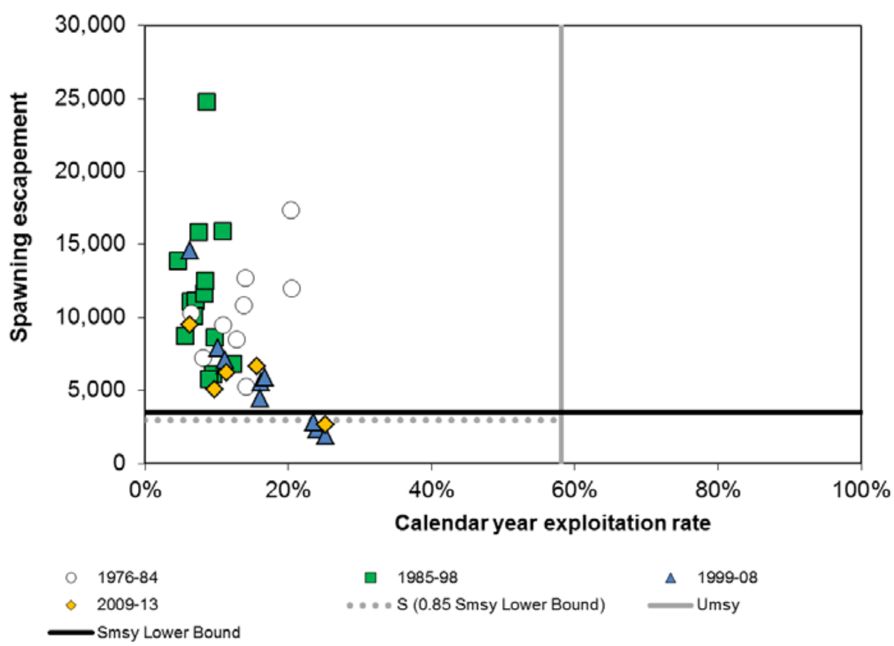

Figure 3.6.–Calendar year exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Alsek River stock of Chinook salmon, 1976–2013.

Even with very restrictive management measures, escapement goals for the Situk and Alsek river stocks will be difficult to attain until productivity improves.

The Taku and Stikine river stocks have also demonstrated reduced productivity; however, the changes are more recent and the productivity decline is of a lesser magnitude than that of the Situk and Alsek river stocks and the other more northerly stocks in Alaska. Preseason forecasts are developed for both the Taku and Stikine river stocks and directed fisheries are based on these forecasts and inseason run assessments and projections. Preseason forecasts for the last few years have been higher than actual run abundance. Inseason assessments have been used in both the U.S. and Canada to manage fishing. As a result, since 2007 escapement goals have been achieved for both stocks in all but three years even with reduced productivity.

Beginning in 2005, for both the Taku and Stikine River stocks of Chinook salmon, new directed fisheries were implemented in years identified with surplus production. As a result, in years of surplus production, exploitation rates have been higher and at times have exceeded the threshold reference value. These stocks are outside rearing and leave SEAK to rear in the Gulf of Alaska and Bering Sea shortly after leaving each river as smolt, and are, therefore, not available for harvest in SEAK as rearing fish. MRE exploitation rates are not presented for these two stocks as the CWT marked fractions for both stocks are too low, typically less than 2%, making harvest estimates difficult using CWTs alone.

Between 1976 and 2005 commercial fishing for these two stocks in the terminal area was closed or severely restricted. Terminal fisheries relevant for Taku and Stikine Chinook salmon stocks were nearby sport, incidental catch in the traditional sockeye drift gillnet fisheries, a small number in the outside commercial troll, and any inriver fisheries. The onset of the new directed fisheries in 2005 emphasized the need to have more accurate measures of harvest and a genetic stock identification program was implemented. This program, when coupled with the methods described in McPherson et al. (2010) for CYs 1977 to 2007 for the Taku stock and in Bernard et al. (2000) for CYs 1981 to 1997 for the Stikine stock, has been used to provide CY estimates since 2005. Exploitation rates since 1999 for the Taku stock have been low, averaging 20%, less than one-half of the threshold reference value (Figure 3.7). From 1975 to 2012, exploitation rates have remained well below the threshold reference value. Although the threshold reference point of 42% for the Stikine River was exceeded in four years since 1999, the average annual exploitation rate for the Stikine River stock remained low, averaging 30% (Figure 3.8).

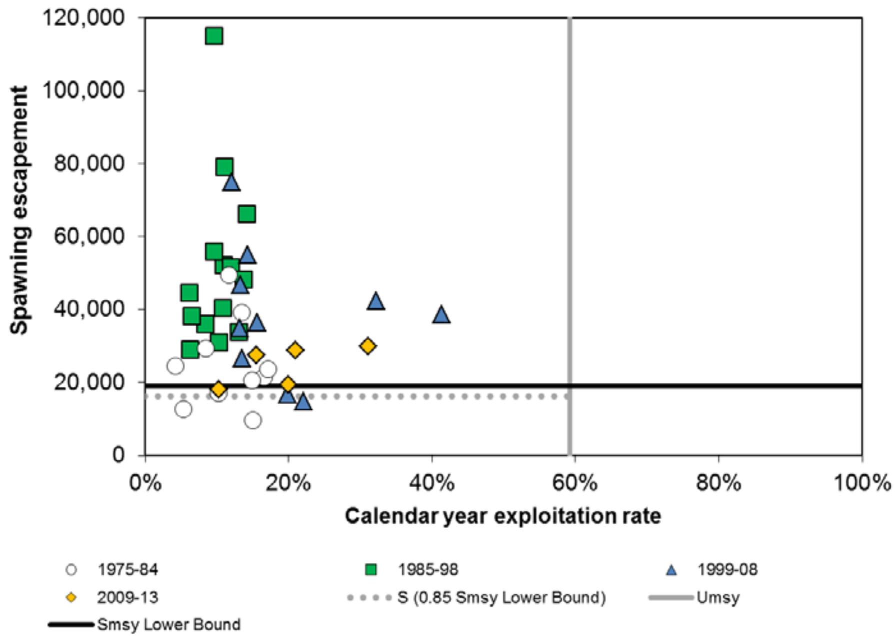

Figure 3.7.–Calendar year exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Taku River stock of Chinook salmon, 1975–2013.

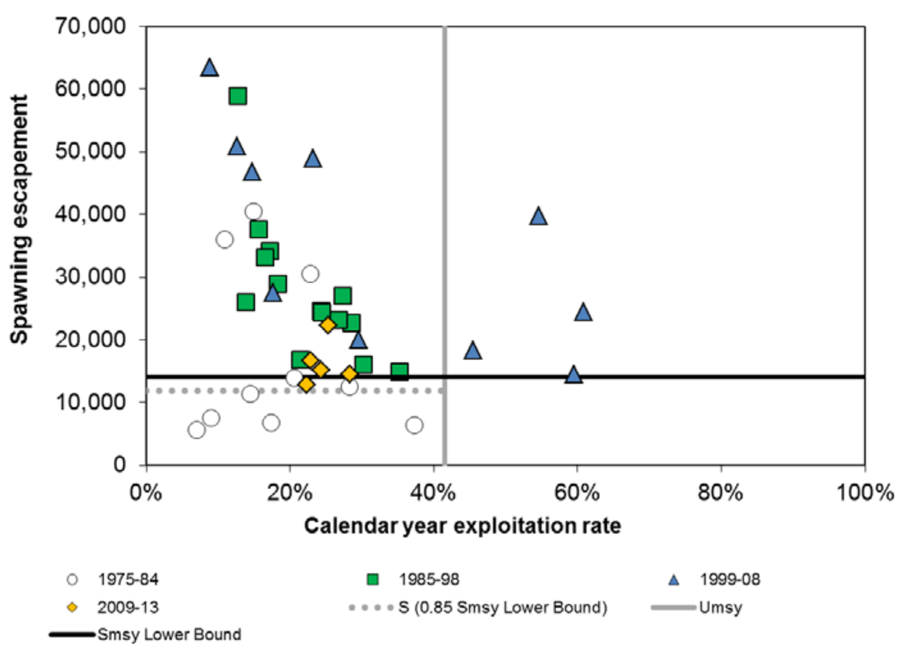

Figure 3.8.–Calendar year exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Stikine River stock of Chinook salmon, 1981–2013.

Until the low productivity regime associated with stocks that rear in the Gulf of Alaska/Bering Sea reverts to normative conditions, exploitation rates on Situk, Alsek, Taku, and Stikine rivers stocks (all outside-rearing stocks), will need to remain well below the estimated sustainable rate. Even if exploitation rates remain low, escapement goals may not always be achieved.

Chinook salmon smolt abundance and survival has been estimated for the Taku River since the 1992 brood year. The data suggest that freshwater survival has been variable with no apparent trend; however, marine survival has undergone cycles throughout this period and for recent brood years it has been the lowest level since smolt abundance estimation began (Figure 3.9).

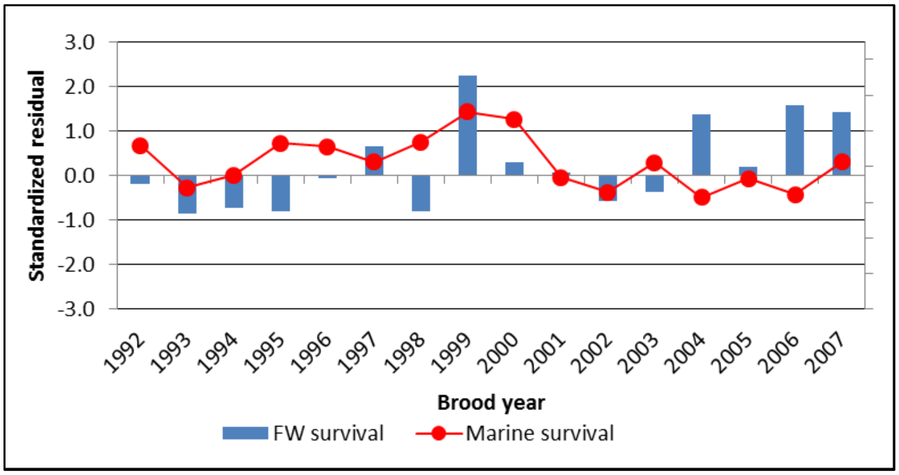

Figure 3.9.–Freshwater and marine survival indices (standardized to a mean of zero) for the Taku River stock of Chinook salmon, 1992–2007 brood years.

Smolt abundance and survival have been estimated for the Stikine River stock of Chinook salmon since the 1998 brood year. The data suggest that freshwater survival was favorable for brood years 1998 to 2001. Beginning with the 2001 brood year, marine survival has been low (Figure 3.10).

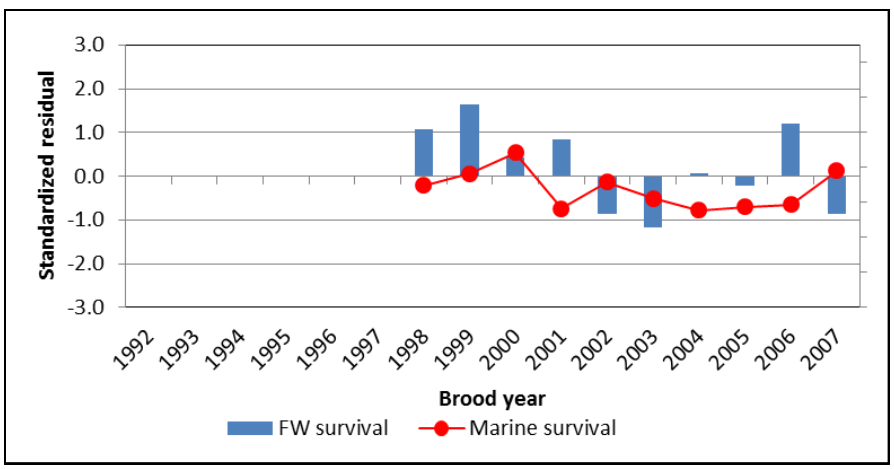

Figure 3.10.–Freshwater and marine survival indices (standardized to a mean of zero) for the Stikine River stock of Chinook salmon, 1998–2007 brood years.

3.2.1.2 *Chilkat Chinook Salmon Stock Status: Inside Rearing (Northern Southeast Alaska)*

The Chilkat River stock returns to northern SEAK and is inside rearing. The Chilkat River stock failed to achieve the escapement goal in three of the past seven years. The Chilkat River is located at the northern end of Lynn Canal and gillnet and sport fisheries in the upper canal can be managed to conserve the Chilkat River stock of Chinook salmon.

A successful CWT program is in place to estimate harvest for the Chilkat River stock of Chinook salmon. MRE exploitation rates from 2003 to 2013 for the Chilkat River stock of Chinook salmon have not exceeded the threshold reference value and have averaged about one-third of the threshold reference value (Figure 3.11). Undoubtedly some Chilkat River Chinook salmon are caught while rearing in SEAK but CWT recovery data indicate most harvest is on mature fish. In general, exploitation rates on the Chilkat River stock of Chinook salmon are some of the lowest observed for Chinook salmon stocks, with a recent 10-year average exploitation rate of 15%.

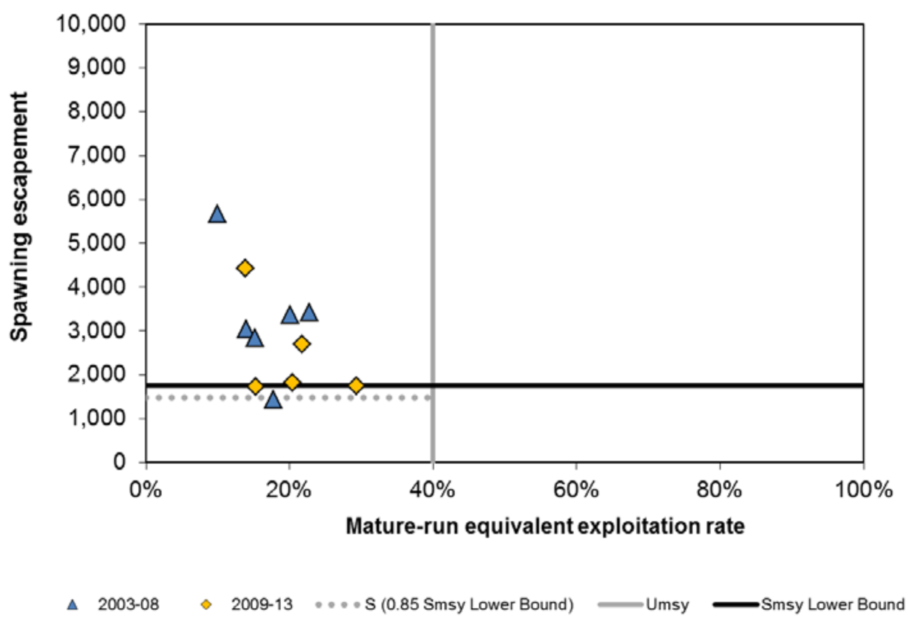

Figure 3.11.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Chilkat River stock of Chinook salmon, 2003–2012.

Chinook salmon smolt abundance and survival have been estimated for the Chilkat River stock since the 1998 brood year. Freshwater survival has, for the most part, been about average with the exception of the 2006 and 2007 brood years. Marine survival was above average for brood years 1998 to 2001 and about average for the more recent broods (Figure 3.12).

Below average productivity has negatively affected Chinook salmon abundance in the Chilkat River and continued low harvest rates will be needed until productivity improves to achieve the escapement goal.

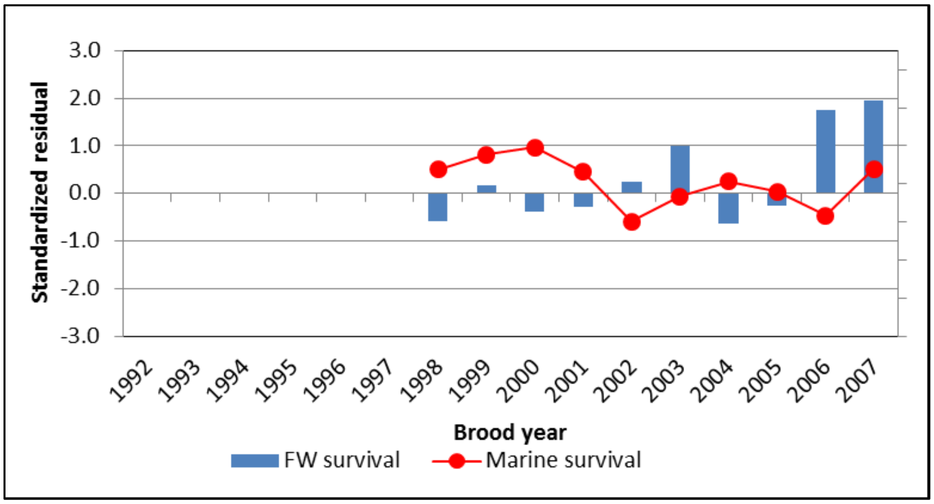

Figure 3.12.–Freshwater and marine survival indices (standardized to a mean of zero) for the Chilkat River stock of Chinook salmon, 1998–2007 brood years.

3.2.1.3 *Unuk and Chickamin Rivers Chinook Salmon Stock Status: Inside Rearing (Southern SEAK)*

The Unuk and Chickamin rivers stocks of Chinook salmon spawn in and around Behm Canal in southern SEAK and are inside-rearing stocks. Escapement trends for these stocks have been decreasing over the last six years. The Unuk River stock was below the escapement goal in 2012 and 2013 and the Chickamin River stock was below the escapement goal in 2012. Fishing is closed for Chinook salmon in these rivers as well as in most of Behm Canal. Southern SEAK stocks are harvested at relatively low rates while rearing and maturing and they are not harvested in terminal areas due to management closures. The bulk of the Southern SEAK stocks are harvested outside of the terminal areas and as returning mature fish. Although the Unuk River stock is similar in size at age to other northern SEAK stocks, unique to the Chickamin River stock is their large size at age. Due to their larger size, the majority of ocean age-2 Chinook salmon from the Chickamin River exceed the 28-inch legal length for harvest and are available to harvest in the sport and troll fisheries. The increased contribution of these fish to the catch due to fast growth rates is another reason for the higher exploitation rates (2002–2013 average = 31%) than measured in the nearby Unuk River stock (2002–2013 average = 25%).

A very successful CWT program is in place to estimate harvest for the Unuk River stock. Some Unuk River Chinook salmon are caught while rearing in SEAK but most harvest occurs on mature fish and this is supported by CWT recovery information. Productivity of the Unuk River stock has been poor in recent years. Exploitation rates on this stock have averaged about one-half the threshold reference value but the escapement goal was not met for the first time on record in 2012 and again in 2013. Coupled with poor production, exploitation rates were the highest on record these years (Figure 3.13). Additional domestic management measures will be necessary to attain the escapement goal during this period of poor production.

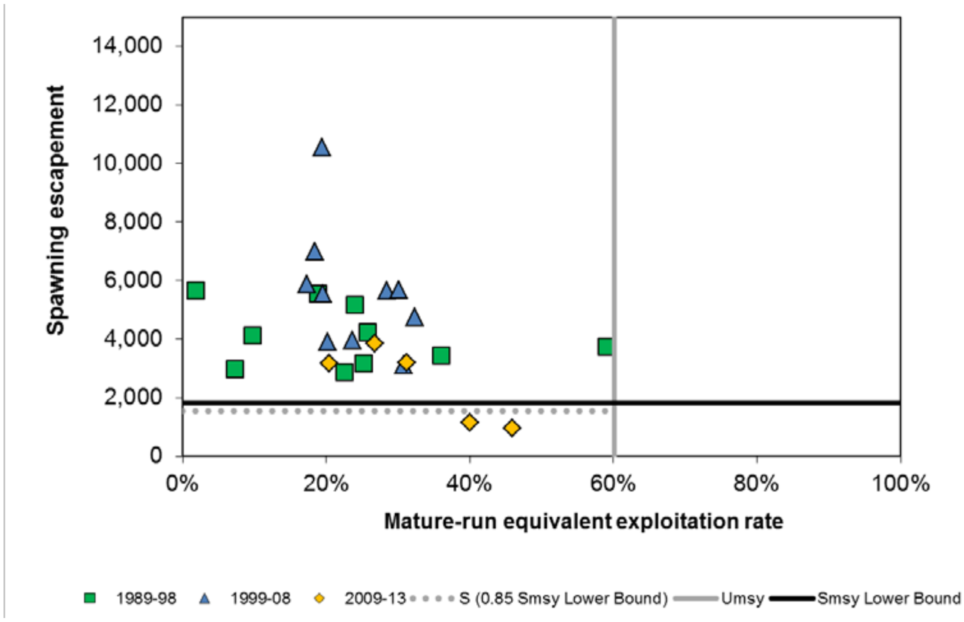

Figure 3.13.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Unuk River stock of Chinook salmon, 1988–1991 and 1998–2012.

Chinook salmon smolt abundance and survival has been estimated for the Unuk River stock since the 1992 brood year. Freshwater survival has, for the most part, shown no apparent pattern. The 2003 and 2005 brood years were some of the lowest freshwater survivals on record; however, like the Chilkat stock, the 2006 brood year showed the best freshwater survival observed since the project began. Marine survival was near average and cycled annually over the 1991 to 2005 brood years. However, the 2006 and 2007 brood years declined and were the lowest marine survivals over the range of data (Figure 3.14).

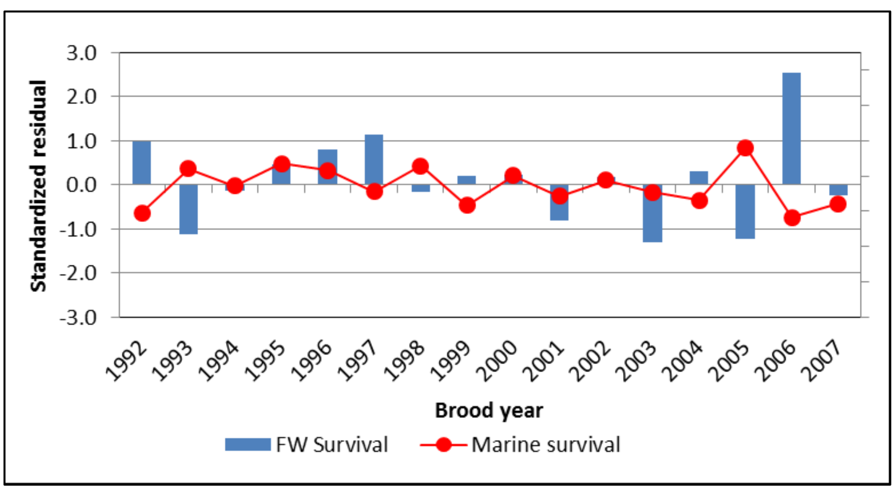

Figure 3.14.–Freshwater and marine survival indices (standardized to a mean of zero) for the Unuk River stock of Chinook salmon, 1992–2007 brood years.

There are no CWT programs in place to estimate harvest for the Chickamin River stock of Chinook salmon. As a result, MRE exploitation rates from the nearby Neets Bay, Deer Mountain, and Whitman Lake hatcheries are used as surrogate values after discounting any terminal hatchery harvests. These hatcheries use the Chickamin River as a brood source and are available to harvest as rearing and mature fish in SEAK. Over this same period, exploitation rates on the Chickamin River stock have never exceeded the threshold reference line and have averaged just over one-half the threshold reference value (Figure 3.15).

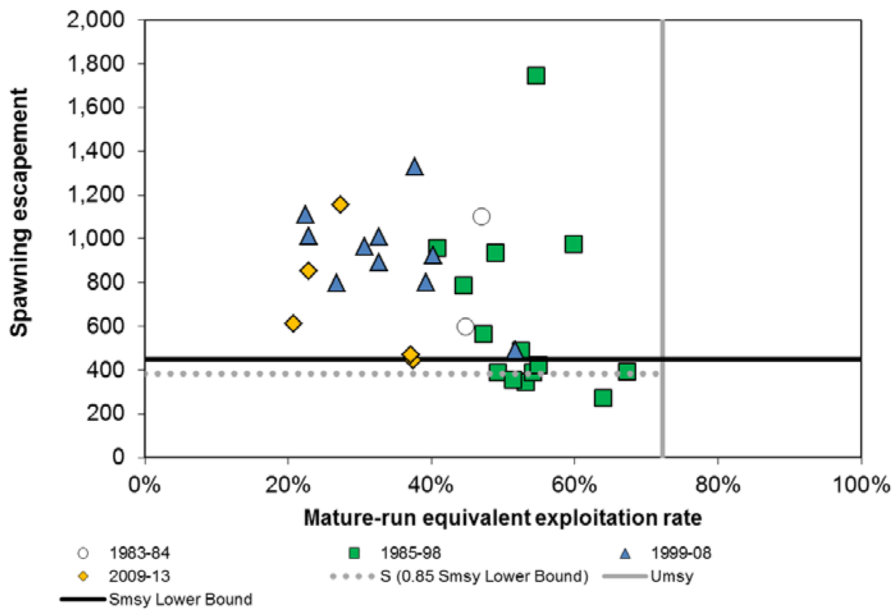

Figure 3.15.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Chickamin River stock of Chinook salmon, 1983–2012.

3.2.2 Canadian Stocks

3.2.2.1 *Northern British Columbia: Kitsumkalum River*

The North/Central British Columbia stock group includes the Yakoun, Nass, and Skeena as escapement indicators. Currently, none of these stocks have CTC escapement goals. The Kitsumkalum River is an exploitation rate indicator stock in the Lower Skeena River; it has produced high quality escapement estimates each year since 1984. This stock has had a very low level of enhancement for the CWT indicator stock targets (mean enhanced contribution = 3.4%, range = 0.4–9.4%, return years 1985–2012). McNicol (1999) reviewed these data and estimated the stock–recruit relationship, which was updated by Parken et al. (2006). Marine survival was generally below average for brood years 1988 to 1996, and has varied around average since then (Figure 3.16). The cumulative exploitation rates have been below the threshold reference line in all years and escapements have exceeded S_{MSY} in all but three years (Figure 3.17). In most years, the stock was in the safe zone.

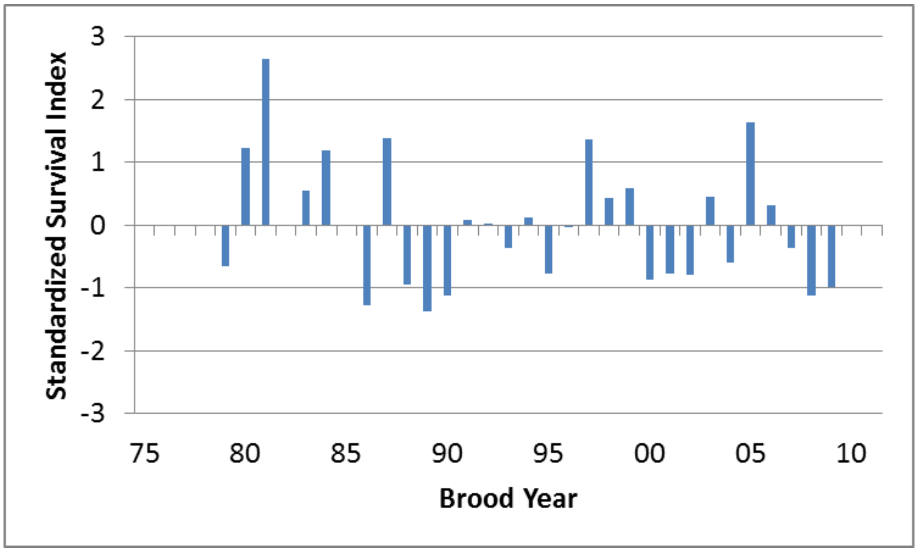

Figure 3.16.–Marine survival index (standardized to a mean of zero) for the Kitsumkalum River stock of Chinook salmon, 1979–2009 brood years. Brood year 1982 was not represented by CWTs, thus no datum is available.

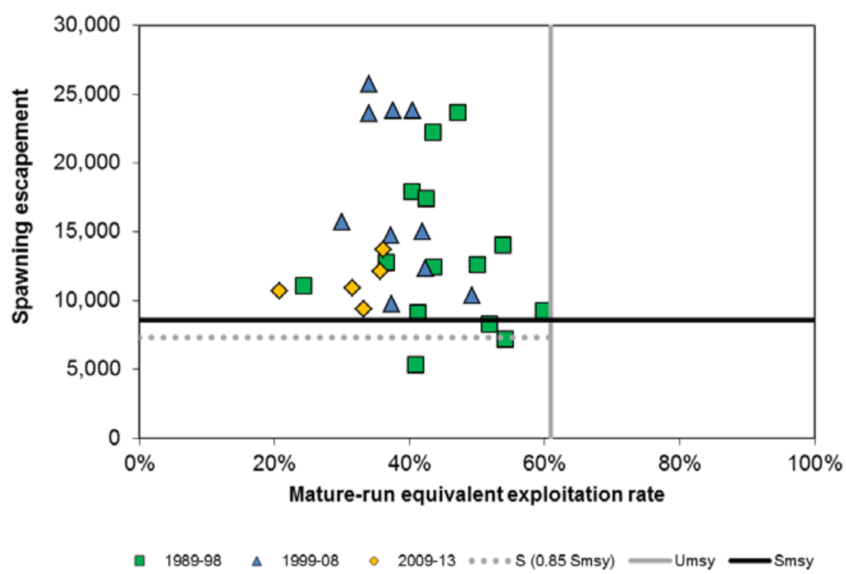

Figure 3.17.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Kitsumkalum River stock of Chinook salmon, 1985–2013.

3.2.2.2 *Central British Columbia: Atnarko River*

Central British Columbia stocks are part of the North/Central British Columbia model stock group, which has the Dean and Atnarko river escapement indicators in Central British Columbia. Currently, none of these stocks have CTC escapement goals. The Atnarko River was added as an exploitation rate indicator stock in Area 8 in 2012 (Vélez-Espino et al. 2011) and has escapement estimates produced by MR data (Vélez-Espino et al. 2010) and a calibrated time series of escapement since 1990 based on MR data and both carcass counts and broodstock CPUE (Vélez-Espino et al. 2014). This stock has had a moderate level of enhancement (Figure

3.18). Hatchery contribution has averaged 34% in Atnarko escapements from 1990 to 2013 and 27% over the last 12 years. The largest contributions occurred in the mid-1990s, reaching 67% in 1996. The recent increase in hatchery contribution is partly due to the implementation of yearling releases in addition to the subyearling releases of previous years. Adjustments have been made to remove hatchery fish in order to make inferences for unenhanced stocks in Central British Columbia (Vélez-Espino et al. 2014). A stock–recruitment relationship has not been generated for this stock yet, but a habitat-based estimate of S_{msy} (Parken et al. 2006) has been developed for Atnarko Chinook salmon (5,009 large adults; Vélez-Espino et al. 2014).

Marine survival (i.e., age-2 cohort survival) of Atnarko Chinook salmon for brood years 1986 to 2010 averaged 2.6%, showing an increasing tendency from brood year 1986 to brood year 1991 and remaining generally below average from brood year 1992 up to brood year 2008. Marine survival increased for brood year 2009 to a level comparable to that achieved for brood year 1991 and reached the highest recorded level (9.9%) for brood year 2010 (Figure 3.19).

Escapements of large adults (excluding jacks) have exceeded S_{MSY} in all years except for 2012 with an escapement of 4,622 large Chinook salmon, whereas total escapement (including jacks) for 2012 was 7,425 Chinook salmon (Figure 3.20). The 2012 escapement of large adults was, however, greater than the 0.85 S_{MSY} lower threshold of 4,258, and the cumulative exploitation rates have been below the threshold reference line (Figure 3.21). Atnarko Chinook salmon have been in the safe zone in all years and in the escapement buffer zone in 2012.

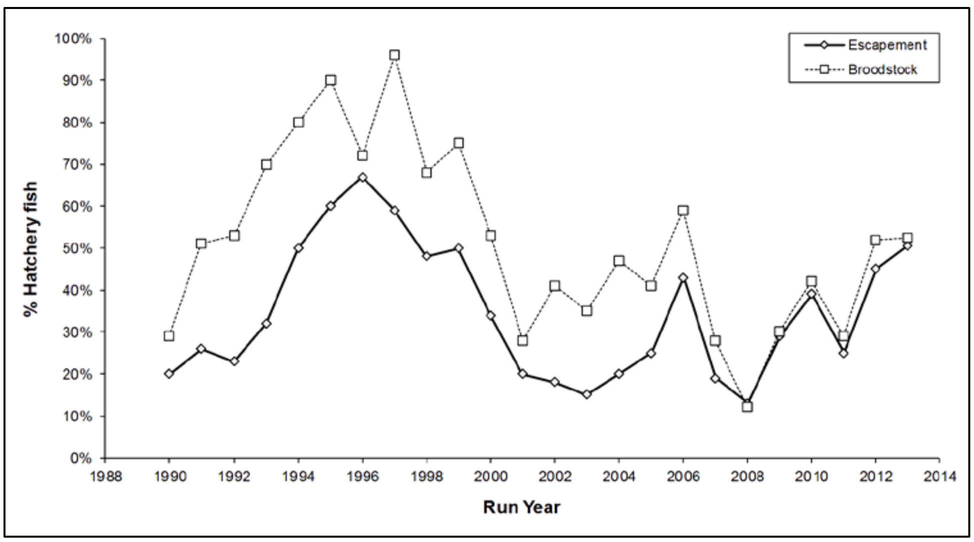

Figure 3.18.–The percentage of first generation hatchery origin Chinook salmon in the Atnarko River escapement and in the hatchery broodstock, 1990–2013.

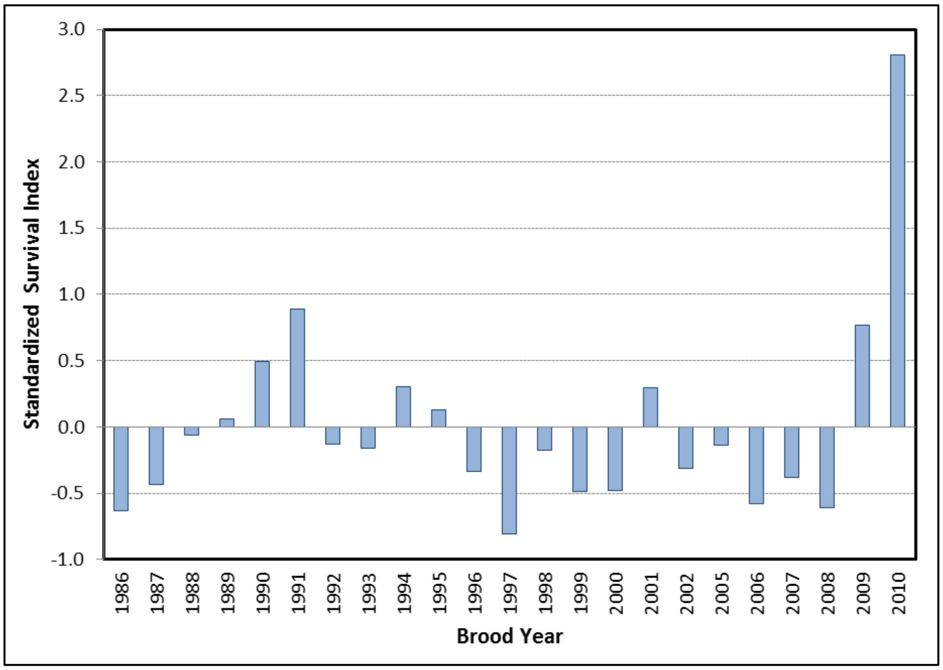

Figure 3.19.–Marine survival index (standardized to a mean of zero) for subyearling releases of the Atnarko River stock of Chinook salmon, 1986–2010 brood years. There were no CWT releases for brood years 2003 and 2004.

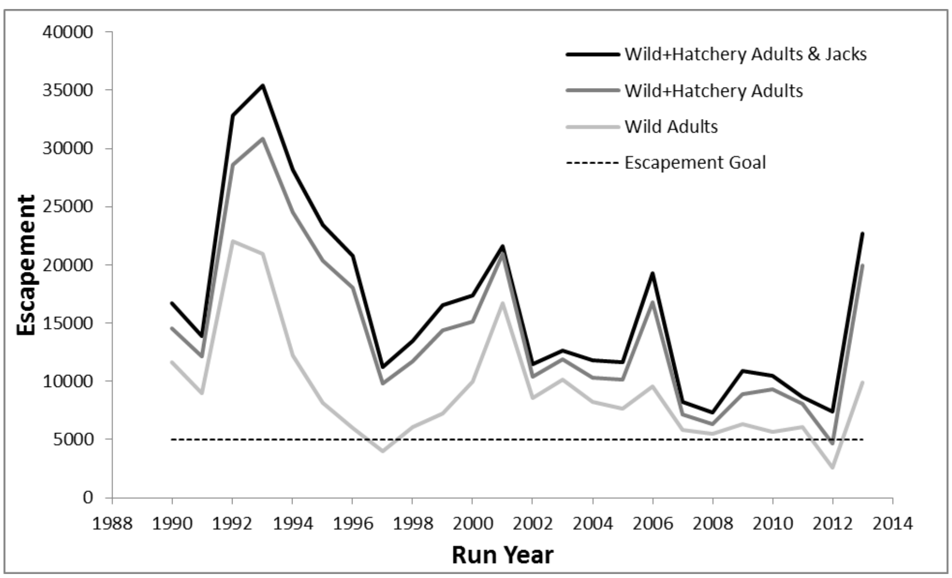

Figure 3.20.–Time series of Atnarko Chinook escapement integrating the calibrated values from best Generalized Linear Model and the best Maximum Likelihood estimates for years with MR studies (2001–2003 and 2009–2013).

Note: Time series are shown for total escapement including hatchery and wild females (F), males (M), and jacks (J), large adult escapement including hatchery and wild F and M, and large wild escapement including only wild F and M. The dashed line shows the habitat-based escapement goal.

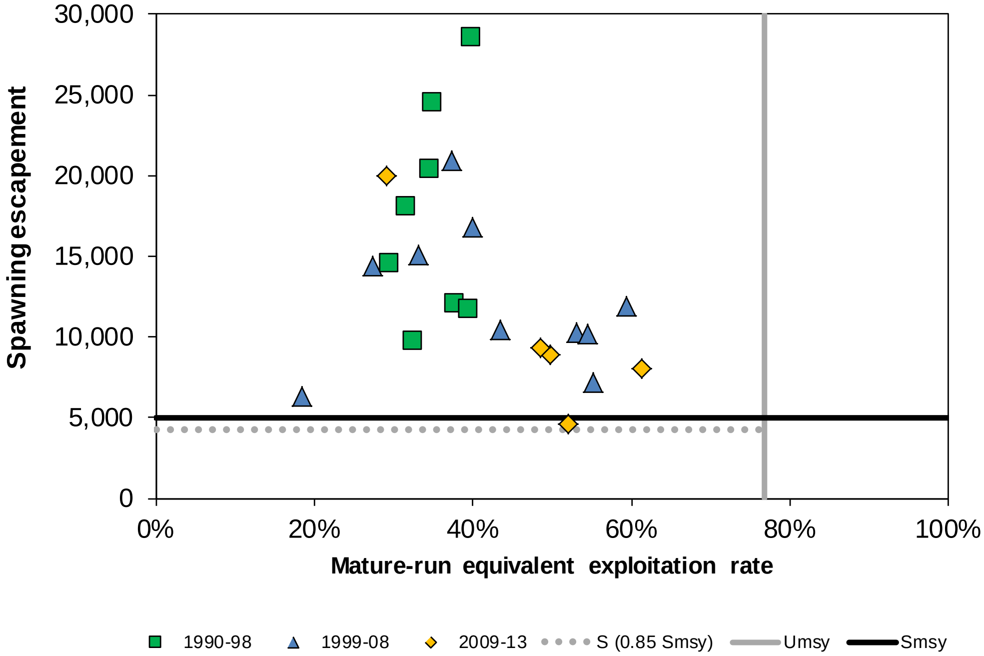

Figure 3.21.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Atnarko River stock of Chinook salmon, 1990–2013.

Note: Spawning escapement excludes jacks to be consistent with the units represented by the S_{MSY}-based escapement goal.

3.2.2.3 *Lower Strait of Georgia: Cowichan River*

The LGS natural stock group includes the Cowichan River and Nanaimo River escapement indicators. Currently, only the Cowichan has a CTC escapement goal. A habitat-based estimate of S_{MSY} is available for the Nanaimo River; however, the exploitation rate indicator program was discontinued after brood year 2004. The Cowichan River is an exploitation rate indicator stock that has escapement estimates produced by fence (weir) and MR methods. This stock has had a high level of enhancement (Figure 3.22), which influences the representativeness of this stock for others in LGS. Hatchery contribution averaged 24% in the escapement from 1982 to 2011 and 29% over the last 12 years. The largest contribution occurred in 2002 reaching 59%. Tompkins et al. (2005) reviewed these data and estimated the stock–recruit relationship. Marine survival was generally above average for brood years 1985 to 1992, was below average from 1993 to 2009, and slightly above average in 2010 and about average in 2011 (Figure 3.23). The cumulative exploitation rates have been above the threshold reference line in about 80% of the years and escapements have been below S_{MSY} since 1997 (Figure 3.24). The stock has rarely been in the safe zone of the synoptic plot, only once during the last 26 years, with most of the recent years in the high risk zone. The stock experiences the highest exploitation of the stocks examined in Section 3.

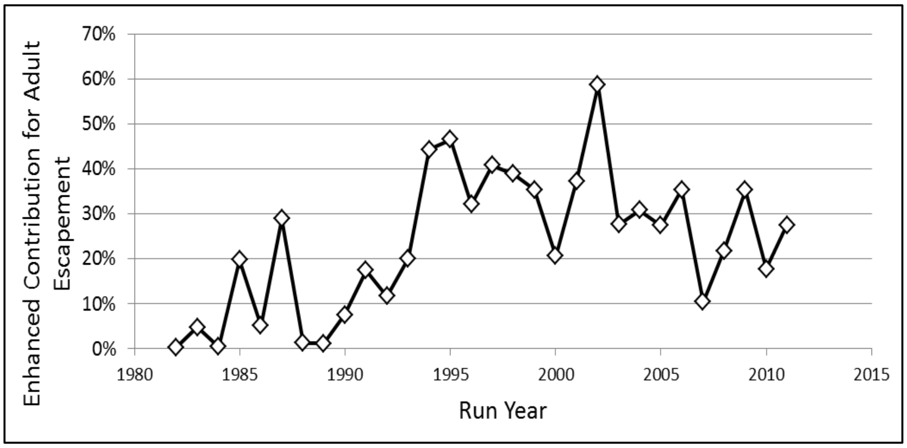

Figure 3.22.–The percentage of first generation hatchery origin Chinook salmon in the Cowichan River adult escapement, 1982–2011.

