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CERTIFICATION UNIT PROFILE:
FRASER RIVER CHUM SALMON

by

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ABSTRACT

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This profile includes information about stock status, management reference points, management approach for fisheries in the area, assessment programs, and specific conservation measures.

RÉSUMÉ

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Le présent profil comprend des données sur l'état des stocks, les points de référence pour la gestion, l'approche de gestion pour les pêches dans la région, les programmes d'évaluation et les mesures de conservation particulières.

PREFACE

MSC Ecocertification

Ecocertification is intended to link market incentives to the sustainability of fisheries, and a rapidly growing body of academic work is exploring the theoretical aspects of certification. However, substantial challenges remain in the practical implementation of certification programs, particularly in terms of transparency and consistency across different fisheries, species, and regions.

The Marine Stewardship Council (MSC) has developed a comprehensive and thoroughly documented certification process, with sufficient flexibility in the details to allow for adaptation to different settings. A standardized set of assessment criteria was recently released (www.msc.org).

This Document

This Certification Unit Profile (CUP) for Fraser River chum salmon includes information about stock status, management reference points, management approach for fisheries in the area, assessment programs, and specific conservation measures.

CUPs are available for all of the pink and chum certification units identified for ecocertification by the Marine Stewardship Council (MSC): North Coast and Central Coast chum salmon, West Coast Vancouver Island chum salmon, Inner South Coast chum salmon (excluding Fraser chum), Fraser chum salmon, North Coast and Central Coast pink salmon, Inner South Coast pink salmon (excluding Fraser pink), and Fraser pink salmon.

A more general *Pink & Chum Management Summary* is also available. The management summary describes laws and policies, the structure of the management system, coast-wide conservation and recovery measures, as well as processes for collaboration and public consultation.

This CUP captures the official DFO position expressed in published materials, through staff interviews, and in written staff contributions. Almost all of the information contained in this document has been previously distributed to the public by DFO. Some of the text in this CUP is directly carried over from the earlier BC sockeye submissions, the departmental response to the draft assessment of BC sockeye, the 2008 IFMP, the Wild Salmon Policy, DFO websites, and DFO draft reports. Any material copied verbatim from sources other than these is put into “quotes”. Where possible, cited material is followed by a web link to the source or a catalogue number for DFO’s online library WAVES, which can be accessed at <http://inter01.dfo-mpo.gc.ca/waves2/index.html>.

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1 INTRODUCTION

1.1 Stocks covered in this document

This profile covers all chum salmon spawning in statistical area 29, which includes the Fraser River mainstem and Fraser River tributaries. The major chum stocks, accounting for about 90% of the chum production on the Fraser, originate from the Harrison/Chehalis/Weaver watershed, the Chilliwack/Vedder watershed, and Stave watershed.

This profile also briefly describes chum salmon that spawn in other watersheds in the Fraser approach areas (i.e. statistical area 28), with a substantial run originating from the Indian River in Burrard Inlet, as well as several persistent populations in Howe Sound and on the Sunshine Coast.

1.2 Fisheries covered in this document

This profile covers commercial, First Nations, and recreational fisheries harvesting chum salmon in the Lower Fraser and approach areas.

Commercial fisheries occur in Canadian Statistical 20 (Juan de Fuca), Area 29 (Fraser) and United States Statistical Areas 4B, 5, 6C and 7 and 7A.

First Nations harvest local chum stocks throughout the Fraser River and its tributaries in food, social and ceremonial (FSC) fisheries and in economic opportunity fisheries. Long-term harvest patterns depend on the local abundance of all salmon species, and annual chum catches depend on in-season assessments of actual stock strength, management measures taken to ensure conservation of individual stocks, and targeted fishing effort by First Nations.

Recreational fisheries occur in the Fraser River mainstem and tributaries, with angler effort concentrated on the mainstem, Harrison River, and Chilliwack River.

Fraser chum are also intercepted in major mixed-stock fisheries in the Strait of Georgia and Johnstone Strait, which are covered in the profile for Inner South Coast Chum Profile (excluding Fraser) .

2 BACKGROUND AND STOCK OBJECTIVES

2.1 Life history

2.1.1 Stock units

2.1.1.1 Definition of stock units for Fraser River chum salmon

Populations of BC salmon are organized into a hierarchy of biological units: Natal streams, watershed aggregates, run-timing aggregates, statistical area and management sub-area aggregates, and Conservation Units (CU).

Different components of the management system focus on different levels within this hierarchy. The basic planning units for fisheries are watershed aggregates (e.g. for setting escapement targets), but in-season implementation operates at the level of statistical areas and sub-areas (e.g. area closures to reduce incidental harvest of weak stocks). Stock assessment collects data at the level of natal streams and watershed aggregates. Conservation strategies under the *Wild Salmon Policy* emphasize the preservation of conservation units and their component populations.

Section 2.2.2 of the *Pink & Chum Management Summary* includes more information about each of these biological units and how they are used in the management system.

The Fraser River is home to the largest run of chum salmon (*Oncorhynchus keta*) in British Columbia with total escapement averaging over 2 million over the most recent decade, and a peak escapement of 3.4 million in 1998. Spawning occurs in the lower Fraser (i.e. Fraser Canyon downstream to the Fraser River outlet). Although approximately 110 spawning streams are utilized by chum salmon, major tributaries are responsible for 90% of the total Fraser chum production, with the largest stocks originating in the Harrison/Chehalis/Weaver, Chilliwack/Vedder, and Stave watersheds (Table 1).

Fraser chum are first intercepted in the mixed stock fisheries that occur in the Johnstone Strait, Strait of Georgia and Juan de Fuca Strait as they migrate back to their spawning grounds. All chum that migrate through these waters are managed as a single management unit: the Inner South Coast (ISC) chum stock. ISC chum return to spawn in the Fraser, Johnstone Strait and Strait of Georgia (DFO Science 1999). ISC chum stocks are divided into two timing groups, summer run and fall run. Fraser chum are fall run stocks that migrate from September to December.

When chum reach the Fraser River they are intercepted by commercial, First Nations and recreational fisheries in the approach areas and in the Fraser River. In this area, the management unit is the Fraser aggregate, with an escapement goal of 800,000).

Table 1 summarizes the population structure of Fraser chum salmon by grouping individual spawning sites according to management area, statistical area, and conservation unit. Sites with recent escapements surveys are clearly identified, as are systems with active hatchery enhancement. Complete records of escapement data and detailed maps for each statistical area are available through the Annacis DFO office.

2.1.1.2 Conservation units for Fraser River chum salmon

The *Wild Salmon Policy* (DFO 2005) formally expresses many years of conceptual and practical development in the department's management of Pacific salmon. It serves as a crucial platform for

launching and coordinating comprehensive planning processes for the long-term conservation and sustainability of wild Pacific salmon.

The WSP maps out 4 key elements:

- Identifying irreplaceable groupings of salmon stocks, called Conservation Units (CU), formally defined as “*a group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to recolonize naturally within an acceptable timeframe*” (DFO 2005). Populations within a CU are assumed to experience similar survival conditions and fishery management actions are taken to address conservation of the entire CU, with the objective of ensuring spawner abundance is distributed across populations within the area.
- Identifying upper and lower benchmarks to monitor the status of each CU. The lower benchmark will be established at a level of abundance high enough to ensure there is a substantial buffer between it and any level of abundance that could lead to a CU being considered at risk of extinction by COSEWIC. The upper benchmark will be established to identify whether harvests are greater or less than the level expected to provide, on an average annual basis, the maximum annual catch for a CU, given existing environmental conditions (DFO 2005).
- Assessing habitat and ecosystem status of conservation units
- Implementing a public process for establishing strategic plans that cover all Conservation Units and identify resource management actions required to address declines in status of CUs, habitat and ecosystems.

Section 3.2.2 of the *2009 Pink and Chum Management Summary* summarizes the intent, development, and regional implementation of the *Wild Salmon Policy*, including the development of status benchmarks for each CU. Formal evaluations of CU status have not been completed, but there have been regular status assessments of Fraser chum salmon (Section 5.1).

Holtby and Ciruna (2007) developed a comprehensive approach for identifying conservation units of anadromous Pacific salmon, based on a combination of the ecological context, the life history of each population, and genetic populations structure. To identify CUs for each species, they applied the following considerations in sequence:

- Map out *Joint Adaptive Zones (JAZ)* based on a combination of freshwater characteristics and marine characteristics.
- Within each each JAZ, species were further divided into conservation units based on differences in life history, spawning time, and other ecological characteristics.

Holtby and Ciruna (2007) identify two conservation units for Fraser chum salmon based on their evolutionary lineage, life history, productivity, and ocean migrations:

- *Fraser Canyon*
- *Lower Fraser*

Total chum escapements and index escapements to assess population trends are evaluated within these two CUs. Populations within a CU are assumed to experience similar survival conditions. Fishery management actions are taken to address conservation of the entire CU, with the objective of ensuring spawner abundance is distributed across populations within the area.

Table 1 lists the management areas and spawning sites for each of these conservation units. A complete and up-to-date list of sites for each Conservation Unit (CU) is available at http://www-comm.pac.dfo-mpo.gc.ca/pages/consultations/wsp/CUs_e.htm.

Non-Fraser chum salmon in the approach area are grouped with the *Howe Sound-Burrard Inlet* CU or the *Georgia Strait* CU.

Holtby and Ciruna (2007) also document the defining characteristics for each conservation unit:

- Chapter 6 summarizes the distribution, life history, ecotypes, and genetic population structure of chum salmon.
- Figure 17 (p. 155) shows locations with records of chum salmon.
- Table 10 (p. 156) summarizes presence, relative abundance, and genetic population structure of chum salmon in each of the *Joint Adaptive Zones*.
- Table 18 (p. 188) summarizes classification criteria for chum salmon CUs, shown in Figure 27 (p. 187).
- Appendix 1 summarizes the zoological, geographic, and physical characteristics of each *Freshwater Adaptive Zone* (e.g. salmon species, other fish fauna, major drainages, geology, hydrology, temperatures)

2.1.1.3 Indicator Stocks

Indicator stocks are not used in the Fraser watershed.

2.1.1.4 Agreement on stock units

Extensive research has been completed to identify the population structure of BC chum salmon. The analyses were peer-reviewed and accepted through the PSARC process, which includes scientists from outside the management agency, and some have been published in peer-reviewed journals:

- Genetic studies (Beacham et al., 1985; Seeb & Crane, 1999) suggest two lineages of North American chum, likely resulting from isolation in separate northern and southern refugia (Bering & Columbia refuges) during the last glaciation. All Fraser chum are from the southern lineage.
- Beacham et al. (2008) assess the stock structure of BC chum salmon using microsatellite DNA, which they found to be more informative than other DNA-based methods such as allozymes. The study identifies 16 regional stocks based on 14 microsatellites. The Fraser River is one of these regional stocks, although genetic differentiation between the Fraser River and the east coast of Vancouver Island was modest.
- Holtby and Ciruna (2007) document the multi-criteria approach used to delineate conservation units under the Wild Salmon Policy. Their Appendix 8 lists the consultations conducted to develop the initial list of conservation units. Up-to-date materials for continuing public consultations on the definition of conservation units for BC chum salmon are available at http://www-comm.pac.dfo-mpo.gc.ca/pages/consultations/wsp/CUs_e.htm.
- Since 2002, Fraser chum have been managed as single aggregate (one timing group) given the lack of evidence in recent years of bi-modal run timing in the Albion test fishery. Evidence for bi-modality of run timing was observed historically only in the Cottonwood test fishery and from run

timing into individual systems, however, this characteristic has never been detected in the Albion test catches from which in-season run size estimates are derived.

