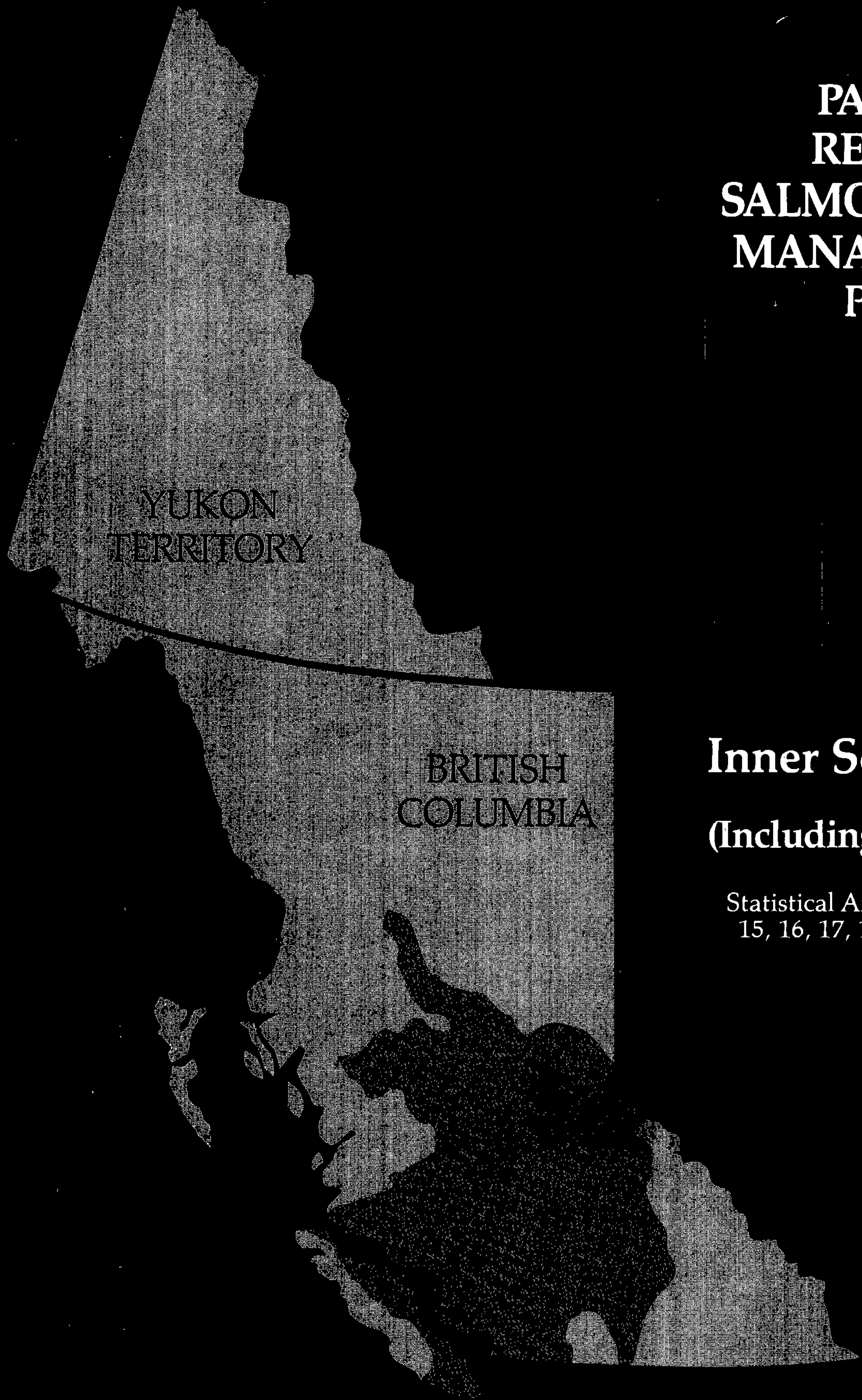
PACIFIC REGION SALMON STOCK MANAGEMENT PLAN

I

Inner South Coast

(Including Fraser River)

Statistical Areas - 11, 12, 13, 14,
15, 16, 17, 18, 19, 20, 28 & 29



DISCUSSION
DOCUMENT
1986

Fisheries and Oceans
Pêches et Océans
Canada

C O N T E N T S

PACIFIC REGION
SALMON RESOURCE MANAGEMENT PLAN

VOLUME I

INNER SOUTH COAST AND
FRASER RIVER

Department of Fisheries and Oceans
Vancouver, B.C.

1988

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Fall 1988

TO: THE READER

This discussion document was prepared to replace the April, 1985, edition of the Pacific Region Salmon Resource Management Plan. This edition differs from the original in title, in format, and in the inclusion of additional management options.

The title has been changed to the Pacific Region Salmon Stock Management Plan to make clear the distinction between stock management and fleet management. This document contains options for managing salmon stock production and harvest to make best use of the salmonid resource. It is hoped that a first edition of a Salmon Fleet Management Plan will be published by mid-1989. That document will contain options for managing the salmon fishing fleet to make best use of the labour, capital and other resources that are employed in harvesting the salmonid resource.

This edition was prepared in a new format to encourage review and comment by area, and to facilitate a regular revision process. This volume is one of twelve dealing with salmonid stocks by geographical area (individual or small groups of Statistical Areas) and by species (for Chinook and Coho salmon). Discussed in this volume are the salmon resources of the Inner South Coast (including Fraser River).

This document contains information on the status of salmon stocks, habitat, and fisheries, and a detailed discussion of some of the management problems that exist. Its purpose is to present existing information to provide a context for some management and enhancement options that have been suggested to rebuild the salmon resources. The local and specialized knowledge of advisors and others familiar with the Inner South Coast and Fraser River is vital to improving existing options, creating new ones if necessary, and to choosing the best possible combination of options to form the basis of our long-term management plans.

Pending such a review, no endorsement of the analysis or proposals contained in this document is implied or intended. Rather, I see a consultative process being applied to develop long-term management plans using the Salmon Stock Management Plan as a basis for discussion. Please approach this document constructively strengthening its weaknesses and building on its strengths. Working together, we can develop a plan to manage the Pacific salmon resource to the detriment of none and for the benefit of all.

Yours truly,

P.S. Chamut
Director General
Fisheries - Pacific

Canada

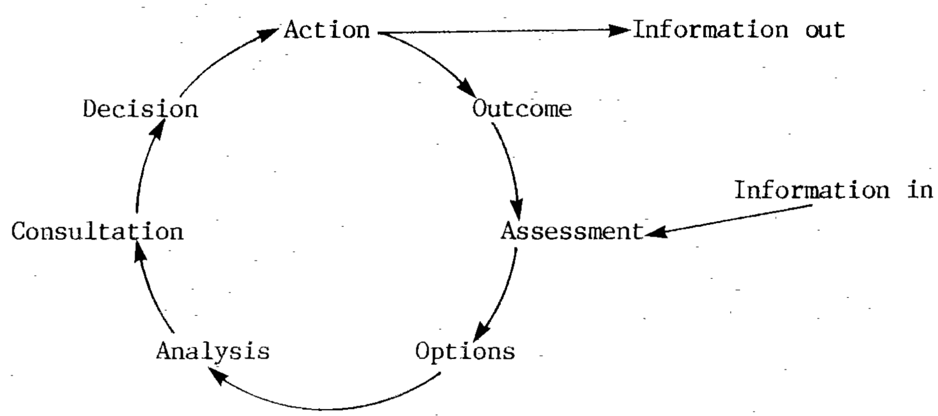
FOREWORD

This document contains plans for managing Pacific salmon fisheries. No decisions have yet been taken on these plans; they remain options from which to choose a direction for the future of Pacific salmon fisheries. Starting soon, but probably extending over a long period and subject to review and revision, decisions will be made in concert by all parties with an interest in the resource. The Salmon Stock Management Plan has been produced to motivate discussion and assist the decision-making process by identifying current strategies and problems, stating goals, and describing means by which they might be achieved.

The genesis of this document can be found on the first page of the Pearse Report, where the most serious criticism of the Department of Fisheries and Oceans was identified as, "the lack of cohesive, consistent, and forward-looking policies and programs with respect to fisheries management, enhancement, and environmental protection".* The Department has responded to this criticism, and to the subsequent recommendations made by Pearse,** by devoting considerable effort and resources, beginning in mid-1984 and continuing to date, to the production of the Salmon Stock Management Plan.

Nevertheless, this document is not finalized; in fact, it probably can never be finalized. The Salmon Stock Management Plan has been written as a discussion document that will evolve over time as the planning cycle, illustrated below, proceeds.

The Planning Cycle



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* P.H. Pearse, Turning the Tide: A New Policy for Canada's Pacific Fisheries, (Ottawa, Supply and Services Canada, (1982), p.1.
**Pearse, p. 39.

Past actions and outcomes of salmon management are documented and assessed in this report. New ideas and options for future management strategies are also analysed and will be the subject of informal and formal consultation. In this way, options can be transformed into decisions to take new and different actions leading to better outcomes. Because fisheries in general, and salmon fisheries in particular, are susceptible to rapid change, these outcomes will, in turn, generate renewed discussions as the cycle continues. The Salmon Stock Management Plan, then,is a record of management planning and action that is intended to motivate and facilitate this planning cycle.

This document contains information on the status of salmon stocks, habitat, and enhancement. As well, it discusses in some detail the fisheries that exist in each area, management problems, and options to rebuild our salmon resource by management and enhancement. The Salmon Stock Management Plan is a diverse document that will continue to evolve through annual updates to incorporate new information, assess performance, review objectives, identify problems, describe strategies, and analyse new options for managing salmon stocks. It should be read in this spirit. It is a document that is meant to stimulate thought and discussion with a view to generating interesting and useful new ideas that will find their way back into the document.

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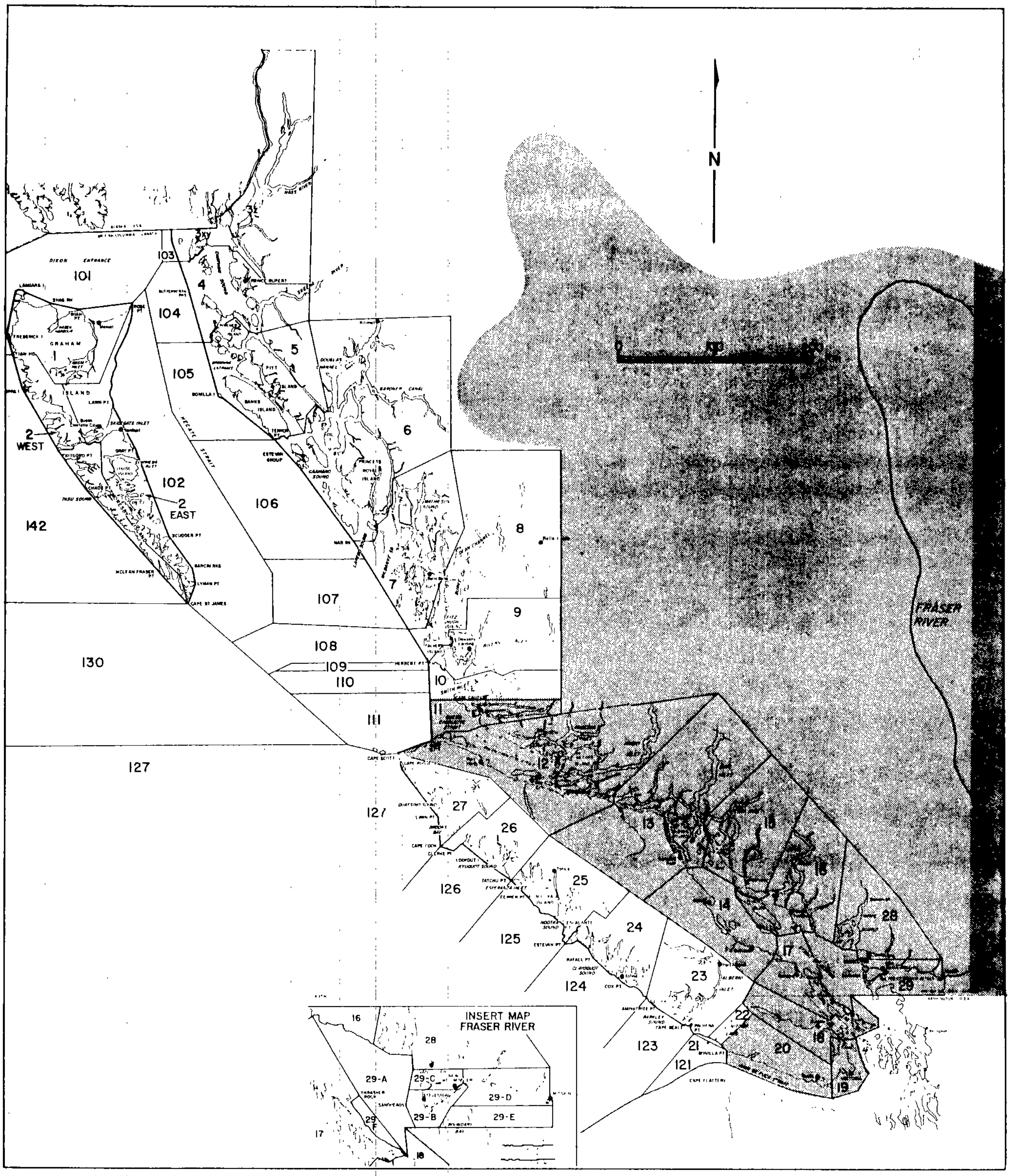

Figure 1. Department of Fisheries and Oceans Statistical Areas, British Columbia.

1. INTRODUCTION

This volume of the Pacific Region Salmon Stock Management Plan deals with Statistical Areas 11 - 20, 28 and 29, on the Inner South Coast of British Columbia (Figure 1). These areas are discussed in a single volume because the major harvest of salmon stocks from these areas occurs concurrently in a few fisheries. Major interception fisheries on the Inner South Coast stocks include Johnstone Strait, Juan de Fuca Strait, U.S. and Fraser River net fisheries and the West Coast Vancouver Island (WCVI) troll fishery. Most of these fisheries are directed at Fraser River stocks but also intercept salmon stocks from the other production areas. Therefore, the Inner South Coast is considered as a unit because management of any of its stocks depends on the management of Fraser River stocks.

The production areas of the Inner South Coast can be grouped into three broad categories: the east and south coast of Vancouver Island (Figure 2); the mainland inlets south of Cape Caution (Figure 2); and the Fraser River (Figure 3). All five salmon species and steelhead trout are produced on the Inner South Coast. However, salmon productivity varies among the production areas as a result of natural differences in habitat. The topography and climate of the region ranges from the dry and temperate interior plateau of the Fraser River drainage to the rugged, wet mainland coastal. The productivity of salmon stocks from these areas is also influenced by numerous development activities such as forestry, agriculture, transportation, hydroelectric generation, industry and urban settlement, which have occurred with varying intensity.

Between 1978 and 1982, about 40% of the annual average catch of salmon in the entire province was caught in the Inner South Coast area.[1] The stocks produced in this area also contribute to other B.C. fisheries, primarily the WCVI troll, the Central and Northern troll and Queen Charlotte interception fisheries.

Fisheries management in the Inner South Coast is considerably more complex than elsewhere along the coast because it involves an enormous area and hundreds of individual salmon stocks that are taken in several mixed-stock fisheries. In addition, cyclic changes in sockeye returns and differences in odd- and even-year pink runs result in dramatic variation in stock abundance and this has implications to the management of salmon fisheries in any given year. Annual variability in the numbers of salmon migrating through the northern (Johnstone Strait) or southern (Juan de Fuca Strait) approaches to the South Coast (i.e., diversion rates) further

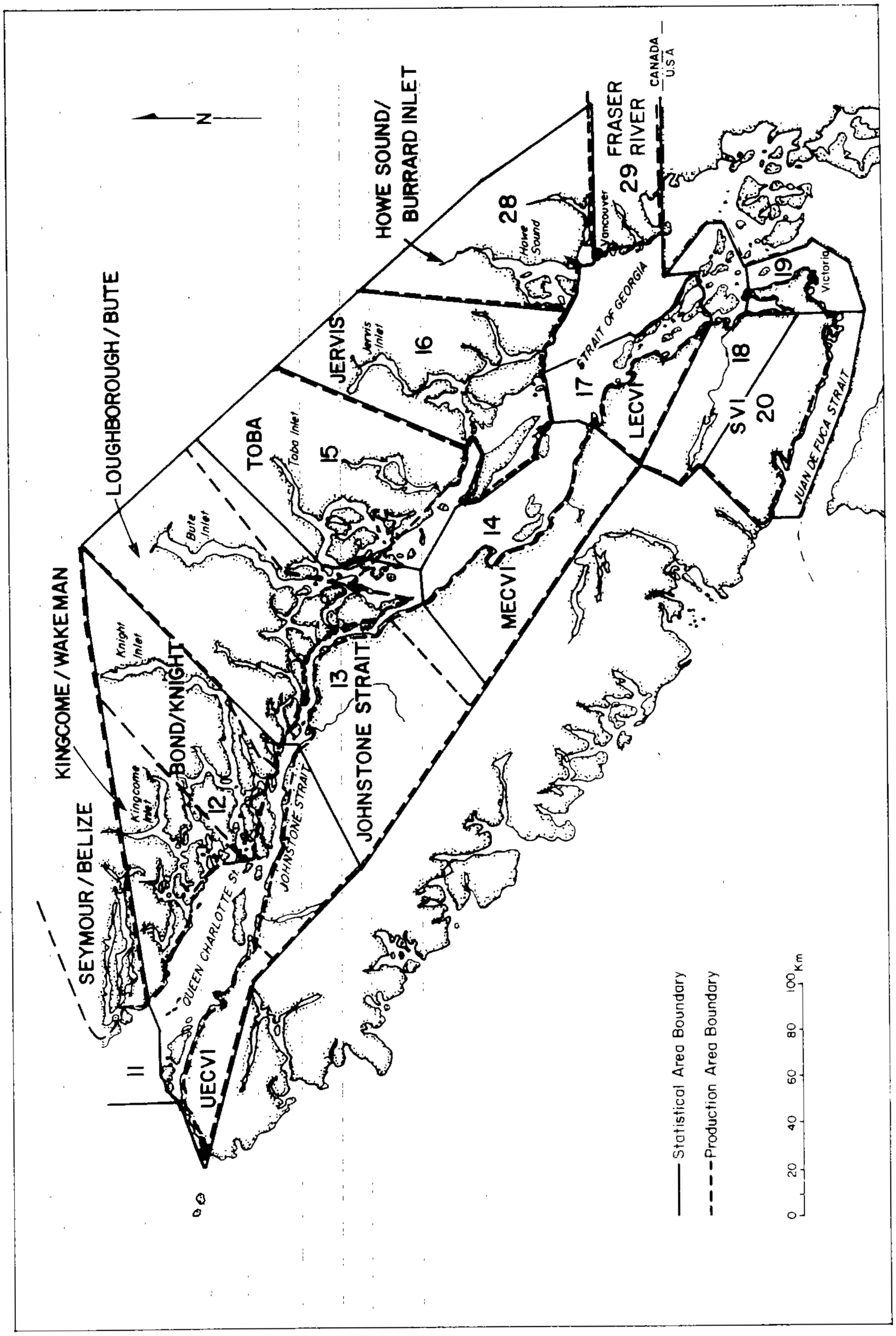

Figure 2. Location of statistical and production areas in the Inner South Coast (excluding those in the Fraser River watershed).

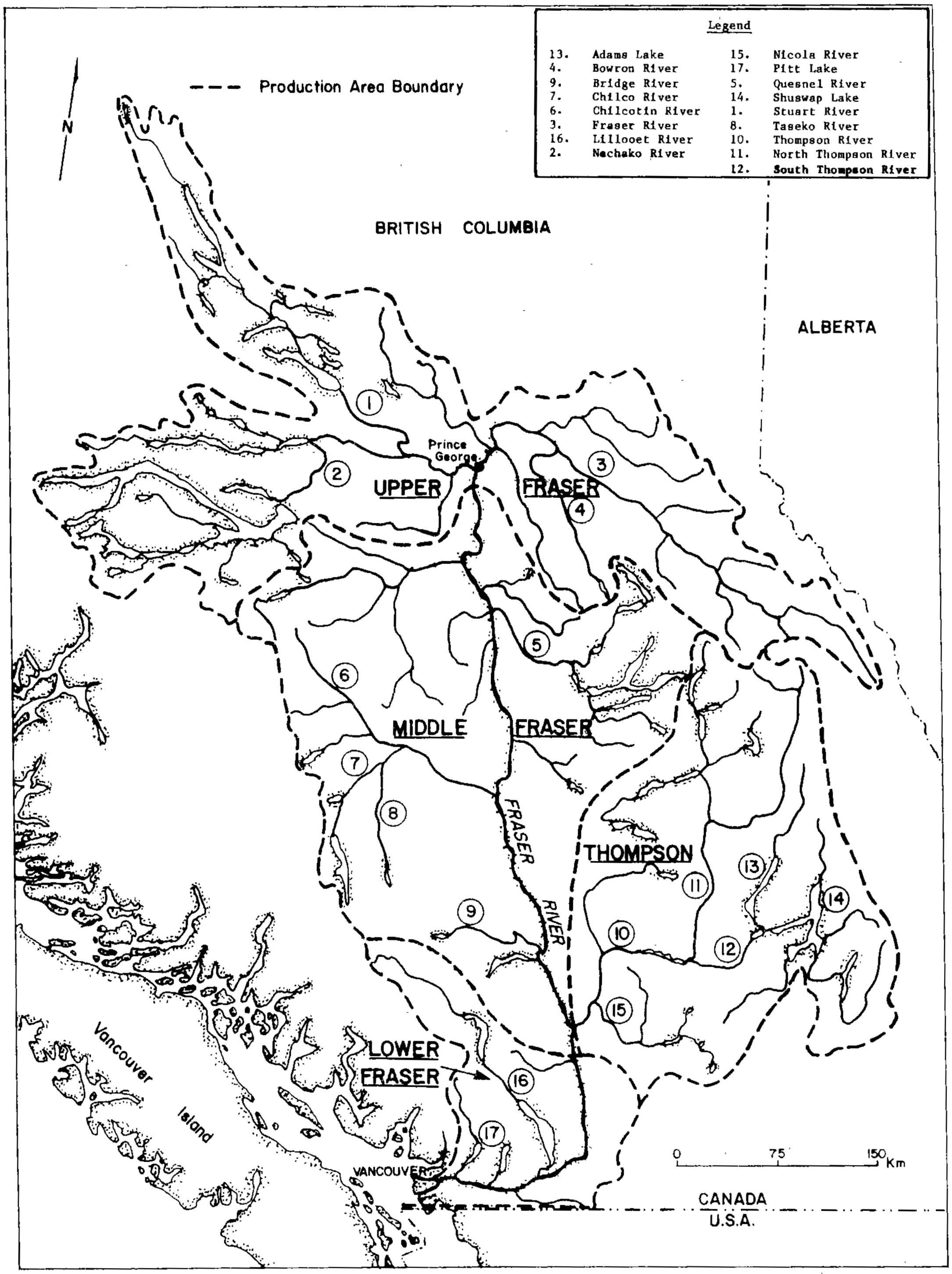

Figure 3. Location of production areas in the Fraser River watershed.

complicates management of some stocks. The coordination and integration of management strategies for numerous fisheries is compounded by involvement of two divisions within DFO (the South Coast and Fraser River Division), numerous domestic user groups, international fishery representatives (U.S. federal, state and native) and the Pacific Salmon Commission.

Despite the complexity of and difficulties associated with the management of South Coast salmon fisheries, DFO has an obligation to improve production from this area. The Pacific Salmon Treaty provides Canada with an opportunity to benefit from increased production. It was estimated that the major potential benefits of the Treaty could be achieved through management and enhancement of stocks, while minor benefits could be obtained by balancing the catch of U.S. and Canadian interception fisheries. This document is the first step in developing a plan to achieve these potential benefits.

Detailed descriptions of present stock status and habitat status are provided in Appendices I and II, respectively. Appendix III provides a description of the known distribution of fish disease agents.

2. STOCK DESCRIPTION

2.1 Vancouver Island

2.1.1 Upper East Coast Vancouver Island

Salmon stocks north of Port McNeil on the east coast of Vancouver Island are managed as an aggregate and are collectively referred to as Upper East Coast Vancouver Island (UECVI) stocks. The area extends from the Stranby drainage on the north end of the island to the Cluxewe drainage and encompasses the northern half of Statistical Area 12 (Figure 4).

There are two passively-managed sockeye stocks in the UECVI area, and these originate from the Nahwitti and Quatse rivers. These stocks are thought to migrate through Goletas Channel from early to mid-May and then move into their natal streams. Since 1981, there have been no Indian food fisheries directed at these stocks. Escapements to the Nahwitti River are similar to historic levels of 2000 - 3000 spawners. Sockeye escapements to the Quatse River are depressed and are about one-tenth of the historic level of 2000 spawners.[2]

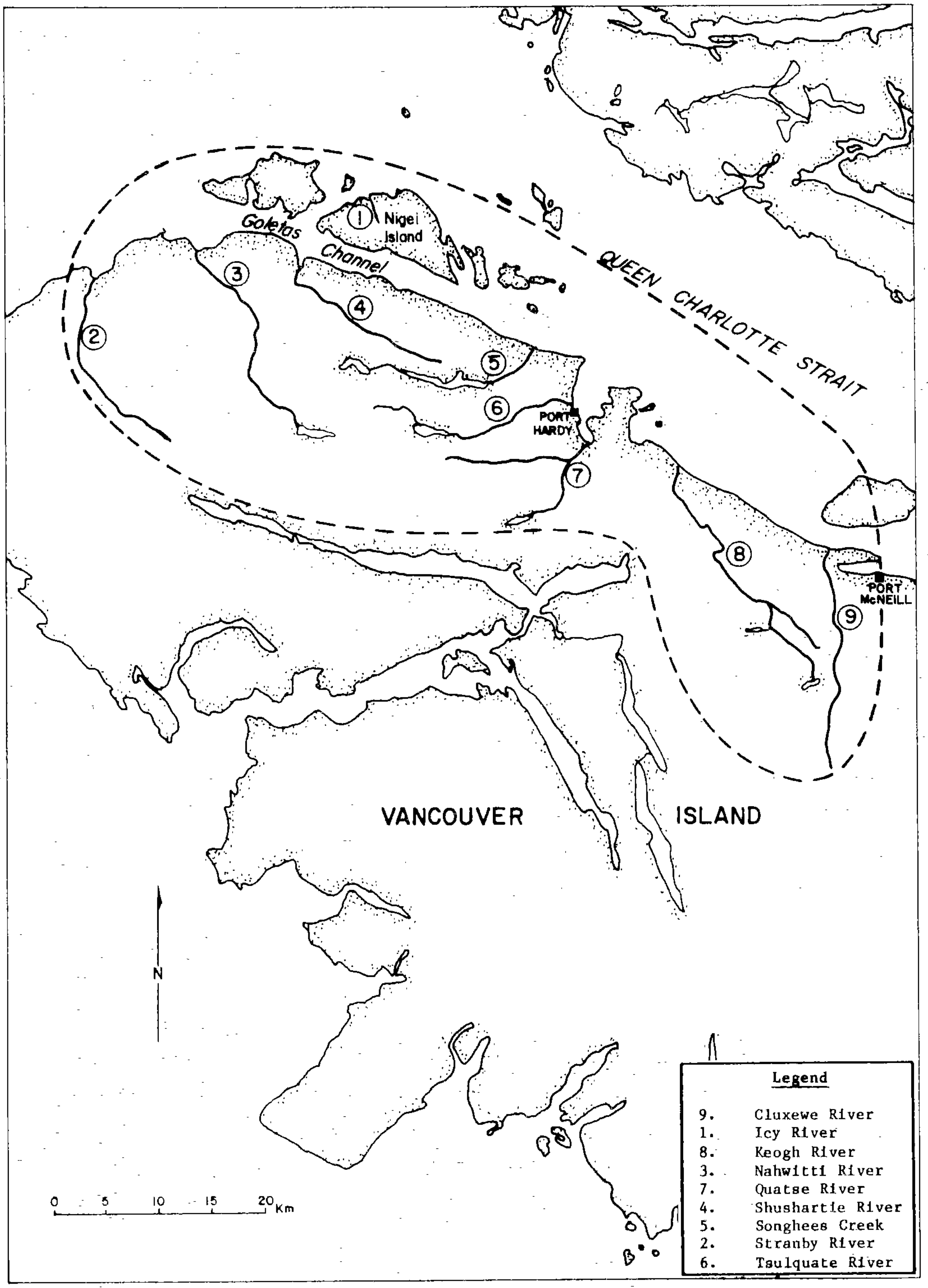

Figure 4. Streams in the Upper East Coast Vancouver Island production area.

There are eight passively-managed pink stocks in the UECVI area. River systems to the north of Port Hardy that support pink salmon include the Shushartie, Nahwitti, Tsulquate, Stranby and Songhees rivers. Pink populations south of Port Hardy occur in the Keogh, Quatse and Cluxewe rivers. The Keogh and Quatse systems account for more than 50% of the total pink salmon production in the UECVI area. Production is predominantly from the even-year cycle.

UEVIC pink stocks returning to their natal streams are present in the approach waters from the second week of July to the second week of August. These stocks hold at the mouths of the streams until flows permit upstream migration. Stocks originating from rivers north of Port Hardy approach their spawning streams primarily through Goletas Channel, whereas stocks south of Port Hardy approach through Goletas or Gordon Channel.

Escapement information indicates that UECVI pink stocks are currently depressed. Total average escapement to the area has been well below the target level since the 1950s. Escapement levels for the even-year stock peaked during the 1960s at an average of 271,800 spawners but have since declined.[3] From 1980 to 1984, escapements have averaged less than 100,000 spawners. Target escapement for the even-year pink stock is 690,000. Although escapements of all UECVI pink stocks have declined, the northern populations have drastically decreased in size. The odd-year stocks are very small. Escapements averaged 50,000 spawners in the 1950s and declined to less than 15,000 in the following years.[3] The aggregate target for the odd-year pink stocks is 690,000. There is presently limited information on the productivity of UECVI pink salmon stocks.

There are six passively-managed chum populations in the UECVI area. In terms of total production, the most significant stocks are from the Quatse, Keogh and Cluxewe rivers. During the period from 1950 to 1980, their relative contributions to the total escapement were 43%, 24% and 13%, respectively. Escapement records indicate that chum escapements to the UECVI are steadily declining. The average escapement was 25,200 during the 1950s and declined to 9000 and 1500 during the 1960s and 1970s, respectively.[3] Escapements have declined further in the 1980s, averaging less than 500 chum. The target escapement for the area is 67,000 chum adults.

UECVI is not considered an important production area for chinook salmon. The only stock that may have some rebuilding potential originates from the Quatse River. However, the status of this stock is not well documented.

Coho salmon occur in small numbers in many UECVI streams. However, the Keogh River is the only major coho producer in this area.[4] Although information on some coho stocks in this area is unavailable, populations are thought to be declining.[4] Results of coded-wire tag studies indicate that UECVI coho are harvested primarily in the central coast and WCVI troll fisheries, with some incidental catch occurring in the Johnstone Strait net fisheries. Coho from UECVI tend to be larger than most coho from the B.C. coast. During recent years, effort in the sport fishery has increased in the area.

Both summer and winter runs of steelhead occur in streams along the UECVI but are relatively small (<1000 fish). Populations of summer-run steelhead from Statistical Areas 12 and 13 are currently depressed, presumably as a result of fishing pressure from the Johnstone Strait net fisheries.[5] To date, catch-and-release sport fishing regulations have failed to promote rebuilding of these stocks.

2.1.2 Johnstone Strait

The Johnstone Strait production area encompasses the southern half of Statistical Area 12 and most of Area 13 on Vancouver Island and includes streams between Port McNeil and Campbell River (Figure 5). The northernmost and southernmost systems in the area are the Nimpkish River and Mohun Creek, respectively.

The Nimpkish stock is the only actively-managed sockeye stock from the Johnstone Strait production area. These sockeye approach their natal streams through Gordon and Goletas channels, enter the lower part of Queen Charlotte Strait and move through Broughton Strait into the Nimpkish estuary. There are two distinct runs of Nimpkish sockeye. The first is an early run to the Vernon Lake system, which consists mostly of 5-year old lake spawners. These fish return to the river between mid-May to mid-June. This population is currently depressed well below the target level, with escapements of approximately 5000 to 10,000 spawners. It is harvested primarily in the Indian food fishery. The second run, the main Nimpkish sockeye stock, consists mostly of 4- and 5-year old fish that return to the river from mid-June to early August. The run peaks during the middle of July

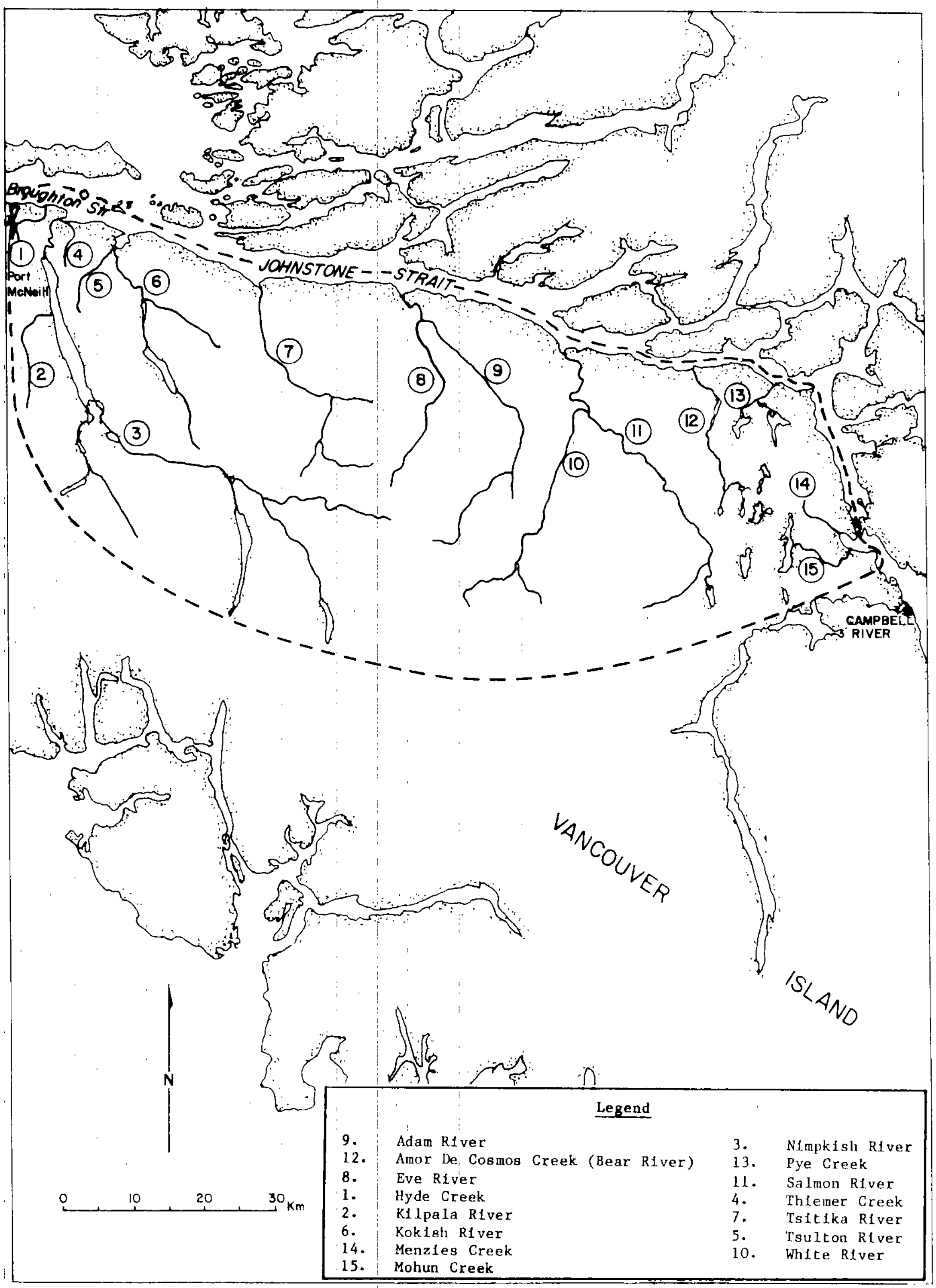

Figure 5. Streams in the Johnstone Strait production area.

in the Broughton Strait-Malcolm Island fishing area. Most of these fish appear to spawn at the outlet of Woss and Nimpkish lakes. However, the number of lake spawners is presently unknown.

Although estimates of sockeye escapement to the area are not reliable, a declining trend is apparent for the Nimpkish stock. Escapements to the Nimpkish system averaged 90,000 from 1950 to 1959; 88,000 from 1960 to 1969; and 55,000 from 1970 to 1979.[3] During the period 1980 - 1985, escapement of Nimpkish sockeye averaged 56,000. The Nimpkish Technical Working Group was established to identify the baseline data on the stock, production targets and regulations required to achieve these targets. The target escapement for the Nimpkish River system is currently 250,000, which is based on continuation of a lake fertilization program initiated in 1981.

Both odd- and even-year pink runs return to the Johnstone Strait region of Vancouver Island. Even-year stocks are the more abundant of the two cycles. Target escapements for the stock aggregates are 299,000 and 194,000 for even and odd years, respectively. There are 11 streams that contribute most of the even-year pink salmon production in the area. The Amor de Cosmos Creek (Bear River) population is the only actively-managed stock in the area and accounts for about 55% of the escapement based on data from 1950 to 1980. There are seven odd-year pink stocks in the area, and these are passively managed. There is no odd-year run in Amor de Cosmos Creek. Historic data (1950 to 1980) indicate that 84% of the escapement in odd years is from the Adam and Salmon rivers.

Johnstone Strait pink salmon approach their natal streams from the north and are present in the Strait from mid-July through early September, with peak abundance occurring in mid-August.[6] As a result of their migration pattern and timing, these pink stocks are incidentally harvested in the Johnstone Strait mixed-stock fisheries directed at Fraser River sockeye. Johnstone Strait pink populations are depressed. Escapements prior to 1980 remained relatively stable at about 40-50% of target levels. However, even-year escapements during the 1980s have been significantly below the target of 299,000, with 38,300 spawners in 1980, 7000 in 1982, and 6500 in 1984.[3] Odd-year returns have exhibited a similar trend, with escapements averaging 30-40% of the target in years prior to 1980 and averaging less than 15% of target in recent years.

In the Johnstone Strait area, there are one actively-managed and six passively-managed chum stocks. The actively-managed stock is from the Nimpkish River and has contributed more than 75% of the escapement to the area. The average escapement to the Johnstone Strait area was 75,000 in the 1950s, declined to 17,000 in the 1970s, and has increased to 35,000 during the period from 1980 to 1985.[3] The target escapement for the area is 160,000 spawners.

The Nimpkish is the largest and most important chinook stock in the Johnstone Strait production area. Escapement averaged approximately 8600 from 1955 to 1964 and declined to an average of 4300 from 1965 to 1974. Recent escapements averaged 1300 from 1975 to 1984.[7] Nimpkish chinook school in Parsons Bay from mid August to early September at which time they begin migration into the river.[2] Escapements to the Salmon River, another noteworthy chinook producer, have shown a similar trend. Average escapement declined from 1100 (1955-1964) to 535 (1975-1984).[7]

The Nimpkish and Salmon rivers are also the major coho producers in the Johnstone Strait area. These populations are thought to be depressed as a result of interceptions in the Johnstone Strait fisheries and habitat alterations from logging activities.[2,8]

In the Johnstone Strait area, there are four major summer steelhead runs that originate in the Nimpkish, Kokish, Tsitika and White rivers. The Nimpkish River also supports a winter run of steelhead. The summer runs arrive in the area in late June through early July, while the winter run is present from late October through early January. The Nimpkish system has the largest capacity for steelhead smolt production of all Vancouver Island streams (estimated to be greater than 70,000). However, the Nimpkish stock is one of the most seriously depressed runs in this region.[5]

2.1.3 Mid East Coast Vancouver Island

The area from Campbell River to Nanoose Bay is considered the Mid East Coast Vancouver Island (MECVI) production area. It includes the lower portion of Statistical Area 13 and all of Area 14 (Figure 6). The major salmon stocks in MECVI include fall chum, Little Qualicum and Big Qualicum River chinook and Big Qualicum, Quinsam, and Puntledge River coho. There is no sockeye production from this area.

All of the pink salmon stocks in the MECVI area are passively managed. There are six streams that support pink salmon populations. Even- and odd-year runs are found in all of these systems except Campbell River, which supports only an even-year run. MECVI pink salmon enter Johnstone Strait from the north through Queen Charlotte Strait. They are present in the area from mid-July to early September, with abundance peaking in early August.[6] Escapements were historically much higher than in recent years. During the 1950s, escapements averaged 166,600 for the even-year run and 88,500 for the odd-year run. During the 1970s, average escapements of the even- and odd-year runs declined to 24,700 and 16,500, respectively. Recently, odd-year escapements have increased to an average of 40,000 from 1981 to 1985, while even-year escapements continued to decline to an average of 18,000 from 1980 to 1984.[3] MECVI pink stocks are severely depressed due to incidental harvest in fisheries directed at Fraser River sockeye. The overall target escapement for both even- and odd-year runs is 300,000.

There are 16 chum stocks in the MECVI area. The three actively-managed stocks, Big and Little Qualicum and Puntledge, accounted for about 90% of the total escapement during the period 1980 to 1985. Although these three systems are currently enhanced, they have historically accounted for the majority of chum escapement to the area. Escapement to these systems represented about 70%, 85%, and 90% of the total escapement during the 1950s, 1960s, and 1970s, respectively.

MECVI chum migrate through Johnstone Strait from the first of October to the end of the first week in November. The timing of peak abundance varies but usually occurs during the third week of October. In general, chum abundance in the terminal area peaks in the first to second week of November for the stocks returning to Big Qualicum River. Little Qualicum River and Puntledge stocks typically appear ten days to two weeks prior to the Big Qualicum stock.[9]

Total escapement to the area has increased from 162,000 chum in the 1950s to 263,000 in the 1980s.[3] The target escapement for the area is 326,000, of which the actively-managed stock component is 277,000 (Section 4.1.3).

There are five major chinook stocks that spawn in the MECVI area. These are the Big Qualicum, Little Qualicum, Campbell, Puntledge and Englishman stocks. Escapements to Campbell River averaged about 3000 from 1955 to 1964, increased to 5000 from 1965 to 1974 and declined to 3000 from 1975 to 1984. In the other

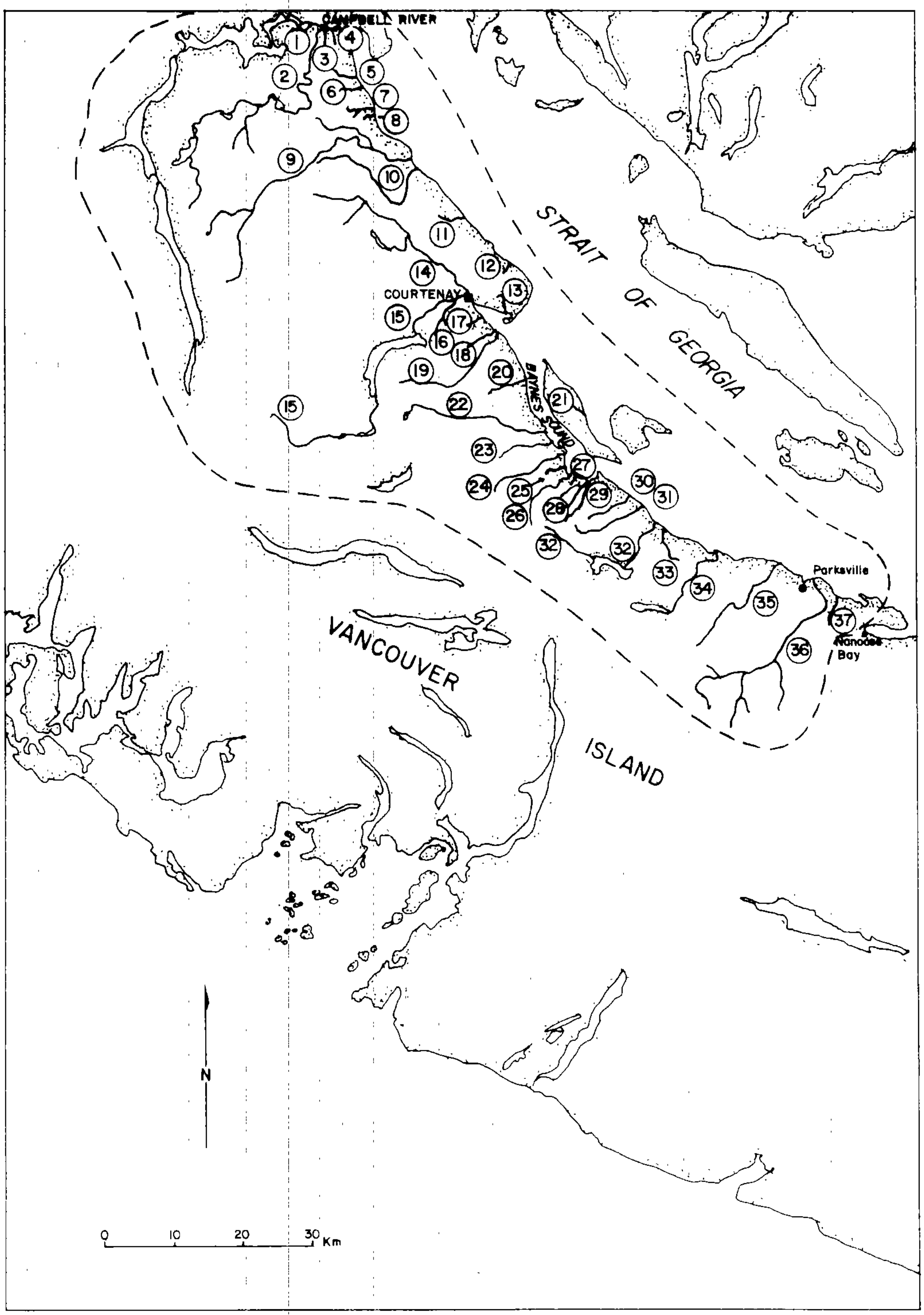

Figure 6. Streams in Mid East Coast Vancouver Island production area (see Table 1 for key to stream numbers).

Table 1. Streams in Mid East Coast Vancouver Island production area (from Figure 6).

No.	Stream	No.	Stream
10.	Black Creek	31.	Nile Creek
13.	Brooklyn Creek	4.	Nunns Creek
1.	Campbell River	9.	Oyster River
28.	Chef Creek	15.	Puntledge River
23.	Cowie Creek	32.	Qualicum River
37.	Craig Creek	2.	Quinsam River
36.	Englishman River	26.	Rosewall Creek
21.	Fillongley Park Creek	18.	Roy Creek
6.	Ford Creek	33.	Shaw Creek
35.	French Creek	5.	Simms Creek
20.	Hart Creek	8.	Storie Creek
3.	Kingfisher Creek	30.	Thames Creek
11.	Kitty Coleman Creek	19.	Trent River
12.	Little River	22	Tsable River
34.	Little Qualicum River	14.	Tsolum River
29.	Lymn Creek	25.	Waterloo Creek
27.	McNaughton Creek	24.	Wilfred Creek
17.	Millard Creek	7.	Woods Creek
16.	Morrison Creek		

systems, chinook escapement averaged 5200 from 1955 to 1964, declined to 2200 from 1965 to 1974 and increased to 6400 from 1975 to 1984.[7]

Escapement records indicate that a total of 36 streams in MECVI have supported coho salmon at some time between 1953 and 1983.[10] The major producers are the Big Qualicum, Little Qualicum, Quinsam and Puntledge rivers and Black Creek. Spawning escapements to streams in this area are believed to be below historic levels.[4]

MECVI streams support both winter and summer runs of steelhead. The major winter run occurs in the Campbell/Quinsam system. These fish are present in the area from October through December. There are also summer runs to the Campbell and Puntledge rivers, which arrive in late June through early July.[5]

2.1.4 Lower East Coast Vancouver Island

The Lower East Coast of Vancouver Island (LECVI) production area is located between Nanoose Bay and Crofton and includes Statistical Area 17 (Figure 7).

Of the nine chum stocks in the LECVI area, only the Nanaimo and Chemainus stock are actively managed. These two stocks accounted for 75% of the total escapement to the area over the period 1980 to 1985. Average escapements to the area were 116,000 in the 1950s, declined to 42,000 in the 1960s, increased to 67,000 in the 1970s, and increased to 100,000 from 1980 to 1985.[3] The target for the area is 180,000 spawners.