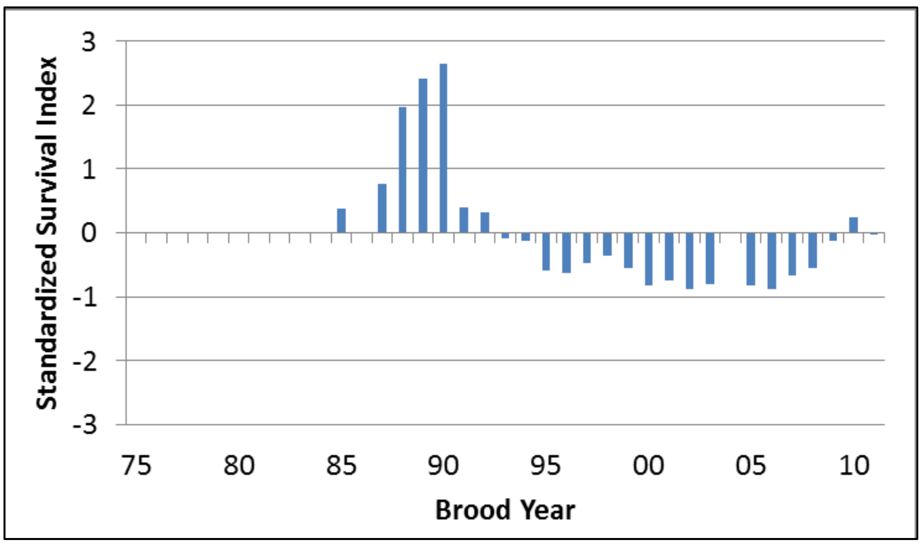

Figure 3.23.–Marine survival index (standardized to a mean of zero) for the Cowichan River stock of Chinook salmon, 1985–2011 brood years. Brood years 1986 and 2004 were not represented by CWTs, thus no data are available.

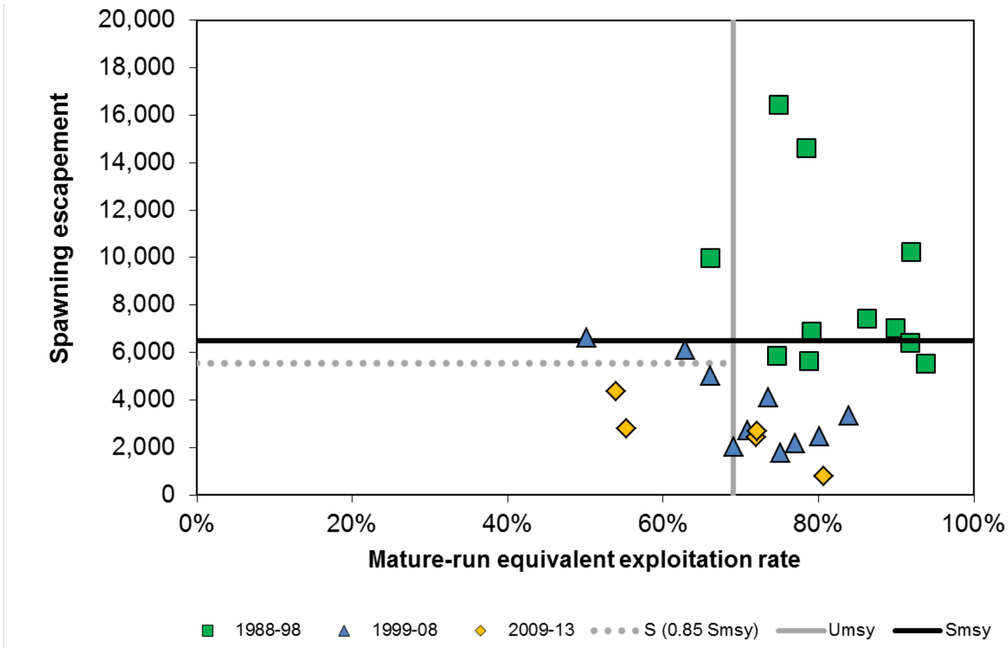

Figure 3.24.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Cowichan River stock of Chinook salmon, 1988–2013.

3.2.2.4 *Fraser River Stocks*

Within the Fraser River, three of five escapement indicator stocks are represented currently by exploitation rate indicator stocks. Fraser River spring run age 1.2 are represented by the Nicola River, Fraser River summer run age 0.3 are represented by the Lower Shuswap River, and Fraser River late run are represented by the Harrison River. Fraser River spring run age 1.3 and Fraser River summer run age 1.3 are not currently represented by CWT-based indicator stocks.

3.2.2.4.1 Fraser River Spring Run Age 1.2: Nicola River

The Fraser River spring run age-1.2 stocks are small-bodied, early-maturing stocks that spawn in tributaries to the Lower Thompson River, Louis Creek in the North Thompson River, and Bessette Creek in the South Thompson River. Currently, there are no CTC-approved escapement goals for this group and the reference lines were estimated from habitat-based methods (Parken et al. 2006). Harvest occurs almost exclusively during the return migration, while passing through approach fisheries and within the gauntlet of Fraser River fisheries. Escapements declined steeply between 2003 and 2009, and currently this is a stock group of concern for Canadian fishery planning. The Nicola River indicator stock has had a high level of enhancement, which influences its representativeness for other unenhanced stocks. Hatchery contribution averaged 26% for the 1987 to 2013 escapement and 19% over the last 12 years. The largest contribution was 76% in 1991 (Figure 3.25).

The Nicola River stock has been in either the safe or low escapement and low exploitation zones of the synoptic plot in all years. Since 2009, the stock has been in the low escapement and low exploitation zone in all years (Figure 3.26). The recent low escapements and low exploitation rates indicate that smolt survival, freshwater survival, or their interaction have contributed to low production. This pattern showing a shift to a below average survival regime beginning with brood year 2000 appears similar to the pattern described previously for the outside-rearing stocks in Alaska. Cohorts that entered the ocean in 2005 and 2007 (returned in 2007 and 2009) survived particularly poorly. A pattern of alternating years of very poor escapements has persisted due to the weak returns from those smolts despite increased conservation measures. Survivals decreased steeply with the 2000 brood (2002 ocean entry) and remained below average subsequently, with the modest exception of 2006 brood (2008 ocean entry; Figure 3.27). The very low survival for the 1992 brood year was caused by a Myxobacteria infection at Spius hatchery, and the survival for the 1994 brood year was affected by high prespawn mortality in 1998 (not measured). Rebuilding will require a sustained return to more favorable survival conditions.

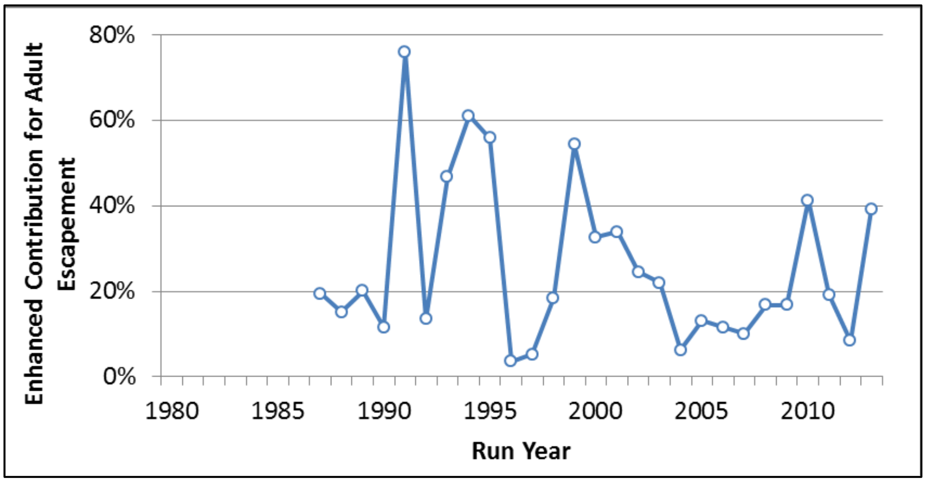

Figure 3.25.–The percentage of first generation hatchery origin Chinook salmon in the Nicola River escapement, 1987–2013.

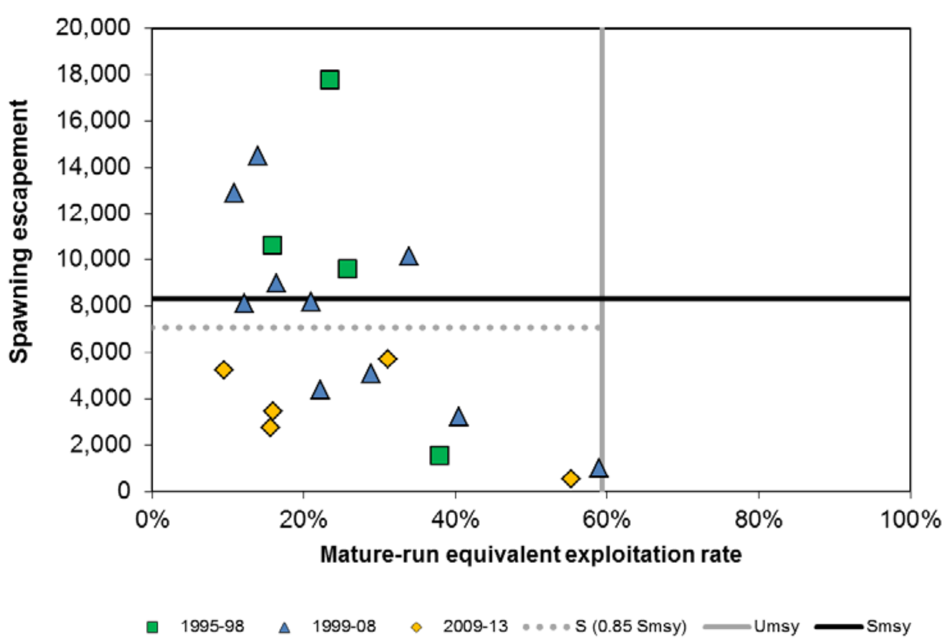

Figure 3.26.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Nicola River stock of Chinook salmon, 1995–2013.

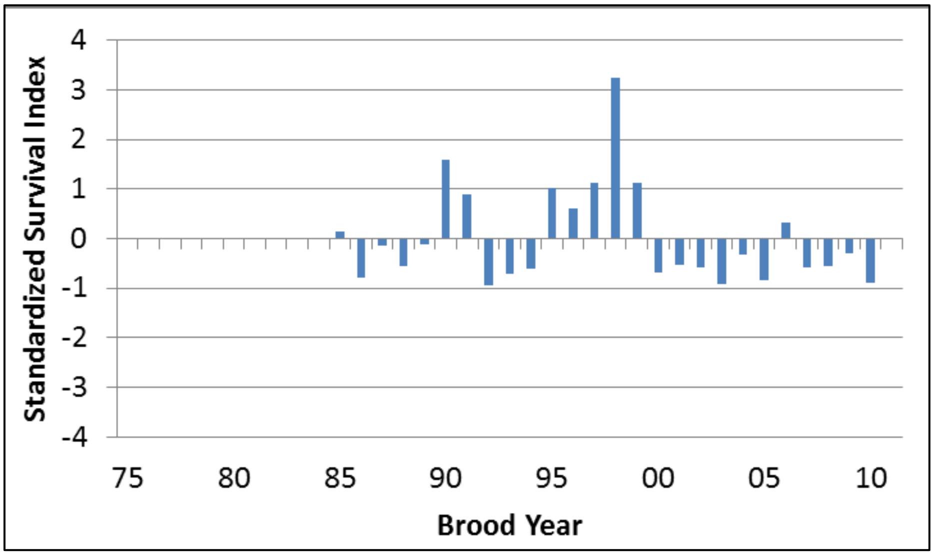

Figure 3.27.–Marine survival index (standardized to a mean of zero) for the Nicola River stock of Chinook salmon, 1985–2010 brood years.

3.2.2.4.2 Fraser River Summer Run Age 0.3: Lower Shuswap

The Fraser River summer run age-.3 stocks are far north migrating, ocean-type stocks that spawn in Maria Slough (Lower Fraser River), the Lower Thompson River, and South Thompson River and tributaries. These fish remain upon the continental shelf for their entire marine residence and are vulnerable to harvest throughout that period and during return migration, in both marine and Fraser River fisheries. Escapements to this stock group increased from about 25,000 through the 1980s to more than 100,000 between 2006 and 2011, peaking in 2010 at an estimated 156,600 fish, and declining steeply in 2012 to about 48,000 fish. Currently, there are no CTC-approved escapement goals for this group and the reference lines were estimated from habitat-based methods (Parken et al. 2006). The Lower Shuswap River indicator program provides survival and exploitation information. This stock has had a mean enhancement level of 7% from 1987 to 2013 (range = 2–19%), and averaged 10% over the last 12 years. Survivals were poor for the 2008 and 2009 brood years (both incomplete cohorts), contributing to the lower abundance in 2012 (Figure 3.28). Survival increased considerably for the 2010 brood year, leading to a high abundance of age-3 fish in the 2013 escapement. The cumulative exploitation rates have been below the threshold reference line in all but two years and escapements have exceeded S_{MSY} in all but two years. The Lower Shuswap CWT stock has been in the healthy zone of the synoptic plot in all but four years (Figure 3.29). Since implementation of the 2009 Agreement, four years were in the safe zone and the other year was in the low escapement and low exploitation zone.

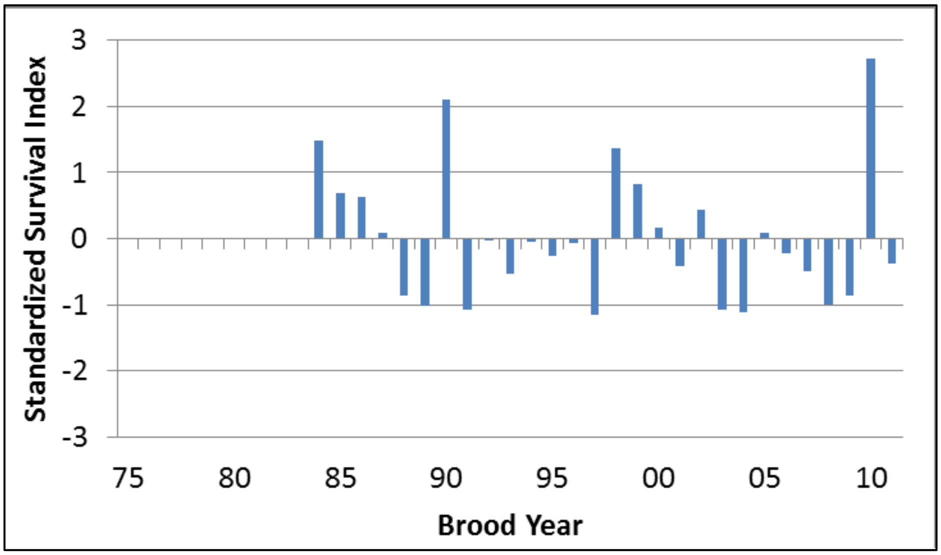

Figure 3.28.–Marine survival index (standardized to a mean of zero) for the Lower Shuswap River stock of Chinook salmon, 1984–2011 brood years.

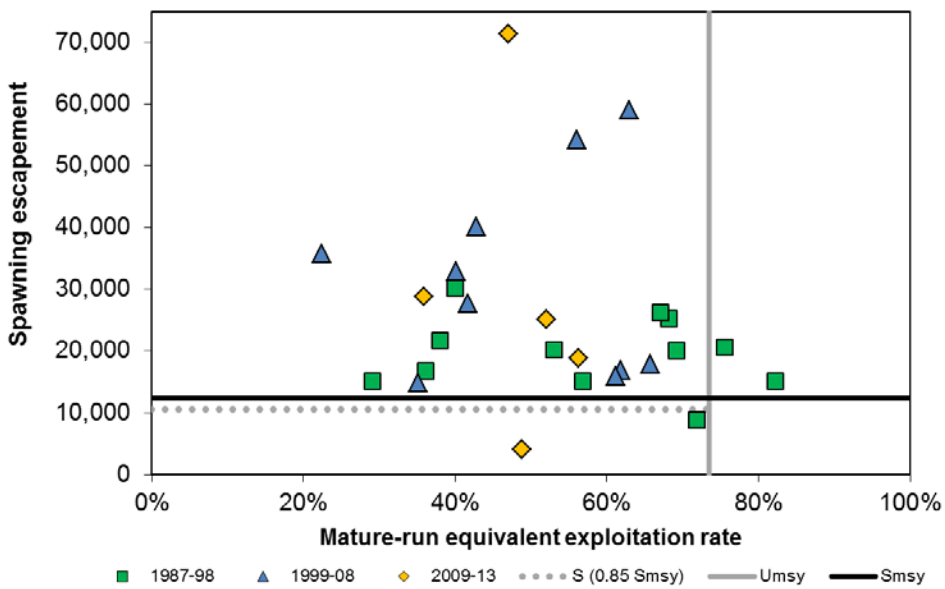

Figure 3.29.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Lower Shuswap River stock of Chinook salmon, 1989–2013.

3.2.2.5 *Fraser Late: Harrison River*

The Fraser late stocks are white-fleshed fall-run Chinook salmon, originating from the Harrison River downstream of Harrison Lake in the Lower Fraser River. Juveniles migrate to the Fraser estuary immediately after emergence and remain in the estuary area for up to six weeks before moving into the Strait of Georgia. Their ocean distribution is principally in the Salish Sea, WCVI and Coastal Washington, where they are vulnerable to fisheries throughout their ocean residence. The stock group was represented originally by the Chilliwack River exploitation rate indicator stock, but recently data have been reported for the Harrison River indicator stock.

This stock has had a mean enhancement level of 6% from 1984 to 2013 (range = 0.3–24%), and averaged 3% over the last 12 years. With a few exceptions, survivals have been below average since the early 1990s (Figure 3.30), and escapements have been below the goal range for three of the past seven seasons. The synoptic plot shows the stock with exploitation rates higher than the reference line in the majority of years from 1985 to 1998, with two years in the high risk zone but only one year in the safe zone (Figure 3.31). Cumulative exploitation rates were reduced under the 1999 Agreement, with the majority of years having exploitation rates less than U_{MSY}. Exploitation rates were further reduced under the 2009 Agreement, with only two years in the safe zone and the others in the buffer zone or the low escapement and low exploitation zone. The recent low escapements and low exploitation rates indicate that smolt survival, freshwater survival or their interaction have contributed to low production.

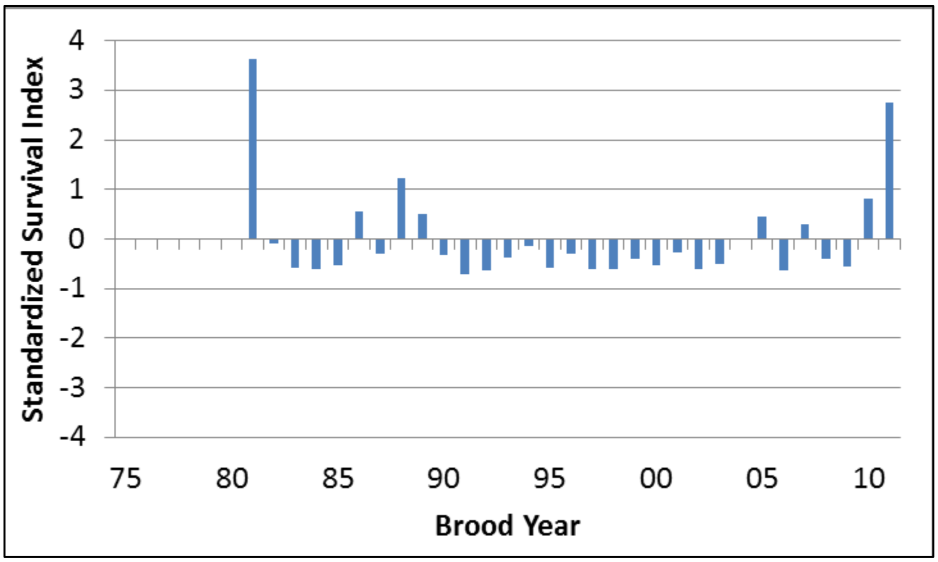

Figure 3.30.–Marine survival index (standardized to a mean of zero) for the Harrison River stock of Chinook salmon, 1981–2011 brood years. No data are available for brood year 2004.

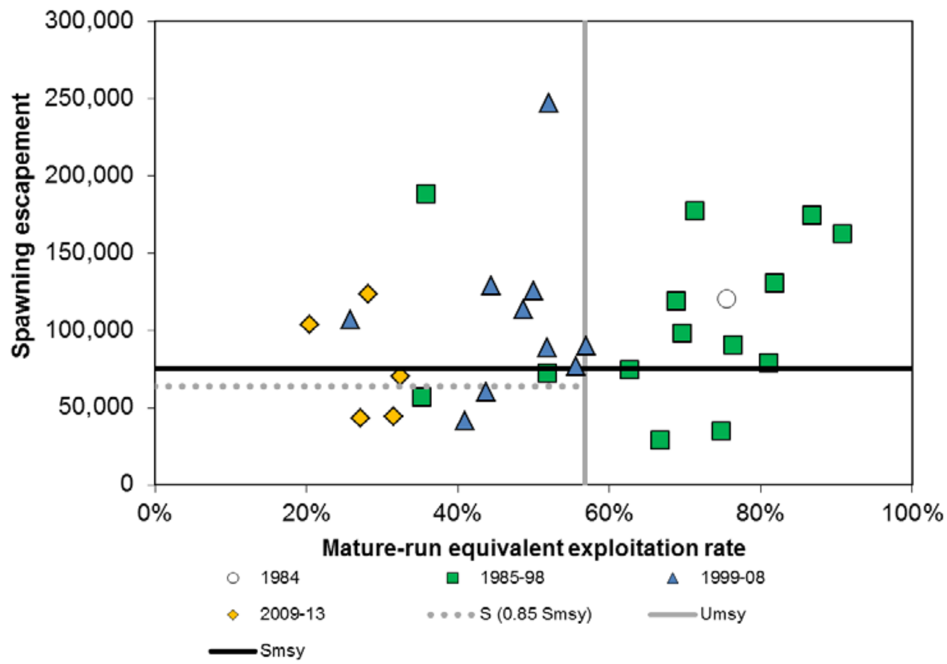

Figure 3.31.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Harrison River stock of Chinook salmon, 1984–2013.

3.2.3 Puget Sound, Coastal Washington, Columbia River, and Coastal Oregon Stocks

3.2.3.1 *Puget Sound*

Puget Sound stocks are a mixture of natural- and hatchery-origin production of spring run and summer/fall run fish. This mix of hatchery- and natural-origin production influences both the fisheries within Puget Sound, where terminal fisheries target abundant hatchery stocks, as well as the escapement to the spawning grounds, which contains many hatchery strays in some cases. Consequently, historic patterns of wild Puget Sound Chinook salmon abundance may be obscured because of the interaction of hatchery- and natural-origin production in the fishery and escapement accounting. Hatchery programs in Puget Sound have annually released between about 23 million (1976) to over 56 million (1989) Chinook salmon (Figure 3.32). Since Puget Sound Chinook salmon were listed as threatened status under the ESA in 1999, hatchery production has averaged about 33 million releases annually. Although Puget Sound hatchery programs historically emphasized production for fisheries alone, many of today's programs are also associated with endangered species recovery or wild broodstock CWT indicator programs.

Spring run stocks in Puget Sound exhibit both ocean-type (age-0 fingerling outmigrants) and stream-type (age-1 yearling outmigrants) life history types. Key spring stocks are the PSC escapement indicators in the Nooksack and Skagit rivers, as well as the White River (PSC CWT indicator), with associated hatchery programs in each. Natural escapement in the Nooksack River is predominately hatchery-origin fish, whereas on the Skagit River, hatchery-origin fish are rarely seen in the spawning areas. Summer/fall run stocks are predominately ocean-type fish and this run timing group comprises the majority of Chinook salmon production from Puget Sound. Skagit River summer/fall Chinook salmon is the largest stock in Puget Sound, and consists almost exclusively of natural-origin fish. The Skagit and Stillaguamish rivers have PSC CWT exploitation rate indicator stocks (Skagit and Stillaguamish rivers) and supplementation programs (Stillaguamish only) that use broodstock collected from the spawning grounds. Basins with large hatchery programs include the Snohomish and Green PSC escapement indicators as well as the Samish, Puyallup, Nisqually and Skokomish rivers. In addition, net-pen programs in Bellingham and Tulalip bays release large number of juvenile Chinook salmon.

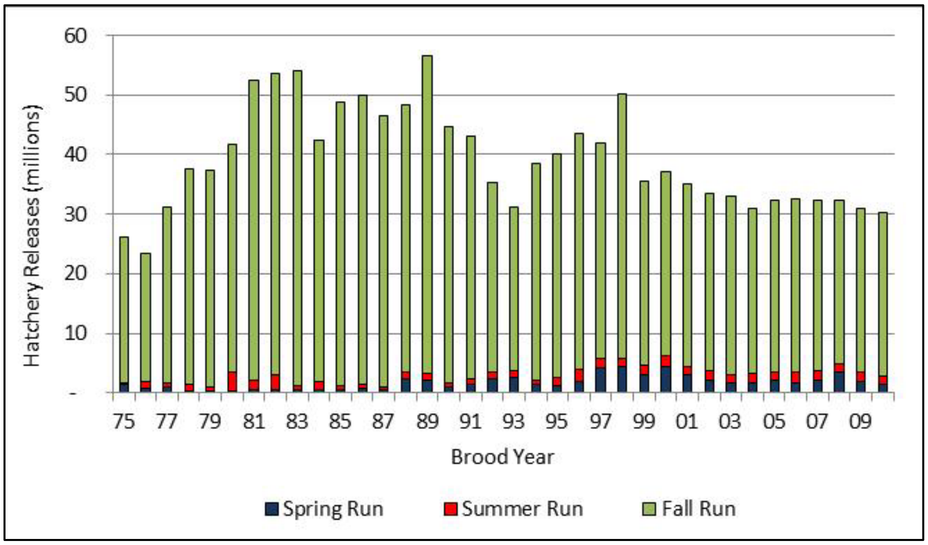

Figure 3.32.–Chinook salmon released from Puget Sound hatcheries, 1975–2010 brood years.

Estimates of total production for the Puget Sound PSC escapement indicator stocks have not been made in part because of the lack of long-term representative tag groups for the natural stocks (except Green River). The trend in the escapement of Puget Sound summer/fall PSC escapement indicator stocks is driven primarily by the status of Skagit River summer/fall Chinook salmon. Consequently, the status and trend of Puget Sound summer/fall Chinook salmon will track with the abundance of Skagit River fish since in most years the abundance of Skagit River fish is higher than the sum of the escapement of the other PSC indicator stocks. This is especially true when the escapement of Skagit River Chinook salmon averaged 17,900 from 2000 to 2006, and exceeded 20,000 from 2004 to 2006. For the period of 1975 to 2013, the aggregate escapement of Puget Sound summer/fall indicator stocks has ranged from a low of about 12,000 fish in 2009 and 2011 to a high of 45,000 in 2004 (Figure 3.33). The aggregate escapement was 19,775 in 2013. None of the Puget Sound Chinook salmon stocks have CTC-approved escapement goals.

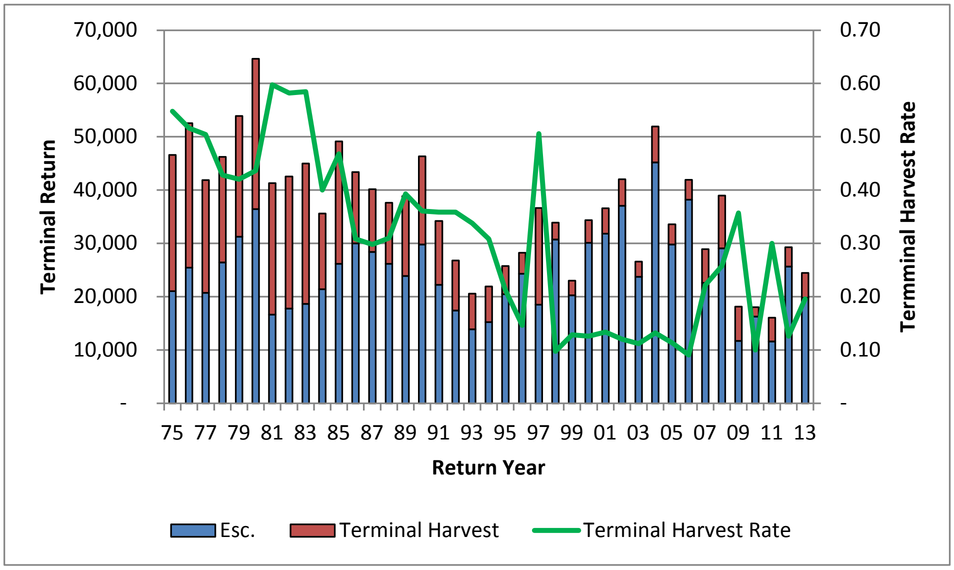

Figure 3.33.–Escapement and terminal fishery harvest for the aggregate of Puget Sound summer/fall Chinook salmon PSC escapement indicator stocks.

The harvest rate in the terminal fisheries for these stocks has generally declined from between 40% and 50% fishing mortality in the early 1980s to about 10% at the time of listing under the ESA in 1999. In most years, the majority of the terminal fishery harvest has depended on the status of Green River Chinook salmon and to a lesser extent on Skagit River fish. Directed terminal fisheries do not occur on Snohomish River, Stillaguamish River, and Lake Washington Chinook salmon.

The long-term escapement trends for Puget Sound Chinook salmon stocks cannot be identified with certainty because of the inability to assess total production of natural stocks in Puget Sound, coupled with the changes in fishery patterns and hatchery production over the 1975 to 2013 time period. Data limitations notwithstanding, it is still possible to make some generalizations about the current status of Puget Sound escapement indicators based on the recent past at both the aggregate and individual population levels. Spring Chinook salmon in the Nooksack and Skagit rivers, for instance, exhibit variable but stable escapement trends. Overall, summer/fall escapements have declined notably from near-peak levels in the recent decade and in a manner commensurate with the escapement declines of the 1990s that led to ESA listing. Examined at the individual stock level, however, some variation on this general theme emerges (Section 2.2.4). Trends for summer/fall indicator stocks in the Green and Snohomish rivers show significant decline (Section 2.2), whereas Skagit, Stillaguamish, and Lake Washington tributary populations exhibit stable to increasing escapement trajectories. Although it is important to acknowledge the influence of the time period choice on conclusions about recent abundance trends (i.e., near-record escapements were seen for many Puget Sound populations in the early 2000s), the observation of low escapements in recent years for multiple populations suggests this group of stocks remains depressed overall. It should be noted, however, that some stocks (Skagit River spring and summer/fall, Lake Washington) have experienced consecutive years (2012, 2013) of increased escapement. Future assessments of escapement trends should attempt to separate hatchery strays from natural-origin spawners, where data permit.

3.2.3.2 *Coastal Washington*

Coastal Washington is the only region in the state accessible to anadromous salmonids where Chinook salmon are not listed under the U.S. ESA. Consequently, salmon fishery management of the coastal Chinook salmon stocks in this region has one less regulatory framework to consider each year, but still has to balance conservation needs with state and tribal co-management, federal fishery management plans, and international agreement under the PST. Additionally, compared to Puget Sound, the confounding influence of hatchery production on trend assessments is considerably less.

The aggregate escapement of spring and summer Chinook salmon PSC escapement indicator stocks in the Queets, Quillayute, and Hoh rivers and Grays Harbor ranged from a high of 11,740 in 1989 to a low of 2,016 in 2007 (Figure 3.34). Queets River spring/summer and Quillayute River summer Chinook salmon populations have not met escapement goals in the majority of years since 1999, and both the Hoh and Quillayute stocks exhibit escapement trends indicating considerable decline since the late 1980s but consistency since the 1999 PST went into effect (Section 2.2.4). There are no representative PSC indicator tag groups for these stocks. However, CWT groups were released from Sol Duc Salmon Hatchery in the Quillayute Basin in the early 1990s and were discontinued for about 10 years before starting new tagging programs with the 2004 brood. Based on limited information from these tag groups that generally showed poor survival, the Quillayute stock has a northerly ocean catch distribution. Exploitation rates cannot be determined because recoveries are low and escapement area sampling appears inadequate in some years.

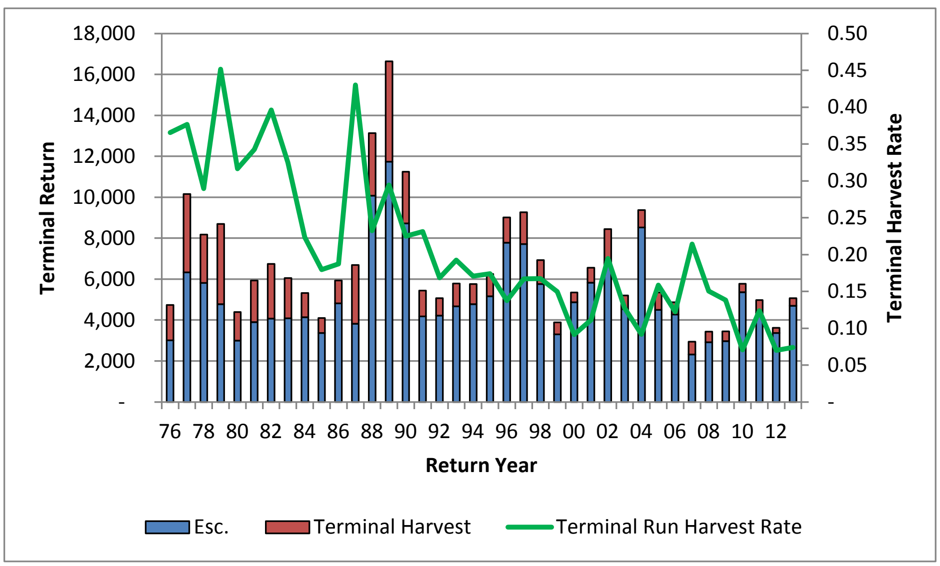

Figure 3.34.–Escapement and terminal fishery harvest for the aggregate of Washington coastal spring/summer Chinook salmon PSC escapement indicator stocks.

Coastal Washington fall Chinook salmon escapement indicators include Queets, Quillayute, Grays Harbor (accepted in 2014) and Hoh stocks that have CTC-approved escapement goals and the Hoko that only has an agency management goal. Aggregate coastal fall Chinook salmon escapement has ranged from a low of 14,512 in 1983 to a high of 56,692 in 1988 (Figure 3.35). Similar to spring/summer stocks, coastal fall stocks are characterized by escapement declines since the highs of the late 1980s and generally stable escapements in the more recent past (Section 2.2.4). Over the entire 1975 to 2013 time period, terminal harvest rates have varied substantially without a definitive trend and have averaged about 27% since 1999. With the exception of the Hoko stock, harvest in the terminal fisheries is a mixture of directed catch on Chinook salmon and incidental catch while targeting other species (Figure 3.35).

Unlike in Puget Sound where hatchery production is significant and widespread and can complicate natural stock accounting, fall Chinook salmon hatchery production is more limited on the Washington Coast and not extensive in the PSC indicator stock basins. Hatchery programs that currently release fall Chinook salmon in the PSC indicator stock basins include the Hoko Falls Hatchery that releases smolts for natural stock supplementation/CWT indicator stock purposes, Salmon River Fish Culture Hatchery in the Queets Basin, and Humptulips Salmon Hatchery in the Grays Harbor watershed. Other significant programs outside of the PSC escapement indicator stock programs include releases from Makah National Fish Hatchery on Tsoo-Yess River (formerly Sooes River), Quinault National Fish Hatchery on Cook Creek in the Quinault Basin, and Forks Creek Hatchery in Willapa Bay. All of these hatchery programs influence the management of terminal fisheries and the extent of directed harvest on fall run Chinook salmon.

Despite the lack of clear trends in escapement for coastal Chinook salmon stocks (Section 2.2.4), conclusions on stock status and population trend are speculative without a full run reconstruction (CWT-based) that can account for total production. Ocean fishery impacts for these stocks can be estimated using the Queets CWT indicator tag group. From a simple fishery distribution basis, the portion of the Queets stock impacted in ocean fisheries shows no apparent trend and has averaged about 44% of the total accounting in all fisheries and escapement since 1985 (CTC 2012). Since ocean fishery impacts show no trend and terminal returns have declined since the late 1980s, it appears that total adult production has also declined. Further investigation and analysis is needed to confirm this generalization.

Queets CWT indicator tag groups were used to produce plots for a synoptic evaluation of the three coastal Washington fall Chinook salmon stocks with CTC-approved escapement goals—Queets, Quillayute, and Hoh rivers. Queets CWT groups were assumed to be representative of the exploitation and ocean distribution of Quillayute and Hoh stocks. All three stocks have active terminal fisheries with similar terminal fishery harvest rates; therefore, Queets CWTs are considered a suitable surrogate to estimate exploitation in the Quillayute and Hoh rivers.

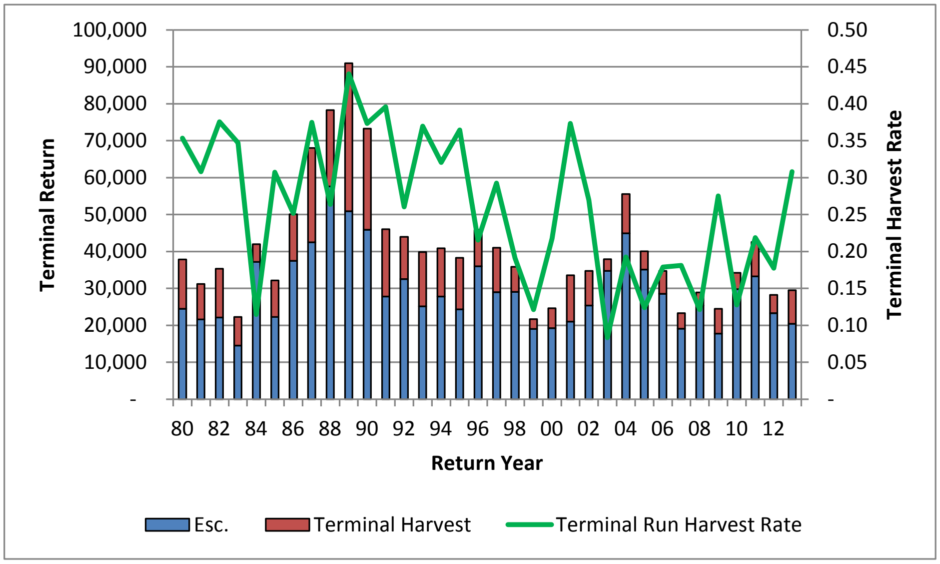

Figure 3.35.–Escapement, aggregate escapement goal and terminal fishery harvest for the aggregate of Washington coastal fall Chinook salmon PSC escapement indicator stocks.

A simultaneous evaluation of spawning escapement and cumulative MRE exploitation rates shows management of Queets River fall Chinook salmon (Figure 3.36) in the safe zone with spawning escapement exceeding the goal and exploitation rates below S_{MSY} in all years except 1999 and 2007. Management for escapement and mature-run exploitation rate was in the safe zone in all years for Quillayute (Figure 3.37) and Hoh (Figure 3.38) rivers. Productivity of these stocks is high, evidenced by their high U_{MSY} (0.87 for Queets and Quillayute; 0.90 for Hoh), which provides for less stringent management than some stocks with lower U_{MSY}. From this synoptic evaluation perspective, these coastal Washington stocks exhibit a track record demonstrative of sustainable management. Further, this view of the fishery impact and escapement data suggests that much of the variation in escapements for these stocks has been driven by nonfishing factors (e.g., anomalously high or low marine survival).

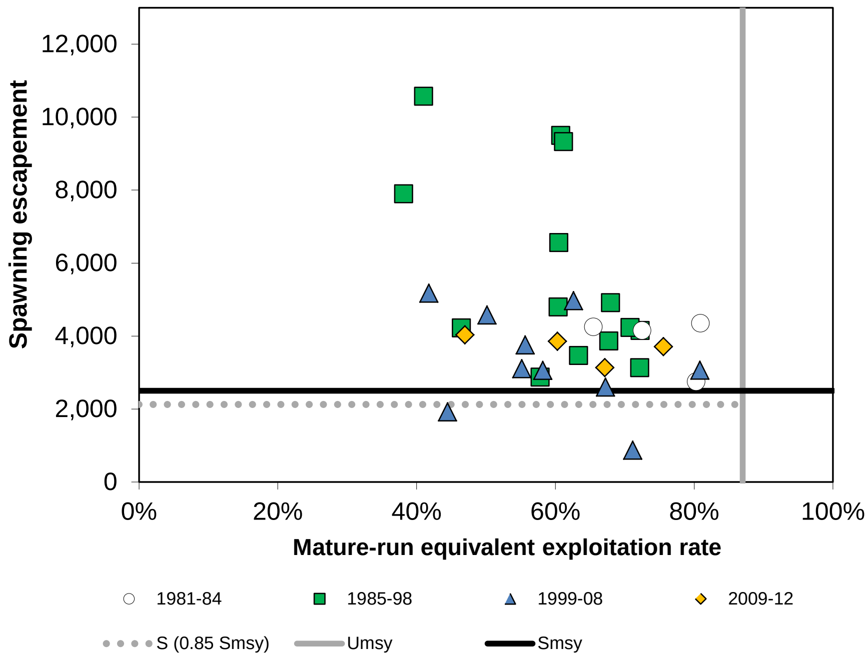

Figure 3.36.–Queets River fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Queets River PSC indicator CWTs.

