

PACIFIC SALMON COMMISSION  
JOINT CHUM TECHNICAL COMMITTEE  
2018 POST SEASON SUMMARY REPORT  
TCCHUM (22) – 01

JANUARY 2022

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## LIST OF ACRONYMS WITH DEFINITIONS

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

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# 1 Executive Summary

This Pacific Salmon Commission (PSC) Joint Chum Salmon Technical Committee report documents the information on Chum Salmon stocks and fisheries in southern British Columbia (B.C.) and Washington (WA) for the year 2018 to address the specific provisions and requirements of Chapter 6, Annex IV (Chum Salmon 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 Salmon Annex requires that Canada and the U.S. maintain a Joint Chum Salmon 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 2018 were below the recent 9-year average in B.C. and below the recent 9-year average in WA. The Chum Technical Committee continued developing components of the Southern Chum Salmon Strategic Plan.

## 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 2018.

Paragraph 1:

*The Parties were to maintain a Joint Chum Salmon 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 three times in 2018-2019 season: during the PSC Post-Season Meeting in January, during the PSC Annual Meeting in February, and during the Joint Chum Salmon Technical Meeting in May. Additional detail of the work performed by the Committee in 2018 can be found in the Committee’s 2018-2019 Work Plan (Appendix C). In 2010 the Committee published a direction paper to guide development and application of a jointly agreed genetic baseline for Chum Salmon stocks in southern B.C. and Washington (ChumTC 2013). This led to the development of the Southern Chum Salmon Strategic Plan and the concept of a Chum Salmon Genetic and Environmental Model (ChumGEM) in 2011 (Figure 2-1). In 2018, 4

projects were funded by the PST Southern Boundary Restoration and Enhancement Fund (Southern Fund) to carry forward priorities identified by the TCCHUM SALMON. More details on these projects can be found in Appendix D.

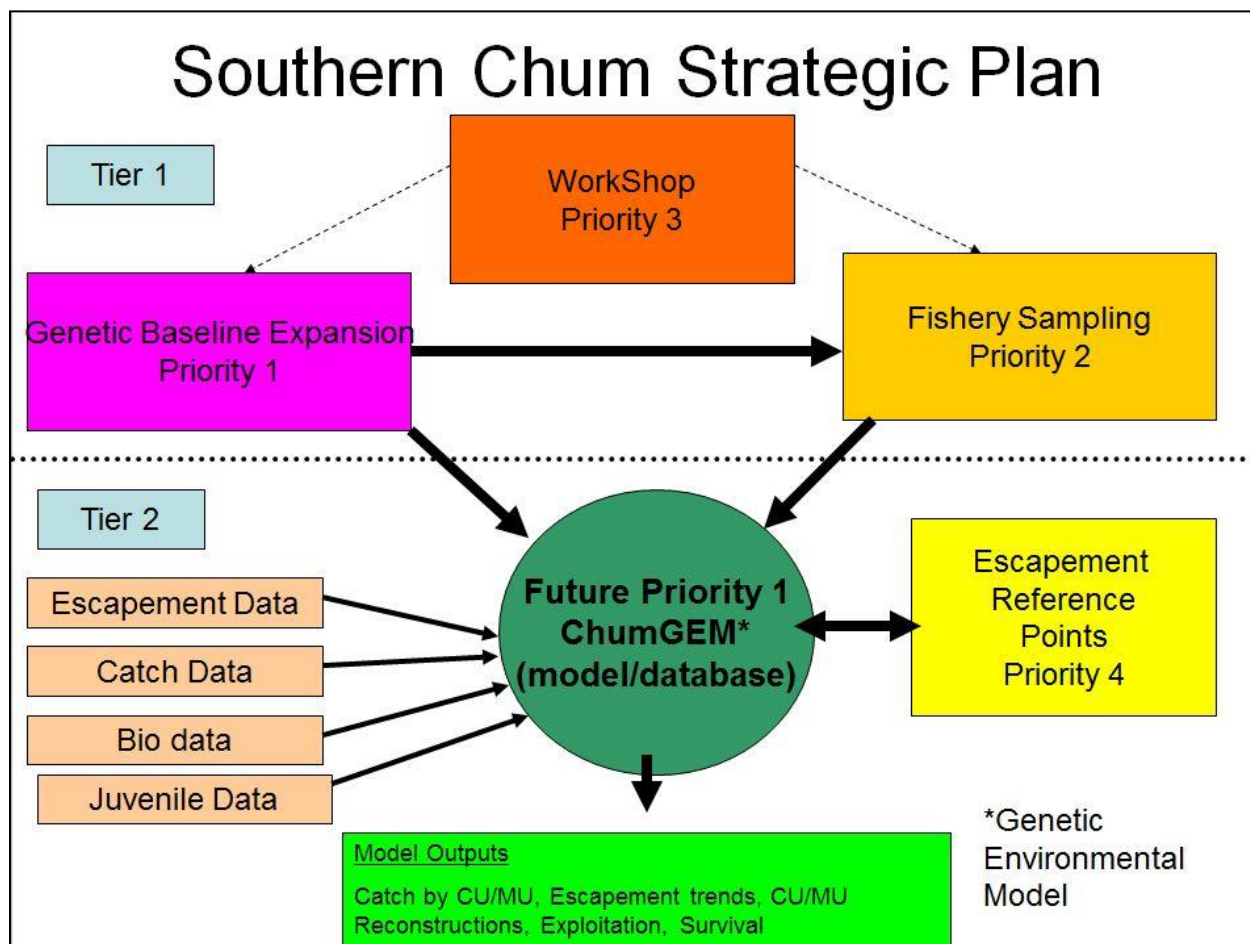


Figure 2-1. Schematic of Southern Chum Salmon Strategic Plan created by the joint Chum Salmon Technical Committee June 1-3, 2011.

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 applied stock composition information obtained through sampling key fisheries during the 2018 season. Historical stock compositions were used for fisheries that were not sampled in 2018.

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 4-3 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 (2009–2018). Historical GSI results and genetic estimates from 2009 through 2018 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 3.2) and annual fishery descriptions (see section 3.3) 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.*

Initially, Chum Salmon catch per unit effort (CPUE) in the test fishery was at or below what was encountered in the low 2010 return and it was determined on October 1<sup>st</sup> that the ISC index of abundance was likely below the 1.0 million critical level and planned commercial fisheries were suspended. As the season progressed, test fishery CPUE improved and on October 10<sup>th</sup>,

indicated abundance was now at or above the 1.0 million threshold for ISC Chum Salmon and timing appeared to be slightly later. Commercial fishery plans were modified and initiated based on the updated assessment. The test fishery CPUE demonstrated that the front end of the return in 2018 was similar to that in 2010 but the back end of the run was stronger than 2010.

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 2018, in-season abundance estimate indicated a terminal return below the specified Fraser River terminal area run size breakpoint (see section 3.3.3).

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 low abundance of Nitinat Chum Salmon in 2018, minimal commercial gill net fisheries occurred (see section 3.3.4.1; 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 2018 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 Salmon 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 2018, U.S. fisheries in Areas 7 and 7A were managed in accordance with the above provisions. After initial notification from Canada on October 8 that the Inside Southern Chum Salmon return was expected to be below the critical threshold, the abundance estimate was subsequently revised upward on October 10, allowing U.S. commercial fisheries to be initiated on October 13. However, when the estimated Fraser River Chum Salmon terminal run size was provided by Canada on October 19, consistent with the Treaty obligations, the U.S. closed Area 7 and 7A commercial Chum Salmon fisheries on October 20. (see section 4.3.2).

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 this commercial fishery for contribution of Canadian-origin Chum Salmon since 1996. Genetic stock identification (GSI) samples collected from this fishery in prior years indicated the majority of the catch is Chum Salmon of U.S. origin (Beattie et al. 1996).

Paragraph 12:

*All information concerning bycatch 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.*

Bycatch 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 2018.

### **3 Southern British Columbia Chum Salmon**

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.

#### ***3.1 Status of Treaty Requirements***

During 2018, the Southern B.C. Chum Salmon fisheries were managed according to the requirements of Annex IV, Chapter 6, as amended in 2009 (Appendix A).

#### ***3.2 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.

### **3.2.1 Johnstone Strait Chum Salmon Management Strategy**

Since 2002, the mixed stock Chum Salmon 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 2018 (CDFO 2018).

Some of the key objectives of this strategy are to ensure sufficient escapement levels while providing more stable fishing opportunities (CDFO 2018). 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 2018). The impact of the Johnstone Strait fisheries during the last 10 years of the fixed exploitation approach (2009–2018) on Inside Southern Chum Salmon stocks is detailed in Table 3-1.

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

- establish a conservative 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 Salmon total return, harvest and spawning escapements. Comparison of fixed target and actual harvest rates in the Johnstone Strait fisheries, 2009–2018<sup>1</sup>.

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>PRE-SEASON</b>										
<b>Inside Southern Abundance Forecast (or Outlook)</b>	Below Average	Average to Below Average	Average to Below Average	Average to Below Average	Average to Below Average	Average to Below Average	Average to Below Average	Average to Below Average	Average to Below Average	Average to Below Average
<b>POST-SEASON</b>										
<b>Inside Southern Abundance<sup>2</sup></b>	2,227,134	1,181,534	3,449,783	3,501,098	3,156,129	2,354,404	2,751,791	6,355,112	2,471,591	1,572,917
<b>Inside Southern Harvest</b>	747,067	127,973	1,441,680	911,427	1,079,567	732,429	1,240,133	2,868,926	1,142,908	361,547
<b>Est. Inside Southern Harvest Rate</b>	33.54%	10.83%	41.79%	26.03%	34.21%	31.11%	45.07%	45.14%	46.24%	23.00%
<b><u>Johnstone Strait Harvest</u></b>										
<b>Commercial, Sport Area 11-13<sup>3</sup></b>	513,884	55,520	750,436	392,608	635,814	332,140	529,541	1,373,171	437,075	94,820
<b>First Nations Area 11-13</b>	13,576	4,060	9,880	13,106	13,444	113	22,472	20,493	14,818	2,373
<b>Johnstone Strait Harvest Total</b>	527,460	59,580	760,316	405,714	649,258	332,253	552,013	1,393,664	451,893	97,193
<b>Target Johnstone Strait Harvest Rate</b>	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
<b>Est. Johnstone Strait Harvest Rate</b>	23.68%	5.04%	22.04%	11.59%	20.57%	14.11%	20.06%	21.93%	18.28%	6.20%
<b><u>Escapement (Includes wild and enhanced)<sup>4</sup></u></b>										
<b>Inside Southern Escapement</b>	1,480,067	1,053,561	2,008,103	2,589,671	2,076,562	1,621,975	1,511,658	3,486,186	1,328,683	1,211,370

(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



### **3.2.2 Strait of Georgia Chum Salmon Management Strategy**

Chum Salmon stocks return to all areas of the Strait of Georgia (mid-Vancouver Island PFMA 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, Deserter 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 14 have limited use due to their inability to reasonably predict returns (CDFO 2018). The one exception is Chum Salmon returning to Area 14. As a result, unlike some other units of Southern B.C. 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 Salmon Advisory Committee (Chum Salmon Advisory Committee or Chum Salmon Working Group). The Chum Salmon 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 Salmon 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 Salmon 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 guided by advice from the Cowichan Fisheries Roundtable.

Chum Salmon fishing opportunities in the Strait of Georgia PFMA 14 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 Salmon abundance is used, in addition to the in-season information listed above, to guide management decisions on fishing opportunities (CDFO 2018).

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

PFMA	System	Spawning Escapement Goal	Hatchery Requirements	Net Escapement Goal
14	Puntledge River	60,000	10,000	240,000
	Big Qualicum River	85,000		
	Little Qualicum River	85,000		
16	Jervis Inlet Streams	n/a	n/a	85,000
17	Nanaimo River	n/a	n/a	40,000
18	Cowichan River	n/a	n/a	160,000
19	Goldstream River	n/a	n/a	15,000

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 Salmon 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 Region and take into consideration FSC needs.

### *3.2.2.1 Area 14 Chum Salmon Management Strategy*

Chum Salmon returning to Area 14 have been enhanced since the late 1960s, 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 1970s. 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, 85,000 to Big Qualicum River, and 85,000 to Little Qualicum River; including enhancement facility requirements of 10,000, the overall escapement goal is 240,000 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 Salmon Working Group. This meeting is tentatively scheduled for the first week of October; Chum Salmon Working Group meetings are subsequently held every week until late November.

Area 14 commercial Chum Salmon fisheries are managed based on forecasted abundance. In-season, the management strategy for considering fishery openings falls under one of two categories; Area 14 Pre-Season Forecast greater than 340,000 Chum Salmon or Area 14 Pre-Season Forecast less than 340,000 Chum Salmon. The 340,000 Chum Salmon is the aggregate escapement target (240,000) plus a 100,000 Chum Salmon buffer. The buffer safeguards against errors in the pre-season forecast of Area 14 stock abundance. When the pre-season forecast is greater than 340,000 early Chum Salmon openings would target up to 65% of the anticipated surplus above 340,000. When pre-season forecast is less than 340,000 an early timed small fleet gill net fishery would be used to evaluate the MVI aggregate abundance (CDFO 2018).