The two major chinook producers in LECVI are the Nanaimo and Chemainus rivers. Escapements to the Nanaimo River averaged 2600 from 1955 to 1964, 1670 from 1965 to 1974, and 2050 from 1975 to 1984. Escapements to the Chemainus River averaged 30, 60, and 400 chinook for the same periods, respectively.[7]

Coho salmon have been reported in 19 streams in LECVI.[10] Based on escapement data, the largest producer is the Nanaimo River.[4]

The Nanaimo River also supports a major steelhead run. Late in-migrating steelhead spawners and out-migrating kelts may be intercepted in freshwater fisheries that target on chinook salmon in the Nanaimo River during March.[5]

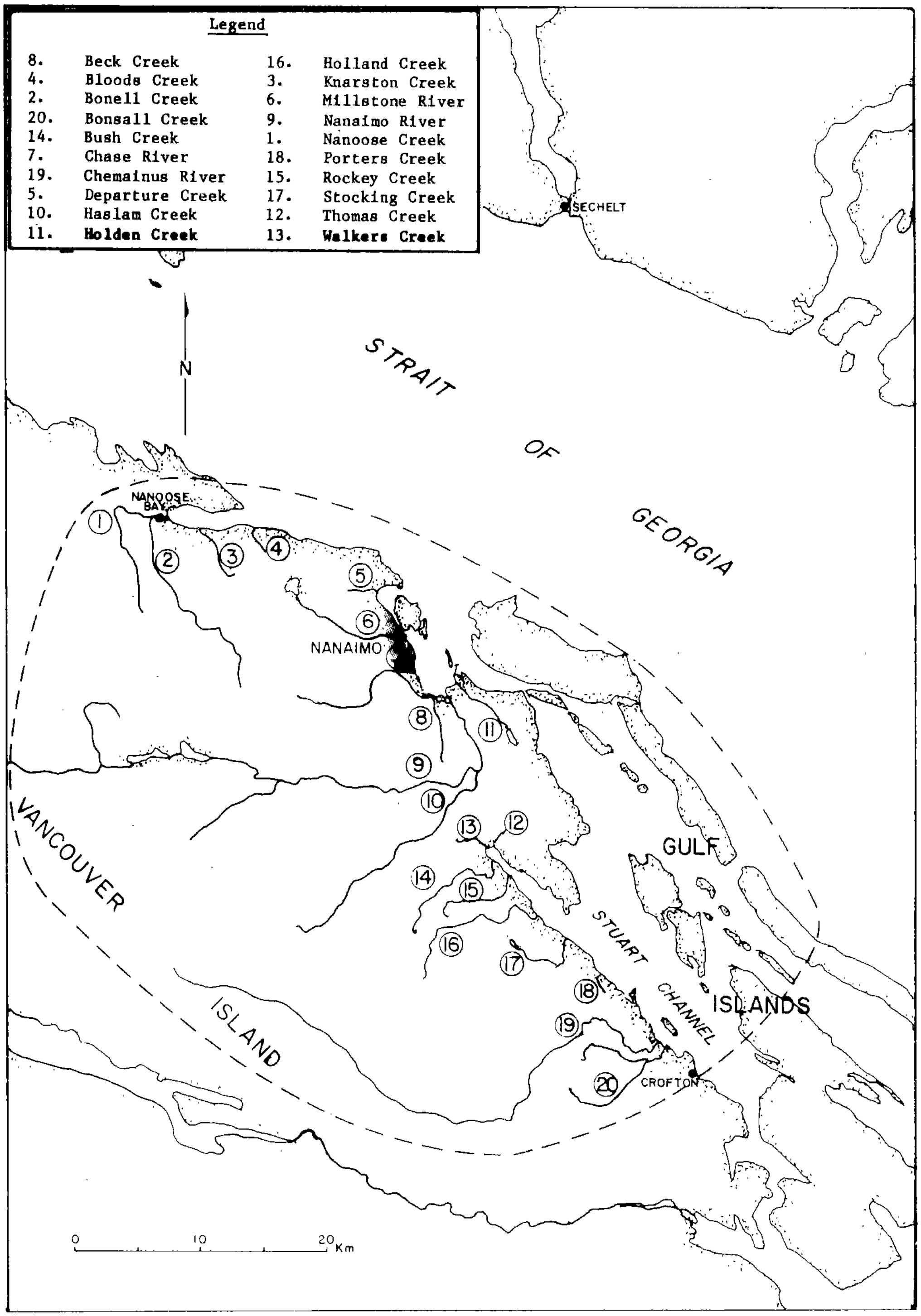

Figure 7. Streams in Lower East Coast Vancouver Island production area.

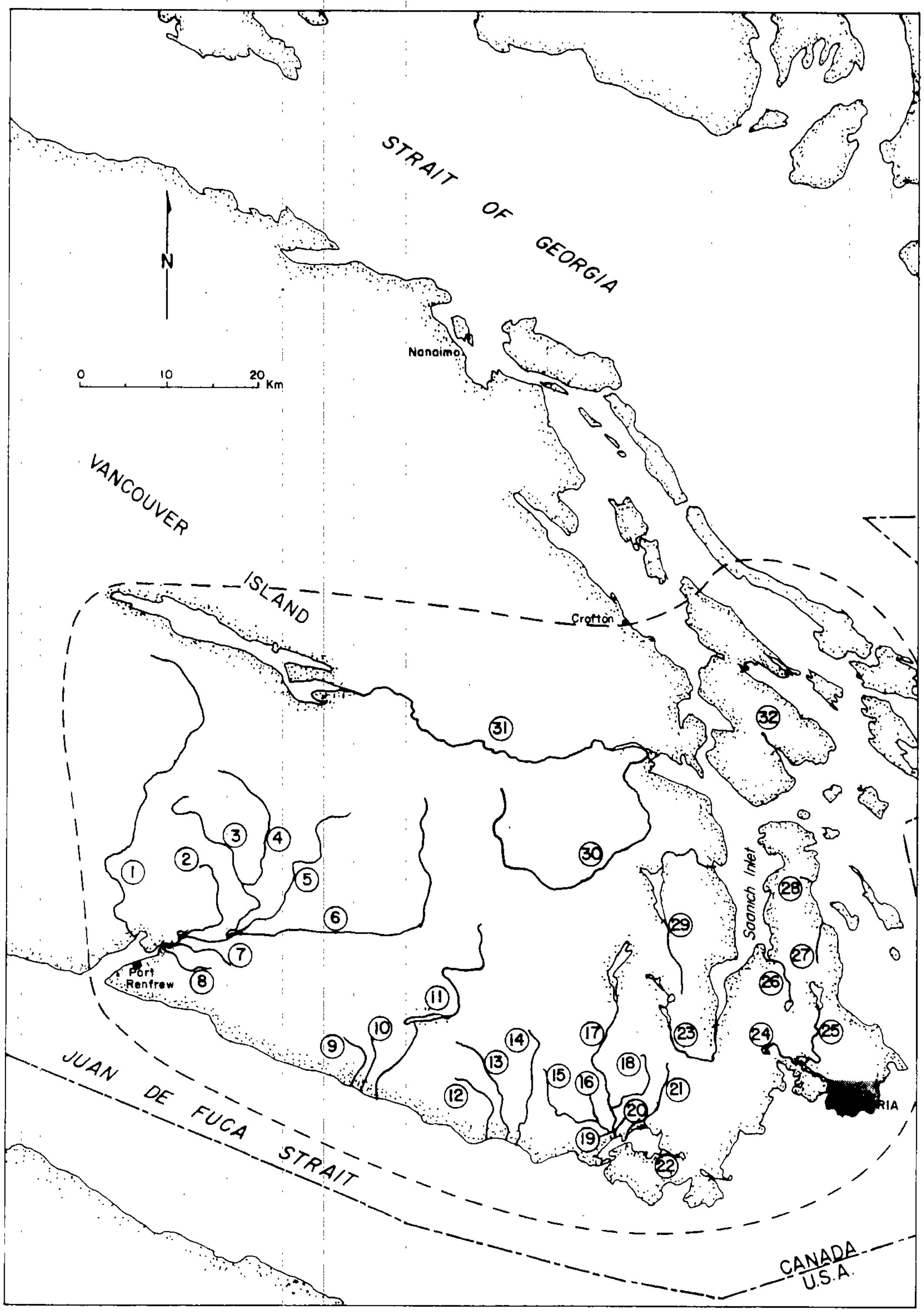

Figure 8. Streams in Southern Vancouver Island production area (see Table 2 for key to stream numbers).

Table 2. Streams in Southern Vancouver Island production area (from Figure 8).

No.	Stream	No.	Stream
21.	Ayum Creek	20.	Lannon Creek
19.	Baker Creek	5.	Lens Creek
18.	Charters Rivers	9.	Maidenhair Creek
25.	Colquitz River	22.	Matheson Creek
31.	Cowichan River	7.	Mosquito Creek
24.	Craigflower Creek	13.	Muir Creek
15.	De Mamiel Creek	28.	Reay Creek
8.	Falls Creek	2.	Renfrew Creek
32.	Fulford Creek	16.	Rocky Creek
23.	Goldstream River	27.	Sandhill Creek
1.	Gordon River	6.	San Juan River
4.	Harris Creek	29.	Shawnigan Creek
3.	Hemmingsen Creek	17.	Sooke River
11.	Jordan River	26.	Tod Creek
12.	Kirby Creek	14.	Tugwell Creek
30.	Koksilah River	10.	Uglow Creek

2.1.5 Southern Vancouver Island

Southern Vancouver Island (SVI) refers to the production area south of Crofton and east of Port Renfrew (Figure 8) and includes Statistical Areas 18, 19 and 20.

There are seven chum stocks in the SVI area. The three major stocks are the Cowichan, Koksilah and Goldstream. Escapements of these stocks have been relatively consistent over the last 3 decades, averaging 68,000 to 75,000 spawners. During the period from 1980 to 1985, chum escapements increased to an average of 127,000, which is about 75% of the escapement target (167,000).

There are six chinook stocks in Statistical Areas 18, 19 and 20. The largest producer is the Cowichan River, while the smaller producers include the Koksilah, San Juan, Sooke, Gordon and Goldstream rivers. Total chinook escapements for all six systems averaged 7000 from 1955 to 1964, 12,000 from 1965 to 1974, and 7100 from 1975 to 1984.[7]

Thirty coho stocks have been reported in the SVI area between 1953 and 1983.[10] The majority of these stocks (22) are from Area 20, where the San Juan, Gordon and De Mamiel rivers are the major coho producers.[11] The Cowichan River is the major coho producer in Areas 18 and 19.

There is a major steelhead run to the Cowichan River. In recent years, native fisheries have targeted on these steelhead.[5] There are also two smaller steelhead runs to the San Juan and Gordon rivers in Area 20. However, these stocks are depressed from historic levels, presumably as a result of incidental harvest in fisheries directed at sockeye and pink salmon in the approach areas.[5]

2.2 Mainland Inlets

2.2.1 Seymour/Belize Inlet

Seymour/Belize Inlet area includes Statistical Area 11 (Figure 9). The streams in this area support both chum and coho stocks, all of which are passively managed. The three key indicator streams are the Seymour, Waump and Taaltz rivers. The total escapement for the seven chum stocks in the area averaged less than 10,000 spawners from 1950 to 1982.[12] These stocks migrate into the inlets in

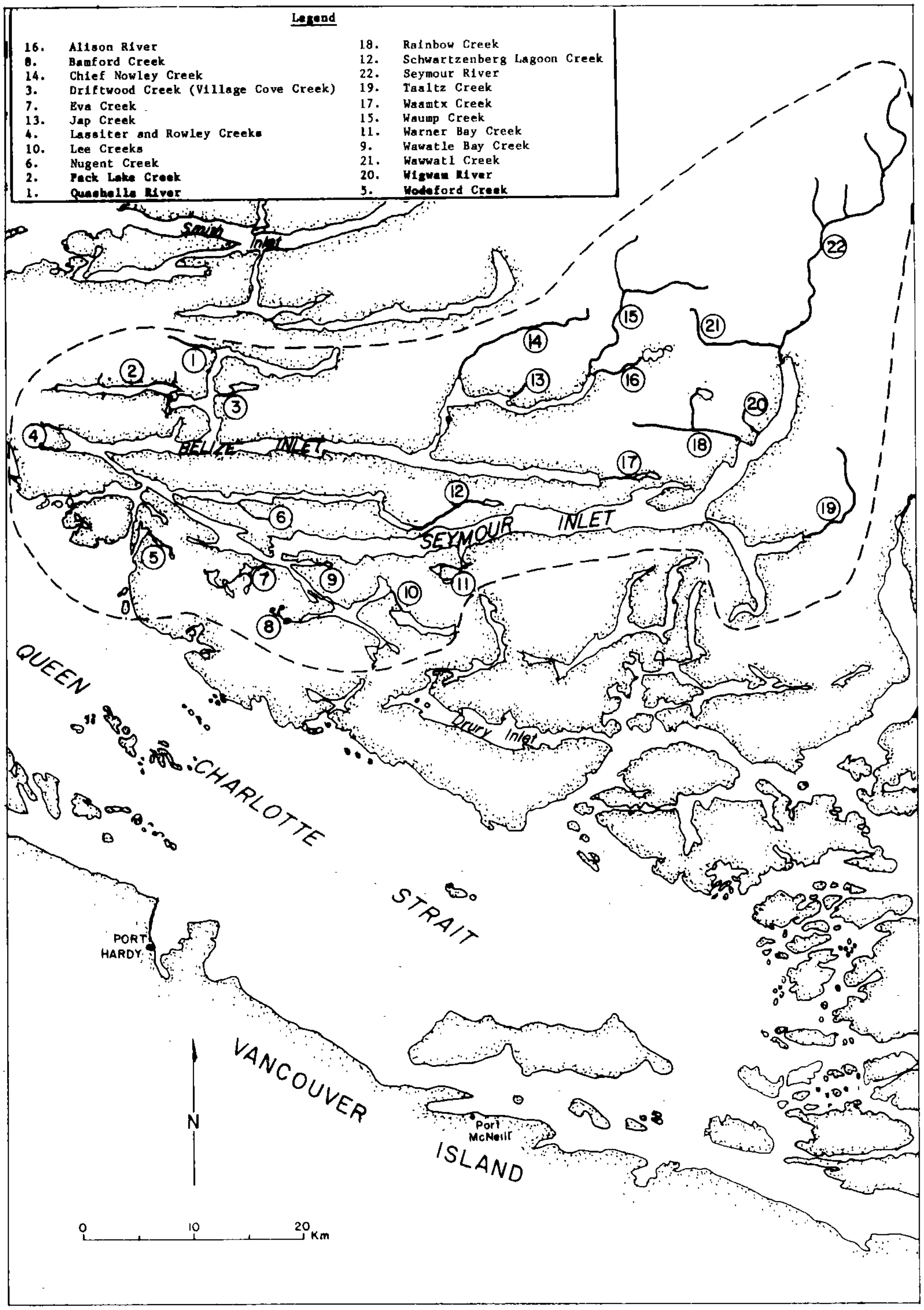

Figure 9. Streams in Seymour/Belize Inlet production area.

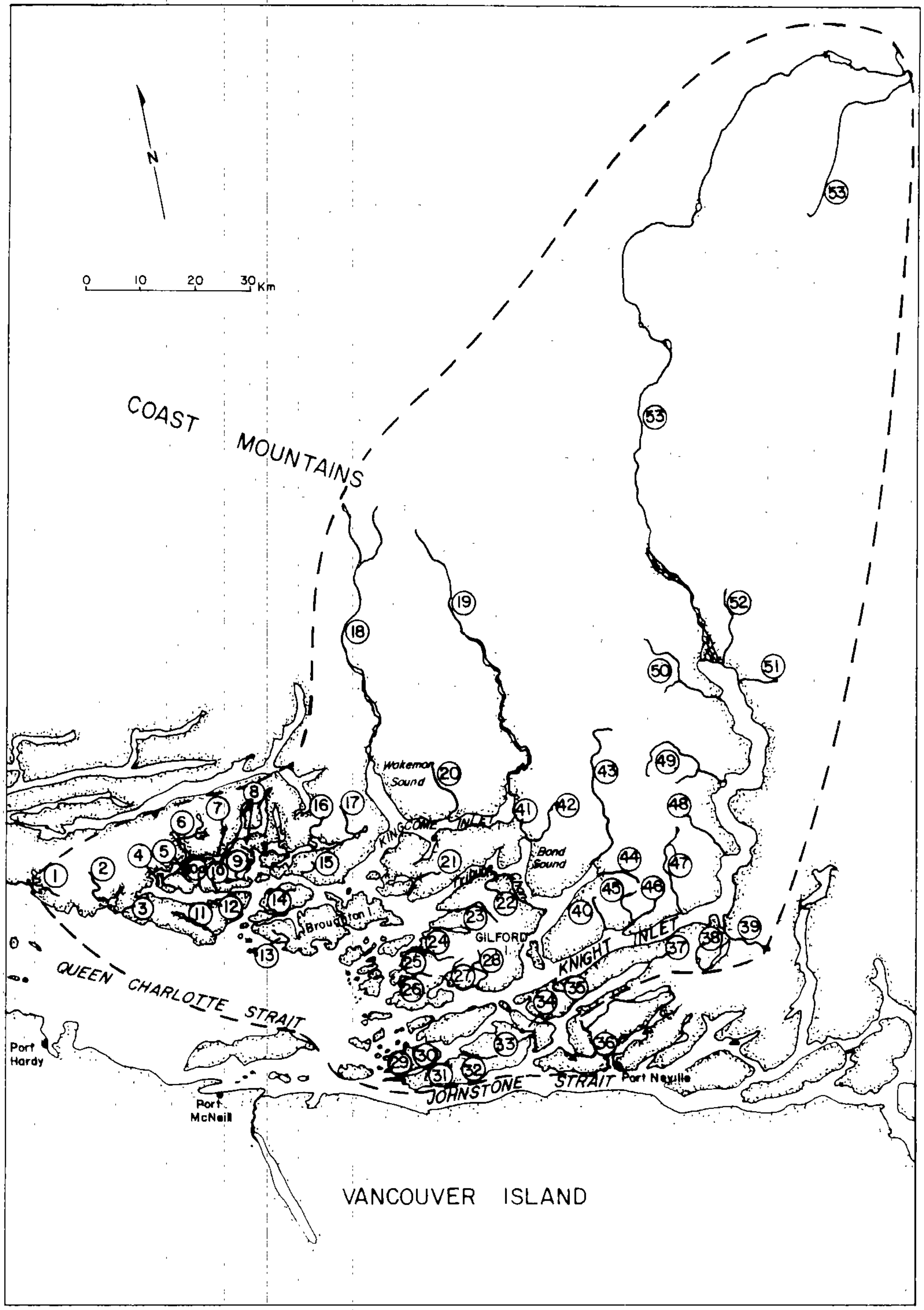

Figure 10. Streams in Kingcome/Knight Inlet production area (see Table 3 for key to stream numbers).

Table 3. Streams in Kingcome/Knight Inlet production area (from Figure 10).

No.	Stream	No.	Stream
49.	Ahnuhati River	40.	Lull Creek
42.	Ahta River	17.	Mackenzie Sound Creek
41.	Ahta Valley Creek	6.	Marion Creek
36.	Boughey Creek	27.	Maple Creek
2.	Bradley Creek	47.	Matsiu Creek
10.	Bughouse Creek	44.	McAlister Creek
37.	Call Creek	29.	New Vancouver Creek
9.	Carriden Creek	46.	Nigger Creek
20.	Charles Creek	16.	Nimmo Creek
3.	Cohoe Creek	13.	Phyllis Creek
33.	Cracroft Creek	34.	Port Harvey Lagoon Creeks
8.	Embley Creek	32.	Potts Lagoon Creek
52.	Franklin River	35.	Protection Point Creek
28.	Gilford Creek	12.	Richmond Bay Creek
39.	Glendale Creek	24.	Scott Cove Creek
5.	Hand Creek	1.	Shelter Bay Creek
26.	Health Lagoon Creek	25.	Shoal Harbour Creek
45.	Hoeya Sound Creek	50.	Sim River
7.	Huaskin Creek	21.	Simoom Sound Creek
15.	Hycund Creek	14.	Sullivan Bay Creek
10a.	Jennis Bay Creek	4.	Tancred Creek
43.	Kakweiken River	38.	Tom Browne Creek
30.	Kamano Bay Creek	51.	Village Creek
11.	Kenneth River	23.	Viner Sound Creek
19.	Kingcome River	22.	Wahkana Bay Creek
53.	Klinaklini River	18.	Wakeman River
48.	Kwalate Creek	31.	Waldon Creek

early August. The Seymour stock is the first to arrive in late August, while the Village Cove stock is the last to arrive in late October.[2]

Between 1953 and 1985, coho salmon were reported in 18 streams in Area 11.[10] The Seymour River accounts for most of the coho production in the area,but the size of this population is unknown.[4] Escapements to the Seymour, Taaltz and Waump rivers are monitored annually.

2.2.2 Kingcome/Knight Inlets

The Kingcome/Knight Inlets area includes the mainland portion of Statistical Area 12 with the exception of Port Neville (Figure 10). It is divided into two sub-areas, Kingcome/Wakeman and Bond/Knight for the purpose of managing pink and chum salmon stocks.

Pink salmon spawn in five streams in the Kingcome/Wakeman sub-area. The major producers in even years are the Kingcome and Wakeman rivers and Embley Creek. In odd years, the Wakeman River accounts for more than 90% of the total escapement to the area. Kingcome/Wakeman pink salmon migrate through Queen Charlotte Strait from the third week in June to the first week in August. Peak abundance occurs in the second week of July. The exploitation rate on these stocks is low because the majority (75%) of the run migrates through areas of Johnstone Strait closed to commercial fisheries (MU 12-13, 12-7, 12-41 and 12-39).

Escapement of the even-year pink salmon to the Kingcome/Wakeman area increased markedly from 50,000 and 42,000 in the 1950s and 1960s, respectively, to 240,000 in the 1970s. Escapements were in the order of 70,000 in the early 1980s but declined drastically to 15,000 in 1984.[3] The odd-year run also increased significantly in the 1970s, averaging 186,000 compared to 36,000 and 30,000 in the previous two decades.[3] Escapements of odd-year pink averaged 153,000 from 1981 to 1985. The target for both even- and odd-year runs is 287,000 spawners.

There are 12 streams in the Bond/Knight sub-area that support even-and odd-year pink salmon runs. In the recent years, the Glendale, Kakweiken and Ahnuhati rivers have accounted for about 90% of the escapement of even-year pink to the sub-area. The Glendale and Kakweiken rivers are also the major producers of pink salmon in the odd-year cycle.

The Kakweiken pink stock migrates through Queen Charlotte Strait from mid-July until early September. The fish hold in Tribune Channel and along the shoreline between Bond and Thompson sounds, with peak abundance occurring in early August.[2] The timing and migration route suggest that exploitation of the Kakweiken stocks in Johnstone Strait is minimal. The Glendale stock runs about two weeks later than the Kakweiken stock, with peak abundance in the river by the third week of September.[2] It is thought that a portion of the Glendale stock enters the upper Johnstone Strait fishing area and may be harvested in the sockeye fishery. The Ahnuahti pink salmon migrate generally two weeks earlier than the Kakweiken stock. They migrate through lower Knight Inlet in early to late July, and peak arrival at the river occurs in late August.[2] Of the three stocks, Ahnuahti is probably harvested the least in the Johnstone Strait fishery.

Escapement of even-year pink salmon to Bond/Knight streams have increased steadily over the last three decades with averages of 138,000, 236,000, 370,000 and 561,000 in the 1950s, 1960s, 1970s, and early 1980s,respectively.[3] The target escapement for these stocks is 888,000. Returns of odd-year pinks have exhibited a similar trend, with average escapements of 156,000, 162,000, 433,000 and 834,000 for the same periods. The target for odd years is also 888,000.

There are six passively-managed chum stocks in the Kingcome/Wakeman sub-area. Escapement records indicate that these stocks have declined from an average of 66,000 in the 1950s to 21,000 in the 1960s and 39,000 in the 1970s.[3] Recent escapements (1980-1985) have averaged 10,000, which is about 5% of the target in this sub-area (196,000).

There are 10 chum stocks in the Bond/Knight sub-area. Average escapements have declined from 151,000 in the 1950s to 83,000, 69,000 and 45,000 in the 1960s, 1970s and 1980s, respectively. In recent years, Viner Creek has accounted for 65% of the total chum escapement for the area and has consistently averaged escapements in the order of 30,000 to 50,000 spawners since 1950. The target for the area is 396,000 chum salmon. The Viner River supports both an early and late run of chum. The early run, which is the main chum stock, arrives in the river from late September to mid October. The later run arrives near the end of October. There is also a summer chum run to the Ahnuhati River. These fish migrate up Knight Inlet from early July, and peak arrival in the stream is in late July.[30]

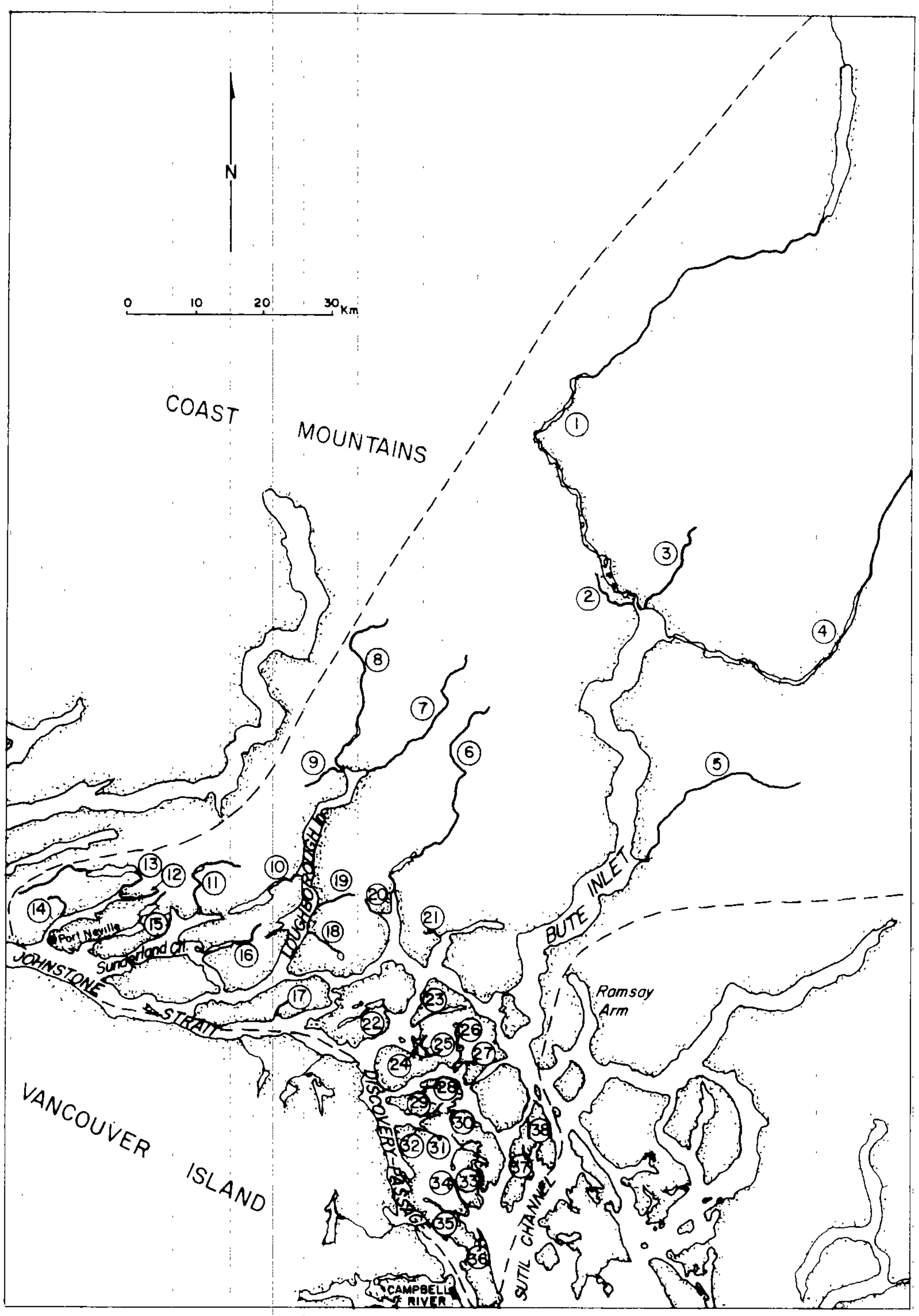

Figure 11. Streams in the Loughborough/Bute Inlet production area (see Table 4 for key to stream numbers).

Table 4. Streams in Loughborough/Bute Inlet production area (from Figure 11).

No.	Stream	No.	Stream
7.	Apple River	35.	Hyacinthe Bay Creek
32.	Bachus Creek	29.	Kanish Creek
37.	Bird Cove Creek	17.	Knox Bay Creek
25.	Cameleon Harbour Creek	34.	Open Bay Creek
28.	Chonat Creek	5.	Orford River
26.	Christie Creek	27.	Owen Bay Creek
2.	Cumsack River	6.	Phillips River
36.	Drew Creek	11.	Read Creek
20.	Fanny Bay Creek	14.	Robbers Knob Creek
9.	Frazer Bay Creek	12.	Shoal Creek
21.	Fredrick Creek	4.	Southgate River
13.	Fulmore River	8.	Stafford River
31.	Granite Bay Creek	3.	Teaqhahan River
18.	Grassy Creek	23.	Thurston Bay Creek
19.	Gray Creek	15.	Tuna River
24.	Handfield Creek	33.	Village Bay Creek
22.	Hemming Bay Creek	30.	Waiatt Bay Creek
10.	Heydon Creek	38.	Whiterock Pass Creek
1.	Homathko River	16.	Wortley Creek

There are five major chinook stocks in the Kingcome/Knight Inlet area: two from the Kingcome and Wakeman rivers, and three from the Klinaklini, Kakweiken and Ahnuhati rivers. The Klinaklini stock accounts for 50 - 70% of chinook escapement to the area. Total escapement has declined from an average of 14,700 during the period 1955 - 1964, to 4500 from 1975 to 1984.[7]

Coho salmon have been reported in numerous streams in the Kingcome/Knight Inlet area. The Kakweiken, Glendale and Wakeman rivers support the largest stocks.[4]

2.2.3 Loughborough/Bute Inlets

The Loughborough/Bute production area includes the mainland and island portions of Statistical Area 13 and Ramsay Arm and Port Neville in Statistical Area 12 (Figure 11).

Sockeye stocks originating from Fulmore, Heydon and Phillips lakes are managed as an aggregate due to similar migration timing and size. All three lakes are small coastal systems that have a low productivity. Sockeye spawning in rivers draining into each lake are characteristically 4- and 5-year old fish and most spend three years in fresh water. They migrate through upper Johnstone Strait from mid-May to late June, returning to the mainland inlets of Area 12 (Fulmore) and Area 13 (Phillips and Heydon).[2,8] These stocks are passively managed due to their concurrent migration with Nimpkish and early Fraser River stocks. Closures for the early Nimpkish stock reduce the harvest of Fulmore, Heydon and Phillips sockeye in upper Johnstone Strait. The total escapement for these stocks averaged 8200 from 1980 to 1985. Escapement has been stable but well below the target level of 32,000 spawners. The Phillips run accounts for about 80% of the total sockeye escapement to the area.

There are 19 even-year and 14 odd-year pink stocks that spawn in the Loughborough/Bute sub-area. These stocks are passively managed as a group with Johnstone Strait and Mid East Coast Vancouver Island pink stocks. Escapements of even-year pink have recently declined from 204,000 in 1980 to 14,000 in 1984. Historically, these stocks supported major fisheries that supplied two local canneries. The stocks declined in the 1950s.[8] Escapements averaged 65,000 in the 1950s, 188,000 in the 1960s, and 141,000 in the 1970s.[3] The odd-year run has also shown recent declines from 195,000 in 1983 to 29,000 in 1985. Odd-year returns averaged about 87,000 in the 1950s and 1960s, and 134,000 in the 1970s.[3] The escapement targets for even- and odd-year pink are 647,000 and 392,000, respectively.

There are three actively-managed (Orford, Homathko and Southgate) and seven passively-managed chum stocks in the Loughborough/Bute area. The Orford River supports both summer and fall runs. The summer run migrates through Johnstone Strait, Sunderland Channel and Chancellor Channel from mid- to late August. It is incidentally harvested in the Johnstone Strait fishery directed at Fraser sockeye and pink salmon. The number of chum taken each year varies since effort is directed at harvesting various cycles of Fraser sockeye and odd-year pink. The Orford River fall run arrives about a week later than the summer run, and the chum are relatively smaller, averaging 13 pounds compared to 18 pounds. Summer chum returns have increased from about 10,000 in the 1950s and 1960s to 50,000 in the 1970s and early 1980s.[3] The combined escapement target for the Orford summer and fall runs is 100,000. The migration timing of the other chum stocks from the Loughborough/Bute area is similar to that of other fall runs on the south coast of B.C. They arrive at their natal streams from late August through to December. The total chum escapement of the fall runs was 51,000 in the 1950s, 30,000 in the 1960s, 92,000 in the 1970s and 139,000 from 1980 to 1985.[3] The target escapement for the area is 526,000 chum adults.

The Homathko, Southgate, Orford, Phillips, Teaqualan and Apple rivers are the six major chinook salmon producers in the Loughborough/Bute area. The Homathko and Southgate account for 80% of the total chinook escapement to the area. The total escapement has steadily declined from 10,900 (1955-64), to to 6500 (1975-84).[7]

The Homathko River is the major coho producer in the Loughborough/Bute area.[4] Other noteworthy stocks include the Apple, Phillips, and Southgate River coho runs.[8]

2.2.4 Toba Inlet

The Toba Inlet production area includes all of Statistical Area 15 and Ramsay Arm in Statistical Area 13 (Figure 12).

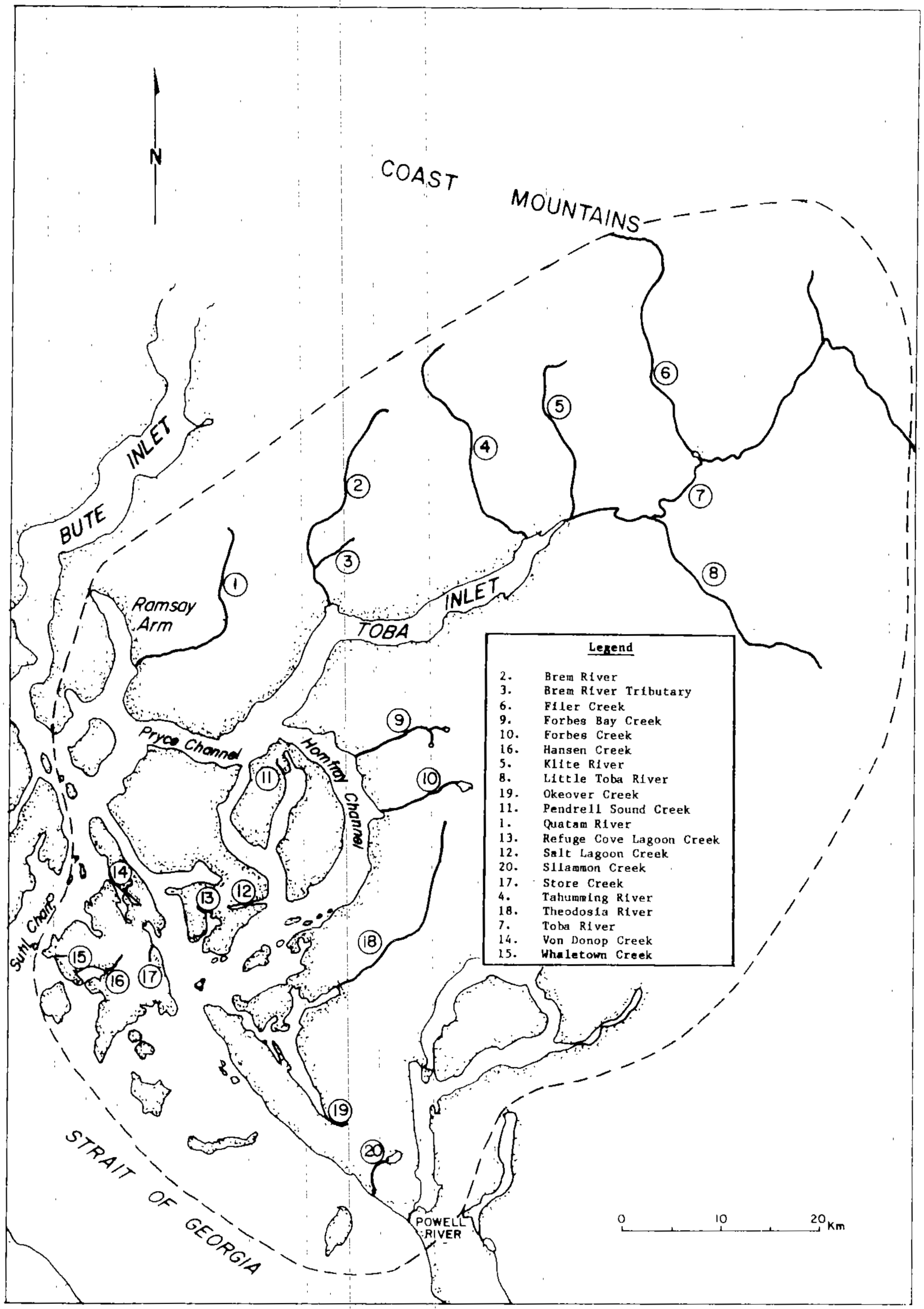

Figure 12. Streams in the Toba Inlet production area.

There are four streams that support odd-year pink salmon stocks. There are no even-year pink stocks of any significant size. The odd-year run is passively managed and is severely depressed compared to historic levels. Total escapement in the 1950s averaged 90,500, compared to 34,000 and 21,000 in the 1960s and 1970s, respectively. Recent escapements have been well below the target of 135,000, averaging only 4400 spawners from 1981 to 1985.[3]

The majority of Toba Inlet pink salmon (93%) approach their natal streams from the north through Johnstone Strait, while the remainder approach from the south through Juan de Fuca Strait. The timing of migration is concurrent with Fraser pink and sockeye salmon and, therefore, exploitation rates on these stocks are high.

There are nine streams in Toba Inlet that support chum salmon. Only the Okeover and Toba River stocks are actively managed. From 1980 to 1985, these stocks accounted for 60% of the total chum escapement to the area. Total escapement averaged 65,800 in the 1950s and declined to 23,300 in the 1960s, 18,300 in the 1970s and 15,000 in the early 1980s.[3] The target for the area is 180,000 fish.

There are four chinook stocks in the Toba Inlet area. Total escapements increased from 3900 (1955 - 1964) to 12,200 (1965 - 1974) but declined to an average of only 400 during the period 1975 - 1984.[7]

Coho salmon have been reported in 15 streams in Statistical Area 15 from 1953 to 1983.[10]

2.2.5 Jervis Inlet

The Jervis Inlet production area includes all of Statistical Area 16 (Figure 13).

The only sockeye stock in the Jervis Inlet area originates from Sakinaw Lake. This stock consists primarily of 5-year old lake-spawning fish. They migrate through Johnstone Strait and are considered an early-run stock. Peak abundance occurs during the first two weeks of July. Although there are no fisheries directed specifically at this stock, Sakinaw sockeye are intercepted in Johnstone Strait fisheries for Nimpkish and early Fraser River (early Stuart, Nadina, Gates and Raft) sockeye stocks. Reliable escapement data indicate that the

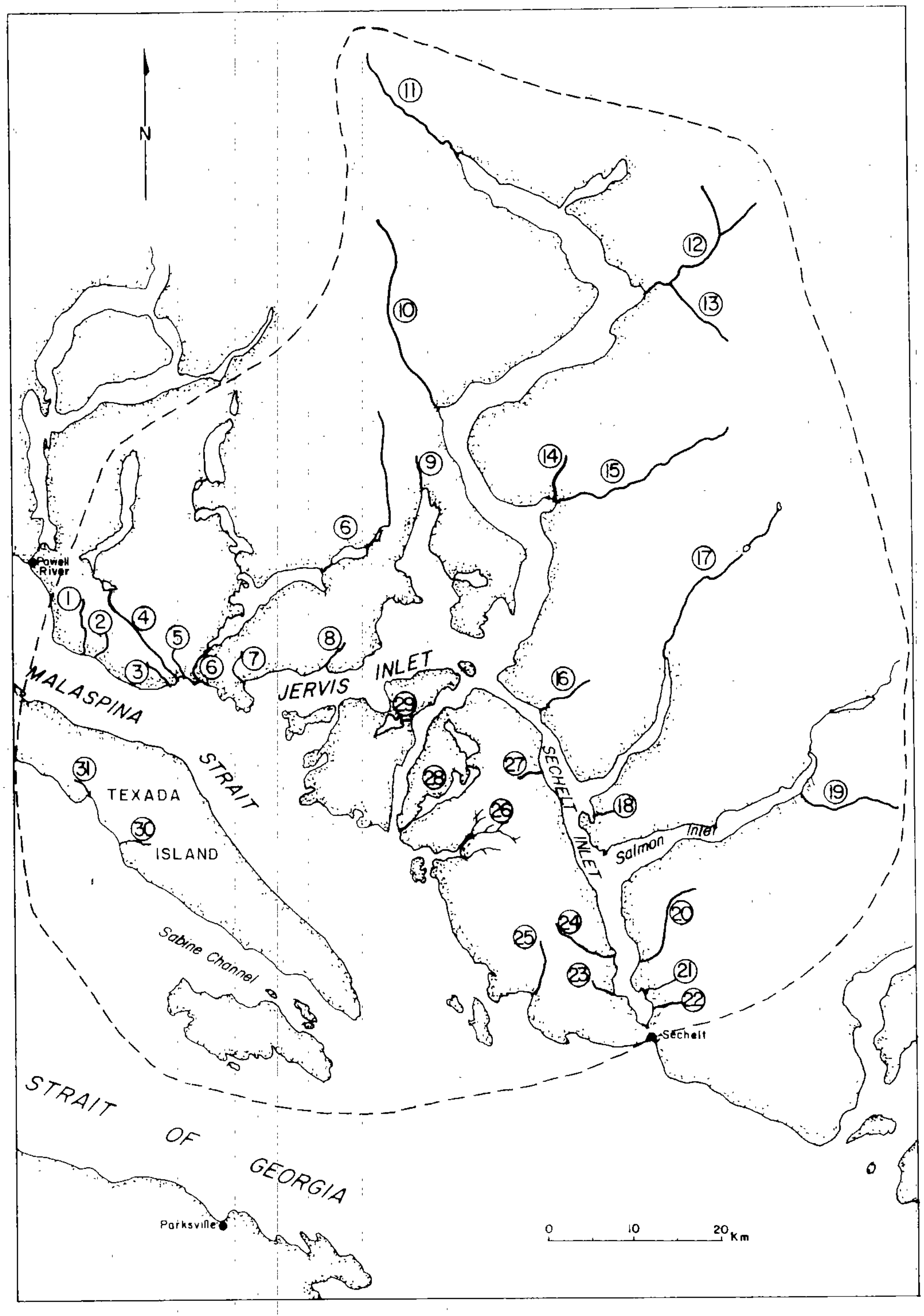

Figure 13. Streams in the Jervis Inlet production area (see Table 5 for key to stream numbers).

Table 5. Key to streams in Jervis Inlet production area (from Figure 13).

No.	Stream	No.	Stream
21.	Angus Creek	4.	Lang Creek
9.	Baker Creek	6.	Lois River
10.	Brittain River	30.	Mouat Creek
22.	Burnet Creek	1.	Myrtle Creek
24.	Carlson Creek	26.	Pender Harbour Creeks
2.	Dayton Creek	28.	Sakinaw Lake
12.	Deserted River	8.	Saltery Bay Creeks
27.	Doriston Creek	19.	Sechelt Creek
16.	Earle Creek	11.	Skwawka River
20.	Gray Creek	23.	Snake Creek
25.	Halfmoon Creek	18.	Storm Creek
14.	High Creek	13.	Tsuahdi Creek
7.	Jefferd Creek	17.	Tzoonie River
15.	Jitco (Vancouver River)	15.	Vancouver River (Jitco)
3.	Kelly Creek	29.	West Creek
		5.	Whittal Creek

Sakinaw stock is declining. Average escapements of 5000 - 6000 spawners in previous decades declined to 2400 during the period from 1980 to 1985.[3] The maximum number of potential spawners is estimated at 10,000 and is restricted by the availability of spawning habitat. In addition, rearing of sockeye smolts is limited because of predation by trout. Urban settlement and logging activities have adversely affected both the spawning and rearing habitats of Sakinaw sockeye.

There are six odd-year pink stocks that spawn in the Jervis Inlet area. All of these are passively managed. The majority (63%) of these fish migrate to their natal streams from the north through Johnstone Strait, while the remainder (37%) approach from the south through the Juan de Fuca Strait. The timing of their migration through Johnstone and Juan de Fuca straits is concurrent with Fraser River pink and sockeye stocks. The Jervis Inlet stocks are severely depressed, and little is known about their productivity rate. Escapements have declined from 132,000 in the 1950s to 15,000 in recent years (1981-1985). The target escapement for the area is 130,500 spawners.

There are 20 streams in Jervis Inlet that support chum salmon populations. The five actively-managed stocks account for more than 70% of the total escapement. Chum returns have increased from 60,000-70,000 in previous decades to an average of 106,500 during the period from 1980 to 1985. The target for the area is 142,000 spawners.

Chinook salmon were reported in the Skwawka and Tzoonie rivers in the past, but have not been reported in any streams in the area since 1974.[7]

Coho salmon have been reported in 28 streams in the Jervis Inlet area.[10] Although stock information is limited, the Skwawka and Vancouver rivers are considered the major coho producers in the area.[4]

2.2.6 Howe Sound/Burrard Inlet

The Howe Sound and Burrard Inlet production area includes all of Statistical Area 28 (Figure 14).

Odd-year pink stocks in Howe Sound and Burrard Inlet are passively managed. There are no even-year runs in this area. All of the pink salmon produced in Howe Sound originate from the Squamish River system. Most spawning occurs in the mainstem and its major tributary, the Chekamus River. Smaller numbers spawn in the Mamquam and Ashlu rivers, which are other tribuaries of the Squamish. The only pink stock in Burrard Inlet originates from the Indian River. Historically, pink runs to these rivers were substantial, and probably contributed to interception fisheries along their migration routes. However, escapements of pink salmon to the area have declined significantly in recent years. Escapement to the Squamish River system averaged 146,000 from 1951 to 1960, but declined to an average of only 5400 over the last three cycles (1981-1985).[13] In 1985, escapement of pink salmon was at a record low of 700 spawners. Escapement of pink salmon to the Indian River averaged 105,000 in the 1950s. Over the three most recent cycles, escapement averaged 25,000 indicating that this stock has not declined as much as the Squamish River stock.[13] The target escapements for the Squamish and Indian River stocks are 422,500 and 100,000, respectively.

Howe Sound and Burrard Inlet pink salmon approach their natal streams from the north through Johnstone Strait and from the south through Juan de Fuca Strait. Results of a tagging study conducted in 1959 indicated that the two routes are used by about equal numbers of these fish.[14] Squamish pink salmon have an earlier migration timing than the Indian Arm stocks. They are present in Johnstone and Juan de Fuca straits from late July to late August,with peak abundance in early to mid-August. The Indian River pink run is slightly later, peaking in Johnstone and Juan de Fuca straits in the second to third week of August. The migration timing of both stocks is concurrent with that of the Fraser River and Puget Sound pink stocks and some Fraser sockeye stocks.

There are 25 streams in Howe Sound and Burrard Inlet that support chum spawners. However, only the Squamish and Indian rivers are considered major chum producers. During the period 1981-1985, these two streams accounted for 97% of the average total chum escapement to the area. Total escapement averaged approximately 58,500 spawners from 1961 to 1970, increased to 159,000 from 1971 to 1980 and again to 202,000 from 1981 to 1985.[13] The target escapement is 350,000 chum for Howe Sound and 50,000 for Burrard Inlet. The stocks are currently rebuilding to capacity.

