TCCHUM (24)-01

2020 Post Season Summary Report

Prepared by the

CHUM TECHNICAL COMMITTEE

for the

PACIFIC SALMON COMMISSION

July 2024

PACIFIC SALMON COMMISSION
CHUM TECHNICAL COMMITTEE

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LIST OF ACRONYMS AND ABBREVIATIONS

B.C.	British Columbia
CDFO	Canadian Department of Fisheries and Oceans or Fisheries and Oceans Canada
ChumTC	Joint Chum Technical Committee
ChumGEM	Chum Genetic Environmental Model
CPUE	Catch per Unit Effort
EO	Economic Opportunity
ESSR	Excess Salmon to Spawning Requirements
FN	First Nation
FSC	Food, Social, and Ceremonial
GN	Gill net
GSI	Genetic Stock Identification
ISC	Inside Southern Chum
NOAA	National Oceanic and Atmospheric Administration
NWIFC	Northwest Indian Fisheries Commission
PFMA	Pacific Fishery Management Area
PNPTC	Point No Point Treaty Council
PSC	Pacific Salmon Commission
PST	Pacific Salmon Treaty
SJF	Strait of Juan de Fuca
SJI/PR	San Juan Islands/Point Roberts
SN	Seine net
SNP	Single Nucleotide Polymorphism
TCCHUM	Joint Chum Technical Committee
U.S.	United States of America
UW	University of Washington
WA	Washington State
WCVI	West Coast Vancouver Island
WDFW	Washington Department of Fish and Wildlife

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1 Executive Summary

This Pacific Salmon Commission (PSC) Joint Chum Technical Committee report documents the information on Chum Salmon stocks and fisheries in southern British Columbia (B.C.) and Washington (WA) for the year 2020 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. On May 3, 2019, Canada and the U.S. (the Parties) ratified a new 10-year agreement for these fisheries that is now in force through 2028. The Chum Salmon Annex requires that Canada and the U.S. maintain a Joint Chum Technical Committee, reporting to the Southern Panel and the Commission, and that certain fisheries for Chum Salmon in southern B.C. and WA be managed in a specified manner (Appendix A). Certain fisheries of each country, while not specifically mentioned in the PST, are known to harvest Chum Salmon originating in the other country.

This report presents information for 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 stocks of concern to the Treaty. These data represent the current estimates, some of which may have been updated since the publication of previous reports.

Returns in 2020 were below the recent 9-year average in B.C. and WA.

In 2020, the Chum Salmon 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. (Appendix B-2; Appendix B-3) and in U.S. Areas 4B, 5, 6C, 7, and 7A (Appendix B-1) 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 each countries Treaty provisions in 2020.

Paragraph 1:

> *The Parties shall establish and maintain a Joint Chum Salmon Technical Committee (the "Committee"). The Committee shall report, unless the Parties otherwise decide, to the Southern Panel and the Commission.*
>
> Note: Specific tasks for the Committee are listed in Annex IV Chapter 6, Paragraph 1.

The Committee convened remotely four times in the 2020-2021 season: during the Joint Chum Technical Meetings in May 2020 and March 2021, and during the PSC Post-Season Meeting in January 2021 and the PSC Annual Meeting in February 2021. Additional detail of the work performed by the Committee in 2020-2021 can be found in the Committee's 2020-2021 Work Plan (Appendix C).

In 2010 the Committee developed a direction paper to guide development and application of a jointly agreed genetic baseline for Chum Salmon stocks in southern B.C. and Washington (TCCHUM 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 2020, ten projects were funded by the PST Southern Boundary Restoration and Enhancement Fund (Southern Fund) to carry forward priorities identified by the ChumTC or to further knowledge of Chum Salmon. Project inventory and final reports can be found at the PSC Northern and Southern Fund Projects webpages. Details on select projects involving ChumTC members can be found in Appendix D.

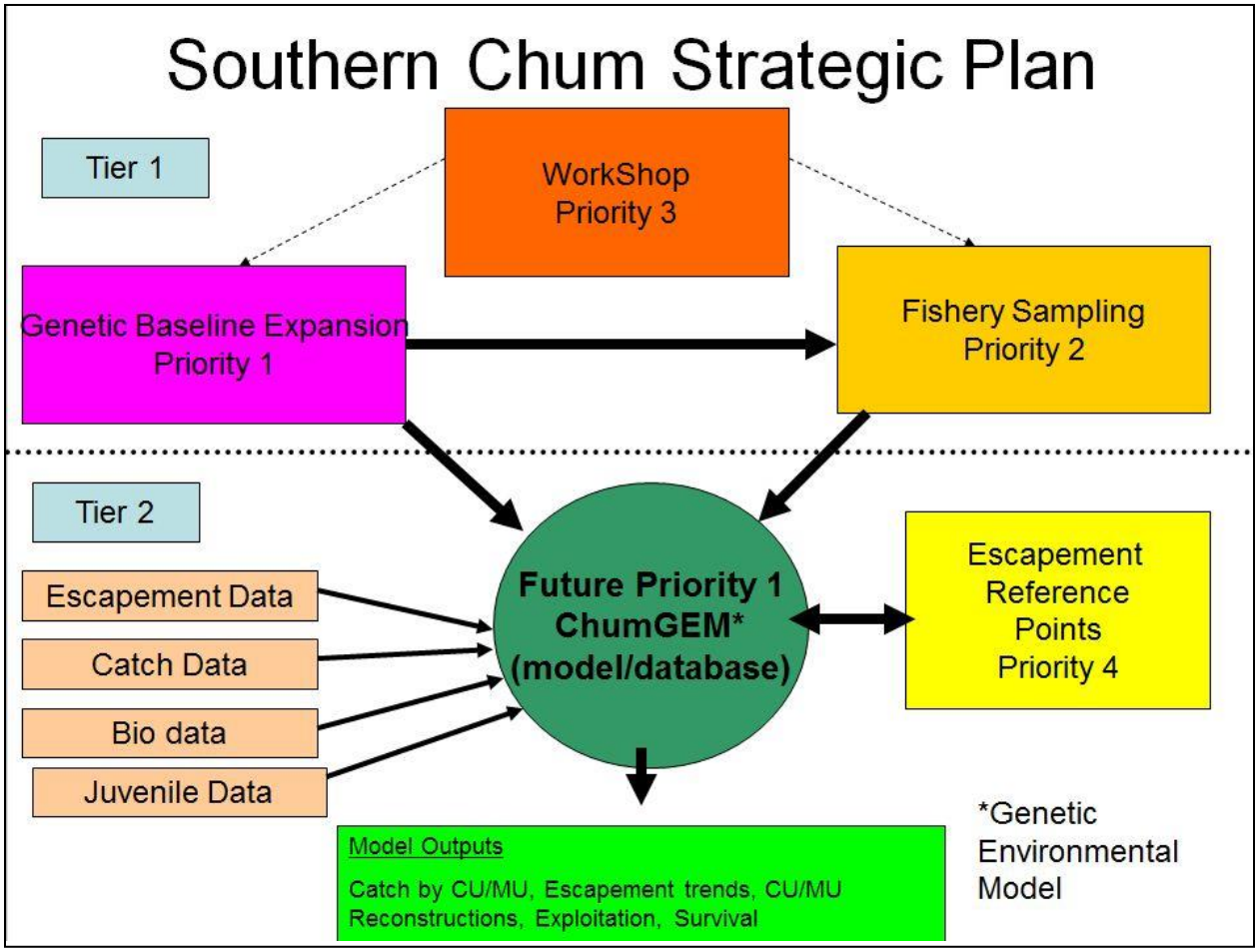

Figure 2-1. Schematic of Southern Chum Salmon Strategic Plan created by the PSC Joint Chum Technical Committee June 1-3, 2011.

Paragraph 2:

> *When the Parties provide stock composition information for fisheries, the Committee shall evaluate and use bilaterally approved methods to report its conclusions.*

For this report, the Committee applied stock composition information obtained through sampling key fisheries during the 2020 season. Where appropriate, historical stock compositions were used for fisheries that were not sampled in 2020.

Paragraph 3:

> *The Parties shall assess catch levels and attempt to collect additional genetic samples from any chum salmon caught between July 1 and September 15 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:

> *From July 1 through September 15, Canada shall 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 (U.S.) shall require the same for the non-Indian seine fisheries in Areas 7 and 7A. 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 shall 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 (2011–2021). Historical GSI results and genetic estimates from 2011 through 2020 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 shall manage its Johnstone Strait mixed stock fishery as follows:*
>
> *a) The Inside Southern Chum run size estimate by Canada of 1.0 million chum is defined as the Inside Southern Chum Critical Threshold. Inside Southern Chum salmon levels of less than this Threshold are considered critical for the purposes of this Chapter;*

b) For run sizes above the Inside Southern Chum Critical Threshold, Canada shall 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 Inside Southern Chum Critical Threshold, Canada shall notify the U.S. and shall only conduct assessment fisheries and non-commercial fisheries. Canada shall suspend the operation of commercial fisheries that target chum salmon in Johnstone Strait.

From the onset of the Johnstone Strait Test Fishing program the Chum Salmon catch per unit effort (CPUE) in the test fishery was well above what was encountered during 2019, which had been the lowest Chum return on record (1980-2019). On October 7th Canada notified the U.S. that the Inside Southern Chum (ISC) index of abundance was estimated to be above the 1.0 million critical level, and Chum Salmon directed fisheries occurred in Johnstone Strait (PFMA 11-13).

Paragraph 7:

Canada shall 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), shall be suspended; and

b) For Fraser River terminal area run sizes, identified in-season at abundance levels greater than 900,000 chum salmon, the 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 2020, in-season abundance estimate indicated a terminal return above the specified Fraser River terminal area run size breakpoint (see section 3.3.3).

Paragraph 8:

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

Due to low Chum return, escapement goals to the Nitinat system were not met in season; therefore, no commercial fisheries were authorized in 2020. The terminal return in 2020 was estimated at 172,264 Chum Salmon which remains below the lower reference point, although an improvement against the 46,000 returns in 2019 (see section 3.3.4.1; Table 3-10).

Paragraph 9:

The U.S. shall manage its chum salmon fishery in Areas 7 and 7A as follows:

a) Inside Southern chum salmon levels of less than the Inside Southern Chum Critical Threshold of 1.0 million as estimated by Canada are considered critical for purposes of this Chapter;

b) For the run sizes below the Inside Southern Chum 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 20,0000. Catches for the purpose of genetic stock identification sampling shall not be included in this limit;

c) For run sizes above the Inside Southern Chum Critical Threshold, the catch ceiling for the U.S. chum salmon fishery in Areas 7 and 7A shall be 125,000 chum salmon, except as provided in sub-paragraph;

d) Canada shall provide a run size estimate of chum salmon entering the Fraser River no later than October 22 of each year. Canada shall notify the U.S. whenever Canada updates the formal Fraser River chum run size estimate if that update results in a change to the U.S. catch ceiling. If the Fraser run size estimate is less than 1,050,000, the U.S. shall 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. If the Fraser River run size estimate is between 1,050,000 and 1,600,000, the U.S. catch ceiling shall be revised to 160,000;

e) U.S. commercial fisheries for chum salmon in Areas 7 and 7A shall not occur prior to October 10 of each year;

f) The U.S. shall manage the Areas 7 and 7A fisheries for chum salmon in order to minimize the harvest of non-target species;

g) U.S. catch shortfalls may not be accrued; however, overages shall be carried forward as indicated in sub-paragraphs (h), (I), and (j);

h) Due to management imprecision:

(i) if the U.S. chum catch ceiling is 125,000, a catch in the U.S. of up to 135,000 chum salmon shall not result in an overage calculation. A catch that exceeds 135,000 shall result in an overage, which is calculated by subtracting 125,000 from the total U.S. chum catch; and

(ii) if the U.S. chum catch ceiling is 160,000, a catch in the U.S. of up to 170,000 shall not result in an overage calculation. A catch that exceeds 170,000 shall result in an overage, which is calculated by subtracting 160,000 from the total U.S. chum catch;

i) Overages under paragraph 9 (h)(I) or 9 (h)(ii) shall be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern chum salmon years;

j) From the day following the date the U.S. is notified of a run size below the Inside Southern Chum Critical Threshold as defined in paragraph 9(a) or below a Fraser River chum run size estimate of 1,050,000, any catch that exceeds 20,000 chum salmon results in an overage. Overages shall be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern chum salmon years;

k) If, subsequent to the revision of the U.S. catch ceiling to 160,000, further in-season run size information changes such that the Fraser River chum run size estimate is revised downward to between 1,050,000 and 1,600,000, the U.S. shall manage their

fisheries in Area 7 and 7A to stay below the catch ceiling of 125,000. If the lower catch ceiling has already been reached, the U.S. shall terminate these fisheries; and

l) In circumstances described in paragraph 9(k), overage calculations shall be based on the highest catch ceiling determined in that season provided the U.S. terminates these fisheries.