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 240,000;
- 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 Salmon 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 2018).

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 Salmon 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.

### *3.2.2.2 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 85,000. 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 Salmon 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 Salmon 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 2018).

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, Brittain, Vancouver and Skwawka rivers.

### *3.2.2.3 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 40,000 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 2018). 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 Salmon 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 Salmon 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 Salmon 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 Salmon 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.

#### *3.2.2.4 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 2018).

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 Salmon 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 2018). In-season management is guided by advice from the Cowichan Fisheries Roundtable (the Roundtable) and the Chum Salmon Working Group. Commercial fishing opportunities are evaluated during the weekly in-season meetings of the Roundtable and the Chum Salmon 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 Salmon Working Group and an in-season Chum Salmon Escapement Forecast Tool based on the DIDSON count by date (CDFO 2018).

Like other Strait of Georgia PFMA's, 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 Salmon 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.

#### 3.2.2.5 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 Salmon Working Group. Commercial fishing opportunities are evaluated at the Chum Salmon 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.

### **3.2.3 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. If the terminal return allows for commercial fisheries to occur, based on in-season information derived from the CDFO Albion Chum Salmon test fishery (see section 3.2.3.1), fisheries are structured to ensure a minimum spawning escapement of 800,000 Chum Salmon. 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 Coho Salmon and Interior Fraser River Steelhead. To limit incidental impacts on Interior Fraser 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 main-stem 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.

Terminal Return	Harvest Plan	First Nations	Commercial	Recreational
<500,000 in Fraser	<10%	Limited (reduced hours and days/week fishing)	Closed	Mainstem Fraser River closed, restricted openings on tributaries
500,000 to 800,000 in Fraser	Directed fisheries limited to First Nations FSC	Normal	Closed	Mainstem Fraser River closed, restricted openings on tributaries
800,000 to 916,000 in Fraser	Catch not to exceed 91,800 (82,800 First Nations and 9,000 test fishing)	Normal	Closed	Mainstem Fraser River open, restricted openings on tributaries
916,000 to 1,050,000 in Fraser	Commercial catch not to exceed 10% for Chum Salmon	Normal	Open (35,000-105,000)	Open
>1,050,000 in Fraser	Commercial catch not to exceed 15% for Chum Salmon	Normal	Open (105,000 plus)	Open

### 3.2.3.1 Fraser River In-season Terminal Abundance Estimation

Terminal abundance of Fraser River Chum Salmon is estimated using a Bayesian model that incorporates post-season information on terminal return 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, B.C. 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 1 through October 20, alternating days with the Albion Chinook Salmon test fishery (which fishes an 8" mesh gill net during this period). Until 2013, the Chum Salmon test fishery operated daily from October 21 through the end of November. Since 2013, the Chum Salmon test fishery operates daily from October 21 through approximately November 10 and then every other day until November 23. 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. Recreational and limited First Nations FSC fisheries for Fraser Chum Salmon may be permitted prior to this date, unless a conservation concern has been identified.

### **3.2.4 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/Thupana 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 2000s for those fisheries targeting mixed stock aggregates.

With the exception of near-terminal areas, such as Nitinat (Area 21 and 22) or Thupana 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 Salmon 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 2018).

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 Thupana 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 are 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.

#### ***3.2.4.1 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 2018). 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 2016). 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 brood year 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 brood year 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 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 2016). 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.

### 3.3 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, 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 is presented in Table 3-4.

The main components of the Inside South Coast (ISC) Chum Salmon return were expected to be both Fraser and non-Fraser stocks. These stocks are typically dominated by four year old fish which were from an average 2014 brood return that out-migrated in 2015. Other salmon species that out-migrated in 2015 encountered poor survival conditions (i.e. local Pink and Coho returns in 2016 were poor). The pre-season expectation for ISC Chum Salmon suggested below to near target returns to the area but was highly uncertain.

Table 3-4. Estimated harvest of summer Chum Salmon by PFMA for commercial, research and test fishing vessels<sup>1</sup> (July through the second week of September), 2009–2018.

Year	Statistical Weeks	Pacific Fishery Management Area					Total
		18	19	20	21	29 <sup>2</sup>	
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	4,516	4,516
2014	7/1–9/2	0	0	0	0	686	686
2015	7/1–9/2	0	0	0	0	1	1
2016	7/1–9/2	0	0	0	0	1087	1087
2017	7/1–9/2	0	0	0	0	8	8
2018	7/1–9/2	0	0	0	0	76	76
Average		0	0	2	0	779	781

(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 2018.

### **3.3.1 Johnstone Strait**

The Johnstone Strait test fishery, which ran from September 12th through October 27th, provided timing and abundance information for the 2018 return, which is 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 ISC Chum Salmon being over the 1.0 million critical level (requirement for commercial openings). Initially, Chum Salmon catch per unit effort (CPUE) in the test fishery was at or below what was encountered in the low 2010 return and it was determined on October 1st that the ISC index of abundance was likely below the 1.0 million critical level and planned commercial fisheries were suspended. As the season progressed, test fishery CPUE improved and on October 10<sup>th</sup>, indicated abundance was now at or above the 1.0 million threshold for ISC Chum Salmon and timing appeared to be slightly later. Commercial fishery plans were modified and initiated based on the updated assessment. The test fishery CPUE demonstrated that the front end of the return in 2018 was similar to that in 2010 but the back end of the run was stronger than 2010. The age composition derived from the test fishery and commercial samples exhibited a lower than average contribution of 4 year olds throughout the season confirming the reduced survival of the 2014 brood. Escapements and catches in 2018 suggested returns were below average but highly variable with some populations well below goal and others well above goal throughout the ISC area. Table 3-5 outlines the duration and Chum Salmon harvest in fisheries that occurred during the 2018 season.

In 2018 the pre-season plan was to have two commercial seine openings for Chum Salmon in portions of Areas 12 and 13. The two openings were scheduled pre-season to occur October 1 and October 15, for 12 hours and 10 hours respectively. The first opening that was scheduled to take place on October 1 did not occur since the ISC Chum Salmon return was tracking below the 1.0 million threshold identified in the Pacific Salmon Treaty. By mid-October the ISC Chum Salmon return was tracking above the 1.0 Million threshold, and an Area B seine opening was scheduled on October 15 for 10 hours, and extended by 1 hours due to lower than expected effort. The estimated catches from the 2018 seine Johnstone Strait Chum Salmon directed fisheries can be found in Table 3-5. The peak effort on the October 15 opening was 65 vessels.

Pre-season, three (3) commercial gill net openings were planned for 41 hours in duration each but these openings were subject to change based on in-season assessment information, weather constraints, and effort information. The first gill net opening, that was planned pre-season to occur October 9 to 11, did not occur since the ISC Chum Salmon return was tracking below the 1.0 million threshold identified in the Pacific Salmon Treaty. In 2018, a new window closure to provide protection for migrating Interior Fraser River Steelhead was implemented in Areas 12 and 13. Details on the management approach for Interior Fraser River Steelhead in South Coast fisheries can be found in the 2018-19 South Coast Salmon IFMP (CDFO, 2018). The window closure restricted gill net fisheries from September 12 to October 8 in Area 12 and from September 17 to October 13 in Area 13. Gill net fisheries were planned pre-season to occur outside these window closure dates. The first gill net fishery planned pre-season (as mentioned above) was to only occur in Area 12. By mid-October the ISC Chum Salmon return was tracking above the 1.0 Million thresholds, and two commercial gill net openings for Chum Salmon in portions of Areas 12 and 13 were planned. The first opening was for 41 hours from 16:00 hours on October 18 to 09:00 hours on October 20. The second opening was initially scheduled for 41 hours from 16:00 hours on October 26 to 09:00 hours on October 28, but due to poor weather conditions that hampered fishing on October 27, the opening was extended to 09:00 on October 29. The estimated

catches from the 2018 gill net Johnstone Strait Chum Salmon directed fisheries can be found in Table 3-5. The peak effort on the October 18 to 20 opening was 110 vessels and 58 vessels on the October 26 to 29 opening.

The troll 2018 pre-season plan for the Individual Transferable Effort (ITE) demonstration fishery was divided into two fishing periods: September 28 to October 14 (Period 1) and October 16 to October 31 (Period 2); with a one day closure during the Area B Seine which aligned to be between the two periods on October 15, and a closures during the Area B seine fishery on October 1. Each license was initially allocated three boat days during the first fishing period and two boat days during the second fishing period. Boat days could be transferred between vessels within each fishing period but not between fishing periods. The first period was initially opened on September 28, however it closed shortly after on September 30 since Southern Chum Salmon return was tracking below the 1.0 million threshold identified in the Pacific Salmon Treaty. No fishing effort occurred during this period. By mid-October the ISC return was tracking above the 1.0 Million threshold, and the fishing plan was altered. The fishery was divided into two fishing periods. Period One (October 12, 2018 to October 14, 2018) and Period Two (October 16, 2018 to October 31, 2018). Each license was assigned an allocation of one boat day in fishing Period One and two boat days in fishing Period Two. There was a one day closure between fishing periods during the Area B seine fishery on October 15, 2018. Boat-days could be fished at any time within each fishing period. Boat-days in each fishing period could be transferred between eligible license holders within each fishing period but not between fishing periods. Total effort for the Johnstone strait fishery was 57 boat days, 22 in Period One, and 35 in Period Two. The estimated catches from the 2018 troll (ITE) Johnstone Strait Chum Salmon directed fisheries can be found in Table 3-5.

The total 2018 commercial harvest for Johnstone Strait, including test fishery harvest, was 74,562 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 >700 Chum Salmon; Table 3-5) with little monitoring during the month of October. First Nations FSC harvest was estimated at 2,373 in the Johnstone Strait area (Table 3-5). The total estimated harvest of Chum Salmon in Johnstone Strait in 2018 was 77,599.

Table 3-5. Estimated Chum Salmon harvest from Chum Salmon-directed fisheries occurring in Johnstone Strait by PFMA, 2018.

Gear Type	PFMA	Fishery Dates		Fishery Duration (hours)	Estimated Harvest
		Start	End		
Purse Seine (Test)	12	Sep. 11	Oct. 28	n/a	20,517
Purse Seine	12	Sockeye / Pink Directed <sup>1</sup>			1750
	13				144
	12	Oct. 15	Oct. 15	11	17,252
	13	Oct. 15	Oct. 15	11	20,533
Gill Net	12	Oct. 18	Oct. 20	41	5,053
	13	Oct. 18	Oct. 20	41	1,594
	12	Oct. 26	Oct. 29	65	2,450
	13	Oct. 26	Oct. 29	65	3,293
Troll <sup>2</sup>	12	Oct. 12	Oct. 31	n/a	90
	13	Oct. 12	Oct. 31	n/a	1,886
Recreational <sup>3</sup>	11/12	Jul.	Aug.	n/a	66
	13	Aug.	Oct.	n/a	598
First Nations <sup>3</sup>	12	n/a	n/a	n/a	406
	13	n/a	n/a	n/a	1,967
Total					77,599

(1) This is bycatch from Fraser Sockeye- and Pink-directed fisheries that took place during early September.

(2) The troll fishery was opened from October 12 to October 30. The fishery was an effort-based quota over that time period.

(3) The recreational and First Nation fisheries time periods varied over the season.

### 3.3.2 Strait of Georgia

In 2018 the Mid-Vancouver Island (Area 14) aggregate was managed based on the pre-season forecast of less than 340,000 Chum Salmon. No commercial Chum Salmon fisheries occurred as escapement targets were not met in the three main hatchery systems (Puntledge, Big Qualicum and Little Qualicum).

In season information associated with Chum Salmon systems in Jervis Inlet (Area 16) indicated below target escapements. The main Area 16 systems are Tzoonie, Deserted and Skwawka Rivers. The overall escapement goal for rivers in Jervis/Narrows Inlet is 85,000. These terminal fisheries occur when the individual or combined escapement goals have been assured. Fishing opportunities do not occur on a regular basis. There were no fisheries in Area 16 in 2018.

Escapements returning to the Nanaimo River in Area 17 indicated above goal returns and fisheries were initiated. Commercial gill net fisheries opened on from October 24 to November 15, harvesting a total of 79,000 Chum Salmon (Table 3-6). A commercial seine opening was also provided from October 26 to November 15, harvesting a total of 9,600 Chum Salmon.

In Area 18, Chum Salmon escapement in 2018 to the Cowichan river was above the 160,000 escapement goal. The Cowichan Tribes demonstration fishery was triggered on October 24 when the DIDSON Chum Salmon count was forecast to achieve escapement goal. The Cowichan Tribes demonstration fishery was licensed to fish on October 24 daily until December 31 but was not active after November 6. The Cowichan Tribes commercial demonstration catch is approximately 5,644 Chum Salmon. An Area H Troll fished was triggered when the DIDSON Chum Salmon count was approximately 60,000 Chum Salmon. The Area 18 troll fishery was to fish for 3000 Chum Salmon on November 1 daily until the TAC was caught. No Area H vessels participated in the fishery. Area E and Area B fished in Area 18 daily from October 24 until November 21. The total gill net commercial Chum Salmon catch is estimated to be approximately 17,000 Chum Salmon. The total seine commercial Chum Salmon catch is estimated to be approximately 7,500 Chum Salmon (Table 3-6).

