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CERTIFICATION UNIT PROFILE:
WEST COAST VANCOUVER ISLAND
CHUM SALMON

by

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ABSTRACT

Dobson D., D. O'Brien, and G. Pestal . 2009. Certification Unit Profile: West Coast Vancouver Island Chum Salmon. Can. Man. Rep. Fish. Aquat. Sci. 2881: viii + 45 p.

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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 West Coast Vancouver Island (WCVI) chum 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 watersheds on the west coast of Vancouver Island from Juan de Fuca Strait (Area 20) north to the Cape Scott (Area 27). The major chum systems are:

- *Area 20*: De Mamiel Creek, Sooke River.
- *Area 22*: Nitinat River (enhanced).
- *Area 23*: Cous Creek, Effinghan River, Little Toquart Creek, Nahmint River, Sarita River, Toquart River.
- *Area 24*: Atleo River, Moyeha River, Tranquil Creek, Warn Bay Creek.
- *Area 25*: Black Creek, Burman River, Canton Creek (enhanced), Conuma River (enhanced), Deserted Creek (enhanced), Espinosa Creek, Leiner River, Sucwoa River, Tahsis River, Tlupana River (enhanced) Tsowinn River, Zeballos River
- *Area 26*: Chamiss Creek, Kaouk River
- *Area 27*: Colonial / Cayeghle Creeks

1.2 Fisheries covered in this document

This profile covers fisheries harvesting chum salmon on the West Coast of Vancouver Island from Juan de Fuca Strait (Area 20) north to the Cape Scott (Area 27).

WCVI chum are harvested primarily in terminal areas by commercial fisheries targeting single hatchery or mixed hatchery and wild stocks. Major commercial fisheries occur in Nootka Sound and offshore from the Nitinat Lake outlet. Assessment fisheries with limited effort have also occurred in Esperanza Inlet, Barkley Sound and Clayoquot Sound in recent years.

First Nations target local salmon stocks for food, social and ceremonial (FSC) purposes throughout the west coast of Vancouver Island. Long-term harvest patterns depend on the local abundance of all salmon species. 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 salmon harvests in tidal waters and freshwater occur throughout the west coast of Vancouver Island, but harvest relatively few chum salmon.

2 BACKGROUND AND OBJECTIVES

2.1 Life history

2.1.1 Stock units

2.1.1.1 Definition of stock units for WCVI chum

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.

Chum salmon (*Oncorhynchus keta*) are common to many streams on the west coast of Vancouver Island. From Juan De Fuca Strait to Cape Scott (Statistical Areas 20-27; Figure 1) spawning chum are recorded in more than 190 streams. Streams are identified according to the standardized stream naming and numbering system used by DFO and the Province of BC (DFO 2008b). Major runs of chum salmon originate in the following systems:

- *Area 20*: De Mamiel Creek, Sooke River.
- *Area 22*: Nitinat River (enhanced).
- *Area 23*: Cous Creek, Effinghan River, Little Toquart Creek, Nahmint River, Sarita River, Toquart River.
- *Area 24*: Atleo River, Moyeha River, Tranquil Creek, Warn Bay Creek.
- *Area 25*: Black Creek, Burman River, Canton Creek (enhanced), Conuma River (enhanced), Deserted Creek (enhanced), Espinosa Creek, Leiner River, Sucwoa River, Tahsis River, Tlupana River (enhanced) Tsowinn River, Zeballos River
- *Area 26*: Chamiss Creek, Kaouk River
- *Area 27*: Colonial/Cayeghle Creeks

Table 1 summarizes the population structure of WCVI chum salmon by grouping individual spawning sites according to management area, statistical area, and conservation unit. Note that Table 1 only lists spawning sites with more than 5 observations since 1990. Sites with average annual escapement exceeding 5,000 spawners over the period 1995 to 2005 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 South Coast DFO office in Nanaimo.

2.1.1.2 Conservation units for WCVI 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 WCVI 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 population 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 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 2 conservation units for WCVI chum salmon based on their evolutionary lineage, life history, productivity, and ocean migrations:

- Southwest Vancouver Island CU with 171 distinct spawning sites.
- Northwest Vancouver Island CU with 61 distinct spawning sites.

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 both of these conservation units. A complete and up-to-date list of sites for all CUs is available at http://www-comm.pac.dfo-mpo.gc.ca/pages/consultations/wsp/CUs_e.htm

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

Commercial fisheries targeting WCVI chum salmon generally rely on indicator stocks to identify local abundance in-season. Indicator stocks tend to be more intensively surveyed, and provide more accurate estimates of local abundance than the visual surveys used for the majority of chum salmon spawning streams. Table 2 lists 21 indicator streams surveyed annually on the west coast of Vancouver Island.

In addition to intensive surveys in these indicator systems, less frequent and less rigorous escapement on a variable set of additional streams provide information about chum distribution and large-scale patterns in abundance. Section 4.2 summarizes assessment coverage for WCVI chum salmon.

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 by Beacham et al. (1985) and 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.
- Beacham et al. (2008) assess the stock structure of BC chum salmon using microsatellite DNA, which they found to be more informative than other genetics-based methods such as alloyzmes. The study identifies 16 regional stocks based on 14 microsatellites.
- 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.

2.1.2 Stock characteristics

2.1.2.1 Abundance and distribution

Annual returns of WCVI chum are highly variable and have averaged approximately 1.2 million chum for the 1995 to 2007 period, ranging from a low of 193,000 in 2000 to a high of 2.12 million in 1998 (Table 3).

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

2.1.2.2 Age / size / fecundity

Chum return to spawn in natal streams after three to six summers at sea, with most chum returning to spawn as four year olds (Salo 1991). Using the Gilbert-Rich age designation system, Inner South Coast chum range in age from 3_1 to 6_1 with the greatest proportion of chum being 4_1. Age composition may vary considerably from year to year.

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).

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 WCVI 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

Juvenile chum enter the ocean shortly after emerging from the gravel in spring (late April to early May) and migrate to feeding areas in the north east Pacific Ocean.

In the first year, chum are primarily located along the coast of North America and into the Gulf of Alaska (Salo, 1991).

Return migrations are of considerable distance, and the timing of the start of return migrations is not well documented. For WCVI populations, chum are first observed in streams in mid to late September, with the peak of spawning occurring in late October (Lightly et al., 1985). Spawning is generally complete by mid to late November in WCVI populations.

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 for harvest 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), and 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 wild and enhanced chum are implemented on the WCVI.

2.2.2 WCVI chum enhancement facilities

There are two major chum enhancement facilities located on the WCVI. Nitinat hatchery is located in south-west Vancouver Island and Conuma hatchery is located in north-west Vancouver Island (Figure 1). These facilities have been operating for about 30 years. Nitinat Hatchery enhances chum originating from the Nitinat River and recently, since 2001, the Klanawa River. Conuma Hatchery enhances chum populations in systems tributary to Tlupana Inlet including Conuma, Tlupana, Sucowa and Canton. Deserted River was also enhanced for many years, up to the 2003 brood, but low returns and the remote location made it too difficult to continue.

Most chum are released from the hatcheries at the fed fry stage, weighing about 1 gram. There has been some experimentation with alternate release strategies, including releasing fry at larger sizes (i.e. 2+ grams), releasing after net-pen rearing, and releasing with variable timing. Annual releases are summarized in Table 6. Production increased at Nitinat over time (max release = 39.5 million, 2005 brood year), but the target production was reduced in 2006 to 33 million. At Conuma production decreased in recent years due to changes in production planning (max release = 19.8 million, 1986 brood year).

In addition to these large hatchery programs, chum are also enhanced with unmanned spawning channels and through numerous small-scale programs managed by local groups.

Detailed information about chum enhancement on the west coast of Vancouver Island is publicly available, and evaluated regularly. For example, Section 4.7.4 of the 2008 South Coast Salmon IMFP lists brood production targets for chum salmon for 2008, and Section 9.7.3 reviews enhancement activities from 2007.

Commercial fisheries harvest enhanced chum from the Nitinat River in Area 21, and from Tlupana Inlet tributaries in Area 25 (Figure 1). Section 3 explains how the regional approach to the harvest and assessment of enhanced chum is implemented on the WCVI.

2.3 Fisheries intercepting WCVI 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 at a number of hatchery sites throughout the South Coast, including the Nitinat River for chum.

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 west coast of Vancouver Island. 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 WCVI First Nations.

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.

On the west coast of Vancouver Island, First Nations harvest of chum salmon for FSC purposes typically occurs on individual stocks in terminal staging areas. Some First Nation economic opportunity fisheries also occur in Area 23. Catch summaries for past years are currently in preparation. In 2007, the combined FSC and economic opportunity fishery catch of WCVI chum was approximately 16,000 pieces. There is also some legal commercial harvest by First Nations authorized under the Tsu-mass agreement between DFO and the Hupacaseth and Tseshaht bands of Port Alberni.

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.

Recreational salmon harvests in tidal waters and freshwater occur throughout the west coast of Vancouver Island, but do not target or catch chum in significant numbers. The annual total catch in the WCVI recreational fishery averaged 280 chum caught from 2000 to 2006.

2.3.4 Commercial

Commercial net fisheries target returning WCVI chum in approach areas close to their natal rivers. Commercial licence groups that target WCVI chum are the Area D and E gillnet fleet and Area B seine fleet.

The two primary fishing areas are offshore of Nitinat Lake and in Nootka Sound. From 1995 to 2007, annual catch off Nitinat Lake averaged approximately 380,000 chum, and Nootka fisheries harvested an average of 73,000 chum. Limited effort assessment fisheries have also occurred in Esperanza Inlet and Barkley Sound since 2004 and in Clayoquot Sound since 2007. Total annual catch in these areas averaged 13,700 pieces since 2004.

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 Inner South Coast chum 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 pink 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 WCVI 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 WCVI chum salmon, these fundamental objectives translate into a cautionary approach to fisheries management, with a focus of identifying fishing opportunities in terminal areas based on in-season abundance estimates and observed escapements into the natal streams. As the level of stock status information varies across areas, so does the level of harvest management that is applied. Where assessment data are strong, fisheries are managed to escapement goals; where the data are less comprehensive, a more conservative approach is taken.

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 to limit encounters of non-target species and minimize impacts on species of concern.
- Geographic separation of harvests of identified surpluses of enhanced chum returns from weaker wild stocks by locating fisheries terminally, adjacent to natal stream to minimize impacts on stocks and species of concern.
- Non-retention of non-target chum and steelhead stocks to minimize impacts on stocks of concern.
- Daylight only to reduce coho encounters and minimize fishery impacts.
- Mandatory seine brailing and sorting and 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.

An integrated planning pilot for the Alberni Inlet/Barkley Sound area (DFO Statistical Area 23) started up in 2008 as part of the *Wild Salmon Policy* implementation. This process is guided by the 5-step planning process outlined in the *Wild Salmon Policy*, and will develop a strategic management plan to comprehensively address aspects of salmon management for populations within that area, including the development of specific objectives and performance measures for biodiversity, production, habitat, and harvest.

2.4.3 Management objectives for WCVI 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 control of 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). Identified surplus stocks are harvested by nets terminally, adjacent to natal stream using knowledge of run timing as a management tool to limit by-catch of non-target stocks and species. Time and area closures, as well as selective fishing techniques, are used to protect specific non-target populations or species of concern.