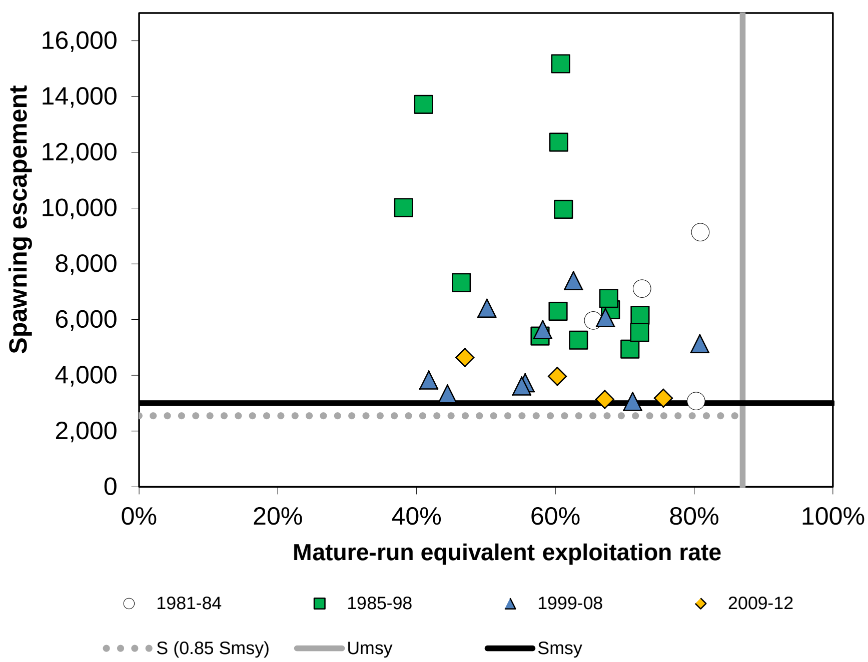

Figure 3.37.–Quillayute River fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Queets River PSC indicator CWTs.

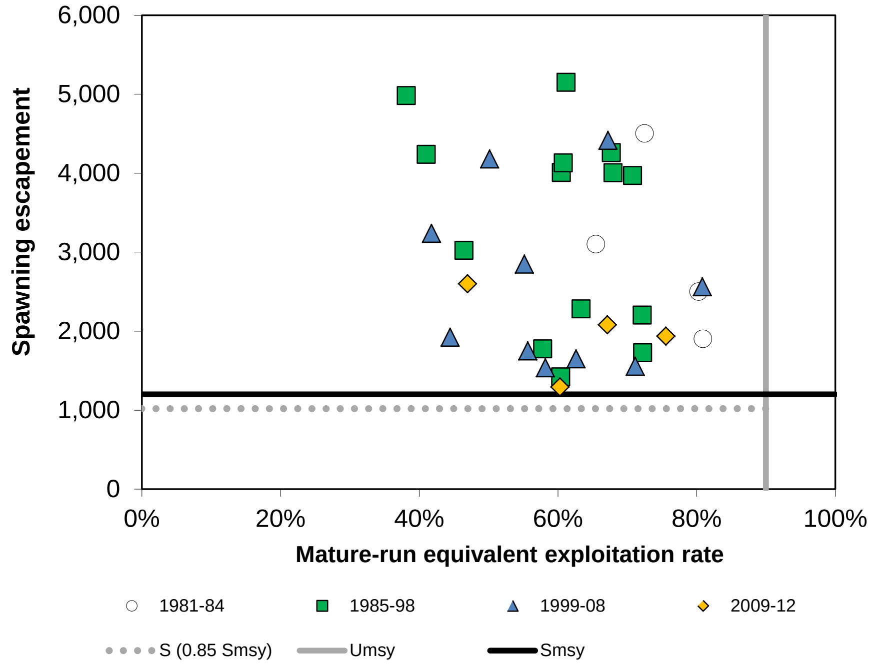

Figure 3.38.–Hoh River fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Queets River PSC indicator CWTs.

3.2.3.3 *Columbia River*

3.2.3.3.1 Columbia River Summers

Columbia upriver summer Chinook salmon are the only escapement indicator stock in this stock group. Since 2008, Columbia upriver summer Chinook salmon have been managed inriver by comanagers for a spawning escapement of 17,000, including 13,500 Wenatchee/Entiat/Chelan tributary spawners, 3,500 Methow/Okanagan tributary spawners, and an additional 3,000 fish for hatchery brood stock. Inriver fisheries are managed using a sliding scale of harvest rates based on the expected terminal run size.

For consistency with the CTC escapement goal, the synoptic evaluation shows combined hatchery and wild fish past Rock Island Dam (Figure 3.39). Although survival rates have been slightly below average, the counts of Chinook salmon past Rock Island Dam have exceeded 40,000 since 2009 while the stock experienced MRE exploitation rates of 51% to 73%. The CTC goal of 12,143 summer Chinook salmon past Rock Island Dam was developed prior to sport and nontreaty tribal fisheries that now take place above Rock Island Dam, so the recent dam counts overestimate escapement. The simultaneous evaluation of spawning escapement and cumulative MRE exploitation rates shows management of Columbia River summers (Figure 3.40) in the safe zone of spawning escapement exceeding the goal and exploitation rates below U_{MSY} in all years since 2008.

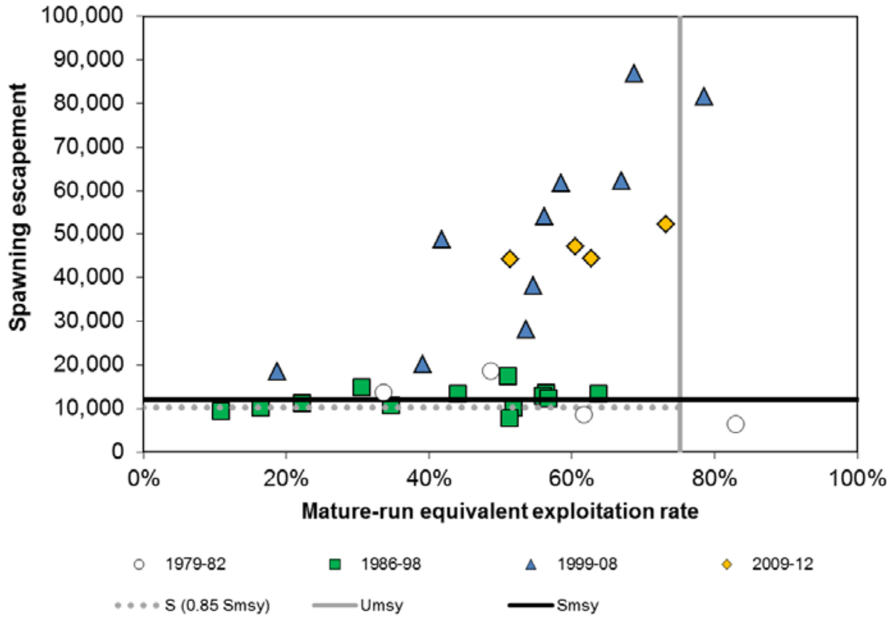

Figure 3.39.–Mid-Columbia summer Chinook salmon spawning escapement past Rock Island Dam and cumulative mature-run equivalent exploitation rate calculated from Wells Hatchery PSC indicator CWTs.

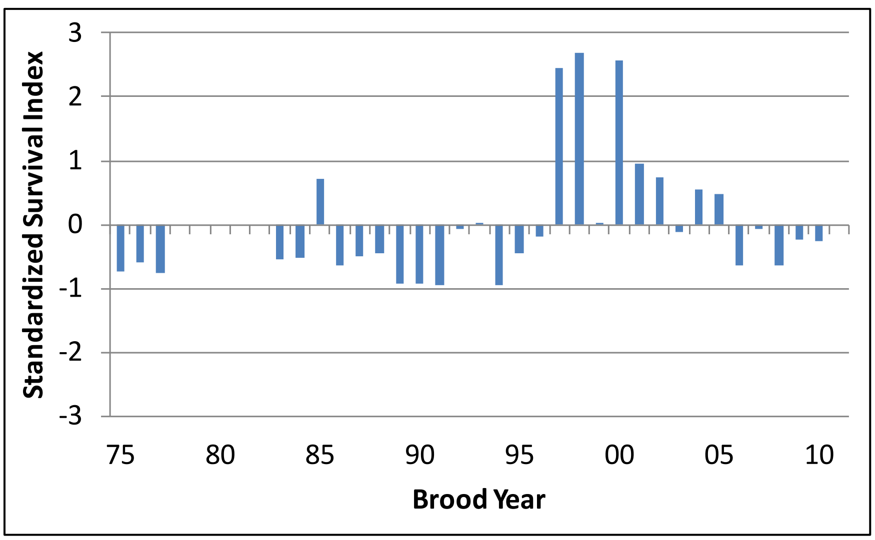

Figure 3.40.–Marine survival index (standardized to a mean of zero) for Columbia upriver summer Chinook salmon.

3.2.3.3.2 Columbia River Fall

The Columbia River fall stock group in the annex tables has three escapement indicator stocks: Columbia Upriver Bright, Deschutes River, and Lewis River Wild. The Columbia Upriver Bright management unit is comprised of all bright fall Chinook salmon returning above Bonneville Dam, including Deschutes, upper Columbia and Snake river populations. The CTC-agreed escapement goal for the upper Columbia fall Chinook salmon populations of 40,000 adult spawners past McNary Dam has been met since 1983, and the CTC goal of 4,532 Deschutes River fall Chinook salmon has been met since 1993, while MRE exploitation rates have varied widely between 40% and 80% (Figure 3.41, Figure 3.42). The simultaneous evaluation of spawning escapement and cumulative MRE exploitation rates shows management of Columbia Upriver Bright and Deschutes (Figure 3.41, Figure 3.42) in the safe zone or the high escapement/high exploitation zone in all years since 1998.

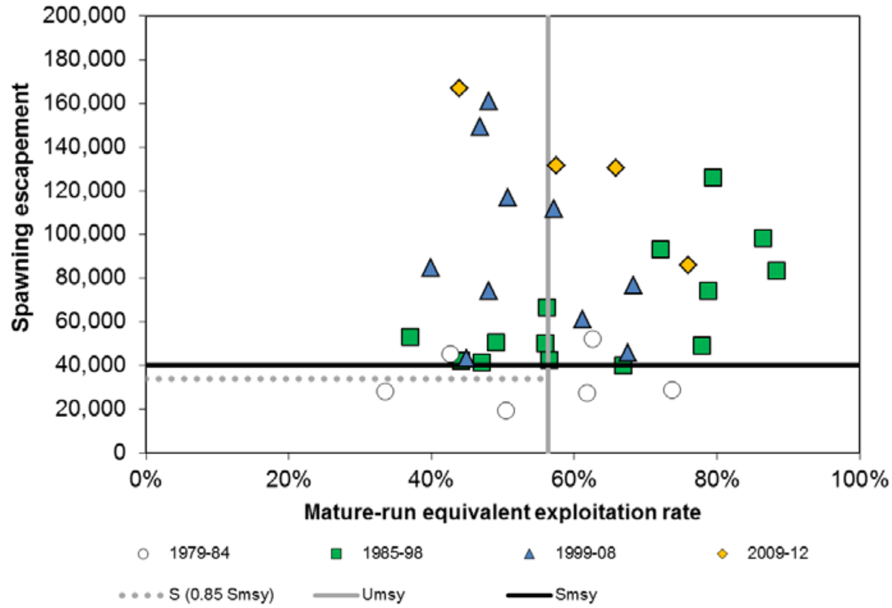

Figure 3.41.–Upriver Bright fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Priest Rapids Hatchery and Hanford Reach Wild PSC indicator CWTs.

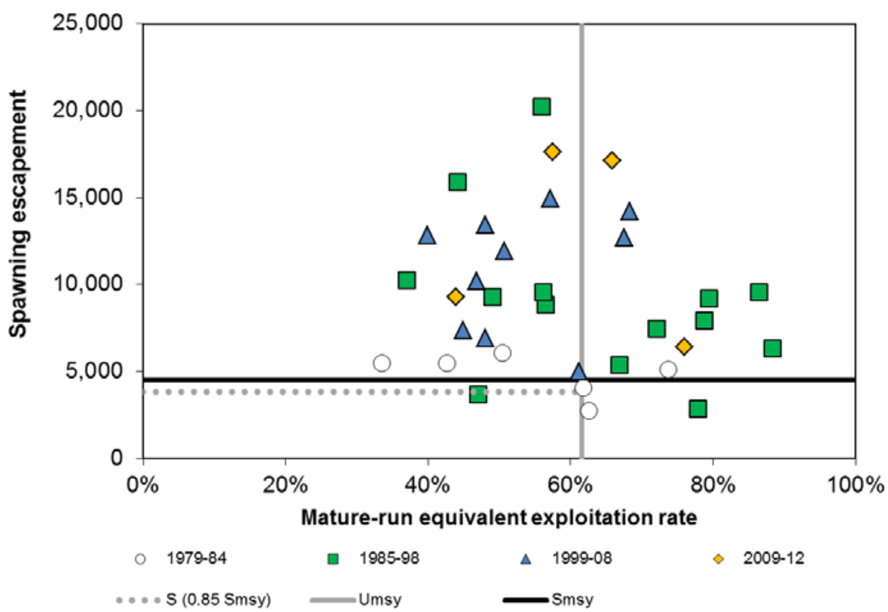

Figure 3.42.–Deschutes River fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Priest Rapids Hatchery PSC indicator CWTs.

The CTC escapement goal of 5,700 Lewis River fall Chinook salmon has been met since 2000, except for 2007 to 2009, when tributary returns were insufficient to meet escapement needs even in the absence of tributary fishing. Exploitation rates since 1980 have never exceeded the estimated U_{MSY} (Figure 3.43).

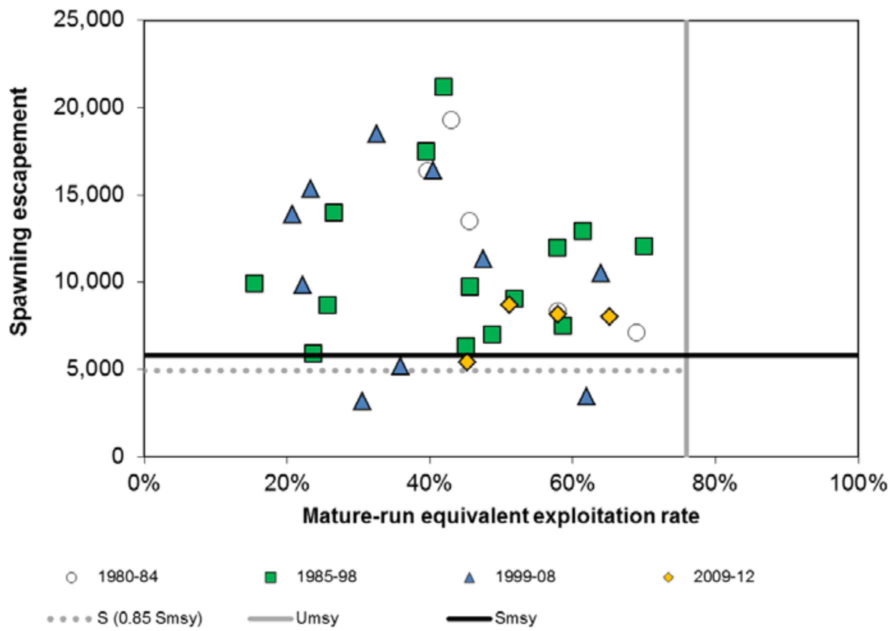

Figure 3.43.–Lewis River Wild fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Lewis River Wild PSC indicator CWTs.

Standardized survival indices for Columbia River falls have been fairly stable. Based on wild Hanford Reach CWT data, brood years 1999, 2007, and 2009 exceeded one standard deviation from average (Figure 3.44). Based upon Priest Rapids Hatchery CWT data, the 2009 brood exhibited an exceptionally high marine survival (Figure 3.45). The recent increases to above average survival observed for wild Hanford Reach and Priest Rapids Hatchery fish are not reflected in the data available for Lewis River wild fall fish where recent survivals are below average (Figure 3.46).

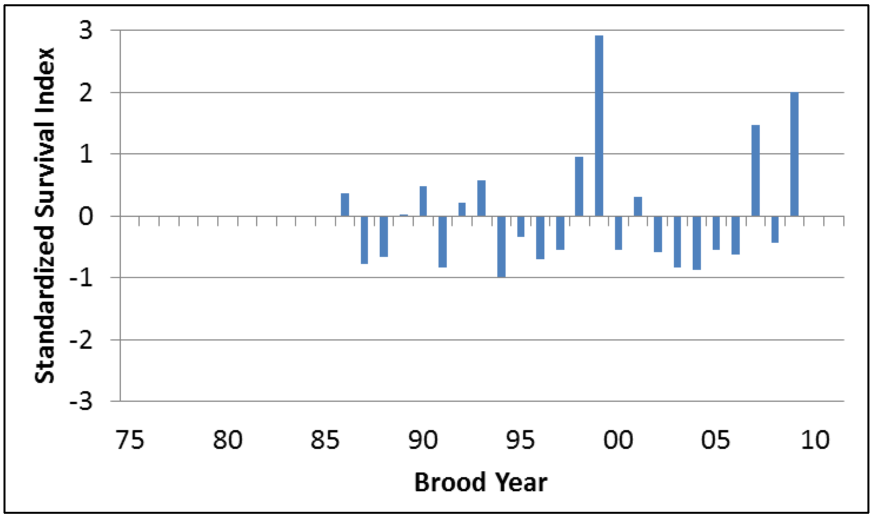

Figure 3.44.–Marine survival index (standardized to a mean of zero) for Columbia Upriver Bright Chinook salmon, as represented by Hanford Reach Wild Chinook salmon.

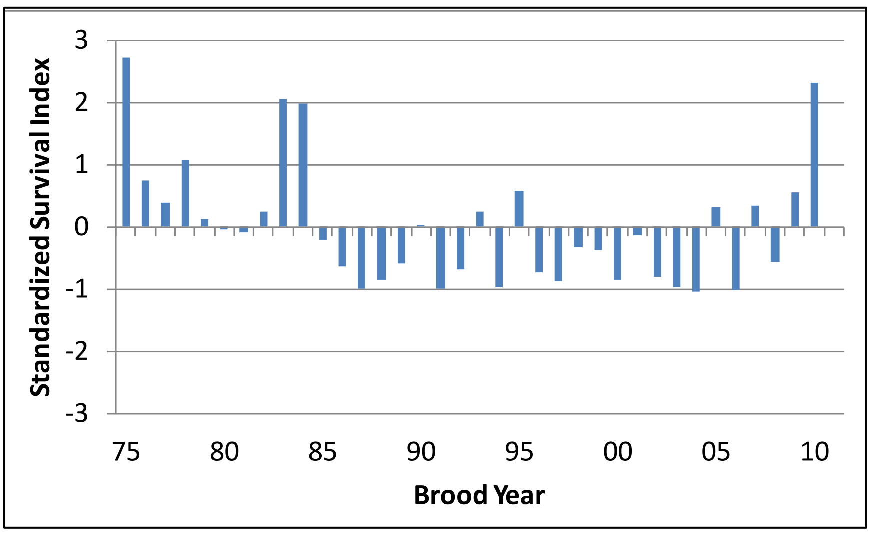

Figure 3.45.–Marine survival index (standardized to a mean of zero) for Columbia Upriver Bright Chinook salmon, as represented by Priest Rapids Hatchery Chinook salmon.

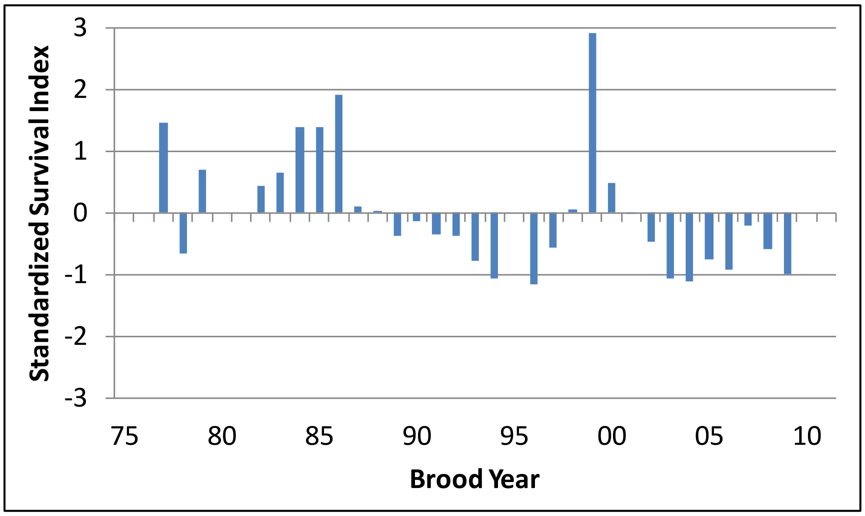

Figure 3.46.–Marine survival index (standardized to a mean of zero) for Lewis River Wild fall Chinook salmon.

3.2.3.4 *Coastal Oregon*

3.2.3.4.1 Oregon Coastal North Migrating

Total estimated spawning escapement for the NOC aggregate stock has ranged from approximately 39,000 in 2008 to 190,000 Chinook salmon in 1988. The 10-year (2004–2013) average for the aggregate escapement is about 86,500 salmon. Estimated escapement in 2013 was 99,500 Chinook salmon. Abundance forecast expressed in terms of spawning escapement is 109,000 Chinook salmon for 2014.

After low escapements from 2007 to 2009, the NOC stock aggregate has returned to above average escapement in 2013. All three NOC escapement indicator stocks—the Nehalem, Siuslaw, and Siletz stocks—failed to achieve their escapement objectives in 2007 and 2008. The Nehalem stock did not attain its goal in 2009 and 2010, but all three escapement indicator stocks exceeded their escapement objectives in 2013 and are forecasted to reach or exceed their objectives in 2014.

Management actions in terminal fisheries, along with reductions in AABM fisheries, and better-than-average survival rates (Figure 3.47) contributed to the increased escapements. Restriction of fishing effort in terminal fisheries, which included closure in the Nehalem River during 2009, have been adopted and maintained through 2012. Many of these restrictions were dropped for the 2013 return year.

The MRE exploitation rates in the synoptic plots (Figure 3.48–Figure 3.50) are based on the exploitation of the Salmon River Hatchery stock, the exploitation indicator stock for the NOC aggregate. Because there is a directed, high-intensity terminal fishery for hatchery-origin fish returning to the Salmon River Hatchery, exploitation on the Salmon River Hatchery stock is more intense than in terminal fisheries for NOC escapement indicator stocks. For that reason, the synoptic plots representing the Nehalem, Siletz and Siuslaw stocks are depictions of worst-case scenarios in regards to exploitation rates. Analysis is ongoing to estimate MRE exploitation rates specific to the NOC escapement indicator stocks as used for other stocks in this report. A scan of the synoptic plots shows that the three NOC escapement indicator stocks have spent most years in the upper left sector. Exploitation rates have been lower and escapements have been higher than required for MSY for the majority of years in each stock. Of the three stocks, the Nehalem stock has spent more years below the escapement objective than the others, and the Siuslaw stock the most years with high exploitation rates. While casual inspection of Figure 3.50 indicates that higher than optimal exploitation rates for the Siuslaw stock occurred about half the time, that judgment should be tempered with the knowledge that those exploitation rates represent a worst-case scenario and are currently being represented by the terminal impacts incurred by the Salmon River CWT indicator stock and not the terminal harvest impacts experienced within the Siuslaw basin.

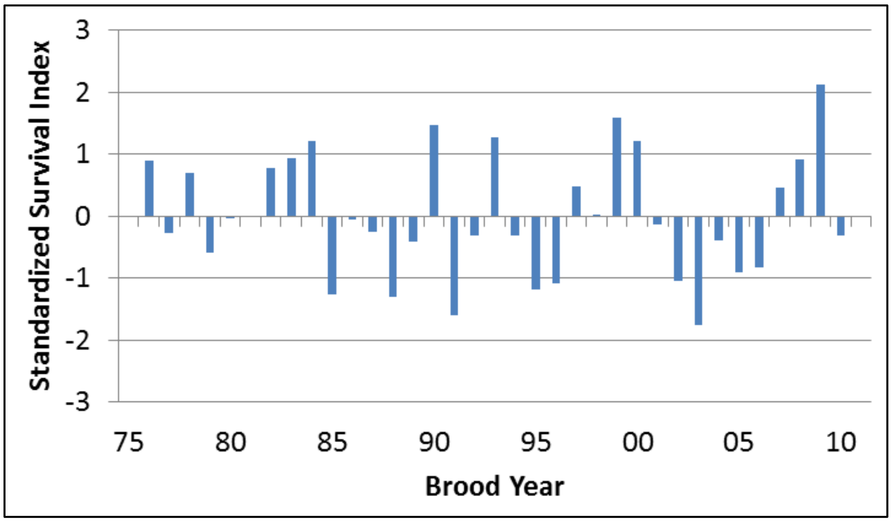

Figure 3.47.–Marine survival index (standardized to a mean of zero) for the Salmon River hatchery stock of Chinook salmon.

Note: Brood years 1976–2010 are shown, with the exception of 1981, for which there is no information.

The Nehalem River stock of Chinook salmon has experienced a wide array of both exploitation and escapement from 1979 to 2012 (Figure 3.48). From 2006 to 2010 this stock failed to meet 85% of its escapement goal (Figure 3.49). Since 2011, escapements have shown an upward trend. Since 2009, the Nehalem River stock of Chinook salmon has been in either the safe or low escapement and low exploitation zones of the synoptic plot in all years. Additional analysis is needed to account for different terminal exploitation experienced between this stock and its model stock counterpart, the Salmon River Hatchery stock.

The Siletz River stock of Chinook salmon exhibit high productivity as demonstrated by one of the higher U_{MSY}s presented in this chapter. Most of the observed points of escapement and exploitation are within the safe zone, in spite of the likelihood that the exploitation rates may overestimate impacts on this stock. Recent year's escapements (2010–2013) have increased over lower escapements observed in return years 2007 to 2009.

The Siuslaw stock of Chinook salmon, similar to the Nehalem stock, has experienced a wide array of both escapement and exploitation since 1979 (Figure 3.50). Most of the observations of escapement below S_{MSY} occurred during the pre-Treaty period of 1979 to 1984. Since 2009, this stock has met or exceeded its escapement goal.

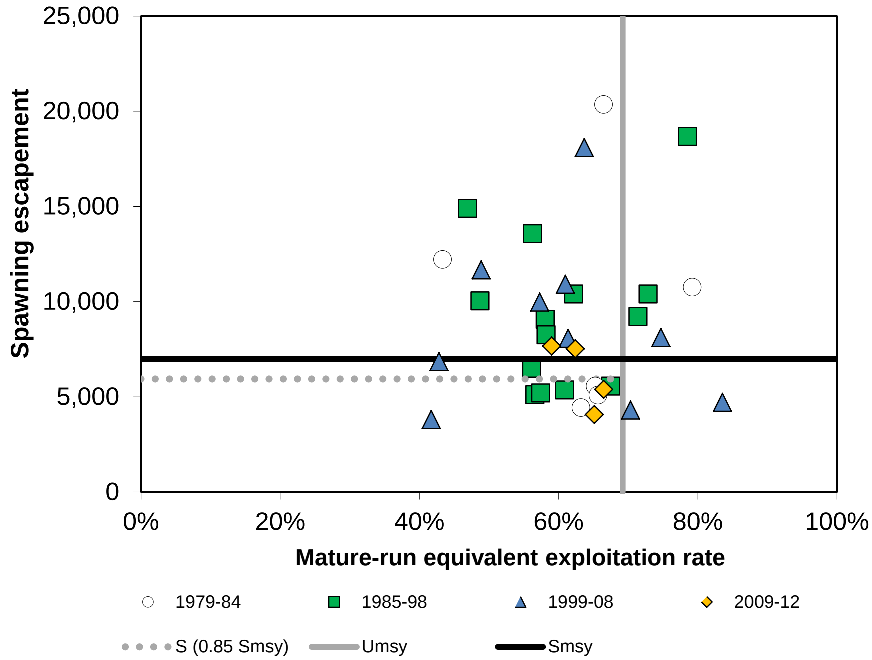

Figure 3.48.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Nehalem River stock of Chinook salmon, 1979–2012.

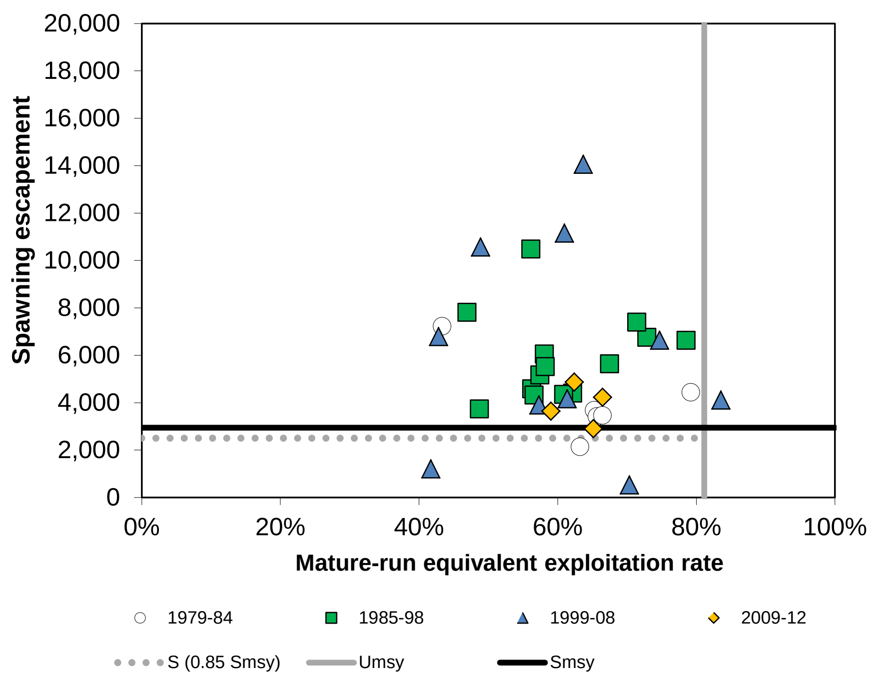

Figure 3.49.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Siletz River stock of Chinook salmon, 1979–2012.

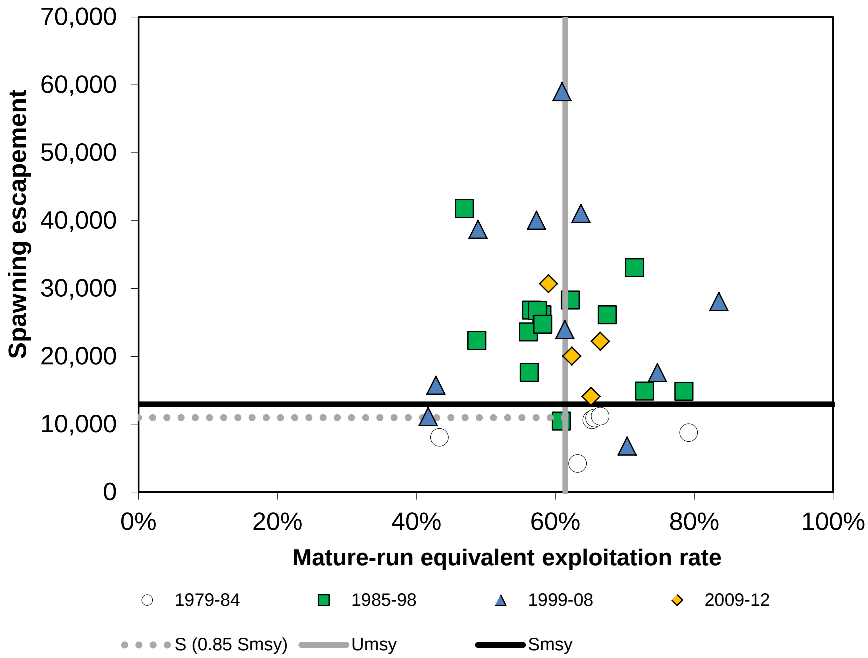

Figure 3.50.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Siuslaw River stock of Chinook salmon, 1979–2012.

3.2.3.4.2 Mid-Oregon Coast

After a period of declines in escapement from 2006 to 2008, the MOC stock aggregate has rebounded to historical averages during the 2010 through 2013 return years. Total aggregated estimated escapement for the MOC has ranged from a low of 11,387 in 2008 to a high of 70,072 in 2011. The 10-year average (2004–2013) escapement for the MOC is about 34,303 Chinook salmon. Estimated escapement in the MOC for 2013 was 31,403 Chinook salmon. Forecasted escapement for the 2014 return year is about 33,639 Chinook salmon. Marine survival rates (Figure 3.51) decreased below average in the most recent year.

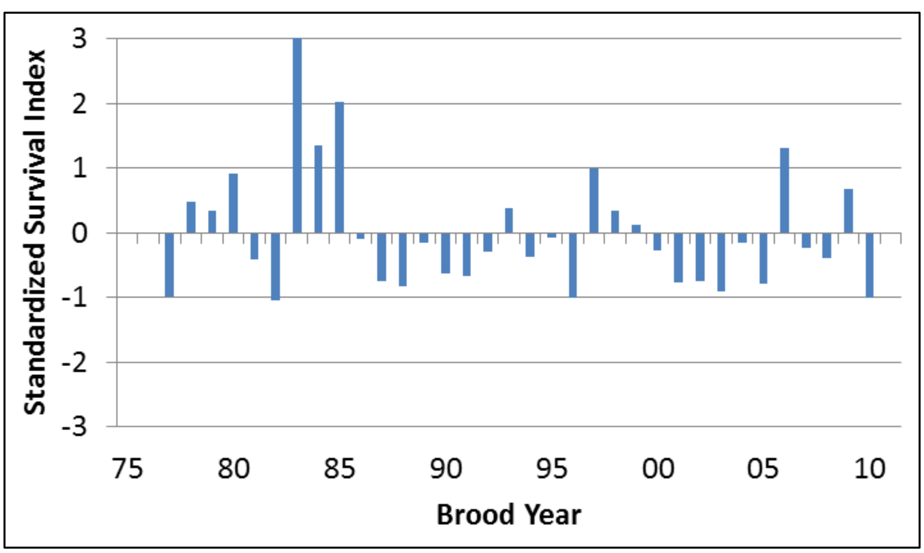

Figure 3.51.–Marine survival index (standardized to a mean of zero) for the Elk River hatchery stock of Chinook salmon.

4 SENTINEL STOCKS PROGRAM

During recent negotiations within the PSC to amend the current Chinook salmon regime under Chapter 3, Annex IV of the PST, it became apparent that the accuracy and precision of spawning escapement estimates for many important natural stocks of Chinook salmon may not be adequate to support the Treaty management process. Reliable estimates of spawning escapements for a large number of natural Chinook salmon stocks over time are critical to assessing and monitoring the status of the resource throughout the Treaty area, as well as to determining whether adjustments to particular fisheries are necessary and effective for achieving the long-term conservation and production goals of the Treaty.

Recognizing the importance of better estimates of Chinook salmon spawning escapements, the Commission conceived the five-year SSP and included it as a specific requirement in the revised Chinook salmon regime (see Paragraph 3(a) of Chapter 3, Annex IV). The SSP is intended to focus on improving spawning escapement estimates for a select subset of important natural Chinook salmon stocks for which existing estimates are critical to fishery management decisions required by the Chinook salmon regime. Improving these estimates will bolster the scientific basis of the Chinook salmon regime, increase confidence in management decisions required under the new regime, and better inform the development of future regimes.

The goal of the SSP is to improve estimates of the spawning escapements for each of the included stocks to a level that meets or exceeds bilateral assessment accuracy and precision standards (CTC 2013, Technical Note 13-01). Twelve projects were funded by the SSP in 2013, the fifth year of the SSP. Synopses for 11 of these 12 projects are included in this section, plus a synopsis of one project funded in 2012. The excluded project was funded in 2013, but by design has yet to produce results. Summaries of all 13 projects are reported in Appendix C.

4.1 Oregon

4.1.1 Nehalem River

The spawning escapement in 2013 was estimated at 15,989 (CV = 12%) using MR methods. Returning adults were captured using nets and weirs and then marked with opercular punches. Subsequent carcass surveys were undertaken to recover marked and unmarked fish from the spawning grounds.

4.1.2 Siletz River

This MR program relied on nets and weirs to capture returning fish in the lower river, which were then marked with opercular punches. Carcasses were examined for marks at the spawning grounds. The preliminary 2013 spawning escapement was estimated at 13,878 Chinook salmon (CV = 13%).

4.2 Puget Sound

Three escapement studies were funded in Puget Sound, all employing Lincoln-Petersen GMR abundance estimators. These programs all generated estimates of escapements for 2012.

4.2.1 Green River

The abundance of Chinook salmon spawning in the Green River in 2012 was estimated using GMR methods. Spawning adults were marked by obtaining a DNA microsatellite profile from tissue sampled from carcasses. Marks were later recaptured by sampling outmigrating smolts (captures) and genetically identifying some fraction of marks as parents of some outmigrating offspring. The preliminary estimate of the number of Chinook salmon spawning upstream of the smolt trap was 4,528 (CV = 8.0%).

4.2.2 Stillaguamish River

The abundance of Chinook salmon spawning in the Stillaguamish River in 2012 was estimated using GMR methods. Spawning adults were marked by obtaining a DNA microsatellite profile from tissue sampled from adult carcasses. Marks were later recaptured by sampling outmigrating smolts (captures) and genetically identifying some fraction of marks as parents of some outmigrating offspring. The preliminary GMR results include corrections for unmarked hatchery juveniles; no yearling smolts were observed. The preliminary estimate of Chinook salmon spawner abundance is 1,750 (CV = 6.6%).

4.2.3 Snohomish River

The abundance of Chinook salmon spawning in the Skykomish and Snoqualmie rivers in 2012 were estimated using GMR techniques. As with other Puget Sound rivers, spawning adults from both the Skykomish and Snoqualmie rivers were marked by obtaining DNA microsatellite profiles from tissue sampled from adult carcasses (first sampling event). Marks were later recaptured by sampling outmigrating subyearling smolt the following spring (second sampling event) and genetically identifying some fraction of marks as parents of some outmigrating offspring. Preliminary unadjusted estimates of Chinook salmon spawner abundance for areas upstream of each smolt trap were 5,335 Chinook salmon spawning in the Skykomish River (CV = 14%) and 2,428 Chinook salmon spawning in the Snoqualmie River (CV = 13%). Performance standards for the Snohomish escapement were met in 2012 with an overall estimate of 7,763 Chinook salmon (CV = 13%).

4.3 West Coast Vancouver Island

4.3.1 Burman River

The Burman River project estimated spawning escapement (8,275 Chinook salmon; CV = 11%) using open population MR methods. The study applied 1,358 tags and had encounter histories for 807 live fish (adult males, females, and jacks). Returning fish were captured with beach seines in the lower river and then tagged and released. Carcasses were recovered upstream at the spawning grounds (C = 608) and examined for tags (R = 57). Chinook salmon escapement (8,131) was also estimated using 14 snorkel surveys and AUC methods. Survey life was estimated from five tag groups using visual tag depletion curves (mean = 5.9 d; SD = 3.5 d, n = 1212), but no corrections for observer efficiency. This estimate is close to the normative estimate of 8,285 developed from 10 snorkel surveys, self-reported observer efficiencies, and an assumed survey life of eight days.

4.3.2 Marble, Sarita, and Tranquil Rivers

This project was conducted to estimate survey life of Chinook salmon entering survey areas and to estimate observer efficiency of swimmers counting fish as a means to improve AUC estimates of spawner abundance. These empirical data were used to develop improved AUC estimates of Chinook salmon spawner abundance while normative procedures were used to generate AUC estimates as provided to the CTC. The estimated mean survey life of Chinook salmon was 35 days (SD = 9 d, n = 19) in the Marble River, 17.2 days (SD = 8.9 d, n = 82) in the Sarita River, and 17.5 days (SD = 3.4 d, n = 24) in the Tranquil River. Estimates of observer efficiency ranged from 27% to 100% in the Marble River, from 67% to 100% in the Tranquil River and from 19% to 33% in the Sarita River. The AUC estimates using measured survey life and observer efficiency at Marble (2,240), Sarita (824), and Tranquil rivers (4,220) exceeded the normative AUC estimates provided to the CTC for Marble (2,080), Sarita (684) and Tranquil rivers (1,432).

4.3.3 WCVI Statistical Framework to Assess Chinook Salmon Escapement

A Canadian Science Advisory Secretariat Centres for Science Advice–Pacific workshop during June 2013 (1) evaluated the escapement estimation methodology used to evaluate the abundance of WCVI extensive indicator stocks relative to escapement targets, and (2) recommended methods for estimating an annual aggregate escapement or appropriate surrogate for the entire management unit. This review concluded that the current application of the method to estimate stream escapement does not provide estimates of uncertainty. Several sources of uncertainty and bias were identified, including the estimation of observer efficiency, survey life, the frequency of site visits and the identification of peak counts. Approaches for investigating the sensitivity of the estimates of escapement to these biases, as well as approaches for the evaluation of the bias and the development of correction factors were identified. Refinements of the AUC and maximum likelihood estimation models, data inputs, and further development of both estimation models, as well as thorough documentation of protocols and analytical methods, are recommended. Given the further analysis and revisions required to provide advice on the validity of the current visual survey method, it was recommended that these initiatives be completed and the technical document resubmitted for peer review.

4.4 Fraser River

4.4.1 South Thompson River

Spawning escapement to the South Thompson age-0.3 aggregate was estimated using a combination of genetic, scale age, and CWT information collected from the Northern British Columbia troll fishery and Albion (Fraser River) gillnet test fishery, along with CWT information collected at the Lower and Middle Shuswap rivers. A Bayesian estimation model was used to estimate escapement while considering uncertainty in these information sources. For 2012, the estimate of Chinook salmon total spawner abundance for age-3 and older was 58,167 (CV = 73%) using data from the Fraser River gillnet test fisheries (Albion and Qualark), 74,073 (CV = 100%) using data from the NBC troll fishery, and 83,745 (CV = 152%), using both data sets. For 2013, genetic samples collected at Albion and Qualark are being processed, and analyses to estimate the aggregate escapement are expected to commence in late May 2014. The 2013 escapement will be reported in next year's CTC Catch and Escapement report.

4.4.2 Chilko River

The 2013 escapement of Chinook salmon to the Chilko River (3,971, CV = 5%) was estimated using a two-event MR study. Petersen tags and sex-specific secondary marks were applied to returning salmon and recovery sampling was undertaken on carcasses. Work is ongoing to generate an appropriately stratified estimate of the female escapement using the Maximum Likelihood Darroch estimator, and the escapement will likely increase slightly once the estimate has been generated.

