PACIFIC SALMON COMMISSION
JOINT CHINOOK TECHNICAL COMMITTEE

ANNUAL REPORT OF CATCH AND ESCAPEMENT FOR 2012

REPORT TCCHINOOK (13)-1

July 2013

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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
COLR	Columbia River
CNR	Chinook Non-Retention
CR	Chinook Retention
CRITFC	Columbia River Intertribal Fish Commission
CRFMP	Columbia River Fish Management Plan
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
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
MSH	Maximum sustainable catch
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	Queen Charlotte Islands
SE	Standard Error
SIM	Sublegal Incidental Mortality
SMSY	Escapement producing MSY
SEAK	Southeast Alaska Cape Suckling to Dixon Entrance
SPAS	Stratified Populations Analysis System
SSP	Sentinel Stocks Program
SRA	Stock-Recruit Analysis
SUS	Southern U.S.
SWVI	Southwest Vancouver Island
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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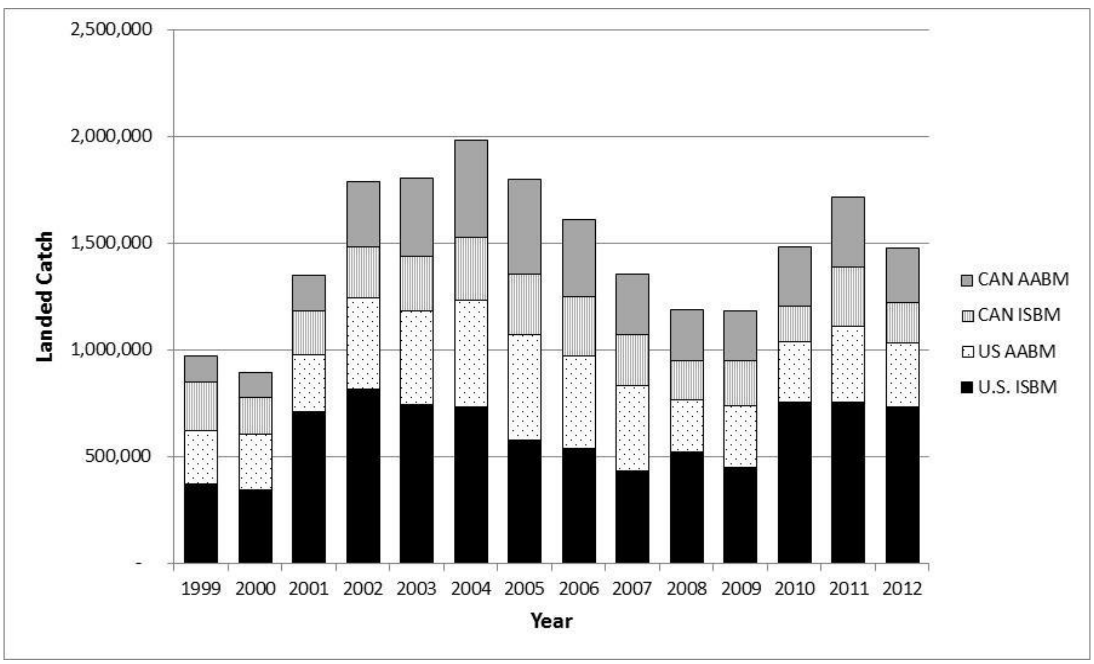
EXECUTIVE SUMMARY

The Pacific Salmon Treaty (PST) requires the Chinook Technical Committee (CTC) to report annual catch and escapement data for Chinook salmon. 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 catch, escapements, a new section on stock status that provides an indication of stock performance in the context of management objectives, and a summary of the Sentinel Stocks Program for 2012.

Annual catch data for the report is 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 incidental mortality (IM) by fishery in 2012, 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 AABM and ISBM fisheries, from 1999 to 2012, is provided in the figure below. In addition, time series of available IM estimates were added this year 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.

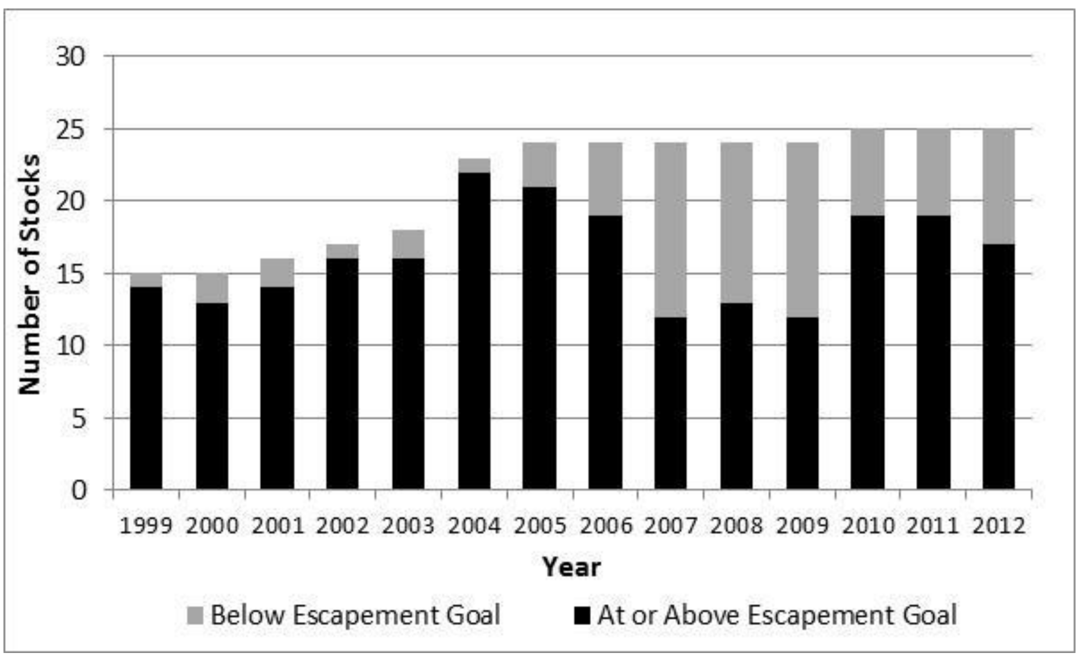


Estimates of landed catch for U.S. and Canada AABM and ISBM fisheries 1999–2012.

The preliminary estimate of total LC of Chinook salmon for all PSC fisheries prosecuted in 2012 was 1,474,149, of which 1,029,554 and 444,595 were taken in U.S. and Canadian fisheries, respectively. The estimated total IM associated with this harvest is 211,881 nominal Chinook salmon. The TM for all PSC fisheries in nominal fish was 1,686,030 Chinook salmon, of which 1,181,283 were taken in U.S. fisheries and 504,746 in Canadian fisheries. For U.S. fisheries, 71% of the LC and 69% of TM occurred in ISBM fisheries; in Canada, 43% of the LC and 44% of TM occurred in ISBM fisheries. For some component sport fisheries, 2012 LC and IM estimates are not yet available.

Section 2 includes an assessment of escapement for stocks with CTC accepted goals, and escapement data through 2012 for all PST escapement indicator stocks. The escapements of 50 naturally spawning escapement indicator stocks are reviewed annually, along with the results from the Sentinel Stocks Program (SSP). The CTC will continue to review escapement goals for stocks as they are provided by respective agencies. Biologically-based escapement goals have been accepted by the CTC for 25 of the 50 escapement indicator stocks/stock aggregates. For 12 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 escapement that is more than 15% below the lower end of the range or the S_{MSY} point estimate is of particular concern.

From 1999 to 2011, the percentage of stocks that met or exceeded escapement goals or goal ranges has varied from 50% to 96%. In 2012, 17 of 25 stocks (68%) met or exceeded escapement objectives. Of the eight stocks below goal, three stocks (Chilkat, Andrew, and Chickamin) were within 15% of the target goal; five stocks (Situk, Unuk, Alsek, Harrison, and Cowichan) were more than 15% below goal.

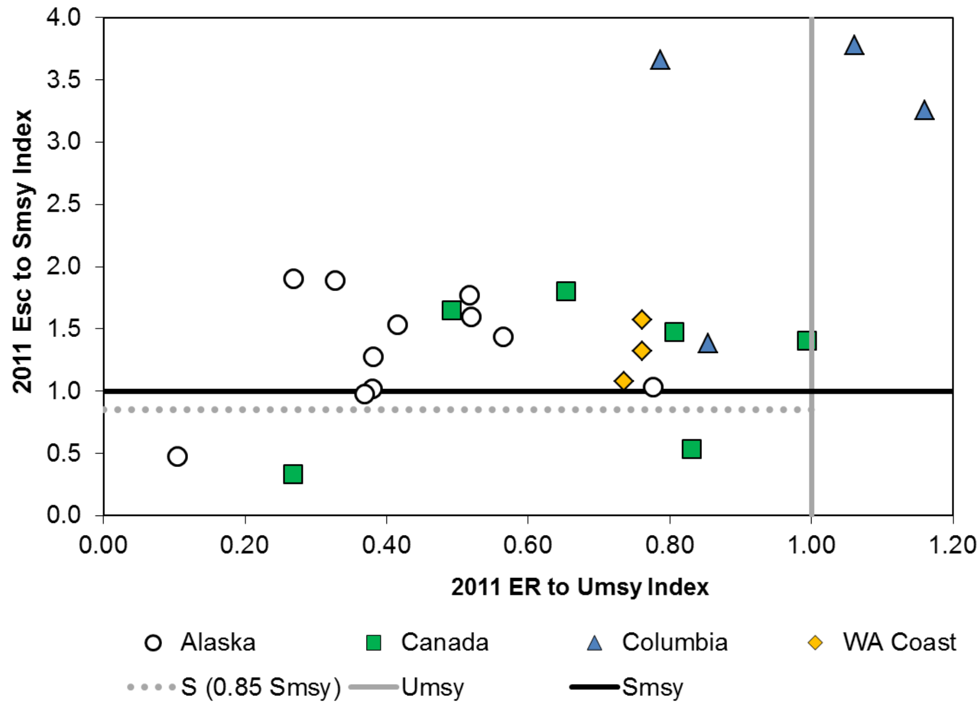


Number and status of stocks with CTC-accepted escapement goals for 1999–2012.

The CTC evaluated the performance of the stock groups against the criteria for triggering additional management action in regards to PST Chapter 3, Paragraph 13 (c), based upon observed escapements and exploitation rates through 2012 and stock forecasts for 2013. No stock groups listed in Attachment I–III met the criteria for triggering additional management action for the 2011 and 2012 observed values. The 2012 observed escapement and 2013 forecast values indicate that one stock group (Fraser late, i.e., Harrison River) potentially meets the flagging criteria for triggering Paragraph 13 action, however 13(g) notes no further reduction will be taken in the West Coast Vancouver Island (WCVI) fishery unless otherwise agreed by the PSC. Note that ISBM obligations for 2012 cannot be calculated for some stocks until 2014 because of a delay in required coded wire tag (CWT) data under current fishery monitoring programs.

No stocks in Attachments I-III of the PST with an agreed escapement objective were more than 15% below the management objective in both 2011 and 2012. However, only five of the 10 different stock groups in Attachments I–III have stocks with CTC-accepted management objectives that can be evaluated against Paragraph 13 (c) criteria, and 11 of these stocks had forecasts available for 2012. The CTC has identified a need to develop management objectives (higher priority) and forecast capabilities (lower priority) for more of the stocks and stock groups included in Attachments I–III to improve the efficacy of Paragraph 13.

A synoptic evaluation of stock status is presented in Section 3 for each escapement indicator stock for each region, summarizing the performance of those stocks relative to established goals over time. This evaluation draws upon the catch information in Section 1, escapement information in Section 2, and exploitation rates and other information to evaluate the status of stocks in a region. Synoptic plots present both the current status of stocks and the history of the stocks relative to PST management objectives to clearly summarize the performance of the stocks and fisheries management relative to established or potential goals. A synoptic summary figure for 24 stocks with 2011 data shows that the majority of stocks were in the safe zone. None of the stocks were in the high risk zone, however three stocks were in the low escapement and low exploitation zone. Two stocks had experienced high exploitation, but their escapements exceeded the escapement goal objective. When stock status was examined by region there was not a strong regional pattern, other than for Washington Coast.



Synoptic summary by region of stock status for stocks with escapement and exploitation rate data in 2011 (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 2012 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, WCVI, Puget Sound, and North Oregon Coast (NOC) to a level that meets or exceeds bilateral assessment accuracy and precision standards. The 2012 season is the fourth year of the program. In 2012, the PSC approved $2,157,600 in funding for 14 projects. The funded projects estimated escapements for stocks in the Nass, Skeena (two projects), Harrison, Chilko, South Thompson, Burman, WCVI, Snohomish, Stillaguamish, Green, Siltez, and Nehalem rivers and to develop a statistical framework for escapement estimation in the WCVI. Escapement estimates and methods used to obtain those estimates are described in Section 4 and Appendix C for each of the funded programs.

The CTC has been working to develop bilateral data standards for the minimum (or desired) assessment program required to effectively implement the 2009 Agreement. For escapement indicator stocks, asymptotically accurate (unbiased) and a CV of 15% are the CTC data standards for escapement estimates. These standards were adopted in 2008 and documentation of that action is provided in Appendix D. In June 2013, the CTC adopted standards for escapement goals. A technical note (CTC Technical Note 1301) on maximum sustained yield (MSY) or other biologically-based escapement goals is provided in Appendix E.

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 for Chinook salmon AABM fisheries while ISBM fisheries are limited by adult equivalent mortality rates for stocks not meeting their escapement objectives. 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 Non-Retention, CNR); all are reported here as occurring within the three AABM and the Canada and U.S. ISBM fisheries. For 2012, estimates for the three AABM fisheries are presented by gear sector in Table 1.2.1 and Table 1.2.2.2, and similar estimates for ISBM fisheries of Canada and the U.S. are summarized in Table 1.3.1 and Table 1.3.3, respectively. A summary of the estimated LC, IM, and TM for Chinook salmon in all PST AABM and ISBM fisheries is presented in Table 1.4.

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 of the 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:

1) Southeast Alaska (SEAK) All Gear,
2) Northern British Columbia (NBC) Troll and Queen Charlotte Islands (QCI) sport, and
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	36.4
2000	178.5	186.5	74.3	123.5	31.9	86.2	101.4
2001	250.3	186.9	77.3	158.9	43.5	145.5	117.7
2002	371.9	357.1	68.2	237.8	150.1	196.8	165.0
2003	439.6	380.2	57.2	277.2	191.7	268.9	175.8
2004	418.3	417.0	76.0	267.0	241.5	209.6	216.6
2005	387.4	390.3[3]	65.2[3]	240.7	243.6	179.7	202.7
2006	354.5	361.3[3]	48.5[3]	200.0	216.0	145.5	146.9
2007	259.2	328.0[3]	68.9[3]	143.0	144.2	121.9	139.2
2008	152.9	172.0[3]	66.2[3]	120.9	95.6	136.9	143.8
2009[2]	176.0	227.7[3]	62.3[3]	139.1	109.5	91.3	124.6
2010	215.8	229.4[3]	54.3[3]	160.4	136.6	142.3	136.8
2011	283.3	292.0[3]	64.5[3]	186.8	122.7	134.8	204.2
2012	205.1	241.0	53.2	149.5	120.3	113.8	134.5
2013	176.0			143.0		115.3	

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

[1] Allowable treaty catches correspond to the first post season abundance indices for 1999 to 2012 and the pre-season abundance indices for 2013.

[2] 2009 was the first year of implementation of the 2009 Agreement.

[3] Values changed because the method used to partition gillnet catch into large and non-large fish changed.

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 pre-season abundance index generated by the CTC Chinook Model each spring. The catch is allocated through regulations established by the Alaska Board of Fisheries. This plan establishes allocations 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 in-season 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 pre-season abundance index. Regulatory history and maps for each SEAK fishery are described in CTC 2004b.

In addition, the SEAK fisheries are managed for:

1) An Alaska hatchery add-on estimated from CWT sampling. The add-on is the total estimated Alaskan hatchery catch, minus 5,000 base-period Alaskan hatchery catch, and minus the standard error (SE) for the total estimated Alaskan hatchery catch.
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 2012 pre-season abundance index of 1.52 provided for an all-gear PST allowable catch of 266,800 Chinook salmon. The preliminary total all-gear catch in 2012 was 295,395 with a PST catch of 241,015, an Alaska hatchery add-on of 53,205, and a terminal exclusion catch of 1,175 Chinook salmon. Historical SEAK Chinook salmon catch numbers for 1975 to 2012 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, 2011 and ended with the summer fishery in September 2012. The winter troll fishery continues until 45,000 Chinook salmon are caught, or through April 30, whichever is earlier. In 2012, the winter troll fishery was open through April 27. The spring fishery, which targets Alaska hatchery-produced Chinook salmon, was conducted from May 1 to June 30 in a total of 31 spring areas and five terminal harvest areas. While there is no ceiling on the number of Chinook salmon harvested in the spring fisheries in aggregate, the take of treaty Chinook salmon is managed in consideration of the percentage of Alaska hatchery fish taken in each individual fishery area. The 2012 summer troll fishery included two Chinook salmon retention periods, from July 1 to July 9 and August 11 to September 8. 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 2012, the troll fishery harvested 209,392 Chinook salmon, which included 21,234 Alaska hatchery fish. There was an Alaska hatchery add-on of 17,193 and a Transboundary Rivers (TBR) exclusion of 343 fish, and subtraction of these from the total harvest results in a total of 191,856 PST fish. The winter fishery harvested 47,888 fish, of which 5,897 were from Alaska hatcheries and 43,149 were PST fish. The spring fishery caught a total of 25,563, of which 10,351 were Alaska hatchery fish and 16,773 were PST fish. The total summer catch was 135,941, of which 4,985 were from Alaska hatcheries and 131,934 were PST fish (Table 1.1.1.1).

Table 1.1.1.1.–Harvest of Chinook salmon in Southeast Alaska by gear type in 2012.

Gear	Total Catch	Alaska Hatchery Catch	Alaska Hatchery Add-on	Terminal Exclusion Catch[1]	AABM Catch[4]
Troll					
Winter	47,888	5,897	4,739	0	43,149
Spring	25,563	10,351	8,447	343	16,773
Summer	135,941	4,985	4,007	0	131,934
Troll subtotal	209,392[2]	21,234	17,193	343	191,856
Sport[3]	46,520	11,700	10,071	0	36,449
Net					
Set Net	382			0	382
Drift gillnet	17,956	12,316	10,822	832	6,302
Seine	21,145	15,273	15,120	0	6,025
Net subtotal	39,483	27,590	25,942	832	12,709
Total	295,395	60,523	53,205	1,175	241,015

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

2 Includes 11 fish confiscated by the State of Alaska due to illegal fishing.

3 Preliminary values until mail-out survey results are available.

4 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.

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 2012 total net catch was 39,483 Chinook salmon, which included 27,590 Alaska hatchery fish. There was an Alaska hatchery add-on of 25,942 and a TBR exclusion of 832, resulting in a PST catch of 12,709 (Table 1.1.1.1).

The purse seine fishery is open from mid-June through early fall and is limited to specific areas and time periods established in season by emergency order (Davidson et al. 2011b). In 2012, a total of 21,145 Chinook salmon, which included 15,273 Alaska hatchery fish and an Alaska hatchery add-on of 15,120 resulting in a PST catch of 6,025.

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 2012, surplus production and associated allowable catches were identified in both the Taku and Stikine rivers based on pre-season forecasts, and the allowable catches were large enough to implement limited directed commercial fisheries in Canada and sport fisheries in the U.S. However, the first in-season forecast updates for the Taku and Stikine rivers suggested run sizes were too low to provide for additional openings.

Overall, the drift gillnet fishery is limited to five traditional areas within the region and time periods are established in season by emergency order. The drift gillnet fishery caught a total of 17,956 Chinook salmon, including 12,316 Alaska hatchery fish. There was an Alaska hatchery add-on of 10,822 and a TBR exclusion of 832, resulting in a PST catch of 6,302.

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 2012 set gillnet fishery caught 382 Chinook salmon, all of which were PST fish.

1.1.1.3 Sport Fishery Catch

Sport catches are monitored in season by creel surveys throughout the region, and sampling programs are in place to recover tags from coded wire tagged Chinook salmon and coho 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 creel surveys while final sport catch estimates are computed from a mail-out survey and are available one year after the fishery occurs. In 2012, Chinook salmon regulations for the sport fishery allowed for a three fish daily bag limit and no annual limit for residents. Non-resident anglers had a one fish daily bag limit except during May, when the bag and possession limit was two. Nonresident anglers had an annual limit of four Chinook salmon. The minimum size limit of 71 cm (28 inches) in total length was in effect for both resident and non-resident anglers throughout the season. 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 2012 total sport Chinook salmon catch was 46,520 with an estimate of 11,700 Alaska hatchery fish. There was an Alaska hatchery add-on of 10,071 fish, resulting in a PST catch of 36,449 Chinook salmon (Table 1.1.1.1).

1.1.2 British Columbia Fisheries

Under the 1999 PST Agreement, AABM regimes were implemented to constrain catch. This agreement extended through 2008 and was renewed in the 2009 PST Agreement that extends through 2018. 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 2012 was 120,306. 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 2012 was 134,468 (Table 1.1.2). Troll catches from 1996 to 2004 have been updated with data from Canadian Department of Fisheries and Oceans (CDFO 2009; Appendix A).

Table 1.1.2.–Harvest of Chinook salmon by gear for Canadian AABM fisheries in 2012.

AABM Fishery	NBC	WCVI
Northern BC Troll (Area F)	80,257	
WCVI Troll (Area G)		55,530
FSC Troll		5,000
Maanulth Troll		2,232
T'aaq-wiihak Troll		6,292
Sport	40,050	65,414
Total	**120,307**	**134,468**

1.1.2.1 *Northern British Columbia AABM*

The total NBC AABM catch (troll plus sport) between October 1, 2011 and September 30, 2012 was 120,307 Chinook salmon (Table 1.1.2).

1.1.2.1.1 Northern British Columbia Troll Fishery Catch

The NBC troll fishery landed 80,257 Chinook salmon in 2012. The NBC troll fishery was opened for Chinook salmon fishing from June 21 to July 15, July 20 to August 11, and September 4 to September 30. The entire 2012 NBC troll fishery was conducted under a system of individual transferable quotas. A total of 282 vessels were licensed but catch was conducted by 156 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 (26.4 in). No troll test fisheries were conducted in 2012. 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 10, 2012.

1.1.2.1.2 Northern British Columbia Sport Fishery Catch

Only the QCI sport catch is included in the AABM totals. Since 1995, catches in the QCI sport fisheries have been estimated by creel surveys, lodge logbook programs and independent observations by CDFO staff. Catch for this fishery in 2012 was 40,050 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 landed catch in the commercial troll, outside tidal sport, and FN troll in 2012 was 134,468 Chinook salmon (Table 1.1.2).

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 Statistical Areas 21, 23–27, and 121–127. In the 2012 season (October 1, 2011 to September 30, 2012), WCVI troll fishing opportunities were consistent with a CDFO commitment to evaluate winter fisheries as a means to improve the economic base for the fleet and local communities while increasing flexibility in catch opportunities and reducing the catch rates on stocks encountered in summer fisheries (Table 1.1.2.2.1). 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 1.1.2.2.1.–Fishing periods and Chinook salmon caught and released during the 2012 catch year in the West Coast Vancouver Island (WCVI) commercial troll fishery.

Fishing Period[1]	Areas Open	Main Area Fished	Landed Catch	Legal Releases	Sub-legal releases
Nov 15–Dec 31	Areas; 23, 24, 25, 26, 27, 123, 124, 125, 126, 127	123/126	245	0	54
Jan 1–31	Areas; 23, 24, 25, 26, 27, 123, 124, 125, 126, 127	23/126	129	0	21
Feb 1–29	Areas; 23, 24, 25, 26, 27, 123, 124, 125, 126, 127	123/126	542	3	63
March 1– 15	Areas; 23, 24, 25, 26, 27, 125, 126, 127	23/126	243	0	10
Apr 19–24	Areas; 23, 24, 25, 26, 27, 125, 126, 127	126/127	10,493	5	200
May 1– 6	Areas; 23, 24, 25, 26, 27, 124, 125, 126, 127	126/127	10,924	3	252
May 7	Areas; 23, 24, 25, 26, 27, 123, 124, 125, 126, 127	123/126	491	1	30
May 12–15	Areas; 23, 24, 25, 26, 27, 123, 124, 125, 126, 127	126/127	10,919	9	465
Aug 5	Areas; 123, 124, 125, 126, 127	123	4,280	4	232
Sep 4–8[2]	Area; 123	123	0	173	262
Sep 15–30	Areas; 123, 124, 125, 126, 127		17,264	0	0
Oct 10–11	Areas; 123, 124, 125, 126, 127	123/126	0	0	0
Total			55,530	198	1,589

[1] West Coast Vancouver Island 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.

[2] DNA sampling of sublegal Chinook salmon by Area G.

To reduce impacts on Fraser and LGS Chinook salmon, Southwest Vancouver Island areas 123 and 124 were closed from March 1 to April 23. In addition, fisheries from April 19 to June 10 were managed to monthly effort quotas rather than catch quotas. To reduce impacts on interior coho, coho non-retention remained in effect for the spring/summer period, Fraser coho encounter rates were monitored, commercial fisheries were closed from mid-June through July, and plugs were used to avoid impacts on coho in August and early September fisheries. To reduce impacts on WCVI Chinook salmon, nearshore area closures were in effect from August through mid-September. To reduce impacts on LGS Chinook salmon, catch levels were reduced during the spring period when recent impacts were highest. This measure also provides some benefits to spring run U.S. Chinook salmon stocks when the mature run is abundant on the WCVI. Statistical Area 121 (Swiftsure Bank) remained closed in 2012. Selective fishing practices were mandatory, including single barbless hooks and "revival tanks" for resuscitating coho salmon prior to release. The minimum size limit for commercial troll for all periods was 55 cm (21.6 in) fork length.

From July 18 to September 30, 2012, the T'aaq-wiihak demonstration fishery, a new fishery 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 2012 commercial troll fisheries was 55,530 Chinook salmon (Table 1.4). The WCVI FN caught an estimated 5,000 Chinook salmon in FSC fisheries, 2,232 Maanulth Treaty catch, and 6,292 in T'aaq-wiihak Demonstration fisheries 2012. Therefore, the total WCVI AABM troll catch for 2012 was 69,054 with 198 legal and 1,589 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 NWVI and August through mid-September in the Southwest Vancouver Island. Creel surveys two Chinook salmon greater than 45 were conducted from early June to mid-September. The Chinook salmon daily bag limit was 45 cm (17.7 in). Barbless hooks were mandatory.

The 2012 WCVI AABM sport landed catch estimate during the creel period was 65,414 Chinook salmon (Table 1.1.2.2.2). 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 1.1.2.2.2.–West Coast Vancouver Island AABM sport fishery catches of Chinook salmon by Pacific Fishery Management Areas (PFMA) in 2012 representing catch from June 1 to September 15.

PFMA	21/121	23/123	24/124	25/125	26/126	27/127	Total
Catch	10,226	25,004	10,119	6,601	7,476	5,988	65,414

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 2012 in Table 1.2.1 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 landed catch for each respective fishery. The 2012 troll encounters were estimated from regressions of historical encounter estimates and troll effort. The regression predicts encounter estimates 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 where 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 2012 was 286,623 nominal Treaty fish, including 241,015 Treaty fish in the landed catch, and 45,608 incidental mortalities.

Table 1.2.1.– Estimates of treaty and total (Includes total treaty, terminal exclusion, and hatchery add-on catch and estimates of incidental mortality) landed catch, incidental mortality (in nominal numbers of fish), and total mortality in SEAK AABM fishery, 2012.

SEAK Fishery	Landed Catch	Legal Encounters	Sublegal Encounters	Total LIM[2]	Total SIM[2]	Total IM	Total Mortality
Treaty							
Troll CR	191,856	191,856	69,131	1,535	18,181	19,716	211,572
Troll CNR	0	26,406	17,488	5,783	4,599	10,382	10,382
Troll Total	191,856	218,262	86,618	7,318	22,781	30,098	221,954
Sport Total[1]	36,449	17,848	30,717	4,150	4,884	9,034	45,483
Gillnet	6,684	6,684	0	134	0	134	6,818
Seine CR	6,025	6,025	875	0	751	751	6,776
Seine CNR	0	2,271	6,032	1,158	4,433	5,592	5,592
Net Total	12,709	14,981	6,906	1,292	5,184	6,476	19,185
Treaty Total	241,015	251,090	124,241	12,760	32,848	45,608	286,623
Total SEAK							
Troll CR	209,392	209,392	75,449	1,675	19,843	21,518	230,910
Troll CNR	0	27,208	18,019	5,958	4,739	10,697	10,697

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Table 1.2.1.– Page 2 of 2.

SEAK Fishery	Landed Catch	Legal Encounters	Sublegal Encounters	Total LIM[2]	Total SIM[2]	Total IM	Total Mortality
Troll Total	209,392	236,600	93,468	7,634	24,582	32,216	241,608
Sport Total[1]	46,520	22,779	39,204	5,297	6,233	11,530	58,050
Gillnet	18,338	18,338	0	367	0	367	18,704
Seine CR	21,145	21,145	3,070	0	2,634	2,634	23,779
Seine CNR	0	7,971	21,168	4,065	15,558	19,624	19,624
Net Total	39,483	47,454	24,238	4,432	18,192	22,624	62,107
SEAK Total	295,395	306,832	156,909	17,362	49,008	66,370	361,765

[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 1.2.2.2 summarizes estimates of landed catch, encounters and associated incidental mortalities by size class during CR and CNR fishing periods that occurred within the NBC AABM fishery in 2012. 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 size specific rates from the CTC (1997). The estimated total mortality for 2012 was 131,782 nominal fish including 120,307 fish in the landed catch and 11,475 incidental mortalities.

1.2.2.2 *West Coast Vancouver Island Fisheries*

The estimated total mortality of Chinook salmon that occurred within the WCVI AABM fishery in 2012 was 150,858 nominal fish, including 134,468 Chinook salmon in the landed catch and 16,390 Chinook salmon from IM (Table 1.2.2.2). The estimated IM included 12,190 legal and 4,200 sublegal nominal Chinook salmon. Table 1.2.2.2 also summarizes encounters for these fisheries by size class during CR and CNR fisheries. In 2012, a non-retention AABM troll fishery opened in September to collect DNA samples from sublegal Chinook salmon.

Table 1.2.2.2.–Estimates of treaty and total landed catch, incidental mortality (in nominal numbers of fish), and total mortality in NBC and WCVI AABM fisheries, 2012.

Fishery	Landed Catch	Legal Encounters	Sublegal Encounters	LIM Drop-off	Total LIM	Total SIM	Total IM	Total Mortality
NBC								
Troll CR	80,257	-	10,461	1,364	1,364	4,140	5,505	85,762
Troll CNR	-	3,901	518	-	788	205	993	993
Troll Total	80,257	3,901	10,979	1,364	2,152	4,345	6,498	86,755
Sport Total	40,050	22,235	-	1,442	4,977	-	4,977	45,027
NBC Total	120,307	26,136	10,979	2,806	7,130	4,345	11,475	131,782
WCVI								-
Troll CR	55,530	25	1,327	944	949	525	1,474	57,004
Troll CNR	-	173	262	-	35	104	139	139
FN Troll[1]	13,524	-	-	230	230	-	230	13,754
Troll Total	69,054	198	1,589	1,174	1,214	629	1,843	70,897
Sport Total	65,414	33,661	18,598	4,514	10,976	3,571	14,547	79,961
WCVI Total	134,468	33,859	20,187	5,688	12,190	4,200	16,390	150,858

[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 to 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 2012, 189,820 Chinook salmon were caught in Canadian ISBM fisheries in British Columbia and Canadian sections of the transboundary Alsek, Taku and Stikine rivers. Total estimated IM in 2012 was 17,535 legal and 21,530 sublegal Chinook salmon. The distribution of the landed catches and estimated incidental mortalities are presented in Table 1.3.1.

Table 1.3.1. –Landed catch and incidental mortalities in Canadian ISBM fisheries for 2012.

Region/Gear	Landed Catch	Release Legals	Release Sublegals	Total LIM	Total SIM	Total IM
Transboundary Rivers	8,241	377	53	465	84	549
Net	7,407	10	53	350	84	434
Freshwater Sport	254	367		88	-	88
FN-FSC	580			27	-	27
Northern British Columbia	16,982	3,067		3,345	-	3,345
Net	780	3,067		2,661	-	2,661
Tidal Sport	7,017			253	-	253
Freshwater Sport	421			29	-	29
FN-FSC	8,189			377	-	377
Tyee Test Fishery	575			26	-	26
Central British Columbia	11,754	500	-	860	-	860
Net	3,624	500	-	533	-	533
Tidal Sport	5,861			211	-	211
Freshwater Sport	524			36	-	36
FN-FSC	1,745			80	-	80
Troll				-	-	0
West Coast Vancouver Island	45,804	3,291	10,277	3,682	1,973	5,655
Net	10,214	521		917	-	917
Tidal Sport	25,890	2,770	10,277	2,318	1,973	4,291
Freshwater Sport	-	-	-	-	-	0
FN-EO	9,700			446	-	446
Johnstone Strait	8,232	1,959	6,452	1,191	1,239	2,429
Net	37	468		346	-	346
Tidal Sport	7,874	1,447	6,452	821	1,239	2,060
Freshwater Sport	-	-	-	-	-	0
FN-FSC	321			15	-	15
Troll	-	44		9	-	9
Georgia Strait	25,553	2,010	43,775	2,078	8,405	10,483
Net	-	-	-	-	-	0
Tidal Sport	22,457	2,010	43,775	1,935	8,405	10,340
Freshwater Sport	-	-	-	-	-	0
FN-FSC	3,096			142	-	142
Troll	-	-	-	-	-	0
Juan de Fuca	22,438	3,366	8,361	2,306	2,111	4,417
Net	284	219	905	173	680	853
Tidal Sport	22,154	3,147	7,456	2,133	1,432	3,564
FN-FSC				-	-	0
Fraser River	50,816	5,868	2,037	3,805	744	4,549
Commercial Net	-	-	-	-	-	0
FN-EO Net	1,069	-	468	49	443	492
FN-FSC Net	36,521	104	-	1,778	-	1,778
Mainstem Catch Sport	5,204	378	119	432	23	455
Test Fishery Net	1,830			84	-	84
Trib Catch Sport	6,192	5,386	1,450	1,461	278	1,740
Grand Total	**189,820**	**20,438**	**70,955**	**17,731**	**14,556**	**32,287**

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 Endangered Species Act. 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” if they are fishing under the Native American Treaty fishing rights and “non treaty” 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 2012 Chinook salmon catch in Strait of Juan de Fuca tribal net fisheries was 1,525 fish with the majority of these taken during fisheries targeting Fraser River sockeye. There were 441 Chinook salmon harvested in the San Juan Islands net fisheries. The preliminary estimate of the 2012 Strait of Juan de Fuca treaty troll fishery catch (through December 2012) is 1,026 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 2012 tribal and non-tribal net fishery harvests in Puget Sound marine areas is 79,387 (70,354 tribal, 9,033 non-tribal) 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 tribal net harvest occurred in freshwater fisheries with a preliminary estimate of 36,530. Estimates of the sport catch in 2012 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 2012 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*

Tribal commercial, ceremonial and subsistence fisheries harvested 13,429 Chinook salmon in north coastal rivers (Quinault, Queets, Hoh, and Quillayute) in 2012. An additional 33 Chinook salmon were harvested by the Makah tribal fisheries in the Waatch and Sooes rivers.

Harvest in Grays Harbor includes catch from both the Humptulips and Chehalis rivers. The 2012 tribal net fisheries harvested an estimated 3,988 Chinook salmon. The 2012 non-treaty commercial net harvest in Grays Harbor was 2,089 Chinook salmon. An estimated 9,726 Chinook salmon were harvested by non-treaty commercial net fisheries in Willapa Bay in 2012.

From Grays Harbor north, sport fisheries were implemented based upon pre-season tribal-state agreements and were subject to in-season adjustment. Estimates of sport fishery catches for Washington coastal terminal fishing areas in 2012 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. For 2012, the estimated catch of Chinook salmon in commercial troll fisheries from Cape Falcon, Oregon to the U.S.-Canada border was 99,792 for treaty and non-treaty fisheries combined. Estimated catch in the ocean sport fishery north of Cape Falcon in 2012 was 35,428 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.

For 2012, the preliminary estimate of total annual harvest for all fisheries (spring, summer and fall) in the Columbia River basin was 367,551 Chinook salmon, which included a non-treaty commercial net harvest of 76,292, a sport harvest of 122,411, a treaty Indian commercial, ceremonial and subsistence harvest of 168,825, and a Wanapum-Colville harvest of 23 Chinook salmon. Historic catch estimates for Columbia River fisheries are shown in Appendix A.21.

1.3.2.6 *Oregon Coast Terminal*

Most harvest in ocean fisheries off Oregon's coast is comprised of a mixture of southern 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 of the NOC streams do migrate north and these populations are already 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 ocean fisheries has historically been believed to be greater (based on CWT distribution data). MOC catch statistics 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 2012 was 636 Chinook salmon.

Sport catch of these two stock groups occurs primarily in estuary and freshwater areas as mature fish return to spawn and is reported through a punch card accounting system. These estimates become available more than two years after the current season. Therefore, in-river and estuary sport catch punch card estimates are provided through 2011 only for the NOC. The 2011 punch card estimate of estuary and freshwater catch for the NOC group is 33,089 Chinook salmon. However, catch projections have been made for 2012 using correlations between escapement and punch card catch estimates for past years; these preliminary estimates of terminal sport catch for 2012 are presented in Table 1.3.1. Historical catch estimates for the Elk River troll fishery and the estuary and freshwater sport fisheries targeting on MOC and NOC stocks are shown in Appendix A.22.

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

Table 1.3.3 shows estimates of incidental mortalities 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. Incidental mortality 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, on-water monitoring, or extrapolated from similarly structured fisheries with known release information data.

Table 1.3.3.–Estimated incidental mortality in Southern U.S. troll, net, and sport fisheries, 2009–2012.

Fishery	**Gear**	**2012**			**2011**			**2010**		
		LC	**Releases**	**IM**	**LC**	**Releases**	**IM**	**LC**	**Releases**	**IM**
Juan de Fuca	**Net**	1,523	NA	122	352	NA	28	1,339	NA	107
	Sport	10,726[1]	34,894[1]	10,907[1]	9,504	20,601	6,899	11,508	38,036	11,862
	Troll	1,026	NA	26	4,090	NA	102	2,011	NA	50
Total		**13,275**	**34,894**	**11,054**	**13,946**	**20,601**	**7,029**	**14,858**	**38,036**	**12,020**
San Juans	**Net**	441	218	210	5,810	11,893	9,979	5,950	4,972	4,454
	Sport	4,476[1]	4,793[1]	1,934[1]	6,193	6,603	2,668	3,157	2,402	1,102
Total		**4,917**	**5,011**	**2,144**	**12,003**	**18,496**	**12,647**	**9,107**	**7,374**	**5,555**
Puget Sound	**Net**	115,917	NA	9,273	100,692	NA	8,055	72,576	NA	5,806
	Sport	31,993[1]	66,031[1]	22,335[1]	29,829	78,760	25,433	32,817	43,512	16,420
Total		**147,910**	**66,031**	**31,608**	**130,521**	**78,760**	**33,488**	**105,393**	**43,512**	**22,226**
Wash. Inside Coastal	**Net**	29,232	NA	585	39,034	NA	781	12,794	NA	256
	Sport	8,933[1]	NA	616[1]	13,340	NA	920	6,831	NA	471
Total		**38,165**	**-**	**1,201**	**52,374**	**-**	**1,701**	**19,625**	**-**	**727**
Columbia River	**Net**	245,140	4,436	13,672	265,740	6,964	15,138	291,417	7,826	17,016
	Sport	122,411	28,719	13,960	149,907	27,161	15,558	162,707	24,187	15,871
Total		**367,551**	**33,155**	**27,633**	**415,647**	**34,125**	**30,696**	**454,124**	**32,013**	**32,886**

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Table 1.3.3.–Page 2 of 2.

Fishery	Gear	2012			2011			2010		
		LC	Releases	IM	LC	Releases	IM	LC	Releases	IM
Wa./Or. North Falcon	**Sport**	35,428	42,874	7,388	30,826	55,050	9,090	38,686	36,403	6,505
	Troll	99,792	NA	2,495	61,433	NA	1,536	88,565	NA	2,214
Total		**135,220**	**42,874**	**9,882**	**92,259**	**55,050**	**10,626**	**127,251**	**36,403**	**8,719**
Oregon Inside	**Sport**	26,485[3]	NA	1,827[3]	33,089[3]	NA	2,283[3]	23,366	NA	1,612
	Troll[4]	636	NA	10	1,954	NA	31	1,315	NA	21
Total		27,121	NA	1,837	27,493	NA	1,793	24,681	NA	1,633
GRAND TOTAL		**734,159**	**181,965**	**85,360**	**751,793**	**207,032**	**98,501**	**755,039**	**157,338**	**83,766**

[1] WDFW Catch Record Card estimates of landed catch were not yet available; LC and releases for 2012 were computed using 2009–2011 mean values.

[2] The catch estimate is not yet available. Both landed catch and releases are based on the relationship between historical estimates of catches, escapements and releases. IM is imputed onto estimates of releases in accordance with mortality rates agreed to by the Pacific Fishery Management Council's Model Evaluation Workshop document Fishery Regulation Assessment Model (FRAM) An Overview for Coho and Chinook – v 3.0.

[3] Values for 2011 and 2012 landed catch and IM are estimates based on averages, not actual observed values. These will become available after the timeframe required for this report.

[4] The value represented by "troll" represents the concentrated fishery off of the mouth of the Elk River which is designed to specifically exploit returning Elk River Chinook.

1.4 Summary of 2012 Coastwide LC, IM, and TM in PSC Fisheries

Table 1.4 provides a coastwide summary of Chinook salmon catches and estimates of IM and TM in PSC fisheries for 2012. It should be noted, for some component fisheries, that current 2012 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 2012 is 1,474,149, of which 1,029,554 were taken in U.S. fisheries and 444,595 in Canadian fisheries (Table 1.4). Total estimated IM associated with this harvest was 211,881 Chinook salmon (13% of the TM) in nominal fish. The TM for all PSC fisheries in nominal fish was 1,686,030 Chinook salmon which is approximately 240,000 less than recorded for 2011 and is equivalent to 2010 PSC TM (Appendix A.25). Of the 1,686,030 total PSC TM estimated for 2012, 1,181,283 occurred in U.S. fisheries and 504,746 in Canadian fisheries. For U.S. fisheries, 71% of the LC and 69% of TM occurred in ISBM fisheries, whereas in Canada, 43% of the LC and 44% of TM occurred in ISBM fisheries. Data for calculating summary information contained in Table 1.4 for 2012 and previous years can be found in Appendix A.23, A.24, and A.25.

Table 1.4.–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 2012.

	2012		
Fishery	**LC**	**IM**	**TM**
SEAK AABM	241,015	45,608	286,623
SEAK hatchery add-on and terminal exclusion	54,380	20,762	75,142
U.S. ISBM	734,159	85,360	819,519
U.S. TOTAL	**1,029,554**	**151,729**	**1,181,283**
NBC AABM	120,307	11,475	131,782
WCVI AABM	134,468	16,390	150,858
CANADA ISBM	189,820	32,287	222,107
CANADA TOTAL	**438,944**	**60,151**	**504,746**
PST FISHERIES TOTAL	**1,474,149**	**211,881**	**1,686,030**

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 25 stocks included in this report.

This annual report, like those prior to 2006 (see CTC 2005) 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 (Figures 2.2.1.1.1–2.2.3.4.5). Table 2.1.1 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"*

In this report, escapement assessments include stock specific graphs of escapements and commentary, presented to provide a perspective on stock status and escapement trends through 2012.

The escapement goals and 2010 to 2012 escapements for the 25 stocks with CTC-accepted escapement goals are listed in Table 2.1.2. For 12 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 2012, escapements were within the goal range for 5 stocks, above the range or S_{MSY} point estimate for 13 stocks, and below the goal for 7 stocks.

The CTC has now assessed the status of stocks with CTC-accepted goals for return years 1999 to 2012. Over this time period, the number of stocks with CTC-accepted goals has increased from 15 to 25 (Figure 2.1). From 1999 to 2011, the percentage of stocks that met or exceeded escapement goals or goal ranges has varied from 50% to 96%. In 2012, the percentage of stocks that met or exceeded goal was 68%. Of the eight stocks below goal, three stocks (Chilkat, Andrew, and Chickamin) were within 15% of the target goal. Five stocks were more than 15% below goal: Situk, Unuk, Alsek, Harrison, and Cowichan.

Table 2.1.1..–Pacific Salmon Commission Chinook salmon escapement indicator stocks.

Presence in Treaty Attachments					Stock Group In Att. I–V	Escapement Indicator	Region	Run
SEAK	**NBC/ QCI**	**WCVI**	**BC ISBM**	**SUS ISBM**				
✓						Situk	Yakutat	Spring
✓						Chilkat	N. Inside	Spring
✓						King Salmon	N. Inside	Spring
✓						Andrew Creek	C. Inside	Spring
✓						Unuk	S. Inside	Spring
✓						Chickamin	S. Inside	Spring
✓						Blossom	S. Inside	Spring
✓						Keta	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	Sum/Fall
			✓		LGS	Cowichan/Nanaimo[2]	LGS	Fall
✓	✓		✓		Fraser Early[1] (Spr/Sum)	Fraser Spring 1.3	FR	Spring
✓	✓		✓		Fraser Early[1] (Spr/Sum)	Fraser Spring 1.2	FR	Spring
✓	✓		✓		Fraser Early[1] (Spr/Sum)	Fraser Summer 1.3	FR	Summer
✓	✓		✓		Fraser Early[1] (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

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Table 2.1.1.–Page 2 of 2.

Presence in Treaty Attachments					Stock Group In Att. I–V	Escapement Indicator	Region	Run
SEAK	**NBC/ QCI**	**WCVI**	**BC ISBM**	**SUS ISBM**				
		✓	✓	✓	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
✓	✓			✓	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	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: Refer to List of Acronyms for definitions.

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

[1] The escapement indicator stocks listed in the Annex tables for this group are Upper Fraser, Middle Fraser, and Thompson. The Fraser spring/summer group is split into these 4 escapement indicators to represent the stock group by life history type rather than geographically.

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

Table 2.1.2.–Escapement goals, 2010–2012 escapements, and 2013 forecasts for stocks with CTC-agreed goals.

Stock	Region	Stock Group	Escapement Goal	2010 Escapement	2011 Escapement	2012 Escapement	2013 Forecast
Situk	SEAK	Yakutat	500–1,000	**167 (33%)**	**240 (48%)**	**322 (64%)**	475 (95%)
Chilkat	SEAK	Northern Inside	1,750–3,500	1,815 (104%)	2,688 (153%)	1,627 (93%)	2,022[1] (115%)
King Salmon	SEAK	Northern Inside	120–240	158 (132%)	192 (160%)	155 (129%)	NA
Andrew Creek	SEAK	Central Inside	650–1,500	1,205 (185%)	936 (144%)	587 (90%)	NA
Unuk	SEAK	Southern Inside	1,800–3,800	3,835 (213%)	3,195 (178%)	**956 (53%)**	NA
Chickamin (survey index)	SEAK	Southern Inside	450–900	1,156 (257%)	852 (189%)	444 (99%)	NA
Blossom	SEAK	Southern Inside	565–1,160	1,405 (249%)	569 (100%)	793 (140%)	NA
Keta	SEAK	Southern Inside	525–1,200	1,430 (273%)	671 (128%)	725 (138%)	NA
Alsek	SEAK/ TBR	TBR	3,500–5,300	9,518 (272%)	6,668 (191%)	**2,660 (76%)**	NA
Taku	SEAK/ TBR	TBR	19,000–36,000	29,302 (154%)	27,523 (145%)	19,429 (102%)	28,066[1] (148%)
Stikine	SEAK/ TBR	TBR	14,000–28,000	15,180 (108%)	14,569 (104%)	22,671 (162%)	32,032[1] (229%)
Harrison	BC	Fraser River	75,100–98,500	103,515 (138%)	123,647 (165%)	**44,467 (59%)**	**47,452 (63%)**
Cowichan	BC	LGS	6,500	**2,879 (44%)**	**3,492 (54%)**	**3508 (54%)**	NA
Columbia Upriver Summer	COLR	COLR	12,143[3]	47,228 (389%)	44,432 (366%)	52,184 (430%)	50,715 (418%)[2]
Columbia Upriver brights	COLR	COLR	40,000	167,007 (418%)	130,395 (326%)	131,613 (329%)	164,350 (411%)[2]
Deschutes Fall	COLR	COLR	4,532	9,275 (205%)	17,117 (378%)	17,624 (389%)	NA
Lewis	COLR	COLR	5,700	8,701 (153%)	8,009 (141%)	8,143 (143%)	10,650 (187%)[2]
Quillayute Fall	WAC	WAC	3,000	4,635 (155%)	3,993 (133%)	3,181 (106%)	5,815[1] (194%)
Queets Spr/Sum	WAC	WAC	700	**382 (55%)**	**373 (53%)**	764 (109%)	**357[1] (51%)**
Queets Fall	WAC	WAC	2,500	4,022 (161%)	3,928 (157%)	3,993 (160%)	4,710[1] (188%)

–continued–

Table 2.1.2.–Page 2 of 2.

Stock	Region	Stock Group	Escapement Goal	2010 Escapement	2011 Escapement	2012 Escapement	2013 Forecast
Hoh Spr/Sum	WAC	WAC	900	828 (92%)	827 (92%)	915 (102%)	851[1] (95%)
Hoh Fall	WAC	WAC	1,200	2,599 (217%)	1,293 (108%)	1,937 (161%)	3,095[1] (258%)
Nehalem	ORC	NOC	6,989	**5,384 (77%)**	7,655 (109)%	7,515 (108%)	7,815 (112%)
Siletz	ORC	NOC	2,944	4,225 (144%)	3,638 (124%)	4,871 (165%)	5,764 (196%)
Siuslaw	ORC	NOC	12,925	22,197 (172%)	30,713 (238%)	20,018 (155%)	22,592 (175%)

Note: 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.

[1] 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; the inriver run forecasts for the Washington Coastals in 2013 are forecasts of escapement.

[2] The goal of 12,143 is based upon adults counted past Rock Island dam. The previously cited goal of 17,857 was obtained by expanding this Rock Island escapement goal for interdam losses between Bonneville and Rock Island dams, as documented in TCCHINOOK (99–3). These escapements and forecast presented are the sum of both hatchery and wild adults counted past Rock Island dam. Both escapement goals are documented by the CTC in TCCHINOOK (99–3).

[3] Projected escapement in 2013 based on 2010–2012 average escapement rate applied to 2013 terminal run forecast.

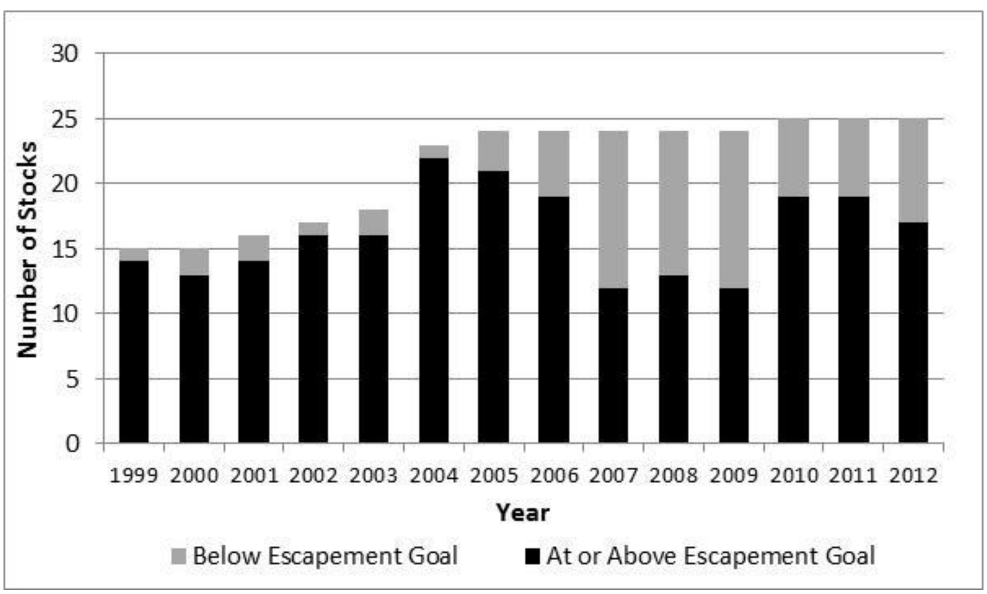


Figure 2.1.–Number and status of stocks with CTC-accepted escapement goals, 1999–2012.

2.2 Trends and 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.3, B.4, and B.5), Puget Sound (Appendix B.6), Washington Coastal stocks (Appendix B.7), Columbia River stocks (Appendix B.8) and Oregon Coastal stocks (Appendix B.9 and B.10).

2.2.1 Southeast Alaska and Transboundary River Stocks

Of the 11 SEAK and TBR stocks included in the escapement assessment, the Situk, Chilkat, Taku, King Salmon, Stikine, Unuk, Blossom, and Keta rivers and Andrew Creek include estimates of total escapement of large fish, Chinook salmon ≥ 660 mm mid eye to fork of tail length. In most systems these include ocean-age-3, -4, and -5 fish and include almost all females and large males in the stocks; ocean-age-1 and -2 males are not included in these estimates except those fish >659 mm mid eye to tail fork. Escapement estimates for the Chickamin River are index 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. Except for the Chilkat River, survey methods have been standardized for all systems since 1975. The assessment of Chilkat River Chinook salmon was standardized in 1991 as an annual mark–recapture (MR) estimate of escapement. Escapement goals have been defined as a range for the SEAK/TBR stocks. Escapement estimates for the Alsek River are estimates of total escapement of age-1.2 fish and older.

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 seven SEAK indicator stocks. Note that there is some overlap in these stocks within these two broad classifications. All SEAK and TBR indicator stocks produce primarily yearling smolt except the Situk River, which presently produces primarily sub-yearling smolt. Sub-yearling smolts comprise about 10% of the annual runs in the Keta and Blossom rivers.

A 15-year rebuilding program was established by the Alaska Department of Fish and Game ADF&G in 1981 (ADF&G 1981). At the same time, ADF&G established interim point escapement goals for all 11 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 eight 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.

2.2.1.1 *Southeast Alaska Stocks*

2.2.1.1.1 Situk River

The Situk River is a non-glacial 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.

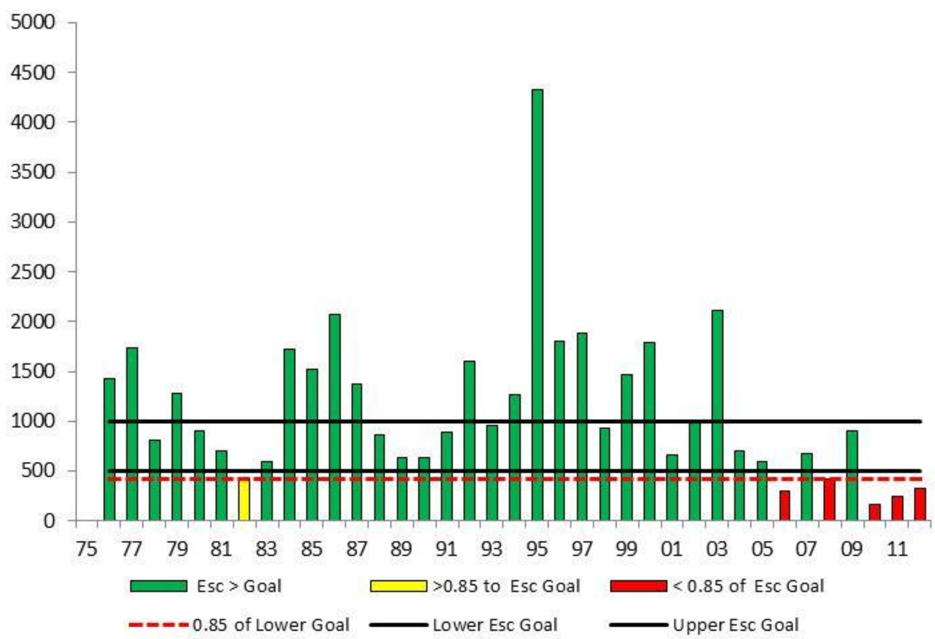


Figure 2.2.1.1.1.–Situk River escapements of Chinook salmon, 1976–2012.

Escapement Methodology: Escapements are based on weir counts minus upstream sport fishery harvests (if any), which are estimated from an on-site creel survey and a post-season 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 fish.

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

[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.

adopted by the CTC. In 1997, ADF&G revised the Situk River escapement goal range to 500 to 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 to 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 seven years. The 2012 escapement was 322 fish, 64% of the lower end of the range, but the 2012 escapement was an improvement over the escapement levels observed in 2010 and 2011. There were no estimated harvests above the weir in 2012 and this is an exact count of escapement (Figure 2.2.1.1.1).

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 in sport and commercial fisheries have been restricted to non-retention of Chinook salmon since 2010.

2.2.1.1.2 Chilkat River

The Chilkat River is a moderate-sized glacial system located near Haines, Alaska which supports a moderate-sized, 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.

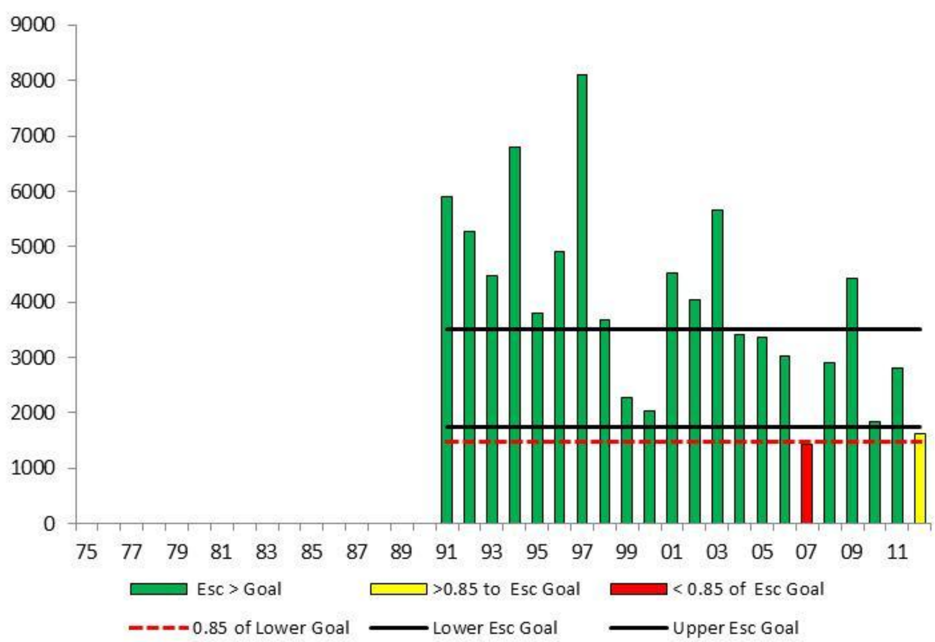


Figure 2.2.1.1.2.–Chilkat River escapements of Chinook salmon, 1991–2012.

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 15% since 1991. 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. In 2003 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 2012 escapement was 1,627 (CV = 0.16) Chinook salmon, 93% of the low end of the escapement goal range (Figure 2.2.1.1.2). This stock, like others in Alaska, has recently experienced a decline in productivity.

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 and 2012.

2.2.1.1.3 King Salmon River

The King Salmon River is a small non-glacial system located on Admiralty Island southeast of Juneau that supports a small, inside-rearing stock. Few Chinook salmon originating in the King Salmon River are caught in PSC fisheries and there is no terminal fishery targeting this stock. However, harvests of immature and mature fish do occur in SEAK fisheries.

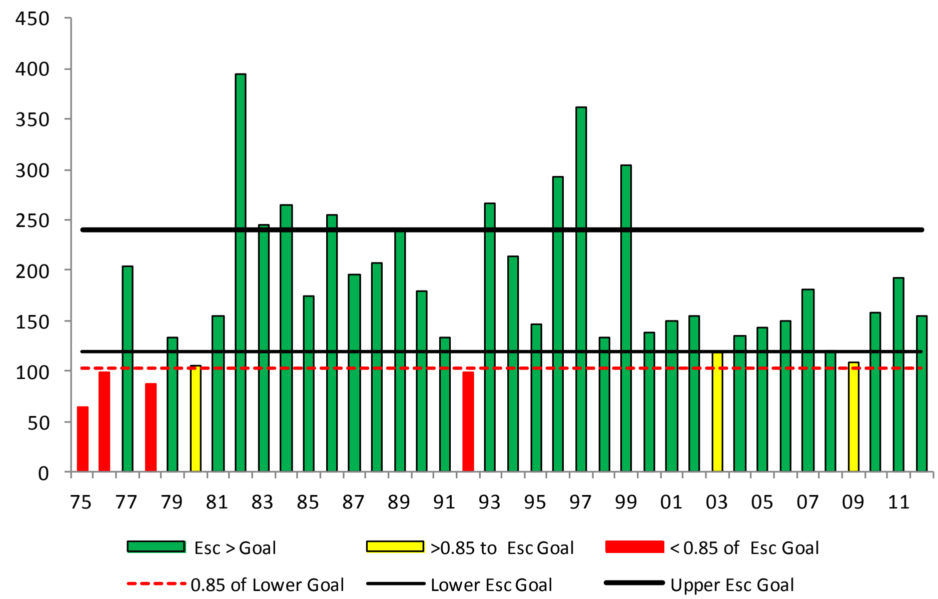


Figure 2.2.1.1.3.–King Salmon River escapements of Chinook salmon, 1975–2012.

Escapement Methodology: Escapements of large Chinook salmon are based upon weir counts from 1983 to 1992 and expansions of survey counts from 1971 to 1982 and 1993 to 2011, to make estimates equivalent to weir counts. A weir was operated for 10 years (1983–1992) along with the surveys and, on average the total escapement was 1.52 times the survey count (McPherson and Clark 2001). Jacks (ocean-age-2 fish) represented an average of 22% of the weir counts from 1983 to 1992 and are not included in the graph above.

Escapement Goal Basis: In 1981, ADF&G set the index goal at 200 large fish based upon peak survey counts of 200 spawners in 1957 and 211 spawners in 1973. In 1997, ADF&G revised the goal to 120 to 240 total large fish based upon a spawner–recruit analysis for the 1971 to 1991 brood years (McPherson and Clark 2001). The analysis and goal range was accepted by the CTC in 1998.

Escapement Evaluation: The King Salmon River stock is reasonably healthy with annual escapements of less than 85% of the goal only four times since 1976; three of those instances occurred in the mid- to late 1970s and the other was in 1992. The 2012 escapement was 155 (CV = 0.17) fish, within the goal range (Figure 2.2.1.1.3).

Agency Comments: There is no terminal fishery targeting this stock and escapements have been within or above the accepted range in most recent years.

2.2.1.1.4 Andrew Creek

Andrew Creek, near Petersburg, Alaska, is a small non-glacial U. S. tributary of the Lower Stikine River that supports a moderate run of inside-rearing Chinook salmon. Before 1976, a large terminal marine gillnet fishery occurred in the spring, targeting Stikine River and other nearby Chinook salmon stocks. Harvests of immature and mature Andrew Creek fish occur primarily in

SEAK and to a small extent in NBC fisheries, based on CWT recoveries of Chinook salmon from SEAK hatcheries using Andrew Creek brood stock.