In 2020, U.S. fisheries in Areas 7 and 7A were managed in accordance with the above provisions. Initial notification from Canada occurred on October 7, 2020, that the Inside Southern Chum Salmon return was expected to be above the critical threshold of 1.0 million. Following this notification, the U.S. initiated Area 7 and 7A commercial chum fisheries on October 10. Consistent with the Treaty obligations, the estimated Fraser River Chum Salmon terminal run size was provided by Canada on October 22, 2020. This estimate was above the 1,050,000 fish threshold but below the 1,600,000 fish threshold, allowing U.S. chum fisheries in Areas 7 and 7A to continue up to the catch ceiling of 125,000 fish. Areas 7 and 7A therefore remained open to commercial chum fisheries through the remainder of the Chum management period.

Paragraph 10:

The U.S. shall conduct its chum salmon fishery in the Strait of Juan de Fuca (U.S. Areas 4B, 5 and 6C) with a view to maintaining the limited effort nature of this fishery, and, to the extent practicable, not increase interceptions of Canadian origin chum salmon. The U.S. 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 11:

The Parties shall exchange all information concerning non-target catch of other salmon species, including steelhead, from the chum salmon fisheries covered by this Chapter 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 12:

If circumstances arise that are inconsistent with a Party's understanding of the intent of this Chapter, the Southern Panel shall discuss the matter in the post-season and explore options for taking the appropriate corrective action.

No such circumstances arose during 2020.

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 2020, Southern B.C. Chum Salmon fisheries were managed according to the requirements of Annex IV, Chapter 6, as amended on May 3, 2019 (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 2020 (CDFO 2020).

Some of the key objectives of this strategy are to ensure sufficient escapement levels while providing more stable fishing opportunities (CDFO 2020). 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 in Johnstone Strait can be conducted and are planned to not exceed an exploitation rate of 20% on all Inside Southern Chum (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 2020). The impact of the Johnstone Strait fisheries during the last 10 years of the fixed exploitation approach (2011–2020) 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.

On July 11, 2019, the Government of Canada and the Province of BC announced a comprehensive Steelhead Action Plan that contains new conservation measures for Thompson and Chilcotin Steelhead Trout (CDFO 2019). A decision was made to not proceed with an emergency listing of Thompson and Chilcotin (Interior Fraser River or IFR) Steelhead under SARA due to suboptimal ecological, social and economic outcomes relative to a collaborative federal/provincial Action Plan. Based on estimates of migration timing, IFR Steelhead are assumed to be encountered primarily in fisheries targeting southern Chum. A key component of the Action Plan is a series of window closures for fisheries on the approach routes of IFR Steelhead to the spawning grounds in both marine and freshwater fishing areas.

The announcement of these closures precipitated significant changes to the 20% fixed ER strategy for the Johnstone Strait Chum fishery. In 2020, the pre-season commercial fishing plan was modified to maintain opportunity in Johnstone Strait, while ensuring that fishing did not occur within the outlined IFR Steelhead closure times and areas. With the window closures reducing access to the earlier-timed components of the Inside Southern Chum (ISC) run, fisheries were planned at a reduced ER (below the typical 20% ER) (CDFO 2020).

Table 3-1. Aggregate Inside Southern Chum estimates of total return, harvest and spawning escapements. Comparison of fixed target and actual harvest rates in the Johnstone Strait fisheries, 2011–2020[1].

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
PRE-SEASON										
Inside Southern Chum Forecast (or Outlook)	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	Average to Below Average
POST-SEASON										
Inside Southern Abundance[2]	3,468,425	3,735,890	3,225,591	2,384,532	2,917,494	6,473,283	2,470,283	1,662,990	574,018	1,400,397
Inside Southern Harvest	1,423,705	912,053	1,092,206	721,540	1,251,188	2,778,956	1,148,506	364,962	39,301	403,865
Est. Inside Southern Harvest Rate	40.6%	24.6%	34.0%	30.7%	42.5%	42.3%	46.4%	21.9%	6.8%	29.3%
Johnstone Strait Harvest										
Commercial, Sport Area 11-13[3]	750,892	392,981	635,866	332,391	536,983	1,375,476	436,520	75,322	4,728	183,885
First Nations Area 11-13	9,436	12,365	12,919	2,010	22,312	16,788	12,013	1,969	7,702	19,682
Johnstone Strait Harvest Total	760,328	405,346	648,785	334,401	559,295	1,392,264	448,533	77,291	12,430	203,567
Target Johnstone Strait Harvest Rate	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Est. Johnstone Strait Harvest Rate	21.92%	10.85%	20.11%	14.02%	19.17%	21.51%	18.16%	4.65%	2.17%	14.54%
Escapement (Includes wild and enhanced)[4]										
Inside Southern Escapement	2,044,720	2,823,837	2,133,385	1,662,992	1,666,306	3,694,327	1,321,777	1,298,028	534,717	996,532

(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 and recent GSI for 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 PFMAs 14–19) and are of enhanced and wild (natural) origin. Fisheries can target enhanced returns (e.g. Area 14: Puntledge, Big Qualicum and Little Qualicum rivers), wild returns (e.g. Area 16: main river systems of Tzoonie, Deserted and Skwawka rivers in the Jervis inlet area) and mixed returns (e.g. Area 19: directed primarily at enhanced Goldstream River population although some natural Cowichan River Chum Salmon are also harvested).

With one exception, pre-season forecasts of the return of Strait of Georgia Chum Salmon for population aggregates corresponding to PFMAs have limited use due to their inability to reasonably predict returns (CDFO 2020) 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 PFMAs 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 PFMAs 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 2020).

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 2020).

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; and,
- 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 2020).

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 (CDFO 2020).

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. Potential implementation of a weekly assessment fishery with limited fleet size (3-5 vessels) in conjunction with river escapement assessments is being explored but not yet implemented.

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 2020). 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 2020).

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.

Commercial opportunities occur only if in-season observations indicate high probability of meeting the escapement goal. A small TAC fishery is triggered at approx. 40,000 chum past the DIDSON dependent on date. Further commercial opportunities are based on abundance/date triggers as discussed and agreed upon at the Cowichan Harvest Roundtable (CDFO 2020).

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

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

In-season management measures aimed at reducing bycatch mortality (e.g. maximum soak time and daylight fishing only in the gill net fishery) would be implemented after consultation with the Roundtable and the Chum 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 PFMAs; 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 River Coho Salmon and Interior Fraser River Steelhead. To limit incidental impacts on Interior Fraser River Coho Salmon, fishing for salmon with non-selective gear is restricted for all sectors (First Nations, recreational, and commercial) from early September to mid-October within the Fraser River 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 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. Beginning in 2019, a window closure was implemented that restricts commercial fisheries

along the Interior Fraser River Steelhead migration route (including South Coast marine areas) and Fraser River recreational fisheries for 42 days from approximately mid-September to late November. First Nations FSC fisheries in the Fraser River and commercial troll fisheries are restricted by a shorter 27-day window closure; exact dates of the closures vary by area and are detailed in the annual Integrated Fishery Management Plan (CDFO 2020).

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/weeks 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/Tlupana and Esperanza Inlet (Areas 25). Both commercial gill net and purse seine fleets target WCVI Chum Salmon in these Areas.

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

With the exception of near-terminal areas, such as Nitinat (Area 21 and 22) or Tlupana Inlet (Area 25), where hatchery stocks dominate, WCVI Chum Salmon fisheries are currently managed to an exploitation rate of approximately 20% or less. Exploitation is controlled by limiting fishing effort to specific areas, specific times or to a specific number of vessel fishing days per week. Since 2012, revised fishery lower and target reference points (FLRPs and FTRPs) were developed based on the Sustainable Escapement Goal (SEG) method. The SEG approach uses the long-term escapement series to set fishery reference points. Conservative "SEGs" are defined as the 25% and 75% of a long-term escapement time series. Although the WCVI Chum 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 2019).

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

WCVI First Nations FSC fisheries remain a priority and occur in terminal areas targeting individual populations from river systems within or adjacent to band territories. Harvest limits may be set when there are conservation concerns for the target population; however, First Nations FSC fisheries have priority over other fisheries. Generally, harvest and effort in First Nations FSC Chum Salmon fisheries 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 2019). 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 2019). 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 2019). 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. In some years, ESSR fisheries may occur on male Chum Salmon, as high male abundance has limited the ability of the hatchery to achieve brood targets.

3.3 Annual Fishery Summaries

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.

Table 3-4. Estimated harvest of Chum Salmon by PFMA for commercial, research and test fishing vessels[1] during the summer Chum Salmon accounting period (July through the second week of September), 2011–2020.

		PFMA					
Year	Statistical Week	18	19	20	21	29[2]	Total
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	4516	4516
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
2019	7/1–9/2	0	0	0	0	6	6
2020	7/1–9/2	0	0	0	0	0	0
Average		0	0	0	0	739	739

(1) Does not include the Pacific Salmon Commission test fisheries harvest.
(2) Majority of this harvest is terminal marine and likely of Fraser River origin.

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 Southern Chum (ISC) 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 exceptionally strong 2016 return that out-migrated in 2017. Returns of Pink and Coho Salmon in 2018 were below expectations, suggesting survival conditions were poor for the 2017 juvenile emigrants. These poor survival conditions suggested that we would expect average to below average Chum Salmon returns in 2020, despite strong abundance in 2016 and near average returns in 2017. We expected to see typical age contributions to the return, with age 4_1 returns being the dominant age class, followed by 3_1 and 5_1 respectively, reflecting the relative brood abundance for each age class.

The following sections describe the fisheries directed at fall Chum Salmon in each of the Southern B.C. areas in 2020.

3.3.1 Johnstone Strait

The Johnstone Strait test fishery, which ran from September 21 through October 28, provided timing and abundance information for the 2020 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 Chum being over the 1.0 million critical level (requirement for commercial openings).

From the onset of the program the Chum catch per unit effort (CPUE) in the test fishery was well above those observed in 2019, which was the lowest Chum return on record (1980-2019). On October 7th it was determined that the ISC index of abundance was likely above the 1.0 million critical level. In compliance with the Treaty, Canada notified the U.S. that the ISC Chum Aggregate was above the critical threshold, and the U.S. subsequently initiated Area 7 and 7A commercial Chum Salmon fisheries on October 10, which continued through November 10.

The age composition derived from the test fishery and commercial samples exhibited a typical strength of 4_1 fish, but very low prevalence of 5_1 age fish, further supporting poor survival of the 2015 brood. Escapements and catches in 2020 suggested returns were low, but above the ISC critical threshold of 1 million. Table 3-5 outlines the duration and Chum Salmon harvest in fisheries that occurred during the 2020 season.

