PACIFIC SALMON COMMISSION
JOINT CHUM TECHNICAL COMMITTEE

2013 POST SEASON SUMMARY REPORT

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May 2016

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Canadian Members	United States Members
Mr. Pieter Van Will, Co-Chair, CDFO	Mr. Jay Zischke, Co-Chair, Suquamish Indian Tribe
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LIST OF ACRONYMS WITH DEFINITIONS

B.C.	British Columbia
CDFO	Canadian Department of Fisheries and Oceans or Fisheries and Oceans Canada
CPUE	Catch per Unit Effort
CU	Conservation Unit (Canada)
CWT	Coded-Wire Tag
ECVI	East Coast Vancouver Island
EO	Economic Opportunity
ESSR	Excess Salmon to Spawning Requirements
ESU	Evolutionarily Significant Unit
FN	First Nation
FN FSC	First Nations Food, Social and Ceremonial
FSC	Food, Social, and Ceremonial (Canada)
GN	Gill net
GSI	Genetic Stock Identification
ITQ	Individual Transferable Quota
mtDNA	Mitochondrial DNA
mSAT	Microsatellite DNA
NOAA	National Oceanic and Atmospheric Administration
NWIFC	Northwest Indian Fisheries Commission
PFMA	Pacific Fishery Management Area
PNPTC	Point No Point Treaty Council
PSC	Pacific Salmon Commission
PST	Pacific Salmon Treaty
SJF	Strait of Juan de Fuca
SJI/PR	San Juan Islands/Point Roberts
SN	Seine net
SNPs	Single-Nucleotide Polymorphisms
TCCHUM	Chum Technical Committee
TR	Troll
U.S.	United States of America
WA	Washington State
WCVI	West Coast Vancouver Island
WDFW	Washington Department of Fish and Wildlife
WSP	Wild Salmon Policy (Canada's Policy for Conservation of Wild Pacific Salmon)

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1 Executive Summary

This Pacific Salmon Commission (PSC) Joint Chum Technical Committee report presents the information on Chum salmon stocks and fisheries in southern British Columbia (B.C.) and Washington (WA) for the year 2013 to address the specific provisions and requirements of Chapter 6, Annex IV (Chum Annex) of the Pacific Salmon Treaty (PST or Treaty) (Appendix A). The Treaty between the governments of Canada and the United States of America (U.S.) concerning Pacific salmon is designed to facilitate co-operation in the management, research and enhancement of Pacific salmon stocks. The Chum Annex requires that Canada and the U.S. maintain a Joint Chum Technical Committee reporting to the Southern Panel and the Commission and that certain fisheries for Chum salmon in southern B.C. and WA be managed in a specified manner (Appendix A). Certain fisheries of each country, while not specifically mentioned in the PST, are known to harvest Chum salmon originating in the other country.

This report presents various aspects of Chum salmon found in B.C. waters between Vancouver Island and the mainland, off the west coast of Vancouver Island, and in WA waters. This report also discusses the management actions of Canada and the U.S. in relation to the PST requirements for Chum salmon and provides a summary of the last 10 years of catch and escapement information for Chum salmon of concern to the Treaty. Returns in 2013 were slightly below the recent 9-yr average in B.C. to slightly above this average in WA. The Chum Technical Committee continued work on components of the strategic plan outlined in the 2010 report, which included collecting and exchanging tissue samples from mixed-stock fisheries and spawning escapements, conducting genetic sampling workshops in US and Canada, as well as initiating development of a run reconstruction model.

2 Status of Treaty Requirements

Chum salmon stocks and fisheries in southern B.C. and in U.S. Areas 4B, 5, 6C, 7, and 7A (Appendix B) were managed under the terms set out in Chapter 6, Annex IV (Appendix A). The following provides a brief synopsis of the Canadian and U.S. management actions taken to meet its provisions in 2013.

Paragraph 1:

> *The Parties were to maintain a Joint Chum Technical Committee ("*the Committee"*) reporting, unless otherwise agreed, to the Southern Panel and the Commission. [Specific tasks for the Committee are listed in Annex IV Chapter 6, Paragraph 1. Some of these include review stock status, develop new methods for stock management and report on management and research findings.]*

The Committee convened two times in 2013: during the PSC Post-Season Meeting in January and during the PSC 25th Annual Meeting in February. In 2010 the committee developed a strategic plan to guide development and application of a jointly agreed genetic baseline for Chum salmon stocks in southern BC and Washington and eventual development of the Chum Genetic and Environmental Model (ChumGEM) (Figure 2-1). The committee also completed three proposals for submission to the PST Southern Boundary Restoration and Enhancement Fund (Southern Fund) to carry forward the first three priorities in this strategic plan. Additional detail

of the work performed by the Committee in 2013 can be found in the Committee's 2013 Work Plan (Appendix C).

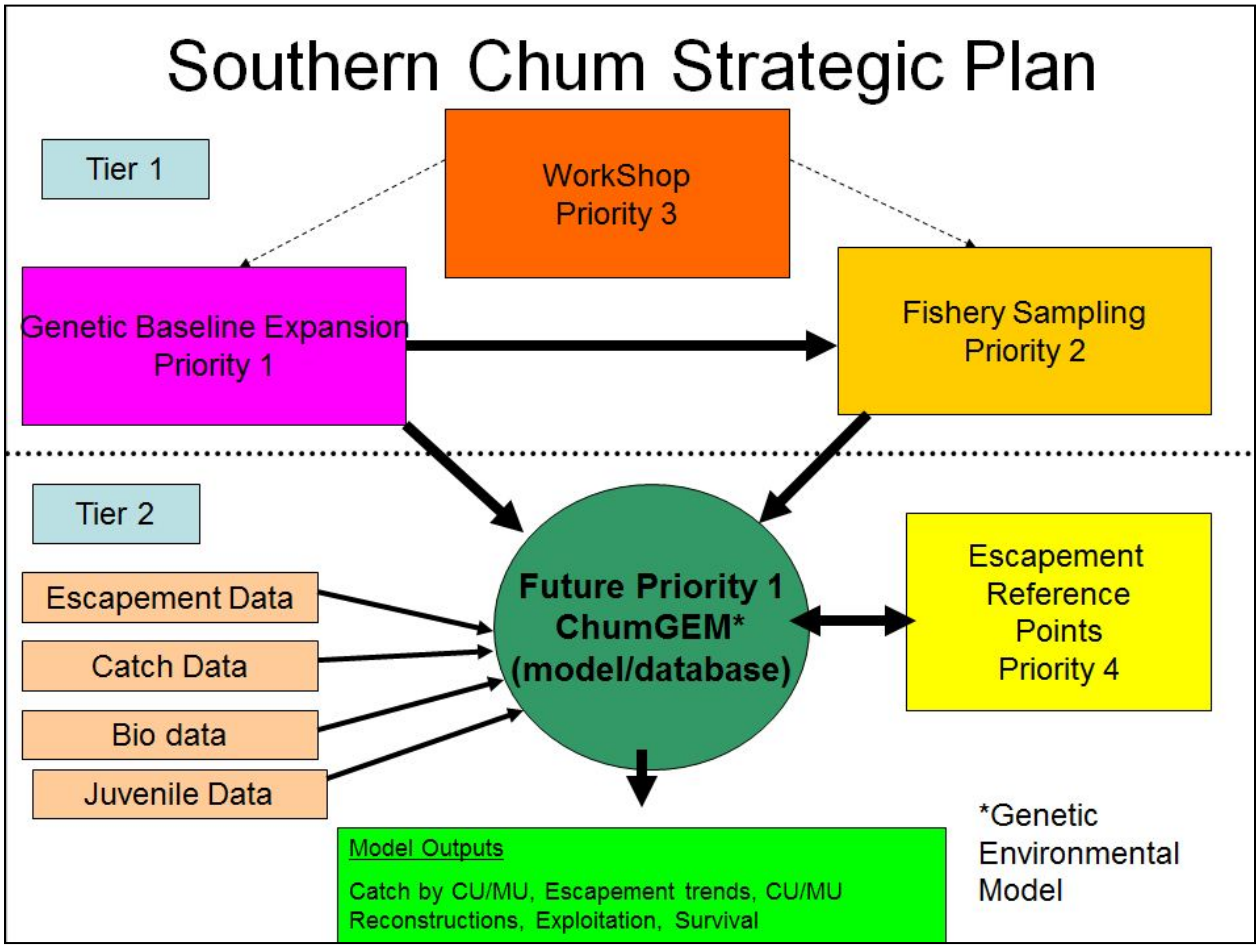

Figure 2-1. Southern Chum Strategic Plan developed by the joint Chum Technical Committee in 2012.

Paragraph 2:

> *When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods.*

For this report, the Committee continued to use historical stock composition information to estimate Chum salmon stock composition for 2013 fisheries. These historical stock composition estimates may no longer be representative of current stock composition, and the Committee is continuing to evaluate and implement new methods following the Committee's Strategic Plan (Figure 2-1) of which improved stock identification methodologies play a significant role. The initial stages of this Strategic Plan have been implemented and work on the development and implementation of the final stage of the plan is ongoing.

Paragraph 3:

Canada and the United States shall assess catch levels and make attempts to collect additional genetic samples from any Chum salmon caught during the July 1 through September 15 time period in the boundary area fisheries (U.S. Areas 4B, 5, 6C, 7 and 7A; Canadian Areas 18, 19, 20, 21, and 29).

Table 3-4 and Table 4-4 provide the harvest of Chum salmon during the period of summer Chum salmon migration in boundary areas. Due to the low numbers of Chum salmon encountered, neither party collected samples for genetic stock identification (GSI) during this time period.

Paragraph 4:

During the period from July 1 through September 15, Canada will require the live release of Chum salmon from all purse seine gear fishing in the Strait of Juan de Fuca (Canadian Area 20) and the United States will require the same for the non-Indian seine fisheries in Areas 7 and 7A. Note: By U.S. regulation, purse seine fisheries are not permitted in U.S. Areas 4B, 5 and 6C.

Regulations were implemented by both countries to require the live release of Chum salmon in these areas during this time period.

Paragraph 5:

Canada will manage its Johnstone Strait, Strait of Georgia, and Fraser River Chum salmon fisheries to provide continued rebuilding of depressed naturally spawning Chum salmon stocks, and, to the extent practicable, not increase interceptions of U.S. origin Chum salmon. Terminal fisheries conducted on specific stocks with identified surpluses will be managed to minimize interception of non-targeted stocks.

Table 3-1 provides an evaluation of the performance of the current Johnstone Strait management strategy (2004–2013). Historical GSI results and genetic estimates from 2006 through 2013 continued to indicate a low contribution of U.S. stocks in Johnstone Strait, Strait of Georgia and Fraser River Chum salmon fisheries.

Management strategies (see section 3.3) and annual fishery descriptions (see section 3.4) indicate that Canada's Johnstone Strait, Strait of Georgia, and Fraser River Chum salmon fisheries in addition to the terminal area fisheries, were managed to meet the provisions of Paragraph 5 of Annex IV, Chapter 6, of the PST.

Paragraph 6:

Canada will manage its Johnstone Strait mixed stock fishery as follows:

a) *Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical.*

b) *For run sizes above the critical threshold, Canada will conduct fisheries with an exploitation rate of up to 20% in Johnstone Strait of Inside Southern Chum salmon; and*

c) *When run sizes are expected to be below the critical threshold, Canada will notify the United States and will only conduct assessment fisheries and non-commercial fisheries. Commercial fisheries targeting Chum salmon will be suspended.*

While no specific estimates of Inside Southern Chum salmon abundance were provided, Canada notified the U.S. in early October, on the basis of inside area fisheries, that the return abundance of Inside Southern Chum salmon was likely above the critical threshold. Canada continued to manage the Johnstone Strait fisheries to target to 20% of Inside Southern Chum.

Paragraph 7:

Canada will manage its Fraser River fisheries for Chum salmon as follows:

a) For Fraser River terminal area run sizes, identified in-season, at abundance levels lower than 900,000 Chum salmon, the Canadian commercial Chum salmon fisheries within the Fraser River and in associated marine areas (Area 29), will be suspended; and

b) For Fraser River terminal area run sizes, identified in-season at levels greater than 900,000 Chum salmon, Canadian commercial Chum salmon fisheries within the Fraser River, shall be guided by the limits of the in-river Total Allowable Catch set by Canada.

In 2013, initial in-season abundance estimate indicated a terminal return above the specified Fraser River gross escapement threshold (see section 3.4.3).

Paragraph 8:

Canada will manage the Nitinat gill net and purse seine fisheries for Chum salmon to minimize the harvest of non-targeted stocks.

Due to identified low abundance of Nitinat Chum salmon in 2013, only limited commercial gill net fisheries occurred (see section 3.4.4.1; Table 3-10). To minimize the harvest of non-targeted stocks a variety of management actions were applied to this fishery (see section 3.3.4.1)

Paragraph 9:

Canada shall conduct a genetic sampling program of Chum salmon taken in the West Coast Vancouver Island troll fishery if early-season catch information indicates that catch totals for the July 1 through September 15 season may reach levels similar to 1985 and 1986. Sampling, should it occur, will include catches taken from the southern areas (Canadian Areas 121–124).

Chum salmon catch levels in the 2013 West Coast Vancouver Island troll fishery were significantly below the 1985 and 1986 levels. Therefore, no GSI sampling occurred.

Paragraph 10:

The United States will manage its Chum salmon fishery in Areas 7 and 7A as follows:

a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical;

b) For run sizes below the critical threshold, the U.S. catch of Chum salmon in Areas 7 and 7A shall be limited to Chum salmon taken incidentally to other species and in other minor fisheries, but shall not exceed 20,000, provided that

catches for the purpose of genetic stock identification sampling shall not be included in the aforementioned limit;

c) *For run sizes above the critical threshold, the base catch ceiling for the U.S. Chum salmon fisheries in Areas 7 and 7A will be 130,000 Chum salmon;*

d) *Canada will provide a run size estimate of Chum salmon entering the Fraser River no later than October 22. If the estimate is less than 900,000, the U.S. will limit its fishery impacts on Fraser River Chum salmon by restricting catch in Areas 7 and 7A to not exceed 20,000 additional Chum salmon from the day following the date the U.S is notified. The total catch is not to exceed the catch ceiling of 130,000 Chum salmon;*

e) *U.S. commercial fisheries for fall Chum salmon in Areas 7 and 7A will not occur prior to October 10;*

f) *The U.S. will manage the Areas 7 and 7A fisheries for Chum salmon with the intent to minimize the harvest of non-targeted species;*

g) *No U.S. catch shortfalls may be accrued; however any overages shall be carried forward as indicated in (h) and (i);*

h) *Due to management imprecision, a catch in the U.S. of up to 135,000 Chum salmon will not result in an overage calculation. Catches in excess of 135,000 Chum salmon shall result in an overage being calculated by subtracting 130,000 from the total Chum catch. Overages will be accounted for by reducing the U.S. annual catch ceiling in up to two subsequent non-critical Inside Southern Chum salmon years; and*

i) *From the day following the date the U.S. is notified of a run size below the critical threshold as defined in 10(b) or (d), any catches in excess of 20,000 Chum salmon will result in an overage. Overages will be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern Chum salmon years.*

In 2013, U.S. fisheries in Areas 7 and 7A were managed in accordance with the above provisions. U.S. commercial fisheries were initiated as scheduled on October 10. An estimated Fraser River Chum salmon run size was provided by Canada prior to October 22, consistent with the Treaty obligations. The fishery was therefore continued without restriction through November 9.

Paragraph 11:

The United States shall conduct its Chum salmon fishery in the Strait of Juan de Fuca (United States Areas 4B, 5, and 6C) so as to maintain the limited effort nature of this fishery, and, to the extent practicable, not increase interceptions of Canadian origin Chum salmon. The United States shall continue to monitor this fishery to determine if recent catch levels indicate an increasing level of interception.

This fishery is restricted to Treaty Indian fishers from four tribes and to gill net gear only. Due to the limited effort of the Juan de Fuca fishery, the Committee has not sampled the fishery for contribution of Canadian origin Chum salmon since 1996. Genetic stock identification (GSI)

samples collected from this fishery in prior years indicate the majority of the catch is Chum salmon of U.S. origin (Beattie et al. 1996).

Paragraph 12:

> *All information concerning by-catch of other salmon species from the Chum salmon fisheries covered by this chapter will be shared between the Parties in the annual Post Season Report.*

By-catch information for other salmon species was shared in accordance with the Treaty through each Party's post-season reporting process.

Paragraph 13:

> *Should circumstances arise that are inconsistent with either Parties understanding of the intent of the chapter, the Southern Panel will discuss the matter postseason and explore options for taking the appropriate corrective actions.*

No such circumstances arose in 2013.

3 Southern British Columbia Chum salmon

3.1 Introduction

Southern B.C. Chum salmon stocks and fishing areas (Pacific Fishery Management Areas or PFMAs; Appendix B) are, for the purposes of management, analysis and reporting, grouped into four major units: Johnstone Strait, Strait of Georgia, Fraser River, and the West Coast Vancouver Island (WCVI). Additionally, Chum salmon originating from Johnstone Strait, the Strait of Georgia, and the Fraser River are collectively described as Inside Southern Chum salmon.

3.2 Status of Treaty Requirements

During 2013, the Southern B.C. Chum salmon fisheries were managed according to the requirements of Annex IV, Chapter 6, as amended in 2009 (Appendix A).