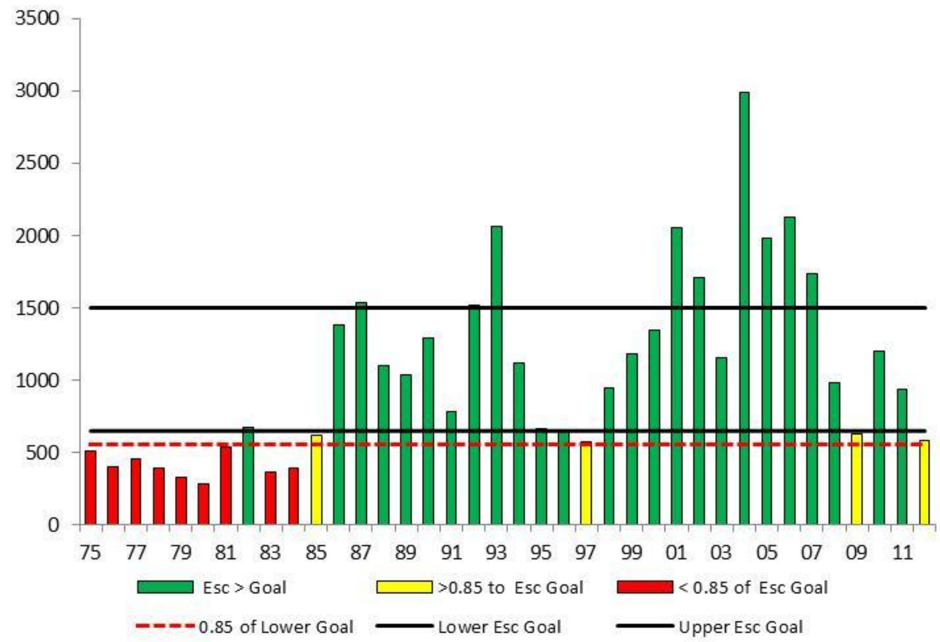


Figure 2.2.1.1.4.–Andrew Creek escapements of Chinook salmon, 1975–2012.

Escapement Methodology: Escapements are based upon weir counts from 1976 to 1984 and expansions of index counts in 1975 and from 1985 to 2011. Four years of concurrent weir and index count data were used to estimate the expansion factor of 1.95. Jacks have represented an average of 19% of the weir counts and are excluded in the figure above.

Escapement Goal Basis: In the early 1980s, ADF&G set the Andrew Creek Chinook salmon escapement goal at 750 large fish (total escapement). In 1997, an initial stock-recruit analysis was developed that underwent review by ADF&G and the CTC. This analysis was completed in 1998 and the technical report (Clark et al. 1998) recommended a revised biological escapement goal range of 650 to 1,500 large Chinook salmon that was accepted and adopted by the ADF&G and the CTC.

Escapement Evaluation: The Andrew Creek stock remains reasonably healthy, however, productivity has declined in recent years as has occurred with the Stikine origin Chinook salmon that spawn in Canada and has occurred with other Alaskan stock. Annual escapements of less than 85% of the goal have occurred nine times since 1975; however, all of those instances occurred prior to 1985. The 2012 escapement was 587 (CV = 0.23) fish, 90% of the lower end of the goal (Figure 2.2.1.1.4).

Agency Comments: Before 1976 a large terminal marine gillnet fishery occurred in the spring, targeting Stikine River and other nearby Chinook salmon stocks. 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. Directed fisheries were allowed between 2005 and 2009. Very limited directed fishing for Stikine origin Chinook salmon occurred in 2011 and 2012. The implementation of the new directed fisheries has resulted in increased harvest rates of Andrew Creek Chinook salmon. Nevertheless, escapements since 2005 have been within or above the escapement goal range each year with the exception of 2009 and 2012, when escapements were below the range but more than 85% of the lower range.

2.2.1.1.5 Unuk River

The Unuk River is a moderate-sized glacial system that supports a moderate run of inside-rearing 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.

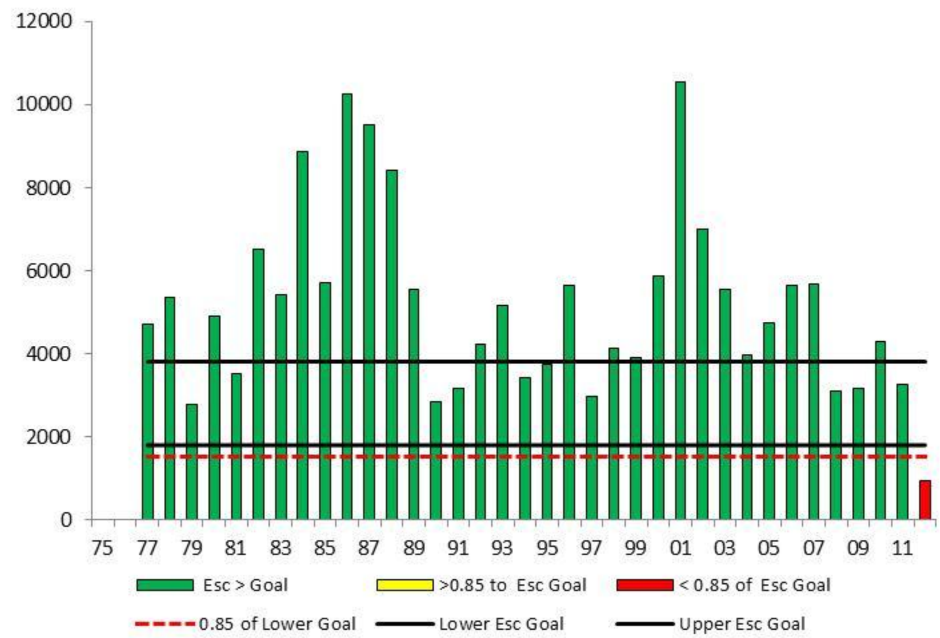


Figure 2.2.1.1.5.–Unuk River escapements of Chinook salmon, 1977–2012.

Escapement Methodology: Escapements of large spawners are MR estimates of total escapement from 1997 to 2011 and expanded survey counts from 1977 to 1996. 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 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 in survey count currency. 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 escapement was only 956 (CV = 0.16) large Chinook salmon, 53% of the lower end of the goal range (Figure 2.2.1.1.5).

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 was unexpected, given its past history. There are no directed fisheries that target this stock, fishing in the Unuk River itself is banned, and nearby marine waters are closed to commercial fishing. Identification of additional management measures to take will be difficult.

2.2.1.1.6 Chickamin River

The Chickamin River is a moderate-sized glacial system that supports a moderate 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 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.

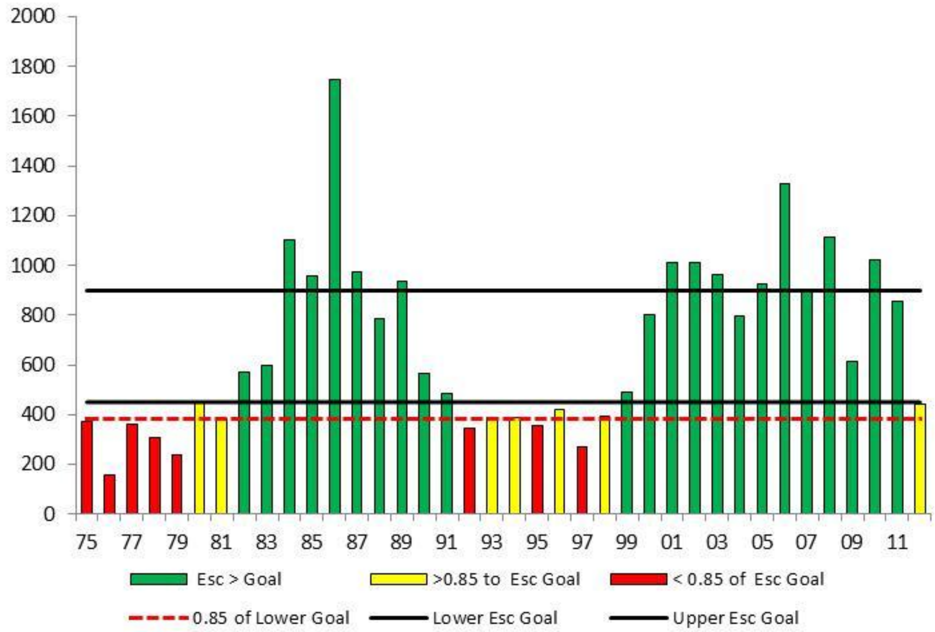


Figure 2.2.1.1.6.–Chickamin River peak index counts of Chinook salmon, 1975–2012.

Escapement Methodology: The escapements shown in Figure 2.2.1.1.6 are survey counts (unexpanded highest single-day counts) of large fish in eight tributaries of the Chickamin River using standardized methodology (Pahlke 2003). MR studies in 1995, 1996 and 2001 to 2005 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.

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 to 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 2012 escapement index was 444 large spawning Chinook salmon, 99% of the lower end of the goal range. This index count is not expanded to an estimate of total escapement and has no associated variance, accordingly (Figure 2.2.1.1.6).

Agency Comments: Like the nearby Blossom and Keta rivers, this stock produces the largest Chinook salmon in SEAK. 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 reduced 2012 escapement for this stock probably indicates reduced productivity as has been observed with many other Chinook salmon stocks in Alaska. If the cyclic pattern as observed in the past is recurring, future escapements will likely be low, even in the absence of fishing.

2.2.1.1.7 Blossom River

The Blossom River is a small-sized non-glacial system that supports a small run of inside-rearing Chinook salmon and empties into Behm Canal near Ketchikan. There is no terminal fishery targeting this stock; harvests of immature and mature fish occur in SEAK and NBC fisheries, based on wild stock and hatchery stock data from the nearby Unuk and Chickamin River. All waters of east Behm Canal are closed to Chinook salmon fishing year round. Age data collected since 1998 indicate that about 10% of the annual run had under-yearling smolt life history.

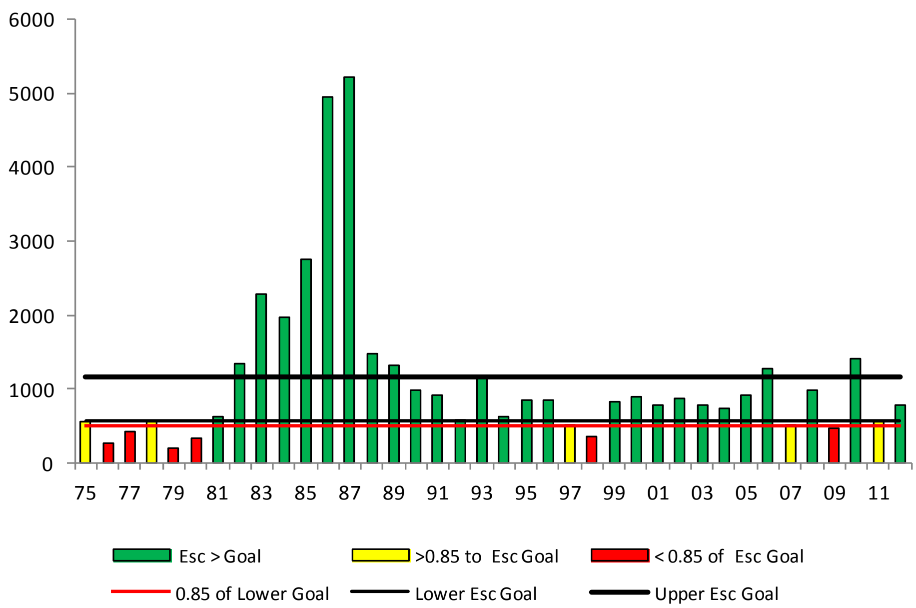


Figure 2.2.1.1.7.–Blossom River escapements of Chinook salmon, 1975–2012.

Escapement Methodology: Escapements are based upon MR experiments in 1998, 2004 to 2006 and expansions of index counts in all other years since 1975. Four years of concurrent MR and index count data were used to estimate the expansion factor of 3.87. Escapement estimates are expanded peak single-day survey counts of large spawners that have been standardized in area and time since 1975 (Pahlke 2003).

Escapement Goal Basis: In 1994, ADF&G revised the Blossom River goal to 300 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 a range of 250 to 500 large index spawners in conformance with 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. In 2010, the ADF&G submitted a report to the CTC with a revised goal of 580 to 1,160 large spawners (Fleischman et al. 2011). The CTC accepted the revision in June 2011.

Escapement Evaluation: The Blossom River stock is reasonably healthy with annual escapements of less than 85% of the goal only six times since 1975. The 2012 escapement was 793 (CV = 0.62) large spawning Chinook salmon, a level within the goal range (Figure 2.2.1.1.7).

Agency Comments: Between 1976 and 1980, escapements were below the current escapement goal in four out of five years, averaging 361 large fish. These smaller escapements subsequently produced large runs with resultant large escapements during the six-year period from 1982 to 1987, averaging about 3,000 large fish. This six-year period of larger escapements has been followed by a 24-year period (1988–2011) of reduced, but relatively stable, escapements averaging about 850 large fish.

2.2.1.1.8 Keta River

The Keta River is a small-sized non-glacial system southeast of Ketchikan that supports a small run of inside-rearing Chinook salmon. There is no terminal fishery targeting this stock; harvests of immature and mature fish occur in SEAK and NBC fisheries, based on wild-stock and hatchery-stock data from the nearby Unuk and Chickamin River. All waters of east Behm Canal are closed to Chinook salmon fishing year round. Age data collected since 1998 indicate that about 10% of the annual run had under-yearling smolt life history.

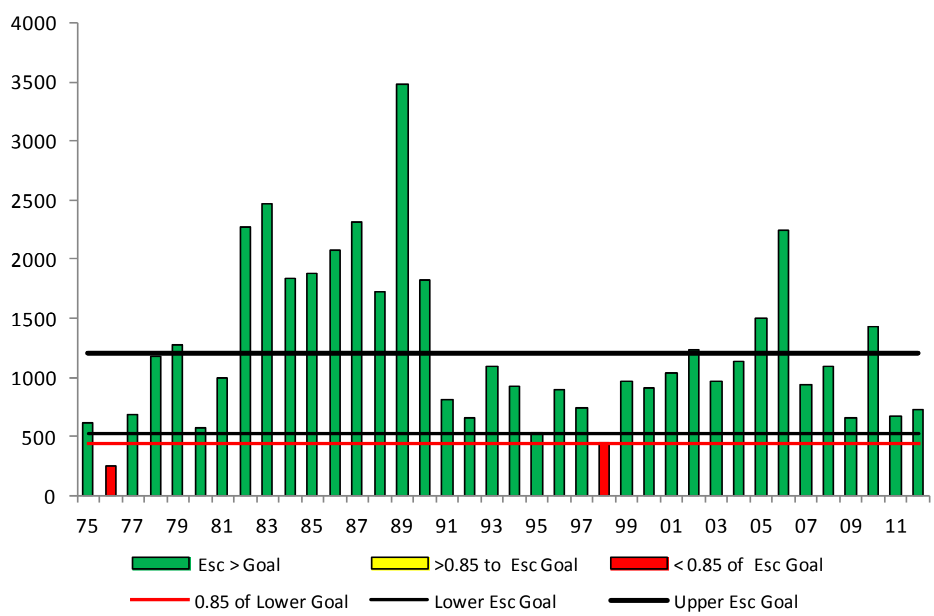


Figure 2.2.1.1.8.–Keta River escapements of Chinook salmon, 1975–2012.

Escapement Methodology: Escapements are based upon MR experiments in 1998 to 2000 and expansions of index counts in all other years since 1975 (Freeman et al. 2001). Three years of concurrent MR and index count data were used to estimate the expansion factor of 3.01. Escapement estimates are expanded peak single-day survey counts of large spawners that have been standardized in area and time since 1975 (Pahlke 2003).

Escapement Goal Basis: In 1994, ADF&G revised the escapement goal to 300 large index spawners based upon a spawner–recruit analysis (McPherson and Carlile 1997), which the CTC reviewed and accepted in 1994. In 1997, ADF&G revised the escapement goal to a range of 250 to 500 large index spawners in conformance with 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. In 2010, ADF&G submitted a report to the CTC with a revised goal of 525 to 1,200 large spawners (Fleischman et al. 2011). The CTC accepted the revision in June 2011.

Escapement Evaluation: The Keta River stock is reasonably healthy, with annual escapements of less than 85% of the goal only one time since 1975. The 2012 escapement was 725 (CV = 0.56) large spawning Chinook salmon, a level again within the goal range (Figure 2.2.1.1.8).

Agency Comments: Like the nearby Blossom River, survey counts were low in the 1970s, rose in the mid to late 1980s and have been relatively stable since that time. Between 1975 and 1981, annual escapements averaged about 800 large spawners. Production from the 1975 to 1981 escapements was high and from 1982 to 1990 averaged about 2,200 large fish. This was followed by a 21-year period (1991–2012) of relatively stable escapements, averaging about 1,000 large spawners. The recent reduction in productivity observed for many Alaskan stocks of Chinook salmon has not been noticeable with either the Blossom or Keta stocks of Chinook salmon to date.

2.2.1.2 *Transboundary River Stocks*

2.2.1.2.1 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 moderate run of outside-rearing Chinook salmon.

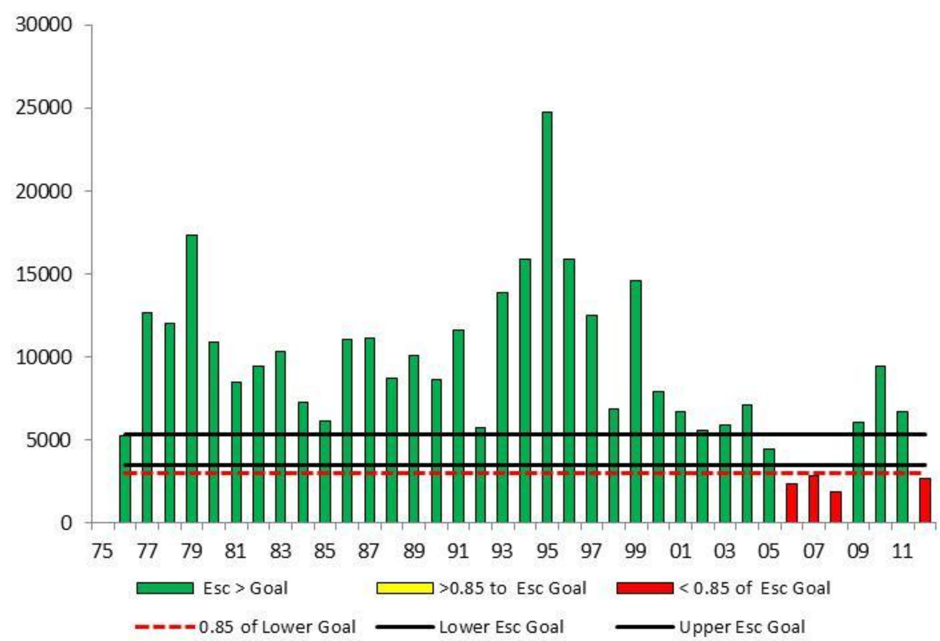


Figure 2.2.1.2.1.–Alsek River escapements of Chinook salmon, 1976–2012.

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, drainage-wide, 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.

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. Were none of the known harvest to have occurred in 2006, 2007, 2008, and 2012, the stock would have still failed to achieve the goal range. The 2012 escapement was only 2,660 (CV = 0.35) large Chinook salmon, 76% of the lower end of the goal range (Figure 2.2.1.2.1).

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 directed fishery that takes place in-river 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).

2.2.1.2.2 Taku River

The Taku River is a large Transboundary glacial system that supports a large run of outside-rearing Chinook salmon. Few Taku 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 origin Chinook salmon are caught as bycatch in directed gillnet fisheries for sockeye salmon in terminal waters (District 11 of Southeast Alaska and in-river in Canada), in sport fisheries near Juneau Alaska, and in in-river First Nation fisheries in Canada.

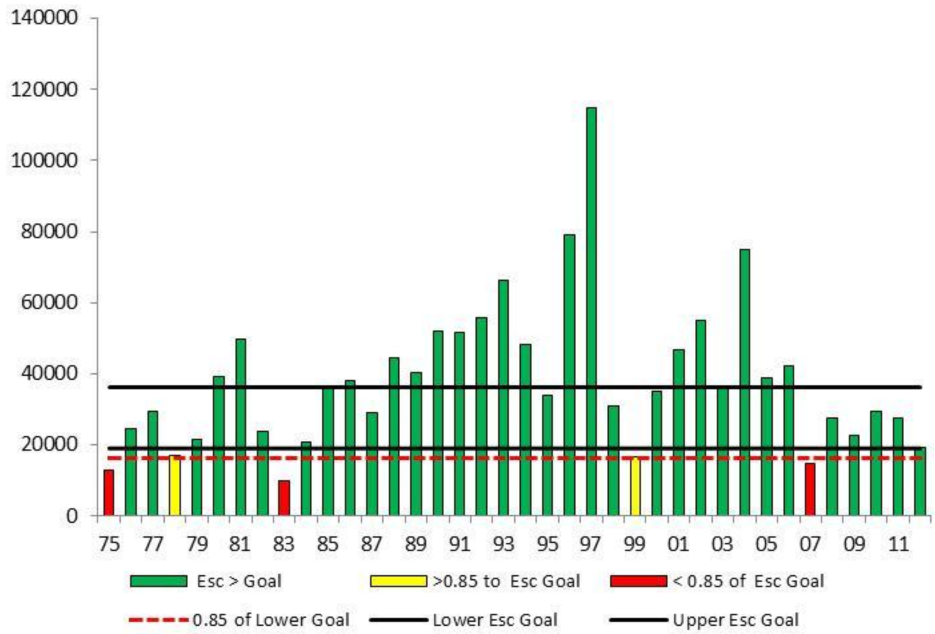


Figure 2.2.1.2.2.–Taku River escapements of Chinook salmon, 1975–2012.

Escapement Methodology: Total escapements of large fish (>659 mm mid eye to tail fork length) 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%. Aerial survey counts in other years 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 system-wide 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 only three times since 1975 (1975, 1983, and 2007). Exploitation rates on the stock have never exceeded the MSY exploitation rate level. The 2012 escapement was estimated to be 19,429 (CV = 0.12) large Chinook salmon, just barely in excess of the goal range (Figure 2.2.1.2.2).

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 pre-season forecasts, in-season run projections, and post-season 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.

2.2.1.2.3 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 a large, 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 in-river in Canada.

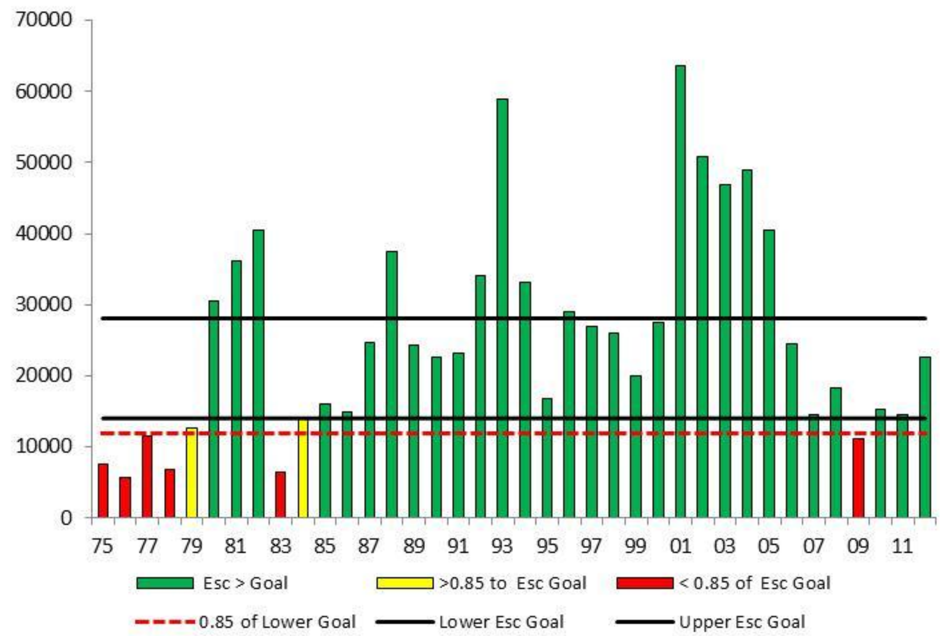


Figure 2.2.1.2.3.–Stikine River escapements of Chinook salmon, 1975–2012.

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).

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 system-wide 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 2012 escapement was estimated to be 22,671 (CV = 0.16) large Chinook salmon, within the goal range (Figure 2.2.1.2.3).

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 in-river in the Canadian gillnet and aboriginal fisheries. CDFO and ADF&G currently 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 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.

2.2.2 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 the Canadian stocks are currently being reviewed.

2.2.2.1 *Northern British Columbia*

2.2.2.1.1 Yakoun River

The CTC was unable to assess stock performance because the agency has not reported escapements since 2005. See Appendix Table B.2 for escapements through 2005.

2.2.2.1.2 Nass River

The Nass River is the largest river in Area 3, representing a group of approximately 25 streams. It flows southwest from the BC interior into Portland Inlet and the estuary is only 30 km from the Alaska-BC 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 and are thought to be far north migrating.

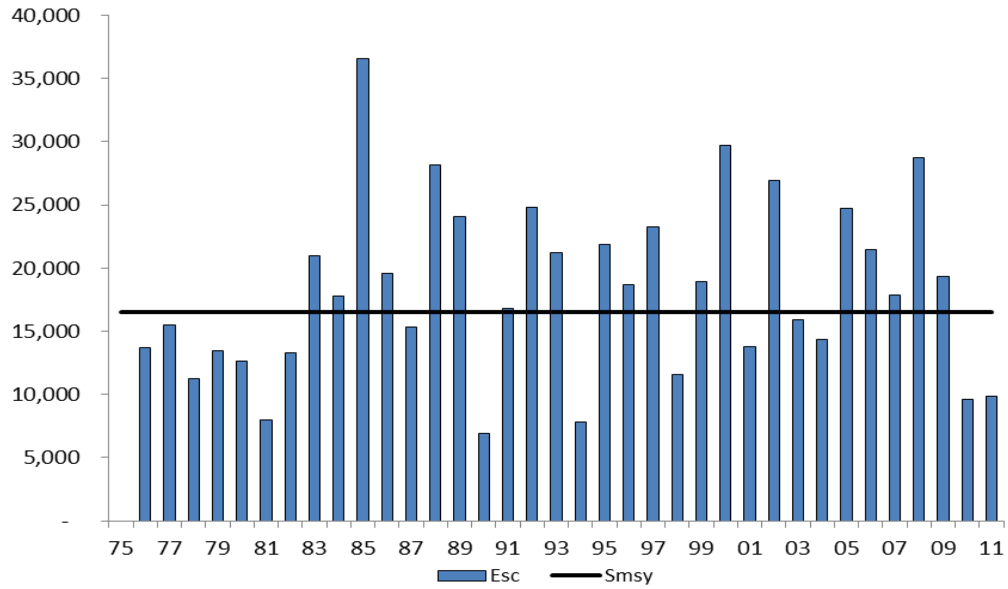


Figure 2.2.2.1.2.–Nass River escapements of Chinook salmon, 1977–2012.

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).

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 aggregate.

2.2.2.1.3 Skeena River

The Skeena River is the second largest river in BC and drains an area of approximately 54,400 km^2. It supports the second largest aggregate of Chinook salmon stocks in BC 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. 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 (~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.

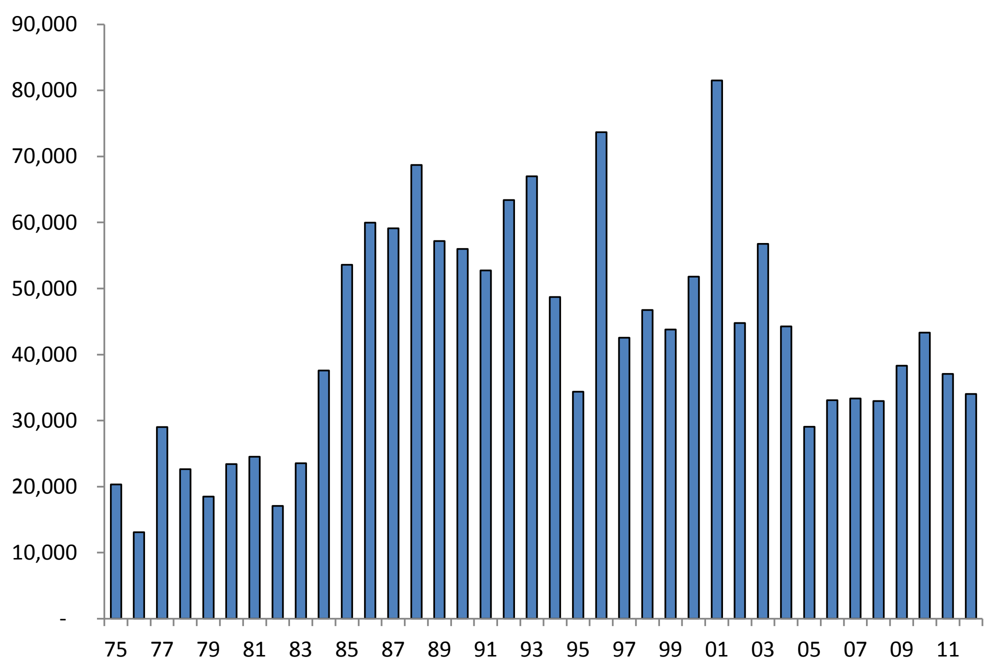


Figure 2.2.2.1.3.1.–Skeena River escapements of Chinook salmon, 1975–2012.

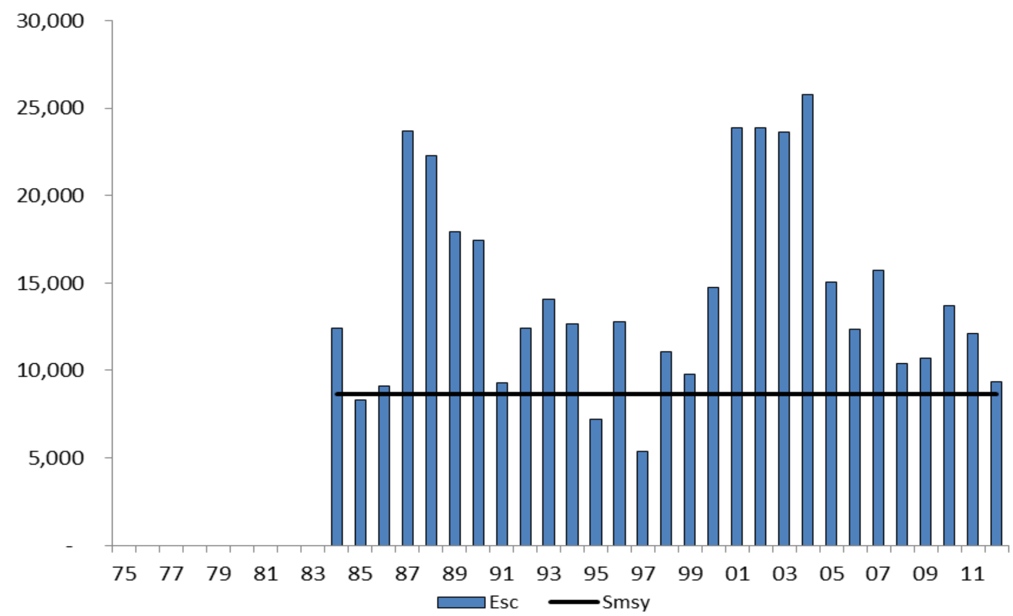


Figure 2.2.2.1.3.2..–Kitsumkalum River escapements of Chinook salmon, 1984–2012.

Escapement Methodology: Chinook salmon escapements to the Skeena River are represented by an index that includes approximately 40 populations surveyed annually using a variety of techniques. 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% and 26% to the escapement index respectively since 1984. Visual estimates for these systems tend to underestimate their actual contribution to the total escapement in the aggregate.

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), in-river sport, and aboriginal fisheries. Estimates of in-river sport catch were not available from 1997 to 2002 but creel surveys were conducted on the Lower Skeena in 2003, 2010, 2011 and 2012. 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. There are two SSP funded projects on the Skeena River (see Sections 4.5.1 and 4.5.2 and Appendix C.12) that provide estimates of total escapement for the Skeena River and its component tributaries. When complete, these projects will provide a 30-year time series of escapement estimates suitable for comparison with habitat-based or stock-recruit estimates of S_{MSY} and capacity.

2.2.2.2 *Central British Columbia*

2.2.2.2.1 Dean River

Chinook salmon populations in Area 8 consist of seven non-enhanced systems and the Bella Coola and Atnarko River system which is enhanced. Among non-enhanced systems the Dean River has the largest spawning population and the most consistent escapement surveys. Chinook salmon returning to the Dean River have summer timing and are predominantly stream type (94%).

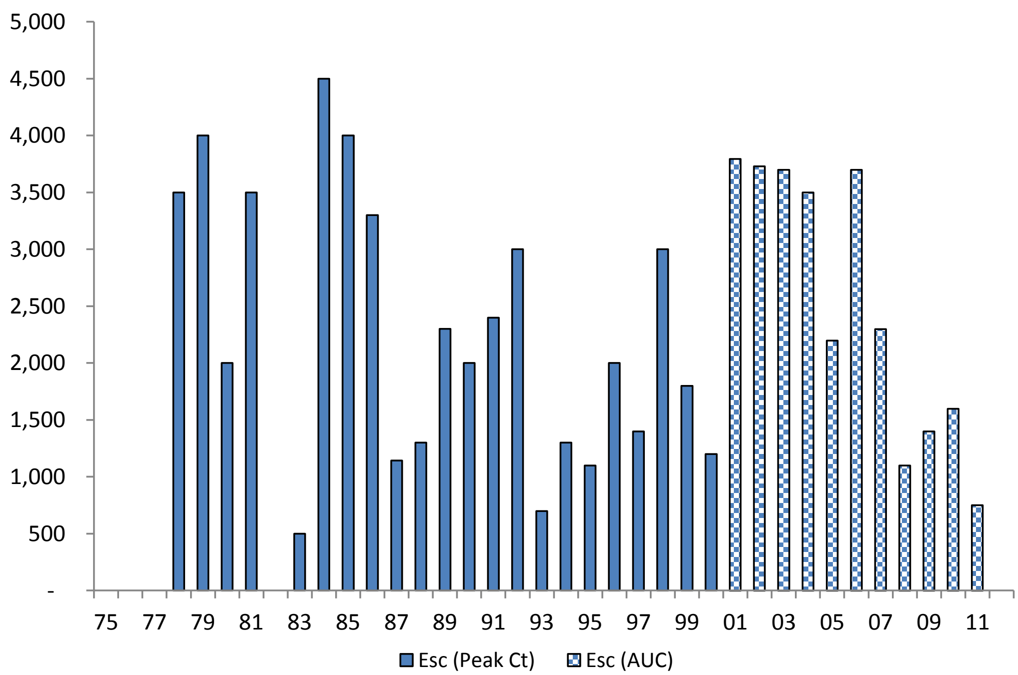


Figure 2.2.2.2.1.–Dean River escapements of Chinook salmon, 1978–2012.

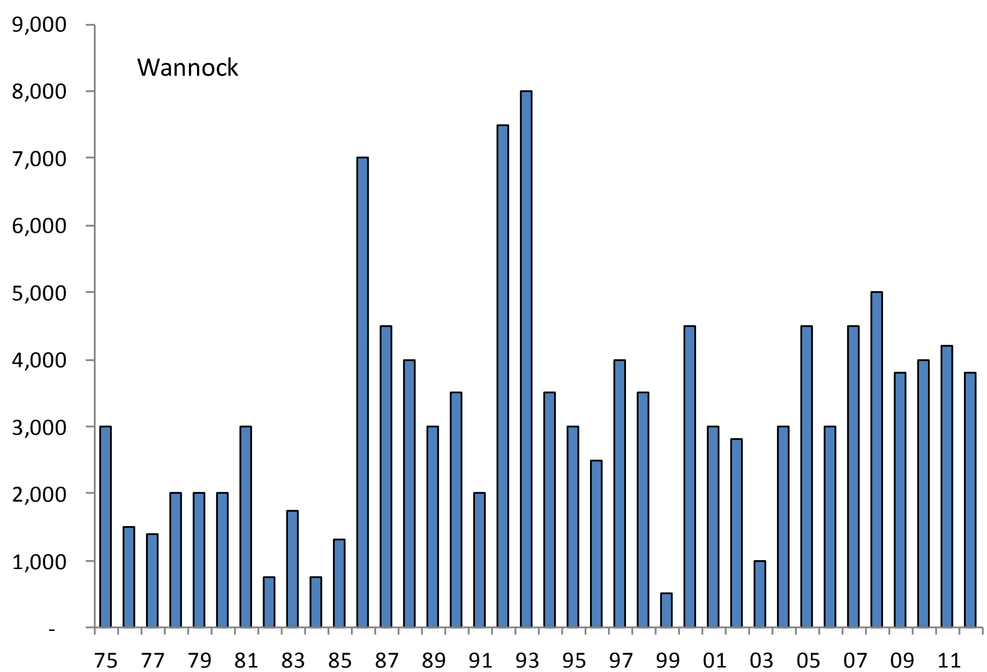
Escapement Methodology: Since 2001, the Chinook salmon escapement index for the Dean River has been derived using area-under-the-curve (AUC) methodology based on three aerial counts. In years where viewing conditions are poor, a maximum likelihood procedure has been used (e.g., 2004). A Chinook salmon MR program was conducted on the Dean River in 2006 to develop an expansion factor for converting the escapement indices into estimates of total escapement. The preliminary estimate of escapement based on the MR program was 5,478 compared to the maximum likelihood estimate of 3,689 (factor = 1.49).

Escapement Goal Basis: There is no CTC-accepted escapement goal for this stock. Biologically-based goals for this complex of Chinook salmon spawning populations have not yet been developed. Habitat-based estimates of S_{MSY} and other stock-recruitment reference points are available for the Dean River (median S_{MSY} = 3,646, CV = 14%), but estimates of total escapement are needed to make them effective

Agency Comments: Chinook salmon escapement was not estimated in 2012, however the escapement assessment program is expected to resume in 2013.

2.2.2.2.2 Rivers Inlet

The Rivers Inlet escapement index consists of an aggregate of Chinook salmon escapements to the Wannock, Kilbella and Chuckwalla rivers. 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. 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 90% recently.



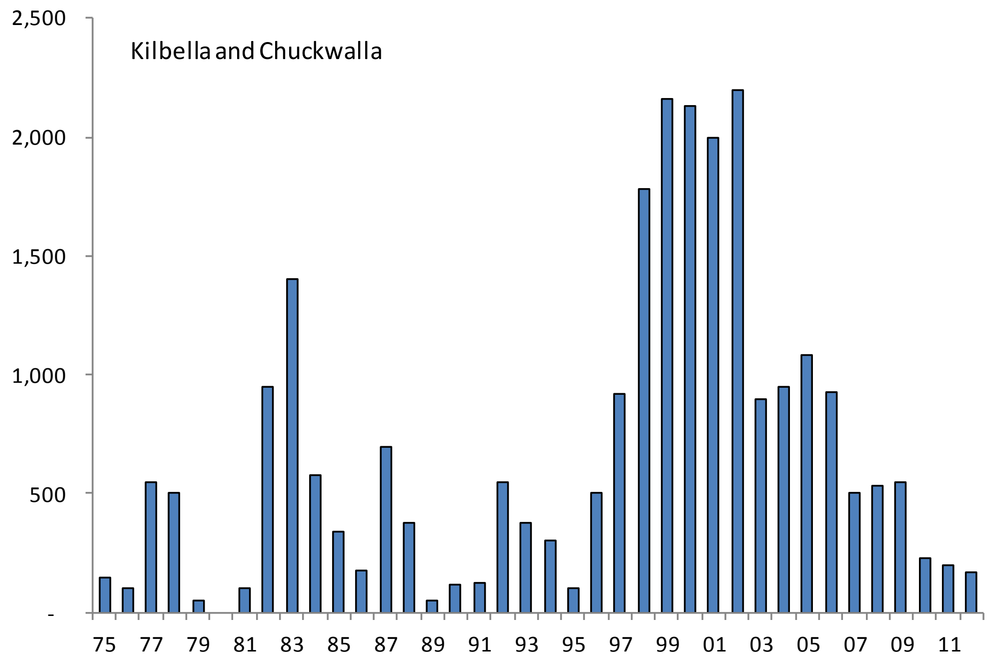


Figure 2.2.2.2.2.–Rivers Inlet escapement index of Chinook salmon, 1975–2012, including Wannock, Kilbella and Chuckwalla rivers.

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 2012 was 3800 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 AUC methods applied to visual counts from helicopter surveys. Typically four flights are made during the spawning period. Three assessment flights of the Kilbella and Chuckwalla rivers were completed in 2012; however, zero Chinook salmon were observed in the Chuckwalla River and escapement was below the level detectable. The estimated escapement to the Kilbella River was 170.

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).

Agency Comments: A small 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.

2.2.2.2.3 Atnarko River

Following the 2009 Agreement, a CWT Improvement Program was initiated to improve the CWT system, including CWT reporting systems, data quality, tagging levels, sampling levels, and the precision and accuracy of statistics such as abundance, exploitation rates, survival estimates, etc. for Chinook salmon. Upon review of notable deficiencies, the lack of a Chinook salmon indicator in the Central BC region was highlighted. 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 incremental CWTs, sampling of the terminal commercial, sport and FN fisheries, and reintroduction of a MR program to improve escapement estimates. Implementation of these changes began in 2009 and subsequent MR programs have yielded escapement estimates with corresponding CVs of less than 15% for all years except for 2012 (CV = 16%).

The Northern BC 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 BC is predominantly an ocean-type stock. It constitutes the largest complex of Chinook salmon in Central BC. 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 BC ISBM fisheries.

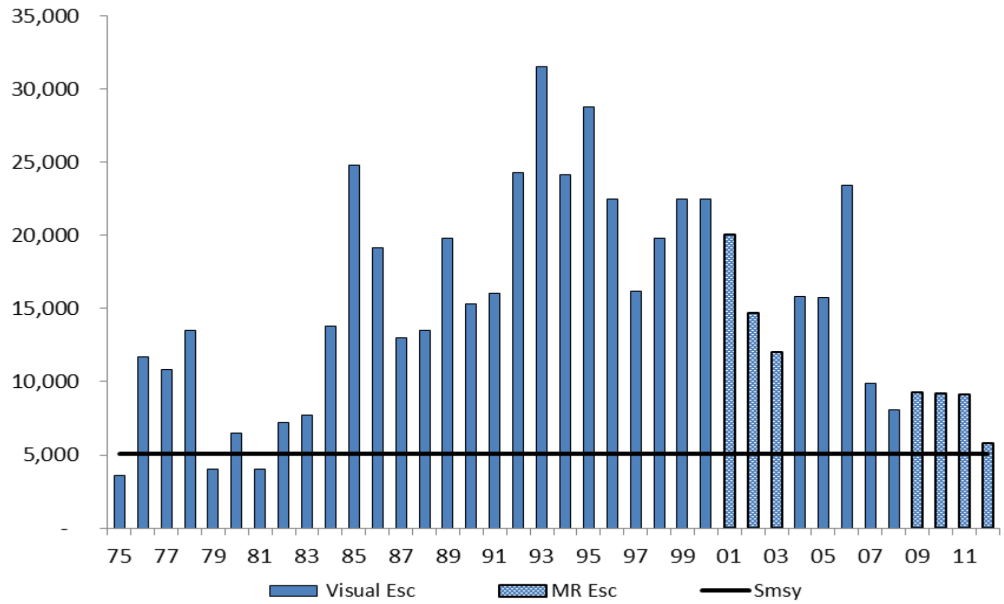


Figure 2.2.2.2.3.–Atnarko River escapements of Chinook salmon, 1975–2012. Petersen MR estimates are also provided for 2001–2003 and 2009–2012.

Escapement Methodology: Atnarko River Chinook salmon escapements have primarily been estimated using the three-method) average (3M Average). The 3M Average includes methods derived from (i) average of peak drift counts; (ii) brood stock capture CPUE; and (iii) number of carcasses pitched. Population estimates derived using the 3M Average show no significant difference from Petersen estimates produced in years of MR programs (Wilcoxon matched pair test: $z = 0.94$; $p = 0.35$) with the Petersen estimate being on average 97% (SD = 12%) of the estimate produced by the 3M Average method (Vélez-Espino et al. 2011). 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; subsequently, traditional population estimates beginning in 2011 have been derived using only the brood stock capture CPUE and number of carcasses pitched. This change in methodology is identified as the two-method average (2M Average). Recent brood stock CPUE data are not likely comparable with that of the pre-flood period as the pools used for broodstock collection have been negatively altered and may not be as conducive to these efforts as in the past.

Escapement Goal Basis: There is no CTC-accepted escapement goal for Atnarko Chinook salmon. The median estimate of S_{MSY} for the Atnarko River using the habitat model is 5,048 (CV = 13%) Chinook salmon.

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 six of seven program years. Following completion of the five-year CWT program in 2013, MR derived escapement estimates will be assessed against the 3M Average estimates in an effort to recalibrate the 1990 to 2013 time series.

2.2.2.3 *West Coast Vancouver Island and Georgia Strait*

2.2.2.3.1 West Coast Vancouver Island

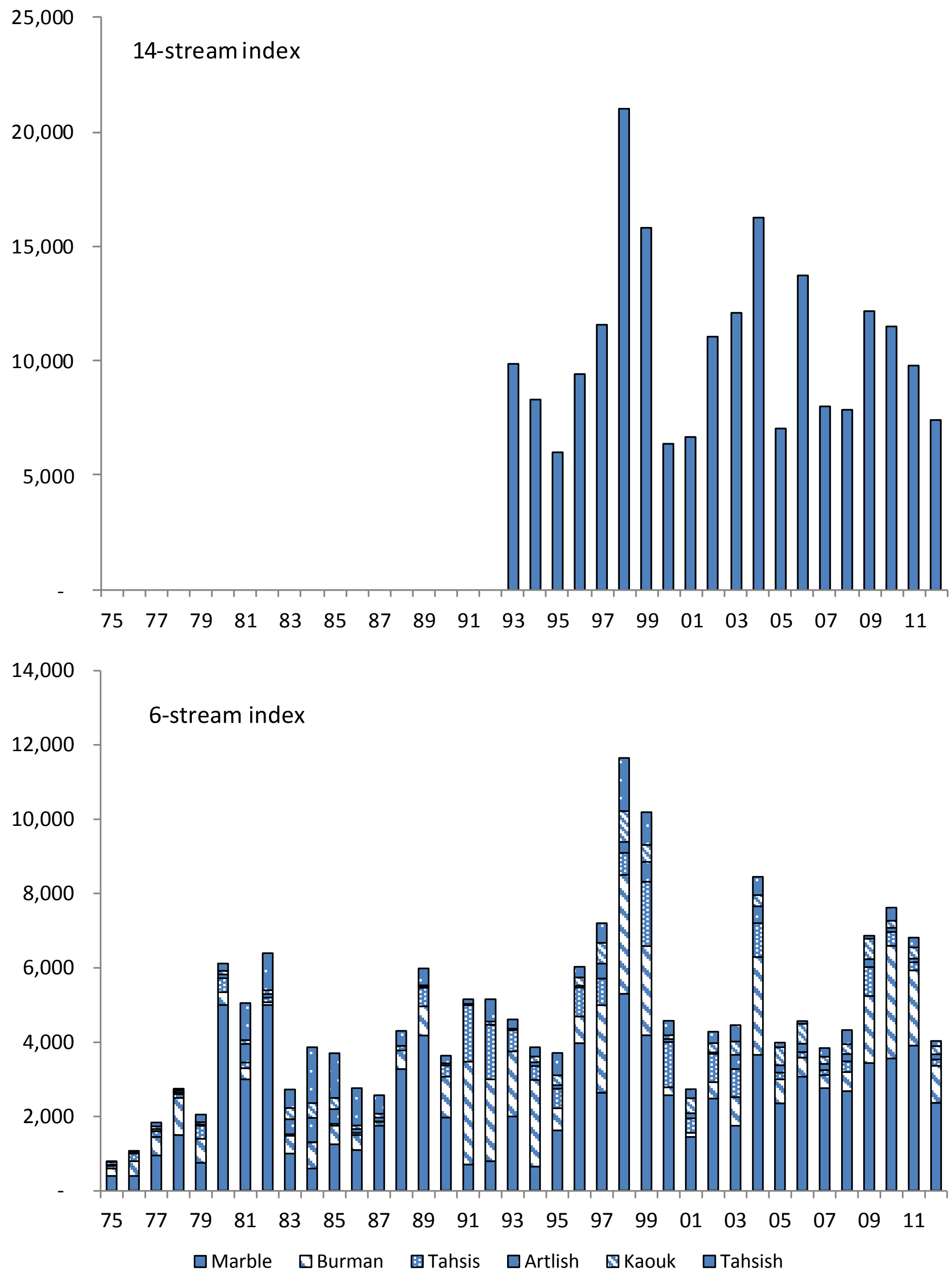


Figure 2.2.2.3.1.–The WCVI Index of escapement includes both a 14-stream and a 6-stream index. The escapement methodology changed for the six-stream index in 1995 and prior estimates have not been calibrated to the new methodology.

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 1996 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. 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. However, the escapement estimate used for the index followed the same methodology since 2005.

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

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 2012 projects occurred at the Burman, Marble, Tahsis and Leiner rivers (Section 4.3.2 and Appendix C.6). WCVI Chinook salmon have remained below the agency goals for these streams since 1999 despite terminal fishing closures in effect in Areas 24–26 from July to September each year and efforts to conserve WCVI Chinook salmon in Canadian fisheries. Escapements to all non-enhanced Clayoquot Sound and Kyuquot Sound Chinook salmon streams in the indices remain below 500 fish.

2.2.2.3.2 Upper Georgia Strait

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.

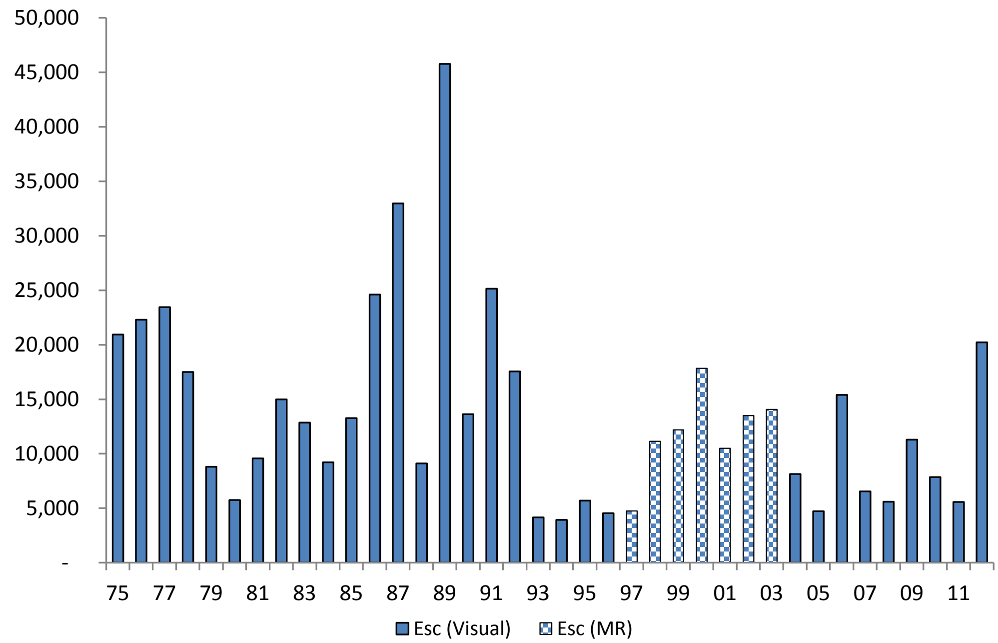


Figure 2.2.2.3.2.–Upper Georgia Strait stock group escapements of Chinook salmon, 1975–2012.

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.

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 Upper Strait of Georgia stock group has been revised this year and varies from the series reported previously. The revised time series now 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).

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

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.

2.2.2.3.3 Lower Georgia Strait

The LGS natural rivers monitored for naturally spawning fall Chinook salmon escapement are the Cowichan and Nanaimo rivers (Figure 2.2.2.3.3.1 and Figure 2.2.2.3.3.2).

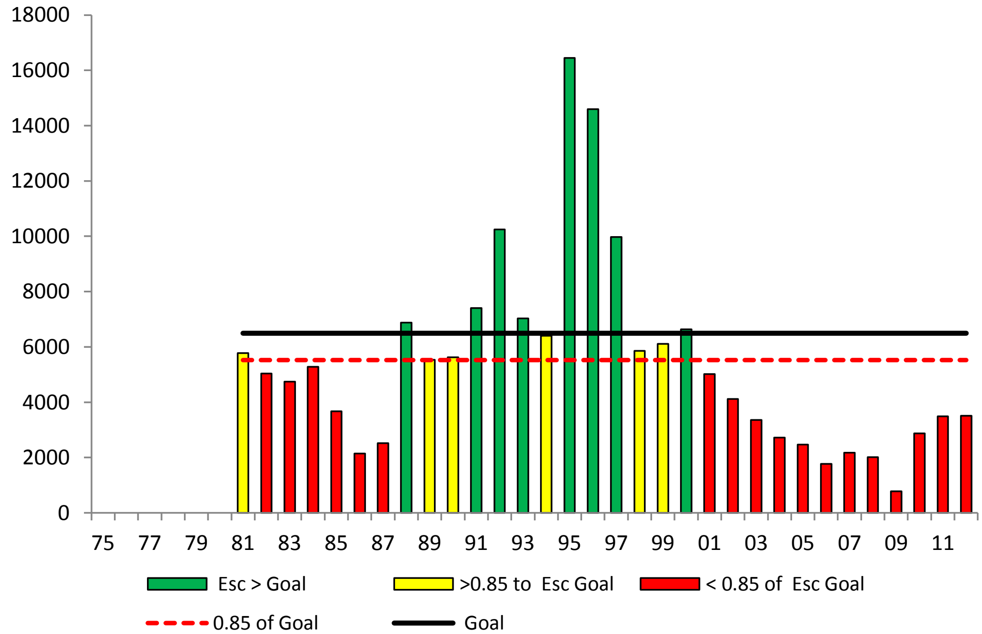


Figure 2.2.2.3.3.1..–Cowichan River escapements of Chinook salmon, 1981–2012.

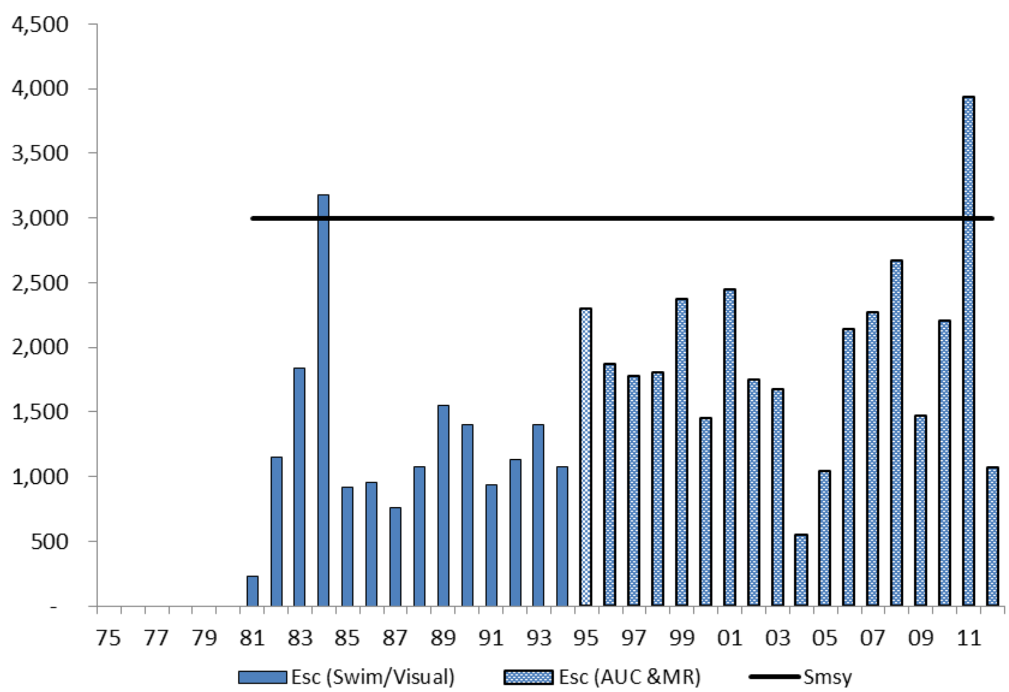


Figure 2.2.2.3.3.2.Nanaimo River escapements of Chinook salmon, 1981–2012.

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.

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.

2.2.2.4 *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, although 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 spring run age 1.2, Fraser spring run age 1.3, Fraser summer run age 1.3, Fraser summer run age .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 spring run age-1.2), Lower Shuswap (Fraser summer run age .3), and Harrison River and Chilliwack River for Fraser late. Dome Creek (Fraser spring run age 1.3) CWT application and recovery (Fraser 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 summer run age .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 summer run age .3 built and remained very strong until 2012, when they declined steeply, like many other far-north migrating stocks.

Returns to the Fraser late stock failed to meet the escapement goal in 2012.

2.2.2.4.1 Fraser River Spring Run: Age 1.3

The Fraser River spring run age-1.3 aggregate includes the Upper Pitt River 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).

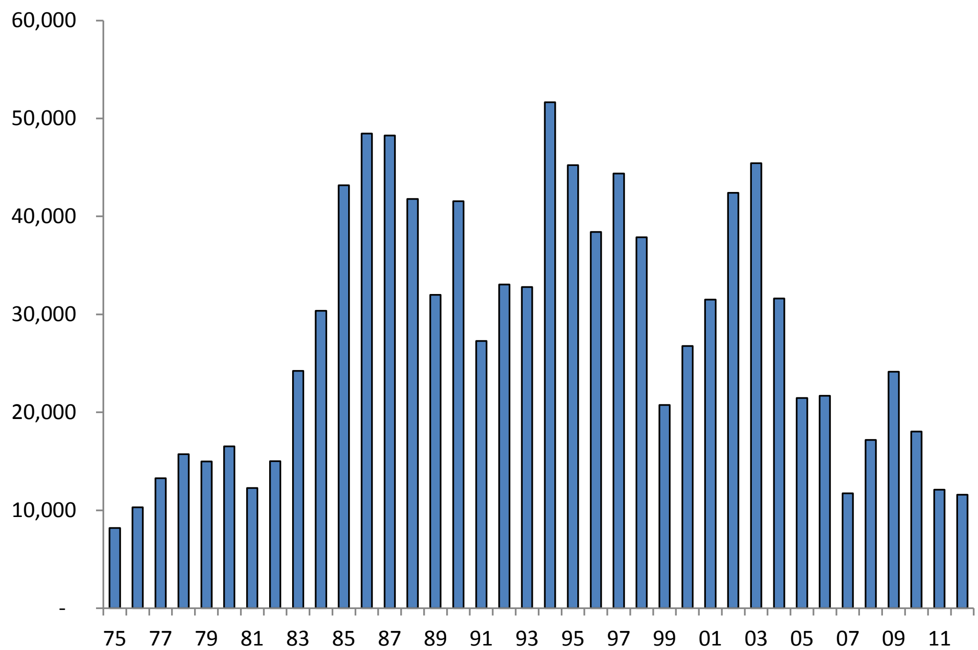


Figure 2.2.2.4.1.–Fraser River spring run age-1.3 stock group escapements of Chinook salmon, 1975–2012.

Commentary: Escapements are mostly estimated by expanded peak live counts of spawners, holders and carcasses, surveyed from helicopters or on foot. Escapements continued to decline in 2012, and also just failed to exceed the parental brood escapement levels in 2007. Escapement to the aggregate was estimated at 11,584 in 2012.

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.

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

2.2.2.4.2 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 a 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.

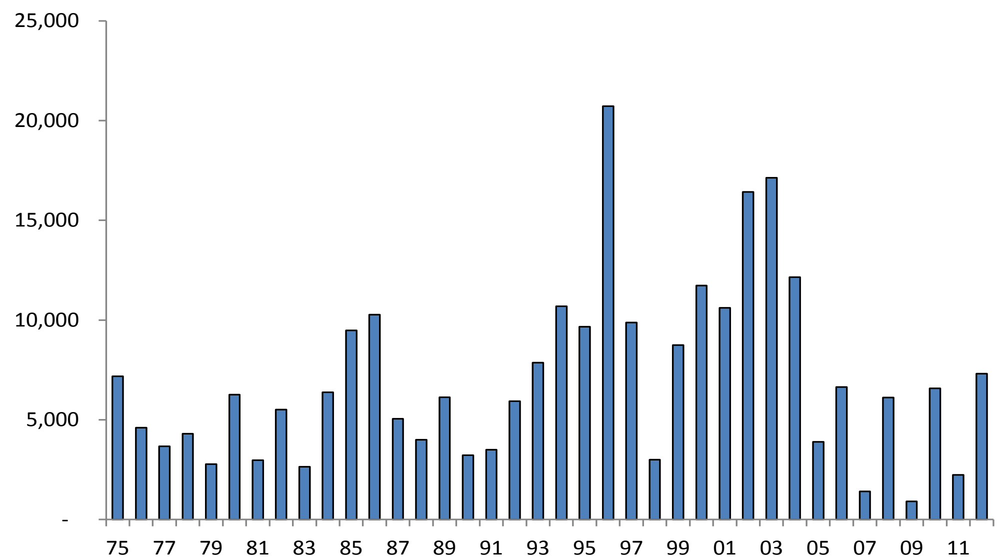


Figure 2.2.2.4.2.–Fraser River spring run age 1.2 stock group escapements of Chinook salmon, 1975–2012.

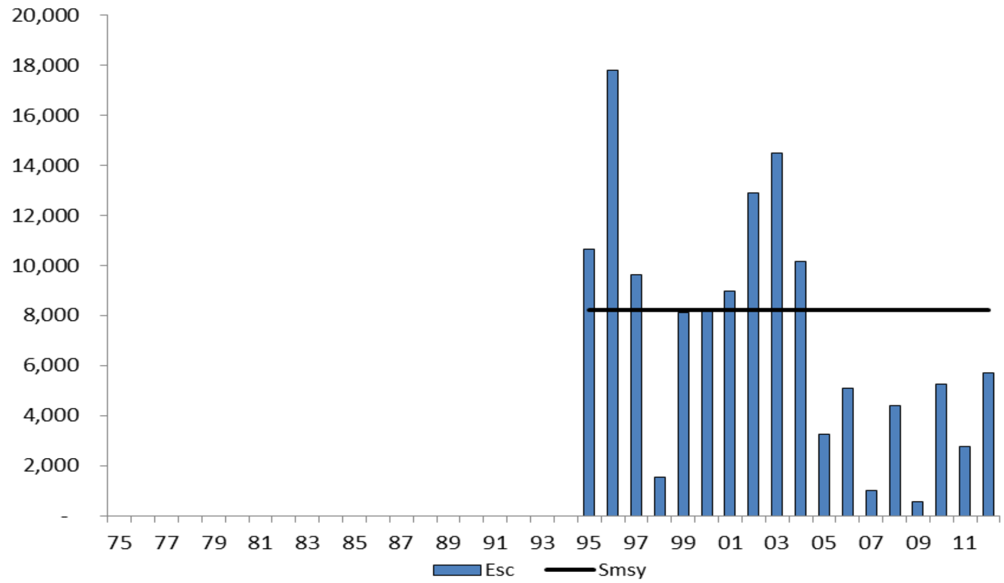


Figure 2.2.2.4.3.–Nicola River escapements of Chinook salmon, 1995–2012.

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 improved in 2012 from levels observed in 2011, and escapements also exceeded those of the 2008 parental brood. Aggregate escapement was estimated at 7,314.

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 post-spawned 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 spring run age-1.2 aggregate time series. The MR estimated escapement of 5,702 is well above that observed in 2011 (2,745), and the 2012 escapement also exceeded that of the 2008 parental brood (4,411). Since 1995 hatchery origin fish averaged 26% of the spawning escapement (range: 4%–71%).

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%).

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

2.2.2.4.3 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).

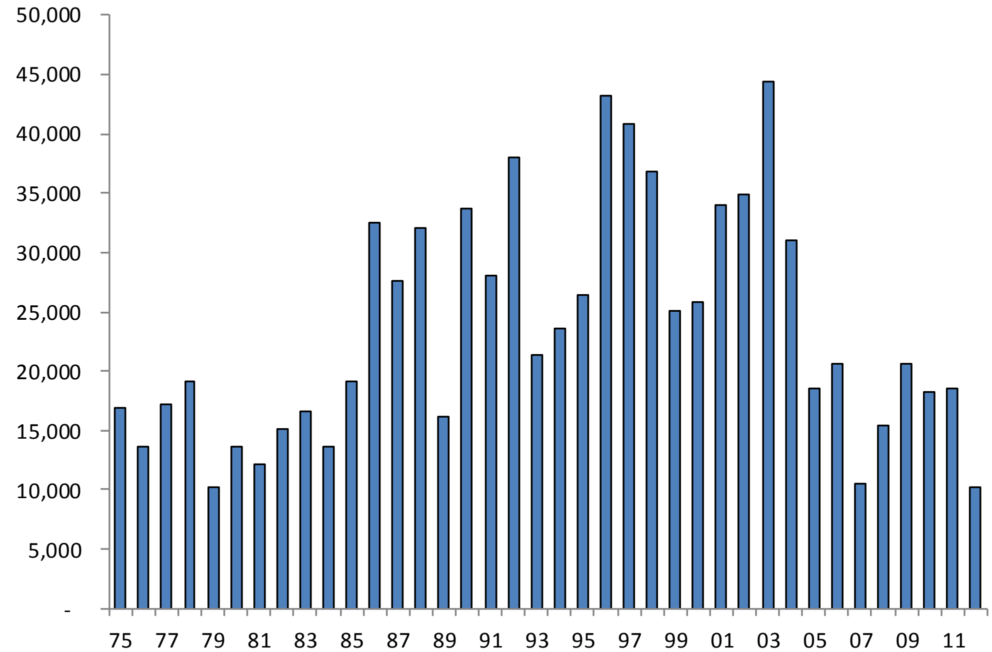


Figure 2.2.2.4.4.–Fraser River summer run Age 1.3 stock group escapements of Chinook salmon, 1975–2012.