For example, by-catch of non-target steelhead salmon was a concern in the Nitinat commercial gillnet fishery. Unpublished studies by DFO, the Provincial Fisheries Branch, and consultants reviewed steelhead capture in statistical area 21/121 chum fisheries through the late 1990s. These studies indicated that by-catch was reduced by fishing for chum only after the end of September, restricting fisheries to areas within the

surfline (allowing openings only in area 21, not 121) and incorporating a mandatory ‘weedline’ on nets. These changes were incorporated into the fishery.

Similarly, concern for by-catch of chinook in area 24 (Clayoquot) resulted in a delayed opening there compared to other WCVI chum fisheries.

Finally, there are many areas within the WCVI simply closed to salmon fishing in order to protect weak stocks.

2.4.4 Performance measures

Performance measures for most of the WCVI chum objectives relate back to estimates of escapement and total returns:

- Annual escapement is the main performance measure for Nitinat chum, where the fishery is managed to an escapement target.
- Annual escapement is the main performance measure for statistical areas (Table 4). Formal Limit Reference Points (LRP) or Target Reference Points (TRP) have not yet been developed for WCVI chum stocks. However, operational *Management Escapement Goals* (MEG) have been identified for each of the statistical areas. These operational equivalents were developed by interviewing DFO managers, biologists and contract field enumeration staff who had considerable years of local knowledge of particular streams and corresponding escapements of salmonids. The MEG represent the best estimate by these local experts and are used in a non-technical way as the operational equivalent for long-term benchmarks reflecting highly productive stocks (i.e. high sustainable yields).
- For exploitation rate-based fisheries, management performance is measured relative to the exploitation rate target, calculated from escapement and catch estimates. Escapement is also monitored to provide a measure of performance relative to conservation objectives.
- Performance relative to genetic diversity objectives is measured in terms of the distribution across spawning sites in each CU, as well as the proportion of returns from wild and enhanced populations.
- Escapement estimates, together with catch estimates, are also used to evaluate forecast performance.
- For hatcheries, performance is measured in terms of broodstock targets, releases, and adult returns of hatchery origin.
- 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*.

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 WCVI chum salmon

To limit exploitation rate or meet escapement targets for WCVI chum, 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).

In WCVI commercial chum fisheries intercepting wild stocks, the allowable harvest rate is limited to 20% when sufficient information is available to assess stock productivity. For areas where less assessment information is available (e.g. Barkley, Esperanza, Clayoquot), the harvest rate is set at a more pre-cautionary level and limited to less than 20% (e.g. 10 to 15%).

The fixed harvest rate strategy is achieved by limiting fishing effort. Openings are limited to 1 day per week in areas identified as migration corridors. Therefore, fish passing through the fishing area are assumed to be vulnerable to harvest for no more than about 1.5 days per week. In areas where the harvest rate is limited to less than 20%, harvest is further controlled by limiting fleet size. Under the fixed harvest rate strategy, in-season abundance or escapement data are generally not used to modify plans, although these data have been used to curtail fishing effort when escapement is very low (e.g. termination of Nootka Sound fishery in 2007 after low escapement observations and correspondingly low catch-per-effort in the fishery).

Flexibility in the harvest strategy permitted a second opening within a week if the number of vessels was low. However, this flexibility has been curtailed after a recent review of harvest rates. In 2006, the Esperanza Inlet limited fleet of 8 boats caught about 27% of the total Area 25 chum catch and the estimated harvest rate was greater than the 20% limit. Similarly, in 2005 and 2006 the estimated harvest rate in the Nootka Sound fishery exceeded the allowable limit. In both cases, two-day openings were permitted within one week periods. In 2007 and 2008, fishery plans have been modified to account for this problem by reducing allowable openings to one-day within a week period.

A general issue with estimating exploitation rates is the uncertainty associated with escapement data. Total escapement to the two WCVI chum CUs is expanded from index stream escapement estimates (see *Escapement Monitoring* below). The index streams represent approximately 60% of the total chum escapement based on historical escapement data. All estimates of exploitation rate from catch and escapement data are an index of actual exploitation rate and are therefore interpreted with caution. For example, the allowable 20% harvest rate is conservatively set given the average productivity of the populations.

In fisheries operating in terminal areas and targeting primarily hatchery surpluses, the allowable harvest rate may exceed 20%, depending on the estimated hatchery contribution and escapement target. For example :

- *Nitinat chum*: The pre-season forecast sets an expectation for catch, which is modified in-season by test fishery estimates of abundance. The escapement target for Nitinat is a minimum 225,000 spawners to meet river and hatchery brood requirements. However, in recent years a more conservative target of 325,000 has been set to ease brood collection and increase distribution of spawners within tributaries to Nitinat Lake.
- *Conuma chum:* Surplus returns to Tlupana Inlet may be identified in-season through marine and stream assessments of terminal abundance (i.e. escapement, estuary counts). The escapement target for Conuma brood stock is 7,000 spawners and the aggregate Area 25 escapement goal is 205,000 spawners (Table 4)

The sections below summarize the management approach for commercial fisheries on the west coast of Vancouver Island.

3.3 Decision guidelines for commercial fisheries

3.3.1 Nitinat chum fisheries

3.3.1.1 Fisheries

Commercial fisheries occur on a regular basis for seine and gill net. Trolling is also permitted, but there has been little interest. The fishing period is generally from October 1 to November 15.

Other fisheries include:

- *First Nations FSC*: no constraints on FSC fisheries at normal run sizes. Ditidaht First Nation works closely with Nitinat Hatchery and participates in research projects which normally require a modest allocation of chum.
- *Recreational:* Tidal fisheries under normal limits, but a finfish closure is implemented at mouth of the Nitinat River to prevent foul hooking. Non-tidal recreational fishing opportunities are contingent on escapement and concern for impacts on spawning fish.
- *ESSR fishery:* Nitinat Lake ESSR fishery by Ditidaht First Nations, when surplus occurs.
- *Sampling:* A scientific licence may be issued to the Ditidaht First Nation to provide biological samples and additional information on stock status and movement in Nitinat Lake.

3.3.1.2 Management Objectives

The minimum gross escapement goal is 225,000; 175,000 into the rivers, 10,000 for FSC fisheries, and a minimum 40,000 into the hatchery. The maximum escapement target is 325,000. These additional 100,000 chum salmon are partly utilized as hatchery broodstock. These additional chum are also intended to increase the distribution of spawners in the Nitinat River and to other Nitinat Lake tributaries.

3.3.1.3 Planning

- A gill net fishery may occur in the first week of October, if an adequate surplus is forecast or if assessment information is required. Normally the opening would be for two days, daylight only to minimize by-catch, with a possible extension.
- If the forecast surplus is low a gill net test fish program outside Nitinat Lake may be implemented to provide additional abundance information.
- If no surplus is forecast, the commercial fishery is contingent on in-season assessment. Annual pre-season forecasts for the Nitinat system (predominantly enhanced) are based on escapement, hatchery fry output, and estimated survival rates.

3.3.1.4 Implementation

A gill net test fishery occurs in Nitinat Lake that provides escapement estimates for the lake. Escapement estimates for the Nitinat River and other lake tributaries are based on river swims and aerial surveys. Chapter 4 of this document describes the test fishery and escapement surveys in more detail.

Table 5 summarizes the decision guidelines for Nitinat chum fisheries:

- Gill net catch ceiling of 200,000 is set prior to the commencement of a seine fishery.
- A seine fishery may proceed when there is a need to limit the migration of chum into Nitinat Lake. This depends on escapement numbers to Nitinat Lake and an identifiable surplus outside the lake. Seines fish one or two days by themselves initially to balance early season catch allocation. After this initial fishery and if a surplus is still identified, the second phase of the fishery is initiated. This allows for both gears to fish at the same time in the same areas, except that gill nets have an exclusive fishing area between Bonilla Point and Logan Creek.
- The allocation target for the early season is 50% for gill net and 50% for seine, with an overall allocation target of 30% for gill net and 70% for seine.

- The commencement/continuation of gill net fisheries after the first week of October is contingent on an escapement to Nitinat Lake of 100,000 chums with a demonstrated abundance of fish holding in terminal areas and an expectation of a weekly escapement of 50,000 chums.

3.3.1.5 Conservation Measures

Commercial fisheries targeting Nitinat chum have been modified to include the following conservation measures:

- Typically no commercial fishery prior to the first week in October due to Fraser River steelhead by-catch concerns unless consultations with provincial fisheries biologist allow for late September opening.
- Fisheries from October 01 to October 15 will operate inside a one mile boundary between Dare Point and Pachena Point, with a weedline of between 1.2 and 2.0 metres in order to minimize steelhead mortalities.
- After October 15, fisheries are permitted within a two mile boundary of the shore line between Bonilla Point and Pachena Point.
- Non-retention of steelhead, coho and chinook during periods of low abundance.
- No commercial fishery inside Nitinat Lake.
- Boundaries at Cheewhat and Klanawa Rivers in place to protect local chum and coho.
- When both fleets fish together gill nets only may be permitted between Bonilla Point and Logan Creek, subject to coho encounters

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

3.3.1.6 On-going Developments

The Area Harvest Committee (AHC) for Area B seiners met DFO representatives on February 11, 2008. Area B representatives requested changes in current fishery management plans in an attempt to increase the probability of achieving their allocation target in a number of fisheries. Consistent with the principles of the *Pacific Fisheries Reform* (PFR) Initiative, the Area B AHC intends to work towards share-based fishery arrangements, including individual quotas, individual transferable quotas, and transfer of shares among gear groups. Implementation of this proposal may not be completely achievable in 2008, so the AHC proposes to expand the use of pooled fisheries with limited effort fisheries, like the small fleet seine fisheries for sockeye and chinook in use in Barkley Sound, to other fisheries targeting Nitinat, Johnstone Strait, Qualicum, and Cowichan chum.

Using the Nitinat Chum fishery as a template, Area B has also requested the current management plan be amended to incorporate seine openings earlier in the fishery. To address this proposal prior to the 2008 fishery, cooperative planning sessions involving seine, gill net, and troll groups will be required. It is anticipated that the current decision rules outlined above will likely be amended as a result of these on-going fishery planning sessions.

3.3.2 Nootka chum fisheries

3.3.2.1 Fisheries

Gillnet fisheries take place in various areas from mid/late September and October. Seines have fished in years of high abundance.

A terminal harvest in Tlupana Inlet occurs if a surplus is identified through in-season abundance indicators.

There is potential for an ESSR fishery which is dependent upon identifying a surplus to the enhanced systems in Tlupana Inlet through in-season abundance indicators. The likelihood of an ESSR fishery has been reduced in recent years due to the ability of the fishing industry to conduct controlled fisheries on identifiable surpluses.

3.3.2.2 Management Objectives

The general fishery management approach is to achieve an approximately 20% exploitation rate in the approach waters (outer Nootka Sound). The goal is to optimize Nootka chum harvest and limit by-catch of chinook and dogfish.