3.3 Conservation and Harvest Management Strategies

The general management approach adopted by Fisheries and Oceans Canada (CDFO) for Southern B.C. Chum salmon is to achieve wild escapement targets, while augmenting production through enhancement of selected stocks. In practice, this approach is achieved through the application, in mixed stock fisheries, of harvest rates which are compatible with wild or natural stock productivity. If there are Chum salmon stocks that return to their area of origin in numbers above that area's escapement goal, they may be subject to additional harvesting within their terminal areas.

The following describes the management strategies and fishing plans for the four units of Southern B.C. Chum salmon stocks.

3.3.1 Johnstone Strait Chum Salmon Management Strategy

Since 2002, the mixed stock Chum directed fisheries in Johnstone Strait have been managed to approximate a fixed exploitation rate (~20%). Tagging studies conducted from 2000 through 2002 helped in the development of this fixed exploitation rate strategy by assessing the migration timing and harvest rate by fishing gear on an available abundance of Chum salmon in Johnstone Strait. This fixed exploitation strategy continued to be employed through 2013 (CDFO 2013).

Some of the key objectives of this strategy are to ensure sufficient escapement levels while providing more stable fishing opportunities (CDFO 2013). The exploitation rate is set at 20% across all harvesters, when abundance is estimated to be above a critical level. The critical level, or threshold, was determined to be 1.0 million Chum salmon (Appendix A). The Johnstone Strait Chum salmon test fishery, as well as the information gained from any commercial openings, is used in-season to determine the likelihood of achieving the critical level for Inside Southern Chum salmon. When expected levels are less than 1.0 million, only assessment fisheries and non-commercial fisheries will be conducted and any planned commercial fisheries targeting Chum salmon will be suspended (Appendix A). When the critical level is expected to be achieved, fisheries with an exploitation rate of up to 20% in Johnstone Strait can be conducted (Appendix A).

Of this 20%, the commercial sector is allocated 15%. The remaining 5% is set aside to provide for First Nations' food, social and ceremonial needs (FSC) satisfy recreational and test fishing

requirements, and to provide a buffer to the commercial exploitation (CDFO 2013). The impact of the Johnstone Strait fisheries during fixed exploitation approach (2004–2013), on Inside Southern Chum salmon stocks are detailed in Table 3-1.

The specific objectives of the fixed exploitation rate strategy are to:

- continue to rebuild/maintain stocks to the optimum wild escapement objective (defined as 2.5 million wild Inside Southern Chum salmon);
- establish a pre-season fishing plan to achieve an exploitation rate of 20% on Inside Southern Chum salmon in the Johnstone Strait Chum salmon fishery; and,
- stabilize commercial catch rates to provide opportunities at both low and high abundance levels

Table 3-1. Aggregate Inner South Coast Chum total return, harvest and spawning escapements. Comparison of fixed target and actual harvest rates in the Johnstone Strait fisheries. 2004–2013[1]

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
PRE-SEASON										
Inside Southern Abundance Forecast (or Outlook)	Average	Average	Average	Average to Above Average	Below Average	Below Average	Average to Below Average	Average to Below Average	Average to Below Average	Average to Below Average
POST-SEASON										
Inside Southern Abundance[2]	5,519,205	3,126,617	4,301,780	2,728,020	2,227,630	2,227,110	1,181,528	3,449,783	3,518,607	2,931,714
Inside Southern Harvest	1,876,239	1,304,237	1,527,453	796,239	579,756	747,043	127,967	1,441,680	911,427	981,945
Est. Inside Southern Harvest Rate	34.0%	41.7%	35.5%	29.2%	26.0%	33.5%	10.8%	41.8%	25.9%	33.49%
Johnstone Strait Harvest										
Commercial, Sport Area 11-13[3]	1,176,611	856,029	859,201	480,620	299,775	513,884	55,520	750,436	392,608	635,814
First Nations Area 11-13	27,041	18,841	16,453	14,870	11,630	13,576	4,060	9,880	13,106	13,444
Johnstone Strait Harvest Total	1,203,652	874,870	875,654	495,490	311,405	527,460	59,580	760,316	405,714	649,258
Target Johnstone Strait Harvest Rate	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
Est. Johnstone Strait Harvest Rate	21.8%	28.0%	20.4%	18.2%	14.0%	23.7%	5.0%	22.0%	11.5%	22.2%
ESCAPEMENT (Includes wild and enhanced)[4]										
Inside Southern Escapement	3,642,966	1,822,380	2,774,327	1,931,781	1,647,874	1,480,067	1,053,561	2,008,103	2,607,180	1,949,769

(1) Historic data in this table have been updated with most recent estimates; values may deviate from past reports.
(2) Total Inside Southern abundance includes total Inside Southern harvest plus escapement. Harvest composition based on historic GSI for all fisheries.
(3) Includes commercial, sport and test fishery harvest.
(4) Escapement estimates do not include any removals associated with hatchery rack (e.g. ESSR); those values are included in harvest. Escapement estimates have not been expanded for populations not monitored for escapement

3.3.2 Strait of Georgia Chum Salmon Management Strategy

Chum salmon stocks return to all areas of the Strait of Georgia (mid-Vancouver Island PFMA's 14-19) and are of enhanced and wild (natural) origin. Fisheries can target enhanced returns (e.g. Area 14: Puntledge, Big Qualicum and Little Qualicum rivers), wild returns (e.g. Area 16: main river systems of Tzoonie, Deserted and Skwawka rivers in the Jervis inlet area) and mixed returns (e.g. Area 19: directed primarily at enhanced Goldstream River population although some natural Cowichan River Chum salmon are also harvested).

With one exception, pre-season forecasts of the return of Strait of Georgia Chum salmon for population aggregates corresponding to PFMA's have limited use due to their inability to reasonably predict returns (CDFO 2013). The one exception is Chum salmon returning to Area 14. As a result, unlike some other units of Southern BC Chum Salmon (e.g. WCVI see section 3.3.4), pre-season fishing plans based on a pre-season forecast are not typically developed for Strait of Georgia Chum salmon stocks.

Strait of Georgia Chum salmon are managed as a component of a "mixed-stock harvest strategy" for Johnstone Strait and the northern Strait of Georgia. In-season management of Strait of Georgia Chum salmon is guided by advice from the South Coast Chum Advisory Committee (Chum Advisory Committee or Chum Working Group). The Chum Working Group represents interests for Strait of Georgia (mid-Vancouver Island Areas 14-19), Johnstone Strait, WCVI and Fraser River Chum salmon-directed fisheries. Fishing opportunities for Chum salmon are evaluated at weekly meetings of the Chum Working Group that usually start in the first week of October. In-season data is reviewed on a weekly basis until the conclusion of the fishing season that usually occurs around the end of November. The Chum Working Group includes internal (CDFO staff) and external (First Nations, commercial and recreational) representation and has been in operation since 2004. Additionally, Chum salmon management in Area 18 is also guided by advice from the Cowichan Fisheries Roundtable.

Chum salmon fishing opportunities in the Strait of Georgia PFMA's are predominately shaped by in-season escapement information, test fishing data, commercial harvesting data from Johnstone Strait fisheries when available, and coast-wide allocations of Chum salmon. When escapement goals are achieved (Table 3-2) or when stock abundance allows, commercial gill net, purse seine and troll fisheries can be permitted. As mentioned, the exception is Area 14 where a pre-season forecast of returning Chum abundance is used in addition to the in-season information listed above, to guide management decisions on fishing opportunities (CDFO 2013).

Chum salmon stocks return to all areas of the Strait of Georgia (mid-Vancouver Island PFMA's 14-19) and are of enhanced and wild (natural) origin. Fisheries can target enhanced returns (e.g. Area 14: Puntledge, Big Qualicum and Little Qualicum rivers), wild returns (e.g. Area 16: main river systems of Tzoonie, Deserted and Skwawka rivers in the Jervis inlet area) and mixed returns (e.g. Area 19: directed primarily at enhanced Goldstream River population, although some natural Cowichan River Chum salmon are also harvested).

Table 3-2. Current spawning escapement goal, hatchery requirements and overall escapement goal for Chum salmon returning to the Strait of Georgia by PFMA's and system.

PFMA	System	Spawning Escapement Goal	Hatchery Requirements	Overall Escapement Goal
Area 14	Puntledge River	60,000	10,000	300,000
	Big Qualicum River	100,000		
	Little Qualicum River	130,000		
Area 16	Jervis Inlet Streams	n/a	n/a	110,000
Area 17	Nanaimo River	n/a	n/a	60,000
Area 18	Cowichan River	n/a	n/a	160,000
Area 19	Goldstream River	n/a	n/a	15,000

(n/a) not applicable.

Fishing opportunities in the Strait of Georgia are constrained by concerns over bycatch of passing Chum salmon stocks and local Chinook and Coho salmon populations. These concerns are addressed by Area specific pre- and in-season management measures that may include:

- *area closures*: beach boundaries and limiting fisheries to terminal areas to minimize impacts on passing stocks; and,
- *non-retention*: of Chinook and Coho salmon.

As well, to reduce bycatch mortality and to improve the quality of catch data, additional pre-and in-season management measures may be implemented in the Strait of Georgia fisheries. These additional measures may include:

- *daylight fishing only*: in the gill net fishery;
- *maximum soak time*: in the gill net fishery;
- *mandatory brailing*: in the seine fishery;
- *barbless hooks*: in the troll fishery; and,
- *on-board observers*: if high bycatch occurs.

Pre- and in-season management measures aimed at reducing bycatch mortality are commonly implemented after consultation with the Chum Working Group.

First Nations FSC fisheries remain a priority and occur in terminal areas targeting individual populations from river systems within or adjacent to band territories. Harvest limits may be set when there are conservation concerns for the target population; however, First Nations FSC fisheries have priority over other fisheries. Generally, catch and effort in First Nations FSC Chum salmon fisheries is low compared to commercial Chum salmon fisheries.

Although tidal recreational fisheries are open throughout the Strait of Georgia, Chum salmon are not commonly targeted by recreational anglers. Nevertheless, the Strait of Georgia recreational Chum salmon catch is estimated annually through a Creel Survey conducted by CDFO. In most years, the Creel Survey operates from the beginning of May through to the end of September. Data from this survey is compiled and analyzed to produce catch and effort statistics by Area for

each salmon species. Non-tidal recreational fisheries vary by Area and are considered if escapement and FSC needs have been met.

3.3.2.1 Area 14 Chum Salmon Management Strategy

Chum salmon returning to Area 14 have been enhanced since the late 1960's, and terminal fisheries targeting the enhanced Chum salmon populations of Puntledge, Big Qualicum and Little Qualicum rivers have occurred in October and November since the early 1970's. Returning Area 14 Chum salmon abundance is forecasted pre-season using brood escapement, average survival, and age composition. In-season run strength is assessed from any early catch information, visual observations at river estuaries, and escapement counts to the three enhanced river systems.

The spawning escapement goals for Chum salmon to the three river systems are 60,000 to Puntledge River, 100,000 to Big Qualicum River, and 130,000 to Little Qualicum River; including enhancement facility requirements of 10,000, the overall escapement goal is 300,000 Chum salmon for Area 14 (Table 3-2). Spawning escapements are monitored by CDFO Stock Assessment and hatchery staff.

The recommended approach regarding Chum salmon-directed fishing opportunities in Area 14 is made at the first meeting of the Chum Working Group. This meeting is tentatively scheduled for the first week of October; Chum Working Group meetings are subsequently held every week until late November.

Commercial Chum salmon-directed fisheries have a specific harvest strategy, implemented since 1981 that consists of limited early harvest prior to any escapement occurring. The allowable early Chum salmon harvest is set at 65% of the predicted surplus. The predicted surplus is calculated by subtracting the overall escapement goal (300,000; Table 3-2) and a buffer (100,000) from the pre-season terminal run size forecast (CDFO 2013). The buffer safeguards against errors in the pre-season forecast of Area 14 stock abundance.

The limited early commercial harvest of Chum salmon is planned pre-season and executed in-season in the second or third week of October based on whether a surplus, using the formula described above, is identified. However, if catches in the commercial Chum salmon fisheries in Johnstone Strait indicate low Chum salmon abundance, a decision on the approach in Area 14 may be deferred until the following week.

The management objectives for Area 14 are:

- achieve Area 14 Chum salmon escapement requirements of 300,000;
- ensure adequate Chinook and Coho salmon escapements to Area 14 enhancement facilities;
- provide access to First Nations for FSC purposes;
- minimize the harvest of passing salmon populations;
- maximize economic return;
- work towards south coast Chum salmon allocation targets for gill net, seine net and troll sectors;

- attempt to manage initial fisheries in Area 14 to avoid large surpluses (e.g. greater than 100,000).

Starting in the second or third week of October, opportunities for gill net, seine net and troll fisheries are based on pre-season forecasts, in-season catch per unit effort (CPUE) information from commercial Chum salmon fisheries in Johnstone Strait, and escapement information. Escapement information becomes increasingly important when considering further commercial opportunities in the latter part of October. These commercial opportunities are determined at the weekly Chum Working Group meetings and may include consideration for:

- *limited effort seine net fishery*: a limited effort seine fishery with a harvest target will be considered from late October to late November, based on Chum salmon escapement, abundance in the approach areas and South Coast allocation guidelines. Full fleet opportunities may also be available;
- *expanded gill net and troll fishery*: if gear counts indicate a modest fleet size of 50 vessels or less, gill net and troll openings may be expanded beyond one to two days per week; as well, additional fishing opportunities for gill net and troll may be considered following the seine net fisheries; and,
- *additional fishing days*: additional fishing days are considered if fishing time is lost due to poor weather conditions.

Once spawning escapement goals and hatchery requirements have been achieved, any returns above the overall escapement goal may be harvested (CDFO 2013).

Commercial fishing opportunities are constrained by concerns over local and passing Chinook, Coho and Chum salmon populations. Management measures to address these concerns can include:

- *area closures*: beach boundaries to protect Chinook and Coho salmon (boundaries may range from half a mile to one and a half miles depending upon bycatch concerns and time of year); French Creek radius boundary and Baynes Sound area closures to protect wild Chum and Coho salmon populations;
- *non-retention*: of Coho salmon;
- *maximum soak time*: in the gill net fishery;
- *mandatory brailing*: in the seine fishery;
- *barbless hooks*: in the troll fishery;
- *daylight fishing only*: in the gill net fishery if there are significant levels of bycatch; and,
- *outside boundaries*: designed to minimize impacts on passing salmon populations.

First Nations FSC fisheries are conducted in Area 14 and at the enhancement facilities prior to consideration of ESSR fisheries targeting Chum salmon. Tidal recreational fisheries are subject to the normal daily and possession limits for Chum salmon (daily limit four per day/possession limit eight) and are open throughout the Area.

Once escapements have been confirmed, non-tidal recreational fisheries for Chum salmon in the Puntledge and Big Qualicum rivers will be considered. These fishing opportunities may occur as early as the second to fourth week of October and are based, in part, upon in-season and past return timing of Chum salmon.

Chum salmon returning to Area 14 have been enhanced since the late 1960's, and terminal fisheries targeting the enhanced Chum salmon populations of Puntledge, (Big) Qualicum and Little Qualicum rivers have occurred in October and November since the early 1970's. Returning Area 14 Chum salmon abundance is forecast pre-season using brood escapement, average survival and age composition. In-season run strength is assessed from any early catch information, visual observations at river estuaries, and escapement counts to the three enhanced river systems.

3.3.2.2 Area 16 Chum Salmon Management Strategy

This fishery targets wild Chum salmon stocks returning to river systems in the Jervis Inlet area. The main systems are Tzoonie, Deserted and Skwawka rivers. The overall escapement goal for Jervis Inlet streams is 110,000. These terminal fisheries occur when the individual or combined escapement goals have been assured.

Area 16 Chum salmon are managed as a component of "mixed-stock harvest strategy" for Chum salmon, and fishing opportunities are guided by coast-wide allocations of Chum salmon. Commercial fishing opportunities are evaluated at weekly meetings of the Chum Advisory Committee, usually starting in the first week of October. Assessment in the area is conducted by Fisheries and Oceans Canada Charter Patrol vessels, DFO Stock Assessment and Sechelt Indian Band staff. In-season data is reviewed on a weekly basis until the end of the season, which usually occurs around the end of November. Area 16 Chum fisheries are not planned based on pre-season forecasts alone. Fishing opportunities will be provided in an area when the escapement goal has been achieved. Achievement of the escapement goal includes the numbers of fish in-river plus the amount of fish inside a designated sanctuary area. The earliest potential fishing opportunity is anticipated near the end of October (CDFO 2013).

Chum salmon fishing opportunities are constrained by concerns over fishing impacts on Coho salmon and passing Chum salmon populations. To address these concerns, there is mandatory non-retention of Coho salmon and fishing is limited to terminal areas.

Historically, Chum salmon fishing opportunities in Area 16 do not occur on a regular basis. There have been no fisheries in Area 16 in recent years.

Area 16 Chum salmon-directed fisheries target wild Chum salmon populations returning to river systems in the Jervis Inlet area. The main systems are Tzoonie, Deserted, and Skwawka rivers.

3.3.2.3 Area 17 Chum Salmon Management Strategy

Chum salmon fisheries in Area 17 are directed primarily at the Nanaimo River population. On poor return years, the Nanaimo River Chum salmon stock is supplemented by production from the Nanaimo River Hatchery.

The overall escapement goal for the Nanaimo River is 60,000 Chum salmon (Table 3-2). Chum salmon escapement estimates are derived from joint DFO/Snuneymuxw in-river assessments.