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. Escapements in 2012 declined substantially from those observed in 2010 and 2011, however, they were very similar to those observed in the parental brood year in 2007. Aggregate escapement was estimated at 10,180.

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.

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

2.2.2.4.4 Fraser River Summer Run: Age .3

The Fraser River summer run age-.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 the BC interior, and Maria Slough in the Lower Fraser River (CTC 2002b).

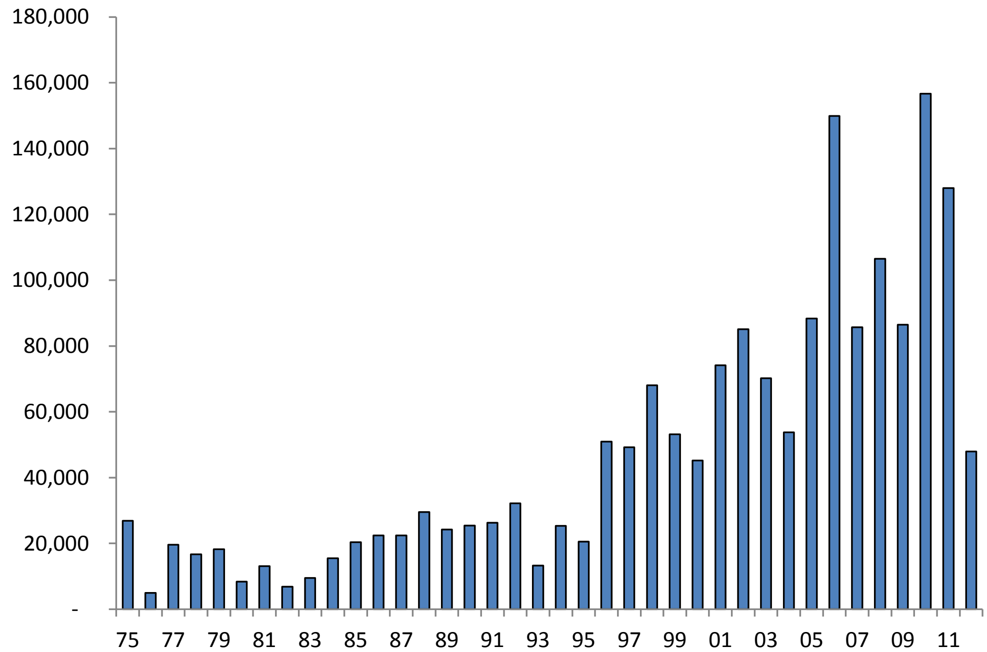


Figure 2.2.2.4.5.–Fraser River summer run age-.3 stock group escapements of Chinook salmon, 1975–2012.

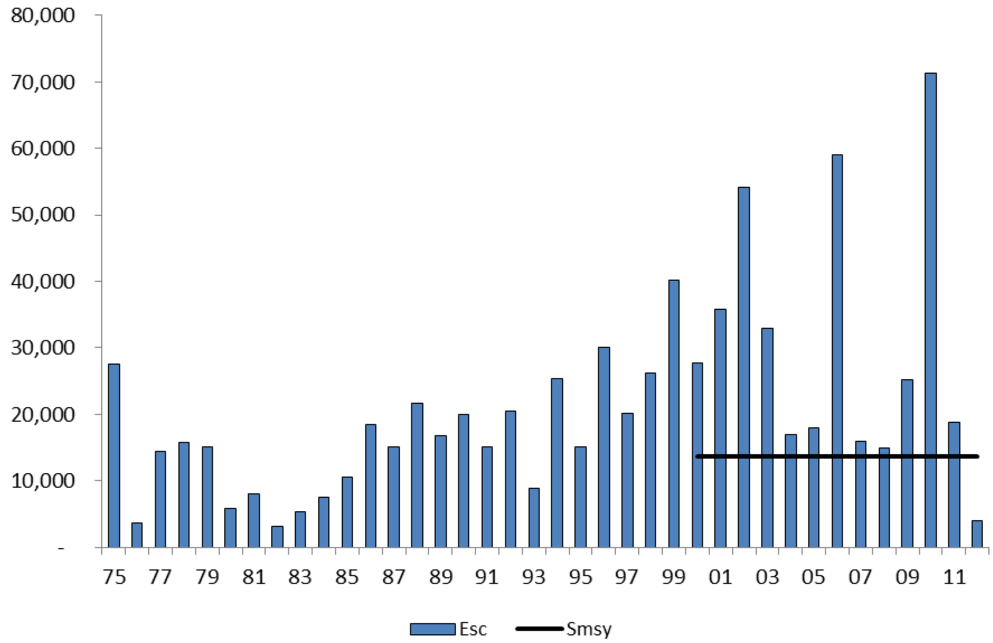


Figure 2.2.2.4.6.–Lower Shuswap River escapements of Chinook salmon, 1975–2012. The visual escapement estimates have been calibrated with the MR estimates.

Escapement Methodology: Escapements are estimated using peak count visual survey methods. Escapements to the summer run age-.3 aggregate declined steeply in 2012, and were the lowest estimated since 1996 (47,621), approximately 45% of the parental brood year escapements in 2008. Escapements to the Middle Shuswap River were particularly poor. The estimated escapement was 286; only 20% of the estimated parental escapement in 2008 (1,418).

The Lower Shuswap River is the exploitation rate indicator stock for the Fraser River summer run age-.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 visual escapements are calibrated values that have been estimated using a relationship between MR and peak methods. The Lower Shuswap peak count series (uncalibrated) is included in the Fraser River summer run age-.3 aggregate time series. The 2012 estimated escapement of 3,958 is substantially lower than that observed in 2011 (18,874), and represents only 27% of the 2008 parental brood of 14,921. Since 2000, hatchery origin fish averaged 6% of the spawning escapement (range: 2%–13%).

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. Prior to 2012, Lower Shuswap River escapements have exceeded the median estimate of S_{MSY} (12,800; CV = 37%); however, the 2012 escapements represent only 30% of the median estimate of S_{MSY}.

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

2.2.2.4.5 Fraser River Late Run (Harrison River)

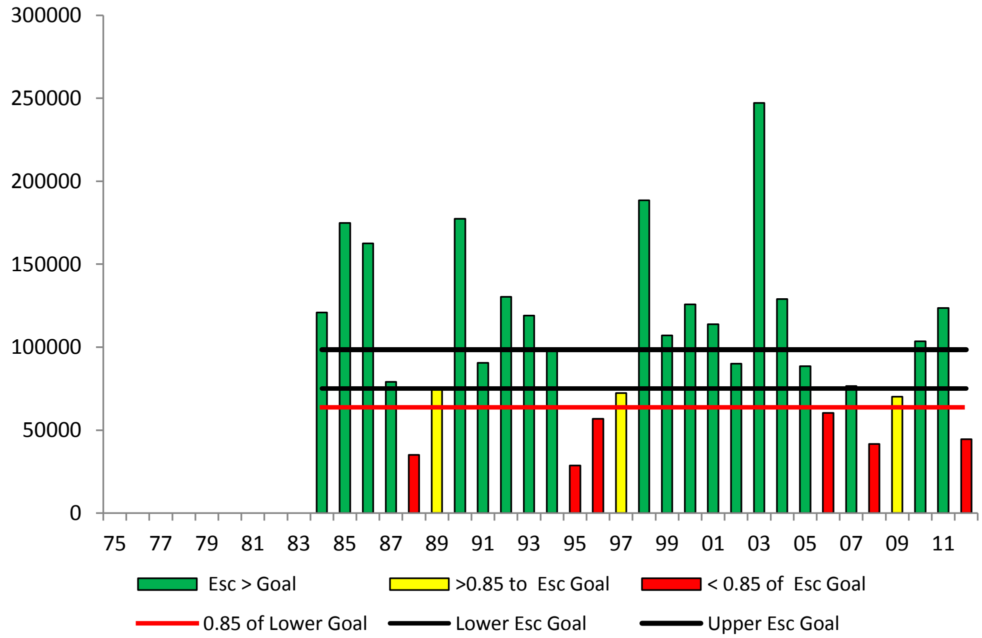


Figure 2.2.2.4.7.–Harrison River escapements of Chinook salmon, 1984–2012.

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 in 2012 were estimated to be 44,467 adult Chinook salmon, and 11,409 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. This stock is forecast to be below 85% of the escapement goal in 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 BC, and Washington State.

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

The PSC escapement indicator stocks in Washington and Oregon are separated into five regional groups: Puget Sound, Washington Coastal, Columbia River, North Oregon Coastal, and Mid-Oregon Coastal. 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).

2.2.3.1 *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.

2.2.3.1.1 Nooksack River

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

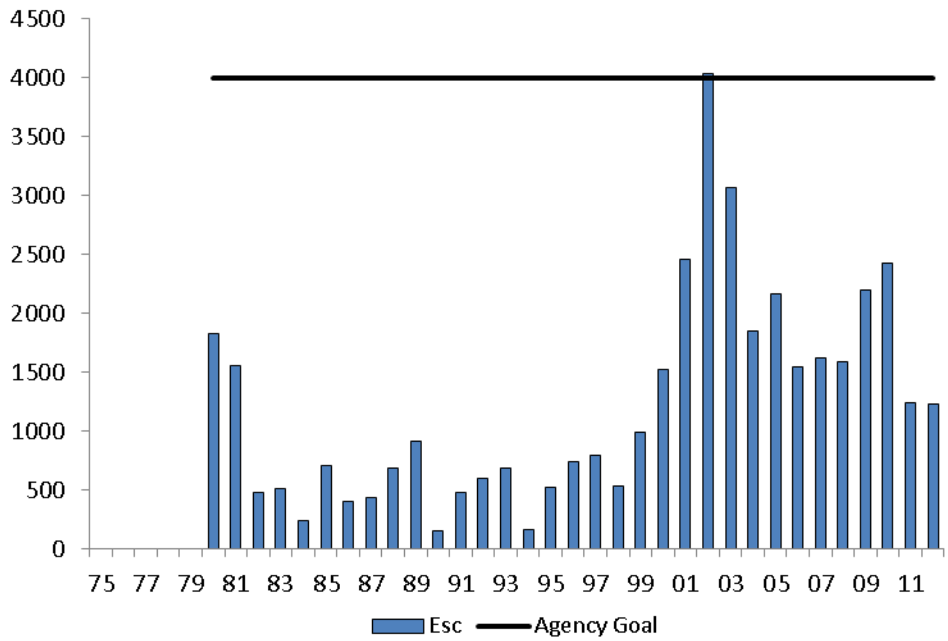


Figure 2.2.3.1.1.–Nooksack River escapement of natural- and hatchery-origin spring Chinook salmon, 1980–2012.

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 natural escapement is composed of hatchery-origin returns from the supplementation program. During the period from 1999 to 2008, only 15% of the escapement in the north fork and 50% of the escapement in the south fork was composed of natural-origin fish, annually ranged between 117 to 390 fish combined (CCMP 2010). In 2012, the natural escapement estimate was 759 for the north fork and a projected 466 for the south fork using the relationship between the north fork and south fork in 2011.

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 (MSH). 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. The stock achieved the LAT in 2010.

2.2.3.1.2 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 spring Chinook salmon stock includes early-timed populations returning to the Upper Sauk, Cascade, and Suiattle rivers.

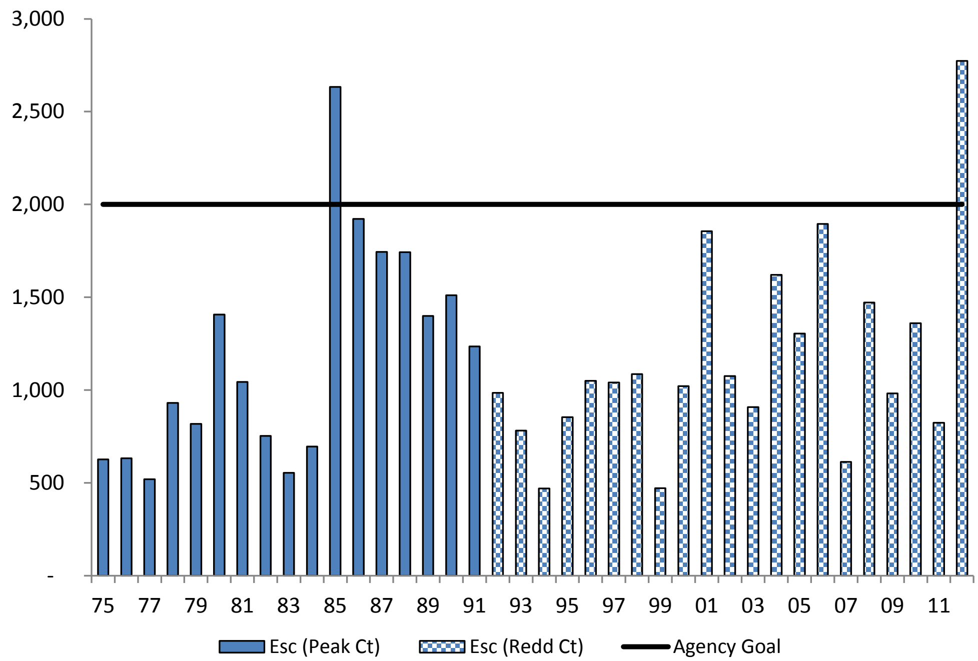


Figure 2.2.3.1.2.*–Skagit River escapement of spring Chinook salmon to the spawning grounds, 1975–2012.*

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 Forks), 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 2012 escapement estimate was 2,774 natural spawners.

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

Agency Comments: The current UMT used by the state and tribal co-managers 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.

2.2.3.1.3 Skagit River Summer/Fall

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

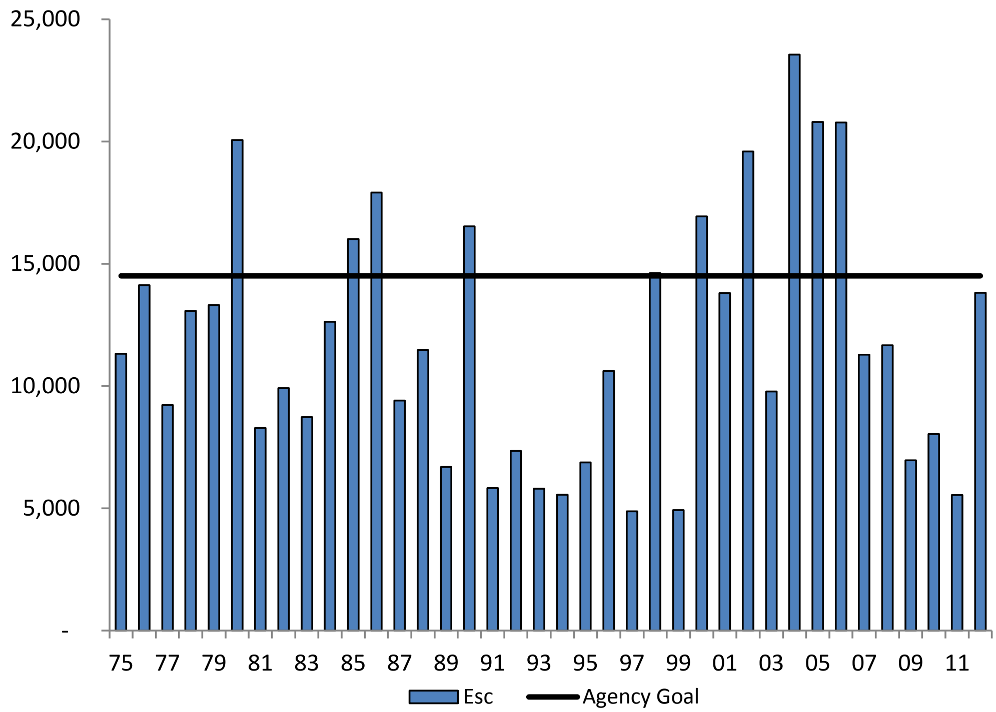


Figure 2.2.3.1.3.–Skagit River escapement of summer/fall Chinook salmon to the spawning grounds, 1975–2012.

Escapement Methodology: Escapement of Skagit 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 2012 escapement estimate was 13,817.

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

Agency Comments: The UMT used by the state–tribal co-managers 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.

2.2.3.1.4 Stillaguamish River

The Stillaguamish River drains into northern Puget Sound between Everett and Mount Vernon. The Stillaguamish River Chinook salmon stock includes a run of summer-timed Chinook salmon in the north fork of the Stillaguamish River and a much smaller number of fall fish in the south fork and mainstem of the Stillaguamish River.

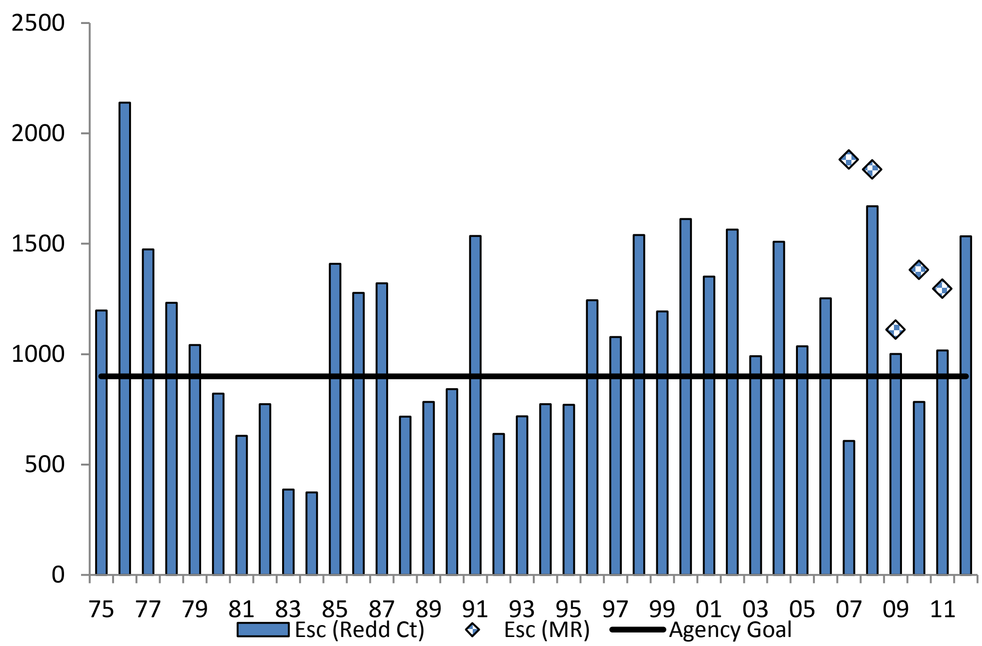


Figure 2.2.3.1.4.–Stillaguamish River escapement of Chinook salmon to the spawning grounds, 1975–2012.

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. Evidence of this is supported by MR studies in 2007 through 2010 funded through the SSP where escapement estimates were 1.1 times to 3.1 times higher than those from redd counts. 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 2012 was estimated at 1,534 fish.

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

Agency Comments: State–tribal co-managers 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 are into the north fork of the Stillaguamish River, via 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.

2.2.3.1.5 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.

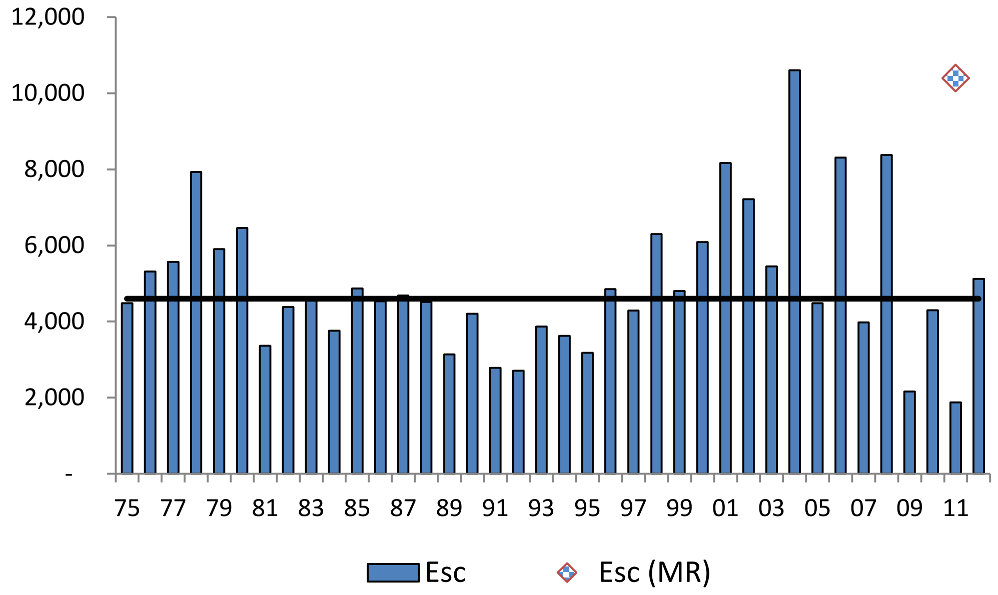


Figure 2.2.3.1.5.–Snohomish River escapement of Chinook salmon to the spawning grounds, 1975–2012.

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 for 2011 compared to the redd-based estimate of 1,880. The 2012 escapement was estimated at 5,123 natural spawners using redd counts.

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

Agency Comments: The state–tribal co-managers 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 fish. 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.

2.2.3.1.6 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.

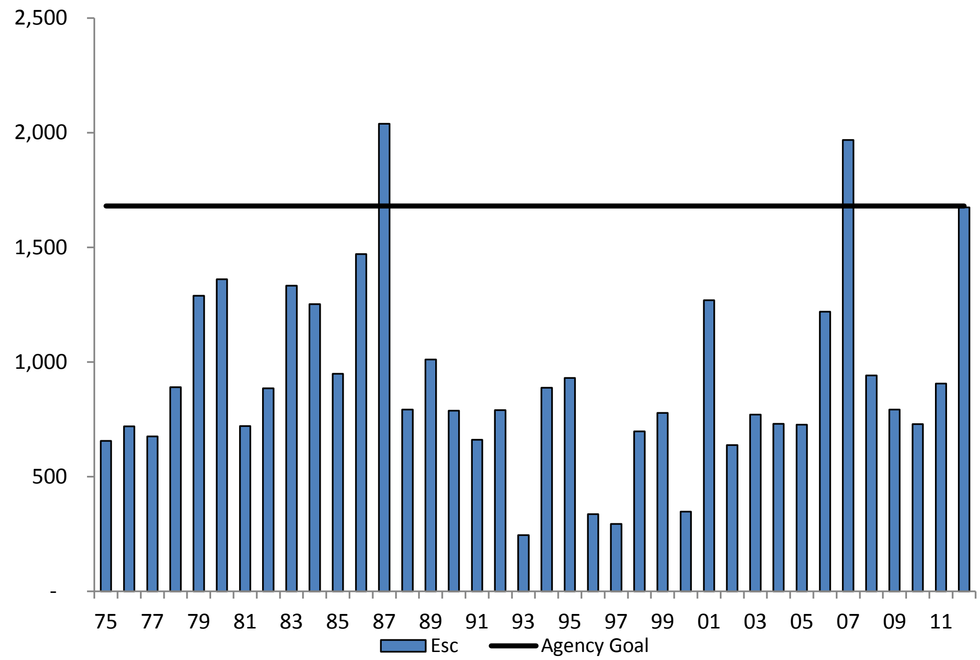


Figure 2.2.3.1.6.–Escapement of Chinook salmon to the spawning grounds in the tributaries of Lake Washington (Cedar River and Bear and Cottage creeks), 1975–2012.

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 2012 escapement for Lake Washington was 1,674 spawners, including 591 primarily hatchery origin fish in Bear and Cottage creeks.

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

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.

2.2.3.1.7 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.

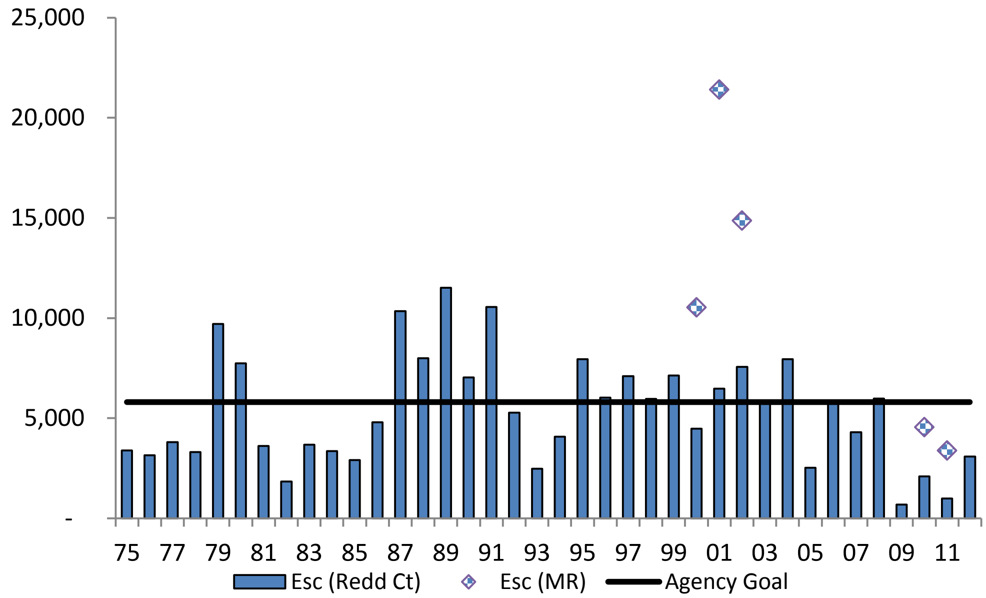


Figure 2.2.3.1.7.–Green River escapement of Chinook salmon to the spawning grounds, 1975–2012.

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 non-index 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 and 2011, the MR-based escapements from studies funded under the SSP were more than twice as high as the redd count expansion estimates. 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 2012 from redd count expansion was 3,091 Chinook salmon of mixed hatchery and natural origin.

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

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. pre-terminal fisheries and for the UMT in the terminal fisheries.

2.2.3.2 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.

2.2.3.2.1 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 U.S. 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.

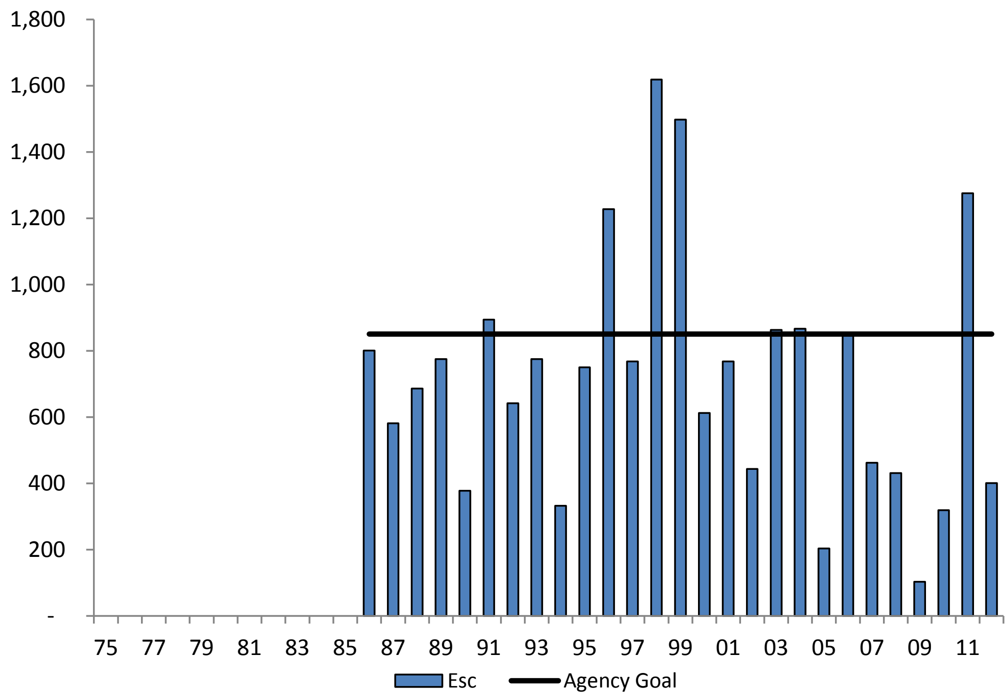


Figure 2.2.3.2.1.–Hoko River escapement of Chinook salmon to the spawning grounds, 1986–2012.

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 to 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, NF 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 2012, 219 fish were retained for the supplementation program leaving a total natural spawning escapement estimate of 401 of mixed natural origin and returns from the supplementation program.

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

Agency Comments: The UMT escapement goal established by state and tribal co-managers 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).

2.2.3.2.2 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.

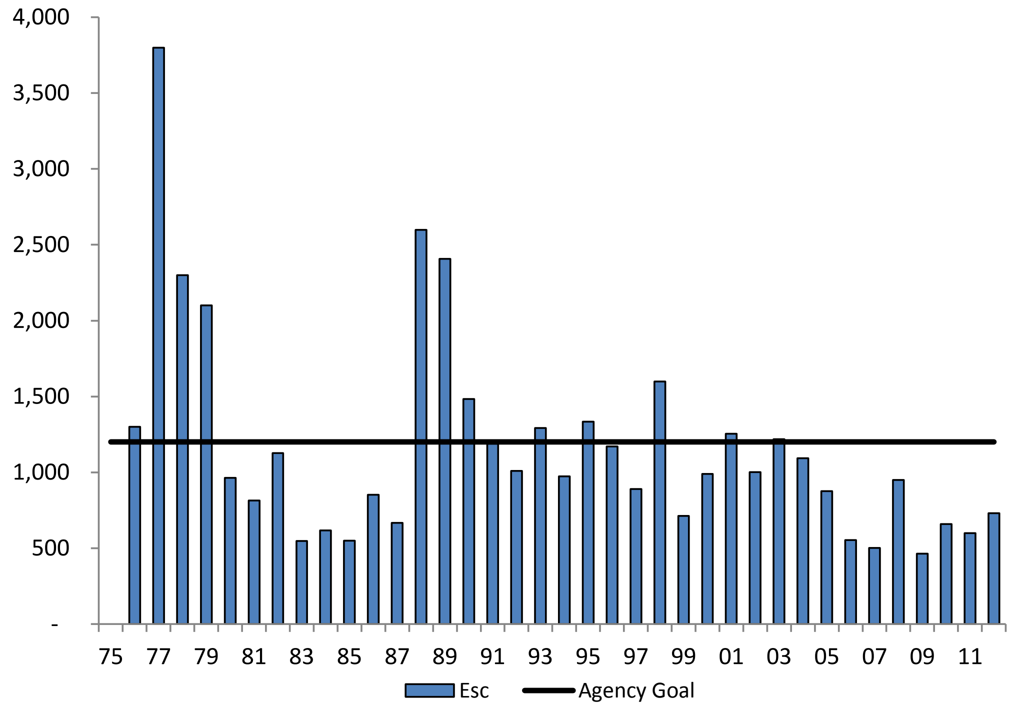


Figure 2.2.3.2.2.–Quillayute River escapement of summer Chinook salmon to the spawning grounds, 1976–2012.

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 bi-weekly 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 2012 escapement estimate for summer Chinook salmon was 731.

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

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

2.2.3.2.3 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.

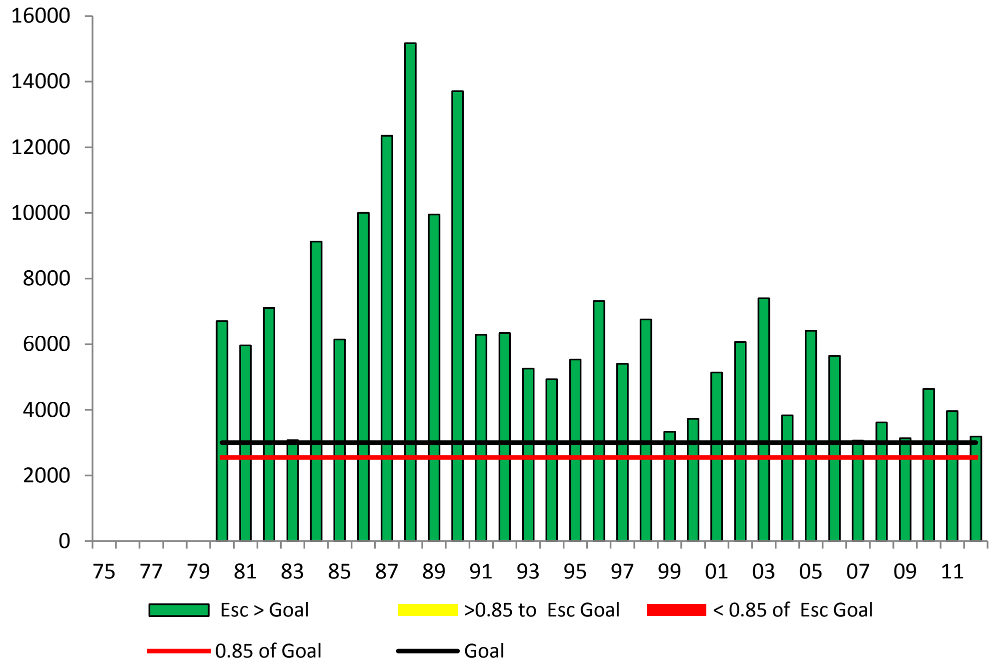


Figure 2.2.3.2.3.–Quillayute River escapement of fall Chinook salmon to the spawning grounds, 1980–2012.

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 bi-weekly 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 2012 escapement estimate was 3,181.

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).

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 MSH, 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.

2.2.3.2.4 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.

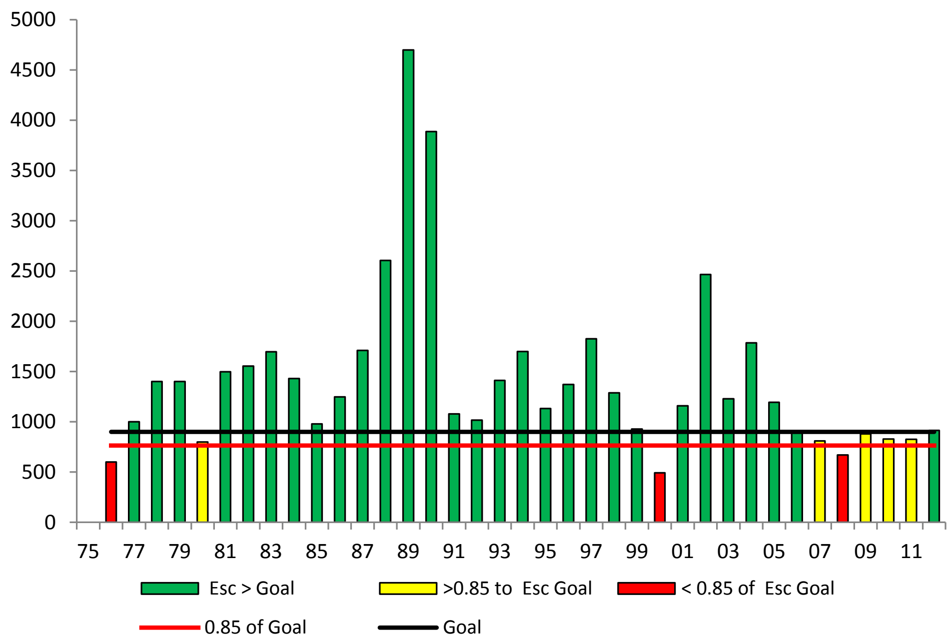


Figure 2.2.3.2.4.–Hoh River escapement of spring/summer Chinook salmon to the spawning grounds, 1976–2012.

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 2012 natural escapement estimate was 915 fish.

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.

2.2.3.2.5 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.

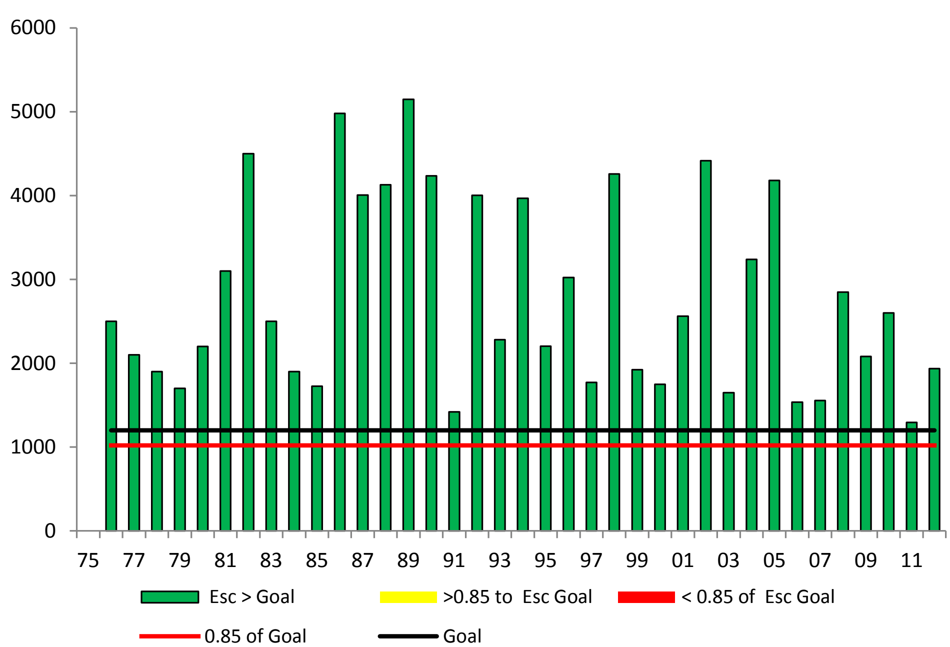


Figure 2.2.3.2.5.–Hoh River escapement of fall Chinook salmon to the spawning grounds, 1976–2012.

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 non-intensively 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 2012 escapement estimate was 1,937 fish.

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.

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 MSH, 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.

2.2.3.2.6 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.

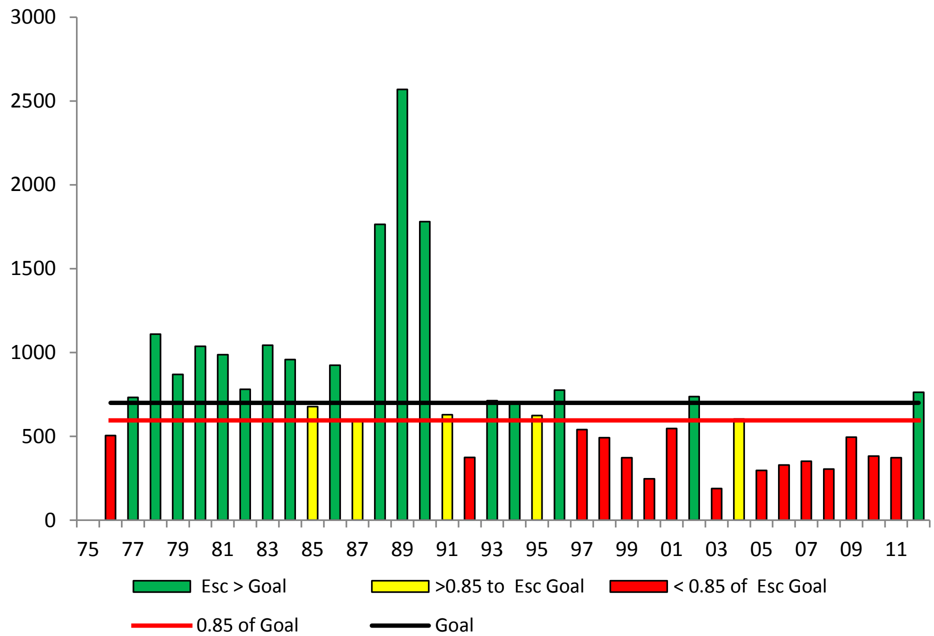


Figure 2.2.3.2.6.–Queets River escapement of spring/summer Chinook salmon to the spawning grounds, 1976–2012.

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 non-intensively 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 2012 estimate of natural escapement was 764.

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.

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 MSH. 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.

2.2.3.2.7 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.

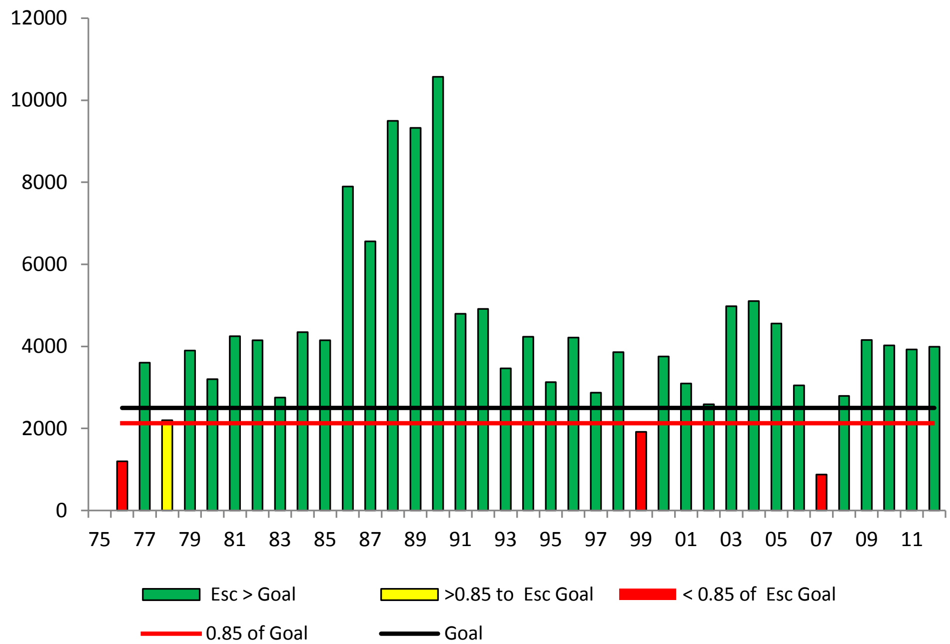


Figure 2.2.3.2.7.–Queets River escapement of fall Chinook salmon to the spawning grounds, 1976–2012.

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 non-intensively 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 of Queets River fall Chinook salmon was 3,993 in 2012.

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.

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 MSH. Stock production analyses of spawning escapements from 1967 to 1982 were used to determine the initial escapement floor.

2.2.3.2.8 Grays Harbor Spring

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

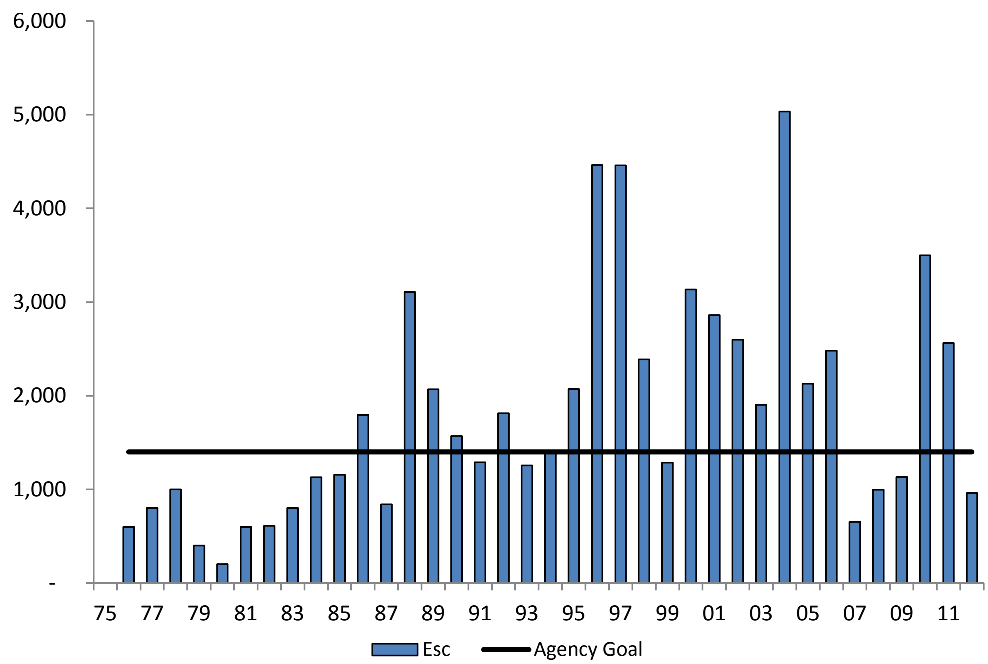


Figure 2.2.3.2.8.–Grays Harbor escapement of spring Chinook salmon to the spawning grounds, 1976–2012.

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 non-intensively 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 2012 escapement was 959 Chinook salmon.

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

Agency Comments: The natural spawning escapement goal established by the state–tribal co-managers 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.

2.2.3.2.9 Grays Harbor Fall

Grays Harbor fall Chinook salmon spawn primarily in the mainstem Chehalis River, in the Humptulips River 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.

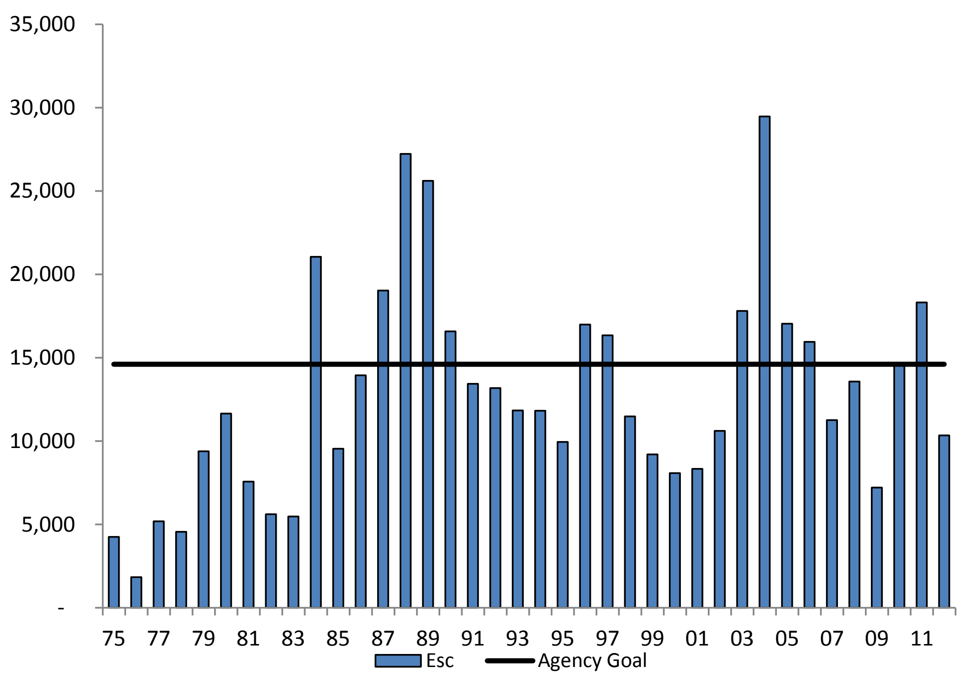


Figure 2.2.3.2.9.–Grays Harbor escapement of fall Chinook salmon to the spawning grounds, 1976–2012.

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 non-intensively 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 2012 escapement was 10,341 spawners.

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

Agency Comments: The state–tribal escapement goal for Grays Harbor fall Chinook salmon is 14,600 spawners to the combined Chehalis and Humptulips rivers (PFMC 2003). This single targeted goal was developed as an MSY proxy. The objective represents assumed optimal spawner density based on estimated available habitat.

2.2.3.3 *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 as a PSC escapement indicator stock 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.

2.2.3.3.1 Columbia Upriver Spring

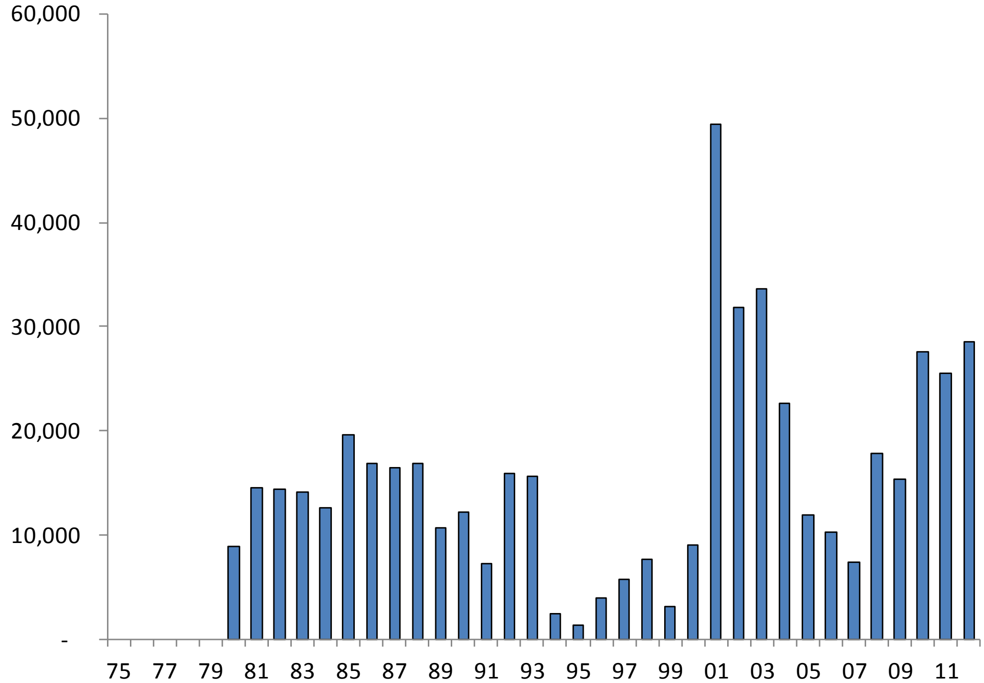


Figure 2.2.3.3.1.–Columbia upriver escapement of spring Chinook salmon, 1980–2012.

Escapement Methodology: Historically, the spring run through Bonneville Dam was assessed through June 1. Following ESA listing of Snake River spring/summer Chinook salmon, the spring management period was extended to June 15 so the listed stock could be managed under more restrictive catch rates. In previous CTC reports, graphed escapements were Bonneville Dam count minus total fishery mortalities above Bonneville Dam, multiplied by a complicated estimate of the proportion at Bonneville of fish not subsequently caught that didn't return to hatcheries, i.e., proportion wild. To simplify and provide consistency with the Technical Advisory Committee's annual Joint Staffs Reports (Joint Columbia River Management Staff, 2013, Tables 8 and 9), future graphs will simply provide the sum of wild adult upper Columbia spring Chinook salmon passing Rock Island Dam and wild adult Snake River spring/summer Chinook salmon passing Lower Granite Dam (plus Tucannon escapements below), recognizing that for purposes of fishery management and allocation, Columbia Upriver spring stock includes all (hatchery and wild) fish destined to return past Bonneville during the spring management period and there are also additional tributary spawning escapements (e.g., Deschutes and John Day rivers) that comprise the Columbia Upriver spring management unit. This times series should provide a more consistent and easily attained index of the abundance trend of naturally spawning fish, although it is not a completely comprehensive estimate of the naturally spawning fraction of Columbia Upriver spring Chinook salmon escapement past Bonneville.

Escapement Goal Basis: Under the 1988 Columbia River Fisheries Management Plan (CRFMP 1988), the interim management goal was 115,000 hatchery and wild adult Chinook salmon counted at Bonneville Dam and 25,000 naturally produced plus 10,000 hatchery-produced adults counted at Lower Granite Dam (CRFMP 1988). 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, Table A1).

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.

2.2.3.3.2 Columbia Upriver Summer

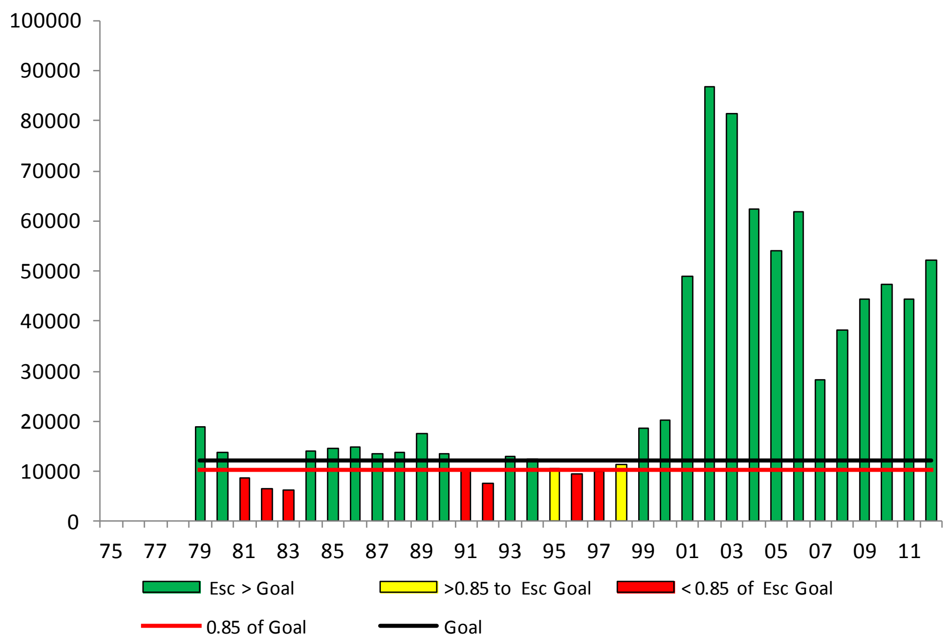


Figure 2.2.3.3.2.–Columbia upriver summer Chinook salmon escapements, 1979–2012.

Escapement Methodology: Graphed escapements are Rock Island Dam counts of all adult summer Chinook salmon, for compatibility with the interim escapement goal.

Escapement Goal Basis: The CTC (1999) developed an interim escapement goal of 12,143 summer Chinook salmon past Rock Island Dam, based on PSC Chinook salmon model data. Because model data used to develop the escapement goal included both hatchery and wild fish, the goal is not directly comparable to naturally spawning escapement estimates above Rock Island Dam. A revised analysis in 2008 using actual escapement data resulted in a similar goal, but modifications to the analysis were requested by the CTC and no action was taken.

Agency Comments: Columbia upriver summer Chinook salmon fisheries occur from June 16 to July 31, according to a catch rate schedule based on expected river mouth abundance. The schedule is provided in Table A2 of the 2008–2017 *U.S. v. Oregon* MA. In addition, Columbia upriver summer Chinook salmon are managed for a goal of 29,000 hatchery and natural-origin adults, as measured at the Columbia River mouth. This management goal is based on an interim combined spawning escapement goal of 20,000 hatchery and natural adults, including the following three components: 13,500 Wenatchee/Entiat/Chelan natural fish, 3,500 Methow/Okanogan natural fish and 3,000 hatchery fish.

2.2.3.3.3 Columbia Upriver Bright

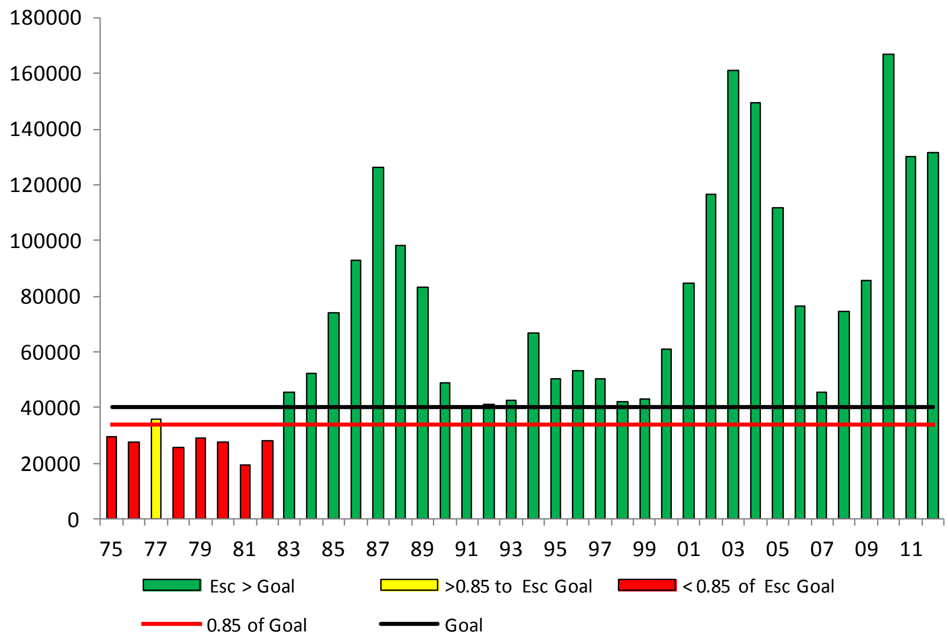


Figure 2.2.3.3.3.–Columbia Upriver escapement of bright Chinook salmon, 1975–2012.

Escapement Methodology: Escapement estimates are calculated as the McNary Dam count minus Hanford Reach adult sport catch, minus brood stock 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.

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 adult 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).

2.2.3.3.4 Deschutes River

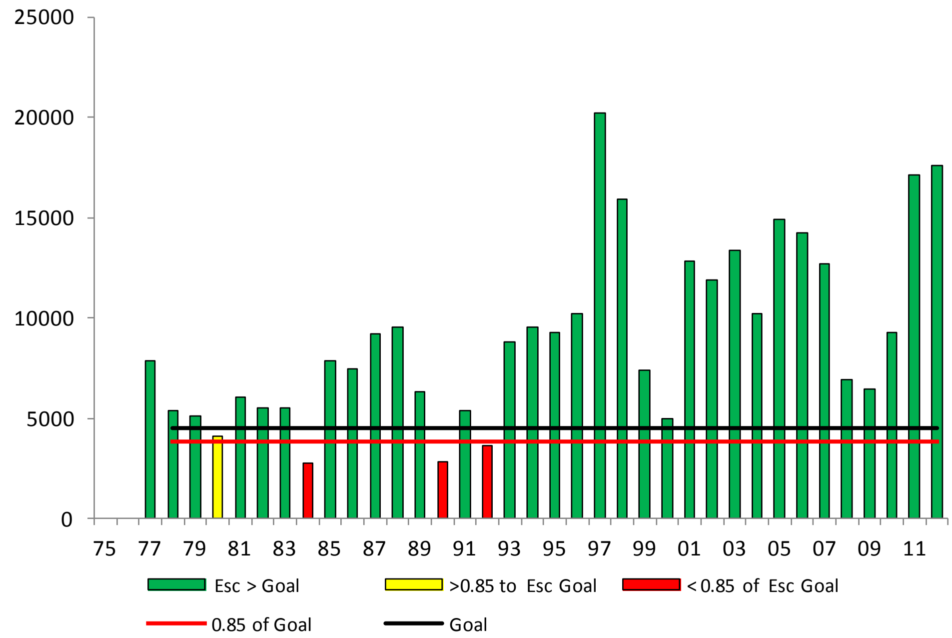


Figure 2.2.3.3.4.–Deschutes River escapements of fall Chinook salmon, 1977–2012.

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 through 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, Oregon Department of Fish and Wildlife (ODFW) and Columbia River Intertribal Fish Commission (CRITFC) staff.[2] An escapement goal was derived from the updated time series and approved by the CTC. The metric reported above is the ODFW MR estimate based on expanding the Sherars Falls MR estimate for redds below Sherars Falls.

Escapement Goal Basis: The CTC-agreed escapement goal for Deschutes River fall Chinook salmon is 4,532 fish.[2]

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

[2] Sharma, R, J. Seals, J. Graham, E. Clemons, H. Yuen, M. McClure, K. Kostow, and S. Ellis. 2010. Deschutes River Chinook spawner escapement goal using U.S. v. Oregon Technical Advisory Committee data. Unpublished Report.

2.2.3.3.5 Lewis River

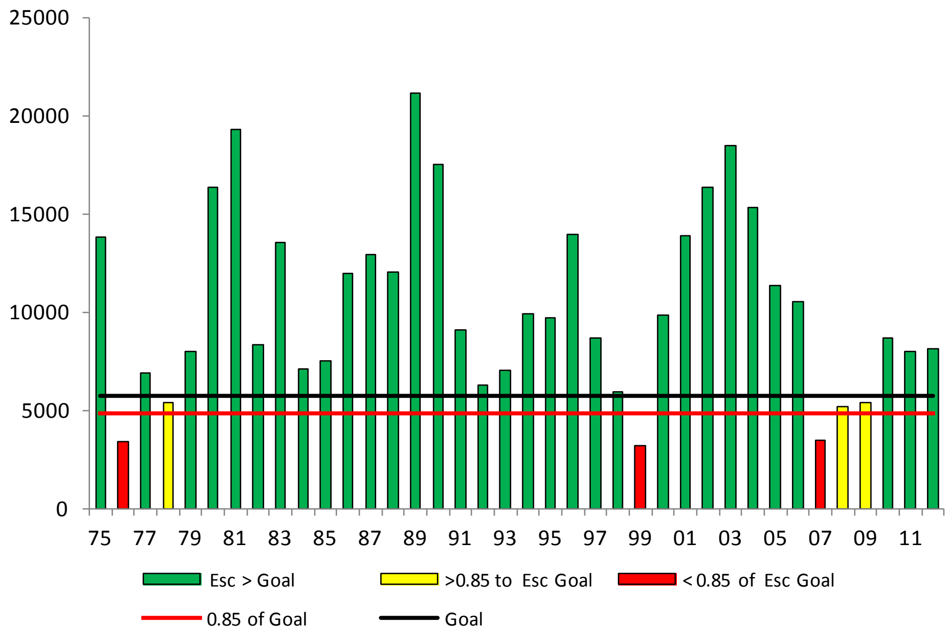


Figure 2.2.3.3.5.–Lewis River escapements of fall Chinook salmon, 1975–2012.

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/peak count).This factor was derived from a carcass tagging and recapture study performed in 1976 (McIsaac 1990). From 1999 to 2001, an 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.

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.

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

2.2.3.4 *Coastal Oregon*

2.2.3.4.1 Oregon Coastal North Migrating

The predominance of Chinook salmon production in the NOC occurs from naturally produced, fall-returning, ocean-type life histories of fish. The largest age classes which normally contribute to spawning escapement are 4- and 5-year-old adult 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 terminal fisheries.

Currently, only NOC fall Chinook salmon are accounted for in PSC management, while work is underway to include MOC production into the auspices of the PSC regime. The NOC production is bounded by the Necanicum on the north through the Siuslaw Basin on the south. There are three escapement indicator stocks representing the production of NOC Chinook salmon: the Nehalem, Siletz, and Siuslaw stocks. The geographic range of production encompassed by the NOC includes four additional major basins: the Tillamook, Nestucca, Yaquina and Alsea. The Tillamook drainage system includes five sub-basins: the Kilchis, Miami, Trask, Wilson and Tillamook rivers.

Forecasts for this aggregate are based on sibling regression relationships developed for each discrete population, both indicator and non-indicator stocks. The aggregated forecast for the NOC is the sum of the forecasts for the individual basins within the geographic range. These 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.

2.2.3.4.1.1 Nehalem River

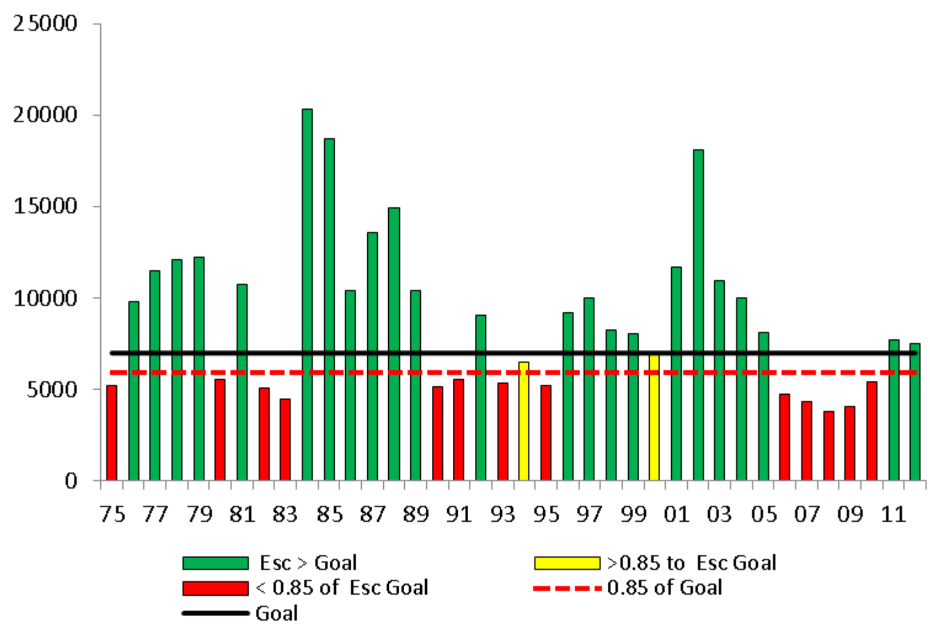


Figure 2.2.3.4.1.1.–Nehalem River escapements of Chinook salmon, 1975–2012.