4.5 Northern British Columbia

4.5.1 Skeena River

The escapement of summer timed Chinook salmon to the Skeena River in 2013 was estimated at 39,179 fish (CV = 12%). Genetic analysis of representative samples collected at the Tyee test fishery and the spawning abundance in the Kitsumkalum River were used to generate the estimate. The SSP funded the genetic analysis of the test fishery samples to identify fish originating from the Kitsumkalum River. The Kitsumkalum Chinook salmon escapement was estimated from an independent MR project. The Kitsumkalum escapement estimate was expanded to an estimate for the aggregate of Skeena River summer timed Chinook salmon using the proportion of Chinook salmon identified as Kitsumkalum stock in the Tyee Test fishery catch. This methodology was used to create a new time series of Skeena River escapement estimates, with measures of precision, for 1984 to 2013 using genetic analysis of archived scales from the test fishery and past MR studies on the Kitsumkalum River.

4.5.2 Nass River

This SSP project was part of a larger basinwide escapement program where Chinook salmon were captured and tagged at fishwheels in the lower Nass River and then recovered and examined for marks at upstream tributaries to generate a MR estimate. The SSP partly funded fishwheel operations and funded the operation of a counting fence on the Kwinageese River and carcass surveys on Damdochax Creek. The total run above the Gitwinkslhlkw fishwheels was estimated to be 8,298 Chinook salmon (CV = 8%); 287 Chinook salmon were harvested above Grease Harbor and the spawning escapement above the Gitwinkslhlkw fishwheels was estimated to be 8,011 Chinook salmon—the lowest return recorded since the fishwheel program began in 1992.

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APPENDICES

APPENDIX A. LANDED CHINOOK SALMON CATCHES BY REGION AND GEAR, 1975–2013

Appendix A.1.–Southeast Alaska AABM Chinook salmon catches.

Year	Southeast Alaska						
	Troll	Net	Sport	Total	Add-on	Terminal Exclusion	Treaty Catch
1975	287,342	13,365	17,000	317,707	NA	NA	NA
1976	231,239	10,523	17,000	258,762	NA	NA	NA
1977	271,735	13,443	17,000	302,178	NA	NA	NA
1978	375,919	25,492	17,000	418,411	NA	NA	NA
1979	337,672	28,388	16,581	382,641	NA	NA	NA
1980	303,643	20,114	20,213	343,970	NA	NA	NA
1981	248,782	18,952	21,300	289,034	NA	NA	NA
1982	241,938	46,992	25,756	314,686	NA	NA	NA
1983	269,821	19,516	22,321	311,658	NA	NA	NA
1984	235,622	32,405	22,050	290,077	NA	NA	NA
1985	215,811	33,870	24,858	274,539	6,246	NA	268,293
1986	237,703	22,099	22,551	282,353	11,091	NA	271,262
1987	242,562	15,532	24,324	282,418	17,095	NA	265,323
1988	231,364	21,788	26,160	279,312	22,525	NA	256,787
1989	235,716	24,245	31,071	291,032	21,510	NA	269,522
1990	287,939	27,712	51,218	366,869	45,873	NA	320,996
1991	264,106	34,864	60,492	359,462	61,476	NA	297,986
1992	183,759	32,140	42,892	258,791	36,811	NA	221,980
1993	226,866	27,991	49,246	304,103	32,910	NA	271,193
1994	186,331	35,654	42,365	264,350	29,185	NA	235,165
1995	138,117	47,955	49,667	235,739	58,800	NA	176,939
1996	141,452	37,298	57,509	236,259	72,599	8,663	154,997
1997	246,409	25,069	71,524	343,002	46,463	9,843	286,696
1998	192,066	23,514	55,013	270,593	25,021	2,420	243,152
1999	146,219	32,720	72,081	251,020	47,725	4,453	198,842
2000	158,717	41,400	63,173	263,290	74,316	2,481	186,493
2001	153,280	40,163	72,291	265,734	77,287	1,528	186,919
2002	325,308	31,689	69,537	426,534	68,164	1,237	357,133
2003	330,692	39,374	69,370	439,436	57,228	2,056	380,152
2004	354,658	64,038	80,572	499,268	75,955	6,295	417,019
2005	338,451	68,091	86,575	493,117	64,826	40,154	388,137
2006	282,315	67,396	85,794	435,505	48,893	27,047	359,566
2007	268,146	53,644	82,849	404,639	68,891	8,051	327,697
2008	151,936	43,029	49,265	244,230	66,616	5,273	172,341
2009	175,644	48,465	69,565	293,674	62,407	3,733	227,533
2010	195,614	30,582	58,503	284,699	53,949	500	230,250
2011	242,193	48,220	66,576	356,989	65,954	739	290,297
2012	209,036	39,491	46,495	295,022	51,882	1,106	242,034
2013[1]	149,615	51,325	45,787	246,727	62,570	266	183,891

Note: Troll, net, sport and total catches include catch of SEAK hatchery-origin fish and terminal exclusion catch; catches that count towards the all-gear ceiling (with hatchery add-on and terminal exclusion subtracted) are shown in the treaty catch column.

Note: NA = not applicable.

[1] Preliminary value until sport mail-out survey results are available.

Appendix A.2.–Estimates of incidental mortality associated with Southeast Alaska AABM Chinook salmon treaty catches.

Year	Troll		Sport		Net		Total Treaty
	LIM	SIM	LIM	SIM	LIM	SIM	IM
1985	15,319	79,828	2,397	3,413	6,545	41,606	149,107
1986	21,169	63,137	1,982	2,823	6,880	25,268	121,259
1987	35,097	66,688	2,112	3,007	1,142	10,730	118,776
1988	11,997	34,995	2,315	3,297	6,563	15,046	74,213
1989	24,573	47,841	2,788	3,970	7,305	32,912	119,390
1990	20,490	49,423	4,494	15,554	3,401	16,562	109,925
1991	22,633	41,165	2,831	5,292	3,605	18,803	94,330
1992	24,737	43,468	4,832	7,129	24,728	103,344	208,238
1993	20,148	44,953	4,277	5,979	2,580	12,194	90,131
1994	24,611	45,623	2,747	6,051	8,937	39,091	127,060
1995	13,745	29,666	3,020	5,291	3,440	12,441	67,602
1996	14,576	27,280	3,404	4,242	221	427	50,149
1997	11,452	25,423	6,768	6,219	729	3,049	53,640
1998	5,791	11,728	4,479	5,246	1,173	6,860	35,278
1999	16,517	15,618	5,924	8,835	514	2,357	49,764
2000	9,746	19,040	4,525	5,593	222	536	39,661
2001	11,020	24,406	5,633	5,993	426	1,621	49,100
2002	8,440	33,248	5,690	6,089	249	1,429	55,145
2003	10,678	20,196	5,147	6,804	415	9,232	52,471
2004	14,061	15,482	7,060	7,233	4,901	4,177	52,913
2005	11,909	13,951	5,778	9,298	142	4,768	45,846
2006	10,251	17,280	6,094	8,688	221	5,373	47,907
2007	10,623	21,656	5,234	8,816	4,107	20,919	71,355
2008	11,711	16,571	4,591	4,669	241	287	38,070
2009	11,617	18,349	4,799	6,410	136	3,579	44,890
2010	12,756	16,929	3,743	4,545	143	260	38,376
2011	10,389	14,800	6,147	7,234	374	2,622	41,567
2012	7,311	22,773	3,691	4,932	1,397	5,664	45,769
2013[1]	14,579	14,948	3,465	4,630	3,023	12,001	52,647

[1] Preliminary estimates for Sport IM and Total IM. Legal dropoffs in sport retention fishery estimated from creel estimate while all other IM for the Southeast Alaska sport fishery is estimated from the preliminary LC and the previous year IM to LC ratios. Final estimates are available from mail-out surveys in October one year postfishing season and will be reported in this appendix in the next annual catch and escapement Report.

Appendix A.3.–Estimates of incidental mortality associated with Southeast Alaska Chinook salmon total catches.

Year	Troll		Sport		Net		Total
	LIM	SIM	LIM	SIM	LIM	SIM	IM[1]
1985	15,584	81,237	2,587	3,684	6,575	41,746	151,412
1986	21,690	64,744	2,346	3,342	7,224	26,491	125,837
1987	36,565	69,648	2,531	3,604	1,200	11,058	124,607
1988	12,502	36,744	2,722	3,876	6,813	15,442	78,100
1989	25,226	49,392	3,233	4,604	8,785	39,395	130,636
1990	21,761	53,067	5,565	19,262	4,499	21,260	125,414
1991	23,659	43,731	3,794	7,092	4,548	22,738	105,561
1992	25,574	45,574	5,863	8,651	26,524	110,309	222,497
1993	20,758	46,882	4,935	6,899	3,353	15,090	97,917
1994	25,489	47,395	3,281	7,228	10,987	47,326	141,706
1995	15,106	33,534	4,225	7,403	7,970	29,946	98,184
1996	15,502	30,411	5,022	6,259	1,349	4,968	63,512
1997	11,829	26,906	9,082	8,345	1,737	7,536	65,434
1998	5,939	12,211	5,322	6,233	2,013	11,680	43,398
1999	17,101	16,419	8,033	11,980	1,419	7,068	62,021
2000	10,483	21,726	6,898	8,526	828	2,675	51,136
2001	11,668	27,697	9,105	9,686	1,383	6,027	65,566
2002	8,787	35,345	8,695	9,305	573	4,116	66,822
2003	11,085	21,501	7,252	9,585	711	12,642	62,776
2004	14,742	16,618	10,266	10,516	6,959	5,776	64,878
2005	12,572	15,151	7,919	12,742	964	7,148	56,498
2006	10,619	18,178	7,552	10,766	849	8,636	56,600
2007	11,136	23,598	6,975	11,749	6,828	33,435	93,720
2008	12,336	18,551	6,963	7,081	734	1,102	46,768
2009	12,141	19,722	6,964	9,302	389	7,498	56,016
2010	13,236	17,991	4,956	6,018	501	1,243	43,945
2011	10,783	15,769	7,580	8,921	1,104	7,325	51,482
2012	7,631	24,603	4,565	6,099	4,432	18,192	65,522
2013[2]	15,073	15,704	4,495	6,006	10,506	41,354	93,138

[1] Includes total treaty, terminal exclusion, and hatchery add-on estimates of incidental mortality.

[2] Preliminary estimates for Sport IM and Total IM. Legal dropoffs in sport retention fishery estimated from creel estimate while all other IM for the Southeast Alaska sport fishery is estimated from the preliminary LC and the previous year IM to LC ratios. Final estimates are available from mail out surveys in October one year postfishing season and will be reported in this appendix in the next annual catch and escapement Report.

Appendix A.4.–Canadian Transboundary Rivers (Taku, Stikine, Alsek) ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

	Transboundary Rivers											
	First Nations			Net			Sport			Total		
Year	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	1,024		47	178		8	0			1,202		
1976	1,074		49	236			200			1,510		
1977	450		21	62			300			812		
1978	750		35	100			300			1,150		
1979	2,150		99	872			734			3,756		
1980	822		38	1,869			354			3,045		
1981	736		34	977			556			2,269		
1982	1,018		47	1,823			429			3,270		
1983	1,375		63	1,553			355			3,283		
1984	802		37	515			569			1,886		
1985	1,066		49	759			654			2,479		
1986	1,707		79	1,668			570			3,945		
1987	1,491		69	1,512			823			3,826		
1988	1,445		66	2,170			780			4,395		
1989	1,433		66	2,799			722			4,954		
1990	1,094		50	3,703			1,001			5,798		
1991	1,572		72	2,717			834			5,123		
1992	1,311		60	2,629			608			4,548		
1993	1,248		57	2,830			909			4,987		
1994	1,297		60	3,551			744			5,592		
1995	1,464		67	3,567			1,465			6,496		
1996	1,389		64	5,489			1,134			8,012		
1997	1,584		73	6,336			811			8,731		
1998	864		40	3,288			662			4,814		
1999	1,516		70	4,117			662			6,295		
2000	1,616		74	3,882			633			6,131		
2001	954		44	2,461			659			4,074		
2002	1,450		67	2,499			963			4,912		
2003	1,659		76	3,839			651			6,149		
2004	2,454		113	6,969			455			9,878		
2005	952	0	44	20,334	-	935	323	0	22	21,609		1001
2006	962	0	44	17,076	-	785	243	0	17	18,281	-	847
2007	781	0	36	14,715	-	539	145	0	10	15,641	-	585
2008	920	0	42	10,831	-	498	327	0	23	12,078	-	563
2009	940	0	43	10,031	510	944	140	0	10	11,111	510	997
2010	1,090	0	50	9,410	124	550	247	0	17	10,747	124	617
2011	999	0	46	7,769	158	570	299	275	73	9,067	433	690
2012	764	0	35	9,119	63	513	254	367	88	10,137	430	636
2013	1,454	0	67	4,858	38	283	160	197	49	6,472	235	399

Appendix A.5.–Northern British Columbia (NBC) AABM Chinook salmon catches.

Year	Northern British Columbia		
	Area 1-5 Troll[1,2]	Areas 1,2E, 2W Sport	Total
1975	228,121	0	228,121
1976	190,267	0	190,267
1977	130,899	106	131,005
1978	146,054	125	146,179
1979	147,576	0	147,576
1980	157,198	200	157,398
1981	153,065	184	153,249
1982	173,472	215	173,687
1983	162,837	90	162,927
1984	185,134	171	185,305
1985	165,845	600	166,445
1986	175,715	1,153	176,868
1987	177,457	2,644	180,101
1988	152,369	7,059	159,428
1989	207,679	20,652	228,331
1990	154,109	16,827	170,936
1991	194,018	15,047	209,065
1992	142,340	21,358	163,698
1993	161,686	25,297	186,983
1994	164,581	28,973	193,554
1995	56,857	22,531	79,388
1996	8	670	678
1997	83,261	27,738	110,999
1998	109,072	34,130	143,202
1999	54,097	30,227	84,324
2000	9,948	22,100	32,048
2001	12,934	30,400	43,334
2002	102,731	47,100	149,831
2003	140,497	54,300	194,797
2004	167,508	74,000	241,508
2005	174,806	68,800	243,606
2006	151,485	64,500	215,985
2007	83,235	61,000	144,235
2008	52,147	43,500	95,647
2009	75,470	34,000	109,470
2010	90,213	46,400	136,613
2011	74,660	48,000	122,660
2012	80,257	40,050	120,307
2013	69,264	46,650	115,914

[1] Since 1998, the catch accounting year for troll fisheries was set from October 1 to September 30. To make comparisons to previous years more meaningful, the same catch accounting period was applied for years prior to 1998.

[2] Troll catches from 1996 to 2004 have been updated with data from CDFO (2009).

[3] Note that troll (Areas 1–5) and tidal sport (Areas 1, 2E, 2W) are the components of the Northern British Columbia aggregate abundance-based management fishery.

Appendix A.6.–Estimates of incidental mortality associated with Northern British Columbia (NBC) AABM Chinook salmon catches.

Year	Area 1-5 Troll[1]		Areas 1, 2E, 2W Sport		Total
	LIM	SIM	LIM	SIM	IM
1985	2,819	12,405	97	0	15,321
1986	2,987	19,637	204	0	22,828
1987	4,307	40,626	535	0	45,468
1988	4,829	40,749	1,505	0	47,083
1989	3,740	35,135	4,068	0	42,943
1990	5,195	46,172	3,248	0	54,615
1991	4,385	43,848	2,734	0	50,967
1992	4,985	49,332	3,634	0	57,951
1993	4,444	36,696	4,353	0	45,493
1994	3,709	27,882	4,524	0	36,115
1995	3,721	26,123	2,935	0	32,779
1996[2]	0	0	2,562	0	2,562
1997[2]	1,415	0	6,021	0	7,436
1998[2]	1,854	0	6,102	0	7,956
1999	920	674	3,605	0	5,199
2000	169	147	4,707	0	5,023
2001	376	276	5,955	0	6,607
2002	2,778	1,083	8,417	0	12,278
2003	4,772	740	9,519	0	15,031
2004	9,336	1,225	21,237	0	31,798
2005	7,896	446	12,221	0	20,563
2006	3,300	3,958	7,503	0	14,761
2007	2,282	3,771	7,870	0	13,923
2008	1,321	1,748	3,266	0	6,335
2009	2,069	3,625	4,011	0	9,705
2010	2,798	3,164	6,777	0	12,739
2011	7,732	1,773	9,114	0	18,619
2012	2,152	4,427	4,977	0	11,556
2013	7,236	3,390	9,300	0	19,926

Note: Troll (Areas 1–5) and tidal sport (Areas 1, 2E, 2W) are the components of the Northern British Columbia aggregate abundance-based management fishery.

[1] Since 1998, the catch accounting year for troll fisheries was set from October 1 to September 30. To make comparisons to previous years more meaningful, the same catch accounting period was applied for years prior to 1998.

[2] Release data are not yet available for 1996 to 1998.

Appendix A.7.–Northern British Columbia (NBC) ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

	Area 1–5 First Nations			Area 1–5 Net			Tyee Test Fishery			Area 3–5 Sport			Area 1–5 Freshwater Sport			Total		
Year	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	4,055		187	24,786		1,140	309		14	0		0	0		0	29,150		1,341
1976	2,791		128	15,849		729	256		12	0		0	0		0	18,896		869
1977	6,998		322	43,926		2,021	270		12	1,670		60	2,158		149	55,022		2,564
1978	5,363		247	27,731		1,276	193		9	1,668		60	6,610		456	41,565		2,048
1979	5,266		242	40,208		1,850	432		20	2,523		91	1,960		135	50,389		2,338
1980	10,121		466	26,612		1,224	283		13	3,867		139	4,515		312	45,398		2,154
1981	11,115		511	41,379		1,903	345		16	2,760		99	2,613		180	58,212		2,709
1982	13,255		610	44,844		2,063	243		11	3,760		135	2,726		188	64,828		3,007
1983	15,532		714	16,752		771	362		17	4,092		147	5,374		371	42,112		2,020
1984	11,408		525	31,072		1,429	587		27	2,300		83	3,426		236	48,793		2,300
1985	15,794		727	39,543		1,819	545		25	3,600		130	3,186		220	62,668		2,921
1986	24,448		1,125	23,902		1,099	752		35	3,950		142	4,410		304	57,462		2,705
1987	16,329		751	17,494		805	725		33	4,150		149	3,625		250	42,323		1,988
1988	21,727		999	30,620		1,409	740		34	4,300		155	3,745		258	61,132		2,855
1989	21,023		967	38,403		1,767	653		30	4,150		149	5,247		362	69,476		3,275
1990	27,105		1,247	28,220		1,298	651		30	4,300		155	4,090		282	64,366		3,012
1991	23,441		1,078	40,782		1,876	591		27	4,256		153	4,764		329	73,834		3,463
1992	27,012		1,243	35,057		1,613	554		25	6,250		225	6,182		427	75,055		3,533
1993	21,353		982	33,351		1,534	776		36	3,279		118	7,813		539	66,572		3,209
1994	15,949		734	21,691		998	521		24	3,171		114	3,093		213	44,425		2,083
1995	13,635		627	17,629		811	464		21	2,475		89	3,503		242	37,706		1,790

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Year	Area 1–5 First Nations			Area 1–5 Net			Tyee Test Fishery			Area 3–5 Sport			Area 1–5 Freshwater Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1996	13,345		614	26,935		1,239	2,178		100	3,382		122	1,250		86	47,090	0	2,161
1997	14,610		672	18,749		862	1,578		73	0		0	0			34,937	0	1,607
1998	20,622		949	5,790		266	1,338		62	4,750		171	0			32,500	0	1,448
1999	27,399		1,260	8,123		374	2,135		98	11,700		421	0			49,357	0	2,153
2000	23,476		1,080	19,464		895	3,004		138	8,600		310	0			54,544	0	2,423
2001	23,508		1,081	22,580			2,953		136	11,000		396	0			60,041	0	1,613
2002	14,125		650	13,554		623	1,413		65	8,000		288	0			37,092	0	1,626
2003	20,950		964	13,094		602	1,636		75	8,000		288	5,711		394	49,391	0	1,929
2004	20,548		945	15,198		699	995		46	8,000		288	0			44,741	0	1,978
2005	17,553	NA	807	5,416	5,502	4,368	1,136	NA	52	8,000	0	288	0			32,105	5,502	5,515
2006	17,262	NA	794	10,571	9,904	7,968	1,178	NA	54	8,000	0	288	0			37,011	9,904	9,104
2007	14,087	NA	648	9,520	10,273	8,011	1,302	NA	60	8,000	0	288	0			32,909	10,273	9,007
2008	14,963	NA	688	4,619	3,359	2,829	1,293	NA	59	11,970	1,643	460	0			32,845	5,002	4,036
2009	13,083	NA	602	4,348	2,003	1,642	1,189	NA	55	9,177	1,703	601	0			27,797	3,706	2,900
2010	13,693	NA	630	2,191	0	101	959	NA	44	7,570	563	362	2,689	NA	186	27,102	563	1,323
2011	10,863	NA	500	3,586	0	165	976	NA	45	14,677	2,246	885	2,540	NA	175	32,642	2,246	1,770
2012	8,189	NA	377	788	3,067	2,661	575	NA	26	7,017	0	253	421	NA	29	16,990	3,067	3,346
2013	8,557	NA	394	2,126	3,163	2,739	547		25	10,259	560	458	2,024	958	324	23,513	4,681	3,548

Appendix A.8.–Central British Columbia ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

	Central British Columbia																	
	First Nations			Net[1]			Troll[1,2]			Tidal Sport[3]			Freshwater Sport			Total		
Year	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	NA			40,985			135,470			NA			NA			176,455		
1976	NA			32,669			145,204			NA			NA			177,873		
1977	6,972			32,409			122,689			4,773			1,544			168,387		
1978	7,944			35,708			91,025			5,694			1,770			142,141		
1979	7,585			50,445			107,884			5,225			1,940			173,079		
1980	6,240			27,715			95,377			4,802			988			135,122		
1981	5,701			18,912			69,247			3,490			1,261			98,611		
1982	9,112			32,419			69,748			5,419			1,293			117,991		
1983	6,442			12,556			97,447			4,271			821			121,537		
1984	9,736			4,630			78,120			4,354			1,332			98,172		
1985	6,019			12,391			27,090			3,943			823			50,266		
1986	6,353			23,032			54,407			4,566			1,245			89,603		
1987	6,296			10,893			65,776			3,933			1,563			88,461		
1988	6,000			12,886			36,125			3,596			1,496			60,103		
1989	8,992			6,599			21,694			3,438			4,526			45,249		
1990	9,811			18,630			29,882			4,053			5,626			68,002		
1991	8,801			15,926			29,843			4,409			3,335			62,314		
1992	8,533			18,337			47,868			4,891			3,204			82,833		
1993	9,095			10,579			23,376			6,114			2,880			52,044		
1994	5,383			14,424			18,976			4,303			973			44,059		
1995	3,501			11,007			5,819			2,172			1,180			23,679		

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Year	Central British Columbia																	
	First Nations			Net[1]			Troll[1,2]			Tidal Sport[3]			Freshwater Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1996	6,922			7,201			0			2,936			3,986			21,045		
1997	9,764			3,650			9,274			8,524			1,139			32,351		
1998	6,671			5,467			2,188			5,514			779			20,619		
1999	5,440			4,342			2,073			10,300			NA			22,155		
2000	4,576			3,197			0			7,400			NA			15,173		
2001	5,435			6,465			482			7,650			1,024			21,056		
2002	3,292			4,676			0			7,330			723			16,021		
2003	3,173			2,815			0			8,385	146	325	491			14,864	146	325
2004	4,003			5,404			0			10,677	77	397	524			20,608	77	397
2005	4,180		192	6,323	15,281	11,298	0		0	9,017	302	373	809		56	20,329	15,583	11,919
2006	4,013		185	5,231	1,391	1,247	0	786	160	9,400	428	406	NA		60	18,644	2,605	2,058
2007	2,102		97	5,542	5,349	4,106	0	1,804	371	6,130	118	239	522	20	40	14,296	7,291	4,853
2008	3,018		139	1,133	181	183	9	757	155	2,909	607	201	276		19	7,345	1,545	697
2009	4,011		185	3,132	0	144	0	0	0	3,239	0	117	0		38	10,382	0	483
2010	3,710		171	1,549	0	71	0	0	0	4,043	0	146	NA		45	9,302	0	432
2011	2,323		107	4,794	0	221	0	0	0	7,701	498	356	646		45	15,464	498	728
2012	1,745		80	3,624	500	533	0	0	0	5,861	0	211	524		36	11,754	500	860
2013	3,945		181	5,301	2,044	1,728	0	430	93	4,457	0	160	1,506	0	104	15,209	2,474	2,267

[1] Troll and net catches from 1996 to 2004 have been updated with data from CDFO (2009), catch excludes jacks and small red-fleshed Chinook salmon.

[2] Since 1998, the catch accounting year for troll fisheries was set from October 1 to September 30. To make comparisons to previous years more meaningful, the same catch accounting period was applied for years prior to 1998.

[3] Freshwater catch included with tidal catch.

Appendix A.9.–West Coast Vancouver Island (WCVI) AABM Chinook salmon catches.

Year	West Coast Vancouver Island AABM		
	Troll[1,2]	AABM Sport[3]	Total
1975	546,214	–	546,214
1976	665,010	–	665,010
1977	545,742	–	545,742
1978	568,705	–	568,705
1979	477,222	–	477,222
1980	486,303	–	486,303
1981	423,266	–	423,266
1982	538,510	–	538,510
1983	395,636	–	395,636
1984	471,294	–	471,294
1985	345,937	–	345,937
1986	350,227	–	350,227
1987	378,931	–	378,931
1988	408,668	–	408,668
1989	203,751	–	203,751
1990	297,858	–	297,858
1991	203,035	–	203,035
1992	340,146	18,518	358,664
1993	277,033	23,312	300,345
1994	150,039	10,313	160,352
1995	81,454	13,956	95,410
1996	4	10,229	10,233
1997	52,688	6,400	59,088
1998	5,140	4,177	9,317
1999	7,434	31,106	38,540
2000	64,547	24,070	88,617
2001	79,668	40,636	120,304
2002	126,383	31,503	157,886
2003	146,736	26,825	173,561
2004	176,166	39,086	215,252
2005	148,798	50,681	199,479
2006	108,978	36,507	145,485
2007	94,291	46,323	140,614
2008	95,170	50,556	145,726
2009	58,191	66,426	124,617
2010	84,123	54,924	139,047
2011	129,023	75,209	204,232
2012[4]	69,054	65,414	134,468
2013	49,526	64,072	113,598

Note: Troll= Areas 21, 23–27, and 121–127; Net = Areas 21, and 23–27; Sport = Areas 23a, 23b, 24–27.

[1] Since 1998, the catch accounting year for troll fisheries was set from October 1 to September 30. The same catch accounting period was applied for years prior to 1998.

[2] Troll catches from 1996 to 2004 have been updated with data from CDFO (2009).

[3] AABM sport catch 1975 to 1991 is under review. No estimate available; it is currently included in ISBM catch in Appendix A.11.

[4] Including 5,000 First Nations troll catch, 1,710 Maanulth Treaty catch and 7,650 T'aaq-wiihak troll catch.

Appendix A.10.–Estimates of incidental mortality (IM) associated with West Coast Vancouver Island (WCVI) AABM Chinook salmon catches.

Year	Troll[1,2]		Outside Sport[3]		Total
	LIM	SIM	LIM	SIM	IM
1985	7,261	102,749			110,010
1986	5,954	66,075			72,029
1987	11,169	148,659			159,828
1988	16,283	169,260			185,543
1989	3,464	63,325			66,789
1990	5,064	91,521			96,585
1991	3,452	84,116			87,568
1992	5,782	95,732			101,514
1993	4,710	84,325	3,078	1,074	93,187
1994	2,551	76,372	1,217	475	80,615
1995	6,622	45,231	1,531	643	54,027
1996[4,5]					
1997[4,5]					
1998[4,5]					
1999[4]	126	432	4,272	17,081	21,911
2000[4]	1,097	2,455	2,626	3,629	9,807
2001[4]	2,321	3,601	4,397	3,271	13,590
2002[4]	3,754	5,329	4,540	1,441	15,064
2003[4]	2,509	6,126	6,297	1,216	16,148
2004[4]	2,995	4,127	5,781	1,053	13,956
2005	2,641	4,088	7,207	878	14,814
2006	2,565	3,031	4,800	1,161	11,557
2007	1,653	3,414	4,343	2,993	12,403
2008	1,631	2,863	6,269	1,549	12,312
2009	1,059	1,653	7,755	5,350	15,817
2010	1,506	1,936	10,679	1,896	16,017
2011	2,281	2,313	9,660	2,751	17,005
2012	1,214	629	10,976	3,571	16,390
2013[6]	852	1,734	10,714	3,306	16,606

Note: Troll = Areas 21, 23–27, and 121–127; Net = Areas 21, and 23–27; Sport = Areas 23a, 23b, 24–27

1 Since 1998, the catch accounting year for troll fisheries was set from October 1 to September 30. The same catch accounting period was applied for years prior to 1998.

2 Troll and net catches from 1996 to 2004 have been updated with data from CDFO, 2009.

3 Prior to 1992, catch was not reported as inside or outside. Therefore inside catch for those years represents total tidal sport catch.

4 First Nations catch is mainly commercial catch 1996–2004 has been updated.

5 Release data are not yet available for 1996–1998.

6 Including 5,000 First Nations troll catch, 1,710 Maanulth Treaty catch and 7,650 T'aaq-wiihak troll catch.

Appendix A.11.–West Coast Vancouver Island (WCVI) ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

	West Coast Vancouver Island ISBM														
	First Nations[1]			Net[2]			Tidal Sport[3]			Freshwater Sport			Total		
Year	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	NA			19,233			NA			NA			19,233	0	0
1976	NA			17,492			NA			NA			17,492	0	0
1977	NA			13,745			NA			NA			13,745	0	0
1978	NA			25,143			NA			NA			25,143	0	0
1979	NA			35,623			7,964			NA			43,587	0	0
1980	NA			34,732			8,539			NA			43,271	0	0
1981	NA			36,411			11,230			NA			47,641	0	0
1982	NA			41,172			17,100			NA			58,272	0	0
1983	NA			37,535			28,000			NA			65,535	0	0
1984	NA			43,792			44,162			NA			87,954	0	0
1985	NA			11,089			21,587			NA			32,676	0	0
1986	NA			3,276			13,158			NA			16,434	0	0
1987	NA			478			38,283			NA			38,761	0	0
1988	NA			15,438			35,820			NA			51,258	0	0
1989	NA			40,321			55,239			NA			95,560	0	0
1990	1,199		55	29,578			69,723			NA			188,102	0	55
1991	41,322		1,901	60,797			85,983			NA			64,769	0	1,901
1992	8,315		382	9,486			46,968	28,322	8,679	NA			99,376	28,322	9,061
1993	5,078		234	28,694			65,604	37,263	11,681	NA			56,410	37,263	11,915
1994	1,515		70	2,369			52,526	26,000	8,616	NA			28,001	26,000	8,686
1995	5,868		270	458			21,675	9,797	3,377	NA			2,324	9,797	3,647

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Year	West Coast Vancouver Island ISBM														
	First Nations[1]			Net[2]			Tidal Sport[3]			Freshwater Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1996	–			58			2,266	1,096	367	NA			2,324	1,096	367
1997	5,726		263	208			47,355	24,667	8,004	NA			53,289	24,667	8,267
1998	7,172		330	345			55,697	28,552	9,325	NA			63,214	28,552	9,655
1999	3,591		165	112			47,163	11,319	5,428	NA			50,866	11,319	5,593
2000	–			126			5,443	13,954	3,055	NA			5,569	13,954	3,055
2001	–			11			6,354	10,684	2,490	6,198			12,563	10,684	2,490
2002	10,893		501	260			36,073	14,629	5,298	77			47,303	14,629	5,799
2003	10,000		460	9,251			51,186	25,341	8,397	NA			70,437	25,341	8,857
2004	16,696		726	12,348			61,218	29,852	9,956	26			89,381	29,852	10,682
2005	35,000		1,610	23,599	354	4,687	43,577	9,534	4,837	6,225		430	108,401	9,888	11,564
2006	28,628		1,239	20,308	228	2,584	44,025	9,638	4,888	NA		0	92,961	9,866	8,711
2007	20,098		925	26,881	88	4,031	39,368	12,060	5,032	NA		0	86,347	12,148	9,987
2008	12,159		559	8,257	2	2,677	24,855	8,914	3,426	NA		0	45,271	8,916	6,663
2009	9,026		415	9,765	0	2,201	31,921	16,641	5,398	NA		0	50,712	16,641	8,014
2010	7,485		344	1,747	372	372	24,687	12,721	4,146	NA		0	33,919	13,093	4,862
2011	22,794		1,049	21,843	355	1,337	52,131	15,539	6,581	NA		0	96,768	15,894	8,967
2012	9,700		446	10,214	521	917	25,890	13,047	4,291	NA		0	45,804	13,568	5,654
2013	1,101		51	8,854	259	597	22,272	18,275	5,046	NA		0	32,227	18,534	5,694

[1] First Nations catch is mainly commercial catch, 1996 to 2004 has been updated.

[2] Net catches from 1996 to 2004 have been updated with data from CDFO (2009).

[3] Prior to 1992, catch was not reported as inside or outside. Therefore inside catch for those years represents total tidal sport catch.

Appendix A.12.–Johnstone Strait ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

Year	Johnstone Strait														
	First Nations			Net[1]			Troll[1,2]			Tidal Sport[3]			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	NA			30,295			18,065			NA			48,360	0	0
1976	NA			31,855			30,838			NA			62,693	0	0
1977	NA			49,511			26,868			NA			76,379	0	0
1978	NA			55,148			13,052			NA			68,200	0	0
1979	NA			31,291			13,052			NA			44,343	0	0
1980	NA			30,325			11,743			NA			42,068	0	0
1981	NA			28,620			13,035			NA			41,655	0	0
1982	NA			29,454			11,234			NA			40,688	0	0
1983	NA			28,364			14,653			NA			43,017	0	0
1984	NA			18,361			9,260			NA			27,621	0	0
1985	NA			38,073			3,567			NA			41,640	0	0
1986	NA			17,866			3,951			NA			21,817	0	0
1987	NA			13,863			1,780			NA			15,643	0	0
1988	NA			6,292			1,566			NA			7,858	0	0
1989	NA			29,486			1,825			NA			31,311	0	0
1990	NA			18,433			2,298			NA			20,731	0	0
1991	1,287			15,071			1,228			9,311			26,897	0	0
1992	29			9,571			2,721			15,470			27,791	0	0
1993	20			15,530			4,172			12,679			32,401	0	0
1994	0			8,991			2,231			5,433			16,655	0	0
1995	71			970			4			4,296			5,341	0	0
1996	107			472			0			3,057			3,636	0	0

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Year	Johnstone Strait														
	First Nations			Net[1]			Troll[1,2]			Tidal Sport[3]			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1997	179			1,018			1,246			4,047			6,490	0	0
1998	138			328			2,129			2,710			5,305	0	0
1999	469			472			273			8,985			10,199	0	0
2000	212			280			85			5,960			6,537	0	0
2001	370			332			453			4,150			5,305	0	0
2002	400			569			129			3,696			4,794	0	0
2003	130			306			719			9,851			11,006	0	0
2004	28			525			316			16,131			17,000	0	0
2005	NA	NA	0	291	1,925	1,596	2	0	0	16,076	9,522	2,937	16,369	11,447	4,533
2006	200	NA	9	244	5,304	4,073	0	612	135	10,532	4,526	1,596	10,976	10,442	5,813
2007	200	NA	9	2	331	304	0	293	68	9,882	5,814	1,798	10,084	6,438	2,179
2008	324	NA	15	48	447	325	0	0	0	4,436	3,985	1,071	4,808	4,432	1,411
2009	344	NA	16	597	14	426	0	0	0	11,501	15,984	3,862	12,442	15,998	4,304
2010	250	NA	12	98	2,908	2,278	2	428	101	10,016	9,092	2,437	10,366	12,428	4,827
2011	268	NA	12	46	2,312	1,710	0	36	7	11,934	5,169	1,816	12,248	7,517	3,546
2012	321	NA	15	37	468	346	0	44	9	7,874	7,899	2,060	8,232	8,411	2,429
2013	258	NA	12	35	241	181	0	0	0	8,260	6,710	1,858	8,553	6,951	2,051

Note: Troll = Area 12; Net = Areas 11–13.

Note: Sport: Based on July and August creel census in Area 12 and northern half of Area 13.

[1] Troll and net catches from 1996 to 2004 have been updated with data from CDFO (2009).

[2] Since 1998, the catch accounting year for troll fisheries was set from October 1 to September 30. The same catch accounting period was applied for years prior to 1998.

[3] Tidal sport creel catches include additional catch estimated using Argue et al., 1977.

Appendix A.13.–Georgia Strait ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

	Georgia Strait														
	First Nations			Net[1]			Troll[1,2]			Tidal Sport			Total		
Year	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975							174,001			398,000			572,001	0	0
1976							200,229			490,000			690,229	0	0
1977							248,082			372,000			620,082	0	0
1978							217,955			500,000			717,955	0	0
1979							255,057			350,000			605,057	0	0
1980							273,077			204,100			477,177	0	0
1981							239,266			197,239			436,505	0	0
1982							179,040			124,390			303,430	0	0
1983							105,133			198,433			303,566	0	0
1984							90,280			369,445			459,725	0	0
1985							55,888			234,838			290,726	0	0
1986							44,043			181,896			225,939	0	0
1987							38,084			121,081			159,165	0	0
1988							20,224			119,117			139,341	0	0
1989							28,444			132,846			161,290	0	0
1990							34,304			111,914			146,218	0	0
1991							32,412			115,523			147,935	0	0
1992							37,250			116,581			153,831	0	0
1993							33,293			127,576			160,869	0	0
1994							12,916			70,839			83,755	0	0
1995							138			62,173			62,311	0	0
1996				8			14			89,589			89,611	0	0

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Year	Georgia Strait														
	First Nations			Net[1]			Troll[1,2]			Tidal Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1997				1			806			56,332			57,139	0	0
1998				11			303			20,923			21,237	0	0
1999				0			219			43,588			43,807	0	0
2000				0			609			32,750			33,359	0	0
2001				3	708	512	311	169	39	31,259			31,573	877	551
2002				16	601	446	459	205	49	52,979			53,454	806	496
2003				18	1,368	999	279	189	43	19,981			20,278	1,557	1,042
2004				0	881	645	389	235	54	13,475			13,864	1,116	699
2005				20	703	485	0	206	42	11,972	10,102	2,766	11,992	11,011	3,293
2006				0	3	3	0	3	1	12,181	4,730	1,749	12,181	4,736	1,752
2007				0	200	144	0	0	0	14,561	25,595	5,919	14,561	25,795	6,063
2008	4,848		223	0	156	112	0	0	0	8,836	8,772	2,294	13,684	8,928	2,629
2009	0	0	0	239	0	171	0	135	0	17,884	21,644	5,390	18,123	21,779	5,561
2010	40		2	54	1,128	863	5	359	85	14,942	13,704	3,662	15,041	15,191	4,613
2011	2,379	17	126	3	113	86	0	177	36	21,651	20,327	5,397	24,033	20,634	5,644
2012	3,096		142	0	0	0	0	0	0	22,457	45,785	10,340	25,553	45,785	10,483
2013	843	0	39	4	188	138	0	0	0	25,036	74,417	16,016	25,883	74,605	16,193

Note: Troll = Areas 13–18; Net = Areas 14–19; Sport = Areas 13–18, 19a.

[1] Troll and net catches from 1996–2004 have been updated with data from CDFO (2009).

[2] Since 1998, the catch accounting year for troll fisheries was set from October 1 to September 30. The same catch accounting period was applied for years prior to 1998.

Appendix A.14.–Fraser River ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

Year	Fraser River Watershed											
	First Nations[1]			Net[2]			Freshwater Sport[3,4]			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	20,170			66,119			7,740			94,029	0	0
1976	19,189			73,018			6,354			98,561	0	0
1977	23,310			85,222			3,071			111,603	0	0
1978	19,541			50,247			3,627			73,415	0	0
1979	10,217			51,488			4,450			66,155	0	0
1980	10,528			40,061			7			50,596	0	0
1981	8,389			22,447			0			30,836	0	0
1982	29,043			23,792			96			52,931	0	0
1983	11,875			25,580			0			37,455	0	0
1984	17,111			27,929			80			45,120	0	0
1985	8,387			28,894			596			37,877	0	0
1986	12,274			31,401			1,421			45,096	0	0
1987	12,050			12,021			3,561			27,632	0	0
1988	12,063			8,446			3,702			24,211	0	0
1989	4,784			23,443			2,500			30,727	0	0
1990	14,180			15,689			2,982			32,851	0	0
1991	13,950			14,757			3,116			31,823	0	0
1992	10,067			7,363			4,677			22,107	0	0
1993	15,395			13,885			3,430			32,710	0	0
1994	17,892			13,693			3,195			34,780	0	0
1995	17,791			6,451			8,258			32,500	0	0
1996	12,665			12,910			7,635			33,210	0	0

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Year	Fraser River Watershed											
	First Nations[1]			Net[2]			Freshwater Sport[3,4]			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1997	13,453			40,877			5,051			59,381	0	0
1998	14,702			8,292			18,073			41,067	0	0
1999	17,999			4,043			8,509			30,551	0	0
2000	20,839			8,244			12,836			41,919	0	0
2001	18,429			10,398	28	26	25,023			53,850	28	26
2002	21,796			9,732	329	281	24,355			55,883	329	281
2003	28,137			11,204	287	272	19,520			58,861	287	272
2004	31,165			19,224	197	186	18,581			68,970	197	186
2005	19,832	0	879	9,088	97	335	22,688	13,322	2,720	51,608	13,419	3,934
2006	14,793	333	950	7,686	61	213	26,662	550	1,062	49,141	944	2,225
2007	13,714	759	1,333	6,795	44	166	12,945	8,694	1,586	33,454	9,497	3,085
2008	22,417	96	973	4,575	89	276	18,597	13,810	3,366	45,589	13,995	4,615
2009	27,288	105	1,203	7,848	146	330	17,485	15,845	3,611	52,621	16,096	5,143
2010	15,432	298	992	13,953	67	499	14,324	13,512	3,583	43,709	13,877	5,074
2011	33,118	96	1,614	17,989	104	351	20,349	9,022	3,136	71,456	9,222	5,101
2012	36,521	104	1,778	2,899	0	576	11,396	7,333	2,194	50,816	7,437	4,549
2013	17,092	113	893	3,124	6,307	6,110	11,506	10,211	2,754	31,722	16,631	9,757

[1] First Nations Chinook salmon catch includes food, social and ceremonial from the mainstem and tributaries. Economic opportunity included in commercial net.

[2] Fraser River net includes commercial Area E Gillnet, test fisheries, First Nations economic opportunities and scientific licenses.