The two main chinook stocks in Howe Sound and Burrard Inlet originate from Squamish and Capilano rivers. The size of the Squamish chinook stock has declined markedly from historic levels and is currently among the most depressed stocks on the B.C. coast. Total escapements have declined from an average of 16,900 during

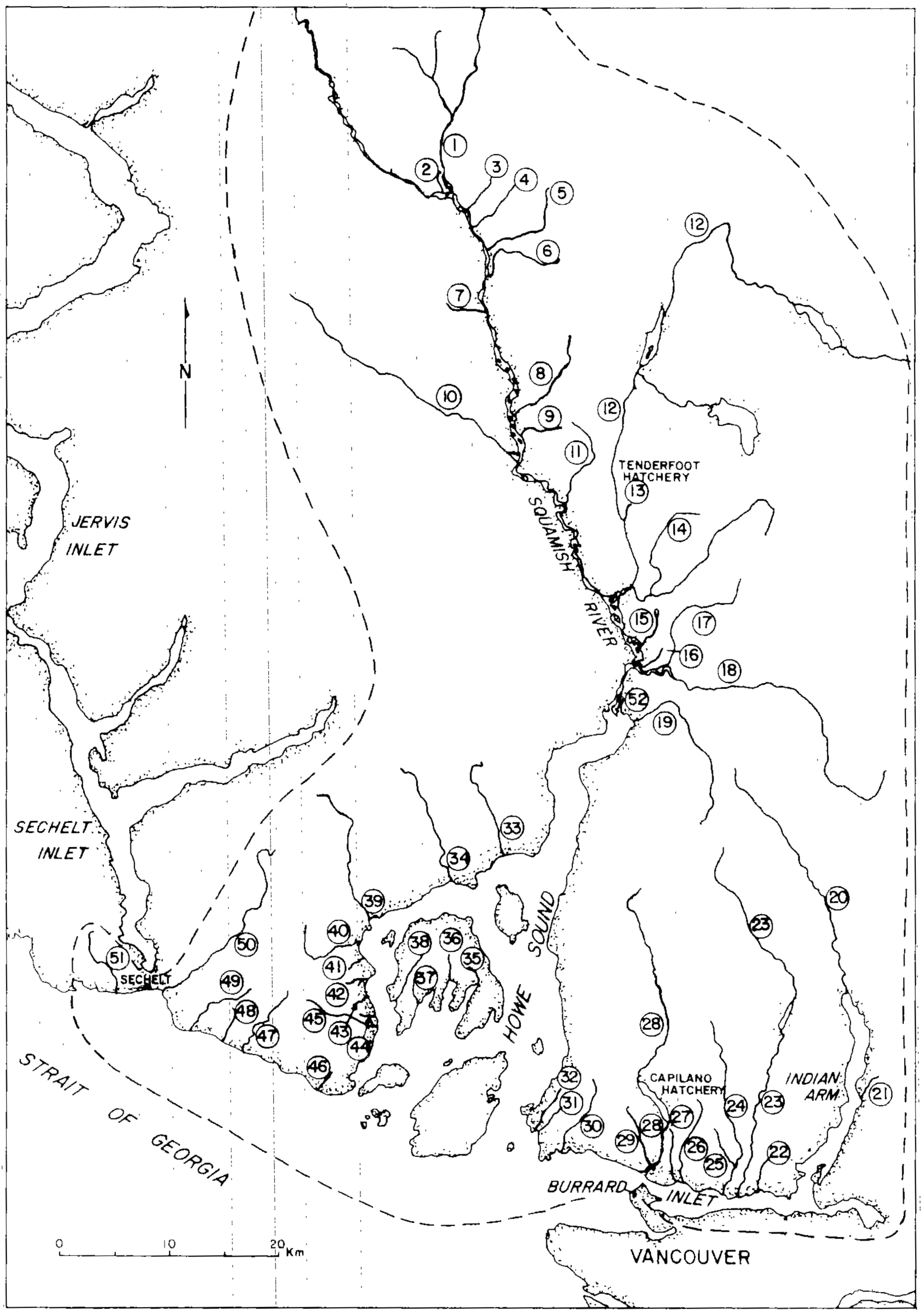

Figure 14. Streams in the Howe Sound and Burrard Inlet production area (see Table 6 for key to stream numbers).

Table 6. Key to streams in Howe Sound/Burrard Inlet production area (from Figure 14).

No.	Stream	No.	Stream
42.	Archies Creek	38.	Mannion Creek
10.	Ashlu Creek	17.	Mashiter Creek
41.	Avalon Creek	22.	McCartney Creek
9.	Branch 100 Creek	34.	McNab Creek
14.	Brohm River	16.	Meighan Creek
29.	Brothers Creek	26.	Mosquito Creek
28.	Capilano River	32.	Nelson Creek
36.	Centre Creek	43.	Ouillet Creek
50.	Chapman Creek	11.	Pillchuck Creek
46.	Chaster Creek	33.	Potlatch Creek
12.	Cheakamus River	39.	Rainy River
6.	Chuk-Chuk Creek	21.	Richards Creek
30.	Cypress Creek	47.	Roberts Creek
40.	Dakota Creek	23.	Seymour River
31.	Eagle Creek	2.	Shop 3 Creek
48.	Flume Creek	4.	Shovelnose Creek
25.	Hastings Creek	7.	Spring Creek
8.	High Falls Creek	1.	Squamish River
15.	Hop Ranch Creek	19.	Stawamus River
20.	Indian River	13.	Tenderfoot Creek
45.	Langdale Creek	3.	Thirty Seven Mile Creek
52.	Loggers Lane Creek	5.	Twenty Eight Mile Creek
35.	Long Bay Creek	51.	Wakefield Creek
24.	Lynn Creek	37.	Whispering Creek
27.	MacKay Creek	44.	Williamson Creek
18.	Mamquam River	49.	Wilson Creek

the period 1951 to 1960 to an average of 3100 during 1981 - 1985 (Figure 15). The 1985 escapement of 860 chinook spawners was one of the lowest on record for the area, and is well below the escapement target of 35,000. Returns of marked Squamish chinook indicate that their distribution extends along the coast as far north as Alaska, and they are taken in large numbers by the Georgia Strait sport and troll fisheries and the central and northern British Columbia net fisheries. Although the exploitation on this stock is unknown, it is thought to be similar to that of other B.C. chinook stocks (about 90%); which is higher than the population can support.

Chinook salmon were first introduced to the Capilano River in 1979 as a transplant from the Big Qualicum River hatchery. The escapement was 2600 in 1979, but declined to only 776 in 1985 and 100 in 1986.[13] The total average escapement was 1200 spawners during the period from 1981 to 1985. The recent low escapements have been attributed to extreme low river discharge during the chinook migration period as well as the high exploitation rates on this stock.

Coho salmon have been reported in 31 streams in the Howe Sound and Burrard Inlet area during the period from 1951 to 1985.[13] The Capilano River is the largest coho producer in the area. Since 1971, returns to the river have been largely enhanced fish. Recorded escapements have strongly reflected enhancement activities within the watershed. For example, the average escapement during the period 1981 to 1985 was six times greater than that recorded in the 1960s. Target escapements for the area are based on hatchery broodstock requirements and generally vary from year to year. Escapements in excess of broodstock requirements have occurred since the Capilano hatchery began production. The Capilano coho stock has the earliest and most protracted migration timing of all coho stocks in Areas 28 and 29. The migration begins in June and extends into November, with peak abundance occurring in October.[4]

The second largest coho producer in Area 28 is the Squamish River. Production was entirely from wild stocks until 1985 when enhanced fish from two minor facilities contributed to returns. Escapements of Squamish coho have shown an erratic but declining trend over the period of record, with an estimated decline of 6% per year since 1970.[4] Squamish coho return to the river from mid-August to December.[15]

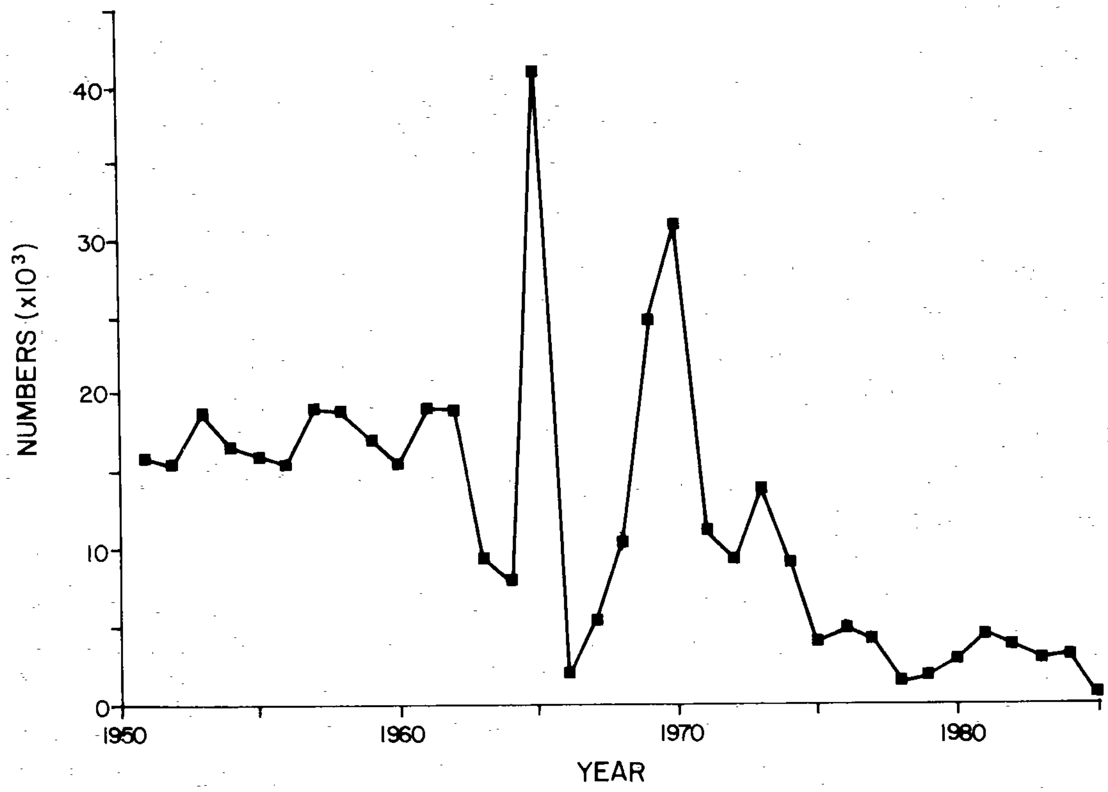

Figure 15. Squamish River system chinook escapement (from Farwell et al. 1987).[13]

The Seymour River is the third largest coho producer in this area. Escapements have increased from an average of 2000 (1951-1960) to 10,000 spawners (1981-1985),[13] which is attributable, in part, to a small enhancement facility that has operated in the watershed since 1977.[15]

2.3 Fraser River

The Fraser River is the largest producer of salmon in British Columbia. It supports populations of all five species of Pacific salmon and steelhead trout as well as numerous resident species. About one third of B.C. salmon stocks originate from the Fraser River watershed.

Approximately 20 lakes in the Fraser River watershed support sockeye salmon. There are many individual stocks which range in size from a few thousand to several million fish. Together they form the largest sockeye run in British Columbia. Fraser River sockeye runs were historically much larger than they are at the present time. Escapements averaged 10.5 million from 1894 to 1913, and peaked at 36.5 million in 1913. Recently, escapements have averaged 5.9 million (1964-1983) with peak returns of 15.8 million in 1986.

A characteristic feature of Fraser River sockeye populations is the occurrence of quadrennial cyclic dominance, in which the number of returning adults is much greater in every fourth year. This cycle is maintained because most returning adults are four-year old fish. Each of the four-year classes is referred to as a different cycle. This phenomenon has largely been confined to those stocks that spawn upstream of the Fraser Canyon. Prior to 1914, all major upriver sockeye stocks exhibited dominance in the 1913 cycle. However, blockage of the Hell's Gate Canyon in 1913 prevented a substantial portion of this run from reaching upstream spawning areas. In addition, an intensive fishery directed at this cycle in 1917 caused low escapement during that year. As a result, the cycle was reduced to approximately the level of other cycles and dominance was eliminated. A logging splash dam at the outlet of Adams Lake and a placer mining storage dam at the outlet of Quesnel Lake also contributed to the decline of the Fraser sockeye populations.

Removal of the dams, construction of fishways at Hell's Gate and several other locations, and regulatory control of the fishery to allow greater escapements have led to increased production of Fraser River sockeye stocks. In some areas of the watershed, dominance has recently reappeared but has not occurred in the same cycle for all stocks. For example, dominance has returned to the original 1913 (1981) cycle in the Stuart and Quesnel systems, whereas it occurs in the 1982 cycle in the Shuswap system, particularly in the Adams River run. The 1982 cycle is presently the largest on the Fraser River with an average run of about 12 million from 1974 to 1986. The 1984 cycle is the smallest, with an average run of 4.3 million from 1972 to 1984 (Figure 16). Because of the predominance of different stocks in each cycle, the stock composition and timing of migrations vary among cycle years, and this complicates the management of the fishery.

The reasons for cyclic changes in Fraser River sockeye returns are not clear. Ward and Larkin (1964) proposed that the interaction among sockeye-year classes resulted from depensatory predation of juvenile sockeye by trout.[16] Subsequent monitoring of sockeye fry abundance in Shuswap Lake did not support this hypothesis because the ratio of underyearlings per spawner did not increase with increased spawner abundances.[17] Support for the hypothesis has come primarily from stock-recruitment analysis by cycle year, which shows different curves for each cycle (J. Woodey, IPSFC per. comm.). There is an alternate hypothesis that states that cyclic dominance does not have a biological basis but is generated and maintained by fishing pressure. Walters and Staley (1987) analyzed the spawner-recruitment data for eight Fraser River stocks and found that there were no significant differences among the relationships for each cycle year.[18] This supports the idea that high harvest rates in off-cycle years maintains cyclic dominance among Fraser sockeye stocks.

Prior to ratification of the Pacific Salmon Treaty, the International Pacific Salmon Fisheries Commission (IPSFC) were responsible for setting escapement targets for Fraser sockeye stocks. DFO is currently reviewing these targets and, therefore, they are subject to change.

Approximately 90% of Fraser River sockeye return to spawn as 4-year old fish. The remaining 10% spawn at age 3 (jacks) and 5. Some stocks characteristically have a higher proportion of age 5 fish than other stocks, particularly those from lower Fraser tributaries such as Pitt, Birkenhead, Weaver (in some years) and Cultus. Age 3 sockeye are most abundant in the Birkenhead, Weaver, Portage, Gates, Chilko, Horsefly and Adams runs.

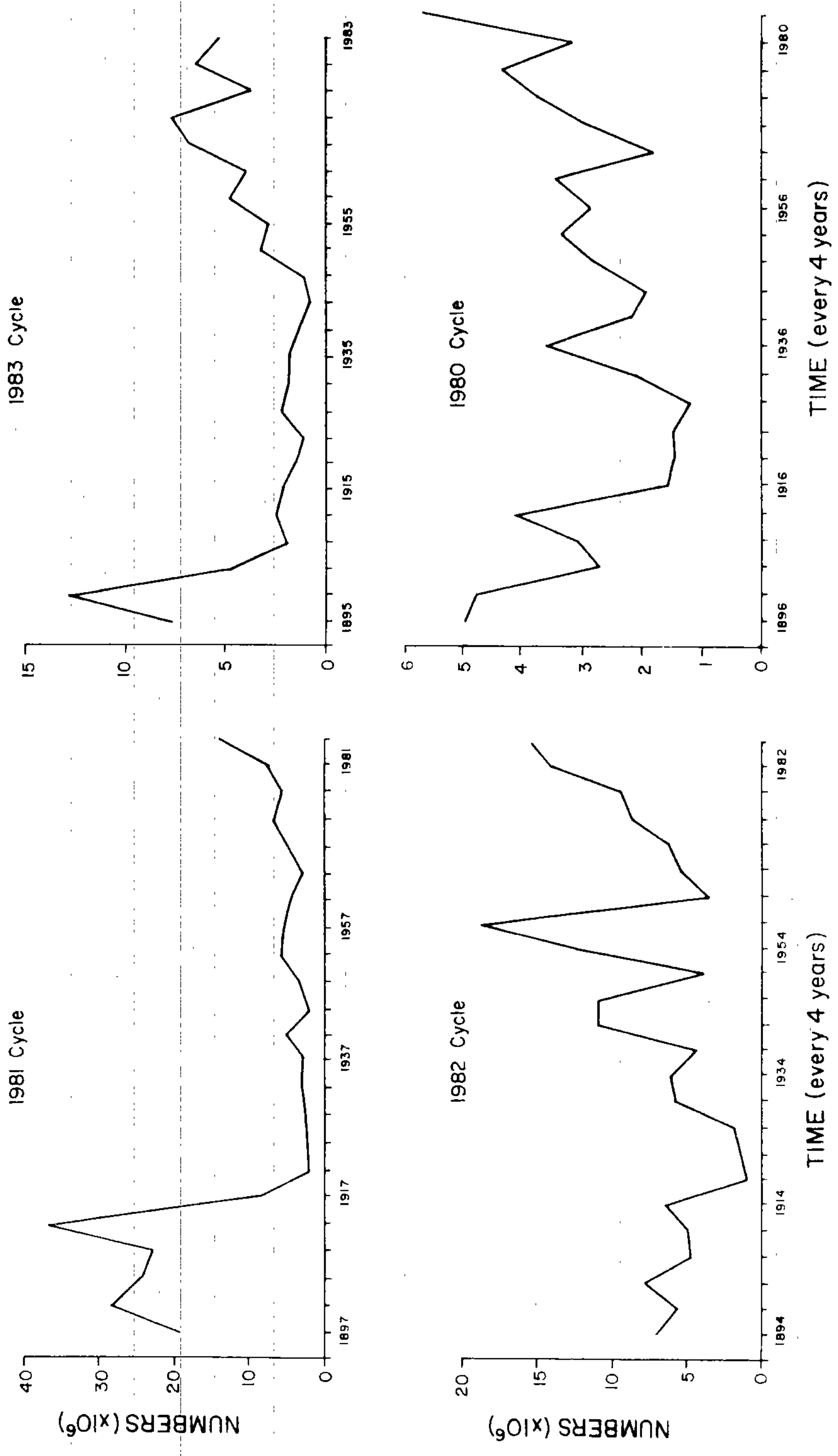

Figure 16. Historical total runs of Fraser River sockeye by cycle.

Maturing Fraser River sockeye make landfall along the northern B.C.,central B.C., and west Vancouver Island coasts and then migrate southward through Juan de Fuca or Johnstone straits to Georgia Strait. From 1952 to 1977, an average of 16% of the Fraser sockeye stocks migrated through Johnstone Strait. Since 1978, the proportion of the run migrating through Johnstone Strait increased to an average of 46%, with a high of 80% in 1983 (Figure 17). This change in the number of sockeye migrating through the northern and southern approaches has been due to alterations in oceanographic conditions known as "El Nino".[19] Generally, the diversion rate through Johnstone Strait is greater for later runs than for the earlier runs.

The Fraser River supports the largest pink salmon run in British Columbia, with an average of 15.1 million fish over the last five cycles. Although information on the size of historical runs is limited, Fishery Officer reports indicate that millions of pink salmon spawned in Seton Creek and the Thompson and Nicola rivers in the early 1900s. The size of runs prior to 1913 have been estimated at 28 million pink. The Hell's Gate rock slide of 1913 drastically reduced the Fraser pink run by completely blocking access to upstream spawning areas. However, installation of the Hell's Gate fishway in 1946, construction of spawning channels at Seton Creek, and some reduction of exploitation rates in peak years has resulted in the use of upriver spawning areas and increased pink escapement to the Fraser system, which have led to larger-sized runs in recent years (Figure 18). There appears to be a relationship between the size of pink salmon runs and the size of the individual fish, where large runs consist primarily of smaller-sized fish and small runs consist primarily of larger fish.

Fraser pink salmon are managed as a single stock, but can be grouped into two broad categories on the basis of run timing. However, the difference in timing between early and late runs is only 7 to 10 days. In recent years, the early-run stocks have comprised more than 90% of the total escapements to the area. Like other southern Georgia Strait pink stocks, Fraser River pink spawn only in odd years.

Fraser River chum salmon are managed to total abundance rather than as individual stocks. This stock is currently rebuilding after a period of stable but low abundance. During the period 1981 to 1985 the size of this run averaged 511,800 fish.[13]

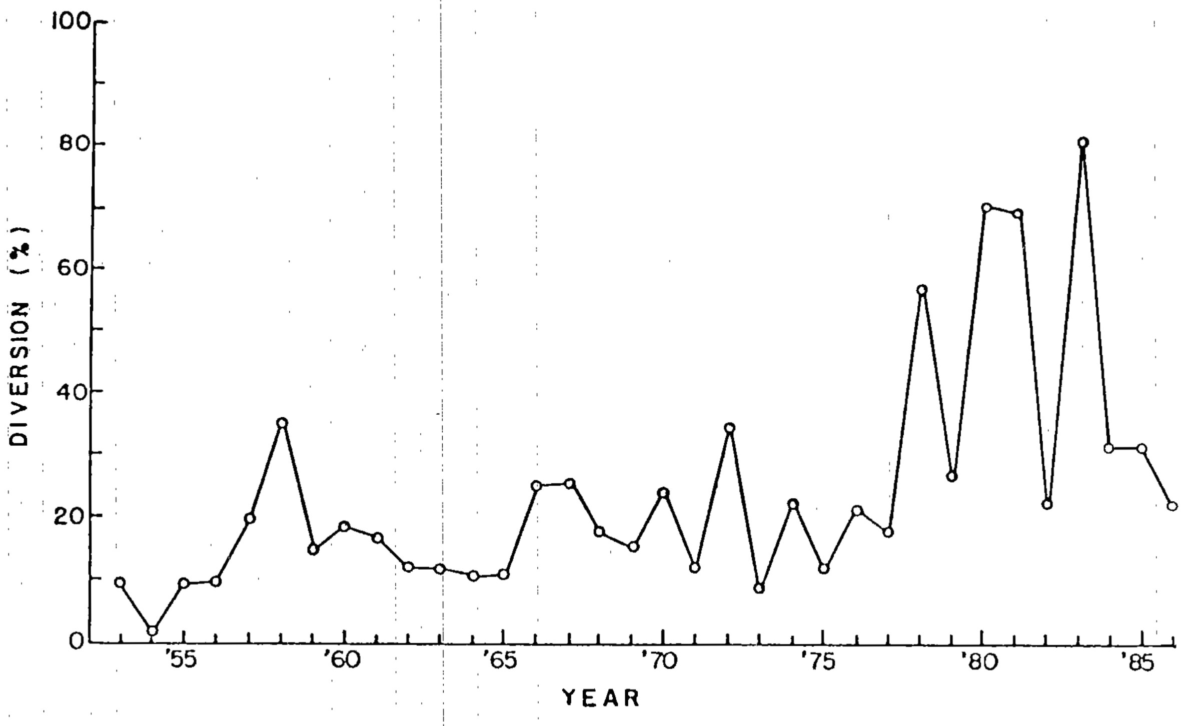

Figure 17. The diversion rate of Fraser River sockeye migrating through Johnstone Strait.

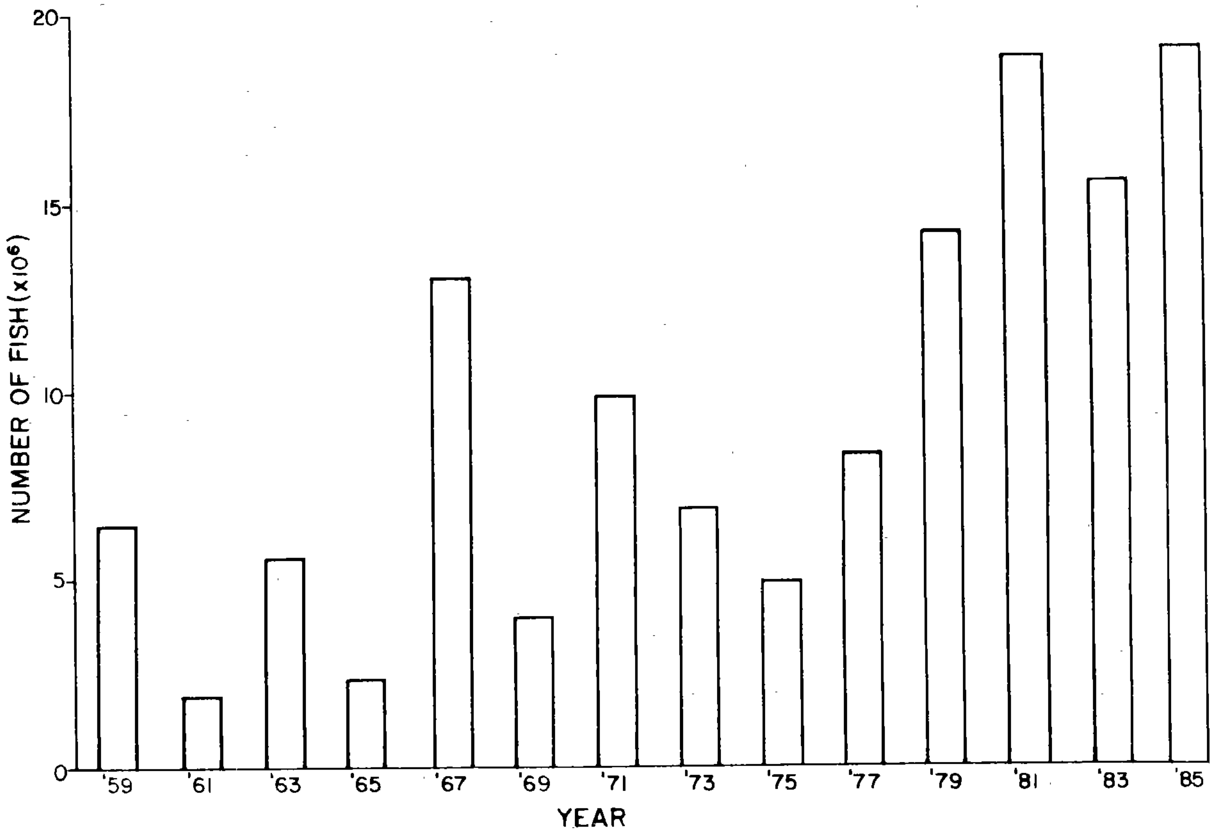

Figure 18. Fraser River odd-year pink salmon runs from 1959 to 1985.

Declining chinook catches in the 1970s and an increased awareness of chinook conservation problems have resulted in greater effort being expended in assessing chinook escapements to the Fraser River. At the same time, road access to many remote spawning areas has improved, and greater use has been made of helicopter and fixed-wing aircraft to increase counting efficiency. In general, this would tend to increase escapement estimates whether or not numbers of spawners actually increased. Nevertheless, estimates of chinook escapement to the Fraser River system are believed to be a good index of spawner abundance (Figure 19). Chinook test fishing began in the lower Fraser in 1980, and takes place each year throughout the chinook migration. Although the data set is small, there is a high correlation between the test fishery index and total estimated escapement.

The Fraser River is the major producer of coho salmon in British Columbia. Although escapements have been erratic, they have been declining at a rate of 1% per year since 1951, and 1.9% per year since 1970.[4] There is currently no test fishery intended specifically to index Fraser River coho escapement. However, an index of coho abundance has been developed by combining coho data from the IPSFC sockeye test fishery which generally ceases operation by mid-October, with coho data from the chum test fishery which operates from early October through mid-December. This index confirms that there has been a significant decline in the number of returns to the Fraser River since 1970. Uncertainties in escapement enumeration and estimation of the escapement level required for optimum yield preclude assessment of the status of the Fraser River coho stock. However, the apparent declines in the number of returning adults indicate that current escapements are well below the target level for this stock.

The Fraser River is subdivided into four major production areas (Figure 3). The Lower Fraser includes the area from the mouth of the river to Boston Bar in the Fraser Canyon as well as Boundary Bay streams, the Middle Fraser extends from Boston Bar to Prince George and the Upper Fraser is the area from Prince George to the headwaters. The Thompson includes the mainstem and North and South Thompson drainages. Average escapements of salmon to each of these production areas are shown in Table 7, while stock descriptions are provided in the following sections.

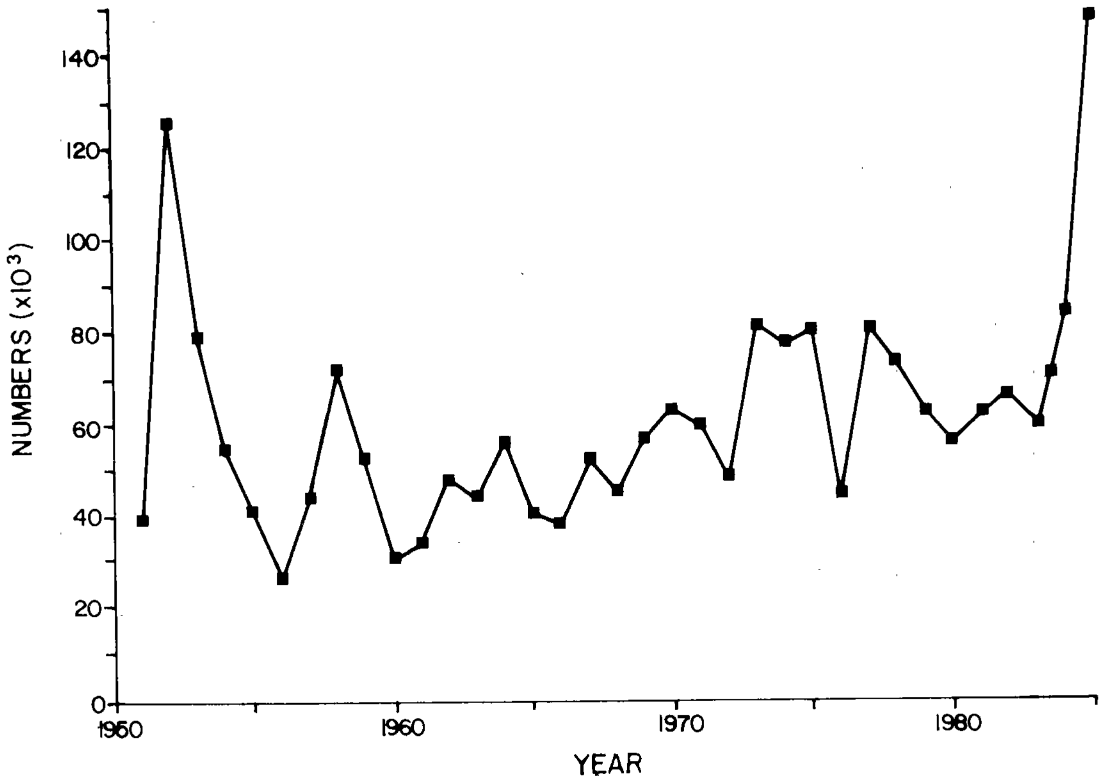

Figure 19. Total escapement of Fraser River chinook salmon (from Farwell et al. 1987).[13]

Table 7. Average escapements of salmon to the Fraser River by production area.

	Lower Fraser	Middle Fraser	Thompson	Upper Fraser	Total Fraser
Sockeye (1970-85)					
82 Cycle	275,000	200,000	1,972,000	108,000	2,555,000
83 Cycle	157,000	291,000	286,000	293,000	1,027,000
84 Cycle	172,000	536,000	35,000	113,000	856,000
85 Cycle	137,000	763,000	69,000	468,000	1,437,000
Average	185,250	447,500	590,500	245,500	1,468,750
Pink (1981-85)	4,090,000	465,000	624,000	0	5,179,000
Chum (1981-85)	511,000	0	0	0	511,000
Chinook (1979-84)	18,000	10,000	18,000	12,000	58,000
Coho (1979-83)	38,000	2,000	10,000	0	58,000
Steelhead *	7,500	4,000	15,000	0	26,500

* Mean of estimated range for total run size

2.3.1 Lower Fraser

The Lower Fraser encompasses the area between the mouth of the Fraser and the Fraser Canyon as well as Boundary Bay streams (Figure 20). It includes District 02 and Sub Districts 29B, 29C, 29D and 29E.[20]

The Birkenhead River and Weaver Creek are the major producers of sockeye salmon in the Lower Fraser. These two stocks are actively managed to escapement targets of 120,000 and 50,000, respectively. There are also five smaller stocks that spawn in the Harrison and Pitt River drainages and Cultus Lake. Sockeye escapements in the Lower Fraser averaged about 185,000 spawners from 1970 to 1985.[21] These stocks do not exhibit extreme cyclic patterns.

Escapements of the Birkenhead stock have averaged near the target level during the 1982 cycle, but range between 50% to 75% of target in the other cycle years. Escapements of the Weaver stock generally reach or exceed the target. The productivity of this stock has increased as a result of construction of a spawning channel. In 1982, the Weaver greatly exceeded its target since the primary management objective this cycle is to achieve the escapement target in the co-migrating Adams stock.

The Lower Fraser sockeye have a mid- to late summer run timing.[21] The Birkenhead stock has a mid-summer run timing, with peak spawning occurring in late September. Peak spawning of the Weaver stock occurs in late October. Some stocks in the Pitt and Harrison systems spawn in mid- to late September, while others spawn in early November. The Cultus Lake stock also spawns in November.

Total escapement of pink salmon to the Lower Fraser production area has increased from an average of 1.1 million in the 1960s to 1.2 million in the 1970s. Recent escapements have been substantially higher, with 2.7 million in 1981, 3.6 million in 1983, and 6.0 million in 1985. The marked increase in the number of returns in 1985 is attributed to low flows coupled with the small size of the fish which prevented upriver stocks from migrating through the canyon and resulted in those fish spawning in the lower river.

The mainstem Fraser, Coquihalla, Jones and Chehalis rivers support early runs of pink salmon, while the Harrison, Weaver and Chilliwack-Vedder rivers support late runs. From 1981 to 1985, escapements of the early runs averaged 3.7

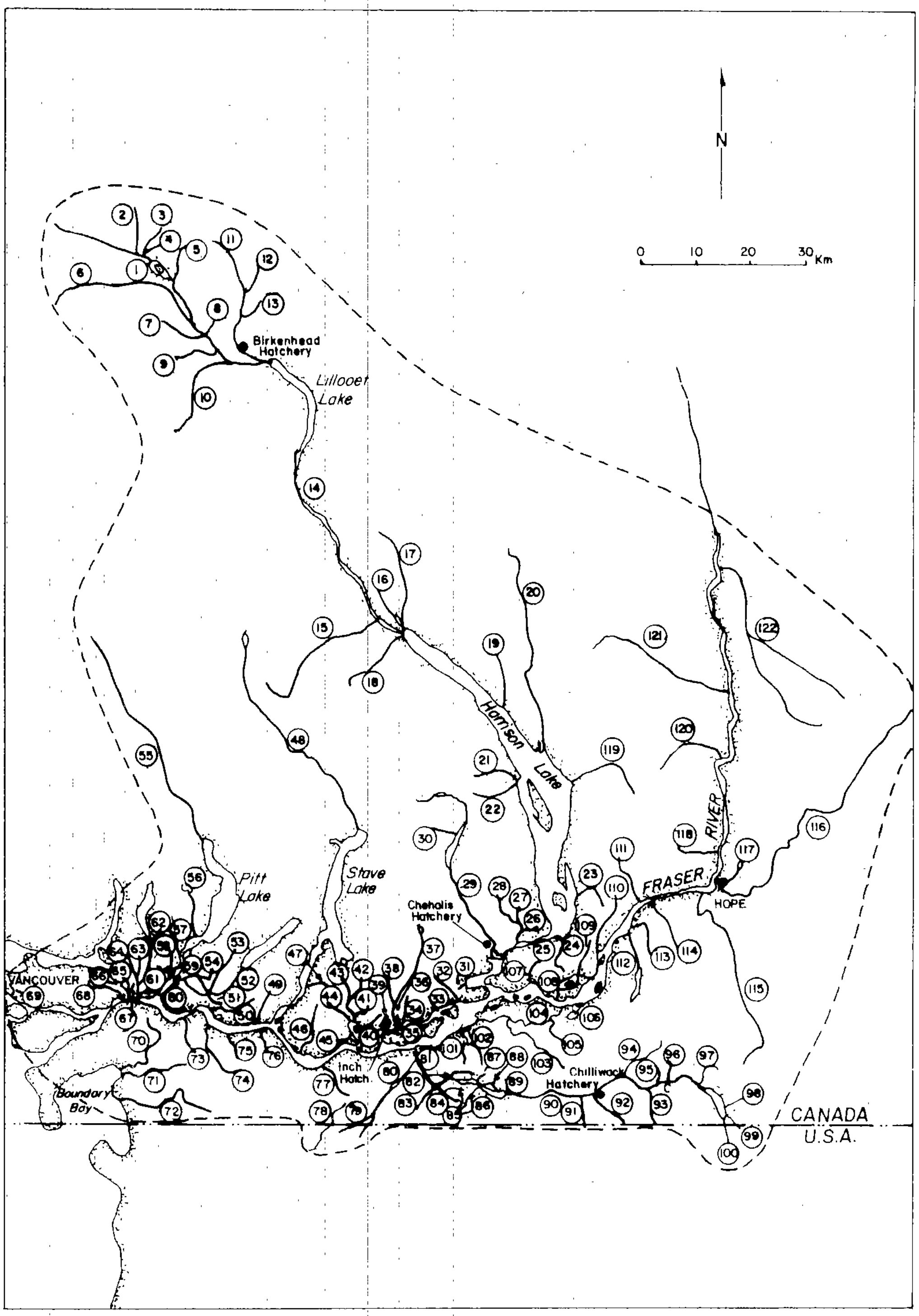

Figure 20. Streams in the Lower Fraser production area.

Table 8. Key to streams in the Lower Fraser production area (from Figure 20).

No.	Stream	No.	Stream
52.	Alouette River	107.	Mountain Slough
118.	American Creek	69.	Musqueam Creek
122.	Anderson River	22.	Mystery Creek
101.	Atchelitz Creek	76.	Nathan Creek
87.	Barrett Creek	93.	Nesakwatch Creek
20.	Big Silver Creek	71.	Nicomekl River
11.	Birkenhead River	35.	Nicomen Slough
54.	Blaney Creek	37.	Norrish Creek
91.	Borden Creek	53.	North Alouete River
44.	Bouchier Creek	62.	Or Creek
34.	Brosseau Creek	98.	Paleface Creek
68.	Brunette River	9.	Pemberton Creek
72.	Campbell River	55.	Pitt River
58.	Cedar Creek	12.	Poole Creek
29.	Chehalis River	67.	Popyey Creek
90.	Chilliwack River	106.	Popkum Creek
100.	Chilliwack River	97.	Post Creek
40.	Chilqua Creek	16.	Purcell Creek
77.	Clayburn Creek	33.	Pye Creek
119.	Cogburn Creek	2.	Railroad Creek
30.	Coho Creek	111.	Ruby Creek
51.	Coho Creek	6.	Ryan River
116.	Coquihalla River	89.	Ryder Creek
61.	Coquitlam River	28.	Sakwi Creek
99.	Depot Creek	74.	Salmon River
17.	Douglas Creek	1.	Salmon Slough
45.	Draper Creek	82.	Salwein Creek
105.	Dunville Creek	3.	Sampson Creek
26.	East Creek	4.	Sampson Slough
103.	Elk Creek	66.	Schoolhouse Creek
95.	Fifteen Mile Creek	41.	Scorey Creek
78.	Fishtrap Creek	64.	Scott Creek
94.	Foley Creek	70.	Serpentine River
96.	Fourteen Mile Creek	32.	Siddle Creek
110.	Gallagher Creek	46.	Silverdale Creek
10.	Green River	115.	Silverhope Creek
25.	Harrison River	92.	Sleese Creek
38.	Hawkins Creek	15.	Sloquet Creek
109.	Hicks Creek	13.	Spring Creek
88.	Hipp Creek	121.	Spuzzum Creek
104.	Hope Slough	31.	Squawkum Creek
85.	Hopedale Slough	48.	Stave River
63.	Hoy Creek	47.	Steelhead Creek
114.	Hunter Creek	83.	Stewart Slough
59.	Hyde Creek	19.	Stokke Creek
39.	Inches Creek	84.	Street Creek
5.	John Sandy Creek	80.	Sumas River
50.	Kanaka Creek	86.	Sweltzer River
117.	Kawkawa Creek	18.	Tipella Creek
42.	Lagace Creek	23.	Trout Lake Creek
65.	Laurentian Creek	21.	Twenty Mile Creek
14.	Lillooet River	81.	Vedder River
79.	Lonzo Creek	27.	Weaver Creek
113.	Lorenzetta Creek	75.	West Creek
102.	Luckakuck Creek	112.	Whaleach Creek
57.	MacIntyre Creek	49.	Whonnock Creek/York Creek
60.	Maple Creek	56.	Widgeon Creek
108.	Maria Slough	43.	(Wilkinson Ck; Bellchanton Ck.)
8.	McKenzie Creek	36.	(Worth Creek; Worths Creek)
24.	Miami Creek	120.	Yale Creek
7.	Miller Creek	73.	Yorkson Creek

million, of which 98% returned to the Fraser mainstem. Escapements of the late runs averaged 400,000 fish over the same period of which 75% returned to the Harrison River. The early-run stocks spawn in early to mid-October, while the late-run stocks spawn in late October.[22]

Fraser chum salmon have been reported to spawn only in the lower Fraser production area. Although Fraser chum are managed as an aggregate stock, escapements are enumerated separately for 11 stock groups (Appendix 1). Total escapement to the lower Fraser averaged 130,500 in the 1950s, and increased to 322,000 in the 1960s and 339,000 in the 1970s.[13] The number of chum returns continued to increase in recent years, where escapements averaged 511,000 from 1981 to 1985. The Harrison, Chilliwack and Stave River systems account for 56%, 18%, and 9% of the total escapement, respectively. The current target for chum escapement to the Fraser River is 700,000. The target level for Boundary Bay streams has not yet been established. Chum escapement to the Fraser River was 900,000 in 1985. At present, it is believed that the Fraser River could support significantly larger runs, perhaps up to twice the current escapement target. The recent increase in Fraser River chum spawners is attributed to the clockwork rebuilding strategy and the contribution of hatchery fish.

The majority of Fraser River chum salmon migrate to their natal streams from the north through Johnstone Strait, while the remainder approach from the south through Juan de Fuca Strait. It was estimated that 25-30% of this stock migrated through the southern route in 1985, while only 10% used this approach route in 1986.

Chum salmon are present in the Fraser River from late September to mid-December, with peak abundance occurring in the lower Fraser River from mid to late October, and from late November to early December. It appears that the chum productivity of Fraser chum stocks is lower in odd-numbered brood years when Fraser River pink are abundant.[23] Therefore, an increase in the number of Fraser pink salmon could have an adverse affect on chum production.

The major chinook stock in the lower Fraser area is the Harrison River fall run, which enters the river from early September through October. There are also a small number of early- to mid-run stocks. These are the Birkenhead, Lillooet, Chilliwack and Pitt rivers and Maria Slough stocks, which arrive in the lower Fraser during July and August. Estimated escapement to the Harrison River averaged 23,000 from 1971 to 1975, declined to 14,500 from 1976 to 1980, and increased to 22,600 from 1981 to 1985. However, it is difficult to estimate visually the number of returns to the Harrison River because the spawning area is in deep water at the outlet of a large lake. A mark-recovery program conducted in 1984 and 1985 indicated that there were significantly higher escapements than the visual counts suggested.[23]

Escapements of the mid-timing runs averaged 2330 chinook from 1971 to 1975, 1200 from 1976 to 1980, and 1065 from 1981 to 1985. Populations such as the Chilliwack River stock were substantial in the past, but are now virtually eliminated.[23]

There are 110 coho stocks that spawn in streams within the Lower Fraser area. This group of stocks accounts for 76% of the coho production from the Fraser River.[4] Major coho populations spawning in the Chilliwack River system include: the mainstem and upper Chilliwack River, Post and Salwein creeks; the Harrison system (Chehalis, Harrison, Lillooet and Birkenhead rivers and Weaver Creek) and the Upper Pitt and Salmon rivers.

The major steelhead stocks in the lower Fraser area include the Alouette, Chehalis, Coquihalla and Silverhope River runs and the Chilliwack/Vedder, which is the largest run on the coast. The Chilliwack/Vedder and Alouette stocks are winter runs that return from November through April. The Chehalis, Coquihalla and Silverhope stocks are summer runs that migrate into the Fraser system simultaneously with the sockeye stocks during June and July. The Chehalis summer run has been virtually eliminated. The Vedder supports a wild run of steelhead that ranges between 5000 and 10,000 fish. Although the summer runs are relatively small (i.e., <500 fish), they provide unique sport fishing opportunities early in the season.[24]

2.3.2 Middle Fraser

The middle Fraser encompasses the area between the Fraser Canyon and Prince George (Figure 21). It includes District 01 and Sub Districts 29F (excluding the portion in the Thompson watershed), 29G and 29H.[20]

The major sockeye stocks in the middle Fraser area originate in the Horsefly and Chilko rivers. The abundance of both stocks exhibits a cyclic pattern with the Horsefly dominant in the 1985 cycle and the Chilko dominant in the 1984

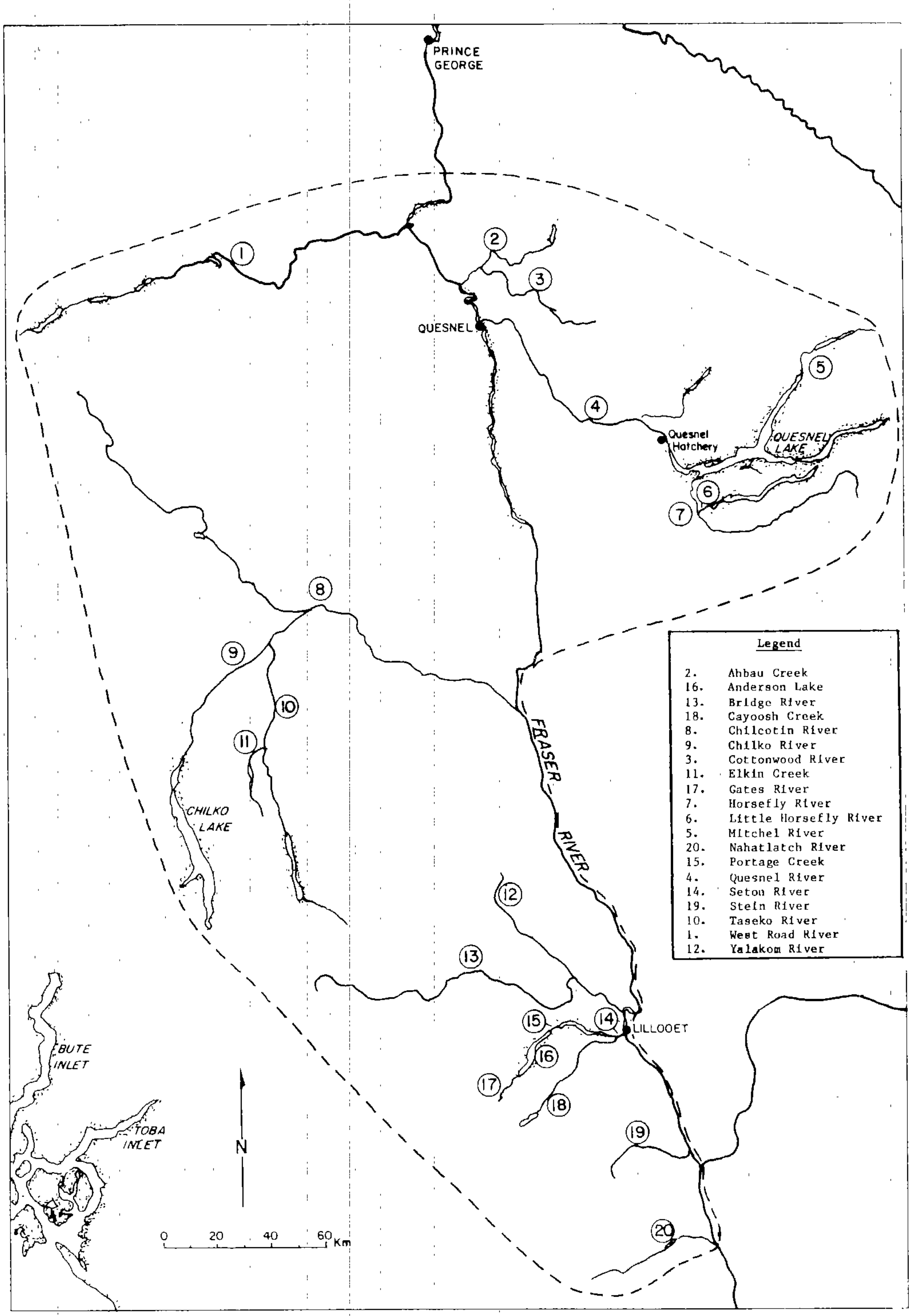

Figure 21. Streams in the Middle Fraser production area.

cycle. There are also two smaller stocks in the Chilko and Quesnel River system as well as three small stocks in the Seton River system. Sockeye escapements to the middle Fraser averaged 447,500 from 1970 to 1985, and ranged from 200,000 in the 1982 cycle to 763,000 in the 1985 cycle.

Sockeye escapement to the Horsefly River during the 1985 cycle increased from an average of 32,000 between 1941 and 1953, to 288,000 between 1957 and 1969. In recent years, escapements have continued to increase dramatically from 253,000 in 1973 to 473,000 in 1977, 677,000 in 1981 and 1.02 million in 1985.[21] Escapement to the Horsefly River in other cycles have generally been less than 10,000 spawners, although 30,000 spawners were enumerated in 1982 (the subdominant year).[21] The escapement targets for the river are 1 million, 100,000, 2000 and 900 for the 1985, 1982, 1983, and 1984 cycles, respectively.

Sockeye escapements to the Chilko River during the 1984 cycle have been relatively consistent, with only a slight increase in recent years. From 1972 to 1984, escapements averaged 510,000 spawners, which exceeds the target of 475,000. The 1982 and 1983 cycles are also substantial runs. Escapements recently averaged 175,000 and 281,000 spawners, respectively. Escapement records indicate that although the 1982 cycle has been increasing, escapements of the 1983 cycle have declined from the previous 4-year average of 459,000.[21] The targets for these runs are 250,000 and 300,000, respectively. Escapements during the 1985 cycle declined from an average of 185,000 from 1941 to 1953, to 76,000 from 1957 to 1969 and 60,000 from 1973 to 1985. The target for this run is 150,000 spawners.

Sockeye escapement to the Seton system is relatively consistent, ranging between 8700 and 22,000 over the four cycles.[21] The targets for these stocks total about 30,000 spawners.