Escapement Methodology: Both directed MR studies and historically conducted surveys were used to measure escapement during the past return year. Standard estimates are generated from conducting surveys of peak abundance in historically walked predefined areas of known Chinook salmon spawning habitat within the basin. These observations are then adjusted by estimates of the total available habitat, observer biases, the total run encountered during the peak count, and the bias seen between these predefined surveys and other survey areas that are randomly selected.

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

Agency Comments: This stock is being studied by the Sentinel Stock Committee's program to improve escapement estimation. Direct MR adult spawner estimation indicated an escapement of 12,952 Chinook salmon in 2012. Methods comparable to those used to generate the agreed to escapement goal for the Nehalem indicate 2012 escapement of 7,515 adult spawners. This is 108% of the current escapement goal. This is the second return year since 2005 that Nehalem Chinook salmon have met their escapement goal. While a terminal sport fishery was conducted from 2010 through 2012 return years, significant area closures, daily and seasonal bag restrictions were deployed to assist in the rebuilding of this stock. Based on sibling regression forecasting methods, the Nehalem is forecasted to meet the escapement goal in 2013. ODFW is engaged in analysis to best use results from recent MR experiments to reconstruct historic estimates from peak-counts observed in standard surveys.

2.2.3.4.1.2 Siletz River Fall

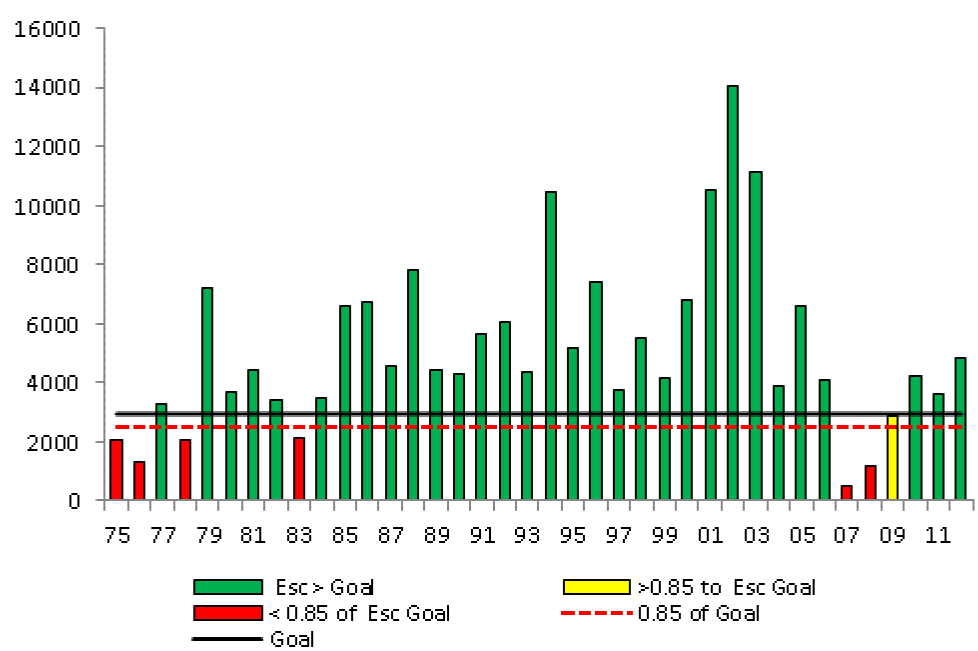


Figure 2.2.3.4.1.2.–Siletz River fall escapements of Chinook salmon, 1975–2012.

Escapement Methodology: Both directed MR studies and historically conducted surveys were used to measure escapement during the past return year. Standard estimates are generated from conducting surveys of peak abundance in historically walked predefined areas of known Chinook salmon spawning habitat within the basin. These observations are then adjusted by estimates of the total available habitat, observer biases, the total run encountered during the peak, and the bias seen between these predefined surveys and other survey areas that are randomly selected.

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

Agency Comments: This stock is being studied under the auspices of the Sentinel Stock Committee's program to improve escapement estimation. Calibration studies were initiated in the 2009 spawning year, and traditional methods of escapement estimation remain in place until MR experiment-based estimation is complete. The MR study of escapement in the Siletz resulted in an independent estimate of 8,738 adult spawners in 2012. Data used to derive the escapement goal are not directly comparable to MR based estimates of escapement. The estimate based upon historically produced habitat expansion methods for 2012 was 4,871 adult fall Chinook salmon. Significant terminal area sport fisheries restrictions which included substantial area closures, restrictive daily and seasonal bag limits are believed to have assisted in the achievement of the escapement goal. This stock is forecasted to exceed its escapement goal in 2013.

2.2.3.4.1.3 Siuslaw River Fall

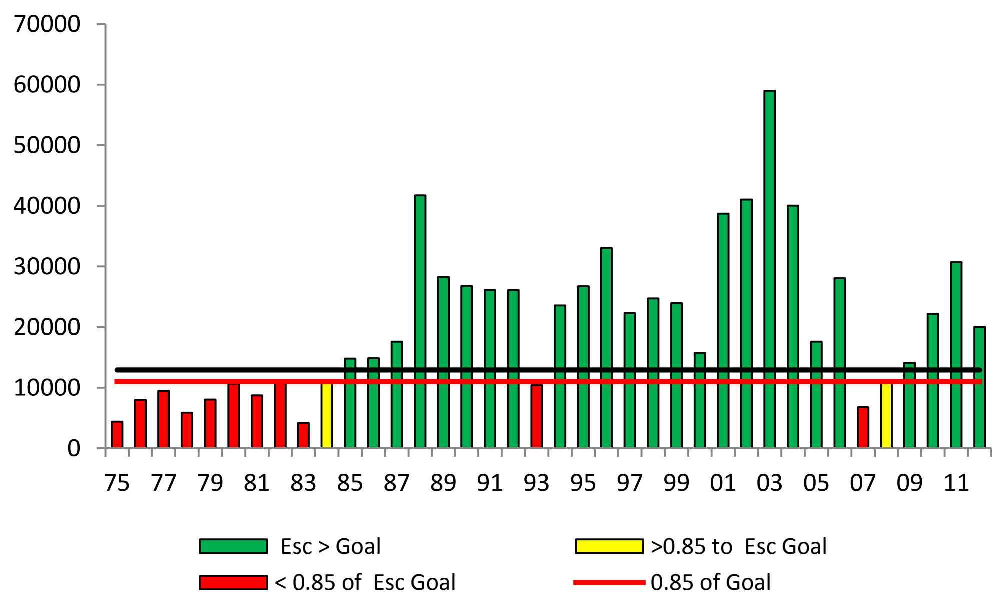


Figure 2.2.3.4.1.3.– Siuslaw River fall escapements of Chinook salmon, 1975–2012.

Escapement Methodology: Both MR-based calibration factors and historically conducted surveys have been utilized to measure escapement during 2012. Standard estimates are generated from conducting surveys of peak abundance in historically walked predefined areas of known Chinook salmon spawning habitat within the basin. These observations are then adjusted by estimates of the total available habitat, observer biases, the total run encountered during the peak, and the bias seen between these predefined surveys and those that are randomly selected. A simple ratio comparison between MR-based estimates and observations of peak abundance in standard survey areas was used to generate a calibrated estimate.

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: The preliminary estimated spawner abundance in 2012 was 16,023 adult Chinook salmon based on methods employing five years (2002–2006) of peak counts on six standard surveys calibrated to MR-based escapement estimates. The current escapement goal estimate was based upon available habitat expansion escapement estimates, as used in other basins on the Oregon coast, but these estimates and goals will be obviated through the improvement of estimation techniques based upon the MR-based estimates. Escapement in 2012, estimated based on habitat expansion methods used to derive the escapement goal, was 20,018 adult spawners. Spawner–recruit analysis utilizing the MR-based data set will yield a new escapement goal (backcast through historical data sets). This stock is forecast to exceed the current escapement goal in 2013.

2.2.3.4.2 Mid-Oregon Coast

The MOC aggregate has been proposed as an additional stock aggregate to be included in PSC management, pending analysis and review of escapement goals for the South Umpqua and Coquille. The MOC is bounded by the Umpqua on the north and the Elk 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 production originating from the MOC, both of which are fall-returning, ocean-type life histories. The largest age classes which normally contribute to spawning escapement are 4- and 5-year-old adult 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 are caught primarily in SEAK, NBC, PFMC and terminal fisheries.

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

2.2.3.4.2.1 South Umpqua River Fall

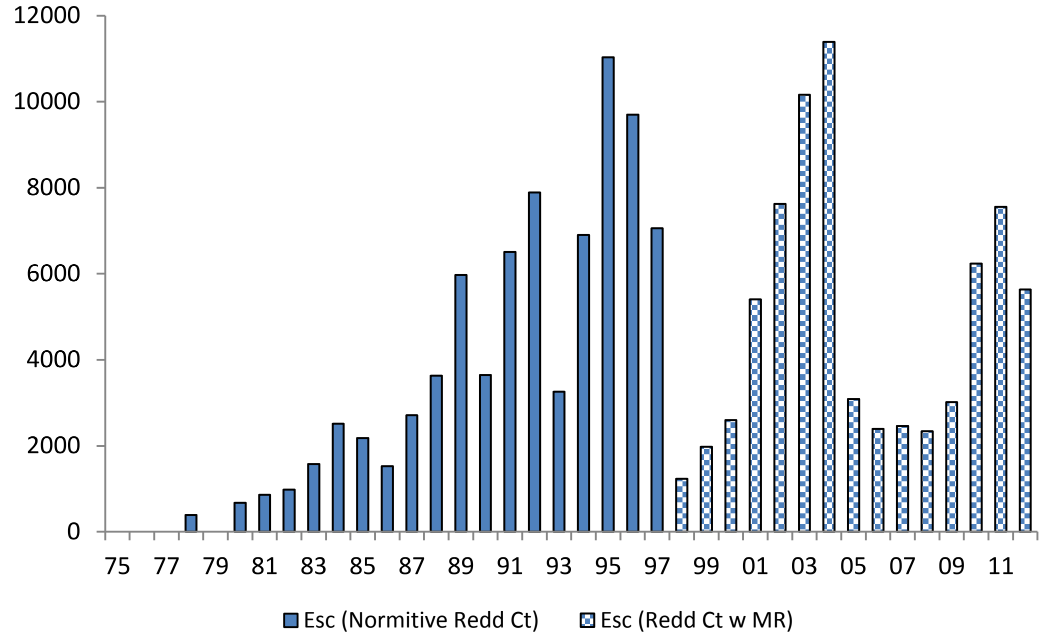


Figure 2.2.3.4.2.1.–South Umpqua River escapement of fall Chinook salmon, 1978–2012.

Escapement Methodology: Indices of Chinook salmon spawner abundance in the South Umpqua/Cow Creek sub-basin were derived from aerial redd count surveys calibrated to six years of MR study. The aerial surveys are funded by Douglas County and were conducted twice during the spawning season. Aerial redd counts were conducted on the lower 69 miles of the South Umpqua and the lower 60 miles of Cow Creek. These counts 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.

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 2012 was 5,635 adults based on redd count expansions.

2.2.3.4.2.2 Coquille River Fall

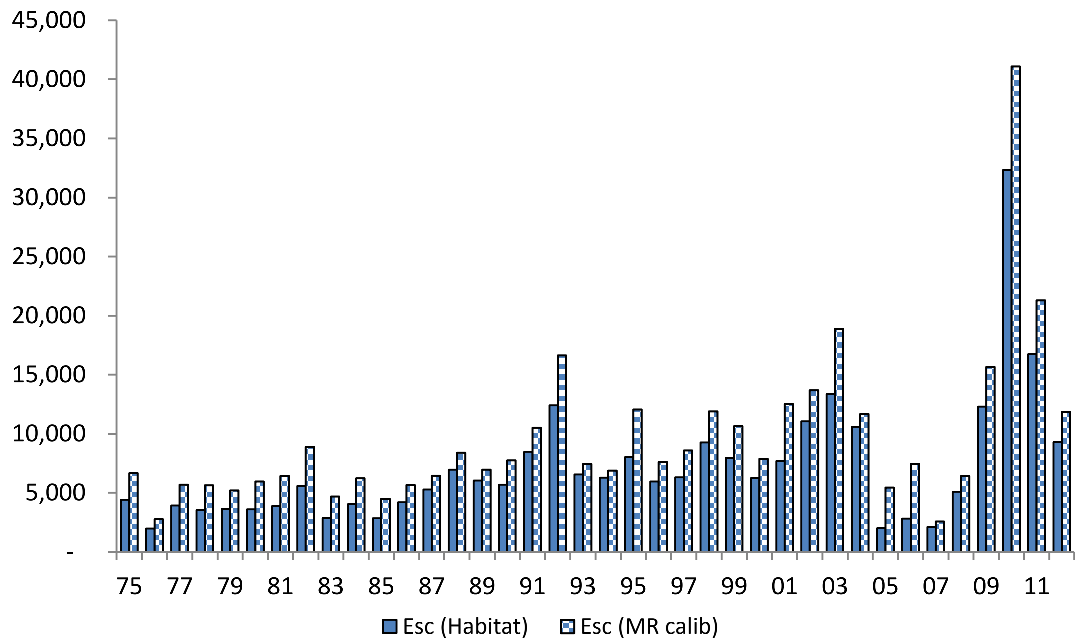


Figure 2.2.3.4.2.2.–Coquille River escapement of fall Chinook salmon, 1975–2012.

Escapement Methodology: Both MR study based calibration factors (Figure 2.2.3.4.2.2) 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. A simple ratio comparison between those years of MR-based estimates and observations of peak abundance in standard survey areas have been used to generate a preliminary "calibrated" estimate. Values presented in the above graph are based on standard habitat survey estimations along with the calibrated values. Both standard and MR calibrated estimates may be found in the appendix tables.

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 11,828 spawners in 2012. The traditional habitat expansion-based estimate is only somewhat lower at 9,300 adult 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.

The U.S. CTC recommends that a CV of less than 30% should be achieved in order for an index to be used as an estimator of abundance within the Chinook salmon management scheme. The average CV among the qualifying calibration values computed from studies conducted from 2001 through 2004 for the Coquille River basin is was 14%.

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 Paragraph 13 (c) Analysis

Paragraph 13 of the 2009 Agreement describes a process to implement additional management actions in AABM and ISBM fisheries if the management as prescribed in paragraphs 8 and 10 fail to meet MSY or other biologically based escapement objectives. Paragraph 13 of the PST details a process for evaluating stock groups and indicator stocks listed in Attachments I–II to determine if additional management actions should be implemented in AABM fisheries. If additional management action is required, the ISBM fisheries listed in Attachments IV and V for those stock groups would commensurably be reduced to increase the escapements of the depressed stocks within the stock groups triggering the additional management actions. The CTC is to notify the commission of any required fishery restrictions to be implemented under Paragraph 13 at the February annual meeting.

Additional management actions for SEAK or NBC AABM fisheries would reduce Table 1 catch limits by 10% if a majority of stocks with agreed management objectives in at least two of the stock groups listed in Attachment I and II of the Chinook Annex were observed:

- at least 15% below their escapement goal management objectives for the past year and are forecast to be at least 15% below their escapement goal objectives in the upcoming year; or
- at least 15% below their escapement goal objectives for the past two consecutive years (unless a forecast for escapement will exceed the escapement objective in the coming year).

If three or more stock groups in Attachments I and II meet the criteria to trigger additional management action, Table 1 catch limits in the relevant AABM fishery would be reduced by 20%. For the WCVI AABM fishery, Attachment III of the 2009 Agreement lists stock groups applicable to the obligations defined in paragraph 13. However, in consideration of the 30% reduction in catch limits for the WCVI AABM fishery, the 2009 Agreement states that additional actions will not be taken for this fishery except as otherwise may be agreed by the Commission.

The 2009 Agreement directs the CTC to provide a review of Attachments I–V by 2014 or earlier, to determine if the current lists of stock groups continue to be appropriate, if there are new criteria that could be employed to revise stock group listings for each attachment, and whether any changes to the Attachments proposed by a Party may be appropriate. In the interim, the CTC in this report provides an evaluation of the stocks listed in Attachments I–III following the criteria described in Paragraph 13 (c).

In Table 3.1, the CTC summarizes the performance of the stock groups and the criteria for additional management action, based upon observed escapements and exploitation rates through 2012 and stock forecasts for 2013.

For SEAK and NBC AABM fisheries, the stock groups in Attachments I and II are identical; thus they are combined in Table 3.1. All stocks relevant to Paragraph 13 decisions for SEAK and NBC AABM fisheries have escapement-based management objectives. Although not meeting management objectives does not automatically trigger reductions in the WCVI AABM fishery, the CTC included an evaluation of the stock groups in Attachment III to inform the Commission about their performance. For the WCVI AABM fishery, the Puget Sound summer/fall stock group includes three stocks with exploitation rate management objectives that have yet to be submitted for CTC review.

Table 3.1.–Evaluation of criteria for initiating additional management action in regards to Paragraph 13 of Chapter 3 of the 2009 PST Agreement.

Fishery	Stock Group	Stocks	Stocks with agreed objective	Number below threshold (2011 and 2012)	Stocks with a 2013 forecast	Number of 2013 forecasts below threshold	Paragraph 13 criteria met
SEAK/ NBC	North/Central British Columbia	3	0	NA	0	NA	**No**
	Upper Strait of Georgia	5	0	NA	0	NA	**No**
	West Coast Vancouver Island Falls	7	0	NA	0	NA	**No**
	Far North Migrating Oregon Coastal Falls	3	3	0	3	0	**No**
	Columbia River Falls	3	3	0	2	0	**No**
	Columbia River Summers	1	1	0	1	0	**No**
	Washington Coastal Fall Naturals	5	3	0	3	0	**No**
	Fraser Early (Spring & Summers)	3	0	NA	0	NA	**No**
WCVI	Columbia River Falls	3	3	0	2	0	**No**
	Fraser Late	1	1	0	1	1	**Yes**
	Puget Sound Natural Summer/Falls	5	0	NA	0	NA	**No**
	Columbia River Summers	1	1	0	1	0	**No**

Note: When the stock group cannot be evaluated because an insufficient number of stocks in the group have agreed escapement objectives, or that forecasts were not provided to the CTC for stocks with agreed escapement objectives, NA is shown.

No stock groups listed in Attachment I–III met the criteria for triggering additional management action under Paragraph 13 (c) for the 2011 and 2012 observed escapements. The 2012 observed escapements and 2013 forecasts (Table 3.1) indicate that one stock group (Fraser late, i.e., Harrison River) potentially meets criteria for the flagging of Paragraph 13. However, Paragraph 13 (g) specifies that no further reduction will be taken in the WCVI fishery unless otherwise agreed by the PSC. Further, the CTC has expressed that it is not practical to use forecasts for Paragraph 13.

Note that ISBM obligations for 2012 cannot be calculated for most Oregon and Washington stocks until 2014 because of the delay in availability of required CWT data under most southern U.S. monitoring programs.

Only 5 of the 10 different stock groups in Table 3.1 have stocks with agreed management objectives that can be evaluated for triggering additional management action (Far North Migrating Oregon Coastal falls, Columbia River falls, Columbia River summers, Washington Coastal fall naturals, and Fraser lates). These 5 stock groups contain 13 stocks, of which 11 have agreed escapement objectives. Of the 11 stocks with agreed escapement objectives, forecasts for 2013 were available for 11 (Table 3.1). The CTC has identified a need to develop management objectives and forecast capabilities for more of the stocks and stock groups included in Attachments I–III to improve the efficacy of the Paragraph 13.

As stated previously, the CTC is to notify the Commission of any required fishery restrictions to be implemented under Paragraph 13 (c) at the February annual meeting; however, due to the delay in compiling escapement data for 2012 and forecasts for 2013, the Paragraph 13 escapement analysis was not completed until well after the February due date. Much of the data were not available until late April. Also, in January 2013 the CTC advised the Chinook Interface Group that annual escapement forecasts are not practical for use in Paragraph 13 (c) for determining if additional management action is warranted. To meet the timing requirement for implementation of Paragraph 13 (c), the CTC would need the following before the February annual meeting: a) escapement and exploitation rate estimates for the prior year, and depending upon the recommendations of the Chinook Interface Group and the Commission, b) projections of exploitation rates and forecasts of escapements for the coming year for stocks included in Paragraph 13, Attachments I–V. The CTC has developed a computer program with the capability to evaluate stock status and exploitation rate provisions under Paragraph 13 (d) and (e) but the availability of this analysis in February for the current management year remains an issue.

Since the January meeting with the Chinook Interface Group, the CTC has carried out the evaluation of the Paragraph 13 (c) criteria to provide insight into the current status of stocks in relation to the criteria and to identify data needs for the application of Paragraph 13. The evaluation for Paragraph (d) and (e) will be provided in the 2013 Exploitation Rate Analysis and Model Calibration report.

3.2 Synoptic Evaluation of Stock Status

The following sections include graphics to display stock status information consisting of escapement and exploitation figures 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 in Figure 3.2.1. 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_{SMSY}) and two for escapement abundance (S_{MSY}, $0.85*S_{MSY}$) that define five areas. 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.

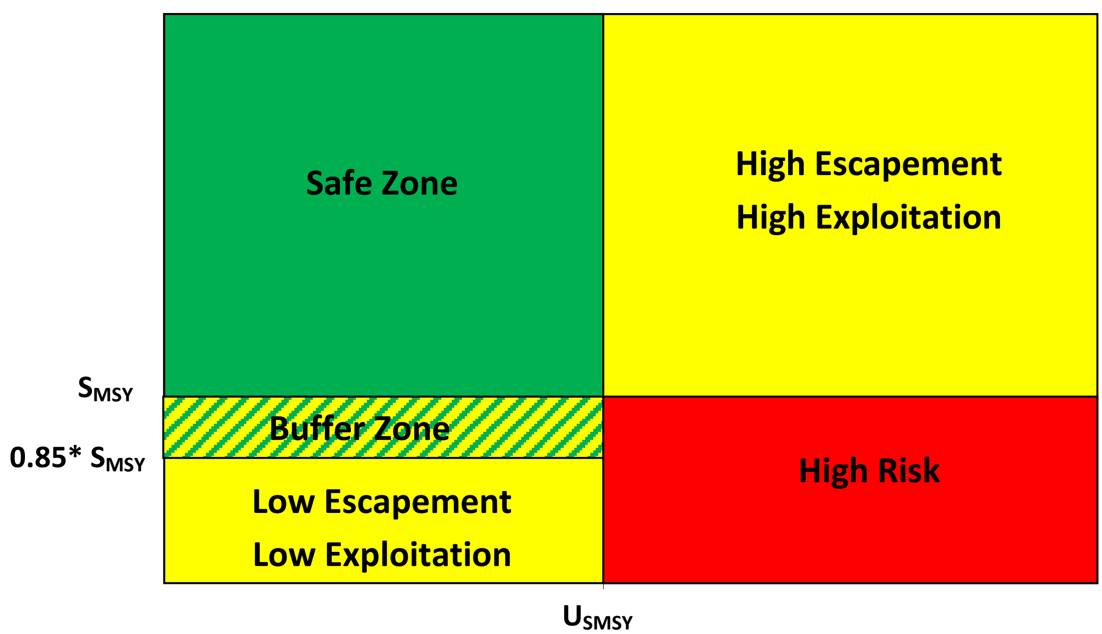


Figure 3.2.1. –Precautionary plot for synoptic evaluations of PST Chinook salmon stocks.

The three reference lines produce five zones in the synoptic plots. The green area (Safe Zone) in Figure 3.2.1 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 where a higher-than-prescribed fishing mortality is 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 and the population is below a desired minimum escapement. The cross-hatched region is the PSC buffer zone, indicating problems may arise in the future.

Exploitation rates used in the synoptic plots are one of the following: CY exploitation rates, pre-terminal cumulative mature-run equivalent exploitation rates, or total (pre-terminal and terminal) cumulative mature-run equivalent exploitation rates. Total cumulative mature-run equivalent 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 3.2.1 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

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

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

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

When computing total (pre-terminal 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 pre-terminal 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 pre-terminal harvest rates for each age in a brood year are computed as:

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

The pre-terminal survival rates for each age in a brood year are computed as:

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

Table 3.2.1.–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 mature-run equivalent 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 3.2.2). Most escapement indicator stocks have companion exploitation rate indicator stocks that are assumed capable of reflecting the exploitation rates in pre-terminal 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 west coast of Vancouver Island 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 3.3.

Table 3.2.2.–Summary of information available for synoptic stock evaluations.

Region	Escapement Indicator	S_{msy}	85% of S_{msy}[1]	Exploitation Rate Indicator	U_{msy}	Type of Exp. Rate[2]
SEAK	Situk	600	425	Situk wild	0.81	CY
SEAK	Chilkat	2,200	1,488	Chilkat wild	0.40	CY
SEAK	King Salmon	150	102	Alaska Hatchery (Crystal Lake)	0.73	CMRE
SEAK	Andrew Creek	800	553	Alaska Hatchery (Crystal Lake)	0.67	CMRE
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	Blossom	750	493	Alaska Hatchery (Neets, Whitman, Deer) and Unuk wild	0.64	CMRE
SEAK	Keta	750	446	Alaska Hatchery (Neets, Whitman, Deer) and Unuk wild	0.62	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	5,048	4,291	Atnarko	0.77	CMRE
BC	Nicola	8,159	6,935	Nicola	0.60	CMRE
BC	L Shuswap	12,799	10,879	L 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 R Wild	0.79	CMRE
COLR	Lewis River Fall	5,791	4,922	Lewis R. Wild	0.79	CMRE
WAC	Quillayute Fall	3,000	2,550	NA		NA
WAC	Queets Spr/Sum	700	595	NA		NA
WAC	Queets Fall	3,000	2,550	Queets Fall Fing.	0.74	CMRE
WAC	Hoh Spr/Sum	900	765	NA		NA
WAC	Hoh Fall	1,200	1,020	NA		NA
ORC	Nehalem	6,989	5,941	Salmon River	0.69	NA
ORC	Siletz	2,944	2,502	Salmon River	0.81	NA
ORC	Siuslaw	12,925	10,986	Salmon River	0.61	NA

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

[2] 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 24 stocks for 2011 data shows that the majority were in the safe zone (Figure 3.2.2). No stocks were in the high risk zone; however, three stocks (Situk, Nicola, and Cowichan) were in the low escapement and low exploitation zone. Two stocks (Deschutes Falls and Columbia Upriver brights) experienced high exploitation, but their escapements exceeded escapement goal objectives. When stock status was examined by region there was not a strong regional pattern, other than for Washington Coast.

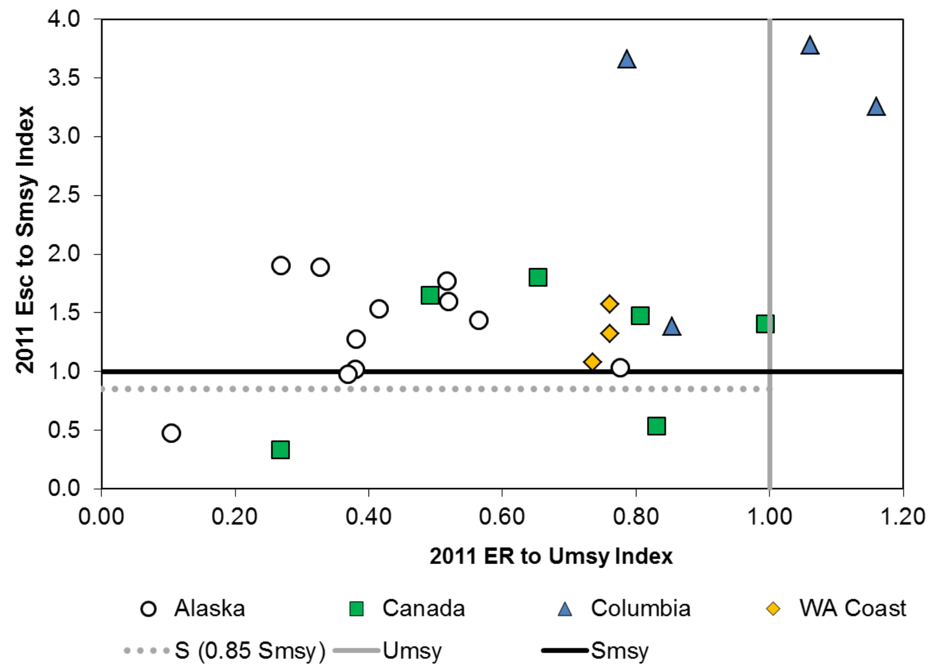


Figure 3.2.2. –A synoptic summary by region of stock status for stocks with escapement and exploitation rate data in 2011.

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

3.3 Regional Trends and Profiles

3.3.1 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 with 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 3.3.1.1; ADF&G 2013). This pattern indicates that productivity was consistently lower than would be expected given the density-dependent effect of abundance of spawning adults since brood year 2001. 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 run abundances during 2007 through to the present when all age classes would have been affected by a decline in productivity. For more than half of the stocks included in Figure 3.3.1.1, recent measures of productivity 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 3.3.1.2; ADF&G

2013). 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.

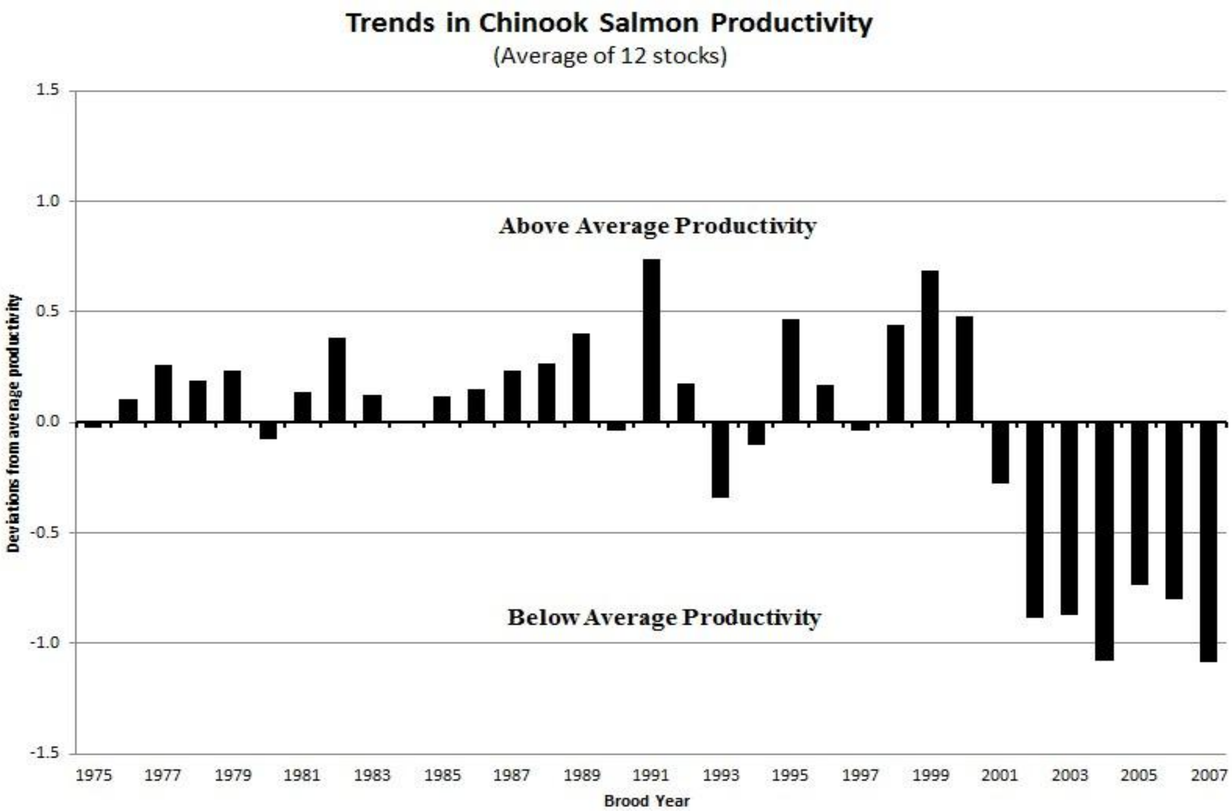


Figure 3.3.1.1. –Average of standardized deviations from average productivity for 12 stocks of Chinook salmon in Alaska (the Kuskokwim, Canadian Yukon, and Nelson on the Alaska Peninsula; the Ayakulik and Karluk on Kodiak Island; the Anchor and Deshka in Cook Inlet; and the Situk, Alsek, Taku, Stikine, 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, King Salmon, Unuk, Chickamin, Blossom and Keta rivers and Andrews Creek 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 Alaskan stocks of Chinook salmon.

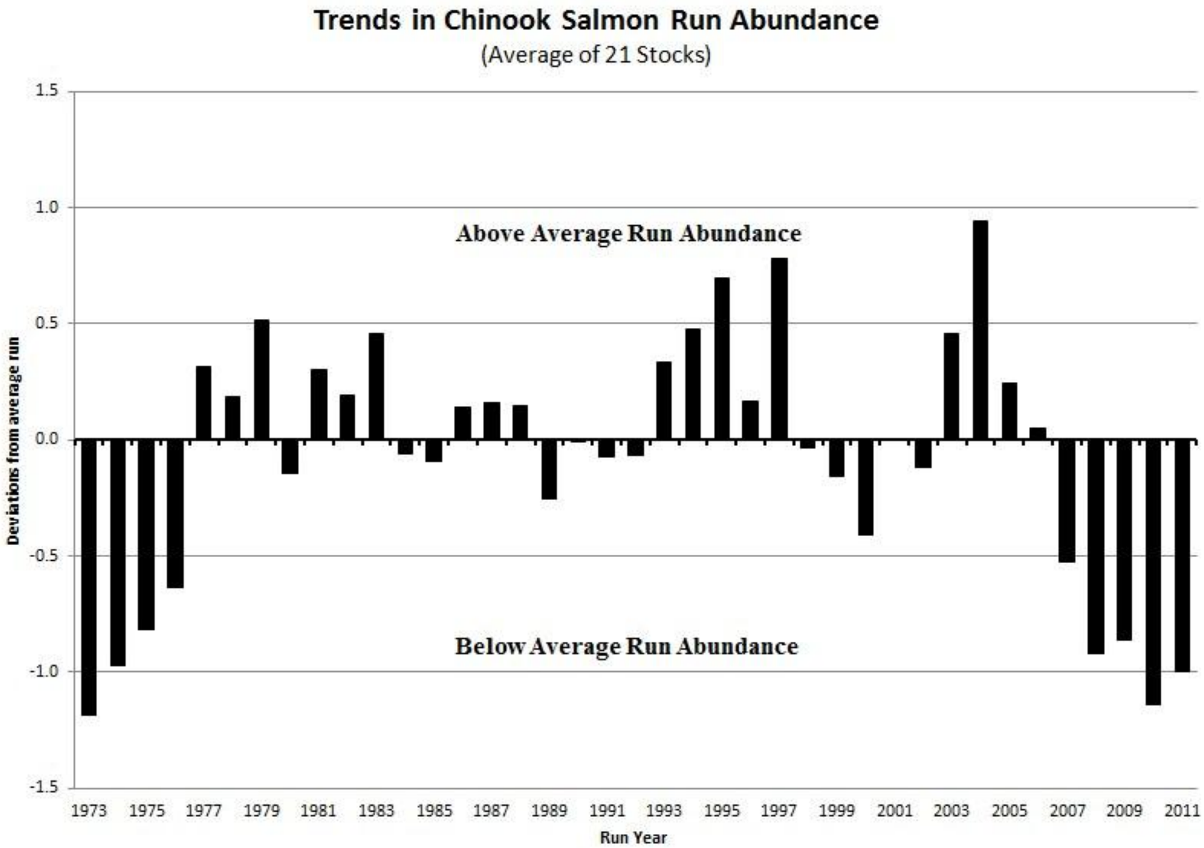


Figure 3.3.1.2. –Average of standardized deviations from average run abundance for 21 stocks of Chinook salmon in Alaska (the Unalakleet, Nushagak, Goodnews and Kuskokwim in western Alaska; the Chena and Salcha on the Yukon River; the Canadian Yukon, the Chignik and Nelson on the Alaska Peninsula; the 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).

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

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 seven years. Over the past decade, these two stocks demonstrate the poorest performance in meeting escapement goals of all 11 SEAK TBR stocks, yet harvest rates exerted in recent years were very low, and among the lowest for all 11 SEAK/TBR stocks. Mature-run equivalent 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 for the Situk River stock were about 10%; rates exerted on the Alsek River stock have never approached 50% of the U_{msy} rate; Figure 3.3.1.1.1 and

Figure 3.3.1.1.2. The poor runs and escapement performance result from decreased productivity and mirror the very low productivity of other Alaskan 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.

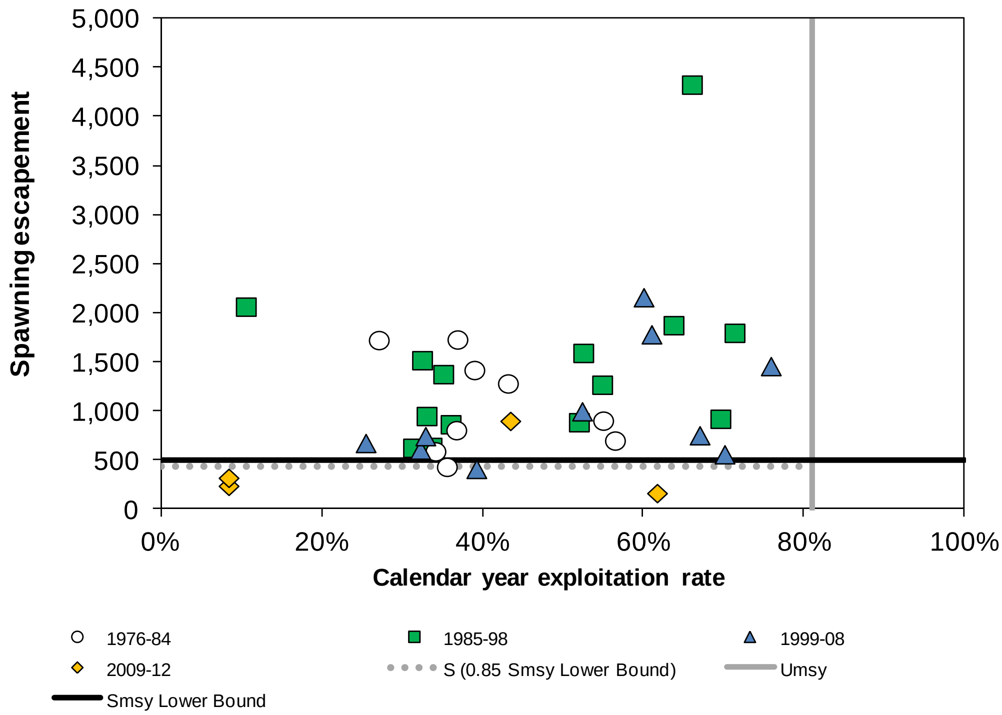


Figure 3.3.1.1.1.–Calendar year exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Situk River stock of Chinook salmon, 1976–2012.

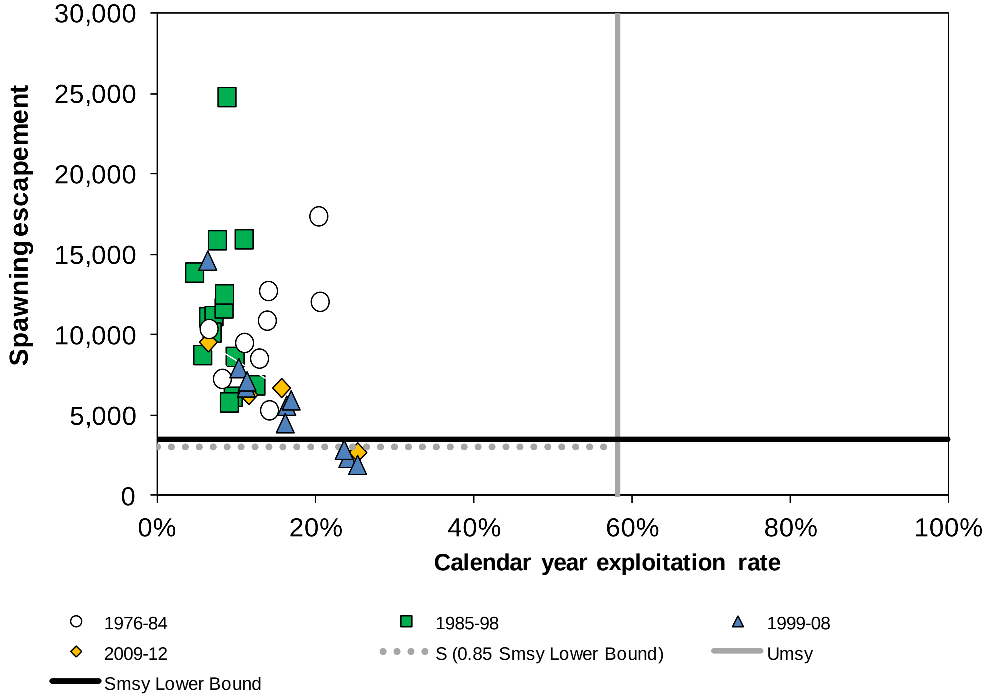


Figure 3.3.1.1.2.–Calendar year exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Alsek River stock of Chinook salmon, 1976–2012.

Even with very restrictive management measures, escapement goals for the Situk and Alsek river stocks may not be achieved in future years until survival improves leading to increased productivity and run abundances.

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. Pre-season forecasts are developed for both the Taku and Stikine river stocks and directed fisheries are based on these forecasts and in-season run assessments and projections. Pre-season forecasts for the last few years have been higher than actual run abundance due to reduced productivity. In-season assessments have been used in both the U.S. and Canada to manage fishing. As a result, escapement goals have been achieved for both stocks in five of the six years since 2007 when poor productivity resulted in reduced runs.

For both the Taku and Stikine River stocks of Chinook salmon, new directed fisheries were implemented in years identified with surplus production beginning in 2005. 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 shortly after leaving each river as smolt, leave SEAK to rear in the Gulf of Alaska and Bering Sea and are not available for harvest in SEAK as rearing fish. Mature-run equivalent exploitation rates are not presented for these two stocks as the CWT marked fractions for both stocks are too low, typically less than 2%, producing inaccurate measures of harvest when using CWTs alone.

Prior to 2005, commercial fishing for these two stocks in the terminal area was closed or severely restricted since 1976. By default, harvests were germane to 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. CY exploitation rates since 1999 for the Taku stock have been low, averaging 22%, less than one-half of the threshold reference value (Figure 3.3.1.1.3). From 1975 to 2012, exploitation rates not approached or exceeded the threshold reference value. Annual exploitation rates for the Stikine River stock since 1999 have also been low, averaging 32% (Figure 3.3.1.1.4), below the threshold reference value of 42%.

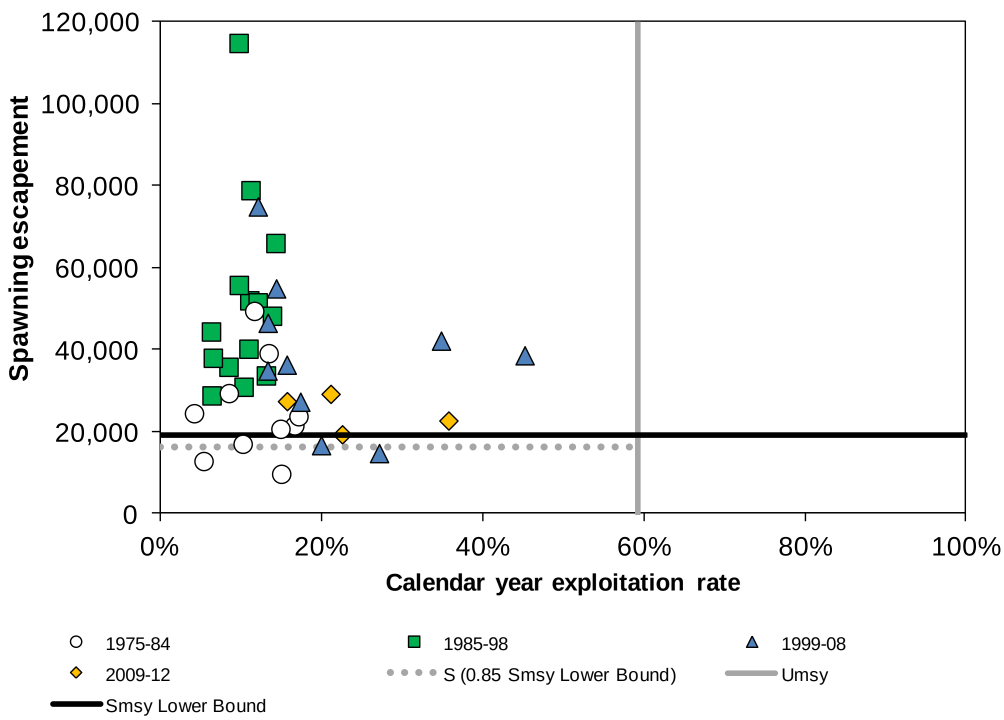


Figure 3.3.1.1.3.–Calendar year exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Taku River stock of Chinook salmon, 1975–2012.

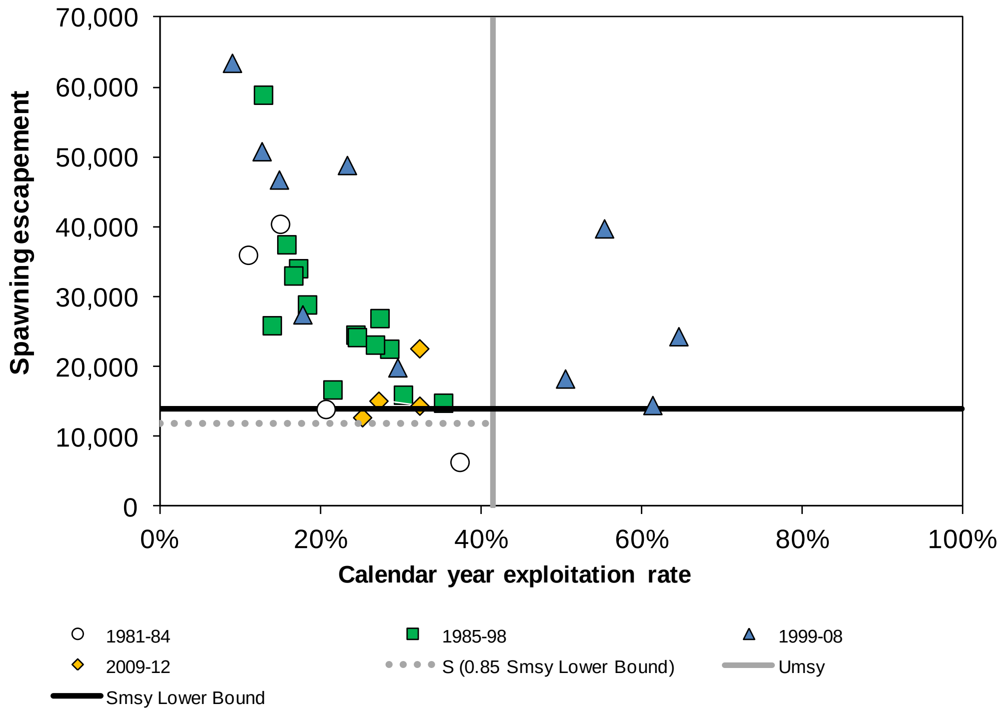


Figure 3.3.1.1.4.–Calendar year exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Stikine River stock of Chinook salmon, 1981–2012.

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 (that are 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 1991 brood year. The data suggest that freshwater survival has been variable with no apparent trend from year to year; 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 3.3.1.1.5).

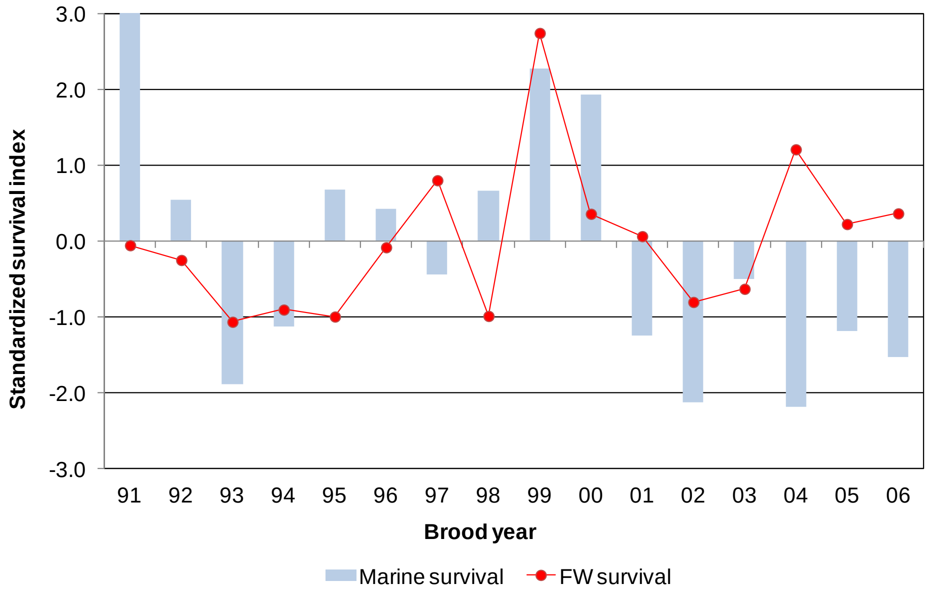


Figure 3.3.1.1.5.–Freshwater and marine survival indices (standardized to a mean of zero) for the Taku River stock of Chinook salmon, 1991–2006 brood years.

Smolt abundance and survival has 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 2002 brood year, it has been near average or well below average. At the same time, marine survival has been very low over the 2001 to 2006 brood years (Figure 3.3.1.1.6).

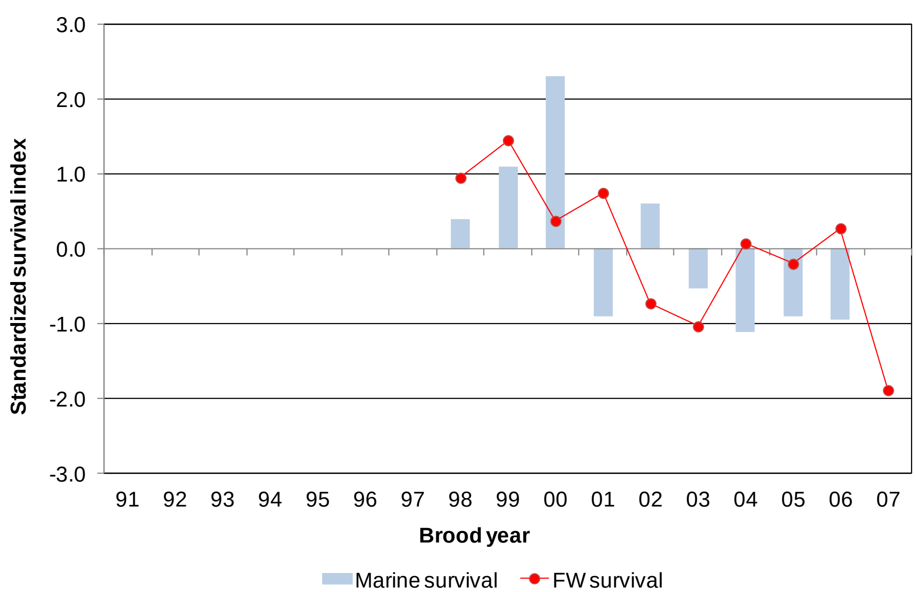


Figure 3.3.1.1.6.–Freshwater and marine survival indices (standardized to a mean of zero) for the Stikine River stock of Chinook salmon, 1998–2007 brood years.

3.3.1.2 *Chilkat and King Salmon Rivers and Andrew Creek Chinook Salmon Stock Status: Inside Rearing (Northern and Central SEAK)*

The Chilkat River, Andrew Creek, and King Salmon River stocks return to northern and central portions of SEAK and are inside rearing stocks. Both the Chilkat River and Andrew Creek stocks have failed to achieve escapement goals in two of the past six years and escapements for both have been decreasing over the last decade. The King Salmon River stock failed to achieve the escapement goal once in the last six years and escapements have been relatively stable over the last decade. 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. Andrew Creek is the farthest downstream tributary of the Stikine River and management measures used to conserve Stikine River origin Chinook salmon during their spawning migration directly influence escapement patterns for the Andrew Creek stock. The King Salmon River is located on Admiralty Island and is the only documented island stock of Chinook salmon in SEAK. There are no directed fisheries that target the stock of King Salmon River Chinook salmon.

A successful CWT program is in place to estimate harvest for the Chilkat River stock of Chinook salmon. Mature-run equivalent exploitation rates from 2003 to 2011 on the Chilkat River stock of Chinook salmon have not exceeded the threshold reference value and have been on average about one-third of the threshold reference value (Figure 3.3.1.2.1). Undoubtedly some Chilkat River Chinook salmon are caught while rearing in SEAK but most harvest is presumed to be on mature fish and this is supported by CWT recovery information. In general, exploitation rates on the Chilkat River stock of Chinook salmon are some of the lowest seen by the CTC with a recent 10-year average exploitation rate of a mere 15%.

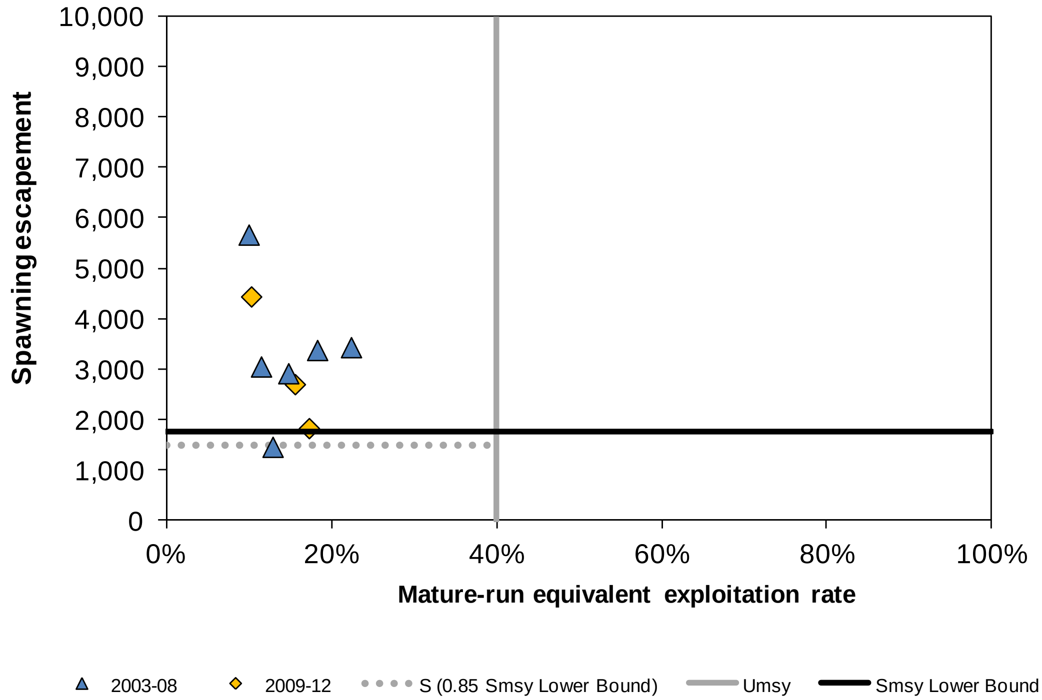


Figure 3.3.1.2.1.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Chilkat River stock of Chinook salmon, 2003–2011.

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 below average with the exception of the 2006 brood year which, like the Unuk River stock, had the best freshwater survival on record. Marine survival was above average for brood years 1998 to 2001 and about average for the more recent broods (Figure 3.3.1.2.2).

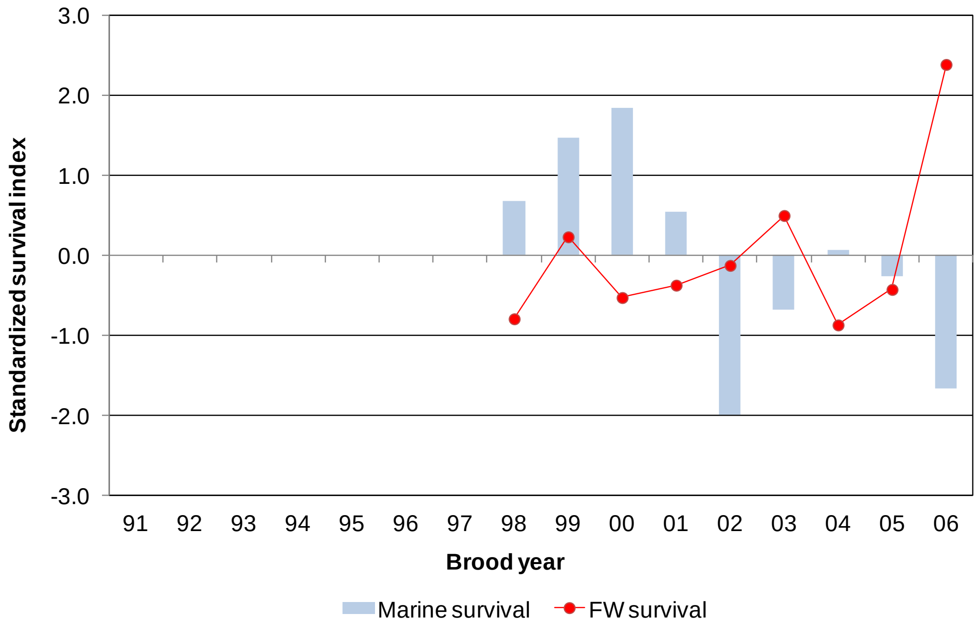


Figure 3.3.1.2.2.–Freshwater and marine survival indices (standardized to a mean of zero) for the Chilkat River stock of Chinook salmon, 1998–2006 brood years.

There is no CWT program in place to estimate harvest for the King Salmon River stock of Chinook salmon; therefore, mature-run equivalent exploitation rates from the nearby Crystal Lake hatchery, minus any terminal harvests, are used as surrogate values. Crystal Lake Hatchery uses Andrews Creek as a brood source, and like the King Salmon River stock, both stocks are inside rearing, centrally located, and are available to harvest as rearing and mature fish in SEAK. Since 1985, exploitation rates have not exceeded and only closely approached the threshold reference line in one year (1988) and have averaged a little over one-half the threshold reference line (Figure 3.3.1.2.3). Variations in survival that influence productivity are the primary influence on annual run abundance for this island stock of Chinook salmon. Harvest is incidental and management actions that can be taken to positively or negatively influence the exploitation rate on these fish are almost non-existent.

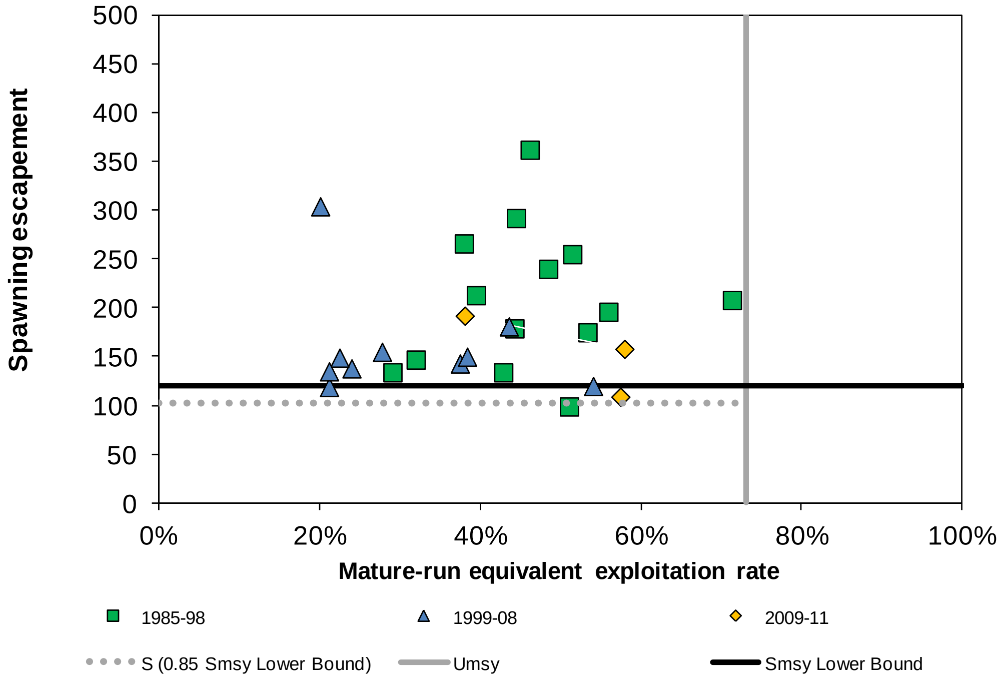


Figure 3.3.1.2.3.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the King Salmon River stock of Chinook salmon, 1985–2011.

There is no CWT program in place to estimate harvest for the Andrews Creek stock of Chinook salmon; therefore, mature-run equivalent exploitation rates from the nearby Crystal Lake hatchery, which uses Andrews Creek as a brood source, are used as surrogate values. Any terminal hatchery harvests were not included in the calculations.

Cumulative mature-run equivalent exploitation rates from the nearby Crystal Lake hatchery are used as surrogate values for the Andrew Creek stock. Since 1985, exploitation rates have only exceeded the threshold reference line in one year (1988) and have averaged about two-thirds of the threshold reference value (Figure 3.3.1.2.4). Variations in survival are a primary influence on annual run abundance. Some Andrew Creek Chinook salmon are caught while rearing in SEAK. Mature fish are subject to harvest as bycatch in terminal fisheries in District 8 when run abundance of Stikine-origin Chinook salmon is large enough to allow directed fisheries to occur. Lack of in-season information for the Andrew Creek stock and the fact that it is small relative to the Stikine River stock makes terminal in-season management of this stock difficult.

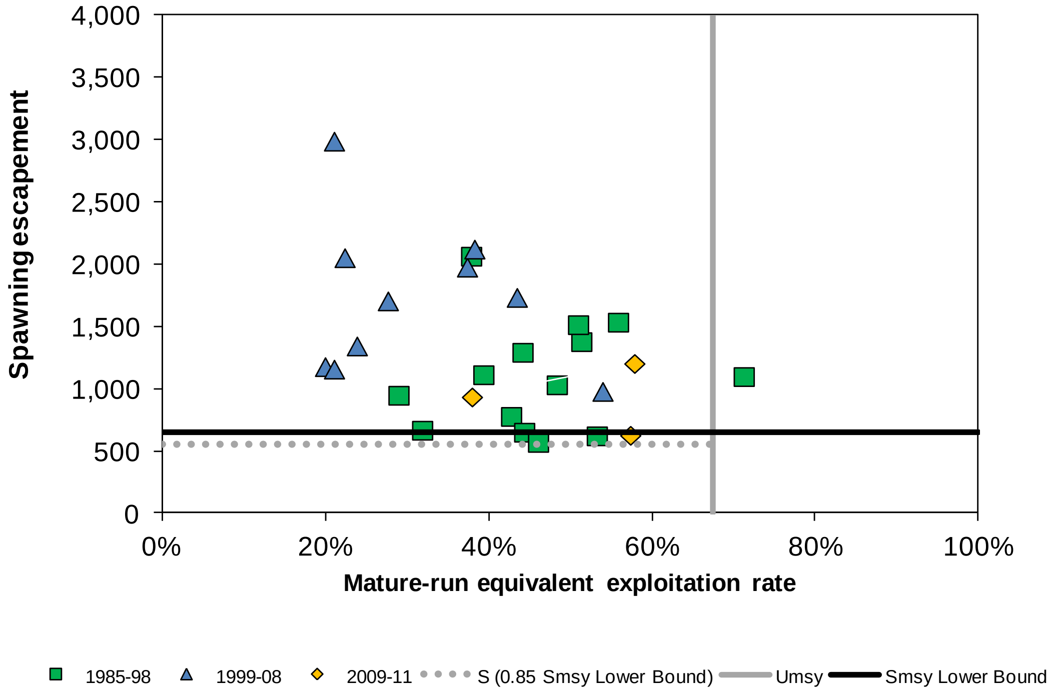


Figure 3.3.1.2.4.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Andrew Creek stock of Chinook salmon, 1985–2011.