Area 19 fisheries are directed primarily on Goldstream River Stocks. In 2018, the Saanich Tribes demonstration fishery was triggered on November 5 when the Goldstream escapement estimate count was approximately 10,000 Chum Salmon. The Saanich Tribes demonstration fishery harvested approximately 1,500 Chum Salmon. Commercial gill net and seine fisheries began on November 9 and continued until November 19 catching 4,841 and 21 Chum Salmon respectively (Table 3-6).

There were 25 Chum Salmon estimated in the creel program for the Strait of Georgia in 2018. The harvest by First Nations in the Strait of Georgia in 2018 was estimated to be 7,150 Chum Salmon (Table 3-6).

The total estimated harvest of Chum Salmon in the Strait of Georgia in 2018 was 124,951 (Table 3-6).



Table 3-6. Estimated Chum Salmon harvest from Chum Salmon-directed fisheries occurring in the Strait of Georgia by PFMA, 2018.

Gear Type	PFMA	Fishery Dates		Fishery Duration (hours)	Estimated Harvest
		Start	End		
Purse Seine (Test)	18-19	n/a	n/a	n/a	0
Purse Seine	17	Oct. 26	Oct. 27	20	9,195
		Oct. 30	Nov. 15	177	381
	18	Nov. 7	Nov. 21	150	7,534
	19	Nov. 9	Nov. 19	110	21
Gillnet	17	Oct. 24	Oct. 25	26	39,695
	17	Oct. 28	Nov. 15	189	39,382
	18	Nov. 9	Nov. 21	130	16,727
	19	Nov. 9	Nov. 19	110	4,841
Recreational <sup>1</sup>	14-19, 28, 29 <sup>3</sup>	Sep	Sep	n/a	25
First Nations <sup>2</sup>	14	n/a	n/a	n/a	2
	15	n/a	n/a	n/a	0
	16	n/a	n/a	n/a	4
	17	n/a	n/a	n/a	0
	18	n/a	n/a	n/a	5,644
	19	n/a	n/a	n/a	1,500
	28	n/a	n/a	n/a	0
Total					124,951

(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, B.C. (Appendix B-3).

### 3.3.3 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 to protect co-migrating stocks of concern, particularly Interior Fraser 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 3.2.3 (*Fraser River Chum Salmon Management Strategy*), First Nations economic opportunity (EO) and commercial 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 19, 2018 was 793,000 Chum Salmon. A subsequent in-season estimate of 769,000 Chum Salmon was provided on October 22.

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, 2018.

Fishing Sector	Fishery Description	Target Species	Fishery Dates		Fishery Duration	Assessment Period <sup>1</sup>		Estimated Harvest
			Start	End		Start	End	
Test <sup>2</sup>	Albion Chinook	Chinook	22-Apr	20-Oct	157 days	n/a	n/a	1,346
	Albion Chum Salmon	Chum	01-Sep	23-Nov	50 days	n/a	n/a	5,374
	Whonnock Sockeye	Sockeye	22-Jun	12-Oct	109 days	n/a	n/a	909
	Cottonwood Sockeye	Sockeye	12-Jul	26-Sep	73 days	n/a	n/a	81
Test Subtotal								7,710
Commercial <sup>2</sup>	Area E gill net	Sockeye	08-Aug	21-Aug	4 days	n/a	n/a	2
		Chum	n/a	n/a	n/a	n/a	n/a	n/a
	Area B seine	Sockeye	12-Sep	17-Sep	6 days	n/a	n/a	601
		Chum	n/a	n/a	n/a	n/a	n/a	n/a
	Area H troll	Sockeye	06-Aug	04-Sep	30 days	n/a	n/a	54
		Chum	n/a	n/a	n/a	n/a	n/a	n/a
Commercial Subtotal								657
Recreational <sup>3,4,5</sup>	Fraser River Mainstem <sup>7</sup>	Mixed	04-Sep	28-Sep	25 days	04-Sep	28-Sep	25
	Chilliwack River <sup>8</sup>	Mixed	01-Jul	31-Dec	184 days	15-Sep	15-Nov	5,088
	Nicomien Slough	Mixed	01-Jan	28-Oct	301 days	05-Oct	30-Nov	2
Recreational Subtotal								5,115
First Nations <sup>2, 6</sup>	FSC	Mixed	14-Apr	12-Oct	n/a	n/a	n/a	4,080
		Chum	10-Oct	19-Nov	n/a	n/a	n/a	58,767
	ESSR	Chum	n/a	n/a	n/a	n/a	n/a	28,510
	EO	Sockeye	23-Sep	28-Sep	5 days	n/a	n/a	1,381
		Chum	n/a	n/a	n/a	n/a	n/a	0
First Nations Subtotal								92,738
Total								106,220

- (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 Salmon 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 fishing for salmon from Jan.1 to Aug.6 and from Sep.29 to Oct.24.
- (8) The Chilliwack River recreational fishery was opened to the retention of Coho only from Jan.1 to Mar.31 and closed to fishing for salmon from Apr.1 to Jun.30.

First Nations FSC gill net fisheries targeting Chum Salmon were initiated October 10 following a closure period to protect co-migrating Interior Fraser Coho Salmon. These fisheries harvested a total of

58,767 Chum Salmon (Table 3-7). First Nations EO fisheries directed at Chum Salmon did not occur in 2018; however, certain First Nations groups were provided access to Chum Salmon that returned to hatchery facilities but that were not required for broodstock. A total of 28,510 Chum Salmon deemed to be surplus to spawning requirements (ESSR) were provided to First Nations from various hatchery facilities in 2018. First Nations FSC Chinook and Sockeye-directed fisheries occurring in 2018 had bycatch of Fraser Chum Salmon, harvesting 4,080 Chum Salmon (Table 3-7). First Nations EO fisheries directed at Sockeye Salmon occurring in 2018 also had bycatch of Fraser Chum Salmon, harvesting 1,381 Chum Salmon (Table 3-7).

The total harvest of Chum Salmon in all Fraser River First Nations fisheries (including hatchery ESSR fish) was 92,738 in 2018 (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 the Fraser River, 2009–2018.

Year	First Nations			Commercial	Test	Other	Total
	FSC	EO	ESSR	Area E GN Area B SN Area H TR	Albion and PSC Test Fisheries	Other Scientific Licenses <sup>1</sup>	
2009	12,991	68,150	8,458	42,116	9,249	n/a	140,964
2010	13,480	185	14,021	168	10,762	n/a	38,616
2011	25,348	4,883	50,067	35,779	3,550	n/a	119,627
2012	30,747	102,185	34,593	60,300	13,487	n/a	241,312
2013	36,852	107,959	43,176	94,268	15,382	n/a	297,637
2014	39,517	100,261	34,638	64,111	12,637	n/a	251,164
2015	36,266	122,309	15,692	127,337	10,525	n/a	312,129
2016	67,257	146,101	34,724	179,158	12,308	n/a	439,548
2017	47,051	111,524	23,106	77,382	10,681	n/a	269,744
2018	62,847	1,381	28,510	657	7,710	n/a	101,105
Average	37,236	76,494	28,699	68,128	10,629	n/a	221,185

(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 2018 include significant fisheries occurring in the lower Fraser River mainstem, the Chilliwack River and the Stave River, and minor salmon fisheries occurring in 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 2018.

The lower Fraser River mainstem was open to the retention of Chum Salmon for 25 days in 2018 (Table 3-7); this retention period is significantly less than previous years. Retention of Chum was permitted starting September 4 in the tidal area downstream of the Mission Bridge to the Fraser River mouth (daily retention limit of 4) and on September 5 the fishing area allowing the retention of Chum was increased to include the non-tidal area upstream of the Mission Bridge and downstream of Hope BC (daily retention limit of 2). Chum Salmon retention ended on September 27 and September 28 in the tidal and non-tidal areas, respectively.

The entire Fraser River mainstem downstream of Hope BC was closed to fishing for salmon from September 29 to October 24 as part of the CDFO's Interior Fraser River Steelhead conservation measures implemented in 2018. Subsequent to this closure, from October 25 to December 31, areas of the Fraser River mainstem were opened to fishing for salmon but the retention of Chum Salmon was not permitted.

In 2018, the mainstem recreational fishery was assessed from September 4 to September 28 during the period Chum Salmon retention was permitted; estimates of 25 and 0 Chum Salmon were harvested and released, respectively (Table 3-7). Additional assessment of the mainstem recreational fishery occurred from August 7 to September 3 and from October 25 to November 30, 2018 when the river was opened to fishing for salmon but closed to the retention of Chum Salmon; estimates of 0 and 15 Chum Salmon were harvested and released, respectively. No assessment took place from December 1 to December 31, 2018.

The estimated harvest in 2018 was lower than the previous five years average (approximately 140 from 2013-2017) and notably less than in 2012 (Table 3-9). Two meaningful factors can be identified for this pattern. First, the estimated Fraser River Chum spawning escapement in 2018 was approximately 60% of the average for the 2012-2017 period, and second, the CDFO closing the mainstem lower Fraser River to fishing for salmon from September 29 to October 24 to protect co-migrating Interior Fraser River Steelhead, a period shown to account for greater than 90% of the Chum Salmon catch in some years (J. Tadey CDFO, pers. comm. 2021).

The Chilliwack River recreational fishery was open to the retention of Chum Salmon from July 1 to December 31, 2018 (daily retention limit of 1). This fishery was assessed from September 15 to November 15, 2018; estimates of 5,088 and 6,737 Chum Salmon were harvested and released, respectively (Table 3-7). The estimated Chum Salmon harvest in 2018 for the Chilliwack fishery was approximately double the estimate for each of the previous five years (Table 3-9). Unlike the lower Fraser mainstem fishery, the duration of the Chilliwack recreational fishery and assessment was relatively constant between 2013 and 2018.

The Harrison River, Stave River and Nicomen Slough recreational fisheries were open to the retention of Chum Salmon from January 1 to October 28 (daily retention limit of 2 per day in the Harrison and Stave rivers and 4 per day in Nicomen Slough). The retention Chum Salmon fisheries were closed in these systems on October 29 over concerns of poor coast-wide and Fraser River returns of Chum Salmon.

The Nicomen Slough fishery was assessed from October 5 to November 30, 2018. Estimates of 2 and 594 Chum Salmon were harvested and released, respectively for this fishery (Table 3-7). Chum Salmon catch in this fishery was low and similar to catch in the previous four years but notably less than that estimated in 2013 (Table 3-9). Recreational fisheries occurring in the Harrison and Stave rivers were not assessed in 2018.

In total, for assessed recreational fisheries occurring in the lower Fraser River watershed in 2018, estimates of 5,115 and 7,331 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 2018, there were no commercial fisheries directed on Fraser Chum Salmon due to the low abundance estimated in-season. There was a small amount of Chum Salmon bycatch (657) in commercial fisheries directed on Sockeye Salmon that occurred in August and September (Table 3-7 and Table 3-8).

Table 3-9. Estimated harvest of Chum Salmon in assessed (i.e. surveyed) lower Fraser River recreational fisheries, 2009–2018.

Year	Recreational Fishery					
	Fraser River <sup>1</sup>	Chilliwack River	Nicomen Slough	Stave River	Harrison River	Total
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
2014 *	344	2,917	15	ns	ns	3,276
2015 *	123	2,466	45	ns	ns	2,634
2016 *	34	3,253	8	ns	ns	3,295
2017*	145	2,361	63	ns	ns	2,569
2018*	25	5,088	2	ns	ns	5,115
Average <sup>2</sup>	465	2,697	119	3,578	742	3,713

(1) Mainstem portion of the lower Fraser River (downstream of Hope, B.C.; Appendix B-3).

(2) Average for years with an assessment.

(\*) Preliminary estimates.

(ns) not surveyed.

Four test fisheries operated in the Fraser River in 2018: 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 3.2.3.1).

In 2018, the Albion Chinook Salmon test fishery operated from April 22 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 Salmon test fisheries operated on alternating days (section 3.2.3.1). Chum Salmon harvest in the Albion Chinook Salmon test fishery, representing 157 fishing days, totaled 1,346 and harvest in the Albion Chum Salmon test fishery, representing 50 days, totaled 5,374 Chum Salmon (Table 3-7).

The PSC Whonnock Sockeye Salmon test fishery operated for 109 days from June 22 through October 12, and harvested 909 Chum Salmon. The PSC Cottonwood Sockeye Salmon test fishery fished for 73 days from July 12 through September 26, and harvested 81 Chum Salmon (Table 3-7).

In total, an estimated 7,710 Chum Salmon were harvested in the CDFO and PSC test fisheries occurring in the Fraser River in 2018 (Table 3-7 and Table 3-8).

### 3.3.4 West Coast Vancouver Island

The total catch of Chum Salmon in 2018 WCVI commercial fisheries was about 27,415. A small commercial gillnet hatchery directed opportunity occurred in Nitinat (Area 21/22) harvesting 11,467 Chum Salmon. A limited-entry commercial fishery in Nootka Sound (Area 25) caught about 7,670 Chum Salmon and another in Kyuquot Sound (Area 26) Caught another 8,278.