Commercial Chum fisheries in 2020 were planned as per the Pacific Salmon Treaty, however a modified approach was taken to maintain opportunity in Johnstone Strait while aligning with the intent of the Interior Fraser Steelhead rolling window closure, which was put in place to protect co-migrating stocks of concern. Fisheries are usually scheduled to achieve a 20% fixed exploitation rate (ER) on Inside Southern Chum (ISC) stocks passing through Johnstone Strait with 15% ER for commercial and 5% ER for test, FSC, recreational and a commercial buffer. Shares of the 15% commercial ER are usually shared among the Area B seine (11.55%), Area D gill net (2.55%), and Area H troll fleets (0.9%). With the Steelhead window closure reducing access to a portion of the ISC, the 2019 fisheries were planned pre-season to a reduced commercial ER of 9.83%, shared between the Area B seine (6.54%), Area D gill net (2.27%), and Area H troll (1.01%) fleets.

Chum Salmon directed fisheries occurred in Johnstone Strait (PFMA 11-13), and a total of 203,256 Chum Salmon were harvested in First Nations FSC, Commercial and Recreational fisheries in 2020.

The total 2020 commercial harvest for Johnstone Strait, including test fishery harvest, was 181,315 Chum Salmon (Table 3-5). We estimate a total of 2,255 Chum Salmon were harvested in recreational fisheries in Johnstone Strait (estimated at >400 Chum Salmon; Table 3-5) with little monitoring during the month of October. First Nations FSC harvest was estimated at 19,686 in the Johnstone Strait area (Table 3-5).

Table 3-5. Estimated Chum Salmon harvest from Chum Salmon-directed fisheries occurring in Johnstone Strait by PFMA, 2020.

Gear Type	Area	Fishery Dates		Fishery Duration (hours)	Estimated Harvest
		Start	End		
Purse Seine (Test)	12	Sep. 21	Oct. 28	n/a	32,077
Purse Seine	12	Sockeye / Pink Directed[1]			0
	13				0
	12	Oct. 21	Oct. 22	18	4,792
	13	Oct. 21	Oct. 22	18	76,131
Gill Net	12	Sockeye / Pink Directed[1]			0
	13				0
	12	Oct. 18	Oct. 20	41	38,849
	13	n/a	n/a		0
	12	Oct. 23	Oct. 26	65	3,802
	13	Oct. 23	Oct. 26	65	12,893
Troll [2]	12	Oct. 12	Oct. 31	n/a	0
	13	Oct. 12	Oct. 31	n/a	12,771
Recreational [3]	11/12	Jul.	Aug.	n/a	36
	13	Aug.	Oct.	n/a	2,219
First Nations [3]	12	n/a	n/a	n/a	3,606
	13	n/a	n/a	n/a	16,080
Total					203,256

(1) This is by-catch from Fraser Sockeye & Pink directed fisheries that took place during early September.
(2) The troll fishery was opened from Oct 12 to 31. The fishery was an effort based quota over that time period.
(3) The recreational and First Nation fisheries time periods varied over the season.
(n/a) not applicable.

3.3.2 Strait of Georgia

Conditions for returning Chum migration and spawning in October began with drier conditions followed by significant rainfall. The end of October through mid-November were marked by below average precipitation. River levels were moderate during the peak of migration and spawning providing suitable conditions in most systems.

Returns for the Jervis/Narrows Inlet aggregate (which includes Brittain River, Skwawka River, Deserted River, Vancouver River and Tzoonie River) continued to be poor following several record-low counts in 2018 and 2019. Returns came in consistently below forecast for mid-Vancouver Island systems and escapement targets for some systems were not met. Returns to the Puntledge River numbered 27,675, which was less than the escapement target of 60,000. Final escapements to Big Qualicum and Little Qualicum were much lower than the 2020 forecast, but were twice as high as the 'Like Last Year" model. Compared to the 4yr and 12 year averages, final escapements were less than 1/5 and 1/2 respectively. The Nanaimo River saw 47,556 Chum returning, which exceeded the escapement target of 22,000. Cowichan River escapement was 153,750, below the target of 160K. Goldstream River saw 16,843 adults returning, which was only slightly above the escapement target of 15,000.

Commercial Chum Salmon fisheries occurred in 2020, and a total of 60,827 fish were harvested in purse seine (2,256), gillnet (48,268), and First Nations demo fisheries (10,303).

Recreationally, there was an estimated 15 Chum Salmon harvested in the Strait of Georgia in 2020. The harvest by First Nations in the Strait of Georgia in 2020 was estimated to be 6,477 Chum Salmon (Table 3-6).

The total estimated harvest of Chum Salmon in the Strait of Georgia in 2020 was 67,319.

Table 3-6. Estimated Chum Salmon harvest from fisheries occurring in the Strait of Georgia by PFMA, 2020.

Gear Type	Area	Fishery Dates		Fishery Duration (hours)	Estimated Harvest
		Start	End		
Purse Seine (Test)	18-19	n/a	n/a	n/a	0
Purse Seine	17	Nov. 5	Nov. 16	121	2,256
Gillnet	14	Oct. 14	Oct. 16	50	3,006
	14	Oct. 21	Oct. 23	50	2,693
	14	Oct. 28	Oct. 31	44	1,036
	17	Nov. 4	Nov. 4	11	4,522
	17	Nov. 6	Nov. 16	110	3,588
	29	Nov. 2	Nov. 6	43	33,423
Recreational [1]	14-19, 28, 29 [3]	Sep	Sep	n/a	15
FN Demo [4] (GN & SN)	17	Oct. 14	Oct. 22	unk	4,960
	17	Nov. 5	Nov. 5	unk	93
	18	Oct. 29	Nov. 7	unk	5,250
First Nations FSC [2]	14	n/a	n/a	n/a	2,250
	15	n/a	n/a	n/a	179
	16	n/a	n/a	n/a	0
	17	n/a	n/a	n/a	0
	18	n/a	n/a	n/a	1,800
	19	n/a	n/a	n/a	2,248
	28	n/a	n/a	n/a	0
Total					67,319

(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. Marine Only
(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).
(n/a) not applicable.

3.3.3 Fraser River

Directed Chum Salmon fisheries occur within the Fraser River for all fishery types, 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 River Coho Salmon and Interior Fraser River Steelhead. Depending on the fishery, these measures have included time and area closures, gear restrictions, and release requirements.

The escapement objective for Fraser River Chum Salmon is 800,000 spawners. As described in Section 3.2.3 (*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 16, 2020 was 1,082,000 Chum Salmon. A subsequent in-season estimate of 1,084,000 Chum Salmon was provided on October 22.

First Nations FSC gill net fisheries targeting Chum Salmon were initiated October 24 following a closure period to protect co-migrating Interior Fraser River Coho Salmon and Interior Fraser River Steelhead. These fisheries harvested a total of 28,431 Chum Salmon (Table 3-7). First Nations EO fisheries directed at Chum Salmon occurred from Nov. 1 to Nov. 6, 2020. A total of 6,318 Chum were harvested. In addition, 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 11,382 Chum Salmon deemed to be surplus to spawning requirements (ESSR) were provided to First Nations from various hatchery facilities in 2020. First Nations FSC Chinook-directed fisheries occurring in 2020 had bycatch of Fraser Chum Salmon, harvesting 52 Chum Salmon (Table 3-7).

The total harvest of Chum Salmon in all Fraser River First Nations fisheries (including hatchery ESSR fish) was 46,183 in 2020 (Table 3-7 and Table 3-8).

The major Fraser River watershed recreational salmon fisheries meaningfully impacting Chum Salmon in 2020 include fisheries occurring in the Chilliwack and Stave rivers; both tributaries to the Fraser River in the lower Fraser Valley. Other major fisheries having historically minor impacts on Chum Salmon include fisheries occurring in the lower Fraser River mainstem, the Harrison River and the Nicomen Slough/Norrish Creek system; the latter two 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 2020.

The entire Fraser River mainstem downstream of Alexandria Bridge (approximately 20 km upstream of Yale B.C.) was closed to fishing for salmon from January 1 to November 2, 2020 to protect Fraser River Chinook stocks of concern and Interior Fraser River Steelhead (CDFO 2020). As a result of these measures, the lower Fraser River mainstem was closed to the retention of Chum Salmon by recreational anglers until November 1, 2020 (Table 3-7). Retention of Chum was permitted starting November 2nd in the tidal area of the Fraser River mainstem (i.e. downstream of the Mission Bridge), the daily retention limit was four Chum Salmon for this fishery. Retention of Chum Salmon was permitted staring November 3rd in non-tidal portion the Fraser River mainstem (i.e. upstream of the Mission Bridge), the daily retention limit was two Chum Salmon for this fishery. This retention period is significantly less than previous years.

In 2020, the mainstem recreational fishery was assessed from November 2 to November 30, with resulting catch estimates of 0 Chum Salmon harvested and released (Table 3-9). No assessment took place from December 1 to December 31, 2020. Chum harvest in the Fraser River mainstem recreational fishery has been minimal in recent years (average of 103 Chum harvested annually for 2014-2019; Table 3-9). Low harvest can be primarily attributed to the limited recreational fishery opening described above.

Table 3-7. Estimated harvest of Chum Salmon from salmon fisheries occurring in PFMA 29 (both marine and in-river) and in Region 2 (non-tidal) of the Fraser River, 2020.

Fishery Type	Fishery Description	Target Species	Fishery Dates		Fishery Duration	Assessment Period [1]		Estimated Harvest
			Start	End		Start	End	
Test [2]	Albion	Chinook	19-Apr	20-Oct	158 d	n/a	n/a	977
		Chum	01-Sep	23-Nov	50 d	n/a	n/a	6,150
	Whonnock	Sockeye	23-Jun	08-Sep	78 d	n/a	n/a	6
	Cottonwood	Sockeye	08-Jul	04-Aug	28 d	n/a	n/a	0
	New West.	Coho	18-Sep	20-Oct	6 d	n/a	n/a	16
	Qualark	Mixed	11-Jul	04-Sep	56 d	n/a	n/a	0
Test total								7,133
Commercial [2]	Area E gill net	Sockeye	n/a	n/a	n/a	n/a	n/a	0
		Chum	02-Nov	06-Nov	3 d	n/a	n/a	33,339
	Area B seine	Pink	n/a	n/a	n/a	n/a	n/a	0
		Sockeye	n/a	n/a	n/a	n/a	n/a	0
		Chum	n/a	n/a	n/a	n/a	n/a	0
	Area H troll	Pink	n/a	n/a	n/a	n/a	n/a	0
		Sockeye	n/a	n/a	n/a	n/a	n/a	0
		Chum	n/a	n/a	n/a	n/a	n/a	0
Commercial total								33,339
Recreational [3,4,5]	Fraser River Mainstem (tidal)[7]	Chum & Coho	02-Nov	31-Dec	60 d	02-Nov	30-Nov	0
	Fraser River Mainstem (non-tidal)[7]	Chum & Coho	03-Nov	31-Dec	59 d	ns	ns	ns
	Chilliwack River[8]	Mixed	01-Oct	31-Dec	92 d	01-Sep	30-Nov	6,450
	Nicomen Slough	Mixed	01-Oct	31-Dec	92 d	01-Oct	15-Dec	168
Recreational total								6,618
First Nations [2, 6]	FSC	Mixed	08-Apr	02-Oct	107 d	n/a	n/a	52
		Chum	24-Oct	31-Dec	69 d	n/a	n/a	28,431
	ESSR	Chum	n/a	n/a	n/a	n/a	n/a	11,382
	EO	Pink	n/a	n/a	n/a	n/a	n/a	0
		Sockeye	n/a	n/a	n/a	n/a	n/a	0
		Chum	01-Nov	06-Nov	5 d	n/a	n/a	6,318
First Nations total								46,183
All Sector total								93,273

(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) Fishery Duration represents maximum number of days provided to First Nations; individual First Nations may have fished shorter periods.
(7) For the Fraser River recreational fishery, the tidal portion of the Fraser R. was closed to fishing for salmon from Jan.1 to Nov.1; and the non-tidal portion was closed to fishing for salmon from Jan.1 to Nov.2.
(8) The Chilliwack River was closed to fishing for salmon from Jan.1 to Jun.30; opened to the retention of Coho & Chinook from Jul.1 to Dec.31; closed to the retention of Chum Salmon from Jul.1 to Sep.30 and opened to the retention of Chum from Oct.1 to Dec.31.