Below average productivity has negatively affected run abundance for the Chilkat River and Andrew Creek stocks in some years, but the effects are not as widespread or as negative as have occurred with offshore rearing stocks. The King Salmon River stock has demonstrated a more stable productivity regime, perhaps because of its spawning location in a very remote portion of an offshore island. Annual harvest rates have exceeded the threshold reference value only one time, for the Andrew Creek stock in 1988. Continued low harvest rates will be needed as productivity varies, particularly for the Chilkat River and Andrew Creek stocks of Chinook salmon to better ensure achievement of escapement goals.

3.3.1.3 *Unuk, Chickamin, Blossom, and Keta Rivers Chinook Salmon Stock Status: Inside Rearing (Southern SEAK)*

The Unuk, Chickamin, Blossom, and Keta rivers stocks of Chinook salmon all spawn in and around Behm Canal in southern SEAK and are all inside rearing stocks. Escapement trends for these stocks have been decreasing over the last six years. Since 2007, the Keta River stock has achieved its goal annually; however, the Unuk River and Chickamin River stocks each missed their escapement goals in 2012. The Blossom stock has only achieved its goal in three of the last six years and has fluctuated around the lower end of the goal range during this time. Fishing is closed for Chinook salmon in all of these rivers; furthermore, fishing is closed in most of Behm Canal. Southern SEAK stocks are harvested at relatively low rates while rearing and maturing and they are not harvested at all 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.

Unique to this group of fish is their large size at age. The Unuk River stock of Chinook salmon are similar in size at age to other northern SEAK stocks; however, the Chickamin, Blossom, and Keta river stocks of Chinook salmon are substantially larger in size at age and include some of the largest Chinook salmon in the world. Moreover, the majority of ocean-age-2 Chinook salmon from the Chickamin, Blossom and Keta rivers are available to harvest in the sport and troll fisheries, exceeding on average the 28 inch legal length criteria for harvest. The increased contribution of these fish to the catch due to fast growth rates is another reason for the higher exploitation rates (2002–2011 average = 31%) than measured in the nearby Unuk River stock (2002–2011 average = 25%).

A very successful CWT program is in place to estimate harvest for the Unuk River stock of Chinook salmon. 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. Abundance of the 2012 Unuk River stock was low and preliminary information suggests the exploitation rate was the highest on record (Figure 3.3.1.3.1). Exploitation rates on this stock have averaged about one-half the threshold reference value. However, in 2012 the escapement goal was not met for the first time on record and if the exploitation rate was excessive in 2012 as suggested by preliminary information, this certainly contributed to the poor escapement and additional domestic management measures may be necessary if this pattern continues.

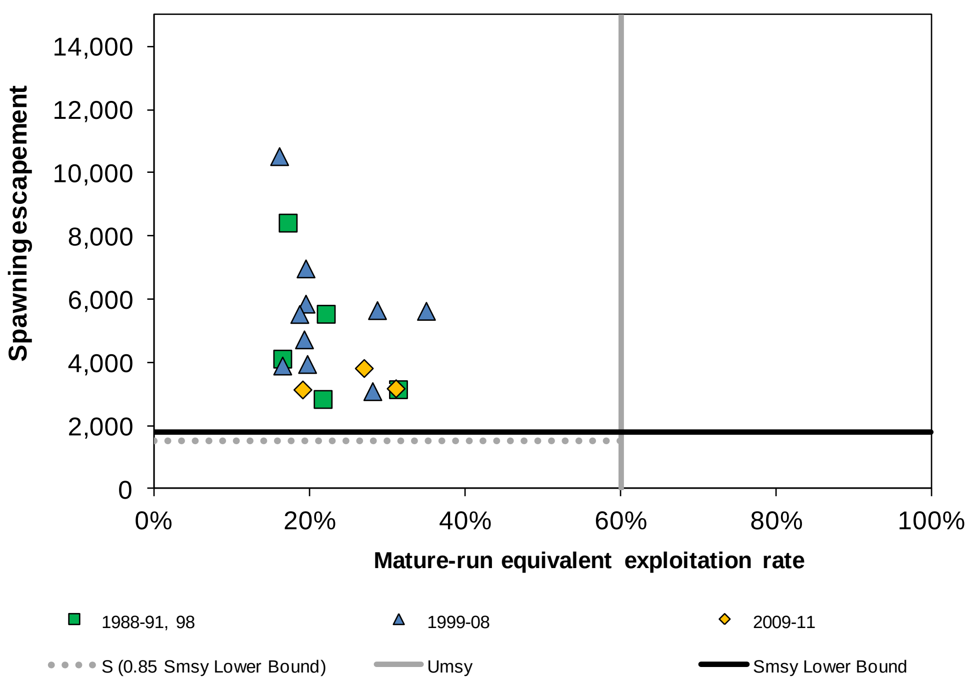


Figure 3.3.1.3.1.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Unuk River stock of Chinook salmon, 1988–1991 and 1998–2011.

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 seen 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 3.3.1.3.2).

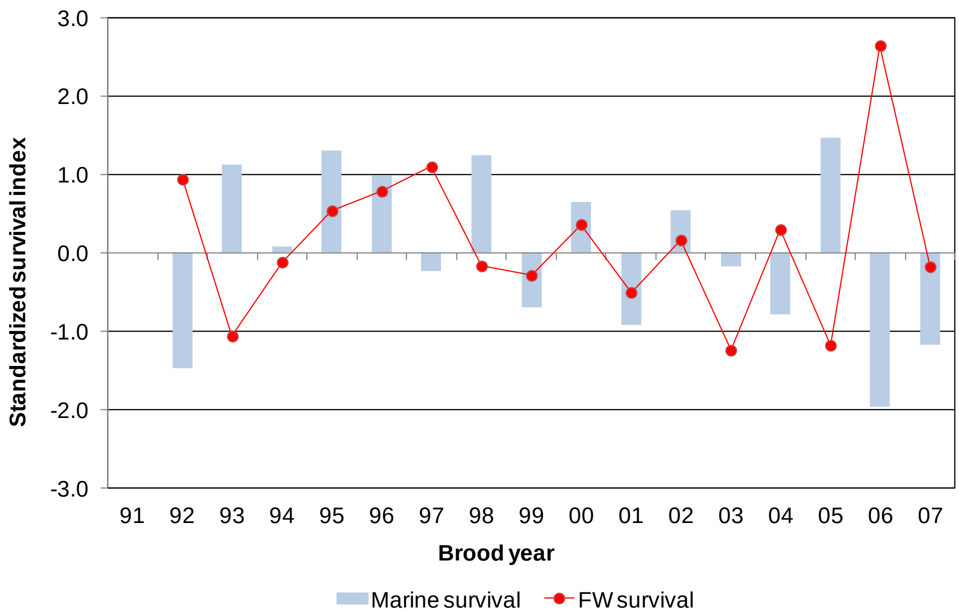


Figure 3.3.1.3.2.–Freshwater and marine survival indices (standardized to a mean of zero) for the Unuk River stock of Chinook salmon, 1992–2007 brood years.

There are no CWT programs in place to estimate harvests in the Chickamin, Blossom and Keta rivers. As a result, mature-run equivalent exploitation rates from the nearby Neets Bay, Deer Mountain, and Whitman Lake hatcheries along with those seen in the Unuk River, minus any terminal hatchery harvests, are used as surrogate values. 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 3.3.1.3.3).

Since 1983, harvest rates on for the Blossom and Keta River stocks have never exceeded their threshold reference values and on average have been about two-thirds of their threshold reference values (Figure 3.3.1.3.4, Figure 3.3.1.3.5).

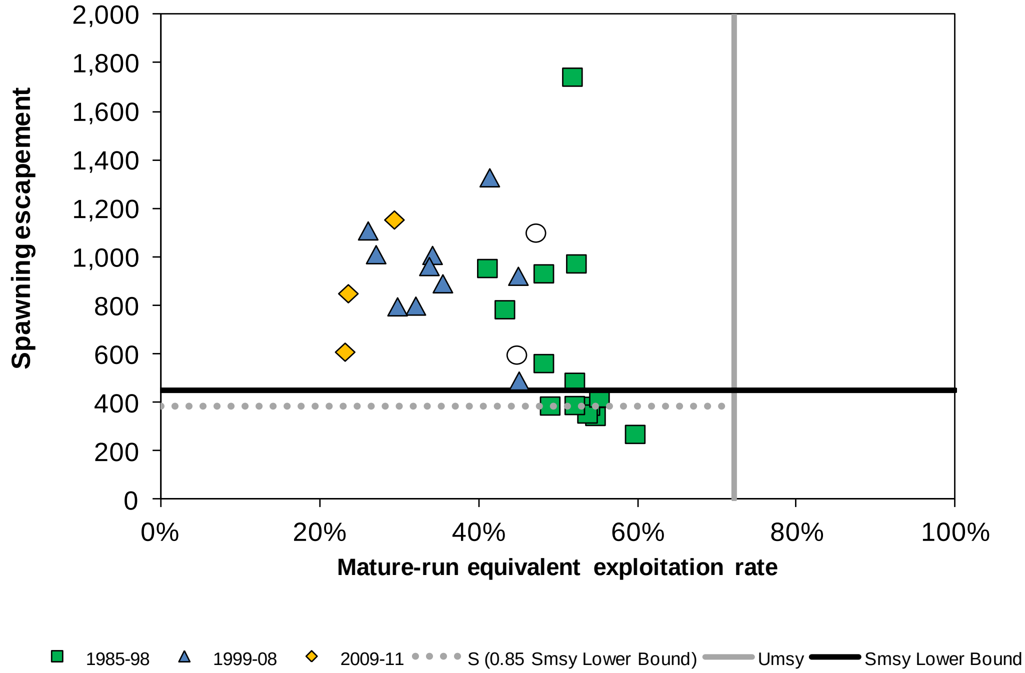


Figure 3.3.1.3.3.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Chickamin River stock of Chinook salmon, 1983–2011.

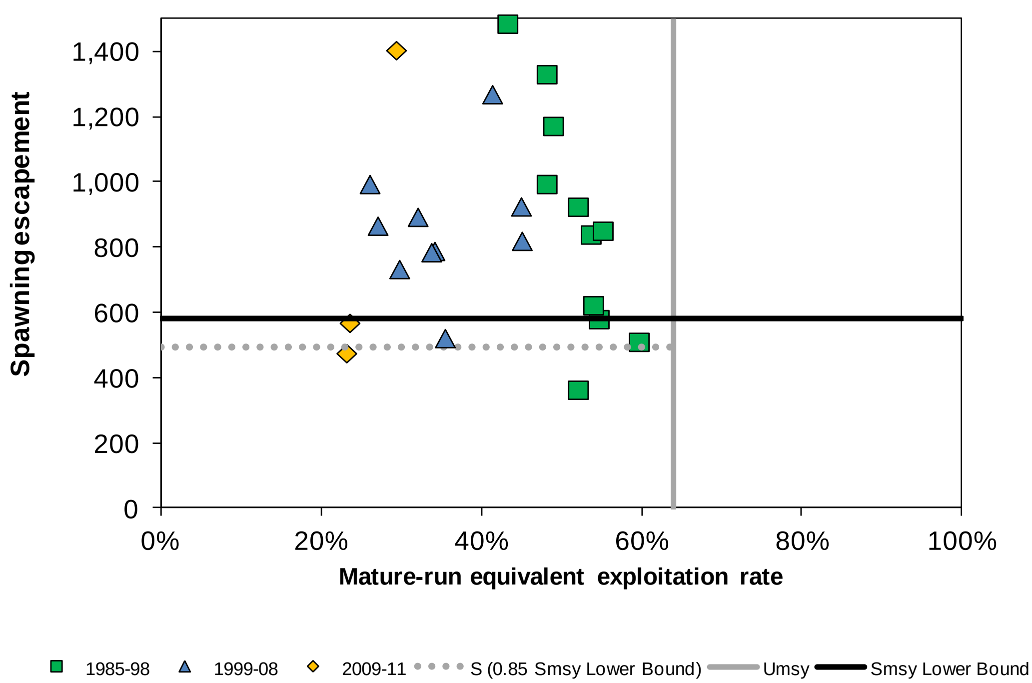


Figure 3.3.1.3.4.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Blossom River stock of Chinook salmon, 1983–2011.

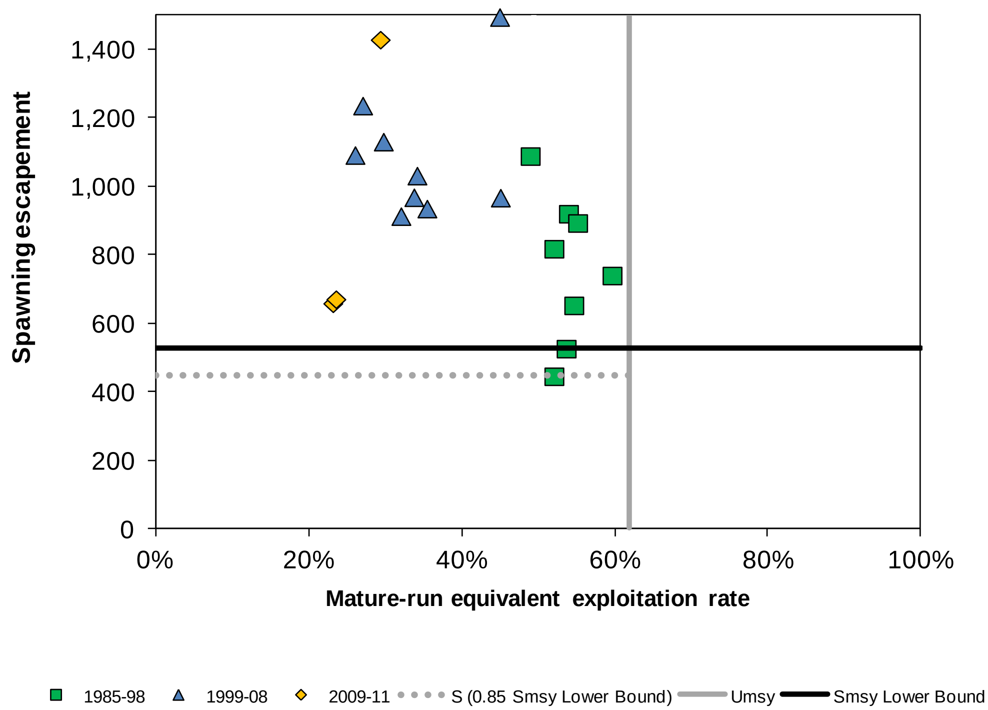


Figure 3.3.1.3.5.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Keta River stock of Chinook salmon, 1983–2011.

3.3.2 Canadian Stocks

3.3.2.1 *Northern British Columbia: Kitsumkalum River*

NBC stocks are part of the North/Central British Columbia stock group, which has the Yakoun, Nass, and Skeena escapement indicators in NBC. 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 3.3.2.1.1). The cumulative exploitation rates have been below the threshold reference line in all but one year and escapements have exceeded S_{MSY} in all but three years (Figure 3.3.2.1.2). In most years, the stock was in the safe zone.

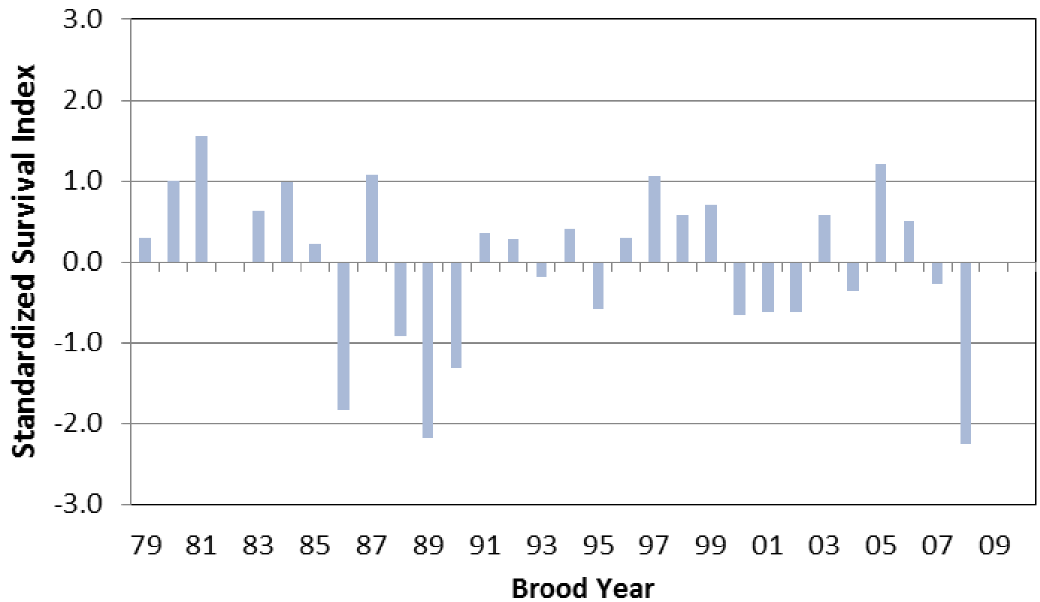


Figure 3.3.2.1.1.–Marine survival index (standardized to a mean of zero) for the Kitsumkalum River stock of Chinook salmon, 1979–2007 brood years. Brood year 1982 was not represented by CWTs, thus no datum is available.

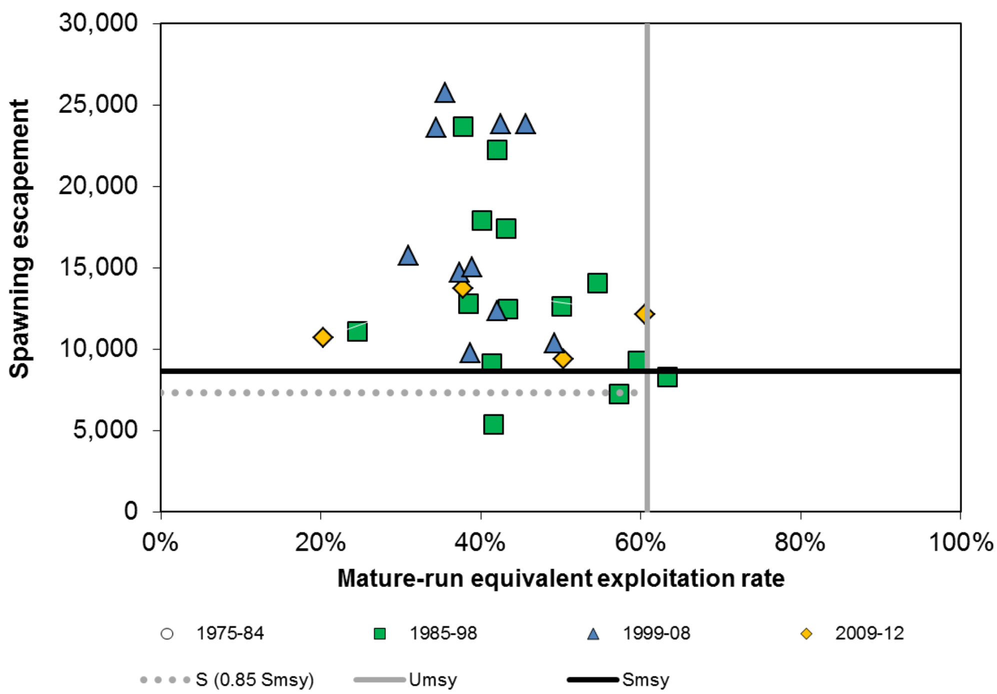


Figure 3.3.2.1.2.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Kitsumkalum River stock of Chinook salmon, 1985–2011.

3.3.2.2 *Central British Columbia: Atnarko River*

Central British Columbia stocks are part of the North/Central British Columbia stock group, which has the Dean and Atnarko river escapement indicators in Central BC. Currently, none of these stocks have CTC escapement goals. The Atnarko River is an exploitation rate indicator stock in Area 8 that has escapement estimates produced by MR and a three-method average since 1975. This stock has had a high level of enhancement (Figure 3.3.2.2.1). Hatchery contribution has averaged 34% in Atnarko escapement from 1990 to 2012 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 sub-yearling releases of previous years. Adjustments have not been made to remove hatchery fish in order to make inferences for unenhanced stocks in Central BC. A stock-recruitment relationship has not been generated for this stock yet, thus the reference lines were estimated using habitat-based methods (Parken et al. 2006). Marine survival was generally above average for brood years 1988 to 1995, and has varied around average since then (Figure 3.3.2.2.2). The cumulative exploitation rates have been below the threshold reference line and escapements have exceeded S_{MSY} in all years (Figure 3.3.2.2.3). The stock was in the safe zone in all years.

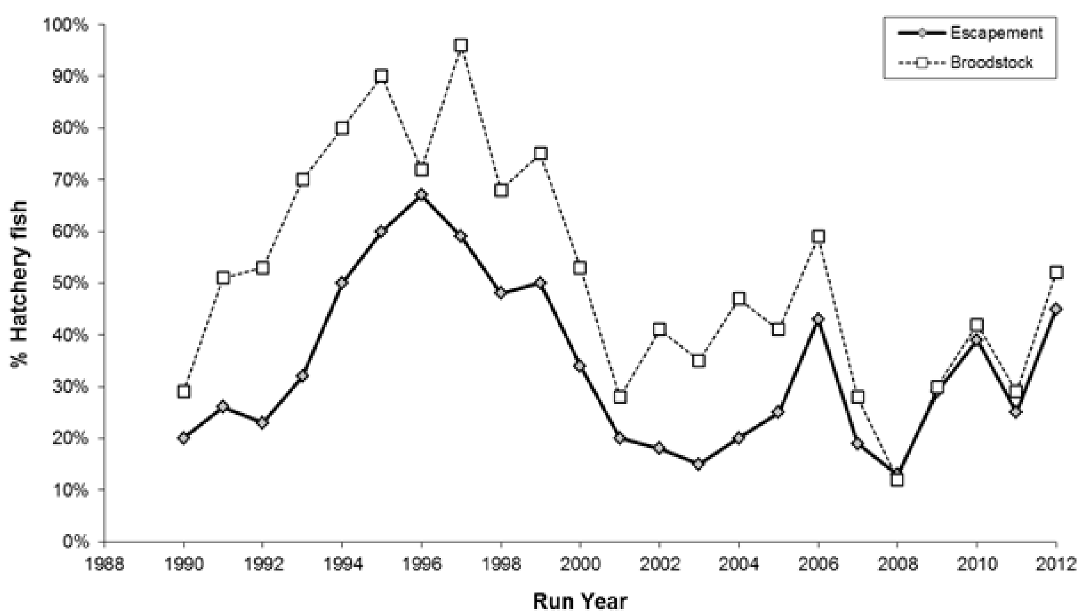


Figure 3.3.2.2.1.–The percentage of first generation hatchery origin Chinook salmon in the Atnarko River escapement and in the hatchery broodstock, 1990–2012.

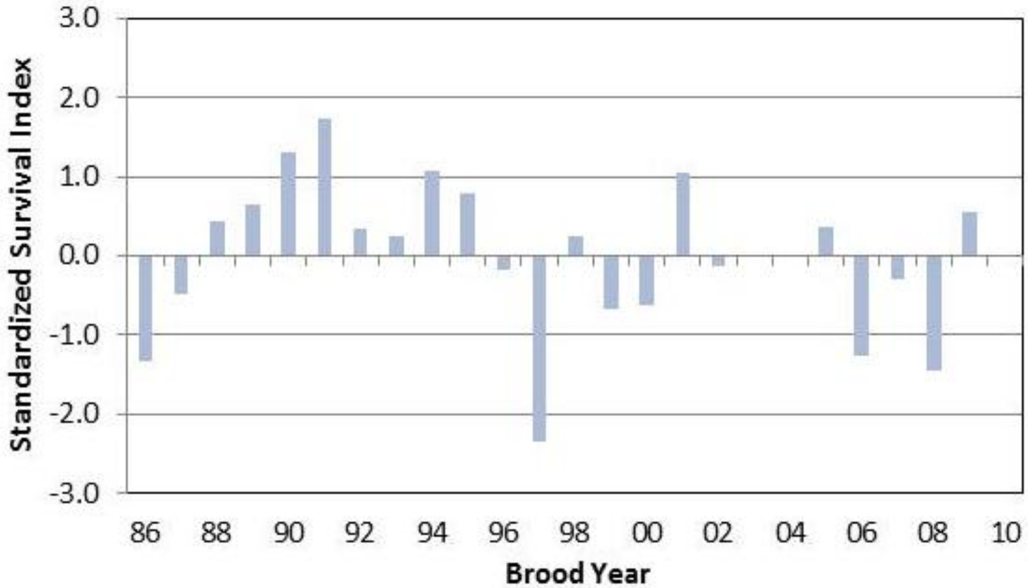


Figure 3.3.2.2.2.–Marine survival index (standardized to a mean of zero) for sub-yearling releases of the Atnarko River stock of Chinook salmon, 1986–2009 brood years. Brood years 2003 and 2004 were not represented by CWTs, thus no data are available.

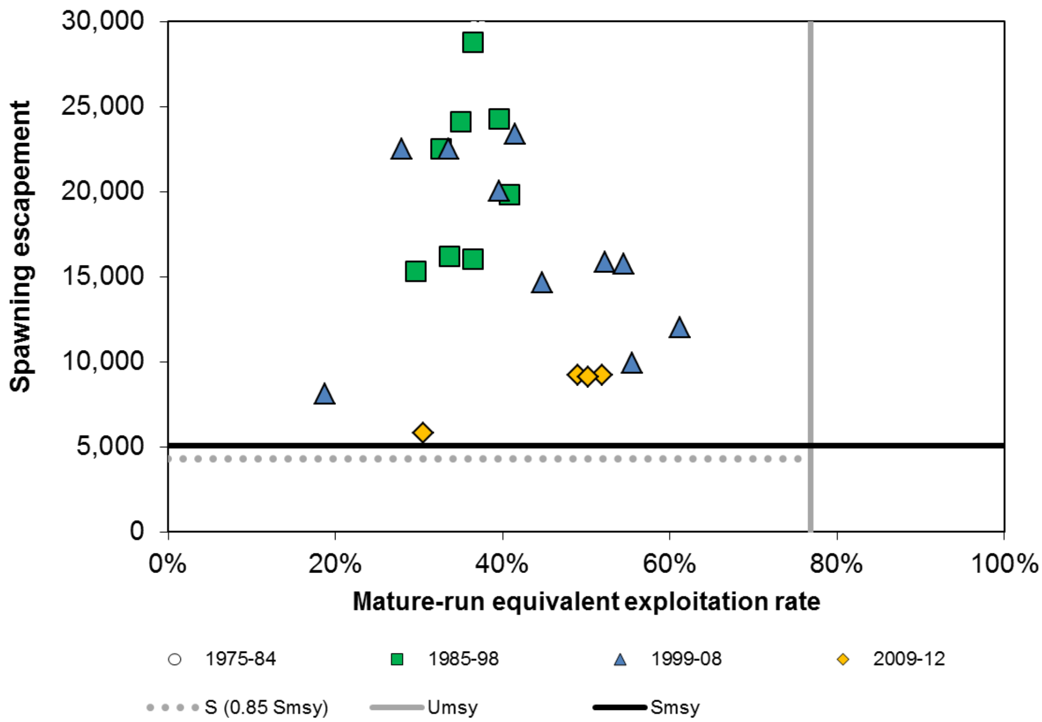


Figure 3.3.2.2.3.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Atnarko River stock of Chinook salmon, 1990–2012.

3.3.2.3 *Lower Strait of Georgia: Cowichan River*

The LGS natural stock group has the Cowichan 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 3.3.2.3.1), 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 2008, and slightly above average from 2009 to 2010 (Figure 3.3.2.3.2). The cumulative exploitation rates have been above the threshold reference line in 80% of the years and escapements have been below S_{MSY} since 1997 (Figure 3.3.2.3.3). The stock has rarely been in the safe zone of the synoptic plot, only once during the last 25 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.

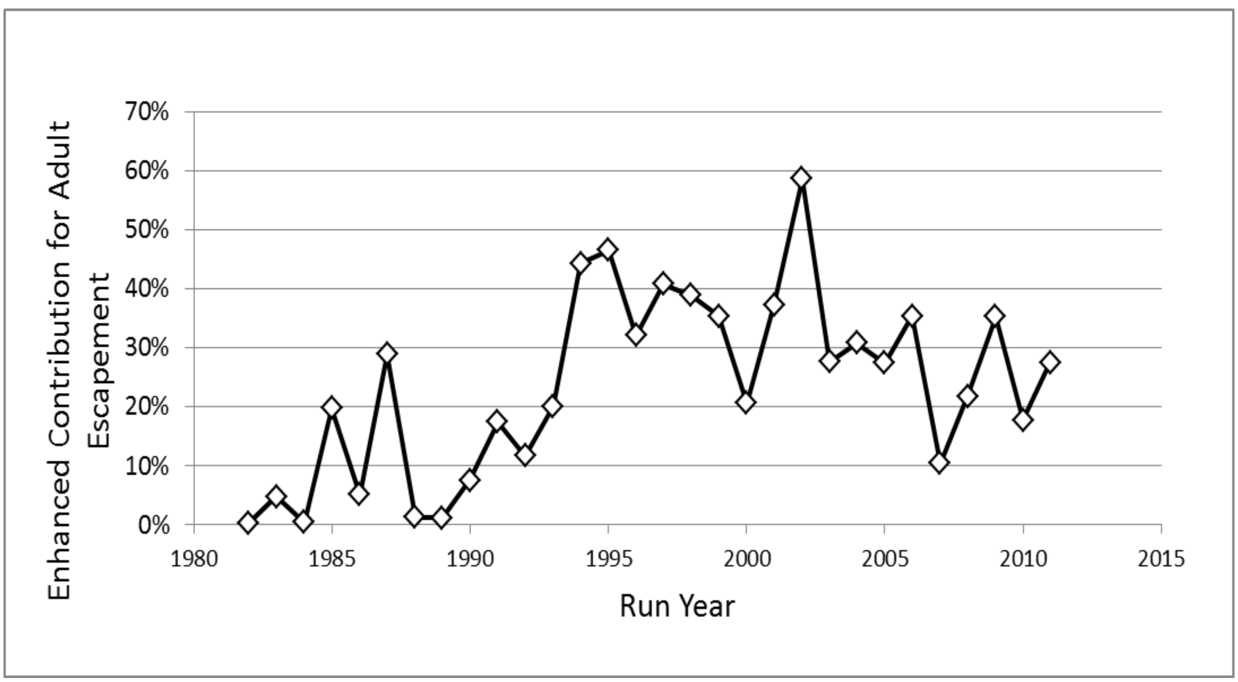


Figure 3.3.2.3.1.–The percentage of first generation hatchery origin Chinook salmon in the Cowichan River adult escapement, 1982–2011.

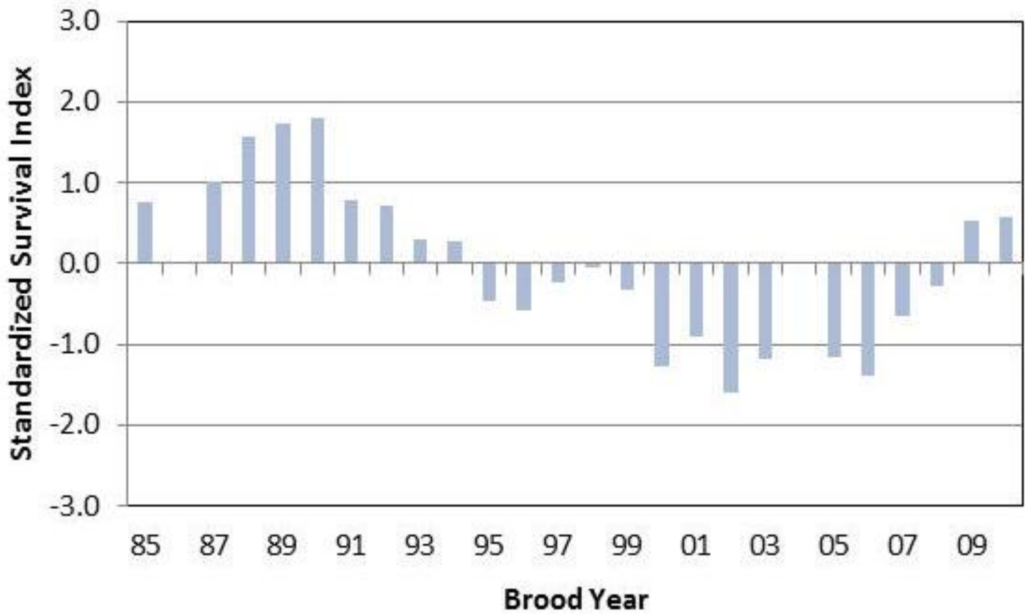


Figure 3.3.2.3.2.–Marine survival index (standardized to a mean of zero) for the Cowichan River stock of Chinook salmon, 1985–2010 brood years. Brood years 1986 and 2004 were not represented by CWTs, thus no data are available.

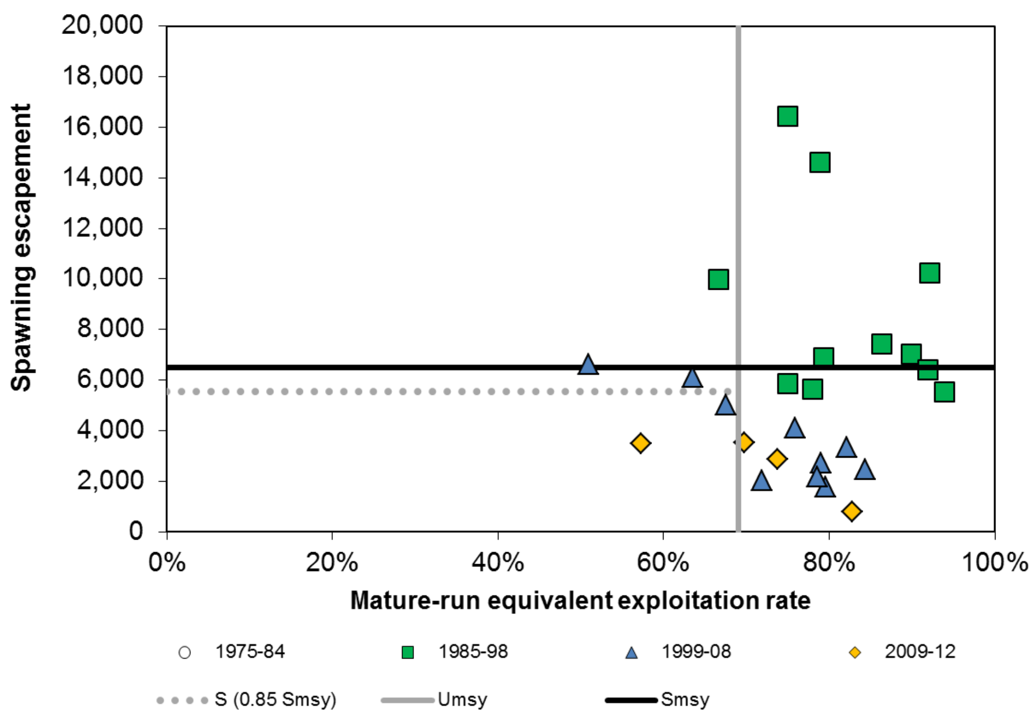


Figure 3.3.2.3.3.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Cowichan River stock of Chinook salmon, 1988–2012.

3.3.2.4 *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 .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.

3.3.2.4.1 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 29% for the 1987 to 2012 escapement and 20% over the last 12 years. The largest contribution was 60% in 1999 (Figure 3.3.2.4.1.1).

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 3.3.2.4.1.2). 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, and returned in 2007 and 2009, faired 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 3.3.2.4.1.3). 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 pre-spawn mortality in 1998 (not measured). Rebuilding will require a sustained return to more favorable survival conditions.

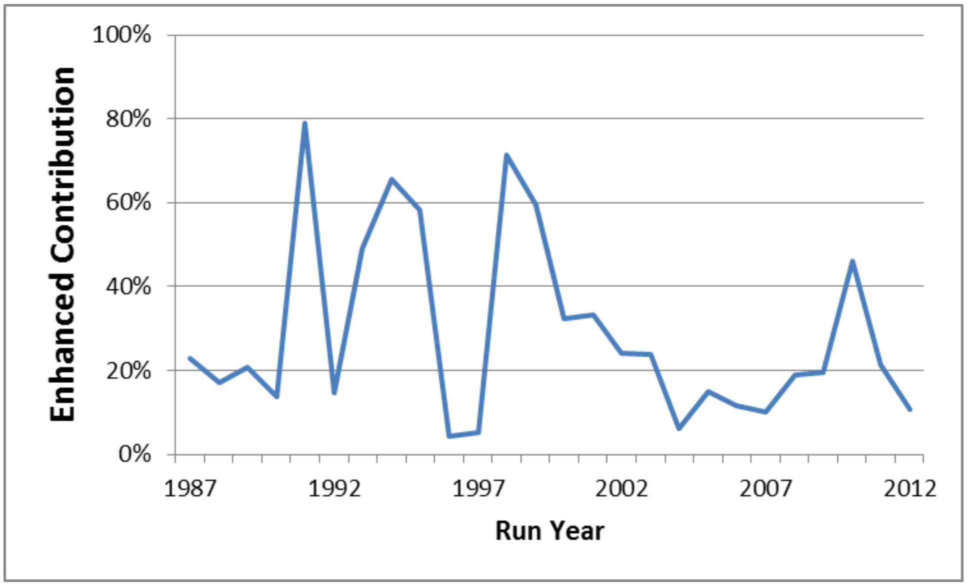


Figure 3.3.2.4.1.1.–The percentage of first generation hatchery origin Chinook salmon in the Nicola River escapement, 1987–2012.

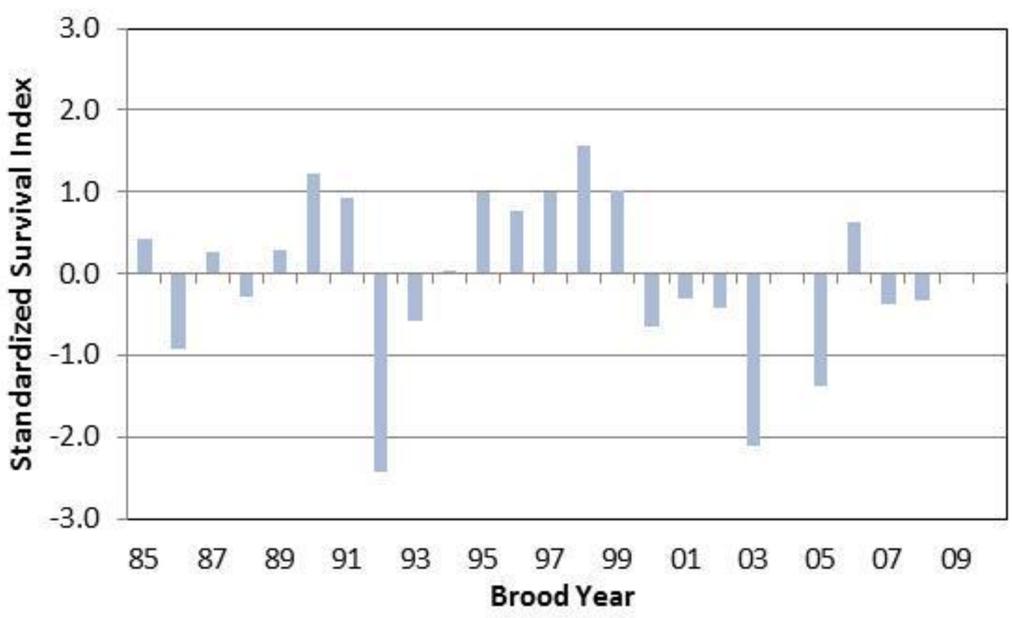


Figure 3.3.2.4.1.2.–Marine survival index (standardized to a mean of zero) for the Nicola River stock of Chinook salmon, 1985–2008 brood years.

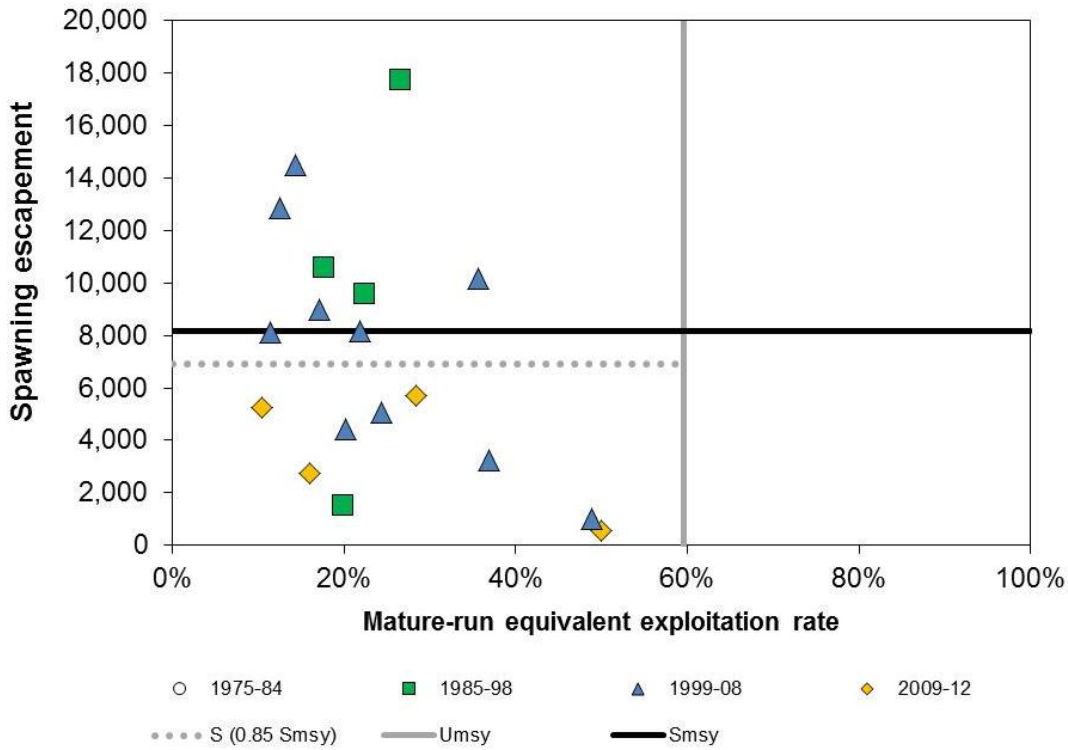


Figure 3.3.2.4.1.3..–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Nicola River stock of Chinook salmon, 1995–2012.

3.3.2.4.2 Fraser River Summer-run Age .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, and declining steeply in 2012 to about 48,000. 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 2012 (range = 1%–20%), and averaged 6% over the last 12 years. Survivals appear poor for the 2008 and 2009 brood years (both incomplete cohorts), contributing to the lower abundance in 2012 Figure 3.3.2.4.1.1). 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 3.3.2.4.1.2). Since implementation of the 2009 Agreement, three years were in the safe zone and the other year was in the low escapement and low exploitation zone.

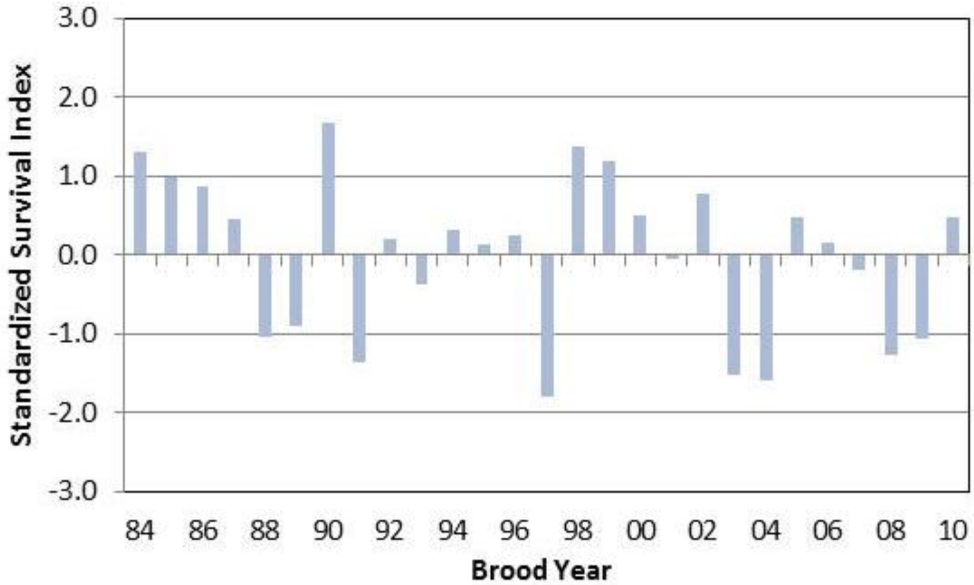


Figure 3.3.2.4.2.1.–Marine survival index (standardized to a mean of zero) for the Lower Shuswap River stock of Chinook salmon, 1984–2010 brood years.

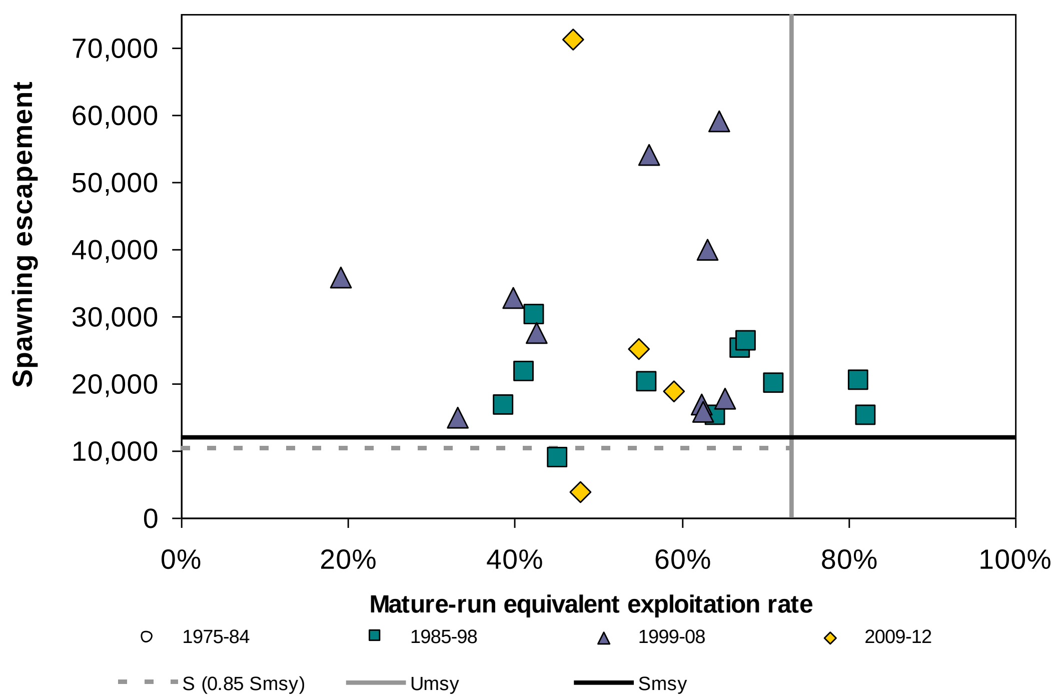


Figure 3.3.2.4.2.2.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Lower Shuswap River stock of Chinook salmon, 1989–2012.

3.3.2.5 *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. The enhanced contribution has been low at the Harrison River over the last 12 years (mean = 3.7%). With a few exceptions, survivals have been below average since the early 1990s (Figure 3.3.2.5.1), 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 3.3.2.5.2). 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.

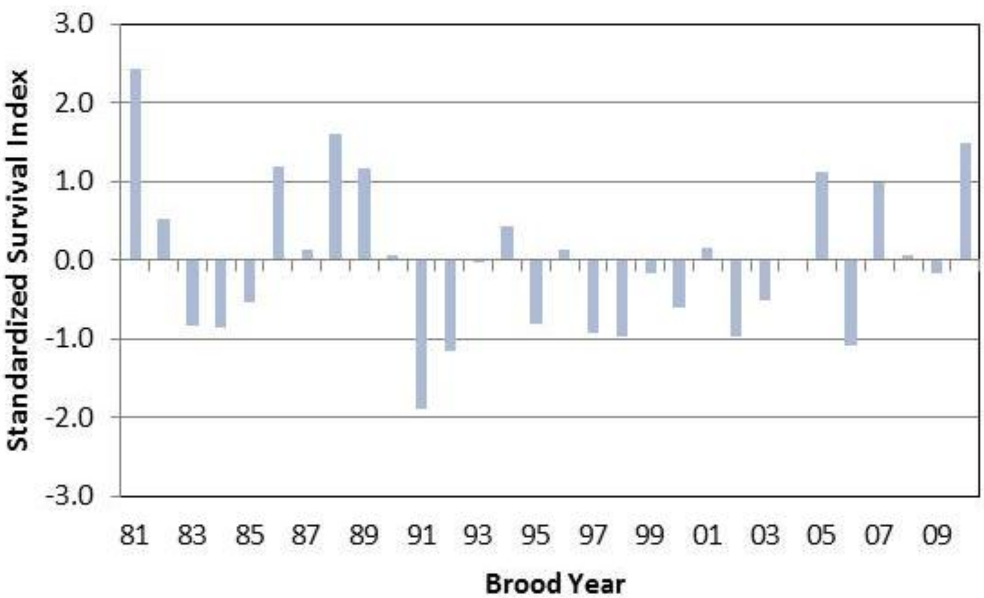


Figure 3.3.2.5.1.–Marine survival index (standardized to a mean of zero) for the Harrison River stock of Chinook salmon, 1981–2010 brood years. No data are available for brood year 2004.

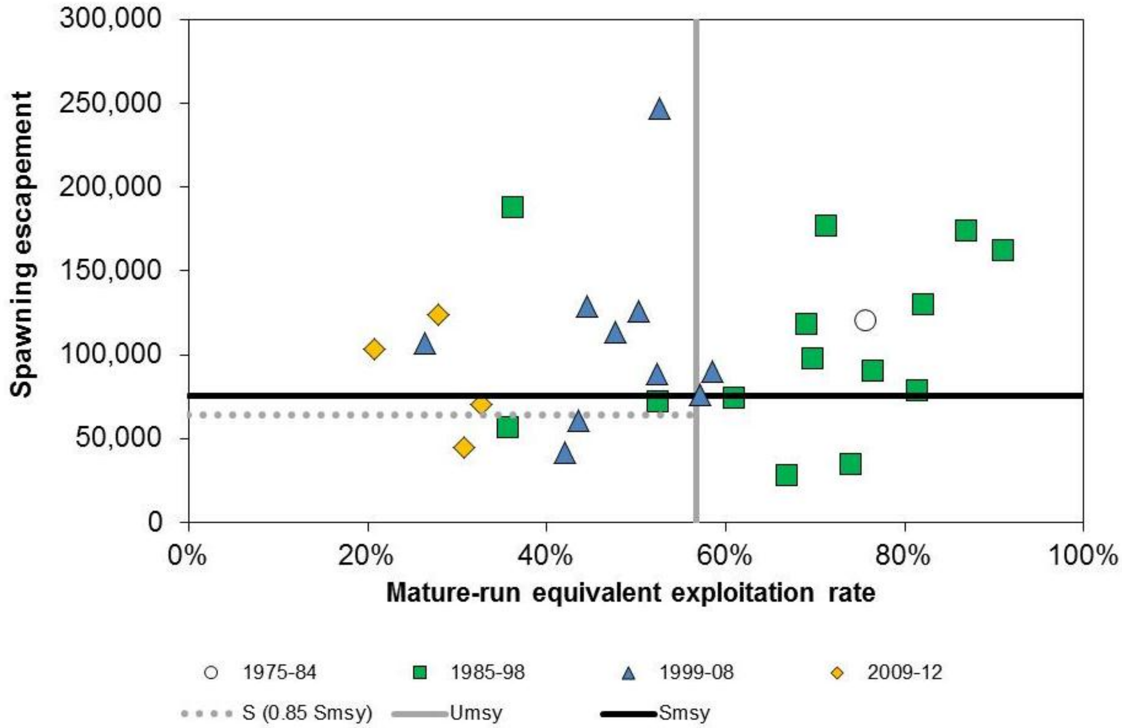


Figure 3.3.2.5.2.–Mature-run equivalent exploitation rate, spawning escapement, and threshold reference lines for exploitation rate and spawning escapement by CY for the Harrison River stock of Chinook salmon, 1984–2012.

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

3.3.3.1 *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, assessing long-term trends of natural stocks in Puget Sound can prove difficult because of the interaction of hatchery- and natural-origin production in 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 3.3.3.1.1). Since Puget Sound Chinook salmon were listed as threatened status under the U.S. 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.

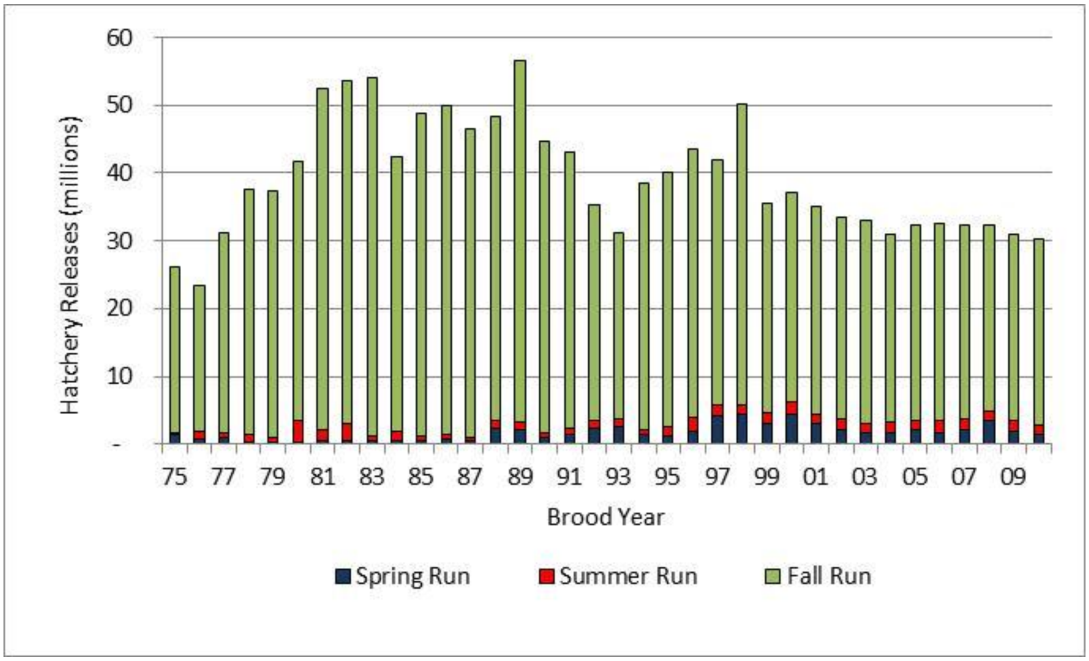


Figure 3.3.3.1.1.–Chinook salmon released from Puget Sound hatcheries, 1975–2010 brood years.

Spring run stocks in Puget Sound are both ocean-type (age-0 fingerling out-migrants) and stream-type (age-1 yearling out-migrants) life history. 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.

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 2012, 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 3.3.3.1.2). None of the Puget Sound Chinook salmon stocks have CTC-approved escapement goals. The aggregate escapement goal calculated by summing the agency upper management goals for these stocks is 27,480. This escapement was achieved in 11 years (30%) during the 1975 to 2012 time period.

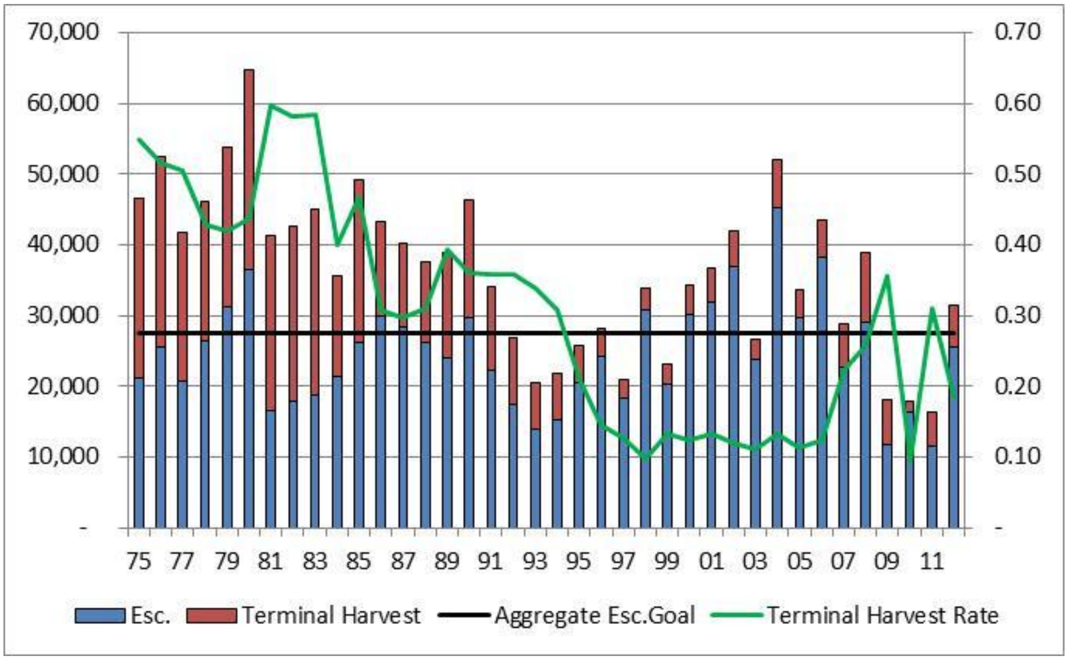


Figure 3.3.3.1.2.–Escapement, aggregate escapement goal and terminal fishery harvest for the aggregate of Puget Sound summer/fall Chinook salmon PSC escapement indicator stocks.

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. Since 1999, the terminal fishery harvest precluded meeting the aggregate escapement goal in 2008 and 2012. 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 2012 time period. Data limitations notwithstanding, it is still possible to make some generalizations about the current status of Puget Sound escapement indicators based on recent abundance trends at both the aggregate and individual population levels. Spring Chinook salmon exhibit variable trends; Nooksack River spring Chinook salmon show recent decline, whereas Skagit River spring Chinook salmon escapements have remained relatively stable. Overall, summer/fall escapements have declined notably from near-peak levels in the recent decade (Figure 3.3.3.1.3) 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 (Figure 3.3.3.1.4). Trends for summer-fall indicator stocks in the Green, Skagit, and Snohomish rivers generally mirror the aggregate pattern (i.e., recent decline), whereas Stillaguamish and Lake Washington tributary populations exhibit stable 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 early 2000s), the observation of low escapements in multiple recent years (2009–2011) for three of the biggest populations suggests a depressed state overall. It should be noted, however, that escapements generally increased in 2012, possibly indicating a period of higher abundances. Future assessments of escapement trends should attempt to separate hatchery strays from natural-origin spawners, where data permit.

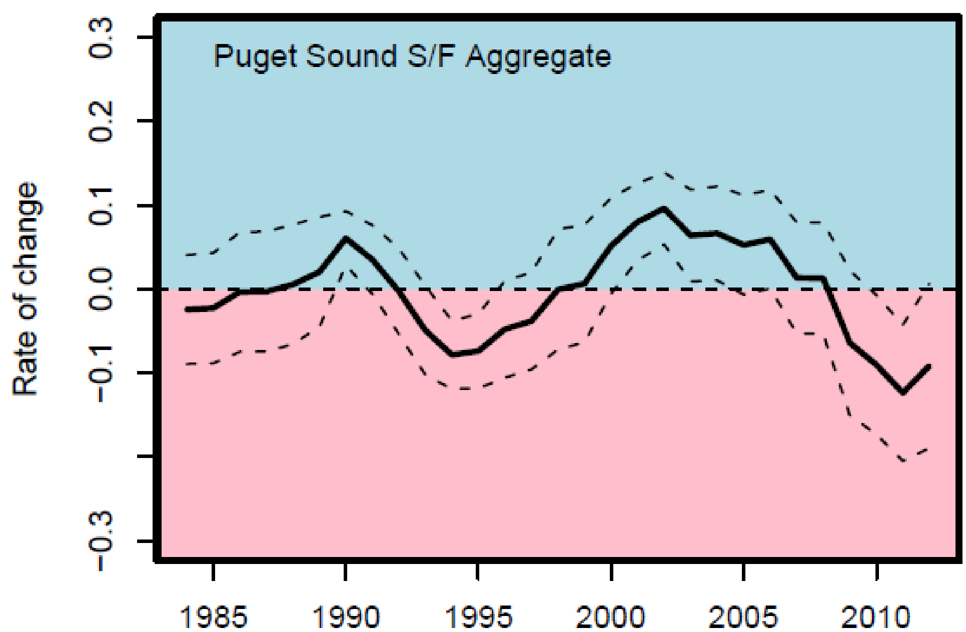


Figure 3.3.3.1.3.–Retrospective evaluations of abundance trends for the historical record of aggregate escapement for Puget Sound summer/fall Chinook salmon indicator stocks.

Note: The y-axis Rate of change is the slope from a $\log_e$(escapement) vs. year regression for the 10-year period ending in the year given on the x-axis. Solid lines denote point estimates for $\log_e$(esc.) vs. time slope parameters, whereas dashed lines denote upper and lower confidence bounds (95%) on these values. Points lying below the zero horizontal reference line indicate years preceded by recent decline, whereas those above imply recent escapement increase.

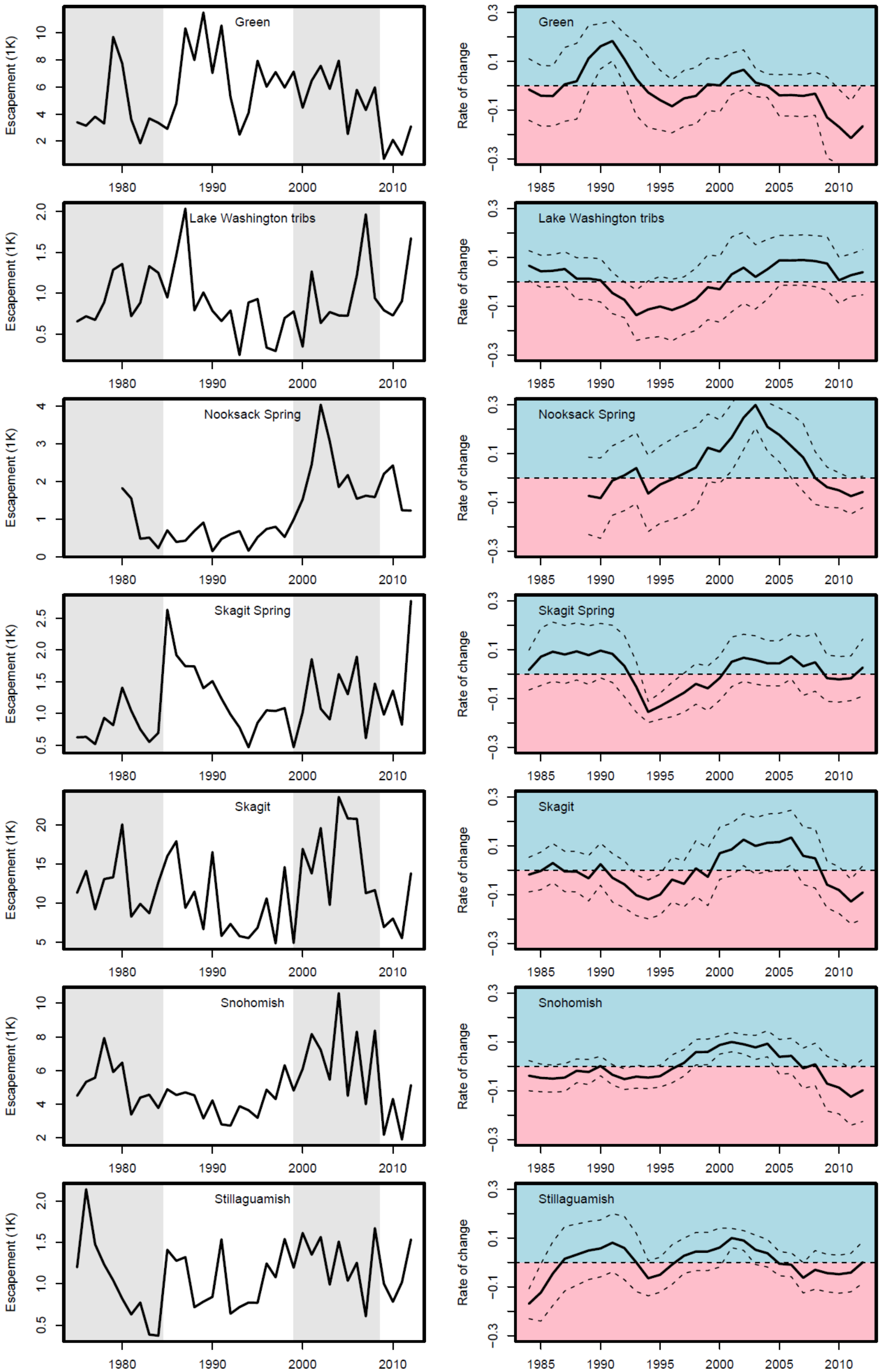

Green
Lake Washington tribs
Nooksack Spring
Skagit Spring
Skagit
Snohomish
Stillaguamish
Escapement (1K)
Rate of change
1980
1990
2000
2010
1985
1995
2005

Figure 3.3.3.1.4.–(Previous Page) Escapement time series plots (left column) and retrospective evaluations of abundance trends for the historical record of escapements (right column) for Puget Sound Chinook salmon indicator stocks.