Pre-season forecasts of Chum salmon abundance are helpful in defining possible opportunities, but decisions to open commercial fisheries are not based on pre-season information (CDFO 2013). Area 17 Chum salmon are managed as a component of the "mixed-stock harvest strategy" for Chum salmon, and in-season management is guided by advice from the Chum Working Group as outlined for Areas 14 and 16. Fishing opportunities are planned in-season based on escapement information and shaped by coast-wide allocations of Chum salmon. Escapements can fluctuate annually and fishery opportunities are evaluated during the weekly in-season review of Nanaimo escapement estimates within the Chum Working Group process.

Opportunities for gill net, troll and seine net fisheries are discussed once Chum salmon have started to enter the Nanaimo River and are present in terminal areas. Final decisions are made at the weekly Chum Working Group meetings. If commercial opportunities are identified, management will be guided by the following considerations:

- gill nets open for one or two days; fishing days and opening duration subject to escapement levels;
- troll open seven days per week due to a demonstrated low catch rate;
- after initial opening, continued fishing opportunities depend upon information derived from CPUE in the commercial fisheries, and on-going approach area and in-river assessments;
- if harvest remains "good" and the escapement goal is reached, commercial fisheries can continue; and,
- additional fishing days will be considered if time is lost due to poor weather conditions.

Commercial fishing opportunities are constrained by concerns over domestic Chinook and Coho salmon populations and passing Chum salmon. Management measures to address these concerns can include:

- *area closures*: subarea boundaries protecting migrating Fraser River Chum salmon and confine the fishery to the Nanaimo River stock;
- *non-retention*: of Coho and Chinook salmon;
- *maximum soak time*: in the gill net fishery if Coho salmon encounters are high;
- *barbless hooks*: in the troll fishery; and,
- *daylight fishing only*: in the gill net fishery if there are significant levels of bycatch.

In-season management measures aimed at reducing bycatch mortality (e.g. maximum soak time and daylight fishing only in the gill net fishery) would be implemented after consultation with the Chum Working Group.

First Nations FSC fisheries as well as tidal/non-tidal recreational fisheries are conducted on these Area 17 populations. Local FSC opportunities are undertaken by Nanaimo First Nations in consultation with the DFO. Tidal recreational fisheries are subject to the normal daily and possession limits and there are no closed areas. There are no opportunities for non-tidal recreational fisheries in the Nanaimo River.

3.3.2.4 Area 18 Chum Salmon Management Strategy

The Area 18 fishery is directed primarily at Cowichan River stocks, although some Goldstream Chum salmon are also harvested. The outer Cowichan Chum salmon fishing boundary is situated to minimize encounters of Saanich Inlet Chum salmon. Chemainus River stocks are also impacted but likely to a lesser extent (CDFO 2013).

The escapement goal for the Cowichan River is 160,000 Chum salmon (Table 3-2). The target was revised from 110,000 in 2009, and is based on habitat area and Chum spawning densities in the Cowichan River. In-river Chum salmon escapement estimates are provided by the operation of a DIDSON Counter (Dual-frequency Identification Sonar) located in the lower river since 2006.

Pre-season forecasts of abundance are helpful in defining possible commercial opportunities, but decisions to open commercial fisheries are not based solely on pre-season information (CDFO 2013). In-season management is guided by advice from the Cowichan Fisheries Roundtable (the Roundtable) and the Chum Working Group. Commercial fishing opportunities are evaluated during the weekly in-season meetings of the Roundtable and the Chum Working Group and are shaped by coast-wide allocations of Chum salmon.

Fishery openings are planned in-season based on escapement estimates from the DIDSON counter and information from a test fishery. Management is also guided by advice from the Cowichan Fisheries Roundtable (the Roundtable), the Chum Working Group and an in-season Chum Escapement Forecast Tool based on the DIDSON count by date (CDFO, 2013)

The following guidelines are used for in-season management:

- 25,000 Chum salmon enumerated in the Cowichan River triggers the start of the Area 18 seine net test fishery;
- over-flight and/or Area 18 seine net test fishery information will be used in conjunction with upper river spot indicators to determine whether the remainder of the escapement goal is expected to be achieved;
- small gill net and troll fisheries may be initiated on short notice if in-stream migration numbers and marine approach area abundance warrants an opening;
- troll fisheries may open seven days per week due to demonstrated low catch rates;
- sustained in-river Chum salmon migration and Chum salmon abundance in the marine area that indicates a higher probability of reaching escapement goals, may trigger a seine net fishery;
- subject to fishery review and continued escapements, commercial fisheries may continue and opening types will be adjusted to meet overall guidelines; and,
- specific fishing dates and boundaries will be determined in-season through the Roundtable and Chum Working Group process; timing of migration is important in terms of the health of the run and in relation to interception of Goldstream River Chum salmon in the Area 18 fisheries.

Like other Strait of Georgia PFMAs, commercial fishing opportunities in Area 18 are constrained by concerns over domestic Chinook and Coho salmon populations and passing Chum salmon. Management measures to address these concerns can include:

- *area closures*: subarea boundaries to protect Coho salmon holding off Cherry Point; limiting commercial fisheries to Satellite Channel to minimize impact on the earlier timed Goldstream River Chum salmon populations; beach boundaries to protect Chinook and Coho salmon;
- *non-retention*: of Coho salmon;
- *maximum soak time*: in the gill net fishery if Coho salmon encounters are high;
- *mandatory brailing*: in the seine net fishery;
- *barbless hooks*: in the troll fishery; and,
- *daylight fishing only*: in the gill net fishery if there are significant levels of bycatch.

In-season management measures aimed at reducing bycatch mortality (e.g. maximum soak time and daylight fishing only in the gill net fishery) would be implemented after consultation with the Roundtable and the Chum Working Group.

First Nations FSC fisheries and tidal/non-tidal recreational fisheries are conducted on these Area 18 Chum salmon populations. Tidal recreational fisheries are subject to the normal daily and possession limits. Non-tidal recreational fisheries will also be considered if escapement targets and First Nations FSC needs are achieved.

3.3.2.5 Area 19 Chum Salmon Management Strategy

Chum salmon fisheries are directed primarily at the Goldstream River population although some Cowichan River Chum salmon are also harvested. The overall escapement goal for Goldstream River is 15,000 Chum salmon (Table 3-2). Goldstream River is a relatively small system with good viewing conditions; as such, escapement estimates are derived from stream walks.

Due to the inability of pre-season forecasts to reliably predict returns of Area 19 Chum salmon, pre-season fishing plans are not developed for Area 19. In-season management is guided by advice from the Chum Working Group. Commercial fishing opportunities are evaluated at the Chum Working Group's weekly meetings where in-season data is reviewed. In-season escapement information forms the basis for determining commercial fishing opportunities. Area 19 falls under the same management regime as other Strait of Georgia PFMA's; consequently, fishing opportunities are also shaped by coast-wide allocations of Chum salmon.

Commercial fishing opportunities in Area 19 are constrained by concerns over domestic Chinook and Coho salmon populations and passing Chum salmon. Management measures to address these concerns can include:

- *area closures*: subarea boundaries to protect Goldstream River Chinook and Coho salmon holding at Squally Reach and minimize encounters of Cowichan River Chum salmon; commercial fishery openings set for mid to late November are limited to portions of Saanich Inlet that are outside or to the north of Squally Reach;
- *non-retention*: of Coho and Chinook salmon;
- *maximum soak time*: in the gill net fishery if Coho salmon encounters are high;
- *mandatory brailing*: in the seine net fishery;

- *barbless hooks*: in the troll fishery;
- *daylight fishing only*: in the gill net fishery if Coho salmon encounters are high;
- *selective fishing techniques*: commercial fisheries will utilize selective fishing techniques to minimize bycatch impacts; and,
- *on-board observers*: on-board observers could be employed if high bycatch occurs.

3.3.3 Fraser River Chum Salmon Management Strategy

The management strategy for Fraser River Chum salmon includes management goals and harvest allocation objectives for Chum salmon fisheries occurring within the Fraser River. Fisheries are structured to ensure a spawning escapement of 800,000 Chum salmon using in-season information derived from the CDFO Albion Chum salmon test fishery (see section 3.3.3.1). Decision rules that guide the management of Fraser River Chum salmon fisheries are summarized in Table 3-3.

Additionally, management of in-river Chum salmon fisheries is guided by the need to minimize impacts on co-migrating stocks of concern, including Interior Fraser River Coho salmon and Interior Fraser River Steelhead. In order to limit incidental impacts on Interior Fraser River Coho salmon, fishing for salmon with non-selective gear is restricted for all sectors (First Nations, recreational, and commercial) from early September to mid-October within the Fraser River mainstem below Sawmill Creek. Conservation measures taken to protect Interior Fraser River Steelhead are developed in conjunction with the B.C. Ministry of Environment on an annual basis, and are primarily focused on reducing the impact of Fraser River commercial gill net fisheries. In recent years, these restrictions have resulted in the delay of commercial fishing opportunities for Chum salmon until late October, with the exception of those fisheries that operate with selective gear.

Table 3-3. Key decision points for Fraser River Chum salmon management.

Run Size	Harvest Plan	First Nations	Commercial	Recreational
<500,000 in Fraser	<10%	Limited (reduced hours and days/week fishing)	Closed	Main stem Fraser River closed, restricted openings on tributaries
500,000 to 800,000 in Fraser	Directed fisheries limited to FSC	Normal (72,000)	Closed	Main stem Fraser River closed, restricted openings on tributaries
800,000 to 916,000 in Fraser	Catch not to exceed 81,000 (72,000 First Nations and 9,000 test fishing)	Normal (72,000)	Closed	Main stem Fraser River open, restricted openings on tributaries
916,000 to 1,050,000 in Fraser	Commercial catch not to exceed 10% for Chum.	Normal (72,000)	Open (35,000-105,000)	Open
>1,050,000 in Fraser	Commercial catch not to exceed 15% for Chum.	Normal (72,000)	Open	Open

3.3.3.1 Fraser River In-season Terminal Abundance Estimation

Terminal abundance of Fraser River Chum salmon is estimated using a Bayesian model that incorporates pre-season information on run size and migration timing, with in-season information on Chum salmon catch from the Albion Chum salmon test fishery (Gazey and Palermo 2000).

The Albion Chum salmon test fishery has operated annually since 1979 on the lower Fraser River in Area 29 near Fort Langley. The test fishery is conducted with a drifted gill net at a specific site near the old Albion ferry crossing. The test fishery begins in early September of each year, and usually fishes until the end of November. On each day of operation, the boat fishes two sets, timed to coincide with the daily high tide. The Albion Chum salmon test fishery normally fishes every other day from September 1st through October 20th, alternating days with the Albion Chinook salmon test fishery (which fishes an 8” mesh gill net during this period). From October 21st through the end of November, the Chum salmon test fishery operates daily. The gill net used in the Albion Chum salmon test fishery is 150 fathoms long, constructed from uniform 6.75" mesh.

The first in-season estimate of terminal Fraser River Chum salmon abundance is typically provided in mid-October. Limited First Nations FSC fisheries for Fraser Chum salmon may be permitted prior to this date, unless a conservation concern has been identified.

3.3.4 West Coast Vancouver Island Chum Salmon Management Strategy

Chum salmon stocks return to all areas on the West Coast of Vancouver Island (WCVI). When stock abundance allows, commercial Chum salmon fisheries are conducted in the marine waters outside Nitinat Lake (Area 21), Barkley Sound (Area 23), Clayoquot Sound (Area 24) and Outer Nootka Sound/Tlupana and Esperanza Inlet (Areas 25). Both commercial gill net and purse seine fleets target WCVI Chum salmon in these Areas.

A pre-season forecast of the return of WCVI Chum salmon is predicted for population aggregates corresponding to CDFO's Pacific Fishery Management Areas. Natural and enhanced returns are approximated through separate models and summed to produce a total return forecast for each Area. However, the relative inaccuracy of the pre-season forecasts resulted in the adoption of a fixed harvest rate strategy in the early 2000's for those fisheries targeting mixed stock aggregates.

With the exception of near-terminal areas, such as Nitinat (Area 21 & 22) or Tlupana Inlet (Area 25), where hatchery stocks dominate, WCVI Chum salmon fisheries are currently managed to an exploitation rate of approximately 20% or less. Exploitation is controlled by limiting fishing effort to specific areas, specific times or to a specific number of vessel fishing days per week. Since 2012, revised fishery lower and target reference points (FLRPs and FTRPs) were developed based on the Sustainable Escapement Goal (SEG) method. The SEG approach uses the long-term escapement series to set fishery reference points. Conservative "SEGs" are defined as the 25% and 75% of a long-term escapement time series. Although the WCVI Chum forecast is highly uncertain, the forecast is used to inform pre-season fishery planning. Where the forecast is below the FLRP for an area, fisheries are curtailed. Where the forecast is below the FTRP, fisheries are more limited (CDFO 2013)

Purse seine opportunities generally occur when excess salmon to spawning requirements (ESSR) are identified in near terminal areas (e.g. hatchery stocks returning to Nitinat River or Tlupana Inlet).

WCVI First Nations FSC fisheries remain a priority and occur in terminal areas targeting individual populations from river systems within or adjacent to band territories. Harvest limits may be set when there are conservation concerns for the target population; however, First Nations FSC fisheries have priority over other fisheries. Generally, harvest and effort in First Nations FSC Chum salmon fisheries is low compared to commercial Chum salmon fisheries.

Chum salmon are not commonly targeted by recreational anglers on the WCVI. Nevertheless, the WCVI recreational Chum salmon catch is estimated annually through a Creel Survey conducted by CDFO. Creel Survey information is augmented by logbook and manifest records of catch and effort submitted by lodges operating guided fishing trips on the WCVI. These data are compiled and analyzed to produce catch and effort statistics by Area for each salmon species.

3.3.4.1 Nitinat Chum Salmon Management Strategy

Of importance to the Pacific Salmon Treaty is the WCVI group of Chum salmon populations returning to the Nitinat watershed (Nitinat River and Nitinat Lake and tributaries). This Nitinat stock is the most significant WCVI group of populations and includes production from a major CDFO hatchery on the Nitinat River.

The Nitinat commercial Chum salmon fishery (Area 21), along with the ESSR fisheries (Area 22), is the largest fishery on the WCVI and targets returning Nitinat River hatchery Chum salmon. In the past, catch of non-WCVI Chum salmon has occurred in the outside seaward portion of the Nitinat fishing area. Management actions have been implemented to reduce this catch of non-WCVI Chum salmon by restricting the Nitinat fishery to subareas closer to the terminal area (i.e. outlet of Nitinat Lake). More recently, First Nations' ESSR harvests have occurred within Nitinat Lake (Area 22). Historical Chum salmon harvest is shown in Table 3-10.

The spawning escapement target for Chum salmon returning to the Nitinat system (i.e. Nitinat River and other tributaries to Nitinat Lake) has been set at 175,000 fish (CDFO 2013). The target distribution of this spawning escapement between Nitinat River and the tributaries to Nitinat Lake has varied slightly over the last number of years; currently it is set at 125,000 into the Nitinat River and 50,000 into other Nitinat Lake tributaries. This spawning escapement requirement is set at a level to ensure that all run timing components are represented. Additional allocation for First Nations FSC requirements and hatchery requirements (i.e. broodstock) may total up to 50,000 Chum salmon. Consequently, the *gross escapement requirement* (spawning escapement + FN FSC requirements + hatchery requirements) for this Nitinat group of populations is 225,000 Chum salmon (CDFO 2013). Historical Chum salmon escapements are shown in Table 3-10.

A pre-season forecast of current year returns for the Nitinat stock is approximated based on broodyear escapements, estimated freshwater production from natural spawners, hatchery production, average age at return, environmental and ocean condition factors during brood ocean entry and estimated marine survival of each broodyear class.

A pre-season fishing plan is commonly developed by the end of the summer and is based on the forecast of current year returns. The fishery is managed through a fixed-harvest rate strategy to limit the harvest rate to approximately 25%. The allowable effort of the commercial fleets was determined from an analysis of the average exploitation rate per unit effort in Nitinat Chum salmon fisheries over the last decade.

In addition to concerns over catch of non-WCVI Chum salmon, early season opportunities are constrained by concerns over bycatch of Interior Fraser River Steelhead (Thompson River) and passing stocks of Coho salmon. Since 1995, these bycatch concerns in the commercial Nitinat fishery have been addressed by:

- *delayed opening dates*: the first commercial gill net fishery, if conducted, has been delayed until the beginning of October since 1998;
- *reduced fishing areas*: the traditional fishing area has been reduced to within a one-mile boundary between lines true south from Pachena and Dare Points (a portion of Area 21);
- *increased use of weed lines*: a 1.2m - 2.0m weed line for gill nets; and,
- *species selective fishing techniques*: non-retention of Coho salmon and Steelhead.

Additionally, to reduce bycatch mortality and to improve the quality of catch data, the following measures have been implemented in the Nitinat fisheries:

- *daylight fishing only*: gill net fishery;

- *mandatory functional revival tanks*: in purse seine and gill net fisheries;
- *on-board observers*: portions of purse seine and gill net fleet; and,
- *logbooks and weekly hail-ins*: purse seine and gill net fisheries.

The in-season management of the Nitinat fisheries (Area 21 and 22) are based on achieving the *gross escapement requirement* into the Nitinat watershed. Broodstock collection success, hatchery swim-ins, and visual surveys of Nitinat River spawners are used to determine whether the weekly *escapement milestone levels* into Nitinat Lake are achieved (CDFO 2013). Weekly fisheries are generally scheduled in Area 21 and surrounding waters to harvest any identified surplus.