Table 3-8. Estimated harvest of Chum Salmon from First Nations, commercial, and test salmon fisheries occurring in PFMA 29 and the Fraser River, 2011–2020.

Year	First Nations FSC	First Nations EO	First Nations ESSR	Commercial Area E GN Area B SN Area H TR	Fraser River Test Fisheries	Total
2011	25,348	4,883	50,067	36,059	3,550	119,907
2012	30,747	102,768	34,593	64,531	13,487	246,126
2013	36,852	107,959	43,176	101,890	15,382	305,259
2014	39,517	100,261	34,638	64,111	12,637	251,164
2015	36,266	122,309	15,692	127,061	10,525	311,853
2016	67,257	146,101	34,724	179,158	12,308	439,548
2017	47,051	111,524	23,106	77,382	10,681	269,744
2018	62,847	1,381	28,510	608	7,710	101,056
2019	15,827	30	2,726	0	3,918	22,501
2020	28,483	6,318	11,382	33,339	7,149	86,671
Average	39,020	70,353	27,861	68,414	9,735	215,383

Table 3-9. Preliminary estimates of Chum Salmon harvest in assessed (i.e., surveyed) lower Fraser River recreational fisheries, 2011–2020.

Year	Fraser River [1]	Chilliwack River	Nicomen Slough/Norrish Creek	Total
2011	32	278	14	324
2012	2,298	4,633	9	6,940
2013	53	2,429	1,016	3,498
2014	344	2,917	15	3,276
2015	123	2,466	45	2,634
2016	34	3,253	8	3,295
2017	145	2,361	63	2,569
2018	25	5,088	2	5,115
2019	0	921	2	923
2020	0	6,450	158	6,608
Average	305	3,080	133	3,518

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

The Chilliwack River recreational fishery was open to the retention of Chum Salmon from October 1 to December 30, 2020 (daily retention limit of 1). This fishery was assessed from September 1 to November 30, 2020; estimates of 6,450 and 14,657 Chum Salmon were harvested and released, respectively (Table 3-7). The estimated Chum Salmon harvest in 2020 for the Chilliwack River was noticeably higher than previous years (Table 3-9). The Chilliwack recreational fishery opened one month earlier than the lower Fraser mainstem fishery: this

combined with the terminal aspect of the Chilliwack River resulted in significantly more Chum encountered in the Chilliwack River recreational fishery.

The Harrison River, Stave River and Nicomen Slough recreational fisheries were open to the retention of Chum Salmon from October 1 to December 31 (daily retention limit of 2 per day). The Nicomen Slough fishery was assessed from October 1 to December 15, 2020. Estimates of 168 and 7,477 Chum Salmon were harvested and released, respectively for this fishery (Table 3-7). Chum Salmon harvest in this fishery was low and similar to harvest in the previous five years (averaged approximately 30 from 2014-2020) but notably less than that estimated in 2013 (Table 3-9). Recreational fisheries occurring in the Harrison and Stave rivers were not assessed in 2020.

In total, for assessed recreational fisheries occurring in the lower Fraser River watershed in 2020, estimates of 6,608 and 22,134 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 River Coho migration period. In recent years, this closure has been extended into late October to provide additional protection to Interior Fraser River Steelhead. As a result, commercial Area E gill net Chum Salmon fisheries have typically occurred during the last week of October and first week of November. In 2020, there were 3 days of commercial fishing directed on Fraser Chum Salmon between Nov. 2 and Nov. 6. Total catch of Chum Salmon in this fishery was 33,339 (Table 3-7 and Table 3-8). There was no bycatch of Chum Salmon in Area 29 commercial fisheries in 2020, as commercial fisheries were not opened for Area B and H fleets in Area 29.

Six test fisheries operated in the Fraser River in 2020: the CDFO-operated Albion Chinook and Chum Salmon gill net test fisheries, the PSC-operated Whonnock and Cottonwood Sockeye Salmon gill net test fisheries, the New Westminster tangle net Lower Fraser Coho assessment fishery, and the Qualark species composition gill net test fishery.

In 2020, the Albion Chinook Salmon test fishery operated from April 19 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 160 fishing days, totaled 369 and harvest in the Albion Chum Salmon test fishery, representing 50 days, totaled 7,127 Chum Salmon (Table 3-7).

The PSC Whonnock Sockeye Salmon test fishery operated for 78 days from June 23 through September 8, and harvested 6 Chum Salmon. The PSC Cottonwood Sockeye Salmon test fishery fished for 28 days from July 8 through August 4, and harvested 0 Chum Salmon (Table 3-7).

New for 2020, the New Westminster Lower Fraser Coho assessment fishery operated for 6 days between September 18 and October 20, and harvested 16 Chum Salmon.

The Qualark species composition test fishery operated for 56 days between July 11 and September 4, and harvested 0 Chum Salmon.

In total, an estimated 7,133 Chum Salmon were harvested in all test fisheries occurring in the Fraser River in 2020 (Table 3-7 and Table 3-8).

3.3.4 West Coast Vancouver Island

The estimated total harvest of Chum Salmon in 2020 WCVI commercial fisheries was 9,036. A limited-entry commercial fishery in Nootka Sound (Area 25) harvested an estimated 6,059 Chum Salmon and a fishery in Kyuquot Sound (Area 26) harvested an estimated 2,977 Chum Salmon.

First Nations FSC harvest of Chum Salmon occurred in all WCVI areas and totaled 2,080 for 2020.

3.3.4.1 Nitinat

In 2020, the pre-season forecast for Nitinat Chum was of 92,541. This forecast was below the target escapement, and no fisheries in either Area E gill net or Area B seine fisheries were permitted. Due to ongoing declines in Interior Fraser River (IFR) Steelhead escapement, and the recent designation of the Thompson and Chilcotin River Steelhead as Endangered by COSEWIC, DFO implemented a precautionary approach to the management of those fisheries in southern BC that are likely to impact this stock of concern. In Areas 21 and 121, a fishing window closure was in place from September 11 to October 22 to address IFR Steelhead bycatch concerns. Following the window closure, fisheries may occur within a two mile boundary of the shore line between Bonilla Point and Pachena Point.

No commercial fisheries were authorized in 2020. The terminal return in 2020 was estimated at 172,264 Chum Salmon, which is below the targeted escapement but a dramatic improvement over 2019 returns (46,000, Table 3-10).

First Nations FSC (Area 21/22) and hatchery broodstock of Chum Salmon in 2020 totaled 47,576 Chum Salmon (Table 3-10).

Table 3-10. Nitinat area[1] Chum Salmon harvest, hatchery broodstock collection and spawning escapement estimates by PFMA, 2011–2020.

Year	PFMA 21		PFMA 22	
	Seine Harvest	Gill Net Harvest	In-lake Harvest & Broodstock	Natural Spawners
2011	65,469	211,968	136,641	248,655
2012	97	23,219	75,816	206,704
2013	0	15,730	25,800	25,066
2014	0	0	56,069	125,500
2015	58,580	110,535	93,177	240,000
2016	269,042	137,591	145,179	445,000
2017	0	36,051	62,229	99,000
2018	0	11,467	54,363	83,794
2019	0	0	18,500	27,500
2020	NFO[2]	NFO[2]	47,576	124,688
Average	134,922	57,152	71,535	162,597

(1) Includes Nitinat tributaries.
(2) No fishery occurred

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 man-made channel (e.g. controlled spawning channel), and does not include salmon used for broodstock.

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

3.4.1 Inside Southern

The stocks that are managed within the context of the Inside Southern Chum (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 2010, are presented in Table 3-11.

Table 3-11. Inside Southern Chum Salmon net escapement estimates (spawning escapement plus hatchery broodstock) for Fraser and non-Fraser stock aggregates, 2011–2020[1].

Year	Inside Southern Chum Salmon Escapement		
	Fraser River	Non-Fraser River [1]	Total
2011	1,115,873	928,847	2,044,720
2012	1,523,901	1,299,936	2,823,837
2013	979,906	1,153,479	2,133,385
2014	1,141,803	521,189	1,662,992
2015	985,248	681,058	1,666,306
2016	1,988,604	1,705,767	3,694,371
2017	665,119	656,754	1,321,873
2018	706,948	591,134	1,298,082
2019	316,507	218,231	534,738
2020	553,359	443,298	996,657
Average	997,727	819,969	1,817,696

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

The primary enhanced escapement areas for ISC Salmon are presently limited to the mid-Vancouver Island, Squamish River, Burrard Inlet and Fraser River areas. The enhancement facilities in the mid-Vancouver Island consist of Big Qualicum, Little Qualicum and Puntledge rivers Hatcheries. There is one enhancement facility in the Burrard Inlet (Capilano River Hatchery: limited Chum Salmon hatchery production), and the Squamish watershed (Tenderfoot Creek Hatchery) and four in the Fraser River watershed (Inch Creek, Chilliwack River, and Chehalis River Hatcheries and Weaver Creek Spawning Channel). Enhancement on the Capilano River is opportunistic, only using Chum Salmon that return to the hatchery facility for broodstock.

3.4.2 West Coast Vancouver Island

In 2020, Nitinat Chum Salmon spawning escapement was estimated at 124,688 (Table 3-10) which is a decline over the 2016 brood year (445,000) 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[1] by PFMA, 2011–2020.

Year	WCVI Pacific Fishery Management Area			
	PFMA 23 (Barkley)	PFMA 24 (Clayoquot)	PFMA 25 [2] (Nootka)	PFMA 26 (Kyuquot)
2011	121,692	149,164	93,600	125,489
2012	40,419	42,276	49,148	49,433
2013	35,302	44,174	69,877	79,312
2014	12,475	36,878	51,476	40,630
2015	32,559	32,342	106,921	82,277
2016	101,006	31,051	191,259	88,676
2017	12,864	30,125	46,758	27,273
2018	6,439	25,468	85,677	20,346
2019	9,221	14,205	38,206	24,872
2020	38,960	19,991	63,040	23,836
Averages	41,094	42,567	68,611	38,114

(1) Index system spawning escapements expanded to total spawning escapement for the PFMA.
(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 2020 Strait of Juan de Fuca summer Chum Salmon post-season run size of 3,937 was 208% of the pre-season forecast and 52% of the 2011–2019 average post season run size (Table 4-1). The Hood Canal summer Chum Salmon post-season run size of 8,752 was 99% of the pre-season forecast and about 30% of the 2011–2019 average post-season run size (Table 4-1). Approximately 99.2% 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 2020 was 24,362, which was about 110% of the pre-season forecast and 80% of the 2011-2019 average post-season run size (Table 4-1).

Table 4-1. Puget Sound summer Chum Salmon pre- and post-season estimates of run size and spawning escapements, 2011-2020.

Year	Strait of Juan de Fuca			Hood Canal			South Puget Sound [1]		
	Pre-Season	Post-Season	Escapement	Pre-Season	Post-Season	Escapement	Pre-Season	Post-Season	Escapement
2011	5,308	5,705	5,675	9,050	7,170	6,914	62,623	39,823	38,515
2012	5,915	6,337	6,304	8,970	31,134	29,855	41,889	38,936	24,521
2013	6,603	14,801	14,727	19,798	24,325	22,618	53,492	38,332	35,444
2014	9,041	8,179	7,811	31,400	30,408	27,396	59,940	25,317	20,593
2015	7,105	15,599	15,532	22,526	36,055	32,644	57,987	32,570	32,521
2016	7,105	9,089	9,077	22,526	52,753	47,966	86,254	19,294	19,068
2017	11,094	2,119	2,113	34,188	59,850	55,655	33,716	38,798	37,372
2018	2,309	1,586	1,567	17,034	13,308	12,868	25,178	25,995	25,358
2019	1,684	4,834	4,830	10,315	7,590	7,582	28,420	16,208	14,769
2020	1,894	3,937	3,933	8,858	8,752	8,649	22,073	24,362	23,323
Averages	5,806	7,219	7,157	18,466	27,134	25,215	47,157	29,964	27,148

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

4.1.2 Fall and Winter Chum Salmon

The combined Puget Sound fall Chum Salmon post-season run size estimate was 510,655 fish, or 58% of the pre-season forecast and approximately 36% of the 2011−2019 average post-season run size.