First Nations FSC harvest of Chum Salmon occurred in all WCVI areas and totaled 1,067 for 2018.

#### 3.3.4.1 Nitinat

In 2018, the preseason forecast of 178,00 precluded regular full fleet fisheries for both gillnet and seine fisheries. A one day Area E gillnet fishery occurred on October 1st. The catch per unit effort (CPUE) was used to predict an in season run size reforecast. The fishery was poor and the low CPUE precluded any further fishery for two weeks. On October 19 and 20th, because the weekly escapement targets for the Nitinat System were met, a regular gillnet fishery occurred. This fishery also had low catches. The terminal return in 2018 was estimated at 149,624 Chum Salmon which is below the lower reference point (Table 3-10).

The 2018 commercial catch was based on the early gill net opening (Area 21) for a total of 11,467 Chum Salmon. First Nations FSC (Area 21/22), ESSR (Area 22) harvest and hatchery broodstock of Chum Salmon in 2018 totaled 54,363 Chum Salmon (Table 3-10).

### 3.4 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.

Table 3-10. Nitinat area Chum Salmon harvest, hatchery broodstock collection and spawning escapement estimates by PFMA, 2009–2018.

Year	Area 21		Area 22	
	Seine Catch	Gillnet Catch	In-lake Catch & Broodstock	Natural Spawners
2009			32,434	54,000
2010			42,971	59,900
2011	65,469	211,968	136,641	248,655
2012	97	23,219	75,816	206,704
2013		15,730	25,800	25,066
2014			56,069	125,500
2015	58,580	110,535	93,177	240,000
2016	269,042	137,591	145,179	445,000
2017		36,051	62,229	99,000

2018		11,467	54,363	83,794
Average	98,297	78,080	72,468	158,762

(1) includes Nitinat tributaries.

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).

### 3.4.1 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 2009, are presented in Table 3-11. 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.

Table 3-11. Inside Southern Chum Salmon net escapement estimates (spawning escapement plus hatchery broodstock) for Fraser and non-Fraser stock aggregates, 2009–2018<sup>1</sup>.

Year	Inside Southern Chum Salmon Escapement		
	Fraser River	Non-Fraser River	Total
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	1,287,850	2,568,182
2013	799,573	1,224,131	2,023,704
2014	986,114	619,296	1,605,410
2015	808,219	659,847	1,468,066
2016	1,781,307	1,651,511	3,432,818
2017	662,874	656,521	1,319,395
2018	659,542	543,619	1,203,161
Average	931,647	882,497	1,814,144

(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.

### 3.4.2 West Coast Vancouver Island

In 2018, Nitinat Chum Salmon spawning escapement was estimated at 84,000 (Table 3-10) which is a decline over the 2014 brood year (126,000) and below average. In other WCVI Areas, Chum Salmon spawning escapements were all well below average in the areas monitored (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<sup>1</sup> by PFMA, 2009–2018.

Year	WCVI Pacific Fishery Management Area			
	Area 23 (Barkley)	Area 24 (Clayoquot)	Area 25 <sup>2</sup> (Nootka)	Area 26 (Kyuquot)
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
2014	12,475	36,878	51,323	41,130
2015	32,559	33,299	108,154	82,277
2016	101,006	31,049	191,631	88,676
2017	12,864	30,125	46,024	27,273
2018	6,439	25,468	85,600	20,346
Averages	41,503	48,962	82,704	58,459

(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, Spawning Escapements, and Catches

Tables 4-1 and 4-2 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, fall and winter).

#### 4.1.1 Summer Chum Salmon

The Strait of Juan de Fuca summer Chum Salmon post-season run size of 1,586 was 68% of the pre-season forecast and 19% of the 2009–2017 average post season run size. The Hood Canal summer Chum Salmon post-season run size of 13,308 was about 78% of the pre-season forecast and about 58% of the 2009–2017 average post-season run size. Approximately 97% of the combined Strait of Juan de Fuca and Hood Canal summer Chum Salmon run went to escapement. The post-season run size estimate of South Puget Sound summer Chum Salmon in 2018 was 25,995, which was about 1.03 times larger than the pre-season forecast and 0.76 times smaller than the 2009-2017 average post-season run size.





Table 4-1. Puget Sound summer Chum Salmon pre-and post-season estimates of run size and spawning escapements, 2009–2018.

Region	Type	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Strait of Juan de Fuca	Pre-Season	5,198	3,991	5,308	5,915	6,603	9,041	7,105	7,105	11,094	2,309
	Post-Season	5,147	9,332	5,705	6,337	14,801	8,179	15,599	9,089	2,119	1,586
	Escapement	5,029	9,179	5,675	6,304	14,727	7,811	15,532	9,077	2,113	1,567
Hood Canal	Pre-Season	18,009	5,999	9,050	8,970	19,798	31,400	22,526	22,526	34,188	17,034
	Post-Season	9,200	12,957	7,170	31,134	24,325	30,408	36,055	52,753	59,850	13,308
	Escapement	7,236	12,533	6,914	29,855	22,618	27,396	32,644	47,966	55,655	12,868
South Puget Sound <sup>1</sup>	Pre-Season	57,352	62,991	62,623	41,889	53,492	59,940	57,987	86,254	33,716	25,178
	Post-Season	25,010	49,098	39,823	38,936	38,332	25,317	32,570	19,294	38,798	25,995
	Escapement	21,660	43,739	38,515	24,521	35,444	20,593	32,521	19,068	37,372	25,358

(1) South Puget Sound estimates include only commercial harvest and escapement within Puget Sound.

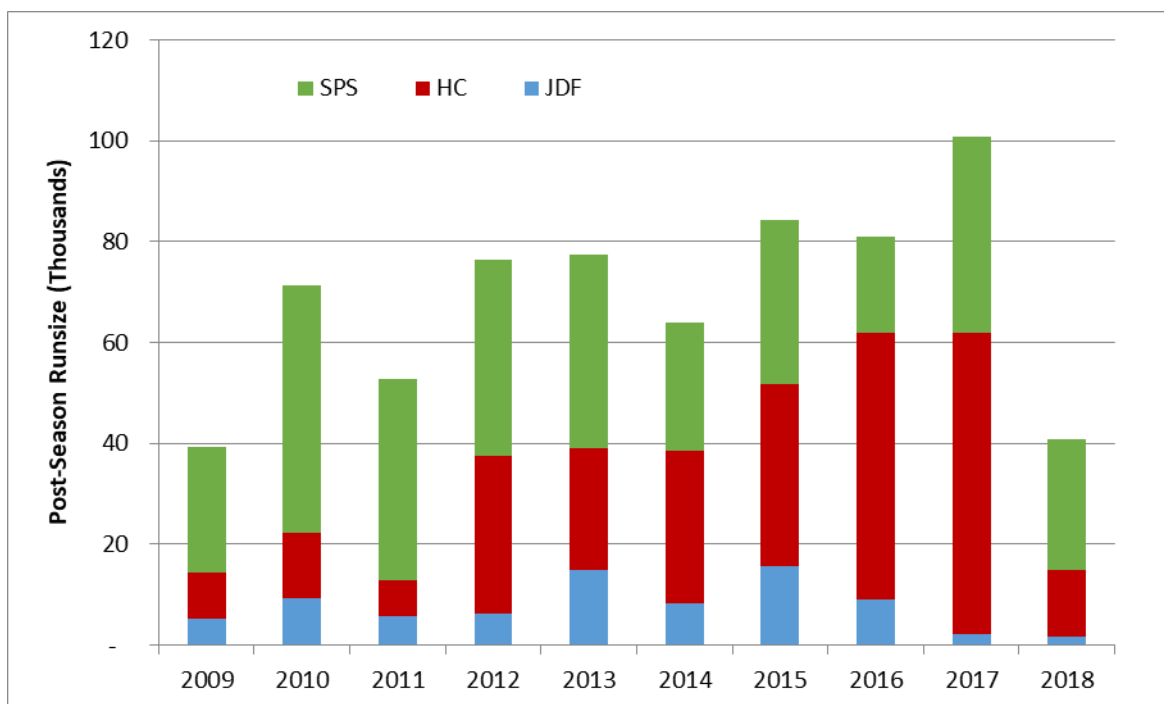


Figure 4-1. Puget Sound summer Chum Salmon abundance, 2009–2018, by region of origin (JDF: Strait of Juan de Fuca, HC: Hood Canal, SPS: South Puget Sound).

#### 4.1.2 Fall and Winter Chum Salmon

The combined Puget Sound fall Chum Salmon post-season run size estimate was 1,276,644 fish, or 91% of the pre-season forecast and approximately 89% of the 2009–2018 average post-season run size. Regional post-season numbers varied in their deviation from the forecasted numbers, ranging from 1.7 times larger than the pre-season forecast (South Puget Sound) to 15% of the pre-season forecast (Nooksack/Samish) (Table 4-2, Figure 4-2). The Washington coastal (Willapa Bay and Grays Harbor) fall Chum Salmon post-season run size estimate was 83,663 fish, or approximately 83% of the pre-season forecast, and 1.09 times greater than the 2008–2016 post-season average run size.

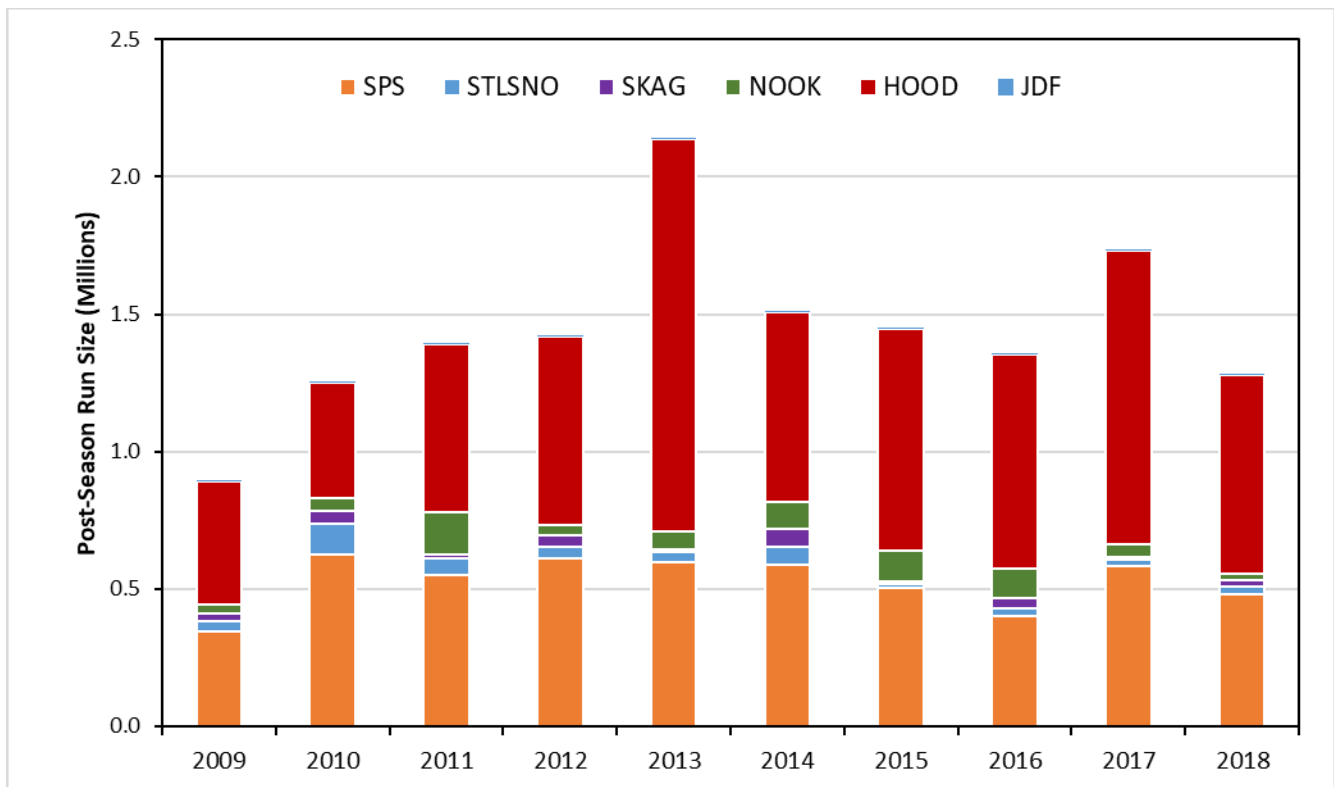


Figure 4-2. Puget Sound fall Chum Salmon abundance, 2009-2018, by region of origin (JDF: Strait of Juan de Fuca, NOOK: Nooksack-Samish, SKAG: Skagit, STLSNO: Stillaguamish/Snohomish, SPS: South Puget Sound, HOOD: Hood Canal).

The Puget Sound winter Chum Salmon 2018 post-season run size assessment was 43,501, which was approximately 53% of the pre-season forecast and 74% of the 2009–2017 average post-season run size (Table 4-2, Figure 4-3).