2.1.2 Stock characteristics

2.1.2.1 Abundance and distribution

Chum salmon are distributed widely in the north Pacific, with BC populations mostly found north of 50°N latitude and east of 175°W longitude (Salo, 1991).

The Fraser River supports the largest chum stock aggregate in British Columbia with total escapement averaging 1.3 million (1990-2001), and a peak of 3.4 million in 1998. In the Fraser River, they occur in the Fraser Canyon, downstream to the Fraser outlet spawning both in the mainstem and tributaries.

2.1.2.2 Age / size / fecundity

Chum return to spawn in natal streams after two to five winters at sea (Salo 1991). Using the Gilbert-Rich age designation system, Fraser chum range in age from 3₁ to 6₁ with the greatest proportion of chum being 4₁. Fraser River chum ages have been assessed across all stocks in the Albion test fishery with average age distribution from 2003 to 2007 as follows: 80% 4₁, 11% 5₁, and 6% 3₁; a negligible number of 6₁ fish were also identified in this fishery. Age composition may vary considerably from year to year; for example the age 3 component was reported at 3.3% in 1973 and at 53.7% in 1975. Age composition for Harrison River (1991-2006) chum on average has been 74.3% 4₁, 10.2% 5₁, and 15.2% 3₁; a negligible number of 6₁ fish have also been identified.

Chum are the second largest Pacific salmon species, with an average fork length of about 70 cm and average weight roughly 5 kg for WCVI stocks (Salo, 1991). Fraser chum assessed in the Albion test fishery from 2003 to 2007 averaged 59.6 cm and 5.1 kg. Harrison River chum on average were 63.1 cm (1991-2006).

Chum eggs are large relative to other Pacific salmon, with fecundities of between about two and three thousand eggs per female, depending on size (40 – 45 eggs per cm of fork length; Salo 1991).

The egg to fry survival of Fraser chum is influenced largely by fluctuations in environmental conditions, particularly rainfall and water temperature. By comparison, fry to adult survival may be related to competition for resources and predation during the marine stages (and to a lesser extent during the short period of freshwater rearing).

2.1.2.3 Migration timing

Fraser River chum fry emerge from the gravel as early as February and migrate downstream primarily March and April. Unlike most other species of Pacific salmon, chum salmon rear in the Strait of Georgia for up to six months prior to migrating to the North Pacific Ocean (Sweeting, personal communication). The majority of juvenile chum salmon tend to exit the Strait of Georgia through Johnstone Strait en-route to offshore waters and the Gulf of Alaska. In their first year in the North Pacific, chum are primarily located along the coast of North America and into the Gulf of Alaska (Salo 1991).

Adult return migrations are of considerable distance and most Fraser chum migrate through the Johnstone Strait and to a lesser extent the Juan de Fuca Strait. The estimated adult migration timing through Johnstone Strait begins in early September, peaks in October and continues until late November. This timing is somewhat truncated compared to observed migration timing in the past when

catches were observed into December. Tagging studies conducted in 2000, 2001 and 2002 have shown that the time interval between tagging of adult Fraser chum in Johnstone Strait and their recovery at the Fraser mouth averaged 22 days; however this period could include an estuarial delay of up to several weeks. More recent studies indicate that passage from the top end to the bottom end of Johnstone Strait takes approximately 7 days.

Chum adults enter the lower Fraser between late September and late December before migrating upstream to their spawning streams. The distribution of chum spawning is limited to that portion of the Fraser River and its tributaries between the mouth and Hope (approximately 170 km upstream). A few very small populations of chum spawn in tributaries in the Canyon section of the Fraser River. Spawning starts in late September, peaks in late October, and is generally complete by mid to late November, but some spawners are observed as late as January. Spawning events last 2-3 weeks in smaller streams and up to several months in larger systems such as the Harrison.

2.2 Stock enhancement activities

2.2.1 Enhancement approach

DFO leads or supports enhancement activities to:

- Rebuild or re-establish salmon runs by enhancing abundance of spawners in an area (e.g. re-establishing pink and coho populations in lower Fraser tributaries where there is historic evidence of spawning populations)
- Provide fishing opportunities either in targeted fisheries or through enhancement of populations contributing to mixed stock fisheries.

In addition, some enhancement activities provide stock assessment information.

In recent years, the emphasis has been shifting from production to conservation and rebuilding, and many enhancement facilities do both.

The *2009 Pink & Chum Management Summary* includes additional information about salmon enhancement in BC. Specifically:

- Section 3.2.5 describes the regional approach to salmon enhancement, reviews the history of the *Salmon Enhancement Program* (SEP), summarizes coast-wide pink and chum enhancement activities, and briefly discusses enhancement in the context of the *Wild Salmon Policy*.
- Section 2.4.2 describes the regional approach to monitoring and assessing BC pink and chum salmon, including estimation of enhanced contributions to chum harvest and escapement.
- Section 2.5.2 describes the regional approach to salmon harvest and explains conservation measures implemented in fisheries that target enhanced chum (e.g. cap on total exploitation rate, terminal fisheries).

All hatchery releases are counted and made publicly available through the facility descriptions on the SEP website at http://www-heb.pac.dfo-mpo.gc.ca/facilities/salmonid_e.htm, and through integrated data resources such as *Mapster*, available at http://www-heb.pac.dfo-mpo.gc.ca/maps/maps-data_e.htm.

Production planning meetings are held annually within DFO to discuss changes in targets or in release strategies. Annual production targets for each salmon species and enhancement facility, except the

smaller Public Involvement projects, are then publicly reviewed as part of the *Integrated Fisheries Management Plan*, which also includes a review of enhancement activities in the previous year.

The remainder of this document explains how the regional approach to the harvest and assessment of enhanced Fraser chum is implemented.

2.2.2 Fraser River chum enhancement facilities

Major enhancement efforts commenced in 1980 to rebuild depressed Inner South Coast chum populations including Fraser River stocks.

Fraser populations increased in size starting in the mid- to late-1980s. During the 1990-1993 period, the annual enhanced contribution from major facilities averaged 35% of the total Fraser chum return. Mean annual total escapements and total returns nearly tripled, increasing from a pre-enhancement average return of 0.63 million (1953-1980) to a post-enhancement average return of 1.67 million (1981-2005). Due to the increased total chum escapement and surpluses to spawning in combination with reduced market demand for chum, Fraser chum enhancement activities have been reduced since 1998.

Four major chum enhancement facilities are currently operating on the Fraser: Chehalis River hatchery, Chilliwack River hatchery, Inch Creek hatchery, and the Weaver Creek Spawning Channel, which is operated primarily for sockeye but incidentally enhances chum:

- *Chehalis River Hatchery* incubates and rears chum salmon collected from Chehalis River for release from the hatchery.
- *Chilliwack River Hatchery* releases substantial numbers of chum salmon fry into both the Chilliwack River and Chilliwack Slough streams, including Atchelitz Creek and Luckakuck Creek. In some years, chum salmon are released into another Chilliwack Slough tributary, the Little Chilliwack Creek, by the community hatchery operated by the Skowkale First Nation in Chilliwack.
- *Inch Creek Hatchery* releases chum fry into Inch Creek and upper Nicomen Slough (upstream from Mission). The hatchery also produces chum to supplement West Creek and Yorkson Creek. The Stave River was enhanced by Inch Creek hatchery until 1997 brood year when the Stave population was rebuilt (Bailey et al. 2005).

In addition, there are community enhancement projects in place throughout the Fraser watershed, including:

- Enhancement on Hyde Creek and Alouette River (Pitt River tributaries), by local community groups.
- A small amount of enhancement carried out on the Stave River by a local community group.
- Enhancement of chum salmon populations in Fraser tributaries downstream from Mission which were derived from transplants of eggs and fry from other Lower Fraser chum populations such as the Alouette River, Chehalis River and Kanaka Creek. These derived populations include Brunette River, Stoney Creek, Nathan Creek, Salmon River, Cougar Canyon Creek, Nicomekl River, Serpentine River and Byrne Creek. Most of this enhancement is coordinated by local community groups.

2.3 Fisheries intercepting Fraser River chum salmon

2.3.1 Overview

Pacific salmon fisheries fall into one of three basic categories:

- *Food, Social, and Ceremonial (FSC) fisheries* are communal aboriginal fisheries. FSC fish cannot be sold legally.
- *Commercial fisheries* harvest salmon for sale during openings that are clearly delineated by time, location, gear, and sometimes even the number of vessels.
- *Recreational fisheries* target salmon for personal consumption or as a sport (i.e. catch-and-release).

Three additional types of fisheries have evolved in recent years, each with a distinct legal setting:

- *Treaty fisheries* are covered under formalized agreements that specify FSC allocations and commercial allocations to a First Nation.
- *Economic Opportunity fisheries* are designed to improve First Nations' access to economic benefits. The long-term intent is to formalize communal FSC fisheries and economic opportunity fisheries as part of the treaty process
- *Excess Salmon to Spawning Requirements (ESSR) fisheries* may occur when salmon stocks return to a system after passing through the various fisheries and are at a level in excess of their spawning target. These fisheries have occurred on a regular basis in the Skeena River for sockeye and pink, on the Nass River for sockeye, and in the Fraser River system for chum on the Chehalis River.

Priority of access for these different fisheries depends on the salmon species, as set out in the *Allocation Policy*.

The 2009 *Pink & Chum Management Summary* includes additional information about salmon fisheries in BC. Specifically:

- Section 1.3.2 summarizes allocation principles and their implementation.
- Section 2.2.3 provides a brief overview of fisheries targeting BC pink and chum salmon.
- Section 2.5 summarizes the planning and implementation of pink and chum fisheries, including access controls and compliance measures.

2.3.2 First Nations

First Nations target local salmon stocks for food, social and ceremonial (FSC) purposes throughout the Fraser River. Sockeye salmon are a priority species for First Nations, but the overall objective expressed by First Nations in consultation is to access a diversity of fishing opportunities throughout the season and across species. Chum salmon are an important part of that diversity for Fraser First Nations.