Regional post-season numbers varied in their deviation from the forecasted numbers, ranging from 200% of the pre-season forecast in the Strait of Juan de Fuca, to 32% of the pre-season forecast in Hood Canal (Table 4-2).

The Puget Sound winter Chum Salmon 2020 post-season run size assessment was 14,734, which was approximately 46% of the pre-season forecast and 33% of the 2011–2019 average post-season run size (Table 4-2).

Table 4-2. Washington fall and winter Chum Salmon pre- and post-season estimates of run size and spawning escapements, 2011–2020.

Year	Strait of Juan de Fuca			Nooksack/ Samish		
	Pre-Season	Post-Season	Escapement	Pre-Season	Post-Season	Escapement
2011	1,618	4,839	4,707	31,924	152,176	100,748
2012	1,203	3,174	2,973	34,739	39,100	21,703
2013	813	1,468	1,394	52,585	68,176	48,506
2014	4,285	2,045	1,952	59,908	95,440	60,058
2015	4,673	3,076	2,958	180,759	112,704	68,690
2016	3,240	2,920	2,805	89,207	109,824	60,573
2017	2,061	447	435	109,337	45,023	26,429
2018	2,309	1,118	1,054	163,114	24,576	18,970
2019	1,684	843	794	115,653	24,162	17,636
2020	1,506	3,006	2,837	26,594	49,155	41,450
Averages	2,339	2,294	2,191	86,382	72,034	46,476

Year	Skagit			Stillaguamish/ Snohomish		
	Pre-Season	Post-Season	Escapement	Pre-Season	Post-Season	Escapement
2011	26,834	15,850	15,494	71,277	61,598	60,792
2012	59,167	41,601	36,601	86,598	40,003	35,450
2013	15,325	9,786	8,554	48,884	35,145	30,317
2014	16,505	65,734	63,013	87,476	64,272	51,599
2015	47,292	8,155	7,964	168,104	13,669	8,169
2016	45,449	35,388	33,797	32,905	27,372	24,434
2017	6,966	7,107	6,750	26,516	23,656	20,060
2018	124,295	19,557	18,718	132,580	29,226	27,448
2019	84,270	3,406	3,197	80,461	5,336	5,025
2020	17,680	14,875	13,779	46,914	35,665	33,664
Averages	44,378	22,146	20,787	78,172	33,594	29,696

Table 4-2. continued…

Year	Central/South Puget Sound			Hood Canal		
	Pre-Season	Post-Season	Escapement	Pre-Season	Post-Season	Escapement
2011	487,514	548,484	179,094	352,019	610,507	102,374
2012	323,928	611,657	190,817	426,675	684,643	91,940
2013	349,623	597,762	186,457	323,597	1,427,350	240,169
2014	465,970	589,869	200,660	442,308	691,862	105,192
2015	377,032	503,531	160,260	394,246	809,162	146,004
2016	526,060	401,462	167,561	489,698	777,359	179,118
2017	433,196	584,264	179,797	492,892	1,071,179	193,760
2018	543,637	480,953	191,425	432,980	722,332	238,583
2019	449,345	163,566	83,718	389,129	222,543	28,363
2020	309,573	256,442	176,723	471,810	151,512	43,153
Averages	426,588	473,799	171,651	421,535	716,845	136,866

Year	South Puget Sound Winter		
	Pre-Season	Post-Season	Escapement
2011	55,923	121,079	74,110
2012	51,599	25,522	18,987
2013	61,113	34,839	21,754
2014	84,263	59,672	46,587
2015	45,170	20,043	19,600
2016	47,053	20,043	19,600
2017	36,696	67,988	60,420
2018	82,144	43,501	37,127
2019	35,608	4,106	2,955
2020	32,063	14,734	14,734
Averages	53,163	41,153	31,587

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 during the July 1 through September 15 time period in boundary area fisheries. Table 4-3 provides Chum Salmon harvest totals during this accounting period for U.S. boundary area fisheries in Puget Sound Salmon Management and Catch Reporting Areas (Catch Areas or Areas, Appendix B-1) 4B, 5, 6C, 7 and 7A.

Table 4-3. Harvest of Chum Salmon in U.S. Catch Areas (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 2011–2020.

Year	Strait of Juan de Fuca			San Juan Islands		Total
	Area 4B	Area 5	Area 6C	Area 7	Area 7A	
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	39	84
2018	0	186	0	7	16	209
2019	0	0	0	4	14	18
2020	0	0	0	0	0	0
Average	17	43	0	86	56	201

Table 4-4. Harvest of summer, fall, and winter Chum Salmon in U.S. Catch Areas (Areas) in the Strait of Juan de Fuca (SJF), San Juan Islands and Point Roberts (SJI/PR), and Puget Sound, 2011–2020.

Year	Region		
	SJF (Areas 4B, 5, 6C)	SJI/PR (Areas 7, 7A)	Puget Sound [1]
2011	1,865	70,359	989,986
2012	476	73,236	1,064,532
2013	1,200	80,472	1,644,328
2014	3,700	147,022	1,011,660
2015	6,858	124,791	1,037,455
2016	25,807	118,461	846,808
2017	3,426	123,282	1,282,595
2018	4,579	66,444	781,237
2019	376	612	283,526
2020	205	87,483	183,203
Averages	291	44,048	233,365

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

Table 4-4 provides Chum Salmon harvest totals from the Strait of Juan de Fuca (SJF) fisheries in Catch Areas 4B, 5, and 6C and the San Juan Islands/Point Roberts (SJI/PR) fisheries in Catch Areas 7 and 7A as well as annual Chum Salmon harvest totals for the other areas of Puget Sound.

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

4.2.1 Management Intent

During the 2020 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 2011–2020 (Table 4-4). Effort and harvest over this period 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 U.S. Catch Areas 4B, 5 and 6C was restricted to Treaty Indian fishers using gill nets. The 2020 Treaty Chum Salmon fishery opened the week of October 11, with a schedule of six days per week and continued through November 14. A total of 205 Chum Salmon was harvested in this fishery, and there was a reported bycatch of 1,326 Coho salmon, one Chinook salmon, and zero Steelhead.

In Catch Areas 4B, 5, and 6C, the incidental harvest of Chum Salmon prior to the Chum Salmon-directed fishing season was below the recent ten-year average. Zero Chum Salmon were harvested during the summer Chum Salmon accounting period (July 1–September 15). During the subsequent Coho salmon-directed fishery, 5 Chum Salmon were harvested.

The total 2020 Chum Salmon catch by all gears (including recreational) in the SJF was 205 Chum Salmon (Table 4-4).

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

4.3.1 Management Intent

Chum salmon fisheries in Catch Areas 7 and 7A are regulated to comply with a base harvest ceiling of 125,000 Chum salmon, unless Canada estimates Chum stocks migrating through Johnstone Strait (“Inside Southern Chum Salmon”) are below the critical threshold of 1.0 million (PST 2019). Chapter 6 of Annex IV specifies that U.S. commercial fisheries for Chum salmon in Catch Areas 7 and 7A will not occur prior to October 10. Paragraph 9 (a) specifies run sizes below 1.0 million as critical (estimated by Canada). For Inside Southern Chum run sizes below the critical threshold, Paragraph 10 (b) states the U.S. catch of Chum Salmon in Catch Areas 7 and 7A will be limited to those taken incidentally to other species and in other minor fisheries, and shall not exceed 20,000.

4.3.2 Fishery Description

On October 7, 2020 Canada notified the U.S. that the Inside Southern Chum Salmon aggregate was estimated to be above the critical threshold of 1.0 million. and the U.S. Following this notification, the U.S. initiated Area 7 and 7A commercial chum fisheries on October 10, which continued through November 10.

Paragraph 9 (d) states that Canada will provide an in-season estimate of Fraser River Chum salmon run size no later than October 22. If that estimate is below 1,050,000, then the U.S. will limit its fishery in Areas 7 and 7A to not exceed a catch of 20,000 additional Chum salmon from the day following notification. On October 22, 2020, Canada notified the U.S. that the Fraser River chum run size was estimated to be 1,084,000. This estimate was above the 1,050,000 fish threshold but below the 1,600,000 fish threshold, allowing U.S. chum fisheries in Areas 7 and 7A to continue up to the catch ceiling of 125,000 fish. Areas 7 and 7A therefore remained open to commercial chum fisheries through the remainder of the Chum management period.

Chum Salmon catch by reef nets in Coho Salmon-directed fisheries between October 1 and October 10 was 164 fish (Table 4-5). The combined U.S. commercial catch in Areas 7 and 7A for all gear types was 87,483 Chum Salmon (Table 4-4). There were no Chum Salmon harvested in recreational fisheries in Areas 6, 7 and 7A during 2020.

Although Catch Area 6 is not mentioned in the Chum Salmon Annex, and harvests from this boundary area do not count against the U.S. harvest ceiling, it is worth noting that no Chum Salmon were harvested from Area 6 in 2020.

Table 4-5. Harvest of Chum Salmon in U.S. Catch Areas (Areas) 6, 7 and 7A Coho Salmon fisheries, 2020.

Catch Area	Gill Net	Purse Seine	Reef Net
6	0	0	0
7	0	0	164
7A	0	0	0
Total	0	0	164

Table 4-6. Harvest of Chinook salmon, Coho salmon and Steelhead in U.S. Catch Areas (Areas) 6, 7 and 7A in Chum Salmon directed fisheries (October 1-November 13, 2020).

Catch Area	Chinook	Coho	Steelhead
6	0	0	0
7	18	3,265	0
7A	3	1,101	0
Total	21	4,366	0

In 2020, there was a reported bycatch of 21 Chinook Salmon, 4,366 Coho Salmon and zero Steelhead in Area 7 and 7A in Chum Salmon directed fisheries between October 1 and November 13 (Table 4-6).

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 2020.

5.2 Otolith Thermal Marking, Fin Marking and Coded-Wire Tagging of Juvenile Chum Salmon

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).

A second hatchery on the West Coast of Vancouver Island, Conuma River Hatchery, first began thermally marking otoliths for several populations of Chum Salmon beginning with the 1998 broodyear. This continued in 2020 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.

A new Chum Salmon recovery program had been initiated on the Nimpkish River which included thermal marking of various release groups for future evaluation of release strategies. Small numbers of native stock were initially marked for the 2017 brood (Table 5-1). In subsequent brood years (2018-2020) large egg transfers from the Puntledge River were reared and released from the Namgis First Nation Gwa'ni Hatchery (formerly Nimpkish River Hatchery) with unique thermal marks (brood years 2018, 2019, 2020)

Table 5-1. Releases of Chum Salmon with thermally-marked otoliths from CDFO hatchery facilities[1], 2011–2020.

Brood Year	Hatchery Facility Release Sites										
	Conuma River Hatchery						Namgis First Nation Gwa'ni Hatchery			Nitinat River Hatchery	
	Canton Creek	Canton Creek Estuary	Conuma River	Conuma River Estuary	Sucwoa River	Tlupana River	Alder Bay	Alert Bay	Lower Nimpkish River	Nitinat Lake	Nitinat River
2011	365,682	0	0	1,270,286	223,882	37,241	0	0	0	22,615,891	2,687,395
2012	116,757	0	0	785,682	41,196	813,957	0	0	0	11,431,145	4,381,886
2013	1,009,478	0	0	1,705,633	269,435	820,612	0	0	0	5,312,356	4,426,086
2014	200,646	0	410,214	1,467,870	0	0	0	0	0	7,047,082	10,720,439
2015	576,649	0	534,334	723,867	0	452,375	0	0	0	7,988,837	10,247,463
2016	0	835,191	424,032	1,932,540	0	1,027,846	0	0	174,204	12,794,613	13,648,692
2017	203,990	0	471,129	1,624,825	213,343	580,356	5,082	0	8,974	7,894,803	
2018	511,748	0	563,431	1,679,255	610,249	1,120,443	0	970,995	852,252	7,959,304	8,553,682
2019	465,434	0	491,912	1,477,237	497,567	408,084	0	0	1,584,751	2,858,639	2,271,251
2020	473,481	0	518,251	1,581,815	515,159	156,565	0	955,250	1,291,073	6,492,802	5,971,186
Average [2]	435,985	835,191	487,615	1,424,901	338,690	601,942	5,082	963,123	782,251	9,239,547	6,989,787

(1) CDFO hatchery facilities relevant to the Treaty.
(2) Average of the years with thermally-marked otolith releases.