Based on past observations, a "moderate" fleet of approximately 50 gill net vessels is estimated to harvest roughly 20% of the terminal abundance with one-day daylight opening per week. A second day of fishing is possible if observed effort is less than 25 boats. Over a five week fishery, the target effort is 200 to 250 boat days.

3.3.2.3 Planning

The first gill net fishing date typically occurs after September 20th. Following the harvest rate management strategy, a fishery would not occur if the forecast was extremely poor.

3.3.2.4 Implementation

- If fleet size is modest (approximately 50 vessels) openings are one day per week in approach waters.
- If fleet size is small (less than 25 vessels) openings are two days per week in approach waters.
- A terminal fishery on hatchery stocks in Tlupana Inlet is carried out if there is an identified surplus based on escapement or test fishery information.
- Seine opportunities are considered in-season.

3.3.2.5 Conservation Measures

- Conuma Hatchery enhances four systems in Tlupana Inlet that have different run timings. There are also approximately 30 unenhanced chum systems in Nootka Sound. The target harvest rate on the total aggregate is limited to 20% to protect less productive unenhanced systems.
- Outer Nootka boundaries are designed to target fish migrating through the approach area and to avoid fish holding off the stream mouths.
- Daylight only fisheries to reduce by-catch (chinook and dogfish).
- Stream mouth boundary at Marvinas Bay to protect local stocks adjacent to fishing area.
- Hisnit Inlet closed during Tlupana Inlet fisheries to protect Deserted River chums.

- There are separate approach area and terminal fisheries to facilitate bio-sampling for age and hatchery contribution.
- Concern for wild chinook stocks in mid-September in outer Nootka Sound.

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

3.3.2.6 On-going Developments

- A review of the harvest approach has been initiated which will include discussion with local stakeholders.
- Minimum forecast to trigger commercial fishery needs to be developed.
- Conuma hatchery frequently has difficulty in achieving egg targets on all four Tlupana Inlet enhanced systems. Production targets may be reduced.
- Deserted River chum stocks are no longer enhanced, resulting in increased need for protection during later Tlupana Inlet openings.
- Chinook by-catch in mid-September needs will be considered when planning fisheries.
- With the introduction of the limited fleet fishery in Esperanza Inlet the overall Area 25 chum harvest rate is under review.
- Coho and chinook retention in net fisheries when abundance permits.

3.3.3 Terminal chum fisheries with controlled effort

3.3.3.1 Fisheries

Starting in 2004 the Area D Gillnet Association proposed limited, small fleet fishing opportunities for chum salmon in terminal areas.

3.3.3.2 Management Objectives

The intent of this program is to determine if small scale limited effort gill net fisheries could be economically viable while limiting exploitation rates to 10 to 20% of returning stocks and also provide stock assessment information.

3.3.3.3 Planning

Fishing plans were developed including observer coverage and data collection for each area. Decision guidelines have also been developed for each of these fisheries, and are available through the local resource manager.

3.3.3.4 Implementation

In 2007, limited-effort fisheries occurred in:

- Barkley Sound - 8 vessels fish a maximum of 2 days per week
- Clayoquot Sound - 4 vessels started 2 weeks later than Barkley Sound and Esperanza Inlet fisheries to avoid chinook bycatch

- Esperanza Inlet - 8 vessels fished concurrent with the Nootka Sound gill net openings to a maximum of 2 days per week
- Quatsino Sound (Neroutsos Inlet) - 2 vessels fished 1 day per week for a total of 3 fishing days
- Bute Inlet - 5 vessels fished for a total of 3 fishing days.

3.3.3.5 Conservation Measures

Conservation measures in these fisheries are implemented consistent with regional conservation efforts and adapted to local circumstances. Details are available through the local resource manager.

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

3.3.3.6 On-going Developments

A review of these fisheries has been conducted, and suggests exploitation rates have exceeded targets in the Esperanza fishery. Effort and fishing time will be reduced in this fishery to achieve target exploitation rates in future years, and performance will be assessed annually. Opportunities in 2009 will be subject to pre-season forecast and in-season information and anticipated harvest rate impacts.

3.3.4 Summary: Annual timeline for commercial WCVI chum fisheries

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

Mid September to Late October:

- *Area 23*: Limited small fleet gill net opportunities in Barkley Sound dependent on the pre-season forecast and allocation guidelines.
- *Area 24*: Limited small fleet gill net opportunities in Clayoquot Sound dependent on the pre-season forecast and allocation guidelines.
- *Area 25*: Gill net chum fishery for one daylight day per week in outer Nootka Sound (Subarea 25-7 and portion of 25-6 and Sub area 25-13 and portions of 25-14). Limited small fleet gill net fishery in Esperanza Inlet. Possible seine opportunity dependent on abundance levels and allocation considerations. Terminal fisheries in Tlupana Inlet based on identified surplus chums to enhanced systems.

October:

- *Area 21 and 121:* Dependent on pre-season forecast Area E gill net fishery anticipated for two days per week starting September 29 (daylight only) inside one mile boundary and north of Dare Point. Further fisheries depend on reaching escapement milestones into Nitinat Lake and indications of abundance through commercial fishing, test fishing and stream enumeration. Area B seine fishery in October dependent on reaching escapement milestones into Nitinat Lake and indication of abundance through commercial fishing, test fishing and stream enumeration.

4 ASSESSMENT FRAMEWORK

4.1 Overview

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)

Catch and escapement of BC chum salmon are assessed annually. Catch in terminal areas is sampled in order to determine stock composition (i.e. hatchery versus wild origin) and age composition. Exploitation rates on wild and hatchery populations are estimated by accounting for the origin of the catch in each fishing area and the total escapement of hatchery and wild populations. Estimates of aggregate escapement to each statistical area and estimates of the average number of recruits per spawner and age at maturity are used to forecast annual returns.

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

4.2 Annual monitoring

4.2.1 Escapement surveys

Twenty one systems throughout the WCVI are surveyed annually by DFO-contracted survey crews or hatchery staff, as listed in Table 2.

Crews count spawners in these systems several times throughout the run. Spawners are usually counted during swim surveys, but other methods may be used, such as aerial surveys or bank walks. The counts are compiled and analyzed (via area under the curve methods where survey number is adequate) to estimate total escapement. Chinook are the priority species for escapement surveys on the WCVI. Chum escape and spawn later, so the surveys may not capture the entire return and therefore the chum estimates are generally less reliable.

A suite of other systems are surveyed less frequently and less rigorously by charter patrols and other groups (e.g. First Nations, BC Streamkeepers). Statistical estimates of abundance are not generated for these systems; however, they provide a gauge of spawner distribution among other chum rivers. For chum in particular, partial in-season estimates of spawner abundance may be used to trigger fishery openings on identified hatchery surpluses. Therefore, these surveys can be an integral part of fisheries management.

Aggregate escapement for each statistical area is estimated by expanding annual survey observations to account for systems that were not surveyed. Expansion factors for each statistical area are based on the ratio of escapement in annual surveyed streams to observed total escapement estimates in the past (Table 7).

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 run timing, stock composition, and fish condition.

An annual test fishery operates on Nitinat Lake during the chum migration, in order to estimate the abundance of returning chum. This in-season information is used to manage the commercial fisheries targeting Nitinat hatchery chum. Specific weekly escapement targets are used to trigger commercial fisheries at Nitinat. The weekly targets are a function of escapement requirements, run timing and preseason forecasts, and are outlined in the annual Integrated Fisheries Management Plan. Escapement to Nitinat is estimated through a combination of test fishing in Nitinat Lake, brood collection activities at the mouth of Nitinat River, and escapement surveys in the river.

Additional test fisheries are also conducted in terminal inlets in some years. Complete records for each of these test fisheries are available through the links below:

- Area 21 (Nitinat) - Chum – Seine (http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/salmon/testfish/Chum/Area21_Nitinat_Seine.htm)
- Area 22 (Nitinat Lake) – Chum – Gill Net (http://www-ops2.pac.dfo-mpo.gc.ca/fos2_Internet/Testfish/rptdtfdparm.cfm?fsub_id=251). Operated in 2005, 2006, and 2007
- Area 23 (Barkley) – Chum - Seine (http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/salmon/testfish/Chum/Area23_Seine.htm).
- Area 24 (Clayoquot)– Chum – Seine (http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/salmon/testfish/Chum/Area24_Seine.htm)
- Area 25 (Nootka/ Esperanza) – Chum – Seine (http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/salmon/testfish/Chum/Area25_Nootka-Esperanza_Seine.htm)
- Area 26 (Kyuquot) - Chum – Seine (http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/salmon/testfish/Chum/Area26_Kyuquot_Seine.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.

Initial openings in the terminal chum fisheries with controlled effort (Section 3.3.3) serve the purpose of assessment fisheries.

4.2.3 Catch monitoring

4.2.3.1 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.

The *2009 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 west coast of Vancouver Island is sufficient for estimating chum removals from stock groupings at a resolution finer than the conservation unit (i.e. by statistical area). Trends in catch and harvest rate are discussed in Section 5.2.3.

Removal estimates at a the level of individual spawning streams are highly uncertain for WCVI chum stocks due to the high variability in migration routes, run timing, and abundance of individual populations. However, the harvest strategy for WCVI chum limits the risk associated with this uncertainty through terminal fisheries with limited effort on local abundances identified in-season (e.g. Section 3.3.3)

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.

4.2.3.2 Recreational

Chum are generally not targeted by recreational harvesters. However, all recreational catch is monitored through the WCVI Creel Survey. Creel surveyors gather catch-per-unit-effort data and take biological samples from boat landing sites throughout the west coast of Vancouver Island. These data are augmented by logbook and manifest records of catch and effort submitted by lodges operating guided trips. Effort is determined through periodic aerial surveys of fishing areas. These data are compiled and analyzed to produce catch and effort statistics by area and species.

4.2.3.3 First Nations

Larger terminal First Nation fisheries (e.g. at Nitinat) are monitored and sampled by either First Nation fishery or DFO staff. Smaller fisheries are generally not monitored, although as a condition of their communal licences First Nation bands are required to report catch.

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 the larger hatcheries are marked to allow determination of hatchery contribution to returns and, when suitable, estimation of survival, exploitation and distribution parameters.

In the past, adipose or ventral fin clips were the primary marking method for chum. Currently, chum production at Nitinat River and Conuma River (all stocks) hatcheries is marked using otolith thermal marks. *"Thermal marking has been used as a technique of mass marking hatchery-raised salmonids in B.C. since 1992. The method involves manipulating the temperature of the rearing water by at least 2^{o}C to induce a mark on the otolith. The change in water temperature can be accomplished through the use of two different water sources, through heating the water or by chilling it. By altering water temperatures over a period of time a unique mark can be created"* (PSC 2008).

Where hatchery contribution data are required and assessment funds allow, samples from fisheries and escapement are analyzed for hatchery contribution. In addition, scales are collected from catch, escapement and broodstock for age determination.

4.3.1.3 Genetic Stock Identification (GSI)

A comprehensive GSI program is on-going for BC chum salmon, summarized in the publications listed in Section 2.1.1.4.

4.3.2 Forecasts

Annual salmon stock outlooks provide qualitative expectations for the upcoming season (http://www.pac.dfo-mpo.gc.ca/fm-gp/species-especes/salmon-saumon/index-eng.htm).