Note: n left column figures, the alternating gray shaded areas denote periods corresponding to pre-treaty (<1985) and post-treaty agreement periods (1985–1999, 1999–2008, 2009+). In the right column figures, the y-axis Rate of change is the slope from a log_e(escapement) vs. year regression for the ten-year period ending in the year given on the x-axis. Solid lines denote point estimates for log_e(esc.) vs. time slope parameters, whereas dashed lines denote upper and lower confidence bounds (95%) on these values. Points lying below the zero horizontal reference line indicate years preceded by recent decline, whereas those above imply recent escapement increase. Unless specified, stocks are of summer/fall run timing.

3.3.3.2 *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 low of 2,016 in 2007 to a high of 11,740 in 1989 (Figure 3.3.3.2.1). Since 1999, total escapement did not achieve the aggregate agency goal (sum of stock-specific goals) of 4,200 in 5 of the 14 years. Despite a declining terminal harvest rate that averaged only 13%, the escapement goal was met only twice in the last six years. Thus, in most years, terminal fisheries played a minimal role in determining whether or not the aggregate escapement goal was achieved. Given that the historical escapement record is punctuated by multiple periods of decline and subsequent increase (Figure 3.3.3.2.2), it is unclear whether the recent decline in returns is temporary or whether it will continue in the future. For individual stocks, 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 a recent decline (Figure 3.3.3.2.3). 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.

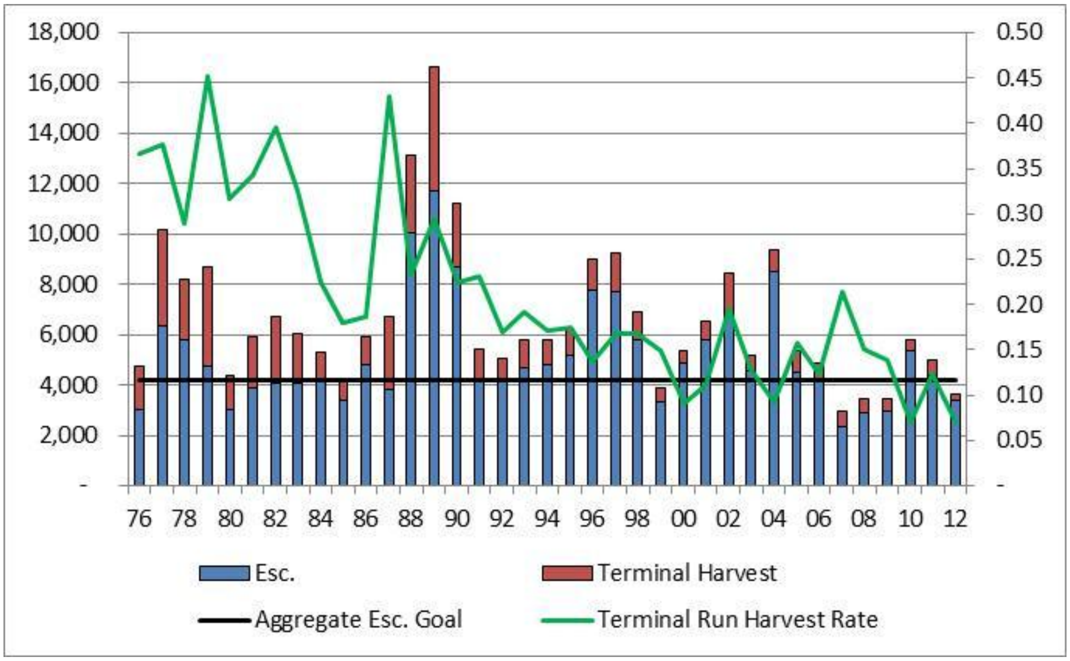


Figure 3.3.3.2.1.–Escapement, aggregate escapement goal and terminal fishery harvest for the aggregate of Washington coastal spring/summer Chinook salmon PSC escapement indicator stocks.

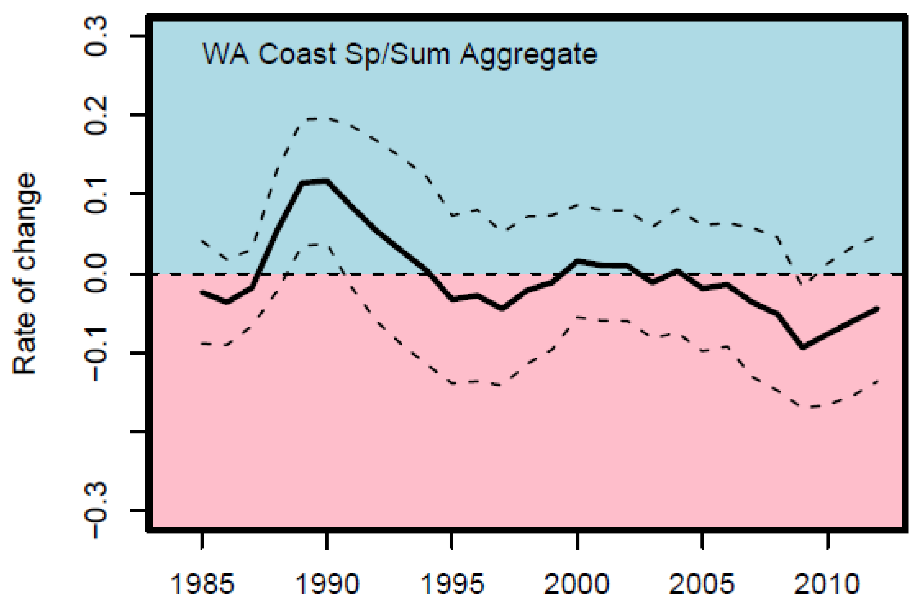


Figure 3.3.3.2.2.–Retrospective evaluations of abundance trends for the historical record of aggregate escapement for Washington Coast spring/summer Chinook salmon indicator stocks.

Note: The y-axis 'Rate of change' is the slope from a log$_e$(escapement) vs. year regression for the 10-year period ending in the year given on the x-axis. Solid lines denote point estimates for log$_e$(esc.) vs. time slope parameters, whereas dashed lines denote upper and lower confidence bounds (95%) on these values. Points lying below the zero horizontal reference line indicate years preceded by recent decline, whereas those above imply recent escapement increase.

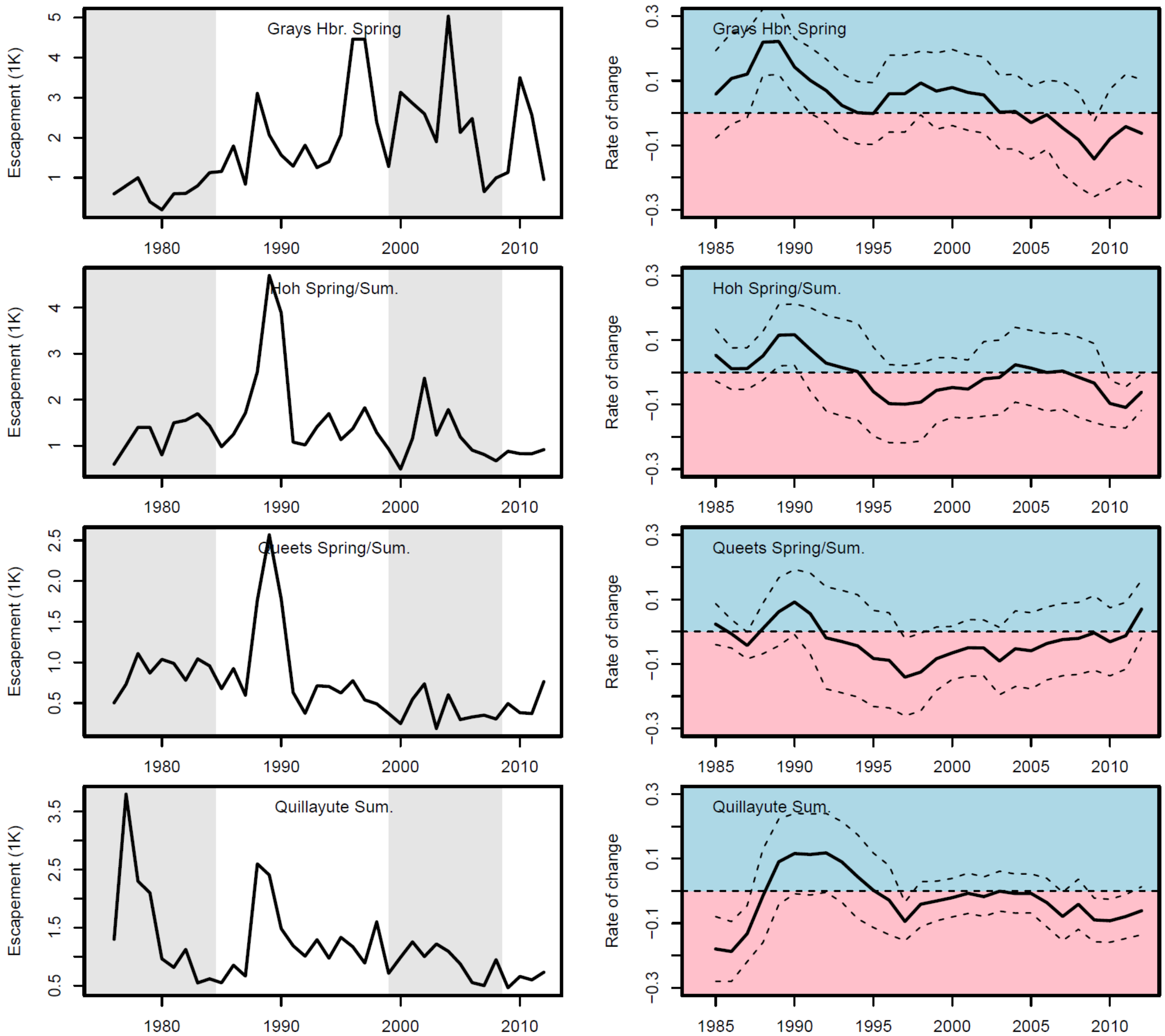


Figure 3.3.3.2.3.–Escapement time series plots (left column) and retrospective evaluations of abundance trends for the historical record of escapements (right column) for Washington Coast Spring/Summer indicator stocks.

Note: In left column figures, the alternating gray shaded areas denote periods corresponding to pre-treaty (<1985) and post-treaty agreement periods (1985–1999, 1999–2008, 2009+). In the right column figures, the y-axis 'Rate of change' is the slope from a $\log_e$(escapement) vs. year regression for the 10-year period ending in the year given on the x-axis. Solid lines denote point estimates for $\log_e$(esc.) vs. time slope parameters, whereas dashed lines denote upper and lower confidence bounds (95%) on these values. Points lying below the zero horizontal reference line indicate years preceded by recent decline, whereas those above imply recent escapement increase.

Coastal Washington fall Chinook salmon escapement indicators include Queets, Quillayute, and Hoh stocks that have CTC-approved escapement goals and the Hoko and Grays Harbor area stocks that only have agency management goals. Aggregate escapement has ranged from a low of 14,512 in 1983 to a high of 56,692 in 1988 (Figure 3.3.3.2.4). The aggregate escapement goal combining CTC-approved goals with the agency goals is 22,150. This escapement was achieved in 23 years or 62% of the 1975 to 2012 time period. Since 1999, the aggregate escapement goal has been achieved 57% of the time. Considering the most recent decade only, it appears that this aggregate of stocks is in decline relative to the high escapements of the early 2000s (Figure 3.3.3.2.5), although this is heavily influenced by the escapement trends for two of the larger stock components (Grays Harbor, Quillayute River). It should be noted, however, that phases of increasing/decreasing escapements appear to show a similar pattern for the stock group. Over the entire 1975 to 2012 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 3.3.3.2.6).

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 Sooes Creek, 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 presence of some trends in escapement, conclusions on stock status and population trend are speculative without a full run reconstruction (CWT-based) that can account for total production. A comprehensive run reconstruction has not been conducted for any coastal Washington stocks, although Queets stock is a logical candidate given the availability of data for the Queets CWT indicator group. Terminal area returns for the aggregate coastal fall stocks show a decline since the late 1980s and a relatively level trend since 1999. 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.

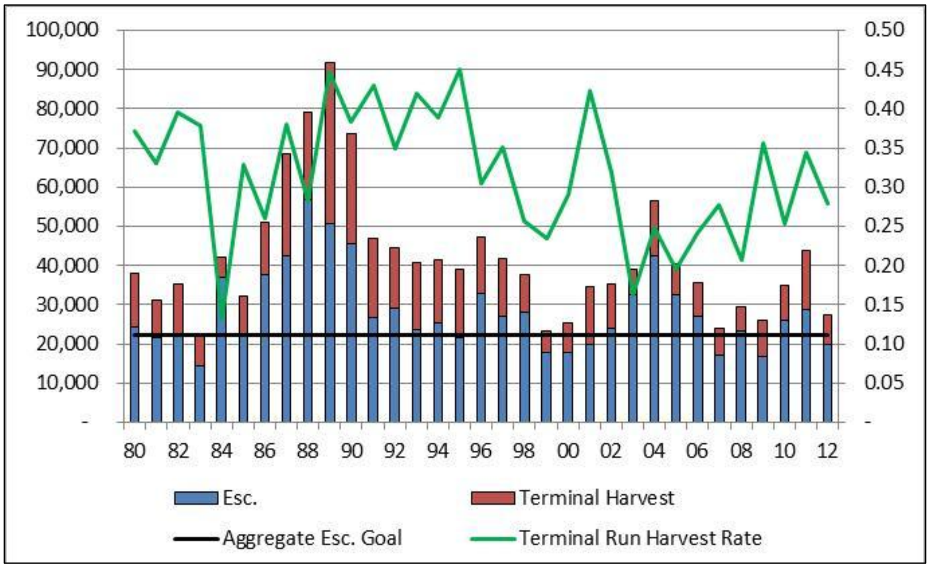


Figure 3.3.3.2.4.–Escapement, aggregate escapement goal and terminal fishery harvest for the aggregate of Washington coastal fall Chinook salmon PSC escapement indicator stocks.

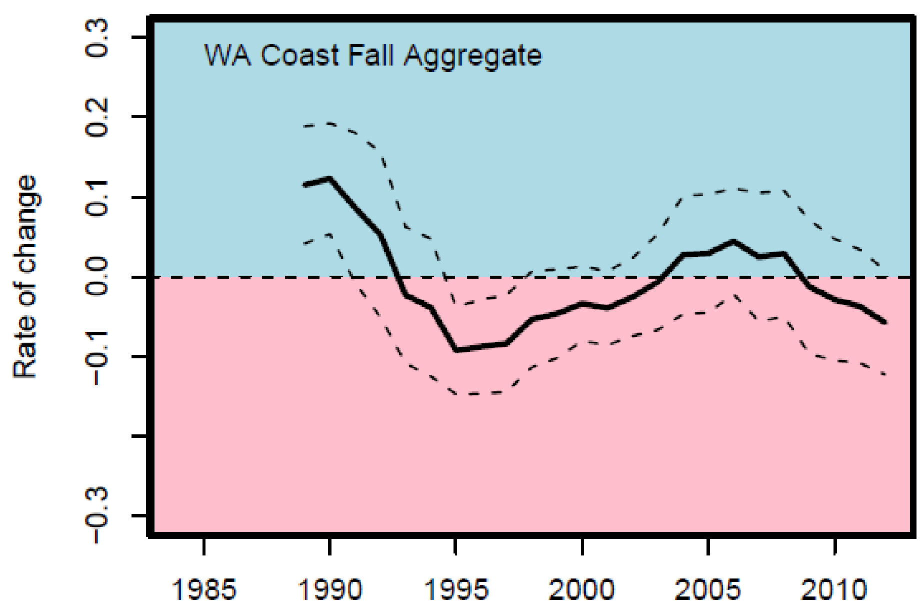


Figure 3.3.3.2.5.–Retrospective evaluations of abundance trends for the historical record of aggregate escapement for Washington Coast Fall Chinook salmon indicator stocks.

Note: The y-axis Rate of change is the slope from a $\log_e$(escapement) vs. year regression for the 10-year period ending in the year given on the x-axis. Solid lines denote point estimates for $\log_e$(esc.) vs. time slope parameters, whereas dashed lines denote upper and lower confidence bounds (95%) on these values. Points lying below the zero horizontal reference line indicate years preceded by recent decline, whereas those above imply recent escapement increase.

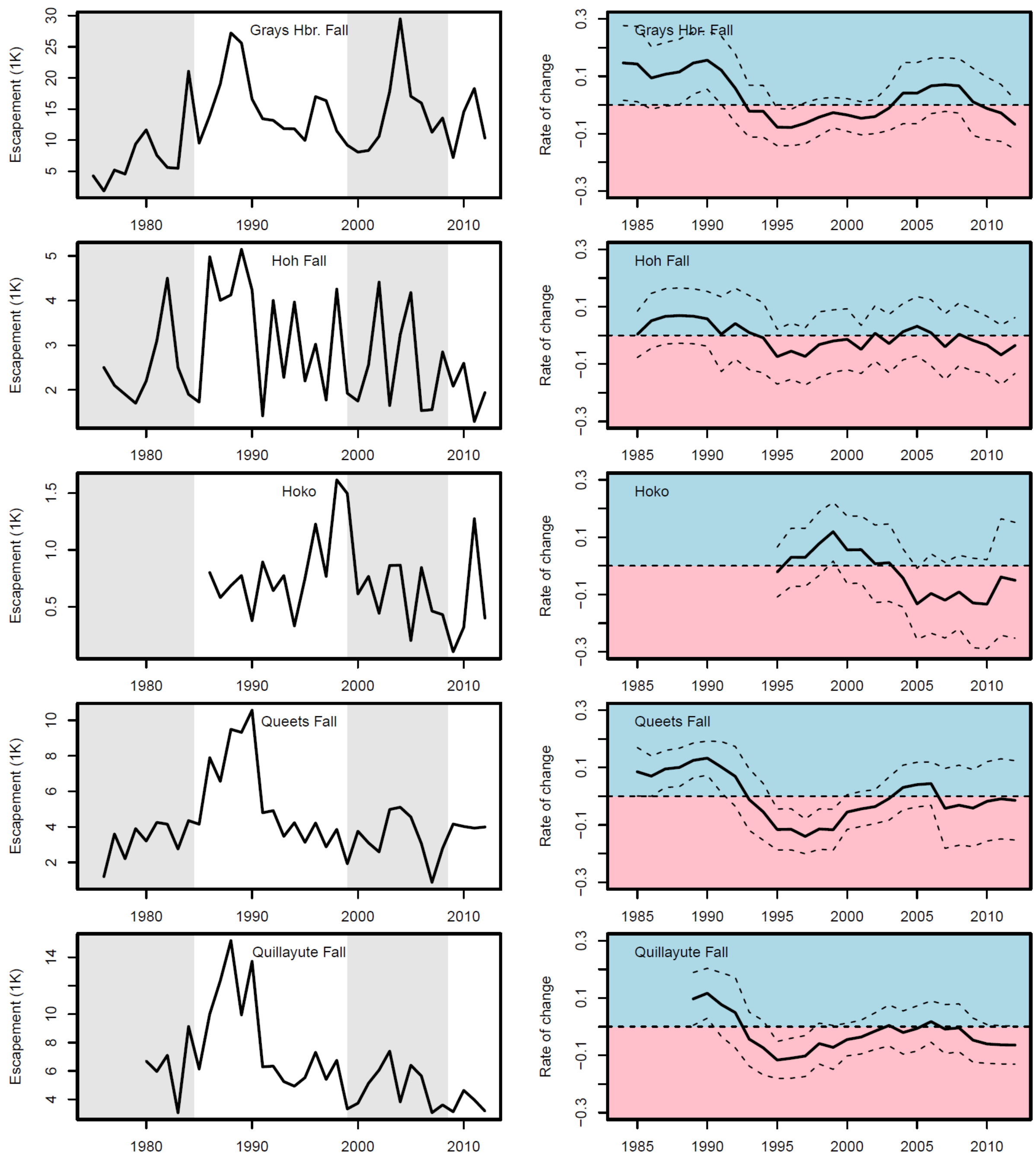


Figure 3.3.3.2.6.–Escapement time series plots (left column) and retrospective evaluations of abundance trends for the historical record of escapements (right column) for Washington Coast Fall indicator stocks.

Note: In left column figures, the alternating gray shaded areas denote periods corresponding to pre-treaty (<1985) and post-treaty agreement periods (1985–1999, 1999–2008, 2009+). In the right column figures, the y-axis 'Rate of change' is the slope from a log$_e$(escapement) vs. year regression for the ten-year period ending in the year given on the x-axis. Solid lines denote point estimates for log$_e$(esc.) vs. time slope parameters, whereas dashed lines denote upper and lower confidence bounds (95%) on these values. Points lying below the zero horizontal reference line indicate years preceded by recent decline, whereas those above imply recent escapement increase.

A simultaneous evaluation of spawning escapement and cumulative mature-run equivalent exploitation rates shows management of Queets River fall Chinook salmon (Figure 3.3.3.2.7) in the "safe zone" of 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 3.3.3.2.8) and Hoh (Figure 3.3.3.2.9) 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 necessitate. 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 non-fishing factors (e.g., anomalously high or low marine survival).

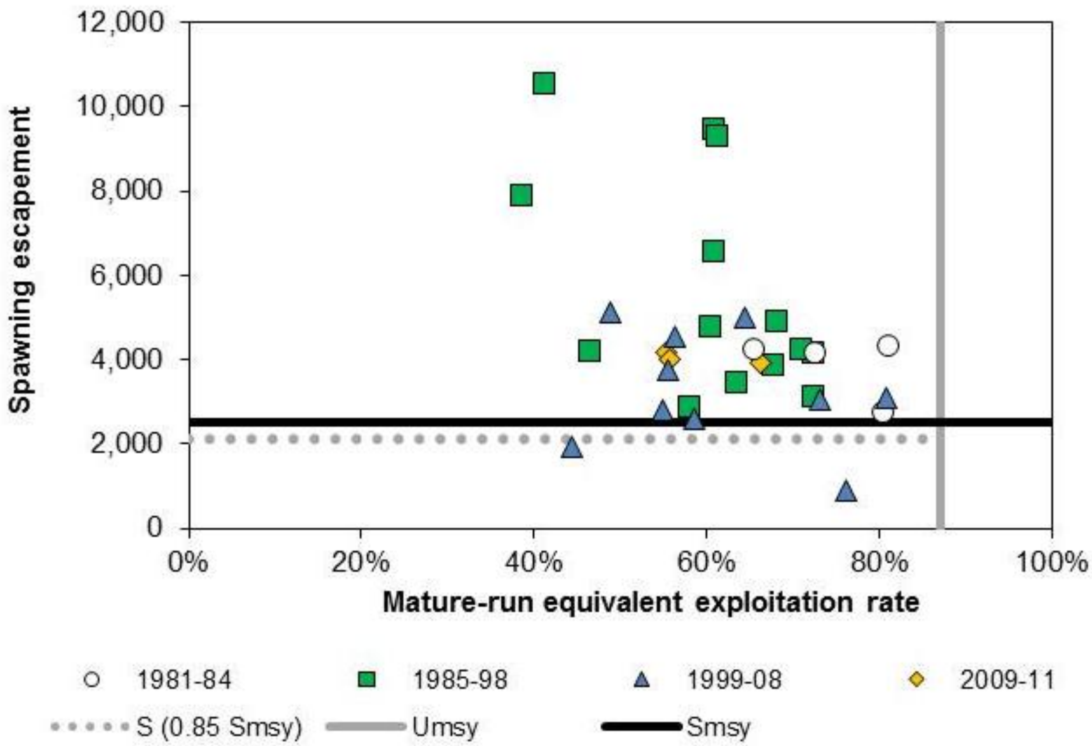


Figure 3.3.3.2.7.–Queets River fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Queets River PSC indicator CWTs.

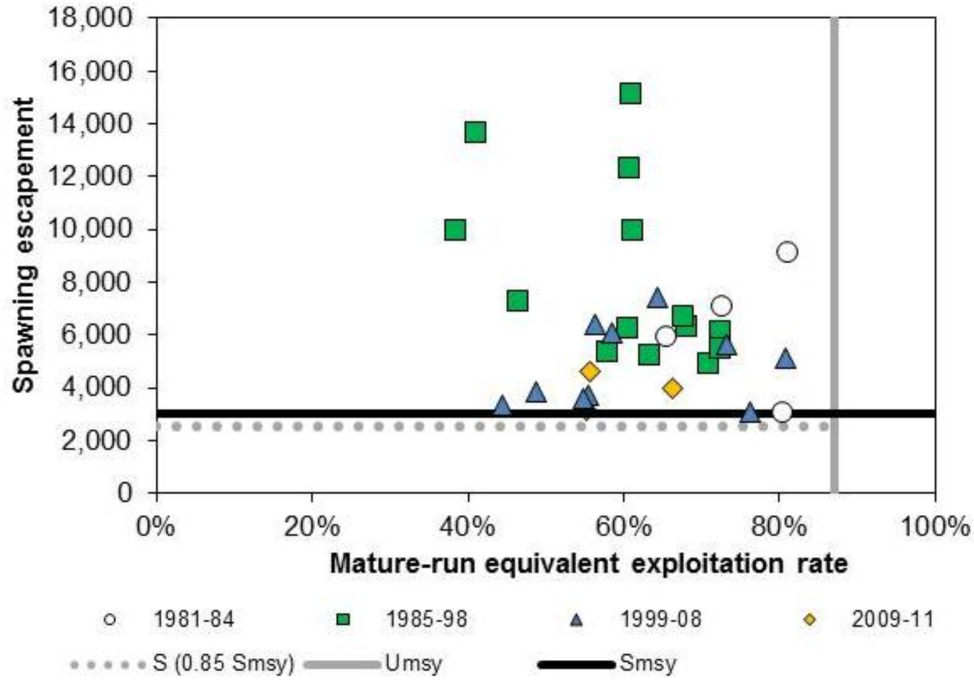


Figure 3.3.3.2.8.–Quillayute River fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Queets River PSC indicator CWTs.

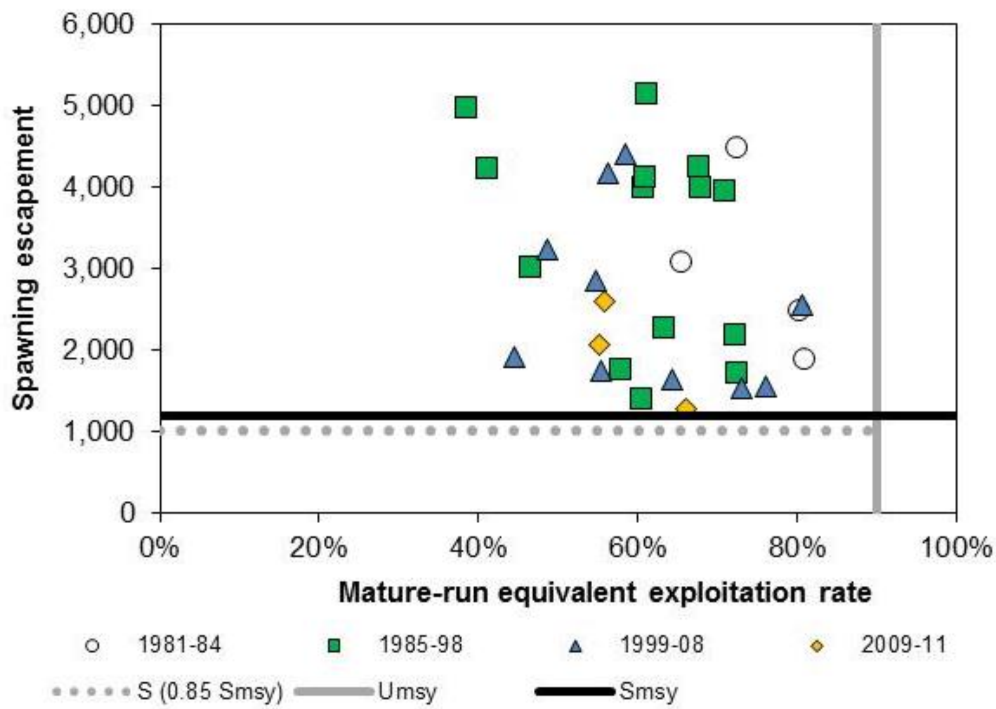


Figure 3.3.3.2.9.–Hoh River fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Queets River PSC indicator CWTs.

3.3.3.3 *Columbia River*

3.3.3.3.1 Columbia River Summers

Mid-Columbia summer Chinook salmon are the only escapement indicator stock in this stock group. Since 2008, Columbia upriver summer Chinook salmon have been managed in-river by co-managers for a spawning escapement of 17,000, including 13,500 Wenatchee/Entiat/Chelan tributary spawners, and 3,500 Methow/Okanagan tributary spawners, and an additional 3,000 fish for hatchery brood stock. In-river 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 3.3.3.3.1.1). These counts of Chinook salmon past Rock Island Dam have exceeded 40,000 since 2009 while the stock has shown exploitation rates of 50% to 60%. Survival rates have been mostly below average since brood year 1997 but have been slowly improving (Figure 3.3.3.3.1.2).

U.S. v. Oregon co-managers account for substantial sport and Colville tribal fisheries that occur in mainstem spawning areas above Rock Island Dam (*U.S. Oregon* TAC 1999). The CTC goal of 12,143 summer Chinook salmon past Rock Island Dam was developed prior to the fisheries that now take place above Rock Island Dam and should be updated to better represent recent population dynamics.

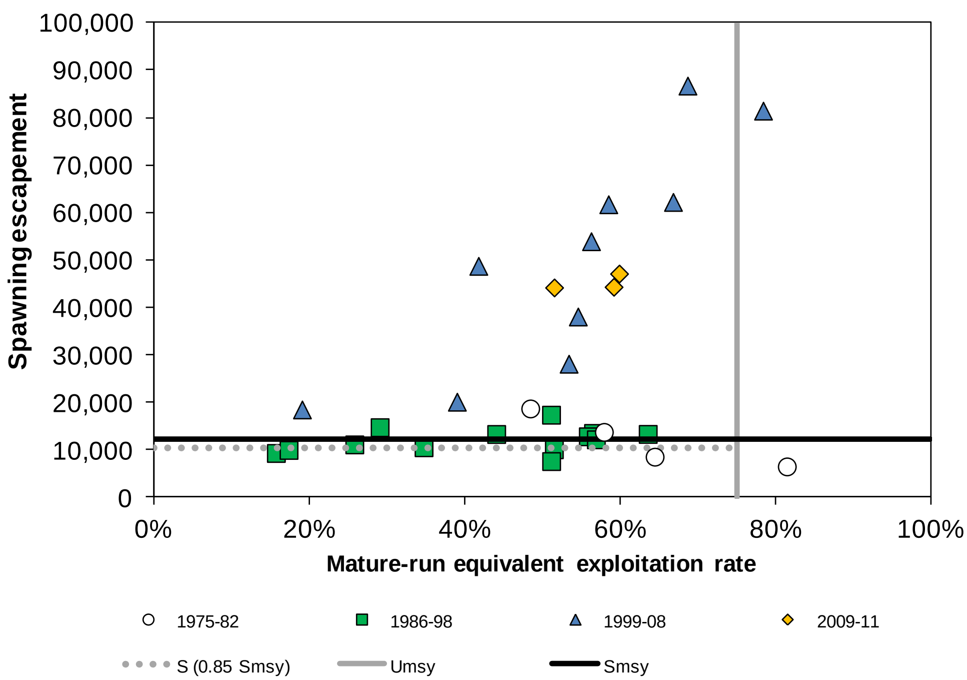


Figure 3.3.3.3.1.1.–Mid-Columbia summer Chinook salmon spawning escapement past Rock Island Dam and cumulative mature-run equivalent exploitation rate calculated from Wells Hatchery PSC indicator CWTs.

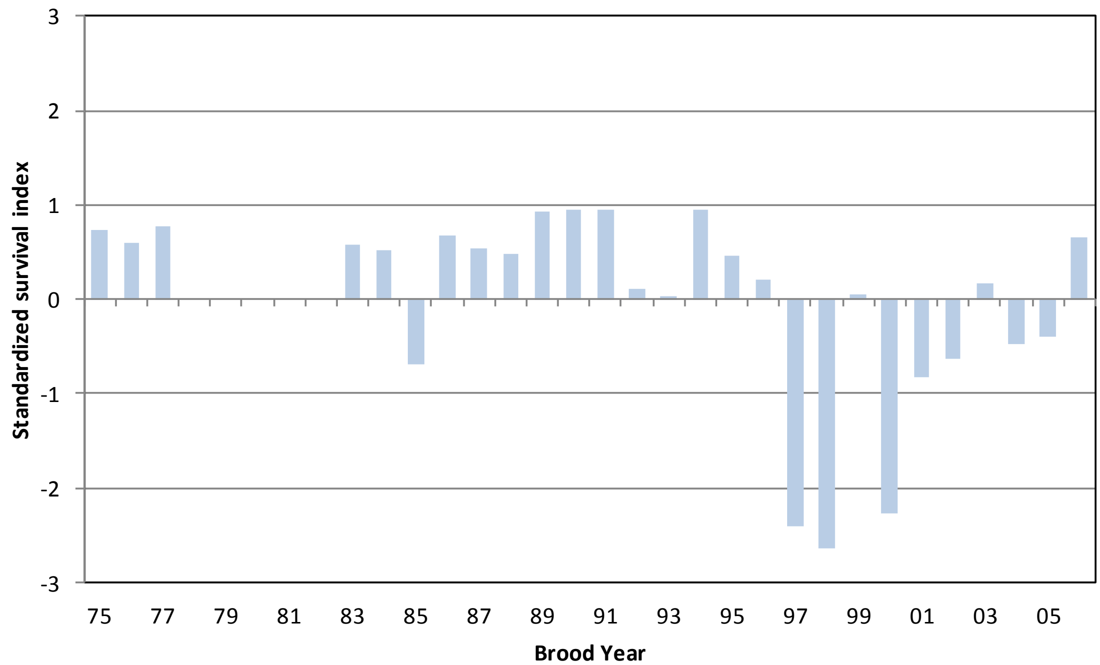


Figure 3.3.3.3.1.2.–Marine survival index (standardized to a mean of zero) for Columbia Upriver Summer Chinook salmon.

3.3.3.3.2 Columbia River Falls

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 exploitation rates have varied widely between 40% and 90% (Figure 3.3.3.3.2.1 and Figure 3.3.3.3.1.2).

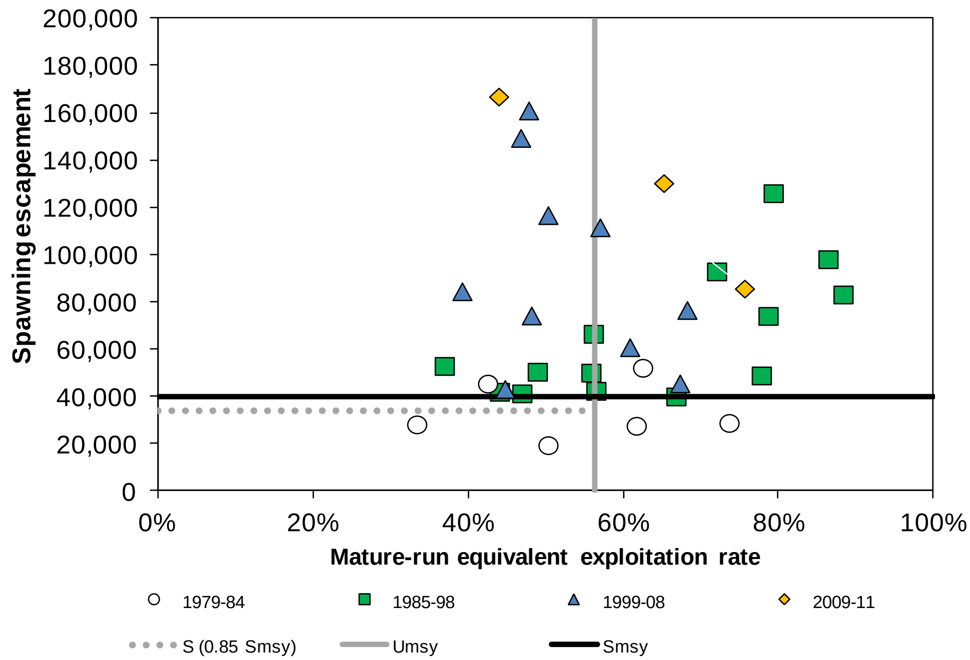


Figure 3.3.3.3.2.1.–Upriver bright fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Priest Rapids Hatchery and Hanford Reach Wild PSC indicator CWTs.

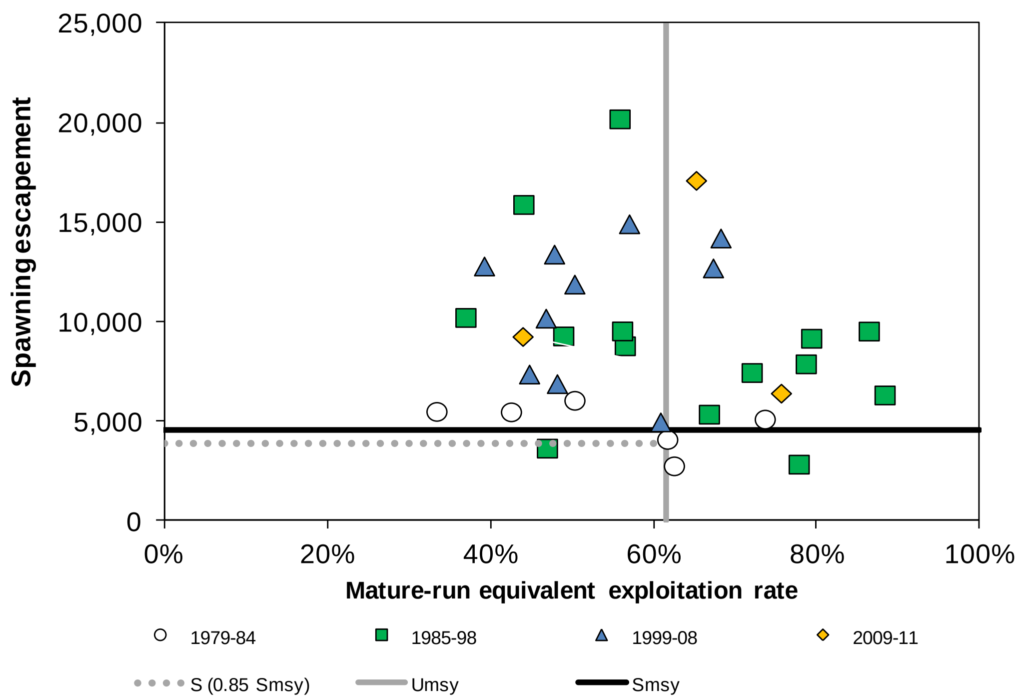


Figure 3.3.3.3.2.2.–Deschutes River fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Priest Rapids Hatchery PSC indicator CWTs.

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}, but have varied widely from between 20% and 65% in recent years (Figure 3.3.3.3.2.3). Tributary fishing has been nonexistent or severely constrained since 2006, except for a catch of 3,016 in 2011, which contributed to a 65% exploitation rate.

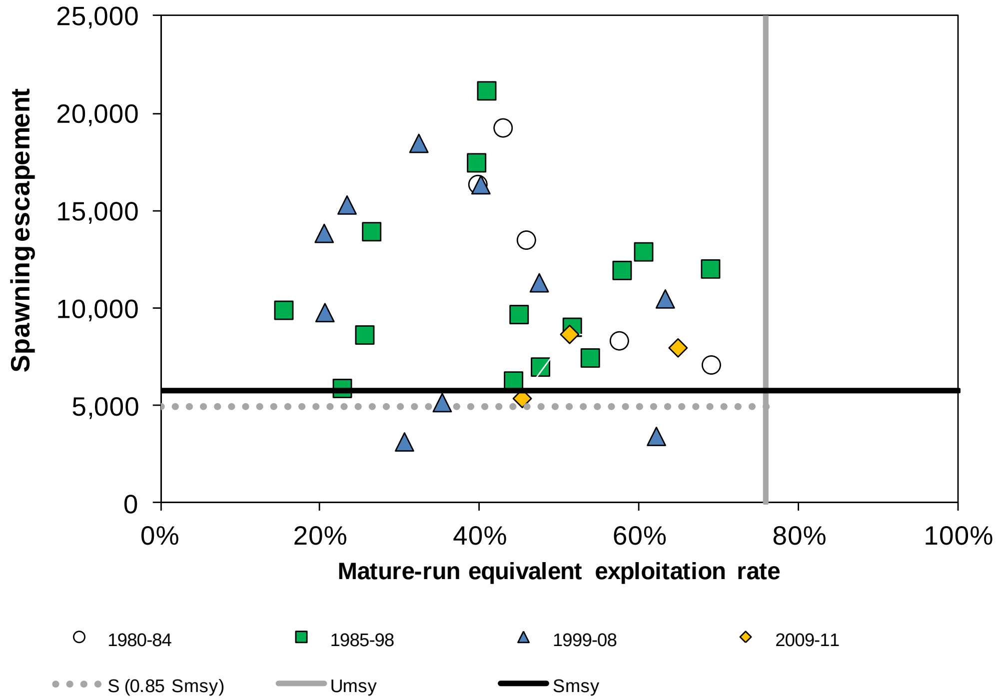


Figure 3.3.3.3.2.3.–Lewis River Wild fall Chinook salmon spawning escapement and cumulative mature-run equivalent exploitation rate calculated from Lewis River Wild PSC indicator CWTs.

Standardized survival indices for Columbia River Falls have been fairly stable. Only brood years 1998 and 1999 exceeded one standard deviation from average since the mid-80s (Figure 3.3.3.3.2.4 and Figure 3.3.3.3.2.6).

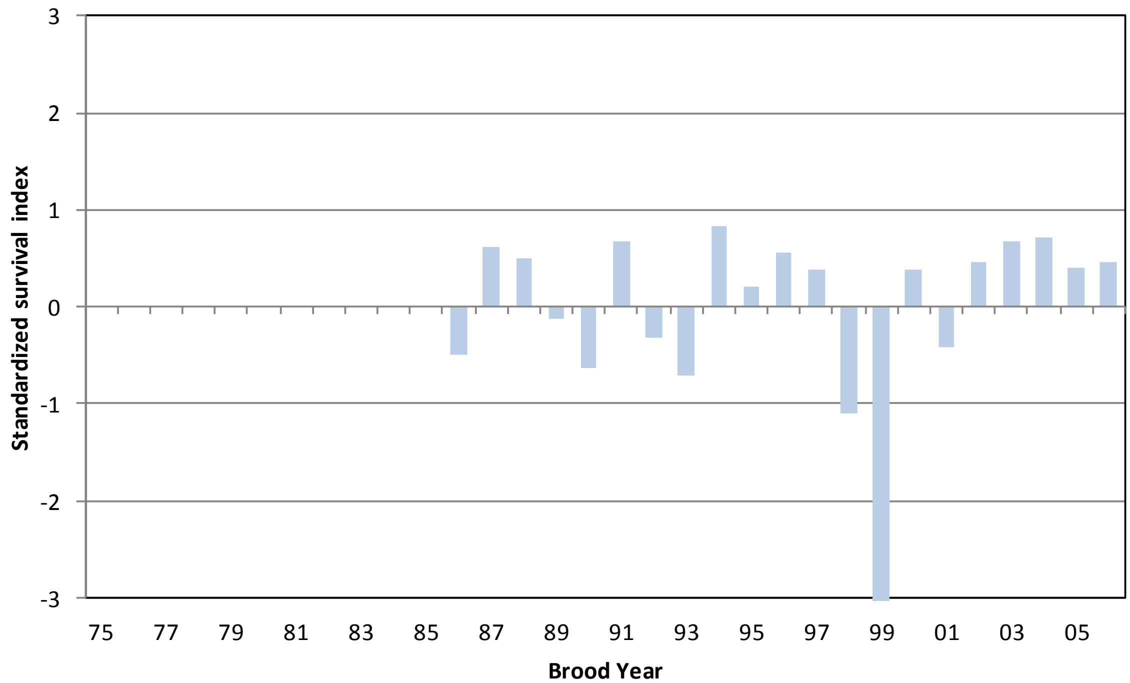


Figure 3.3.3.3.2.4.–Marine survival index (standardized to a mean of zero) for Columbia Upriver bright Chinook salmon, as represented by Hanford Reach Wild Chinook salmon.

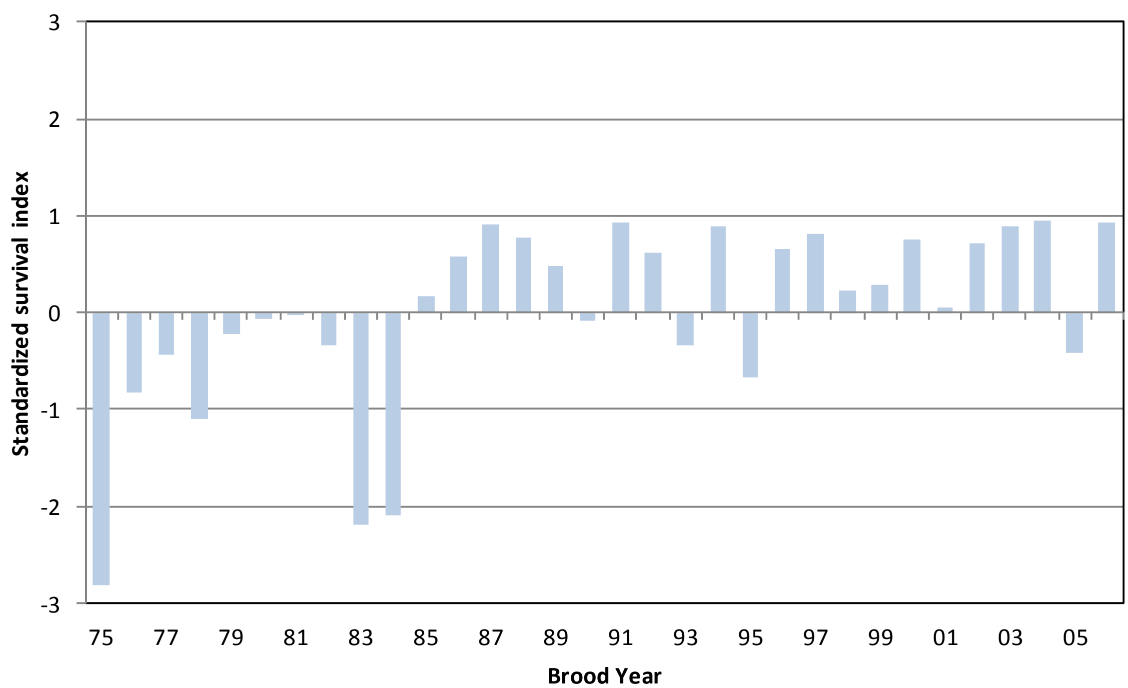


Figure 3.3.3.3.2.5.–Marine survival index (standardized to a mean of zero) for Columbia Upriver bright Chinook salmon, as represented by Priest Rapids Hatchery Chinook salmon.

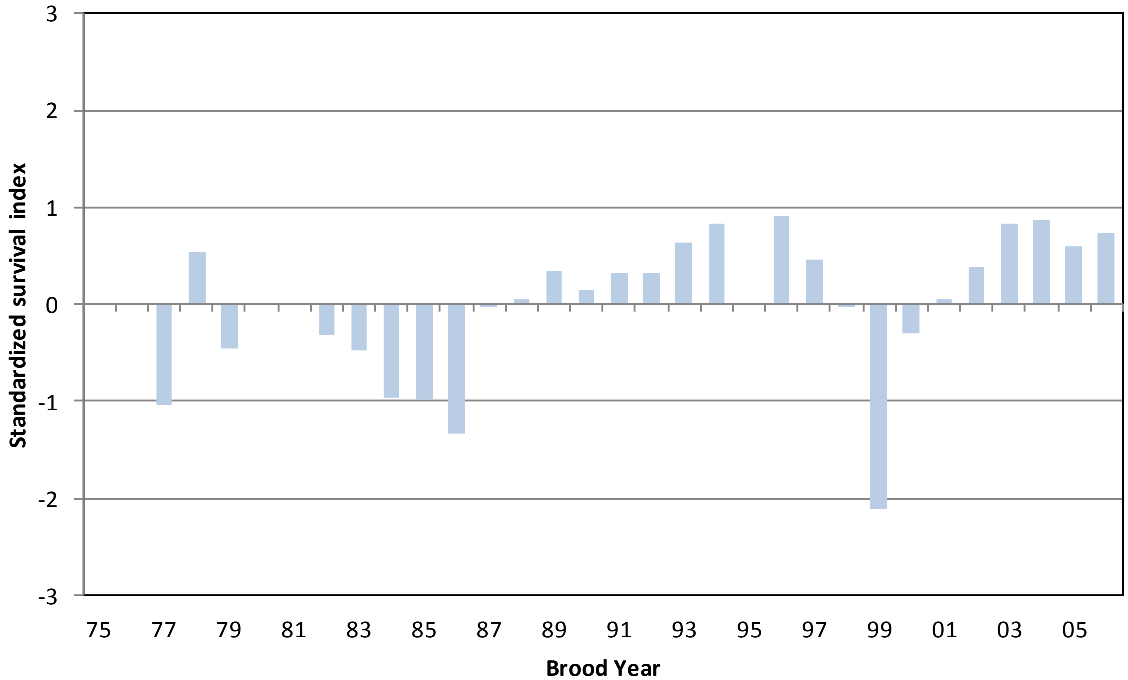


Figure 3.3.3.3.2.6.–Marine survival index (standardized to a mean of zero) for Lewis River Wild fall Chinook salmon.

3.3.3.4 *Coastal Oregon*

3.3.3.4.1 Oregon Coastal North Migrating

After a period of precipitous declines in escapement from 2007 to 2009, during the 2011 and 2012 return years the NOC stock aggregate has indicated signs of rebuilding to historical averages. Total estimated spawning escapement has ranged from approximately 39,000 in 2008 to 190,000 Chinook salmon in 1988. The 10-year (2002–2012) average for the NOC aggregate escapement is about 85,000 Chinook salmon. Estimated escapement in 2012 was 77,000 Chinook salmon. Abundance forecasts are expressed in terms of spawning escapement. Forecasted escapement for 2013 is 80,000 Chinook salmon.

All three NOC escapement indicator stocks failed to achieve goals in both 2007 and 2008, the Nehalem River did not attain its goal in either 2009 or 2010, but all three escapement indicator stocks exceeded the goals in 2012 and are forecasted to reach or exceed their goals in 2013. Recent year escapements in the southern range of the NOC (Siuslaw, Alsea) have shown encouraging rates of increase, while their northern counterparts (Nehalem, Tillamook, Nestucca) have displayed a more protracted rebuilding pattern. Escapements in the middle of the NOC area have been observed to be steadily rebuilding. Terminal fisheries management action, along with reductions in AABM fisheries, is contributing to the rebuilding of the NOC escapement. Terminal fisheries restrictions, which included closure in the Nehalem River during 2009, have been adopted and maintained through 2012. Many of these restrictions were dropped for the 2011 return year in the southern extent of the geographic aggregate, but most have been retained or extended through 2012 for basins north of the Nestucca. The analysis of stock synthesis status as represented by synoptic plots is confounded by different terminal exploitation experienced by the CWT group representing this stock group (Salmon River Hatchery) and the aggregate's three escapement indicator stocks (i.e., Nehalem, Siletz and Siuslaw basins). There is a directed high-intensity terminal fishery which impacts hatchery-origin fish returning to the Salmon River Hatchery. The terminal fishery impacts are lower magnitude on the NOC escapement indicator stocks. Nonetheless, analysis is ongoing to account for those differences to allow more comprehensive synoptic evaluations as summarized for other stocks in this report. Such analysis and material will be presented in future reports by the CTC. As shown in Figure 3.3.3.4.1, after a series of low marine survival from 2002 to 2006, which undoubtedly contributed towards failing escapements in the 2007 through 2008 return years, a higher marine survival in more recent years (2007–2009) may be similarly attributed with greater escapements in the 2011 and 2012 return years.

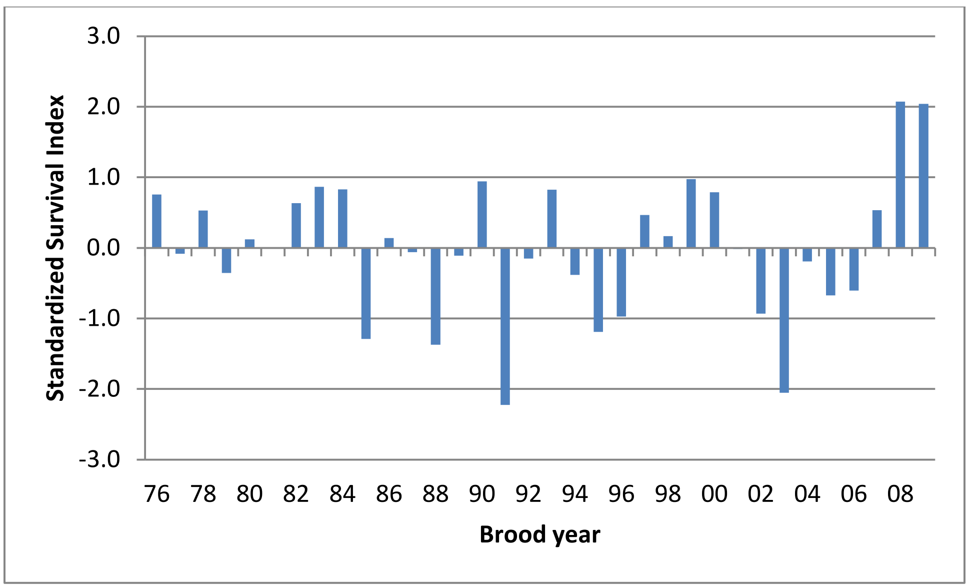


Figure 3.3.3.4.1.–Marine survival index (standardized to a mean of zero) for the Salmon River hatchery stock of Chinook salmon.

Note: Brood years 1976–2009 are shown, with the exception of 1981, for which there is no information.

3.3.3.4.2 Mid-Oregon Coast

After a period of precipitous declines in escapement from 2005 to 2007, the MOC stock aggregate has rebounded to historical averages during the 2010 through 2012 return years. Total aggregated estimated escapement for the MOC has ranged from a low of 7,556 in 2007 to a high of 53,860 in 2010. The 10-year average (2001–2012) escapement for the MOC is about 26,500 adult Chinook salmon. Estimated escapement in the MOC for 2012 was 27,623 adult Chinook salmon. Forecasted escapement for the 2013 return year is about 25,000 large bodied Chinook salmon. Marine survival, as indicated in Figure 3.3.3.4.2 has increased for those years from which recent recruitment has occurred and consequently expectation of average escapement is based on these observations.

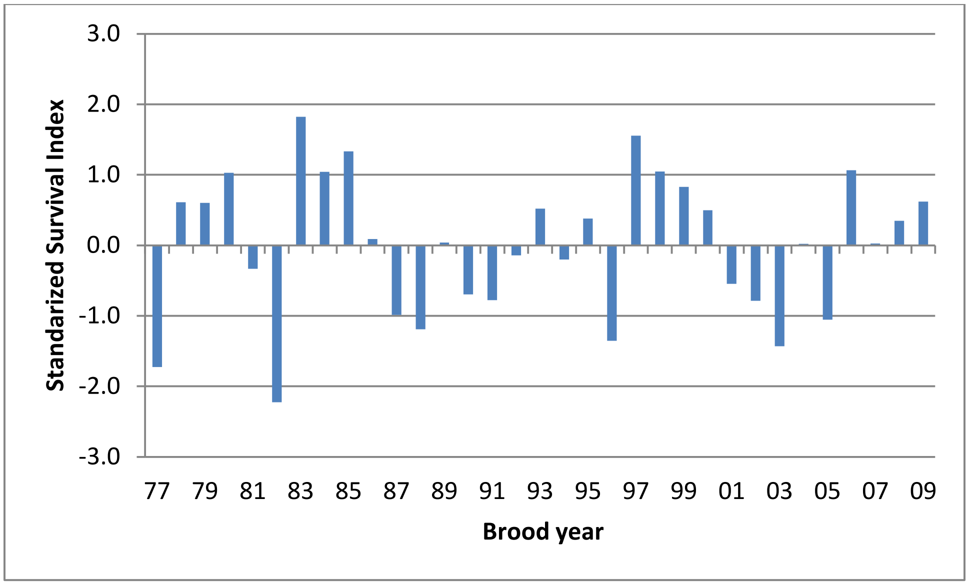


Figure 3.3.3.4.2.–Marine survival index (standardized to a mean of zero) for the Elk River hatchery stock of Chinook salmon.

Note: Brood years 1977–2009 are shown.

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. Fourteen projects were funded by the SSP in 2012, the fourth year of the SSP. Summaries for each project are reported in Appendix C.

4.1 Oregon

4.1.1 Nehalem River

The 2012 spawning escapement, 12,952 (CV = 19%) was estimated using MR methods. Returning fish 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. A creel survey was also conducted to both identify instances when marked fish were removed from the system and to generate timely and robust estimates of terminal harvest.

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. A creel survey was also conducted to estimate removals of marked fish by the terminal sport fishery, and estimate the terminal harvest. The preliminary 2012 spawning escapement was estimated at 8,738 Chinook salmon (CV = 19%).

4.2 Puget Sound

Three escapement studies were funded in Puget Sound, all employing genetic Lincoln-Petersen MR abundance estimates (GMR). Due to the requirement to sample downstream migrant juvenile fish to obtain a recapture sample, these programs all generated estimates of escapements in 2011, whereas all other SSP studies summarized in this section reported estimates for escapements in 2012.

4.2.1 Green River

The abundance of Chinook salmon spawning to the Green River in 2011 was estimated using GMR. Spawning adults were marked by obtaining a DNA microsatellite profile from tissue sampled from adult carcasses. Marks were later recaptured by sampling out-migrating smolts (captures) and genetically identifying some fraction of marks as parents of some out-migrating offspring. The preliminary estimate of Chinook salmon total spawner abundance for upstream of the smolt trap was 3,382 (CV = 5%).

4.2.2 Stillaguamish River

The abundance of Chinook salmon spawning in the Stillaguamish River in 2011 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 out-migrating smolts (captures) and genetically identifying some fraction of marks as parents of some out-migrating offspring. Unmarked hatchery juveniles and yearlings can present some challenges to the program, and the preliminary GMR results include corrections for unmarked hatchery juveniles and no adjustment for yearlings was necessary since none were observed. The preliminary estimate of Chinook salmon spawner abundance was 1,296 (CV = 6%).

4.2.3 Snohomish River

The abundance of Chinook salmon spawning in the Skykomish and Snoqualmie rivers in 2011 were estimated using GMR techniques. As with other Puget Sound rivers, spawning adults from both the Skykomish and Snoqualmie rivers were marked by obtaining a DNA microsatellite profile from tissue sampled from adult carcasses (first sampling event). Marks were later recaptured by sampling out-migrating sub-yearling smolt offspring (second sampling event) and genetically identifying some fraction of marks as parents of some out-migrating offspring. Preliminary unadjusted estimates of Chinook spawner abundance for areas upstream of each smolt trap were 6,857 Chinook salmon in the Skykomish River and 3,542 Chinook salmon in the Snohomish River. Performance standards were not met with GMR for 2011 (CV >15% for both estimates) due to low juvenile trap efficiencies and few carcass recoveries from the spawning ground surveys.

4.3 West Coast Vancouver Island

4.3.1 Burman River

The Burman River project estimated spawning escapement (4,119 Chinook salmon; CV = 10%) using MR methods. Returning fish were captured with beach seines in the lower river and then tagged and released. Carcasses were recovered upstream at the spawning grounds and examined for tags. Chinook salmon escapement (4,051) was also estimated using snorkel surveys and AUC methods. Visual observations of live radio marked fish were used to estimate observation efficiency (mean = 0.52; SE = 0.41) during 22 snorkel surveys. Survey life was estimated with radio tags (mean = 5.0; SE = 4.1; n = 108) and independently from visual tag depletion curves. Individual radio tags were intended to signal time of death by emitting an altered code when motion of the tagged fish had ceased for 12 hours, however many of the radio tags did not function as intended or operated in reverse with the inactive code preceding the active code signal. Fixed telemetry receiver sites were established at the lower and upper bounds of the spawning area. Only 1 (<1%) radiotagged Chinook salmon was detected leaving the Burman River two weeks after tagging; that fish was detected at the nearby Gold River.

4.3.2 Marble, Tahsis, and Leiner 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 25.4 days (SD = 15, n = 10) in the Tahsis River, 28.8 days (SD = 14, n = 38) in the Leiner River, and 27.4 days (SD = 14, n = 10) in the Marble River. Estimates of observer efficiency ranged from 33% to 100% in the Tahsis and Leiner rivers and from 13% to 100% in the Marble River. The AUC estimates using measured survey life and observer efficiency at Marble (2,509), Tahsis (227), and Leiner (772) rivers exceeded the normative AUC estimates provided to the CTC for Marble (2,364), Tahsis (566) and Leiner (163) rivers.

4.3.3 West Coast Vancouver Island Statistical Framework to Assess Chinook Salmon Escapement

A Canadian Science Advisory Process workshop has been scheduled for June 2013. The goal of the workshop is to produce Chinook salmon escapement monitoring framework for the WCVI area.

4.4 Fraser River

4.4.1 South Thompson River

Spawning escapement to the South Thompson age-.3 aggregate will be estimated using a combination of genetic, scale age, and CWT information collected from the Northern BC 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 will be used to estimate escapement while considering uncertainty in these information sources. For 2011, the estimate of Chinook salmon total spawner abundance for age-3 and older was 145,700 (CV = 17%). For 2012, genetic samples collected at Albion have recently been processed, and analyses to estimate the aggregate escapement are expected to commence in late May 2013. The 2012 escapement will be reported in next year's CTC catch and escapement report.

4.4.2 Chilko River

The 2012 escapement of Chinook salmon to the Chilko River (4,222, CV = 6%) was estimated using a two-event MR study, and concurrent aerial visual surveys. Petersen tags and sex-specific secondary marks were applied to returning salmon and recovery sampling was undertaken on carcasses.

4.4.3 Harrison River

Radio telemetry was used to determine whether this two-event MR study met the assumption of closure and to investigate the behaviour and distribution of the spawning population. Ninety-four radio tags were applied proportionally to male and female Chinook salmon throughout the MR tag application period. Movements of tagged fish were monitored throughout the entire MR study. All radiotagged Chinook salmon were tracked within the Harrison River, except for one radio tag that failed directly after application and release. All radiotagged Chinook salmon remained within the Harrison River MR study area to spawn. None passed above the upper boundary of the study area and none entered the nearby Chilliwack River. Fourteen radiotagged fish passed the lower boundary of the study area, and three of these were confirmed as carcasses downstream of the Harrison-Fraser confluence. It is likely that all 14 of these radiotagged fish were either moribund or recently dead, and very unlikely to have spawned elsewhere. Overall, the assumption of closure for the two-event MR was confirmed based on the results of this study. The adult spawning escapement was estimated at 44,500 fish (CV = 9%) based on the MR study.