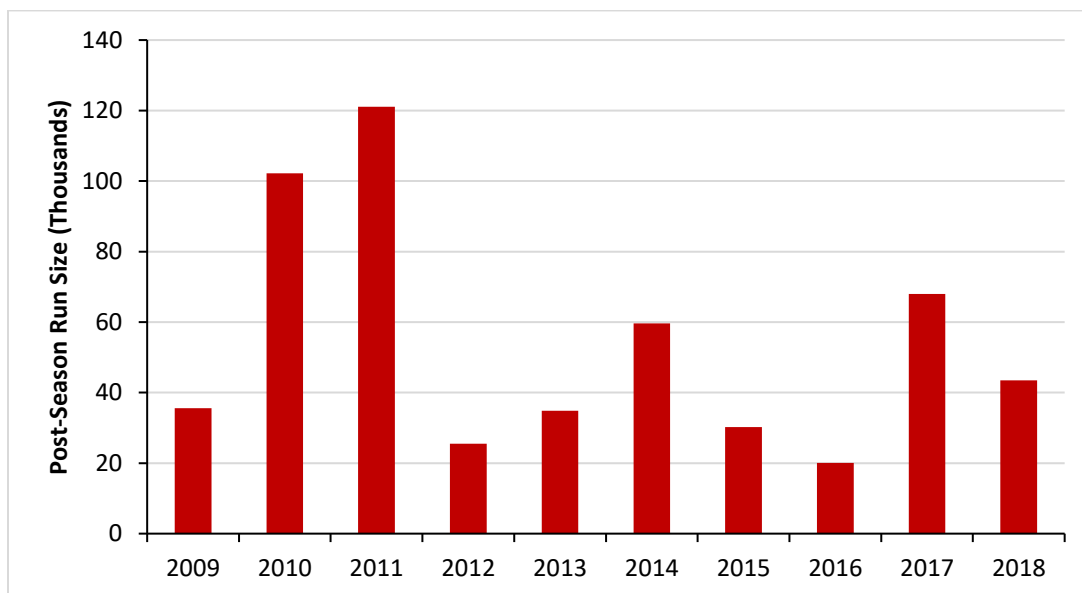


Figure 4-3. South Puget Sound winter Chum Salmon abundance, 2009–2018.

Table 4-2. Washington fall and winter Chum Salmon pre-and post-season estimates of run size and spawning escapements, 2009–2018.

Run	Region	Type	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Fall	Willapa Bay	Pre-Season	7,139	33,442	22,254	28,273	35,584	55,378	39,994	47,555	57,726	39,932
		Post-Season	17,444	26,701	69,802	43,069	27,564	30,276	48,756	86,673	22,609	41,448
		Escapement	12,743	25,204	66,871	26,640	24,979	26,508	45,409	80,931	21,986	38,582
	Grays Harbor	Pre-Season	17,665	18,492	33,669	24,603	30,716	44,670	28,852	35,700	31,300	61,144
		Post-Season	19,776	43,582	50,494	40,561	41,524	28,728	48,049	70,434	29,678	42,185
		Escapement	15,216	34,644	30,101	27,876	22,519	15,378	34,587	64,704	19,613	29,314
	Strait of Juan de Fuca	Pre-Season	2,587	2,222	1,618	1,203	813	4,369	9,305	3,240	1,688	7,076
		Post-Season	1,462	1,849	4,839	3,174	1,468	2,045	3,076	2,920	447	1,118
		Escapement	1,305	1,343	4,707	2,973	1,394	1,952	2,958	2,805	435	1,054
	Nooksack/ Samish	Pre-Season	69,145	61,827	31,924	34,739	52,585	59,908	180,759	89,207	109,337	163,114
		Post-Season	32,007	48,892	152,176	39,100	68,176	95,440	112,704	109,824	45,023	24,576
		Escapement	26,268	30,510	100,748	21,703	48,506	60,058	68,690	60,573	26,429	18,970
	Skagit	Pre-Season	26,828	50,226	26,834	59,167	15,325	16,505	47,292	45,449	6,966	124,295
		Post-Season	29,479	46,503	15,850	41,601	9,786	65,734	8,155	35,388	7,107	19,557
		Escapement	26,744	39,884	15,494	36,601	8,554	63,013	7,964	33,797	6,750	18,718
	Stillaguamish/ Snohomish	Pre-Season	92,477	90,660	71,277	86,598	48,884	87,476	168,104	32,905	26,516	132,580
		Post-Season	37,689	110,050	61,598	40,003	35,145	64,272	13,669	27,372	23,656	29,226
		Escapement	29,378	46,628	60,792	35,450	30,317	51,599	8,169	24,434	20,060	27,448
	Hood Canal	Pre-Season	374,929	477,409	352,019	426,675	323,597	442,308	394,246	489,698	492,892	543,637
		Post-Season	446,476	419,094	610,507	684,643	1,427,350	691,862	809,162	777,359	1,071,179	480,953
		Escapement	55,879	49,486	102,374	91,940	240,169	105,192	146,004	179,118	193,760	191,425
	South Puget Sound	Pre-Season	348,333	650,986	487,514	323,928	349,623	465,970	377,032	526,060	433,196	432,980
		Post-Season	344,854	627,131	548,484	611,657	597,762	589,869	503,531	401,462	584,264	722,332
		Escapement	150,732	201,992	179,094	190,817	186,457	200,660	160,260	167,561	179,797	238,583
Winter	South Puget Sound	Pre-Season	83,380	89,293	55,923	51,599	61,113	84,263	45,170	47,053	36,696	82,144
		Post-Season	35,544	102,235	121,079	25,522	34,839	59,672	30,227	20,043	67,988	43,501
		Escapement	15,486	79,550	74,110	18,987	21,754	46,587	28,855	19,600	60,420	37,127

### 4.1.3 Chum Salmon Harvest

Paragraph 3 of the Chapter 6, Annex IV of the Treaty requires that the United States and Canada assess catch levels of Chum Salmon caught during the July 1 through September 15 time period in boundary area fisheries (Catch Areas 4B, 5, 6C, 7 and 7A). Table 4-3 provides Chum Salmon harvest totals during this accounting period for U.S. boundary area fisheries.

Table 4-3. Harvest of Chum Salmon in Catch Areas in the Strait of Juan de Fuca (SJF) and the San Juan Islands (SJI) commercial fisheries during the HC/JDF summer Chum Salmon accounting period (July 1–September 15) in years 2009–2018.

	Strait of Juan de Fuca			San Juan Islands		Total
	Area 4B	Area 5	Area 6C	Area 7	Area 7A	
2009	5	13	0	64	5	87
2010	95	77	0	122	29	323
2011	0	27	0	53	110	190
2012	61	63	0	9	3	136
2013	63	11	0	705	107	886
2014	6	59	0	9	258	332
2015	44	54	0	26	8	132
2016	0	27	0	0	0	27
2017	0	0	0	45	41	86
2018	0	207	0	8	18	233
Average	27	54	0	104	58	243

Table 4-4 provides Chum Salmon harvest totals 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 B-1). Table 4-4 also includes annual Chum Salmon harvest totals for the Puget Sound and the Washington Coastal areas.

Table 4-4. Harvest of summer, fall, and winter Chum Salmon in Strait of Juan de Fuca (SJF), San Juan Islands and Point Roberts (SJI/PR), Puget Sound and Washington coastal areas, 2009–2018.

Year	Region			
	SJF (Areas 4B, 5, 6C)	SJI/PR (Areas 7, 7A)	Puget Sound <sup>1</sup>	WA Coast <sup>2</sup>
2009	574	24,233	622,372	10,351
2010	1,796	23,642	927,742	12,593
2011	1,865	70,359	989,986	28,251
2012	476	73,236	1,064,532	30,697
2013	1,200	80,472	1,644,328	23,060
2014	3,700	147,022	1,011,660	18,069
2015	6,858	124,791	1,037,455	20,911
2016	25,807	118,461	846,808	18,830
2017	3,426	123,282	1,282,595	12,675
2018	4,579	66,444	781,237	2,254
Average	5,028	85,194	1,020,872	17,769

(1) All other Puget Sound freshwater and marine harvest areas except Strait of Juan de Fuca or San Juan Islands/Point Roberts Fisheries.

(2) 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 2018 season, the management strategy for the Strait of Juan de Fuca (SJF) fishery consisted of maintaining the limited effort nature of this fishery and considering the needs of Puget Sound stocks of Chum Salmon when making management decisions. This fishery has experienced minimal effort in recent years, resulting in relatively low harvest levels over the period of 2009–2018 (Table 4-4). Harvest and effort for the period of 2009–2018 were generally below levels observed in the late 1980s and early 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 14, 2018 with a schedule of six days per week and continued through November 10, 2018. A total of 4,579 Chum Salmon was harvested in this fishery, and there was a reported bycatch of 656 Coho salmon, 23 Chinook salmon, and zero Steelhead.

In Areas 4B, 5, and 6C, the incidental harvest of Chum Salmon prior to the Chum Salmon-directed fishing season was above the recent ten year average. There were 207 Chum Salmon harvested during the summer Chum Salmon accounting period (July 1–September 15), including

in JDF test fisheries. During the subsequent Coho salmon-directed fishery, nine Chum Salmon were harvested.

The total 2018 Chum Salmon catch by all gears (including recreational) in the SJF was 4,584 Chum Salmon (Table 4-4).

### ***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 Southern 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.

#### **4.3.2 Fishery Description**

On October 8, 2018 Canada notified the U.S. that the Inside Southern Chum Salmon aggregate was estimated to be below the critical threshold of 1.0 million and the U.S. was expected to limit Chum Salmon harvest to incidental and minor fisheries not exceeding 20,000. Following this notification, the U.S. cancelled Area 7 and 7A commercial Chum Salmon fisheries that were scheduled to open on October 10. Additionally, beginning October 10, the U.S. required Chum Salmon release from reef net fisheries targeting Coho, and the reef net fishery was scheduled to close on October 13. However, on October 10, Canada notified the U.S. that it had revised the Inside Southern Chum Salmon aggregate abundance, which was now estimated to exceed the 1.0 million critical threshold, allowing the U.S. to target the 130,000 Chum Salmon ceiling in Area 7 and 7A fisheries. Following this notification from Canada, the U.S. Tribal fishery first opened October 12; the U.S. non-Tribal purse seine and gillnet fisheries first opened October 13; and the U.S. non-Tribal reef net fishery resumed Chum Salmon retention on October 11.

On October 19, 2018, Canada notified the U.S. that the Fraser River Chum Salmon run size was estimated to be below the 900,000 fish threshold. Therefore, the U.S. was expected to limit Chum Salmon harvest to not exceed 20,000 from the day following this notification. The U.S. closed Area 7 and 7A commercial Chum Salmon fisheries on October 20. The Tribal fishery opened on October 12 and ran continuously through October 20. Non-Tribal purse seine and gillnet fisheries were open daily October 13, 14, 16. Non-Tribal reef net fisheries was open daily through October 20.

Chum Salmon catch by reef nets during this time was 1,968 fish (Table 4-5). The U.S. catch for gill nets and purse seines in Area 7 and 7A was 64,476 Chum Salmon (Table 4-5). The combined U.S. commercial catch in Areas 7 and 7A for all gear types was 66,444 Chum Salmon. There were no Chum Salmon harvested in recreational fisheries in Areas 6, 7 and 7A during 2018.

Although Area 6 is not mentioned in the Chum Salmon Annex, and harvests from this area do not count against the U.S. harvest ceiling, it is worth noting that no Chum Salmon were harvested from Area 6 in 2018.

The total 2018 Chum Salmon catch by all gear types (including recreational) in Areas 6, 7 and 7A for the October 1 to November 11 time period was 66,444. Catch distribution, between Areas 6, 7 and 7A was 0%, 70% and 30%, respectively.

Table 4-5. Harvest of Chum Salmon in U.S. Catch Areas 6, 7 and 7A Chum Salmon fisheries during 2018.

Catch Area	Gill Net	Purse Seine	Reef Net
6			
7	1,944	42,268	1,968
7A	13,478	6,786	0
Total	15,422	49,054	1,968

In 2018, 27 Chum Salmon harvested as bycatch in Fraser Panel approved Sockeye Salmon fisheries in Catch Areas 6, 7 and 7A. During Chum Salmon-directed fisheries in Areas 6, 7, and 7A, there was a reported bycatch of 30 Chinook salmon, 2,525 Coho salmon and zero Steelhead (Table 4-6).

Table 4-6. Bycatch of Chinook salmon, Coho salmon and Steelhead during the 2018 U.S. Chum Salmon commercial fishing period beginning October 1 in Catch Areas 6, 7 and 7A.

Catch Area	Chinook	Coho	Steelhead
6	7	25	0
7	6	2,284	0
7A	17	216	0
Total	30	2,525	0

## 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 2018.



## 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 1990s (Hargreaves et al. 2001). The method involves manipulating the temperature of the rearing water by at least 2°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). In 2018, thermally marked eggs from the Puntledge River were transplanted to the Nimpkish River as part of a recovery program for that stock on the East Coast of Vancouver Island.