In the past, enhanced contributions of Chum Salmon from major hatchery facilities were also based on marking a portion of the fry released with a variety of fin clips. Not all hatchery 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. A summary of fin clip (or mark) combinations applied in brood years prior to 2016 for hatchery Chum Salmon can be found in previous ChumTC reports.

There were no coded-wire tagged Chum Salmon released from Canadian facilities during the 2011–2020 time period.

5.2.2 United States

Historically, hatchery supplementation was used to enhance 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 thermal marking (Volk *et al.* 1987) ceased for hatchery supplementation and re-introduction programs for summer Chum Salmon in the Strait of Juan de Fuca and Hood Canal (Table 5-2) but continued for some fall Chum Salmon in Hood Canal, Puget Sound and the Lower Columbia River (Table 5-3). 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 5-2. Numbers of summer Chum Salmon released in river systems within the Strait of Juan de Fuca (SJF) and Hood Canal with thermally-marked otoliths, 2011–2020.

Brood year	Summer Chum	
	Lilliwaup	Tahuya
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	-	-
2019	-	-
2020	-	-

Table 5-3. Numbers of fall Chum Salmon released in river systems within Hood Canal, Puget Sound with thermally-marked otoliths, 2011–2020.

Brood year	Hood Canal		Puget Sound					
	Union River	Skokomish River	Elwha River	Tulalip Bay	Kendall Creek	Terrell Creek	Whatcom Creek	Skykomish River
2011	0	0	0	0	0	0	1,360,000	0
2012	0	0	0	0	0	0	1,547,900	0
2013	0	0	450,000	40,000	650,895	85,000	3,048,000	0
2014	0	0	450,000	8,000,000	1,094,383	1,000,000	2,283,000	0
2015	0	0	450,000	8,000,000	1,000,000	0	2,000,000	0
2016	0	0	450,000	8,000,000	1,000,000	0	2,000,000	0
2017	0	0	450,000	8,000,000	1,000,000	0	2,000,000	0
2018	0	11,996,785	450,000	8,000,000	1,000,000	0	2,000,000	0
2019	35,000	0	450,000	8,000,000	2,000,000	0	2,000,000	41,532
2020	0	0	450,000	8,000,000	5,000,000	0	2,000,000	0

5.3 Genetic Stock Identification

In 2010, the Committee completed a joint recommendation to the Southern Panel concerning the type of genetic stock identification (GSI) methodology to be used for immediate and future application of Canada and United States Chum Salmon stock assessment (TCCHUM 2013). 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, east coast of Vancouver Island, 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

In 2020, supplementation work continued on the joint bilateral (DFO and WDFW) SNP baseline, though in a reduced capacity due to significant impacts of the COVID-19 pandemic.

The commercial seine fishery opened in Johnstone Strait (PFMA 12-13) and east coast Vancouver Island (PFMA 14-18) opened commercial gillnet and seine fisheries in 2020 (Table 5-4). 2020 results for Southern Fund reporting purposes include samples collected in 2019 (due to low sample numbers in 2019; Candy *et al.* 2021).

Table 5-4. Chum Salmon tissue samples collected and analyzed from Johnstone Strait (PFMAs 12-13), east coast of Vancouver Island (PFMAs 14-17), and Juan de Fuca (PFMA 20/US Areas 5, 6) from commercial and test fisheries 2010-2020.

Year	Commercial Samples				Test Fishery Samples			
	Areas 14-18		Areas 12-13		Areas 12		Area 20/Areas 5-6	
	Collected	Analyzed	Collected	Analyzed	Collected	Analyzed	Collected	Analyzed
2011	101	101	865	863	1,404	905	na	na
2012	307	307	987	935	1,275	1,261	na	na
2013	na	na	1,185	973	1,311	1,291	na	na
2014	na	na	1,087	990	1,369	1,342	na	na
2015	na	na	1,348	982	1,395	1,326	na	na
2016	na	na	1,425	1,231	1,350	1,341	1,025	1,025
2017	633	574	1,323	988	1,415	1,381	1,538	1,534
2018	224	224	600	499	1,473	1,436	1,656	1,619
2019	na	na	na	na	1,274	1,266	643	639
2020	879	802	603	580	1,070	1,063	1,137	896

5.3.1.2 United States

Limited mixed-stock fishery GSI sampling efforts occurred in U.S. Chum Salmon fisheries in 2020. Very limited Chum Salmon fisheries occurred in Catch Areas 10 and 11, while no Chum Salmon samples were collected from the fishery in U.S. Catch Areas 7 and 7A. Samples were collected in U.S. Catch Area 9 from Chum Salmon in the test fishery, as well as from the commercial fishery (Table 5-5).

Table 5-5. Chum Salmon tissue samples from U.S. Catch Areas (Areas) 7, 7A, 9, and 10/11 analyzed for GSI in 2011–2020.

Year	Area 7	Area 7A	Area 9			Area 10	Area 11
	Commercial		Test	Commercial	Research	Commercial	
2011	0	0	527	0	366	0	
2012	1,328	829	493	0	50	0	
2013	419	423	692	0	961	0	
2014	121	285	877	0	504	0	
2015	196	123	732	0	357	0	
2016	784	336	718	288	0	0	
2017	921	415	749	450	0	1,447	
2018	70	348	809	593	933	730	
2019	0	0	0	0	0	672	
2020	0	0	868	320	0	0	

5.3.2 Baseline Collection for Genetic Stock Identification

In 2020 researchers in Canada and US continued to collect baseline samples to support the development phase of the Chum Salmon SNP panel with funding from the Southern Endowment Fund. The Chum Salmon SNP panel aims to allow researchers to genotype samples and generate compatible data across labs for submission to a common Chum Salmon genetic database.

5.3.2.1 Canada

In 2020, CDFO continued to supplement the baseline with samples from Southern British Columbia Chum Salmon populations (Table 5-6). This work aimed to support collections with underperforming genetic delineation. The CDFO Molecular Genetics Section continues to expand the southern B.C. baseline SNP panel in collaboration with the WDFW lab.

Table 5-6. Fall Chum Salmon GSI tissue collections from Southern B.C. by Conservation Unit, collection site, life stage, and influence of enhancement, 2020

Conservation Unit	Collection Site	Life Stage	Enhancement Level [1]	Sample Size
Georgia Strait	Cowichan River	Adult	Mixed	71
Georgia Strait	Englishman River	Adult	Natural	83
Georgia Strait	Hyacinthe Creek	Adult	Natural	94
Georgia Strait	Nanaimo River	Adult	Mixed	95
Lower Fraser	Chilliwack River	Adult	Mixed	14

(1) Enhancement level refers to the degree to which the CDFO Committee members believed hatchery production contributed to the returns to the collection site at the time of the collection. 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

A Southern Boundary Restoration and Enhancement Fund project was undertaken to address two Southern Panel priorities: genetic stock identification (GSI) sampling of Chum salmon and developing the Chum salmon Single Nucleotide Polymorphism (SNP) genetic baseline (Small *et al.* 2022). Because of low salmon returns and COVID related sampling issues, the project was extended six months. In 2020, the project added ten key Chum salmon populations to the SNP baseline and augmented five other key Chum salmon populations in the baseline (Table 5-7) to improve baseline representation of Puget Sound Chum salmon population. The objective of this work was to improve representation of North Puget Sound Chum salmon populations and hatchery broodstocks in the bilateral Chum SNP baseline by adding or supplementing (bringing representation up to 95 samples) up to 15 populations. During 2020, six collections were added and four populations were supplemented. However, researchers were unable to collect samples from five other populations in 2020 due to poor returns and COVID safety restrictions.

Table 5-7. List of collections genotyped with 350 SNPs in 2020 to expand the Southern Boundary Chum Salmon SNP baseline.

Regional Grouping	Collection Name	Number of Samples Added	WDFW Collection Code
North Puget Sound	Tulalip Hatchery	135	20NO
North Puget Sound	lower Sauk River	30	19QN
North Puget Sound	Marblemount Hatchery (upper Skagit River)	136	20LM
North Puget Sound	Snohomish (Skykomish River)	67	19NH
North Puget Sound	Stillaguamish River	84	20HX, 20NX
South Puget Sound-Winters	South Prairie Creek Winter (Puyallup River)	62	11KT
Hood Canal-Falls	Spencer Creek	68	20NF
Hood Canal-Falls	Jackson Creek	19	20NH
Hood Canal-Falls	Vance Creek	61	20NJ
Central Puget Sound-Falls	Keta Creek Hatchery (Green River)	88	20NC

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APPENDICES

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

Southern British Columbia and Washington State Chum Salmon

This Chapter shall apply to the period from 2019 through 2028.

1. The Parties shall establish and maintain a Joint Chum Technical Committee (the "Committee"). The Committee shall report, unless the Parties otherwise decide, to the Southern Panel and the Commission. The Committee shall, inter alia:
   (a) maintain and present to the Panel historical catch and escapement information for stocks referred to in this Chapter;
   (b) use available information to estimate and document stock composition and exploitation rates in fisheries referred to in this Chapter;
   (c) annually review the Parties' assessment of stock status and fisheries activities for chum fisheries referred to in this Chapter;
   (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 or when requested by the Panel;
      (i) exchange available information on the productivity and escapement requirements of stocks referred to in this this Chapter,
      (ii) identify and document stocks of concern (with respect to conservation) referred to in this Chapter,
      (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 use bilaterally approved methods to report its conclusions.
3. The Parties shall assess catch levels and attempt to collect additional genetic samples from any chum salmon caught between July 1 and September 15 in the boundary area fisheries (U.S. Areas 4B, 5, 6C, 7, and 7A; Canadian Areas 18, 19, 20, 21, and 29).
4. From July 1 to September 15, Canada shall 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 (U.S.) shall require the same for the non-Indian seine fisheries in Areas 7 and 7A. By U.S. regulation, purse seine fisheries are not permitted in U.S. Areas 4B, 5, or 6C.
5. Canada shall 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 shall be managed to minimize the interception of non-targeted stocks.
6. Canada shall manage its Johnstone Strait mixed stock fishery as follows:
   (a) The Inside Southern Chum run size estimate by Canada of 1.0 million chum is defined as the Inside Southern Chum Critical Threshold. Inside Southern Chum salmon levels of less than this Threshold are considered critical for the purposes of this Chapter;

(b) For run sizes above the Inside Southern Chum Critical Threshold, Canada shall 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 Inside Southern Chum Critical Threshold, Canada shall notify the U.S. and shall only conduct assessment fisheries and non-commercial fisheries. Canada shall suspend the operation of commercial fisheries that target chum salmon in Johnstone Strait.

7. Canada shall 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), shall be suspended; and

(b) For Fraser River terminal area run sizes, identified in-season at abundance levels greater than 900,000 chum salmon, the 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 shall manage the Nitinat gill net and purse seine fisheries for chum salmon to minimize the harvest of non-targeted stocks.