The middle Fraser sockeye stocks are generally early-run stocks, with peak migration occurring in the lower Fraser from late July through early August. Peak spawning occurs from early to mid-September in the Horsefly River and from mid to late September in the Chilko River. Stocks in the Seton system consist of both an early run to Gates Creek and a late run to Portage Creek.[22]

There are four pink salmon stocks in the middle Fraser area, and they all spawn in the Seton River system. Seton Creek accounts for about 85% of the escapement. Total escapement to the area increased from an average of 170,000 in the

1950s to 397,000 in the 1960s. Escapements continued to increase to 626,000 and 500,000 in 1981 and 1983, respectively, which is largely attributable to increased production from the Seton Creek spawning channels. In 1985, the number of returns to Seton Creek declined to 267,500. Low escapement in this year was a result of low river flows in the canyon, which prevented migration of the pink stocks to upstream spawning habitat. The Seton-Anderson pink stocks are from the early-timing group. Peak spawning occurs in mid-October.[21]

There are nine major chinook stocks in the middle Fraser River. Highest escapements occur in the Chilko, West Road, Quesnel and Chilcotin rivers. Total escapement to the middle Fraser spawning areas appears to be increasing,with average escapements of 8600 from 1971 to 1975, 10,500 from 1976 to 1980, and 12,300 from 1981 to 1985. However, this increase may be attributable to increased enumeration effort. Some populations, particularly the early runs such as West Road and Cottonwood stocks, are rebuilding in response to management efforts to reduce chinook interceptions. Most of the middle Fraser chinook stocks are mid-timing runs that migrate into the Fraser River system between mid-July and late August.[23]

There are about seven streams in the area from Hope to Lillooet that regularly support coho salmon. The most notable of these are the Bridge and Gates rivers. Coho salmon have been reported as far upstream as the Quesnel River system.[2]

Steelhead trout spawn in the Chilko, Chilcotin, Cayoosh, Bridge, Stein, Nahatlach and Yalakom rivers. The Chilko/Chilcotin stock supports a major freshwater sport fishery. These are fall-run stocks that migrate through the lower Fraser during September and October. The Chilcotin fishery occurs from October through December and in June. The Chilko/Chilcotin run is estimated at 3000 to 5000 fish.[3]

2.3.3 Thompson

The Thompson River drainage includes tributaries to the North Thompson, South Thompson and mainstem Thompson (Figure 22). This includes Subdistricts 29J, K and F.[20]

There are four rivers in the North Thompson and 11 rivers in the South Thompson that support sockeye populations. From 1970 to 1985, sockeye escapements to the Thompson system averaged 1.97 million in the 1982 cycle, 286,000 in the 1983 cycle, 35,000 in the 1984 cycle, and 69,000 in the 1985 cycle. The extreme cyclic dominance in sockeye returns is driven by the Adams stock, which accounts for 75% of the escapement in the dominant year (1982). The Seymour, Little River and Lower Shuswap stocks (the South Thompson drainage) account for most of the remaining escapement. The North Thompson stocks are most abundant during the 1984 cycle, accounting for about half of the total average escapement of 35,000. The escapement targets for sockeye in the Thompson system are 3.14 million in the 1982 cycle, 717,000 in the 1983 cycle, and 42,000 in both the 1984 and 1985 cycles.

The North Thompson sockeye stocks have an early run timing and spawn from late August to early September. Most of the South Thompson stocks (including the Adams) are late-run stocks, with peak spawning occurring in mid- to late October. These fish hold in the Gulf of Georgia for about 21 days prior to migrating up the Fraser to their spawning grounds. The Seymour, Scotch and Momich Creek stocks from the South Thompson have an early run timing, with peak spawning occurring at the end of August.[21]

Pink salmon escapements to the Thompson River and tributaries averaged 257,000 during the 1950s and increased to 576,000 during the 1960s. However, escapements to the area declined from 1.17 million in 1981 to 512,000 in 1983 and 193,000 in 1985. Low escapements during these years were due to high and low river flows in the Fraser Canyon, which impeded upstream migration. The Thompson River pink salmon are an early timing stock, with peak spawning occurring in early to mid October.[22]

There are 16 major chinook stocks in this area, of which seven originate from the South Thompson, five from the North Thompson, and four from the mainstem Thompson. Since 1971, escapements of these stocks have been relatively consistent, averaging slightly less than 25,000 fish. The largest stocks are from the Lower Shuswap, South Thompson, Nicola, Clearwater, and the North Thompson. During the period from 1981 to 1985, chinook escapements to these rivers averaged 5800, 5100, 3500, 3300 and 2000 spawners, respectively. Thompson River chinook salmon have a mid-summer run timing. They migrate through the lower Fraser in late July and August.[23]

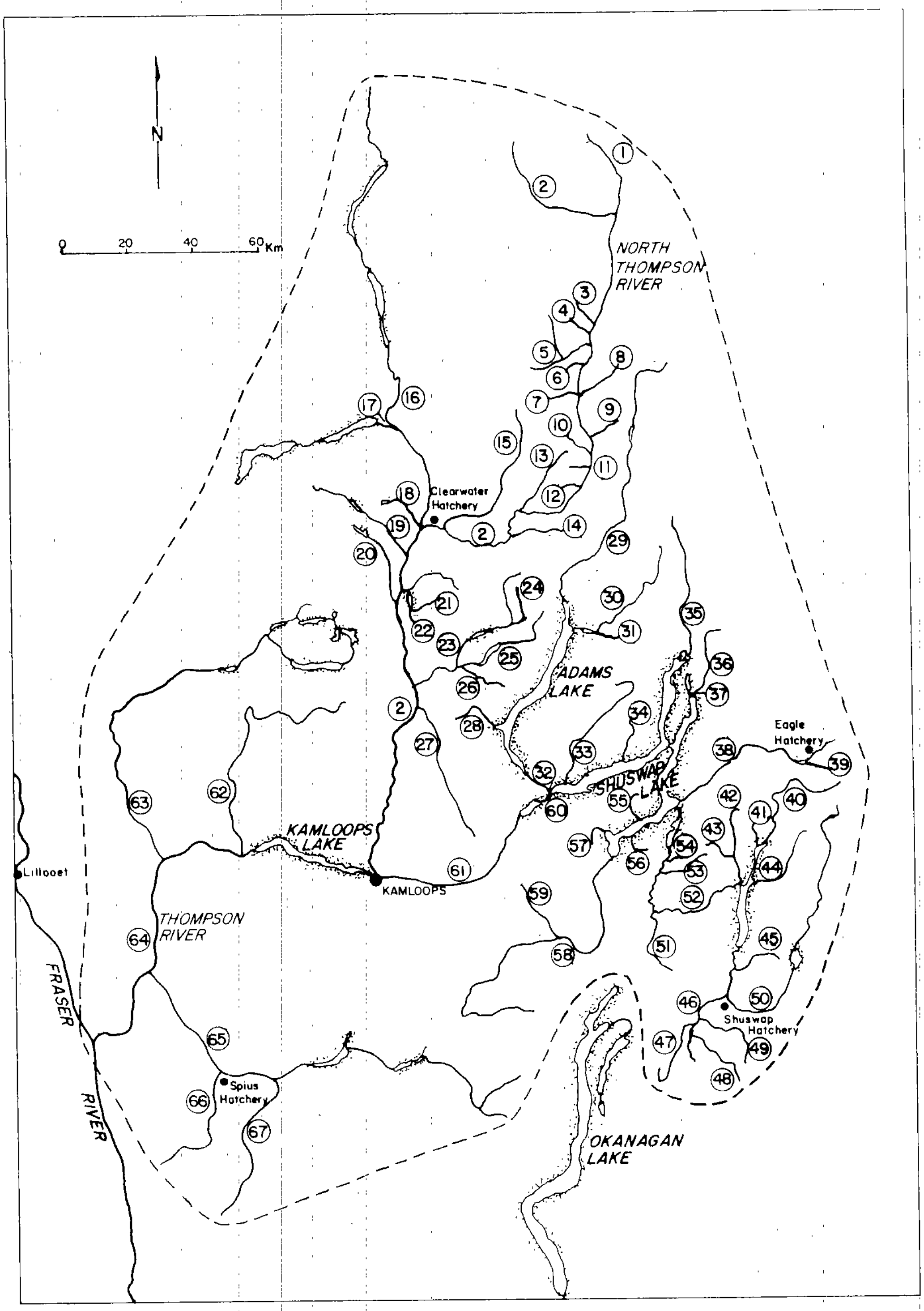

Figure 22. Streams in the Thompson production area (see Table 9 for key to stream numbers).

Table 9. Key to streams in the Thompson production area (from Figure 22).

No.	Stream	No.	Stream
29.	Adams River	42.	Kingfisher Creek
32.	Adams River	20.	Lemieux Creek
1.	Albreda River	7.	Lion Creek
36.	Anstey River	27.	Louis Creek
11.	Avola Creek	60.	Little River
23.	Barriere River	13.	Mad River
46.	Bassette Creek	17.	Mahood River
5.	Blue River	19.	Mann Creek
53.	Blurton Creek	22.	McTaggart Creek
59.	Bolean Creek	31.	Momich River
63.	Bonaparte River	65.	Nicola River
18.	Brookfield Creek	41.	Noisy Creek
56.	Canoe Creek	2.	North Thompson River
30.	Cayenne Creek	15.	Raft River
4.	Cedar Creek	14.	Reg Christie Creek
16.	Clearwater River	55.	Reienecker Creek
67.	Coldwater River	34.	Ross Creek
3.	Cook Creek	58.	Salmon River
49.	Creighton Creek	33.	Scotch Creek
10.	Crossing Creek	35.	Seymour River
43.	Danforth Creek	50.	Shuswap River
62.	Deadman River	52.	Shuswap River
21.	Dunn Creek	28.	Sinman Creek
47.	Duteau Creek	39.	South Pass Creek
38.	Eagle Creek	61.	South Thompson River
25.	East Barriere River	66.	Spius Creek
24.	Fennell Creek	57.	Tappan Creel
8.	Finn Creek	64.	Thompson River
6.	Goose Creek	51.	Trinity Creek
26.	Haggard Creek	9.	Tumtum Creek
48.	Harris Creek	40.	Wap Creek
37.	Hunakwa Creek	12.	Wire Cache Creek
45.	Ireland Creek	44.	Tsuius Creek
54.	Johnson Creek		

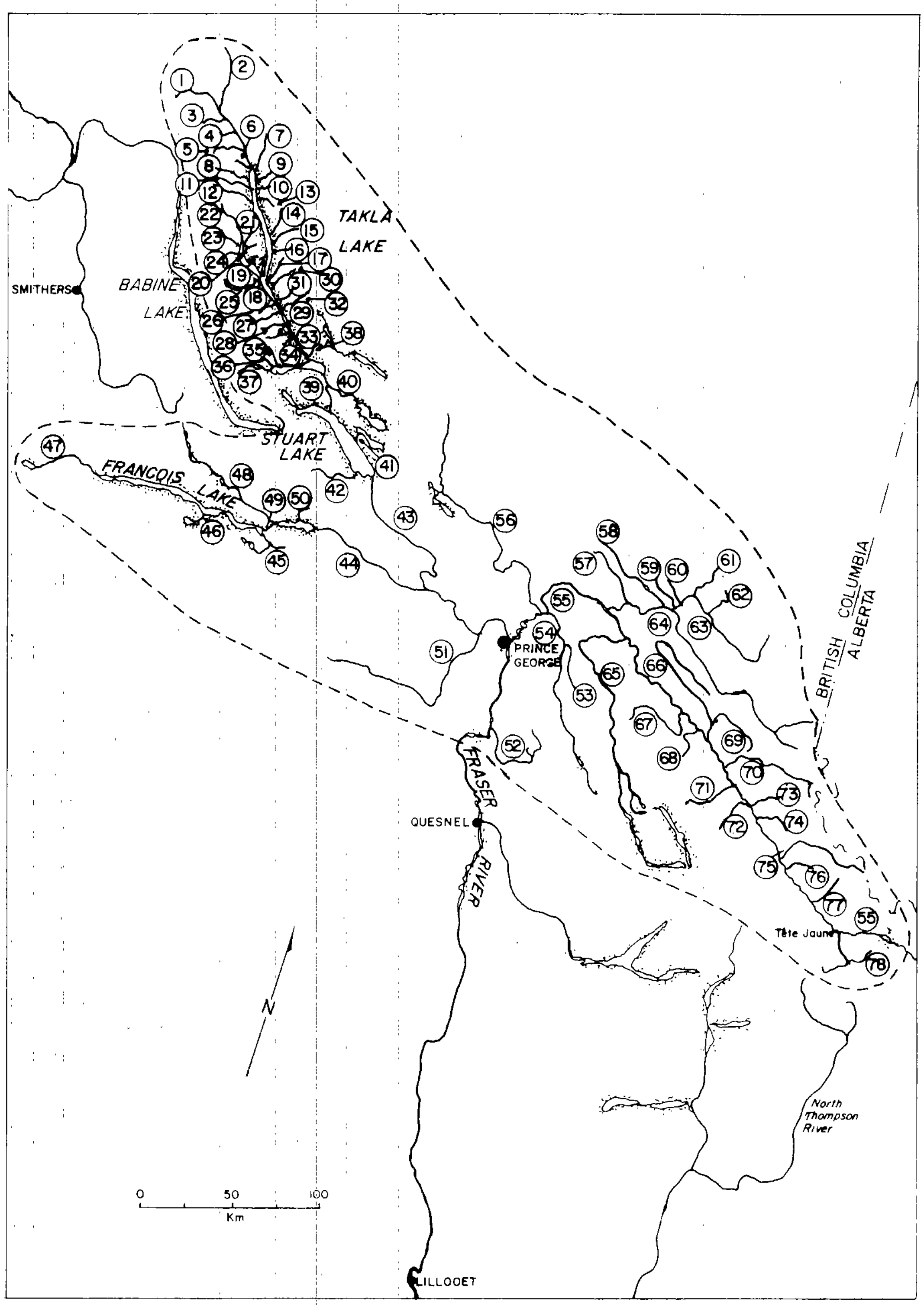

Figure 23. Streams in the Upper Fraser production area (see Table 10 for key to stream numbers).

Table 10. Key to streams in Upper Fraser production area (from Figure 10).

No.	Stream	No.	Stream
8	Ankwill Creek	64	McGregor River
7	Bates Creek	33	Middle River
26	Bivouac Creek	70	Morkill River
6	Blackwater Creek	47	Nadina River
18	Blanchet Creek	17	Narrows Creek
65	Bowron River	52	Naver Creek
59	Captain Creek	44	Nechako River
32	Casimer Creek	45	Nithi River
51	Chilako River	29	O'Ne-Ell Creek
3	Consolidate Creek	50	Ormond Creek
21	Crow Creek	58	Otter Creek
68	Dome Creek	36	Paula Creek
1	Driftwood River	41	Pinchi Creek
22	Dust Creek	19	Point Creek
48	Endako River	4	Porter Creek
14	Fifteen Mile Creek	25	Sakeniche River
37	Fleming Creek	56	Salmon River
61	Fontoniko Creek	30	Sandpoint Creek
28	Forfar Creek	57	Seeback Creek
11	Forsythe Creek	15	Shale Creek
55	Fraser River	35	Sidney Creek
9	French Creek	23	Sinta Creek
12	Frypan Creek	67	Slim Creek
27	Gluskie Creek	42	Sowchea Creek
63	Herrick Creek	62	Spakwaniko Creek
20	Hooker Creek	49	Stellako River
10	Hudson Bay Creek	43	Stuart River
60	James Creek	39	Tachie River
2	Kastberg Creek	66	Torpy River
38	Kazchek Creek	16	Twenty Five Mile Creek
40	Kazkwa River	46	Uncha Creek
5	Kotsine River	34	Van Decar Creek
31	Leo Creek	69	Walker Creek
24	MacDougall Creek	53	Wansa Creek
13	Maclaing Creek	54	Willow Creek

Most of the coho salmon that migrate upstream of the Fraser Canyon spawn in the Thompson River system.[4] Coho spawners have been reported in 71 streams in the Thompson drainage from 1953 to 1983.[10] The most important spawning areas include Albreda, Barriere, Blue and Clearwater rivers and Dunn, Lemieux, Lion and Louis creeks in the North Thompson, and Eagle, Salmon, Lower Shuswap and Middle Shuswap rivers in the South Thompson. The Nicola River and tributaries are the major coho producers of the lower Thompson River. These coho stocks are present in the Fraser River between late August and early December. The mid-point of migration occurs during the first week of October. The earlier run timing of these stocks relative to the lower Fraser stock causes them to be more susceptible to harvest in fisheries directed at sockeye and pink salmon.[4]

The Thompson, Deadman, Bonaparte, and Nicola rivers are important steelhead producers. These stocks support major sport fisheries in the Thompson River and lower Fraser rivers. These are fall-run fish that arrive in the lower Fraser between mid September and the end of October. Peak abundance occurs during the first two weeks of October.[5]

2.3.4 Upper Fraser

The Upper Fraser encompasses the tributaries and headwaters of the Fraser above Prince George (Figure 23). It includes the Prince George Sub District 29I and the headwater section of Sub District 29J.[20] Sockeye and chinook are the only salmon species that spawn in this area.

The major sockeye groups in the Upper Fraser are the Early and Late Stuart and Nechako stock aggregates. Sockeye spawn in 36 streams in the Upper Fraser, of which 23 support the Early Stuart stock group, six support the Late Stuart group, six support the Nechako stocks, and one the Bowron stock. Total sockeye escapement to the Upper Fraser averaged 245,500 from 1970 to 1985 (Table 1). The major stocks exhibit cyclic abundance, with the Early and Late Stuart dominant in the 1985 cycle and the Nechako dominant in the 1983 cycle.

Escapements of the dominant Early Stuart stock have been relatively consistent, averaging 198,000 from 1941 to 1953, 142,000 from 1957 to 1969 and 196,000 from 1973 to 1985.[21] Over the past four years of the 1985 cycle, Driftwood Creek accounted for 40% of the escapement, while the other 22 streams accounted for the remaining 60% with each contributing less than 10% to the total escapement.

Recently, escapements of Early Stuart sockeye have averaged 32,000 for the 1982 cycle, 70,000 for the 1983 cycle and 20,000 for the 1984 cycle. The targets for this stock are 50,000, 150,000, 50,000, and 230,000 spawners for the 1982, 1983, 1984 and 1985 cycles, respectively.

Sockeye escapements of the dominant Late Stuart run have fluctuated, averaging 136,000 from 1941 to 1953, 341,000 from 1957 to 1969 and 221,000 from 1973 to 1985.[21] The Middle and Tachie rivers account for about 90% of the Late Stuart sockeye escapement. Average escapements in the off-cycle years are generally increasing but are less than 20,000 fish. Escapement targets for the dominant cycle (1985) and subdominant cycle (1982) are 225,000 and 10,000 respectively. There are no target levels set for the other two cycles.

The average escapement of the Nechako sockeye stocks has been increasing in the dominant (1983) and subdominant (1984) cycles. Escapements in the 1985 cycle increased from 41,000 (1939 to 1951) to 97,000 (1955 to 1967) and to 188,000 (1971 to 1983).[21] Escapements in the 1984 cycle were 17,000, 37,000 and 84,000 spawners for the corresponding periods. The Stellako stock accounted for 83% of the escapement in the dominant year and 95% in the subdominant year. The Early and Late Nadina stocks account for most of the remaining escapement to the area. Targets for the Nechako run are 150,000, 225,000, 60,000 and 110,000 in 1982, 1983, 1984 and 1985 cycles, respectively.

There are 12 major chinook stocks in the Upper Fraser area. Chinook escapements to the Upper Fraser have been increasing since the 1950s. Average escapements increased from 6500 from 1971 to 1975 to 19,000 from 1981 to 1985. Much of the increase in escapement is attributed to increased enumeration efforts and improved access to spawning areas. With the exception of the Nechako and Salmon River populations, all Upper Fraser chinook stocks exceeded the interim escapement goal for 1985. The highest escapements in recent years have been to the mainstem Fraser, Bowron River and Slim Creek.[23]

3. FISHERIES

The following section describes fisheries that harvest the Inner South Coast salmon stocks (Statistical Areas 11 - 20, 28 and 29) (Figure 24). The major Inner South Coast fisheries operate in Johnstone Strait, Juan de Fuca Strait and in the lower Fraser River and adjacent portion of the Strait of Georgia. The WCVI troll

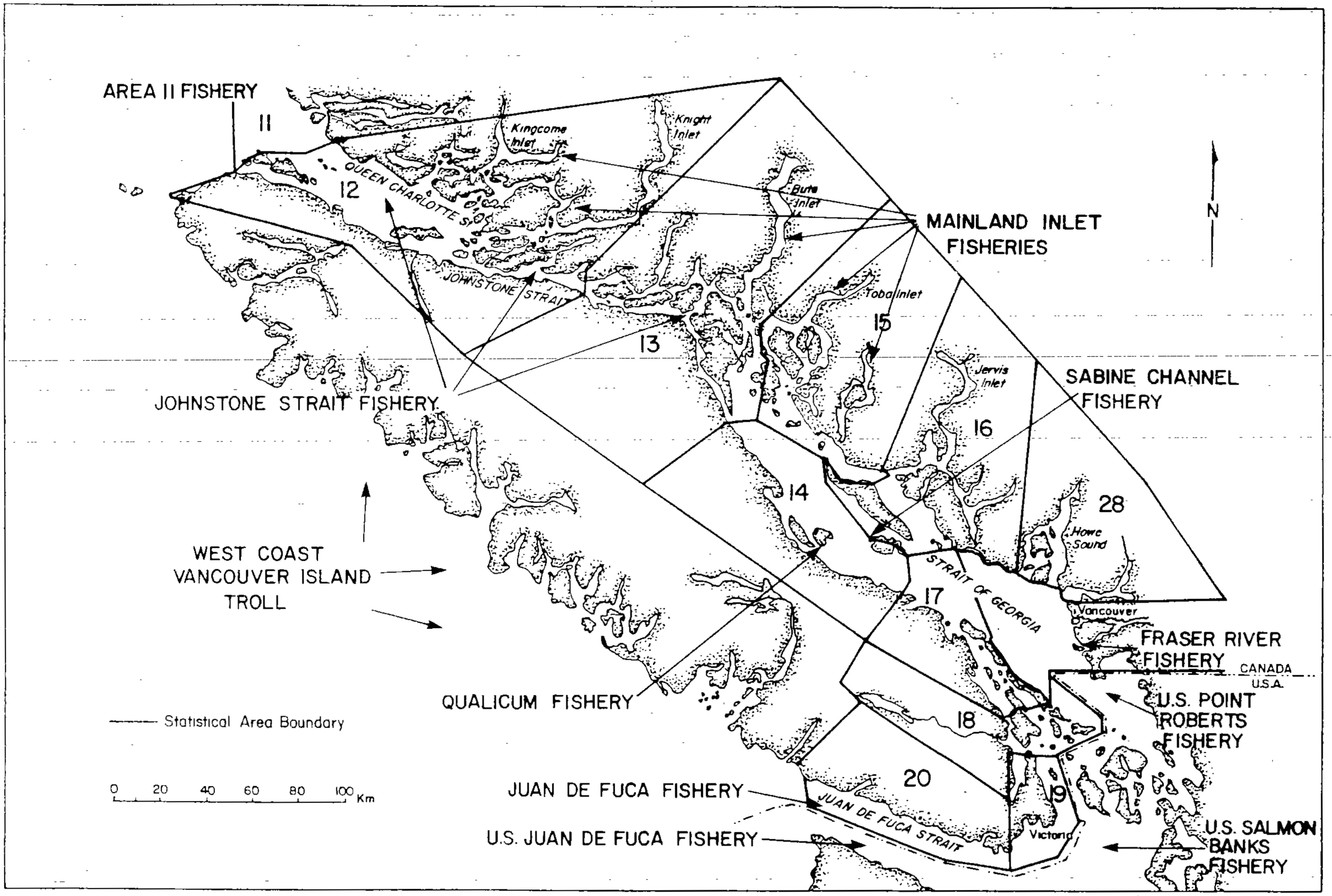

Figure 24. Major commercial fisheries that harvest the Inner South Coast salmon stocks.

and U.S. net fisheries operate outside of the production areas but are significant harvesters of Fraser River stocks. The major fisheries are directed at Fraser River stocks but also harvest a diverse mixture of other salmon stocks from the area. There are also some minor fisheries that target on non-Fraser stocks (Table 11). The average catch in these fisheries from 1977 to 1986 are shown in Table 12.

The sockeye and pink salmon fisheries are managed separately from the chum fisheries and, therefore, are discussed separately below.

3.1 Sockeye and Pink Salmon Fisheries

3.1.1 Overview

Fraser River sockeye and pink salmon are susceptible to a series of fisheries along both the northern and southern approach routes (Figures 25 and 26). Stocks that migrate through the northern route are taken in Area 11 net and troll, Johnstone Strait net and troll, Strait of Georgia troll, Sabine net and Fraser River net fisheries. Stocks that migrate through the outside route are harvested in the WCVI troll, Canadian Juan de Fuca net, U.S. net, Strait of Georgia troll and Fraser River net fisheries. Once in the river, these fish are also subject to a series of Indian food fisheries along the mainstem Fraser and in some tributaries. Sockeye and pink stocks from other Inner South Coast production areas can be intercepted in some of these fisheries depending on their migration routes and timing (Figures 27 and 28). These stocks may also be harvested by Indian food fisheries in their spawning streams.

South Coast net fisheries are mixed-stock fisheries directed at Fraser sockeye and pink salmon. They also intercept other south coast sockeye and pink, summer chum, chinook, coho and steelhead stocks as well as passing U.S.stocks. There is minor interception of fall chum stocks during the later sockeye and pink fisheries. Due to the quadrenniel cyclic dominance exhibited by Fraser sockeye stocks, fishing patterns vary each year depending on the timing and abundance of the dominant stocks. Consequently, interceptions of other stocks in these fisheries also differ from year to year. Figures 29 to 32 show the migration timing and relative run size of the Fraser sockeye stocks in the lower Fraser River for each cycle year.

Table 11. Summary of major and minor commercial fisheries that harvest Inner South Coast salmon stocks.

Fisheries	Major Stocks	Timing	Gear Type
Major			
Johnstone Strait	Fraser sockeye, pink and chum; even-year JS pink, odd-year GS/JS pink, and JS/GS chum	mid-July to October	seine, gillnet and troll
Fraser River	Fraser sockeye and chum	late July to late November	gillnet and troll
Juan de Fuca Strait	Fraser sockeye and pink	mid-July to mid-September	seine, gillnet and troll
West Coast Vancouver Island	Fraser sockeye and pink	July and August	troll
U.S. Fisheries	Fraser sockeye and pink	mid-July to mid-September	seine, gillnet and troll
Minor			
Sabine Channel	Fraser River sockeye	late July to early September	seine, gillnet and troll
Mainland Area 12	Mainland Area 12 pink	late July to August	seine and gillnet
Qualicum	Enhanced Mid Vancouver Island chum	early October to end of November	seine and gillnet

Table 12. Average catch in South Coast fisheries (1977-1986) (from D.F.O. catch statistics).

Fishery	Sockeye	Even Pink	Odd Pink	Chum	Chinook	Coho
Johnstone St. Net	1,866,500	659,000	4,295,000	542,800	99,500	236,200
Sabine Channel Net	127,300	1,500	76,500	480	3,800	4,900
Qualicum Net	165	160	270	162,600	750	7,000
WCVI Troll	629,500	116,000	2,106,000	67,400	462,000	1,771,000
Juan de Fuca Net (Area 20)	869,900	5,600	1,696,000	17,500	32,200	198,000
U.S. Net *	1,726,900	0	2,712,340	n/a	n/a	n/a
Georgia St. Troll	89,200	1,600	93,700	500	129,200	124,600
Fraser River Net	995,300	0	403,500	40,600	42,900	30,200
Fraser River Indian Food	** 350,800	0	66,700	12,400	18,600	26,200

* only includes catch of Canadian origin fish (from Salmon Commission data records)

** from Macdonald (1987). The Indian Food Fishery of the Fraser River: 1987 summary. Can. Data Rep. Fish. Aquat. Sci. No. 690.

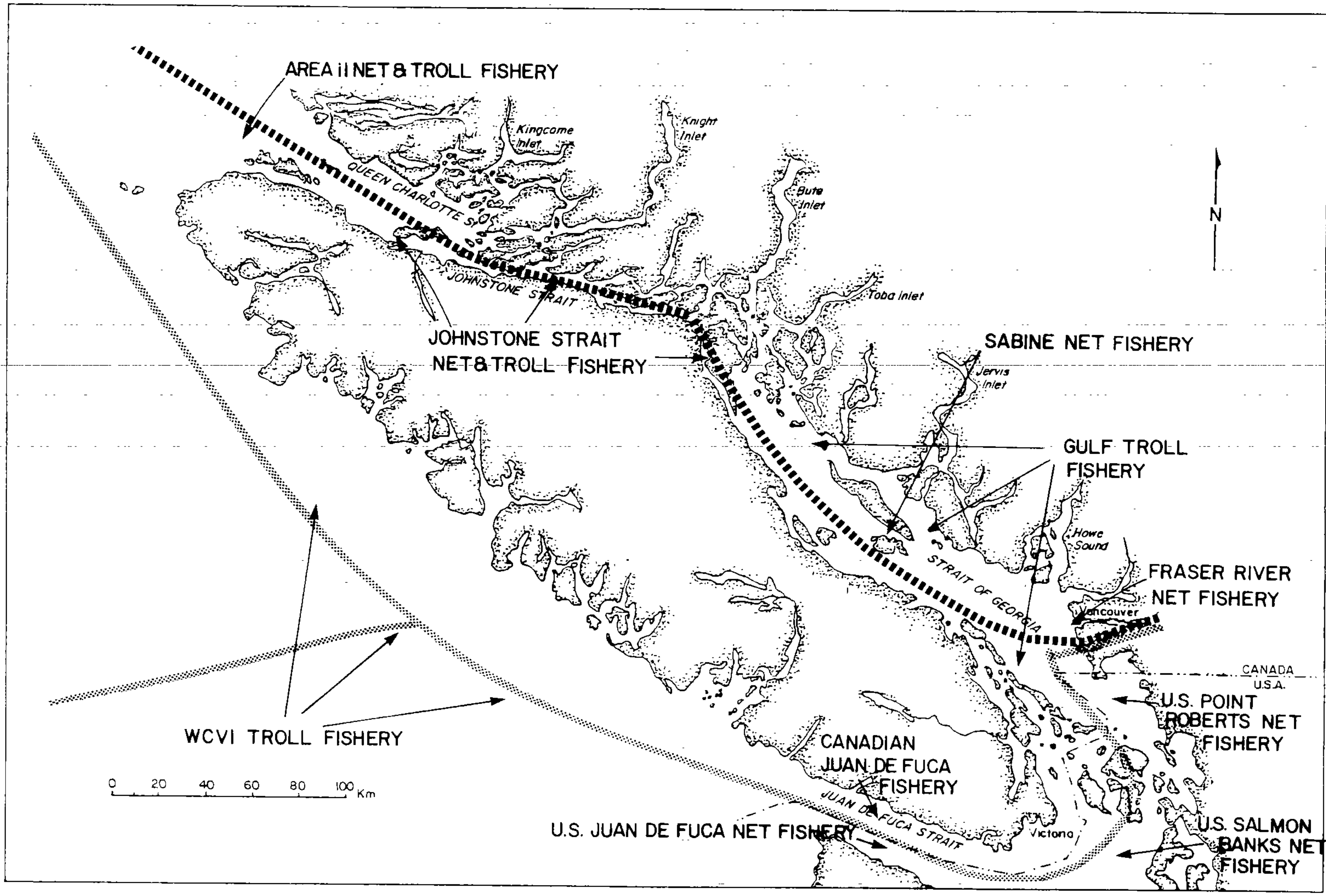

Figure 25. Major fisheries directed at Fraser River sockeye along northern and southern approach routes.

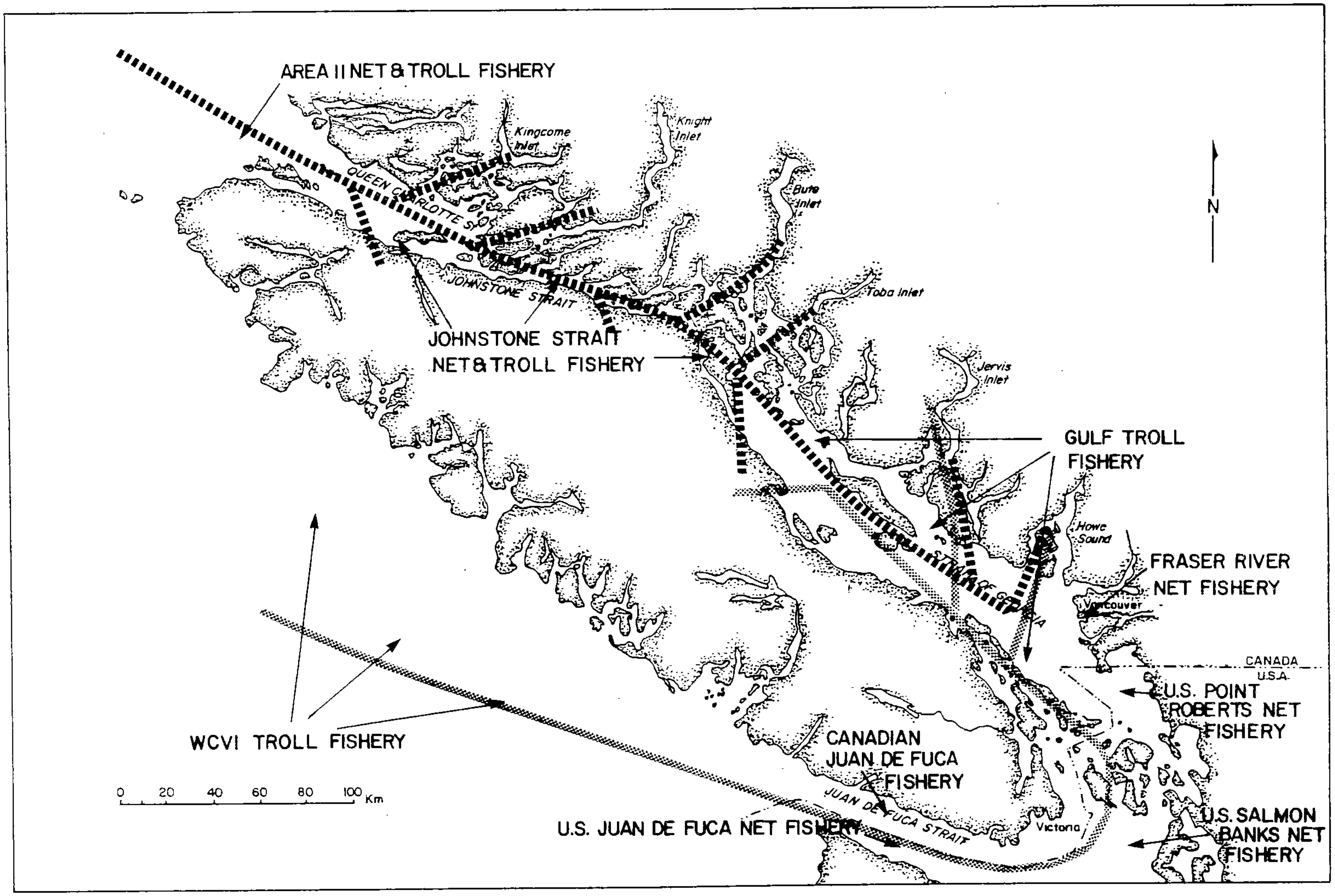

Figure 26. Major fisheries directed at Fraser River odd-year pink along northern and southern approach routes.

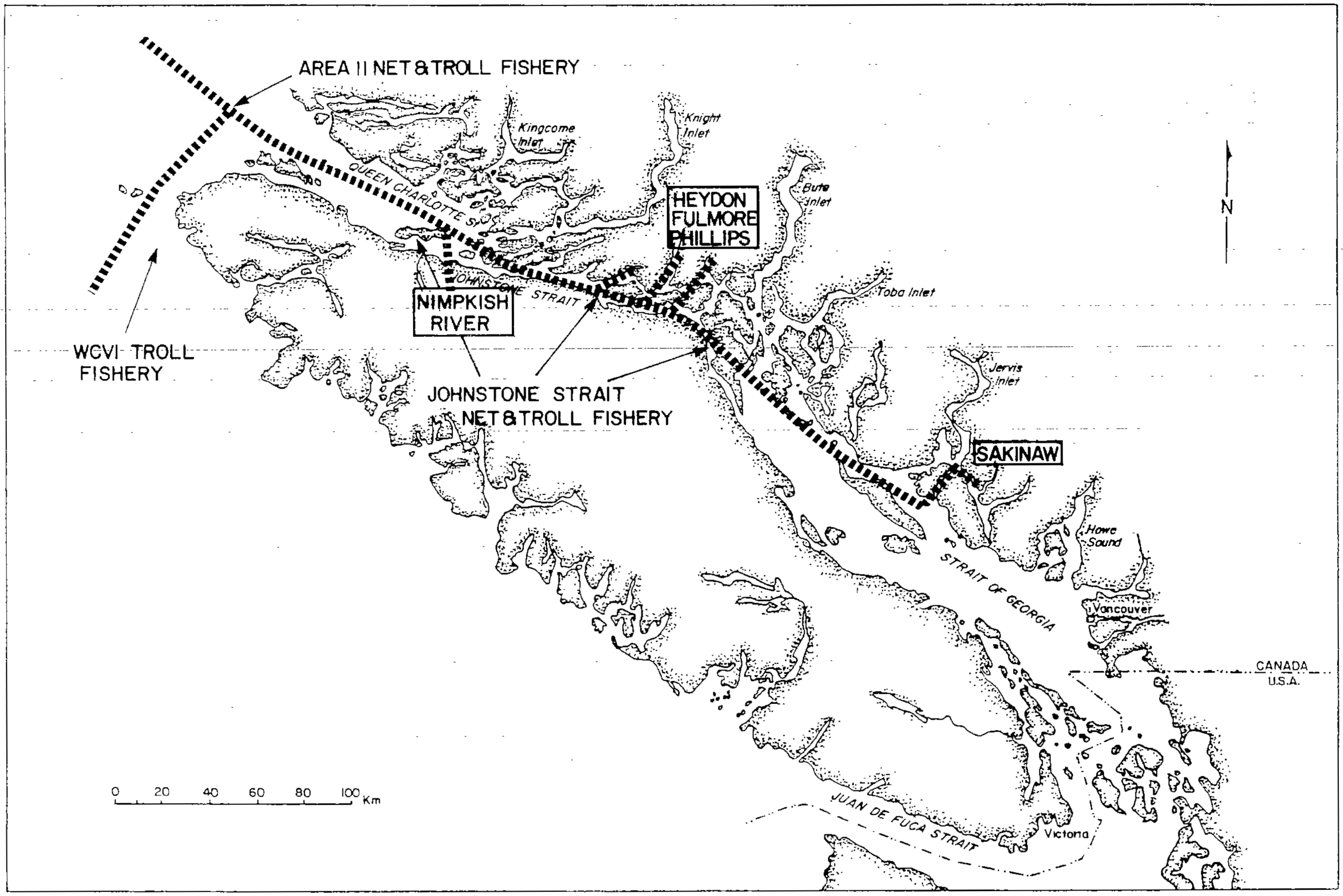

Figure 27. Major approach routes for non-Fraser River sockeye.

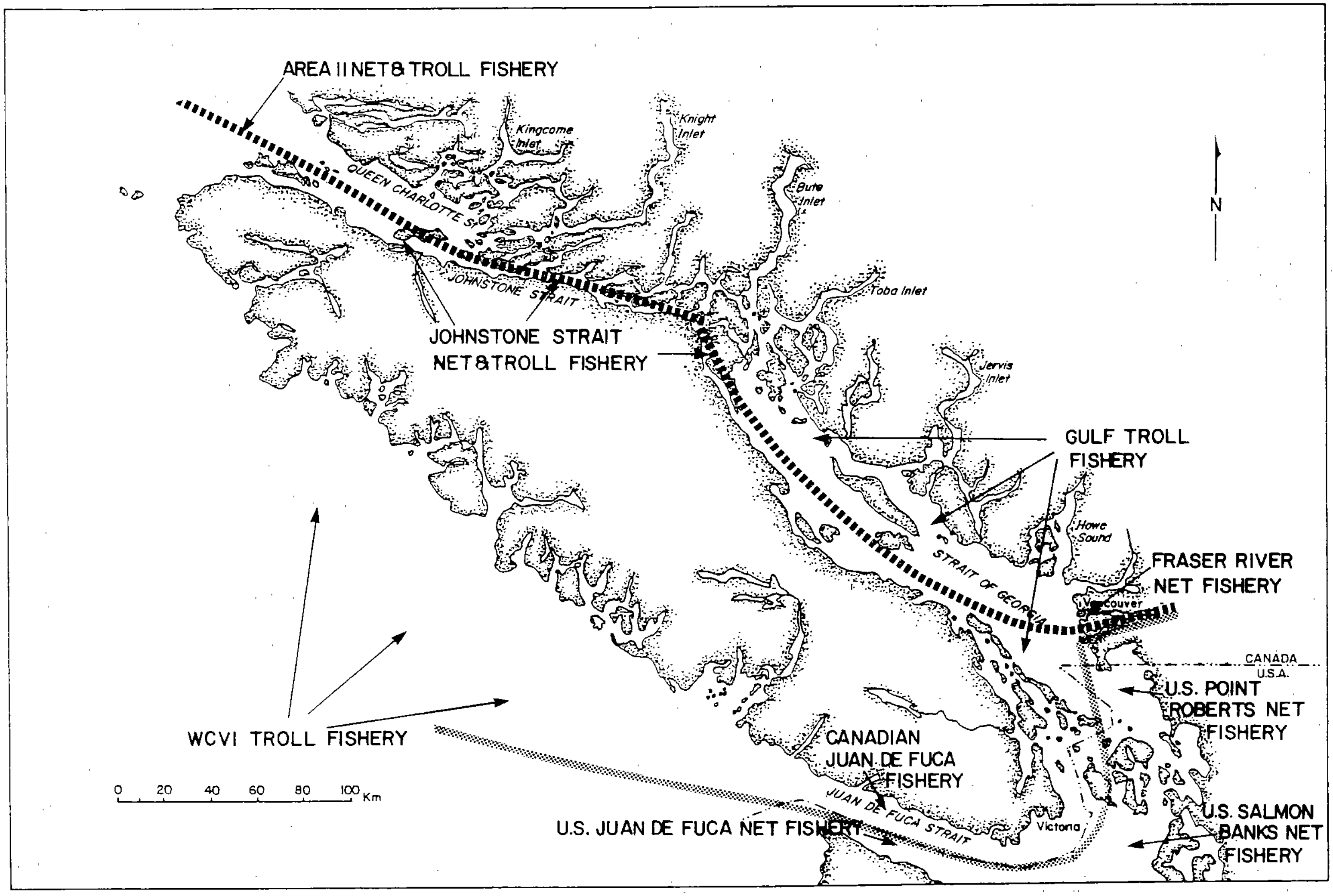

Figure 28. Major approach routes for Johnstone Strait and Georgia Strait even- and odd-year pink stocks.

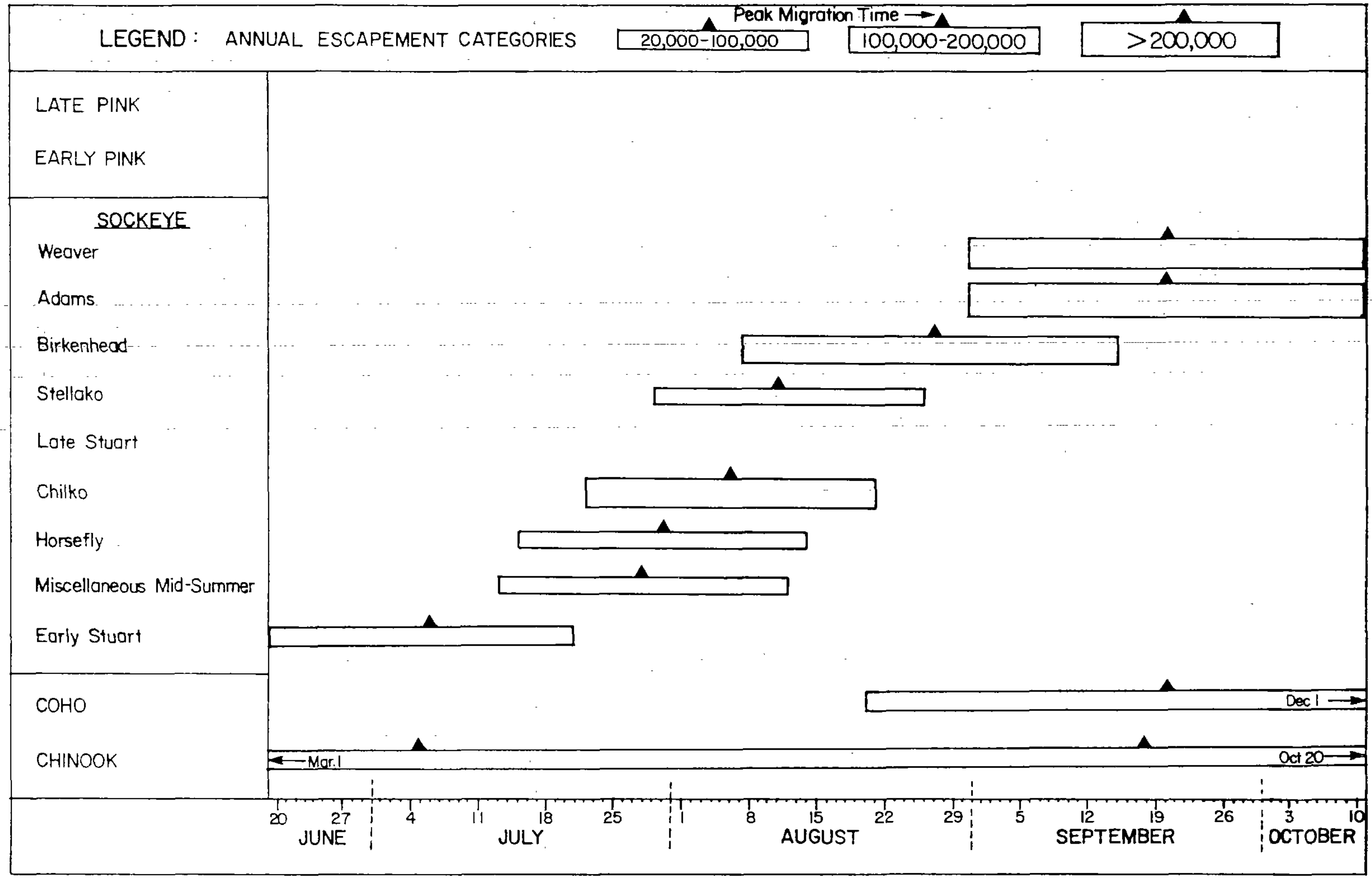

Figure 29. Approximate migration timing and abundance of salmon in the lower Fraser River in the 1982 cycle.

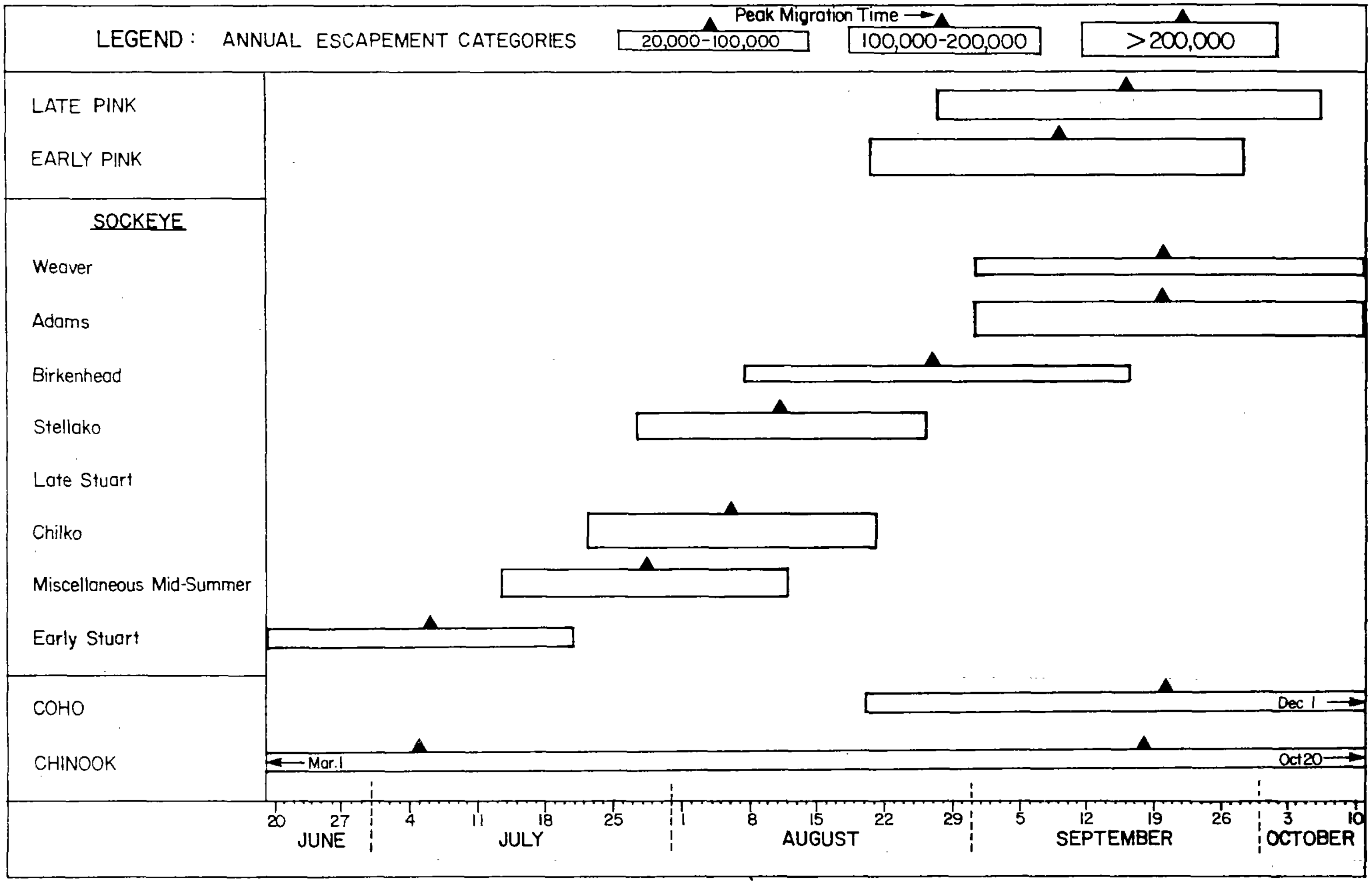

Figure 30. Approximate migration timing and abundance of salmon in the lower Fraser River in the 1983 cycle.