Table 5-1. Releases of Chum Salmon with thermally-marked otoliths from Canadian hatchery facilities, 2009–2018.

Broodyear	East Coast Vancouver Island Hatcheries	West Coast Vancouver Island Hatcheries					
	Gwa’ni Hatchery Release Site	Nitinat Release Sites	Conuma Hatchery Release Sites				
	Nimpkish River	Nitinat River & Lake	Conuma River	Conuma Estuary	Tlupana River	Sucowa River	Canton River
2009		5,252,749	18,847	1,814,475	685,465	551,365	854,548
2010		14,182,582	0	1,794,205	1,015,355	311,828	646,203
2011		25,303,286	0	1,270,286	37,241	223,882	365,682
2012		15,813,031	0	785,682	813,957	41,196	116,757
2013		9,738,442	0	1,705,633	820,612	269,435	1,009,478
2014		17,767,521	410,214	1,467,870	0	0	200,646
2015		18,236,300	534,334	723,867	452,375	0	576,649
2016		26,443,305	424,032	1,932,540	1,027,846	0	835,191
2017		7,894,803	471,129	1,624,825	580,356	213,343	203,990
2018	1,823,247	16,512,986	563,431	1,679,255	1,120,443	610,249	511,748

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 2018 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 Big Qualicum River Chum Salmon from southern B.C.-based Canadian hatchery facilities, 2009–2018.

Broodyear	Fin Clip Type <sup>1</sup>	Clipped	Poor Clips + Unclipped	Total
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
2014	AD	191,823	7,248	199,071
2015	AD	250,646	4,423	255,069
2016	-	None clipped	-	0
2017	-	None clipped	-	0
2018	-	None clipped	-	0

(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 2009–2018 broodyears. Fin clipping was suspended at Big Qualicum River in 2016 (Table 5-2).

There were no coded wire tagged Chum Salmon released from Canadian facilities during the 2009–2018 time period.

## 5.2.2 United States

Historically, hatchery supplementation was used to supplement depressed wild summer Chum Salmon populations and to reintroduce summer Chum Salmon back into streams where the original population was extirpated. The duration of all JDF/HC hatchery supplementation programs were limited to three summer Chum Salmon generations (12 years) to minimize the likelihood for divergence between hatchery broodstocks and target natural stocks. However, the Lilliwaup supplementation program extended beyond 12 years, due to continued extremely low Lilliwaup sub-population run sizes and lack of habitat protection and restoration efforts in the Lilliwaup River.

In 2018, otolith marking (Volk et al. 1987) continued only for hatchery supplementation of Lilliwaup River summer Chum Salmon in the Strait of Juan de Fuca and Hood Canal (Table 5-3) and continued for some fall Chum Salmon in Hood Canal, 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 summer Chum Salmon released in river systems within the Strait of Juan de Fuca (SJF) and Hood Canal with thermally-marked otoliths by brood year, 2009–2018.

Brood year	SJF	Hood Canal	
	Jimmycomelately	Lilliwaup	Tahuya
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
2014	-	109,680	-
2015	-	165,024	-
2016	-	199,824	-
2017	-	150,000	-
2018	-	150,000	-

Table 5-4. Numbers of Puget Sound and Lower Columbia River fall Chum Salmon released with thermally-marked otoliths, 2009–2018.

Brood year	Hood Canal	Puget Sound					Lower Columbia River	
	Skokomish River	Elwha River	Tulalip Bay	Kendall Creek	Terrell Creek	Whatcom Creek	Grays River Hatchery <sup>1</sup>	Washougal Hatchery
2009	0	0	0	0	0	0	300,000	70,000
2010	0	0	0	0	0	2,000,000	250,000	57,455
2011	0	0	0	0	0	1,360,000	206,000	74,893
2012	0	0	0	0	0	1,547,900	157,800	58,004
2013	0	450,000	40,000	650,895	85,000	3,048,000	151,567	46,083
2014	0	450,000	8,000,000	1,094,383	1,000,000	2,283,000	192,156	400,000
2015	0	450,000	8,000,000	1,000,000	0	2,000,000	250,000	500,000
2016	0	450,000	8,000,000	1,000,000	0	2,000,000	250,000	100,000
2017	0	450,000	8,000,000	1,000,000	0	2,000,000	250,000	100,000
2018	11,996,785	450,000	8,000,000	1,000,000	0	2,000,000	250,000	0

(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. 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 2018 (Table 5-5). In 2018, these samples were analysed for microsatellite markers using the third year of four years of funding supported by the Southern Endowment Funds. Genetic Stock Identification (GSI) was conducted on 1968 Chum Salmon migrating to natal streams through Johnstone Strait (Areas 12 and 13) and along the central Strait of Georgia (Area 14-18) using analyses of microsatellite variation (Araujo et al. 2019). In a separate Southern Fund project, the Juan de Fuca Sampling Program started in 2016 in Canadian Area 20 and US Areas 5-6. In 2018, 1615 Chum Salmon were analysed with microsatellites from this assessment fishery (Van Will et al. 2019).

Table 5-5. Chum Salmon tissue samples collected and analyzed in Johnstone Strait (Area 12-13), east coast of Vancouver Island (Area 14-18), and Juan de Fuca (Area 20/US Areas 5, 6 from commercial and test fisheries 2009-2018.

Year	Commercial Samples				Test Fishery Samples			
	Areas 14-18		Areas 12-13		Area 12		Area 20/Areas 5-6	
	Collected	Analysed	Collected	Analysed	Collected	Analysed	Collected	Analysed
2009	146	145	1418	1,101	999	-	-	-
2010	59	59	400	400	1,015	1,014	-	-
2011	101	101	865	863	1,404	905	-	-
2012	307	307	987	935	1,275	1,261	-	-
2013	-	-	1,185	973	1,311	1,291	-	-
2014	-	-	1,087	990	1,369	1,342	-	-
2015	-	-	1,348	982	1,395	1,326	-	-
2016	-	-	1,425	1,231	1,350	1,341	1,025	1,025
2017	633	574	1,323	988	1,415	990	1,538	1,373
2018	224	224	600	500	1,473	1,244	1,656	1,615

#### 5.3.1.2 United States

In 2018, WDFW started using the Chum Salmon SNPs to genotype hatchery broodstocks used in the Lower Columbia Chum Salmon reintroduction work for parent-based tagging: genotype broodstocks, in subsequent years genotype spawners that are potentially offspring of the hatchery parents, assign the spawners to the broodstocks and determine which program they came from or if they were born in the wild, rather than a hatchery (Hillson 2018). WDFW has also conducted

juvenile stock assignment studies in the Strait of Juan de Fuca and Hood Canal during 2009–2018. The juvenile studies documented emigration timing and relative production of summer and fall Chum Salmon in key populations. In another application of the SNP baseline, WDFW characterized Chum Salmon in the Elwha and Lyre rivers in the Strait of Juan de Fuca to estimate the contributions of hatchery Chum Salmon to recolonization in the Elwha River following dam removal (Small et al. 2018).

Mixed-stock fishery GSI sampling occurred in various U.S. Chum Salmon fisheries both in conjunction with Southern Endowment Fund projects and also independently funded. In 2018 an independent project funded by WDFW, conducted a GSI analysis of the 2017 Catch Area 10/11 fishery (N = 1490) in South Puget Sound using the Chum Salmon SNP baseline. In 2018, 418 samples were collected from fisheries in U.S. Catch Areas 7 and 7A. In addition, there were samples collected in U.S. Catch Area 9 from 809 Chum Salmon in the Test fishery, from 593 Chum Salmon in the commercial fishery, and from 933 Chum Salmon in a research fishery. These samples were analyzed in an independently funded project using microsatellites. (Table 5-6).

Table 5-6. Chum Salmon tissue samples from U.S. Catch Areas 7, 7A and 9 analyzed for GSI in 2009–2018. These years of samples were analyzed by CDFO lab using microsatellite DNA.

Year	Area 7	Area 7A	Area 9		
	Commercial		Test	Commercial	Research
2009	0	0	585	0	0
2010	403	203	352	0	0
2011	0	0	527	0	366
2012	1,328	829	493	0	50
2013	419	423	692	0	961
2014	121	285	877	0	504
2015	196	123	732	0	357
2016	784	336	718	288	0
2017	921	415	749	450	0
2018	291	127	809	593	933

### 5.3.2 Baseline Collection for Genetic Stock Identification

In 2018 researchers in Canada and US collected baseline samples in anticipation of the completion of the development phase of the Chum Salmon SNP locus panel under funding from the Southern Fund. The Chum Salmon SNP panel would enable Chum Salmon researchers in any lab to genotype Chum Salmon and generate compatible data to be entered into a common Chum Salmon genetic database.

### 5.3.2.1 Canada

In 2018, CDFO continued to collect baseline GSI tissue samples of Southern British Columbia Chum Salmon populations (Table 5-7). The focus was to sample fish from the east coast of Vancouver Island to improve resolution between populations. The CDFO Molecular Genetics Lab continues to expand the southern BC baseline SNP panel in collaboration with the WDFW lab.

Table 5-7. Fall Chum Salmon GSI tissue collections from Southern B.C. by Conservation Unit, collection site, life stage, and influence<sup>1</sup> of enhancement, 2018.

Conservation Unit	Collection Site	Life Stage	Enhancement Level <sup>1</sup>	Sample Size
Loughborough	Heydon Creek	Adult	Natural	40
Georgia Strait	Campbell River	Adult	Mixed	216
Georgia Strait	Chemainus River	Adult	Mixed	90
Georgia Strait	Goldstream River	Adult	Mixed	78
Georgia Strait	Cowichan River	Adult	Mixed	70
Georgia Strait	Nanaimo River	Adult	Mixed	158
Georgia Strait	Little Qualicum River	Adult	Natural	147
Lower Fraser	Stave River	Adult	Natural	75

(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).

### 5.3.2.2 United States

In 2018, the UW lab finalized GTseq development of two SNP panels and the WDFW lab implemented the GTseq protocol to genotype baseline samples (Small et al. 2018). Because there were two GTseq amplicon panels, the costs to the WDFW lab limited genotyping to half the samples originally intended (Table 5-8). Further, WDFW encountered difficulties with high throughput genotyping because the GTseq method was more sensitive to sample quality than Taqman assays and most of the samples were from carcasses. Because of these challenges, WDFW reassessed the SNP loci and the GTseq protocol. WDFW reorganized the SNP loci into a single panel of 350 SNP loci and modified the DNA extraction protocol to improve genotyping results. The WDFW lab genotyped an initial baseline data set of 43 collections (N = 2466 total fish) from the Southern Boundary Region.

Table 5-8. List of collections genotyped with 350 SNPs to expand the Southern Boundary Chum Salmon SNP baseline in 2018. The region column has the regional groupings. The total number of samples run for each collection is under “N Run”.

Country	region	Collections	N Run	WDFW code
US	HoodCanal_F	Anderson	48	11MD
US	HoodCanal_F	Big Beef	48	10LY

Country	region	Collections	N Run	WDFW code
US	HoodCanal_F	Dewatto	48	11KN
US	HoodCanal_F	Duckabush_F	48	11MF
US	HoodCanal_F	Lilliwaup	48	10LZ
US	HoodCanal_F	HammaHamma_F	70	12AN
US	HoodCanal_F	NF Skokomish	19	10LO
US	HoodCanal_F	NF Skokomish	48	11KQ
US	HoodCanal_S	Dosewallips_S	18	12HR
US	HoodCanal_S	Dosewallips_S	18	14MB
US	HoodCanal_S	HammaHamma_S	25	12AN
US	HoodCanal_S	HammaHamma_S	11	14PI
US	HoodCanal_S	Duckabush_S	48	14MC
US	NorthPS	Lower_Sauk	48	14QN
US	NorthPS	Nooksack	48	10LT
US	NorthPS	Skagit_lower_mainstem	48	14QM
US	NorthPS	Snohomish	48	10PB
US	NorthPS	Stillaguamish	48	10PC
US	NorthPS	upper_Skagit	48	10LR
US	NorthPS	upper_Skagit	80	14DB
US	SJF	Dungeness (Beebe Cr)	48	10LK
US	SouthPS	Chico/Grovers	48	10MA
US	SouthPS	Chico/Grovers	66	15TJ
US	SouthPS	Green River Hatchery	96	07LB
US	SouthPS	Kennedy	48	11KS
US	SouthPS	Skookum	48	10MH
US	SouthPS_W	DIRU_Puyallup H	48	11KR
US	SouthPS_W	Nisqually	75	11KV
US	LowColumbia	I_205	95	16MN
US	LowColumbia	Horsetail	26	16MQ
US	LowColumbia	Ives Island	68	16MR
CAN	Fraser	Hopedale	48	11NS
CAN	Fraser	Peach	48	10OT
CAN	Fraser	Squawkum	48	10QT
CAN	GeorgiaSt	Big Qualicum	48	10OV
CAN	GeorgiaSt	Campbell	34	11OL
CAN	GeorgiaSt	Cheakamus	43	12ON
CAN	GeorgiaSt	Cowichan	48	11OJ
CAN	GeorgiaSt	Lang	48	11NU
CAN	GeorgiaSt	Little Qualicum	96	10OU
CAN	GeorgiaSt	Nanaimo	96	10OP
CAN	GeorgiaSt	Phillips	48	11NT
CAN	GeorgiaSt	Puntledge	48	10OQ
CAN	GeorgiaSt	Snake	48	10OS