First Nations FSC fisheries remain a priority and occur in terminal areas of Nitinat (Areas 21 and 22). First Nations ESSR fisheries can also occur in Nitinat Lake (Area 22) targeting returns surplus to spawning and hatchery requirements.

3.4 Annual Fishery Descriptions

Fisheries targeting Chum salmon in Johnstone Strait, Strait of Georgia, Fraser River, and on the West Coast of Vancouver Island (WCVI) generally begin in late September and end in November. These fisheries are directed at fall Chum salmon.

In addition to these directed fisheries, a bycatch of Chum salmon may occur in fisheries directed at Sockeye and Pink salmon earlier in the season. This Chum salmon bycatch is assumed to be comprised mainly of summer Chum salmon. The summer Chum salmon harvest in boundary area fisheries are presented in Table 3-4.

The main components of the Inside South Coast (ISC) Chum salmon return was expected to be both Fraser and non-Fraser stocks. These stocks are typically dominated by four year old fish from a below average 2009 brood return which out-migrated to the ocean in 2010. It was quite apparent that other salmon species that also out-migrated in 2010 encountered lower productivity and reduced survivals (Pink and Coho salmon returns in 2011). The pre-season expectation for ISC Chum salmon suggested low to near target returns to the area.

Table 3-4. Estimated harvest of summer Chum salmon by PFMA for commercial, research and test fishing vessels 1 (July through the second week of September), 2004–2013.

Year	Statistical Weeks	Pacific Fishery Management Area					
		18	19	20	21	29 [2]	Total
2004	7/1–9/2	0	0	17	0	686	703
2005	7/1–9/2	0	0	0	0	115	115
2006	7/1–9/2	0	0	52	0	419	471
2007	7/1–9/2	0	0	0	0	49	49
2008	7/1–9/2	0	0	0	0	67	67
2009	7/1–9/2	0	0	0	0	27	27
2010	7/1–9/2	0	0	16	0	384	400
2011	7/1–9/2	0	0	0	0	883	883
2012	7/1–9/2	0	0	0	0	125	125
2013	7/1–9/2	0	0	0	0	27	27
Average		0	0	9	0	278	287

(1) Does not include PSC test fisheries harvest.
(2) Majority of this harvest is fresh water based and likely of Fraser River origin.

The following sections describe the fisheries directed at fall Chum salmon in each of the Southern B.C. areas in 2013.

3.4.1 Johnstone Strait

The Johnstone Strait test-fishery provided timing and abundance information for the 2013 return, which are important in assessing the performance of the 20% fixed exploitation rate strategy. It also provided an index of abundance, used to determine the likelihood of the number of returning Chum salmon being over the 1.0 million critical threshold level (requirement for commercial openings). Catch per unit effort in the test fishery was relatively strong and it was determined that the returning abundance was likely higher than the critical threshold required for continuation of commercial fisheries. All subsequent commercial openings in Johnstone Strait were prosecuted as planned. Age composition derived from the test-fishery and commercial samples was dominated by 4 year olds throughout the season. Escapements and catches in 2013 suggested returns were average to below average in many ISC Chum. Table 3-5 outlines the duration and Chum salmon harvest, of fishery openings during the 2013.

In 2013, there were two competitive commercial purse seine openings; three gill net openings in and one troll individual transferable quota (ITQ) fishery in Johnstone Straits (Area 12 and Area 13). The total 2013 commercial harvest for Johnstone Strait, including test fishery harvest, was 635,813 Chum salmon (Table 3-5). There were no directed commercial Chum salmon fisheries in the terminal areas of Johnstone Strait. Recreational harvest was low in Johnstone Strait (estimated at <200 Chum salmon; Table 3-5) with little monitoring during the month of October. First Nations FSC harvest was estimated at 13,444 in the Johnstone Strait area (Table 3-5). The total estimated harvest of Chum salmon in Johnstone Strait in 2013 was 649,400.

Table 3-5. Estimated Chum salmon harvest from Chum salmon-directed fisheries occurring in Johnstone Strait by PFMA, 2013.

Gear Type	Area	Fishery Dates		Fishery Duration (hours)	Estimated Harvest
		Start	End		
Purse Seine (Test)	12	Sep. 16	Oct. 29	n/a	38,426
Purse Seine	12	Sockeye/Pink Directed[1]			7,538
	13				731
	12	Oct. 2	Oct. 3	16	105,028
	13	Oct. 2	Oct. 3	16	144,478
	12	Oct. 21	Oct. 21	10	64,992
	13	Oct. 21	Oct. 21	10	109,659
Gill Net	12	Oct. 7	Oct. 9	41	31,350
	13	Oct. 7	Oct. 9	41	14,422
	12	Oct. 15	Oct. 17	41	33,402
	13	Oct. 15	Oct. 17	41	12,411
	12	Oct. 25	Oct. 27	41	14,968
	13	Oct. 25	Oct. 27	41	16,034
Troll [2]	12	Sep. 27	Oct. 13	n/a [2]	0
	13	Sep. 27	Oct. 13	n/a [2]	33,415
	12	Oct. 15	Nov. 3	n/a [2]	0
	13	Oct. 15	Nov. 3	n/a [2]	8,959
Recreational [3]	12	n/a	n/a	n/a	41
	13	n/a	n/a	n/a	102
First Nations [3]	12	n/a	n/a	n/a	3,565
	13	n/a	n/a	n/a	9,879
Total					649,400

(1) This is bycatch from Fraser Sockeye and Pink salmon directed fisheries that took place during early September.
(2) The troll fishery was opened from Sep. 27 to Nov. 3. The fishery was an effort based quota over that time period. Statweeks 9/4 to 10/2 are grouped and weeks 10/3 to 10/5 are grouped.
(3) The recreational and First Nation fisheries time periods varied over the season.

3.4.2 Strait of Georgia

In 2013, the total return of Chum salmon to Area 14 systems was within the preseason forecasted range (198,000 and 297,000). Commercial openings targeted Chum salmon returning to the three major systems in this area (Puntledge, Little Qualicum and Big Qualicum rivers). There were two competitive gill net openings and one purse seine opening in Area 14. Total commercial catch associated with Area 14 fisheries was 30,883 Chum salmon (Table 3-6).

In-season assessments in Area 18 did not identify sufficient escapement levels in the Cowichan River to initiate fisheries. Test fishery harvest was a total of 8,270 Chum salmon (Table 3-6).

The recreational creel survey within the Strait of Georgia area was not conducted after September in 2013.

The harvest by First Nations in the Strait of Georgia in 2013 was estimated to be 4,315 Chum salmon (Table 3-6).

The total estimated harvest of Chum salmon in the Strait of Georgia in 2012 was 53,461.

Table 3-6. Estimated Chum salmon harvest from Chum salmon-directed fisheries occurring in the Strait of Georgia by PFMA, 2013.

Gear Type	Area	Fishery Dates		Fishery Duration (hours)	Estimated Harvest
		Start	End		
Purse Seine (Test)	18-19	Oct. 28	Dec. 3	n/a	8,270
Purse Seine	14	Nov. 6	Nov. 14	210	0
Gillnet	14	Nov. 3	Nov. 5	50	18,531
	14	Nov. 6	Nov. 20	354	12,352
	17	Nov. 3	Nov. 4	24	9,993
Recreational [1]	14-19, 28, 29 [3]	May 1	Sep. 30	n/a	0
First Nations [2]	14	n/a	n/a	n/a	30
	15	n/a	n/a	n/a	150
	16	n/a	n/a	n/a	0
	17	n/a	n/a	n/a	0
	18	n/a	n/a	n/a	3,030
	19	n/a	n/a	n/a	1,105
	28	n/a	n/a	n/a	0
Total					53,461

(1) The recreational fishery was not monitored after September; harvest of Chum salmon was likely very low.
(2) The First Nation fisheries time periods varied over the season.
(3) Marine subareas of Area 29; i.e. does not include an estimate for Chum salmon harvest in the tidal portion of the lower Fraser River downstream of Mission BC (Appendix B3).
(n/a) not applicable.

3.4.3 Fraser River

Directed Chum salmon fisheries occur within the Fraser River for all fishing sectors, including First Nations, recreational, commercial, and test fisheries. In recent years, significant conservation measures have been implemented in-river during the Fraser River Chum salmon migration period in order to protect co-migrating stocks of concern, particularly Interior Fraser River Coho salmon and Interior Fraser River Steelhead. Depending on the fishery, these measures have included time and area closures, gear restrictions and release requirements.

The escapement objective for Fraser River Chum salmon is 800,000 spawners. As described in section 3.3.3 (*Fraser River Chum Salmon Management Strategy*), Chum salmon fishing opportunities are provided based on in-season assessments of run-size, using CPUE information from the CDFO Albion Chum salmon test fishery. The initial in-season estimate of terminal abundance provided to the US on October 16, 2013 was 1,489 million Chum salmon. A subsequent in-season estimate of 1,634 million was provided on October 21.

Table 3-7. Estimated harvest of Chum salmon from salmon fisheries occurring in Area 29 (both marine and in-river) and in Region 2 (non-tidal) of the Fraser River, 2013.

Fishing Sector	Fishery Description	Target Species	Fishery Dates		Fishery Duration	Assessment Period [1]		Estimated Harvest
			Start	End		Start	End	
Test	Albion Chinook	Chinook	21-Apr	20-Oct	158 days	n/a	n/a	2,600
	Albion Chum	Chum	1-Sep	23-Nov	58 days	n/a	n/a	8,500
	Whonnock Sockeye	Sockeye	24-Jun	4-Oct	103 days	n/a	n/a	1,166
	Cottonwood Sockeye	Sockeye	10-Jul	16-Sep	69 days	n/a	n/a	4
	Test Subtotal							**12,270**
Commercial [2]	Area E Gill Net	Chum	24-Oct	24-Oct	1 day	n/a	n/a	94,412
	Area B Seine	Pink	1-Sep	18-Sep	12 days	n/a	n/a	943
		Chum	17-Oct	17-Oct	1 day	n/a	n/a	6,535
	Commercial Subtotal							**101,890**
Recreational [3, 4, 5]	Fraser River Mainstem	Mixed	27-Jul	15-Aug	20 days	27-Jul	15-Aug	0
		Mixed	31-Aug	31-Dec	123 days	31-Aug	30-Sep	53
	Chilliwack River	Coho	1-Jan	31-Mar	90 days	15-Sep	15-Nov	2,429
		Mixed	1-Jul	31-Dec	184 days			
	Nicomen Slough	Mixed	1-Jan	31-Dec	365 days	12-Oct	30-Nov	1,016
	Recreational Subtotal							**3,498**
First Nations [2, 6]	FSC	Mixed	11-May	6-Sep	n/a	n/a	n/a	219
		Chum	5-Oct	24-Nov	n/a	n/a	n/a	37,216
	ESSR	Chum	n/a	n/a	n/a	n/a	n/a	43,176
	EO	Pink	10-Sep	29-Sep	n/a	n/a	n/a	1,941
		Chum	18-Oct	6-Nov	n/a	n/a	n/a	106,018
	First Nations Subtotal							**188,570**

(1) Assessment Period Start and End dates refer to the period of assessment for the recreational fisheries only.

(2) Fishery Start and End Dates for the commercial and First Nations fisheries reflect the first and last date the fisheries were permitted; the fisheries were not continuous between these dates.

(3) Fishery Start and End Dates for the recreational fisheries reflect the period the fishery was opened to the retention of Chum salmon; retention of other salmon species may have been allowed beyond these dates.

(4) The recreational estimates are for the periods of assessment; assessment periods may or may not coincide with Chum retention fishery opening and closing dates.

(5) Recreational estimates are preliminary.

(6) The Fishery Duration represents the maximum number of days provided to First Nations; individual First Nations may have fished for shorter periods.

(7) The Fraser River mainstem recreational fishery was closed to salmon fishing from Aug.16 to Aug.30, 2013.

(n/a) not applicable

First Nations FSC gill net fisheries targeting Chum salmon were initiated October 5 following a closure period to protect co-migrating Interior Fraser Coho salmon. These fisheries harvested a total of 37,216 Chum salmon. First Nations Economic Opportunity (EO) fisheries directed at Chum salmon in 2013 harvested 106,018 Chum (Table 3-7). In addition to these fisheries, certain

First Nations groups were also provided access to Chum salmon that returned to hatchery facilities but that were not required for broodstock. A total of 43,176 Chum salmon deemed to be surplus to spawning requirements (ESSR) were provided to First Nations from various hatchery facilities in 2013.

First Nations FSC Chinook and Sockeye-directed fisheries occurring in 2013 had minimal bycatch of Fraser Chum salmon, harvesting 219 Chum salmon (Table 3-7). An additional 1,941 Chum were taken as bycatch in Pink-directed Economic Opportunity fisheries in 2013.

The total harvest of Chum salmon in all Fraser River First Nations fisheries (including hatchery ESSR fish) was 188,570 in 2013 (Table 3-7 and Table 3-8).

Table 3-8. Estimated harvest of Chum salmon from First Nations and commercial salmon fisheries occurring in Area 29 and Fraser River, 2004-2013.

Year	First Nations			Commercial			Total
	FSC	EO	ESSR	Area E GN Area B SN Area H TR	Albion and PSC Test Fisheries	Other Scientific Licenses [1]	
2004	19,846	50,668	96,682	70,855	16,383	n/a	258,880
2005	7,267	95,527	38,487	56,898	12,920	n/a	212,770
2006	15,150	114,708	93,516	163,757	16,942	n/a	410,350
2007	13,344	77,490	29,884	30,400	7,650	n/a	163,332
2008	31,553	50,004	41,683	38,006	10,155	n/a	176,098
2009	12,991	68,150	8,458	42,116	9,249	n/a	144,163
2010	13,480	186	14,021	209	10,762	n/a	44,925
2011	22,331	4,886	50,867	36,058	3,553	n/a	117,695
2012	30,746	102,185	34,593	60,404	13,487	n/a	241,415
2013	37,435	107,959	43,176	101,890	12,270	n/a	302,730
Average	**20,414**	**67,176**	**45,137**	**60,059**	**11,337**	**n/a**	**207,236**

(1) Includes "experimental" selective fishing scientific licenses issued under the CDFO Selective Fishing Program. (n/a) not applicable.

The major Fraser River watershed recreational salmon fisheries impacting Chum salmon in 2013 include significant fisheries occurring in the lower Fraser River mainstem, the Chilliwack River and the Stave River, and minor salmon fisheries occurring on the Harrison River and the Nicomen Slough/Norrish Creek system. The latter four systems are tributaries to the Fraser River in the lower Fraser Valley. The recreational fisheries occurring in the Harrison and Stave rivers were not assessed in 2013.

The lower Fraser River mainstem was open to recreational angling and the retention of Chum salmon on two separate occasions in 2013. The initial opening occurred from July 27 to August 15, 2013 (daily retention limit of 2) and was followed by a closed period of approximately 2 weeks. The lower Fraser River mainstem was subsequently opened from August 31 to December 31, 2013 (daily retention limit of 2). In 2013, this mainstem recreational fishery was assessed from July 27 to August 15 and August 31 to September 30, 2013; estimates of 53 and 355 Chum salmon were harvested and released, respectively (Table 3-7). The estimated harvest in 2013 was notably less than in 2012 (Table 3-9); however, assessment in 2013 was truncated

two months earlier than in 2012. In 2012, approximately 90% of the reported harvest occurred in the October 1 to November 30 period.

The Chilliwack River recreational fishery was open to the retention of Chum salmon from July 1 to December 31, 2013 (daily retention limit of 1). This fishery was assessed from September 15 to November 15, 2013; estimates of 2,429 and 12,690 Chum salmon were harvested and released, respectively (Table 3-7). Similar to the Fraser River mainstem recreational fishery, the estimated Chum salmon catch in 2013 decreased from 2012 for the Chilliwack River recreational fishery (Table 3-9); however, unlike the Fraser fishery, the fishery assessment was relatively consistent between 2012 and 2013.

The Harrison River, Stave River and Nicomen Slough recreational fisheries were open to the retention of Chum salmon year round (daily retention limit of 2). The Nicomen Slough fishery was assessed from October 12 to November 30, 2013. Estimates of 1,016 and 4,525 Chum salmon were harvested and released, respectively for this fishery (Table 3-7) and were a significant increase over the estimates reported for 2012 (Table 3-9). Similar to the Chilliwack recreational fishery, the fishery assessment in 2013 was comparable to the assessment in 2012. Recreational fisheries occurring in the Harrison and Stave rivers were not assessed in 2013.

In total, for assessed recreational fisheries occurring in the lower Fraser River watershed in 2013, estimates of 3,498 and 17,570 Chum salmon were harvested and released, respectively (Table 3-7 and Table 3-9).

Commercial fisheries in the lower Fraser River (i.e. Area E gill net) are closed annually from early September to mid-October during the Interior Fraser Coho migration period. In recent years, this closure has been extended into late October to provide additional protection to Interior Fraser Steelhead. As a result, commercial Area E gill net Chum salmon fisheries now typically occur during the last week of October and first week of November. In 2013, there was one Area E commercial opening in the Fraser River on October 24 that harvested a total of 94,412 Chum salmon. The Area B seine fleet also mounted a limited-participation Chum salmon-directed fishery off the mouth of the Fraser River on October 17 that harvested 6,535 Chum salmon (Table 3-7). Finally, Area B also had a demonstration fishery targeted on Fraser River Pink salmon off the mouth of the Fraser River. This fishery harvested 943 Chum salmon between September 1 and September 18.