Quantitative forecasts for WCVI chum salmon are developed for population aggregates corresponding to each statistical area on the west coast of Vancouver Island. Wild and enhanced production is predicted through separate models.

For wild populations, production from each brood year within an area is estimated by multiplying the estimated spawners by the average historic productivity of WCVI wild chum (1.6 recruits per spawner). Density dependence is not incorporated in the model. For each brood year, production estimates are then scaled according to a subjective interpretation of brood year success relative to average conditions. Factors indicating brood success include return rates of younger siblings from the same brood, estimates of marine survival from other species, and qualitative estimates of predator and prey density during early ocean residence. Production estimates for each brood year are then partitioned to future return years based on the historical average age composition of returns.

Return of WCVI hatchery populations are predicted by multiplying specific release numbers for each brood year by hatchery-specific average smolt-to-adult survival. Again, density dependence is not currently included in the model. Like the wild production estimates, the hatchery estimates are modified by supplementary biological information, and then partitioned to return year based on average age compositions.

Within a statistical area, the wild and hatchery production estimates from multiple brood years are summed by return year to generate annual pre-season return forecasts. The forecasts include estimates of age-specific hatchery and wild return. Estimates of age and hatchery contribution from samples of the return are used to evaluate and update the forecast model for future years.

Chum forecasts are relatively inaccurate compared to forecasts for other salmon species. For example, the mean absolute percent error (MAPE) of pre-season forecasts in Area 25 (Nootka Sound) over the last 14 years is 66% (Table 10). This MAPE indicates the pre-season forecast was on average 66% higher or lower than the post-season estimated chum return. Unfortunately, the worst performing forecast years tend to be over-predictions of return (1995, 2000, 2007; Table 10). In general, pre-season forecasts in recent years have generally been higher than post-season estimates of total return. The relative inaccuracy of pre-season forecasts requires a conservative management approach for WCVI chum, except where in-season assessment data allows for more accurate management or when the fishery targets an individual hatchery stock. Therefore, a fixed harvest-rate strategy was adopted for those fisheries targeting wild stocks as opposed to a fixed-escapement strategy.

4.3.3 Trend Summaries

This section describes the time series shown in Figure 3 to Figure 7.

4.3.3.1 Escapement

Observed escapements are aggregated by management unit or statistical area (Table 2), and total escapements for each aggregate are adjusted to account for systems that were not surveyed. Expansion factors for each statistical area are based on the ratio of escapement in annual surveyed streams to observed total escapement estimates in the past (Table 7).

4.3.3.2 Catch, harvest rate, and exploitation rate

Catch estimates in Table 8 are compiled for terminal fisheries as described in Section 4.2.3. In general, total abundance is estimated as expanded escapement plus catch, and exploitation rate is simply catch / total abundance.

Additional assumptions are required for the following systems:

- *Nootka Sound gillnet fishery*: Because the fishery targets a mix of wild and enhanced chum (destined for Tlupana Inlet, Conuma Hatchery), exploitation rate estimates are made using a run reconstruction approach. A run reconstruction works backwards through time from escapement through fisheries, adding catch in sequential fisheries to escapement to estimate the total return prior to fishing. The run reconstruction for Nootka Sound is complicated by the presence of both wild and enhanced fish, and a fishery that occurs in both outer Nootka Sound and Tlupana Inlet in most years (Table 8). The method assumes: (1) all fish returning to Tlupana Inlet are enhanced; (2) Tlupana Inlet fisheries only target fish returning to Tlupana Inlet; (3) Tlupana Inlet fisheries occur after outer Nootka fisheries; and (4) that weekly openings can be aggregated. The run reconstruction estimates the exploitation rate for wild chum in outer Nootka Sound and for enhanced fish in both outer Nootka Sound and Tlupana Inlet. Exploitation rate estimates for wild chum in outer Nootka fisheries (1995 to 2008) are presented in Table 11.

- *Limited fleet assessment gillnet fisheries*: Limited fleet assessment fisheries have operated in Esperanza Inlet and Barkley Sound since 2004 and Clayoquot Sound since 2007. Estimating exploitation rate in these fisheries is easier than for the outer Nootka fishery, as they primarily only target wild stocks. In the Esperanza fishery, Conuma hatchery marked fish have been identified in catch (average 3% in 2004 & 2005), but the minor enhanced component is ignored for exploitation rate calculations. The exploitation rate is estimated from total catch and expanded escapement estimates (catch divided by catch + expanded escapement) for each statistical area separately. Effort is limited to eight boats in Esperanza and Barkley and four boats in Clayoquot. The fisheries were open for two days per week during the fishing season in Barkley and Clayoquot sound. In Esperanza Inlet, the fishery has the same openings as the outer Nootka fishery: either one or two days per week depending on effort in the outer Nootka Fishery. All assessment fisheries occur during daylight hours. The fisheries operate within defined fishing zones for each boat for the first day of a weekly opening. On the second day, access to the fishing area is unrestricted.

5 STOCK STATUS

5.1 Regular status evaluations

DFO evaluates the status of WCVI 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.

5.2 Current status

5.2.1 Conservation priorities

Currently, WCVI chum populations are healthy enough not to warrant a legislated level of protection. The major factor contributing to low production in recent years is low marine productivity. Even with low productivity, the persistence of WCVI chum populations is not immediately threatened. However, if the conservation unit declined to a point where its persistence was threatened, the Canada Species at Risk Act (SARA) provides a legislative and policy framework for recovery.

Deserted River chum have been identified as a conservation priority, and local measures have been implemented in Nootka fisheries (Section 3.3.2).

5.2.2 Production objectives

Chum production is generally quite variable. Productivity of the WCVI aggregate has been average to above average in recent years (2001 to 2006); although 2007 and 2008 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 and other salmonids. Recent fisheries management has responded appropriately to fluctuations in productivity: in years of low returns, fishing mortality has been constrained (e.g. 2000, 2008; Table 8)

5.2.3 Trends

5.2.3.1 Abundance

Annual returns of WCVI chum are summarised in Table 3. Average total estimated return for the period 1995 to 2008 is 1.11 million chum (range: 220,000 – 2.25 million; Table 3). Area 21/22 (Nitinat) returns are the largest, averaging about 60% of the annual WCVI chum return over the 1995 to 2008 period. Area 25 (Nootka) is about 20% of the annual return and populations originating from other areas contribute less than 10%. Correlations between adult chum returns and conditions during the early marine phase of the life history (e.g. sea surface temperature, euphausiid density) have been identified, but no formal analysis has been published.

5.2.3.2 Escapement

Escapement trends are summarized in Table 2 and Figure 2 to Figure 7.

Observed escapement of chum (i.e. peak live plus dead counts) to most natural systems decreased in 2007 and 2008 relative to recent estimates (2002 – 2006) in the WCVI area (Figure 2). Total escapement estimates were well below average across most Statistical Areas in 2007 and 2008, with the exception of returns to Statistical Areas 24 and 26 in 2007 (Figure 2). Low returns and resulting escapements recorded in

the last two years are not unprecedented: escapements across the WCVI chum CU in 2000 were also very low. Average expanded escapement to area 21/22 (Nitinat) from 1995 to 2008 was approximately 198,000 chum. This average is very close to the operational escapement target for the area (175,000).

5.2.3.3 Catch

Catch trends are summarized in Table 8 and Figure 3 to Figure 7.

Commercial catch has ranged from about 19,000 to 1.13 million chum since 1995 (Table 8). On average, approximately 460,000 chum have been commercially harvested each year from the two WCVI chum conservation units since 1995. From 1995 to 2003, all commercial catch was taken in the Nitinat and Nootka fisheries with Nitinat catch being on average about 74% of the commercial catch during this period. Since 2004, limited fleet assessment fisheries have contributed to WCVI chum catch, averaging about 8% of total catch (Table 8).

5.2.3.4 Exploitation Rate

Catch trends are summarized in Figure 3 to Figure 7.

The Nootka Sound gillnet fishery and limited effort gillnet assessment fisheries in Barkley, Clayoquot and Esperanza Inlets are managed to fixed exploitation rate targets. Estimates of exploitation rates in these fisheries are presented in Table 11 and Table 12. Estimated exploitation rates show varied performance relative to targets. In Nootka Sound gillnet fisheries, estimated exploitation rate has clearly exceeded the 20% target on wild chum from 2005 to 2007, after several years of remaining close to target levels (Table 11). Estimated exploitation rate in the Esperanza assessment fishery has also exceeded the target exploitation rate in recent years (Table 12). For Barkley and Clayoquot Sound assessment fisheries, the estimated exploitation rates have generally been close to target levels (Table 12). Increases in effort (Nootka fishery) or effort levels too high for local productivity (Esperanza fishery) likely resulted in exceeding exploitation rate targets. Reductions in the number of fishery openings were made in the 2008 Nootka fishery, and effort reductions in the Esperanza fishery are planned for 2009. Exploitation rate is reviewed annually to relative to targets.

5.2.3.5 Marine Survival

Chum marine survival estimates are not routinely calculated, as they are for other species using coded wire tags or other mark recoveries. In the past, when release specific fin clips applied to all hatchery produced chum were recovered in fisheries and brood collections, such calculations were made; but since 1999, hatchery marks consist only of otolith thermal marks. The average marine survival across all releases of fin-clipped marked chum from Nitinat hatchery during the 1990 to 1998 period was 1.5% (R. Tanasichuk, *pers comm*.). Processing of otolith thermal marks has been sporadic for chum due to funding constraints. Current estimates of marine survival from otolith marks are in preparation. For WCVI salmonid populations, trends in marine survival rate tend to be correlated. Therefore, for forecasting and planning purposes, major fluctuations in the marine survival rate of chum broods are somewhat anticipated.

6 CONSERVATION MEASURES IN WCVI 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 that lists local conservation measures by statistical area.

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 list specific conservation measures for each fishery. This section highlights some examples of local conservation measures in WCVI chum fisheries.

6.2 Chum conservation measures

For WCVI chum fisheries targeting hatchery returns, in-season information is used to trigger fisheries. When surpluses to escapement and brood requirements are identified, fisheries occur. Spawning escapement and brood requirements act as proxy limit reference points in these fisheries. In years where in-season information indicates returns below requirements, fisheries are closed. Some effort is required for refining the operation of in-season test fisheries and use of the information for making management decisions. Alternative assessment approaches, such as the use of an acoustic counter at Nitinat Lake, are being evaluated.

For fisheries targeting wild stocks and limited to fixed exploitation rates, there are currently no defined limit reference points at which fishing ceases. However, in the 2007 Nootka fishery, in-season estimates of escapement indicated a very low return and this information resulted in the decision to close the fishery. Post-season estimates of exploitation rate for the local stocks indicate this management action was appropriate.

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, by-catch of non-target steelhead salmon was a concern in the Nitinat commercial gillnet fishery. Unpublished studies by DFO, the Provincial Fisheries Branch, and consultants reviewed steelhead capture in statistical area 21/121 chum fisheries through the late 1990s. These

studies indicated that by-catch was reduced by fishing for chum only after the end of September, restricting fisheries to areas within the surfline (allowing openings only in area 21, not 121) and incorporating a mandatory ‘weedline’ on nets. These changes were incorporated into the fishery.