Country	region	Collections	N Run	WDFW code
CAN	GeorgiaSt	Southgate	48	03AA
CAN	JohnstoneSt	Nimpkish	48	10OR
CAN	WCVI	Conuma	43	12OM
CAN	WCVI	Nitinat	48	10OW
CAN	WCVI	Sooke	47	11OK



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## APPENDICES

### **Appendix A 1.** Annex IV, Chapter 6, of the Pacific Salmon Treaty

#### **Southern British Columbia and Washington State Chum Salmon**

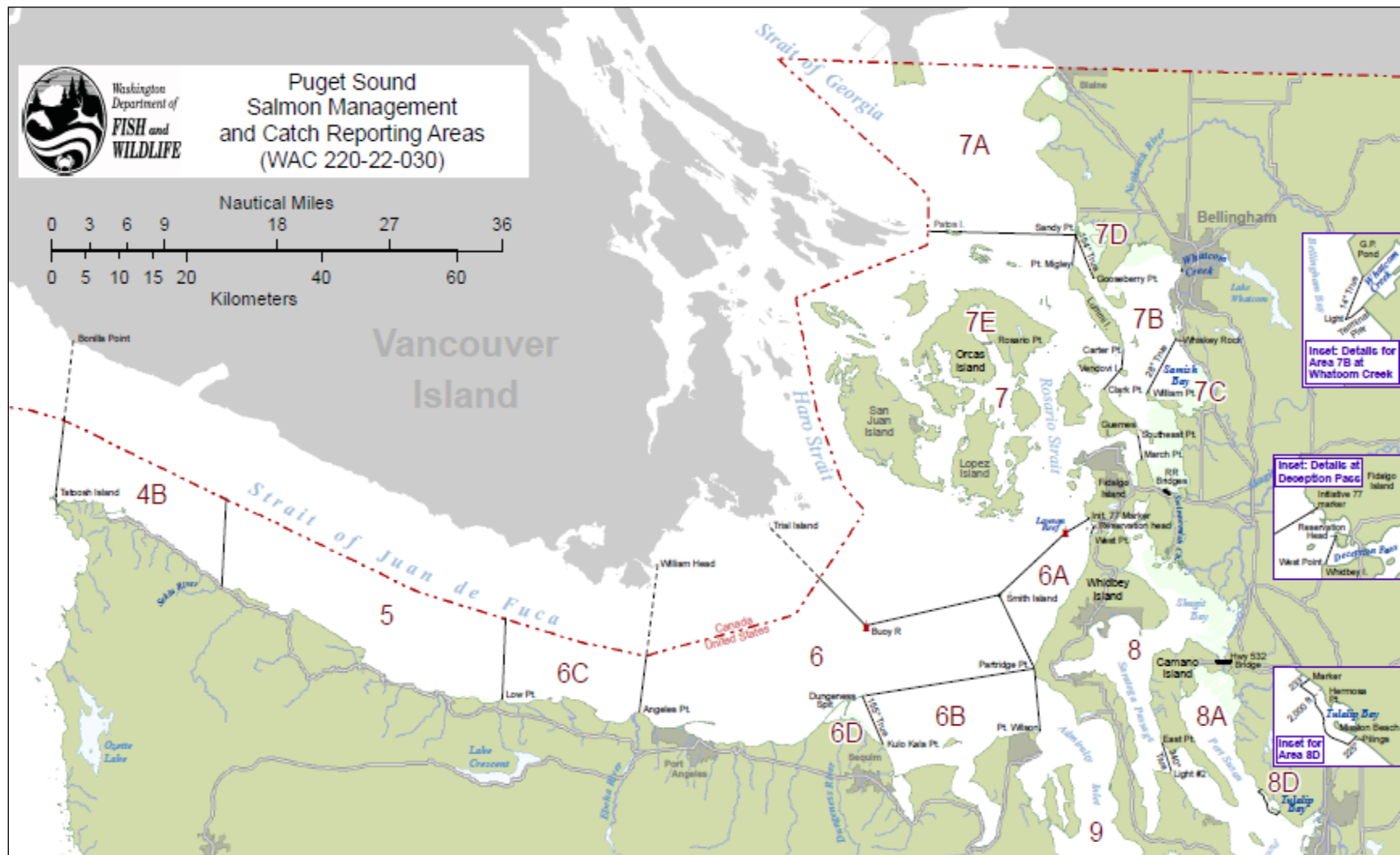
The provisions of this Chapter shall apply for the period 2010 through 2018.

1. The Parties shall maintain a Joint Chum Salmon 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 Salmon 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.

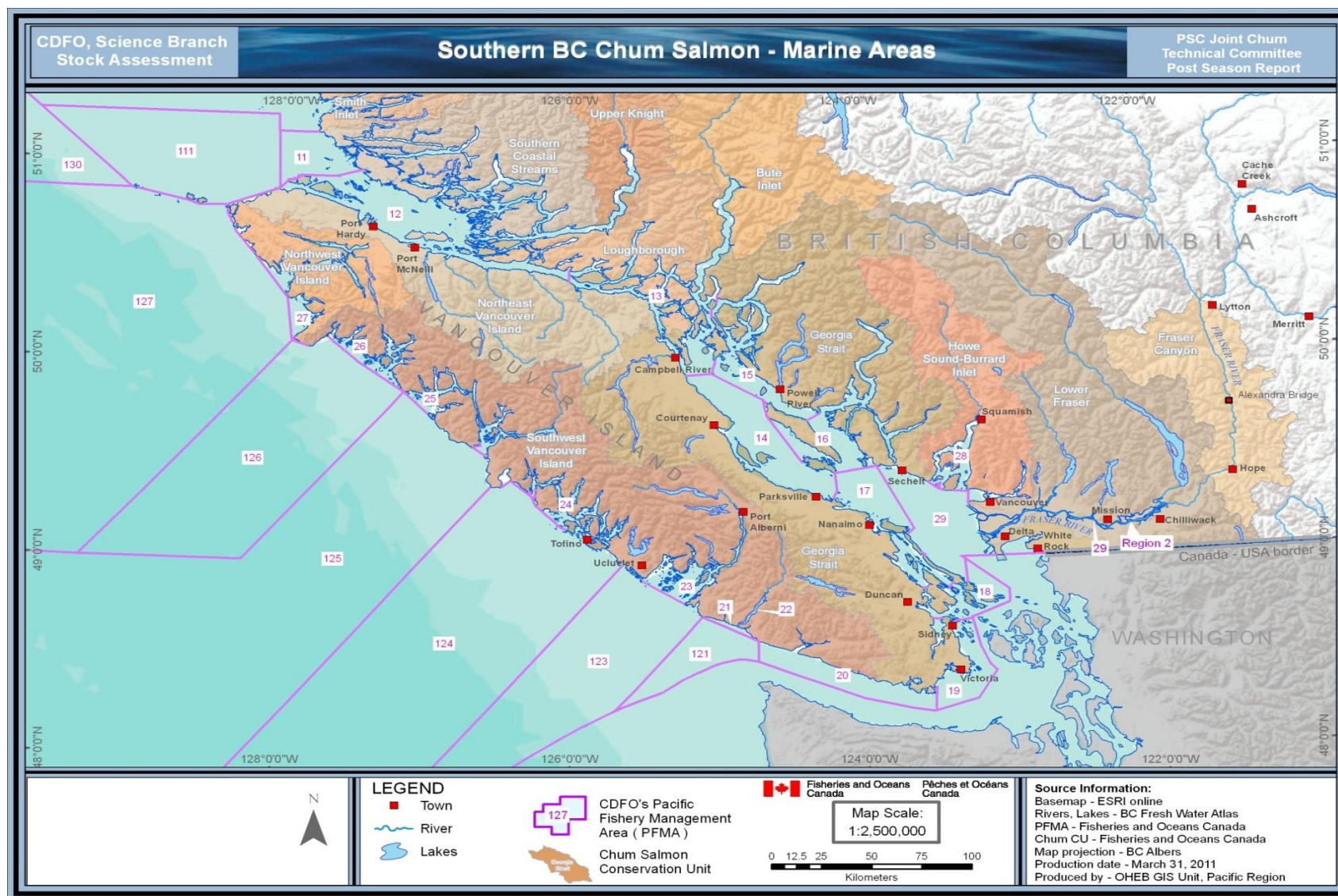
5. Canada will manage its Johnstone Strait, Strait of Georgia, and Fraser River Chum Salmon fisheries to provide continued rebuilding of depressed naturally spawning Chum Salmon stocks, and, to the extent practicable, not increase interceptions of U.S. origin Chum Salmon. Terminal fisheries conducted 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 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 Salmon 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 bycatch 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 A 2.** United States commercial salmon catch areas for the Strait of Juan de Fuca and Northern Puget Sound.



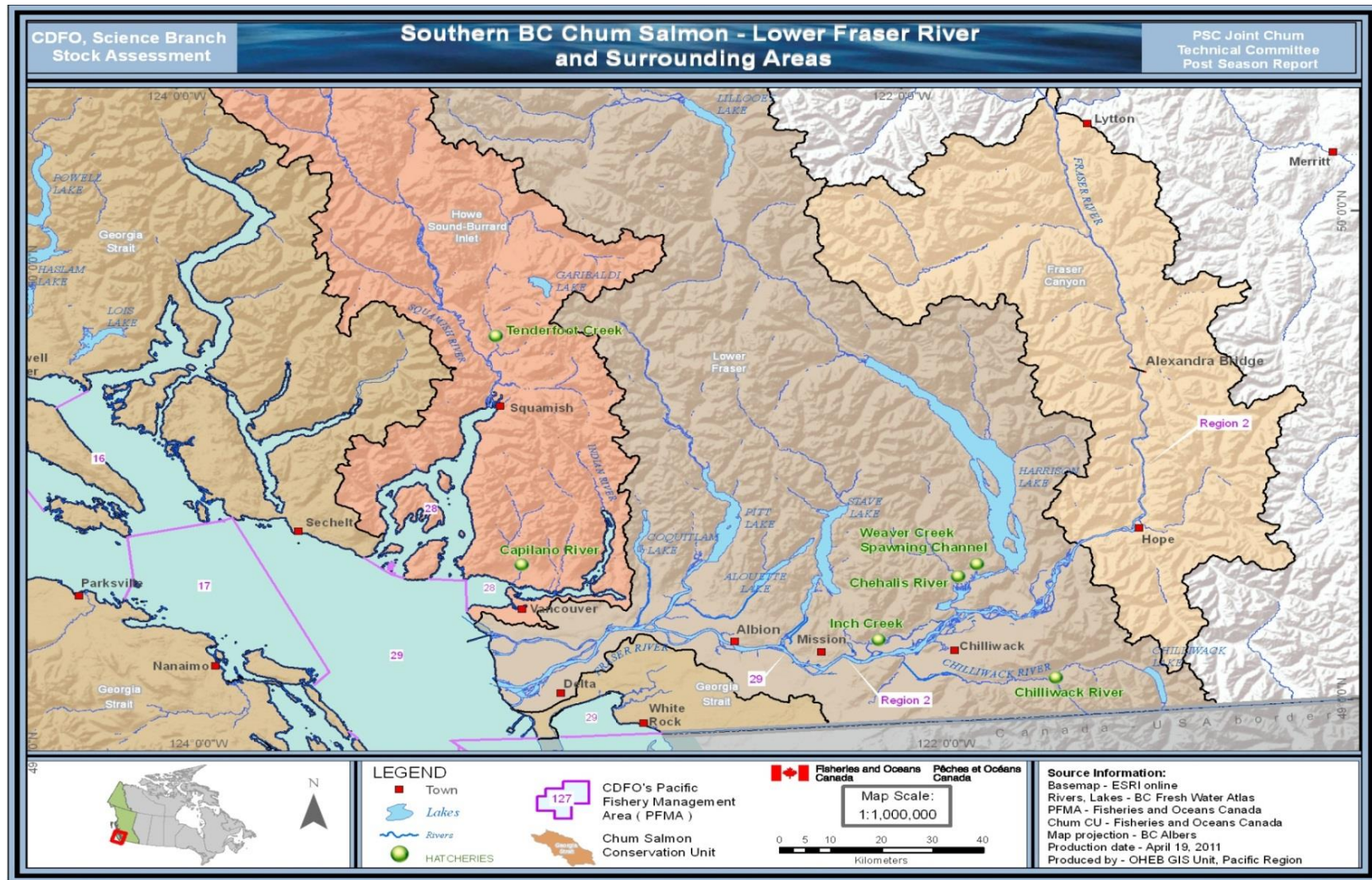
### Appendix A 3. Canadian Pacific Fishery Management Areas (PFMA) for Southern B.C. - Marine areas.



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**Appendix A 4.** Canadian Pacific Fishery Management Areas (PFMA) for Southern B.C. - Lower Fraser River and surrounding areas.