9. The U.S. shall manage its chum salmon fishery in Areas 7 and 7A as follows:

(a) Inside Southern chum salmon levels of less than the Inside Southern Chum Critical Threshold of 1.0 million as estimated by Canada are considered critical for purposes of this Chapter;

(b) For the run sizes below the Inside Southern Chum 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. Catches for the purpose of genetic stock identification sampling shall not be included in this limit;

(c) For run sizes above the Inside Southern Chum Critical Threshold, the catch ceiling for the U.S. chum salmon fishery in Areas 7 and 7A shall be 125,000 chum salmon, except as provided in sub-paragraph (d);

(d) Canada shall provide a run size estimate of chum salmon entering the Fraser River no later than October 22 of each year. Canada shall notify the U.S. whenever Canada updates the formal Fraser River chum run size estimate if that update results in a change to the U.S. catch ceiling. If the Fraser run size estimate is less than 1,050,000, the U. S. shall 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. If the Fraser River run size estimate is between 1,050,000 and 1,600,000, the U.S catch ceiling shall remain at 125,000. If the Fraser River run size estimate is above 1,600,000, the U.S. catch ceiling shall be revised to 160,000;

(e) U.S. commercial fisheries for chum salmon in Areas 7 and 7A shall not occur prior to October 10 of each year;

(f) The U. S. shall manage the Areas 7 and 7A fisheries for chum salmon in order to minimize the harvest of non-target species;

(g) U.S. catch shortfalls may not be accrued; however, overages shall be carried forward as indicated in sub-paragraphs (h), (i), and (j);

(h) Due to management imprecision:

(i) if the U.S. chum catch ceiling is 125,000, a catch in the U.S. of up to 135,000 chum salmon shall not result in an overage calculation. A catch that exceeds 135,000 shall result in an overage, which is calculated by subtracting 125,000 from the total U.S. chum catch; and

(ii) if the U.S. chum catch ceiling is 160,000, a catch in the U.S. of up to170,000 shall not result in an overage calculation. A catch that exceeds170,000 shall result in an overage, which is calculated by subtracting 160,000 from the total U.S. chum catch;

(i) Overages under paragraph 9 (h)(i) or 9 (h)(ii) shall be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern chum salmon years;

(j) From the day following the date the U.S. is notified of a run size below the Inside Southern Chum Critical Threshold as defined in paragraph 9(a) or below a Fraser River chum run size estimate of 1,050,000, any catch that exceeds 20,000 chum salmon results in an overage. Overages shall be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern chum salmon years;

(k) If, subsequent to the revision of the U.S. catch ceiling to 160,000, further in-season run size information changes such that the Fraser River chum run size estimate is revised downward to between 1,050,000 and 1,600,000, the U.S. shall manage their fisheries in Area 7 and 7A to stay below the catch ceiling of 125,000. If the lower catch ceiling has already been reached, the U.S. shall terminate these fisheries; and

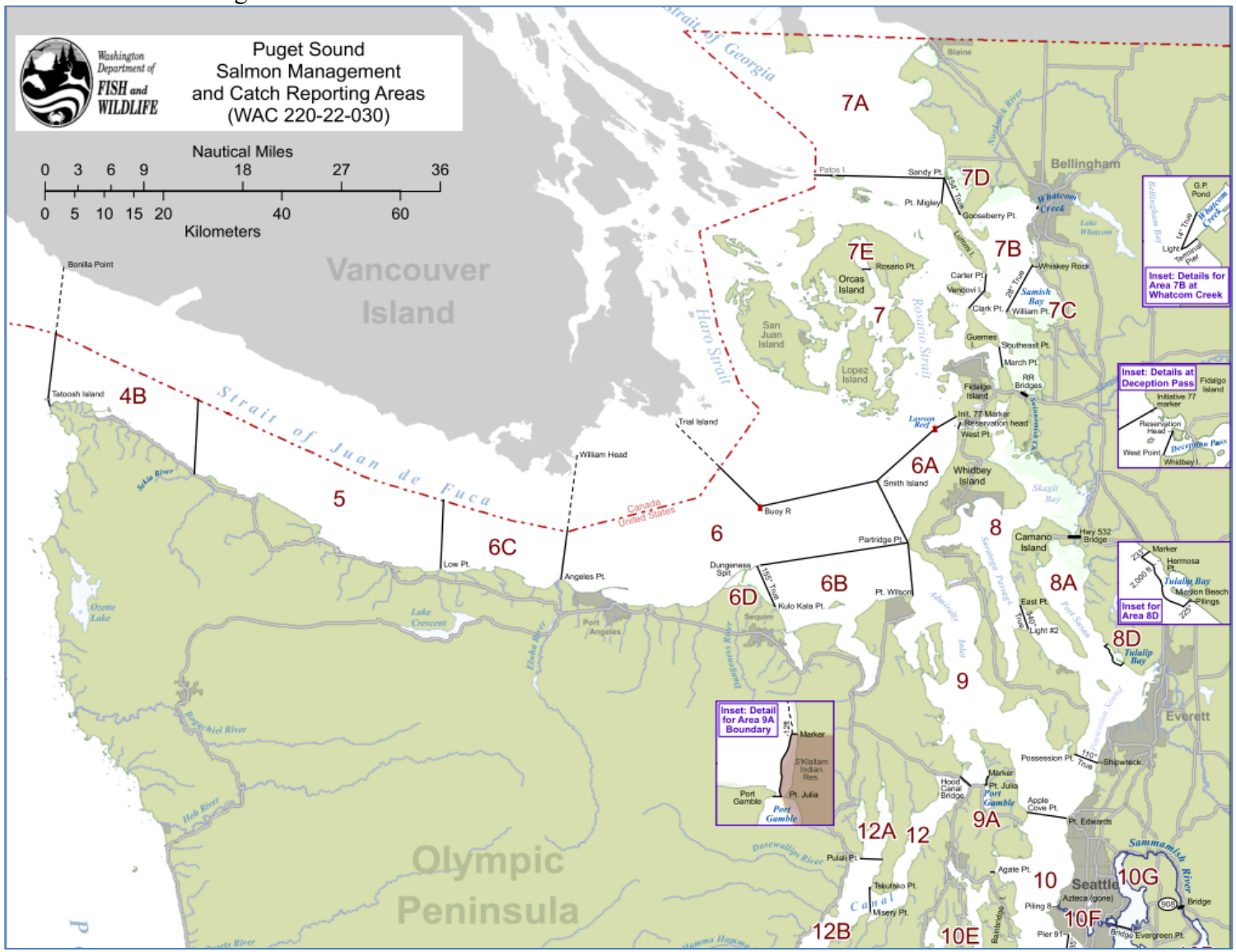
(l) In the circumstances described in paragraph 9(k), overage calculations shall be based on the highest catch ceiling determined in that season provided the U.S. terminates these fisheries.

10. The U.S. shall conduct its chum salmon fishery in the Strait of Juan de Fuca (U.S. Areas 4B, 5 and 6C) with a view to maintaining the limited effort nature of this fishery, and, to the extent practicable, not increase interceptions of Canadian origin chum salmon. The U.S. shall continue to monitor this fishery to determine if recent catch levels indicate an increasing level of interception.

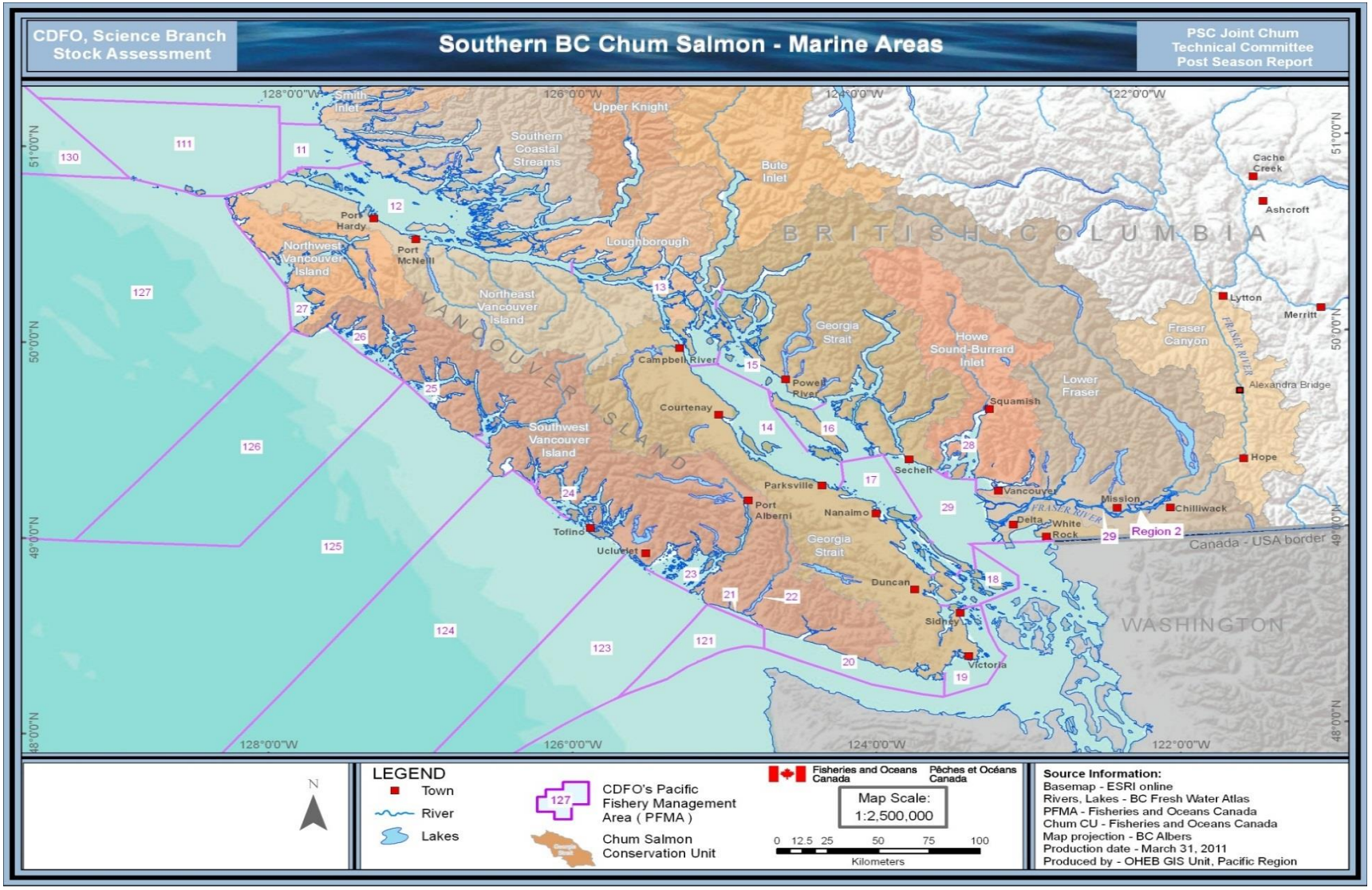
11. The Parties shall exchange all information concerning non-target catch of other salmon species, including steelhead, from the chum salmon fisheries covered by this Chapter in the annual post-season report.

12. If circumstances arise that are inconsistent with a Party's understanding of the intent of this Chapter, the Southern Panel shall discuss the matter in the post-season and explore options for taking the appropriate corrective action.