Concern for by-catch of chinook in area 24 (Clayoquot) resulted in a delayed opening there compared to other WCVI chum fisheries.

Finally, there are many areas within the WCVI simply closed to salmon fishing in order to protect weak stocks.

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TABLES

Table 1. Population structure of WCVI chum.
Spawning sites are listed if there is at least escapement estimate available since 1995. **Bold font** indicates systems with average escapement larger than 5,000 over the period 1995 to 2005. *Underlined italic font with an asterisk** marks systems with active hatchery enhancement. 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).

CU	Mgmt Area	Stat Area	Spawning Sites
Southwest Vancouver Island	Juan de Fuca Strait	20	Ayum Creek, Baker Creek, Charters River, **De Mamiel Creek**, Gordon River, Harris Creek, Hemmingsen Creek, Lens Creek, Mosquito Creek, Muir Creek, Renfrew Creek, San Juan River, **Sooke River**
	Nitinat	21	Carmanah Creek, Cheewhat River, *Klanawa River**
		22	Campus Creek, Caycuse River, Doobah Creek, Hobiton Creek, ***Nitinat River****
	Barkley Sound and Alberni Inlet	23	Beaver Creek, Campsite Creek, Canoe Pass Creek, Carnation Creek, Cass Creek, Cataract Creek, Cherry Creek, China Creek, Clemens Creek, Coeur D'Alene Creek, Coleman Creek, Consinka Creek, **Cous Creek,** Deer Creek, Dutch Harbour Creek (east and west), **Effinghan River,** Franklin River, Frederick Creek, Henderson Lake, Hillier Creek, Holford Creek, Itatsoo Creek, Kitsucksus Creek, Little Maggie River, **Little Toquart Creek,** Lucky Creek, Macktush Creek, Maggie River, Mercantile Creek, **Nahmint River,** Owatchet Creek, Pachena River, Pipesteam Creek, Poett Nook Creek, Ritherdon Creek, **Sarita River,** Sechart Creek, Smith Creek, Snug Basin Creek, Somass System, *Sugsaw Creek**, Thornton Creek, **Toquart River,** Twin Rivers Creek (east and west), Uchuck Creek, Useless Creek, Vernon Bay Creek, Wallace Creek
	Clayoquot Sound	24	Angora Creek, **Atleo River,** Bawden Creek, Bedingield Bay Creek, Bedwell/Ursus, Bulson Creek, Cecilia Creek, Clayoquot River, Close Creeks (2), Cold Creek, Cone Creeks (2), Cow Creek, Cypre River, Fundy Creek, Hesquiat Harbour #1 to 4 Creeks, Hesquiat Lake Creek, Hesquiat Point Creek, Hootla Kootla Creek, Hot Springs Cove Creek, Ice River, Kennedy Lake Beaches, Kennedy Lake Feeder Streams, Kennedy River (lower and upper), Kootowis Creek, Little Whitepine Cove #1 Creek, Lost Shoe Creek, Megin River, **Moyeha River,** Riley Creek, Sand River, Sandhill Creek, Sutton Mill Creek, Sydney River, Tofina Creek, **Tranquil Creek, Warn Bay Creek,** Watta Creek, White Pine Cove Creek
	Nootka Sound and Esperanza Inlet	25	Beano Creek, Bingo Creek, **Black Creek**, Brodick Creek, **Burman River**, ***Canton Creek***, Chum Creek, ***Conuma River***, Cougar Creek, **Deserted Creek**, Eliza Creek, **Espinosa Creek**, Gold River, Guise Creek, Hammond Creek, Hoiss Creek, Inner Basin River, Kendrick Creek, Kleeptee Creek, **Leiner River**, Little Zeballos River, Lord Creel, Mamat Creek, Marvinas Bay Creek, McCurdy Creek, Middle Eliza Creek, Mooyah River, Muchalat River, Oktwanch River, Owossitsa Creek, Park River, ***Sucwoa River***, **Tahsis River**, ***Tlupana River***, **Tsowinn River**, **Zeballos River**
	Kyuquot Sound	26	Amai Creek, Artlish River, Cachalot Creek, **Chamiss Creek**, Clanninick Creek, Easy Creek, Elaine Creek, Jansen Lake Creek, **Kaouk River**, Kashutl River, Kauwinch River, Malskope River, Narrowgut Creek, Ououkinsh River, Tahsish River, Yaku River
Northwest Vancouver Island	Quatsino Sound	27	**Colonial/Cayeghle Creeks,** Marble River

Table 2. Recent escapement estimates to 21 annually surveyed spawning streams of WCVI chum salmon. Estimates are rounded to the nearest hundred chum. Missing data indicate the stream was not surveyed in that year.

AREA	STREAM	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average ('95 - '08)
21	NITINAT RIVER	119,300	330,000	423,200	179,200	145,000	20,800	301,000	36,200	235,400	235,000	300,000	147,300	110,000	50,000	*188,000*
	Area 21 Total	**119,300**	**330,000**	**423,200**	**179,200**	**145,000**	**20,800**	**301,000**	**36,200**	**235,400**	**235,000**	**300,000**	**147,300**	**110,000**	**50,000**	***188,000***
23	CARNATION CREEK	100	200	1,100	700	100	0	100	100	500	2,100					*500*
	NAHMINT RIVER	15,000	19,900	46,400	140,600	37,700	5,100	9,700	60,000	51,300	35,200	28,800	8,500	23,600	8,400	*35,000*
	SARITA RIVER	3,700	8,500	14,400	31,600	11,900	3,300	5,300	35,000	10,000	22,200	15,000	2,500	1,200	4,100	*12,000*
	TOQUART RIVER	2,100	4,600	10,000	11,000	10,000	3,800	800	1,300	8,900	1,700		2,100			*5,100*
	Area 23 Total	**20,900**	**33,100**	**71,900**	**183,900**	**59,600**	**12,200**	**15,900**	**96,400**	**70,700**	**61,200**	**43,800**	**13,100**	**24,800**	**12,500**	***51,400***
24	BEDWELL/URSUS	800	2,900	1,400	6,500	2,300	2,000	3,900	4,700	4,800	8,100	2,800	5,600	1,500	300	*3,400*
	MEGIN RIVER	800	1,200	2,700	12,200	4,400	1,600	4,300	3,300	3,100	4,000	100	9,000	100	900	*3,400*
	MOYEHA RIVER	2,600	5,900	5,200	19,100	12,700	4,700	8,900	14,600	15,100	11,900	7,900	21,600	24,000	7,600	*11,500*
	TRANQUIL RIVER	400	3,500	4,500	6,500	4,000	4,600	6,100	13,900	8,400	31,300	11,200	10,700	4,900	2,600	*8,000*
	Area 24 Total	**4,600**	**13,500**	**13,700**	**44,300**	**23,300**	**12,900**	**23,300**	**36,500**	**31,500**	**55,200**	**22,100**	**47,000**	**30,500**	**11,400**	***26,400***
25	BURMAN RIVER	2,900	6,000	10,100	22,200	5,300	2,200	12,200	25,100	4,500	7,500	8,300	5,100	700	3,400	*8,300*
	CANTON CREEK	3,000	8,000	25,500	40,600	9,900	1,500	2,600	7,000	11,000	8,800	6,000	1,200	100	0	*9,600*
	CONUMA RIVER	11,700	35,000	74,300	162,300	32,400	12,200	60,700	50,000	33,500	37,200	8,200	6,600	3,300	5,500	*38,100*
	LEINER RIVER	2,800	1,600	3,600	15,700	7,900	2,200	2,000	5,700	1,600	22,100	3,700	5,100	1,100	1,400	*5,500*
	SUCWOA RIVER	2,800	10,100	12,900	53,800	6,600	1,200	3,400	3,000	6,000	9,800	5,800	1,300	100	0	*9,000*
	TAHSIS RIVER	5,500	8,300	10,500	32,000	14,100	10,500	11,900	5,900	7,600	26,100	9,300	4,400	1,000	1,800	*10,600*
	TLUPANA RIVER	7,000	20,000	12,600	34,800	24,000	9,400	4,200	15,700	8,000	21,900	15,000	10,500			*15,300*
	TSOWWIN RIVER	1,500	7,300	8,400	22,000	5,800	7,800	11,200	100		19,500		1,500			*7,800*
	ZEBALLOS RIVER	3,000	8,500	12,300	18,600	10,600	4,000	4,000	6,600	9,500	10,500	11,100	7,800	5,100	2,100	*8,100*
	Area 25 Total	**40,100**	**104,800**	**170,200**	**402,100**	**116,600**	**51,200**	**112,300**	**119,000**	**81,600**	**163,400**	**67,400**	**43,400**	**11,400**	**15,400**	***107,100***
26	ARTLISH RIVER	0	1,300	2,500	10,400	8,200	800	300	2,800	7,900	7,600	4,400	2,500	6,100	2,700	*4,100*
	KAOUK RIVER	2,000	3,500	3,200	25,900	19,500	1,400	900	2,800	10,300	7,800	11,500	6,600	13,000	3,200	*8,000*
	TAHSISH RIVER	3,700	3,300	4,300	11,400	6,800	3,800	2,800	1,500	4,300	6,900	500	13,700	7,500	3,700	*5,300*
	Area 26 Total	**5,700**	**8,100**	**10,000**	**47,800**	**34,600**	**6,100**	**3,900**	**7,100**	**22,500**	**22,300**	**16,400**	**22,800**	**26,500**	**9,600**	***17,400***

Table 3. Post season estimates of WCVI chum return by Statistical Area and Conservation Unit (CU). Estimates are rounded to the nearest thousand chum.

Return Year	Statistical Area					WCVI (CU) Total
	21	23	24	25	26	
1995	336,000	34,000	12,000	93,000	18,000	493,000
1996	696,000	54,000	35,000	171,000	25,000	981,000
1997	1,500,000	118,000	35,000	361,000	31,000	2,045,000
1998	891,000	301,000	114,000	799,000	149,000	2,254,000
1999	317,000	98,000	60,000	302,000	108,000	885,000
2000	33,000	20,000	33,000	115,000	19,000	220,000
2001	627,000	26,000	60,000	229,000	12,000	954,000
2002	717,000	158,000	94,000	349,000	22,000	1,340,000
2003	781,000	116,000	81,000	266,000	70,000	1,314,000
2004	641,000	112,000	142,000	367,000	70,000	1,332,000
2005	1,233,000	92,000	57,000	244,000	51,000	1,677,000
2006	754,000	40,000	120,000	213,000	71,000	1,198,000
2007	318,000	59,000	85,000	51,000	83,000	596,000
2008	125,000	27,000	30,000	50,000	30,000	262,000
Average	*641,000*	*90,000*	*68,000*	*258,000*	*54,000*	*1,111,000*

Table 4. Operational escapement and broodstock targets for WCVI chum by statistical areas.