First Nations chum fisheries are concentrated in the lower river mainstem, using drift nets from the river mouth to Mission, and beach seines from the Mission to the Chilliwack confluence. Fishing opportunities are structured as a combination of FSC fisheries and Economic Opportunity fisheries, depending on in-season estimates of abundance and coordinated with commercial openings. Weekly fishery reports for Fraser River First Nations back to 2004 are available at <http://www.pac.dfo->

mpo.gc.ca/fraserriver/firstnations/firstnationsLF_e.htm. These reports document openings, gear types, and catches

Section 1.1.5 of the *2009 Pink and Chum Management Summary* describes the different elements of First Nations' access to fishing opportunities in more detail.

First Nations access to salmon for FSC purposes is managed through communal licences. These licences are designed for the effective management and regulation of First Nations fisheries through a negotiated series of mutually acceptable conditions wherever possible. The dates, times, and locations where harvesting may occur, acceptable gear types, and other conditions are described in these licences. Communal licences can be amended in-season for resource conservation and other purposes. DFO seeks to provide for the effective management and regulation of First Nations fisheries through negotiation of mutually acceptable and time-limited Fisheries Agreements.

Section 6.3 of the *2008 Integrated Fisheries Management Plan for Salmon – South Coast* identifies communal licence harvest targets of 75,000 chum for Lower Fraser First Nations, and 500 chum for Middle and Upper Fraser First Nations. Note that actual numbers of fish on some communal licences are still in negotiation, and therefore these numbers are subject to change. Also note that these are long-term targets, and actual catches in any given year will depend on, among other factors, in-season assessments of actual stock strength, management measures taken to ensure conservation of individual stocks, abundance of other species, and targeted fishing effort.

Lower Fraser First Nations also target sockeye, pink and chum salmon in Economic Opportunity (EO) fisheries. These fisheries only occur when a commercial Total Allowable Catch has been identified, and are triggered by commercial openings. EO fisheries can take place in all of the Lower Fraser area, from the mouth to Sawmill Creek, using beach seines, dip nets, drift nets, or set nets. All EO fisheries have a mandatory landing program for monitoring of catches.

2.3.3 Recreational

DFO regulates sport fisheries in tidal waters, and salmon fisheries in freshwater. DFO's regulations for salmon sport fisheries in freshwater are published as a supplement to provincial regulations for all freshwater fisheries. Recreational limits and regulations are announced pre-season, with in-season updates where necessary:

- 2007-2009 BC Tidal Waters Sport Fishing Guide and the 2007 to 2009 BC Freshwater Salmon Supplement are available at http://www.pac.dfo-mpo.gc.ca/recfish/SFG_e.htm
- 2007-2008 BC Freshwater Fishing Regulations are available at www.env.gov.bc.ca/fw/fish/regulations/.
- Local in-season changes to recreational limits and regulations are announced and archived at www-ops2.pac.dfo-mpo.gc.ca/xnet/content/fns/index.cfm?pg=fishery_search&lang=en&ID=recreational.

In marine waters off the Pacific coast of British Columbia, hook and line harvest of chum salmon is open year round. Coast wide the minimum size limit for chum is 30 cm. There are area closures, listed in the Tidal Water Sport Fishing Guide, in effect for various inlets and off river mouths to protect chum stocks where there are conservation concerns. The majority of these are long-term closures.

Non-tidal fisheries for chum within the Fraser watershed have been open year-round with the exception of a few years in the late 1990s/early 2000s when the Fraser was closed for all salmon fishing in

October to protect Interior Fraser coho stocks. Major tributaries including the Stave, Harrison, and Chilliwack/Vedder rivers are open to chum fishing.

Detailed assessment reports for recreational fisheries in the Fraser watershed are available at http://www.pac.dfo-mpo.gc.ca/fraserriver/recreational/recfisherystudies_e.htm.

2.3.4 Commercial

Fraser River stocks are fall run stocks that migrate in from September to December. Fraser chum are intercepted in commercial fisheries that occur in the Johnstone Strait (Canadian Statistical Areas 11 to 13), Strait of Georgia (Canadian Statistical Area 14), Juan de Fuca Strait (Canadian Statistical Area 20 and 21; United States Statistical Area 4B, 5, 6C) and the Fraser River (Canadian Statistical Area 29 and United States Statistical Areas 7 and 7A).

The greatest percentage of Fraser chum are harvested in the Johnstone Strait mixed-stock fisheries, which account for about 50% of the total Fraser chum harvest, and in the Fraser River fisheries, which account for about 26% of the total Fraser chum harvest (Table 4)

The *2008 Certification Unit Profile for Inner South Coast Chum (excluding Fraser)* describes the management approach for chum fisheries in Johnstone Strait and Johnstone Strait.

The Area 29 commercial fishery takes place on the Fraser River downstream of Mission, the Fraser estuary, and adjacent waters of Georgia Strait. Targeted chum fisheries occur between Steveston and Mission, targeting enhanced chum from Harrison, Chehalis, Inch, Stave, and Chilliwack / Vedder systems. Section 3.3.1 describes the management approach.

Commercial US fisheries also intercept Fraser River chum salmon. The 2006 Post-Season Report (PSC 2008) provides the details. Briefly:

- The management approach for chum fisheries in the Strait of Juan de Fuca (Areas 4B, 5, 6C) is designed to target Puget Sound stocks with limited total effort (i.e. four US Treaty Indian tribes, gillnet only). Catch levels have been moderate and below historical levels due to low catch rates, low market prices, and inclement weather conditions. Genetic stock identification GSI samples indicate that the majority of the catch is chum salmon of U.S. origin.
- Management of chum fisheries in the San Juan Islands and around Point Roberts (Areas 7/7A) has recently been disconnected from the harvest levels in Johnstone Strait. A harvest limit of 130,000 chum salmon has been set, which is reduced to 20,000 if Canada indicates that abundance is critically low. Fisheries are managed to maintain established catch sharing between Areas 7 and 7A and to avoid concentrations of effort along the international boundary in Area 7A.

2.4 Objectives

2.4.1 Regional objectives

Pacific salmon are managed under a comprehensive umbrella of laws, treaties, and policies. Particularly relevant for the year-to-year management of Fraser River chum salmon are the *Fisheries Act*, the *Oceans Act*, the *Species at Risk Act*, the *Wild Salmon Policy*, the *Pacific Salmon Treaty*, the *Selective Fishing Policy*, and the *Allocation Policy*.

The provisions of these laws, treaties, and policies form the basis for long-term objectives that shape the management of North Coast and Central Coast chum and the fisheries that harvest them.

The *2009 Pink & Chum Management Summary* includes additional information about regional objectives. Specifically:

- Chapter 1 summarizes the legal and policy context for the management of Pacific salmon, with a section for each of the acts and policies listed above.
- Section 2.3 reviews long-term objectives and explains the use of management reference points for BC chum.
- Chapter 3 describes the different elements of DFO's conservation strategy, outlines integrated management initiatives, and includes a coast-wide inventory of major conservation initiatives.

Annual conservation objectives for specific stocks, and the resulting conservation measures in Fraser chum fisheries, are publicly reviewed each year as part of the *South Coast Integrated Fisheries Management Plan for Salmon*, which are available at <http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/MPLANS/MPlans.htm>. Draft versions are publicly available each spring through the Salmon Consultation Website at http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/consultations/salmon/sapdefault_e.htm.

2.4.2 Conservation objectives for Fraser River chum salmon

The fundamental conservation objectives for Pacific salmon contained in national legislation and regional policies can be summarized as follows:

- Maintain healthy and diverse populations by conserving functionally distinct groups of salmon, called *Conservation Units*.
- Protect the integrity of each conservation unit by ensuring sufficient escapement for component populations.
- Monitor the status of conservation units relative to formal benchmarks for conservation and long-term production.

DFO has established a comprehensive assessment and management system to work towards these objectives through close monitoring, adaptive management, habitat protection, and enforcement.

For Fraser chum salmon, these fundamental objectives translate into a cautionary approach to fisheries management, with a focus on identifying fishing opportunities based on in-season abundance estimates and conservation measures that limit encounters of non-target species and minimize impacts on species of concern.

Specific conservation objectives include:

- Time and area net restrictions to limit encounters of non-target stocks and species to minimize fishery impacts.
- Gillnet mesh restrictions
- Non-retention of steelhead
- Daylight only to reduce coho encounters and minimize fishery impacts.
- Gillnet short sets and use of revival boxes when specified by Public Notice to minimize impacts on encountered non-target species.

- In-season (field inspections) and post-season (catch analysis) monitoring of net fisheries to assess fleet compliance to fishery regulations and guidelines and confirm in-season phone-in and hail data from fishery participants.
- By-catch of non-target species is closely monitored in-season to ensure impacts on these stocks are within management goals.

Escapement targets for Fraser chum have been refined and updated over the years. Minimum escapement goals were set in the 1970s for the early run at 365,000 and for the late run group at 335,000, for an overall Fraser River escapement goal of 700,000. Spawner-recruit analyses in the 1990s estimated that an average spawner abundance of 800,000 Fraser chum would maximize sustainable yield (S_{MSY}). However, S_{MSY} is poorly determined for Fraser chum and the 80% confidence interval for the estimate ranged from about 500,000 to about 2.5 Million. Given this range of uncertainty, 800,000 was formally adopted as the escapement target in 1999, following a recommendation by the PSARC salmon sub-committee.

Fisheries on the Fraser and in approach areas are managed each year to achieve the 800,000 target. Management reference points, described below, have been implemented to formalize the annual planning and implementation process.

2.4.3 Management objectives for Fraser River chum salmon fisheries

The fundamental management objectives for Pacific salmon contained in national legislation and regional policies can be summarized as follows:

- Plan and implement sustainable, equitable, and efficient fisheries.
- Minimize incidental harvest of non-target salmon stocks, and by-catch of non-target species.

The primary management tool is to control fishing effort through restricting the length of fishery openings and the number of licensed vessels fishing within an area. Other tools include altering gear efficiency or fishing power through manipulation of permitted gears (e.g. net length or depth, mesh sizes, methods used). Time and area closures, as well as selective fishing techniques, are used to protect specific non-target populations or species of concern.

2.4.4 Performance measures

Performance measures for Fraser chum salmon generally relate to escapement and terminal harvests:

- Annual escapement is the main performance measure for Fraser chum. Formal Limit Reference Points (LRP) or Target Reference Points (TRP) have not yet been developed. However, an operational *Management Escapement Goal* (MEG) has been identified. In 1999, the escapement goal (following two recommendations from PSARC, 1992 and 1999) was increased to 800,000 and the early and late run escapements were increased proportionately.
- Performance relative to genetic diversity objectives is measured in terms of the distribution across spawning sites in the CU, as well as the proportion of returns from wild and enhanced populations.
- For hatcheries, performance is measured in terms of broodstock targets and releases, which are reported in the annual *Integrated Fisheries Management Plans*, for all but smaller Public Involvement projects.

- Post-season performance reviews are compiled annually. These reviews report catch and escapement statistics and describe whether or not the fishery met objectives. Post-season reviews are included in the annual *Integrated Fisheries Management Plans*. Detailed post-season reviews from the PSC Joint Chum Technical Committee are available at http://www.psc.org/publications_tech_techcommitteereport.htm.