[3] Freshwater sport catch includes Fraser mainstem and tributary Chinook salmon catch (adults only).

[4] Updated 1975 to 1980 sport catch from Fraser et al. 1982.

Appendix A.15.–Canada: Strait of Juan de Fuca ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

Year	Canada: Strait of Juan de Fuca											
	First Nations			Net[1]			Tidal Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	NA			9,799			NA			9,799	0	0
1976	NA			13,004			NA			13,004	0	0
1977	NA			25,344			NA			25,344	0	0
1978	NA			9,725			NA			9,725	0	0
1979	NA			8,665			NA			8,665	0	0
1980	NA			3,438			37,900			41,338	0	0
1981	NA			9,982			29,832			39,814	0	0
1982	NA			7,072			30,646			37,718	0	0
1983	NA			328			30,228			30,556	0	0
1984	NA			6,237			24,353			30,590	0	0
1985	NA			17,164			27,843			45,007	0	0
1986	NA			17,727			34,387			52,114	0	0
1987	NA			6,782			24,878			31,660	0	0
1988	NA			4,473			31,233			35,706	0	0
1989	NA			21,238			32,539			53,777	0	0
1990	42			7,405			30,127			37,574	0	0
1991	250			8,893			19,017			28,160	0	0
1992	302			10,023			21,090			31,415	0	0
1993	317			2,287			13,967			16,571	0	0
1994	600			8,931			14,372			23,903	0	0
1995	751			631			14,405			15,787	0	0
1996	20			655			19,012			19,687	0	0
1997	42			657			17,080			17,779	0	0
1998	1,500			495			9,709			11,704	0	0
1999	52			771			14,808			15,631	0	0

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Year	Canada: Strait of Juan de Fuca											
	First Nations			Net[1]			Tidal Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
2000	272			199			10,973			11,444	0	0
2001	135			439			23,463			24,037	0	0
2002	NA			345			24,084			24,429	0	0
2003	NA			292			26,630			26,922	0	0
2004	NA			187			40,877			41,064	0	0
2005	NA			153	0	110	30,480	11,857	4,380	30,633	11,857	4,490
2006	NA			155	801	606	26,437	5,079	2,799	26,592	5,880	3,405
2007	NA			138	690	534	26,549	11,832	4,104	26,687	12,522	4,638
2008	NA			172	573	442	22,263	6,540	2,792	22,435	7,113	3,234
2009	NA			385	0	277	25,587	44,169	10,246	25,972	44,169	10,523
2010	NA			206	1,239	920	15,612	4,868	2,012	15,818	6,107	2,932
2011	NA			278	1,522	1,166	21,075	12,878	3,927	21,353	14,400	5,093
2012	NA			284	1,124	853	22,154	10,603	3,564	22,438	11,727	4,417
2013	NA			273	1,411	1,099	32,363	24,550	6,947	32,636	25,961	8,046

Note: Net = Area 20; Sport = Areas 19b and 20.

[1] Net catches from 1996 to 2004 have been updated with data from CDFO (2009).

Appendix A.16.–Washington: Strait of Juan de Fuca ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

Year	Washington: Strait of Juan de Fuca											
	Troll			Net			Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	5,752	NA	144	8,048	NA	644	81,681	NA	11,844	95,481	NA	12,631
1976	10,488	NA	262	6,072	NA	486	75,308	NA	10,920	91,868	NA	11,668
1977	8,915	NA	223	14,930	NA	1,194	53,238	NA	7,720	77,083	NA	9,137
1978	10,006	NA	250	11,224	NA	898	62,299	NA	9,033	83,529	NA	10,181
1979	7,804	NA	195	10,939	NA	875	67,094	NA	9,729	85,837	NA	10,799
1980	10,682	NA	267	11,320	NA	906	56,415	NA	8,180	78,417	NA	9,353
1981	15,638	NA	391	18,541	NA	1,483	51,352	NA	7,446	85,531	NA	9,320
1982	19,024	NA	476	22,547	NA	1,804	29,842	NA	4,327	71,413	NA	6,606
1983	18,489	NA	462	16,141	NA	1,291	58,060	NA	8,419	92,690	NA	10,172
1984	15,650	NA	391	12,120	NA	970	48,003	NA	6,960	75,773	NA	8,321
1985	11,808	NA	295	12,784	NA	1,023	44,267	NA	6,419	68,859	NA	7,737
1986	30,000	NA	750	17,000	NA	1,360	69,000	NA	10,005	116,000	NA	12,115
1987	45,000	NA	1,125	11,000	NA	880	53,000	NA	7,685	109,000	NA	9,690
1988	49,000	NA	1,225	10,000	NA	800	39,000	NA	5,655	98,000	NA	7,680
1989	65,000	NA	1,625	10,000	NA	800	52,000	NA	7,540	127,000	NA	9,965
1990	47,162	NA	1,179	5,294	NA	424	50,903	NA	7,381	103,359	NA	8,984
1991	37,127	NA	928	3,390	NA	271	39,667	NA	5,752	80,184	NA	6,951
1992	31,452	NA	786	927	NA	74	38,438	NA	5,574	70,817	NA	6,434
1993	9,794	NA	245	1,482	NA	119	32,434	NA	4,703	43,710	NA	5,066
1994	3,346	NA	84	5,864	NA	469	1,661	NA	241	10,871	NA	794
1995	6,397	NA	160	4,769	NA	382	6,349	NA	921	17,515	NA	1,462
1996	9,757	NA	244	604	NA	48	4,825	NA	700	15,186	NA	992

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Year	Washington: Strait of Juan de Fuca											
	Troll			Net			Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1997	829	NA	21	492	NA	39	12,238	NA	1,775	13,559	NA	1,835
1998	338	NA	8	265	NA	21	2,159	NA	313	2,762	NA	343
1999	544	NA	14	589	NA	47	1,990	NA	289	3,123	NA	349
2000	332	NA	8	640	NA	51	1,670	NA	242	2,642	NA	302
2001	1,974	NA	49	931	NA	74	4,819	NA	699	7,724	NA	823
2002	1,783	NA	45	1,076	NA	86	2,028	NA	294	4,887	NA	425
2003	436	NA	11	908	NA	73	5,290	28201	8325	6,634	28,201	8,408
2004	20,627	NA	516	592	NA	47	4,519	22275	6625	25,738	22,275	7,188
2005	5,344	NA	134	175	NA	14	2,700	10189	3122	8,219	10,189	3,270
2006	1,115	NA	28	957	NA	77	5,695	14823	4798	7,767	14,823	4,903
2007	4,329	NA	108	107	NA	9	6,967	23133	7210	11,403	23,133	7,327
2008	1,816	NA	45	4,579	NA	366	4,844	13359	4283	11,239	13,359	4,694
2009	3,280	NA	82	99	NA	8	11,167	46047	13960	14,546	46,047	14,050
2010	2,011	NA	50	1,339	NA	107	11,508	38036	11862	14,858	38,036	12,020
2011	4,090	NA	102	352	NA	28	9,504	20601	6899	13,946	20,601	7,029
2012	1,026	NA	26	1,523	NA	122	13,854	28,235	9,576	13,275	28,235	11,054
2013	3,295	NA	82	449	NA	36	11,622[1]	28,957[1]	9,446[1]	15,366	NA	9,564

Note: Troll = Areas 5 and 6C, Area 4B from January 1 to April 30 and October 1 to December 31; Net = Areas 4B, 5, and 6C; Sport = Areas 5 and 6, 4B Neah Bay "add-on" fishery.

Note: NA = not available; for fisheries without estimate of releases, IM is dropoff/dropout only.

[1] Current year not available; values are average of previous three years.

Appendix A.17.–Washington: San Juan ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

	Washington: San Juan											
	Troll			Net			Sport			Total		
Year	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	3	NA	0	90,100	NA	7,208	31,988	NA	4,638	122,091	NA	11,846
1976	0	NA	0	66,832	NA	5,347	34,505	NA	5,003	101,337	NA	10,350
1977	62	NA	2	84,316	NA	6,745	14,049	NA	2,037	98,427	NA	8,784
1978	3	NA	0	87,565	NA	7,005	15,083	NA	2,187	102,651	NA	9,192
1979	5	NA	0	53,750	NA	4,300	17,367	NA	2,518	71,122	NA	6,818
1980	0	NA	0	64,338	NA	5,147	12,231	NA	1,773	76,569	NA	6,921
1981	4	NA	0	50,695	NA	4,056	9,727	NA	1,410	60,426	NA	5,466
1982	0	NA	0	38,763	NA	3,101	6,953	NA	1,008	45,716	NA	4,109
1983	2	NA	0	28,497	NA	2,280	15,166	NA	2,199	43,665	NA	4,479
1984	83	NA	2	33,432	NA	2,675	25,759	NA	3,735	59,274	NA	6,412
1985	872	NA	22	33,579	NA	2,686	12,610	NA	1,828	47,061	NA	4,537
1986	0	NA	0	21,000	NA	1,680	15,000	NA	2,175	36,000	NA	3,855
1987	0	NA	0	29,000	NA	2,320	14,000	NA	2,030	43,000	NA	4,350
1988	0	NA	0	32,000	NA	2,560	9,000	NA	1,305	41,000	NA	3,865
1989	1,000	NA	25	16,000	NA	1,280	9,000	NA	1,305	26,000	NA	2,610
1990	666	NA	17	8,608	NA	689	7,370	NA	1,069	16,644	NA	1,774
1991	135	NA	3	11,753	NA	940	5,115	NA	742	17,003	NA	1,685
1992	172	NA	4	14,011	NA	1,121	6,788	NA	984	20,971	NA	2,109
1993	243	NA	6	14,002	NA	1,120	6,916	NA	1,003	21,161	NA	2,129
1994	73	NA	2	13,908	NA	1,113	5,795	NA	840	19,776	NA	1,955
1995	9	NA	0	5,333	NA	427	7,863	NA	1,140	13,205	NA	1,567
1996	153	NA	4	3,934	NA	315	12,674	NA	1,838	16,761	NA	2,156
1997	29	NA	1	29,593	NA	2,367	9,155	NA	1,327	38,777	NA	3,696

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Year	Washington: San Juan											
	Troll			Net			Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1998	376	NA	9	3,804	NA	304	3,069	NA	445	7,249	NA	759
1999	114	NA	3	3	NA	0	3,421	NA	496	3,538	NA	499
2000	22	NA	1	1,091	NA	87	4,447	NA	645	5,560	NA	733
2001	0	NA	0	970	NA	78	6,522	NA	946	7,492	NA	1,023
2002	0	NA	0	2,231	NA	178	4,827	NA	700	7,058	NA	878
2003	0	NA	0	4,827	NA	386	3,008	1646	877	7,835	1,646	1,264
2004	123	NA	3	5,184	NA	415	1,971	1190	605	7,278	1,190	1,022
2005	0	NA	0	4,358	491	741	2,703	1544	806	7,061	2,035	1,547
2006	0	NA	0	5,278	439	773	4,168	1278	947	9,446	1,717	1,720
2007	0	NA	0	2,621	476	590	4,955	3933	1773	7,576	4,409	2,363
2008	0	NA	0	48	76	65	5,829	2673	1562	5,877	2,749	1,626
2009	0	NA	0	1,014	2,012	1,691	4,077	5375	2032	5,091	7,387	3,722
2010	0	NA	0	5,950	4,972	4,454	3,157	2402	1102	9,107	7,374	5,555
2011	0	NA	0	5,810	11,893	9,979	6,193	6603	2668	12,003	18,496	12,647
2012	0	NA	0	441	218	210	5,764	5688	2,360	6,205	5,906	2,570
2013	0	NA	0	3,872	12,065	9,962	5,038[1]	4,898[1]	2,043[1]	8,910	16,963	12,005

Note: Troll = Areas 6, 6A, 7, and 7A; Net = Areas 6, 6A, 7 and 7A.

Note: NA = not available; for fisheries without estimate of releases, IM is dropoff/dropout only.

[1] Current year not available; values are average of previous three years.

Appendix A.18.–Washington: Other Puget Sound ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

	Washington: Other Puget Sound								
	Net			Sport			Total		
Year	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	131,982	NA	10,559	173,086	NA	25,097	305,068	NA	35,656
1976	141,281	NA	11,302	151,246	NA	21,931	292,527	NA	33,233
1977	145,470	NA	11,638	97,761	NA	14,175	243,231	NA	25,813
1978	150,298	NA	12,024	116,979	NA	16,962	267,277	NA	28,986
1979	128,073	NA	10,246	156,402	NA	22,678	284,475	NA	32,924
1980	171,516	NA	13,721	142,799	NA	20,706	314,315	NA	34,427
1981	145,152	NA	11,612	106,048	NA	15,377	251,200	NA	26,989
1982	149,274	NA	11,942	85,703	NA	12,427	234,977	NA	24,369
1983	134,492	NA	10,759	123,752	NA	17,944	258,244	NA	28,703
1984	180,248	NA	14,420	102,740	NA	14,897	282,988	NA	29,317
1985	184,907	NA	14,793	92,603	NA	13,427	277,510	NA	28,220
1986	153,000	NA	12,240	88,000	NA	12,760	241,000	NA	25,000
1987	127,000	NA	10,160	59,000	NA	8,555	186,000	NA	18,715
1988	133,000	NA	10,640	63,000	NA	9,135	196,000	NA	19,775
1989	156,000	NA	12,480	75,000	NA	10,875	231,000	NA	23,355
1990	179,593	NA	14,367	71,000	NA	10,295	250,593	NA	24,662
1991	89,495	NA	7,160	48,859	NA	7,085	138,354	NA	14,244
1992	63,460	NA	5,077	51,656	NA	7,490	115,116	NA	12,567
1993	54,968	NA	4,397	41,034	NA	5,950	96,002	NA	10,347
1994	63,577	NA	5,086	44,181	NA	6,406	107,758	NA	11,492
1995	63,593	NA	5,087	61,509	NA	8,919	125,102	NA	14,006
1996	61,658	NA	4,933	58,538	NA	8,488	120,196	NA	13,421

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Year	Washington: Other Puget Sound								
	Net			Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1997	47,522	NA	3,802	43,961	NA	6,374	91,483	NA	10,176
1998	50,915	NA	4,073	30,016	NA	4,352	80,931	NA	8,426
1999	91,947	NA	7,356	34,116	NA	4,947	126,063	NA	12,303
2000	79,494	NA	6,360	29,328	NA	4,253	108,822	NA	10,612
2001	123,266	NA	9,861	40,170	NA	5,825	163,436	NA	15,686
2002	108,566	NA	8,685	35,031	NA	5,079	143,597	NA	13,765
2003	86,206	NA	6,896	32,210	93,129	29,629	118,416	93,129	36,526
2004	69,211	NA	5,537	22,650	64,586	20,593	91,861	64,586	26,130
2005	82,629	557	7,156	30,760	50,748	18,061	108,638	51,306	25,217
2006	109,557	NA	8,765	40,082	152,129	46,582	149,639	152,129	55,347
2007	118,628	NA	9,490	57,468	149,778	48,473	176,096	149,778	57,964
2008	101,322	NA	8,106	36,969	86,174	28,455	138,291	86,174	36,561
2009	68,764	NA	5,501	33,332	75,820	25,153	102,096	75,820	30,654
2010	72,576	NA	5,806	32,817	43,512	16,420	105,393	43,512	22,226
2011	100,692	NA	8,055	29,829	78,760	25,433	130,521	78,760	33,488
2012	115,917	NA	9,273	22,036	115,056	34,030	137,953	115,056	43,304
2013	105,029	NA	8,402	28,227[1]	77,777[1]	24,937[1]	133,256	77,777	33,339

Note: Net = Areas 6B, 6D, 7B, 7C, and 7E, Areas 8–13 (including all subareas), and Areas 74C–83F; Sport = Areas 8–13 and all Puget Sound Rivers.

Note: NA = not available. For fisheries without estimate of releases, IM is dropoff/dropout only.

[1] Current year not available; values are average of previous three years.

Appendix A.19.–Washington: Inside Coastal ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

	Washington: Inside Coastal								
	Net			Sport			Total		
Year	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	34,859	NA	697	1,716	NA	118	36,575	NA	816
1976	51,995	NA	1,040	2,219	NA	153	54,214	NA	1,193
1977	72,467	NA	1,449	2,043	NA	141	74,510	NA	1,590
1978	32,662	NA	653	3,399	NA	235	36,061	NA	888
1979	36,501	NA	730	2,199	NA	152	38,700	NA	882
1980	47,681	NA	954	1,476	NA	102	49,157	NA	1,055
1981	36,880	NA	738	786	NA	54	37,666	NA	792
1982	33,271	NA	665	1,114	NA	77	34,385	NA	742
1983	16,210	NA	324	1,452	NA	100	17,662	NA	424
1984	16,239	NA	325	1,319	NA	91	17,558	NA	416
1985	25,162	NA	503	1,955	NA	135	27,117	NA	638
1986	29,000	NA	580	3,000	NA	207	32,000	NA	787
1987	51,000	NA	1,020	3,000	NA	207	54,000	NA	1,227
1988	74,000	NA	1,480	7,000	NA	483	81,000	NA	1,963
1989	85,000	NA	1,700	6,000	NA	414	91,000	NA	2,114
1990	57,770	NA	1,155	5,000	NA	345	62,770	NA	1,500
1991	54,397	NA	1,088	6,070	NA	419	60,467	NA	1,507
1992	64,223	NA	1,284	6,577	NA	454	70,800	NA	1,738
1993	59,285	NA	1,186	9,180	NA	633	68,465	NA	1,819
1994	46,059	NA	921	7,454	NA	514	53,513	NA	1,436
1995	46,490	NA	930	9,881	NA	682	56,371	NA	1,612
1996	55,408	NA	1,108	12,059	NA	832	67,467	NA	1,940
1997	28,269	NA	565	6,619	NA	457	34,888	NA	1,022
1998	20,266	NA	405	6,569	NA	453	26,835	NA	859
1999	11,400	NA	228	3,165	NA	218	14,565	NA	446
2000	15,660	NA	313	3,179	NA	219	18,839	NA	533
2001	19,480	NA	390	8,645	NA	597	28,125	NA	986
2002	23,372	NA	467	6,038	NA	417	29,410	NA	884
2003	18,443	NA	369	6,075	NA	419	24,518	NA	788
2004	21,965	NA	439	12,088	NA	834	34,053	NA	1,273
2005	20,668	NA	413	7,051	NA	487	27,719	NA	900
2006	27,414	NA	548	8,030	NA	554	35,444	NA	1,102
2007	12,353	NA	247	5,066	NA	350	17,419	NA	597

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Year	Washington: Inside Coastal								
	Net			Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
2008	15,028	NA	301	3,808	NA	263	18,836	NA	563
2009	18,728	NA	375	6,629	NA	457	25,357	NA	832
2010	12,794	NA	256	6,831	NA	471	19,625	NA	727
2011	39,034	NA	781	13,340	NA	920	52,374	NA	1,701
2012	29,232	NA	585	9,646	NA	666	38,878	NA	1,250
2013	31,111	NA	622	10,143[1]	NA	700[1]	41,254	NA	1,322

Note: Net = Areas 2A–2M;, and Areas 72B–73H; Sport = All coastal rivers, Area 2.1, and Area 2.2 (when Area 2 is closed)

Note: NA = not available. For fisheries without estimate of releases, IM is dropoff/dropout only.

[1] Current year not available; values are average of previous three years.

Appendix A.20.–Washington/Oregon North of Cape Falcon ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

	Washington/Oregon North of Cape Falcon											
	Troll			Net			Sport			Total		
Year	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	268,971	NA	6,724	1,212	NA	24	265,785	NA	7,176	535,968	NA	13,925
1976	371,239	NA	9,281	203	NA	4	215,319	NA	5,814	586,761	NA	15,099
1977	244,491	NA	6,112	4	NA	0	197,563	NA	5,334	442,058	NA	11,447
1978	150,673	NA	3,767	4	NA	0	104,306	NA	2,816	254,983	NA	6,583
1979	133,035	NA	3,326	3	NA	0	84,977	NA	2,294	218,015	NA	5,620
1980	125,709	NA	3,143	1,215	NA	24	59,099	NA	1,596	186,023	NA	4,763
1981	109,519	NA	2,738	209	NA	4	96,151	NA	2,596	205,879	NA	5,338
1982	154,720	NA	3,868	267	NA	5	114,952	NA	3,104	269,939	NA	6,977
1983	63,584	NA	1,590	62	NA	1	51,789	NA	1,398	115,435	NA	2,989
1984	15,392	NA	385	0	NA	0	6,980	NA	188	22,372	NA	573
1985	55,408	NA	1,385	493	NA	10	30,189	NA	815	86,090	NA	2,210
1986	52,000	NA	1,300	0	NA	0	23,000	NA	621	75,000	NA	1,921
1987	81,000	NA	2,025	4,000	NA	80	44,000	NA	1,188	129,000	NA	3,293
1988	108,000	NA	2,700	3,000	NA	60	19,000	NA	513	130,000	NA	3,273
1989	74,600	NA	1,865	1,000	NA	20	20,900	NA	564	96,500	NA	2,449
1990	65,800	NA	1,645	0	0	0	32,900	NA	888	98,700	NA	2,533
1991	51,600	NA	1,290	0	0	0	13,300	NA	359	64,900	NA	1,649
1992	69,000	NA	1,725	0	0	0	18,900	NA	510	87,900	NA	2,235
1993	55,900	NA	1,398	0	0	0	13,600	NA	367	69,500	NA	1,765
1994	4,500	NA	113	0	0	0	0	NA	–	4,500	NA	113
1995	9,500	NA	238	0	0	0	600	NA	16	10,100	NA	254
1996	12,300	NA	308	0	0	0	200	NA	5	12,500	NA	313

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Year	Washington/Oregon North of Cape Falcon											
	Troll			Net			Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1997	20,500	NA	513	0	0	0	4,100	NA	111	24,600	NA	623
1998	20,615	12,496	3,577	0	0	0	2,292	2,729	471	22,907	15,225	4,048
1999	44,923	27,231	7,795	0	0	0	10,821	6,782	1,309	55,744	34,013	9,104
2000	20,152	12,215	3,497	0	0	0	9,242	8,433	1,515	29,394	20,649	5,011
2001	54,163	35,824	10,131	0	0	0	25,592	34,500	5,866	79,755	70,324	15,997
2002	106,462	60,250	17,423	0	0	0	60,575	74,008	12,737	167,037	134,257	30,159
2003	101,758	54,313	15,851	0	0	0	36,513	50,214	8,518	138,271	104,526	24,368
2004	88,225	83,219	22,594	0	0	0	27,090	74,410	11,893	115,315	157,629	34,487
2005	87,126	36,282	11,067	0	0	0	40,004	22,798	4,500	127,130	59,080	15,567
2006	57,313	52,482	14,291	0	0	0	11,176	10,309	1,848	68,489	62,791	16,139
2007	38,742	36,050	9,801	0	0	0	9,535	22,629	3,652	48,277	58,678	13,452
2008	35,100	NA	878	0	0	0	15,452	7,400	1,527	50,552	7,400	2,405
2009	25,410	NA	635	0	0	0	13,331	38,717	6,168	38,741	38,717	6,803
2010	88,565	NA	2,214	0	0	0	38,686	36,403	6,505	127,251	36,403	8,719
2011	61,433	NA	1,536	0	0	0	30,826	55,050	9,090	92,259	55,050	10,626
2012	99,792	NA	2,495	0	0	0	35,428	42,874	7,388	135,220	42,874	9,882
2013	91,915	NA	2,298	0	0	0	30,837	32,048	5,640	122,752	32,048	7,938

Note: Troll = Oregon Area 2; Washington Areas 1, 2, 3 and 4: Area 4B from May 1 through September 30 (during Pacific Fishery Management Council management); Net = Washington Areas 1, 2, 3, 4, 4A; Sport = Oregon Area 2; Washington Areas 1, 1.1, 1.2, 2, 3, 4 and 2.2 (when Area 2 is open).

Note: For fisheries without estimate of releases, IM is dropoff/dropout only.

[1] Current year not available; values are average of previous three years.

Appendix A.21.–Columbia River ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

Year	Washington and Oregon Columbia River[1]											
	Nontreaty Net			Treaty Indian Net			Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975[2]	323,000	0	9,690				34,870	NA	2,406	357,870	NA	12,096
1976[2]	288,400	0	8,652				42,527	NA	2,934	330,927	NA	11,586
1977[2]	255,600	0	7,668				58,838	NA	4,060	314,438	NA	11,728
1978[2]	189,100	0	5,673				56,582	NA	3,904	245,682	NA	9,577
1979[2]	169,691	0	5,091	7,865	0	236	38,700	NA	2,670	216,256	NA	7,997
1980	113,569	0	3,407	35,604	0	1,068	15,011	NA	1,036	164,184	NA	5,511
1981	35,881	0	1,076	54,190	0	1,626	21,151	NA	1,459	111,222	NA	4,162
1982	94,289	0	2,829	67,224	0	2,017	31,236	NA	2,155	192,749	NA	7,001
1983	32,877	0	986	34,036	0	1,021	23,206	NA	1,601	90,119	NA	3,609
1984	73,481	0	2,204	61,828	0	1,855	43,760	NA	3,019	179,069	NA	7,079
1985	74,982	0	2,249	80,436	0	2,413	45,444	NA	3,136	200,862	NA	7,798
1986	168,038	0	5,041	118,578	0	3,557	57,993	NA	4,002	344,609	NA	12,600
1987	340,931	0	10,228	154,169	0	4,625	105,835	NA	7,303	600,935	NA	22,156
1988	341,114	0	10,233	165,677	0	4,970	97,638	NA	6,737	604,429	NA	21,941
1989	146,739	0	4,402	145,859	0	4,376	88,088	NA	6,078	380,686	NA	14,856
1990	63,602	0	1,908	95,317	0	2,860	79,467	NA	5,483	238,386	NA	10,251
1991	53,935	0	1,618	60,931	0	1,828	79,260	NA	5,469	194,126	NA	8,915
1992	24,063	0	722	39,616	0	1,188	56,417	NA	3,893	120,096	NA	5,803
1993	19,929	0	598	51,516	0	1,545	64,995	NA	4,485	136,440	NA	6,628
1994	2,773	0	83	36,633	0	1,099	29,634	NA	2,045	69,040	NA	3,227
1995	777	0	23	43,010	0	1,290	36,394	NA	2,511	80,181	NA	3,825
1996	17,774	0	533	70,956	0	2,129	31,672	NA	2,185	120,402	NA	4,847

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Year	Washington and Oregon Columbia River[1]											
	Nontreaty Net			Treaty Indian Net			Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1997	11,268	0	338	76,473	0	2,294	45,984	NA	3,173	133,725	NA	5,805
1998	6,409	0	192	48,410	0	1,452	34,342	NA	2,370	89,161	NA	4,014
1999	10,090	NA	303	81,164	0	2,435	45,094	NA	3,111	136,348	NA	5,849
2000	11,268	0	338	76,473	0	2,294	45,984	NA	3,173	133,725	NA	5,805
2001	41,651	473	1382	184,393	0	5,532	139,356	16,454	12,817	365,400	16,927	19,731
2002	68,517	12,420	5549	181,413	0	5,442	147,685	21,625	14,377	397,615	34,045	25,368
2003	75,819	2,165	3223	157,329	0	4,720	146,573	15,966	13,098	379,721	18,131	21,041
2004	76,901	3,280	3797	160,856	0	4,826	146,545	15,153	12,970	384,302	18,433	21,593
2005	45,698	993	1789	133,533	0	4,006	89,665	32,106	12,318	268,896	33,099	18,113
2006	44,192	1,298	2533	109,384	0	3,282	70,930	4,252	5,729	224,506	5,550	11,543
2007	26,697	391	977	60,485	0	1,815	54,881	5,273	4,798	142,063	5,664	7,590
2008	51,881	1,599	2006	144,471	0	4,334	86,607	11,490	8,058	282,959	13,089	14,399
2009	54,841	898	1899	112,097	0	3,363	88,784	10,443	7,985	255,723	11,341	13,247
2010	89,018	1,270	3026	207,657	0	6,230	162,097	11,211	13,220	458,772	12,481	22,476
2011	91,723	1,663	3524	175,950	0	5,278	150,159	13,492	12,671	417,832	15,155	21,473
2012	73,146	850	2432	170,224	0	5,107	148,323	23,162	14,215	391,694	24,012	21,754
2013	130,816	818	4428	259,820	0	7,795	109,741	43,648	15,869	500,376	44,466	28,092

[1] The historical time series of catches in this year's report has changed from previous year's report. Catches after 1980 have been broken out into nontreaty net and treaty Indian due to the inability to separate Treaty Indian commercial versus noncommercial. Nontreaty net includes catches by Wanapum and Colville tribes. Sport and total catches from 1975 to 1980 are consistent with previous year's reports.

Appendix A.22.–Oregon ISBM Chinook salmon landed catch (LC), releases (Rel.), and incidental mortality (IM).

Year	Oregon Coastal Inside								
	Troll			Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
1975	300	NA	5	19,000	NA	1,311	19,300	NA	1,316
1976	1,000	NA	17	21,000	NA	1,449	22,000	NA	1,466
1977	3,000	NA	51	34,000	NA	2,346	37,000	NA	2,397
1978	1,000	NA	17	37,000	NA	2,553	38,000	NA	2,570
1979	800	NA	14	31,000	NA	2,139	31,800	NA	2,153
1980	300	NA	5	22,000	NA	1,518	22,300	NA	1,523
1981	300	NA	5	28,000	NA	1,932	28,300	NA	1,937
1982	500	NA	9	23,000	NA	1,587	23,500	NA	1,596
1983	700	NA	12	19,000	NA	1,311	19,700	NA	1,323
1984	1,088	NA	17	27,000	NA	1,863	28,088	NA	1,880
1985	1,700	NA	27	25,000	NA	1,725	26,700	NA	1,752
1986	1,900	NA	30	33,000	NA	2,277	34,900	NA	2,307
1987	3,600	NA	58	46,000	NA	3,174	49,600	NA	3,232
1988	4,800	NA	77	49,000	NA	3,381	53,800	NA	3,458
1989	4,500	NA	72	45,000	NA	3,105	49,500	NA	3,177
1990	0	NA	0	38,000	NA	2,622	38,000	NA	2,622
1991	0	NA	0	44,500	NA	3,071	44,500	NA	3,071
1992	384	NA	6	39,000	NA	2,691	39,384	NA	2,697
1993	649	NA	10	52,000	NA	3,588	52,649	NA	3,598
1994	371	NA	6	33,590	NA	2,318	33,961	NA	2,324
1995	206	NA	3	48,366	NA	3,337	48,572	NA	3,341
1996	989	NA	16	56,202	NA	3,878	57,191	NA	3,894
1997	513	NA	8	37,659	NA	2,598	38,172	NA	2,607
1998	858	NA	14	37,990	NA	2,621	38,848	NA	2,635
1999	1,233	NA	20	30,735	NA	2,121	31,968	NA	2,140
2000	1,860	NA	30	33,262	NA	2,295	35,122	NA	2,325
2001	1,184	NA	19	54,988	NA	3,794	56,172	NA	3,813
2002	1,633	NA	26	61,085	NA	4,215	62,718	NA	4,241
2003	1,459	NA	23	67,939	NA	4,688	69,398	NA	4,711
2004	2,258	NA	36	71,726	NA	4,949	73,984	NA	4,985
2005	1,956	NA	31	27,866	NA	1,923	29,822	NA	1,954

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Year	Oregon Coastal Inside								
	Troll			Sport			Total		
	LC	Rel.	IM	LC	Rel.	IM	LC	Rel.	IM
2006	1,884	NA	30	39,357	NA	2,716	41,241	NA	2,746
2007	1,018	NA	16	25,684	NA	1,772	26,702	NA	1,788
2008	208	NA	3	10,780	NA	744	10,988	NA	747
2009	293	NA	5	6,537	NA	451	6,830	NA	456
2010	1,315	NA	21	23,366	NA	1,612	24,681	NA	1,633
2011	1,954	NA	31	33,089	NA	2,283	35,043	NA	2,314
2012	636	NA	10	26,485	NA	1,827	27,121	NA	1,837
2013	1,188	NA	30	35,317[1]	NA	2,437[1]	36,505	NA	2,467

Note: Troll = late season off Elk River mouth, Sport = estuary and inland.

Note: NA = not available.

[1] Preliminary value based on average harvest rates.

Appendix A.23.–Summary of landed catches (LC) of PSC AABM and ISBM fisheries.

Year[1]	Southeast Alaska AABM [2,3]	Southeast Alaska Non-Treaty	U.S. ISBM[4]	U.S. Total	NBC AABM[2]	WCVI AABM[2]	Canada ISBM[4,5]	Canada Total	PSC Total
1975	317,707		1,114,483	1,432,190	228,121	546,214	949,027	1,723,362	3,155,552
1976	258,762		1,148,707	1,407,469	190,267	665,010	1,078,748	1,934,025	3,341,494
1977	302,178		972,309	1,274,487	131,005	545,742	1,070,562	1,747,309	3,021,796
1978	418,411		782,501	1,200,912	146,179	568,705	1,078,144	1,793,028	2,993,940
1979	382,641		729,949	1,112,590	147,576	477,222	991,275	1,616,073	2,728,663
1980	343,970		890,965	1,234,935	157,398	486,303	834,970	1,478,671	2,713,606
1981	289,034		780,224	1,069,258	153,249	423,266	753,274	1,329,789	2,399,047
1982	314,686		872,679	1,187,365	173,687	538,510	675,858	1,388,055	2,575,420
1983	311,658		637,515	949,173	162,927	395,636	643,778	1,202,341	2,151,514
1984	290,077		665,122	955,199	185,305	471,294	797,975	1,454,574	2,409,773
1985	268,293	6,246	734,199	1,002,492	166,445	345,937	560,860	1,073,242	2,075,734
1986	271,262	11,091	879,509	1,150,771	176,868	350,227	508,465	1,035,560	2,186,331
1987	265,323	17,095	1,171,535	1,436,858	180,101	378,931	403,645	962,677	2,399,535
1988	256,787	22,525	1,204,229	1,461,016	159,428	408,668	379,609	947,705	2,408,721
1989	269,522	21,510	1,001,686	1,271,208	228,331	203,751	487,390	919,472	2,190,680
1990	320,996	45,873	808,452	1,129,448	170,936	297,858	470,242	939,036	2,068,484
1991	297,986	61,476	599,534	897,520	209,065	203,035	559,065	971,165	1,868,685
1992	221,980	36,811	525,084	747,064	163,698	358,664	457,801	980,163	1,727,227
1993	271,193	32,910	487,927	759,120	186,983	300,345	460,543	947,871	1,706,991
1994	235,165	29,185	299,419	534,584	193,554	160,352	303,987	657,893	1,192,477
1995	176,939	58,800	351,046	527,985	79,388	95,410	205,325	380,123	908,108
1996	154,997	81,262	409,703	564,700	678	10,233	216,603	227,514	792,214

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Year[1]	Southeast Alaska AABM [2,3]	Southeast Alaska Non-Treaty	U.S. ISBM[4]	U.S. Total[6]	NBC AABM[2]	WCVI AABM[2]	Canada ISBM[4,5]	Canada Total	PSC Total[6]
1997	286,696	56,306	375,204	661,900	110,999	59,088	261,366	431,453	1,093,353
1998	243,152	27,441	268,693	511,845	143,202	9,317	195,646	348,165	860,010
1999	198,842	52,178	371,349	570,191	84,324	38,540	222,566	345,430	915,621
2000	186,493	76,797	342,176	528,669	32,048	88,617	168,545	289,210	817,879
2001	186,919	78,815	708,104	895,023	43,334	120,304	208,425	372,063	1,267,087
2002	357,133	69,401	812,322	1,169,455	149,831	157,886	238,976	546,693	1,716,148
2003	380,152	59,284	744,793	1,124,945	194,797	173,561	251,759	620,117	1,745,062
2004	417,019	82,249	732,531	1,149,550	241,508	215,252	295,628	752,388	1,901,937
2005	388,137	104,980	577,485	965,622	243,606	199,479	293,046	736,131	1,701,753
2006	359,566	75,939	536,532	896,098	215,985	145,485	265,787	627,257	1,523,355
2007	327,697	76,942	429,536	757,233	144,235	140,614	233,979	518,828	1,276,061
2008	172,341	71,889	518,742	691,083	95,647	145,726	184,055	425,428	1,116,511
2009	227,533	66,141	448,384	675,917	109,470	124,617	209,160	443,247	1,119,164
2010	230,250	54,449	759,687	989,937	136,613	139,047	166,004	441,664	1,431,601
2011	290,297	66,692	753,978	1,044,275	122,660	204,232	283,031	609,923	1,654,198
2012	242,034	52,988	750,133	992,167	120,307	134,468	191,724	446,499	1,438,666
2013	183,891	62,836	858,420	1,042,311	115,914	113,598	176,215	405,727	1,448,038

1 All LC from 1975 to 1984 were taken prior to implementation of the PST.
2 LC in AABM fisheries from 1985 to 1994 were taken under fixed ceiling management per the 1985 PST Agreement. Catches from 1995 to 1998 were between agreements. LC from 1999 to 2012 was taken commensurate with abundance-based management per the 1999 PST Agreement (1999–2008) and the 2009 PST Agreement (2009–present).
3 Southeast Alaska nontreaty catches are primarily Alaska hatchery add-ons, but include terminal exclusions in some years from terminal catches from the Situk, Taku and Stikine rivers.
4 U.S. and Canadian ISBM fisheries had a pass-through obligation from 1985 to 1994 under the 1985 PST Agreement and have operated with the ISBM index obligations since 1999, under the 1999 and 2009 Agreements
5 Catches in the Canada ISBM column include catches in the Strait of Georgia (troll and sport), Central British Columbia troll, and Northern British Columbia net and mainland sport fisheries from 1985 to 1994 when these were AABM fisheries operating under fixed ceiling management provisions of the 1985 PST Agreement.
6 Does not include SEAK AABM fishery nontreaty catch from hatchery add-on and terminal exclusion.

Appendix A.24.–Estimated incidental mortality (LIM and SIM in nominal fish) associated with Chinook salmon catches in U.S. and Canadian AABM and ISBM fisheries.

Year[1]	Southeast Alaska AABM[2]	Southeast Alaska Non-Treaty	U.S. ISBM	U.S. Total[5]	NBC AABM[2]	WCVI AABM[2]	Can ISBM[3]	Can Total	PSC Total[4, 5]
2005	45,846	10,652	66,568	112,414	20,563	14,814	46,248	81,625	194,039
2006	47,907	8,693	93,500	141,407	14,761	11,557	33,914	60,232	201,640
2007	71,355	22,365	91,080	162,435	13,923	12,403	40,397	66,723	229,158
2008	38,070	8,698	60,995	99,065	6,335	12,312	23,848	42,495	141,560
2009	44,890	11,126	69,763	114,653	9,705	15,817	37,925	63,447	178,100
2010	38,376	5,569	73,356	111,732	12,739	16,017	24,680	53,436	165,168
2011	41,567	9,915	89,279	130,846	18,619	17,005	31,538	67,162	198,008
2012	45,769	19,753	91,644	137,413	11,556	16,390	32,375	60,321	197,733
2013	52,647	40,491	94,727	147,374	19,926	16,449	48,347	84,722	232,096

[1] The IM estimates presented in this table are not equivalent to LC on a one-to-one fish basis because of the inclusion of SIMs, which are smaller, less mature fish.

[2] IM estimates (LIM + SIM) are available for AABM fisheries from 1985 to present (CTC 2011).

[3] IM estimates for the ISBM fisheries prior to 2005 were not available for many subcomponents of these fisheries at this printing, but will be included in next year's CTC catch and escapement report.

[4] The PST total needs to be viewed with caution per footnote 1.

[5] Does not include SEAK AABM fishery nontreaty catch from hatchery add-on and terminal exclusion.

Appendix A.25.–Estimated total mortality (LC and IM) associated with Chinook salmon catches in U.S. and Canadian AABM and ISBM fisheries.

Year	Southeast Alaska AABM	Southeast Alaska Non-Treaty	U.S. ISBM	U.S. Total[2]	NBC AABM	WCVI AABM	Can ISBM	Can Total	PSC Total[1,2]
2005	433,983	115,632	644,053	1,078,036	264,169	214,293	339,294	817,756	1,895,792
2006	407,473	84,632	630,033	1,037,506	230,746	157,042	299,701	687,489	1,724,995
2007	399,052	99,307	520,616	919,668	158,158	153,017	274,376	585,551	1,505,219
2008	210,411	80,587	579,737	790,148	101,982	158,038	207,903	467,923	1,258,071
2009	272,423	77,267	518,147	790,570	119,175	140,434	247,085	506,694	1,297,264
2010	268,626	60,018	833,044	1,101,670	149,352	155,064	190,684	495,100	1,596,769
2011	331,864	76,607	843,257	1,175,121	141,279	221,237	314,569	677,085	1,852,206
2012	287,803	72,741	841,777	1,129,580	131,863	150,858	224,099	506,820	1,636,399
2013	236,538	103,327	953,147	1,189,685	135,840	130,047	224,562	490,449	1,680,134

[1] Total mortality estimates prior to 2005 will be included in next year's CTC catch and escapement report when estimates from the ISBM fisheries are available.

[2] Does not include SEAK AABM fishery nontreaty catch from hatchery add-on and terminal exclusion.

APPENDIX B. ESCAPEMENTS AND TERMINAL RUNS OF PACIFIC SALMON COMMISSION CHINOOK TECHNICAL COMMITTEE CHINOOK SALMON ESCAPEMENT INDICATOR STOCKS, 1975–2013

Appendix B.1.–Southeast Alaska and Transboundary River estimates of escapement and CVs of Pacific Salmon Commission Chinook Technical Committee wild Chinook salmon escapement indicator stocks.