4.5 Northern BC

4.5.1 Skeena River

The escapement of summer timed Chinook salmon to the Skeena River in 2012 was estimated at 36,006 fish (CV = 16%). 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 in order to identify fish originating from the Kitsumkalum River. The Kitsumkalum River 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 in the Tyee Test fishery catch.

4.5.2 Skeena River Retrospective Analysis

In 2012, historical escapements to the Skeena River were investigated using similar techniques to those described above. DNA was extracted from archived Tyee test fishery scale samples and analyzed to determine stock composition, and the ratios of fish of Kitsumkalum River origin. Escapement estimates were generated for 13 previous years between 1984 and 2008. Estimated escapements to the Skeena ranged from 36,006 (CV = 16%) to 155,474 (CV = 7%). The escapement estimates and associated CVs are presented in Appendix Table C.9.

4.5.3 Nass River

This SSP project was part of a larger basin-wide escapement program where Chinook salmon were captured and tagged at fish wheels in the Lower Nass River and then recovered and examined for marks at upstream tributaries to generate a MR estimate. The SSP partly funded fish wheel operations and funded the operation of a counting fence on the Kwinageese River and carcass surveys on Damdochax Creek. The total run above the GW fish wheels was estimated to be 8,966 Chinook salmon (CV = 6%); 308 Chinook salmon were harvested above Grease Harbor and the spawning escapement above the GW fish wheels was estimated to be 8,688 Chinook salmon—the second lowest return recorded since the fish wheel program was initiated in 1994.

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APPENDICES

APPENDIX A. LANDED CHINOOK SALMON CATCHES BY REGION AND GEAR, 1975–2012.

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[1]	338,451	68,091	86,575	493,117	65,219	37,561	390,336
2006[1]	282,315	67,396	85,794	435,505	48,511	25,711	361,283
2007[1]	268,146	53,644	82,848	404,638	68,903	7,746	327,989
2008[1]	151,936	43,029	49,265	244,230	66,183	6,064	171,983
2009[1]	175,644	48,465	69,565	293,674	62,311	3,696	227,667
2010[1]	195,495	30,582	58,503	284,580	54,289	937	229,355
2011[1]	242,193	48,220	66,575	356,988	64,456	504	292,028
2012[2]	209,392	39,483	46,520	295,395	53,205	1,175	241,015

Note: Troll, net, sport and total catches include catch of Southeast Alaska 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] Values changed because the method used to partition gillnet catch into large and non-large fish has changed. This change affects the computation of the terminal exclusion, add-on, and treaty catch.

[2] 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	11,910	13,947	5,854	9,420	176	4,709	46,016
2006	10,260	17,302	6,160	8,782	238	5,258	48,000
2007	10,631	21,672	5,249	8,841	4,003	20,323	70,719
2008	11,723	16,618	4,622	4,701	222	241	38,127
2009	11,623	18,358	4,820	6,439	138	3,515	44,893
2010	12,758	16,917	3,755	4,559	134	230	38,353
2011	10,405	14,839	6,190	7,285	383	2,598	41,700
2012[1]	7,318	22,781	4,150	4,884	1,292	5,184	45,608

[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 post fishing 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	17,992	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[2]	7,634	24,582	5,297	6,233	4,432	18,192	66,370

[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 post fishing 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			178			0			1,202		
1976	1,074			236			200			1,510		
1977	450			62			300			812		
1978	750			100			300			1,150		
1979	2,150			872			734			3,756		
1980	822			1,869			354			3,045		
1981	736			977			556			2,269		
1982	1,018			1,823			429			3,270		
1983	1,375			1,553			355			3,283		
1984	802			515			569			1,886		
1985	1,066			759			654			2,479		
1986	1,707			1,668			570			3,945		
1987	1,491			1,512			823			3,826		
1988	1,445			2,170			780			4,395		
1989	1,433			2,799			722			4,954		
1990	1,094			3,703			1,001			5,798		
1991	1,572			2,717			834			5,123		
1992	1,311			2,629			608			4,548		
1993	1,248			2,830			909			4,987		
1994	1,297			3,551			744			5,592		
1995	1,464			3,567			1,465			6,496		
1996	1,389			5,489			1,134			8,012		
1997	1,584			6,336			811			8,731		
1998	864			3,288			662			4,814		
1999	1,516			4,117			662			6,295		
2000	1,616			3,882			633			6,131		
2001	954			2,461			659			4,074		
2002	1,450			2,499			963			4,912		
2003	1,659			3,839			651			6,149		
2004	2,454			6,969			455			9,878		
2005	1,119	0	51	9,515	0	438	35	0	2	10,669	0	492
2006	960	0	44	23,480	0	1,080	243	0	17	24,683	0	1,141
2007	781	0	36	14,715	0	0	145	0	10	15,641	0	46
2008	920	0	42	10,831	0	498	327	0	23	12,078	0	563
2009	773	0	36	8,378	510	868	140	0	10	9,291	510	913
2010	835	0	38	7,815	124	477	247	0	17	8,897	124	532
2011	784	0	36	5,028	158	444	253	275	70	6,065	433	550
2012	580	0	27	7,407	63	434	254	367	88	8,241	430	549

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

	Northern British Columbia			
Year	Area 1-5 Troll[1,2]	Area 1-5 CNR Troll[1,3]	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	130	47,100	149,961
2003	140,497	555	54,300	195,352
2004	167,508	2,298	74,000	243,806
2005	174,806	975	68,800	244,581
2006	151,485	8	64,500	215,993
2007	83,235	104	61,000	144,339
2008	52,147	0	43,500	95,647
2009	75,470	170	34,000	109,640
2010	90,213	1	46,400	136,614
2011	74,660	0	48,000	122,660
2012	80,257	0	40,050	120,307

[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	2,733	0	50,966
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	36,116
1995	3,721	26,123	2,935	0	32,778
1996[2]					
1997[2]					
1998[2]					
1999	920	674	3,604	0	5,198
2000	169	147	4,703	0	5,019
2001	376	276	5,947	0	6,599
2002	2,807	880	8,410	0	12,097
2003	4,751	696	9,515	0	14,962
2004	7,836	2,420	21,226	0	31,482
2005	4,934	4,593	12,174	0	21,701
2006	3,244	2,630	7,486	0	13,360
2007	2,094	3,063	7,845	0	13,003
2008	1,189	1,316	3,259	0	5,764
2009	1,874	3,075	3,964	0	8,913
2010	1,953	2,326	6,777	0	11,056
2011	7,732	1,773	9,114	0	18,619
2012	2,152	4,345	4,977	0	11,475

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			25,095						0			0			29,150		
1976	2,791			16,105						0			0			18,896		
1977	6,998			44,196						1,670			2,158			55,022		
1978	5,363			27,924						1,668			6,610			41,565		
1979	5,266			40,640						2,523			1,960			50,389		
1980	10,121			26,895						3,867			4,515			45,398		
1981	11,115			41,724						2,760			2,613			58,212		
1982	13,255			44,844						3,760			2,726			64,585		
1983	15,532			17,134						4,092			5,374			42,132		
1984	11,408			31,321						2,300			3,426			48,455		
1985	15,794			39,562						3,600			3,186			62,142		
1986	24,448			23,902						3,950			4,410			56,710		
1987	16,329			18,357						4,150			3,625			42,461		
1988	21,727			31,339						4,300			3,745			61,111		
1989	21,023			38,623						4,150			5,247			69,043		
1990	27,105			28,359						4,300			4,090			63,854		
1991	23,441			40,899						4,256			4,764			73,360		
1992	27,012			35,716						6,250			6,182			75,160		
1993	21,353			33,944						3,279			7,813			66,389		
1994	15,949			22,032						3,171			3,093			44,245		
1995	13,635			18,076						2,475			3,503			37,689		

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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			33,080						3,382			1,250			51,057		
1997	14,610			22,355						0			0			36,965		
1998	20,622			7,833						4,750			0			33,205		
1999	27,399			11,387						11,700			0			50,486		
2000	23,476			22,849						8,600			0			54,925		
2001	23,508			25,410						11,000			0			59,918		
2002	14,125			15,211						8,000			0			37,336		
2003	20,950			15,230						8,000			5,711			49,891		
2004	20,548			12,305						8,000			0			40,853		
2005	17,553	NA	807	6,850	5,502	4,434	1,332	NA	61	8,000	0	0	0			33,735	5,502	5,302
2006	17,262	NA	794	12,561	9,904	8,059	1,178	NA	54	8,000	0	0	0			39,001	9,904	8,908
2007	14,087	NA	648	10,079	10,273	8,037	1,302	NA	60	8,000	0	288	0			33,468	10,273	9,033
2008	14,963	NA	688	5,938	3,359	2,889	1,401	NA	64	11,970	1,643	460	0			34,272	5,002	4,101
2009	13,083	NA	602	3,083	2,003	1,584	1,189	NA	55	9,177	1,703	601	0			26,532	3,706	2,842
2010	13,693	NA	630	3,141	0	144	959	NA	44	7,570	563	362	2,689	NA	186	28,052	563	1,367
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	780	3,067	2,661	575	NA	26	7,017	0	253	421	NA	29	16,982	3,067	3,345

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

	Central British Columbia																	
	First Nations			Net[2]			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[2]			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

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

[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

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, 2,232 Maanulth Treaty catch and 6,292 T'aaq-wiihak troll catch.

Appendix A.10.–Estimates of incidental mortality 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[6]	1,214	629	10,976	3,571	16,390

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, 2,232 Maanulth Treaty catch and 6,292 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).

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
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			29,578			69,723			NA			188,102	0	0
1991	41,322			60,797			85,983			NA			64,769	0	0
1992	8,315			9,486			46,968	28,322	8,679	NA			99,376	28,322	8,679
1993	5,078			28,694			65,604	37,263	11,681	NA			56,410	37,263	11,681
1994	1,515			2,369			52,526	26,000	8,616	NA			28,001	26,000	8,616
1995	5,868			458			21,675	9,797	3,377	NA			2,324	9,797	3,377

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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	544	261	NA			53,241	544	261
1997	5,678			208			47,355	11,365	5,450	NA			63,214	11,365	5,450
1998	7,172			345			55,697	13,367	6,410	NA			50,866	13,367	6,410
1999	3,591			112			47,163	11,319	5,428	NA			5,569	11,319	5,428
2000	–			126			5,443	13,954	3,055	NA			12,563	13,954	3,055
2001	–			11			6,354	10,684	2,490	6,198			47,195	10,684	2,490
2002	10,785			260			36,073	14,629	5,298	77			70,437	14,629	5,298
2003	10,000			9,251			51,186	25,341	8,397	NA			90,288	25,341	8,397
2004	16,696			12,348			61,218	29,852	9,956	26			108,401	29,852	9,956
2005	35,000		1,610	23,599	354	4,687	43,577	9,534	4,837	6,225		430	92,961	9,888	11,564
2006	28,628		1,239	20,308	228	2,584	44,025	9,638	4,888	NA		0	86,347	9,866	8,711
2007	20,098		925	26,881	88	4,031	39,368	12,060	5,032	NA		0	45,271	12,148	9,987
2008	12,159		559	8,257	2	2,677	24,855	8,914	3,426	NA		0	50,712	8,916	6,663
2009	9,026		415	9,765	0	2,201	31,921	16,641	5,398	NA		0	33,919	16,641	8,014
2010	7,485		344	1,747	372	372	24,687	12,721	4,146	NA		0	96,768	13,093	4,862
2011	22,794		1,049	21,843	355	1,337	52,131	15,539	6,581	NA		0	45,804	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

[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).

	Johnstone Strait														
	First Nations			Net[1]			Troll[1,2]			Tidal Sport[3]			Total		
Year	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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	Johnstone Strait														
	First Nations			Net[1]			Troll[1,2]			Tidal Sport[3]			Total		
Year	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

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

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

[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

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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	Washington – Strait of Juan de Fuca											
	Troll			Net			Sport			Total		
Year	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	1523	NA	122	10,726[1]	34,894[1]	10,907[1]	13,275	34,894	11,054

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 drop-off/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	4,476[1]	4,793[1]	1,934[1]	4,917	5,011	2,144

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	31,993[1]	66,031[1]	22,335[1]	147,910	66,031	31,608

Note: Net = Areas 6B, 6D, 7B, 7C, and 7E, Areas 8–13 (including all sub-areas), 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).

Year	Washington – Inside Coastal								
	Net			Sport			Total		
	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	8,933[1]	NA	616[1]	38,165	NA	1,201

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[1]	42,874[1]	7,388[1]	135,220	42,874	9,882

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).

	Washington and Oregon Columbia River[1]											
	Non-treaty Net			Treaty Indian Net			Sport			Total		
Year	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]											
	Non-treaty 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	21,318	NA	640	70,848	0	2,125	49,150	NA	3,391	141,316	NA	6,156
2001	42,570	3,050	7,663	184,393	0	5,532	138,360	61,882	21,428	365,323	64,933	34,623
2002	70,386	28,160	15,439	181,413	0	5,442	147,146	61,769	22,013	398,945	89,929	42,894
2003	76,030	9,271	9,597	157,329	0	4,720	145,794	44,122	18,531	379,153	53,393	32,848
2004	77,443	9,205	9,726	160,855	0	4,826	145,916	32,757	16,358	384,214	41,962	30,909
2005	45,856	2,540	6,093	133,533	0	4,006	89,933	39,043	13,702	269,322	41,583	23,801
2006	44,478	6,098	6,323	109,384	0	3,282	70,990	12,235	7,247	224,852	18,333	16,852
2007	26,767	2,560	3,334	60,485	0	1,815	54,613	10,060	5,700	141,865	12,620	10,849
2008	51,988	2,810	6,656	143,641	0	4,309	87,118	14,019	8,703	282,747	16,829	19,668
2009	54,913	3,073	5,823	110,079	0	3,302	88,783	14,422	8,895	253,775	17,496	18,021
2010	89,129	7,826	10,947	202,288	0	6,069	162,707	24,187	15,871	454,124	32,013	32,886
2011	92,082	6,964	9,928	173,658	0	5,210	149,907	27,161	15,558	415,647	34,125	30,696
2012	76,315	4,436	8,608	168,825	0	5,065	122,411	28,719	13,960	367,551	33,155	27,633

[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 non-treaty net and treaty Indian due to the inability to separate Treaty Indian commercial versus non-commercial. Non-treaty net includes catches by Wanapum and Colville tribes. Sport and total catches from 1975 to 1980 are consistent with previous year's reports.

[2] The Treaty Indian Net catch estimates from 1975 to 1979 are not available, but are believed to be of the magnitude seen after 1979; the catch for 1979 represents spring run catches and does not include catch estimates for summer and fall stocks. Sport and total catch estimates from 1975 to 1979 are consistent with previous year's reports, but the total is underestimated because of the missing estimates.

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

	Oregon Coastal Inside								
	Troll			Sport			Total		
Year	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[1]	NA	1,827[1]	27,121	NA	1,837

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 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	1,114,483	228,121	546,214	949,027	1,723,362	2,837,845
1976	258,762		1,148,707	1,148,707	190,267	665,010	1,078,748	1,934,025	3,082,732
1977	302,178		972,309	972,309	131,005	545,742	1,070,562	1,747,309	2,719,618
1978	418,411		782,501	782,501	146,179	568,705	1,078,144	1,793,028	2,575,529
1979	382,641		729,949	729,949	147,576	477,222	991,275	1,616,073	2,346,022
1980	343,970		890,965	890,965	157,398	486,303	834,970	1,478,671	2,369,636
1981	289,034		780,224	780,224	153,249	423,266	753,274	1,329,789	2,110,013
1982	314,686		872,679	872,679	173,687	538,510	675,615	1,387,812	2,260,491
1983	311,658		637,515	637,515	162,927	395,636	643,798	1,202,361	1,839,876
1984	290,077		665,122	665,122	185,305	471,294	797,637	1,454,236	2,119,358
1985	268,293	6,246	734,199	1,008,738	166,445	345,937	560,334	1,072,716	2,081,454
1986	271,262	11,091	879,509	1,161,862	176,868	350,227	507,713	1,034,808	2,196,670
1987	265,323	17,095	1,171,535	1,453,953	180,101	378,931	403,783	962,815	2,416,768
1988	256,787	22,525	1,204,229	1,483,541	159,428	408,668	379,588	947,684	2,431,225
1989	269,522	21,510	1,001,686	1,292,718	228,331	203,751	486,957	919,039	2,211,757
1990	320,996	45,873	808,452	1,175,321	170,936	297,858	469,730	938,524	2,113,845
1991	297,986	61,476	599,534	958,996	209,065	203,035	558,591	970,691	1,929,687
1992	221,980	36,811	525,084	783,875	163,698	358,664	457,906	980,268	1,764,143
1993	271,193	32,910	487,927	792,030	186,983	300,345	460,360	947,688	1,739,718
1994	235,165	29,185	299,419	563,769	193,554	160,352	303,807	657,713	1,221,482
1995	176,939	58,800	351,046	586,785	79,388	95,410	205,308	380,106	966,891
1996	154,997	81,262	409,703	645,962	678	10,233	220,570	231,481	877,443

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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
1997	286,696	56,306	375,204	718,206	110,999	59,088	263,346	433,433	1,151,639
1998	243,152	27,441	268,693	539,286	143,202	9,317	196,352	348,871	888,157
1999	198,842	52,178	371,349	622,369	84,324	38,540	223,695	346,559	968,928
2000	186,493	76,797	341,695	604,985	32,048	88,617	168,926	289,591	894,576
2001	186,919	78,815	708,027	973,761	43,334	120,304	208,302	371,940	1,345,701
2002	357,133	69,401	813,652	1,240,186	149,961	157,886	239,111	546,958	1,787,144
2003	380,152	59,284	744,225	1,183,661	195,352	173,561	252,260	621,173	1,804,834
2004	417,019	82,249	732,443	1,231,711	243,806	215,252	292,646	751,704	1,983,415
2005	390,336	102,781	577,911	1,071,028	244,581	199,479	283,736	727,796	1,798,824
2006	361,283	74,222	536,878	972,383	215,993	145,485	274,179	635,657	1,608,040
2007	327,989	76,649	429,338	833,976	144,339	140,614	234,538	519,491	1,353,467
2008	171,983	72,247	518,530	762,760	95,647	145,726	185,482	426,855	1,189,615
2009	227,667	66,007	446,436	740,110	109,640	124,617	206,075	440,332	1,180,442
2010	229,355	55,225	755,039	1,039,619	136,614	139,047	165,104	440,765	1,480,384
2011	292,028	64,960	751,793	1,108,781	122,660	204,232	280,029	606,921	1,715,702
2012	241,015	54,380	734,159	1,029,554	120,307	134,468	189,820	444,595	1,474,149

[1] All landed catches 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 non-treaty catches are primarily Alaska hatchery add-ons, but include terminal exclusions is 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.

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	NBC AABM[2]	WCVI AABM[2]	Can ISBM[3]	Can Total	PSC Total[4]
2005	46,016	10,482	72,256	128,754	21,701	14,814	45,526	82,041	210,794
2006	48,000	8,600	98,809	155,409	13,360	11,557	34,013	58,930	214,339
2007	70,719	23,001	94,340	188,060	13,003	12,403	39,884	65,290	253,349
2008	38,127	8,641	66,264	113,032	5,764	12,312	23,914	41,990	155,022
2009	44,893	11,123	74,537	130,553	8,913	15,817	37,783	62,512	193,065
2010	38,353	5,592	83,767	127,712	11,056	16,017	24,638	51,712	179,424
2011	41,700	9,782	98,502	149,983	18,619	17,005	31,400	67,024	217,007
2012	45,608	20,762	85,360	151,729	11,475	16,390	32,287	60,151	211,881

[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 sub-components 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.

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	NBC AABM	WCVI AABM	Can ISBM	Can Total	PSC Total[1]
2005	436,352	113,263	650,167	1,199,782	266,282	214,293	329,262	809,837	2,009,618
2006	409,283	82,822	635,687	1,127,792	229,353	157,042	308,192	694,587	1,822,379
2007	398,708	99,650	523,678	1,022,036	157,342	153,017	274,422	584,781	1,606,816
2008	210,110	80,888	584,794	875,792	101,411	158,038	209,395	468,844	1,344,636
2009	272,560	77,130	520,973	870,663	118,553	140,434	243,858	502,844	1,373,507
2010	267,708	60,817	838,806	1,167,331	147,670	155,064	189,742	492,477	1,659,808
2011	333,728	74,742	850,295	1,258,764	141,279	221,237	311,429	673,945	1,932,709
2012	286,623	75,142	819,519	1,181,283	131,782	150,858	222,107	504,746	1,686,030

[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.

APPENDIX B. ESCAPEMENTS AND TERMINAL RUNS OF PACIFIC SALMON COMMISSION CHINOOK TECHNICAL COMMITTEE CHINOOK SALMON ESCAPEMENT INDICATOR STOCKS, 1975–2012.

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									
	Situk River		Chilkat R.		King Salmon R.		Andrew Creek		Unuk River	
Year	Esc	CV[1]	Esc	CV	Esc	CV[1]	Esc	CV[1]	Esc	CV
1975					64	0.17	507	0.23		
1976	1,421	0			99	0.17	404			
1977	1,732	0			204	0.17	465		4,706	0.12
1978	808	0			87	0.17	388		5,344	0.12
1979	1,284	0			134	0.17	327		2,783	0.12
1980	905	0			106	0.17	282		4,909	0.12
1981	702	0			154	0.17	536		3,532	0.12
1982	434	0			394	0.17	672		6,528	0.12
1983	592	0			245		366		5,436	0.12
1984	1,726	0			265		389		8,876	0.12
1985	1,521	0			175		622	0.23	5,721	0.12
1986	2,067	0			255		1,379	0.23	10,273	0.12
1987	1,379	0			196		1,537	0.23	9,533	0.12
1988	868	0.02			208		1,100	0.23	8,437	0.12
1989	637	0			240		1,034	0.23	5,552	0.12
1990	628	0			179		1,295	0.23	2,856	0.12
1991	889	0.01	5,897	0.17	134		780	0.23	3,165	0.12
1992	1,595	0.01	5,284	0.18	99		1,517	0.23	4,223	0.12
1993	952	0.03	4,472	0.19	266	0.17	2,067	0.23	5,160	0.12
1994	1,271	0.03	6,795	0.16	213	0.17	1,115	0.23	3,435	0.12
1995	4,330	0.04	3,790	0.21	147	0.17	669	0.23	3,730	0.12
1996	1,800	0.10	4,920	0.15	292	0.17	653	0.23	5,639	0.12
1997	1,878	0.11	8,100	0.15	362	0.17	571	0.23	2,970	0.09
1998	924	0.14	3,675	0.15	134	0.17	950	0.23	4,132	0.1
1999	1,461	0.10	2,271	0.18	304	0.17	1,180	0.23	3,914	0.13
2000	1,785	0.08	2,035	0.16	138	0.17	1,346	0.23	5,872	0.11
2001	656	0.03	4,517	0.16	149	0.17	2,055	0.23	10,541	0.11
2002	1,000	0.01	4,051	0.11	155	0.17	1,708	0.23	6,988	0.12
2003	2,117	0.03	5,657	0.12	119	0.17	1,160	0.23	5,546	0.08
2004	698	0.03	3,422	0.13	135	0.17	2,991	0.23	3,963	0.08
2005	595	0.01	3,366	0.17	143	0.17	1,979	0.23	4,742	0.08
2006	295		3,039	0.15	150	0.17	2,124	0.23	5,645	0.08
2007	677		1,442	0.16	181	0.17	1,736	0.23	5,668	0.08
2008	413		2,905	0.19	120	0.17	981	0.23	3,104	0.12
2009	902		4,429	0.17	109	0.17	628	0.23	3,157	0.11
2010	167		1,815	0.13	158	0.17	1,205	0.23	3,835	0.16
2011	240		2,688	0.12	192	0.17	936	0.23	3,195	0.21
2012	322		1,627	0.17	155	0.17	587	0.23	956	0.16
Lower	500		1,750		120		650		1,800	
Upper	1,000		3,500		240		1,500		3,800	

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Year	Southeast Alaska Stocks (cont.)					Transboundary River Stocks					
	Chickamin R. index	Blossom R.		Keta R.		Alsek R.		Taku R.		Stikine R.	
	Esc.[2]	Esc	CV	Esc	CV	Esc	CV	Esc	CV	Esc	CV
1975	370	565	0.62	611	0.56			12,920	0.38	7,571	0.21
1976	157	263	0.62	253	0.56	5,282	0.35	24,582	0.38	5,723	0.16
1977	363	433	0.62	692	0.56	12,706	0.35	29,496	0.38	11,445	0.16
1978	308	553	0.62	1,180	0.56	12,034	0.35	17,124	0.38	6,835	0.21
1979	239	209	0.62	1,282	0.56	17,354	0.35	21,617	0.38	12,610	0.21
1980	445	344	0.62	578	0.56	10,862	0.35	39,239	0.38	30,573	0.16
1981	384	615	0.62	990	0.56	8,502	0.35	49,559	0.38	36,057	0.21
1982	571	1,335	0.62	2,270	0.56	9,475	0.35	23,847	0.38	40,488	0.16
1983	599	2,279	0.62	2,474	0.56	10,344	0.35	9,795	0.38	6,424	0.21
1984	1,102	1,966	0.62	1,836	0.56	7,238	0.35	20,778	0.38	13,995	0.21
1985	956	2,744	0.62	1,878	0.56	6,127	0.35	35,916	0.38	16,037	0.15
1986	1,745	4,946	0.62	2,077	0.56	11,069	0.35	38,110	0.38	14,889	0.15
1987	975	5,221	0.62	2,312	0.56	11,141	0.35	28,935	0.38	24,632	0.15
1988	786	1,486	0.62	1,731	0.56	8,717	0.35	44,524	0.38	37,554	0.15
1989	934	1,331	0.62	3,477	0.56	10,119	0.35	40,329	0.14	24,282	0.15
1990	564	995	0.62	1,824	0.56	8,609	0.35	52,143	0.18	22,619	0.15
1991	487	925	0.62	819	0.56	11,625	0.35	51,645	0.38	23,206	0.15
1992	346	581	0.62	653	0.56	5,773	0.35	55,889	0.38	34,129	0.15
1993	389	1,173	0.62	1,090	0.56	13,855	0.35	66,125	0.38	58,962	0.15
1994	388	623	0.62	921	0.56	15,863	0.35	48,368	0.38	33,094	0.15
1995	356	840	0.62	527	0.56	24,772	0.35	33,805	0.15	16,784	0.15
1996	422	851	0.62	894	0.56	15,922	0.35	79,019	0.12	28,949	0.01
1997	272	511	0.62	740	0.56	12,494	0.35	114,938	0.16	26,996	0.11
1998	391	364	0.18	446	0.1	6,833	0.33	31,039	0.38	25,968	0.15
1999	492	820	0.62	968	0.11	14,597	0.24	16,786	0.19	19,947	0.16
2000	801	894	0.62	914	0.11	7,905	0.25	34,997	0.15	27,531	0.12
2001	1,010	789	0.62	1,032	0.56	6,705	0.41	46,554	0.15	63,523	0.09
2002	1,013	867	0.62	1,237	0.56	5,569	0.61	55,044	0.2	50,875	0.12
2003	964	786	0.62	969	0.56	5,904	0.44	36,435	0.18	46,824	0.13
2004	798	734	0.09	1,132	0.56	7,083	0.52	75,032	0.14	48,900	0.08
2005	924	926	0.09	1,496	0.56	4,478	0.35	38,725	0.12	40,501	0.07
2006	1,330	1,270	0.12	2,248	0.56	2,323	0.35	42,296	0.13	24,405	0.28
2007	893	522	0.62	936	0.56	2,827	0.35	14,854	0.22	14,560	0.15
2008	1,111	995	0.62	1,093	0.56	1,885	0.35	27,383	0.09	18,352	0.16
2009	611	476	0.62	659	0.56	6,239	0.35	22,801	0.12	11,086	0.23
2010	1,156	1,405	0.62	1,430	0.56	9,518	0.35	29,302	0.09	15,180	0.13
2011	852	569	0.62	671	0.56	6,668	0.35	27,523	0.15	14,569	0.11
2012	444	793	0.62	725	0.56	2,660	0.35	19,429	0.12	22,671	0.17
Lower	450	565		525		3,500		19,000		14,000	
Upper	900	1,160		1,200		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 harvest above the weir. A weir was also in place for a few years at the King Salmon River and Andrew Creek.

[2] Escapement is enumerated using index counts on the Chickamin, Blossom, and Keta rivers and these counts are not expanded to an estimate of total escapement; therefore, CVs are not applicable.

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 Atnarko R.		Area 9 Rivers	Area 10 Smith
Year	Esc	Above GW[1]	Esc	t. run	Esc	t. run	index	Esc	CV	Inlet	Inlet[2]
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	39,606		10,800		2,225	1,050
1978	600	15,485	16,885	21,807	22,661	35,055	3,500	13,500		2,800	2,100
1979	400	11,253	12,783	16,229	18,488	28,166	4,000	4,050		2,150	500
1980	600	13,476	14,855	18,744	23,429	38,626	2,000	6,480		2,325	1,200
1981	750	12,625	13,925	17,606	24,523	42,018	3,500	4,050		3,175	1,020
1982	1,400	7,959	10,359	13,287	17,092	35,185		7,200		2,250	1,500
1983	600	13,252	16,301	20,516	23,562	39,510	500	7,740		3,320	1,050
1984	300	20,967	24,967	31,408	37,598	53,516	4,500	13,788		1,400	770
1985	1,500	17,782	19,694	24,768	53,599	76,544	4,000	24,804		3,371	230
1986	500	36,523	38,123	47,967	59,968	87,566	3,300	19,170		7,623	532
1987	2,000	19,540	20,986	26,568	59,120	76,349	1,144	12,983		5,239	1,050
1988	2,000	15,345	16,715	21,094	68,705	102,563	1,300	13,500		4,429	1,050
1989	2,800	28,133	29,175	36,594	57,202	83,439	2,300	19,800		3,265	225
1990	2,000	24,051	26,551	33,384	55,976	89,447	2,000	15,300		4,039	510
1991	1,900	6,907	8,259	13,136	52,753	79,343	2,400	16,020		6,635	500
1992	2,000	16,808	17,408	25,405	63,392	92,184	3,000	24,300		7,500	500
1993	1,000	24,814	26,508	36,678	66,977	96,018	700	31,500		10,000	500
1994	2,000	21,169	25,689	32,864	48,712	68,127	1,300	24,120		3,500	700
1995	1,500	7,844	8,776	16,187	34,390	48,351	1,100	28,800		3,196	400
1996	3,000	21,842	22,712	30,889	73,684	96,453	2,000	22,500		3,000	250
1997	2,500	18,702	20,584	27,658	42,539	65,350	1,400	16,200		4,980	100
1998	3,000	23,213	25,361	34,922	46,744	65,167	3,000	19,800		5,367	1,100
1999	3,200	11,544	13,118	22,310	43,775	70,993	1,800	22,500		2,739	500
2000	3,600	18,912	20,565	31,159	51,804	77,320	1,200	22,500		6,700	500

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Year	Northern British Columbia										
	Area 1 Yakoun R.	Area 3[1] Nass R.			Area 4 Skeena R.		Area 8 Dean R.	Area 8 Atnarko R.		Area 9 Rivers	Area 10 Smith
Year	Esc	Above GW[1]	Esc	t. run	Esc	t. run	index	Esc	CV	Inlet	Inlet[2]
2001	3,500	29,687	31,915	44,595	81,504	112,346	3,795	20,044	.059	5,062	300
2002	3,000	13,773	15,382	21,528	44,771	63,069	3,731	14,651	.122	5,031	
2003	4,000	26,940	28,330	36,503	56,758	82,410	3,700	12,027	.084	1,900	
2004	4,500	15,912	18,185	25,137	44,243	61,065	3,500	15,840		3,950	
2005	5,000	14,363	16,595	24,067	29,067	39,278	2,200	15,750		5,585	
2006	NA	24,725	27,743	37,098	33,094	43,689	3,700	23,400		3,930	
2007	NA	21,459	25,524	34,221	33,352	44,185	2,300	9,900		5,000	
2008	NA	17,862	20,198	26,202	32,963	54,279	1,100	8,100		5,792	
2009	NA	28,710	30,334	36,865	38,297	55,921	1,400	9,231	.072	4,580	
2010	NA	19,341	20,821	26,052	43,331	54,252	1,600	9,198	.113	4,225	
2011	NA	9,639	10,415	15,092	37,073	46,683	750	9,105	.126	4,400	
2012	NA	8,309	9,815	15,086	34,024	38,065	NA	5,800	.156	3,970	

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

[2] 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.

	LGS		UGS[1]					
Year	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	2,313	17,614	267	4	20	20,219
Goal		6,500						

Note: Refer to List of Acronyms for definitions.

[1] Upper Strait of Gerogia (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
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	16,423	42,408	85,132	34,886	221,020	89,968	.082	91,122	54,219	0.017
2003	17,137	45,441	70,164	44,451	231,689	247,121	.083	251,453	32,921	0.344
2004	12,156	31,614	53,764	30,980	194,440	128,990		131,894	16,963	0.045
2005	3,898	21,458	88,329	18,586	172,281	88,580	.063	94,880	17,892	0.031
2006	6,642	21,699	149,928	20,565	242,878	60,422	.135	62,419	59,085	0.024
2007	1,407	11,737	85,722	10,536	137,206	76,483	.068	80,718	15,926	0.027
2008	6,121	17,181	106,539	15,431	187,591	41,603	.073	43,798	14,921	0.037
2009	911	24,150	86,443	20,619	172,858	70,141	.064	75,550	25,113	0.018
2010	6,576	18,029	156,657	18,229	199,491	103,515	.056	106,777	71,379	0.021
2011	2,233	12,104	127,958	18,570	215,499	123,647	.052	132,021	18,874	0.029
2012	7,314	11,584	47,949	1,080	127,845	44,467	.086	56,859	3,958	0.030
Goal						75,100				
Goal						98,500				

[1]Escapement was estimated by mark–recapture 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 mark–recapture 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)																	
	Skagit River Spring		Skagit River Sum/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]	Esc	t. run	MR esc[2]	Esc	t. run	N. Fork	S. Fork	Esc	t. run
1975	627	627	11,320	30,299		1,198	1,801	4,485	6,627		3,394	6,838			656	1004
1976	633	633	14,120	28,589		2,140	4,241	5,315	10,544		3,140	8,246			719	937
1977	520	520	9,218	21,502		1,475	2,847	5,565	10,676		3,804	5,936			675	889
1978	932	932	13,075	24,285		1,232	2,159	7,931	13,672		3,304	4,766			890	1353
1979	818	818	13,306	24,350		1,042	2,531	5,903	13,743		9,704	11,689			1,289	1578
1980	1,408	1,408	20,058	31,250		821	2,818	6460	17,653		7,743	11,248			1,360	1683
1981	1,045	1,045	8,283	21,817		630	3,014	3368	9,991		3,606	5,532			721	924
1982	753	753	9,910	24,259		773	3,229	4379	9,429		1,840	4,271			885	1384
1983	554	554	8,723	15,758		387	1,089	4549	11,236		3,679	14,376			1,332	2515
1984	696	696	12,628	15,616		374	920	3762	8,975		3,353	5,890	45	188	1,252	4211
1985	2,634	2,634	16,002	26,230		1,409	2,717	4,873	9,637		2,908	7,914	258	445	949	2627
1986	1,922	1,922	17,908	22,906		1,277	2,499	4,534	8,969		4,792	6,114	226	170	1,470	2863
1987	1,745	1,745	9,409	13,387		1,321	1,982	4,689	7,107		10,338	12,283	181	248	2,038	4835
1988	1,743	1,743	11,468	15,262		717	1,245	4,513	7,933		7,994	9,667	456	233	792	2829
1989	1,400	1,809	6,684	13,270		784	1,664	3,138	6,379		11,512	15,244	303	606	1,011	1544
1990	1,511	1,546	16,521	18,950		842	1,867	4,209	8,562		7,035	15,483	10	142	787	1098
1991	1,236	1,273	5,824	8,604		1,536	2,969	2,783	5,151		10,548	15,451	108	365	661	1115
1992	986	1,010	7,348	9,021		639	1,279	2,708	4,448		5,267	10,165	498	103	790	1212
1993	782	812	5,801	7,097		719	1,259	3,866	5,609		2,476	5,507	449	235	245	324
1994	470	496	5,549	5,912		773	1,323	3,626	5,039		4,078	8,368	45	118	888	926
1995	855	887	6,877	9,239		775	1,495	3,176	3,370		7,939	9,935	230	290	930	966
1996	1,051	1,078	10,613	10,828		1,244	2,276	4,851	4,877		6,026	8,664	534	203	336	362
1997	1,041	1,064	4,872	6,092		1,156	17,298	4,292	4,382		7,101	7,778	520	180	294	302
1998	1,086	1,091	14,609	14,965		1,544	2,434	6,304	6,376		5,963	7,777	368	157	697	711
1999	471	476	4,924	5,229		1,098	2,264	4,799	4,839		7,135	8,376	823	166	778	791
2000	1,021	1,025	16,930	17,265		1,645	3,065	6,092	6,120	10,526	4,473	6,880	1,245	284	347	393
2001	1,856	1,866	13,793	14,046		1,349	2,051	8,164	8,464	21,402	6,473	9,721	2,209	267	1,269	1555
2002	1,076	1,092	19,591	19,911		1,588	2,219	7,220	7,266	14,857	7,564	11,539	3,741	289	637	663
2003	909	987	9,777	10,106		988	1,320	5,447	5,597		5,864	7,871	2,857	204	771	826

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Puget Sound (includes hatchery strays in natural escapement)																	
	Skagit Spring		Skagit Sum/fall		Stillaguamish			Snohomish		Green			Nooksack Spring Esc		Lake Washington Fall	
Year	Esc	t. run	Esc	t. run[1]	MR esc[2]	Esc	t. run[1]	Esc	t. run	MR esc[2]	Esc	t. run	N. Fork	S. Fork	Esc	t. run
2004	1,622	1,622	23,553	24,107		1,506	1,974	10,606	10,701		7,947	13,498	1,746	130	730	794
2005	1,305	1,305	20,803	23,405		1,036	1,493	4,484	4,680		2,523	2,987	2,167	120	726	788
2006	1,896	1,919	20,768	22,539		1,254	1,543	8,308	8,481		5,790	8,604	1,184	355	1,219	1433
2007	613	613	11,281	13,027	1,881	607	866	3,982	4,004		4,301	7,205	1,438	182	1,968	3342
2008	1,472	1,472	11,664	14,995	1,836	1,671	1,861	8,373	8,494		5,971	10,290	1,266	318	941	2917
2009	983	983	6,955	12,460	1,110	1,001	1,218	2,161	2,347		688	1,067	1,903	294	793	951
2010	1,361	1,537	8,037	9,060	1,381	783	1,014	4,299	4,697	4,541	2,092	2,112	2,044	377	729	734
2011	825	1,015	5,536	9,181		1,017	1,413	1,880	1,892		993	1,464	875	124	906	1,034
2012	2,774	3,278	13,817	15,442		1,534	1,924	5,123	5,306		3,091	3,804	759	466	1,674	1,875

[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 mark–recapture studies funded under Sentinel Stocks Program and/or U.S. Letter of Agreement.

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	13,951	21,534
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	19,023	30,861
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	27,216	36,778
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	25,599	52,777
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	16,580	36,821
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	13,432	29,158
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	13,175	24,162
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	11,844	24,487
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	11,817	24,015
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	9,952	23,570
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	16,988	26,618
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	16,342	26,948
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	11,476	17,368
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	9,196	10,859
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	8,081	13,010
2001	1,255	1,429	5,136	7,545	1,159	1,231	2,560	4,116	768	946	548	565	3,099	4,808	2,860	3,326	8,340	17,109

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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	2,589	5,561	2,598	3,217	10,621	13,942
2003	1,219	1,262	7,398	9,469	1,228	1,646	1,649	2,345	863	1,098	189	195	4,979	6,618	1,904	2,101	17,808	19,488
2004	1,093	1,189	3,831	6,133	1,786	2,239	3,237	4,410	866	1,086	604	619	5,105	6,797	5,034	5,330	29,461	38,161
2005	876	965	6,406	8,319	1,193	1,389	4,180	5,337	203	284	298	306	4,557	6,734	2,130	2,683	17,040	19,599
2006	553	604	5,642	7,646	904	1,061	1,535	2,324	845	895	330	336	3,051	4,258	2,481	2,863	15,955	20,482
2007	502	568	3,066	4,137	810	1,023	1,556	2,427	462	568	352	358	878	1,600	652	999	11,264	15,126
2008	949	1,134	3,612	5,250	671	717	2,849	3,761	431	483	305	305	2,790	4,157	996	1,282	13,570	15,666
2009	464	682	3,130	5,874	880	913	2,081	2,851	103	385	495	495	4,156	5,939	1,133	1,358	7,215	10,832
2010	659	828	4,635	6,431	828	861	2,599	2,941	319	793	382	382	4,022	6,032	3,497	3,704	14,531	18,802
2011	600	995	3,993	7,207	827	948	1,293	2,157	1,275	1,504	373	373	3,928	6,479	2,563	2,664	18,311	26,553
2012	731	845	3,181	6,416	915	1,055	1,937	3,015	401	620	764	764	3,993	5,392	959	959	10,341	12,081
Goal			3,000		900		1,200				700		2,500					

[1] Escapement excludes brood stock for supplementation program. Total run includes redd count based escapement, terminal catch, and adult brood stock collected for supplementation and Pacific Salmon Commission indicator program.

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

	Columbia Upriver Springs[1]						Columbia Upriver Summers[2]		Lewis River Fall Chinook salmon [3]		Columbia Upriver Fall Chinook salmon				
	Upper Col. R.		Snake R. Spr/Sum		Total[1]						Deschutes River[4]			Upriver brights[5]	
Year	Esc	t.run	Esc	t.run	Esc	t.run	Esc	t.run	Esc	t.run	Esc	Esc	t.run	Esc	t.run
												Above			
1975									13,859	13,859	Mark	Falls		29,600	163,833
1976									3,371	3,371	Recapture	Expanded		27,700	109,076
1977									6,930	6,930		7,903	9,764	36,060	85,336
1978									5,363	5,363		5,393	7,364	25,798	77,936
1979							18,797	22,142	8,023	8,023		5,126	6,718	28,926	82,482
1980	2,772	7,128	6,134	20,968	8,906	28,096	13,854	22,498	16,394	16,856		4,106	6,057	27,708	70,743
1981	3,253	6,056	11,318	24,774	14,571	30,830	8,639	18,746	19,297	20,298		6,070	7,907	19,520	58,693
1982	3,015	6,328	11,307	27,628	14,322	33,956	6,587	14,369	8,370	10,126		5,513	7,529	28,313	71,471
1983	4,286	7,299	9,845	20,948	14,131	28,247	6,334	13,145	13,540	14,489		5,491	6,987	45,567	79,113
1984	4,608	6,725	7,929	14,126	12,537	20,851	13,984	18,765	7,132	8,128		2,779	3,749	52,266	127,651
1985	8,941	10,311	10,682	14,866	19,623	25,177	14,505	18,522	7,491	8,241		7,902	8,709	74,206	187,691
1986	5,519	7,931	11,359	20,096	16,878	28,027	14,850	18,752	11,983	13,504		7,467	8,620	93,051	272,949
1987	6,352	8,783	10,140	15,874	16,492	24,657	13,415	22,715	12,935	14,173		9,187	11,244	126,153	409,412
1988	5,658	7,507	11,182	17,369	16,840	24,876	13,634	22,720	12,059	13,636		9,548	11,939	98,220	327,976
1989	4,130	7,476	6,499	14,722	10,629	22,198	17,484	22,201	21,199	22,813		6,339	8,069	83,281	253,233
1990	2,808	4,446	9,357	17,596	12,165	22,042	13,432	18,794	17,506	18,784		2,864	3,834	49,020	149,759
1991	1,533	2,442	5,756	13,115	7,289	15,557	10,191	14,323	9,066	10,354		5,374	5,528	40,132	97,758
1992	3,163	4,272	12,677	20,676	15,840	24,948	7,706	9,428	6,307	7,129		3,668	3,705	41,434	77,311
1993	3,102	4,062	12,531	17,928	15,633	21,990	12,927	14,021	7,025	8,106		8,809	8,820	42,515	94,088
1994	611	1,045	1,856	3,721	2,467	4,766	12,292	14,691	9,939	10,541		9,556	9,625	66,645	123,214
1995	108	225	1,167	3,399	1,275	3,624	10,623	12,455	9,718	12,155		9,304	9,340	50,595	97,119
1996	317	577	3,643	9,042	3,960	9,619	9,417	12,080	13,971	13,971		10,233	10,311	53,049	132,882
1997	746	1,224	5,055	9,565	5,801	10,789	10,063	17,709	8,670	8,670		20,208	20,341	50,215	141,386
1998	367	548	7,281	13,762	7,648	14,310	11,225	15,536	5,929	5,929		15,908	16,415	42,113	125,886
1999	284	403	2,853	5,770	3,137	6,173	18,588	21,867	3,184	3,184		7,389	7,762	43,313	158,044
2000	904	1,370	8,187	13,856	9,091	15,226	20,218	22,595	9,820	9,820		4,985	5,392	60,988	150,352

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Year	Columbia Upriver Springs[1]						Columbia Upriver Summers[2]		Lewis River Fall Chinook salmon [3]		Columbia Upriver Fall Chinook salmon				
	Upper Col. R.		Snake R. Spr/Sum		Total[1]						Deschutes River[4]			Upriver brights[5]	
	Esc	t.run	Esc	t.run	Esc	t.run	Esc	t.run	Esc	t.run	Esc	Esc	t.run	Esc	t.run
2001	4,807	6,263	44,572	63,401	49,379	69,664	48,844	52,960	13,886	14,186	9,527	12,817	9,861	84,652	222,630
2002	1,957	2,995	29,872	52,746	31,829	55,741	86,825	89,524	16,380	18,230	11,133	11,907	12,125	116,858	265,144
2003	1,554	2,165	32,080	51,369	33,634	53,534	81,543	83,058	18,505	20,505	14,265	13,413	15,343	161,136	357,848
2004	1,638	2,305	20,967	33,498	22,605	35,803	62,311	65,623	15,342	17,133	10,197	10,197	11,421	149,529	356,437
2005	2,057	2,779	9,832	15,274	11,889	18,053	54,033	60,272	11,348	13,348	9,355	14,937	10,190	111,721	258,554
2006	920	1,441	9,340	16,820	10,260	18,261	61,821	77,573	10,522	11,999	14,196	14,223	14,981	76,722	215,407
2007	448	521	6,903	10,614	7,351	11,135	28,222	37,035	3,468	3,606	13,181	12,721	13,968	45,652	98,657
2008	694	856	17,171	24,040	17,865	24,896	38,171	55,532	5,200	5,200		6,908	7,614	74,386	189,681
2009	1,089	1,089	14,313	20,399	15,402	21,488	44,295	53,881	5,410	5,760		6,429	7,116	85,759	204,932
2010	2,399	3,017	25,211	34,934	27,610	37,951	47,220	72,346	8,701	8,701		9,275	10,066	167,007	314,842
2011	1,649	2,020	23,844	30,684	25,493	32,704	44,432	80,574	8,009	11,025		17,117	18,168	130,395	305,940
2012	3,738	4,763	24,828	33,723	28,566	38,486	52,184	58,300	8,143	8,450		17,624	18,785	131,613	276,483
Goal							12,143		5,700			4,532		40,000	

[1] For the purposes of U.S. v. Oregon management and tribal treaty/non-treaty 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). Previously, escapements were obtained as the product of terminal run fish not subsequently caught, the percent destined for the upper Columbia, and percent destined to spawn naturally. The reporting methodology was changed for consistency, stability and simplicity, and should provide for adequate analysis of escapement trends for Columbia Upriver Springs overall.

[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.

[3] 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.

[4] The first column gives the estimate based on a mark–recapture 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 done by Warm Springs, ODFW and CRITFC staff (Sharma, R, J. Seals, J. Graham, E. Clemons, H. Yuen, M. McClure, K. Kostow, and S. Ellis. 2010. Deschutes River Chinook spawner escapement goal using U.S. v. Oregon Technical Advisory Committee data. Unpublished Report).

[5] 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.

Appendix B.9.–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	NA	9,300	NA
Goal	6,989		2,944		12,925		pending	

Appendix B.10.–Oregon Coastal escapements and terminal runs (t. run) as estimated by mark–recapture calibrated indexes of Pacific Salmon Commission Chinook Technical Committee wild Chinook salmon escapement indicator stocks. Those estimates presented in boldface represent estimates generated from direct mark–recapture study.

	Oregon Coastal						
	Nehalem R.		**Siuslaw R.**		**Umpqua R. S. Fork**	**Coquille R.**	
Year	**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	**11,568**	**13,832**	4,648	8,506	3,140	7,880	10,170
2001	**12,431**	**16,767**	16,814	21,933	6,510	**12,512**	**16,286**
2002	**19,956**	**24,524**	**22,506**	**29,353**	3,831	**13,675**	**17,405**
2003	**24,196**	**28,385**	**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	**14,884**	**18,813**	3,084	5,438	6,176
2006	11,938	13,129	11,815	14,850	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	**5,332**	**5,440**	5,237	7,024	3,014	15,653	16,875
2010	7,250	**9,120**	11,165	14,813	6,184	41,104	45,726
2011	**11,143**	**13,258**	11,909	17,742	7,550	21,291	25,697
2012	**12,952**	**15,505**	16,023	NA	5,635	11,828	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 2012

The Sentinal Stocks Committee (SSC) of the Sentinel Stocks Program (SSP) met in Seattle during December 2011 to review progress for projects funded in 2011 and to develop a request for proposals for projects in 2012. In response, the SSC was provided with 17 proposals for work in 2012. The SSC met in Vancouver from 29 January through February 1, 2012 to review proposals and 14 of the 17 submitted proposals were recommended for SSP funding in 2012. In February 2012, the PSC approved funding for all 14 proposals. The proposals were chosen as per the approach outlined in the directive from the Commission to the SSC 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, west coast of Vancouver Island, 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. Final funded projects and budget amounts for the 2012 SSP are summarized in Appendix Table C.1. Summaries of results from these funded projects are provided in the narratives below.

Table C.1.–Projects and funding levels for the SSP in 2012.

Stock Group	Stock	Title	2012 Funding
Oregon Coast	Nehalem River	Nehalem R. Chinook Escapement Enumeration	$301,100
Oregon Coast	Siletz River	Siletz River Chinook Escapement Enumeration	$228,900
Puget Sound	Green River	Abundance Estimate for Green River Chinook	$141,900
Puget Sound	Stillaguamish River	Abundance Estimate for Stillaguamish Chinook	$71,500
Puget Sound	Snohomish River	Abundance Estimate for Snohomish Chinook	$217,800
WCVI	Burman River	Burman River Chinook Escapement Estimation	$176,100
WCVI	Multiple	Marble, Tahsis & Leiner Survey Life	$219,000
WCVI	WCVI rivers	Statistical Framework	$30,000
Fraser	S. Thompson River	Abundance Estimate S. Thompson Aggregate	$160,800
Fraser	Chilko River	Chilko River Chinook mark–recapture	$224,000
Fraser	Harrison Rover	Harrison Radiotelemetry	$51,100
NBC	Nass River	Estimate of Aggregate Population in Upper Nass	$108,600
NBC	Skeena River	Escapement Estimation of Skeena River w/ GSI	$35,800
NBC	Skeena River	Retrospective Escapements of Skeena R. w/ GSI	$191,000

Note: Refer to List of Acronyms for definitions.

C.1. Nehalem and Siletz River Chinook Salmon Escapement Enumerations in 2012

The Siletz and Nehalem populations of fall Chinook salmon are part of the NOC aggregate. The Nehalem basin is located at the far north of the NOC aggregate, while the Siletz basin is located approximately midway within the NOC aggregate of stocks. The NOC aggregate has historically been a very productive, resilient stock complex; however failures to reach escapement goals in the late 2000s prompted the need to better quantify performance of this group. The prior 10-year average (2002–2011) of adult spawning escapement of Chinook salmon in the Siletz River was 5,201 individuals. In the Nehalem River, the prior 10-year average (2002–2011) was 7,686 adult Chinook salmon.

Under the SSP, the ODFW estimated spawning escapement using standard mark–recapture methods. Adult fish were captured upon return to each basin using tangle nets in both basins. A modified fish ladder was also used in the Nehalem River. The ODFW marked fish using operculum punches, the location of which was varied to represent different time frames of freshwater entry. The second capture event(s) (recovery) occurred on the spawning grounds. ODFW examined carcasses for marks and collected biological data from carcasses when possible (e.g., MEPS length, sex, scales, and other marks). In 2012, a mark–recapture study on the North Fork Nehalem River was also implemented. The mouth of the North Fork is downstream of the usual marking location on the mainstem (South Fork) Nehalem. The ODFW captured and marked Chinook salmon in the North Fork using tangle nets and rod and reel. Recapture events included both spawning ground surveys and ongoing trapping activities at Waterhouse Falls near the NF Nehalem Hatchery.

The ODFW evaluated the likelihood that mark–recapture assumptions were violated using chi-square analyses and Stratified Population Analysis System (SPAS). Then, depending on the results of these tests and the data collected, the ODFW applied the best (least biased and most precise) estimation techniques for the data. The ODFW estimated population size from mark–recapture data in the Nehalem basin using the Chapman version of the Petersen equation. The ODFW used a stratified estimator (Darroch maximum likelihood, SPAS software) to derive a total estimate for the Siletz basin. The Siletz strata were chosen to represent differences in terms of timing of freshwater entrance and carcass recovery rates. The ODFW also conducted tests for size bias using cumulative size distributions and Kolmogorov-Smirnov tests for adult Chinook salmon. These tests suggested possible biases at our initial sampling events; therefore, the age and sex composition data from the recovery events were used to apportion the final estimates. The ODFW conducted creel surveys in both the Siletz and Nehalem basins. The intent of the creel surveys was to adjust escapement estimates accordingly to account for harvest above marking sites and to generate timely and robust estimates of terminal harvests.

The ODFW estimates escapement in Oregon coastal basins using habitat-expansion methodology in addition to mark–recapture estimations. Standardized spawning ground surveys are conducted to record live and dead counts of Chinook salmon. The largest daily sum of live and dead counts for a given survey location (the 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). The ODFW applies additional functions to adjust for likely observation error and non-random bias. Agency personnel have calculated estimates using these traditional methods while concurrently conducting mark–recapture experiments in the Siletz basin since 2005 (Table C.2) and in the Nehalem basin from 2000 to 2003 and from 2009 to 2012 (Table C.3).

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

Run Year	Traditional Estimate	Standard Survey Index (fish/mile)	Mark–Recapture Estimate	CV of Mark–Recapture Estimate
2005	6,426	48	14,355	63%
2006	4,108	30	15,891	21%
2007	528	4	2,625	16%
2008	1,203	9	1,202	20%
2009	2,905	21	2,213	12%
2010	4,225	31	10,985	43%
2011	3,638	26	4,985	7%
2012	4,871	35	8,738[1]	19%

[1] Value reflects a stratified Darroch estimation, additional analyses required to assess the influence of potential biases on the accuracy of the estimate.

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

Run Year	Traditional Estimate	Standard Survey Index (fish/mile)	Mark–Recapture Estimate	CV of Mark–Recapture Estimate
2000	6,855	56	10,678	26%
2001	11,662	96	12,431	12%
2002	18,089	112	19,956	5%
2003	10,906	87	21,283	22%
2009	5,390	34	5,786	18%
2010	5,384	34	7,097	12%
2011	7,665	49	11,084	14%
2012	7,515	48	12,952	19%

In 2012, the ODFW marked a total of 351 adult Chinook salmon in the Siletz River basin. A total of 1,290 adult carcasses were recovered on the spawning grounds; 58 of which were marked (~17% recovery rate). The escapement was estimated to be 8,994 (SE = 1,465) Chinook salmon using the stratified Darroch maximum likelihood estimator (2 × 2 matrix). The CV is 16%. The 2012 terminal in-river regulations allowed for angling above the marking site. Harvest above the marking site was estimated to be 256 adults (SE = 211), and reduced the spawning escapement estimate to 8,738 Chinook salmon adults. The SEs from the harvest and mark–recapture estimate were added to provide an overall SE estimate of 1,676 and a CV of 19%.

In 2012, the ODFW marked a total of 674 adult Chinook salmon in the Nehalem River. A total of 503 adult carcasses were recovered on the spawning grounds; 25 of which were marked (~4% recovery rate). Assumption testing supported the use of the pooled estimator which produced an estimate of 13,084 (SE = 2,405, CV = 18%) adult Chinook salmon. After adjusting for the area-specific harvest above the marking site (132 fish, SE = 69), an estimate of 12,952 (SE = 2,474, CV = 19%) adult Chinook salmon spawning in the river was developed. The CV of the estimate is above the CTC standard of 15%. In 2012, earlier high water occurred in the Nehalem River during what was likely the peak spawning time for the upper basin summer run fish. A low recovery rate of early returning fish occurred, likely contributing to the higher than desired CV.

Two ODFW crew members were dedicated to a mark–recapture study on the north fork. They marked a total of 27 adult Chinook salmon. During the second event, they examined 140 fish, of which 5 were recaptures (~19% recovery rate). A pooled Petersen estimate of 657 adult Chinook salmon was developed (SE = 216, CV = 33%). A fishery took place in the north fork above the marking site that harvested 78 Chinook salmon. Therefore, it was estimated that 579 adult Chinook salmon spawned in the north fork in 2012.

Previous studies in the Siuslaw, Umpqua, Coos, Coquille and Salmon rivers explored the use of a visual index gathered from the spawning ground surveys to represent accurate and relatively precise estimates of spawner abundance for Chinook salmon. Various survey indices, including but not limited to peak, live AUC, redds, and sum of dead counts were calibrated to mark–recapture derived escapement estimates to determine which index best represents true abundance over a period of years. Results from these studies suggest that peak counts are the most consistent indicator of abundance. These studies indicate that the indices derived using counts from both mainstem and tributary habitat correlated best. Given future and current constraints around personnel and funding resources, this research has focused on identifying surveys from both mainstem and tributary reaches where peak counts or other indices are most likely to adequately track abundance.

Preliminary calibration analysis of spawning ground surveys and mark–recapture experiments from the Nehalem and the Siletz river basins have been conducted. Values presented as calibration value represent the visual index divided by the mark–recapture estimate. The ideal conversion factor would have an inter-annual CV of zero if it tracks perfectly with changes in spawner abundance (Tables C.4 and C.5). Variability in the inter-annual CV is likely underestimated as this descriptive statistic does not incorporate the precision of the population estimate used, nor does it incorporate the variability within the survey index.

Results from standard survey calibration efforts using peak counts in the Nehalem River basin suggest a relatively strong relationship (CV = 24%; see Table C.4). Bias detected in some of the mark–recapture estimates may exclude these abundance estimates from the calibration analysis, thus additional studies may be necessary to improve confidence in the index relationship. Additional years of data in the North Fork Nehalem River are needed.

Table C.4.–Calibration of index values from Chinook salmon (>600 mm) encountered on standard spawning ground surveys to mark–recapture estimates in the Nehalem River basin.

Run Year	Traditional Estimate	Mark–Recapture Estimate	CV of Mark–Recapture Estimate	Index (fish/mile)	Calibration Value (fish/mile)
2000	6,855	10,678	26%	56.0	0.00524
2001	11,662	12,431	12%	95.8	0.00770
2002	18,089	19,956	5%	112.3	0.00563
2003	10,906	21,283	22%	86.5	0.00406
2009	4,070	5,786	18$	29.1	0.00503
2010	5,384	7,097	12%	31.0	0.00436
2011	7,665	11,084	14%	46.1	0.00416
		Calibrated Index CV			**24.4%**

Note: The index value is an annual average from four surveys totaling 3.5 miles. The calibrated index CV represents the variation around the calibration value over the seven years of study. The fish/mile index represents the average from all surveys of the maximum sum of live and dead Chinook salmon encountered on a given day.

Table C.5.–Calibration of two index values from Chinook salmon (>600 mm) encountered on select spawning ground surveys to mark–recapture estimates in the Siletz basin.

Run Year	Traditional Estimate	Mark–Recapture Estimate	CV of Mark–Recapture Estimate	Index (fish/mile)	Calibration Value (fish/mile)
2005	6,426	14,355	63%	84	0.00585
2006	4,108	15,891	21%	131	0.00824
2007	528	2,625	16%	26	0.00990
2008	1,203	1,202	20%	16	0.01331
2009	2,905	2,213	12%	24	0.01085
2010	4,225	10,985	43%	42	0.00382
2011	3,638	4,985	7%	48	0.00963
		Calibrated Index CV			**36.0%**

Note: The calibrated index CV represents the variation around the calibration value over the seven years of study. The fish/mile index represents the average from all surveys of the maximum sum of live and dead Chinook salmon encountered on a given day.

The relationship of visual indices from Siletz River standard surveys have not correlated well with the mark–recapture estimates. The ODFW hypothesizes that one reason for this poor relationship is that the standard surveys in the Siletz River represent smaller, tributary type habitat which is not typically productive Chinook salmon habitat. In basins where the relationship between the standard surveys and the mark–recapture estimate is strong (i.e. Siuslaw and Salmon rivers), the standard surveys occur in habitats more typical of Chinook salmon spawning habitat. All of the standard surveys in the Siletz River are located in small tributary reaches, and this may explain the poor calibration results. The ODFW has identified some select mainstem surveys in the Siletz River basin where a visual index of abundance used in conjunction with tributaries appears to track abundance far better than the standard surveys. A peak count index and the sum of dead index from three surveys totaling 3.2 miles appear to be relatively good indicator of abundance in the basin (Table C.4).

The ODFW intends to identify a cost effective spawning ground survey design in which one or more of the measured metrics accurately and precisely represents Chinook salmon spawner abundance for the basin within the data standards developed by the CTC. The ODFW believes they can identify survey reaches in which Chinook salmon counts will more consistently track the spawner estimate derived through the mark–recapture methods across a range of run sizes and environmental conditions. The ODFW intends to survey such select mainstem and/or large tributary reaches annually throughout the duration of these studies. Such analysis will require multiple years of statistically sound mark–recapture experiments before a complete assessment of survey results can be performed with acceptable levels of certainty. The ODFW is also exploring a weighted least squares regression approach to determine the relationship between visual indices and the mark–recapture estimates of abundance. This technique may allow researchers to include study years where abundance estimates did not meet the precision standards necessary for the calibration approach. Using this approach, annual spawner escapement could be estimated from the regression equation and confidence bounds derived using peak count data.

C.2. Abundance Estimate for Green River Chinook Salmon in 2011

The Green River summer/fall Chinook salmon population is one of five Chinook salmon 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. Based on red count surveys, the 2000 to 2009 average estimated escapement in the Green River was 6,118 Chinook salmon.

The WDFW estimated the abundance of Chinook salmon spawning in the Green River using GMR abundance estimates. Spawning adults were marked by obtaining a DNA microsatellite profiles from tissues sampled from adult carcasses (first sampling event). Marks were later recaptured by sampling out-migrating smolt offspring (second sampling event) and genetically identifying some fraction of marks as parents of some out-migrating offspring. Tissues from 382 Chinook salmon adult carcasses were collected in fall 2011. Tissues from 2,548 migrating smolt offspring of adults that spawned in fall 2011 were collected in spring of 2012 at a smolt trap in the Green River, upstream of the mouth of Soos Creek. Adults and a representative sub-sample (n = 1,996) 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 × 2), and recaptures were then used in a pooled Petersen mark–recapture 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. These were used in a pooled Petersen mark–recapture estimate of spawner abundance based on hypergeometric sampling and in a rarefaction curve estimate of the number of successful breeders.

The WDFW obtained genotypes for 328 marks, 1,902 juveniles, and, through parentage analysis, 368 recaptures. Using these data, the WDFW obtained preliminary unadjusted estimates of the binomial model GMR estimate of Chinook salmon spawner abundance. The 2011 spawner abundance estimate for upstream of the smolt trap was 3,382 (95% CI = 3,055–3,710) Chinook salmon. Performance standards will be met with GMR for 2011 (CV = 4.9%). The preliminary GMR abundance estimate for upstream of the smolt trap was almost 3.5 times the 2011 estimate for the entire Green River made using redd counts (993), which was similar to patterns seen in the 2010 GMR abundance estimate and to estimates made using traditional mark–recapture methods made in 2000, 2001, and 2002. In the final report, the WDFW will adjust the escapement estimate for the few adipose intact hatchery juveniles that escaped from rearing facilities upstream of the smolt trap, expand estimates for the area below the smolt trap using a basin-wide redd survey conducted in October, provide a GMR estimate based on the hypergeometric model, and provide a rarefaction curve estimate of successful breeders.