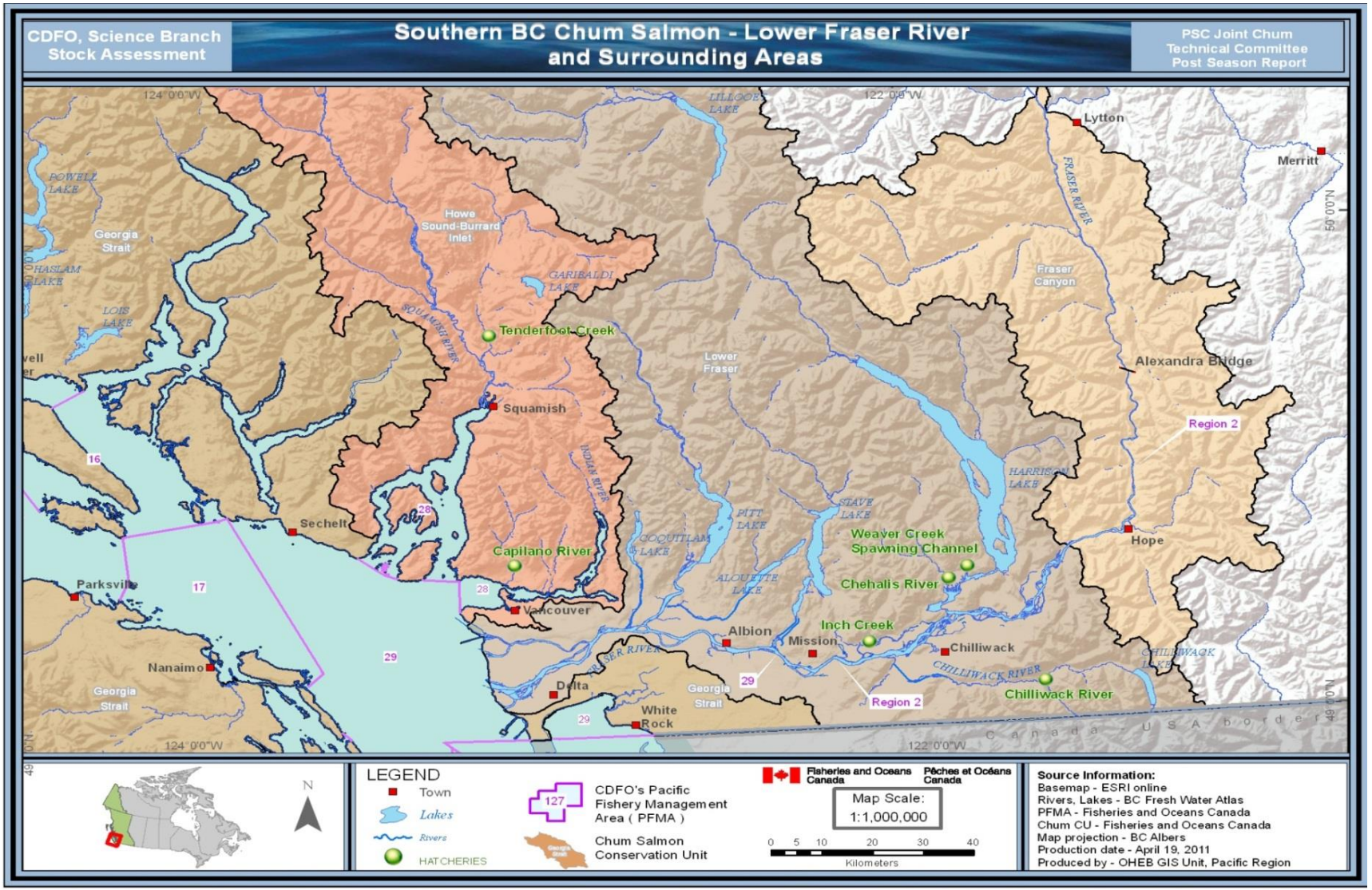
Appendix B-1. United States Puget Sound Salmon Management and Catch Reporting Areas for the Strait of Juan de Fuca and Northern Puget Sound.



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



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



Appendix C. PSC Work Plan for the Joint Chum Technical Committee, 2020.

PACIFIC SALMON COMMISSION WORK PLAN [2020-2021]

Panel / Committee

The Joint Chum Salmon Technical Committee reports to the Southern Panel.

Update on Bi-lateral Tasks Assigned Under Current PSC Agreement

The following list includes updates on the status of ongoing tasks from previous work plans, as well as descriptions of bilateral tasks planned for 2020-21:

- Finalize report covering 2017 fisheries and research as a principal focus during the PSC meetings in January 2020; Initiate 2018 report at the meeting in February 2021;
- Review and discuss preliminary post-season 2020 fisheries information
- Review and update the ChumTC Strategic Plan
- To provide updates on any status of approved 2020 SEF projects: Four Chum Salmon projects were conducted in 2020:
    - Sampling program in the Strait of Juan de Fuca (Year 5),
    - Puget Sound Chum salmon GSI (Year 2)
    - Chum Salmon Baseline and GSI in Southern Boundary Region (Year 1)
    - Fraser River Chum Salmon Spawning Ground Survey Life Study (Year 2)
- Work on 2020 reports associated with SEF projects for later submission;
- Review of SEF priorities and ensure projects are ready for implementation should funding materialize; and
- 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.

Obstacles to Completing above Bi-lateral Tasks

While support from the Southern Endowment Fund has facilitated our efforts to implement the ChumTC strategic plan, time constraints for committee members remain a challenge for 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 identified at this time.

Potential Issues for Committee on Scientific Cooperation

None identified at this time.

Proposed Meeting Dates and Draft Agendas

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

- January 11-15, 2021 – PSC Post Season Meeting (Virtual):
    - Review and discuss preliminary post-season 2020 fisheries information
    - Collate and review report items for 2018 final post-season report
    - Continue work on Southern Chum 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
    - Review and discuss research and analysis activities essential to the Committee tasks
    - Review Chum Strategic Plan and update
    - Provide any bilateral analyses, as requested by the Southern Panel.

- February 8-12, 2021 – PSC Annual Meeting (Virtual):
    - Continue work on 2018 annual report.
    - Update on SEF projects from 2020 and news regarding 2021 submissions
    - Update on ChumGEM progress since the January meetings
    - Update on Chum Baseline GIS project
    - Review Strategic Plan document
    - Continue work on tasks not completed at the January meeting
    - Initiate the development new SEF priorities document for 2022 call
    - Review list of Chum GSI collections which could be analyzed from different sampling programs
    - Initiate assignments for the 2019 annual report
    - Assign workgroups and workgroup tasks for items still pending at the end of the February meeting
    - May Meeting Plan
- May 12-13, 2021 – PSC Chum TC Spring Meeting (Virtual):
    - ChumGEM updates and review
    - Complete the 2018 report and move on 2019 assign tasks
    - Update on Chum Baseline GIS project
    - Look to finalize Strategic Plan Document
    - Diversion discussion (Sockeye world) and options with current programs

Status of Technical or Annual Reports

The Committee anticipates having the 2017 Annual Report complete at the May 2020 ChumTC meeting. The Committee anticipates having the 2018 Annual Report complete by the end of the February meeting in 2020.

Appendix D. Pacific Salmon Commission Southern Boundary Restoration and Enhancement Fund Projects supported by the Chum Technical Committee in 2020.

Project Title: SF-2020-SP-4 Joint US and CA Juan de Fuca Chum Sampling Program 2020 (Van Will *et al.* 2021)

The project plan for 2020, the fifth year of the project, was very similar to previous years. Once approvals were obtained for clearance to fish in both US and Canadian waters, the vessel Nita Maria was chartered to fish based on a 4-day-per-week schedule (2 days in Canadian waters and 2 days in US waters) for a 6-week period starting the 1st week of October 2020. 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 populations.

The program began as planned on September 29th and ran until November 6th. A total of 129 sets were completed (70 in Canadian waters and 59 in US waters). A total of 4,302 Chum were encountered and 1,794 were sampled for stock id and other biologicals. The Catch per Unit Effort (CPUE) was stronger in general on the Canadian side, similar to what was seen in 2017 and 2018. The catch information demonstrated a peak timing on the Canadian side of the Strait during week 43. Timing on the US side is problematic in 2020 as scheduling and weather issues during week 43 on the US side resulted in insufficient sampling. Over the period of the program, Chum CPUE was always higher in in Canadian waters than in US waters.

Stock composition information demonstrated that Canadian Chum stocks dominated the samples throughout the 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.

Weekly target sample sizes were generally achieved in Canadian waters up until the last week of the program when Chum CPUEs dropped off. In US waters lower CPUE was encountered throughout the season and weekly sample targets were only achieved in weeks 41 and 42. It is hoped that with additional years of Chum CPUE data from this Southern approach (through Juan de Fuca) it will help to improve the existing relationship between Chum CPUE and abundance that exists for the Northern Approach (through Johnstone Strait).

Project Title: SF-2020-SP-5 Puget Sound Chum Salmon Genetic Stock Identification (Litz *et al.* 2021)

This project addressed two Southern Panel priorities: genetic stock identification (GSI) sampling of Chum salmon and developing the Chum salmon Single Nucleotide Polymorphism (SNP) genetic baseline. The project identified fall-, winter-, and summer-run Chum salmon population contributions to mixed fisheries in the commercial Chum salmon fishery in US Marine Areas 10 and 11. In year one, the project added six key Chum salmon populations to the SNP baseline and augmented four other key Chum salmon populations to improve baseline representation of Puget Sound Chum salmon populations. This baseline was also used to mixed-stock fishery analysis of Area 10/11 fisheries from 2017 and 2018. In this year 2 report, we applied the baseline to the Area 10/11 fishery in 2019. The baseline identified a single Canadian-origin fish and no Hood Canal summer-run Chum salmon. The South Puget Sound and the Hood Canal falls were the largest and second largest components, respectively, and the South Puget Sound winters were a distant third component at less than 1% of the fishery, all from Diru Hatchery.

Project Title: SF-2020-SP-9 Chum Salmon Baseline and GSI in the Southern Boundary Region (Year 1). (Small *et al.* 2022).

This project addressed two Southern Panel priorities: genetic stock identification (GSI) sampling of Chum salmon and developing the Chum salmon Single Nucleotide Polymorphism (SNP) genetic baseline. The project identified fall-, winter-, and summer-run Chum salmon population contributions to mixed fisheries in the Chum salmon fishery in US Marine Area 9. Because of low salmon returns and COVID-related sampling issues, the project was extended six months. The project added ten key Chum salmon populations to the SNP baseline and augmented five other key Chum salmon populations in the baseline to improve baseline representation of Puget Sound Chum salmon populations. We applied the baseline to estimate the composition of the Area 9 fishery. The fishery was composed of primarily Hood Canal and South Puget Sound fall-run Chum salmon (45% and 36%, respectively). The Central and North Puget Sound falls were the third and fourth largest components (12% and 3%, respectively). Less than 1% of the fish were identified as South Puget Sound winters, Hood Canal summers or Chum salmon originating in Canadian rivers.

Project Title: SF-2020-SP-20 Fraser River Chum Salmon Spawning Ground Survey Life Study, 2020 (Year 2) (McKay *et al.* 2023)

Area-Under-the-Curve (AUC) methods are commonly employed to estimate escapements of Chum Salmon (Oncorhynchus keta) in the Fraser River watershed. One requirement for an accurate AUC estimate is a value for Survey Life (SL), the number of days a fish is alive on the spawning grounds and observable to surveyors. Currently, a region-wide SL value of 10 days is used for Fraser River Chum AUC estimates, but this may not be representative of true SL values for Fraser Chum – a PSC SEF-funded study in 2019 showed SL values closer to 7 days for Fraser Chum. In the fall of 2020, daily surveys of five streams in the Lower Fraser Watershed were conducted during the Chum Salmon spawning season. Data collected included number of live and dead Chum Salmon observed each day. In one system a fish fence was used to collect live adults and apply coloured Peterson disc tags, and fish with coloured tags were counted separately during daily surveys. Three different methods were used to calculate SL values for the surveyed streams: Area-Under-Tag-Depletion-Curve (Method A: estimated SL 8.7 ± 2.6 days), comparison of peak live and peak dead counts (Method B: estimated SL 6.4 ± 3.0 days), and average difference between equivalent proportions of cumulative live and cumulative dead count dates (Method C, estimated SL 7.5 ± 2.9 days). All three methods suggest a SL that is lower than the current 10 day survey life value used for Lower Fraser Chum Salmon, and that survey life can vary significantly between systems. Additionally, each method for calculating SL presented its own challenges and uncertainty. While method A is robust it is also more intensive, requiring the resources to apply tags to live salmon as they enter the study area: for this reason it was used only on a single stream system. Method B is fairly unreliable as it requires many subjective decisions to calculate SL. Method C appears to provide a robust estimate and a more readily accessible method to apply to field projects. It is recommended that this study continue for a total of four seasons to observe SL variability across several Chum Salmon generations.