Location	Statistical Area	Escapement Target	Broodstock Target
Nitinat	21/22	175,000	30,000
Barkley	23	150,000	
Clayoquo	24	100,000	
Nootka	25	205,000	4,000
Kyuquot	26	180,000	

Table 5. 2008 Nitinat chum decision guidelines

DATE (9/2 = 2nd week of Sept.)	**GUIDELINES**	**ACTION**
Week 9/2		• No fisheries due to Fraser steelhead concerns.
Week 9/3		• No fisheries due to Fraser steelhead concerns. • No gill net test or commercial fishery anticipated.
Week 9/4	• Preseason Forecast is not yet available.	• No fisheries due to Fraser steelhead concerns. • No gill net test or commercial fishery anticipated
Week 10/1	• Fishery opportunity based on preseason forecast. • Escapement in lake by Oct.5-8 = 75,000 with sufficient stock outside. • Min weekly influx = 50,000.	• Gill net fishery anticipated. Fishery inside a line 1 mile south of Pachena point to 1 mile south of Dare Pt. Continue assessment with test fishing and escapement monitoring to lake.
Week 10/2	• Escapement in lake byOct 9-11 = 125,00 with sufficient stock outside. • Min weekly influx = 50,000.	• Seine fishery anticipated. Seine opportunity dependent on test fishing results and escapement into the lake. Early season allocation is 50:50 gill net:seine. Maximum gill net catch of 200,000 chum before seine fishery.
Week 10/3	• Escapement in lake byOct 16-18 = 175,000; • Min weekly influx = 50,000. •	• Seine and/or gill net opportunities depending on escapement to date, escapement rate, effort.
Week 10/4	• Escapement in lake by Oct 23 = 225,000; • Min weekly influx = 25,000.	• Seine and/or gill net opportunities depending on escapement to date, escapement rate, effort.

Table 6. Releases of chum (millions) from Nitinat and Conuma hatcheries.

		Hatchery Releases	
Brood Year	Release Year	Nitinat	Conuma
1978	1979	-	1.70
1979	1980	-	5.23
1980	1981	2.34	18.11
1981	1982	27.18	25.45
1982	1983	8.43	37.59
1983	1984	17.28	37.93
1984	1985	26.23	38.92
1985	1986	17.59	39.63
1986	1987	16.58	30.13
1987	1988	12.17	21.47
1988	1989	16.67	25.00
1989	1990	23.74	28.53
1990	1991	23.43	24.69
1991	1992	30.53	27.13
1992	1993	24.21	26.81
1993	1994	28.36	21.38
1994	1995	30.83	29.06
1995	1996	24.65	8.26
1996	1997	31.94	14.68
1997	1998	34.39	20.03
1998	1999	35.46	23.44
1999	2000	23.72	15.55
2000	2001	5.15	8.51
2001	2002	30.26	8.31
2002	2003	25.67	9.02
2003	2004	23.77	7.41
2004	2005	35.32	9.04
2005	2006	39.46	4.70
2006	2007	28.91	5.82
2007	2008	13.00	0.89

Table 7. Expansion factors used to estimate total statistical area specific escapement from index stream escapement data.

Location	Statistical Area	No. of Index streams	Expansion Factor
Nitinat	21/22	1	1.1
Barkley	23	4	1.6
Clayoquot	24	4	2.5
Nootka	25	9	1.3
Kyuquot	26	3	3.1

Table 8. Commercial chum catch estimates by WCVI Statistical Area and gear type (SN is Area B Seine Fleet, GN is Area E [Statistical Area 21 only] or Area D Gillnet Fleet).

Statistical Area	21		23	24	25 (Nootka)		25 (Tlupana)	25 (Esperanza)	Total
Gear	SN	GN	GN	GN	SN	GN	GN	GN	
1995		172,950				20,664			**193,614**
1996	257,302	56,144							**313,446**
1997	823,943	213,251				89,515	38,855		**1,126,709**
1998	523,415	142,313			78,000	91,255	26,059		**834,983**
1999		108,959				85,613	58,750		**194,572**
2000						18,939			**18,939**
2001	65,256	60,710				61,841	24,674		**187,807**
2002	466,340	80,738				116,149	54,931	6,111	**663,227**
2003	265,146	190,245				100,308	58,234		**555,699**
2004	71,898	155,709	12,047			100,794	43,396	20,417	**340,448**
2005	385,487	294,054	12,274			89,905	5,749	24,788	**781,720**
2006	224,000	230,000	18,268			90,934	12,524	33,875	**563,202**
2007		180,111	7,828	4,473		7,449		9,199	**199,861**
2008	18,796	24,519	2,109	483		7,276		7,534	**53,183**
Average [1]	*310,158*	*146,900*	*10,505*	*2,478*	*78,000*	*67,742*	*35,908*	*16,987*	***651,691***

1 – Average calculation excludes zeros

Table 9. Proportion of hatchery marked chum (Conuma Hatchery) in Statistical Area 25 commercial fisheries.

	Hatchery contribution (Conuma Hatchery)		
Year	Outer Nootka	Tlupana	Esperanza
1995	43%		
1996			
1997	29%	49%	
1998	30%	6%	
1999	9%	24%	
2000	12%		
2001	52%	50%	
2002			
2003	40%	46%	
2004			5%
2005	27%		1%
2006			
2007			
2008			

Table 10. Pre-season forecast and post-season estimates of return for Statistical Area 25 (Nootka Sound) chum. Mean absolute percentage error is the absolute difference between pre-season forecast and post-season estimate as a percentage of (scaled to) the post-season estimate.

Year	Pre-season Forecast	Post-season Return Estimate	MAPE
1995	444,000	93,000	377%
1996	144,000	171,000	16%
1997	329,000	361,000	9%
1998	468,000	799,000	41%
1999	165,000	302,000	45%
2000	205,000	115,000	78%
2001	224,000	229,000	2%
2002	325,000	349,000	7%
2003	286,000	266,000	8%
2004	160,000	367,000	56%
2005	235,000	244,000	4%
2006	259,000	213,000	22%
2007	147,000	51,000	188%
2008	48,000	50,000	4%
Average	**246,000**	**258,000**	**66%**

Table 11. Run-reconstruction derived estimates of exploitation rate on wild and enhanced chum in Outer Nootka Sound and Tlupana Inlet fisheries.

	Catch		Exploitation Rate Estimate	
Year	Outer Nootka	Tlupana	Wild	Enhanced
1995	20,644		29%	43%
1996			3%	15%
1997	50,660	38,855	19%	41%
1998	120,254	26,059	20%	38%
1999	20,379	58,750	12%	56%
2000	19,338		26%	52%
2001	32,706	24,674	18%	45%
2002	62,308	54,828	23%	60%
2003	47,587	58,221	24%	64%
2004	57,172	43,396	20%	45%
2005	79,186	5,749	47%	55%
2006	78,197	12,524	55%	72%
2007	7,449		41%	46%
2008	7,276		22%	33%
Average [1]	**46,397**	**35,895**	**26%**	**48%**

1 – Average calculation excludes zeros

Table 12. Trends in effort (boat days), catch and exploitation rate (ER) estimates in WCVI limited fleet gillnet assessment fisheries.

Year	Barkley (Area 23)			Clayoqout (Area 24)			Esperanza (Area 25)		
	Effort	Catch	ER	Effort	Catch	ER	Effort	Catch	ER
2004	48	12,047	11%				43	20,417	30%
2005	71	12,274	13%				62	24,788	33%
2006	78	18,268	46%				64	33,875	49%
2007	70	7,828	13%	34	4,473	5%	31	9,199	28%
2008	24	2,109	7%	6	483	2%	32	7,534	43%
Average	**58**	**10,505**	**18%**	**20**	**2,478**	**4%**	**46**	**19,163**	**37%**

FIGURES

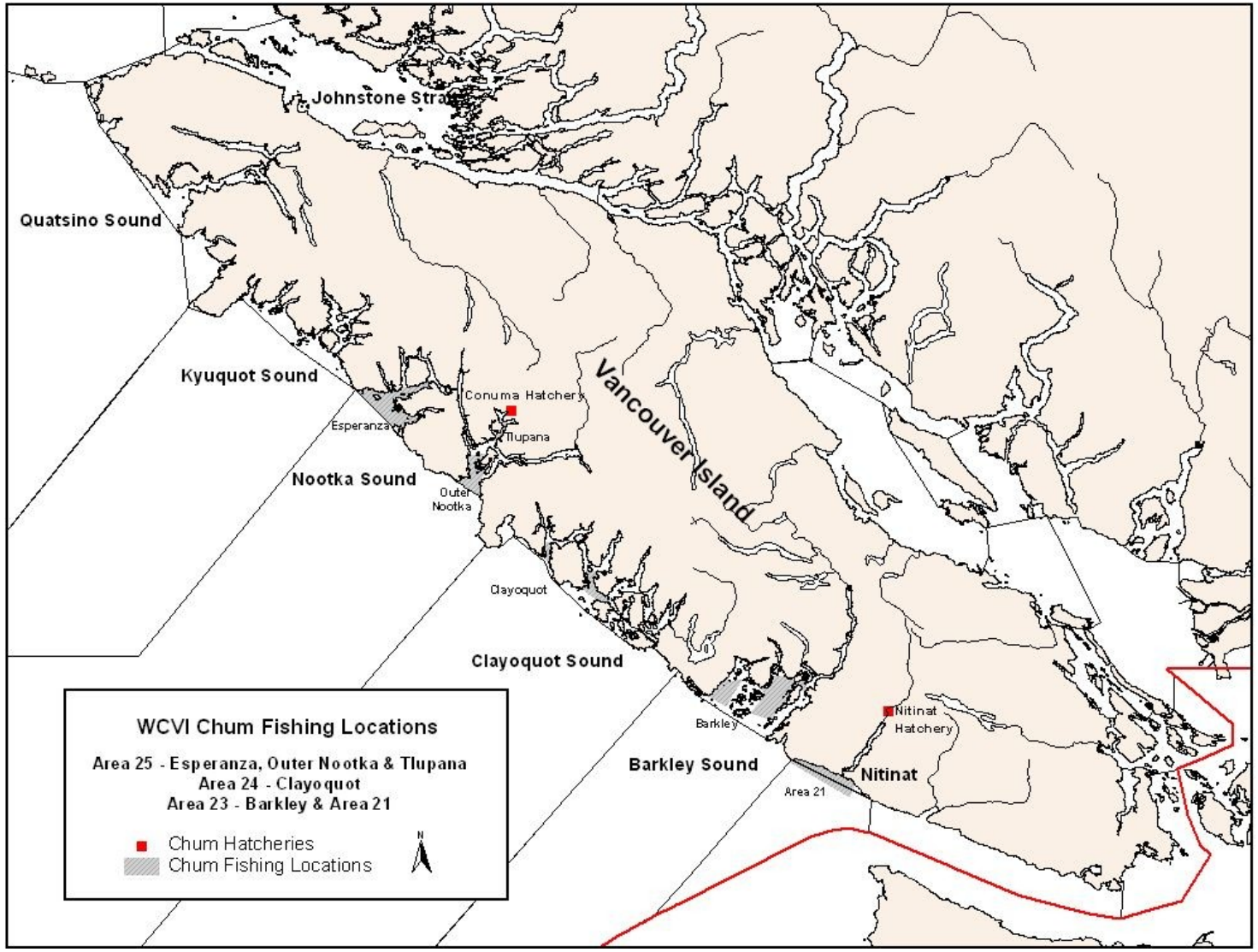

Figure 1. Map of the West Coast Vancouver Island Chum Conservation Unit, major enhancement facilities and location of commercial fisheries.