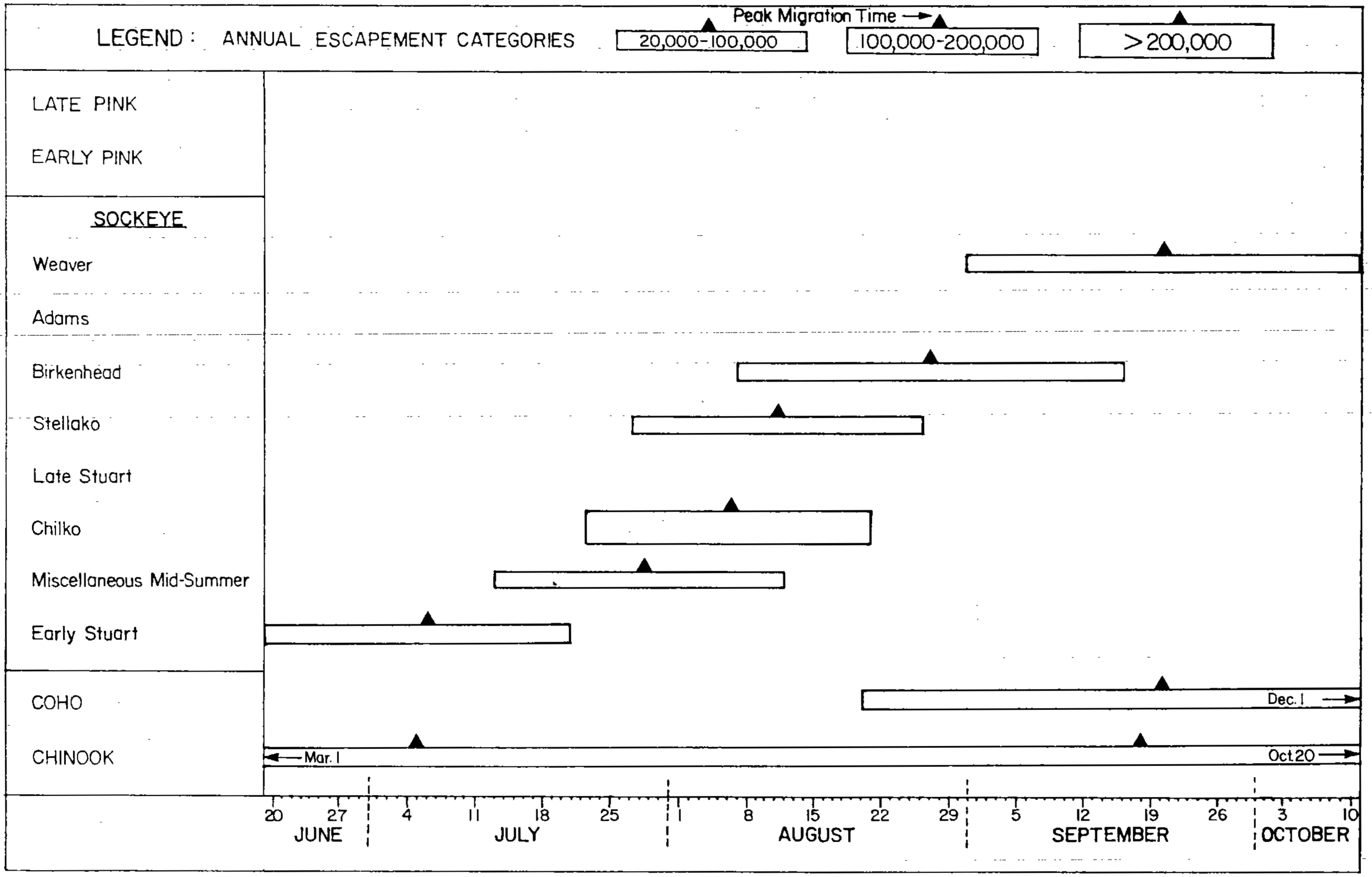

Figure 31. Approximate migration timing and abundance of salmon in the lower Fraser River in the 1984 cycle.

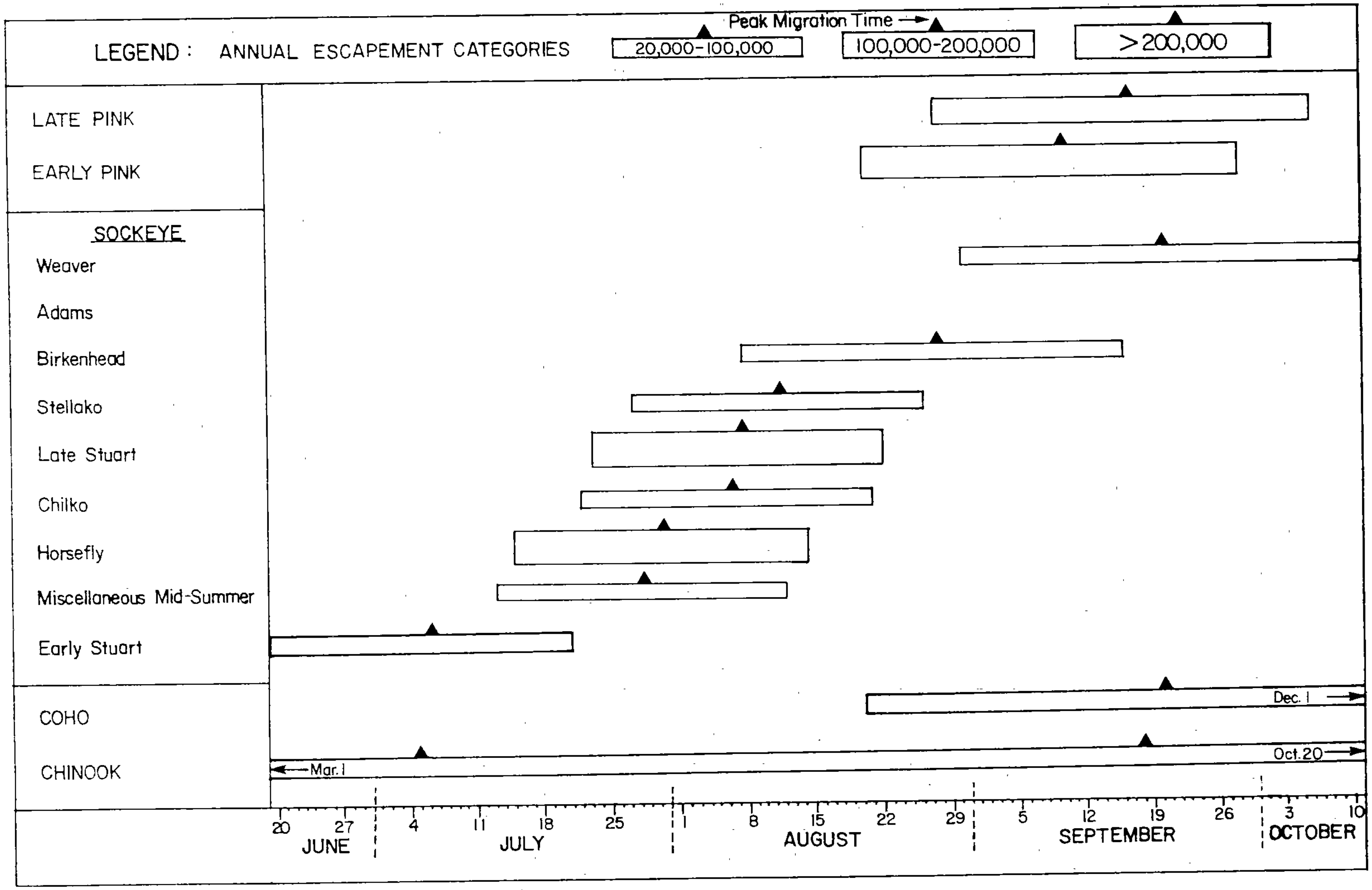

Figure 32. Approximate migration timing and abundance of salmon in the lower Fraser River in the 1985 cycle.

Prior to ratification of the Pacific Salmon Treaty in March 1985, the International Pacific Salmon Fisheries Commission (IPSFC) was responsible for managing Fraser River sockeye and pink stocks and fisheries within the established "Convention Area" (Figure 33). The catch taken within the Convention waters was shared equally between Canada and the United States. The Johnstone Strait and WCVI troll fisheries were encouraged in order to maximize the Canadian catch outside of the Convention area. Under the Pacific Salmon Treaty, Canada has full responsibility for management of the Fraser River stocks. The U.S. share is based on the total allowable catch (TAC). Decisions regarding the inseason management of these stocks within the Convention Area are made by the Fraser Panel, which comprises Canadian and American representatives.

The timing and duration of the South Coast fisheries are determined by the abundance of salmon stocks within the fishing areas and the size and mobility of the fishing fleet. Management of the fisheries is based initially on pre-season forecasts of stock abundance and diversion rates. It is later refined by in-season estimates derived from test fishery, harvest and escapement data as well as stock composition analyses. Management strategies are based primarily on within-season data and short-term management responses because of the lack of precision in pre-season estimates of run size. The pre-season estimates consider several factors that affect the annual abundance of the Fraser River sockeye and pink salmon. For example, total abundance is related to the 4-year cycle in returning run size and natural variability in survival rates. In addition, the abundance of stocks harvested in specific fisheries depends on the diversion rates of the various stocks along the two migration routes.

The fishing fleet of the South Coast fisheries is extremely powerful and mobile and, therefore, must be restricted to prevent overfishing. For example, the Johnstone Strait fishery is capable of harvest rates of 60-70%per week. Generally, the surplus of fish available for harvest is moderate compared to the efficiency of the fleet. In addition, the potential for overharvesting is high because the fish are vulnerable to several fisheries along their migration route. In recent years, the major south coast fisheries have usually been restricted to openings of one to three days per week over a period of 7 - 10 weeks. Adjacent fishing areas are often open simultaneously to prevent concentration of the mobile fleet.

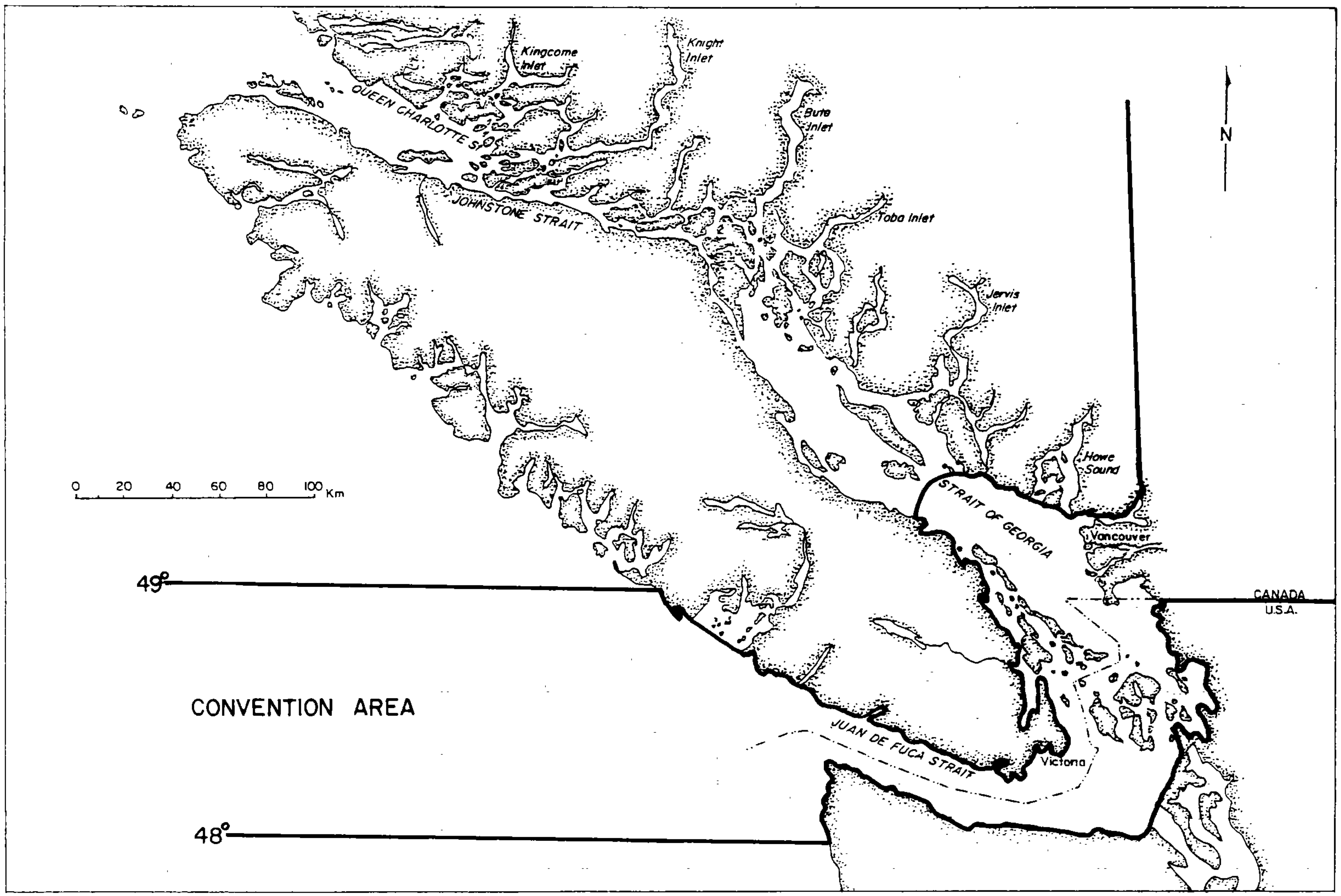

Figure 33. Convention area managed by the IPSFC prior to the Pacific Salmon Treaty.

3.1.2 Johnstone Strait Fishery

The Johnstone Strait fishery operates within Statistical Areas 11, 12 and 13, which are managed as a unit. These three areas are open simultaneously except when there are specific closures to protect local stocks. This fishery is directed primarily at passing dominant Fraser River sockeye stocks that migrate through Queen Charlotte Strait, Johnstone Strait and Discovery Passage. However, it also targets on passing Fraser pink salmon in odd years.Management of the fishery is directed primarily at reducing the incidental catch of other stocks.

All three gear types (seine, gillnet and troll) are used in the Johnstone Strait fishery. Seine fishing accounts for the majority of the catch. The potential catch in the Johnstone Strait fishery is highly dependent on the diversion rate of Fraser River sockeye and pink stocks.

The fishing pattern currently used in this area was established between 1978 and 1986 in consultation with fishermen. The fishing plan recognizes the complex social structure associated with the historical fishery in the area. The objective of this plan is to maximize the catch of target stocks while minimizing the incidental catch. This has been achieved through development of the Ribbon Boundary, which is a series of area closures in Upper Area 12 along Queen Charlotte Strait and a half-mile section along the mainland in Johnstone Strait and the Vancouver Island shoreline in Discovery Passage. The Ribbon Boundary was originally established to reduce the harvest rates on the mainland inlet pink stocks. Subsequently, it was found to have a positive effect on other non-target stocks. The Pacific Salmon Treaty has adopted the Ribbon Boundary as an integral part of the 15-year chinook rebuilding program.[2]

The northern half of the Johnstone Strait fishery, above Lewis Point, (Area 11, Gordon Channel and Queen Charlotte Strait portions of Area 12) has been managed for local stocks. This area is generally closed until late July to protect the Nimpkish sockeye stock. This closure also protects the UECVI pink stocks that arrive prior to mid-July, which are currently at very depressed levels. Goletas Channel has been closed permanently to protect the northern pink stocks. However, some of the southern UECVI pink stocks are intercepted in the Gordon Channel fishery when the area opens in late July.

The southern half of the fishing area, below Lewis Point (Johnstone Strait proper and Discovery Passage) is a relatively confined area in which the fish are concentrated. Fishing in this area is very intensive, with harvest rates in the order of 60-70% per week. In the past, seines were set off-shore from tie-up points, and effort was limited by the number of suitable sites. However, modern equipment makes it feasible to set in open water, and boats are no longer limited by available sites.

It takes about 5 to 7 days for sockeye salmon to migrate through the Johnstone Strait fishing area. The first day of the opening results in the largest catch because there is an accumulation of fish available throughout the area. The catch on the following day is lower because it is relying on one day of incoming fish and those that escaped harvest on the previous day.

3.1.3 Sabine Channel Fishery

The Sabine Channel fishery is located in Area 16 between Texada and Lasquiti islands. This fishery was developed to increase the interception of Fraser River stocks without increasing interception of stocks that pass through Johnstone Strait. It is currently managed simultaneously with the Johnstone Strait fishery. Seines harvest the greatest share of the catch in this fishery.

3.1.4 Mainland Inlets Fisheries

Fisheries in the Mainland Inlets are terminal fisheries directed at stocks with a harvestable surplus remaining after interceptions in the mixed-stock fisheries. Prior to the late 1970s, the Mainland Inlet fishing areas were open simultaneously with the Johnstone Strait fishery. These were the major fisheries in the area until 1958, when most of the effort was shifted toward the large runs of Fraser sockeye that began migrating through Johnstone Strait.[2] Catch in the Mainland Inlet fisheries is presently small compared to that of the Johnstone Strait fishery. Both seines and gillnets are used in the Mainland Inlets.

In recent years, Kingcome/Wakeman and Bond/Knight pink stocks have been taken in the Mainland Inlet fisheries. These stocks are primarily protected by Queen Charlotte Sound area closures and, therefore, are not subject to high interceptions in the Johnstone Strait fishery. It is estimated that harvest rates on these stocks may be as high as 40-60% in the mixed-stock fishery in some years. Although the harvest rate in the mixed-stock fishery is relatively low, the available surplus of these stocks in the inlet fishing areas is irregular because survival rates are highly variable. Therefore, these inlet fishing areas are open only in years when stock abundance exceeds target escapement levels.

There have been no fisheries in the southern Mainland Inlets in recent years because local stocks (Heydon, Phillips and Fulmore sockeye and Phillips, Toba and Jervis pink) are below their target escapement levels and are subject to high harvest rates in the Johnstone Strait fishery. Those portions of the stocks that migrate from the southern approach route are also intercepted in the Juan de Fuca and U.S. mixed-stock fisheries. Inlet fisheries would be considered if these stocks are rebuilt.

3.1.5 Juan de Fuca Strait Fishery

The Juan de Fuca Strait fishery operates in Statistical Area 20 and is directed at dominant Fraser River sockeye and Fraser pink stocks. This fishery also intercepts minor Fraser sockeye stocks, other south coast pink stocks, chinook and coho salmon and U.S. stocks. Although the incidental harvest of these fish is unavoidable, the timing of the fishery is adjusted to minimize interceptions of the less productive stocks.

Management of the Juan de Fuca fishery is co-ordinated with management of the U.S. net and the Fraser River fisheries by the Fraser Panel of the Pacific Salmon Commission. The Juan de Fuca fishery is the first net fishery directed at salmon approaching the Fraser River from the southern route. It is a highly efficient fishery and, therefore, openings and closings are carefully conducted to ensure that there are sufficient fish available for the U.S. and Fraser River fisheries. It is particularly important to ensure that the U.S. share of the total allowable catch, as allocated by the treaty, can be met.

Both seine and gillnet gear are used in the Juan de Fuca fishery. Seine fishing accounts for the majority of the catch.

When the Juan de Fuca fishery opens, the fleet harvests fish throughout the area. However, as the day progresses, the number of fish within the area diminishes and the fleet concentrates more on fish migrating into the area. By the end of the day, the fleet forms a line across the entrance to Statistical Area 20.

3.1.6 U.S. Net Fisheries

There are three U.S. fisheries directed at passing Fraser sockeye and pink salmon, and they are located in the U.S. side of Juan de Fuca Strait, Salmon Banks and Point Roberts. These fisheries are managed in conjunction with the Canadian Juan de Fuca and the Fraser River fisheries by the Fraser Panel of the Pacific Salmon Commission. The objective is to provide the U.S. with its share of the Fraser River sockeye and pink catch as agreed to in the Pacific Salmon Treaty. Another consideration in the management of the U.S. fisheries is to ensure that half of the U.S. catch is allocated to their Native fleet. The efficiency of the Native fleet is relatively poor compared to the rest of the U.S. fleet because it includes a small component of the total gear and is composed primarily of gillnetters. Therefore, in order to achieve the allocation, the U.S. fisheries are frequently open exclusively for the Native fleet.

The U.S. Juan de Fuca fishery is a minor fishery that harvests relatively few fish because the majority of the fish migrate along the Canadian side of the strait.

The Salmon Banks fishery is a diffuse fishery; there is no set fishing pattern, because the migration routes of the fish tend to vary. However, catches are substantially greater than in the U.S. Juan de Fuca fishery because Fraser sockeye migrate through the area.

In the Point Roberts fishery, the fleet initially directs effort throughout the area to capture all of the available fish. Because the Salmon Banks fishery has the first opportunity to harvest these stocks, migration into the Point Roberts fishing area is limited. Late in the season, the fleet moves to form a line at the entrance to the area, along the Canadian border, to harvest Fraser River fish that are holding at the mouth of the river.

3.1.7 Fraser River Fishery

This fishery occurs in Statistical Area 29 and is directed at Fraser River sockeye and odd-year pink stocks. Although it is primarily a gillnet fishery, troll and infrequently seine gear may harvest some fish. The gillnet fleet was first introduced to the area in the mid-1860s, at the time when canneries were being built.

The Fraser River fishery is managed in conjunction with the Juan de Fuca and the U.S. net fisheries by the Fraser Panel of the Pacific Salmon Commission. The fishery harvests salmon that migrate to the river from both the north and south approach routes. Early-run fish are primarily harvested by gillnets from the main river channel to 80 km upstream of the mouth. Late-run stocks are harvested either in the river or off the mouth of the river in the shallow areas of the estuary.

This fishery is very efficient and is capable of capturing nearly all of the fish that pass through the fishing area during the opening. The late run sockeye hold off the mouth of the river in deep water for several weeks prior to migrating upstream. Previous gillnet openings in these areas resulted in low harvest rates. Although the holding areas are generally closed to fishing to avoid overharvesting, a seine fishery was opened in these areas in 1986 because there was a harvestable surplus and domestic allocations for the seine fleet had not been met. A catch of over 700,000 fish was taken within a few hours.

Although the Fraser River fishery is directed at the dominant sockeye and pink stocks, minor sockeye stocks, chinook, chum, coho and steelhead are also intercepted in these fisheries (Figures 28 - 31). Management of this fishery has been directed primarily at reducing interceptions of chinook salmon because of a declining abundance of these stocks. Changes in management include: (1) a reduction in total fishing days; (2) elimination of early openings that were specifically directed at chinook salmon; and (3) establishment of maximum net size regulations. These measures have been successful in reducing the catch of chinook salmon in the Fraser River fishery.

3.1.8 Troll Fisheries

Troll fisheries operate throughout the South Coast. Management of the troll fleet is separated into two groups: the Gulf trollers which fish in the Strait of Georgia, and the outside trollers which fish on the west coast of Vancouver Island and Area 11. Both groups can fish in upper Johnstone Strait (Area 12), but may be subject to different restrictions.

The West Coast Vancouver Island (WCVI) troll fishery can be a significant harvester of Fraser River sockeye and pink salmon. In years when sockeye are very abundant (i.e., as in the 1985 or 1986 cycle year) and there is a low diversion rate, trollers will shift effort from their traditional targets of chinook and coho salmon to sockeye and pink. For example, in 1981, the diversion rate was high and the abundance of sockeye on the west coast of Vancouver Island was modest despite relatively high returns. During the next cycle (1985), the total run remained about the same but a relatively low diversion rate generated a 4-fold increase in the abundance of fish in the WCVI troll area. There was a 20-fold increase in the WCVI troll sockeye catch in 1985 as a result of this higher abundance. The same conditions have also occurred in 1982 and 1986.

Peak sockeye catches in the WCVI troll fishery occur in mid-August. The largest troll catches consistently occur in the Adams cycle years. In 1982, the number of sockeye harvested in the WCVI troll fishery was the highest on record and was more than 50 times greater than the number harvested in other cycle years.[25]

Pink salmon catches in the WCVI troll fishery are markedly different between odd and even years. Catches of even-year pink are generally low, while catches of odd-year pink are large and have exceeded 2 million in recent years. The catch consists primarily of Fraser River stocks although Puget Sound pinks can be a major component in some years. Catches peak in late August or early September and most are taken in a 2- to 3-week period.[25]

The troll fishery in the inside waters is not a major harvester of sockeye and pink salmon. The inside trollers do not have access to the high abundance of fish that the WCVI troll fleet has because of the competition from the more efficient net fleet and their catch is limited by allocation agreements. They usually target on chinook and coho salmon. The largest sockeye and pink troll catches in the inside waters have occurred in Johnstone Strait and Sabine Channel but recently major catches also occurred in the Strait of Georgia near the confluence of Statistical Areas 17, 18 and 29.

3.1.9 Indian Food Fisheries

The Indian food fishery is a traditional fishery that is regulated to meet the reasonable food and ceremonial needs of native communities. Departmental policy recognizes the Indian food fishery as the second priority following conservation of salmon stocks. This is an acknowledgement of the Indian's historical dependence on salmon and their cultural ties with the fisheries resource, particularly salmon.

Indian food fisheries generally occur in terminal areas near reserve lands. There are numerous food fisheries distributed throughout the Inner South Coast production areas and some are also permitted in the interception commercial fishing areas such as Johnstone Strait. In some systems, surplus hatchery returns have been provided to local bands for food and commercial purposes.

Sockeye are the target species of most Indian food fisheries. Chinook, chum and coho salmon and steelhead trout are valued incidental catches. In the South Coast and Fraser River areas, pink salmon are the least desirable species, and many incidentally caught pink salmon may be discarded. Fishing methods vary depending on local conditions and target species, and include seines, dip nets, set nets, drift nets, angling gear, gaffs, spears, harpoons, weirs and traps.

Indian food fisheries are regulated through the issuance of free-food fishing licences, which may specify area, gear, fishing time, species and quantity of fish. Catch and effort levels in the Indian food fisheries are monitored by local Fishery Officers. Enumeration techniques include interviews with fishermen and direct observations. Although the accuracy of catch estimates is unknown, most Fishery Officers believe that they are under-estimated.

The Fraser River food fishery is the largest Indian food fishery in the South Coast. It is actually a series of fisheries operated by different bands throughout the watershed. Catches in these fisheries have increased substantially in the last 15 years and frequently exceed 400,000 fish, primarily sockeye. The exploitation rate on some stocks is extremely high. This is particularly evident for the early-run stocks that migrate far upriver through a gauntlet of food fisheries. The food fishery can reduce spawning escapements of these stocks by 50%. In many years, Fraser River food fisheries have been closed for 2 or 3 weeks to protect the early Stuart sockeye while the weekly fishing period prior to arrival of sockeye has been reduced to conserve early-timing chinook stocks. The catch of mid-run chinook stocks is reduced by restrictions on gillnet mesh size.

3.2 Chum Salmon Fisheries

3.2.1 Overview

Chum salmon fisheries include the interception fisheries in Johnstone Strait and the United States and terminal fisheries in Qualicum, Fraser River and the Mainland Inlets. It is assumed that in most years the majority of the Inner South Coast chum stocks migrate to their natal streams from the north through Johnstone Strait (Figure 34). Some Fraser River and Georgia Strait chum salmon have been reported to migrate from the south through Juan de Fuca Strait.

Until recently, southern coast inside chum stocks were not managed to achieve their full potential. Fisheries were opened whether or not spawning escapement targets were achieved and consequently, these stocks were over-harvested. Harvests were often allowed after the user groups made demands on DFO. A new management approach (the "clockwork plan"), was developed jointly between DFO and the fishing industry and has been used since 1983. The goal of this approach is to rebuild chum stocks by lowering the harvest rate in order to increase spawning escapements.

The basic strategy of the "clockwork plan" is to establish a set of rules prior to the fishery. As the season progresses, these rules dictate how and when management decisions are made (i.e., whether fishing can be allowed or if conservation measures should be implemented). The harvest rate is fixed according to the total size of the run returning through Johnstone Strait. As run size projections increase, the harvest rate is increased in the step-wise manner shown below.

Total Run Size (millions)	Harvest Rate	Probable Number of Fishery Openings
0 - 3.0	10%	0
3.0 - 3.7	20%	1 - 2
3.7 - 5.2	30%	2 - 3
> 5.2	40%	4 or more

The "clockwork plan" was revised in 1987 to permit separate management practices for the different chum stock groups. The Fraser River fishery now

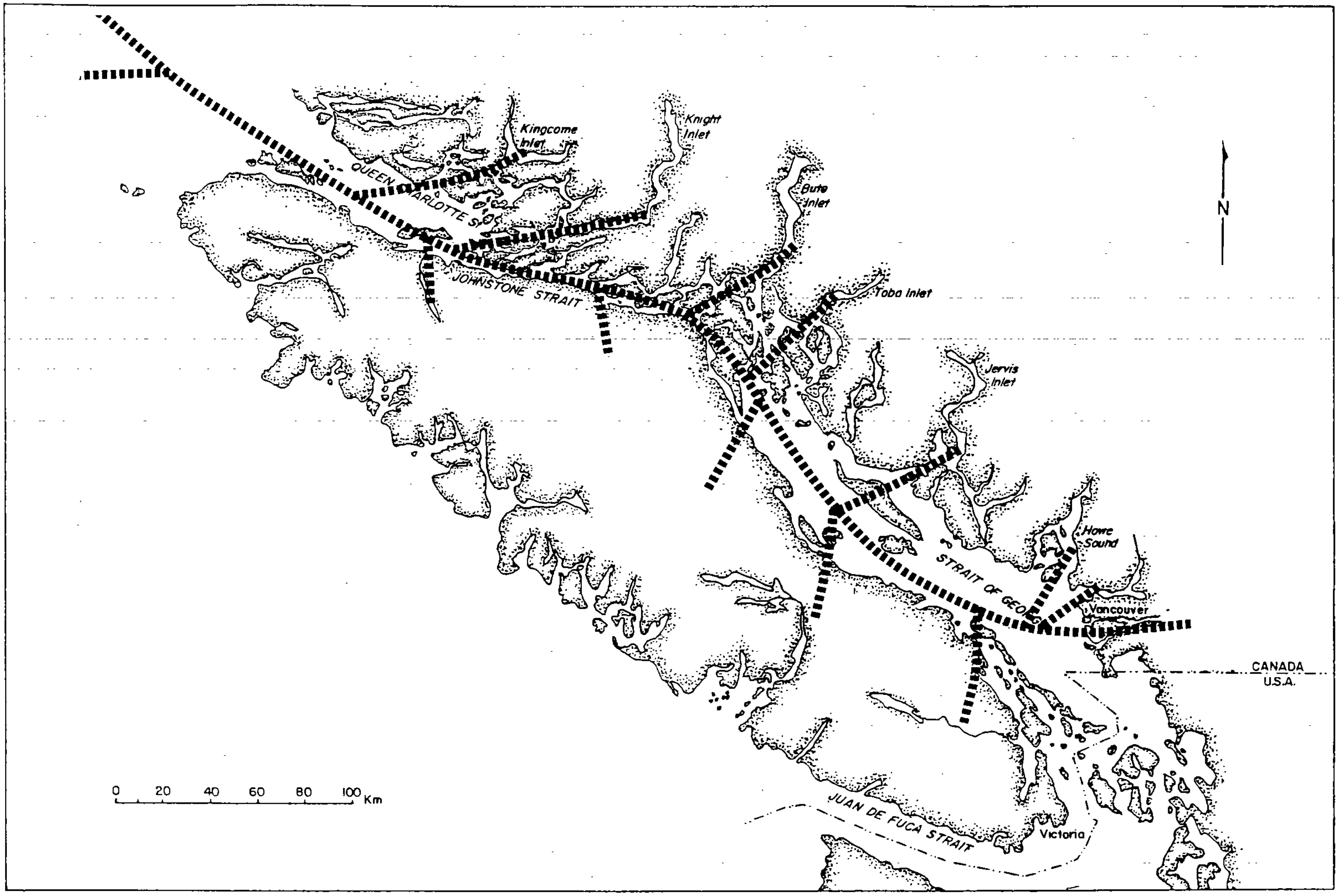

Figure 34. Major approach routes of Johnstone Strait and Fraser River chum salmon.

operates under its own management plan which was designed to permit some harvesting while allowing escapements to increase (see Section 3.2.3).

3.2.2 Interception Fisheries

The main commercial interception fishing areas for the inside chum stocks are Johnstone Strait and the U.S. fisheries at Salmon Banks and Point Roberts (Areas 7 and 7A).

The Johnstone Strait fishery is a mixed-stock fishery that harvests virtually all of the Inner South Coast chum stocks to some extent. Chum salmon intercepted in this fishery are of higher quality (i.e., silver bright) and are more valuable than those caught in terminal areas. The largest proportion of the total chum catch is taken in Johnstone Strait. Figure 35 shows the run timing of stocks passing through Johnstone Strait.

The chum salmon caught in the Salmon Banks and Point Roberts areas are primarily of Canadian origin. Recent estimates indicate that Canadian-origin chum account for 95% of the catch in the Point Roberts and 70% of the catch in the Salmon Banks fisheries. These fish are mostly Fraser River stocks. Since ratification of the treaty, the U.S. allocation has been negotiated during annual meetings. In 1986, the allowable catch was determined based on the Canadian clockwork plan. In recent years, the U.S. fisheries have operated only when fisheries have been conducted in Johnstone Strait or the Fraser River.

3.2.3 Terminal Fisheries

Terminal fisheries may be permitted if there is a harvestable surplus of chum available after the interception fisheries. The major terminal fishery is directed at the enhanced Big and Little Qualicum and Puntledge chum stocks in Area 14. The quality of chum taken in this fishery early in the season is relatively high but deteriorates as the season progresses.

The Fraser River Chum Salmon Harvest Management Plan was developed in 1987. It is designed to protect those portions of the run which have been harvested to the maximum amount in the interception areas while permitting harvest of those portions of the run which have surpluses.

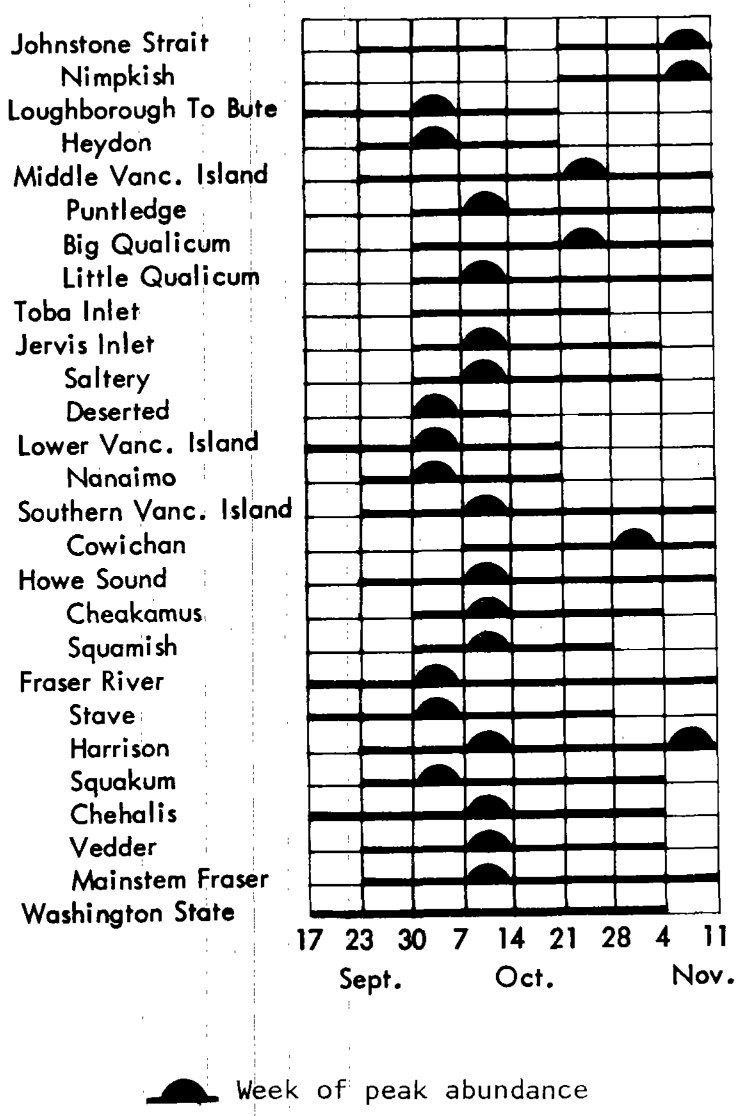

Figure 35. Timing of chum salmon stocks entering Johnstone Strait.

Chum abundance within the river, the timing of commercial openings and catch projections are determined by test fishing. The majority of the run into the river is required for spawning escapement and a smaller portion is required for Indian food purposes. The escapement requirements are a function of run size and are designed to determine the optimum escapement. Any surplus to these basic requirements may be harvested in directed fisheries as indicated in the plan.

Although there are several mainland inlet chum stocks, returning runs have not been sufficient to support terminal fisheries. In recent years, only the Bute Inlet stocks have sustained a minor terminal fishery.

4. CURRENT ENHANCEMENT ACTIVITIES

This section summarizes the major enhancement activities that occur in the Inner South Coast. It includes the major facilities, Community Economic Development Projects (CEDP) and small enhancement projects. There are also numerous public-involvement programs (PIP) throughout the South Coast that contribute to salmon production, but these are not included in this summary. Based on 1986 production targets, the expected production from the PIP projects for the Inner South Coast is 24,000 pink, 14,000 chum, 4900 chinook, 60,000 coho and 600 steelhead.

Current enhancement facilities in the south coast and Fraser River have the capacity to produce a total of 622,000 sockeye, 1.22 million pink, 1.49 million chum, 546,000 chinook, 931,000 coho, and 24,000 steelhead (Table 13). Most of these facilities are operating at capacity, and those that are not are either limited by broodstock availability or budgets, or are in the process of shifting their production to another species.

4.1 Vancouver Island

4.1.1 Upper East Coast Vancouver Island

The only enhancement facility for UECVI stocks is the Quatse River hatchery, which is operated by the Northern Vancouver Island Salmon Enhancement Association. The hatchery began operation in 1984 and currently raises pink, chum and coho salmon from the Quatse, Cluxewe and Keogh rivers. The production capacity of the facility is summarized in Table 14.

Table 13. Total adult production capacity of enhancement facilities in the South Coast and Fraser River area.

	Sockeye	Pink	Chum	Chinook	Coho	Steelhead
Vancouver Island						
Upper East Coast	—	47,330	3,450	—	3,080	2,890
Johnstone Strait	31,500	80,000	17,140	7,200	4,860	
Mid East Coast	—	159,450	793,900	340,000	425,700	8,100
Lower East Coast	—	—	25,900	13,580	5,715	
Southern	—	—	280	3,530	17,330	
Total	31,500	286,780	839,670	364,310	456,685	10,990
Mainland Inlets						
Kingcome/Wakeman	—	—	—	—	—	—
Bond/Knight	—	—	—	—	—	—
Loughborough/Bute		245,000	1,000	1,000	1,000	
Toba		13,500	13,460	610	9,860	
Jervis	—	17,420	8,570	2,090	19,330	
Howe	—	13,500	137,900	34,340	19,760	
Burrard	—	1,350	1,080	34,950	61,800	1,600
Total	—	290,770	162,010	72,990	111,750	1,600
Fraser River						
Lower Fraser	437,700	34,500	487,810	51,700	319,555	11,450
Middle Fraser	63,500	607,500	—	21,060	720	
Thompson	—	—	—	35,500	42,540	
Upper Fraser	89,600	—	—	720	—	
Total	590,800	642,000	487,810	108,980	362,815	11,450

Table 14. Production capacity of enhancement facilities in the Upper East Coast of Vancouver Island area.[27]

		Production Capacity			
Facility	Species	Eggs	Releases	Adult Returns	Target Stocks
Quatse	Pink	3,400,000	2,336,000	47,330	Quatse, Cluxewe, Keogh
Quatse	Chum	400,000	266,000	3,450	Quatse, Cluxewe
Quatse	Coho	425,000	344,250	3,080	Quatse, Cluxewe, Hyde, Mills, Nahwitti, Quatsese
Quatse	Steelhead	100,000	52,500	2,100	Keogh + Quatse Winter
		50,000	26,250	790	Tsitika Summer
		150,000	78,750	2,890	

Table 15. Production capacity of enhancement facilities on Vancouver Island in the Johnstone Strait area.[27]

		Production Capacity			
Facility	Species	Eggs	Releases	Adult Returns	Target Stocks
Willow	Sockeye	4,375,000	3,500,000	31,500	Willow
Bear River	Pink		3,200,000	80,000	Quinsam/transplant to Bear River
Cheslakee	Chum	1,400,000	1,008,000	17,140	Nimpkish
Willow	Chinook	500,000	360,000	7,200	Nimpkish
Willow	Coho	300,000	243,000	4,860	Nimpkish

4.1.2 Johnstone Strait

There are two hatcheries on Nimpkish Lake, and both are operated by the Nimpkish Band. The Willow facility is located in the upper lake and is designed to produce sockeye, chinook and coho salmon. The Cheslakee facility is located at the mouth of the lake and produces chum salmon.[26] The production capacity of these facilities is summarized in Table 15.

The Nimpkish sockeye stock is also enhanced through a lake fertilization program, which began in 1982 and is expected to increase total adult production to about 700,000 fish. Because the contribution of hatchery fish is minor in comparison to that of lake enrichment, many DFO staff believe that hatchery production should be directed at other salmon species. Although the local community has expressed a desire for sockeye enhancement to continue at the hatchery, there has been a shift towards producing fewer sockeye and more coho and chinook salmon in recent years.

The Nimpkish stock is the only sockeye stock in British Columbia that is currently being enhanced using hatchery technology. Although sockeye hatcheries were very popular in the province during the early 1900s, their overall success is questionable. More recent experiences at hatcheries in Alaska and spawning channels in B.C. suggest that some past failures were likely due to the infectious hematopoietic necrosis (IHN) virus, which normally causes mortality in sockeye during the late alevin and early fry stages. The IHN virus has been found in virtually every sockeye stock that has been examined. The potential for outbreak of the disease appears to increase if fish are stressed during critical stages of their development.

Although hatchery rearing on pilot-scale levels has demonstrated that high quality smolts can be produced, all enhancement facilities in British Columbia release sockeye as emergent fry. Mixing sockeye with other salmon species in the hatcheries is generally avoided because of the potential for transfer of the IHN virus, particularly to chinook and steelhead. Both these species in the Columbia River suffer heavy losses due to this virus. There has been only one small outbreak of IHN at the Nimpkish facility and it was quickly contained.

The Bear River pink stock is the only enhanced run in the Johnstone Strait area. It is an even-year run. In 1980, the Bear River stock was enhanced from a local incubation facility . However, since then enhancement has been in the form of transplanting unfed fry from the Quinsam hatchery into the Bear River or estuary. In 1981, efforts were made to establish an odd-year run. Although spawning escapement in 1983 was greater than the even-year runs in 1982 and 1984, there have been no further attempts to establish the odd-year run.

4.1.3 Mid East Coast Vancouver Island

There are four major enhancement facilities within the MECVI area and these are located on the Quinsam, Puntledge, Big Qualicum and Little Qualicum systems. These facilities have the capacity to produce about 160,000 pink, 800,000 chum, 340,000 chinook, 400,000 coho and 8000 steelhead. The production capacity of each facility is shown in Table 16.

These facilities are currently operating at or near production capacity. The Big Qualicum was the first enhancement facility in the area. The development was staged with flow controls in place in 1963, spawning channels completed in 1967 and a hatchery program initiated in 1968. The Little Qualicum facility began operations in 1979 and consists of spawning and rearing channels for chinook and coho salmon. The Quinsam hatchery has been operating since 1974. The Puntledge hatchery has been operating since 1971[26], but has only recently achieved capacity as a result of massive pink and chinook transplants.

A description of the enhancement activities directed at each salmon species is provided below.

4.1.3.1 Pink: Pink stocks are enhanced in the Puntledge and Quinsam river systems. There is capacity for incubation of pink eggs at the main site of the Puntledge hatchery complex. The facility was intended to enhance Puntledge and Tsolum pink stocks. A satellite facility for freshwater rearing of Tsolum pink salmon was constructed on a tributary of the Tsolum River. Puntledge and Tsolum pinks have not been treated as separate stocks because of extremely low escapements during the 1980s. Escapements were so low that no eggs were taken from the Puntledge stock in 1984 or 1986 and the Tsolum facility has not been in operation for the past several years. In 1985 and 1986, the Puntledge stock was enhanced by transplanting fish from the Quinsam hatchery.

Table 16. Production capacity of enhancement facilities in the Mid East Coast Vancouver Island area.[27]

Facility	Production Capacity: Eggs	Releases	Adult Returns	Target Stocks
Pink				
Puntledge	3,500,000	2,800,000	64,400	Puntledge, Tsolum
Quinsam	7,000,000	4,950,000	95,050	Quinsam
Total	10,500,000	7,750,000	159,450	
Chum				
Puntledge	5,500,000	3,960,000	67,300	Puntledge
L. Qualicum	75,000,000	44,800,000	341,600	Little Qualicum
B. Qualicum	134,000,000	55,000,000	385,000	Big Qualicum
Total	214,500,000	103,760,000	793,900	
Chinook				
Puntledge	6,300,000	4,500,000	90,000	Puntledge Summer, Fall
Quinsam	4,000,000	3,000,000	60,000	Campbell, Quinsam
L. Qualicum	5,600,000	4,000,000	60,000	Big/Little Qualicum
B. Qualicum	7,300,000	6,500,000	130,000	Big Qualicum
Total	23,200,000	18,000,000	340,000	
Coho				
Puntledge	3,200,000	2,300,000	122,750	Puntledge
Quinsam	2,100,000	1,500,000	126,000	Quinsam
B. Qualicum	2,780,000	1,950,000	177,000	Big Qualicum
Total	8,080,000	5,750,000	425,700	
Steelhead				
Puntledge	200,000	100,000	3,500	Puntledge Summer, Winter
Quinsam	75,000	40,000	1,000	Quinsam
L.Qualicum		25,000	1,000	Big/Little Qualicum
B.Qualicum	180,000	65,000	2,600	Big/Little Qualicum/ Englishman
Total	455,000	230,000	8,100	

Puntledge and Tsolum pinks are released as fry either after emergence or after being reared in sea-pens in Comox Harbour. Fish are marked prior to release to assess the success of the different strategies. However, too few marked fish have returned to allow this to be determined. Fry have been reared in fresh water prior to release at the Quinsam and Puntledge facilities, but this has proven unsuccessful. More recent experiments involving rearing pink fry in sea-pens prior to release at Quinsam and Puntledge have been successful, and returns to the Quinsam facility indicate that sea-pen rearing may double the ocean survival rates of these fish. This is a successful production technique in Alaska. Although the benefits of sea-pen rearing of pink salmon may not justify the costs of large-scale production, it is worth considering for the rehabilitation of threatened stocks.

Incubation boxes were used at the Quinsam Hatchery when it became apparent that the Quinsam pink stock was declining rapidly. Hatchery returns presently account for a major portion of the Quinsam run. High returns in 1986 were used to boost other runs such as the Oyster River stock.

4.1.3.2 Chum: Chum stocks are enhanced by the Japanese-style hatchery technique at the Puntledge facility. The eggs are incubated in bulk containers, and fry are reared prior to release. However, unlike the Japanese-style technique, surface water is used rather than groundwater. This facility has contributed significantly to the Area 14 terminal chum fishery since 1984 and the Johnstone Strait mixed-stock fishery.

The Little Qualicum facility is a spawning channel that has only recently been used to capacity. Previous difficulties in filling the spawning channel were due to relatively low escapements and the fact that the channel is located upstream from most of the natural spawning grounds. The rate of stock rebuilding was increased by taking adults from the lower river and transporting them to the spawning channel. Some of the early-migrating fry were also captured and reared in the spawning channel to increase their post-release survival rate. The Little Qualicum stock is a major contributor to the Area 14 terminal fishery and the mixed-stock Johnstone Strait fishery. The enhancement program was designed to mitigate losses of the Little Qualicum chum stocks while permitting a higher exploitation rate on Big Qualicum chum, and to develop a terminal fishery for Big Qualicum coho salmon.