Table 3-9. Estimated harvest of Chum salmon in assessed (i.e. surveyed) lower Fraser River recreational fisheries, 2004–2013.

Year	Recreational Fishery					
	Fraser River [1]	Chilliwack River	Nicomen Slough	Stave River	Harrison River	Total
2004	0	4,384	62	ns	ns	4,446
2005	39	1,624	8	ns	ns	1,671
2006	900	5,375	2	ns	ns	6,277
2007	3,007	1,553	4	ns	ns	4,564
2008 *	760	3,937	0	ns	ns	4,697
2009 *	43	2,404	10	ns	742	3,199
2010 *	1,549	1,142	10	3,578	ns	6,279
2011 *	32	278	14	ns	ns	324
2012 *	2,298	4,633	9	ns	ns	6,940
2013 *	53	2,429	1,016	ns	ns	3,498
Average	868	2,776	114	3,578	742	4,190

(1) Mainstem portion of the lower Fraser River (downstream of Hope, B.C.; Appendix B).
(*) Preliminary estimates.
(ns) not surveyed.

In 2013, a total of 101,890 Chum salmon were harvested in commercial (excluding Economic Opportunity and test fisheries) fisheries in the Fraser River and the marine areas immediately off the Fraser River mouth (Table 3-7 and Table 3-8).

Four test fisheries operated in the Fraser River in 2013: the CDFO-operated Albion Chinook and Chum salmon gill net test fisheries and the PSC-operated Whonnock and Cottonwood Sockeye salmon gill net test fisheries. While Whonnock and Cottonwood test fisheries target Sockeye salmon, the Albion test fishery assesses abundance of both Chinook and Chum salmon, using different net configurations to target the two different species (section 3.3.3.1).

In 2013, the Albion Chinook salmon test fishery operated from April 21 through October 20, and the Albion Chum salmon test fishery operated from September 1 through November 23. From September 1 to October 20, the Chinook and Chum test fisheries operated on alternating days (section 3.3.3.1). The Albion test fishery did not operate on October 24 due to gear conflicts with the Area E opening in the Fraser River. Chum salmon harvest in the Albion Chinook salmon test fishery, representing 158 fishing days, totaled 2,600 and harvest in the Albion Chum salmon test fishery, representing 58 days, totaled 8,500 Chum salmon (Table 3-7).

The PSC Whonnock Sockeye salmon test fishery operated for 103 days from June 24 through October 4, and harvested 1,166 Chum salmon. The PSC Cottonwood Sockeye salmon test fishery fished for 69 days from July 10 through September 16, harvesting only 4 Chum salmon (Table 3-7).

In total, an estimated 12,270 Chum salmon were harvested in the CDFO and PSC test fisheries occurring in the Fraser River in 2013 (Table 3-7 and Table 3-8).

3.4.4 West Coast Vancouver Island

There was only gill-net commercial fisheries in 2013 based on abundance in Nitinat Lake and River. Limited effort gill net fisheries only occurred in Areas 23; harvest totaled 1,418 Chum salmon.

First Nations FSC harvest of Chum salmon occurred in all WCVI areas and totaled 2,009 for 2013.

3.4.4.1 Nitinat

The pre-season forecast for the 2013 return to the Nitinat watershed at 328,000 was above the gross escapement target (gross escapement target of 250,000). Based on the preseason forecast and the lack of a test fishery in 2013, a fixed harvest rate strategy through limiting effort was initiated. The harvest plans initiated with 2 gill net openings during the beginning of October. CPUE from the gill net openings, observation by the hatchery during broodstock activities and in-river observations confirmed a much lower return than anticipated. As a result, only the initial commercial gill net occurred and no purse seine fisheries were entertained for a total harvest in Area 21 of 15,730 by gill nets (Table 3-10).

First Nations FSC (Area 21/22) and ESSR (Area 22) harvest of Chum salmon in 2013 totaled 1,661 Chum. An additional 24,089 Chum salmon were taken for broodstock at Nitinat, and 10,790 Chum salmon were harvested by the gill net test fishery in Nitinat Lake. Recreational fisheries targeting Chum salmon are very limited; harvest in 2013 was not estimated but was assumed to be very small (~50 Chum salmon). All Chum salmon removals (i.e. all harvest plus broodstock collections) totaled 41,530 Chum salmon in 2013 (Table 3-10).

Table 3-10. Nitinat area harvest, hatchery broodstock collection and spawning escapement estimates by PFMA, 2004–2013.

Year	Area 21		Area 22	
	Seine Net Harvest	Gill Net Harvest	In-Lake Harvest and Broodstock	Escapement [1] (Natural Spawners)
2004	74,613	162,933	166,200	247,368
2005	385,487	294,054	237,200	315,789
2006	223,927	229,243	145,000	155,053
2007	0	180,111	22,268	115,789
2008	18,796	23,919	34,505	52,632
2009	0	0	32,434	54,000
2010	0	0	42,971	59,900
2011	65,469	211,968	136,641	248,655
2012	97	23,219	75,816	206,704
2013	0	15,730	25,800	25,066
Average	76,389	114,118	91,884	148,096

(1) includes Nitinat tributaries.

3.5 Escapement

Chum salmon that escape First Nations, commercial (including test fisheries), and recreational fisheries, and any First Nations ESSR harvests, form the escapement totals of spawning Chum salmon for this section of the report. This *net escapement* can include Chum salmon that spawn in natural areas and constructed spawning channels, and those that are used as broodstock in enhancement facilities for hatchery production purposes. For the purposes of this report *spawning escapement* refers to salmon that spawn by their own volition in nature in either a natural (e.g. river) or manmade channel (e.g. controlled spawning channel), and does not include salmon used for broodstock.

Some river systems in southern B.C. support summer Chum salmon populations. However, because the summer aggregate is relatively minor when compared to the larger fall aggregate in southern B.C., and due to their distinctively early run timing (e.g. July to late August in Johnstone Strait) allowing for only a minimal bycatch in southern B.C. salmon fisheries (Table 3-4), summer Chum salmon escapement is not included in the escapement totals for this section of the report (i.e. escapement totals in this section refer to fall Chum salmon only).

3.5.1 Inside Southern

The stocks that are managed within the context of the ISC salmon plan are the fall Chum salmon. These Chum salmon enter Johnstone Strait during the September to November time period. Escapement estimates for these Chum salmon since 2004, are presented in Table 3-11.

Table 3-11. Inside Southern Chum salmon net escapement estimates (spawning escapement plus hatchery broodstock) for Fraser and Non-Fraser stock aggregates, 2004–2013[1].

Year	Inside Southern Chum Escapement		
	Fraser River	Non-Fraser River	Total
2004	2,633,549	973,010	3,606,559
2005	1,264,071	547,538	1,811,609
2006	2,026,673	696,960	2,723,633
2007	1,026,701	902,149	1,928,850
2008	940,143	690,814	1,630,957
2009	619,363	853,501	1,472,864
2010	634,493	416,398	1,050,891
2011	1,084,652	912,293	1,996,945
2012	1,280,332	1,305,359	2,585,691
2013	799,573	1,139,582	1,939,155
Average	1,230,995	843,760	2,074,715

(1) Does not include Chum salmon which are surplus to spawning requirements (ESSR) and are removed from the spawning areas as they do not contribute to production in subsequent years. Those Chum salmon are assigned to harvest. Hatchery broodstock removals are included as they contribute to subsequent production.

The primary enhanced escapement areas for Inside Southern Chum salmon are presently limited to the mid-Vancouver Island, Squamish River, Burrard Inlet and Fraser River areas. The enhancement facilities in the mid-Vancouver Island consist of Big Qualicum, Little Qualicum

and Puntledge rivers Hatcheries. There is one enhancement facility in the Burrard Inlet (Capilano River Hatchery: limited Chum salmon hatchery production), and the Squamish watershed (Tenderfoot Creek Hatchery) and four in the Fraser River watershed (Inch Creek, Chilliwack River, and Chehalis River Hatcheries and Weaver Creek Spawning Channel). Enhancement on the Capilano River is opportunistic, only using Chum salmon that return to the hatchery facility for broodstock.

3.5.2 West Coast Vancouver Island

In 2013, Nitinat Chum salmon spawning escapement was estimated at 25,000 (Table 3-10) which is a significant reduction compared to the 2012 return, and the lowest since 2000. In other WCVI Areas, Chum salmon spawning escapements were poor and below average in all areas except Area 26 (Table 3-12). Spawning escapement estimates given for Areas 23-26 in Table 3-12 are derived from index system assessments in each Area. From historical surveys of Chum salmon streams in each Area, the proportion each stream contributed (on average) to the total spawning escapement for the Area is estimated. Spawning escapement estimates from index systems currently surveyed annually, are expanded to an Area spawning escapement to account for those streams not surveyed.

Table 3-12. WCVI Chum salmon spawning escapement estimates[1] by PFMA, 2004–2013.

Year	WCVI Pacific Fishery Management Area			
	Area 23 (Barkley)	Area 24 (Clayoquot)	Area 25[2] (Nootka)	Area 26 (Kyuquot)
2004	105,422	111,760	241,436	76,768
2005	87,346	53,047	114,007	56,709
2006	22,720	117,817	81,278	78,439
2007	58,012	82,272	43,178	91,197
2008	24,630	25,978	46,495	33,392
2009	27,920	35,392	82,138	32,532
2010	24,352	61,799	51,160	36,624
2011	121,692	149,164	91,989	125,989
2012	40,419	42,276	49,148	49,933
2013	35,302	44,174	69,877	79,812
Average	54,781	72,368	87,071	66,139

(1) Index system spawning escapements expanded to total spawning escapement for the Area.
(2) Nootka spawning escapements include hatchery river systems.

4 United States Chum salmon

4.1 Washington Run Sizes, Catches, and Spawning Escapements

Tables 4-1 through 4-3 provide pre-season forecasts of run size, post-season estimates of run size and post-season estimates of spawning escapement for the Chum salmon runs returning to Puget Sound and coastal Washington areas. The tables present estimates for three major Chum salmon groupings, defined by their return timings.

Summer Chum Salmon

The Strait of Juan de Fuca summer Chum salmon post-season run size of 14,801 was 2.2 times larger than the pre-season forecast and was 2.2 times larger than the 2004 – 2012 average post season run size. The Hood Canal summer Chum salmon run size of 24,325 was 23% larger than the pre-season forecast and was 97% of the 2004 – 2012 average post-season run size. Approximately 95% of the combined Strait of Juan de Fuca and Hood Canal summer Chum salmon run went to escapement. The summer Chum salmon pre-season forecast for South Puget Sound for 2013 was estimated at approximately 53,500 fish, which is 88% of the average return for 2004-2012. The post-season run size estimate of South Puget Sound summer Chum salmon in 2013 was 25,317 fish, or 43% of the pre-season forecast, and was 42% of the 2004-2012 average post-season run size.

Table 4-1. Puget Sound summer Chum salmon pre-and post-season estimates of run size and spawning escapements, 2004–2013.

Region	Type	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Strait of Juan de Fuca	Pre-Season	4,739	6,803	8,238	8,566	5,969	5,198	3,991	5,308	5,915	6,603
	Post-Season	9,361	9,730	8,280	3,324	3,576	5,147	9,332	5,705	6,337	14,801
	Escapement	9,280	9,619	8,181	3,219	3,449	5,029	9,179	5,675	6,304	14,727
Hood Canal	Pre-Season	18,078	18,060	19,780	23,729	20,159	18,009	5,998	9,050	8,970	19,798
	Post-Season	88,236	16,313	29,590	12,838	17,618	9,200	12,957	7,170	31,134	24,325
	Escapement	69,565	15,311	26,418	10,539	15,112	7,236	12,533	6,914	29,855	22,618
South Puget Sound	Pre-Season	99,317	38,334	55,300	39,840	64,229	57,352	62,991	62,623	41,889	53,492
	Post-Season	178,199	44,993	78,797	57,786	32,065	25,010	49,098	39,823	38,936	25,317
	Escapement	120,782	24,701	63,345	52,669	20,872	21,659	65,888	38,517	24,522	20,593

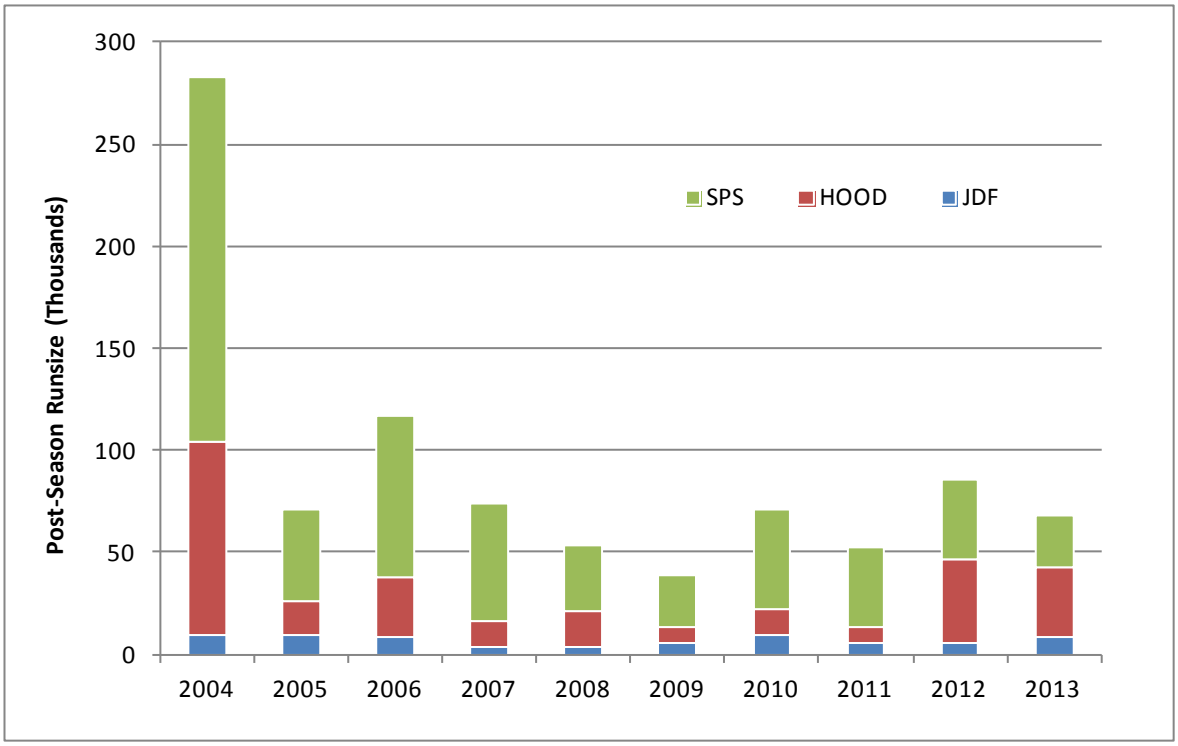

Figure 4-1. Puget Sound summer Chum salmon abundance, 2004-2013, by region of origin (JDF: Strait of Juan de Fuca, HOOD: Hood Canal, SPS: South Puget Sound).

Fall Chum Salmon

The Puget Sound fall Chum salmon post-season assessment total was 2,141,514 fish, or 271% of the preseason forecast and was approximately 340% of the 2004−2013 average run size. Regional post-season numbers varied in their deviation from the forecasted numbers, ranging from 441% (Hood Canal) to 64% (Skagit River) of forecasted values (Table 4-2, Figure 4-2). The Washington coastal (Willapa Bay and Grays Harbor) fall Chum salmon post-season assessment total was 69,088 fish, or approximately 104% of the preseason forecast and was 104% of the 2004-2012 average run size

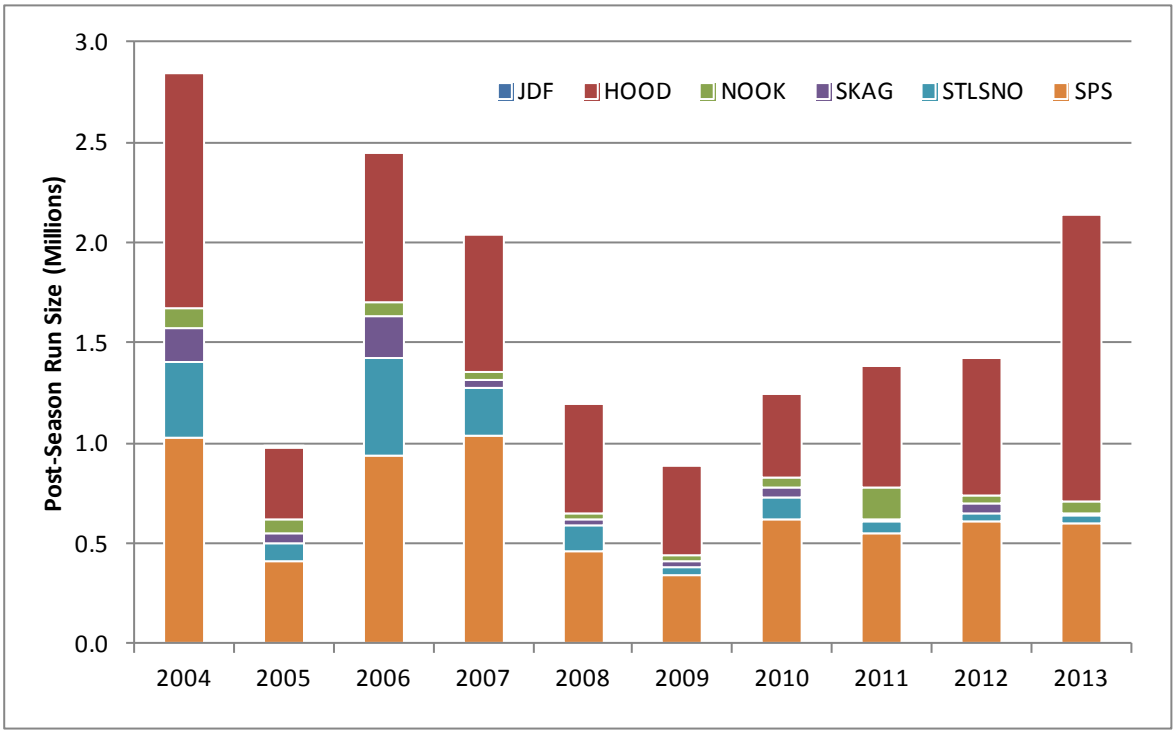

Figure 4-2. Puget Sound fall Chum salmon abundance, 2004-2013, by region of origin (JDF: Strait of Juan de Fuca, NOOK: Nooksack-Samish, SKAG: Skagit, STSNO: Stillaguamish/Snohomish, SPS: South Puget Sound, HOOD: Hood Canal).