	Southeast Alaska Stocks							Transboundary River Stocks					
	Situk River		Chilkat R.		Unuk River		Chickamin R. index	Alsek R.		Taku R.		Stikine R.	
Year	Esc	CV[1]	Esc	CV	Esc	CV	Esc.[2]	Esc	CV	Esc	CV	Esc	CV
1975							370			12,920	0.38	7,571	0.21
1976	1,421						157	5,282	0.35	24,582	0.38	5,723	0.16
1977	1,732				4,706	0.12	363	12,706	0.35	29,496	0.38	11,445	0.16
1978	808				5,344	0.12	308	12,034	0.35	17,124	0.38	6,835	0.21
1979	1,284				2,783	0.12	239	17,354	0.35	21,617	0.38	12,610	0.21
1980	905				4,909	0.12	445	10,862	0.35	39,239	0.38	30,573	0.16
1981	702				3,532	0.12	384	8,502	0.35	49,559	0.38	36,057	0.21
1982	434				6,528	0.12	571	9,475	0.35	23,847	0.38	40,488	0.16
1983	592				5,436	0.12	599	10,344	0.35	9,795	0.38	6,424	0.21
1984	1,726				8,876	0.12	1,102	7,238	0.35	20,778	0.38	13,995	0.21
1985	1,521				5,721	0.12	956	6,127	0.35	35,916	0.38	16,037	0.15
1986	2,067				10,273	0.12	1,745	11,069	0.35	38,110	0.38	14,889	0.15
1987	1,379				9,533	0.12	975	11,141	0.35	28,935	0.38	24,632	0.15
1988	868	0.02			8,437	0.12	786	8,717	0.35	44,524	0.38	37,554	0.15
1989	637				5,552	0.12	934	10,119	0.35	40,329	0.14	24,282	0.15
1990	628				2,856	0.12	564	8,609	0.35	52,143	0.18	22,619	0.15
1991	889	0.01	5,897	0.17	3,165	0.12	487	11,625	0.35	51,645	0.38	23,206	0.15
1992	1,595	0.01	5,284	0.18	4,223	0.12	346	5,773	0.35	55,889	0.38	34,129	0.15
1993	952	0.03	4,472	0.19	5,160	0.12	389	13,855	0.35	66,125	0.38	58,962	0.15
1994	1,271	0.03	6,795	0.16	3,435	0.12	388	15,863	0.35	48,368	0.38	33,094	0.15
1995	4,330	0.04	3,790	0.21	3,730	0.12	356	24,772	0.35	33,805	0.15	16,784	0.15
1996	1,800	0.10	4,920	0.15	5,639	0.12	422	15,922	0.35	79,019	0.12	28,949	0.10
1997	1,878	0.11	8,100	0.15	2,970	0.09	272	12,494	0.35	114,938	0.16	26,996	0.11
1998	924	0.14	3,675	0.15	4,132	0.10	391	6,833	0.33	31,039	0.38	25,968	0.15

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	Southeast Alaska Stocks							Transboundary River Stocks					
	Situk River		Chilkat R.		Unuk River		Chickamin R. index	Alsek R.		Taku R.		Stikine R.	
Year	Esc	CV[1]	Esc	CV	Esc	CV	Esc.[2]	Esc	CV	Esc	CV	Esc	CV
1999	1,461	0.10	2,271	0.18	3,914	0.13	492	14,597	0.24	16,786	0.19	19,947	0.16
2000	1,785	0.08	2,035	0.16	5,872	0.11	801	7,905	0.25	34,997	0.15	27,531	0.12
2001	656	0.03	4,517	0.16	10,541	0.11	1,010	6,705	0.41	46,554	0.15	63,523	0.09
2002	1,000	0.01	4,051	0.11	6,988	0.12	1,013	5,569	0.61	55,044	0.2	50,875	0.12
2003	2,117	0.03	5,657	0.12	5,546	0.08	964	5,904	0.44	36,435	0.18	46,824	0.13
2004	698	0.03	3,422	0.13	3,963	0.08	798	7,083	0.52	75,032	0.14	48,900	0.08
2005	595	0.01	3,366	0.17	4,742	0.08	924	4,478	0.35	38,725	0.12	40,501	0.07
2006	295		3,039	0.15	5,645	0.08	1,330	2,323	0.35	42,296	0.13	24,405	0.28
2007	677		1,442	0.16	5,668	0.08	893	2,827	0.35	14,854	0.22	14,560	0.15
2008	413		2,905	0.19	3,104	0.12	1,111	1,885	0.35	27,383	0.09	18,352	0.16
2009	902		4,429	0.17	3,157	0.11	611	6,239	0.35	22,801	0.12	11,086	0.23
2010	167		1,815	0.13	3,835	0.16	1,156	9,518	0.35	29,302	0.09	15,180	0.13
2011	240		2,688	0.12	3,195	0.21	852	6,668	0.35	27,523	0.15	14,569	0.11
2012	322		1,627	0.17	956	0.16	444	2,660	0.35	19,429	0.12	22,671	0.17
2013[3]	912		1,730	0.20	1,135	0.12	468	5,044	0.35	18,002	0.38	16,735	0.17
Lower	500		1,750		1,800		450	3,500		19,000		14,000	
Upper	1,000		3,500		3,800		900	5,300		36,000		28,000	

[1] Escapement is enumerated using a weir on the Situk River and CVs are only applicable for years having estimates of sport.
[2] Escapement is enumerated using index counts in the Chickamin River and these counts are not expanded to an estimate of total escapement; therefore, CVs are not applicable.
[3] Preliminary data.

Appendix B.2.–Northern British Columbia escapements and terminal runs (t. run) of Pacific Salmon Commission Chinook Technical Committee wild Chinook salmon escapement indicator stocks.

	Northern British Columbia												
	Area 1 Yakoun R.	Area 3[1] Nass R.			Area 4 Skeena R.			Area 8 Dean R.	Area 8[2] Atnarko R.			Area 9 Rivers	Area 10 Smith
Year	Esc	Above GW[1]	Esc	t. run	Total Esc	GSI esc	GSI SD	index	Total Esc	CV	Wild[3]	Inlet	Inlet[4]
1975	1,500		14,895	17,874	20,319				3,600			3,280	960
1976	700		13,819	16,583	13,078				11,700			1,640	1,000
1977	800	13,688	14,288	18,410	29,018				10,800			2,225	1,050
1978	600	15,485	16,885	21,807	22,661			3,500	13,500			2,800	2,100
1979	400	11,253	12,783	16,229	18,488			4,000	4,050			2,150	500
1980	600	13,476	14,855	18,744	23,429			2,000	6,480			2,325	1,200
1981	750	12,625	13,925	17,606	24,523			3,500	4,050			3,175	1,020
1982	1,400	7,959	10,359	13,287	17,092				7,200			2,250	1,500
1983	600	13,252	16,301	20,516	23,562			500	7,740			3,320	1,050
1984	300	20,967	24,967	31,408	37,598	51,348	14,818	4,500	13,788			1,400	770
1985	1,500	17,782	19,694	24,768	53,599	30,875	5,648	4,000	24,804			3,371	230
1986	500	36,523	38,123	47,967	59,968	28,398	6,204	3,300	19,170			7,623	532
1987	2,000	19,540	20,986	26,568	59,120	150,874	27,774	1,144	12,983			5,239	1,050
1988	2,000	15,345	16,715	21,094	68,705	91,496	13,217	1,300	13,500			4,429	1,050
1989	2,800	28,133	29,175	36,594	57,202	72,422	10,457	2,300	19,800			3,265	225
1990	2,000	24,051	26,551	33,384	55,976	64,188	10,638	2,000	16,710	0.143	11,630	4,039	510
1991	1,900	6,907	8,259	13,136	52,753	41,940	7,364	2,400	13,906	0.132	8,952	6,635	500
1992	2,000	16,808	17,408	25,405	63,392	103,365	25,532	3,000	32,862	0.128	22,015	7,500	500
1993	1,000	24,814	26,508	36,678	66,977	119,780	22,066	700	35,430	0.126	20,961	10,000	500
1994	2,000	21,169	25,689	32,864	48,712	78,228	14,149	1,300	28,178	0.112	12,257	3,500	700
1995	1,500	7,844	8,776	16,187	34,390	62,272	16,627	1,100	23,420	0.179	8,150	3,196	400
1996	3,000	21,842	22,712	30,889	73,684	155,637	32,769	2,000	20,767	0.106	5,962	3,000	250
1997	2,500	18,702	20,584	27,658	42,539	57,368	12,437	1,400	11,251	0.088	4,013	4,980	100
1998	3,000	23,213	25,361	34,922	46,744	80,677	16,199	3,000	13,470	0.078	6,094	5,367	1,100
1999	3,200	11,544	13,118	22,310	43,775	53,418	8,204	1,800	16,549	0.141	7,199	2,739	500
2000	3,600	18,912	20,565	31,159	51,804	95,563	13,496	1,200	17,352	0.064	9,964	6,700	500

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		Northern British Columbia											
	Area 1 Yakoun R.	Area 3[1] Nass R.			Area 4 Skeena R.			Area 8 Dean R.	Area 8[2] Atnarko R.			Area 9 Rivers	Area 10 Smith
Year	**Esc**	**Above GW[1]**	**Esc**	**t. run**	**Total Esc**	**GSI esc**	**GSI SD**	**index**	**Total Esc**	**CV**	**Wild[3]**	**Inlet**	**Inlet[4]**
2001	3,500	29,687	31,915	44,595	81,504	145,120	18,738	3,795	***21,635***	***0.034***	***16,743***	5,062	300
2002	3,000	13,773	15,382	21,528	44,771	89,235	11,984	3,731	***11,511***	***0.084***	***8,550***	5,031	
2003	4,000	26,940	28,330	36,503	56,758	114,346	16,234	3,700	***12,619***	***0.055***	***10,136***	1,900	
2004	4,500	15,912	18,185	25,137	44,243	142,141	19,631	3,500	11,825	0.089	8,230	3,950	
2005	5,000	14,363	16,595	24,067	29,067	77,531	9,783	2,200	11,677	0.110	7,619	5,585	
2006	NA	24,725	27,743	37,098	33,094	84,199	15,599	3,700	19,288	0.156	9,565	3,930	
2007	NA	21,459	25,524	34,221	33,352	85,179	17,559	2,300	8,229	0.061	5,799	5,000	
2008	NA	17,862	20,198	26,202	32,963	71,446	13,043	1,100	7,288	0.073	5,517	5,792	
2009	NA	28,710	30,334	36,865	38,297	80,900	16,297	1,400	***10,926***	***0.047***	***6,331***	4,580	
2010	NA	19,341	20,821	26,052	43,331	101,486	19,344	1,600	***10,497***	***0.059***	***5,683***	4,225	
2011	NA	9,639	10,415	15,092	37,073	53,682	12,239	750	***8,645***	***0.071***	***6,061***	4,400	
2012	NA	8,309	9,815	15,086	34,024	33,473	5,746	NA	***7,425***	***0.060***	***2,542***	4,142	
2013	NA	8,011	9,306	13,525	26,699	39,179	4,903	NA	***22,690***	***0.047***	***9,860***	4,672	

[1] GW refers to Gitwinksihlkw, the location of the lower fish wheels on the Nass River used to capture Chinook salmon for the MR estimate.

[2] Estimates prior to 1990 are visual counts, 1990–2000 and 2004–2008 are based on time series calibration, 2001–2003 and 2009–2013 are maximum likelihood estimates based on MR estimates.

[3] Large wild Atnarko Chinook salmon.

[4] The Docee River was dropped as an escapement indicator beginning in 2002 due to an inability to obtain reliable escapement estimates.

Appendix B.3.–Southern British Columbia escapements of Pacific Salmon Commission Chinook Technical Committee wild Chinook salmon escapement indicator stocks.

Year	Lower GS		Upper Georgia Strait[1]					
	Nanaimo	Cowichan	Nimpkish	Klinaklini	Kakweiken	Kingcome	Wakeman	Esc. index
1975	5,475		1,100	16,560	200	1,500	1,500	20,860
1976	4,340		3,500	14,569	650	1,500	2,000	22,219
1977	6,530		750	21,078	130	750	750	23,458
1978	6,495		1,300	13,848	350	1,000	1,000	17,498
1979	2,741	7,945	500	7,955	60	50	233	8,798
1980	2,982	5,837	300	4,883	500	32	35	5,750
1981	225	5,782	700	8,619	200	20	25	9,564
1982	1,152	5,034	700	12,887	196	450	750	14,983
1983	1,840	4,742	1,500	10,536	160	359	309	12,864
1984	3,178	5,278	3,000	5,776	88	197	169	9,230
1985	914	3,675	3,000	9,327	500	150	300	13,277
1986	958	2,147	700	22,697	344	774	100	24,616
1987	757	2,519	3,000	27,069	411	1,500	1,000	32,980
1988	1,079	6,878	1,500	6,800	103	200	500	9,103
1989	1,552	5,535	3,850	40,002	607	500	800	45,759
1990	1,397	5,626	1,200	11,650	177	300	300	13,626
1991	935	7,408	1,400	22,784	140	526	300	25,150
1992	1,127	10,250	3,400	13,643	50	316	152	17,561
1993	1,405	7,030	300	3,406	53	193	223	4,175
1994	1,072	6,407	300	3,427	30	108	79	3,944
1995	2,300	16,449	300	4,755	157	426	54	5,692
1996	1,870	14,595	399	3,857	50	124	108	4,538
1997	1,772	9,973	350	3,800	39	450	125	4,764
1998	1,800	5,858	450	9,980	6	450	250	11,136
1999	2,371	6,110	640	11,068	146	70	281	12,205
2000	1,446	6,638	350	17,202	30	228	31	17,841
2001	2,448	5,015	365	9,355	129	527	116	10,492
2002	1,747	4,115	570	12,529	33	301	73	13,506
2003	1,672	3,356	385	13,365	164	122	21	14,057
2004	550	2,721	969	6,310	96	744	32	8,150
2005	1,036	2,467	576	3,980	60	95	28	4,739
2006	2,135	1,775	500	14,228	216	316	145	15,405
2007	2,267	2,175	514	5,791	88	75	90	6,558
2008	2,671	2,015	532	4,915	75	35	35	5,592
2009	1,470	785	929	10,134	154	64	19	11,300
2010	2,201	2,879	543	7,119	108	55	26	7,851
2011	3,937	3,492	720	4,829	5	6	20	5,580
2012	1,063	3,508	2,630	18,174	276	4	20	21,103
2013	593	4,775	2,589	18,041	274	26	24	20,954
Goal		6,500						

[1] Upper Georgia Strait (UGS) escapement updated with time series for 5 stream index.

Appendix B.4.–West Coast Vancouver Island 6-stream index escapements of Pacific Salmon Commission Chinook Technical Committee wild Chinook salmon escapement indicator stocks.

	WCVI[1]						
Year	Marble	Burman	Tahsis	Artlish	Kaouk	Tahsish	Esc. index
1975	400	200	75	25	75	25	800
1976	400	400	200	25	25	25	1,075
1977	950	500	150	60	75	100	1,835
1978	1,500	1,000	100	50	50	50	2,750
1979	750	650	348	40	60	200	2,048
1980	5,000	345	373	100	100	200	6,118
1981	3,000	300	150	500	100	1,000	5,050
1982	5,000	70	125	100	100	1,000	6,395
1983	1,000	475	50	400	300	500	2,725
1984	600	700	12	650	400	1,500	3,862
1985	1,250	500	50	400	300	1,200	3,700
1986	1,100	400	60	100	100	1,000	2,760
1987	1,750	100	20	100	100	500	2,570
1988	3,275	500	125			400	4,300
1989	4,181	780	500	40	30	450	5,981
1990	1,973	1,100	300	50	10	200	3,633
1991	710	2,767	1,515	20	20	120	5,152
1992	800	2,198	1,463	10	80	600	5,151
1993	2,000	1,750	578	10	20	250	4,608
1994	650	2,330	380	100	150	250	3,860
1995	1,626	594	525	99	266	600	3,710
1996	3,971	724	771	53	219	288	6,026
1997	2,638	2,354	722	402	558	523	7,197
1998	5,297	3,205	587	300	824	1,430	11,643
1999	4,185	2,399	1,731	539	453	879	10,186
2000	2,572	212	1,220	75	105	391	4,575
2001	1,450	107	389	139	409	237	2,731
2002	2,485	440	758	41	251	308	4,283
2003	1,749	768	762	379	358	440	4,456
2004	3,658	2,636	905	454	301	495	8,449
2005	2,354	642	182	199	488	121	3,986
2006	3,071	516	141	228	536	76	4,568
2007	2,764	353	133	162	193	234	3,839
2008	2,683	515	281	200	264	380	4,323
2009	3,440	1,800	780	214	550	80	6,864
2010	3,560	3,028	380	110	185	355	7,618
2011	3,910	2,020	220	100	300	260	6,810
2012	2,364	1,003	163	141	223	138	4,032
2013	2,081	8,285	545	399	240	350	11,900
Goal							

[1] The escapement methodology changed for the WCVI streams in 1995, and the earlier estimates have not been calibrated to the new methodology.

Appendix B.5.–Fraser River escapements and terminal runs (t. run) of Pacific Salmon Commission Chinook Technical Committee wild Chinook salmon escapement indicator stocks.

	Fraser River									
	Fraser Spring Age 1.2	Fraser Spring Age 1.3	Fraser Summer Age .3	Fraser Summer Age 1.3	Fraser Spr/Sum	Harrison			Lower Shuswap[1]	
Year	Esc	Esc	Esc	Esc	t. run	Esc	CV	t. run	Esc	CV
1975	7,179	8,184	26,875	16,875	119,081				27,582	0.342
1976	4,600	10,307	4,925	13,630	98,691				3,604	0.418
1977	3,675	13,261	19,600	17,240	132,553				14,356	0.345
1978	4,305	15,725	16,700	19,200	109,119				15,802	0.343
1979	2,770	14,985	18,275	10,205	101,252				15,158	0.344
1980	6,255	16,521	8,350	13,625	71,504				5,822	0.383
1981	2,975	12,274	13,120	12,202	62,668				8,093	0.365
1982	5,510	15,010	6,850	15,088	85,140				3,168	0.430
1983	2,641	24,225	9,500	16,604	72,526				5,396	0.146
1984	6,380	30,370	15,522	13,595	95,681	120,837		131,740	7,581	0.080
1985	9,477	43,168	20,375	19,099	121,941	174,778		181,367	10,539	0.075
1986	10,275	48,446	22,460	32,505	144,617	162,596		177,662	18,400	0.341
1987	5,049	48,271	22,404	27,646	128,699	79,038		81,799	15,158	0.344
1988	4,003	41,783	29,567	32,066	129,587	35,116		38,285	21,697	0.340
1989	6,126	31,994	24,200	16,200	106,843	74,685		76,294	16,772	0.342
1990	3,225	41,560	25,425	33,747	135,124	177,375		180,837	20,042	0.340
1991	3,495	27,296	26,250	28,097	116,555	90,638		93,363	15,158	0.344
1992	5,937	33,038	32,200	38,011	130,249	130,411		132,042	20,537	0.340
1993	7,870	32,796	13,300	21,385	110,237	118,998		120,600	8,860	0.361
1994	10,696	51,655	25,350	23,657	145,303	98,334		100,839	25,296	0.341
1995	9,670	45,237	20,550	26,371	134,478	28,616		29,840	15,158	0.344
1996	20,726	38,398	50,900	43,142	185,559	56,809			30,146	0.343
1997	9,878	44,373	49,250	40,882	202,795	72,277	.091		20,207	0.340
1998	3,003	37,862	68,033	36,750	169,333	188,420		189,103	26,232	0.341
1999	8,751	20,740	53,204	25,138	140,939	106,995	.102		40,090	0.349
2000	11,731	26,773	45,161	25,869	155,209	125,854			27,676	0.040
2001	10,607	31,512	74,132	33,980	177,008	113,777			35,788	0.026
2002	16,820	41,054	84,286	37,763	222,006	89,968	.082	91,122	54,219	0.017
2003	18,963	46,984	70,070	43,288	231,031	247,121	.083	251,453	32,921	0.344
2004	12,180	32,019	61,550	31,550	203,225	128,944		131,894	16,963	0.045
2005	3,898	21,131	88,313	18,915	172,267	88,580	.063	94,880	17,892	0.031
2006	7,010	21,652	149,883	20,791	243,380	60,422	.135	62,419	59,085	0.024
2007	1,407	11,640	85,732	10,636	137,303	76,483	.068	80,718	15,926	0.027
2008	6,121	16,379	106,539	16,202	187,560	41,603	.073	43,798	14,921	0.037
2009	844	26,284	86,377	20,839	174.719	70,141	.064	75,550	25,113	0.018
2010	6,432	18,057	157,289	18,456	232,095	103,515	.056	106,777	71,379	0.021
2011	2,233	12,104	127,958	18,528	216,154	123,647	.052	132,140	18,874	0.029
2012	7,314	11,617	47,949	10,180	111,427	44,467	.086	46,404	4,091	0.030
2013	3,157	17,582	130,617	12,573	185,922	42,953	.070	44,675	28,797	0.016
Goal						75,100				
Goal						98,500				

[1] Escapement was estimated by MR methods from 1983 to 1985, 2000 to 2002, and 2004 to 2012. All other years are calibrated values that have been estimated using a relationship between MR and peak methods.

Appendix B.6.–Puget Sound escapements and terminal runs (t. run) of Pacific Salmon Commission Chinook Technical Committee wild Chinook salmon escapement indicator stocks.

	Puget Sound (includes hatchery strays in natural escapement unless noted otherwise)																			
	Skagit River Spring		Skagit River Summer/Fall		Stillaguamish River			Snohomish River			Green River			Nooksack Spring Esc				Lake Washington Fall	
Year	Esc	t. run	Esc	t. run[1]	MR esc[2]	Esc	t. run[1]	MR esc[2]	Esc	t. run	MR esc[2]	Esc	t. run	N. Fork Esc	N. Fork NOR[3]	S. Fork Esc[4]	S. Fork NOR[5]	Esc	t. run
1975	627	627	11,320	30,299		1,198	1,801		3,953	5,993		3,394	6,838					656	1004
1976	633	633	14,120	28,589		2,140	4,241		4,659	9,740		3,140	8,246					719	937
1977	520	520	9,218	21,502		1,475	2,847		5,542	10,760		3,804	5,936					675	889
1978	932	932	13,075	24,285		1,232	2,159		7,905	13,747		3,304	4,766					890	1353
1979	818	818	13,306	24,350		1,042	2,531		5,726	14,010		9,704	11,689					1,289	1578
1980	1,408	1,408	20,058	31,250		821	2,818		6,526	18,683		7,743	11,248					1,360	1683
1981	1,045	1,045	8,283	21,817		630	3,014		3,330	10,466		3,606	5,532					721	924
1982	753	753	9,910	24,259		773	3,229		4,498	9,820		1,840	4,271					885	1384
1983	554	554	8,723	15,758		387	1,089		4,537	11,853		3,679	14,376					1,332	2515
1984	696	696	12,628	15,616		374	920		3,484	9,554		3,353	5,890	45		188		1,252	4211
1985	2,634	2,634	16,002	26,230		1,409	2,717		4,730	9,455		2,908	7,914	258		445		949	2627
1986	1,922	1,922	17,908	22,906		1,277	2,499		4,534	7,322		4,792	6,114	226		170		1,470	2863
1987	1,745	1,745	9,409	13,387		1,321	1,982		4,689	6,951		10,338	12,283	181		248		2,038	4835
1988	1,743	1,743	11,468	15,262		717	1,245		4,513	7,529		7,994	9,667	456		233		792	2829
1989	1,400	1,809	6,684	13,270		784	1,664		3,173	5,823		11,512	15,244	303		606		1,011	1544
1990	1,511	1,546	16,521	18,950		842	1,867		4,722	6,913		7,035	15,483	10		142		787	1098
1991	1,236	1,273	5,824	8,604		1,536	2,969		2,800	3,980		10,548	15,451	108		365		661	1115
1992	986	1,010	7,348	9,021		639	1,279		2,708	3,269		5,267	10,165	498		103		790	1212
1993	782	812	5,801	7,097		719	1,259		4,019	4,524		2,476	5,507	449		235		245	324
1994	470	496	5,549	5,912		773	1,323		3,406	3,715		4,078	8,368	45		118		888	926
1995	855	887	6,877	9,239		775	1,495		3,356	3,871		7,939	9,935	230		290		930	966
1996	1,051	1,078	10,613	10,828		1,244	2,276		4,851	5,352		6,026	8,664	535		203		336	362
1997	1,041	1,064	4,872	6,092		1,156	17,298		4,078	4,259		7,101	7,778	617		180		294	302
1998	1,086	1,091	14,609	14,965		1,544	2,434		6,306	6,658		5,963	7,777	370	37	157		697	711
1999	471	476	4,924	5,229		1,098	2,264		4,791	4,964		7,135	8,376	823	85	288	32	778	791
2000	1,021	1,025	16,930	17,265		1,645	3,065		6,095	6,613	10,526	4,473	6,880	1,242	160	373	153	347	393
2001	1,856	1,866	13,793	14,046		1,349	2,051		8,166	8,709	21,402	6,473	9,721	2,209	264	420	209	1,269	1555
2002	1,076	1,092	19,591	19,911		1,588	2,219		7,223	7,444	14,857	7,564	11,539	3,741	224	625	191	637	663
2003	909	987	9,777	10,106		988	1,320		5,447	5,810		5,864	7,871	2,857	210	591	69	771	826
2004	1,622	1,622	23,553	24,107		1,506	1,974		10,602	11,051		7,947	13,498	1,719	314	172	59	730	794
2005	1,305	1,305	20,803	23,405		1,036	1,493		4,480	4,974		2,523	2,987	2,047	210	232	74	726	788
2006	1,896	1,919	20,768	22,539		1,254	1,543		8,188	8,681		5,790	8,604	1,184	275	532	167	1,219	1433
2007	613	613	11,281	13,027	1,881	607	866		3,982	4,208		4,301	7,205	1,438	334	348	73	1,968	3342
2008	1,472	1,472	11,664	14,995	1,836	1,671	1,861		8,373	8,506		5,971	10,290	1,266	307	448	190	941	2917
2009	983	983	6,955	12,460	1,110	1,001	1,218		2,309	2,370		688	1,067	1,903	269	457	103	793	951

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Year	Puget Sound (includes hatchery strays in natural escapement unless noted otherwise)																		
	Skagit Spring		Skagit Sum/fall		Stillaguamish			Snohomish			Green River			Nooksack Spring Esc				Lake Washington Fall	
	Esc	t. run	Esc	t. run[1]	MR esc[2]	Esc	t. run[1]	MR esc[2]	Esc	t. run	MR esc[2]	Esc	t. run	N. Fork Esc[3]	N. Fork NOR[4]	S. Fork Esc[3]	S. Fork NOR[5]	Esc	t. run
2010	1,361	1,537	8,037	9,060	1,381	783	1,014		4,299	4,435	4,541	2,092	2,112	2,044	204	552	73	729	734
2011	825	1,015	5,536	9,181	1,296	1,017	1,264	10,399	1,880	1,972	3,382	993	1,464	865	99	483	165	906	1,034
2012	2,774	3,278	13,817	15,864	1,750	1,534	1,733	7,763	5,124	5,216	4,528	3,091	3,804	758	281	508[6]		1,674	1,875
2013	2,010	2,398	10,882	14,082		854	1,003		3,244	3,320		2,041	2,332					2,098	3,024

1 Escapement excludes brood stock collected for supplementation program. Total run includes redd count based escapement of all natural spawners, terminal catch, and adult brood stock collected for supplementation and PSC indicator program

2 Escapement estimated from MR studies funded under Sentinel Stocks Program and/or U.S. Letter of Agreement.

3 Estimate of total natural spawners (hatchery + natural) during the spring Chinook salmon escapement accounting period (prior to Oct. 1); includes some early-timed summer/fall Chinook salmon in the south Fork but is assumedly spring Chinook salmon only in the north fork/middle fork Chinook salmon (due to spawn timing differences).

4 Natural-origin spring Chinook salmon separated from total spring Chinook salmon escapement based on carcass mark–sampling details (otolith thermal marks, fin clips, CWTs).

5 Natural-origin spring Chinook salmon isolated from total natural spawners based on carcass mark–sampling details (otolith thermal marks, fin clips, CWTs) and GSI; displayed estimate includes stray north fork/middle fork natural-origin spring Chinook salmon and south fork natural-origin spring Chinook salmon.

6 Preliminary; natural-origin breakout not yet available.

Appendix B.7.–Washington Coast escapements and terminal runs (t. run) of Pacific Salmon Commission Chinook Technical Committee wild Chinook salmon escapement indicator stocks.

Washington Coast																		
	Quillayute Summer		Quillayute Fall		Hoh Spr/Sum		Hoh Fall		Hoko Fall		Queets Spr/Sum		Queets Fall		Grays Harbor Spring		Grays Harbor Fall	
Year	Esc	t. run	Esc	t. run	Esc	t. run	Esc	t. run	Esc[1]	t. run	Esc	t. run	Esc	t. run	Esc	t. run	Esc	t. run
1976	1,300	1,700			600	1,300	2,500	3,100			505	737	1,200	2,500	600	1,000	1,836	10,313
1977	3,800	5,300			1,000	2,000	2,100	3,800			732	1,155	3,600	5,500	800	1,700	5,195	14,400
1978	2,300	2,700			1,400	2,472	1,900	2,900			1,110	1,406	2,200	3,100	1,000	1,600	4,555	8,372
1979	2,100	3,900			1,400	2,326	1,700	2,200			870	1,369	3,900	4,700	400	1,100	9,381	10,101
1980	964	1,500	6,700	7,600	800	1,079	2,200	2,800			1,038	1,213	3,200	5,800	200	600	11,656	21,639
1981	815	1,700	5,963	7,102	1,498	2,005	3,100	4,000			988	1,329	4,250	8,200	600	900	7,577	11,915
1982	1,126	2,700	7,107	9,651	1,553	2,125	4,500	5,800			781	1,244	4,150	6,600	610	669	5,606	13,296
1983	548	1,800	3,069	5,530	1,696	2,233	2,500	3,300			1,044	1,173	2,750	4,400	800	850	5,482	8,997
1984	618	1,000	9,128	10,447	1,430	2,005	1,900	2,600			958	1,189	4,350	6,300	1,128	1,130	21,058	22,616
1985	550	700	6,145	8,367	978	1,353	1,725	2,720			677	886	4,150	5,910	1,157	1,159	9,537	15,153
1986	853	1,000	10,006	13,380	1,248	1,912	4,981	6,000	801	801	925	1,193	7,894	9,180	1,795	1,826	13,808	23,535
1987	666	1,600	12,352	20,349	1,710	2,480	4,006	6,147	581	581	598	1,543	6,557	10,638	841	1,071	19,013	34,460
1988	2,599	3,943	15,168	22,115	2,605	3,708	4,128	6,873	686	776	1,765	2,267	9,494	12,505	3,106	3,208	28,158	39,895
1989	2,407	3,472	9,951	17,260	4,697	6,820	5,148	8,682	775	842	2,568	3,954	9,324	12,213	2,068	2,393	25,677	56,028
1990	1,483	1,840	13,711	16,914	3,886	5,294	4,236	6,327	378	493	1,780	2,480	10,569	13,155	1,567	1,630	16,995	39,735
1991	1,188	1,500	6,292	7,631	1,078	1,693	1,420	2,628	894	1,006	630	761	4,795	6,593	1,289	1,489	14,392	33,271
1992	1,009	1,271	6,342	7,750	1,018	1,443	4,003	5,139	642	740	375	505	4,911	6,880	1,813	1,851	16,592	33,276
1993	1,292	1,531	5,254	5,735	1,411	2,065	2,280	3,951	775	894	713	788	3,463	5,667	1,254	1,399	13,349	28,941
1994	974	1,187	4,932	5,692	1,699	2,372	3,967	4,322	332	428	705	727	4,233	6,854	1,403	1,479	14,320	30,718
1995	1,333	1,731	5,532	6,716	1,132	1,686	2,202	2,912	750	905	625	662	3,127	5,101	2,070	2,167	12,727	31,729
1996	1,170	1,388	7,316	9,293	1,371	2,083	3,022	4,061	1,227	1,265	776	891	4,218	5,927	4,462	4,655	20,227	34,040
1997	890	1,177	5,405	6,047	1,826	2,582	1,773	3,034	768	894	540	693	2,872	4,945	4,460	4,812	18,168	30,842
1998	1,599	1,829	6,752	7,940	1,287	1,880	4,257	5,388	1,618	1,722	492	537	3,859	5,173	2,388	2,679	12,529	20,319
1999	713	818	3,334	4,758	928	1,081	1,924	2,941	1,497	1,688	373	426	1,918	3,105	1,285	1,555	10,363	12,846
2000	989	1,149	3,730	4,794	492	529	1,749	2,632	612	731	248	250	3,755	4,147	3,135	3,424	9,385	15,943
2001	1,255	1,429	5,136	7,545	1,159	1,231	2,560	4,116	768	946	548	565	3,066	4,775	2,860	3,326	9,492	19,397

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Washington Coast																		
	Quillayute Summer		Quillayute Fall		Hoh Spr/Sum		Hoh Fall		Hoko Fall		Queets Spr/Sum		Queets Fall		Grays Harbor Spring		Grays Harbor Fall	
Year	Esc	t. run	Esc	t. run	Esc	t. run	Esc	t. run	Esc[1]	t. run	Esc	t. run	Esc	t. run	Esc	t. run	Esc	t. run
2002	1,002	1,100	6,067	9,492	2,464	3,375	4,415	5,716	443	680	738	755	2,598	5,571	2,598	3,217	11,841	16,610
2003	1,219	1,262	7,398	9,469	1,228	1,646	1,649	2,345	863	1,098	189	195	4,971	6,611	1,904	2,101	19,871	22,866
2004	1,093	1,189	3,831	6,133	1,786	2,239	3,237	4,410	866	1,086	604	619	5,173	6,874	5,034	5,330	31,773	42,515
2005	876	965	6,406	8,319	1,193	1,389	4,180	5,337	203	284	298	306	4,578	6,755	2,130	2,683	19,695	23,565
2006	553	604	5,642	7,646	904	1,061	1,535	2,324	845	895	330	336	3,059	4,266	2,481	2,863	17,428	24,928
2007	502	568	3,066	4,137	810	1,023	1,556	2,427	462	568	352	358	872	1,595	652	999	13,117	18,420
2008	949	1,134	3,612	5,250	671	717	2,849	3,761	431	483	305	305	3,105	4,208	996	1,282	15,391	18,661
2009	464	682	3,130	5,874	880	913	2,081	2,851	103	385	495	495	3,135	4,918	1,133	1,358	9,290	14,498
2010	659	828	4,635	6,431	828	861	2,599	2,941	319	793	382	382	4,031	6,001	3,497	3,704	18,228	25,795
2011	600	995	3,993	7,207	827	948	1,293	2,157	1,275	1,504	373	373	3,857	6,649	2,563	2,664	22,870	35,829
2012	731	845	3,181	6,416	915	1,055	1,937	3,015	401	620	764	764	3,707	6,757	959	959	14,034	24,788
2013	968	1,140	3,901	5,969	750	873	1,269	2,810	656	751	520	520	2,413	4,846	2,459	2,540	12,153	15,849
Goal			3,000		900		1,200				700		2,500					

[1] Escapement excludes brood stock for supplementation program. Total run includes red-count-based escapement, terminal catch, and adult brood stock collected for supplementation and PSC indicator program.

Appendix B.8.–Columbia upriver spring and upriver summer escapements and terminal runs (t. run) of Pacific Salmon Commission Chinook Technical Committee Chinook salmon escapement indicator stocks.

	Columbia Upriver Springs[1]						Columbia Upriver Summers[2]	
	Upper Columbia R.		Snake R. Spr/Sum		Total			
Year	Esc	t.run	Esc	t.run	Esc	trun.	Esc	t.run
1975								
1976								
1977								
1978								
1979							18,797	22,142
1980	2,772	7,128	6,134	20,968	8,906	28,096	13,854	22,498
1981	3,253	6,044	11,318	24,753	14,571	30,797	8,639	18,746
1982	3,015	6,314	11,307	27,601	14,322	33,915	6,587	14,369
1983	4,286	7,292	9,845	20,936	14,131	28,228	6,334	13,145
1984	4,608	6,706	7,929	14,119	12,537	20,825	13,984	18,765
1985	8,941	10,290	10,682	14,865	19,623	25,155	14,505	18,522
1986	5,519	7,903	11,359	20,085	16,878	27,988	14,850	18,752
1987	6,352	8,777	10,140	15,870	16,492	24,647	13,415	22,715
1988	5,658	7,503	11,182	17,368	16,840	24,871	13,634	22,720
1989	4,130	7,455	6,499	14,707	10,629	22,162	17,484	22,201
1990	2,808	4,437	9,357	17,582	12,165	22,019	13,432	18,794
1991	1,533	2,437	5,756	13,106	7,289	15,543	10,191	14,323
1992	3,163	4,261	12,677	20,657	15,840	24,918	7,706	9,428
1993	3,102	4,050	12,531	17,911	15,633	21,961	12,927	14,021
1994	611	1,044	1,856	3,721	2,467	4,765	12,292	14,691
1995	108	224	1,167	3,395	1,275	3,619	10,623	12,455
1996	317	575	3,643	9,062	3,960	9,637	9,417	12,080
1997	746	1,222	5,055	9,620	5,801	10,842	10,063	17,709
1998	367	547	7,281	13,725	7,648	14,272	11,225	15,536
1999	284	401	2,853	5,525	3,137	5,926	18,588	21,867
2000	904	1,367	8,187	13,921	9,091	15,288	20,218	22,595
2001	4,807	6,252	44,572	63,154	49,379	69,406	48,844	52,960
2002	1,957	2,992	29,872	52,209	31,829	55,201	86,825	89,524
2003	1,554	2,160	32,080	50,641	33,634	52,801	81,543	83,058
2004	1,638	2,303	20,967	33,103	22,605	35,406	62,311	65,623
2005	2,057	2,776	9,832	15,155	11,889	17,931	54,033	60,272
2006	912	1,430	9,340	16,814	10,252	18,244	61,821	77,573
2007	448	505	6,903	10,373	7,351	10,878	28,222	37,035
2008	664	815	17,171	23,946	17,835	24,761	38,171	55,532
2009	1,089	1,149	14,313	20,240	15,402	21,389	44,295	53,881
2010	2,499	3,127	25,211	34,764	27,710	37,891	47,220	72,346
2011	2,075	2,531	23,844	30,567	25,919	33,098	44,432	80,574
2012	4,352	5,533	24,828	33,856	29,180	39,389	52,184	58,300
2013	2,658	3,584	13,916	21,929	16,574	25,513	68,386	65,570
Goal							12,143	

[1] For the purposes of *U.S. v. Oregon* management and tribal treaty/nontreaty allocation, the Columbia Upriver spring stock includes all fish destined to pass Bonneville Dam during the spring management period, including those destined for major tributaries such as the Deschutes and John Day rivers. These estimates of river mouth return and escapement are for only the adult upper Columbia wild spring Chinook salmon and the adult Snake River wild spring/summer Chinook salmon components. Escapements are past Rock Island Dam and past Lower Granite Dam (plus Tucannon River escapement), respectively. These are reported annually by the *U.S. v. Oregon* Technical Advisory Committee (Joint Columbia River Management Staff 2013, Tables 8 and 9).

[2] Based on a stock–recruitment analysis of model data which included both hatchery and wild fish, an interim goal of 12,143 adult Mid-Columbia summers at Rock Island Dam was developed. For consistency with the goal, the escapement time series reported here was changed to the total adult Rock Island Dam count. The terminal run is that reported for Upriver summer Chinook salmon in the Joint Staffs Reports as the Bonneville Dam Count plus catch in lower river fisheries. These were also changed to include both hatchery and wild returns, where previously only naturally spawning returns were reported.

Appendix B.9.–Columbia River fall Chinook escapements and terminal runs (t. run) of Pacific Salmon Commission Chinook Technical Committee Chinook salmon escapement indicator stocks.

	Coweeman					Columbia Upriver Fall Chinook				
	Index	Total	CV	Lewis River[1]		Deschutes River[2]			Upriver Brights[3]	
Year	Esc	Esc	(Total)	Esc	t.run	MR Esc	Esc	t.run	Esc	t.run
1975	94			13,859	13,859				29,600	163,833
1976	74			3,371	3,371				27,700	109,076
1977	86			6,930	6,930		7,903	9,764	36,060	85,336
1978	62			5,363	5,363		5,393	7,364	25,798	77,936
1979	88			8,023	8,023		5,126	6,718	28,926	82,482
1980	56			16,394	16,856		4,106	6,057	27,708	70,743
1981	38			19,297	20,298		6,070	7,907	19,520	58,693
1982	73			8,370	10,126		5,513	7,529	28,313	71,471
1983	40			13,540	14,489		5,491	6,987	45,567	79,113
1984	164			7,132	8,128		2,779	3,749	52,266	127,651
1985	168			7,491	8,241		7,902	8,709	74,206	187,691
1986	124			11,983	13,504		7,467	8,620	93,051	272,949
1987	86			12,935	14,173		9,187	11,244	126,153	409,412
1988	1,108			12,059	13,636		9,548	11,939	98,220	327,976
1989	794			21,199	22,813		6,339	8,069	83,281	253,233
1990	268			17,506	18,784		2,864	3,834	49,020	149,759
1991	174			9,066	10,354		5,374	5,528	40,132	97,758
1992	434			6,307	7,129		3,668	3,705	41,434	77,311
1993	350			7,025	8,106		8,809	8,820	42,515	94,088
1994	556			9,939	10,541		9,556	9,625	66,645	123,214
1995	794			9,718	12,155		9,304	9,340	50,595	97,119
1996	2,152			13,971	13,971		10,233	10,311	53,049	132,882
1997	1,328			8,670	8,670		20,208	20,341	50,215	141,386
1998	146			5,929	5,929		15,908	16,415	42,113	125,886
1999	96			3,184	3,184		7,389	7,762	43,313	158,044
2000	128			9,820	9,820		4,985	5,392	60,988	150,352
2001	646			13,886	14,186	9,527	12,817	9,861	84,652	222,630
2002	900	915[4]	0.05	16,380	18,230	11,133	11,907	12,125	116,858	265,144
2003	1,090	1,106[4]	0.03	18,505	20,505	14,265	13,413	15,343	161,005	357,848
2004	1,590	1,801[4]	0.12	15,342	17,133	10,197	10,197	11,421	148,212	356,437
2005	753	1,610[5]	0.20	11,348	13,348	9,355	14,937	10,190	111,148	258,554
2006	566	638[5]	0.10	10,522	11,999	14,196	14,223	14,981	76,252	215,407
2007	251	495[6]	0.19	3,468	3,606	13,181	12,721	13,968	44,962	98,657
2008	424	699[6]	0.11	5,200	5,200		6,908	7,614	72,713	189,681
2009	783	913[7]	0.07	5,410	5,760		6,429	7,116	84,327	204,932
2010	421	592[7]	0.12	8,701	8,701		9,275	10,066	165,726	314,842
2011	835	565[4]	0.08	8,009	11,025		17,117	18,168	129,496	305,940
2012	469	--[7]		8,143	8,450		17,624	18,785	130,414	276,483
2013	2,118	--[7]		15,197	20,267		18,068	20,305	370,267	764,029
Goal				5,700			4,532		40,000	

-continued-

Table B.9.–Page 2 of 2.