Several regional policy and conservation initiatives are establishing formal performance measures (refer to the listed section in the *2009 Pink & Chum Management Summary* for details):

- Formal status benchmarks for each conservation unit are being developed under the *Wild Salmon Policy* (Section 3.2.2).
- WSP benchmarks are consistent with the precautionary reference points defined as part of Canada's national implementation strategy for the precautionary approach to fisheries (Section 1.2.2.3).
- Operational performance measures are being developed for the sustainability checklists under the *New Resource Management Sustainable Development Framework* (Section 1.2.2.2)

3 MANAGEMENT FRAMEWORK

3.1 Regional approach to salmon harvest

Pacific salmon fisheries are managed in a regular annual cycle of pre-season planning, in-season implementation, and post-season review. Each phase of this cycle incorporates extensive levels of public participation:

- Pre-season planning centers on the development and broad public review of *Integrated Fisheries Management Plans* (IFMP). These management plans include general decision guidelines for each fishery, expectations for the year, anticipated fishing plans, and a detailed review of the previous year.
- In-season management is subject to rapidly changing, uncertain information. The department works with stakeholder representatives to develop appropriate responses to these changing circumstances, adhering, where possible, to the general decision guidelines and specific fishing plans documented in the IFMP.
- Post-season review meetings in the Fall provide a broad public forum for sharing information about the stocks and fisheries, reviewing management actions, and identifying opportunities for future improvements.

The *2009 Pink & Chum Management Summary* includes additional information about the regional approach to salmon harvest, and the participatory processes that inform each step in the planning cycle. Specifically:

- Section 2.4 outlines monitoring and assessment programs.
- Section 2.5 describes planning and implementation of Pacific salmon fisheries, including long-term decision guidelines, access controls, and conservation measures.
- Section 2.6 compares the three types of compliance mechanisms in place for Pacific salmon fisheries: incentives, education, and enforcement.
- Section 2.7 summarizes DFO's toolkit for monitoring and assessment.
- Section 3.2.4 reviews selective fishing initiatives and other impact reduction measures.
- Section 3.4 contains an inventory of major conservation efforts in the Pacific Region, and describes how they are linked to the annual management of fisheries harvesting BC pink and chum salmon.
- Chapter 4 outlines DFO's strategy for enabling public participation in the management of salmon fisheries.

3.2 Harvest strategy for Fraser River chum salmon

The primary management tool for limiting exploitation rate or meeting escapement targets for Fraser chum salmon is to control fishing effort through restricting the length of fishery openings and the number of licensed vessels fishing within an area. Other tools include altering gear efficiency or fishing power through manipulation of permitted gears (e.g. net length or depth, mesh sizes, methods used).

The Pacific Salmon Treaty, signed in 1985 by Canada and the United States, established the Pacific Salmon Commission (PSC), its Panels, and the framework for managing Fraser River chum salmon in

an integrated international system. The PSC, guided by the principles and provisions of the Treaty, establishes general fishery management regimes for international conservation and harvest sharing of Fraser River chum salmon in the Fraser Panel Area. The PSC's Southern Panel, consisting of Canadian and American representatives, is responsible for developing pre-season fishing plans and implementing in-season management of Fraser River chum salmon to meet the following objectives: 1) spawning escapement goals, and 2) agreed international and domestic catch allocations to Canada and the United States.

In-season fisheries are set based on decision points outlined in the *South Coast Integrated Fisheries Management Plan* (IFMP) and are based on in-season run sizes estimated at the Albion test fishery. Statistical areas and sub-areas are designated to fine-tune the implementation of fisheries (e.g. area closures to reduce incidental harvest of weak stocks).

Note: This document covers only chum fisheries on the Fraser and in approach waters. Fisheries harvesting Fraser chum in Johnstone Strait and Strait of Georgia fisheries are described in the profile for *Inner South Coast Chum (excluding Fraser)*.

3.3 Decision Guidelines for Commercial Fisheries

3.3.1 Decision Guidelines for Area 29 chum fisheries

3.3.1.1 Harvest Objectives

Fraser River chum fisheries are managed to address conservation objectives for the 2 conservation units by achieving a minimum escapement of 800,000 for the entire management aggregate, with fisheries structured to avoid disproportionate impacts on individual components of the extended return migration.

3.3.1.2 Pre-season planning and in-season implementation

The overall harvest strategy in the river and in approach areas (Area 29) has been formalized in a set of multi-sectoral decision guidelines:

- Albion test fishing data is used to determine the timing of commercial openings. A run size estimation model using Bayesian estimation was formally adopted in 2002 (Gazey and Palermo, 2000; PST chum tech report 2006). Test fishing data from September 1 to October 20 is required to establish the first reliable estimate of chum run size. Since 1998, the test fishery has operated on alternate days to reduce coho by-catch.
- Directed commercial harvest will not occur unless the run size estimate derived from cumulative test fishing catches predicts that the abundance of chum exceeds a run size of 916,000 chum.,
- A minimum commercial total allowable catch of 35,000 is required to open a commercial fishery given the costs of mobilizing the Area E gillnet fleet for catch below this amount is not cost-effective.
- The standard openings for directed commercial chum harvesting occur mainly in the lower river (Sub-areas 29–11 through 29–17) where mobilization of the commercial fleet is possible.
- A collaborative planning process has been established.
- In-season advisors will be updated on current status through conference calls.

- Whenever practical, 24 hours notice will be given for commercial openings; however, shorter notice may sometimes be required.
- Notices to Industry, advising of run status and possible management actions will be issued when appropriate.

Table 5 summarizes the abundance-based decision points and corresponding management actions.

3.3.1.3 Conservation measures

Comprehensive conservation measures are in place for Fraser chum fisheries:

- The daily commercial chum openings will be structured to avoid night fishing so that these fisheries can be monitored in daylight hours (as required) by DFO's Conservation & Protection Branch and on-board, hail, and dockside monitoring of catch can occur.
- In-river commercial gear is restricted to gill nets with a minimum mesh size of 158 mm since 1995.
- Revival tanks are mandatory to maximize survival of released non-targeted species; particularly species of concern such as Interior Fraser coho and steelhead.
- Non-retention of all steelhead and coho by-catch is mandatory.
- Commercial harvests are spread over broad time periods to avoid disproportional fishing mortality on specific component populations.
- Area E license conditions include: fish slips, observers, logbooks, hails, and mandatory revival tanks
- Conservation of Thompson River coho became a major issue in 1997 and will likely remain so for the foreseeable future. Fishing restrictions between August 29 and October 15 in Area 29 can be anticipated each year in the main stem of the river from the mouth to Mission.
- Conservation of Thompson and Chilcotin River steelhead results in fishing restrictions in later October and possibly early November. The B.C. Ministry of Water, Lands and Air Protection (MWLAP) has used Albion test fishing data to estimate abundance of Interior Fraser steelhead. Fishing-related mortality is estimated with a steelhead harvest model the MWLAP also developed. Conservation measures during in-river fisheries are discussed with DFO. Commercial fisheries are not allowed before late October to protect Interior Fraser steelhead. Exact timing of commercial and First Nations net fisheries are finalized following discussions with provincial staff.
- Potential low returns of Harrison River Chinook are also a consideration if earlier fisheries are proposed.

Section 3.4 of the *2009 Pink & Chum Management Summary* includes an inventory of regional conservation efforts and provides the context for the specific measures listed above.

3.3.1.4 On-going developments

There is currently full fleet implementation of selective fishing methods to reduce steelhead encounters and to minimize steelhead mortality. Shorter nets, shorter soak times, and reduced open times have been tested since 2002 with some success and will continue to be implemented in 2008. The importance of earlier commencement of the chum fishery in order to harvest higher quality chum salmon is recognized, but must fall within steelhead management objectives. In addition to Area E

fisheries, commercial chum fisheries for Lower Fraser River First Nations will be considered. If Fisheries Agreements are negotiated they will assume the same priority as Area E commercial fleet fisheries.

3.3.2 Summary: Annual timeline for commercial chum fisheries

Based on the decision guidelines outlined in the previous section, commercial fisheries follow the same rough timeline each year.

Early September to Mid October

- Area 29 fishing opportunities will not be available due to Interior Fraser coho, Cultus Lake sockeye and Interior Fraser River steelhead conservation constraints.

Late October to Early November

- Potential gill net fishing opportunities for chum salmon in Area 29 will be determined in-season, based on in-season assessment of the abundance of the chum salmon return and conservation objectives for Interior Fraser steelhead.

Early November to Late November

- Potential gill net fishing opportunities in Area 29 will be determined in-season, based on in-season assessment of the chum salmon return.

4 ASSESSMENT FRAMEWORK

4.1 Overview

Catch and escapement of Fraser River chum salmon are assessed annually. Catch is sampled in order to determine stock composition (i.e. hatchery versus wild origin) and age composition.

The *2009 Pink & Chum Management Summary* includes general information about monitoring and assessment. Specifically:

- Section 2.4 describes the regional assessment approach (stock assessment program, catch monitoring initiatives, data management)
- Section 2.7 summarizes DFO's toolkit for assessment, monitoring, and enforcement (e.g. role of charter patrols)

The remainder of this chapter describes how this regional approach is implemented for Fraser chum.

4.2 Annual Monitoring

4.2.1 Escapement

Chum escapement has been assessed across the Fraser chum distribution over much of the last century. Early chum escapement estimates were compiled by enforcement officers (Farwell et al. 1987). In more recent years, DFO has assessed escapement in a number of Fraser systems (Grant et al. 2007; Chehalis First Nation and DFO 2007), some of them in collaboration with First Nations, that range from intensive surveys that produce relatively accurate and precise escapement estimates to less precise methods that are used more for assessing population trends.

The most precise and accurate escapement estimate is produced on the Harrison/Chehalis/Weaver system using mark-recapture methods by Chehalis First Nation and DFO jointly since 1991. This complex represents the largest populations of chum in the Fraser watershed.

Visual surveys, by foot or helicopter, provide less precise, but cheaper, quantitative estimates of spawner abundance for a larger group of populations with more diverse productivities that utilize a broader range of habitats. Consequently, visual surveys provide information on abundance trends and distribution that could not simply be inferred from the trends obtained from the counting fence and mark-recapture assessments of the more productive populations. Visual counts of spawners throughout the spawning period and over the majority of their spawning range are widely used to produce area-under-the-curve (AUC) estimates of coho and chum escapements. These types of programs dominate assessment methodologies in the Lower Fraser Area and are conducted in numerous systems (Table 1) throughout the chum run in the Fraser watershed from the Fraser Canyon downstream to the Fraser outlet.

In addition to escapement estimation, hatcheries also count all adults that return directly to their facilities; these counts are included in estimates of total returns (see Table 2: swim-ins column).

4.2.2 Other abundance monitoring programs

4.2.2.1 Test fisheries

Test fisheries apply a standardized fishing procedure using a commercial vessel under contract. The purpose is to develop abundance indices and collect additional information, such as stock composition.