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**Appendix A 5. PSC Work Plan for the Joint Chum Salmon Technical Committee, 2018.**

**PACIFIC SALMON COMMISSION WORK PLAN**  
**[2018-2019]**

**Panel / Committee:**

*Chum Salmon Technical Committee reports to the Southern Panel.*

**Update on Bi-lateral Tasks Assigned Under Current PSC Agreement:**

- *Beginning work on the draft report covering 2016 fisheries and research will be a principal focus during the PSC meetings in January 2018.*
- *Review of new treaty language to evaluate data and analysis needs to conform to the information required.*
  - *Determine actual assessment program needs to effectively implement the Chapter Language*
  - *Describe assessment program coverage needed by region/country to effectively implement the Chapter*
  - *Create a table and narrative of what is actually being implemented by region/country*
  - *Summarize significant gaps*
  - *Develop an annual reporting tool to provide a summary of the activities and identified gaps*
- *The committee's other focus will be continued development of the following aspects of the strategic plan (see attached Figure). These include:*
- *To provide updates on any approved 2018 SEF projects: Currently 4 Chum Salmon projects are being conducted in 2018:*
  - **Further development of the run reconstruction module for Southern BC and Washington State Chum Salmon (ChumGEM model).**
  - **Sampling program in the Strait of Juan de Fuca (Year 3)**
  - **Estimate of total Fraser River escapement using GSI information at Albion Test Fishery and enumeration of Chilliwack River escapement (Year 3)**
  - **Mixed stock GSI in Southern BC and Puget Sound (Year 3)**
- *Work on 2018 reports associated with SEF projects for later submission*
- *Review of SEF priorities and ensure projects are ready for 2019 implementation should funding materializes.*
- *Identify additional sampling requirements to complete and/or update the existing baseline collections seeking other funding opportunities or resources to help with the database development, and other priority items such as the Escapement Reference Point development (Update on Holt et al. work).*



**Obstacles to Completing above Bi-lateral Tasks:**

*Chum Salmon Technical Committee:*

- *While support from the Southern Endowment Fund has facilitated our efforts to implement the Chum SalmonTC strategic plan, time constraints for committee members remains a challenge to task completion.*

**Outline of Other Panel / Committee Tasks or Emerging Issues:**

*None Presently Identified*

**Potential Issues for Commissioners, including enhancement activities to be reported under Article V:**

*None presently identified.*

**Potential Issues for Committee on Scientific Cooperation**

*None presently identified.*

**Proposed Meeting Dates and Draft Agendas:**

*Attendance at meetings for Technical Committee members may be dependent on available resources.*

*Chum Salmon Technical Committee:*

*January 14– 18, 2019 – PSC Post-Season Meeting, Vancouver, BC*

- *Review and discuss preliminary post-season 2018 fisheries information*
- *Collate and review report items for 2016 final post-season report*
- *Continue work on Southern Chum Salmon genetic baseline inventory and expansion for adequately identifying stock origin of fish in mixed stock fisheries on both sides of the border*
- *Continue to evaluate and test the ChumGEM model*
  - *Presentation on ChumGEM progress, issues and next steps*
- *Updates on any completed SEF programs related to Chum Salmon*
- *Review and discuss research and analysis activities essential to the Committee tasks*
- *Review Chum Salmon Strategic plan and update*
- *Provide any bilateral analyses, as requested by the Southern Panel.*

*February 11 – 15, 2019 – PSC Annual Meeting, Portland, OR*

- *Continue work on 2016 annual report.*
- *Address any specific tasks assigned to the Committee by the Southern Panel at the January meeting*
- *Continue work on tasks not completed at the January meeting*
- *Assign workgroups and workgroup tasks for items still pending at the end of the February meeting*
- *SEF projects for 2019-2020 should be identified and program planning initiated*
- *Start to develop new SEF priorities document for upcoming call*
- *Initiate 2017 annual report*

*May 2019 – PSC Chum Salmon TC Spring Meeting, location to be determined*

- *Finalize 2016 annual report for submittal*
- *Continue to define and develop Tier 2 components of the Southern Chum Salmon Strategic Plan*
- *Review status of all SEF related projects and develop plan for new submission following identified priorities*

**Status of Technical or Annual Reports:**

*Chum Salmon Technical Committee:*

- *The committee anticipates having the 2016 Annual Report complete at the May 2019 Chum SalmonTC meeting.*
- *The committee anticipates having the 2017 Annual Report complete by the end of the February meeting in 2020.*

## **Appendix A 6. Pacific Salmon Commission Southern Boundary Restoration and Enhancement Fund Projects in 2018.**

**Project Title:** SF-2018-SP-31A Modifications to the Chum Salmon Genetic and Environmental Management Model (ChumGEM), a run reconstruction computer model

<https://www.psc.org/download/590/information/12085/s18-sp31a-modifications-to-the-chumgem-a-run-reconstruction-model.pdf>

The Chum Salmon Genetic and Environmental Management Model (ChumGEM), a run reconstruction model, was developed between 2013 and 2015 to assist in post-season run reconstruction analyses for Chum Salmon fisheries in southern British Columbia and Puget Sound, Washington. The model uses a genetic data set, historic catch data, and escapement estimates to provide estimates of run-specific parameters such as abundance and arrival timing. It also provides daily estimates of exploitation rates and escapement by genetic unit (GU).

Substantial modifications are needed to make the ChumGEM model a useful tool for fisheries management. Testing of the model was conducted in 2017, which concluded that the model should still be considered a work in progress pending further data verification, model checks, and sensitivity analysis. Furthermore, changes to the model structure are likely required. The objective of this project is to modify and improve the ChumGEM model so that it can be used as a fisheries management tool. This work began in mid-2018 and continues into 2019.

**Project Title:** S18-SP08A Joint US and CA Mixed-stock Chum Salmon Fisheries Sampling Design and Analysis 2018 (Araujo et al. 2019)

<https://www.psc.org/download/590/information/11793/s18-sp08a-joint-us-and-ca-mixed-stock-chum-fisheries-sampling-design-and-analysis.pdf>

We conducted Genetic Stock Identification (GSI) of 2932 Chum salmon migrating to natal streams through Johnstone Strait (Statistical Areas 12 and 13), along the central Strait of Georgia (Statistical Area 17) and the San Juan Islands (Statistical Areas 7 and 7A) for 2018 using analyses of microsatellite variation. A total of 2058 Chum salmon were analyzed for Canadian fisheries (Areas 12, 13, and 17) and 874 Chum salmon for U.S. fisheries (Area 7-7A).

The analysis of chum salmon sampled in the commercial and test fisheries in Johnstone Strait (JS) were mainly from Canadian populations (85.8% to 99.4%) comprised largely of sites in that local area, the Fraser River, and Strait of Georgia (east and west sides). The central Strait of Georgia (SoG) was composed of largely Canadian contributions (92.4% to 97.7%), mainly from sites in the eastern and western portions of SoG and Johnstone Strait. The analysis of Chum salmon caught in U.S. commercial fisheries in the San Juan Islands (Area 7 and 7A) were mostly of Canadian origin stocks: 93.5% to 99.2%. U.S. contribution reached 6.5% in late October.

The failure rate was very high for Areas 7 and 7A, where 51.9% of the samples failed due to DNA degradation and contamination issues. In Canadian samples the failure rate was low at 0.097%. A total of 0.41% of the samples were excluded from the analysis because the

number of loci amplified was below threshold (<9 from 14 loci), lower than the previous year (3.04%).

**Project Title: S18-SP-9A Joint US and CA Juan de Fuca Chum Salmon Sampling Program 2018 (Van Will et al. 2019)**

Through the initial work on the ChumGEM reconstruction model, it was very apparent that the diversion of Chum Salmon stocks through the southern route (Strait of Juan de Fuca) was a significant gap in our information needed to populate the model. Currently the model structure is available to incorporate this information but the assumptions on the migration pathways being used require investigation and validation. The purpose of this project was to work towards addressing that data gap by sampling this migration route in both US and Canadian waters to determine:

- The spatial and temporal stock composition of Chum Salmon migrating through the Southern Diversion route,
- Provide sampling platform for stock identification, migration rate studies etc.
- Develop time series of Catch per Unit effort data to pair with the Johnstone Strait Test Fishery to determine diversion rate of various Chum Salmon populations.

2018 was the third year of this project. Through the initial work on the ChumGEM reconstruction model, it was very apparent that the diversion of Chum salmon stocks through the southern route (Strait of Juan de Fuca) was a significant gap in our information needed to populate the model. Currently the model structure is available to incorporate this information but the assumptions on the migration pathways being used require investigation and validation. The program began as planned on October 4th and ran until November 9th. A total of 145 sets were completed (71 in Canadian waters and 74 in US waters). A total of 8,680 Chum were encountered and 1,656 were sampled for stock id and other biologicals. There was a significantly higher Catch per Unit Effort (CPUE) in the Canadian side of the Strait compared to what was encountered in the US. This was the complete opposite as to what was encountered in 2016 but very similar to what was observed in 2017. The catch information demonstrated a slightly later timing on the Canadian side of the Strait with a peak CPUE during week 43 and an earlier peak CPUE in the US waters during week 42 (although CPUE in week 42 and 43 were very similar in US waters). Over the period of the program, Chum CPUE was higher in Canadian waters than in US waters except in week 44.

Stock composition information demonstrated that Canadian Chum stocks dominated the samples throughout the program in Canadian waters similar to previous years. US Chum stocks in Canadian waters varied in composition but increased later in the program. In US waters, US Chum stocks dominated the mixtures throughout the program. Stock timing and distribution differences were observed and this new information has improved our understanding of Chum stock composition and timing through the migratory pathways of Juan de Fuca Strait

**Project Title: Albion-based estimate of total Fraser River Chum Salmon escapement using GSI at Albion and an estimate of Chilliwack River Chum Salmon escapement, 2018 (In press)**

**Project Title: SP18-SP22 Expanded Bilateral Chum Salmon SNP Genetic Baseline for Genetic Stock Identification 2018 US Report (Small et al. 2020)**

<https://www.psc.org/download/590/information/13400/s18-sp22-expanded-bilateral-chum-salmon-snp-genetic-baseline-for-genetic-stock-identification-wdfw-2018-report.pdf>

In this project we expanded the initial SNP baseline generated by WDFW in the Southern Boundary region to include better representation of Canadian (CA) Chum salmon populations in the Fraser River and along Strait of Georgia, and Puget Sound populations. The United States (US) had developed a comprehensive panel of 500 SNPs for a Chum salmon baseline funded in part by the Southern Fund and NOAA Saltonstall Kennedy funding (Seeb et al. 2014, Rawson et al. 2014, Small et al. 2017a). The US incorporated 350 of these SNPs in a SNP panel using the Genotyping-in-Thousands by sequencing (GT-seq) technology (Campbell et al. 2015). and genotyped an initial 31 Chum salmon populations with the Chum GT-seq panel. Under the current grant, the US filled in gaps with six new populations and increased temporal representation and collection sizes for 13 existing populations. Also under this grant, the DFO lab in Nanaimo conducted a parallel project where they tested the 500 Chum SNPs and added SNPs from other species to design a Chum SNP panel specific to their Ion Torrent genotyping technology. The DFO lab genotyped additional CA Chum salmon populations to develop a comprehensive Chum SNP baseline in CA. There are 300 SNPs in common between the US and CA SNP panels: the data are compatible allowing cooperative research and data sharing after minimal standardization.

**Project Title: SP18-SP23 Expanded Bilateral Chum Salmon SNP Genetic Baseline for Genetic Stock Identification 2018 Canadian Report (Sutherland et al. 2020)**

<https://www.psc.org/download/590/information/13206/s18-sp23-expanded-bilateral-chum-salmon-snp-genetic-baseline-for-genetic-stock-identification-dfo-2018-report.pdf>

An amplicon sequencing panel was generated to genotype single nucleotide polymorphisms (SNPs) in chum salmon (*Oncorhynchus keta*) in order to improve the resolution of the current genetic baseline, as well as to improve both automation and genotyping result transferability between laboratories in the United States and Canada. In short, this allowed for the development of a high-resolution, bilateral chum salmon SNP panel that can be applied in the Southern Boundary Region. This panel was generated from a series of markers shared between laboratories, and thus common baselines can be used by both countries, making results more comparable. Specifically, this project aimed to expand the initial SNP baseline containing 38 populations to include better representation of Canadian chum salmon populations in the Fraser River and along the Strait of Georgia, as well as Puget Sound populations in Hood Canal. The SNP markers that have been implemented by the US genetics laboratory are now being genotyped using the DFO sequencing platform and genotyping pipeline. Efforts between the laboratories to calibrate and synchronize output have been largely successful. The goal to use this SNP platform to add an additional 25 Canadian populations that were not yet in the US SNP baseline has been met and surpassed with supplemental genotyping. The chum baseline is now fully operational within DFO, initial steps of calibrating between the US and Canada have been taken to facilitate baseline sharing, and mixed-stock analyses are ready to be undertaken with

this new platform. Here we report the details on the SNP baseline, with a specific focus on the improvements of resolution for specific goals proposed in the study.