Enhancement activities for Big Qualicum chum include controlling the river flow and maintaining a spawning channel. Some fry have been reared prior to release on an experimental basis. Unlike other facilities, the production capacity for the Big Qualicum facility includes the total system (i.e., river and channel) because of the ability to control the river flow. Egg-to-fry survival in the river is twice as high as it was before 1963 when flows were uncontrolled, and survival in the channel is five times the natural survival rate. Returns to the Big Qualicum River were relatively high during the late 1960s and early 1970s, were low during the mid- to late 1970s, and recovered during the 1980s. The Area 14 terminal fishery was directed at only the surplus of Qualicum chum, but is now a significant harvester of the Puntledge and Little Qualicum stocks. The Big and Little Qualicum and Puntledge account for a major portion of the chum catch in the Johnstone Strait mixed-stock fishery.

4.1.3.3 Chinook: The production capacity of MECVI hatcheries is currently 340,000 chinook, which far exceeds the total capacity of all Fraser River hatcheries. Additional enhancement activities in the area would be logical if fixed catch ceilings were established to protect wild stocks. MECVI chinook stocks are enhanced by the four major facilities (Puntledge, Big and Little Qualicum, and Quinsam). Many of the stream systems south of Courtenay have both early-run spring and/or summer stocks, and a later fall-run stock. These stocks exhibit different life histories, with the early run producing predominantly stream-type smolts and the fall run producing predominantly ocean-type smolts. Most hatchery production has been focused on the fall stocks.

Puntledge hatchery produces both summer and fall chinook runs. The summer runs are released from channels upstream near Comox Lake, and the larger fall chinook are produced at facilities in the lower river. Location of the facilities on the Puntledge River reflects the natural distribution of the two chinook stocks. The summer-run chinook spend more time in Georgia Strait than the fall run. The summer run is small but relatively stable. The fall run appears to be declining towards extinction, with fewer than 100 returns estimated in 1984. For this reason, Quinsam chinooks were transplanted to the Puntledge River in 1984 and a multi-stock transplant of Quinsam and Qualicum chinook has been conducted since 1985.

The Big Qualicum facility was the first hatchery in B.C. to release chinook. The hatchery was very successful through the 1970s, but production levels have been low since 1982 due to decreased survival of smolts after release. This trend has been apparent in all hatcheries for which a long-time series of data on the survival of smolt releases is available. Big Qualicum chinook capacity was doubled in 1984; some ponds constructed for EXPO '86 coho production have since been allocated for chinook production.

The Big Qualicum stock is the most widely transplanted chinook stock in British Columbia and has proven very adaptable to new hatchery environments. In addition to the Little Qualicum stock, the Capilano run was also established using Big Qualicum chinook since there was no indigenous stock. Capilano chinook have subsequently been transplanted to Sechelt Inlet, Indian River and Vancouver river facilities, with smaller numbers of fish being transplanted to several Burrard Inlet streams. In addition to Robertson Creek on the west coast of Vancouver Island, the Big Qualicum River is the major source of chinook salmon raised in the commercial fish farming industry in British Columbia.

Little Qualicum is only a rearing facility for chinook salmon; the eggs are incubated at Big Qualicum. The Little Qualicum run was established using transplanted Big Qualicum chinook, and has had escapements of up to several thousand fish. Eggs are now taken from Little Qualicum, incubated at the Big Qualicum hatchery, and then returned to the Little Qualicum facility for rearing and release. The rearing channels were expanded in 1986. Some of the additional production will be used for transplants, aquaculture and research.

In 1984, rearing capacity for chinook at the Quinsam hatchery was tripled to three million smolts. Quinsam chinook are released as 90-day smolts. The Quinsam run was established using Campbell River stock, and a significant portion of the hatchery returns spawn naturally in both the Campbell and Quinsam rivers. The Campbell River estuary is being studied intensively by DFO scientists, and marked releases of Quinsam chinook juveniles into the river, estuary and ocean are expected to provide information on the importance of rearing this species in estuaries.

4.1.3.4 Coho: There are many severely depressed coho stocks in the MECVI area and this has resulted in considerable discussion regarding the benefits of colonization and transplant work. The major hatcheries for coho on the Big Qualicum, Quinsam and Puntledge rivers have the capacity to produce 425,700 adult returns. They release primarily yearling smolts, but Big Qualicum fry are distributed to Horne Lake and local small streams that are presently underutilized. Fry are also planted in rivers and lakes of the upper Puntledge that are otherwise inaccessible to fish, and in the Tsolum River. The public-involvement project at Courtenay also produces fry for release in numerous systems. Quinsam fingerlings are planted directly in the river system above the hatchery. Approximately 343,000 juvenile coho are released by the Small Projects Unit into various streams for colonization studies, of which 3430 adults are expected to return.

The Quinsam colonization program is the best evaluated project of this type in British Columbia. Several broods of released fingerlings were marked to determine their contribution to catch and escapement. In addition, there is a fence on the Quinsam River at the hatchery site, so it has been possible to estimate planted fingerling-to-smolt survival. The results of these studies will be available in the next few years.

Puntledge hatchery has successfully rebuilt the Puntledge coho run from 2700 fish in the mid-1970s to current escapements of 20,000 or more. Colonization of the upper Puntledge River is expected to be less productive than the Quinsam colonization program because some downstream migrating smolts are lost in hydroelectric generating systems.

With the exception of the Chilliwack hatchery, the Big Qualicum has twice the coho production capacity of any other hatchery facility except in British Columbia. Both of these facilities were expanded in 1984 in an effort to double the number of Canadian hatchery coho available to fishermen in Georgia Strait during EXPO '86. Prior to the early 1980s, Big Qualicum was the most consistent and successful coho hatchery. However, survival of coho has declined dramatically in recent years.

4.1.4 Lower East Coast Vancouver Island

There are three enhancement facilities in the LECVI area and these are the Westholme Channel, Nanaimo River and Chemanius hatcheries. These facilities have the capacity to produce about 21,000 chum, 14,000 chinook and 6000 coho (Table 17).

Table 17. Production capacity of enhancement facilities in the Lower East Coast Vancouver Island area.[27]

Facility	Production Capacity: Eggs	Releases	Adult Returns	Target Stocks
Chum				
Westholme Channel		1,500,000	21,000	Chemainus
Nanaimo	500,000	405,000	4,900	Nanaimo
		1,905,000	25,900	
Chinook				
Nanaimo	700,000	504,000	10,080	Nanaimo, Spring, Summer Fall
Chemainus	200,000	175,000	3,500	Chemainus
Total	900,000	679,000	13,580	
Coho				
Nanaimo	620,000	502,200	5,020	Nanaimo
Chemainus	75,000	50,000	500	Chemainus
Westholme Channel		1,300	195	Chemainus
Total	695,000	553,500	5,715	

At the Westholme Channel and Nanaimo River hatcheries, chum are released as emergent fry. The production capacity of these two facilities is estimated at 25,900 chum adults.

Both early- and late-run chinook stocks have been enhanced at the Nanaimo and Chemainus hatcheries. Early-run fish are generally difficult to capture due to their low numbers and because they migrate further upstream in the river systems. Consequently, it is more difficult to collect eggs from early-run chinook stocks. Rebuilding of the Chemainus chinook was accelerated by crossing Cowichan eggs with Chemainus milt. This was considered necessary because of low escapements of Chemainus chinook when the project was initiated. Coded wire tag recovery data indicate that both the Nanaimo and Chemanius facilities have been extremely successful. At full operating capacity, these facilities are expected to produce an estimated 13,580 adult chinook returns.

The Chemainus and Nanaimo hatcheries also enhance LECVI coho stocks. Chemainus coho fry are released in the spring after a reaching weight of 2-3 grams. Nanaimo fry are released at a larger size in late summer, which is expected to double fry-to-smolt survival. Coho salmon also benefit from the spawning and rearing area provided by Westholme Channel. The total production from these three facilities is estimated at 5715 coho adults.

4.1.5 Southern Vancouver Island

Enhancement facilities in the Southern Vancouver Island area include the Cowichan and San Juan hatcheries. Their production capacities are presented in Table 18.

Enhancement of chum stocks in the Southern Vancouver Island area was previously conducted at the Cowichan hatchery. However, production from this hatchery was shifted to chinook and coho salmon in 1985. Currently, there is only minor enhancement of chum at the San Juan facility.

The Cowichan hatchery, like most coastal chinook hatcheries, releases 90-day smolts. It is currently operating slightly below capacity due to limited availability of broodstock. The San Juan facility achieved capacity for production of chinook salmon in 1984.[26]

Table 18. Production capacity of enhancement facilities in the South Vancouver Island area.[27]

Facility	Eggs	Releases	Adult Returns	Target Stocks
	Production Capacity			
Chum				
San Juan	50,000	40,000	280	San Juan
Chinook				
Cowichan	700,000	504,000	10,080	Cowichan
San Juan	350,000	252,000	3,530	San Juan
Total	1,050,000	756,000	13,610	
Coho				
Cowichan	600,000	486,000	4,860	Cowichan
San Juan	750,000	605,000	12,470	San Juan
Total	1,350,000	1,091,000	17,330	

The San Juan and Cowichan hatcheries are community-operated facilities that release pre-migrant coho fry. The San Juan hatchery is the largest coho enhancement facility on lower Vancouver Island, and it is currently releasing premigrant fry in the spring. Projected adult returns from current production are about half of capacity.

4.2 Mainland Inlets

There are presently no enhancement projects in the Seymour/Belize, Kingcome/Wakeman or Bond/Knight production areas due to high costs associated with enhancing remote areas. A fishway was installed on the Kakweiken River in the Bond/Knight area in 1979. It is estimated to have increased pink salmon production by 65,000 adults annually.

4.2.1 Loughborough/Bute

There is currently only one enhancement project in the Loughborough/Bute area. It is an unmanned spawning channel for pink salmon on the lower Phillips River. This channel was completed in 1984 and has the capacity to produce 245,000 adult pink salmon in odd and even years and about 1000 chum, coho and chinook salmon (Table 19). This project involved enlarging, improving and protecting an existing side channel to provide a high production, natural spawning area.[26]

Pink salmon generally spawn in the lower Phillips River, but also spawn in the upper river in even years when the abundance is higher. In the first year of operation (1984), fish were to be transplanted into the channel. However, there were only 2000 spawners in the whole system. In 1985, 1100 adults were moved from the lower river spawning area into the channel and 500 adults swam into the channel naturally. In 1986, 600 pink salmon were placed in the channel. Returns over the next few years will indicate the success of the channel.

4.2.2 Toba Inlet

The Sliammon hatchery and rearing facility is operated by the Sliammon Indian Band under CEDP (Table 19). Production in the past has focused on chum salmon. However, more emphasis was placed on the enhancement of pink salmon in 1987. Production capacity for pink salmon will not likely be achieved in the next few years because of limited availability of broodstock.

Table 19. Production capacity of enhancement facilities in the Loughborough/Bute, Toba and Jervis Inlet areas.[27]

Production Area and Facility	Species	Production Capacity: Eggs	Releases	Adult Returns	Target Stocks
Loughborough/Bute					
Phillips	Pink			245,000	Phillips
	Chum			1,000	
	Chinook			1,000	
	Coho			1,000	
Toba Inlet					
Sliammon	Pink	1,000,000	900,000	13,500	Sliammon
	Chum	1,100,000	792,000	13,460	Sliammon
	Chinook	50,000	36,000	610	Sliammon
	Coho	180,000	123,750	9,860	Sliammon, Okeover, Theodosia
Jervis Inlet					
Vancouver	Pink	1,000,000	800,000	12,000	Jitco
Powell River	Pink	300,000	270,000	4,050	Lang
Sechelt	Pink	100,000	59,400	1,370	Angus Gray
Total		1,400,000	1,129,400	17,420	
Vancouver	Chum	500,000	360,000	6,120	Jitco, Deserted, Hunachin, Skwawka
Powell River	Chum	100,000	90,000	1,080	Lang
Sechelt	Chum	100,000	72,000	1,370	Porpoise Bay
Total		700,000	522,000	8,570	
Vancouver	Chinook	60,000	43,200	730	Capilano transplant
Sechelt	Chinook	100,000	68,620	1,360	Porpoise Bay/Capilano
Total		160,000	111,820	2,090	
Vancouver R.	Coho	150,000	108,000	3,240	Jitco
Powell River	Coho	385,000	291,000	9,340	Lang, Kelly
Sechelt	Coho	100,000	67,500	6,750	Porpoise Bay/Capilano
Total		635,000	466,500	19,330	

Coho stocks are also enhanced at the Sliammon facility. Coho production in Okeover Creek in the upper watershed is limited due to a barrier that restricts the upstream migration of spawners. Currently, coho eggs are taken from Okeover and Theodosia creeks and incubated at the hatchery. Sea pens are used to rear coho fry in Okeover estuary. Limited availability of broodstock has prevented the facility from operating at capacity. To increase the rebuilding rate, some of the fry are being reared to maturity to meet future broodstock requirements. Once rebuilding of the stock becomes evident, some of the fry will be returned to the Okeover system to colonize the upper watershed. At full capacity, the Sliammon facility is capable of producing about 15,000 coho adults. However it may take a full cycle before this can be achieved because of limited broodstock availability.

4.2.3 Jervis Inlet

Enhancement facilities in Jervis Inlet include the Vancouver Bay, Powell River and Sechelt hatcheries. The production capacity of each facility is shown in Table 19.

Enhancement activities for pink salmon occur at the three facilities during odd years. The largest producer of pink salmon is the Vancouver Bay hatchery, which is a joint project of DFO and B.C. Forest Products. The Sechelt facility, operated by the Sechelt Band, began enhancement of pink stocks in 1987. A spawning channel on Lang Creek contributes to the enhancement of pink and chum stocks in the area. Total production from these facilities is estimated at 17,420 adult pink returns.

Enhancement of Jervis Inlet chum stocks is also conducted at the three facilities. The Vancouver Bay hatchery was designed to enhance pink and chum stocks. In even years, the production capacity for chum salmon is doubled because there is no enhancement of pink stocks in these years. All three facilities are operating near capacity and are expected to produce 8570 adult chum returns.

Enhancement activities for chinook salmon occur at the Vancouver Bay and Sechelt facilities. Both of these stocks have been supplemented by transplanting fish from the Capilano hatchery. The Sechelt facility is presently able to obtain broodstock from returns of the newly-established Porpoise Bay stock.

The Powell River facility was established as a coho hatchery and rearing facility. It is operated by the Powell River Salmon Society. Coho fry will be used to colonize the upper watershed of Lang Creek which is inaccessible to spawners. The Sechelt facility also focuses on coho production, where fry are raised in sea-pens. The objectives of both of these facilities are to improve sport fishing opportunities. A small number of coho salmon are also produced at the Vancouver Bay hatchery.

4.2.4 Howe Sound

Enhancement activities in Howe Sound include numerous spawning channels and the Tenderfoot hatchery. The production capacity of each facility is shown in Table 20.

A pilot spawning channel (the Mamquam side channel) was constructed on the Squamish River for pink salmon. Because broodstock of Squamish pink is limited, eggs from the Indian River stock in Burrard Inlet were transplanted into the channel in 1985 to assist in rebuilding of the stock.

Virtually all enhancement activities for chum salmon in Howe Sound streams are spawning channels directed at stocks in the Squamish River and its major tributary, the Cheakamus. In addition, there is a small channel on McNab Creek and some small facilities on other creeks. There are six groundwater-fed channels (Judd Slough, Upper Paradise, Lower Paradise, Mamquam, Moodies and B.C. Railway) in the Squamish system. These channels are intended to improve incubation conditions for naturally-spawning chum salmon. The Howe Sound channels have the capacity to produce 137,900 adult chum.

The Squamish chinook run is severely depressed, and production at the Tenderfoot hatchery has been limited by broodstock availability. Initial plans were to take eggs from various tributaries within the Squamish River and then return the smolts to these same tributaries. Because some of the target stocks are virtually extinct, smolts are now released from the hatchery with the hope that returning spawners will be easier to capture. This will increase the number of eggs that can be taken from the next generation, and will result in a higher rebuilding rate. Another new method to increase production of Squamish chinook involved taking 4000 smolts of the 1984 brood year from the Tenderfoot hatchery and rearing them to maturity in a commercial fish farm. Eggs taken from mature fish in 1987 and 1988

Table 20. Production capacity of enhancement facilities in Howe Sound.[27]

Facility	Production Capacity Eggs	Releases	Adult Returns	Target Stocks
Pink				
Mamquam		900,000	13,500	Squamish/Indian
Chum				
Judd Slough		2,600,000	36,400	Squamish
L. Paradise		1,500,000	21,000	Cheakamus
U. Paradise		1,300,000	18,200	Cheakamus
Mamquam		1,500,000	21,000	Squamish
Moodies		1,500,000	21,000	Cheakamus
B.C. Railway		1,000,000	14,000	Cheakamus
McNab		450,000	6,300	McNab
Total		9,850,000	137,900	
Chinook				
Tenderfoot	2,800,000	2,020,000	34,340	Capilano/Big Qualicum transplant
Coho				
Tenderfoot	168,000	150,000	15,000	Cheakamus, Squamish, Mamquam
Judd Slough		7,800	1,170	Squamish
L. Paradise		4,500	675	Cheakamus
U. Paradise		7,800	1,170	Cheakamus
Mamquam		4,500	675	Squamish
Moodies		9,900	485	Cheakamus
B.C. Railway		50,000	450	Cheakamus
McNab		1,350	135	McNab
Total		215,850	19,760	
Steelhead				
Tenderfoot	140,000	105,000	1,050	Cheakamus, Squamish

will be returned to the hatchery for incubation, rearing and release. The 4000 smolts are expected to yield 1 million eggs, compared to about 50,000 eggs expected from returns if the young had been released and not reared to maturity. Eggs from the Capilano stock have been transplanted to Tenderfoot to supplement chinook production in the Squamish system. At capacity, the Tenderfoot facility would produce 34,340 adult chinook returns.

Tenderfoot hatchery is the primary enhancement facility for coho salmon on the Squamish River system. This facility is involved in large-scale production of the nearby Cheakamus stock and smaller-scale production of the Mamquam and upper Squamish (and tributaries) stocks. Hatchery staff work closely with the Upper Paradise public project group. Coho production is also increased by spawning channels that were developed for chum salmon. These channels provide a stable rearing habitat, and studies indicate that they are used extensively by juvenile coho.

Steelhead trout are also enhanced at the Tenderfoot hatchery. The expected production is 1050 adults returns.

4.2.5 Burrard Inlet

Capilano and Seymour hatcheries are the only two enhancement facilities in Burrard Inlet (Table 21). A unique feature of the Capilano River is that it is the only stream with a major hatchery that has virtually no natural spawning or rearing capacity. This is because the Cleveland dam, located just upstream of the hatchery, blocks access to the upper river, where most spawning and rearing used to take place. Without the Capilano hatchery, the chinook run would likely be lost and coho and steelhead runs would be a fraction of their current size.

4.2.5.1 **Chinook:** Capilano hatchery has established a chinook population where none existed historically. The Big Qualicum stock was transplanted to create the Capilano chinook run. Production continues to be supplemented by Big Qualicum transplants because of poor marine survival and low river flows, which limit migration of spawners.

Many innovative studies for increasing chinook production have been conducted at the Capilano hatchery. These include investigations of feminization to increase the proportion of females in hatchery returns, rearing density strategies and

Table 21. Production capacity of enhancement facilities in Burrard Inlet.[27]

Facility	Production Capacity: Eggs	Releases	Returns	Target Stocks
Pink				
Seymour	100,000	90,000	1,350	Seymour
Chum				
Seymour	100,000	90,000	1,080	Seymour
Chinook				
Capilano	2,800,000	2,020,000	34,340	Capilano/Big Qualicum
Seymour	50,000	36,000	610	Capilano/Seymour
Total	2,850,000	2,056,000	34,950	
Coho				
Capilano	1,250,000	1,000,000	55,000	Capilano
Seymour	150,000	104,850	6,800	Seymour
Total	1,400,000	1,104,850	61,800	
Steelhead				
Capilano	30,000	14,000	600	Capilano
Seymour	105,000	68,625	1,000	Seymour Winter, Summer
Total	135,000	82,625	1,600	

success of rearing to the yearling smolt versus the 90-day smolt stage. Capilano hatchery has been the source of chinook eggs for enhancement work at Sechelt and Vancouver River and for former programs at False Creek (the children's fishery) and Indian River. Chinook production capacity of the hatchery was expanded in 1983 and 1984 by development of underground rearing ponds that rely on an artificial light source. The success of this technique is being assessed using mark-release/recovery experiments.

In 1985, some Capilano chinook were reared in sea pens at Deep Cove. Their post-release survival will be compared to that of chinook released directly from the hatchery on the same dates. Sea-pen rearing is a potentially important technique for future chinook enhancement efforts in British Columbia, particularly in systems such as the Indian River where water quality may be limiting chinook production.

4.2.5.2 **Coho:** Capilano hatchery is the largest coho producer in the Howe Sound and Burrard Inlet area. It has been so successful that overescapement of coho has been cited as a major management problem in Burrard Inlet because the surplus cannot be taken without harming wild stocks. Most of the coho are reared to the smolt stage. Recent research conducted at the hatchery indicates that escapement levels can be reduced while maintaining current smolt releases by sterilizing coho juveniles. Sterilized fish do not undergo normal maturation processes and do not return to fresh water. Some marked, sterilized Capilano coho have been recovered in the fisheries at age 6 compared to normal age 3 maturity. By sterilizing 50% of the Capilano coho juveniles, escapement will be reduced by 50% and their contribution to the catch will be maintained. Another study conducted at the Capilano hatchery has demonstrated that adult run timing is an important factor in selecting broodstock and can help to maintain the genetic diversity of each stock.

Capilano coho fry are planted in the upper river above the dam in sufficient numbers to ensure an escapement of about 2,000 adults. This would allow the hatchery to operate at full capacity in the event of a major failure such as in 1974, when most fish in the hatchery were killed by accidental chlorine contamination of the water supply.

In the late 1970s, Capilano coho were reared and released from sea pens at the head of Indian Arm in a pilot study. During the same years, coho were also released from the Capilano hatchery and from sea pens in Sechelt Inlet. Although the catch distribution of the Indian Arm and Capilano hatchery releases was very similar, the catch distribution of the Sechelt releases was more northerly, with the greatest catch in Statistical Area 16. These results indicate that stock distribution in the ocean is strongly influenced by release locations, and this offers a management option for increasing catch of coho in specific areas of Georgia Strait.

Coho production from the Seymour hatchery is about one-tenth of the production from the Capilano hatchery (Table 21).

4.2.5.3 Steelhead: Steelhead trout are enhanced at Capilano and Seymour hatcheries. The Seymour hatchery focuses on both the summer and winter runs. Total production is estimated at 1600 adults.

4.3 Fraser River

4.3.1 Lower Fraser

All five salmon species and steelhead trout are enhanced in the Lower Fraser River. The production capacities of enhancement facilities in the area are shown in Table 22.

4.3.1.1 Sockeye: There are two enhancement projects for sockeye in the Lower Fraser area; a spawning channel at Weaver Creek and an incubation channel at Pitt River. The Weaver Creek channel has been operating since 1965 and was the first channel that the IPSFC installed to augment sockeye production.[28] The average production of the channel is estimated at 438,000 adults. However, production has been higher in the 1984 and 1986 cycles and lower in the 1983 and 1985 cycles since the Weaver channel has been operated with varying abundances. The Pitt River facility is composed of a hatchery for incubation of sockeye eggs, to the eyed stage, and two upwelling-incubation beds. It has been operating since 1963.[28]

4.3.1.2 Pink: There are two small-scale enhancement facilities for pink salmon in the Lower Fraser. The combined production capacity of these facilities is 32,500 adult returns.

Table 22. Production capacity of enhancement facilities in the Lower Fraser River area.[27]

Facility	Production Capacity Eggs	Releases	Adult Returns	Target Stocks
Sockeye				
Upper Pitt River	4,500,000	3,600,000	25,200	Pitt River
Weaver Creek	102,000,000	53,500,000	535,000	1986 & 1984 cycle years
	55,000,000	29,000,000	290,000	1983 & 1985 cycle years
Total	83,000,000	44,850,000	437,700*	
Pink				
Jones	2,000,000	700,000	10,500	Jones
Alouette	2,000,000	1,600,000	24,000	Harrison/Alouette
Total	4,000,000	2,300,000	34,500	
Chum				
Chehalis	14,000,000	10,080,000	171,400	Harrison, Weaver, Squakum, Chehalis
Chilliwack	5,000,000	3,600,000	61,200	Chilliwack
Inch	8,600,000	7,310,000	124,300	Stave, Blaney, Inch
Chehalis (CDP)	3,900,000	2,340,000	32,760	Billy Harris, Ed Leon, Chehalis, Pitt
Alouette	1,300,000	936,000	15,900	Alouette
Worth		350,000	4,900	Nicomen
Railroad		350,000	4,900	Nicomen
Peach		1,500,000	21,000	Chilliwack
Chilqui		500,000	7,000	Hatzic (Fraser)
Ed Leon Channel		1,500,000	21,000	Harrison
Ryder		150,000	2,100	Chilliwack
Billy Harris		1,500,000	21,000	Harrison
Hicks Creek		25,000	350	Maria
Total	32,800,000	30,141,000	487,810	

*Average annual production for Weaver was used to estimate total adult returns

continued . . . . . .

Table 22. continued

Facility	Production Capacity: Eggs	Releases	Adult Returns	Target Stocks
Chinook				
Birkenhead	250,000	180,000	450	Birkenhead
Chehalis	2,500,000	1,800,000	30,600	Harrison
Chilliwack	1,500,000	1,215,000	20,650	Harrison, Chilliwack, Pitt, Upper Fraser (Bowron, Slim)
Total	4,250,000	3,195,000	51,700	
Coho				
Chehalis	1,239,000	836,000	83,600	Weaver, Chehalis, Harrison, Coho, Squakum, Evans, Hicks/Maria Trout
Chilliwack	2,200,000	1,900,000	190,000	Dolly Varden, Post, Salwein, Chilliwack
Inch	485,000	325,000	32,500	Inch, Nicomen, Siddle, Norrish, Blaney, Stave, Legace
Alouette	140,000	94,500	9,450	Alouette
Peach Creek		13,500	2,025	Chilliwack
Hicks Creek		8,000	1,200	Maria
Hopedale		4,000	600	Chilliwack
Chilqua		1,200	180	Hatzic
Total	4,064,000	3,182,200	319,555	
Steelhead				
Chehalis	205,500	110,000	4,400	Chehalis, Coquihalla, Harrison, Weaver
Chilliwack	300,000	150,000	6,000	Chilliwack
Alouette	50,000	26,250	1,050	Alouette
Total	555,500	286,250	11,450	

The spawning channel on Jones Creek has produced odd-year pinks since 1955 and accommodates 2100 adults. It was constructed to compensate for loss of spawning grounds caused by development of a hydroelectric facility. Although there have been no mark-release/recovery studies to estimate the number of returns, pink populations are smaller than prior to hydroelectric development on the stream. However, the channel has successfully maintained a moderate escapement level of approximately 2000 fish.

The Alouette facility enhanced pink salmon in 1983, 1985 and 1987. This project involves incubating pink eggs in gravel and then releasing the fry at the time of wild fry migration. Due to poor success in rearing pink salmon in fresh water, attempts may be made to slow down development during incubation so that the emergence fry will correspond more closely to that of wild fry.

4.3.1.3 Chum: Two techniques are used to enhance chum salmon stocks on the Lower Fraser. One involves incubation of naturally-spawned eggs in groundwater channels or improved side channels, with voluntary emergence and downstream migration. Most channels of this type, with the exception of Worth, Railroad and Hicks, are located on the Vedder or Harrison systems. Some of the Chehalis facilities use a variation of this technology, where eggs are planted manually into gravel pits that contain groundwater. The second technique is the Japanese-style hatchery. The key feature of this method is that groundwater is used for incubation and rearing, which results in fry being 2-3 times larger than wild fry by the time of migration. It is expected that this rearing will at least double survival rates from release to return.

All major chum stocks on the Lower Fraser are currently being enhanced,with the possible exception of the mainstem stock whose strength remains unknown. Two major hatcheries (Chehalis and Inch) were designed to enhance several stocks. The Chehalis hatchery has not only produced many separate stocks but also run-timing segments within each stock. Early reports indicate that hatchery returns will distribute themselves and spawn naturally in their native streams rather than flood into the hatcheries. For example, at the Chilliwack facility where fry are released directly from the hatchery, the distribution of marked spawners has been monitored in 1985 and 1986. The results indicate that a significant portion of the hatchery returns spawned naturally in an area that is not used extensively by wild spawners. It is believed that some natural spawning grounds, such as Weaver and Squakum Creeks, could be over-utilized if all fry from the Chehalis hatchery were released into their native stream. Therefore, based on wild spawner levels and expected return rates, enough Weaver and Squakum fry are returned to these streams to provide the optimum number of spawn in 3 and 4 years. The remaining fry are released directly from the Chehalis hatchery. The assumption that release site will dictate return site is being tested through mark/recovery studies.

The production capacity for chum enhancement in the Lower Fraser is approximately 487,000 adult returns. The majority of this production is from the Chehalis, Inch and Chilliwack hatcheries and several spawning channels. These fish could be harvested in Johnstone Strait, in terminal fisheries along the Strait of Georgia, in the mouth of the Fraser or at the hatcheries. However, an important consideration is the quality of these fish, which deteriorates as the fish approach their spawning areas. In an attempt to alleviate mixed-stock fishing problems through enhancement of specific run-timing segments of each stock, SEP has differentially marked fry that were progeny of these groups. It is assumed that eggs spawned in late November will yield fish that migrate through Johnstone Strait in late October. If the returns of marked fry indicate that run timing of chum salmon is hereditary and times can be identified when fishing in Johnstone Strait will not significantly affect other chum stocks, it may be possible to harvest the majority of these fish in the Johnstone Strait mixed-stock fishing areas. The first efforts to select broodstock on the basis of run timing were made in 1986.

4.3.1.4 Chinook: Enhancement activities in the Lower Fraser area have focused primarily on the production of Harrison River chinook at the Chehalis and Chilliwack hatcheries. The objective of the program was to provide a high-quality freshwater sport and possibly gillnet fishery. Although the "90-day smolt" release strategy has been successful for the Harrison stock, it has not been successful for Birkenhead stocks. As a result, various release strategies are currently being used at the Birkenhead facility in an attempt to increase post-release survival.

4.3.1.5 Coho: The total production capacity of the Lower Fraser enhancement facilities is about 320,000 adult coho (Table 22). The majority of enhancement activities occur in the Chilliwack and Harrison systems.

In the Chilliwack area, enhancement activities for coho salmon include a major hatchery and two spawning channels. The Chilliwack hatchery is designed to draw broodstock from major tributaries including the upper Chilliwack River (Dolly Varden Creek). Enhancement activities in these systems are intended to rebuild escapements to historic levels. In most cases, pre-migrant fry are released into the watershed. However, the Dolly Varden Creek stock is released as smolts because most of the creek is in the U.S. and is inaccessible for transplanting fry.

Excess escapement to the Chilliwack facility will be either harvested in a rack fishery or used to establish a hatchery broodstock. Adult returns to the hatchery in 1983 offered the first useful data for assessing the success of coho enhancement in the Lower Fraser River. In addition, the return data provided new information on homing success as a function of release strategy. Although the survival rates were slightly below those projected, these returns supported a very successful sport fishery.

Harrison coho stocks are enhanced by a central satellite facility on the Chehalis River. Chehalis hatchery is designed to draw broodstock from major tributaries and rivers in the Harrison area. Additional coho enhancement in the Lower Fraser River is based primarily on the release of yearling smolts from the Inch Creek facility. Like the other major hatcheries in the Lower Fraser, this facility is designed to draw broodstock from the Alouette River to the Harrison area.

4.3.1.6 Steelhead: Steelhead trout are enhanced at the Chilliwack, Chehalis and Alouette hatcheries. A total of 11,450 adults are expected to be produced at these facilities.

4.3.2 Middle Fraser

The three major enhancement projects in the Middle Fraser area are spawning channels at Gate and Seton creeks and the Quesnel hatchery. Production targets for these facilities are shown in Table 23.

The Gates Creek spawning channel was constructed during 1967 and 1968 by IPSFC to compensate for deteriorating sockeye spawning habitat.[28] The channel was designed to support 9000 female sockeye at capacity. However, based on data from the Weaver Creek channel, it should be able to support 12,500 females. Gates channel was operated at capacity in the 1984 cycle. Low escapements in the other cycle years have resulted in substantially fewer spawners even though the objective has been to fill the channel.[28]

Table 23. Production capacity of enhancement facilities in the Middle Fraser River area.[27]

Facility	Production Capacity: Eggs	Releases	Adult Returns	Target Stocks
Sockeye				
Gates Creek	22,900,000	14,600,000	146,000	1984 cycle
	5,700,000	3,600,000	36,000	1982, 1983, 1985 cycle
Average	10,000,000	6,350,000	63,500	
Pink				
Seton Creek	43,600,000	23,520,000	607,500	Seton Creek
Chinook				
Quesnel	3,900,000	2,808,000	21,060	Quesnel, Bowron, Cariboo Horsefly, Nazko, Baezaeko, Blackwater, Chilko, Swift
Coho				
Quesnel	50,000	36,000	720	McKinley Creek

Enhancement of pink salmon stocks occurs in the Upper and Lower Seton Creek spawning channels, which began operation in 1961 and 1967, respectively. These channels were constructed to compensate for the flooding of natural spawning grounds caused by the development of a hydroelectric facility.[28] The production capacity of both channels is 607,500 adults, which is relatively low compared to the total production of pink salmon from the Fraser system. With the exception of 1985 when low river flows obstructed migration through the canyon, there is usually a surplus escapement of pink salmon to Seton Creek as a result of increased production from these channels.

The Quesnel hatchery was designed as a central facility with the capability of enhancing several chinook stocks each year. Its purpose was to increase production of Middle and Upper Fraser chinook. Table 23 lists the target stocks for 1986. Other stocks have been enhanced at the facility in the past,and target stocks may change in the future. Studies conducted at Quesnel hatchery have included investigations of various release strategies including time and size at release, and the inheritability of flesh colour. Generally, most of the chinook are released as larger-sized fish early enough in the year that they migrate to sea soon after release. To date the recoveries of the Quesnel chinook salmon have been low and the reasons for poor survival are unclear since very little is known regarding the life history of Middle and Upper Fraser chinook stocks. The factors that determine whether a juvenile chinook will overwinter in fresh water or migrate to the ocean in its first summer, the migrational behaviour and the location of the rearing areas are all unknown. Upper Columbia River hatchery production, especially in Idaho, might provide insights applicable to Upper Fraser chinook enhancement; however, the Idaho program has produced few returns, and useful conclusions cannot be made.

There is only minor production of coho salmon at the Quesnel hatchery. The McKinley Creek coho comprise one of the few stocks above the Thompson River confluence. Coded wire tag recoveries of this enhanced stock are expected to provide migration and harvest data for upriver coho stocks.

4.3.3 Thompson

There are four major hatcheries in the Thompson drainage that enhance chinook and coho stocks (Table 24). These are the Spius hatchery on the Nicola River, the

Table 24. Production capacity of enhancement facilities in the Thompson area.[27]

Facility	Eggs	Releases	Adult Returns	Target Stocks
Chinook				
Eagle	1,000,000	860,000	4,150	Eagle, Salmon
Clearwater	2,200,000	1,600,000	12,450	Clearwater, Raft, Finn Lemieux
Spius	1,400,000	1,080,000	8,100	Spius, Coldwater, Bonaparte, Nicola, Deadman
Shuswap	1,600,000	1,440,000	10,800	Middle & Lower Shuswap
Total	6,200,000	4,008,550	35,500	
Coho				
Eagle	1,000,000	720,000	14,400	Eagle, Salmon
Clearwater	600,000	430,000	8,600	Lion, Raft, Clearwater, Dunn
Spius	670,000	480,000	9,600	Coldwater
Barriere	180,000	136,300	3,340	Dunn, Lemieux, Fennel
Shuswap	310,000	220,000	6,600	Shuswap
Total	2,760,000	1,986,000	42,540	

Clearwater Hatchery in the North Thompson, and Shuswap and Eagle hatcheries in the South Thompson. There is also a small-scale community project at Barriers.

4.3.3.1 Chinook: The total production capacity of the enhancement facilities in the Thompson area is about 35,000 adult chinook (Table 24). The basic assumption for chinook enhancement in the Thompson drainage is that the stream-rearing area is not fully utilized. Therefore, all hatchery fish are released as pre-migrant fry into selected rearing areas. The Eagle, Clearwater, Spius and Shuswap facilities are designed to enhance several stocks, with eggs taken from the target stock, incubated at the hatchery and back-planted as fry. The life history of Thompson chinook is poorly understood and, therefore, the pilot hatcheries were designed to produce enough fish to allow statistically valid analyses of mark-release/recovery data. Studies will be conducted to examine the survival rate at different times and sizes of release (including small yearling smolt releases), survival at different planting densities and sites, and the effect of various release strategies on homing. Interactions between wild and hatchery fry during freshwater rearing are also being examined.

4.3.3.2 Coho: Coho enhancement in the Thompson area is based on the assumption that stocks require rebuilding, and that the stream rearing area is not fully utilized. The major hatcheries were designed specifically to investigate optimal rearing and release strategies, and the impact of hatchery fish on wild production. Relevant studies conducted at these facilities have focused on the following:

1. Size and time of release in which the major interest is pre-migrant release of small fry;

2. Determination of natural rearing capacity to establish optimal planting densities;

3. Post-release rearing and migrational behaviour;

4. Effects of hatchery-released fish on wild juveniles (e.g., predation and displacement of wild fry by hatchery fish); and

5. Maximizing genetic contribution of returning hatchery adults to wild stock reproduction.

One major difficulty in studying interactions between hatchery and wild stocks and in determining optimal release strategies at Clearwater is that enhanced fish are reared on groundwater, because there are no cold water supplies in the area suitable for the hatchery.

4.3.4 Upper Fraser

There are currently two enhancement facilities in the Upper Fraser area, the Nadina River sockeye spawning channel and the Penny hatchery. In addition, some upper river chinook stocks such as the McGregor and Bowron populations are enhanced at the Quesnel hatchery.

The Nadina River spawning channel was developed by the IPSFC and began operation in 1973. It was designed to augment the late Nadina run. Previous studies indicated that rearing areas within Francois Lake were only utilized to 4% of their estimated capacity.[28] The channel was designed to support 14,450 female sockeye, which would produce 24 million fry. However, in the two years that capacity was achieved, egg-to-fry survival was below 50%.[28] Therefore, the current capacity estimate is based on producing 18 million fry which would result in 144,000 adult returns (Table 25). It is expected that this capacity would be achieved only in the 1983 and 1985 cycles. The production target for the 1984 and 1986 cycles is 35,200 adult sockeye.

Over the past few years (1980 to 1986), the upper Fraser chinook stocks have been enhanced at the Quesnel and Penny hatcheries. The Penny Hatchery is a satellite facility with the capacity to incubate and rear 200,000 chinook fry to release. The facility was designed to test a production strategy that more closely represented the natural life history of local chinook stocks than the accelerated growth strategies used at the Quesnel Hatchery. The Penny Hatchery will continue operating and testing various release strategies to improve survival of upper Fraser chinook stocks.

Table 25. Production capacity of enhancement facilities in the Upper Fraser area.[27]

Facility	Production Capacity: Eggs	Releases	Adult Returns	Target Stocks
Sockeye				
Nadina	41,000,000	18,000,000	144,000	1983 & 1985 cycle
	10,000,000	4,440,000	35,200	1982 & 1984 cycle
Average	25,500,000	11,200,000	89,600	
Chinook				
Penny	200,000	130,500	1,058	Dome, James

5. HABITAT STATUS

The topography and climate of the Inner South Coast region ranges from the rugged, wet mainland coast to the dry and temperate interior plateau of the Fraser River drainage. Numerous development activities such as forestry, agriculture and hydroelectric generation have occurred throughout the area in varying intensity. Natural differences in geography and development activities have lead to a wide range in conditions of salmon habitat in the area.

The following sections summarize habitat characteristics of and development activities within each of the production areas of the Inner South Coast. Table 26 summarizes the number of streams that have historically supported salmon in the region. Vancouver Island and Mainland Inlet streams are summarized by Statistical Area, while the Fraser River area is summarized by production areas. Detailed information on stock attributes and habitat status is provided in Appendix III.

Table 26. Summary of Inner South Coast streams that have historically supported salmon populations.

Habitat Area	Sockeye			Pink			Chum			Chinook			Coho		
	Total streams[a]	Signif. streams[b]	% of MRE[c]	Total streams	Signif. streams	% of MRE	Total streams	Signif. streams	% of MRE	Total streams	Signif. streams	% of MRE	Total streams	Signif. streams	% of MRE
Vancouver Island															
Area 12	5	4	100	14	14	100	16	5	86	4	3	100	16	12	96
Area 13	0	0		9	5	97	9	6	94	4	4	100	8	8	100
Area 14	0	0		13	3	96	21	10	94	5	3	98	27	13	95
Area 17	0	0		0	0		15	7	96	2	2	100	15	7	93
Area 18	0	0		0	0		3	2	99	2	2	100	4	2	100
Area 19	0	0		0	0		4	2	92	1	1	100	4	4	100
Area 20	1	1	100	3	3	100	8	8	100	3	3	100	8	5	97
Total	6	5		39	25		76	40		21	18		82	51	
Mainland Inlets															
Area 11 & 12	10	6	99	38	13	98	63	26	90	9	9	100	67	35	96
Area 13	7	2	96	33	18	97	39	12	87	9	9	100	32	15	95
Area 15	0	0		11	4	93	12	5	94	4	4	100	13	6	95
Area 16	2	2	100	12	4	95	21	10	87	2	2	100	23	8	93
Area 28 (Howe Sound)	0	0		8	4	95	14	4	92	4	4	100	12	5	99
Area 28 (Burrard Inlet)	0	0		4	2	95	4	1	87	2	1	98	6	3	98
Total	19	10		106	45		153	58		30	29		153	72	
Fraser River															
Lower	14	6	99	46	18	99	46	15	86	12	8	100	82	24	91
Middle	7	6	100	3	3	100	0	0		16	13	99	6	4	94
Thompson	16	11	100	8	4	100	0	0		25	17	97	50	29	
Upper	45	20	96	0	0		0	0		27	17	98	0	0	
Total	82	43		57	25		46	15		80	55		138	57	
TOTAL INNER SOUTH COAST	107	58		202	95		275	113		131	102		373	180	

[a] = Total number of streams that have historically supported the species indicated.
[b] = Significant number of streams which have historically contributed most to production of species indicated.
[c] = Percentage of Maximum Recorded Escapement (MRE) is the percentage contribution of the significant streams to the total maximum recorded escapement.

5.1 Vancouver Island

Vancouver Island streams originate in the central mountainous region of the island. They are relatively small and are characterized by winter floods. Those originating in the highest areas are also subject to spring freshets resulting from snow melt. Stream flows are generally low during the summer months.

The primary development activity on Vancouver Island is forestry. Agriculture is also a major activity particularly in the southeastern area. Hydro-electric generation, mining and urban development have also occurred on the island. Although some of these development activities have affected fish habitat, habitat is generally not considered to be a major factor limiting stocks from reaching target levels.

5.1.1 Area 12 - Island

Forestry is the major development activity within Statistical Area 12 on Vancouver Island. There are presently 151 active and planned logging sites in the area. Most of the logging activities occur in seven of the major salmon-producing watersheds, including 75 sites in the Nimpkish and 26 sites in the Adam drainage. Although it is difficult to assess the effect of logging on salmon production, it is believed that forest industry has generally had a minor impact on salmon populations in this area. A noticeable exception is the Adams River, where logging activity has resulted in scouring of the streambed and has caused moderate to major impacts on chinook habitat in the river.[29] Application of pesticides in the Nimpkish watershed could have affected water quality and survival of salmon fry. However, the effects of spraying have not been monitored. New logging sites will be located further away from spawning and rearing areas of these streams and, therefore, will pose less of a risk to important salmon habitat.[29] As logged areas regenerate, fish habitat conditions are expected to improve.[29]

Mineral deposits have been discovered in several salmon-producing watercourses including the Keogh, Cluxewe and Tsulquate rivers and Hyde Creek. Although development of these reserves is uncertain at the present time, such activities could potentially affect salmon habitat in these streams.[29]

Urban and transportation development may have interfered with coho salmon use of the Quatse River estuary at Port Hardy through dyking and floodgate operations.[29] However, the dykes and floodgates could be modified to improve access for juvenile coho to the estuary.

5.1.2 Area 13 – Island

Forestry, mining and hydroelectric generation have been the major development activities in Statistical Area 13 on Vancouver Island.

There are 36 active or planned logging sites in the area, of which 28 are in the Salmon River watershed. Extreme fluctuations in river flow and scouring caused by logging activities have had a moderate impact on salmon habitat in the Salmon River, and these effects are expected to continue. Fish habitat in the lower reach of the Campbell River and its estuary have been affected by log storage and sorting operations. Although these activities have had a moderate impact on coho and chum salmon habitat, recent changes in industrial use of the Campbell River estuary and development of an estuary-rehabilitation program are expected to restore the production capability of the estuary.[29]

The water quality of the Campbell River system was also affected by mining activities in Buttle Lake. However, improvements in mine waste disposal in the early 1980s has alleviated this problem. The effects of poor water quality on salmon production in this river are presently unknown.[29]

Campbell River has been regulated by hydroelectric dams since the 1950s. Although the dams have stabilized river flow and thereby improved survival of salmon, they have restricted gravel recruitment to the lower river which has resulted in a loss of spawning habitat.[29] However, the available habitat has not been fully utilized in recent years.

Development of a proposed coal mine on the Quinsam River could affect water quality in the Quinsam River, the Quinsam hatchery and the lower Campbell River.[29]

The effects of urban development on salmon-producing streams in the area have been minor. There are opportunities for small-scale improvements to coho habitat through cooperative arrangements with municipalities and developers.

5.1.3 Area 14

Forestry, agriculture, hydroelectric generation and urban development are the major industrial activities in Statistical Area 14.

Logging has occurred in all of the watersheds within Area 14. The forests are currently in a stage of second growth, and there are no plans to log these areas up to 1988. Although logging operations caused moderate to major impacts on salmon habitat, particularly in the Oyster, Englishman and Little Qualicum rivers, these habitats are recovering as a result of regeneration of forest cover.[29]

Agriculture has affected salmon habitat in the lower reaches of several streams and rivers through dyking, water extraction and changes in water quality. The effects of these activities on fish production are unknown. However, agricultural development is generally a compatible land use because cooperative arrangements can be made to minimize the impact of agricultural activities on fish production.[29]

Hydroelectric development on the Puntledge River resulted in a loss of available salmon habitat. Although the Puntledge hatchery was installed to compensate for lost production, natural production from the river remains limited. It has been suggested that improvements in flow regime may increase the production of wild stocks.[29]

Although urban development in Area 14 has been extensive, it has not significantly affected salmon habitat. One exception is dyking and flood protection activities on the Oyster River, which may have had a moderate to high impact on chum and pink salmon habitat. Future urban development is not expected to pose a risk to salmon production since planning initiatives by regional and municipal governments usually include DFO participation to provide opportunities for stream protection.[29]

Seepage of mine wastes from past mining activities in the upper Tsolum and Tsable rivers are presently affecting the water quality of these systems. The effects on salmon production have not been determined. One third of Area 14 is underlain with mineral deposits, primarily coal. Although these reserves are located in major-salmon producing watersheds and development could affect the quality and amount of available salmon habitat, the potential for development of these reserves is presently unknown.[29]

A flow-control dam was installed on the Big Qualicum River to improve survival of salmon downstream. Similar flow control measures are recommended to improve salmon production on Black and Cougar creeks and the Englishman River.

There is currently an abundance of rearing habitat for juvenile coho salmon in inaccessible areas of the Englishman, Little Qualicum, Oyster and Puntledge rivers. A colonization study is currently being conducted to examine the potential for outplanting fry in these areas.

5.1.4 Areas 17 and 18

Forestry, agriculture and urban development have been the major industrial activities in Statistical Areas 17 and 18.

Logging has occurred in all of the watersheds within these areas. There are currently 14 active and planned sites in the Nanaimo River watershed. Logging activities have caused moderate to major impacts on salmon habitat in the Nanaimo, Chemainus, Cowichan and Koksilah rivers through increased flow fluctuations and scouring of the streambed. However, it is expected that salmon habitat in these streams will improve with forest regeneration and stream stabilization.[29]

Agricultural development involving channelling and dyking for drainage and flood protection has occurred in the lower reaches of several salmon-producing streams. These activities have caused water shortages and, consequently, have affected salmon habitat in some streams, particularly the Cowichan and Koksilah rivers and Bonsall, Holland and Walker creeks. In addition, extraction of water from streams for irrigation and reduced water quality caused by run-off could also affect salmon habitat.

Urban development has also resulted in channelling, dyking and installation of culvert barriers in several streams. The effects of urban development on salmon habitat can be minimized through cooperative surface water-management programs. As part of the river management plan, a fishway and side channel were constructed on the Cowichan River to improve salmon habitat.

There was some mining activity in Areas 17 and 18 in the past, and there are undeveloped reserves in about half of the area. Coal deposits have been located in the Nanaimo River and Nanoose and Chase Creek watersheds. Future mining developments could affect salmon habitat in these systems. However, it is not known whether these reserves will be developed.