The Albion chum test fishery is a gill net test fishery operating since 1979. A gill net vessel makes two consecutive sets on the daytime high slack tide. Test sets are of approximately 30 minutes or less duration, depending on the velocity of the river. The chum net used is 6 3/4" mesh X 60 meshes deep X 150 fathoms long. The test fishery does not operate on days when there are commercial fishery openings. Since 1998, the test fishery has operated on alternate days to reduce coho by-catch.

The data collected at the Albion test fishery is used to estimate run timing and to generate an in season run size for Fraser River chum stocks. This information determines the timing of commercial chum openings. A run size estimation model using Bayesian estimation was formally adopted in 2002 (Gazey and Palermo, 2000; PST chum tech report 2006). Test fishing data from September 1 to October 20 is required to establish the first reliable estimate of chum run size. Fish are also sampled for biological information (sex, length, weight, and age) used to estimate age composition, sex ratio, and condition.

Albion chum test fishery catch information is available at http://www.pac.dfo-mpo.gc.ca/fraserriver/commercial/commercialalbionchum_e.htm.

4.2.2.2 Assessment Fisheries

Assessment fisheries are regular commercial fisheries, but with a strict effort limitation (e.g. number of vessels, short opening). The purpose is to collect abundance information and provide low-impact fisheries. There are no assessment fisheries for Fraser chum in Area 29.

4.2.3 Catch

4.2.3.1 Overview

Ocean and terminal fisheries are monitored to estimate both catch and effort. Fisheries may also be sampled to determine the stock and age composition of the catch, either directly from boats in the fishery or from combined catch at processing plants. Figure 2 summarizes catch monitoring programs in Lower Fraser chum fisheries.

4.2.3.2 Commercial

Ocean and terminal fisheries are monitored to estimate both catch and effort. Fisheries may also be sampled to determine the stock and age composition of the catch, either directly from boats in the fishery or from combined catch at processing plants.

Commercial catch data is collected through a comprehensive monitoring and reporting framework:

- Daily harvest logs documenting date, location, species encounters, species kept, and species released are completed by each fishery participant. This data is collated and accessible at the regional level. Appendix 9 of the 2008 *Integrated Fisheries Management Plan for Salmon* includes sample logbook pages for each licence area.
- Weekly phone-in of in-season harvest information by all fishery participants is collated and accessed at the regional level.

- Daily inspections by patrol staff surveying harvest information and monitoring compliance to all fishery restrictions and management guidelines.
- Sales slip data encompassing information such as catch by species, statistical area of catch, date of catch, and gear type is generated as each fishery participant lands catch. The data is available at the regional level through database queries.

Commercial hail-in data are verified occasionally by on-water inspections of catch by Fishery Officers, dock-side monitoring and auditing of sales slip data. Nearly all commercial harvesters submit catch information to DFO. Catch in directed chum fisheries is usually sampled for hatchery marks (otolith) and age (scales) at either landing sites or processing plants, although occasionally observers sample on board fishing vessels.

Independent observers from environmental organizations have recently begun monitoring by-catch in some salmon fisheries as part of collaborative initiatives. A sample report from the Fraser River chum fishery is available at <http://www.watershed-watch.org/news/item.html?nid=157>.

The *Pink & Chum Management Summary* describes on-going regional catch monitoring initiatives. Specifically:

- Section 1.2.9 describes the changing structure of Pacific Fisheries. Catch monitoring and enhanced accountability are key elements of *Pacific Fisheries Reform* (PFR), the *Pacific Integrated Commercial Fisheries Initiative* (PICFI), and the pilot projects for operational implementation.
- Section 2.4.2.6 summarizes fishery monitoring and catch reporting programs.
- Section 2.4.3.2 describes how catch data are compiled and managed. Detailed commercial catch records are available at www.pac.dfo-mpo.gc.ca/sci/sa/Commercial/AnnSumm_e.htm.

Catch monitoring in commercial salmon fisheries on the Fraser River is sufficient for estimating chum removals from larger stock groupings (i.e. by statistical area). Trends in catch and harvest rate are discussed in Section 5.3.

Removal estimates at a finer level of detail are highly uncertain for Fraser chum stocks due to the high variability in run timing and abundance of individual populations. However, the harvest strategy for Fraser chum limits the risk associated with this uncertainty through an aggregate escapement target and abundance-based decision guidelines (Section 3.3.1).

Catch monitoring programs also track by-catch and monitor compliance with conservation restrictions to assess impacts of fishing on non-target species for use in determining conservation measures on stocks of concern. For example, post-season estimates of steelhead by-catch are derived from in-season monitoring by charter patrol boats, weekly call-in by individual harvesters, log book data, and sale slip data.

4.2.3.3 Recreational

Recreational catch is monitored with creel surveys that have been consistently conducted on the Fraser mainstem (May through November), the Chilliwack River (September through November), and the Nicomen (October through November) since the 1980s. Access point or bus-route surveys conducted by creel surveyors are used to obtain angler interviews to collect information on catch rates (catch-per-unit effort (CPUE) and release-per-unit-effort (RPUE). Total angler effort information is obtained from overflight or vehicle rod counts of the entire survey area combined with hourly rod count information collected by creel surveyors. Catch rate and total effort data are compiled and analyzed to produce

catch and effort statistics by area and species (see Schubert 1992). Detailed final reports since 2001, including study design and results, are available for the Fraser watershed at www.pac.dfo-mpo.gc.ca/fraserriver/recreational/recfisherystudies_e.htm. Reports prior to 2001 have been published in previous *Canadian Technical Report of Fisheries and Aquatic Sciences*. The largest assessed recreational catches of chum occur in the Fraser mainstem and the Chilliwack River.

Assessment of recreational fisheries in the Fraser watershed is prioritized based on the size of the fishery (i.e. areas with large angler effort are an assessment priority), local conservation concerns, and wild indicator stocks for assessment purposes.

Recreational effort is concentrated in the Fraser River non-tidal mainstem and the Chilliwack River and intercepts all five species of Pacific Salmon (Chinook, coho, sockeye, pink, chum). These fisheries represent the most significant angler effort in the Fraser River watershed with the Fraser mainstem being among the largest occurring freshwater recreational fisheries in British Columbia. Stocks of concern also migrate through the area during recreational openings. Given the magnitude of effort, recreational fisheries in these areas are the most consistently assessed (Fraser River mainstem since 1980, Chilliwack River since 1985):

- The Fraser River mainstem creel project generally runs from May to October with the greatest effort occurring in July and August, particularly during sockeye retention fisheries which have lasted one to five weeks. Average effort has been 400,000 angler hours on the Fraser River mainstem since 1980.
- The Chilliwack River is generally assessed from September to November when the most significant angler effort occurs. Average effort has been 200,000 angler hours (1985 to present). Very little angler effort occurs in the summer or after November, so this period is not assessed. The Chilliwack River is also assessed because it is an indicator system for Fraser Chinook and estimates of catch and recovery of coded wire tags in the recreational fishery are required. Chum are incidentally assessed in this sport fishery.
- The Nicomen Slough/Norrish Creek system has also been consistently assessed starting in 2001, because Inch Creek, which flows into Nicomen Slough, is an indicator system for Fraser coho salmon and estimates of catch and CWT recovery are required. Effort is not significant for this fishery relative to the Chilliwack and Fraser River fisheries (average total effort: 14,000 angler hours) and chum are only incidentally assessed.
- Smaller systems have been opportunistically assessed, mainly for coho and chinook catch, such as the Stave River (average total effort: 21,000 angler hours), the Chehalis River (average total effort: 50,000 angler hours), and the Harrison River (average total effort: 44,000 angler hours). These systems, however, are not a priority since angler effort is relatively low, they have large hatchery components (Stave & Chehalis) and they are not used as indicator systems for any stocks.

4.2.3.4 First Nations

Catch monitoring programs are in place for all communal FSC fisheries and economic opportunity fisheries:

- *Communal FSC*: There are generally no explicitly specified limits on the number of fish or fishers. Rather, catch and effort are controlled through the duration of fishery openings. These fisheries are actively monitored, generally by individual First Nations, but there is also one larger society that

monitors for many of the First Nations in the upper portion of the Lower Fraser Area. Drift nets are monitored by census, while set nets are surveyed and results sent to DFO for analysis.

- *Economic Opportunity* (EO): EO fisheries are monitored using a mandatory landing program. All landings take place at specific sites or on-board specified packers. All designated sites and packers have a monitor who counts the catch as it is unloaded and provides a landing slip to verify that the fish was caught during a commercial opening.

In addition, specific ceremonial licences may be issued to designated individual fishers for a specified small number of fish and for a short durations. These fisheries are not actively monitored, but DFO requests catch data after the licence expires.

4.3 Analysis

4.3.1 Stock Composition

4.3.1.1 Methods

Estimates of stock composition are required to distinguish harvests of wild chum and enhanced chum, and to identify the presence of weaker stocks in a fishing area.

Stock composition is determined by two methods:

- Coastwide Mark-Recovery Program (MRP).
- Genetic Stock Identification (GSI) analysis.

4.3.1.2 Mark-Recovery Program (MRP)

Chum released from hatcheries are no longer marked in the Fraser River system. It is thus not possible to determine hatchery contribution to returns or to estimate survival, exploitation and distribution parameters. However, this changing in monitoring has concurred with increased escapement and reduced exploitation rates (Figure 1), as well as reduced enhancement since 1998 (Section 2.2.2).

Estimates of enhanced chum contributions from major hatchery facilities were based on marking a portion of the fry released with an adipose clip and coded-wire tag (Ad-cwt) or various types of fin clips, and subsequent recovery of these marks. The Johnstone Strait and Fraser River commercial fisheries were then sampled at a rate of approximately 20%, to determine the incidence of marked fish and the age composition in the catch. Escapement assessment for marks in the adult returns was also carried out on each river. Survival rates, exploitation rates and enhanced contribution were all determined from these sampling programs.

Marked fry were enumerated individually at marking. Released chum marked with fin clips include the Chilliwack River (1980–1997). Released chum marked with adipose clips (Ad) and coded-wire-tags (CWTs) include the Chehalis River (1983–1998), Inch Creek (1978–2001), and Stave River (1982–1997). Unmarked fry represented by the mark are estimated by subtracting egg and fry mortalities from the egg number which is usually calculated using electronic egg counters. Since egg and fry mortality generally is less than 10%, fry enumeration is considered very accurate. Not all release groups are represented by a mark. Contributions for those groups are estimated by associating them with a marked release group with a similar size and release timing.

4.3.1.3 Genetic Stock Identification (GSI)

GSI is a method of analyzing chum tissue to determine the origin (e.g. Fraser River, U.S., east coast Vancouver Island) of chum caught in major fisheries. GSI sampling is conducted in both the Canadian and U.S. chum fisheries and results are available from 1985. Since 1994, this program has been undertaken irregularly (i.e. 1996, 1998, 2000 and 2001). Coast-wide, a comprehensive GSI program is on-going for BC chum salmon, summarized in the publications listed in Section 2.1.1.4.