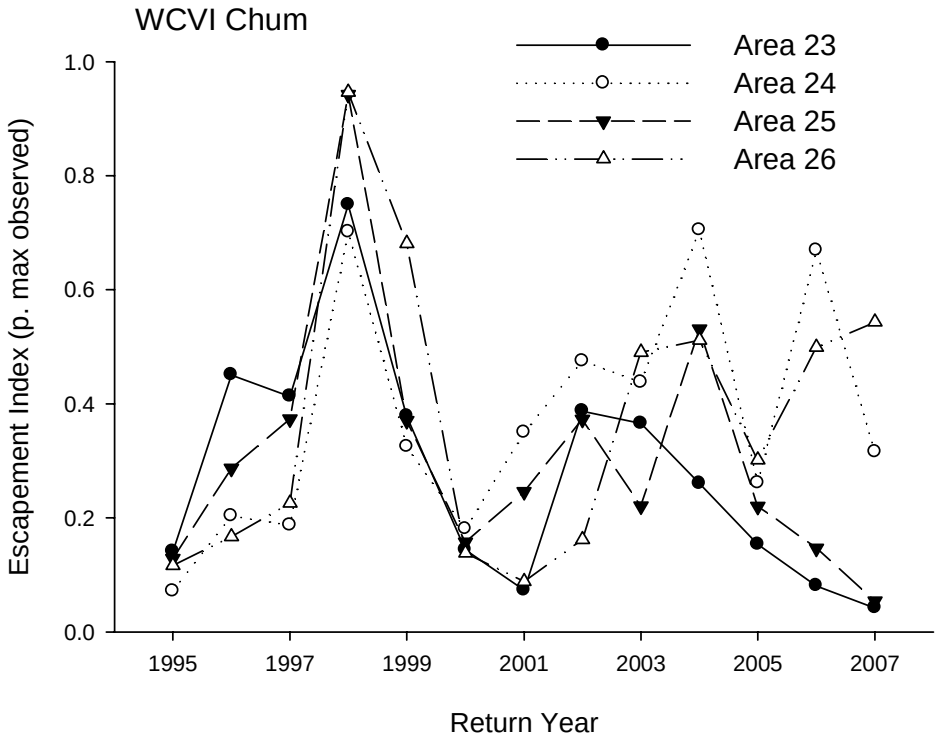

Figure 2. Index abundance of WCVI chum stocks, by statistical area. Averaging over systems, the index expresses the current year escapement relative to the maximum observation from the 1995-2006 period.

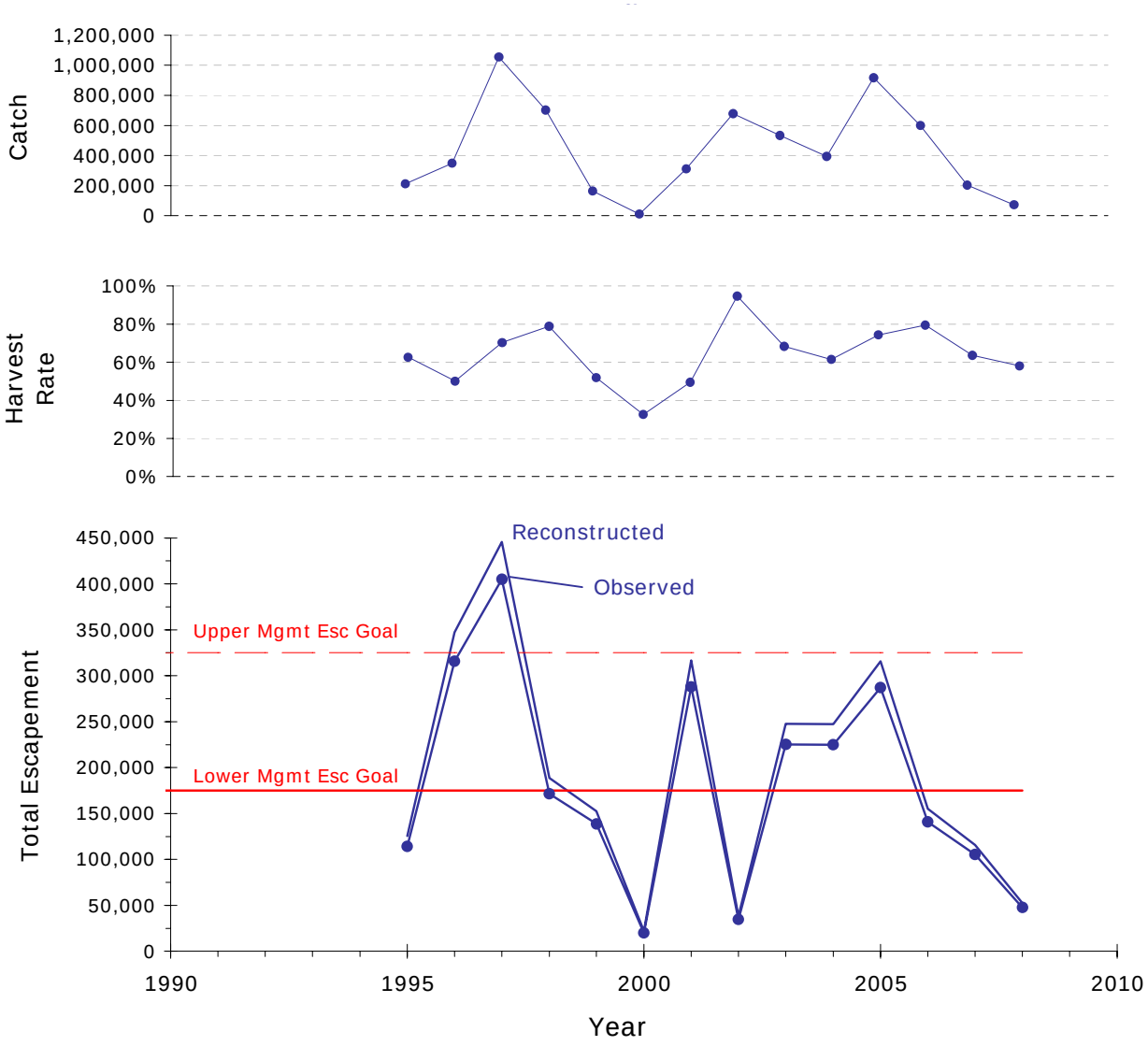

Figure 3. Trend summary for WCVI chum salmon – Nitinat (Area 22)
Data sources and assumptions for each of the time series are summarized in Section 4.3.3.

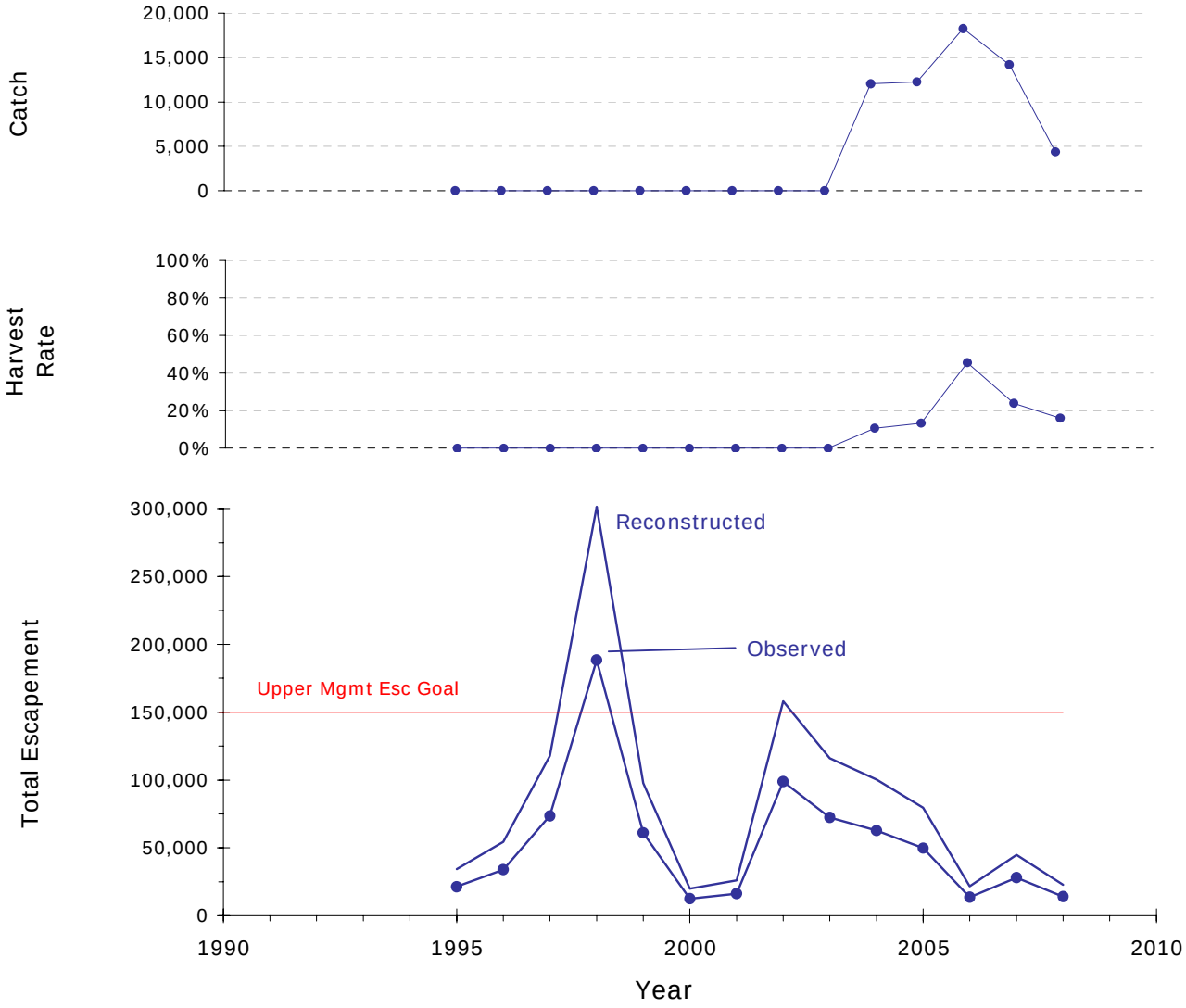

Figure 4. Trend summary for WCVI chum salmon – Barkley (Area 23)
Data sources and assumptions for each of the time series are summarized in Section 4.3.3.