Winter Chum Salmon

The winter Chum salmon 2013 post-season run size assessment for South Puget Sound was 34,839, or approximately 57% of the preseason forecast and was 41% of the 2004-2012 average run size (Table 4-3, Figure 4-3).

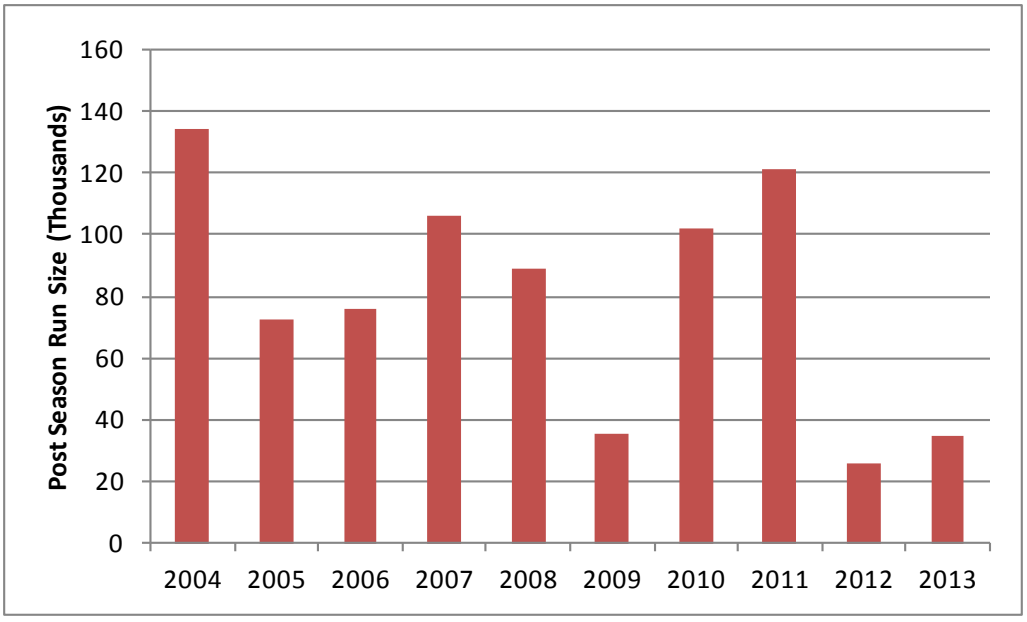

Figure 4-3. South Puget Sound winter Chum salmon abundance, 2004-2013

Table 4-2. Washington fall Chum salmon pre-and post-season estimates of run size and spawning escapements, 2004–2013.

Region	Type	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Willapa Bay	Pre-Season	79,183	63,441	38,754	23,798	40,022	7,139	33,442	22,254	28,273	35,584
	Post-Season	114,758	28,131	23,486	17,668	12,989	17,444	26,701	69,802	43,069	27,564
	Escapement	84,926	11,983	15,250	17,392	9,511	12,743	25,204	66,871	26,640	24,979
Grays Harbor	Pre-Season	45,352	38,038	29,370	12,000	9,903	17,665	18,492	33,669	24,603	30,716
	Post-Season	34,274	20,596	15,786	12,136	8,879	19,776	43,582	50,494	40,561	41,524
	Escapement	17,494	13,483	11,268	11,342	6,249	15,216	34,644	30,101	27,876	22,519
Strait of Juan de Fuca	Pre-Season	2,438	3,460	3,830	2,143	2,745	2,587	2,222	1,618	1,203	813
	Post-Season	3,233	2,382	1,567	769	841	1,462	1,849	4,839	3,174	1,468
	Escapement	2,739	2,034	1,313	503	454	1,305	1,343	4,707	2,973	1,394
Nooksack/ Samish	Pre-Season	78,484	126,869	135,100	19,414	130,070	69,145	61,827	31,924	34,739	52,585
	Post-Season	89,901	67,657	66,610	48,631	27,471	32,007	48,895	152,166	39,080	68,170
	Escapement	53,563	47,644	29,289	21,571	16,257	26,267	30,509	77,995	21,684	48,500
Skagit	Pre-Season	109,715	25,695	164,094	90,481	132,036	26,828	50,226	26,834	59,167	15,325
	Post-Season	171,200	53,672	213,490	37,627	29,946	29,479	46,149	15,851	41,600	9,786
	Escapement	150,196	34,600	105,239	19,576	22,552	26,744	39,911	15,494	36,601	8,554
Stillaguamish/ Snohomish	Pre-Season	264,542	225,113	445,800	287,993	229,251	92,477	90,660	71,277	86,598	48,884
	Post-Season	382,872	84,791	479,987	235,799	125,064	37,689	109,358	61,580	40,002	35,144
	Escapement	212,463	38,788	272,925	43,664	38,553	29,378	46,628	60,792	35,450	30,317
South Puget Sound	Pre-Season	470,048	655,742	466,700	408,040	686,511	348,333	650,986	487,514	323,928	349,623
	Post-Season	1,022,749	414,939	939,638	1,036,774	464,193	344,854	623,197	545,192	613,564	599,668
	Escapement	356,712	137,442	369,035	369,455	152,579	150,887	201,992	175,989	191,290	186,908
Hood Canal	Pre-Season	501,100	749,593	668,400	587,155	668,397	374,929	477,409	352,019	426,675	323,597
	Post-Season	1,173,077	356,243	745,675	676,602	553,122	446,476	416,461	611,349	684,662	1,427,277
	Escapement	229,893	100,242	185,875	162,425	72,012	55,879	49,484	103,383	91,973	240,111

Table 4-3. Washington winter Chum salmon pre- and post-season estimates of run size and spawning escapements, 2004–2013.

Region	Type	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
South Puget Sound	Pre-Season	76,464	142,406	149,200	81,065	98,922	83,380	89,293	55,923	51,599	61,113
	Post-Season	134,002	72,730	75,833	105,933	89,271	35,544	102,235	121,079	25,522	34,839
	Escapement	98,580	43,908	58,786	73,442	45,162	15,486	79,550	74,110	18,987	21,754

Paragraph 3 of the Chapter 6, Annex IV of the Treaty requires that Canada and the United States assess catch levels of summer Chum salmon caught during the August 1 through September 15 time period in boundary area fisheries. Table 4-4 provides Chum salmon harvest during this summer Chum salmon accounting period for U.S. boundary area fisheries. Table 4-5 provides Chum salmon harvest information from the Strait of Juan de Fuca (SJF) fisheries in Areas 4B, 5, and 6C and the San Juan Islands/Point Roberts (SJI/PR) fisheries in Areas 7 and 7A (Appendix B1). Table 4-5 also includes annual Chum salmon harvest totals for the Puget Sound and the Washington Coastal areas.

Table 4-4. Harvest of Chum salmon in the Strait of Juan de Fuca (SJF) and the San Juan Islands (SJI) commercial fisheries during the summer Chum salmon accounting period, July 1–September 15, 2004–2013.

Year	Time Period [1]					Yearly Total
	7/1–8/18	8/19–8/25	8/26–9/1	9/2–9/8	9/9–9/15	
SJF/HC GSI [2]	0.68	0.40	0.45	0.14	0.07	
2004	162	0	15	31	25	233
2005	29	17	17	3	16	82
2006	98	58	10	8	3	177
2007	39	0	0	0	9	48
2008	240	1	0	0	29	270
2009	13	0	0	17	52	82
2010	66	140	46	39	6	297
2011	31	0	3	27	20	81
2012	135	0	0	0	0	135
2013	52	21	115	129	462	779
Averages	87	24	21	25	62	218

(1) Indicates cumulative catch of Chum salmon through this period (GSI would be applied to values to get numbers of HC/SJF summer Chum salmon). Time period notation is month/day (e.g. 7/1-8/11 refers to July 1 to August 11).
(2) Estimated proportions of Hood Canal/Juan de Fuca summer Chum salmon in Boundary area waters (GSI from 1995–1997).

Table 4-5. Harvest of summer, fall, and winter Chum salmon in SJF, SJI/PR, Puget Sound and Washington coastal areas, 2004–2013 [1].

Year	Region			
	SJF (Areas 4B, 5, 6C)	SJI/PR (Areas 7, 7A)	Puget Sound [2]	WA Coast [3]
2004	4926	166,441	2,076,012	48,045
2005	1,771	77,606	668,496	23,870
2006	4,483	106,634	1,568,576	13,532
2007	6,705	27,397	1,444,209	2,728
2008	5,695	75,374	961,036	7,067
2009	746	24,244	637,481	10,351
2010	1941	23,652	949,870	12,593
2011	1,930	70,363	1,009,490	28,251
2012	637	73,255	1,083,578	30,697
2013	1242	80,509	1,667,244	23,060
Averages	3,008	72,548	1,206,599	20,019

(1) Includes recreational harvest: 2013 recreational harvest estimates are preliminary.
(2) All other Puget Sound freshwater and marine harvest areas, except Strait of Juan de Fuca or San Juan Islands/Point Roberts Fisheries.
(3) WA Coast combines harvest from Areas 1–4 including Grays Harbor, Willapa Bay, Columbia River and Coastal Rivers.

4.2 United States Strait of Juan de Fuca Fisheries (Areas 4B, 5, 6C)

4.2.1 Management Intent

During the 2013 season, the management strategy for the Strait of Juan de Fuca (SJF) fishery consisted of maintaining reduced effort in this fishery and making management decisions based on the needs of Puget Sound stocks of Chum salmon. This fishery has experienced minimal effort in recent years, resulting in relatively low harvest levels over the period of 2004–2013 (Table 4-5). Harvest and effort for the period of 2004–2013 was well below levels observed in the late 1980s and 1990s.

4.2.2 Fishery Description

As in previous years, the fall Chum salmon fishery in Areas 4B, 5 and 6C was restricted to Treaty Indian fishers using gill nets. The Treaty Chum salmon fishery opened the week of October 6, 2013 with a schedule of six days per week and continued through November 9, 2013. A total of 1,123 Chum salmon was harvested in this fishery, and there was a reported bycatch of 711 Coho salmon; 0 Steelhead; and 0 Chinook salmon.

In Areas 4B, 5, and 6C, the incidental harvests of Chum salmon prior to the Chum salmon-directed fishing season was relatively low in contrast to the recent ten year average. A total of 74 Chum salmon, including those harvested in SJF test fisheries, were recorded during the summer Chum salmon accounting period (July 1 – September 15). During the subsequent Coho salmon-directed fishery, an additional four Chum salmon were harvested.

The total 2013 Chum salmon catch by all gears (including recreational) in the SJF was 1,242 Chum salmon (Table 4-5).

4.3 San Juan Islands / Point Roberts Fisheries (Areas 7 and 7A)

4.3.1 Management Intent

Chum salmon fisheries in Areas 7 and 7A are regulated to comply with a base harvest ceiling of 130,000 Chum salmon, unless a critically low level of abundance (<1,000,000) is identified for those populations migrating through Johnstone Strait (Inside Chum salmon). Chapter 6, Annex IV, specifies that Chum salmon-directed fishing is not allowed in Areas 7 and 7A before October 10. Paragraph 10 (a-b) specifies that for run sizes below the critical threshold, harvest of Chum salmon in Areas 7 and 7A will be limited to those taken incidentally to other species and in other minor fisheries, and shall not exceed 20,000.

4.3.2 Fishery Description

An estimated Fraser River Chum salmon run size of 1,489,000 was provided by Canada on October 15.

The U.S. Chum salmon fishery which had begun on October 10th continued through November 9th with weekly catch monitoring. The U.S. catch between October 10 and November 9th in Areas 7 and 7A was 79,550 Chum salmon. The Non-Treaty gill net and purse seine fleets were open daily October 12, 13, 15, and then open continuously from October 19 through November

9th. The Treaty Indian gill net and purse seine fisheries were opened on October 10, and then ran continuously from October 22 through November 9th. Catches per vessel and effort were good throughout the fishery.

Non-Indian reef net fisheries targeting adipose-marked Coho salmon were conducted from the end of Fraser Panel control (September 28), until September 30, with Chum salmon retention prohibited. From October 1 through November 9, reef nets were open daily with Chum salmon retention allowed. Chum salmon catch in this fishery, between October 1 and October 10, was 96 fish. Effort was low and there was no reef net fishing effort after early October.

There were 826 Chum salmon reported caught in Areas 7 and 7A during Fraser Panel approved Sockeye and Pink salmon fisheries in August and early September. The total 2013 Chum salmon catch by all gears (including recreational) in Areas 6, 7, and 7A, reported through November 9, was 80,509. Catch distribution, between Areas 7 and 7A, was 72% and 28%, respectively. During the fall Chum salmon fisheries in Areas 6, 7, and 7A, there was a reported bycatch of 4 Chinook and 8,764 Coho salmon and 2 Steelhead.

5 Stock Identification

5.1 Tagging of Adult Chum Salmon

No adult tagging projects were reported by either Canada or the United States in marine or nearshore areas in 2013.

5.2 Otolith, Fin Marking and Coded Wire Tagging (CWT)

5.2.1 Canada

Thermal marking of otoliths (Volk *et al.* 1987) has been used to mass mark hatchery raised salmonids in B.C. since the early 1990's (Hargreaves *et al.* 2001). The method involves manipulating the temperature of the rearing water by at least 2^{o}C to induce lighter or darker deposition (density) of otolith layers. By systematically altering water temperature over a period of time, banding patterns (i.e. a "mark") unique to each hatchery can be created.

Thermal marking was first used on Chum salmon at Nitinat Hatchery on the West Coast of Vancouver Island in 1993 and continues to be used as a means of estimating hatchery contribution to both fisheries and escapement. Thermal marking is currently the only mark being applied to Chum salmon from Nitinat hatchery (Table 5-1). Transplanting thermally-marked Chum salmon into Klanawa River started with the 2001 brood and ended with the 2006 broodyear (Table 5-1).

Table 5-1. Releases of Chum salmon with thermally-marked otoliths from WCVI based Canadian hatchery facilities, 2004–2013

Brood Year	Nitinat Hatchery Release Sites		Conuma Hatchery Release Sites					
	Nitinat River & Lake	Klanawa River	Conuma River	Conuma Estuary	Tlupana River	Sucowa River	Canton River	Deserted River
2004	32,684,608	2,631,539	-	1,882,230	932,556	1,023,658	679,554	-
2005	36,724,205	2,739,742	-	914,381	744,834	256,296	434,449	-
2006	26,323,943	2,585,428	-	1,455,119	1,139,028	181,333	133,731	-
2007	13,004,189	-	-	271,820	109,922	15,701	47,846	-
2008	7,631,058	-	-	1,011,562	254,905	292,430	418,655	-
2009	5,252,749	-	-	1,833,322	685,465	551,365	854,548	-
2010	14,182,582	-	-	1,794,205	1,015,355	311,828	646,203	-
2011	25,303,286	-	-	1,270,286	37,241	223,882	365,682	-
2012	15,813,000	-	-	785,682	813,957	41,196	116,757	-
2013	9,738,442	-	-	1,705,633	820,612	269,435	1,009,478	-

A second hatchery on the West Coast of Vancouver Island, Conuma Hatchery, first began thermally marking otoliths for several populations of Chum salmon beginning with the 1998 broodyear. This continued in 2013 with extensive releases of thermally-marked Chum salmon in various river systems of Nootka Sound (Table 5-1). Similar to Nitinat releases, comprehensive adult sampling programs aimed at detecting (i.e. recapturing) the thermally-marked Chum salmon have occurred during the fall Chum salmon fisheries. Information from these programs has permitted a better understanding of timing and catch distribution for the Chum salmon populations in Nootka Sound.

Table 5-2. Releases of marked Chum salmon from southern B.C. based Canadian hatchery facilities, 2004 to 2013

Population	Broodyear	Fin Clip Type[1]	Clipped	Poor Clips + Unclipped	Total
Big Qualicum River	2004	ADRV	261,366	6,579	267,945
	2005	ADRV	252,585	9,775	262,360
	2006	ADRV	252,016	6,853	258,869
	2007	ADRV	251,329	9,471	260,800
	2008	ADRV	204,801	5,409	210,210
	2009	ADRV	250,692	8,381	259,073
	2010	ADRV	201,825	5,463	207,288
	2011	AD	250,337	4,011	254,348
	2012	AD	249,655	3,636	253,291
	2013	AD	251,108	15,932	267,040
Sugsaw Creek	2004	LV	20,600	0	20,600

(1) Clip Types: AD-adipose fin; LV-left ventral fin; RV-right ventral fin.