GSI data indicate that the proportion of Fraser chum in Johnstone Strait fisheries can be more than 50% and that the year to year variation in the proportion of Fraser fish in the Johnstone Strait catch can vary between 20% and 80%. The reasons are not known. GSI data also indicate that the proportion of Fraser chum caught in Washington State fisheries, especially in area 7 and 7A can be 50% or more.

4.3.2 Harvest / Exploitation Rate Analysis

Area 29 fisheries are managed to terminal harvest rate (Table 5), based on in-season estimates of run size and the minimum catch required for a cost-effective opening for the Area E fleet. Annual terminal harvest rates are estimated as terminal commercial catch / in-river run size.

4.3.3 Forecasts

The practice of providing forecasts for Fraser River chum was discontinued several years ago for two reasons (Beacham et al. 1987):

- Chum salmon typically have highly variable survival and maturation rates, so that chum forecasts are relatively inaccurate compared to forecasts for other salmon species.
- The management approach is designed around decision guidelines that respond directly to in-season estimates of abundance (Table 5).

Although formal forecasts are no longer provided, brood year return and freshwater and ocean survival conditions are evaluated to provide a qualitative estimate of expected returns to the Fraser River. The annual *Pacific Salmon Outlook* is available at <http://www.pac.dfo-mpo.gc.ca/fm-gp/species-especies/salmon-saumon/index-eng.htm>.

5 STOCK STATUS

5.1 Regular status evaluations

DFO evaluates the status of Fraser River chum salmon annually as part of the public post-season review process. These reviews report catch and escapement statistics and describe whether or not the fishery met objectives. Post-season summaries are included in the annual *Integrated Fisheries Management Plans*, as well as the annual reports of the Pacific Salmon Commission and its Joint Chum Technical Committee, available at www.psc.org.

More detailed status evaluations are completed regularly by DFO scientists and stock assessment biologists in collaboration with external experts. These status evaluations are publicly available, and are peer-reviewed through the *Pacific Science Advice Review Committee* (PSARC) where appropriate. The most recent evaluation of Fraser chum is Ryall et al. (1999) *Status of Clockwork chum salmon stock and review of the Clockwork management strategy*. DFO (1999) presents a short status summary.

The remainder of this section summarizes status evaluations and provides updated information on key trend indicators.

Formal status evaluations will be completed for each conservation unit as part of the *Wild Salmon Policy* implementation process.

5.2 Current Status

5.2.1 Conservation priorities

Currently, Fraser chum populations are healthy enough not to warrant a legislated level of protection.

Fraser chum escapements have tripled compared to the historical average, from a 600,000 average over 1953-2000 to a 2 Million average over 2001-2007. Fraser chum populations have remained strong in recent years despite the low marine productivity that has affected other species and populations of Pacific salmon. If the conservation units in the Fraser watershed did decline to a point where their persistence was threatened, the Canada Species at Risk Act (SARA) provides a legislative and policy framework for recovery.

5.2.2 Production

Chum production is generally quite variable and low relative to other species (Ryall et al. 1999). Productivity of the Fraser chum conservation unit has been average to above average in recent years (2001 to 2007), with no evidence for a drastic downturn in productivity in 2007 as other stocks have experienced. Marine conditions were particularly poor in 2005 resulting in relatively poor survivals for other species and populations of salmon that migrated to the ocean in 2005. This could result in poorer productivity for Fraser chum returning in 2008 when most of these fish (4₁ fish) migrated to the ocean.

5.3 Trends

5.3.1 Abundance

Estimates of total run size for Fraser River chum salmon averaged 2.3 Million over the period 1995 to 2007, ranging from 800,000 to 3.9 Million.

5.3.2 Escapement

5.3.2.1 Total

Escapement estimates from a combination of mark recapture studies and visual enumeration programs indicate that escapement of Fraser chum decreased in 2007 (1 Million) relative to 2006 (1.9 Million). However all recent years remain above the long term average (1953-2000: 600 K; 2001-2007: 2 M). The Fraser stock continues to be classified as abundant and remains well above the target escapement of 800,000.

Table 2 summarizes Fraser chum escapement. Figure 1 shows the escapement trend since 1957.

5.3.2.2 Harrison

Harrison mainstem (below Harrison Lake) escapements have exceeded 2,000,000 in some recent years. Escapement was depressed to less than 100,000 fish in the 1950's to the mid 1960's but, the escapement started to increase and this trend continued to about 1980. While there were significant enhanced releases from the 1982 through 1986 brood, a slow decline in escapement was still observed. Escapement has increased again since the early 1990s, but it is not possible to determine if this is the result of enhancement, decreased harvest, improved natural production and survival, or a combination of these factors.

5.3.2.3 Chehalis River

Enhancement of the Chehalis River population began in 1982, with the mid-timing (mid – late October) of the run specifically targeted since 1986. The enhancement of a specific time period of the return followed consultations between DFO's Resource Management and Salmon Enhancement Program (SEP), which resulted in SEP adjusting egg take dates to produce more fish through Johnstone Strait and the Fraser River earlier in the fall when fishing conditions are better. A strong rebuilding trend occurred from 1980-1990's with recent escapements plus hatchery swim-ins from the mid-1990's being on average 120K versus previous year's average of 40K, but the average for the last 5 years has been lower, at about 80,000.

5.3.2.4 Squakum Creek

Historical chum data for Squakum Creek, which drains from Lake Errock into Harrison Bay, show very small returns through the 1950s, followed by a modest increase in the 1960s. Following enhancement from 1982 to 1987, a significant increase in escapement was observed. During the 1980s, the annual escapement was approximately 10,000. Squakum Creek escapements declined from 1986 to 1991 from levels observed in the early 80's although the last year of enhancement was 1987 and augmented returns would have continued until 1991. In recent years chum escapement in Squakum creek has remained strong averaging 20K (Grant et al. 2007).

5.3.2.5 Chilliwack/Vedder River

Chilliwack/Vedder River chum have the same general pattern of historical escapements as the Harrison River. The Chilliwack/Vedder escapement was severely depressed in the 1950's but rebuilt to higher levels through the 1980's. Enhancement of Chilliwack/Vedder chum began in 1980. Escapement increased markedly during the late 1980's and into the 1990's with a record return of 427,000 in 1999. Since 2002, no enumeration of spawners has occurred in Chilliwack River and only swim-ins are

recorded by the hatchery. Escapement has been estimated based on historical proportions of Chilliwack escapement relative to both the Harrison and Stave systems.

5.3.2.6 Stave River

B.C. Hydro constructed a dam at the lower end of the Stave River in 1930. The dam and the resulting low flows reduced or eliminated all chum spawning areas. Subsequent agreements with B.C. Hydro regarding flow increases and resource restoration channel construction have resulted in a greater spawning area for chum. The Stave River chum showed increased escapements in the mid-1960s, followed by another reduction in the late-1970s. In 1982, enhancement of this stock was begun at the Inch Creek Hatchery. Strong escapements of over 200,000 spawners have been observed for this stock since 1989. Current estimates of Stave River returns indicate that this stock is close to or at production potential based on estimates for the spawning ground capacity of 220,000 adults and escapement has averaged 350,000 (1998-2007). This stock has not been enhanced since the 1997 brood.

5.3.2.7 Inch Creek

Inch Creek chum have a pattern of escapement very similar to the Stave River chum. Escapement was low from the 1950s to the mid 1970s. A concerted effort since 1986 to enhance the early portion of the run, to meet fishery requirements, has resulted in a change in spawning timing. Escapement plus hatchery swim ins increased since 1998 to 24K from a long term average of 6K (1953-1997). Now most spawning is completed by mid-November rather than the historical period of late November-late December.

5.3.2.8 Weaver Creek Spawning Channel

Weaver Creek chum have shown a similar pattern of escapement to other Fraser River chum stocks. Escapements were very poor in the 1960s and 1970s. The recent average is about 23K, compared to a long-term average of about half that. They have been incidentally enhanced since 1965 in the spawning channel along with sockeye, the main enhancement target.

5.3.2.9 Miscellaneous Creeks

Streams assessed consistently by DFO are located on the North and South sides of the Fraser River extending from Pitt Lake confluence with the Fraser upstream to the Coquihalla River. Average chum escapement by stream was 3,673, across all streams over 2001-2005

5.3.3 Catch and Exploitation Rate

Due to the implementation of new management strategies and enhancement actions, overall exploitation rate has decreased by 50% since the 1980s (Figure 1), with a corresponding catch reduction from an average of 330,000 prior to 1980 to an average of 196,000.

5.3.4 Survival Rates

Chum production is generally quite variable. Overall productivity of Fraser chum has been average to above average in recent years (2001 – 2006), although 2007 returns suggest a downturn in productivity most likely related to lower than normal marine survival rates. Marine conditions in 2005 appear to have been particularly poor for juvenile chum, which suggests that 2008 productivity will be depressed.

Chum, sockeye and pink marine survival estimates are not routinely calculated for Fraser River stocks, as they are for other species using coded wire tags or other mark recoveries. In the past, when release specific fin clips and coded-wire tags applied to most hatchery produced chum were recovered in fisheries and brood collections, such calculations were made; but since 2001 brood, Fraser River hatchery chum releases have not been marked in any way.

6 CONSERVATION MEASURES IN FRASER RIVER CHUM FISHERIES

6.1 Coast-wide conservation strategy

The *2009 Pink & Chum Management Summary* describes the elements of DFO's conservation strategy (Section 3.2), summarizes integrated management initiatives (Section 3.3), and provides an inventory of major conservation and recovery efforts (Section 3.4). The management summary also includes an appendix listing local conservation measures.

Coast-wide conservation strategies are reflected in the fishery management plans for each area. Pre-season fishing plans use existing data from previous years to anticipate stock levels returning in any given year. These pre-season plans are established through consultation with Departmental managers, biologists and scientists as well as industry and First Nations representatives. Fisheries commence each year using the established pre-season plan. As in-season catch and escapement data becomes available through the season, fishing plans are adjusted on a daily or weekly basis to reflect this 'real time' data.

General conservation measures in salmon fisheries include:

- In-season (field inspections) and post-season (catch analysis) monitoring of net fisheries to assess fleet compliance with fishery regulations and guidelines and confirm in-season phone-in and hail data from fishery participants.
- By-catch of non-target species is closely monitored in-season to ensure impacts on these stocks are within management goals.
- In-season information may not provide a clear-cut indication of run status. In this case, management actions use a precautionary approach on stocks of concern.

The decision guidelines in Section 3.3.1 list specific conservation measures in the Area 29 commercial chum fishery. This section highlights some examples of local conservation measures in Fraser chum fisheries.

6.2 Chum conservation measures

Fraser River chum fisheries are managed to address conservation objectives for the 2 conservation units by achieving a minimum escapement of 800,000 for the entire management aggregate, with fisheries structured to avoid disproportionate impacts on individual components of the extended return migration.