Chinook and coho habitat has been reported in inaccessible areas of the Koksilah and Chemainus rivers, while chum habitat has been identified above the falls on Bush Creek.

Generally, there is adequate habitat available in Area 17 and 18 streams to support historic escapements of chinook, coho and chum salmon. One possible exception is the Cowichan River, in which dyking and channelling may be limiting chum production.

5.1.5 Areas 19 and 20

Forestry, hydroelectric and water storage dams and urban settlement are the major development activities in Statistical Areas 19 and 20.

Logging has been extensive in most watersheds. There are presently 49 active sites in the area, of which 26 are located in the San Juan watershed, 17 in the Gordon watershed and 6 in the Jordan watershed. It is expected that forest regeneration will stabilize river flows and improve fish habitat in these watercourses.

Flow regulation on the Jordan River has eliminated chum and pink salmon production from this system. Stream flow on the Sooke River has been regulated since 1970, and this could have affected the availability of rearing habitat for coho salmon. However, this has not yet been determined. In the Goldstream River, flow regulation has limited spawning areas, coho rearing habitat and access of chinook, coho and chum spawners. The Greater Victoria Water Board has provided special releases for salmon in some years.

Urban development has had a moderate effect on several streams in the Victoria area. However, cooperative arrangements with municipal governments have been successful in preventing additional impacts on salmon habitat in these streams.

There is potential for development of mineral resources in the area. However, there are no known plans to develop these reserves at the present time.

Extreme floods in the 1960s reportedly damaged sockeye, chinook and coho habitat in the San Juan River, but the effects on fish production are unknown.

There is about 40 km of potentially useable coho habitat above the falls on the Sooke River. Chum habitat in DeMamial, Kirby, Muir and Tugwell creeks and Gordon, San Juan and Sooke rivers is presently underutilized. There is also pink salmon habitat in the Gordon and San Juan rivers that is currently not used.

5.2 Mainland Inlets

Rivers and streams of the Mainland Inlets drain the western slope of the Coast Mountain Range. These systems are subject to wide fluctuations in flow. They are characterized by summer freshet conditions resulting from snow melt in the headwaters at high elevations and some of the rivers are also subject to winter floods that result from rain and snowmelt at lower elevations. Many of the streams are turbid.

Forestry has been the only development activity in most drainages in the Mainland Inlets. Extensive clearcutting has exaggerated the natural fluctuations in river flow and contributed to the instability in some systems. Urban development and flow regulation have occurred in watersheds in Area 28.

Salmon production in the Mainland Inlet streams is generally highly variable. In some years, production is limited by extreme fluctuations in flow, which has been compounded by logging activities in some systems. However, habitat is generally not considered to be the primary factor limiting stocks from achieving target levels.

5.2.1 Area 11 and 12 - Mainland

Mainland inlets within Statistical Areas 11 and 12 include Seymour, Kingcome and Knight inlets. Forestry has been the dominant industrial activity in the area since the 1920s. There are presently 79 active or proposed logging sites. These sites are located in 19 watersheds, of which seven are major salmon-producing systems. Logging has occurred in all of the watersheds that support sockeye, chinook and coho salmon and in the 14 major chum- and 8 major pink-producing systems.[29]

Although it is difficult to assess the impacts of logging on salmon habitat, the effects are generally thought to be moderate in mainland streams of Area 12. One exception is on the Kakweiken and Glendale systems, where logging has had a major impact on pink salmon habitat. River systems in this area are characterized by naturally highly variable flows, and logging has contributed to this variability. Although regeneration of forest cover will improve the hydrology of these systems, salmon production is expected to remain variable.

Impassable falls on 11 mainland streams restrict the upstream migration of coho and chum salmon. However, suitability of spawning and rearing habitat in the upper watersheds has not been assessed. There is chinook and coho habitat on Franklin, Kingcome, Klinaklini and Wakeman rivers, chum habitat on Ahta Valley Creek and Fulmore river and pink habitat on Ahnuhati and Embly rivers and Ahta Valley Creek that is presently not used.[29]

5.2.2 Area 13 - Mainland

The mainland section of Statistical Area 13 includes Loughborough and Bute inlets. Forestry is the primary industry of the area. There are presently 11 active or proposed logging sites. Logging has occurred in the watersheds of the major sockeye, chinook, coho, chum and pink producing systems and is expected to continue in the future. It has had a moderate impact on salmon production in these systems.[29] Areas of unused coho and pink salmon habitat have been identified in four mainland systems.

5.2.3 Area 15

Area 15 includes Toba Inlet and Malaspina Inlet. Logging activity has occurred near most of the salmon-producing systems in this area. There are presently 15 active or proposed logging sites in the Toba, Little Toba and Theodosia river watersheds. There are no future plans to log the watersheds of the other major salmon-producing systems.[29]

Productivity of Area 15 salmon stocks is limited by unstable river flows and turbidity, which is due in part to logging activities in the area. This is particularly true for chinook, coho and chum production in the Toba, Little Toba and Theodosia rivers. Recovery of salmon habitat has been evident in some systems where forest regeneration has occurred.[23]

There is chum habitat in Toba, Little Toba and Theodosia rivers and pink habitat in Klite and Toba rivers that is presently not used. About 50 km of suitable habitat for coho, chum and pink salmon has been identified in inaccessible areas of the Brem River.

Diversion of water from Theodosia River to Powell Lake has created low river flows and reduced available coho rearing habitat for coho salmon.[29]

5.2.4 Area 16

Area 16 includes Jervis Inlet. Logging has occurred in the vicinity of most of the salmon-producing streams and there are currently 23 active or proposed logging sites in the area. These sites are located along 10 streams,including the major salmon-producing systems of Deserted River, Sakinaw Lake and Tzoonie River. There is no logging planned in the area of Skwawka River, which is one of the major salmon producers.[29]

Past logging activities in the Tzoonie River watershed and construction and use of cottages on Sakinaw Lake have likely contributed to the low productivity of the Sakinaw sockeye stock by increasing flow instability and reducing water quality. These activities are expected to continue and may potentially limit production of chinook and coho salmon.[29]

Logging operations have increased flow instability on Deserted and Skwawka rivers and have contributed to gravel loss on Britain and Vancouver rivers, which has reduced the amount of spawning habitat of chinook, coho and chum salmon. However, unused pink salmon spawning habitat is available in the Deserted, Tzoonie and Skwawka rivers.

5.2.5 Area 28 - Howe Sound

The major salmon producer in Howe Sound is the Squamish River and its tributaries, the Cheakamus and Mamquam rivers. These systems and adjacent Stawamus Creek are characterized by naturally variable flows and are subject to winter floods, which result in gravel shifting, sedimentation and scouring. These events have adversely affected spawning and rearing habitat and thereby, have limited production of salmon in these systems. Logging activities within the watersheds have accentuated these conditions. Although logging will continue to occur in these watersheds, there is evidence that the hydrology of the Mamquam River is stabilizing.

Port development at the mouth of the Squamish River has affected salmon habitat within the estuary. However, there have been some attempts to restore the habitat capability of the estuary.

The effects of urban development and dyking and channelling for flood protection on salmon habitat in the lower Squamish, Cheakamus and Mamquam rivers is presently unknown.

5.2.6 Area 28 - Burrard Inlet

The Capilano, Indian and Seymour rivers are the major salmon producers in Burrard Inlet. Water storage, flow regulation and lower river channelling and dyking are the major development activities within the Capilano and Seymour systems.

The Capilano chinook run was established by transplanting Big Qualicum stock to the hatchery. However, chinook production continues to depend on the hatchery because there is limited natural spawning habitat. Low summer flows limit migration of returning adults. Low river flows also limit the migration pink spawners and can cause drying of redds.[29] The storage dam on the Capilano River has blocked access to historic coho spawning grounds and has limited the rearing capacity of the river. The Capilano hatchery is intended to enhance coho to offset this lost natural production.

Logging has been the dominant industrial activity in the Indian River and is expected to continue. Hydro-line and road construction has altered the lower reaches of the river and has accentuated naturally unstable flows. However, the effects of development on pink, coho and chum production are unknown.

5.3 Fraser River

The Fraser River watershed covers about one third of the province. Most of the major salmon-producing streams are large lake-fed tributaries. The flows of these systems are less variable than other streams not connected to large lakes because the storage capacity of these lakes tends to reduce extremes in flow.

There has been various development activities throughout the Fraser watershed, including forestry, agriculture, mining, hydroelectric generation, transportation and urban development. The potential cumulative impacts of linear developments on salmon production in the Fraser and Thompson rivers is an issue that cannot be adequately dealt with on a site-specific or even system-specific basis. The construction of railroads and highways involve encroachment into the rivers for either the roadbeds or protection of roadbeds on the banks. These encroachments can impede upstream migration of salmon, particularly in areas of difficult passage. Currently, there is no means for assessing the cumulative impact of a series of encroachments on salmon migration. However, it is a concern and planned expansion of railways imposes further risks of cumulative effects.[29]

Similarly, the risk of cumulative effects of industrial waste and domestic sewage discharge into the Fraser and Thompson River is a concern. There is water contamination from pulp mill discharges at Prince George, Quesnel and Kamloops, domestic sewage discharges (both treated and untreated) from a number of communities along the rivers and an array of industrial dumping along the lower Fraser.[29] The combined effects of these discharges on water quality could increase stress on juvenile and adult migrating fish.

Currently, there is no evidence that these development activities are affecting Fraser River salmon stocks. However, there is concern that they pose a potential risk to salmon production in this system.

5.3.1 Lower Fraser

Tributaries on the north side of the Fraser River drain run-off from the Coast Mountain Range. These streams are within forested watersheds that have been subjected to logging and some channelling and dyking in the lower reaches. Logging has also occurred in the Chilliwack-Vedder watershed on the south side of the Fraser River. Logging along the headwater reaches of many of these streams has contributed to unstable flows and resulted in erosion, scouring and sedimentation, which have affected salmon habitat downstream. Channelling and dyking in the lower reaches for urban, agricultural and transportation development have affected rearing habitat of coho salmon and, in some cases, chum and pink spawning habitat.[29]

Tributaries on the south side of the Fraser River (excluding the Vedder-Chilliwack system) and the Boundary Bay streams are primarily groundwater-fed systems. These streams drain agricultural lands and are subject to increasing urban development and industrial use, which has resulted in channelling, dyking, poor water quality and low summer flows. These developments have affected primarily coho rearing habitat by eliminating many pools, sloughs and side channels that provide protection from winter floods and freezing. Drainage pumps on several tributaries have affected the seaward migration of coho smolts. Cooperative planning and management with land owners and local governments can reduce these impacts and provide opportunities for enhancement of coho stocks.

Sockeye spawning habitat in upper Pitt River and Weaver Creek has been affected by logging activities. Egg survival has declined because of flooding, erosion and scouring. Forest regeneration is expected to alleviate these problems, and future logging will be located further away from river valleys. Enhancement of sockeye stocks in both systems has improved productivity of these stocks. The rearing capacity of the Pitt and Weaver lakes is presently underutilized.[29]

Sockeye, chinook and pink salmon spawn in the mainstem and side channels of the Harrison River. Dredging for log transport is unlikely to affect these spawning areas because it is not conducted during spawning or incubation periods.

High recreational use of Cultus Lake has the potential to reduce the water quality and, thereby, affect spawning, incubation and rearing habitats in the lake.

Most chinook habitat in the larger systems is not affected to a large extent by development. The highest escapements to the lower Fraser occurred after most of the developments along the Fraser River had taken place. Although this may be a function of greater enumeration effort than in recent years, habitat is not limiting chinook production and it appears to have the potential to support more chinook than historically reported.

Chum spawning habitat in the Chehalis, Weaver and Sakwi rivers has been affected by beaver dams in side channels and gravel scouring resulting from logging within these watersheds. Extensive channelling and dyking in the lower Chilliwack River has reduced chum spawning habitat in this system. However, there is still an abundance of spawning habitat in the Lower Fraser tributaries.

There is abundant spawning habitat for pink salmon in the Lower Fraser and its tributaries. However, some of this habitat is subject to periodic flooding and scouring or bedload deposition resulting from logging activities,particularly in the Chehalis, Weaver, Chilliwack, Sleese and Nesakwatch systems. Channelling and dyking activities have likely reduced pink spawning habitat, and gravel extraction on the Coquitlam River has resulted in sediment deposition on downstream habitats.

Habitat is not considered to be the major factor limiting salmon production in the Lower Fraser area.

5.3.2 Middle Fraser

Major tributaries of the Middle Fraser area include the Seton, Chilko and Quesnel systems, which are the largest lake-fed systems of the Interior Plateau. They are characterized by spring freshets resulting from snow melt and most of these rivers have low glacial turbidity.

Forestry has been the major industrial activity in the Quesnel drainage. The most significant effect of this development occurred in the Horsefly system, where removal of forest cover resulted in high water temperatures that caused disease among sockeye eggs. A storage dam for temperature regulation and forest regeneration have alleviated this problem.

An impassable falls on the Horsefly River prevents access to potential spawning habitat. In 1985, sockeye salmon were airlifted over this barrier.

Hydraulic mining and splash dam operations occurred in the Quesnel River more than 50 years ago. These activities likely damaged salmon habitat and impeded migration at the time, but the system appears to have recovered.[29] There is currently an abundance of chinook and sockeye spawning habitat in the system.

The Chilcotin system has not been affected by any major development activities. There are mining claims around Chilko Lake, which if developed may affect water quality in the lake. Currently, there is adequate habitat to support historic production of sockeye and chinook salmon.

Hydroelectric development on the Seton-Anderson system has affected salmon habitat. Spawning channels for sockeye and pink salmon were constructed to offset lost production. All species originally had difficulties with passage around the powerhouse but this has been largely overcome through flow manipulation. Logging activities in the vicinity of Yalkoma and Bridge rivers have had a low to moderate impact on all salmon stocks in this system.

Overall, spawning and rearing habitat is not currently limiting salmon production in the middle Fraser system.

5.3.3 Thompson

The Thompson system consists of the main Thompson, North Thompson and South Thompson rivers and their tributaries. The watershed drains the Columbia and Monashee mountain ranges, the Shuswap Highlands and the Thompson Plateau. Most of the salmon production originates in large lake systems of the South Thompson. The steep tributaries of the North Thompson system are characterized by extreme fluctuations in flow and moderate to high turbidity. One exception is the Clearwater River, which provides stable habitat for chinook salmon.

Shuswap Lake in the South Thompson system provides a large storage capacity, which tends to reduce variability in flow within its tributaries. Consequently, its tributaries offer stable and productive habitat for sockeye coho and chinook salmon. The Adams River has special reserve status, which will offer long-term protection for this system.

The South Thompson watershed is largely forested, with some agriculture and urban development. The main Thompson and its major tributary, the Nicola River, flow through dry forest and agricultural land.

Logging, agriculture, transportation and hydroelectric generation are the major development activities in the area that could potentially affect salmon habitat in the Thompson system. In general, most habitats are relatively stable and have not been significantly affected by these activities. However, specific areas that have been affected by development are discussed below.

Removal of forest cover has contributed to unstable river flows, sedimentation, scouring and debris accumulation within the Thompson River. Past logging activities have affected sockeye habitat in Scotch and Fennel creeks and Seymour, Upper Adams and Raft rivers and to a lesser extent, chinook habitat in Finn Creek, Spius Creek, Raft River and Blue River. Coho habitat in Upper Adams, Blue and Coldwater rivers and in Bessette, Fennel, Finn and Spius creeks has also been influenced by logging operations. Although logging will continue in these watersheds, the effects on fish habitat are expected to decrease as future activities are concentrated in areas further away from these streams.[29]

Agriculture is widespread throughout the area. Withdrawal of water from the Thompson drainage for irrigation purposes has resulted in low summer flows and reduced salmon habitat, particularly for coho salmon.

The capacity of Coldwater, Nicola and Salmon rivers and Deadman, Louis and Lemieux creeks to rear coho fry during the summer months has been reduced as a result of low stream flows caused by the withdrawal of water for irrigation. Chinook rearing habitat in these systems has also been affected. Many of these agricultural-related problems can be addressed through cooperative management with land owners.[29]

Hydroelectric dams on the Shuswap system have had moderate impacts on sockeye, chinook and coho habitat.

Habitat conditions are not presently a major factor limiting sockeye, chinook or coho production from the Thompson River. Although there is an abundance of pink salmon spawning areas in the river, access is limited to the strongest swimmers.

Encroachments into the river from linear developments may be affecting the ability of pink salmon to reach spawning areas.

5.3.4 Upper Fraser

Streams in the eastern part of the Upper Fraser flow from high elevations in the Rocky and Caribou Mountain ranges. They are naturally turbid from ice melt and are characterized by a highly variable seasonal-flow pattern. Streams in the western and northwestern part of the Fraser drain large lakes of the Interior Plateau and have a moderate flow regime. The major tributaries are the Nechako, Stuart, Salmon, Willow, McGregor and Bowron river systems.

Logging, hydroelectric generation and mining are the major development activities in the area. Logging has had a moderate effect on sockeye spawning habitat in the Stuart system as a result of erosion, scouring and sedimentation. Gravel recruitment to some of these streams is limited by the geology of the area and, therefore, any habitat loss may be permanent. Smaller streams in the Upper Fraser have been most affected by logging activities. There is spawning habitat in Driftwood River and juvenile rearing habitat in lake that is presently underutilized. Protection and improvement in the quality of these spawning areas is a primary management goal.

In the Nechako system, log drives on the Stellako River and extensive logging in the Nadina watershed have had an impact on sockeye spawning habitat. However, some of these habitats have since recovered from the effects of these activities.

Logging has occurred in the watersheds of about 90% of the major chinook-producers in the Upper Fraser. Removal of forest cover has resulted in unstable river flows, sedimentation and gravel erosion, which have had a low to moderate impact on chinook habitat in these systems. However, some stabilization of basin hydrology and improvement in habitat is expected to occur with forest regeneration. Chinook production in the upper Fraser is not limited by habitat, and there is an abundance of accessible habitat that is not currently used.

The Nechako River was dammed in 1950s as part of the Kemano hydroelectric project. The impact of this development on chinook habitat in the river has been assessed and was considered in development of the Nechako Settlement agreement.

The discharge of effluent from the Endako Mine is affecting the water quality of the Endako River, which could potentially affect sockeye and chinook habitat in the future.[29]

6. MANAGEMENT CONFLICTS

6.1 Mixed-Stock Fisheries

Management of the South Coast mixed-stock fisheries is complicated by the large number of stocks and stock groups within the region, differences in the abundance and productivity among these stocks and overlapping run timing. Where fisheries occur on mixed groups, selective harvest of a particular stock is not possible. Consequently, some less-productive stocks are subject to the exploitation rate applied to the target stock and can be harvested beyond sustainable levels.

The two main fishing areas on the South Coast are Johnstone Strait (Areas 12 and 13) and Juan de Fuca Strait (Area 20), where interception fisheries target on passing Fraser sockeye and pink stocks. In each cycle, management of these fisheries is directed at those few large stocks that contribute the majority of returning adults. However, timing of these dominant sockeye and pink stocks coincides with smaller less-productive sockeye (Fraser and non-Fraser), pink (mainland inlets and Vancouver Island), chinook and coho stocks. Many of these smaller stocks are passively managed and cannot withstand the high harvest rates applied to capture the surplus of these dominant runs. This problem may be compounded for some stocks such as Toba and Jervis Inlet pink salmon stocks, which migrate at a slower rate than sockeye salmon and, therefore, may be subject to higher harvest rates than the target stock. However, if low harvest rates are maintained for the benefit of the smaller less-productive stocks, escapement of the dominant stock is likely to exceed target.

Conflicts resulting from mixed-stock fishing are also evident in the Johnstone Strait chum fishery. Several chum stocks are present in Johnstone Strait concurrently (Figure 35). Although the fishery is managed on the basis of run-size estimates, the proportion of enhanced and U.S. origin fish are accounted for so that harvest rates are not set beyond the sustainable level of most wild stocks. Surplus fish from enhanced stocks can be harvested terminally, (i.e., in the Qualicum area). However, quality of chum salmon deteriorates as the fish near their spawning streams. Consequently, there is pressure from the fishing industry to harvest more of the surplus in Johnstone Strait to maximize the quality of the catch.

Mixed-stock fishing can also occur in terminal areas. The Fraser River fishery is an example of a large terminal mixed-stock fishery. Although it is directed at the dominant Fraser River sockeye and pink stocks, nearly all of the fish that pass through this area during the opening are intercepted in the fishery and the smaller less-productive stocks are usually overharvested. Howe Sound and Burrard Inlet pink stocks can be intercepted in outside sections of the Fraser River fishing area. The Area 14 terminal chum fishery is also a mixed-stock fishery that harvests several local chum stocks as well as passing Fraser River and U.S. chum stocks.

Many of the Indian food fisheries in the Fraser River are also mixed-stock fisheries. Although the exploitation rate is extremely high for some stocks, effort has been limited to protect some of the early runs that migrate up river through a series of food fisheries, such as the Early Stuart sockeye stock and early-run chinook stocks. To maximize the effect of a rebuilding program, a more sophisticated management system must be developed so that harvest rates can be managed to stock-specific requirements.

Problems with overharvesting less-productive stocks in a mixed-stock fishery can also occur if harvest rates are set at the sustainable level of a more productive enhanced stock to prevent overescapement. This is the case with the Cultus sockeye stock, which has been depressed as a result of high exploitation rate for the enhanced Weaver Creek sockeye stock. Similar problems are expected to occur when the Nimpkish sockeye stock is rebuilt through combined efforts of lake fertilization and management. Fisheries harvesting surplus returns in the Nimpkish estuary will likely intercept even- and odd-year Keogh and Cluxewe River pink stocks. Productivity of these pink stocks must be increased or a selective harvesting area must be established if they are to co-exist with Nimpkish sockeye.

Increased fishing effort for enhanced Nimpkish stocks could also increase harvest rates on non-Fraser sockeye stocks (Heydon, Fulmore, Phillips and Sakinaw), which have similar migration timing. These stocks are currently intercepted in the Johnstone Strait fishery, and an increase in harvest rates would result in stock declines.

The Area 14 fishery targets on the enhanced Big Qualicum chum stock. This fishery results in overharvesting of non-enhanced stocks as well as enhanced Puntledge and Little Qualicum River stocks, which have not yet reached target levels. It is anticipated that out-planting fry from the large facilities to the Baynes Sound and French Creek areas may have to be considered because of the consistently lower productivity of these stocks and their interception in the Puntledge and Qualicum fisheries. Fishing boundaries could be established at the mouths of individual streams to protect the less-productive stocks.

6.2 Management Uncertainty

There are two major uncertainties regarding the management of the South Coast fisheries. These are the uncertainties in identifying optimum escapements and in estimating stock abundance.

The optimum spawning escapements for individual salmon stocks are rarely known with any degree of certainty. Target escapements are the best estimate of optimum escapement and are generally derived from historic data. However, the strategy of managing fisheries to achieve a target eliminates the opportunity to determine whether the system can support a greater number of fish because the target is rarely exceeded. Therefore, the target level may not reflect optimal escapements, which would achieve maximum benefits. There is a major conflict in managing fisheries by adjusting the target escapements to identify the optimum escapement. If the target is less than optimum, the forgone catch from increasing the target could lead to greater returns in the future. However, if the target is increased beyond the optimum escapement, the forgone catch is wasted and future returns may be lower.

The benefits of testing these uncertainties have been evident with the 1985 cycle Horsefly stock. By incrementally increasing the escapement goal for this stock, the total run size has increased from 1.6 million in 1973 to 2.0 million in 1977, 4.2 million in 1981 and 9.5 million in 1985.

Uncertainty in estimating stock abundance in each of the fishing areas can lead to overharvesting certain segments of a run if the fishery is open and stock abundance is lower than expected. Fishing plans are based initially on the expected run size and can be modified as catch and escapement data become available. However, escapement information on Fraser River stocks is of limited use for managing mixed-stock fisheries in Johnstone Strait and Juan de Fuca Strait because of the time lag between fish passing through the fishing areas and arriving in the river. The time lag is generally about seven days. However, the late-run sockeye stocks hold in Georgia Strait for about 21 days, and, therefore, the escapement data are useless for managing the interception fisheries.

The problem of estimating stock size is further complicated by the diversion rates of Fraser River sockeye and pink salmon stocks, which varies annually. These stocks approach the Fraser River either by the northern route through Johnstone Strait or the southern route through Juan de Fuca Strait. The diversion rate refers to the proportion of fish migrating along the northern route. During 1975 to 1983, it ranged from 15% to 80% for sockeye and from 25% to 66% for pink.[22] If the diversion rate could be estimated prior to the fishing season, harvest strategies could be better planned and indicators of stock abundance could be related to run size.

Test fisheries in Johnstone Strait, Juan de Fuca Strait and Fraser River provide in-season estimates of stock abundance, while scale analysis and electrophoresis are used to estimate stock composition. However, because of variation in these indicators and overlap in run timing of the stocks, there is still uncertainty in estimates of individual stock abundance. Echo sounding was attempted in Georgia Strait and the mainland inlets, but this approach was unsuccessful in estimating stock size because it could not distinguish between the target stock and resident fish. It could be extremely difficult to maximize total allowable catch because of the uncertainty in obtaining reliable stock estimates in the terminal areas and streams.

In-season management strategies, such as the clockwork plan for the fall chum fishery, depend on determining run-size estimates early in the season in order to set harvest rates equitably between Johnstone Strait and the Fraser River. The accuracy of the run size estimate affects the success of any management strategy.

6.3 International Agreement

Prior to signing the Pacific Salmon Treaty on March 18, 1985, Canada was not required to share the catch of Fraser sockeye and pink stocks outside the Convention waters equally with the United States. This created the incentive for Canada to maximize the catch, which resulted in higher exploitation rates in the

Johnstone Strait and the WCVI troll fisheries. In some cases, this was done at the cost of other Canadian stocks.

The new agreement ensures that a fixed portion of the total allowable catch of Fraser River stocks is allocated to the U.S. and, thereby, eliminates the incentive for Canada to harvest Fraser stocks outside the Convention waters. This provides the opportunity for better management of the Canadian fisheries since the distribution of catch of Fraser River stocks among fisheries can be adjusted to minimize impacts on other stocks. Under the agreement, Canada is responsible for establishing escapement goals for the Fraser River stocks and setting the pace for rebuilding these stocks.

A conflict resulting from the international agreement is that to take advantage of the opportunities for improved fisheries management, the distribution of catch among fishing areas could change. This could result in lower catches in some established fishing areas such as Johnstone Strait and higher catch levels in other areas such as Strait of Georgia or Fraser River. The fishing industry has generally been resistant to substantial changes in established fishing areas. To achieve the full benefits of the Treaty, changes in management strategies and coordinated enhancement activities should be implemented to increase production from the Fraser River.

6.4 Fleet Control

With the current management system, the size of the fleet and their distribution can not be controlled. However, time and subarea closures are set and specific boundary closures can be implemented for conservation purpose. As previously indicated, openings in adjacent areas will occur simultaneously to distribute the fleet.

Fishing opportunities may be limited by natural features in some areas, such as Johnstone Strait, where tides and the number of tie-up sites limit effort. However, some opportunities are forgone due to the lack of control on fishing effort. For example, a small surplus of Kingcome and Knight Inlet pink salmon stocks may not be harvested because it is expected that too many boats would be attracted to an opening after the Johnstone Strait fishery, resulting in overharvesting of the stocks. On the other hand, if these stocks are rebuilt and Fraser sockeye were concurrently available in Johnstone Strait, there is concern that the fleet would not redistribute to take advantage of the available surplus of Kingcome and Knight Inlet pink salmon.

These concerns should be addressed through a fleet management plan.

7. STOCK REBUILDING POTENTIAL

Tables 27, 28 and 29 summarize the status of the East Coast Vancouver Island, Mainland Inlet and Fraser River sockeye, pink and chum stocks by comparing current escapements to target levels. The majority of stocks are below target and, therefore, have some rebuilding potential. However, in most cases, the rebuilding potential of sockeye and pink salmon stocks depends on the management of the Fraser River stocks. Harvest rates in the South Coast fisheries are driven by the highly productive dominant Fraser sockeye runs and the odd-year pink stock.

7.1 Vancouver Island

The Nimpkish stock is the only sockeye stock on the east coast of Vancouver Island. A management strategy to rebuild the early and late Nimpkish sockeye runs was initiated in the mid-1970s. More stringent area closures were implemented in 1979 because the stock was not rebuilding. At that time, the upper portion of Area 12 (Queen Charlotte Strait) northwest of the Nimpkish estuary was closed to all commercial fishing. Based on scale analysis and stock reconstruction, harvest rates on Nimpkish sockeye were estimated at about 10% in 1982 and 1983. Despite these low harvest rates, Nimpkish sockeye stocks have not rebuilt naturally and escapements are currently only 23% of the target. This is thought to be related to environmental conditions and/or limitations within the lake and marine environment. Therefore, enhancement is considered the only option for rebuilding these stocks. There are currently no other management options that can significantly reduce the harvest rates to allow rebuilding of this stock. The Nimpkish stock is currently being enhanced by lake fertilization and hatchery production. The potential sockeye production from the Nimpkish system, including Woss, Vernon and Nimpkish lakes, is estimated between 700,000 and 1.3 million adults per year.

With the exception of the Quinsam stock, escapements of all pink stocks on the east coast of Vancouver Island are well below the target level. Harvest rates on the UECVI stocks have been minimized through closure of Goletas Channel, early-

Table 27. Status and rebuilding potential of East Coast Vancouver Island salmon stocks.

Production Area	Species	Target	Current Average	Escapement as % of Target	Comments on Natural Rebuilding	Comments on Enhancement
Upper East Coast	Sockeye		N/A			
	Pink (E)	690,000	77,000	11%	Harvest rates on pinks have been minimized,	Anticipate impact on pink when enhanced
	Pink (O)	690,000	17,600	3%	rebuilding response very slow.	Nimpkish sockeye stock becomes harvest-
	Chum	67,000	300	<1%	Chum severely depressed. Rebuilding plan unsuccessful.	able. Need to enhance pink concurrently.
Johnstone St.	Sockeye	250,000	56,600	23%	Management attempts to rebuild sockeye stocks	Enhancement of pink required to withstand
	Pink (E)	299,000	17,300	6%	unsuccessful. Harvest rates on Fraser sockeye	current harvest rates.
	Pink (O)	194,000	21,500	11%	and pink limit rebuilding potential for Johnstone	
	Chum	160,000	35,000	22%	Strait pink. Chum stocks have generally been increasing.	
Mid East Coast	Sockeye		N/A			
	Pink (E)	300,000	17,700	6%	Escapement of most pink below target, except Quinsam	Enhancement of pink stocks required to
	Pink (O)	300,000	39,700	13%	stock. Harvest rates on Fraser sockeye and pink	withstand current harvest rates.
	Chum	327,000	262,800	80%	limit rebuilding potential. Passively-managed chum stocks are depressed, actively-managed stocks have been rebuilt through enhancement.	Enhancement of passive chum stocks needed to withstand terminal harvest rates.
Lower East Coast	Sockeye		N/A			
	Pink (E)		N/A			
	Pink (O)		N/A			
	Chum	180,000	100,000	55%	Most stocks increasing in response to current management.	
Southern Coast	Sockeye		N/A			
	Pink (E)		N/A			
	Pink (O)		N/A			
	Chum	166,500	127,700	77%	Most stocks increasing in response to current management. Area 20 chum not currently managed.	

Table 28. Status and rebuilding potential of Mainland Inlet salmon stocks.

Production Area	Species	Target	Current Average	Escapement as % of Target	Comments on Natural Rebuilding	Comments on Enhancement
Seymour/Belize	Sockeye		N/A			
	Pink (E)		N/A			
	Pink (O)		N/A			
	Chum	165,000	4,300	3%	Passively managed.	
Kingcome/Wakeman	Sockeye		N/A			
	Pink (E)	287,000	54,000	19%	Consistent pink production limited by variable habitat	
	Pink (O)	287,000	153,000	53%	(floods)and uncertainty. Wakeman exceeding target in odd	
	Chum	196,000	10,000	5%	years. Chum declining despite current rebuilding plan.	
Bond/Knight*	Sockeye		N/A			
	Pink (E)	888,000	561,100	63%	Passively-managed pink low, actively-managed pink	
	Pink (O)	888,000	834,000	94%	fluctuate around target. Consistent production	
	Chum	396,000	45,000	11%	limited by variable habitat and uncertainty.	
					Chum not responding to rebuilding plan.	
Loughborough/Bute	Sockeye	32,000	8,300	26%	Limited by habitat and harvest of Fraser stocks.	Low-level enhancement to stabilize
	Pink (E)	647,000	109,600	17%	Pink stocks declining. Rebuilding potential limited	production.
	Pink (O)	392,000	112,300	29%	by harvest rates on Fraser sockeye and pink.	
	Chum	526,000	190,000	36%	Chum are stable but could be rebuilt to target.	
					Harvest rates on Fraser sockeye and pink limit	Enhancement likely the only possibility
					rebuilding potential of summer chum.	for maintaining summer chum stock.
Toba	Sockeye		N/A			
	Pink (E)		N/A		Harvest rates on Fraser sockeye and pink limit	Low-level enhancement to help maintain
	Pink (O)	135,000	4,400	3%	rebuilding potential of pink stocks.	stocks.
	Chum	180,000	15,000	8%	Passive stocks declining despite rebuilding plan.	
Jervis	Sockeye	14,000	2,400	17%	Limited by habitat and Fraser sockeye and pink harvest.	Low-level enhancement to stabilize pro-
	Pink (E)		N/A		Harvest rates on Fraser sockeye and pink limit	duction. Low-level enhancement to help
	Pink (O)	130,500	15,000	11%	rebuilding potential of pink stocks.	maintain stocks.
	Chum	142,500	107,000	75%	Recent chum escapements at target - rebuilding	
					not required.	
Howe	Sockeye		N/A			
	Pink (E)		N/A		Harvest rates on Fraser sockeye and pink limit	Enhancement required to rebuild stocks.
	Pink (O)	422,500	5,400	1%	rebuilding potential of pink stocks.	
	Chum	350,000	184,400	52%	Escapements at target in recent years -	
					rebuilding not required.	
Burrard	Sockeye		N/A			
	Pink (E)		N/A		Harvest rates on Fraser sockeye and pink limit	Enhancement required to rebuild stocks.
	Pink (O)	100,000	24,600	25%	rebuilding potential of pink stocks.	
	Chum	50,000	24,600	49%	Escapements increasing in response to rebuilding plan.	

*Current escapement based on averages from 1980 to 1985 for pink, chum and non-Fraser sockeye.

Table 29. Status and rebuilding potential of Fraser River salmon stocks

Production Area	Species	Target	Current Average	Escapement as % of Target	Comments on Natural Rebuilding	Comments on Enhancement
Lower Fraser	Sockeye					
	82 cycle	240,000	275,500	115%	Weaver exceeding target, Pitt and Cultus below target.	
	83 cycle	240,000	156,900	65%	Generally approaching targets in other cycle years but	
	84 cycle	215,000	172,300	80%	limited by mixed-stock fisheries	
	85 cycle	215,000	137,100	64%		
	Pink (E)		N/A		Total Fraser pink target is 6 million. Need to	
	Pink (O)		4,089,000		determine potential of subareas.	
	Chum	700,000	478,200	68%	1985 escapement at target- potential to increase target.	
Middle Fraser	Sockeye					
	82 cycle	423,000	200,800	47%	Rebuilding potential for Horsefly and Chilko stocks.	
	83 cycle	383,000	291,200	76%	Generally approaching targets in other cycle years but	
	84 cycle	563,000	536,200	95%	limited by mixed-stock tradeoffs.	
	85 cycle	1,258,000	763,400	61%		
	Pink (E)		N/A			
	Pink (O)		464,800		No target for this subarea.	
	Chum		N/A			
Thompson	Sockeye					
	82 cycle	3,140,000	1,972,000	63%	Adams and Shuswap stocks closer to target in 1982.	
	83 cycle	717,000	285,800	40%	Rebuilding potential for subdominant Adams - mixed-	
	84 cycle	42,000	35,400	84%	stock tradeoffs with pink.	
	85 cycle	42,000	69,100	165%	'84 and '85 cycles near target but low stock size.	
	Pink (E)		N/A			
	Pink (O)		624,100			
Upper Fraser	Sockeye					
	82 cycle	210,000	108,100	51%	Nechako runs below target, mixed-stock tradeoffs.	
	83 cycle	400,000	293,600	73%	Other cycles stocks near target.	
	84 cycle	110,000	112,600	102%		
	85 cycle	565,000	468,100	83%	Nechako stocks below target, mixed-stock tradeoffs.	
	Pink (E)		N/A			
	Pink (O)		N/A			
	Chum		N/A			

*Fraser sockeye current escapements are the average for the cycle years from 1970 to 1985, and targets reflect management goals in recent years. Fraser sockeye targets are being revised.

season closure of Gordon Channel and the establishment of large-box boundaries at stream mouths. UECVI pink stocks north of Hardy Bay are harvested at a rate of 3 - 5% by the northern troll fishery. It is suspected that some of these stocks may also be taken in the WCVI troll or central coast net fisheries, but there are no data to support this. Despite low harvest rates, UECVI pink stocks are depressed. Although it is unlikely that management actions will rebuild these stocks, strategies such as outplanting fry from the Quatse or Cluxewe rivers and maintaining closure of Goletas Channel should be examined.

UECVI pink stocks south of Hardy Bay are taken at a rate of 3 - 5% by the northern troll fishery and at a rate of 30% by the Gordon Channel fishery. It is expected that these stocks will slowly rebuild if the low harvest rates are maintained. However, if harvest rates increase due to a surplus of Nimpkish sockeye, natural rebuilding of these pink stocks could be prevented. There may be some enhancement opportunities to boost current production rates and allow these pink stocks to withstand increased harvest rates.

Johnstone Strait and MECVI pink stocks will not likely rebuild if high harvest rates are maintained for Fraser River sockeye and pink stocks in Johnstone Strait. The current harvest rate is about 80%. Natural rebuilding of these pink stocks may occur if harvest rates are reduced. The only other opportunity to rebuild these stocks would be to increase their productivity through enhancement. The only stock that is achieving target is the enhanced Quinsam pink stock.

Most of the chum stocks on the east coast of Vancouver Island are below target levels but are increasing in response to the current rebuilding plan. However, the UECVI and passively-managed MECVI stocks are at very low levels and are not rebuilding. The UECVI stocks may have a lower productivity or may be subjected to higher harvest rates in troll fisheries than expected. Current management has virtually eliminated local harvest of these stocks. The escapement target for chum stocks on UECVI is small relative to other sub-areas on the island and, therefore, there is only minor rebuilding potential. MECVI chum stocks are dominated by three large runs that return to the Puntledge, Big Qualicum and Little Qualicum rivers. There are approximately 15 other wild stocks in the area. Despite enhancement, these stocks have remained small and their production is decreasing due to their interception in the terminal fisheries that target on the enhanced surplus. Further enhancement through outplanting from the three existing facilities will be required to maintain the production from these wild chum stocks. It is anticipated that the productivity of these stocks could be increased to withstand the required harvest rates of the MECVI terminal area within one to two cycles.

7.2 Mainland Inlets

Sockeye stocks in the Loughborough/Bute and Jervis Inlet sub-areas are well below target levels. The total escapement target for these stocks is 46,000 spawners. These stocks are small relative to the Fraser and Nimpkish sockeye. Escapements have remained low as a result of harvest in the Johnstone Strait fisheries and unstable freshwater habitat. Productivity of the Sakinaw stock has also been affected by urban encroachment on its habitat. Mainland Inlet sockeye stocks have low productivities and cannot be rebuilt by management activities alone. The most suitable option for rebuilding these stock is to increase production to levels that can withstand current harvest rates through small-scale enhancement techniques.

Escapements of pink stocks in the Kingcome, Wakeman and Bond/Knight sub-areas are highly variable. These stocks are the only Mainland Inlet pink stocks that are not significantly affected by the Johnstone Strait fishery. It is estimated that harvest rates on these stocks are only 40-60% because their migration corridor is protected. Production of pink salmon from the northern mainland inlets is variable because the area is prone to severe flooding about once every five years. Enhancement of the stocks could stabilize production and, thereby, allow for more consistent returns and a greater number of surplus fish to support local fisheries. The uncertainties of estimating stock size and escapements in these isolated areas limi the ability to maximize total allowable catch. Reducing these uncertainties could improve the benefits from these stocks.

The Loughborough/Bute, Toba, Jervis, and Burrard Inlet and Howe Sound pink stocks are either declining or are at very low levels. The total escapement target for odd-year pink in these areas is estimated at 1.18 million spawners, but current escapements are only about 160,000. The timing of these stocks is concurrent with that of Fraser River sockeye and pink runs. Because these stocks migrate to their spawning streams along both the northern and southern approach routes, they are intercepted in both the Johnstone Strait and Juan de Fuca Strait fisheries. Toba, Jervis, and Burrard Inlet and Howe Sound pink stocks are probably intercepted primarily in the sockeye fisheries due to their early run timing. However, these stocks are susceptible to greater fishing pressure than the target sockeye stocks because of their slower migration through the fishery. The rebuilding potential of the Mainland Inlet pink stocks is limited by harvest rates on the Fraser stocks. Although low escapements would limit the rate of recovery, enhancement could assist in rebuilding these stocks.

Escapements of fall chum stocks in Jervis and Burrard inlets and Howe Sound are at or approaching target levels as a result of the current rebuilding plan. However, the Kingcome, Knight, Loughborough/Bute and Toba chum stocks are at very low levels and continue to decline. These stocks are not responding to current management plan, which has reduced harvest rates on chum salmon. Natural rebuilding of the stocks would occur if harvest rates were reduced further. However, this could result in the other Mainland Inlet chum stocks exceeding target levels. The alternative approach would be to enhance production of the Kingcome, Knight, Loughborough/Bute and Toba stocks to a level that could withstand existing harvest rates.

Escapement of summer chum to Bute Inlet is less than 50% of the target level. The timing of this run is concurrent with that of Fraser sockeye stock, and, consequently, the rebuilding potential is limited by the harvest rates applied to Fraser sockeye. However, enhancement activities could increase productivity of this stock.

7.3 Fraser River

There is some rebuilding potential for Fraser River sockeye stocks given the target escapements established by IPSFC for each cycle year (Table 30). These targets are based on stock-recruitment data and estimates of available spawning area. DFO is currently analysing the potential of Fraser River sockeye and is expected to modify these targets.

Table 30. Recent escapements and target goals for Fraser River sockeye stocks.

Cycle	Escapement (in millions)	Target (in millions)
1982	2.6	4.0
1983	1.0	1.7
1984	0.9	1.0
1985	1.4	2.1

The harvest rates applied to Fraser sockeye are based largely on the dominant stocks in each cycle. Consequently, the rebuilding potential of the other stocks depends on management of the dominant stocks.

In the 1982 cycle, the dominant sockeye runs are from the Lower Adams and Lower Shuswap rivers of the Thompson sub-area. Targets for these stocks are 2 million and 1 million spawners, respectively. The Adams stock was rebuilt to target in 1982, but only achieved an escapement of 1.3 million in 1986. The Lower Shuswap stock is currently rebuilding, with escapement increasing from 514,000 in 1982 to 600,000 in 1986. There is abundant spawning habitat in both Lower Shuswap River and Lower Adams. However, the rearing capacity of Shuswap Lake may limit the rebuilding potential of this stock. There is also potential to increase production of the Horsefly and Chilko sockeye stocks from the middle Fraser and the Nechako stocks from the Upper Fraser during the 1982 cycle. In 1986, these stocks achieved target levels.

The greatest rebuilding potential for the 1983 cycle is for the sub-dominant Lower Adams stock. In 1983, escapement to the river was only 204,000 adult sockeye, which is well below the target goal of 670,000. Increasing escapements of the Upper Fraser early Stuart, late Nadina, and Stellako runs and the lower river Birkenhead stock would also contribute to rebuilding this cycle.

In the 1984 cycle current escapements to all sub-areas were 80-100% of the target levels (Table 29). Based on the current escapement goals, it appears that these sockeye stocks do not require rebuilding (Table 29). However, this cycle has the lowest abundance and, therefore, target levels may be under-estimated.

The dominant Horsefly run has the greatest rebuilding potential of all the Fraser sockeye stocks in the 1985 cycle. This stock has been rebuilding at a rapid rate due to an incremental increase in the escapement target. Sockeye escapement to the Horsefly River increased from 900 spawners in 1941 to 677,000 in 1981. The target of 1 million was achieved in 1985. A very large spawning area is available on the Horsefly River. Although its capacity is unknown, 4 million sockeye spawned in the river in 1909, suggesting that the target escapement could be increased further. The 1985 cycle of the Upper Fraser Nechako stocks and Lower Fraser stocks could be increased to target levels.

There is evidence that the rearing capacity of some lakes in the Fraser River watershed could greatly increase the current production of sockeye juveniles. With the exception of Shuswap and Chilko lakes, these lakes are presently underutilized in the dominant cycle years. Approximately 45% of this unused rearing habitat is in the Stuart River system, and other large reserves are in Francois, Quesnel and Adams lakes. Although this provides considerable opportunity to increase production of fry, production of some stocks, such as the Late Stuart stock, may be limited by the availability of spawning habitat in years of dominant cycles.

There is the potential to increase production of Fraser River sockeye if these stocks are not managed on the basis of cyclic dominance. With the exception of the Lower Fraser stock, there is a substantial difference in the targets among cycle years. By increasing all of the targets to the level of the dominant cycle, production of these stocks may increase. However, there is considerable controversy regarding the cause for cyclic dominance. One opinion is that biological factors could limit sockeye stocks from sustaining maximum production in every cycle and that an attempt to manage in this way may be a risk to the existing populations. However, it was estimated that the average long-term annual yield could be doubled if exploitation rates on Fraser sockeye stocks were reduced in all cycle years.[18] Considering the potentially large increases in fish production and the uncertainty regarding biological feasibility of this management approach, the issue of cyclic dominance should be addressed on an experimental basis to ensure that risk to current populations is minimized and future opportunities are not unknowingly forgone.

Fraser River pink salmon are managed as a single stock. In 1985, the escapement target was set at 6 million spawners and the goal was achieved. At an average of 4.5 returns per spawner, an escapement of this magnitude would produce a run of 27 million adults. This is about 11 million more fish than the average of the previous three cycles (1979-83) and is the same as the estimated total abundance of pinks prior to 1913, when the Hell's Gate slide reduced the run. The goal of 6 million spawners seems realistic and may even be low.

8. MANAGEMENT STRATEGIES FOR REBUILDING

The rebuilding potential of most South Coast sockeye and pink stocks is limited by management of the dominant Fraser sockeye and pink stocks. Management strategies for Fraser stocks and their implications on other South Coast stocks are discussed in the following section. Specific management strategies for non-Fraser stocks are discussed in Section 8.2.

8.1 Management Strategies for Fraser Sockeye and Pink Salmon

In the past, the IPSFC were responsible for managing Fraser River sockeye and pink stocks and any increases in production were shared with the U.S. Under the Pacific Salmon Treaty, Canada has full responsibility for the management and enhancement of Fraser River stocks and is entitled to the benefits of any increased production from management and enhancement programs undertaken by DFO.

Generally, the dominant Fraser stocks are managed to target escapement levels, and this has recently been successful. However, the non-dominant Fraser and other South Coast stocks are harvested in mixed-stock fisheries that target on the dominant runs and, consequently, do not achieve their target escapements.

Non-dominant Fraser and other South Coast stocks could rebuild to target levels if harvest rates in the Johnstone and Juan de Fuca Strait fisheries were reduced to the sustainable levels of these less-productive stocks. Surpluses of the more productive stocks could be harvested in terminal fisheries if the stocks are from discrete areas such as the mainland inlets or sections of Vancouver Island. However, because there are mixed stocks in the Fraser terminal area, it would be necessary to forgo some surplus to allow the non-dominant Fraser runs to rebuild. These surpluses could be used to test the targets and determine the full production capacity of the system. Although the lower harvest rates would be maintained in the future, the catch would increase as the runs rebuild.

Another strategy would be to continue focusing management on the dominant Fraser stocks, but alter harvest locations to benefit the less productive non-Fraser stocks. With the Pacific Salmon Treaty, there is no longer an incentive for Canada to maximize the catch of Fraser River sockeye and pink salmon outside of the Convention Area. Consequently, the exploitation rate in Johnstone Strait could be reduced, which would allow pink, chinook and coho as well as non-Fraser sockeye stocks to be rebuild. However, this would cause some additional fishing effort to be directed at the Fraser River area to harvest sockeye forgone in Johnstone Strait and increase fishing pressure on chinook and coho in the area. If diversion rates were low, much of the catch forgone in Johnstone Strait could be transferred to the Juan de Fuca Strait fishery. This would reduce fishing pressures in the Fraser River terminal fishery and would result in higher exploitation rates in Juan de Fuca Strait. This rebuilding approach would continue to limit the rebuilding potential of non-dominant Fraser sockeye because the harvest is being shifted from one area to another.

Since management has focused on the dominant Fraser stocks, it would be worthwhile to test the target escapement levels to determine the optimal production capacity of the system. If the target levels could be increased, harvest rates would be reduced to allow greater escapements of the dominant stocks. If this reduction in harvest rates were applied to the mixed-stock fisheries such as Johnstone Strait, some of the less productive stocks would also benefit. Rebuilding of stocks that continued to be overharvested at the lower harvest rates could be assisted through enhancement. However, the enhancement potential of these stock may be limited by low stock abundance and habitat constraints. Therefore, those stocks that could not be rebuilt through lower harvest rates and enhancement would be forgone.