C.3. Abundance Estimate for Stillaguamish River Chinook Salmon in 2011

Stillaguamish River Chinook salmon are one of seven escapement indicator stocks in Puget Sound used by the CTC. Stillaguamish River Chinook salmon are of concern under the PST due to declines from historic levels, current low abundance and resultant limitations this imposes on fisheries management. In addition, this stock was identified as a sentinel stock in the latest PST.

The SSP funded a study design to estimate the Chinook salmon spawning escapement using a genetic mark–recapture technique in 2011 and this study design was continued in 2012. In the first sampling, carcasses were collected in 2011 and tissues taken during weekly spawning ground surveys. Collected tissues were genotyped. In the second sampling in 2012, juveniles were collected from a downstream migrant trap located below the spawning area and tissues were taken. These tissues were also genotyped. A total of 112 genotyped carcasses constituted

[1] Fortran program developed by Jinliang Wang, and available for download from http://www.zsl.org/science/research-projects/software/colony,1154,AR.html (Accessed June 27, 2013).

the marks and a total of 246 juveniles assigned back to spawners using parentage analysis constituted the recaptures out of a total of 1,428 captured juveniles. Using the Lincoln-Petersen estimate, based on Bailey's binomial model, the WDFW estimated the 2011 spawner abundance to be 1,296 Chinook salmon (CV = 6%), which was slightly higher than the redd-based estimate of 1,017 Chinook salmon.

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 would inflate abundance estimates since they increase capture numbers yet have no possible parents in the mark pool. The WDFW identified unmarked hatchery juveniles by assigning smolts to hatchery brood stocks for their respective brood years and removed them prior to analyses. The WDFW examined the data for putative yearlings by regressing smolt lengths on capture date and observing outlier smolts—smolts that were much longer that average smolt lengths for each time strata, but found no such outliers. Because there were no Chinook salmon yearlings and few unmarked hatchery fish, adjusting for hatchery juveniles resulted in a small change in the GMR estimate. The WDFW preliminary GMR result is corrected for unmarked hatchery juveniles.

C.4. Abundance Estimate for Snohomish River Chinook Salmon in 2011

The Snohomish River basin is comprised of two Chinook salmon populations: the Skykomish River summer population (which includes Skykomish, mainstem Snohomish, and Pilchuck rivers) and the Snoqualmie River fall population. The combined Skykomish and Snoqualmie river populations comprise the Snohomish River Chinook salmon summer/fall management unit or stock, which is one of five 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 WDFW estimated the abundance of Chinook salmon spawning in the Skykomish and Snoqualmie rivers using GMR abundance estimates. 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 out-migrating sub-yearling smolt offspring (second sampling event) and genetically identifying some fraction of marks as parents of some out-migrating offspring. Scales and other tissues were taken in the fall 2011 from 149 Chinook salmon adult carcasses (marks) found in the Skykomish River (and tributaries) and from 221 Chinook salmon adult carcasses found in the Snoqualmie River (and tributaries). In the spring of 2012, tissues were taken from 1,644 out-migrating sub-yearling offspring of natural-origin Chinook salmon (1,268 from the Skykomish River trap and 376 from the Snoqualmie River trap). All hatchery- and natural-origin adults sampled for scales, all natural-origin adults sampled for operculum and all natural-origin juveniles 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 × 2), and recaptures were then used in a pooled Petersen mark–recapture 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. These were used in a pooled Petersen mark–recapture estimate of spawner abundance based on hyper-geometric sampling and in a rarefaction curve estimate of the number of successful breeders.

For Skykomish River estimates, there were genotypes for 87 adults, 1,122 juveniles, and, through parentage analysis, 27 recaptures. For Snoqualmie River estimates, there were genotypes for 136 adults, 332 juveniles, and, through parentage analysis, 23 recaptures. Using these counts, the WDFW obtained preliminary unadjusted estimates of the binomial model GMR estimate of Chinook spawner abundance for areas upstream of each smolt trap. The Skykomish River spawner abundance estimate for upstream of the smolt trap was 6,857 Chinook salmon (95% CI = 4,377–9,337). The Snoqualmie River spawner abundance estimate for upstream of the smolt trap was 3,542 Chinook salmon (95% CI = 2,180–4,903). Performance standards were not met with GMR for 2011 (CV >15% for both estimates) due to low juvenile trap efficiencies and few carcass recoveries from the spawning ground surveys. To increase the probability of meeting the precision standard, the intensity of spawning ground surveys was increased for brood year 2012.

GMR abundance estimates were more than 4.5 times the 2011 estimates made using redd counts (1,180 for the Skykomish River and 700 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, the WDFW will generate a hypergeometric model-based GMR abundance estimate and a rarefaction curve-based estimate of successful breeders.

C.5. Abundance Estimate for Burman River Chinook Salmon in 2012

The Burman River Chinook salmon population belongs to the WCVI fall Chinook salmon aggregate, an important production group contributing to catches in AABM and ISBM fisheries. Since 2009, the abundance of ≥age-3 Chinook salmon that returned to the Burman River has been estimated with mark–recapture experiments. In 2012, Chinook salmon were captured and marked using a beach seine in the lower river staging area as a first event and carcasses were recovered as a second event. Biological samples were collected while marking, from hatchery brood collections, or during carcass recoveries. In 2012, Chinook salmon were marked with a dorsally visible uniquely numbered 80 pound monofilament-cored Floy tag[2] secured with a 'J' size metal sleeve, and a secondary mutilation mark. One hundred and thirteen fish were marked with radio tags. Fish were identified by sex, post-orbital hypural length was measured,

[2] Product names used in this publication are included for completeness but do not constitute product endorsement.

and scales were collected for ageing. Otoliths were recovered from carcasses to determine origin.

A total of 1,166 adult Chinook salmon (399 females and 767 males) were marked and 94 marked animals (31 females and 63 males) were encountered among 348 carcasses (156 females and 192 males) recovered between September 19 and November 7, 2012. The preliminary pooled Petersen estimate of >age-3 and older Chinook salmon (>500 mm) was 4,119 fish (SE = 406, CV = 9.9%). The CV of the 2012 estimate met the CTC data standard; CVs of estimates from 2009 to 2012 have averaged 13.4%. The sex stratified pooled Petersen estimates were 1,954 females (SE = 323, CV = 16.5%) and 2,165 males (SE = 246, CV = 11.4%). Complete mixing of females (X^2 = 3.47, df = 4, and P = 0.50) and males (X^2 = 7.69, df = 4, P = 0.10) and equal proportions among females (X^2 = 2.27, df = 3, P = 0.52) and males (X^2 = 1.97, df = 2, P = 0.37) suggested the temporally pooled Petersen estimates stratified by sex were appropriate estimators. Sex selectivity was not significant, although marked males (0.082) were recovered at a slightly higher rate than marked females (0.078) (X^2 = 0.185, df = 1, P = 0.667). Size bias was not evident as the cumulative percent length-frequency distributions were not different between all fish marked and all fish recovered in the carcass survey (D_1 = 0.0357, P = 1.00) and of all marked carcasses (D_1 = 0.000, P = 1.000). The hatchery program in 2012 removed 194 adults and 9 jacks for broodstock.

Chinook salmon escapement was also estimated using snorkel surveys and AUC methods. Visual observations of live radio marked and unmarked fish were made to estimate observation efficiency during 22 snorkel surveys. Survey life was estimated with radio tags and from visual tag depletion curves. Individual radio tags were intended to signal when a fish died by emitting an altered code 12 hours after motion of the fish had ceased. Many of the radio tags did not function as intended or operated in reverse with the inactive code preceding the active code signal. Fixed telemetry receivers sites were established at the lower and upper bounds of the spawning area. One-hundred and seven unique radiotagged fish were detected entering the snorkel survey study area. Two faulty radio tags (9.5%) that did not transmit any signals were recovered among 21 radio tags collected during carcass surveys. Eighty-two radio tags were detected during mobile telemetry surveys intended to identify the number of live radiotagged fish available for observation. Three radiotagged fish ascended above the normal survey area boundary. The stray rate was low, validating the critical closure assumption. After ascending 4 km up the Burman River one radiotagged Chinook salmon (<1%) left the Burman River and entered the Gold River. The lower receiver was overwhelmed with signals from September 22 to October 2 due to the high density of radiotagged fish present in Section 1 of the river. Mobile surveys during this period were used to detect entry of radiotagged fish. Entry time was estimated as the mid-point between mobile surveys if not detected at the lower fixed receiver site; and death times were mid-points between surveys less the 12 hour delay period if the radio tag operated properly. When single detections occurred survey life was calculated as the average times between the adjacent surveys times.

Survey life ($SL_{\mathbf{fixed}}$) estimated using the lower receiver site and mobile (foot and raft) detections ranged from 0.1 to 15.7 days and averaged 5.0 days (SE = 4.1, n = 108). Observer efficiency measured with radio tags was variable but averaged 0.52 (SE = 0.41). When snorkel observations were adjusted for observer efficiency and plotted against time, the resulting preliminary AUC estimate of escapement was 21,538 fish days and the population estimate was 4,273 or 1.7% less than the closed population mark–recapture estimate. A maximum likelihood AUC estimate of escapement quantifying the associated uncertainty will be included in the final project report.

The ratio of males to females was 1.1:1.0 in 2012. Although ageing is not complete, a partial sample of 183 scales analyzed to date indicate proportions by age of 21.9% (SE = 3.06, *n* = 183) age 2, 7.7% (SE = 1.96) age 3, 44.3% (SE = 3.67) age 4, and 26.2% (SE= 3.25%) age 5. Unmarked otoliths comprised 17 or 4.8% (SE = 0.011, *n* = 350) of the origin samples (including three overgrinds). Hatchery origin remained high with 95.1% (SE=0.011, *n* = 350) of otolith samples bearing thermal marks. Burman River hatchery fish dominated the marked sample (99.1% or 330) that included one Robertson Creek Hatchery and two Conuma late-release hatchery origin fish. Given the escapement estimate, the number of naturally produced fish was about 200 animals in 2012. Carcass recovery was enhanced in 2012 due to the prolonged low flows over most of the spawning in period.

C.6. Marble River, Tahsis River, and Leiner River Chinook Salmon Study in 2012

This project was conducted on the Marble, Tahsis and Leiner rivers 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. Chinook salmon were radiotagged 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.

In the Tahsis Inlet, 269 Chinook salmon were tagged and 75 (27%) of them were later detected in the Tahsis or Leiner rivers. In Varney Bay, 114 Chinook salmon were tagged; at the mouth of the Marble River another 14 Chinook salmon were tagged, and 28 (21%) of them were later detected in the Marble River. Motion sensors with radio tags used in 2012 malfunctioned, compromising the ability to detect if the fish were alive or dead. Based on position and signal strength of tags over time, a determination was made when individual fish most likely died. For instance, if a tag was showing as dead but had moved upstream since the last survey, it was likely still alive, but if it had not moved or only moved downstream, it was likely dead. The certainty of each determination was then categorized as low, medium, or high based on the information used to make the determination. Survey life estimates based on tags detected entering and leaving the survey area by the fixed telemetry sites were considered highly certain. Survey life based on behavior was less certain, as lack of upsteam movement indicated death, but exact date of death was unknown.

The mean survey life of Chinook salmon was 25.4 days (SD = 15, *n* = 10) in the Tahsis River, 28.8 days (SD = 14, *n* = 38) in the Leiner River, and 27.4 days (SD = 14, *n* = 10) in the Marble River. Estimates of observer efficiency ranged from 33% to 100% in the Tahsis and Leiner rivers and from 13% to 100% in the Marble River. Preliminary analysis indicates a potential weak relationship between river conditions (horizontal visibility and rate of discharge) and observer efficiency (Figure C.1).

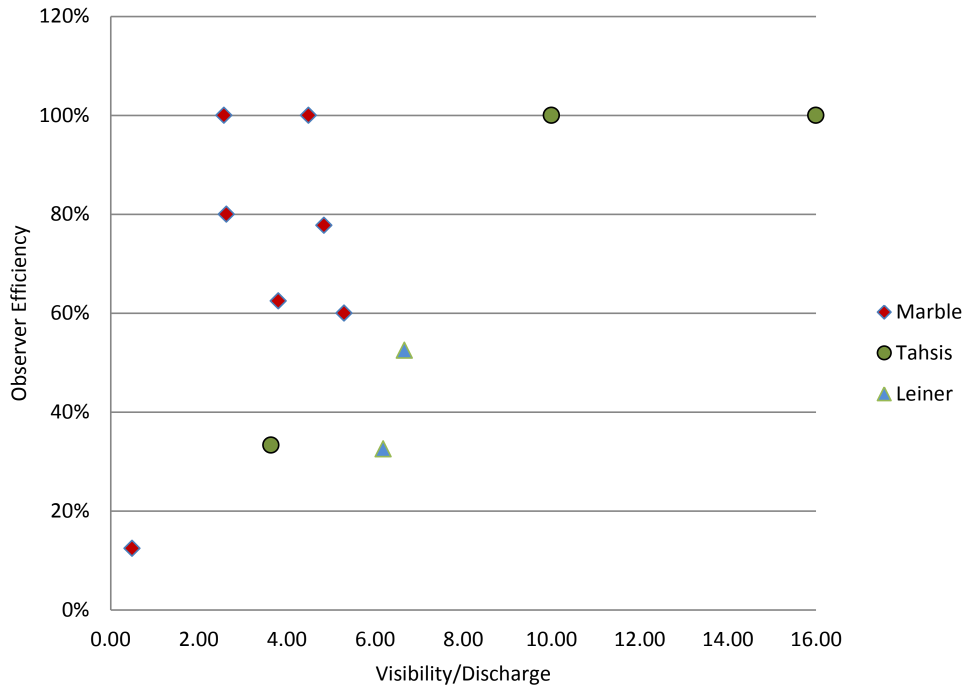


Figure C.1.–Plot of observer efficiencies of swimmers surveying Chinook salmon abundance in the Marble, Tahsis, and Leiner rivers in 2012 versus measures of horizontal visibility divided by discharge.

Estimates of survey life of Chinook salmon in the Marble, Tahsis, and Leiner rivers in 2012 were at the high end of values used for normative WCVI Chinook salmon AUC procedures; values typically used range from 15 to 25 days. Measured observer efficiency in 2012 was typically lower than the self-reported observer efficiency estimates as used in normative WCVI Chinook salmon AUC procedures. Self-reported observer efficiency estimates are rarely less than 80% and are usually 90% to 100%. Based on this study, surveyors appear to overestimate efficiency. Normative AUC estimates as provided to the CTC for the Marble, Tahsis, and Leiner rivers in 2012 are lower than AUC values that include measured survey life and observer efficiency (Table C.6).

Table C.6.–Normative AUC estimates of abundance of Chinook salmon in 2012 in the Marble, Leiner, and Tahsis rivers versus estimates that include measured survey life and observer efficiency.

River	Normative AUC Estimates as Reported to CTC	AUC Estimates Using Measured Survey Life and Observer Efficiency
Marble	2,364	2,509 (6% higher)
Leiner	566	772 (36% higher)
Tahsis	163	227 (39% higher)

C.7. West Coast Vancouver Island Statistical Framework to Assess Chinook Salmon Escapement

A Canadian Science Advisory Process workshop has been scheduled for June 2013. The goal of the workshop is to produce Chinook salmon escapement monitoring framework for the WCVI area.

C.8. Abundance Estimates for South Thompson River Chinook Salmon

The Fraser summer run age-.3 stock group spawns in several locations, ranging from the Lower Fraser River area to the upper reaches of the South Thompson River watershed, and the stock group consists of two genetic reporting groups. 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 mark–recapture 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 mark–recapture 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 BC 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 SSP funded the estimation of South Thompson escapements from 2009 to 2012 and the Northern Endowment Fund supported the approach from 2004 to 2008.

For 2012, some of the genetic samples have not yet been analysed, so the results will be reported next year. The 2012 mark–recapture estimates for the Lower Shuswap was 4,091 (CV = 3%) Chinook salmon and for the Middle Shuswap was 293 (CV = 16%) Chinook salmon, both of which are the lowest escapements observed since the early 1980s. Due to the very low escapement to Middle Shuswap River, applying and recovering sufficient Petersen tags was very challenging; however, enough brood stock were collected to meet the target goal of applying 150,000 CWTs to juvenile Chinook salmon.

The indicator stock expansion method was used as an alternate escapement estimation method from 2004 to 2011. Since the late 1970s, escapements have been estimated mainly using the peak count method for these rivers (Table C.7). 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 2013.

Table C.7.–Estimates of escapement for the South Thompson aggregate using the peak count method and the indicator stock expansion method.

Year	Estimate from Peak Count Method	Estimate from Indicator Stock Expansion Method	CV of Indicator Stock Expansion Method
2004	61,550	155,688	22%
2005	88,313	103,386	15%
2006	149,883	212,667	17%
2007	85,731	167,057	35%
2008	106,539	160,058	15%
2009	86,377	164,300	7%
2010	157,289	213,200	11%
2011	127,958	145,700	17%
2012	47,949	*Not Yet Available*	*Not Yet Available*

C.9. Abundance Estimate for Chilko River Chinook Salmon in 2012

The Chilko River has one of the largest returns of summer-run (age-1.3 stock group) Chinook salmon in the Fraser River watershed with a mean escapement of 9,000 fish (2001–2012) using the peak count method. The 2012 escapement of summer-run Chinook salmon to the Chilko River was estimated using a two-event mark–recapture study and the peak count method based on concurrent aerial visual surveys. Petersen tags and sex-specific secondary marks were applied to 680 adult 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 267 marked adults were recovered from a total recovery sample of 1,490 adult carcasses. The age composition of the recovery sample was 4% age 3, 35% age 4, 59% age 5, and 2% age 6. All samples showed a two-year freshwater growth pattern. Only two tags were applied to jacks, of which none were recovered. There were only four 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 mark–recapture assumption of closure was likely met based on the mark–recapture field observations, aerial survey data, and the 2010 radio telemetry study. There was no evidence of spatial bias in the application or recovery sample for both sexes. There was evidence of temporal bias in the application sample for females and in the recovery sample for both sexes. Due to these temporal biases, the SPAS was used for both sexes. The SPAS results confirmed that due to incomplete mixing there was a requirement to use the maximum likelihood Darroch method for females. However, due to equal proportions there was no requirement to use the maximum likelihood Darroch for males and the Petersen estimator was used. The 2012 adult spawning population estimate was 4,222 (CV = 6%) Chinook salmon with sex-specific escapement estimates of 2,181 males (CV = 10%) and 2,041 females (CV = 7%). The peak count estimate of adult escapement, based on the aerial survey data was 3,845, which is 9% less than the mark–recapture adult estimate. The measured peak count expansion factor was 1.10, using the peak count of 2,499 spawners, holders, and carcasses observed on September 12, 2012.

C.10. Harrison River Radiotelemetry Study of Chinook Salmon in 2012

The Harrison River (fall age-.3 stock group) is the only river with naturally produced fall (late) run Chinook salmon in the lower Fraser watershed. From 1982 to present, the escapement has been estimated using high-precision, two-event mark–recapture methods with a mean annual escapement of 103,500 (2001–2011) adult spawners. In 2012, a telemetry study on Harrison River Chinook salmon was conducted to investigate the behaviour and distribution of the spawning population, and to determine whether this two-event mark–recapture study met the assumption of closure. Ninety-four radio tags were applied proportionally to male and female Chinook salmon throughout the mark–recapture tag application period, and were monitored throughout the mark–recapture study.

Telemetric monitoring results showed that after migrating into the Harrison River, Chinook salmon typically held upstream of the spawning areas before dropping back downstream to spawn. A few male and female radiotagged fish did move downstream of the spawning areas before moving back upstream to spawn. Spawning activity was concentrated in the Harrison Rapids, similar to previous observations.

All radiotagged Chinook salmon were tracked within the Harrison River, with the exception of one radio tag that failed directly after application and release. All radiotagged Chinook salmon remained within the Harrison River mark–recapture study area to spawn. No radiotagged Chinook salmon passed the upper boundary of the study area. Fourteen radiotagged fish passed the lower boundary of the study area, three of these were confirmed as carcasses downstream of the Harrison-Fraser confluence. It is likely that all of those radiotagged fish (14) that passed the lower extent of the study area were either moribund or recently dead, and very unlikely to have spawned elsewhere. No radiotagged Chinook salmon entered the Chilliwack River, a tributary of the Fraser River just downstream of the Harrison River with an introduced hatchery population of fall run Chinook salmon. Overall, the assumption of closure for the two-event mark–recapture for the Harrison River Chinook salmon was confirmed in 2012 based on the results of this telemetric study. For 2012, the spawning escapement based on the MR study was estimated to be 44,500 (CV = 9%) adult Chinook salmon.

C.11. Abundance Estimate for Nass River Chinook Salmon in 2012

The Upper Nass River Chinook salmon aggregate stock (hereafter referred to as Nass Chinook salmon) is one of the CTC indicator stocks. It is a large stock group, comprising a single CDFO conservation unit, consisting of at least 10 separate populations spawning in the Nass River watershed, upstream of and including Tseax River, and has averaged 19,000 spawners from 1994 to 2011. Nass Chinook salmon are an important contributor to the Pacific Coast Chinook salmon resource and represent a very stable proportion of the Chinook salmon stocks caught in the AABM and ISBM fisheries in northern BC 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 mark–recapture methodology. Adult Chinook salmon (≥50 cm nose to tail fork length) are marked at fish wheels 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. Recovery locations have varied over the years but have normally included Damdochax Creek and Kwinageese River, which combined with Meziadin River represent approximately 40% of the Upper Nass Chinook salmon aggregate stock based on radio telemetry (1992–1993) and recent genetic (2007, 2010–2012) data.

From 1994 to 2008, Nass Chinook salmon mark–recapture estimates achieved coefficients of variation less than or equal to 15% in only 9 of 15 (60%) years. The main factor influencing the CV over this period was the number of marked Chinook salmon examined and recovered at terminal spawning areas in the Upper Nass River watershed. From 2009 to 2012 (years 1–4), the PSC has funded a Nass Chinook salmon mark–recapture project as part of the SSP to assist in achieving a more accurate and precise mark–recapture estimate. The funding received from the PSC in year 1 helped achieve the CTC CV standard by permitting sufficient tag-recovery efforts (CV = 13%). However, in year 2 a modest return combined with extreme low water, and therefore low Chinook salmon catchability at the Nass fish wheels, resulted in failure to achieve the standard (CV = 25%). In year 3, tagging at three Grease Harbour (GH) fish wheels in addition to GW fish wheels ensured that the CV standard was met despite a very low return (CV = 9%). Two key recommendations emerged from the first three years of the study, emphasizing the need to both apply and recover adequate marks: 1) to mark Chinook salmon at both the GW and GH fish wheels to ensure that at least 1,000 marks were applied to the aggregate population, and 2) to continue mark recovery operations at Meziadin Fishway, the Kwinageese weir, and Damdochax Creek to ensure adequate numbers of fish were examined and marks were recovered.

In 2012, the PSC funded Year 4 of the Nass Chinook salmon mark–recapture study. A total of 1,164 adult Chinook salmon were marked at two GW fish wheels and an additional 1,917 were marked at three GH fish wheels. The fish wheels operated from June 1 to September 15 with adult Chinook salmon captured and tagged from June 2 to August 28. A total of 3,081 marked Chinook salmon were released, and after accounting for removals by in-river fisheries and estimated tagging/handling related mortality (*n* = 532 censored), an estimated 2,549 marked fish were available for recovery in upstream tributaries. A total of 1,095 fish were examined for marks at mark–recapture sites of which 299 were marked from the fish wheels (overall mark rate = 27.3%).

Tests for size, sex, age, temporal, and spatial bias in capture and recovery samples were conducted in 2012. Unlike past years, a significantly lower mark rate at Meziadin Fishway was detected in this study when compared to the other recovery sites (chi-square χ^2 = 20.96, df = 2, *P* = <0.001). However, genetic results did not suggest a bias in the fish wheel catches when compared to past stock composition estimates. Estimates could not be stratified by recovery location; only 76 of the 299 recoveries had tag data available as tag numbers could not be read at the Kwinageese video counting weir, which accounted for 75% (224) of the tag recoveries in 2012. For size selectivity bias tests, recovered fish were not significantly smaller than examined fish as a whole (Kolmogorov-Smirnov test; D = 0.070, *P* = 0.61) and the mark rate for medium (50–75.4 cm nose to tail fork length) Chinook salmon was not significantly higher than for large (≥75.5 cm nose to tail fork length) Chinook salmon at recovery locations (chi-square χ^2 = 0.16, df = 1, *P* = 0.69). These results are different from years 1–3 and suggest that the higher water and ideal fish wheel fishing conditions during peak Chinook salmon migration in 2012 may have negated the differential ability of larger Chinook salmon to avoid capture by the fish wheels.

Despite the lack of evidence for size bias, to facilitate comparison with other years a size stratified adjusted Petersen population estimate for Nass Chinook salmon was calculated and presented alongside an estimate generated by pooling the size classes. Summing estimates of 1,829 (SE = 223; CV = 14.5%) medium and 7,166 (SE = 380; CV = 6.3%) large Chinook salmon spawning between GW and GH, or passing upstream of GH, produced an overall size stratified escapement estimate of 8,996 Chinook salmon (SE = 440; 95% C.I.: 8115–9876; CV = 5.8%). The stratified estimate was similar (~300 fish smaller) to the estimate generated by pooling size classes (9,315; SE = 458; 95% C.I.: 8321–10,429 CV = 5.8%). Subtracting the in-river harvests above GH (308) from the stratified overall escapement estimate yielded a net escapement estimate of 8,688 adult Chinook salmon above GW. Adding the harvest (2,097) 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 2012 of 10,785. The 2012 return represented the second lowest return of Nass Chinook salmon since the start of the fish wheel program in 1994. Chinook salmon marked and successfully aged (*n* = 2,187) at the fish wheels in 2012 were: 69% age 5, 21% age 4, 8% age 6, and 1% age 3.

Handling and marking a significantly higher proportion of the Chinook salmon population than required to reach the CV standard is not desirable. The very high proportion of the population that was marked in 2012 was a consequence of atypically high catchability of Chinook salmon at the fish wheels during the peak migration period. Therefore, it is recommend that in future years marking of Chinook salmon continue to occur at both the GW and GH fish wheels; however, if 400 tags are applied at the GW fish wheels by June 23, it is recommend that marking at GH be limited to two fish wheels to reduce handling of fish. In addition, it is recommend that mark–recapture efforts continue at the Meziadin Fishway, Kwinageese River, and Damdochax Creek.

C.12. Abundance of Skeena River Chinook Salmon in 2012 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 Tyee and the estimates of the Kitsumkalum Chinook salmon escapement from an independent mark–recapture program. This summary includes results for six projects, the 2009 to 2012 annual projects and two retrospective projects that examined thirty years of data from 1979 to 2008.

The Skeena River has the second largest aggregate of Chinook salmon spawning populations in British Columbia and is one of the escapement indicator stocks defined by the CTC for North/Central British Columbia. Chinook salmon escapements to the Skeena River as reported by the CTC are 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 mark–recapture program since 1984. Other escapement estimates that contribute to the index are based on fish weir counts, visual observations from helicopter, fixed wing aircraft, boats and foot surveys. The index of Chinook salmon escapement to the Skeena aggregate has averaged 50,000 fish since 1984 (Table C.8). The Kitsumkalum River indicator stock represents approximately 30% of the spawners in the escapement index. The Bear and Morice river populations have contributed 20% and 26% of the escapement index respectively since 1984.

Table C.8.–Skeena Chinook salmon escapement index, 1984–2012.

Year	Skeena Escapement Index	Year	Skeena Escapement Index	Year	Skeena Escapement Index
1984	35,864	1994	22,611	2004	39,552
1985	52,407	1995	34,390	2005	29,496
1986	59,719	1996	73,684	2006	36,232
1987	60,948	1997	42,539	2007	36,754
1988	68,307	1998	46,774	2008	34,415
1989	57,192	1999	43,775	2009	36,176
1990	55,541	2000	51,804	2010	42,339
1991	52,792	2001	81,504	2011	34,130
1992	67,118	2002	44,771	2012	34,024
1993	68,286	2003	56,758		

Skeena River Chinook salmon are encountered in the AABM fisheries in Southeast Alaska and Northern British Columbia. They also contribute to the ISBM fisheries in Northern British Columbia including gillnet, tidal sport, non-tidal sport, tidal First Nations and non-tidal First Nations fisheries. Skeena Chinook salmon are north migrating so they do not contribute to the West Coast Vancouver Island AABM fisheries nor do they contribute appreciably to ISBM fisheries south of the Skeena River.

The retrospective project estimated Chinook salmon returns to the Skeena River using genetic stock identification techniques of archived scale samples. In 2012, genetic analyses of 10,196 Chinook salmon were completed from 16,547 fish sampled at the Tyee Test Fishery over 13 years: 1984, 1990, 1992, 1994, 1995, 1996, 1999, 2000, 2001, 2003, 2006, 2007 and 2008. The proportions of Kitsumkalum River Chinook salmon identified in the annual samples were expanded to Skeena-wide population estimates using the return of Kitsumkalum Chinook salmon estimated from independent mark–recapture programs. The preliminary estimates of large Chinook salmon returning to the Skeena River as measured at Tyee ranged from 36,006 in 2012 to 155,474 in 2001. Over the full time series, the coefficients of variation around the preliminary estimates were less than the data standard of 15% in 12 years and were greater than 15% in 17 years (Table C.9; Figure C.2).

Table C.9.–Preliminary escapement estimates for the aggregate of Skeena River Chinook salmon populations caught at Tyee from the 2011 and 2012 retrospective projects and for the 2009 to 2012 annual projects.

Year	Kitsumkalum Mark–Recapture Estimate	CV of Kitsumkalum Mark–Recapture Estimate	Weighted Proportion of Kitsumkalum at Tyee from DNA	CV of Kitsumkalum Proportion	Total Skeena Chinook Salmon Estimate	CV of Skeena Estimate
1984	12,408	19.9%	20.9%	15.1%	59,248	25.0%
1985	8,304	5.9%	20.2%	12.4%	41,175	13.7%
1986	9,109	5.9%	23.3%	14.7%	39,051	15.9%
1987	23,657	10.1%	14.9%	14.3%	158,774	17.5%
1988	22,267	6.9%	21.2%	10.5%	105,196	12.6%
1989	17,925	7.2%	21.9%	10.5%	81,822	12.8%
1990	17,406	6.4%	21.2%	11.3%	82,043	13.0%
1991	9,288	7.2%	17.3%	11.7%	53,640	13.7%
1992	12,437	8.1%	10.8%	20.7%	114,726	22.3%
1993	14,059	5.5%	10.9%	16.1%	129,349	17.1%
1994	12,629	9.5%	14.6%	13.4%	86,368	16.4%
1995	7,221	10.1%	10.6%	22.3%	67,996	24.5%
1996	12,776	16.7%	9.1%	11.1%	141,135	20.0%
1997	5,342	11.3%	8.4%	15.9%	63,657	19.5%
1998	11,065	6.8%	12.2%	16.6%	90,460	17.9%
1999	9,763	8.9%	14.2%	7.9%	68,763	11.9%
2000	14,722	8.2%	13.6%	9.5%	107,859	12.5%

–continued–

Table C.9. Page 2 of 2.

Year	Kitsumkalum Mark–Recapture Estimate	CV of Kitsumkalum Mark–Recapture Estimate	Weighted Proportion of Kitsumkalum at Tyee from DNA	CV of Kitsumkalum Proportion	Total Skeena Chinook Salmon Estimate	CV of Skeena Estimate
2001	23,839	9.5%	15.3%	7.4%	155,474	12.1%
2002	23,849	11.4%	25.0%	5.3%	95,442	12.6%
2003	23,608	11.0%	18.9%	6.9%	124,818	13.0%
2004	25,767	10.2%	16.8%	7.8%	153,065	12.8%
2005	15,046	9.2%	17.8%	7.0%	84,470	11.6%
2006	12,368	14.5%	13.7%	9.3%	90,434	17.2%
2007	15,736	18.0%	17.5%	7.5%	89,995	19.5%
2008	10,374	14.2%	13.1%	8.2%	79,333	16.4%
2009	10,703	13.3%	12.4%	13.3%	86,476	18.8%
2010	13,712	14.8%	12.7%	10.2%	107,601	18.0%
2011	12,059	20.2%	21.0%	6.8%	57,446	21.3%
2012	9,363	13.9%	26.0%	7.8%	36,006	16.0%

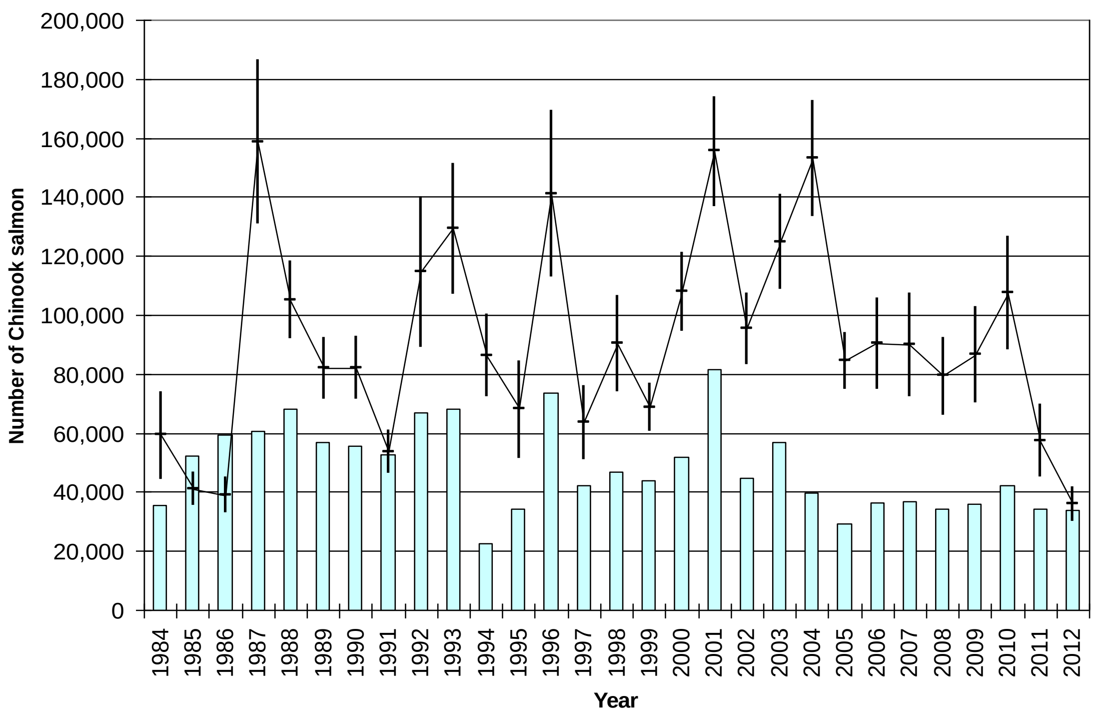


Figure C.2.–Comparison of the number of Chinook salmon estimated past Tyee using the genetic approach with the Skeena River Chinook salmon escapement index.

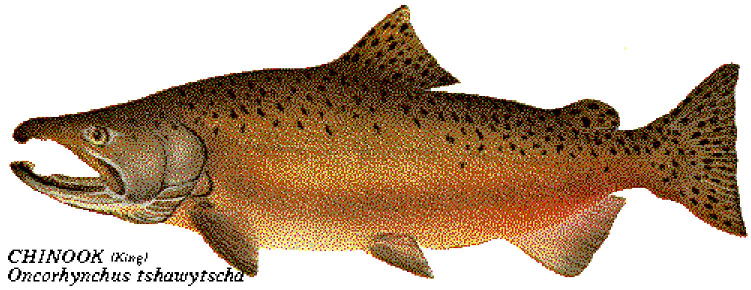
Note: The bars represent the Skeena River Chinook salmon escapement index. The crosses represent the estimates generated using the genetic approach. The vertical lines represent the genetic estimates plus and minus one standard deviation.

These results are preliminary as modifications are scheduled for the genetic baseline for Skeena River Chinook salmon populations. The ultimate objective is to provide aggregate escapement estimates for the complete time series from 1979 to 2013. Genetic stock identifications have been completed for 1,056 samples from the Tyee Test Fishery from 1979 to 1983.

While these efforts failed to meet the CTC data standard in 17 of 29 years, the estimates represent an improvement over existing indices since comparisons may be made between years (Figure C.2) and across component stocks. Further, the estimates include estimates of variance. Variance estimates cannot be produced for the escapement indices of Skeena River Chinook salmon because of the combinations of different escapement techniques involved. The technique that has been used represents a relatively frugal way to estimate the Chinook salmon return to the Skeena River aggregate. It is probable that the program will be continued after the SSP program ends.

APPENDIX D. BILATERAL DATA STANDARDS FOR ESTIMATES OF ESCAPEMENT FOR CHINOOK SALMON ESCAPEMENT INDICATOR STOCKS

In 2008, the CTC adopted data standards for escapement indicator stocks: escapement estimates should be asymptotically accurate (unbiased), and, as a planning goal, escapement estimates for a stock should average a CV of 15% or less. The documentation of that action is provided herein.



PSC Chinook Technical Committee

TO: Sentinel Stocks Committee

FROM: John Carlile, Rick McNicol, and Rishi Sharma: CTC Co-chairs

DATE: October 29, 2008

SUBJECT: Bilateral Data standards for Estimates of Escapement for Chinook Escapement Indicator Stocks

After analysis, review, and discussion, the bilateral CTC has determined two bilateral data standards for estimating spawning escapement:

1) individual estimates of total spawning escapement for a stock should on average attain an estimated coefficient of variation (CV) of 15% or less; and

1) specific estimates of spawning escapement shall be derived with demonstrably asymptotically accurate methods[1], i.e. methods that produce unbiased estimates.

The CTC does not intend that the first standard be used to judge the relevance of the results from past or future studies to managing fisheries under the PST. Given the difficulties and cost of estimating escapement, the CTC felt that the first standard should be treated more as a goal for planning. Results from recent studies to estimate spawning escapement in Oregon, Canada, Alaska, and Washington (see Attachment 1) indicate that the first data standard (a CV of 15% or better) does represent a realistic goal for planning.

These two data standards were decided according to how estimates of spawning escapement will be used to manage salmon fisheries under the new agreement. Four uses were identified: triggering additional management action under paragraph 13, developing escapement goals, exploitation-rate analysis, and forecasting run size. Relative to paragraph 13, a CV of 15% or less

[1] In this context, a method of estimating spawning escapement is 'asymptotically accurate' if the difference between the estimate and the actual escapement decreases to zero as the number of salmon sampled in the study increases.

in estimates of escapement was shown (in an analysis presented to the CTC) to correspond to an acceptable risk (one year or one stock in six) of failing to label a stock of concern when warranted (see Attachment 2). Another analysis submitted to the sub-committee showed that a CV of 15% or less also avoided bias in stock-recruit analyses used to develop escapement goals (see Attachment 3). After discussion the CTC decided that considering exploitation-rate analysis and forecasting run size in determining data standards for escapement estimates is premature. No bilateral data standards as yet exist for exploitation rates or forecasts. Once these standards have been established, data standards for escapement estimates can be reevaluated.

We hope that these bilateral data standards are sufficient for your use in the SSP. Please contact us if they are not. Also, feel free to contact Rick McNicol, Ethan Clemons, Ed Jones, Marianna Alexandersdottir, or Dave Bernard if you have any questions concerning the attachments.

Attachments (3)

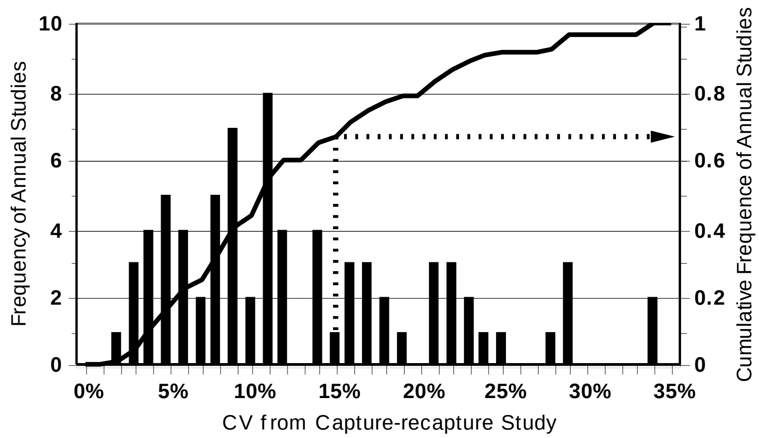
Attachment 1: Note that estimates in this attachment result from capture-recapture experiments, only one of several possible methods of estimating escapements. Relative variation from such experiments is comparable to the first data standard (a CV of 15% or better) only if there is no spawning downstream of the experiment or if there are no removals upstream or within the area covered by the experiment. If for instance a fishery or hatchery occurs upstream of, or within the study area, the estimate from the capture-recapture experiment needs to be reduced by the number of fish 'leaving' the river before a CV appropriate to spawning escapement can be calculated. Also, precision in estimates from capture-recapture experiments designed to produce expansion factors for index surveys do not represent all the imprecision in subsequent expanded estimates of spawning abundance.

Stocks w/ capture-recapture studies:		
Canadian Stocks	Southeast Alaska	Oregon
Burman	Alsek	Coos (SF)
Dean	Blossom	Coquille
Harrison	Chickamin	Nehalem
Kaouk	Keta	Nehalem (NF)
Kateen	Stikine	Siletz
Kitsumkalum	Taku	Siuslaw
Kwinamass	Unuk	Umpqua
Leiner		
Lower Shuswap		
Marble		
Middle Shuswap		
Nicola		
Tahsis		
Tranquil		

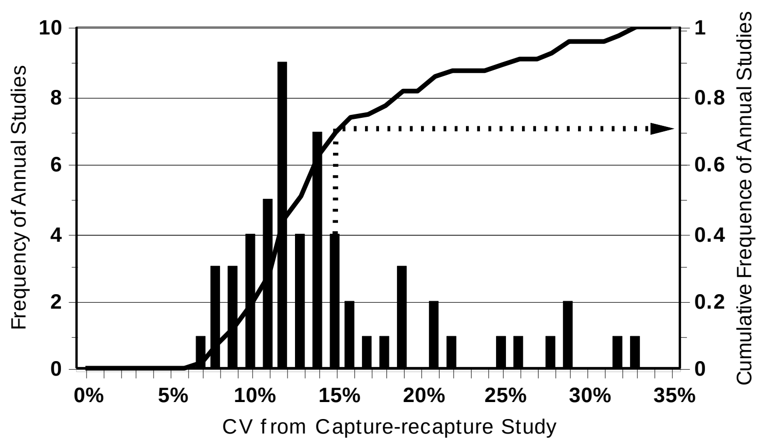
The Green River Stock is the sole representative of Washington stocks in this attachment. Studies in 2000, 2001, and 2002 on the Green stock produced estimates of abundance of 12,952 (CV = 12.1%), 22,855 (CV = 6.8%), and 16,258 (CV = 8.6%) for adults age 2 and older.

Attachment 1 (continued).

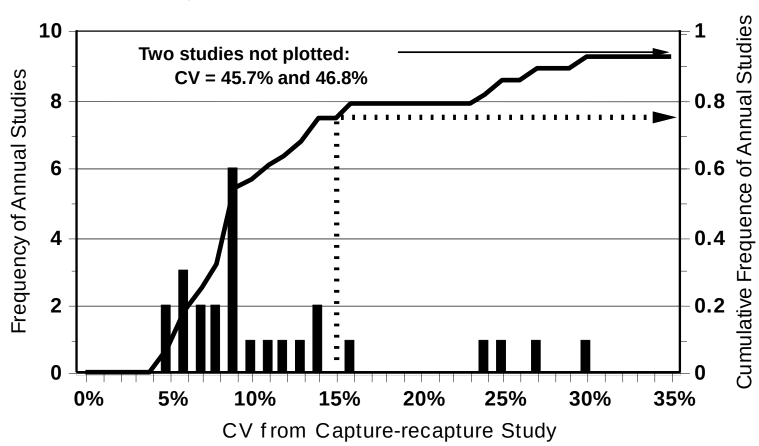
Canadian Stocks (14) from 1984-2007



SEAK Stocks (7) from 1989-2007

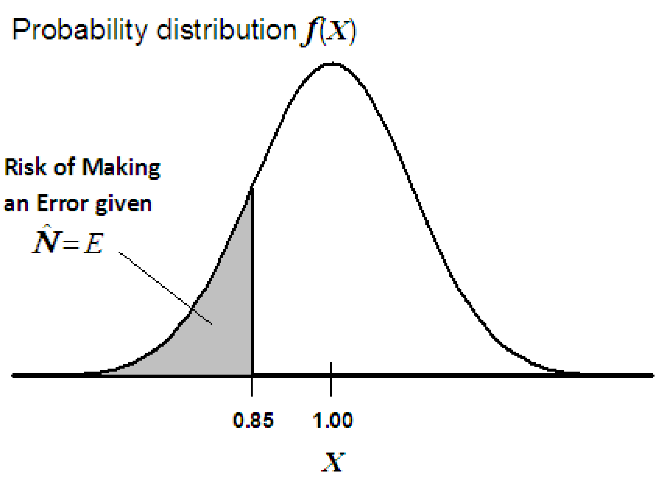


Oregon Stocks (7) from 1998-2007



Attachment 2: One use for estimates of spawning escapement in managing AABM and ISBM fisheries under the new agreement in the Pacific Salmon Treaty is to trigger action under paragraph 13. The management objective for escapement indicator stocks under the treaty is to realize an annual escapement *N* that is equal to an escapement goal *E*. Unless annual escapement is a count, the escapement goal is compared to an estimate $\hat{N}$ instead of *N* for the purpose of the paragraph. Because *N* is estimated, there is some uncertainty in its value; there is a chance (risk) that *N* may be below 85% of the escapement goal laid out in the paragraph as a threshold for labeling a stock of concern, even though $\hat{N} = E$. The relationship between how much of this risk is acceptable and the precision of $\hat{N}$ can be used to develop a datum standard for $\hat{N}$.

Transformations can be used to link risk of management error to precision. The probability of *N* given that $\hat{N} = E$ can follow a near normal probability distribution with mean *E* and a variance for *N*. If such a variable *N* is divided by the constant *E*, the result is a normally distributed variable *X* with mean 1 $(= \hat{N}/E = E/E)$ and variance $Var(N)/E^2$ (see inset). The normal probability distribution for *X* can be transformed into the standard normal variate *Z* by dividing the square root of *Var*(*X*) into the difference between the threshold and the expected escapement (–0.15 = 0.85 – 1). Note that in this circumstance that $Var(X) = CV^2(X) = CV^2(N)$ which means that $Z = -0.15/CV(N)$. If α is the risk (probability) of management error, then precision as function of that risk for this problem would be:



$$CV(N) = \frac{0.15}{Z_\alpha}$$

Note that because the standard normal is symmetric, the negative sign in the above calculation can be ignored.

Plugging in values of Z_α from a standard normal table into the equation above produces the three levels of precision for $\hat{N}$ in the form of $CV(N)$:

α×100%	**Odds of Making an Error**	Z_α	$CV(N)$
5%	1 in 20 years/stocks	1.645	0.09
10%	1 in 10 years/stocks	1.285	0.12
16.6%	1 in 6 years/stocks	0.970	0.15
20%	1 in 5 years/stocks	0.845	0.18

The odds of making an error could be expressed from the perspective of one stock over time (1 in *n* years) or within one year over many stocks (1 in *k* stocks). A CV of 15% has proven to be a do-able standard for many studies to estimate escapement of Chinook salmon (see Attachment 1). Of course, the risk is less than expressed for the same CV if $\hat{N} > E$, and more so if $0.85E < \hat{N} < E$.

Attachment 3: Another use for estimates of spawning escapement in managing AABM and ISBM fisheries under the new agreement in the Pacific Salmon Treaty is to develop production models with which to establish escapement goals. While there are many ways in which information on past escapements can be used to produce defensible goals for management, this discussion is restricted to only one: analysis to avoid bias and improve precision in optimal escapement goals from estimated stock-production relationships.

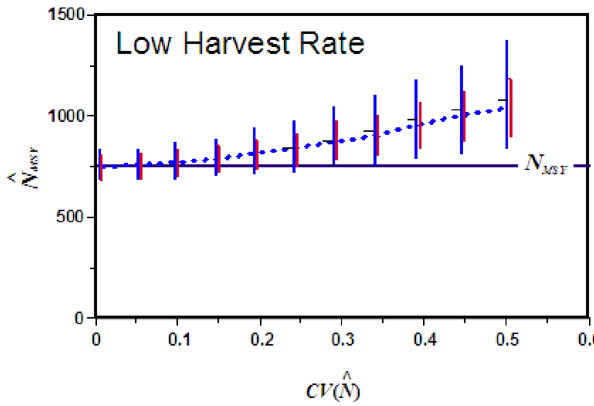
A stock-production model, like the Ricker model $[\ln(R_{by}/N_{by}) = a - bN_{by} + \varepsilon_{by}]^2$, is "fit" to data on production R and escapement N to produce estimates for parameters a and b. These statistics are then rearranged to estimate the optimal escapement goal $\hat{N}_{MSY} \cong (\hat{a}'/\hat{b})(0.5 - 0.07\hat{a}')$ where $\hat{a}' = \hat{a} + \hat{\sigma}^2/2$ (for the Ricker model).

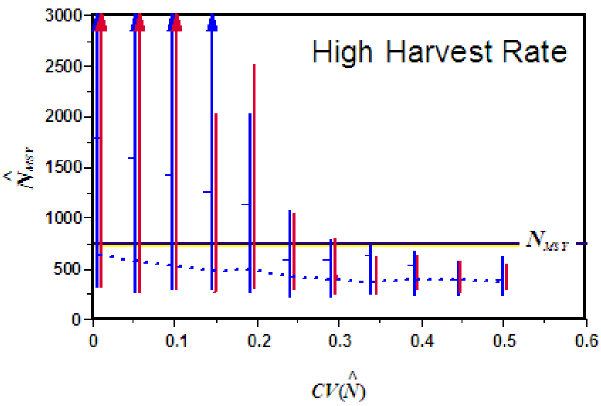
Uncertainty in past escapements (N_{by}) affects the accuracy and precision of $\hat{N}_{MSY}$ (see Kehler et al. 2002)[3]. As part of a short course on developing escapement goals, the Alaska Department of Fish and Game[4] ran a series of simulations to determine the extent that uncertainty in escapements affects escapement goals. Simulations recreated a series of data sets $\{\hat{R}, \hat{N}\}$ with parameter values typical of Chinook stocks ($a \leftarrow 2$, $b \leftarrow 0.001$, and $\sigma \leftarrow 0.5$) and with $CV(N) \leftarrow$ {0; 0.05; 0.1; 0.15; … 0.50}. Harvest rates used to recreate the simulated data sets were set at high (~80%), moderate (~50%), low (~20%), and mixed (20% to 80%). In the inset figures below the vertical blue bars represent the actual uncertainty in $\hat{N}_{MSY}$ and the vertical red bars the estimated uncertainty (red and blue bars cover the 10 to 90 percentiles for simulations). The blue hash marks on the blue bars represent the averages of the $\hat{N}_{MSY}$ in the simulations while the dotted blue line connects the medians of the $\hat{N}_{MSY}$. The black bar across each plot represents the true value of N_{MSY}.

[2] Notation: N_{by} is the escapement in brood year *by*, R is the subsequent production in adults from that escapement in the absence of fishing, and ε is a random normal variate with mean 0 and variance σ^2.

[3] Kehler, D. G., R. A. Myers, and C. A. Field. 2002. Measurement error and bias in the maximum reproductive rate for the Ricker model. Canadian Journal of Fisheries and Aquatic Sciences 59:854–864.

[4] We wish to give credit here to Steven Fleischman, a Fisheries Scientist with the Division of Sport Fish, ADF&G, for his comprehensive work with these simulations. Steve's insights on the matter of measurement error and its effects on developing escapement goals were (are) essential to the success of this short course. Steve can be reached at Steve.Fleischman@alaska.gov.





If data are "collected" when harvest rates had been low, uncertainty from estimating escapements tends to make $\hat{N}_{MSY} > N_{MSY}$ and escapement goals too high, especially when $CV(\hat{N})$> 0.20. The reverse is true if harvest rates had been high during data collection; resulting escapement goals would promote recruitment overfishing because $\hat{N}_{MSY} < N_{MSY}$. Fortunately, estimated imprecision in $\hat{N}_{MSY}$ is so great when $CV(\hat{N}) \leq$ 0.20 and harvest rates high, no goal would likely be developed under these circumstances. The real danger in analyzing data collected during a period of high harvest rates occurs when $CV(\hat{N})$> 0.20; precision of $\hat{N}_{MSY}$ looks good, but the value of $\hat{N}_{MSY}$ is well below the true value. Results from simulations under moderate and mixed harvest rates were not provided here because values of $CV(\hat{N})$ had negligible effects on bias ($\hat{N}_{MSY}$ *vs.* N_{MSY}). Uncertainty in $\hat{N}_{MSY}$ did increase with increase in $CV(\hat{N})$ when harvest rates had been moderate or mixed, but these increases are similar to increases experienced when harvest rates had been low (see above). Regardless of the harvest rates in effect when data were collected, true uncertainty in $\hat{N}_{MSY}$ is understated whenever escapements had been estimated.

Simulations above show that a $CV(\hat{N})$ of about 0.15 to 0.20 would be a good standard relative to setting escapement goals. At that $CV(\hat{N})$ or lower, bias and imprecision in the goal would likely be negligible if that goal was developed from data collected under all but a regime of high harvest rates. Under such a regime, a $CV(\hat{N}) \leq$ 0.15 would produce a goal so obviously imprecise as to be unusable, thereby avoiding recruitment overfishing that would occur if a goal had been developed under these circumstances.

APPENDIX E. BILATERAL DATA STANDARDS FOR ESCAPEMENT GOALS

In 2013, the CTC adopted data standards for MSY or other biologically-based escapement goals. The documentation of that action, CTC Technical Note 1301, is provided herein.

Bilateral Data Standards for MSY or Other Biologically-Based Escapement Goals

CTC Technical Note 1301

June 7, 2013

In Chapter 3, section 2(a)(ii) commits the "Parties" to harvest regimes for Chinook salmon that are

> *"… designed to meet MSY or other agreed biologically-based escapement and/or harvest rate objectives; with the understanding that harvest rate management is designed to provide a desired range of escapement[1] over time;"*

The CTC judges objectives as being biologically based by reviewing biological evidence and scientific arguments that the objective is expected to produce MSY or some other specified yield consistent with the intent of the Treaty. Acceptance of the objective by the CTC will depend on evidence and arguments meeting certain standards.

Precision in management objectives such as escapement goals or exploitation rates have no standard, but the CTC requires that uncertainty be reported. Most escapement or exploitation-rate objectives are functions of many other estimates resulting from different observational studies controlled by separate agencies under various jurisdictions. For these reasons, a single agency cannot control the precision of the objective and a standard for precision is not realistic. Multiple agencies typically contribute fishery data to estimate production, and those agencies often have different resources, sampling designs, and objectives for their catch sampling programs. What we have is what we use, so long as it is accurate. Still, precision is related to uncertainty, so the CTC requires some estimate of uncertainty surrounding the objective—a CV, SE, CI, credible set, and/or posterior distribution are examples.

The standard for accuracy for an objective is evidence that the expected result will on average be attained if the objective is met. The expected result is MSY or another outcome that is consistent with the treaty; the objective is a point value or range of escapements or harvest rates determined from data. Evidence in support of an accurate objective largely depends on how the objective was determined. The balance of this technical note pertains to evidence required for some standard methods: stock-recruit analysis, habitat models, and life-history/ecosystem models.

1. Stock-Recruit Analysis (SRA)

When an escapement or exploitation rate objective is to be confirmed through SRA, and this objective is intended for use in application of Chapter 3 of the 2009 Agreement, the methodology used should be consistent with Chapter 1: General Methods for Stock-Recruit Analysis in CTC (1999). During bilateral review of escapement objectives, the CTC has employed

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[1] Here escapement is defined as the abundance of adult spawners.

a checklist to judge consistency with CTC (1999). That checklist has been modified to address the expectation that methods employed are likely to produce accurate escapement or harvest rate objectives. The checklist of questions for SRA includes:

1) Do escapement and production estimates have measures of uncertainty[2]?
2) Is production measured in adult equivalents and/or smolts?
3) Do the escapement and recruitment estimates exclude jacks (youngest age for spawners)? If they are included, were they accurately estimated?
4) Have production estimates been reduced for any hatchery-produced fish on the spawning grounds?
5) Are total fishing-induced mortalities and escapements estimated by age class?
6) Is production in adults expressed in terms of adult equivalents?
7) If contrast in spawning stock size is insufficient (i.e., <4) for SRA[3], was information from other sources used to complete the SRA (see Sections 2 and 4 for examples).
8) In the choice of a compensatory stock-recruit model[4]:
    a) Does the stock-recruit model have multiplicative process errors?[5]
    b) Is the process error stationary (no discernible trend over time)?
    c) If a density independent covariate is included in the model, was the covariate appropriately modeled?
    d) If the stock-recruit model includes depensatory elements, was a reasonable scientific justification presented for the inclusion?
9) For estimated parameters and reference points:
    a) Was the stock-recruit model correctly fit to the data?
        i. If estimates of escapement and production contain measurement error, was the error in estimates addressed in the fit?
        ii. If serial correlation is evident in errors, was the correlation modeled correctly?

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[2] Uncertainty in production and/or escapement estimates arises from sampling, is referred to as "measurement error", and is usually expressed as a sampling variance or mean-squared error.

[3] See CTC (1999) for criteria.

[4] Ricker's model is the preferred option for escapement objectives, Beverton-Holt's model addresses harvest rate objectives, but other models may be used if justified with reasonable arguments and evidence.

[5] The term "process errors" refers to deviations between realized and expected production from the stock-recruit relationship due to density-independent natural causes.

iii. If log-transformations were involved in calculating parameter estimates, were the calculations adjusted accordingly?

iv. Are the data sufficient to estimate the stock-recruit model? If not, what is the basis for the escapement objective (e.g., spawning escapement range, escapement floor, etc.)

b) Is the escapement or harvest rate objective reasonable given its uncertainty[6]?

10) Are escapement or harvest rates likely to be estimated in years to come for the stock, in units comparable to those used to generate the objective?

The accuracy standard is most likely met if answers are “yes” to questions 1–6, 7a–d, and 8a (i–iii). Answers to question 8b and 9 should also be “yes”. While not related to accuracy of the methods employed, escapement or harvest rate objectives without a measure of uncertainty are not acceptable to the CTC.

SRA based on traditional statistical regression has a long history in management of salmon fisheries (Hilborn and Walters 1992). Recently Bayesian analysis has been developed to estimate reference points in an SRA (Adkison and Peterman 1996, Millar and Meyer 2000, Fleischman et al. 2013). Bayesian analysis using state-space models can be used to determine escapement or exploitation rate objectives with SRA (Bernard and Jones 2010 as an example brought before the CTC). Regardless of the type of SRA employed, a “yes” answer to all or most of the items on the check list above indicates that the objective most likely represents an accurate reference point. Once the management objective has been accepted, the CTC expects to review the objective periodically in the future to ensure that recent population dynamics are represented.

2. Habitat Models

The CTC has accepted escapement objectives based upon the work of Parken et al. (2006) and Liermann et al. (2010). In both studies, empirical relationships are developed between reference points estimated for stock-recruit relationships, life history, and size of natal watersheds for Chinook salmon stocks. Reference points for escapement associated with MSY (S_{MSY}) and carrying capacity (S_{EQ}) were estimated as functions of watershed size (km^2) for 25 stocks from central Alaska to the north Oregon Coast. Parken et al. 2006 provided four relationships predicting two reference points (S_{MSY} or S_{EQ}) for two life-history types (stream-type or ocean-type) as functions of watershed size. Liermann et al. (2010) provided one relationship estimated with Bayesian regression to simultaneously produce posterior distributions for both reference points as functions of watershed size using the same data as Parken et al. (2006). The checklist for this approach includes:

1) Was watershed size[7] correctly measured?

[6] “Uncertainty” results from process error and measurement error combined.

2) Was the relationship appropriate for the life history?

3) Is the quality of the freshwater habitat for the stock in question similar to the quality of habitats for the stocks in Parken et al. (2006)?

4) Were calculations correct?

5) Is the objective reasonable given its uncertainty?

6) Are annual escapements measured in the same units used by the model[8]?

7) Are escapements or harvest rates likely to be estimated in years to come?

If the answers to the first four questions are "yes", the accuracy standard will most likely be met for both escapement and harvest rate objectives designed to produce MSY or near MSY. While an estimate of S_{MSY} and a measure of uncertainty of that estimate may be calculated directly from Parken et al. (2006) under these circumstances, an estimate of the exploitation rate associated with MSY (U_{MSY}) has to be calculated as a function of the estimates for S_{MSY} and S_{EQ}. If the answers are "yes" to the first and third questions on the checklist, but "no" to the second, the accuracy standard requires evidence of the degree to which intrinsic productivity[9] is lower or higher than the average calculated from Parken et al. 2006.

Use of reference points and parameters derived from Parken et al. (2006) can be used as "priors" in a Bayesian SRA. In many instances, stock data have been collected during periods of high or low exploitation. Under high exploitation, the data will contain little information concerning carrying capacity, making estimates of S_{EQ} and S_{MSY} problematic. In contrast, a history of low exploitation contains little information on intrinsic productivity. Using the habitat model of Parken et al. 2006 to produce priors for these two parameters is encouraged [see Bernard and Jones (2011) for an example].

3. Life-history/Ecosystem Models

For some time, life-history models have been proposed to guide management of salmon fisheries (Moussalli and Hilborn 1986, AFS 2009) and along with ecosystem models, proposed to guide planning involved with habitat restoration (SHIRAZ by Scheuerell et al. 2006; EDT by Lichatowich et al. 1995, Mobrand et al. 1997, and McElhany et al. 2010). Both approaches have potential to provide accurate escapement or harvest rate objectives, especially under conditions of compromised habitat. However, this potential is difficult to realize because both

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[7] From Parken et al. (2006), watershed size is the area upstream of the mouth excluding any area no longer accessible to Chinook salmon because of the acts of man, and any area upstream of natural barriers to passage on 4th order streams if the stock has a stream-type life history, or on 5th order streams if the stock has an ocean-type life history.

[8] Escapements for ocean-type Chinook are measured in age 3 and older and for stream-type as age 4 and older.

[9] In the context of an empirical stock-recruit relationship in the usual formulation of Ricker's or Beverton and Holt's models, the parameter represents intrinsic productivity.

approaches tend to be over parameterized. As reported by McElhany et al. (2010) in regards to the ecosystem model EDT:

> "The (our) analyses indicated that as a consequence of internal parameter uncertainty, EDT productivity and capacity predictions lack the precision needed for many management applications."

Under these circumstances the checklist includes:

1) Was the model calibrated with parameters adjusted to "fit" observed statistics for the stock?
2) Do observed statistics have measures of uncertainty?
3) Were parameters from the calibrated model within expected norms for the stock?
4) Were reference points predicted from the calibrated model validated with reference points derived independently and are predictions from two methods similar?
5) Is the objective reasonable given uncertainty?
6) Are escapements or harvest rates likely to be estimated in years to come?

A time-series of escapement estimates is an example of observed statistics used to calibrate the model. A value >20 for a parameter representing intrinsic productivity derived from a calibration would be outside the norm for that parameter. A prediction of carrying capacity from a calibrated life history/ecosystem model that matches the prediction from the habitat model would validate the former model.

If the answers to questions 1–5 are "yes", the accuracy standard has most likely been met.

4. Other Approaches

Standards listed above for accepting harvest rate or escapement objectives as biologically based are not exclusive and the CTC will consider objectives developed from different approaches. Acceptance of such objectives will depend on the same general criteria used in the above methods, and will be based on arguments for accuracy of estimates, the logic of arguments, and scientific validation of the analysis.

The accepted escapement objective for Chilkat River Chinook in Alaska is an example of the CTC accepting non-standard methods as having produced an accurate escapement objective (see Ericksen and McPherson 2004). Escapements for this stock were accurately estimated for a number of consecutive years when harvest rates were low (average 12%). Under this circumstance the mean of escapement estimates was considered a reasonable proxy of carrying capacity for the stock. Ratios of S_{MSY}/S_{EQ} estimated for other stocks in Southeast Alaska were averaged to get an estimate of the ratio for the Chilkat stock. The mean ratio was then multiplied by the estimate of carrying capacity for the Chilkat stock to calculate an escapement objective based on MSY.

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