6.3 Measures to reduce incidental harvest and by-catch in chum fisheries

Time and area closures as well as selective fishing techniques are used to protect specific non-target populations or species of concern. For example, constraints on in-river fisheries for Fraser River chum include conservation concerns for Interior Fraser coho and steelhead:

- Window closures on the Fraser mainstem have been in place since 1998 to prevent bycatch of Interior Fraser coho during their upstream migration.
- To reduce exploitation rates on steelhead measures have been taken in commercial marine chum fisheries (e.g. weed lines, changing fishing boundaries) and commercial in-river Fraser chum fisheries (e.g. short sets, short nets, revival boxes and restrictions on times/areas) to reduce encounters and mortality.

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TABLES

Table 1. Population Structure of Fraser chum salmon

Bold font indicates systems that have been surveyed over the last 5 years for escapement indices. Systems with current hatchery enhancement are identified in *underlined italic font with an asterisk**. A complete list of sites for each Conservation Unit (CU) is available at http://www-comm.pac.dfo-mpo.gc.ca/pages/consultations/wsp/CUs_e.htm. Methods for identifying CUs are documented in Holtby and Ciruna (2007)

Conservation Unit	Stat Area	Spawning Sites
Fraser River Canyon	Mostly 29E	American Creek, Anderson River, Coquihalla River, Emory Creek, Hopedale Slough, Hunter Creek, Kawkawa Creek, Kawkawa Lake, Railway Creek, Ruby Creek , Sawmill Creek, Silverhope Creek, Spuzzum Creek, Sucker Creek
Lower Fraser River	28B	Douglas Creek, Lillooet River (Lower), Purcell Creek, Sloquet Creek, Tipella Creek
	29B	Clayburn Creek, Kelly Creek, Nathan Creek, Salmon River, <u>West Creek*</u>, <u>Yorkson Creek*</u>
	29C	<u>Alouette River*</u>, Blaney Creek , Boise Creek, <u>Brunette River*</u>, Coho Creek, Coquitlam River* , Hoy Creek, <u>Hyde Creek*</u>, <u>Kanaka Creek*</u> , MacDonald Creek, Macintyre Creek, <u>North Alouette River*</u> , Or Creek, Partington Creek, Peters Slough, Scott Creek, Seven Mile Creek, Upper Pitt River, Widgeon Creek
	29D	Belcharton Creek, Big Silver Creek, Barnes Creek, Bouchier Creek, Brousseau Creek, <u>Chehalis River*</u>, Chilqua Creek , Cogburn Creek, Deroche Creek, Draper Creek, East Creek, Harrison River, Hawkins Creek, Hicks Creek, <u>Inch Creek*</u> , Katz Creek, Kenworthy Creek, Lagace Creek, Mahood Creek, Maria Slough, Mountain Slough, <u>Nicomen Slough*</u> , Norrish Creek, Pothole Creek, Pye Creek , Sakwi Creek, Scorey Creek, Siddle Creek, Silverdale Creek, Squawkum Creek, <u>Stave River*</u> , Steelhead Creek, Trout Lake Creek, Twenty Mile Creek, <u>Weaver Creek*</u>, Whonnok Creek, Worth Creek ,
	29E	<u>Atchelitz Creek*</u> , Barret Creek, Centre Creek, <u>Chilliwack Creek*</u>, <u>Chilliwack River*</u> , Chilliwack River (Upper), Depot Creek, Elk Creek, Emory Creek, Fifteen Mile Creek, Foley Creek, Foley Creek side channel, Fourteen Mile Creek, Giesbrecht Spawning Channel, Gravel Slough, Greyell Slough, Kawkawa Lake, Kopp Creek, Liumchen Creek, Lonzo Creek, Lorenzetta Creek, <u>Luckakuck Creek*</u> , Menz Creek, Nesakwatch Creek, Peach Creek, Post Creek , Ranger Creek, Ryder Creek, Salwein Creek, Slesse Creek, Squeah Lake Creek, Steven Creek, Street Creek, Sumas River, Sweltzer Creek, Tamihi Creek, Thurston Creek, Wades Creek, Wahleach Creek, Wahleach Slough, Yale Creek
	29F	Seton and Cayoosh Creeks, Texas Creek

Table 2: Escapement summary for Fraser chum salmon

Escapement estimates are based on a combination of mark-recapture programs, visual foot surveys, and visual overflight surveys. Escapement in enhanced systems is tracked for spawners returning to the hatchery site (i.e. swin-ins) and adults spawning in the wild.

Year	Total Escapement	Harrison	Stave	Chilliwack		Inch Creek		Weaver		Chehalis	
		Total	Total	Swim-ins	In-river	Swim-ins	In-river	Swim-ins	In-river	Swim-ins	In-river
Decadal Averages											
1953-1959	99,115										
1960-1969	250,174										
1970-1979	336,096										
1980-1989	370,552										
1990-1997	1,218,654										
Most recent decade											
1998	3,561,042	2,291,151	500,000	45,367	368,287	27,507	14,892	35,590	2,500	75,748	200,000
1999	2,985,452	1,896,120	320,000	42,001	384,671	15,858	7,404	39,009	4,000	101,389	175,000
2000	699,976	425,236	105,000	11,595	93,824	5,240	4,362	6,286	3,600	17,833	27,000
2001	3,129,707	2,014,862	625,000	18,440	269,564	12,617	12,177	23,628	3,000	69,419	81,000
2002	2,246,665	1,458,066	475,000	15,755	199,970	13,424	12,593	8,568	2,023	31,221	30,045
2003	1,494,491	1,080,967	200,000	4,028	116,225	11,876	13,069	13,829	11,171	23,326	20,000
2004	2,595,283	1,756,873	440,000	9,585	222,296	20,757	12,019	23,455	10,000	55,298	45,000
2005	1,303,941	746,435	300,000	2,053	123,006	8,740	8,471	9,945	1,177	27,114	77,000
2006	1,927,629	1,286,856	320,000	3,791	171,634	15,933	13,463	13,834	1,500	73,618	27,000
2007	1,034,554	624,443	235,000	1,912	104,665	2,826	5,190	10,611	3,156	26,751	20,000
Min	699,976	425,236	105,000	1,912	93,824	2,826	4,362	6,286	1,177	17,833	20,000
Average	2,087,147	1,358,101	352,000	15,453	205,414	13,478	10,364	18,476	4,213	50,172	70,205
Max	3,561,042	2,291,151	625,000	45,367	384,671	27,507	14,892	39,009	11,171	101,389	200,000

Table 3. Age composition for Fraser River chum salmon

Gilbert-Rich age composition by year as a percentage of the total sample (N); obtained from the Harrison and Chehalis spawning ground surveys conducted under the Harrison River mark-recapture program.

	Gilbert-Rich Ages (percent)					Total (N)
	31	41	51	61	71	
1991	5	45	50	0	0	3235
1992	13	78	9	0	0	1151
1993	9	83	8	0	0	1196
1994	7	73	19	0	0	2005
1995	8	48	17	1	0	2,366
1996	30	48	8	1	0	2,657
1997	15	78	2	0	0	3,873
1998	19	65	3	0	0	4,270
1999	NA	NA	NA	NA	NA	2,124
2000	NA	NA	NA	NA	NA	3,148
2001	NA	NA	NA	NA	NA	3,518
2002	NA	NA	NA	NA	NA	2,308
2003	6	84	3	0	0	2,802
2004	NA	NA	NA	NA	NA	1,722
2005	NA	NA	NA	NA	NA	1,244
2006	7	82	2	0	0	2,236
Average	12	68	12	0	0	32,268

Table 4. Catch summary for Fraser chum salmon

Year	Total Returns	Catch					Fraser	Gross Esc.	Total Expl. Rate	
		Areas 11 to 13	Area 14	Areas 20 & 21	Areas 7 & 7a	Areas 4b, 5, 6c				
1953	918,122	434,551	10,184	3,947	0	0	331,815	137,625	85.0%	
1954	1,096,517	542,719	8,768	1,248	0	0	457,407	86,375	92.1%	
1955	397,099	174,665	634	8,217	0	0	103,084	110,500	72.2%	
1956	282,627	175,589	685	591	0	0	72,812	32,950	88.3%	
1957	308,363	97,399	600	1,444	0	0	124,265	84,655	72.5%	
1958	559,829	247,648	8,879	11,935	0	0	201,968	89,400	84.0%	
1959	651,622	241,353	5,430	15,632	0	0	236,907	152,300	76.6%	
1960	390,714	141,635	1,189	4,310	21,523	185	77,090	144,782	62.9%	
1961	253,644	69,640	1,131	5,676	15,803	20	57,454	103,920	59.0%	
1962	249,239	42,750	1,338	7,155	8,741	33	58,866	130,357	47.7%	
1963	339,884	65,476	0	7,567	9,807	360	64,428	192,245	43.4%	
1964	371,556	31,979	0	8,372	11,350	437	72,677	246,741	33.6%	
1965	170,472	8,447	0	7,566	5,595	203	19,202	129,459	24.1%	
1966	419,759	15,213	0	7,402	10,083	216	26,035	360,810	14.0%	
1967	323,003	35,962	0	7,824	9,206	688	55,450	213,873	33.8%	
1968	1,153,257	179,004	0	11,578	77,467	863	214,017	670,328	41.9%	
1969	578,493	129,729	0	6,331	39,026	735	93,453	309,220	46.5%	
1970	739,355	197,753	675	10,345	61,134	0	185,198	284,250	61.6%	
1971	376,364	33,093	0	7,502	19,850	0	25,794	290,125	22.9%	
1972	1,349,820	358,496	15,952	37,276	252,043	0	262,763	423,290	68.6%	
1973	1,506,960	742,948	17,553	77,828	200,744	0	200,807	267,080	82.3%	
1974	717,854	87,421	1,151	25,560	145,411	0	107,996	350,315	51.2%	
1975	486,199	124,247	3,950	16,433	69,307	0	80,842	191,420	60.6%	
1976	1,003,722	237,524	4,559	43,244	191,507	0	186,371	340,517	66.1%	
1977	722,536	54,997	0	6,358	36,660	0	25,180	599,341	17.1%	
1978	1,185,223	405,890	729	11,113	273,516	0	134,985	358,990	69.7%	
1979	308,732	31,093	0	1,381	3,321	0	17,304	255,634	17.2%	
1980	909,353	242,556	8,546	12,026	241,835	0	90,380	314,011	65.5%	
1981	500,271	30,394	3,370	2,288	5,814	0	21,408	436,996	12.6%	
1982	724,011	240,409	12,660	7,095	54,508	0	82,899	326,439	54.9%	
1983	470,101	60,431	14,683	20	1,602	0	21,595	371,770	20.9%	
1984	612,803	30,552	17,335	1	1,192	0	22,246	541,478	11.6%	
1985	1,839,044	248,099	23,242	2,142	124,098	0	57,656	1,383,808	24.8%	
1986	1,580,868	346,413	54,696	1,188	67,221	0	114,023	997,327	36.9%	
1987	481,076	22,167	25,236	10,167	21,984	0	37,852	363,671	24.4%	
1988	1,035,111	296,424	3,964	1,537	96,892	0	107,827	528,467	48.9%	
1989	1,094,661	244,269	6,323	9,749	55,358	0	39,315	739,647	32.4%	

Table 4 continued...