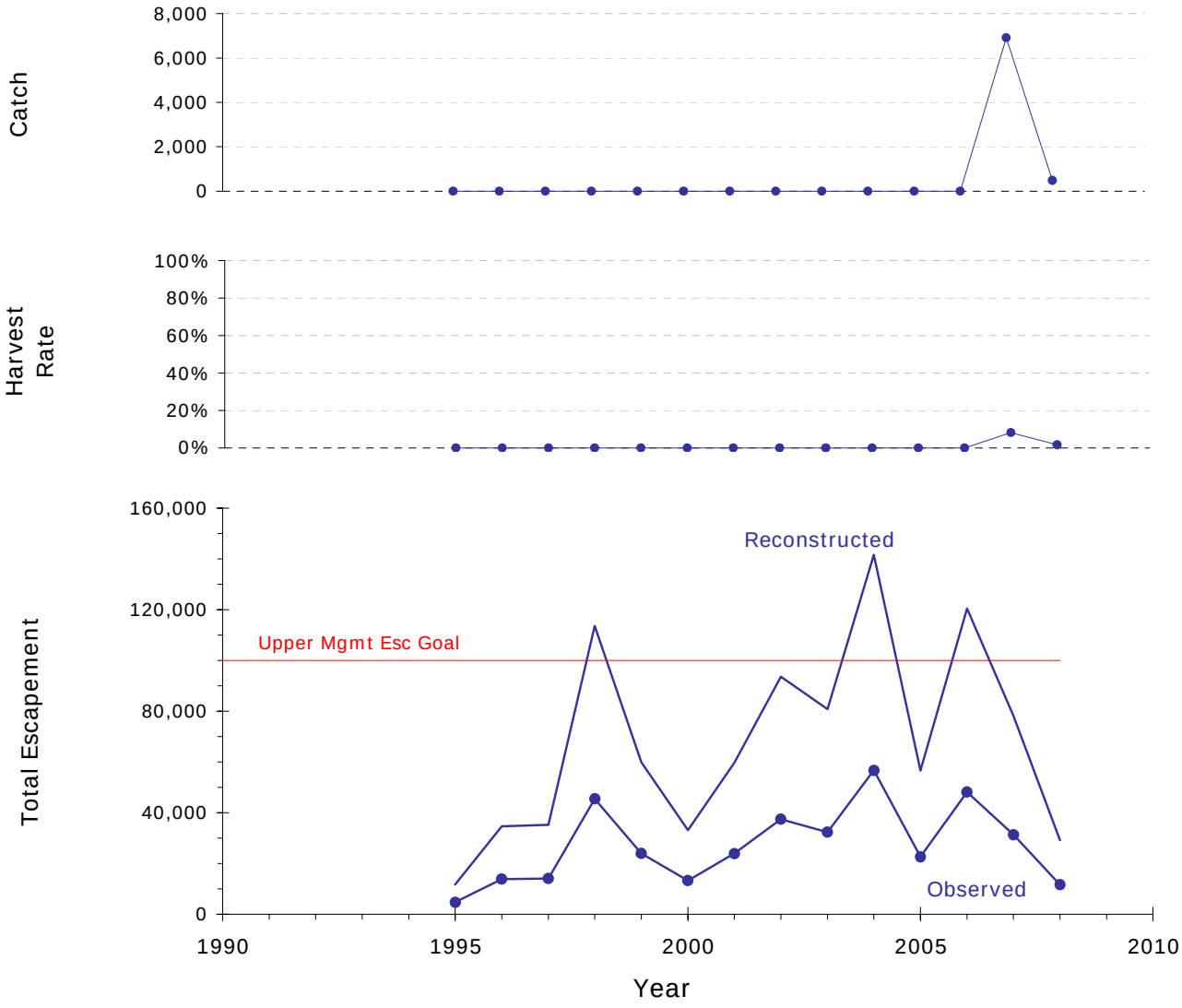

Figure 5. Trend summary for WCVI chum salmon – Clayoquot (Area 24)
Data sources and assumptions for each of the time series are summarized in Section 4.3.3.

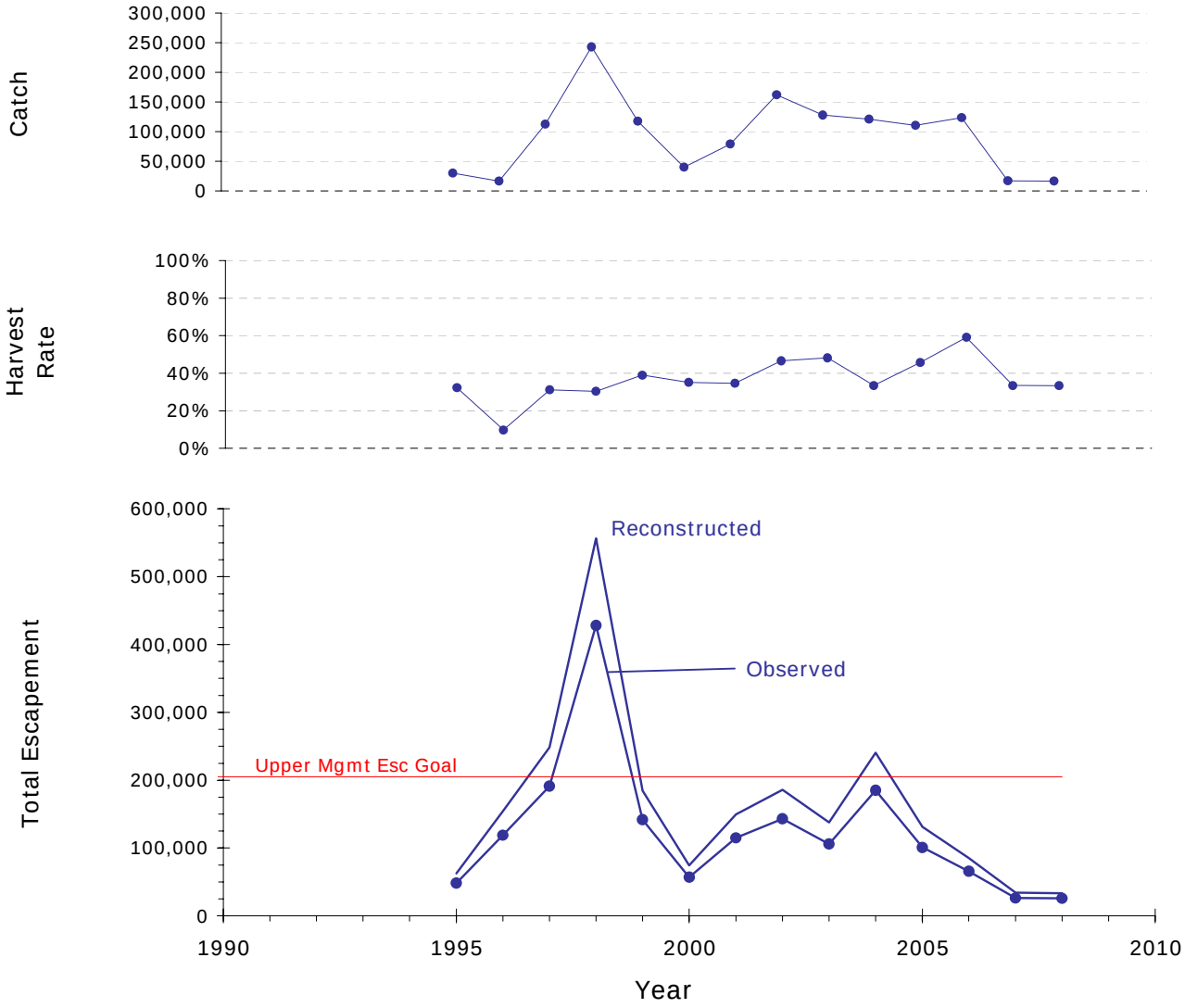

Figure 6. Trend summary for WCVI chum salmon – Nootka (Area 25)
Data sources and assumptions for each of the time series are summarized in Section 4.3.3.

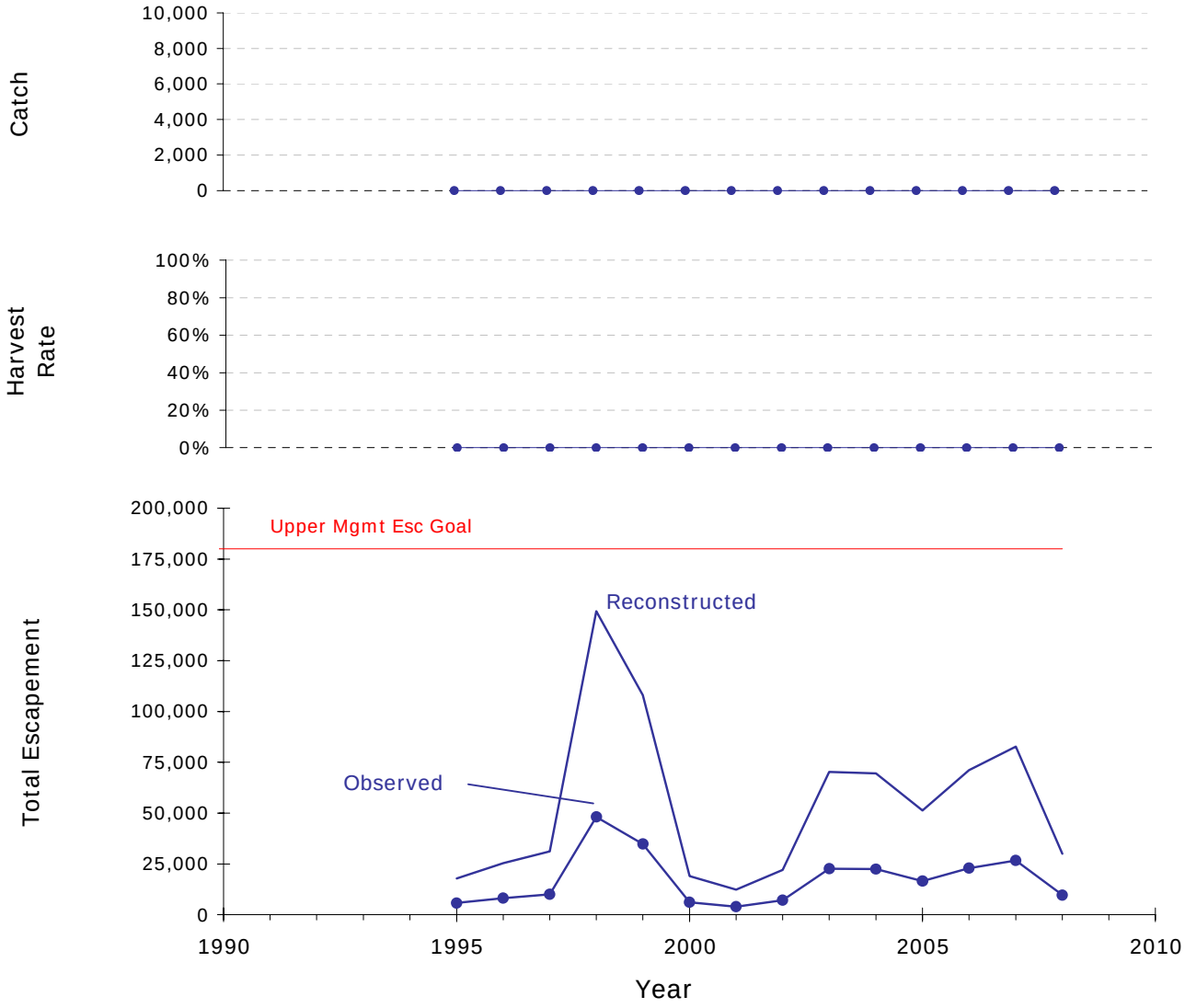

Figure 7. Trend summary for WCVI chum salmon – Kyuquot (Area 26)
Data sources and assumptions for each of the time series are summarized in Section 4.3.3.