[1] This is the number of naturally spawning adult fish in the Lewis River. The terminal run given is the escapement plus the Lewis River sport catch of wild adults.

[2] The first column gives the estimate based on a MR project for the entire river, which was used to verify the Sherars Falls estimates. The second column is the estimate based on using the ratio of redds above and below Sherars Falls. The time series of data through 2009 were updated based on a comprehensive analysis by Warm Springs, ODFW and Columbia River Intertribal Fish Commission (CRITFC) staff (Sharma et al. unpublished).

[3] The CRFMP (1988) stated an interim escapement goal of 40,000 natural spawning Upriver Brights at McNary Dam, including 38,700 for Hanford Reach and 1,100 Snake River. In 1990, the escapement goal was increased to 45,000 for increased hatchery programs. In 1994, a management goal of 46,000 was established, and in 1995, the management goal was retained while the escapement goal was reduced to 43,500. In 2002, the CRFMP (1988) escapement goal of 40,000 was agreed to by the Chinook Technical Committee. Escapement numbers given are McNary adult dam count minus adult sport and broodstock above the dam. The terminal run is the Columbia River mouth terminal run of Upriver Brights minus the Deschutes River fall Chinook salmon terminal run.

[4] Physical MR.

[5] AUC (live counts).

[6] Redd estimates.

[7] Transgenerational GMR; studies were also conducted in 2012 and 2013, estimates are forthcoming.

Appendix B.10.–Oregon Coastal escapements as estimated via traditional habitat expansion methods and terminal runs (t. run) of Pacific Salmon Commission Chinook Technical Committee wild Chinook salmon escapement indicator stocks.

	Oregon Coastal							
	Nehalem R.		**Siletz R.**		**Siuslaw R.**		**Coquille R.**	
Year	**Esc**	**t. run**	**Esc**	**t. run**	**Esc**	**t. run**	**Esc**	**t. run**
1975	5,197	5,303	2,062	2,689	4,427	4,548	4,927	NA
1976	9,807	9,908	1,326	2,036	7,999	8,153	2,188	NA
1977	11,478	12,093	3,314	3,919	9,492	10,362	4,379	NA
1978	12,059	12,244	2,062	3,700	5,872	6,879	3,951	5,290
1979	12,205	12,469	7,217	8,907	8,040	8,799	4,030	4,715
1980	5,555	5,832	3,680	4,820	10,630	11,183	4,014	4,622
1981	10,752	10,939	4,435	6,751	8,724	9,342	4,313	4,996
1982	5,085	5,282	3,415	4,514	10,870	11,774	6,249	6,865
1983	4,431	4,525	2,136	3,152	4,186	4,885	3,193	3,807
1984	20,341	21,623	3,461	4,552	11,168	12,437	4,502	5,164
1985	18,670	19,473	6,628	7,685	14,822	15,805	3,157	3,853
1986	10,389	11,920	6,748	7,799	14,844	15,965	4,470	5,125
1987	13,560	15,725	4,577	6,023	17,603	19,411	5,640	6,997
1988	14,889	17,185	7,805	9,257	41,746	44,380	7,451	8,635
1989	10,389	12,000	4,401	5,980	28,279	31,690	6,462	7,820
1990	5,104	6,789	4,313	5,373	26,799	29,593	6,064	7,567
1991	5,557	7,685	5,633	6,926	26,100	29,825	9,074	11,470
1992	9,060	11,863	6,044	7,460	26,090	28,350	13,293	15,911
1993	5,345	9,317	4,342	6,506	10,446	14,012	6,993	10,419
1994	6,486	9,412	10,475	12,188	23,570	25,890	6,698	8,696
1995	5,194	8,845	5,164	8,045	26,715	31,194	7,885	10,374
1996	9,211	13,285	7,394	10,274	33,051	39,705	6,346	8,790
1997	10,026	13,069	3,726	6,165	22,305	27,516	6,743	8,338
1998	8,245	10,869	5,516	7,175	24,708	28,882	9,930	12,680
1999	8,063	10,632	4,166	6,232	23,963	27,271	8,513	10,950
2000	6,855	9,119	6,787	9,462	15,730	19,588	6,684	8,974
2001	11,662	15,998	10,563	14,704	38,717	43,836	8,233	12,007
2002	18,089	22,657	14,054	19,019	41,058	47,905	11,848	15,578
2003	10,906	15,095	11,149	15,693	58,998	66,246	16,482	21,572
2004	9,975	14,792	3,902	10,419	40,033	46,062	11,346	14,041
2005	8,114	9,535	6,631	8,931	17,618	19,301	5,029	5,767
2006	4,711	5,902	4,108	6,194	28,082	29,926	3,009	3,790
2007	4,304	5,759	528	1,536	6,764	9,665	2,098	3,557
2008	3,810	4,865	1,202	1,682	11,119	12,405	4,562	5,813
2009	4,070	4,070	2,905	3,343	14,094	15,881	12,308	13,530
2010	5,384	7,254	4,225	5,118	22,197	25,846	32,318	36,940
2011	7,665	9,780	3,638	5,861	30,713	36,546	16,745	21,151
2012	7,515	10,068	4,871	6,657	20,018	24,112	9,300	12,541
2013	18,194	NA	7,364	NA	23,411	NA	5,836	NA
Goal	6,989		2,944		12,925		pending	

Appendix B.11.–Oregon Coastal escapements and terminal runs (t. run) as estimated by MR calibrated indexes of Pacific Salmon Commission Chinook Technical Committee wild Chinook salmon escapement indicator stocks. Estimates presented in boldface represent estimates generated from direct MR study.

Year	Oregon Coastal						
	Nehalem R.		Siuslaw R.		Umpqua R. S. Fork	Coquille R.	
	Esc	t. run	Esc	t. run	Esc[1]	Esc	t. run
1975	4,954	5,060	2,567	2,567	NA	6,668	NA
1976	9,345	9,446	4,565	4,565	NA	2,766	NA
1977	10,937	11,552	4,531	4,531	NA	5,676	NA
1978	11,491	11,676	2,867	3,874	400	5,618	6,957
1979	11,794	12,058	3,554	4,313	NA	5,203	5,888
1980	5,368	5,645	5,483	6,036	697	5,952	6,560
1981	10,390	10,577	3,767	4,385	890	6,405	7,088
1982	4,914	5,111	5,094	5,998	1,011	8,885	9,501
1983	4,282	4,376	923	1,622	1,628	4,686	5,300
1984	19,657	20,939	3,384	4,653	2,594	6,229	6,891
1985	18,042	18,845	6,845	7,828	2,246	4,498	5,194
1986	10,039	11,570	6,513	7,634	1,573	5,642	6,297
1987	13,103	15,268	5,568	7,376	2,795	6,429	7,786
1988	14,388	16,684	14,935	17,569	3,778	8,389	9,573
1989	10,039	11,650	12,856	16,267	6,162	6,948	8,306
1990	4,932	6,617	13,662	16,456	3,761	7,738	9,241
1991	5,370	7,498	15,709	19,434	6,717	10,508	12,904
1992	8,755	11,558	13,221	15,481	8,149	16,636	19,254
1993	5,165	9,137	2,960	6,526	3,364	7,446	10,872
1994	6,268	9,194	9,477	11,797	7,128	6,866	8,864
1995	5,020	8,671	10,246	14,725	11,388	12,060	14,549
1996	8,901	12,975	15,788	22,442	10,019	7,618	10,062
1997	9,689	12,732	8,313	13,524	7,286	8,580	10,175
1998	7,967	10,591	5,456	9,630	1,104	11,877	14,627
1999	7,792	10,361	11,785	15,093	1,804	10,653	13,090
2000	**10,678**	**13,943**	4,648	8,506	3,140	7,880	10,170
2001	**12,431**	**16,767**	**9,723**	**14,482**	6,510	**12,512**	**16,286**
2002	**19,956**	**24,524**	**22,506**	**29,353**	3,831	**13,675**	**17,405**
2003	**21,283**	**25,472**	**28,801**	**36,050**	8,918	**18,876**	**23,966**
2004	9,639	14,456	**29,119**	**35,148**	7,487	**11,668**	**14,363**
2005	6,801	8,222	**13,771**	**17,700**	3,084	5,438	6,176
2006	11,938	13,129	**13,380**	**17,449**	2,396	7,438	8,219
2007	5,193	6,648	3,920	6,821	2,457	2,098	4,037
2008	4,596	5,651	4,544	5,830	2,333	5,803	7,661
2009	**5,786**	**5,786**	5,237	7,024	3,014	15,653	16,875
2010	**7,097**	**8,967**	11,165	14,813	6,184	41,104	45,726
2011	**11,084**	**13,199**	11,909	17,742	7,550	21,291	25,697
2012	**12,952**	**15,505**	16,314	20,408	5,635	11,828	15,069
2013	**15,989**	NA	17,452	NA	10,704	7,423	NA
Goal	pending		pending		pending	pending	

[1] Preliminary analysis has shown that terminal catch of South Fork Umpqua River fall Chinook salmon is negligible.

APPENDIX C. SENTINEL STOCKS PROGRAM IN 2013

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The Sentinel Stocks Committee of the Sentinel Stocks Program (SSP) met in Seattle during December, 2012, to review progress for projects funded in 2012 and to develop a request for proposals for projects in 2013. In response, the committee received 12 proposals for work in 2013. The committee met in Vancouver January 29–30, 2013, to review these proposals, and all submitted proposals were recommended for SSP funding in 2013. The proposals were chosen as per the approach outlined in the directive from the Commission to the commmittee entitled *Implementation Approach for the Chinook Sentinel Stocks Program*, *October, 2008* and the *Sentinel Stocks Program Second Stage Proposal Evaluation, February, 2009*. Recommended proposals represented stocks in all five regions specified in the directive (North Oregon Coast, Puget Sound, Fraser River, WCVI, and NBC The stocks recommended for study in the SSP are of significant importance to the management of fisheries for Chinook salmon under the PST. In February 2013, the PSC approved funding for all 12 proposals. Final funded projects and budget amounts for the 2013 SSP are summarized in Appendix Table C.1 along with a still-active project funded in 2012. Summaries of results from these projects as provided by the proponents are included in the narratives below.

Table C.1.–Projects and funding levels for the SSP in 2013.

Stock Group	Stock	Title	2013 Funding
Oregon Coast	Nehalem River	Nehalem R. Chinook Escapement Enumeration	$236,600
Oregon Coast	Siletz River	Siletz River Chinook Escapement Enumeration	$204,600
Puget Sound	Green River	Abundance Estimate for Green River Chinook	$153,000
Puget Sound	Snohomish River	Abundance Estimate for Snohomish Chinook	$239,100
Puget Sound	Stillaguamish River	Abundance Estimate for Stillaguamish Chinook	$85,000
WCVI/Oregon Coast		Abundance Estimates for Terminal Runs	$154,000
WCVI	Burman River	Burman River Chinook Escapement Estimation	122,300
WCVI	Multiple	Marble, Tahsis and Leiner Survey Life	$180,800
Fraser	S. Thompson River	Abundance Estimate South Thompson Aggregate	$202,800
Fraser	Chilko River	Chilko River Chinook MR	$221,000
NBC	Nass River	Estimate of Aggregate Population in Upper Nass	$112,100
NBC	Skeena River	Escapement Estimation of Skeena River w/GSI	$35,800
Stock Group	**Stock**	**Title**	**2012 Funding**
WCVI	Entire Group	WCVI Statistical Framework	$30,600

Note: Refer to List of Acronyms for definitions.

C.1 Oregon's North Oregon Coast Escapement Indicator Stock Chinook Salmon Enumeration and Spawner Survey Calibration: Nehalem and Siletz River Basins

C.1.1 Stock Descriptions

The Siletz and Nehalem populations of fall Chinook salmon are two of three escapement indicator stocks for the NOC aggregate. The Siuslaw basin is the third escapement indicator stock for the NOC. The NOC stock aggregate is considered one of five driver stocks in AABM fisheries in both Southeast Alaska and Northern British Columbia and is important to both AABM and ISBM fisheries. The NOC aggregate has historically been a very productive and resilient stock complex.

C.1.2 Methods to Estimate Escapement

Under the SSP, spawning escapement was estimated using standard MR methods. Adult fish were captured upon return to each basin using tangle nets in both basins and to a limited extent, a modified fish ladder on the Nehalem River. Fish were marked using operculum punches, the location of which was varied to represent different time frames of freshwater entry. The second capture event(s), or recovery, occurred on the spawning grounds. Carcasses were examined for marks and biological data was collected when possible (e.g., length, sex, scales, and other marks).

A chi-square analyses and Salmonid Population Analysis Software (SPAS; Arnason et al. 1996) were used to evaluate the likelihood that any MR assumptions were violated. The results of these tests and the data collected determined the best (least biased and most precise) estimation techniques for the data. Based on evidence supporting a pooled estimator, the population size was calculated from MR data in both the Siletz and Nehalem basins using the Chapman version of the Petersen equation. Tests were also conducted for size bias using cumulative size distributions and Kolmogorov-Smirnov tests for adults. These tests demonstrated no significant differences in adult size between capture and recovery. Lastly, sex-specific estimates were generated and found similar to pooled estimates—indicating no need to stratify by sex.

C.1.3 Comparison to Historic Estimates

The ODFW estimates spawner escapement in Oregon coastal basins using habitat-expansion methodology in addition to MR estimations. Standardized spawning ground surveys are conducted to record live and dead counts of Chinook salmon (normative estimates). The largest daily sum of live and dead counts for a given survey location (peak count) is identified, and an index calculated (number of fish per mile). The index is expanded by the total estimated available spawning habitat in each basin (in miles). Additional functions are applied to adjust for likely observation error and nonrandom bias. Agency personnel have calculated estimates using these traditional methods while concurrently conducting MR experiments in the Siletz basin since 2005 (Table C.2) and in the Nehalem basin from 2000 to 2003 and from 2009 to 2013

(Table C.3). The normative estimate in the Nehalem is derived using standard surveys from both the Nehalem River and North Fork Nehalem and represents an abundance estimate for the entire basin. The Nehalem River MR estimates excludes the North fork, thus an additional expansion should be considered if an entire basin estimate is desired.

C.1.4 Results Summary

Siletz River. A total of 257 wild adult Chinook salmon were marked in the Siletz River basin during the 2013 return year. A total of 3,269 wild adult carcasses were recovered on the spawning grounds; 58 of which were marked (23% recovery rate). The initial estimated spawner escapement was 14,298 (SE = 1,822, CV = 13%) using the pooled Lincoln-Petersen estimator (with Chapman modification). This year's terminal inriver regulations allowed for angling above the marking site, however, a creel survey was not conducted. Therefore, harvest above the marking site was estimated using a regression based relationship between past creel results and an inseason estimator. Using this technique harvest of 420 adults was estimated above our marking site and reduced the final spawner estimate to 13,878 adult Chinook salmon (Table C.2).

Nehalem River. In the Nehalem River basin in 2013, a total of 664 wild adult Chinook salmon were marked. A total of 1,586 wild adult carcasses were examined on the spawning grounds and 65 marked fish were recovered (10% recovery rate). Assumption testing supported the use of the pooled estimator which produced an estimate of 15,989 (SE = 1,909, CV = 12%; Table C.3)

Table C.2.–Siletz River: Comparisons of Chinook salmon escapement estimates between traditional, habitat expansion methods and MR techniques with associated CV.

Run year	Traditional estimate	Survey Index (fish/mile)	MR estimate	CV of MR estimate
2005	6,631	48	14,355	63%
2006	4,108	47	15,891	21%
2007	528	5	2,700	16%
2008	1,203	9	1,218	20%
2009	2,905	24	2,213	12%
2010	4,225	35	10,985	43%
2011	3,638	27	4,985	7%
2012	4,812	35	8,738	19%
2013	7,364	54	13,878	13%

Table C.3.–Nehalem River: Comparisons of Chinook salmon escapement estimates between traditional, habitat expansion methods and MR techniques with associated CV.

Run year	Traditional estimate	Survey Index (fish/mile)	MR estimate	CV of MR estimate
2000	6,855	44	10,678	26%
2001	11,662	74	12,431	12%
2002	18,089	115	19,956	5%
2003	10,906	69	21,283	19%
2009	5,390	34	5,786	17%
2010	5,384	34	7,097	16%
2011	7,665	49	11,084	14%
2012	7,515	48	12,952	19%
2013	18,194	116	15,989	12%

C.1.5 Calibration or Expansion Factors

Studies have been conducted in the Nehalem, Nestucca, Siletz, Siuslaw, Umpqua, Coos, Coquille and Salmon rivers to explore the use of a calibrated visual index from spawning ground surveys to represent an accurate and relatively precise estimate of spawner abundance. Various survey indices; including but not limited to peak count, live AUC estimates, redd counts and sum of dead counts were calibrated to MR-derived escapement estimates to determine which index tracks best over a period of years. Most of these studies suggested peak counts were the most consistent indicator of abundance, but all have some merit. These investigations indicated that the indices derived using surveys in a combination of both mainstem and tributary habitats correlated most consistently to overall abundance. Given future and current constraints around staffing and funding resources, this research has focused on identifying surveys from both mainstem and tributary reaches and a visual index that best tracks abundance.

Analyses of the relationship between spawning ground surveys and MR experiments from the Siletz and the Nehalem River basins have been conducted. Two techniques were explored for comparison: 1) a calibrated index of abundance, and 2) a weighted least squares regression. The calibrated index technique follows the approaches described by Pahlke (2008) and McPherson, et al. (2000).

Siletz River Basin. The relationship of visual indices from standard surveys to MR abundance estimates have not correlated as well in the Siletz basin as they have in the other study basins along the Oregon coast. One reason hypothesized for this poor relationship is that the standard surveys in the Siletz represent smaller, tributary-type habitats which are not typically productive Chinook salmon habitat. A better relationship was realized by selecting a mix of smaller tributary and select mainstem or large tributary surveys. Preliminary results using a Sum of Dead index from three standard surveys and two select surveys totaling 4.9 miles appear to be a relatively good indicator of spawner abundance for the basin (Table C.4).

A weighted least squares regression approach is also being explored to assess the relationship between a visual index and MR estimates of abundance. This technique gives less weight to estimates in years in which the uncertainty around the estimate is high. As mentioned in the previous section, a Sum of Dead index from select reaches in the Siletz River has been identified as a potential indicator of spawner abundance for future management purposes. Using the weighted least squares regression approach, annual spawner escapement and confidence bounds could be estimated from the regression equation and associated prediction table (Figure C.1, Table C.5).

To evaluate the results of the two techniques, potential biases and management implications, the percent difference between the actual MR estimate and each of the predictors was graphed (calibration and regression; Figure C.2). In this assessment, the calibration factor approach was positively biased (+6%) and the weighted least squares regression approach was negatively biased (–13%). Looking at this a little more closely, in years of low abundance (2007, 2008 and 2009), during two of those years, the calibration factor overestimated abundance, by 50% in 2009. While in 2007, both methods underestimated abundance by more than 30%. There are management implications (conservation and fisheries prosecution) to both forms of bias. Further evaluation is required.

Table C.4.–Annual MR estimates, CV's, sum of dead index values and derived calibration factors from Chinook salmon (>510 mm) encountered on spawning ground index surveys to MR estimates in the Siletz basin, 2005–2013.

Year	MR Estimate	CV Mark Recapture	Sum of Dead Index	Calibration Factor
2005	14,355	63%	313	45.86
2006	15,891	21%	410	38.76
2007	2,700	16%	38	71.05
2008	1,218	20%	30	40.60
2009	2,213	12%	69	32.07
2010	10,985	43%	175	62.77
2011	4,985	7%	132	37.77
2012	8,738	19%	193	45.27
2013	13,878	13%	240	57.83
			Mean Calibration Factor	48.00
			Calibration Factor CV	27%

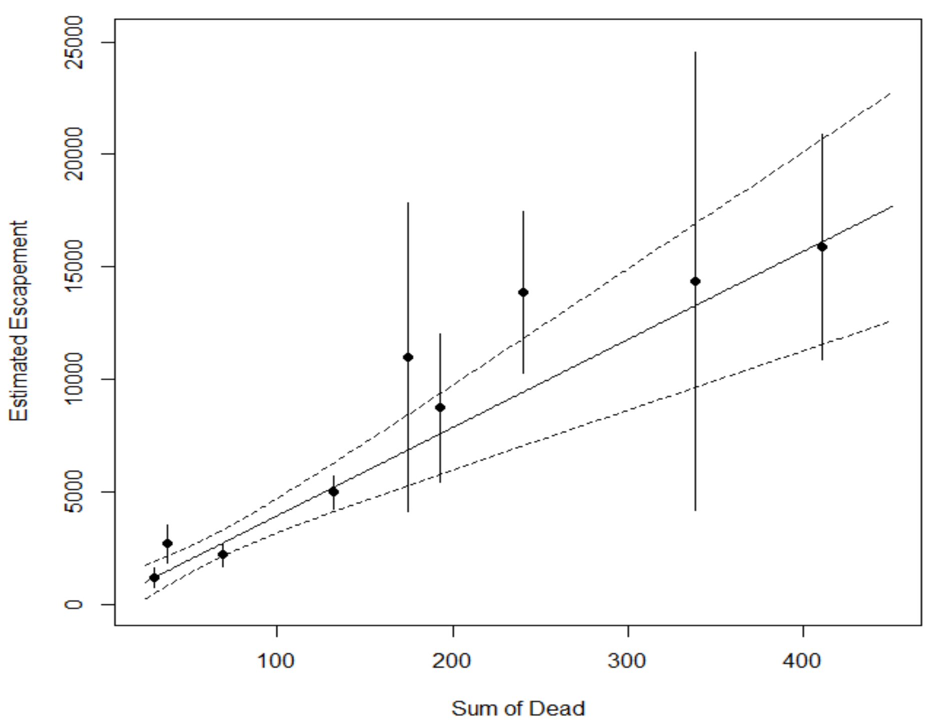

Figure C.1.–Weighted least squares regression of MR estimates and sum of dead index, 2005–2013.

Table C.5.–Excerpts from weighted least squares prediction table using sum of dead index to predict annual spawner escapement, SE and CV.

Sum of Dead Index	Escapement estimate (from regression)	SE	CV
25	1,006	319	32%
26	1,045	315	30%
27	1,084	312	29%
100	3,947	322	8%
101	3,986	326	8%
102	4,025	330	8%
200	7,868	797	10%
201	7,907	802	10%
202	7,946	807	10%
448	17,592	2,133	12%
449	17,631	2,139	12%
450	17,670	2,144	12%

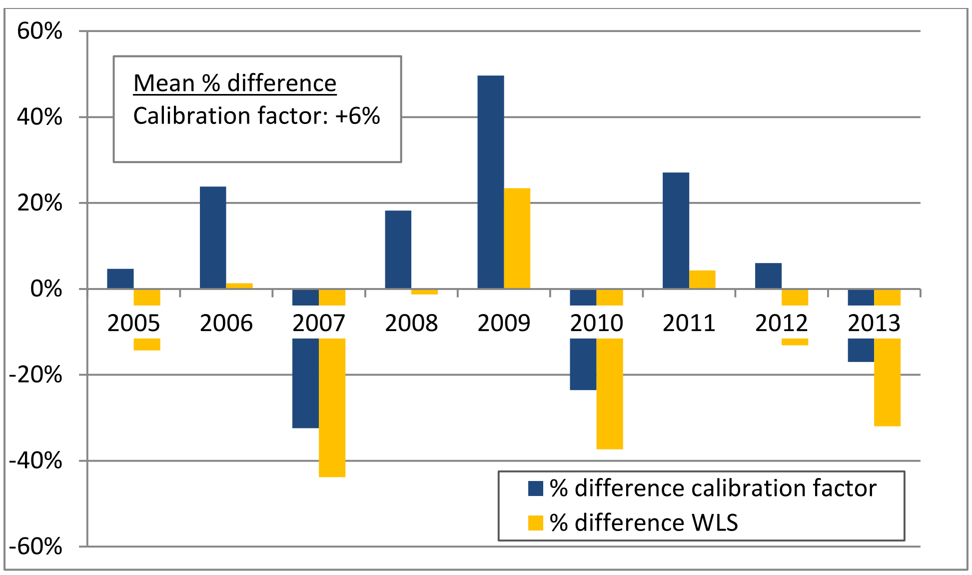

Figure C.2.–Percent difference between annual MR estimate and either the calibration factor estimate or the weighted least square regression estimate.

Nehalem River Basin. The two approaches described above were followed for the Nehalem. Results from standard survey calibration efforts using peak counts from standard surveys in the Nehalem River basin demonstrate a relatively strong relationship (CV = 24%; Table C.6).

Table C.6.–Standard survey calibration. Annual MR estimates, CVs, sum of peak index values and derived calibration factors from Chinook salmon (>510 mm) encountered on standard spawning ground index surveys (4) to MR estimates in the Nehalem basin, 2000–2003 and 2009–2013.

Year	MREstimate	CV MR	Sum of Peak Index	Calibration Factor
2000	10,678	26%	208	51.34
2001	12,431	5%	335	37.11
2002	19,956	12%	436	45.77
2003	21,283	19%	309	68.88
2009	5,786	17%	116	49.88
2010	7,097	16%	117	60.66
2011	11,084	12%	184	60.24
2012	12,952	19%	184	70.39
2013	15,989	12%	448	35.69
			Mean Calibration Factor	53
			Calibration Factor CV	24%

A weighted least square regression analysis was conducted (Figure C.3) to apply uncertainties with the calibration relationship by incorporating the variance associated in the annual abundance estimate derived through MR techniques. Using the weighted least squares regression approach, annual spawner escapement and confidence bounds could be estimated from the regression equation and associated prediction table (Table C.7).

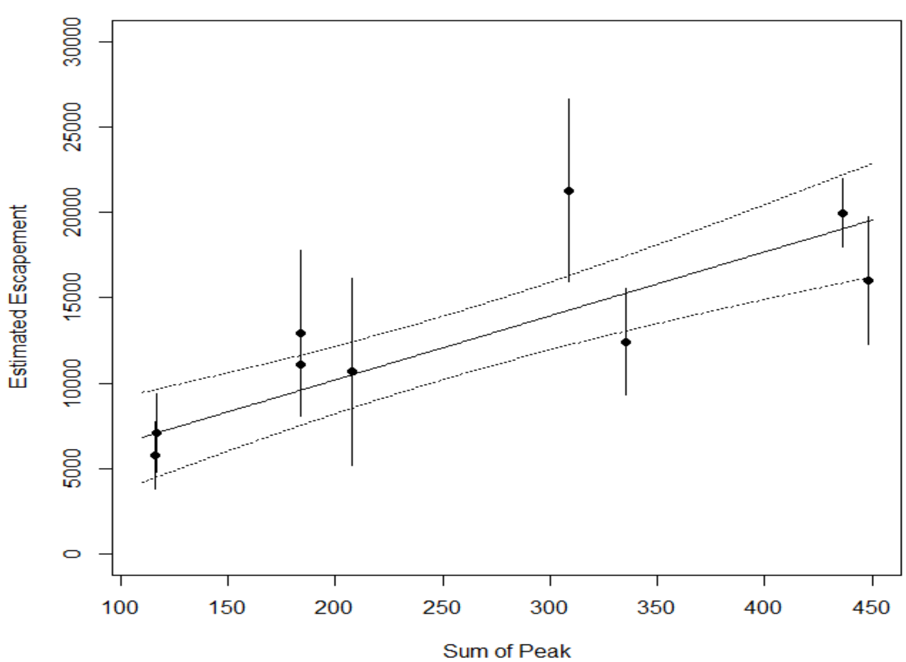

Figure C.3.–Standard surveys. Weighted least squares linear regression of MR estimates and sum of peak index from four standard surveys, 2000–2003 and 2009–2013.

Table C.7.–Standard survey predictive table. Excerpts from weighted least squares prediction table using Sum of Peak index from annual standard surveys to predict spawner escapement, SE and CV.

Sum of Peak Index	Escapement estimate (from regression)	SE	CV
110	6,828	1,116	16%
111	6,866	1,112	16%
112	6,903	1,108	16%
220	10,945	800	7%
221	1,0982	799	7%
222	11,019	798	7%
330	15,061	915	6%
331	15,098	918	6%
332	15,136	921	6%
440	19,177	1,355	7%
441	19,214	1,360	7%
442	19,252	1,365	7%

Evidence suggests two populations, or runs, of Chinook salmon occur in the Nehalem Basin. These groups distinguish themselves through spatial and temporal differences in spawning and some genetic disparity. The early component generally exhibits peak spawning activity in mid-October and occurs in the upper basin, and the late component tends to spawn in November in the lower basin. The presence of distinct populations may have implications for both management and conservation. The current standard index surveys are located entirely in the lower portion of the basin (fall run habitat). Therefore, the index surveys from the upper basin are included for the purposes of calibrating to basinwide spawner abundance.

The two upper basin mainstem surveys are added to the four standard index surveys in another calibration assessment for returns years 2009 to 2013. The inclusion of these surveys improved the index to the abundance estimate relationship from that of only standard surveys, although confidence is not as strong due to fewer years of data collection (Table C.8). A weighted least squares regression was also performed for this suite of six index surveys and associated predictive estimates derived using the software program R (Figure C.4, Table C.9).

Table C.8.–Full survey calibration. Annual MR estimates, CVs, sum of peak index values and derived calibration factors from Chinook salmon (>510 mm) encountered on standard spawning ground index surveys (4) and select surveys (2) to MR estimates in the Nehalem basin, 2009–2013.

Year	MR Estimate	CV MR	Sum of Peak Index	Calibration Factor
2009	5,786	17%	191	30.29
2010	7,097	16%	216	32.86
2011	11,084	14%	380	29.17
2012	12,952	19%	344	37.65
2013	15,989	12%	603	26.52
			Mean Calibration Factor	31.3
			Calibration Factor CV	13.5%

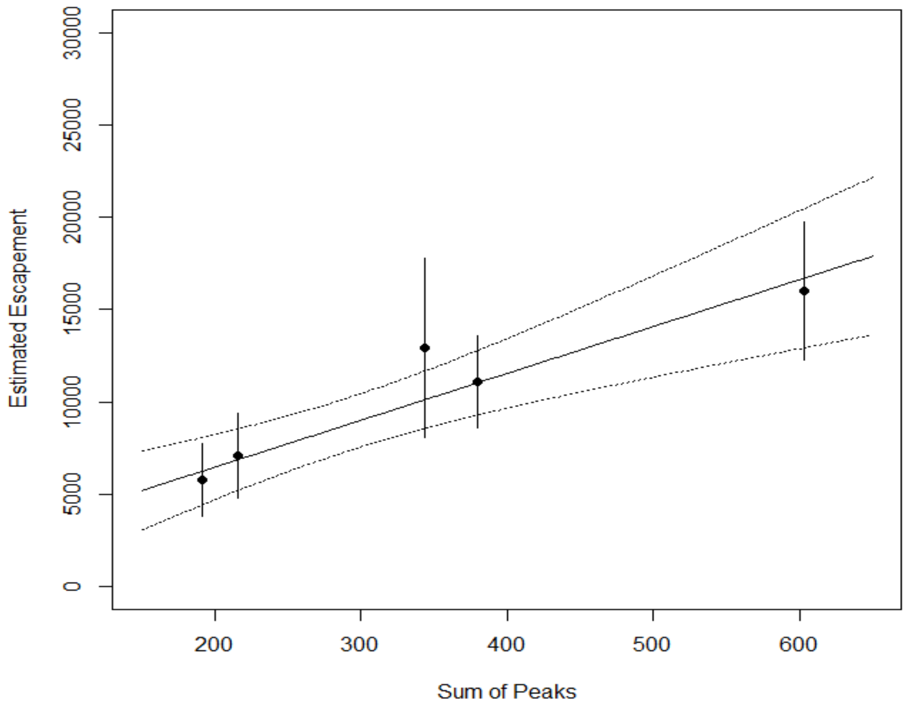

Figure C.4.–Weighted least squares linear regression of MR estimates and sum of peak index from six spawning ground surveys in the Nehalem basin, 2009–2013.

Table C.9.–Full survey weighted least squares predictive table. Excerpts from weighted least squares prediction table using Sum of Peak index from six select spawning ground surveys to predict spawner escapement, SE and CV.

Sum of Peak Index	Escapement estimate (from regression)	SE	CV
150	5,212	668	13%
151	5,237	665	13%
152	5,262	662	13%
350	10,280	498	5%
351	10,305	500	5%
352	10,331	501	5%
648	17,832	1,331	7%
649	17,857	1,334	7%
650	17,883	1,337	7%

To evaluate the results of the two techniques, potential biases and management implications, we graphed the percent difference was graphed between the actual MR estimate and each of the estimators using the six surveys (Figure C.5). In this assessment, the calibration factor approach was very slightly positively biased (+1%) and the weighted least squares regression approach was slightly negatively biased (–3%). A decision in the coming months will determine which estimation technique to use in future assessments, taking into account a range of factors including the number of years included in the analyses, the distribution of sites, and ability to use the technique.

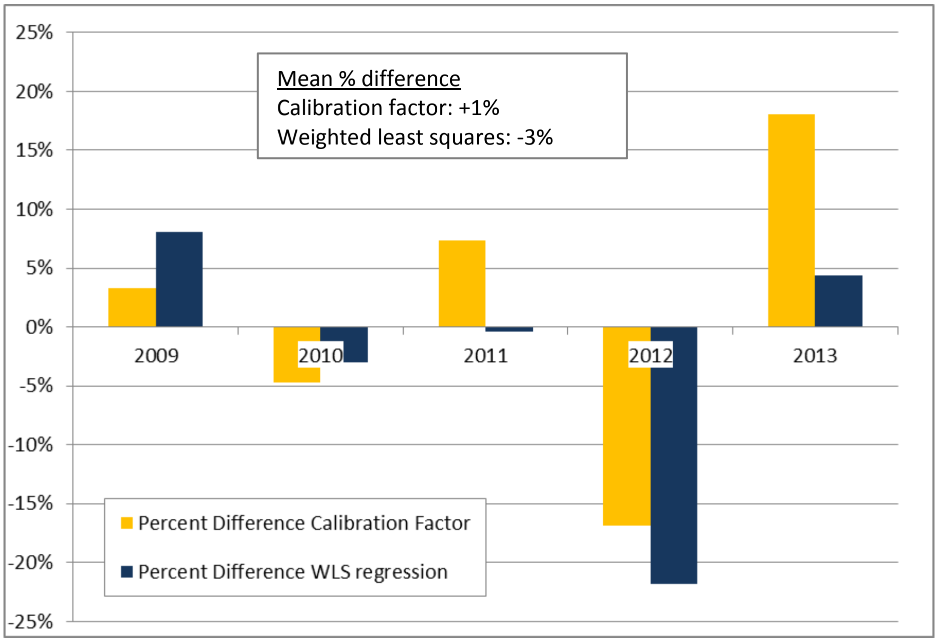

Figure C.5.–Percent difference between annual MR estimates and either the calibration factor estimate or the weighted least square regression estimate, Nehalem basin (6 surveys, 2009–2013).

C.2 Abundance Estimate for Green River Chinook Salmon in 2012

The Green River summer/fall Chinook salmon population is one of the stocks in Puget Sound used by the CTC as an escapement indicator for Puget Sound natural summer/fall fingerlings. Escapement indicator stocks monitor the effectiveness of the management regimes and, if necessary, their status may trigger additional management actions in AABM and ISBM fisheries.

The abundance of Chinook salmon spawning in the Green River was estimated using Lincoln-Petersen GMR abundance estimators. Spawning adults were marked by obtaining a DNA microsatellite profile from tissue sampled from adult carcasses (first sampling event). Marks were later recaptured by sampling outmigrating smolt offspring (second sampling event) and genetically identifying some fraction of marks as parents of some outmigrating offspring. Tissue from 527 adult Chinook salmon carcasses was collected in fall 2012. Tissue from 5,283 migrating smolt offspring of adults that spawned in fall 2012 were collected in spring of 2013 at a smolt trap in the Green River, upstream of the mouth of Soos Creek. Adults and a representative subsample (n = 651) of juveniles were genotyped at 14 microsatellite DNA loci. Using the likelihood algorithms found in the software COLONY,[1] the genetic data were used to match parents to offspring, inferring recaptures. The counts of marks, captures (genotyped juveniles multiplied by 2), and recaptures were then used in a pooled Petersen MR estimate of spawner abundance based on binomial sampling. The algorithms employed by COLONY also infer unsampled parents allowing enumeration of unique captures and unique recaptures.

[1] ZSL Institute of Zoology. http://www.zsl.org/science/software/colony

These were used in a pooled Petersen MR estimate of spawner abundance-based on hypergeometric sampling and in a rarefaction curve estimate of the number of successful breeders.

Genotypes were obtained for 483 marks, 651 juveniles, and, through parentage analysis, 138 recaptures. Using these counts, preliminary unadjusted estimates of the binomial model GMR estimate of Chinook salmon spawner abundance was obtained. The 2012 preliminary spawner abundance estimate for upstream of the smolt trap was 4,528 (95% CI = 3,818 – 5,236; CV = 8.0%). The preliminary GMR abundance estimate upstream of the smolt trap was almost 1.5 times the 2012 estimate for the entire Green River using redd counts (3,090). This was similar to patterns seen in the 2010 and 2011 GMR abundance estimate—and to estimates made using traditional MR methods from previous years. In the final report, an updated final binomial based abundance estimate will be provided, and will include the following items: (1) genotypes from an additional 1,376 juveniles, (2) adjusted escapement estimate for the few adipose intact hatchery juveniles that escaped from rearing facilities upstream of the smolt trap, (3) expanded estimates for the area below the smolt trap using a basinwide redd survey conducted in October, (4) a GMR estimate based on the hypergeometric model, and (5) a rarefaction curve estimate of successful breeders

C.3 Abundance Estimate for Stillaguamish River Chinook Salmon in 2012

Stillaguamish River Chinook salmon are an escapement indicator stock in Puget Sound used by the CTC. Stillaguamish River Chinook salmon was identified as a sentinel stock in Chapter 3 of the 2009 Agreement.

The SSP funded a study design to estimate the Chinook salmon spawning escapement using a GMR technique in 2011 and this study design was continued in subsequent years. In the first sampling, carcasses were collected from weekly spawning ground surveys and genotyped. In the second sampling, juveniles were collected from a downstream migrant trap located below the spawning area and genotyped. A total of 164 genotyped carcasses constituted the marks and a total of 207 juveniles assigned back to spawners using parentage analysis constituted the recaptures out of a total of 1,109 captured juveniles. Using the Lincoln-Petersen estimate, based on Bailey's binomial model, we estimated the 2012 spawner abundance of 1,750 Chinook salmon (CV = 6.6%), which was higher than the redd-based estimate of 1,534.

Unmarked hatchery juveniles and yearling hatchery juveniles presented challenges to the GMR study design. If unmarked hatchery juveniles (juveniles leaving the hatchery upstream of the smolt trap with adipose fins intact) and yearling juveniles (juveniles leaving the system after a year, rather than after emergence) in the smolt samples are unaccounted for, they inflate abundance estimates by increasing capture numbers—yet have no possible parents in the mark pool. Unmarked hatchery juveniles were identified by assigning smolts to the hatchery broodstock and removing them prior to analyses. The data for putative yearlings were examined by regressing smolt lengths on capture date and observing outlier smolts—smolts that were much longer that average smolt lengths for each time strata—and removing such outliers. Because there were few unmarked hatchery fish and few yearlings, adjusting for hatchery juveniles resulted in a small change in the GMR estimate. The preliminary GMR result is corrected for unmarked hatchery juveniles and yearlings.

C.4 Abundance Estimate for Snohomish River Chinook Salmon in 2012

The Snohomish River basin is comprised of two Chinook salmon populations: the Skykomish River summer population (which includes Skykomish, mainstem Snohomish, and Pilchuck River) and the Snoqualmie River fall population. The combined Skykomish and Snoqualmie populations comprise the Snohomish River Chinook (summer/fall) *management unit* or *stock*, which is one of the stocks used by the CTC as an escapement indicator for Puget Sound natural summer/fall fingerlings. Escapement indicator stocks monitor the effectiveness of the management regimes and, if necessary, their status may trigger additional management actions in AABM and ISBM fisheries.

The abundance of Chinook salmon spawning in the Skykomish and Snoqualmie rivers was estimated using Lincoln-Petersen GMR abundance estimates. Spawning adults were marked by obtaining a DNA microsatellite profile from tissue sampled from adult carcasses in the natural escapement (first sampling event). Marks were later recaptured by sampling outmigrating natural-origin subyearling smolt offspring (second sampling event) and genetically identifying some fraction of marks as parents of some outmigrating offspring. Scales, otoliths, and CWTs were collected to identify age and origin along with measuring fork and postorbital–hypural length (measurement from the rear of the eye opening to the end of the last vertebrae at the base of the tail) and noting the sex of all 397 adult Chinook salmon carcasses (marks) found in the Skykomish River (and tributaries) and all 187 adult Chinook salmon carcasses found in the Snoqualmie River (and tributaries) in the fall of 2012. In the spring of 2013, tissues were taken from 3,154 natural-origin outmigrating subyearling offspring (2,513 from the Skykomish River trap, 641 from the Snoqualmie River trap). Operculum tissues collected from all hatchery- and natural-origin adults were genotyped at 14 microsatellite DNA loci. Using the likelihood algorithms found in the software COLONY, the genetic data were used to match parents to offspring inferring recaptures. The counts of marks, captures (genotyped juveniles multiplied by 2), and recaptures were then used in a pooled Petersen MR estimate of spawner abundance-based on binomial sampling. The algorithms employed by COLONY also inferred unsampled parents allowing enumeration of unique captures and unique recaptures. These were used in a pooled Petersen MR estimate of spawner abundance-based on hypergeometric sampling and in a rarefaction curve estimate of the number of successful breeders.

For preliminary Skykomish River estimates, genotypes were identified for 370 adults, 360 juveniles, and, through parentage analysis, 49 recaptures. For preliminary Snoqualmie River estimates, genotypes were identified for 184 adults, 369 juveniles, and, through parentage analysis, 55 recaptures. Using these counts, preliminary unadjusted estimates of the binomial model GMR estimate of Chinook salmon spawner abundance for areas upstream of each smolt trap. The Skykomish River spawner abundance estimate were obtained for upstream of the smolt trap was 5,335 (95% CI = 3,922 – 6,748; CV = 14%). The Snoqualmie River spawner abundance estimate for upstream of the smolt trap was 2,428 (95% CI = 1,822 – 3,034).