1990	1,594,885	451,937	16,682	4	144,478	0	119,812	861,972	46.0%
1991	1,454,169	104,533	54,637	78	110,837	0	77,737	1,106,348	23.9%
1992	1,555,718	309,541	48,931	57	90,015	0	71,317	1,035,859	33.4%
1993	1,476,663	250,194	26,665	28	98,891	0	115,406	985,479	33.3%
1994	2,295,288	335,201	24,576	0	54,975	0	214,456	1,666,079	27.4%
1995	1,844,441	94,747	2,224	507	31,940	0	86,480	1,628,542	11.7%
1996	886,413	24,816	0	0	81	0	16,175	845,342	4.6%
1997	1,689,813	38,231	0	20	191	0	31,764	1,619,608	4.2%
1998	4,093,152	334,938	80,296	0	26,006	0	28,281	3,623,631	11.5%
1999	3,054,879	15,202	0	0	71	0	54,640	2,984,966	2.3%
2000	806,793	59,602	17	4	243	0	24,188	722,739	10.4%
2001	3,400,119	79,639	6,221	541	2,163	0	103,574	3,207,981	5.7%
2002	2,733,571	195,862	25,755	140	77,263	0	76,370	2,358,181	13.7%
2003	2,131,983	429,450	5,941	60	59,987	0	113,264	1,523,281	28.6%
2004	3,364,052	351,817	14,175	124	123,455	0	106,393	2,768,088	17.7%
2005	1,735,808	176,446	3,361	234	50,487	0	77,503	1,427,778	17.7%
2006	2,825,934	455,783	9,497	122	75,541	0	197,432	2,087,558	26.1%
2007									

Harvest rates by area (% of total run, rounded)

		Areas 11 to 13	Area 14	Areas 20 & 21	Areas 7 & 7a	Areas 4b, 5, 6c	Fraser
All Years	Min	0%	0%	0%	0%	0%	1%
	Median	17%	0%	0%	3%	0%	9%
	Max	62%	5%	5%	27%	0%	42%
Before 1990	Min	4%	0%	0%	0%	0%	3%
	Median	22%	0%	1%	5%	0%	16%
	Max	62%	5%	5%	27%	0%	42%
Since 1990	Min	0%	0%	0%	0%	0%	1%
	Median	8%	0%	0%	3%	0%	4%
	Max	28%	4%	0%	9%	0%	9%

Catch distribution (% of total catch, rounded)

All Years	Min	19%	0%	0%	0%	0%	6%
	Median	49%	1%	2%	13%	0%	31%
	Max	71%	24%	18%	41%	1%	78%

Table 5. Harvest Guidelines for Fraser Chum

RUN SIZE*	HARVEST PLAN	FIRST NATIONS	COMMERCIAL	RECREATIONAL
Less than 800,000	<10%	Limited opportunities (reduced hours and days/week fishing)	Closed	Restricted openings
800,000 to 916,000	Catch not to exceed 81,000 (72,000 First Nations and 9,000 test fishing)	Normal opportunities, with harvest target of 72,000	Closed	Tributary openings
916,000 to 1,050,000	Commercial catch not to exceed 10% for chum	Normal opportunities	Potential catch of 35,000 to 105,000	Open
More than 1,050,000	Commercial catch not to exceed 15% for chum	Normal opportunities	Potential catch of 144,000 or more	Open

* In-season estimates of terminal run size based on catch in Albion test fishery.

Table 6. Recreational catch summary for Fraser chum salmon

Year	Total Returns	Creel Survey			Est. Angler Effort	Released	Retained	
		Survey Period	Interviews	Overflights				
1984	612,803	Sep-Dec	5,995	16	380,900	0	0	
1985	1,839,044	Sep-Nov	5,718	22	485,931	806	26	
1986	1,580,868	May-Dec	18,121	60	771,595	456	184	
1987	481,076	March-De	16,858	64	794,658	375	37	
1988	1,035,111	Apr-Dec	16,427	56	722,590	80	284	
1989	1,094,661	Jun-Jul	1,855	16	90,678	0	0	
1990	1,594,885	Jul-Aug	925	10	60,152	0	0	
1991	1,454,169							
1992	1,555,718							
1993	1,476,663							
1994	2,295,288							
1995	1,844,441	Jun-Sep	6,171	32	374,510	64	60	
1996	886,413	Jun-Aug	4,752	25	212,205	0	0	
1997	1,689,813	Jul-Aug	5,275	17	260,874	0	0	
1998	4,093,152	May-Aug	6,704	31	360,449	0	0	
1999	3,054,879	Jul-Aug	603	5	21,765	0	0	
2000	806,793	Jul-Aug	9,778	14	372,341	0	5	
2001	3,400,119	Jul-Nov	7,768	27	253,818	4,749	1,371	
2002	2,733,571	May-Nov	11,606	46	391,511	12,484	2,761	
2003	2,131,983	May-Nov	6,882	48	659,025	3,787	728	
2004	3,364,052	May-Aug	7,446	38	524,886	12	0	
2005	1,735,808	May-Sep	6,823	39	439,876	172	39	
2006		May-Oct	10,235	46	747,058	7,086	900	
2007		May-Nov	6,175	56	258,161	10,068	3,007	

FIGURES

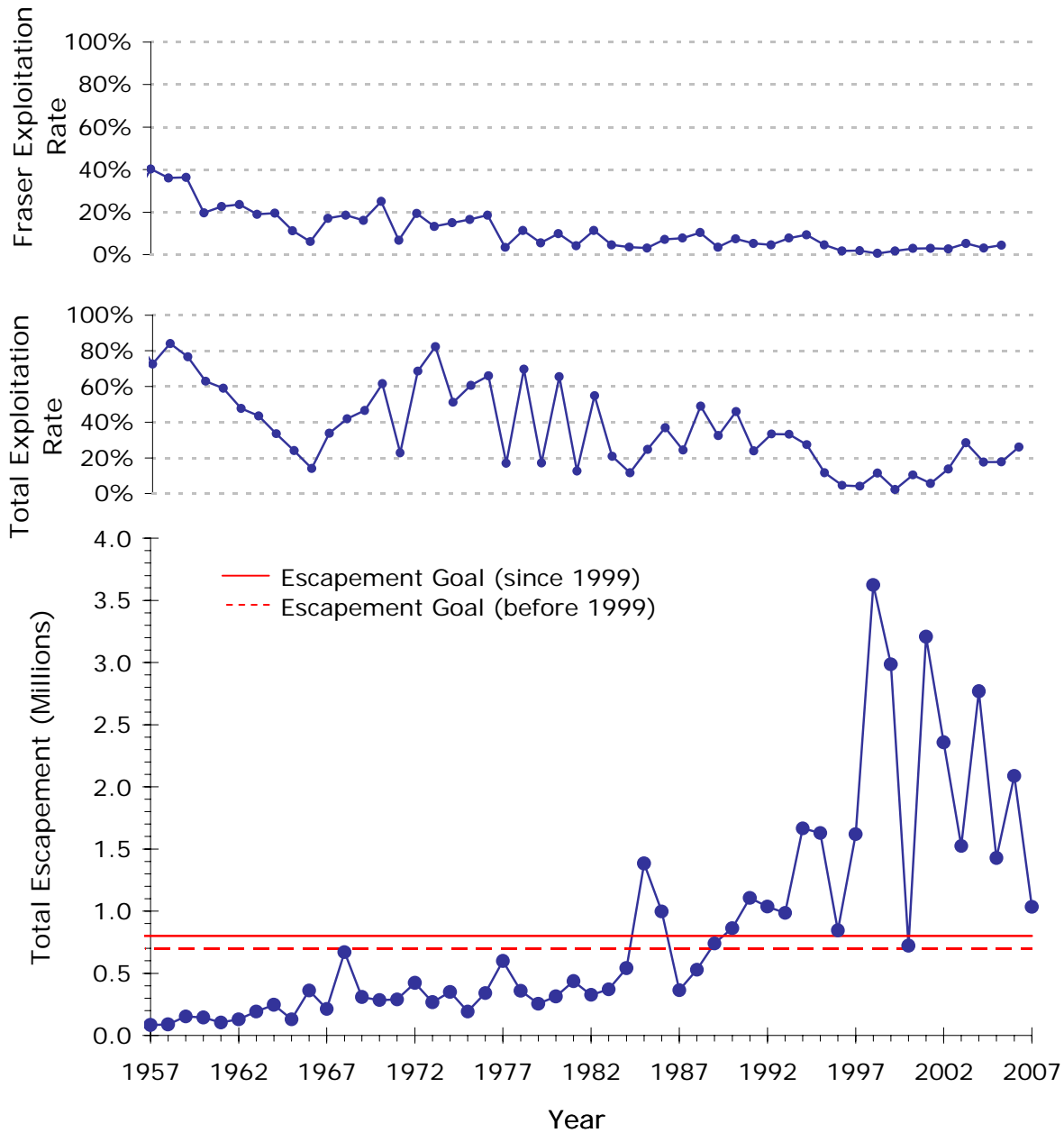
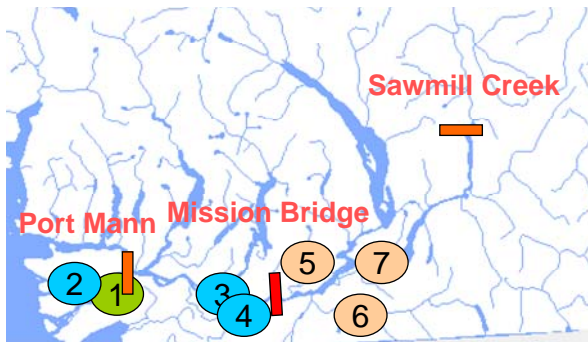


Figure 1. Trend summary for Fraser chum salmon

Fraser exploitation rate is calculated as Fraser catch / total run. Total run is estimated as escapement plus total catch in Canadian Statistical Areas 11 to 14, 20, 21, 28, and 29 plus catch in US statistical areas 4b, 5, 6c, 7, and 7a. Total exploitation rate is estimated as Total catch/Total run.

Lower Fraser River Catch Monitoring



Commercial (PFMA 29: upstream to Mission)

① Area E gillnet

Logbooks, overflights, hails (DFO)
limited no. independent on-board observers

First Nations

② FSC below Port Mann

Hails (FN, DFO)

③ FSC Port Mann to Sawmill Cr.

Creel/Hails (FN, DFO)

④ Economic Opportunity

Mandatory Landing (FN, DFO)

Recreational

⑤ Nicomen

Creel (DFO)

⑥ Chilliwack (Sumas R. to Slesse Cr.)

Creel (DFO)

⑦ Fraser (Sumas R. to Coquihalla R)

Creel (DFO)

Figure 2. Lower Fraser River catch monitoring program