Not all release groups were represented by a mark. Contributions to fisheries and escapement for those groups were estimated by associating them with a marked release group having a similar size and release timing. Table 5-2 provides a summary of mark/tag combinations applied from 2004-2013 broodyears. Big Qualicum River is the only population that had any fin-clipped Chum salmon releases in 2013 (Table 5-2).

There were no coded wire tagged Chum released from Canadian facilities during the 2004-2013 time period.

5.2.2 United States

Otolith marking (Volk *et al.* 1987) was used in several hatchery supplementation and re-introduction programs for summer Chum salmon in the Hood Canal and Strait of Juan de Fuca regions (Table 5-3), and for fall Chum salmon in Puget Sound and the Lower Columbia River (Table 5-4). Otolith marking was used as a tool to assess program success and determine proportions of hatchery- and natural-origin fish (and identify hatchery strays) on spawning grounds.

Table 5-3. Numbers of Hood Canal summer Chum salmon released with thermally-marked otoliths or an adipose fin clip by broodyear, 2004–2013 (Point No Point Treaty Tribes and Washington Department of Fish and Wildlife 2014).

	Hood Canal Summer Chum Salmon				
Brood Year	Jimmycome-lately	Big Beef	Hamma Hamma	Lilliwaup	Tahuya
2004	76,982	14,814	57,000	99,500	118,872
2005	57,300	-	117,837	106,466	119,260
2006	79,428	-	151,550	88,800	133,826
2007	73,840	-	48,530	0	53,632
2008	88,766	-	208,450	68,810	97,142
2009	92,200	-	-	140,210	69,711
2010	85,630	-	-	139,816	27,706
2011	-	-	-	41,006	19,600
2012	-	-	-	157,760	110,000
2013	-	-	-	169,440	52,778

A summer Chum salmon supplementation program was started in 1992 at the Quilcene National Fish Hatchery to address severe declines in the numbers of summer Chum salmon returning to the Quilcene River and for reintroduction in Big Beef Creek. After 1997, an adipose fin clip (with no CWT) was used to identify Quilcene hatchery fish for terminal fisheries management and for project evaluation. Brood year 2003 was the final year that summer Chum salmon were marked and released from Quilcene National Fish Hatchery.

Table 5-4. Numbers of Puget Sound and Lower Columbia River fall Chum salmon released with thermally-marked otoliths or an adipose fin clip by broodyear, 2004–2013

	Puget Sound	Lower Columbia River		
Brood Year	Whatcom Creek	Grays River Hatchery[1]	Sea Resources Hatchery	Washougal Hatchery
2004	-		163,000	-
2005	-		155,501	19,578
2006	-		129,427	-
2007	450,000		77,609	-
2008	400,000		104,600	-
2009	-		300,000	70,000
2010	2,000,000		2,365,271	57,455
2011	1,360,000	417,000	206,000	74,893
2012	1,547,900		157,800	58,004
2013	3,048,000	650,895	151,567	46,083

(1) Includes Grays River broodstock released in Big Creek, OR.

5.3 Genetic Stock Identification

In 2010, the Committee completed a joint recommendation to the Southern Panel concerning the type of stock identification methodology to be used for immediate and future application of Canada and United States (U.S.) Chum salmon stock assessment (Appendix C). The Pacific Salmon Treaty (Annex IV, Chapter 6, Section 2) states:

> *"When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods."*

Fisheries of interest include Johnstone Strait, Qualicum River, Fraser River, and Nitinat in Canada and Point Roberts, San Juan Islands and the Strait of Juan de Fuca in the U.S.

5.3.1 Fishery Sample Collection for Genetic Stock Identification

5.3.1.1 Canada

GSI samples were collected during the Johnstone Straits purse seine fisheries (commercial and test fishery) in 2013 (Table 5-5). In 2013, these samples were analysed for microsatellite markers using the first year of four years of funding supported by the Southern Endowment Funds (Van Will et al. 2013)

Table 5-5. Chum salmon tissue samples collected in Johnstone Strait fisheries and analyzed for GSI, 2004–2013.

Year	Commercial Samples		Test Fishery Samples	
	Collected	Analyzed	Collected	Analyzed
2004	600	600	0	0
2005	0	0	0	0
2006	716	714	0	0
2007	879	869	0	0
2008	995	868	830	449
2009	1,418	1,101	999	0
2010	400	400	1,015	1,114
2011	865	863	1,404	905
2012	987	935	1,275	1,261
2013	1,185	973	1,311	1,291

5.3.1.2 United States

Among focused studies, WDFW used GSI to distinguish supplementation- and natural-origin adult summer Chum salmon in Hood Canal as part of the effort to monitor the Hood Canal summer Chum salmon recovery program. For instance, from 2006-2009 mSAT DNA data were used to clarify uncertain hatchery assignments when otoliths were broken or thermal marks were ambiguous. Each supplementation program for summer Chum salmon had a unique otolith mark and spawners could be identified as supplementation- or natural-origin, but not identified to their program of origin if their otolith mark was ambiguous.

These ambiguous supplementation program fish were genotyped and identified by assigning them to populations in the Hood Canal summer Chum salmon genetic baseline. Genetic analysis was used to evaluate impacts of supplementation on the Hood Canal summer Chum salmon metapopulation (Small et al. 2009). WDFW also conducted juvenile stock assignment studies in the Strait of Juan de Fuca and Hood Canal during 2009 to 2013. The juvenile studies documented emigration timing and relative production of summer and fall Chum salmon in key populations. Further, 943 tissue samples were collected near Apple Cove Point in Puget Sound Area 9 in the eighth year of Chum salmon DNA collection from this test fishery.

Fisheries sampling in Area 7 and Area 7a was sampled and analyzed from the second of four years of Southern Endowment Funding project using microsatellites (Van Will et al. 2013).

Table 5-6. Chum salmon tissue samples collected in Areas 7 and 7a analyzed for GSI in 2012-2013.

Year	Area 7	Area 7A
2012	1,328	829
2013	419	423

5.3.2 Baseline Collection for Genetic Stock Identification

5.3.2.2 Canada

In 2013, CDFO continued to collect baseline GSI tissue samples of Southern British Columbia Chum salmon populations (Table 5-7).

Table 5-7. Fall Chum salmon GSI tissue collections from Southern B.C. by Conservation Unit, collection site, life stage, and influence [1] of enhancement, 2013.

Conservation Unit	Collection Site	Life Stage	Enhancement Level[1]	Sample Size Size
Fraser Canyon	Hunter Cr	Adult	Natural	43
Fraser Canyon	Kawkawa Cr	Adult	Natural	45
Georgia Strait	Okeover	Adult	Natural	223
Georgia Strait	Theodosia R	Adult	Natural	148
Howe Sound-Burrard Inlet	Cheakamus R[2]	Adult	Natural	100
Loughborough	Phillips R[2]	Adult	Natural	37
Lower Fraser	Blaney_Cr	Adult	Natural	66
Lower Fraser	Chilqua_Cr	Adult	Natural	1
Lower Fraser	Silverhope_Cr	Adult	Natural	242
Lower Fraser	Hicks_Cr	Adult	Natural	195
Lower Fraser	Hopedale_Slough	Adult	Natural	77
Lower Fraser	Mcintyre Cr	Adult	Natural	67
Lower Fraser	Railroad_Cr	Adult	Natural	8

Conservation Unit	Collection Site	Life Stage	Enhancement Level[1]	Sample Size Size
Lower Fraser	Street Cr	Adult	Natural	27
Lower Fraser	Whonnock R	Adult	Natural	206
Lower Fraser	Worth_Cr	Adult	Natural	74
Lower Fraser	Big Silver Cr[2]	Adult	Natural	1
Lower Fraser	Cogburn Cr[2]	Adult	Natural	1
Lower Fraser	Siddle Cr[2]	Adult	Natural	2
Lower Fraser	Worth Cr[2]	Adult	Natural	108
Lower Fraser	Peach Cr[2]	Adult	Natural	163
Lower Fraser	Widgeon[2]	Adult	Natural	135
			Total	**1969**

(1) Enhancement level refers to the degree to which the CDFO Committee members believed hatchery production contributed to the returns to the collection site. Based partly on the enhancement history in the CDFO hatchery production database, enhancement level is subjectively classified as either *hatchery* (insignificant contribution of natural production to returns), *mixed* (both enhanced and natural production contribute significantly to returns) or *natural* (insignificant contribution of hatchery production to returns).
(2) indicates samples that have been collected but not analyzed for the microsatellite baseline.

5.3.2.1 United States

During 2013, WDFW and Washington Treaty Tribes continued baseline sampling of Washington State populations of Chum salmon (Table 5-8). Tissues were archived for future genotyping and will be added to the genetic baseline.

Table 5-8. Chum salmon GSI tissue collections from WA State, 2013.

Collection Site / Run group / Locality	Enhancement Level[1]	Sample Size
Puyallup Hatchery - fall	hatchery	81
Grovers Creek - fall	mixed	51
Stillaguamish River-fall	natural	236
Tulalip Hatchery - fall	hatchery	100
Snohomish River - fall	natural	106
Total		547

(1) Enhancement level refers to the degree to which the U.S. Committee members believed hatchery production contributed to the returns to the collection site: *hatchery* (insignificant contribution of natural production to returns), *mixed* (both enhanced and natural production contribute significantly to returns) or *natural* (insignificant contribution of hatchery production to returns).

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APPENDICES

Appendix A. ANNEX IV, CHAPTER 6, OF THE PACIFIC SALMON TREATY

Southern British Columbia and Washington State Chum Salmon

The provisions of this Chapter shall apply for the period 2010 through 2018.

1. The Parties shall maintain a Joint Chum Technical Committee ("the Committee") reporting, unless otherwise agreed, to the Southern Panel and the Commission. The Committee will undertake to*, inter alia*:

    a) maintain and present historical catch and escapement information for stocks relevant to the Treaty;

    b) utilize available information to estimate and document stock composition and exploitation rates in fisheries of concern to the Treaty;

    c) review annually the Parties' assessment of stock status and fisheries activities for Chum fisheries of concern to the Treaty;

    d) identify high priority research and information needs for the Parties, including fishery and escapement monitoring and assessment, stock identification, and enhancement; and

    e) periodically and/or when requested;

        i. Exchange available information on the productivity and escapement requirements of stocks relevant to the treaty;

        ii. Identify and document stocks of concern (with respect to conservation) relevant to the treaty;

        iii. Evaluate the effectiveness and performance of management strategies; and

        iv. Evaluate the effectiveness of alternative regulatory and production strategies recommended by the Parties.

2. When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods.

3. Canada and the United States shall assess catch levels and make attempts to collect additional genetic samples from any Chum salmon caught during the July 1 through September 15 time period in the Boundary Area fisheries (U.S. Areas 4B, 5, 6C, 7 and 7A; Canadian Areas 18, 19, 20, 21, and 29).

4. During the period from July 1 through September 15, Canada will require the live release of Chum salmon from all purse seine gear fishing in the Strait of Juan de Fuca (Canadian Area 20) and the United States will require the same for the non-Indian seine fisheries in Areas 7 and 7A. Note: By U.S. regulation, purse seine fisheries are not permitted in U.S. Areas 4B, 5 and 6C.

5. Canada will manage its Johnstone Strait, Strait of Georgia, and Fraser River Chum salmon fisheries to provide continued rebuilding of depressed naturally spawning Chum salmon stocks, and, to the extent practicable**,** not increase interceptions of U.S. origin Chum salmon. Terminal fisheries conducted on specific stocks with identified surpluses will be managed to minimize interception of non-targeted stocks.

6. Canada will manage its Johnstone Strait mixed stock fishery as follows:

   a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical;

   b) For run sizes above the critical threshold, Canada will conduct fisheries with an exploitation rate of up to 20% in Johnstone Strait of Inside Southern Chum salmon; and

   c) When run sizes are expected to be below the critical threshold, Canada will notify the United States and will only conduct assessment fisheries and non-commercial fisheries. Commercial fisheries targeting Chum salmon will be suspended.

7. Canada will manage its Fraser River fisheries for Chum salmon as follows:

   a) For Fraser River terminal area run sizes, identified in-season, at abundance levels lower than 900,000 Chum salmon, the Canadian commercial Chum salmon fisheries within the Fraser River and in associated marine areas (Area 29), will be suspended; and

   b) For Fraser River terminal area run sizes, identified in-season at levels greater than 900,000 Chum salmon, Canadian commercial Chum salmon fisheries within the Fraser River, shall be guided by the limits of the in-river Total Allowable Catch set by Canada.

8. Canada will manage the Nitinat gill net and purse seine fisheries for Chum salmon to minimize the harvest of non-targeted stocks.

9. Canada shall conduct a genetic sampling program of Chum salmon taken in the West Coast Vancouver Island troll fishery if early-season catch information indicates that catch totals for the July 1 through September 15 season may reach levels similar to 1985 and 1986. Sampling, should it occur, will include catches taken from the southern areas (Canadian Areas 121-124).

10. The United States will manage its Chum salmon fishery in Areas 7 and 7A as follows:

    a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical;

    b) For run sizes below the critical threshold, the U.S. catch of Chum salmon in Areas 7 and 7A shall be limited to Chum salmon taken incidentally to other species and in other minor fisheries, but shall not exceed 20,000, provided that catches for the purpose of genetic stock identification sampling shall not be included in the aforementioned limit;

c) For run sizes above the critical threshold, the base catch ceiling for the U.S. Chum salmon fisheries in Areas 7 and 7A will be 130,000 Chum salmon;

d) Canada will provide a run size estimate of Chum salmon entering the Fraser River no later than October 22. If the estimate is less than 900,000, the U.S. will limit its fishery impacts on Fraser River Chum salmon by restricting catch in Areas 7 and 7A to not exceed 20,000 additional Chum from the day following the date the U.S is notified. The total catch is not to exceed the catch ceiling of 130,000 Chum salmon;

e) U.S. commercial fisheries for fall Chum salmon in Areas 7 and 7A will not occur prior to October 10;

f) The U.S. will manage the Areas 7 and 7A fisheries for Chum salmon with the intent to minimize the harvest of non-targeted species;

g) No U.S. catch shortfalls may be accrued; however any overages shall be carried forward as indicated in (h) and (i);

h) Due to management imprecision, a catch in the U.S. of up to 135,000 Chum salmon will not result in an overage calculation. Catches in excess of 135,000 Chum salmon shall result in an overage being calculated by subtracting 130,000 from the total Chum catch. Overages will be accounted for by reducing the U.S. annual catch ceiling in up to two subsequent non-critical Inside Southern Chum salmon years; and

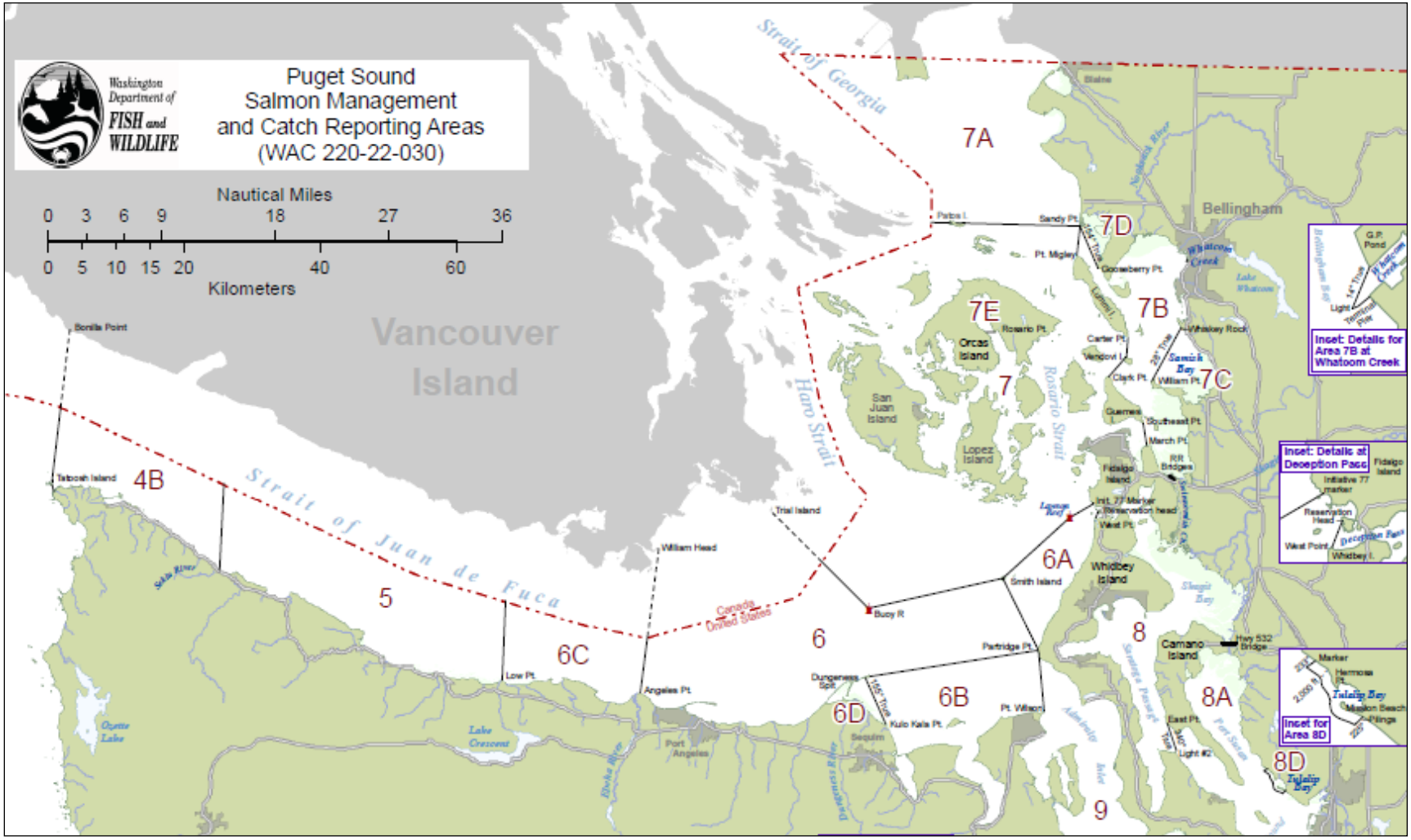
i) From the day following the date the U.S. is notified of a run size below the critical threshold as defined in 10(b) or (d), any catches in excess of 20,000 Chum salmon will result in an overage. Overages will be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern Chum salmon years.