Performance standards were met with GMR for 2012 (CV < 15% for both estimates) due to the increased carcass sampling and smolt sampling efforts.

GMR abundance estimates were around 1.5 times the 2012 estimates made using redd counts (3,744 for the Skykomish River, 1,379 for the Snoqualmie River). These preliminary estimates cover only the spawning areas found upstream of the smolt traps in each basin. The reported CV may not be an accurate estimate of uncertainty, since all sources of uncertainty have not yet been accounted for in these preliminary estimates. In addition to accounting for all sources of uncertainty, in the final report, an updated final binomial based abundance estimate will be provided including genotypes from an additional 1,428 (Skykomish) and 201 (Snoqualmie) juveniles. An abundance estimate will be generated with a hypergeometric model-based GMR and a rarefaction curve-based estimate of successful breeders.

C.5 Estimates of Terminal Run Size for West Coast Vancouver Island and Oregon Coast Stock Groups for 2012

The goal of this project is to estimate the terminal run sizes of aggregate stocks of natural and hatchery-origin Chinook salmon from two stock groups (WCVI and NOC), and aggregate natural escapement to NOC. The method incorporates data from exploitation rate indicator stocks, frequency of marked fish sampled from a mixed stock fishery, and genetic stock composition for that same mixed stock fishery—all of which provides innovative estimates of terminal returns and escapement for these stock groups. Sampling of harvests of Chinook salmon in Southeast Alaska troll and sport fisheries began in May 2013 and concluded in September 2013. Because the harvest allocation for Southeast Alaska Chinook salmon was fulfilled during the first retention period of the summer troll fishery, no second retention period occurred. Thus, sample sizes are half of that expected for those fisheries. Samples from troll fisheries were returned in July 2013, and sport samples were returned October 2013 (Table C.10). Laboratory analysis was completed in January 2014, with a total of 2,918 individuals genotyped at 13 microsatellite loci. Results were used to identify individuals for otolith and age analysis. Otolith and age analysis is currently underway and results are expected in August 2014. Final estimates of terminal run sizes and escapement are expected by November 2014, and a final report completed by December 2014.

Table C.10.–Number of Chinook salmon sampled in selected Southeast Alaska fisheries between May and September 2013. Samples include those sampled for both genetics and otolith extraction.

Fishery	Port	Goal	Sampled
Summer Troll	Craig	220	160
	Pelican	120	59
	Sitka	600	300
	Yakutat	60	30
	Subtotal →	1,000	549
Sport	Sitka	1,500	1,866
	Craig	500	503
	Subtotal →	2,000	2,369
	TOTAL→	3,000	2,918

C.6 Abundance Estimate for Burman River Chinook Salmon in 2013

The Burman River total spawning escapement in 2013 was estimated to be 8,275 Chinook salmon (CV = 11%) using open population MR methods (POPAN[2] in Program MARK[3] applied to lower river site live recaptures). The study applied 1,358 tags and had encounter histories for 807 live fish (adult males, females, and jacks). Returning fish were captured with beach seines in the lower river and then tagged and released. Carcasses were recovered upstream at the spawning grounds (C = 608) and examined for tags (R = 57). Captured live fish and carcasses recovered later upstream in the spawning reach were examined for tags. An inflated (biased high) closed population estimate was expected as the closure assumption was violated by immigration (CloseTest[4]) and transience (U-CARE[5]) was indicated (very short residence in lower river) at the tagging site resulting in a heterogeneous mark rate and an inflated, and consequently biased, closed population estimate.

Chinook salmon escapement was also estimated using visual observations from 14 snorkel surveys and AUC methods. Observed average survey life for the season from five tag groups was 5.90 days (SE = 3.48; n = 1212) using visual tag depletion curves. Visual detection probability was not measured but assumed equal for marked and unmarked fish.

C.7 Marble River, Sarita River, and Tranquil River Chinook Salmon Study in 2013

This project was conducted on the Marble, Tranquil and Sarita rivers to estimate survey life of Chinook salmon entering survey areas and to estimate observer efficiency of swimmers counting Chinook salmon as a means to improve AUC estimates of spawner abundance. These empirical data were used to generate quantitative AUC estimates while the regular procedures were used to generate qualitative AUC estimates. Chinook salmon were radio tagged to estimate survey life and marked with highly visible external spaghetti tags for estimation of observer efficiency. River discharge and visibility data were collected to examine possible relationships between survey conditions and observer efficiency.

Seventeen days of fishing near the entrance to the Marble River and five inriver tagging sessions tagged five Chinook salmon in Varney Bay and another 21 in the Marble River. About 77% of these fish were later detected in the Marble River. Chinook salmon abundance was lower and delayed compared to previous years. The majority of tags were not applied until after mid-October due to very low numbers of Chinook salmon in the river throughout September and unsafe water levels in early October. Assuming the fish tagged after mid-October entered October 15 during a major increase in river level, the mean survey life in the

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[2] Population analysis software group. Available for download at www.cs.umanitoba.ca/~popan/

[3] Program MARK. Available for download at http://www.phidot.org/software/mark/downloads/

[4] Stanley, T.R. and J.D. Richards. 2004. CloseTest: A program for testing capture-recapture data for closure (Software Manual). U. S. Geological Survey, Fort Collins Science Center.

[5] UMR 5175 Centre d’ecologie fonctionnelle & evolutive. Available for download at http://www.cefe.cnrs.fr/biostatistiques-et-biologie-des-populations/logiciels

Marble was 35 days (SD = 9 d, n = 19). Two tagging events in the Tranquil, September 26 and October 16, applied 27 radio tags and an additional 27 spaghetti tags. All radio tags were later detected by telemetry surveys. The mean survey life of Chinook salmon was 17.5 days (SD = 3.4 d, n = 24) in the Tranquil River. Four tagging events from September 17 to September 27 applied a total of 97 radio tags in the Sarita River just below the survey section. A combination of high-water events and large numbers of chum and coho salmon complicated matters and tags were only seen by swim crews on two subsequent surveys. However, based on the telemetry a survey life of 17.2 days (SD = 8.9 d, n = 82) was estimated in the Sarita. Initial estimates of observer efficiency ranged from 27% to 100% in the Marble, from 67% to 100% in the Tranquil and from 19% to 33% in the Sarita. River conditions (horizontal visibility and rate of discharge) were correlated with observed variation in observation efficiency (Figure C.6).

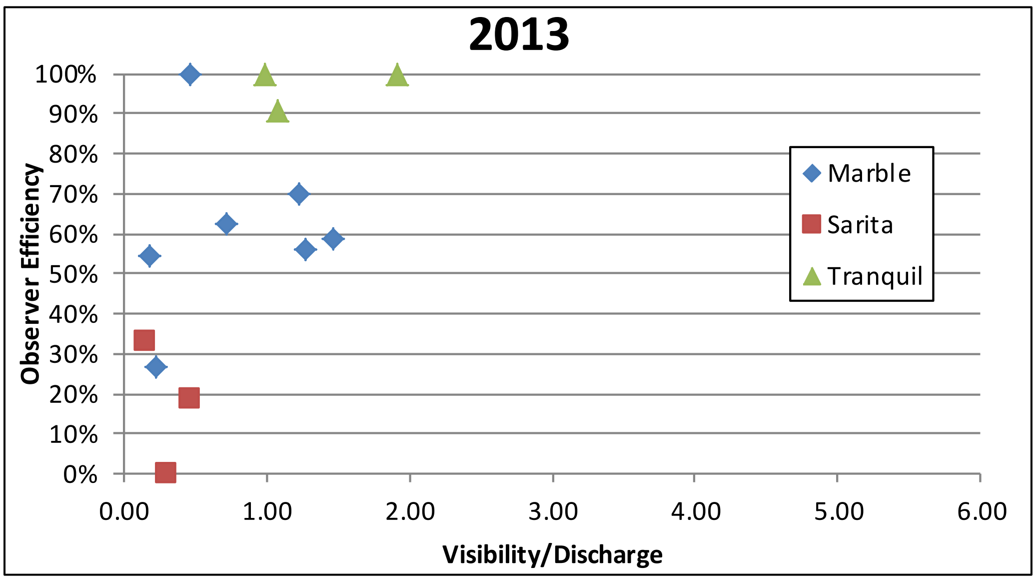


Figure C.6.–2013 Relationship between river conditions and observer efficiency of Chinook salmon for the Marble, Tranquil, and Sarita Rivers. Extremely low flow conditions in the Tranquil in late October (horizontal visibility/rate of discharge greater than 10) are not included in this figure.

The results were not markedly different than assumed values used for the qualitative AUC method (typically 15 to 25 days for Chinook salmon). Observer efficiency was lower than the qualitative estimates reported by crews that have been used for previous AUC estimates. Self-reported observer efficiency estimates are rarely less than 80% and are usually 90% to 100%. Surveyors appear to underestimate the effect of worsening environmental conditions on their ability to count all of the fish present. Much of the variation in observation efficiency was associated with river conditions (horizontal visibility and rate of discharge).

System	AUC Quantitative	AUC Qualitative
Marble	2,240	2,080
Tranquil	824	684
Sarita	4,220	1,432

C.8 Abundance Estimates for South Thompson River Chinook Salmon

The Fraser Summer-run age-0.3 stock group spawns in several locations ranging from the lower Fraser River area to the upper reaches of the South Thompson watershed, and the stock group consists of two genetic reporting groups: Maria Slough in the Lower Fraser and the South Thompson group. The South Thompson genetic group represents fish originating from the Lower Thompson, South Thompson, Little, Lower Adams, Lower Shuswap and Middle Shuswap rivers. The South Thompson aggregate has a mean annual escapement of 95,000 (2001–2012) based on the peak count method, which involves counting spawners, holders, and carcasses or redds from low elevation helicopter surveys. Three of these rivers are extremely large and can have poor conditions for visual counts, yet the visual surveys identified that large numbers of spawners use these systems. The indicator stock expansion methods developed in the mid-1980s were modified to estimate the escapement of the ocean-type component of the South Thompson genetic group. Furthermore, escapement estimates for individual populations can be generated from the stream-specific MR programs on the Middle and Lower Shuswap rivers, and the aggregate escapement to the remaining systems (with poor visual survey conditions) is estimated by subtracting the MR estimates from the total aggregate estimated by the indicator stock expansion method.

The modified indicator stock expansion method uses a Bayesian model that relies on genetic stock identification, scale age, and CWT data sampled from fisheries in Northern British Columbia and at the mouth of the Fraser River, as well as CWT data sampled from the spawning grounds for the Lower Shuswap and Middle Shuswap exploitation rate indicator stocks. The Bayesian model was developed further to enable data from multiple fisheries to be analysed and to better represent the uncertainty in the fraction of the stock that is represented by CWTs. The 2013 model development identified further refinements to be reported in 2014 that will improve the estimated proportion of the stock represented by CWTs—which is the most sensitive parameter in the estimation of the escapement. The SSP funded the estimation of South Thompson escapements for 2009 to 2013 and the Northern Endowment Fund supported the approach for 2004 to 2008.

For 2013, some of the genetic samples have not yet been analysed, so the results will be reported next year. The 2013 MR estimate was 28,797 (CV = 2%) for the Lower Shuswap Chinook salmon, and 2,274 (CV = 7%) for the Middle Shuswap Chinook salmon.

The indicator stock expansion method was used as an alternate escapement estimation method from 2004 to 2012. For 2012, the expected escapements were 58,167 (CV = 73%) based on data from the Fraser River gillnet test fisheries (Albion and Qualark), 74,073 (CV = 100%) based on the NBC troll fishery, and 83,745 (CV = 152%) based on both data sets. The sum of escapement estimates from the peak count and redd count methods was 52,795 in 2012. The development of escapement method calibration relationships has been ongoing for individual and aggregated populations within this stock group and results will be provided in December 2014.

C.9 Abundance Estimate for Chilko River Chinook Salmon in 2013

The Chilko River has one of the largest returns of the summer-run (age-1.3 stock group) Chinook salmon in the Fraser River watershed with a mean annual escapement of 8,160 (2001–2013) using the Peak Count method. The 2013 escapement of summer-run Chinook salmon to the Chilko River was estimated using a two-event MR study, and the Peak Count method based on concurrent aerial visual surveys. Petersen tags and sex-specific secondary marks were applied to 738 adult and 21 jack Chinook salmon captured using a combination of seining and angling (one male was removed during the First Nation fishery). Recovery sampling was undertaken on carcasses, and 398 marked adults were recovered from a total recovery sample of 2,093 adult carcasses. The age composition of the recovery sample was 13% age 3, 52% age 4, 34% age 5, and 1% age 6. All samples showed a yearling smolt freshwater growth pattern (age 1.x). Of the 21 tags applied to jacks, only three were recovered. There were only 45 jacks sampled during carcass recovery; therefore, a valid estimate of the jack escapement could not be calculated.

The results of the bias testing indicated that measurable sources of stress including holding time, marking, number of times recaptured, and release condition did not have a significant impact on the subsequent behaviour of the marked fish. The MR assumption of closure was likely met based on the MR field observations, aerial survey data, and the 2010 radio telemetry study. There was no evidence of temporal or spatial bias in the application and recovery samples for males, however there was evidence of temporal bias in the female application samples and both temporal and spatial bias in recovery samples for females. Work is ongoing to generate an appropriately stratified estimate of the female escapement using the Maximum Likelihood Darroch estimator. The Petersen estimate of the male escapement was 2,145 (CV = 5%). The preliminary estimate of the female escapement was 1,826 (CV = 5%); that value will likely increase slightly once the Maximum Likelihood Darroch estimate has been generated. The preliminary estimate of total escapement was 3,971 adult Chinook salmon. The aerial peak count estimate was generated based on the peak count of 257 holders, 3,058 spawners and 56 carcasses on September 15, all summed and divided by 0.65. The aerial estimate for 2013 was 5,186 adult Chinook salmon. No aerial estimate was generated for jacks because they cannot be counted from a helicopter. This estimate is greater than the preliminary MR estimate of total escapement.

C.10 Abundance Estimate for Nass River Chinook Salmon in 2013

The Upper Nass River Chinook salmon aggregate stock (hereafter referred to as Nass Chinook salmon) is one of the wild indicator stocks used by the CTC. It is a large stock group, comprising a single conservation unit (Holtby and Ciruna 2007), and consists of at least 10 separate populations spawning in the Nass River watershed, upstream of and including Tseax River. This stock has averaged 18,000 spawners (range: 9,000–26,000) over the past 10 years. Nass Chinook salmon are an important contributor to the Pacific Coast Chinook salmon resource and represent a very stable proportion of stocks caught in fisheries in Northern British Columbia and Alaska. Nass Chinook salmon are a completely natural population with no history of enhancement and likely very little, if any, straying from other enhanced systems.

Since 1994, escapement estimates for Nass Chinook salmon have been derived using MR methodology. Adult Chinook salmon (≥50 cm length from mid eye to tail fork) are marked at fishwheels operated on the Lower Nass River by applying numbered aluminum chick-wing tags to the left operculum. Live fish are subsequently examined for marks at the Meziadin Fishway and both live fish and carcasses are examined for marks in other Upper Nass River tributaries. Mark–recovery locations have varied over the years, but they normally include Damdochax Creek and Kwinageese River. Combined with the Meziadin River, these three systems represent approximately 40% of the Nass Chinook salmon aggregate stock, based on radio telemetry (1992–1993) and recent genetic (2007 and 2010–2012) data. From 1994 to 2008, Nass Chinook salmon MR estimates achieved CV less than or equal to 15% in only 8 of 15 (53%) years. The main factor influencing the CV over this period was the number of marked fish examined and recovered at terminal spawning areas in the Upper Nass River watershed.

From 2009 to 2012 (Years 1–4), the SSP funded additional marking and tag–recovery efforts with the goal of achieving more accurate and precise MR estimates that meet or exceed the SSP CV data escapement standard (CV ≤ 15%). The SSP CV data standard was achieved in three of the four funded years (2009 = 13%, 2010 = 25%, 2011 = 9%, and 2012 = 6%). In 2010 the data standard was not achieved due to insufficient marks applied (n = 363) at the Gitwinksihlkw (GW) fishwheels and recovered (n = 15) at tag–recovery sites. The fishwheels operated under extreme low water levels in 2010 that affected overall catchability and number of marks released. This resulted in lower recoveries of marked fish at the tag–recovery sites. Two key recommendations emerged from the 2009 to 2012 projects that emphasize the need to both apply and recover adequate marks to achieve the data escapement standard: (1) to mark Chinook salmon at both the GW and Grease Harbour (GH) fishwheels to ensure that at least 1,000 marks are applied from four to six fishwheels that are operated each year, and (2) to continue mark–recovery operations at Meziadin Fishway, the Kwinageese weir, and Damdochax Creek to ensure that sufficient marks are recovered.

In 2013, the PSC funded Year 5 of the Nass Chinook salmon MR study. A total of 568 adult Chinook salmon were marked at two GW fishwheels (fishwheels 1 and 2) and an additional 1,086 were marked at three GH fishwheels (fishwheels 3, 5, and 6). The fishwheels operated from June 2 to September 13, with fish captured and tagged from June 3 to September 5. A total of 1,654 marked fish were released, and after accounting for removals by inriver fisheries and estimated handling-induced mortality (n = 423 censored; 26% of the total marks released), an estimated 1,231 marked fish were available for recovery in upstream tributaries. A total of 1,100 fish were examined for marks at mark–recovery sites of which 155 were marked from the fishwheels (overall mark rate = 14.1%). Of the total Chinook salmon marked in 2013, 798 (48%) were medium (50.0–75.4 cm length from mid eye to tail fork) and 856 (52%) were large (≥75.5 cm length from mid eye to tail fork) fish. A total of 1,247 marked fish were successfully aged with total ages 4 (50.0%) and 5 (41.1%) being most abundant followed by ages 6 (8.1%), 3 (0.7%), and 7 (0.1%). Medium fish were predominantly age 4 (93%), followed by ages 5 (6%) and 3 (1%). The sex ratio of marked fish was 38% females and 62% males, assuming all medium fish were males based on genetic analyses (n_{medium} = 275; 99% were males). Crew guesses of sex for large fish were 73% correct (81% for females and 40% for males) based on genetic analyses

(n_{large} = 274). A logistic regression model that was developed to predict sex of large marked fish at the fishwheels based on morphological measurements and known sex from genetic samples (n = 224) was 85.7% correct for 2013 and the model discrimination was fair (ROC = 0.762). However, when combining all years (n = 1,345 from 2009–2013 data), the model discrimination level was poor (ROC = 0.677), predicting sex correctly in 77.8% of the cases.

Tests for size, sex, age, temporal, and spatial bias in capture and recovery samples of Nass Chinook salmon were conducted in 2013. For size selectivity bias tests, recovered marked fish with known lengths (n = 77) were not significantly smaller than examined fish (n = 388) as a whole (Kolmogorov–Smirnov test; D_{max} = 0.16, P = 0.05), and the mark rate for medium fish (15.0%; n = 256) was not significantly higher than for large fish (14.3%; n = 805) at recovery locations (χ^2 = 0.03, df = 1, P = 0.86). No significant sex bias was detected, with the mark rate for large males (14.7%; n = 442) not being significantly higher than for large females (13.0%; n = 820) at recovery locations (χ^2 = 0.52, df = 1, P = 0.47). Mark rates by ocean age (n = 200 with 55 recoveries) were also not significantly different among recovery locations (χ^2 = 1.70, df = 1, P = 0.20). The mark rate for recoveries in July (32.5%) was significantly higher than for other recovery time periods (mean = 13.5%; χ^2 = 12.60, df = 3, P = 0.01). However, the sample sizes were small for marked recoveries of known tagging date (54 of 155) and examined fish (374 of 1,100). No significant spatial bias was detected in 2013. Mark rates were not significantly different between Meziadin Fishway (15.1%), Kwinageese weir (13.4%), and Damdochax Creek (16.8%) recovery locations (χ^2 = 1.37, df = 2, P = 0.50).

Despite the lack of evidence for significant size bias, a size-stratified adjusted Petersen population estimate for Nass Chinook salmon was calculated and presented alongside an estimate generated by pooling the size classes to facilitate comparison with other years. Summing estimates of 3,730 (SE = 530; CV = 15.7%) medium and 4,567 (SE = 392; CV = 9.3%) large Chinook salmon spawning between GW and GH, or passing upstream of GH, produced an overall size stratified escapement estimate of 8,298 (SE = 659; 95% CI: 6,980–9,616; CV = 8.0%). The stratified estimate was similar to the estimate generated by pooling size classes (8,694; SE = 643; 95% CI: 7,437–10,165; CV = 8.0%). Subtracting the inriver harvests above GH (287) from the stratified overall escapement estimate yielded a net escapement estimate of 8,011 adult Chinook salmon above GW. Adding the harvest (1,942) of Chinook salmon from all fisheries above GW to the net escapement estimate yielded an estimate of the total return of adult Chinook salmon to GW in 2013 of 10,240. The 2013 return was the lowest return of Nass Chinook salmon since the start of the fishwheel program in 1992.

The SSP funding in 2013 was sufficient to support and augment mark–recovery efforts at Kwinageese River and Damdochax Creek, and additional marking efforts at the GH fishwheels to meet the SSP CV data standard. Without this funding to support one or all of these activities, only 8 (Meziadin recoveries only) to 43 (all recoveries) marks would have been recovered from the GW marked fish resulting in less precise and accurate MR estimates (CV = 33.3% with only Meziadin recoveries; CV = 15.1% with all GW recoveries). We recommend that in future years marking of Chinook salmon continue to occur at both the GW and GH fishwheels. However, if 400 tags are applied at the GW fishwheels by 23 June, we recommend that marking at GH be limited to two fishwheels to reduce handling of fish. In addition, we recommend that mark–

recovery efforts continue at the Meziadin Fishway, Kwinageese River, and Damdochax Creek. These systems represented 39% of the return to GW fishwheels in 2013 from genetic analyses (n = 499).

C.11 Abundance of Skeena River Chinook Salmon in 2013 and in Prior Years

The numbers of Chinook salmon returning to the Skeena River were estimated using the proportion of Kitsumkalum River fish measured from genetic samples collected at the Tyee test fish project and the estimates of the Kitsumkalum Chinook salmon escapement from an independent MR program. This summary includes results for seven SSP projects, the 2009 to 2013 annual projects and two retrospective projects that examined 30 years of data from 1979 to 2008. The data presented are preliminary.

The Skeena River has the second largest aggregate of Chinook salmon spawning populations in British Columbia and is one of the escapement indicator stocks used by the CTC for North/Central British Columbia. Chinook salmon escapements to the Skeena River were represented by an index that includes approximately 20 populations surveyed annually using a variety of techniques. The Kitsumkalum River is the exploitation rate indicator stock for the Skeena Chinook salmon complex, and spawning escapements have been estimated using a MR program since 1984. Other escapement estimates that contribute to the Skeena index are based on fish weir counts, and visual observations from helicopter, fixed wing aircraft, boats and foot surveys. The index of Chinook salmon escapement to the Skeena aggregate has averaged about 50,000 fish since 1984 (Table C.11). On average, since 1984, the Kitsumkalum indicator stock represented approximately 30% of the index and the Bear and Morice river populations contributed 20% (Bear) and 26% (Morice) to the index.

Skeena Chinook salmon are caught in the AABM fisheries in Southeast Alaska and Northern British Columbia as well as in Canadian ISBM fisheries. Skeena Chinook salmon are north migrating so they do not contribute to the WCVI AABM fisheries nor do they contribute appreciably to ISBM fisheries south of the Skeena River.

Genetic analyses of 21,044 Chinook salmon were completed from fish sampled at the Tyee Test Fishery over 35 years. The retrospective projects estimated Chinook salmon returns to the Skeena River using genetic stock identification techniques of archived scale samples. The proportions of Kitsumkalum River Chinook salmon identified in the samples were expanded to Skeena-wide population estimates using estimates of Kitsumkalum Chinook salmon escapement from independent MR programs. The preliminary estimates of large Chinook salmon escapement to the Skeena River ranged from 28,398 in 1986 to 155,637 in 2001. Over the time series the CVs were less than the data standard of 15% in 13 years and were greater than 15% in 17 years (Table C.11, Figure C.7). The projects were close to the data standard (15% < CV < 17%) in four years.

The genetic-based estimates represent an improvement over existing indices since comparisons may be made between years (Figure C.7). The estimates include estimates of variance which cannot be produced for the escapement indices of Skeena Chinook salmon because of the combinations of different escapement estimation techniques involved. The data also make important contributions to understanding stock composition, timing, relative abundance, and age structure.

Table C.11.–Skeena River Chinook salmon historic escapement index, Kitsumkalum MR results and preliminary escapement estimates for the aggregate populations, 1984 to 2013.

Year	Skeena Historic Escapement Index	Kitsumkalum MR Estimate	CV of Kitsumkalum MR Estimate	Weighted Proportion of Kitsumkalum at Tyee from DNA	CV of Kitsumkalum Proportion at Tyee	Skeena Chinook Escapement Estimate	CV of Skeena Chinook Escapement Estimate
1984	35,639	12,408	19.9%	20.9%	15.1%	51,348	25.0%
1985	52,157	8,304	5.9%	20.2%	12.4%	30,875	13.7%
1986	59,439	9,109	5.9%	23.3%	14.7%	28,398	15.9%
1987	60,873	23,657	10.1%	14.9%	14.3%	150,874	17.5%
1988	68,007	22,267	6.9%	21.2%	10.5%	91,496	12.6%
1989	56,824	17,925	7.2%	21.9%	10.5%	72,422	12.8%
1990	55,441	17,406	6.4%	21.2%	11.3%	64,188	13.0%
1991	52,542	9,288	7.2%	17.3%	11.7%	41,940	13.7%
1992	66,868	12,437	8.1%	10.8%	20.7%	103,365	22.3%
1993	68,196	14,059	5.5%	10.9%	16.1%	119,780	17.1%
1994	22,461	12,629	9.5%	14.6%	13.4%	78,228	16.4%
1995	34,190	7,221	10.1%	10.6%	22.3%	62,272	24.5%
1996	73,684	12,776	16.7%	8.0%	11.8%	155,637	20.4%
1997	42,289	5,342	11.3%	8.4%	15.9%	57,368	19.5%
1998	46,774	11,065	6.8%	12.2%	16.6%	80,677	17.9%
1999	43,775	9,763	8.9%	14.2%	7.9%	53,418	11.9%
2000	51,804	14,722	8.2%	13.6%	9.5%	95,563	12.5%
2001	81,504	23,839	9.5%	15.3%	7.4%	145,120	12.1%
2002	44,771	23,849	11.4%	25.0%	5.3%	89,235	12.6%
2003	56,758	23,608	11.0%	18.9%	6.9%	114,346	13.0%
2004	39,552	25,767	10.2%	16.8%	7.8%	142,141	12.8%
2005	29,496	15,046	9.2%	17.8%	7.0%	77,531	11.6%
2006	36,232	12,368	14.5%	13.7%	9.3%	84,199	17.2%
2007	36,754	15,736	18.0%	17.5%	7.5%	85,179	19.5%
2008	34,415	10,374	14.2%	13.1%	8.2%	71,446	16.4%
2009	36,176	10,703	13.3%	12.4%	13.3%	80,900	18.8%
2010	42,139	13,712	14.8%	12.7%	10.2%	101,486	18.0%
2011	34,130	12,059	20.2%	21.0%	6.8%	53,682	21.3%
2012	33,370	9,363	13.9%	26.0%	7.8%	33,473	16.0%
2013	26,699	10,934	9.4%	26.5%	7.2%	39,179	11.9%

The studies have provided new information regarding the components within the Skeena Chinook salmon aggregate. The Kitsumkalum River contributes 18% to the aggregate on average. Other large contributors were the Morice River at 31%, the Bear River at 7.4% and the Babine River at 6.6%. These three populations make up the Skeena River Large Lake Conservation Unit. Skeena tributaries that make up the conservation units of the upper Skeena and the middle Skeena were found to contribute 9% (upper) and 17% (middle) of the total Skeena escapement. The upper and middle Skeena units were poorly represented in the historic escapement index.

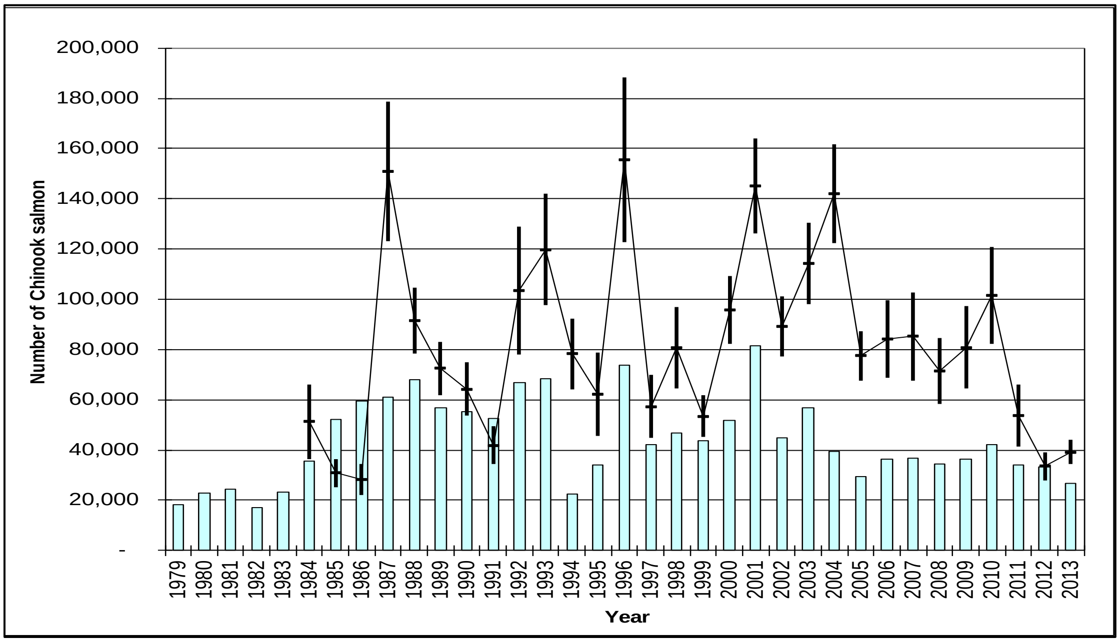


Figure C.7.–Comparison of the Skeena River Chinook salmon escapement index with escapement estimates developed using the genetic approach.

Note: The bars represent the Skeena Chinook salmon escapement index. The crosses represent the estimates generated using the genetic approach. The vertical lines represent the genetic estimates plus and minus one standard deviation.

In addition to the data presented from 1984 to 2013, genetic stock identifications have been completed for 1,056 samples from the Tyee Test Fishery from 1979 to 1983. Although Kitsumkalum MR estimates are not available prior to 1984, estimates from surveys of other systems (e.g., Morice, Bear and Babine rivers) may be used to generate total system estimates. While the variance around these estimates will be broad (well beyond the data standard) they are important to understand as they include the base period used to compare Chinook salmon abundances prior to the PST.

The project has produced 30 years of escapement information with additional information for five years yet to be completed (1979–1983). The technique represents a cost effective way to estimate the Chinook salmon return to the Skeena River aggregate. It is probable that the program will be continued after the SSP funding program ends.

C.12 WCVI Statistical Framework to Assess Chinook Salmon Escapement

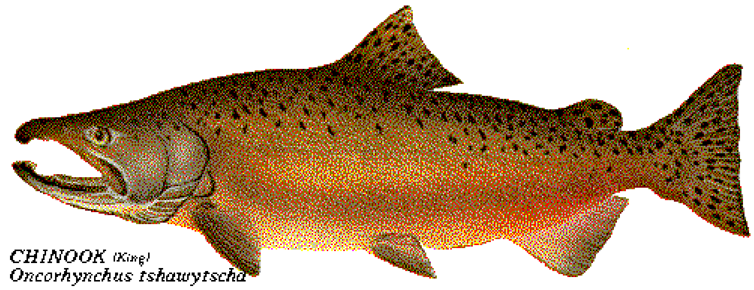
A Canadian Science Advisory Secretariat Centre for Science Advice–Pacific workshop occurred during June 2013 to evaluate the escapement estimation methodology used to evaluate the abundance of WCVI extensive indicator stocks relative to escapement targets, and to recommend methods for estimating an annual aggregate escapement or appropriate surrogate for the entire management unit. The periodic visual survey methodology was evaluated to assess the validity of the method considering biological, distributional and logistical factors specific to WCVI Chinook salmon, the ability of the methods to produce a measure of uncertainty and the potential for bias in the survey procedure.

This review concluded that the current application of the method to estimate stream escapement does not provide estimates of uncertainty. Several sources of uncertainty and bias were identified, including the estimation of observer efficiency, survey life, the frequency of site visits and the identification of peak counts. Approaches for investigating the sensitivity of the estimates of escapement to these biases, as well as approaches for the evaluation of the bias and the development of correction factors were identified. Refinements of the AUC and maximum likelihood estimation models, data inputs, and further development of both estimation models, as well as thorough documentation of protocols and analytical methods, were recommended. Given the further analysis and revisions required to provide advice on the validity of the current visual survey method, it was recommended that these initiatives be completed and the technical document resubmitted for peer review.

APPENDIX D. GRAYS HARBOR ESCAPEMENT GOAL

At the 2014 PSC Preseason Meeting (February 10–14, Vancouver, BC), the bilateral CTC reviewed the report *Development of escapement goals for Grays Harbor fall Chinook using spawner–recruit models* jointly presented by the Quinault Indian Nation-Department of Natural Resources and the Washington Department of Fish and Wildlife. The report and presentation provided data and analytical methods used to develop a biologically based escapement goal for Grays Harbor fall Chinook salmon, one of the Washington Coast escapement indicator stocks without a CTC-approved goal. The CTC approved a goal of 13,500, plus or minus 5%, pending the results of incorporating feedback from the CTC. The presenters have finalized the analysis and report, resulting in a final escapement goal for the Grays Harbor fall Chinook salmon indicator stock of 13,326 adult (age 3+) spawners, which will be used in the CTC's 2014 Catch and Escapement Report assessment. The memo documenting the review and a summary of the analysis follows.

Memo documenting Grays Harbor escapement goal



PSC Chinook Technical Committee

TO:	Susan Farlinger Chair Commissioner Fisheries and Oceans Canada	Robert Turner Vice-Chair Commissioner United States Section

CC: Pete McHugh, Kris Ryding, Kirt Hughes, Mike Scharpf, and Curt Holt,
Washington Dept. of Fish and Wildlife
Gary Morishima, Larry Gilbertson, Rick Coshow, Jim Jorgersen, and Tyler Jurasin,
Quinault Dept. of Natural Resources

FROM: Chinook Technical Committee, Pacific Salmon Commission

DATE: February 14, 2014

SUBJECT: Biologically Based Escapement Goal for Grays Harbor fall Chinook, Washington

At its bilateral meeting February 11th, the Chinook Technical Committee (CTC) was presented a new maximum sustained yield escapement goal for naturally spawning adults for Grays Harbor fall Chinook, and reviewed nearly final documentation of it supplied by the Washington Department of Fish and Wildlife (WDFW) and the Quinault Indian Nation (QIN). The CTC accepted escapement goal of 13,500 adults will be used to evaluate management actions for consistency with the Pacific Salmon Treaty objectives of rebuilding and sustaining healthy Chinook salmon stocks.

The escapement goal is based on spawner-recruit relationships using estimates of production resulting from naturally spawning fish in the Chehalis and Humptulips river basins from brood years 1986 through 2005. The CTC considers the data and methods documenting the escapement goal of 13,500 to be sound and biologically-based. Further details will be summarized in TCCHINOOK (14)-02, Appendix D.

The CTC recommends some minor modifications to the final report, but does not expect these to affect the escapement goal more than 5% and does not anticipate that further review by the CTC is required as a result of incorporating the following suggestions:

1. Tabulate adult spawners and recruits (excluding jacks) by brood year for each river basin (Chehalis and Humptulips) and for the total Grays Harbor production, to facilitate independent analyses and reproducibility.

2. Further clarify the rationale for using the Queets exploitation rate indicator stock.

3. Cite the Little Hoquiam River mark-recapture study supporting the use of 2.5 fish/redd.

4. Explain the analyses exploring marine survival indices or other environmental covariates and why none were used, i.e., that there was no correlation with residuals.

5. Include, where available, estimates of stray rates and percentage hatchery origin by basin, and associated coefficients of variation.

6. Document the proportion of reaches not surveyed.

The CTC appreciates the work done to provide this improved metric and the effort to address 1) the list of desired elements for documentation, as listed in TCCHINOOK (99)-3, and 2) whether the analysis met the recommended data standards for biologically-based escapement goals, as listed in CTC Technical Note 1301 in TCCHINOOK(13)-1.

Summary of Analysis

A brief narrative describing the basis for this new goal is provided here, but readers are referred to QDNR and WDFW (2014) for complete goal-development details.

Stock Profile. The Grays Harbor fall Chinook salmon indicator stock is an aggregate of predominantly wild production. The two major production components comprising the Grays Harbor aggregate are Chehalis and Humptulips fall Chinook salmon, inclusive of tributaries. The stock has a life history typical of Washington Coast fall Chinook salmon, with adults returning to Grays Harbor from September to October and spawning from October to December. Juveniles typically emigrate as subyearling smolts the following spring and spend one to five years rearing off of the Alaska and British Columbia coasts. In addition to mixed-maturity ocean fishery exposure, Grays Harbor fall Chinook salmon are subject to harvest in a combination of terminal estuarine and freshwater commercial (treaty and nontreaty), sport, and ceremonial and subsistence fisheries.

Data and Analysis Overview. The Grays Harbor stock–recruitment analysis was performed using estimates of spawning escapement (spawners) and total production (recruits) for brood years 1986 to 2005, generated separately for the basin's two main production components (Chehalis, Humptulips; Table D.1). Spawning escapement estimates for the Grays Harbor system are based on a combination of extensive and intensive redd surveys and assume 2.5 fish (adults) per redd, as supported by a MR study on the Little Hoquiam River from 1987 to 1989 (Chitwood 1987, 1988, 1989). Production was estimated by expanding terminal run size estimates (inclusive of incidental mortality) to prefishing adult equivalent ocean recruits based on results from the CTC's cohort reconstruction for the Washington Coastal fall Chinook salmon CWT indicator stock (Queets fall Chinook salmon). Escapement goals—the spawning escapement level associated with maximum sustained yield (S_{MSY})—were estimated separately for the Humptulips and Chehalis rivers, and the goal for the indicator stock as a whole is the sum of these estimates. The Ricker model provided a better fit to the Chehalis and Humptulips datasets than the Beverton-Holt model, yielding a system total goal of 13,326 adult spawners (Chehalis River S_{MSY}: 9,753; Humptulips River S_{MSY}: 3,573; Table D.2). The 2004 data point for Chehalis had substantial influence on the relationship, but bootstrap analysis revealed only a 500 fish difference in S_{MSY}; the final analysis includes the 2004 data point. For the Humptulips basin data, residuals were autocorrelated, so an autoregressive moving average (1,1) correction was used.

The presentation included an evaluation of the data and methods employed relative to CTC data standards for escapement goals. No estimates of uncertainty surrounding estimates of escapement and resulting production are available. The contrast (maximum spawners relative to minimum spawners) of escapement data was marginal, at 3.4 for the Chehalis basin and 4.0 for the Humptulips basin, as expected under long-term escapement goal management.

The accepted goal is notably similar to values generated through past CTC-affiliated biologically based escapement goal evaluations, despite limited overlap in underlying datasets and differences in analytical approaches, and is approximately 10% lower than the escapement objective (14,600 spawners, a capacity-based goal) used by QDNR and WDFW in past management (Table D.3).

Table D.1.–Spawner–recruit data used to estimate escapement goals for the Grays Harbor fall Chinook salmon indicator stock. Parent generation spawners include age-3+ individuals of both hatchery and natural origin. Recruitment includes natural-origin production only, inclusive of escapement, terminal catch and incidental mortalities, and adult equivalent ocean catch and incidental mortality. See QDNR and WDFW (2014) for further dataset details.

	Chehalis		Humptulips	
Brood Year	Spawners	Recruits	Spawners	Recruits
1986	9,483	38,805	4,325	20,467
1987	12,850	25,593	6,163	9,935
1988	21,945	38,592	6,213	17,372
1989	20,066	45,980	5,611	18,766
1990	12,893	35,859	4,102	13,861
1991	12,571	14,990	1,821	7,105
1992	11,974	59,771	4,618	16,246
1993	10,472	32,329	2,877	11,425
1994	9,919	7,767	4,401	3,749
1995	9,786	10,937	2,941	1,792
1996	16,161	31,869	4,066	4,398
1997	14,402	22,164	3,766	3,122
1998	10,101	26,921	2,428	5,046
1999	8,409	56,120	1,954	11,975
2000	7,892	26,671	1,493	12,128
2001	7,902	22,275	1,590	8,323
2002	9,694	34,801	2,147	12,596
2003	16,111	28,334	3,760	7,983
2004	26,320	11,281	5,453	5,394
2005	13,367	24,022	6,328	15,125

Table D.2.–Estimates and standard errors for parameters of the Ricker model and S_{MSY} used to compute the escapement goal for the Grays Harbor fall Chinook salmon indicator stock. See QDNR and WDFW (2014) for further details.

Catchment	Parameter	Estimate	S.E.	*t*-test results	Comments
Chehalis	α	5.29	2.10	$P(\alpha \leq 1) < 0.028$	Estimates computed via bootstrapping to minimize influence of outlier brood (2004)
	β	0.000068	0.000029	$P(\beta \leq 0) < 0.012$	
	S_{MSY}	9,753	2983		
Humptulips	α	5.16	2.60	$P(\alpha \leq 1) = 0.064$	Model included ARMA(1,1) function to address autocorrelation
	β	0.0002	0.0001	$P(\beta \leq 0) = 0.031$	
	S_{MSY}	3,573	2177		

Table D3.–History of escapement goals in use or estimated through prior analysis efforts affiliated with the Chinook Technical Committee.

Origin of goal	Broods included	Chehalis River	Humptulips River	Grays Harbor Total
WA Comanager goal (1979)	N/A	12,364	2,236	14,600
CTC (1999)[1]	1976–1991	N/A	NA	13,024
Alexandersdottir (1999)[1]	1976–1991	8,489	3,955	12,444
Goodman (2003)[1]	1976–1991	10,084	3,392	13,476
Proposed goal (2014)	1986–2005	9,753	3,573	13,326

[1] CTC, Alexandersdottir, and Goodman are unpublished analyses reviewed in Clark (2003, unpublished memo) and years attached to names denote the year in which the analysis/review occurred.