11. The United States shall conduct its Chum salmon fishery in the Strait of Juan de Fuca (United States Areas 4B, 5, and 6C) so as to maintain the limited effort nature of this fishery, and, to the extent practicable, not increase interceptions of Canadian origin Chum salmon. The United States shall continue to monitor this fishery to determine if recent catch levels indicate an increasing level of interception.

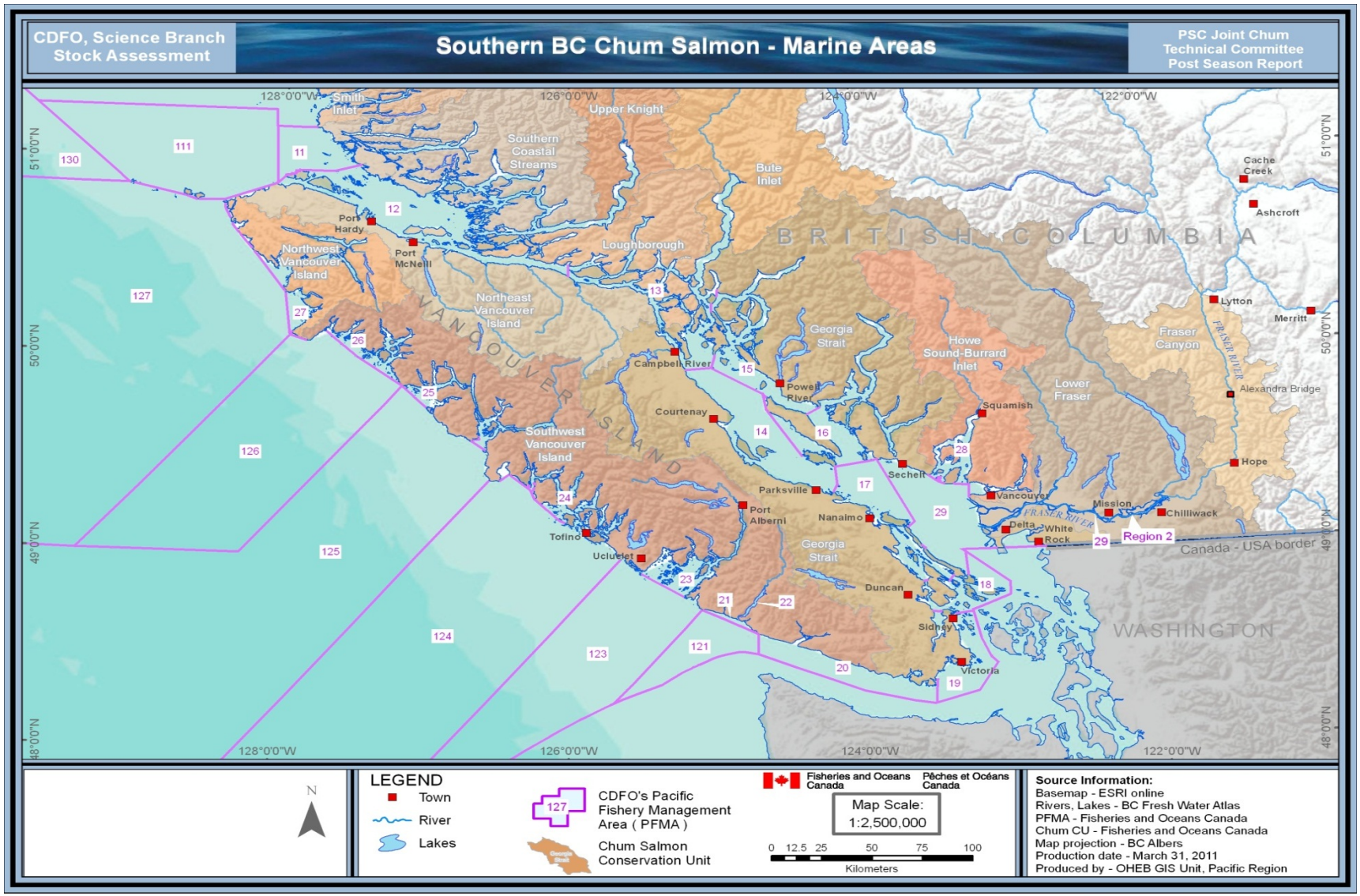
12. All information concerning by-catch of other salmon species from the Chum salmon fisheries covered by this chapter will be shared between the Parties in the annual Post Season Report.

13. Should circumstances arise that are inconsistent with either Parties understanding of the intent of the chapter, the Southern Panel will discuss the matter postseason and explore options for taking the appropriate corrective actions.

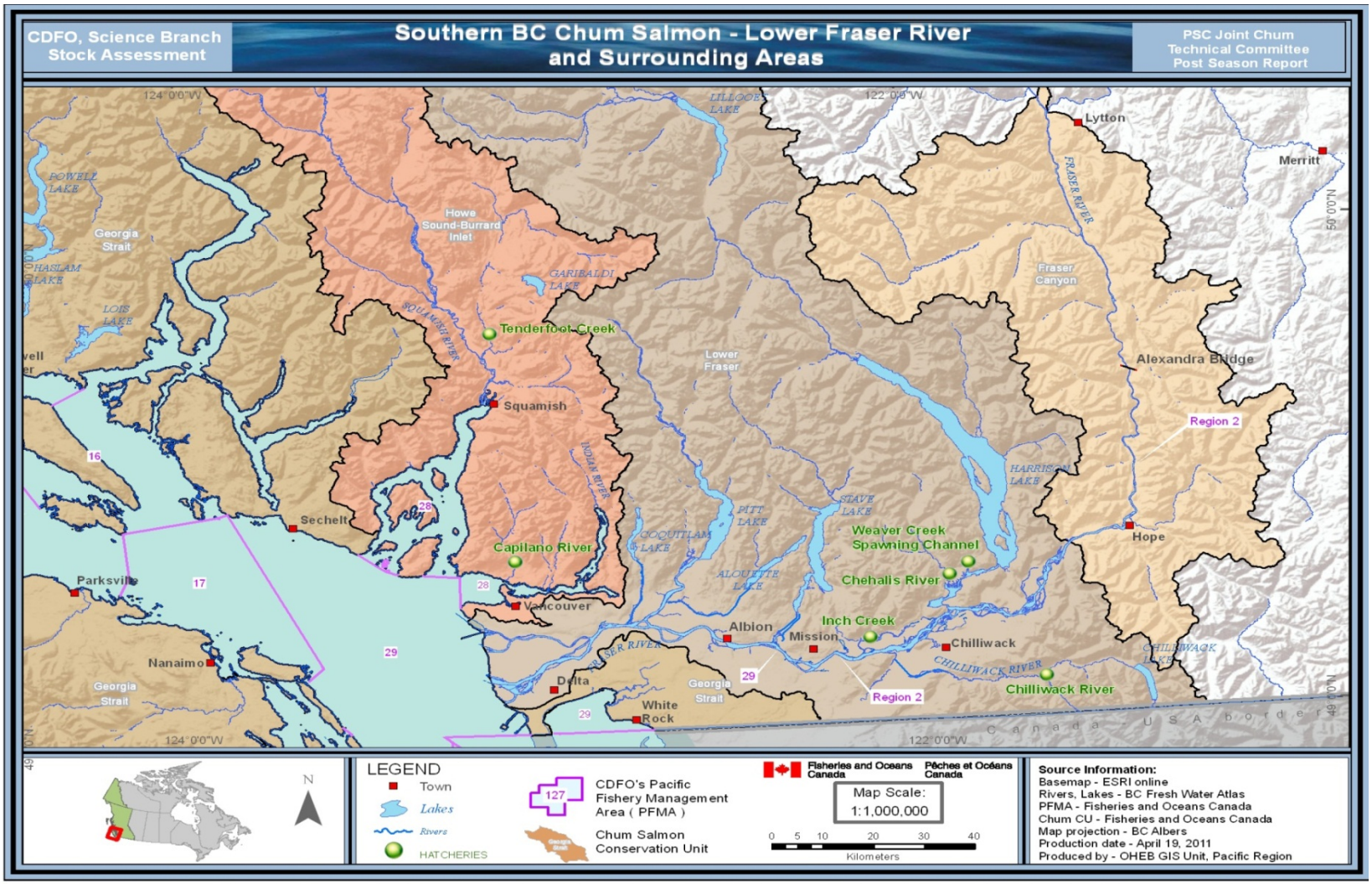
Appendix B-1. United States commercial salmon catch areas for the Strait of Juan de Fuca and Northern Puget Sound.



Appendix B-2. Canadian Pacific Fishery Management Areas (PFMA) for Southern B.C. - Marine areas.



Appendix B-3. Canadian Pacific Fishery Management Areas (PFMA) for Southern B.C. - Lower Fraser River and surrounding areas.



Appendix C. PSC Work Plan for the Joint Chum Technical Committee, 2013.

2013 PSC Post-Season Meeting

Chum Technical Committee

Meeting Plan

Session Objectives:

1) Post Season Review
2) 2010 Annual report
   a) Report out on completion of this item
3) 2011 Annual report
   a) Begin drafting of 2011 postseason report
   b) Make assignments leading to completion of report by end of PSC Annual Meeting in February.
4) Status updates on all projects funded by SEF in 2012.
   a) Workshop update and plan for Friday Jan. 18th
   b) Fishery Sampling Results
   c) Baseline Augmentation and SID technique evaluation
5) Status of NOAA sample mapping database
6) Begin RFP work for the ChumGem Phase I component funded through SEF from 2013
   a) Discuss what is needed from each of the various agencies in regards to data and contacts.
7) Chum TC business
   a) Other Meeting dates (if required)

Outstanding and Upcoming Issues:

- Consultations on PSC performance review (Plan on Tuesday am meeting to discuss)

Noteworthy highlights from the 2012 Post-Season Reports:

Canadian Post-Season Report

- *Large Age 5 component in the 2012 Chum return continued to demonstrate how marine conditions were beneficial to salmon survival during the 2008 outmigration.*
- *Returns varied throughout the area from below target to well above target,*
- *Preliminary Chum harvest estimates (Commercial+Recreational+First Nation+Test):*
  - *Johnstone Strait: 402K*
  - *Fraser River: 250K*
  - *Georgia Strait: 191K*
  - *Total Harvest: 843K*

US Post-Season Report

- *Mixed returns throughout the Puget Sound area with some Chum stocks above and below forecast (similar to what was seen in Canadian populations)*
- *Preliminary harvest estimates:*
  - *Areas 7/7A: 74K*
  - *Areas 4B,5,6C : 0.5K*

Appendix D. Concept proposals (see work plans) submitted to Pacific Salmon Commission Southern Endowment Fund

Project Title: Joint US and CA Mixed-stock Chum Fisheries Sampling Design
In order to facilitate management responses to Southern Chum stock strength, in accordance with Annex IV, Chapter 6 of the Pacific Salmon Treaty (Treaty) it is necessary to provide the catch composition in fisheries targeting Southern origin Chum populations. We are proposing to sample Southern BC and US mixed stock Chum fisheries to determine stock composition to the Canadian Conservation Unit (CU) and United States Management Unit (MU) level using genetic mixed stock analysis. In addition, run timing, distribution and diversion by CU and MU will be explored for run reconstruction. This proposal is informed by the results from the Southern fund project (Southern Study Area Chum stock distribution assessment in Washington and San Juan Island, Point Roberts and BC southern Gulf fisheries) that occurred 2007–2010. The goal is to sample the mixed stock Chum fisheries for four consecutive years in a multi-agency sampling effort.

Project Title: Chum Salmon Southern Area Genetic Baseline Enhancement (year 2)
This project enables the short- and long-term goals of the Joint Chum Technical Committee (Chum TC) to support the development, evaluation, and improvement of microsatellite and SNP data for identification of southern stocks in mixed-stock fisheries (page 3 of the Chum TC Joint Directions white paper, January, 2010). We propose an updated survey of genetic variation in representative population samples of Chum salmon from southern British Columbia (SBC) and Washington State (WA) to enhance the Chum salmon population genetic baseline for management and research. Tissue samples will be collected from representative stocks (roughly 30 stocks for initial evaluation) and genotyped at microsatellite (mSAT) and single nucleotide polymorphism (SNP) loci.

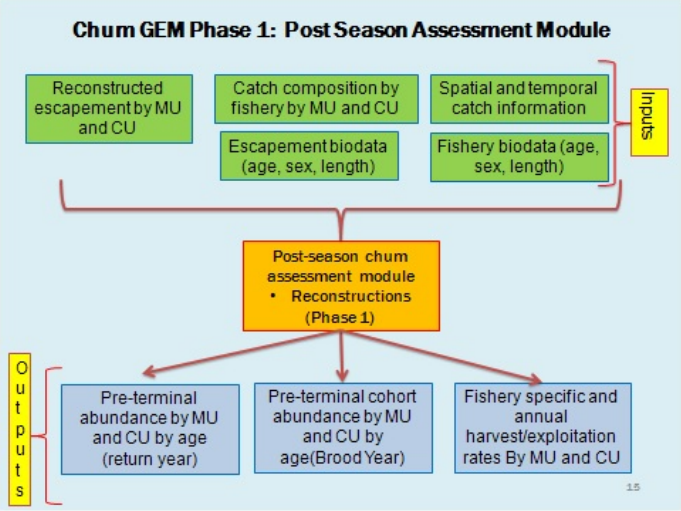
This study will enhance the existing mSAT baseline, particularly in the US, and thus will provide more accurate estimates in its present day use in international fishery estimates. This study will also enhance the existing SNP baseline to improve accuracy in international estimates. The enhanced SNP baseline will build on the panel currently being developed for Chum salmon originating from British Columbia and Washington in an ongoing project of UW and WDFW. The mSAT and SNP baselines will be compared for resolving power individually and in combination (concatenate data types) for mixed stock fishery and other fishery management questions through simulations and analyses of known and unknown mixed samples.

The primary application of these genetic data is resolving the stock composition of mixed stock fisheries. Genetic baselines will also be used to develop a new fisheries model that incorporates genetic and environmental information to manage fisheries. Other analyses could include relative reproductive success of hatchery and wild-origin spawners and the impact of supplementation programs, identifying origins of juvenile Chum salmon using coastal nursery areas and address other management questions. The data set will also be evaluated for it utility in identification of southern stocks harvested in other areas, such as the Bering Sea trawl fishery.

Project Title: Development of Chum Genetic and Environmental Management (ChumGEM) Model: Phase I

The Chum Technical Committee (ChumTC), in consideration of the requirements of the latest version of Annex IV, Chapter 6 (Chum Annex) of the Pacific Salmon Treaty, has determined that a significant amount of stock assessment work should be undertaken by the parties, in order to provide the level of information necessary for the successful implementation of the Annex. ChumTC has developed a strategic plan which has been accepted by the Pacific Salmon Commission (PSC). From this plan the ChumTC submitted three proposals in 2012 which were approved by the Southern Fund Committee. The approved proposals were for building and expanding genetic baselines using genetic stock identification (GSI) techniques, coordinating and conducting a GSI workshop, and coordinating and conducting mixed stock fisheries sample collections and analysis. The Southern Panel of the PSC has identified the first phase of the Chum Genetic and Environmental Management model (ChumGEM) as a top research priority and is looking for proposals to accomplish the first phase of this model development.

A key outcome of the Chum Strategic Plan is a model that incorporates output from Tier 1 components (GSI baseline development and GSI analysis of fishery collections) with the Tier 2 information including fishery and escapement data as well as environmental components. Phase I entails compiling, standardizing, and formatting the appropriate input data, and developing a beta version of the model. The first phase of the model will be used for post-season run reconstructions for Southern BC and Washington Chum salmon. Subsequent phases will incorporate modules for forecasting and annual fishery planning, and long term stock management. The first phase of this model development will be focused on a module to address key post-season requirements under the Chum Annex.



The development of this module will incorporate the following inputs:

1. Escapement by Management Unit (MU) and Conservation Unit (CU)
2. Catch of Chum salmon spatially and temporally
3. Catch composition by MU and CU based on Genetic Stock Identification
4. Biological data (i.e. age, sex and length) from both escapement and fishery samples