As part of these strategies, harvest rates on some stocks in the Fraser River Indian food fishery could be reduced to allow escapement targets to be achieved. Some of the effort could be redirected at stocks with identified surpluses.

As noted earlier, there is the potential to rebuild Fraser sockeye stocks by increasing the escapement targets for the off-cycle years to that of the dominant cycle. This would require reducing the exploitation rates to increase escapements of the non-dominant cycles. Although there is some controversy regarding the biological basis for maintaining cyclic dominance, this strategy should be considered because of the potential for significant increases in production. A cautious approach could be taken, in which the concept is tested on selected stock groups. The implications of harvesting the increased production of Fraser sockeye on the management of other South Coast stocks should also be considered. Although it could be possible to lower exploitation rates during certain times to allow increased escapement of these stocks, its effect on stocks currently producing to capacity would have to be evaluated.

Although the current escapement target for Fraser pink is set at 6 million spawners, the maximum production capacity of the system is presently unknown. Reduction of harvest rates to increase spawning escapement could result in increased numbers of pink salmon as well as sockeye that have concurrent run timing, such as the sub-dominant Adams run. However, in evaluating the benefits of this strategy, it should be noted that the size of individual pink salmon declines as the size of the run increases.

Additional information on the abundance and composition of South Coast salmon stocks would assist in rebuilding these stocks to escapement goals. With the Pacific Salmon Treaty, it is possible to unify the management approach to Fraser River sockeye, and to achieve escapement and catch allocation objectives. As described previously, the IPSFC had a very elaborate management system within Convention waters, and in recent years, this sampling program has also been conducted in Johnstone Strait and the west coast troll fishing area. The IPSFC programs are being continued by DFO and the new Pacific Salmon Commission. Within Johnstone Strait, test fisheries are established at the upper and lower ends of the strait to determine the abundance of sockeye entering and leaving the area. Through a regular sampling program, scale analyses can be conducted to identify stocks and determine the age and size of sockeye taken in the Johnstone Strait, west coast troll and Area 2W fisheries,and Noyes Island fishery in S.E. Alaska.

The management strategies discussed above generally involve a reduction in harvest rates in Johnstone Strait. Figure 36 indicates some of the major management actions that could assist in rebuilding South Coast stocks through reducing harvest on Fraser sockeye in Johnstone Strait.

8.2 Management Strategies for Non-Fraser Stocks

8.2.1 Nimpkish Sockeye

Although management actions have been unsuccessful, enhancement is expected to rebuild the Nimpkish sockeye stock. If lake fertilization is successful in rebuilding this stock, new fisheries will be established to harvest the surplus. Depending on the management strategy, this could create mixed-stock fishery problems for UECVI pink and non-Fraser sockeye stocks as well as other salmon stocks from the Nimpkish system.

Of the three lake systems within the Nimpkish watershed (Nimpkish, Woss and Vernon), only Nimpkish Lake is currently being fertilized. If all three systems have discrete stocks that differ in productivity and if harvest rates are based on the more productive Nimpkish stock, enhancement will eventually lead to a reduction in the Woss and Vernon stocks. Therefore, it is recommended that these stocks should also be enhanced if there is evidence that they are being overharvested.

Management of new fisheries should be aimed at minimizing interception of passing stocks. However, this will require increased enforcement and additional information on South Coast stocks. To obtain this information, the following is required:

1. Obtain test fishery indices or develop enumeration techniques to estimate the total abundance and run timing of stocks prior to entering the fishery area and obtain accurate catch information; prior to entering the fishery area, and accurate catch information from the fishery;

2. Develop stock identification methods to separate Nimpkish sockeye from Fulmore, Heydon, Phillips, Sakinaw and Fraser River sockeye in the fishery. This information is required to allocate catch by stock;

3. Construct a fence on the Nimpkish River to determine daily escapements;

4. Continue monitoring smolt outputs from Nimpkish, Woss and Vernon lakes to estimate survival of freshwater and marine stages;

Stock Affected	Reduce or Eliminate Area 11 Troll	Eliminate Gordon Channel Catch	Prevent Seiners Upstream Lewis Pt.	Only Seine at Peak Sockeye Abundance	Reduce Fishery for Early Stuart, Replace with Intensive Sabine Fishery	Maintain Double Bay Closure	Pink Ribbon Boundary Corridor Extend
UECVI	X	X	X				
Nimpkish Sockeye		X					
Johnstone St. Pink		X	X	X			
MECVI Pink		X	X	X			
Heydon/Fulmore/Phillips Sockeye					X		X
Sakinaw Sockeye					X		
Kingcome/Wakeman Pink	X	X				X	
Bond/Knight Pink	X	X				X	
Toba Pink		X	X			X	X
Jervis Pink		X	X			X	X
Howe Sound Pink		X	X			X	X
Burrard Inlet Pink		X	X			X	X

Figure 36. Management actions for Johnstone Strait to assist in rebuilding of South Coast stocks.

5. Obtain baseline data such as: (i) location of spawning areas and proportions of run utilizing each area by radio-tagging program; (ii) escapement to each spawning area; (iii) egg deposition and retention; (iv) proportion of jacks on spawning grounds as well as in catch; and (v) age class of fish on spawning grounds and in the fishery.

Although this information is necessary to manage the fishery, it will take several years to obtain a useful data base. Under the current management approach, the stock may rebuild rapidly if lake fertilization is successful. Therefore, it may be advisable to begin harvesting Nimpkish stocks during the rebuilding process to obtain information from the fishery before peak production is attained. This approach, however, would likely slow the rebuilding process and may negate rebuilding strategies taken for other stocks such as UECVI pink salmon. These options for management were evaluated prior to development of the South Coast fishery models. The results from this previous analysis are shown in Appendix IV. Since the location of this new fishery could have implications on the management action in Johnstone Strait these options should be evaluated using the integrated South Coast models.

8.2.2 Chum Salmon

A new management approach for inside chum salmon was recently developed and was implemented in the 1985 and 1986 season. This approach involves scheduled harvest rates based on run size. Although most chum stocks are responding well to the rebuilding plan, enhancement strategies may be required to rebuild stocks that are not responding. Since harvest rates on UECVI chum stocks have essentially been eliminated, the only rebuilding option is to enhance these stocks. The passively-managed MECVI stocks also require enhancement to rebuild because they are subject to high harvest rates in the terminal fisheries for enhanced Qualicum and Puntledge stocks. The only other option is to reduce harvest rates in the terminal fishery, but this would require foregoing the surplus of the enhanced stocks. The Kingcome/Wakeman, Bond/Knight and Toba Inlet chum stocks may rebuild if harvest rates in Johnstone Strait were reduced further. However, this would cause harvest rates in the Fraser River to increase, thereby increasing coho and steelhead interceptions. The alternative approach is to enhance production of these stocks.

9. FUTURE ENHANCEMENT ACTIVITIES

The following is a description of potential future enhancement projects that are compatible with current management practices. The project number from Lill et al. (1983) accompanies each project title.[30] Future enhancement projects not compatible with current management strategies are discussed in Section 9.8.

9.1 Upper East Coast Vancouver Island

Potential enhancement opportunities for UECVI stocks are generally compatible with strategies proposed for harvesting the surplus of Nimpkish sockeye. These enhancement projects are directed primarily at increasing production of UECVI stocks so that they can withstand existing and future harvest rates on the enhanced Nimpkish stock.

9.1.1 Woss/Vernon Lakes Fertilization (Project No. 12-11)

The Nimpkish Lake sockeye stock is currently being enhanced through lake fertilization and hatchery incubation. Two other lakes in the watershed (Woss and Vernon) also support sockeye salmon. It is recommended that these lakes also be fertilized if there is evidence that the Woss and Vernon stocks are being over-harvested as a result of high harvest rates on the Nimpkish stock.

9.1.2 Nimpkish (Cheslakee) CEDP Expansion (Project No. 12-12B)

The Nimpkish Band has a CEDP project on the Nimpkish River system, which currently involves the operation of two facilities. The Willow Creek facility has the capacity to produce sockeye, chinook and coho salmon. While the Cheslakee site is a pilot facility that is directed primarily at incubation of chum. The original proposal was to expand the Cheslakee facility and transfer production of chinook and coho to this site, assuming that sockeye enhancement was no longer necessary because of the lake fertilization program. However, there are some concerns regarding the suitability of the Cheslakee site, and expansion of the Willow site is being considered as an alternative. The approved expansion would allow 10,000 an additional chum, 10,000 coho and 17,000 chinook adults to be produced at the site. Construction of an adult counting fence will be required on the Nimpkish River for management purposes.

9.1.3 Quatse River CEDP Expansion (Project No. 12-5B); Nahwitti, Stranby, Shushartie Rivers Recolonization (Project No. 12-1A); Recolonization,Cluxewe and Keogh Transplants (Project Nos. 12-7, 12-8)

Both odd- and even-year pink salmon have been almost eliminated from the Nahwitti, Stranby, Songhees and Shushartie creeks, north of Port Hardy. At one time, escapement of pinks to these streams was 500,000. Although harvest rates on these stocks have been minimized, stock levels remain low and enhancement appears to be the only option for rebuilding these stocks. Pink salmon stocks in streams south of Port Hardy (Cluxewe, Keogh and Quatse) are also below target levels and are expected to be adversely affected by a substantial increase in harvest rates for Nimpkish sockeye. There is a proposal to expand the CEDP project on the Quatse River. Currently, this project involves the incubation of chum, pink and coho salmon from the Quatse, Cluxewe and Keogh rivers.

The first phase of the expansion would involve increasing production of pink salmon to offset losses to the Quatse, Cluxewe and Keogh rivers caused by higher harvest rates directed at Nimpkish sockeye. This would be accomplished by increasing production to 20,000 pink adults for the Quatse River and 30,000 pink adults for both the Cluxewe and Keogh rivers in odd and even years. The second phase of the expansion would involve recolonization of barren northern streams. Eggs would be taken from the Keogh, Cluxewe and Quatse wild stocks and the fry fed and released into the streams to produce a total return of 60,000 adults. In the future, eggs would be taken from brood stock from the Nahwitti, Stranby, Songhees or Shushartie creeks as production permits. In any given year, eggs would be used first to meet the needs of increased production of the Quatse, Keogh and Cluxewe stocks and then to recolonize the northern streams.

9.1.4 Nahwitti River (Project No. 12-C1)

The Nahwitti River is the most northerly large river and lake system on Vancouver Island. This system, which drains into Goletas Channel, produced over 100,000 pink salmon as recently as 1970. Current production for all salmon species is almost negligible, probably as a result of illegal harvest practices. Low flows during the summer may be a factor preventing any rebuilding of the stocks. A small storage dam at the outlet of Nahwitti Lake would improve river flow during the late summer and early fall. The proposed earth fill dam would have good access for the patrolman and would be gated to allow controlled release of water. It has been estimated that production from the Nahwitti River would be increased by 2200 coho and 20,000 pink salmon in both odd and even years.

9.2 Johnstone Strait

Natural rebuilding of Johnstone Strait pink stocks would require substantial changes to the current management approach. However, these stocks could be maintained without changes to the management strategy if they were enhanced. This could be accomplished by constructing additional hatcheries, or expanding the capacity existing hatcheries through development of sea-pen rearing areas and spawning channels in areas where high flows are a problem. Specific projects that have been proposed are described below.

9.2.1 Bear River Pink Rehabilitation (Project No. 13-2)

The even-year pink run from Bear River was historically large but is presently near extinction with less than 1000 fish. There is a proposal to enhance this run by building a facility for incubation of pink eggs. Production of 100,000 even-year pink salmon has been approved by Fisheries Managers. The original facility at Bear River is not currently operating and would require complete upgrading. The Bear River stock is presently being enhanced by transplants from the Quinsam hatchery. Development of a new facility should be delayed until adequate numbers of eggs are available to allow the facility to operate at full capacity. The proposed development includes provisions for incubation and short-term rearing of coho fry, which would be released into the upper watershed. DFO recommends that this work be delayed until current studies on the feasibility and success of coho colonization on MECVI streams are completed.

9.2.2 Read Creek Storage (Project No. 13-10)

Read Creek is a small drainage that flows into Topaze Harbour on the mainland portion of Area 13. Stream records indicate that escapements of coho, chum, and odd- and even-year pink salmon are declining. Production from Read Creek is limited by low stream flows, which usually coincide with spawning of pink salmon. There is a proposal to construct a small storage facility on Shannon Lake, which would have a gate to allow controlled release of water. The site potential is estimated to be 42,000 pinks (primarily an even-year run), 1300 coho and 7000 chums.

9.2.3 Adam River (Project No. 12-19)

This project involves the construction of an unmanned spawning channel on the Adam River, which will create about 5000 m^2 of protected gravel habitat. Production from this channel is estimated at 35,000 pink salmon and 1000 coho salmon.

9.3 Mid East Coast Vancouver Island

It would be highly desirable to increase the harvests of high quality chum salmon in the MECVI area. However, this could only be accomplished by allowing a greater proportion of the total allowable catch (currently 60%) to be harvested earlier in the fishery before escapement requirements are met. This approach would pose an unacceptable risk that target escapements are not reached and, therefore, is not recommended at this time. Minor increases in harvest rates in the Qualicum fishery, perhaps to 75%, may be practical when production from all three hatcheries (Puntledge and Big and Little Qualicum) have reached full capacity.

Because the run timing of the passively-managed chum stocks is concurrent with that of the actively-managed stocks, rebuilding of these minor stocks cannot be achieved through management alone without foregoing much of the terminal harvest of enhanced stocks. Therefore, further enhancement activities have been proposed for Cook, Cougar, French, McNaughton, Rosewall and Winifred (Cole) creeks and Englishman, Nile and Tsolum rivers. Chum stocks from these rivers are currently being overharvested, and escapements are declining dramatically. The best approach to rebuilding these stocks would be to increase their productivity to the same level as the larger stocks. This could be achieved by transplanting fed fry directly from hatcheries or by taking eggs from each of these creeks in the fall, incubating the eggs at the facilities and backplanting fed fry.

In the long term, the best management strategy for the MECVI area may be to reduce the overall production of enhanced chums and use the facilities for other salmon species or shift some of the production to the passively-managed stocks. In the past, increased abundance of enhanced stocks resulted in reductions of wild stocks, which complicated management of the Johnstone Strait fisheries. The new management approach developed by the Johnstone Strait-Fraser River Chum Advisory Board is providing a rational approach for managing chums and several stocks, including the Fraser, are showing a positive response. However, increases in enhanced stocks may limit the success of this strategy. The concept of concentrating enhancement on a specific timing segment of the run that has minimal overlap with other stocks is being considered. However, it is unlikely that harvesting the enhanced stocks would not affect some wild stocks.

Enhancement projects proposed for the Mid East Coast of Vancouver Island are directed at chinook salmon and could be accommodated within the existing management strategy. The specific projects are described below.

9.3.1 Campbell River Side Channel (Project No. 13-6B)

Campbell River is one of the largest chinook-producers in British Columbia, and it supports an intensive sport fishery. This proposed project includes construction of a 500 m channel on the left bank of the Campbell River to augment the natural spawning capacity of the river. The channel would be similar to one constructed in 1985, but it would be protected from floods. It would have screened spawning gravel and cobble bank protection, and would be a natural extension of the river. It is estimated that this channel will produce an additional 10,000 adult chinooks. It is not known whether spawning habitat is currently limiting production of chinook salmon from the river. Although this stock appears to be stable, there is a risk that floods could limit production in the future.

This side channel was initially proposed to increase production of chum salmon by 35,000. However, this is not required at the present time.

9.4 Lower East Coast Vancouver Island

9.4.1 Nanaimo River CEDP Expansion (Project No. 17-7A)

The Nanaimo River is a river and lake system that drains into Nanaimo Harbour. It supports substantial populations of chinook, coho, chum and pink salmon, as well as steelhead. A CEDP project has been active on the Nanaimo River since the late 1970s. The production capacity of the facility is currently 111,000 summer chinook eggs, 295,000 fall chinook eggs, 400,000 coho eggs and 1.1 million chum eggs. Chinook production is currently about 7000 adults (3:1 ratio of fall-summer-run chinook). The proposed expansion would increase chinook production by 7500 adults, of which the majority would be summer-run fish.

9.5 Southern Vancouver Island

9.5.1 San Juan CEDP Expansion (Project 20-4)

It is proposed that the CEDP project be expanded to provide an additional 3000 chinook salmon.

9.6 Mainland Inlets

Enhancement projects proposed for mainland inlets are directed at maintaining small stocks while creating surplus stocks that can be harvested in terminal areas.

9.6.1 Kingcome/Wakeman and Bond/Knight Inlets

Several large-scale production facilities have been proposed for the Kingcome/Wakeman and Bond/Knight inlets, but they are conditional on changes in the current management strategy for Johnstone Strait. These projects are discussed in Section 9.8. Other enhancement opportunities proposed for the area include: (1) instituting flood control or small-scale stabilization of spawning channels, and (2) building spawning channels for smaller stocks so that they remain stable while fisheries are directed at major stocks.

Although no specific projects were identified in Lill et al. (1983)[30], enhanced production of 150,000 - 250,000 pink salmon for the Kakweiken River and 50,000 - 150,000 pink for the Glendale River has been approved. Enhancement on this scale is expected to stabilize production of pink salmon from these inlets production. Currently, harvest potential is limited by a frequent cycle of stock rebuilding and collapse caused by periodic flooding.

9.6.2 Loughborough to Bute Inlet

Enhancement of Loughborough/Bute pink salmon stocks is considered second in priority to enhancement of Johnstone Strait pink salmon.

9.6.2.1 Phillips River Channels (Project No's. 13-19A, 13-19B): A pink salmon spawning channel was completed on Phillips River in 1984 and it is expected to produce 245,000 adults in both odd and even years. When the production capacity of the channel is reached, terminal fisheries in Phillips Inlet will likely be required to harvest fish that were not taken in Johnstone Strait or those exceeding target escapements. Other proposed channel developments include an upper river channel (above Phillips Lake) for pinks and sockeye, and a lower river channel extension for pinks. These projects will be undertaken if the stocks produced from the spawning channel do not compromise the wild stock rebuilding program by creating economic pressure to increase exploitation rates in mixed-stock fisheries. The approval of these projects is contingent on the success of the initial channel. The entire channel has not operated at capacity over the last few years because of low returns to the river. The success of the first phase of the Phillips Channel is important since the next phases and other channels proposed for Knight Inlet are also unmanned channels. Expected production from the Phillips River projects is presented in Table 31.

Table 31. Expected production from the Phillips River projects.

		Species				
Year	River	Sockeye	Pink	Chum	Chinook	Coho
1984	Lower Channel		245,000	1,000	1,000	1,000
1987	Upper Channel	20,000	400,000		1,000	1,000
1989	Lower Channel Extension		275,000	1,000		1,000

9.6.2.2 Phillips Sockeye Spawning Channel (Project No. 13-19D): The Phillips River currently supports a small sockeye population, and escapements are well below optimum levels. There is a proposal to construct a small spawning channel for sockeye in the vicinity of natural spawning habitat. This would provide both better stream flow and gravel selection compared to the natural site, which is prone to flooding. Increased production from the channel would improve the chance of proceeding with the Phillips Lake fertilization program, which is currently limited by low numbers of smolt. Production from the channel is expected to be 20,000 sockeye adults.

9.6.2.3 Orford River Summer Chum Salmon Spawning Channel (Project No. 13-30A): The Orford spawning channel is expected to produce an additional 100,000 summer chum in the Orford River. At full production, the total run is estimated at 250,000 - 350,000 chums. It is expected that 40-50% of this production will be harvested by the Bute Inlet terminal fishery, which currently involves only gillnetters. The increased production of Orford chum will have an impact on chinook salmon returning to all rivers in Bute Inlet, particularly if the harvest rate in the terminal fisheries is increased. This will require the mitigation outlined below.

9.6.2.4 Bute Inlet Chinook Hatchery (Project No. 13-30B): Chinook salmon returning to Orford, Southgate and Homathko rivers have a similar migration timing to Orford chums and, therefore, would be susceptible to the terminal net fisheries directed at the increased production of chum. There is an active and growing sport fishery for Bute Inlet chinook stocks, and chinook escapements have been declining over the past 10 years. A hatchery has been proposed for Bute Inlet or possibly Phillips Arm to incubate chinook eggs for the Southgate, Phillips and Homathko stocks. Production levels would initially be equally divided among the three river systems. Orford River has very few chinook salmon and could not provide adequate broodstock. Total production from the hatchery chinook would be 45,000 chinook (15,000 per river).

9.6.3 Toba and Jervis Inlets

9.6.3.1 Brem River (Project No. 15-1): The Brem River is a small system that drains into Toba Inlet. Production of both pink and chum salmon has been limited by a velocity barrier in the lower river. The current proposal is to facilitate fish passage through a set of rock falls approximately 2.5 km upstream from the mouth of the river. This is expected to open 50 km of rearing area and increase spawning areas for pink and chum salmon. Feasibility studies suggest that production from Brem River would be increased by 2400 chums and 6300 pinks. Present flow problems do not appear to limit production of coho or chinook salmon.

9.6.3.2 Deserted River Side Channel CEDP (Project No. 16-7A): The Deserted River is a remote river that enters Princess Royal Reach in Jervis Inlet. Severe flooding appears to be a limiting factor in the production of chum, coho and pink salmon. The current proposal is to construct an unmanned side channel for these stocks. Production capacity of the side channel is expected to be 4000 chum, 200 coho and 2800 pink salmon.

9.6.4 Howe Sound and Burrard Inlet

There are many opportunities for development of small-scale spawning channels for chum salmon in the Squamish River, which would also provide rearing habitat for coho. Several channels have been developed on the river, and others could be phased in over time. There is also opportunity for development of spawning channels for pink salmon. However, the potential of these projects is limited by broodstock availability. If the pilot spawning channel (the Mamquam channel) is successful in increasing production of pink salmon, these other opportunities could be pursued. An enhancement facility on the Indian River could also be developed to increase productivity of pink and other salmon species in Burrard Inlet. There is also an opportunity to manage Squamish and Indian River pink and chum stocks independently after they have separated from the mixed-stock areas. The possibility of enhancing these stocks to a relatively high level and managing to target fisheries on enhanced fish within the inlets should be considered. Specific projects that have been identified are described below.

9.6.4.1 Squamish River Estuary Rehabilitation (Project No. 28-16): There has been some attempt to restore the production capacity of the Squamish estuary. There are additional opportunities to improve the quality of salmon habitat in the estuary, which would increase chum and coho production.

9.6.4.2 Indian River Pink Channel (Project No. 28-18): Construction of a side channel on the Indian River has been proposed to increase production of odd-year pink salmon by 25,000 adults. Another side channel is also proposed for production of 50,000 chums. The first phase of this project was the development of two groundwater channels for chum and one side channel for pink in 1987.

9.6.4.3 Tenderfoot Pink Pilot: This proposed project involves using a temporary incubation box to test production of pink salmon and increase broodstock for larger facilities. Production capacity of the pilot facility is estimated at 30,000 pink. Currently, this pilot project is limited by broodstock availability. If the Mamquam channel is successful, this project could increase the rebuilding rate of the Squamish pink stock

9.6.4.4 Tenderfoot Facility: This proposal involves construction of a small spawning channel to increase production of chum salmon. This is expected to produce about 50,000 adult chum.

9.7 Fraser River

Large-scale enhancement projects for Fraser River salmon stocks could require changes in the current management approach since these stocks drive the major interception fisheries. The fishery is currently managed on the basis of enhanced production from the existing facilities. Harvesting an additional surplus may have implications on other salmon stocks and require further adjustments to the harvest strategy. A management plan that outlines the changes in harvest strategy associated with each new project is needed prior to implementation of the project. These large-scale enhancement strategies are discussed in Section 9.8.1.

Small-scale enhancement projects for Fraser River stocks that are compatible with the current management strategy are discussed below. These projects have been approved because they are directed at increasing stocks that are currently at low levels or they are experimental projects for potential large-scale developments.

9.7.1 Lower Fraser

9.7.1.1 Chilliwack Pink Spawning Channel (Project No. CH-11): Thee is a proposal to construct a spawning channel for pink salmon in the Chilliwack River. This channel would be smaller than that originally proposed by the IPSFC in 1972. The site was prepared several years ago for construction. The channel would help to stabilize pink salmon production in the Chilliwack River and it would also probably be utilized by chum salmon. Total production from the channel would be 250,000 pink adults. However, it could be expanded to provide additional production if required.

9.7.1.2 Birkenhead Spawning Channel: Construction of a spawning channel on Birkenhead River has been proposed to stabilize the sockeye run. The natural spawning habitat is frequently subject to scour and siltation during freshet periods. Although the stock is very resilient, production of sockeye fry from the channel would result in more stable returns. Since this stock does not exhibit cyclic dominance, it is expected that sockeye in all cycles would use the channel. Total production from the channel is estimated at 100,000 sockeye adults. The

Birkenhead sockeye are relatively large fish compared to other Fraser sockeye and, therefore, are highly desirable.

9.7.1.3 Big Silver Creek Side Channel Improvement: Controlled-flow diversion involving construction of a low weir is proposed to divert a portion of flow from the existing stream into a dry side channel. Historically, this side channel was the main spawning area for sockeye salmon in Big Silver Creek. This diversion is expected to increase production by 25,000 adults. Big Silver sockeye salmon are large fish compared to other Fraser sockeye.

9.7.1.4 Pitt River Incubation Facility: This project involves rebuilding the existing incubation facility on Corbold Creek. The production capacity of this facility would be 67,000 adult sockeye. An unmanned spawning channel on Corbold Creek was initially proposed to increase sockeye production. However, it would not be viable given the existing water supply. An alternative site on Boise Creek, a tributary of the Pitt River, is currently being investigated.

9.7.1.5 Small-Scale Projects: There are several small-scale projects that involve hatchery technology and habitat improvements. The total production from these projects is approximately 12,000 sockeye, 61,400 chum, 4300 chinook and 13,100 coho salmon. Table 32 summarizes the type of enhancement and estimated production for each of the projects.

9.7.1.6 Projects Requiring Further Study: Development of a spawning channel in the Harrison River has been identified as an enhancement opportunity that requires further study. Spawning areas for pink salmon may be limited as a result of drying of side channels caused by dredging in the mainstem. A feasibility study for a habitat improvement project on Waleach Slough is recommended. The upstream side of the slough has been blocked by a dike, and improvement of this habitat would benefit pink and chum salmon.

9.7.2 Middle Fraser

9.7.2.1 Chilko Habitat Improvement: The Chilko River habitat improvement project involves rehabilitation of an existing side channel and a sockeye spawning area below the counting fence where it is suspected that poor gravel quality is limiting egg to fry survival. Other spawning areas in the Chilko River could be improved if these rehabilitation efforts are successful. The natural spawning

Table 32. Small-scale enhancement projects for Lower Fraser stocks.

Project and Number	Enhancement Activity	Estimated Adult Production
Ryder Creek (CH-15)	Side channel development	4,000 Chum
Sweltzer Creek (CH-16A)	Gravel addition	12,000 Chum
Nathan Creek (29-7)	Habitat rehabilitation, incubation and transplant	1,000 Chum
West Creek (29-8A)	Side channel development	4,000 Chum
Cultus Lake	Predator control pilot study	12,000 Sockeye
Iona Slough (29-12)	Estuary rehabilitation	1,100 Coho
		13,600 Chum
		4,300 Chinook
Serpentine River (29-14)	Hatchery	10,000 Coho
Little Campbell River (29-15)	Obstruction removal	1,000 Coho
Hopedale Slough (CH-12B)	Habitat restoration	200 Coho
		7,800 Chum
Chehalis (MH-8)	Spawning channel	400 Coho
		19,000 Chum
Silverdale (MH-11)	Stream rehabilitation	400 Coho

areas are relatively productive, and it is recommended that the areas below the lake be maintained in a natural or semi-natural state. However, spawning habitat could also be increased by directing some flow from the river to dried channels on the right bank. In addition, egg mortality could be reduced by limiting access of spawners to areas that are known to dry and freeze in the winter. The Chilko project is expected to increased sockeye production by 189,000 adults.

9.7.2.2 Seton River Facility: The Seton River project would involve construction of a CEDP facility to rear chinook salmon to smolt size. Production from this facility would be about 500 adult returns.

9.7.2.3 Projects Requiring Further Study: In 1985, migration of pink salmon through the Fraser Canyon was limited by low river flows. Several locations including China Bar, Little Hell's Gate, Saddle Rock, Scuzzy Rapids and the right bank of Hell's Gate were identified as difficult passage points. Studies are required to determine where it is necessary and feasible to improve passage for pink salmon. Investigations could also be conducted to determine if high flows restrict passage of early sockeye and pink stocks through the canyon.

Construction of spawning channels for sockeye salmon has been proposed for Horsefly and Mitchell rivers and McKinley Creek in the Quesnel system. Preliminary estimates indicate that production would be increased by 140,000, 660,000, and 800,000 sockeye adults, respectively. The Mitchell stock has a later run timing than the Horsefly and McKinley Creek stocks. Further feasibility studies are required at these three sites.

A flow-control structure on Crooked Lake has been proposed to supply cool summer flows and augment low winter flows in the Horsefly River. However, the feasibility of this proposal should be investigated further.

9.7.3 Thompson

9.7.3.1 Thompson Pink Spawning Channel (Project No. K-30): This project could be expanded in the future, if warranted. Total production of 100,000 pink adults has been approved for the side channel development project on the Thompson River. However, to date eight potential sites have been identified and, if all were developed, production could be in excess of 6 million pink salmon. The channel site should be carefully selected so that it does not infringe on juvenile chinook or steelhead rearing habitat.

In 1985, relatively few pink spawners were able to reach spawning grounds in the Thompson River because low flows limited access through the Fraser Canyon. Pink salmon that reached the Thompson were small and were not considered very productive spawners. Therefore, it may take a few cycles before an adequate number of pink spawners return to the river and fill the spawning channel.

Areas that may be restricting passage of pink spawners during low flows are currently being investigated. Improvements to these areas should be made prior to the implementation of any enhancement project for the Thompson pink stock.

9.7.3.2 Bonaparte River (Project No. K-32A): This project involves either the installation of a fence and establishment of a trucking operation or the construction of a fishway to facilitate passage of Bonaparte chinook above an impassable obstruction to 50 km of unused rearing and spawning habitat. This is expected to increase chinook production by about 3500 adults. However, depending on egg-to-fry survival, it may take up to three cycles before the target escapement is reached.

9.7.3.3 Upper Adams Incubation: Another potential project is an incubation facility that would assist in developing a self-sustaining sockeye population in the Upper Adams River, where there is an estimated 1.3 million m^2 of spawning gravel available. This facility would produce 50,000 sockeye in the 1984 cycle, and 25,000 in each of the 1986 and 1987 cycles. The native sockeye run to this river was eliminated in the early 1900s by a logging splash dam at the outlet of Adams Lake. Subsequent transplants of eyed eggs and juveniles from Seymour and Taseko rivers have resulted in only limited returns to the Upper Adams River but has created a small run in nearby Momich River. IPSFC transplanted Momich River juveniles to Adams River for rearing and release in 1980. In 1984, there was a substantial return of sockeye to the Adams River as a result of this transplant. This project should be continued. As an alternative to developing the incubation site on the Upper Adams River, a similar facility has been proposed at Momich River. This facility could also be used to rebuild sub-dominant runs. However, the feasibility of this option will have to be evaluated.

9.7.3.4 Small-Scale Projects: Several small-scale projects involving hatchery technology and habitat improvement have been proposed for the Thompson River system. The total production from these projects is estimated at 5050 chinook and 20,550 coho salmon. Table 33 summarizes the type of enhancement activities and the estimated production for each project.

9.7.3.5 Projects Requiring Further Study: There is concern that rail and road encroachments along the Thompson River have restricted gravel recruitment to the mainstem. It is recommended that an area be tested to determine the feasibility of a gravel addition program.

The Seymour and Anstey sockeye stocks could be enhanced because the adjoining areas in Shushwap Lake are not presently used by juvenile sockeye. These stocks have an early run timing and, therefore, could be managed separately from the dominant late-run stocks from the Shushwap area. There is a proposal to increase the Seymour stock by using a temporary incubation facility. Production of the Anstey stock could be increased by improving beach spawning areas. However, both of these proposals need to be studied further to determine their feasibility.

9.7.4 Upper Fraser

9.7.4.1 Tachie River Sockeye Spawning Channel (Project No. PG-18A): Production of late Stuart sockeye is limited by poor quality spawning gravel in Tachie and Middle rivers. Rearing habitat in Stuart Lake is presently underutilized. The migration timing of late Stuart sockeye is coincident with that of the Horsefly stock. This stock has been increasing rapidly in the dominant 1985 cycle and is more productive than the late Stuart stock. Construction of spawning channels and/or gravel addition to existing spawning areas may be needed to increase production of the late Stuart run to a level that can withstand fishing pressures directed at the Horsefly stock.

A pilot spawning channel has been proposed for the Tachie River mainstem. Production from the channel would be relatively low (i.e., 63,000 sockeye adults for the 1985 and 1982 cycle). However, if it is successful in increasing the late Stuart run, the channel could be expanded.

Migration of late Stuart sockeye peaks in the lower Fraser River by the beginning of August. Chinook stocks such as Chilko, Shuswap and North Thompson could

Table 33. Small-scale enhancement projects for Thompson River stocks.

Project and Number	Enhancement Activity	Estimated Adult Production
Avola (K-2)	Hatchery with stock being imported	2,000 Coho 1,000 Chinook
North Thompson (K-4E)	Hatchery expansion at Dunn Lake	1,500 Coho
Finn (K-1B)	Habitat restoration	100 Coho 50 Chinook
Louis (K-88)	Habitat restoration and protection	200 Coho
Salmon River (K-24A)	Habitat restoration and protection	4,000 Coho 4,000 Chinook
Deadman (K-31C)	Habitat restoration and protection	750 Coho
Nicola (K-33C)	Intake screening	12,000 Coho

potentially be affected at this time. Production from the pilot phase of the Tachie channel project would not be a concern. However, major expansion could cause impacts on these chinook stocks and, therefore, should be evaluated.

9.7.4.2 **Projects Requiring Further Study:** Gravel addition and channel alterations in the Tachie River could increase production of the late Stuart run. However, these projects could potentially cause silting below Kuzkwa Creek and create navigation problems. The early Stuart run could be increased through gravel additions to the Middle River or installation of an incubation facility. However, gravel sources are limited in both the Tachie and Middle rivers.

9.8 Enhancement Facilities Contingent on Changes in Current Management

9.8.1 Fraser River Stocks

No major enhancement projects for Fraser River sockeye or pink salmon have been implemented since 1973 because of a policy decision made by the Canadian government. This decision was based on the fact that full benefits of these projects would not accrue to Canadians but would be shared with the U.S. However, the Pacific Salmon Treaty recognizes that the benefit of enhancement should accrue to the country that bears the costs. Therefore, several opportunities for enhancement of Fraser sockeye and pink stocks have been proposed (lake fertilization, spawning channels and incubation facilities) since the signing of the treaty in 1985. DFO is currently evaluating these enhancement proposals and developing a detailed rebuilding plan for Fraser sockeye stocks.

A significant increase in Fraser sockeye and pink stocks may result in higher harvest rates in the major fisheries, which are directed primarily at these stocks. This could cause additional problems in the mixed-stock fishery; therefore, enhancement projects for Fraser sockeye and pink should be carefully evaluated with respect to the implications on fisheries and other salmon stocks. The objective is to integrate enhancement into the management plan. The integrated South Coast computer model could be used to determine the potential effects of each proposal.

Lake enrichment has often been discussed as a technique for increasing the production of Fraser River sockeye. However, most lakes in the Fraser watershed are currently underutilized by sockeye juveniles even during the dominant-cycle years. Therefore, it is not certain that providing additional nutrients to these lakes would result in substantially greater production. However, there may be some opportunities for enrichment. Chilko Lake has been identified as a potential candidate because it appears to be used to near capacity during the dominant-cycle years. Some preliminary work was conducted through the Lake Enrichment Program in 1984 to further evaluate the potential of Chilko Lake for enrichment. It is recommended that this work continue to determine which, if any, Fraser watershed lakes should be fertilized on a trial basis in the future.

In 1972, the IPSFC published a plan that involved enhancing production of Fraser River sockeye and pink stocks through artificial spawning and incubation channels. It was proposed that most of the increase in sockeye would take place during the 1981-cycle years, with an enhanced run of about 20 million adults at full production. The program was designed to take advantage of the unutilized rearing capacity of the major lakes that support sockeye salmon. This program was never implemented because of the moratorium on the construction of additional enhancement facilities for sockeye and pink salmon on the Fraser River. It is believed by some DFO managers that it would be more cost effective to increase production of Fraser sockeye stocks by increasing escapements through management actions. However, it may still be advisable to construct some of the spawning and incubation channels for scaled-down production stocks with limited spawning areas and/or low rates of production.

One example is the Driftwood spawning channel (Project No. P6-20). This project would increase production of the Early Stuart run to 550,000 sockeye in the 1985 cycle. The Early Stuart stock is susceptible to intense native food fisheries and high water temperatures, because of its early run timing. Increased production from this channel would assist in rebuilding the stock. Development of a spawning channel in Kazchek Creek would benefit the Late Stuart run. Production from this channel is estimated at 940,000 sockeye adults. However, the feasibility of these options and their implications on the management of these stock require further evaluation.

Many Fraser River sockeye stocks have a relatively low productivity during the non dominant-cycle years; therefore, natural rebuilding of these stocks will be slow. However, it may be possible to increase the rate of rebuilding and, to some extent, equalize production over the cycles by increasing egg-to-fry survival through various enhancement techniques such as portable temporary hatcheries, incubation boxes, gravel improvement or spawning channels. A thorough assessment of these stocks and enhancement opportunities of this nature is necessary before more specific recommendations can be made.

The current management approach for Fraser River chum is based on setting a harvest rate in Johnstone Strait that is sustainable by the wild stocks. The surplus of enhanced stocks is currently harvested in terminal fisheries,and these fish are generally of poorer quality than if they were taken in Johnstone Strait. Proposals for further large-scale enhancement of Fraser chum stocks should consider the quality of the catch under the current management strategy or identify alternative strategies for capturing the surplus in Johnstone Strait.

9.8.2 Mainland Inlet Pink Salmon

Several opportunities for large-scale enhancement of Kingcome/Wakeman and Bond/Knight pink stocks have been identified. However, these projects are not compatible with the current management strategy and would only aggravate the mixed-stock fishery conflicts in Johnstone Strait. These projects could be approved if the management strategy was to change and it was accepted that these stocks would be harvested only in the terminal inlet areas. Other potential conflicts such as chinook and coho interception and uncertainty in stock assessment need to be considered prior to implementation of large-scale enhancement projects.

Opportunities for enhancement of Mainland Inlet pink stocks include development of spawning channels on the Kakweiken, Glendale and Ahnuhati rivers. The production capacity of each channel would be 1 million, 1 million and 250,000 pink, respectively. These projects could be phased in over time so that production would increase incrementally. When these spawning channels are in place, another channel could be developed in Bond Sound. Development of a channel in the Wakeman Sound was also suggested but is unlikely because feasibility of development is limited by physical constraints.

There is concern regarding interceptions of local and passing chinook and coho stocks in the terminal fisheries directed at the surplus of enhanced pink stocks. Numerous studies have been conducted to identify potential sites for enhancement of chinook and coho stocks in the area. However, there is a lack of suitable sites due to poor water quality and the potential for transfer of the IHN virus.

A site on Devereux Creek (Project No. 12-44D) was found to have acceptable water quality for enhancement of chinook and coho stocks. However, resident kokanee carry the IHN virus. A mobile pilot facility was installed at the site to determine whether the IHN virus would affect chinook salmon culture. In 1985, an experimental group of chinook were deliberately infected with the IHN virus, which indicated that this stock was not genetically immune to the virus. Although the disease was not transferred to chinook raised on the natural water supply, there is a potential for future production to be infected if the virus persists in the water supply. This is a concern because there is currently a lack of technology to test and treat the IHN virus. It was recommended that development of the Devereux hatchery should be postponed until an effective way of treating intake water for the IHN virus has been discovered.

There are alternative options for enhancement of Mainland Inlet chinook and coho stocks, such as satelliting from existing facilities (Quinsam or Scott Cove hatcheries). However, because enhancement opportunities for these stocks are presently limited, the potential problems with interception in terminal fisheries should be assessed to determine if they can be minimized through management actions.

10. EVALUATION OF MANAGEMENT OPTIONS

The short- and long-term implications of various management options for Fraser River salmon stocks was assessed through simulation modelling. As indicated earlier, management strategies developed for Fraser River sockeye and pink will affect the rebuilding of other salmon stocks that are intercepted in mixed-stock fisheries directed at these Fraser fish.

10.1 Evaluation Tools

The South Coast management model described in Volume A was used to evaluate the various management options in terms of the potential implications for stocks and fisheries. To understand the stock and fishery dynamics over the short and long term, two simulation models were developed.

The short-term model was developed to evaluate the potential effects of implementing the various management strategies within a season. To implement the strategies, fishing patterns were altered and the resulting catch, escapement and exploitation rates for sockeye, pink and chum stocks were projected for any given year. Results of this simulation modelling also provided an indication of potential changes in harvest pressure on chinook, coho and steelhead.

The long-term model was developed to evaluate the effects of implementing the various management strategies over a 40-year period. Unlike the short-term model, it incorporates stock-recruitment relationships and economic factors (e.g.,relative price and quality of the catch) as well as exploitation rates produced by the short-term model. For each scenario, trends in escapement of sockeye, pink and chum stocks, trends in catch by fishery and the net present value (NPV)* of these catches were projected.

A detailed description of the South Coast Management model is presented in Gazey et al. (1987).[31] The following analysis is very preliminary and was not reviewed by fisheries managers. However, it reflects the types of options that can be analysed and the results indicate the scope of the potential production that may be available.

A more intensive analysis of options is currently being conducted by DFO.

10.2 Description of Options

Two management scenarios were evaluated for the South Coast stocks; the "rebuilding" options and the "production potential." The rebuilding options assume cyclic dominance among sockeye stocks while the production potential options examine the implications of this assumption. As previously discussed, there is considerable controversy regarding cyclic dominance (varying production of a stock over a four-year period). One view is that cyclic dominance is caused by biological factors (competition, food supply, predation); therefore, a stock is not capable of sustaining a high level of production in all four cycles. This assumption was simulated using a different stock-recruitment relationship for each cycle year. Alternatively others believe that there is no cyclic dominance, that production over the years is a result of overharvesting in the low cycles; and that all cycles are capable of the same production levels. This was simulated using a

*NPV = net present value of the projected 40 years of harvest, discounted at 10% per year.

common stock-recruitment relationship in all cycles. Under the first set of options, stock rebuilding occurs through management, through enhancement and through a combination of management and enhancement. The production potential options reflect the differences in potential production and rebuilding rate with and without cyclic dominance among sockeye stocks. All of the options were compared to the current management regime (Option A) which represents a typical management scenario.

For each option, the short-term model was run for each of the four sockeye cycle-years and at three diversion rates (low, medium and high). The resulting exploitation rates for each stock were used in the long-term model. A fixed sequence of diversion rates based on the historical pattern was assumed over the 40-year simulation period, and the appropriate exploitation rates were used in each of the years.

10.2.1 Option A - The Current Management Regime

The usefulness of simulation modelling is the ability to compare options. The long-term model was used to project trends in catch and escapement of the various management strategies and to identify the merits and shortcomings associated with each option. The results of the modelling are intended to indicate the relative differences in possible outcomes associated with the various management options and should not be viewed as actual predictions for any given year. Therefore, the "current management regime" (Option A) was developed as a standard for evaluating these strategies.

Option A represents a "typical" scenario. The stock and harvest information represent the usual or normal situation. Since there are anomalies in every year (e.g., stocks may be earlier or later than usual), no one year is considered typical from all aspects. Therefore the input data for this option was taken from several years of data. The stock data, run size and timing, was based on run reconstructions. The sizes and timing of sockeye stocks in 1984, 1985, 1982 and 1979 were used to represent the 1984, 1985, 1986 and 1987 cycle-years, respectively. The pink salmon data were based on 1982 and 1985 run reconstructions for even and odd years, respectively. Chum data were also based on the 1982 run reconstruction for the even years. In odd years, the Canadian chum stock sizes were based on 1983 estimates and the U.S. chum stock sizes were based on the 1979 run reconstruction. Typical fishing patterns for each cycle-year and diversion rate were derived by fisheries biologists. These fishing patterns were then modified to reflect the average harvest rates from 1948 to 1984 of the dominant stocks in each cycle-year and to achieve an allocation of catch between Canada and the U.S. that is similar to that agreed to for the first four years of the Treaty.

It is important to note that catch and escapement trends for Option A were based on harvest rates resulting from the typical fishing pattern. It was assumed that the harvest rates for each cycle-year and diversion rate remain constant over time. Therefore, this option did not represent any current management trends, such as decreasing harvest rates on specific stocks in recent fisheries. However, Option A did account for the recent management strategy applied to the Early Stuart stock. Recently, fisheries on the Early Stuart stock have been minimized and the harvest rate is much lower than historically.

10.2.2 Rebuilding Options

Three scenarios were modelled and compared to Option A to simulate the potential merits and shortcomings associated with implementation of these strategies.

Option B represented a strategy of rebuilding through management actions that involved reducing harvest rates for the first 10 years to allow all South Coast stocks to rebuild. After this period, the largest stocks were harvested to the maximum sustainable yield (MSY) based on the stock recruitment assumptions.

Option C is the strategy of rebuilding through enhancement. It is based on the assumption of developing all the enhancement projects, that were identified as being compatible with management (see Section 9). This scenario was developed by increasing the run size of the returning stocks by the projected number of enhanced returns. It assumes the same harvest strategy and uses the same fishing patterns as Option A.

Option D is a compromise of the previous two options involving the use of harvest management and enhancement strategies to rebuild the South Coast stocks. This scenario was modelled by using fishing patterns established for Rebuilding Option B and all of the enhancement projects including those that are conditional on changes in the management approach (see Section 9.8).

10.2.3 Production Potential Options

Numerous assumptions are made in developing the various management strategies. However, the assumption that has the most dramatic effect on the model projections is the stock-recruitment relationship. In Option A and the rebuilding options, the stock-recruitment relationship was based on the assumption that cyclic dominance of Fraser River sockeye was caused by biological factors as opposed to harvesting factors and that there was a different relationship for each of the sockeye cycles. However, if cyclic dominance does not have a biological basis, the stock-recruitment relationship for each stock would be the same in all cycle years. The Production Potential Options were modelled to investigate the potential difference between these two approaches in terms of long-term production and rate of rebuilding. Although these options show the range in projections between these two approaches, the analysis does not account for the uncertainty in the parameters within each strategy.

Option B represented the typical current management strategy (Option A) but assumed that the stock recruitment relationships for Fraser River sockeye were the same for all cycles. The fishing patterns were the same as those used for Option A which reflect a belief in the cyclic dominance theory. A comparison between the results of modelling Option A and Option B reflected the potential difference in projected returns due to the stock recruitment assumption regarding cyclic dominance, since both options are based on the same harvest strategy.

Option C also assumed a common stock recruitment relationship for all cycles of Fraser sockeye stock. However, the harvest strategy was adjusted to reflect the assumption of no cyclic dominance rather than the typical management strategy modelled in Option A and B. This management strategy was initially directed at rebuilding the low cycle-years of Fraser River sockeye to the same levels as the dominant cycles, and later focused on achieving exploitation rates at the MSY level for the most significant stocks. Since Option B and C are based on the same stock recruitment assumptions, the difference in projected returns reflects the consequences of the underlying management strategies, a typical strategy that assumes cyclic dominance is a limiting factor (Option B) and a strategy that assumes no cyclic dominance (Option C).

10.3 Results of Rebuilding Options

The results in this section focus only on the implications of the rebuilding strategies on sockeye, pink and chum stocks. The effects on chinook, coho and steelhead stocks have not yet been analysed. Although the South Coast model can indicate the relative change in harvest rates on these species in response to the net fishing strategies, long-term projections of these stocks require additional analysis since hook-and-line management strategies should must be considered.

10.3.1 Stock Status Implications

The management and enhancement options would have various implications to the Inner South Coast stocks. The status of the individual stocks was considered the key indicator of the potential effects of these strategies. Although the results of the simulation modelling included escapement trends for each sockeye, pink and chum stock, there are too many stocks to present each of the individual trends. An aggregation of the escapement data would mask the trends of the each stock and, therefore, a summary was developed by categorizing the stocks according to their projected status. These categories are as follows:

I - Stock is remnant or extinct
II - Stock is at a moderate level under the escapement target
III - Stock is near escapement target
IV - Stock is over escapement target (surplus)

Figure 37 indicates the proportion of stocks in each of these categories for the rebuilding options. Table 34 summarizes the total escapement, total target and number of the stocks in each category, as well as the target for each category as a percent of the total target to indicate the potential relative contribution of the stocks in each of the four categories.

In Option A, a large proportion of the stocks are projected to decline to remnant levels or extinction. This is shown by the large proportion of level I stocks (approximately 35%) expected with this management strategy (Figure 37). Although there are a large number of stocks in the Level I category, they are relatively small stocks with limited potential since they only represent 17% of the total target escapement (Table 34). There is also a substantial proportion of stocks (about 22%) at moderate levels but below target escapement (Level II). The

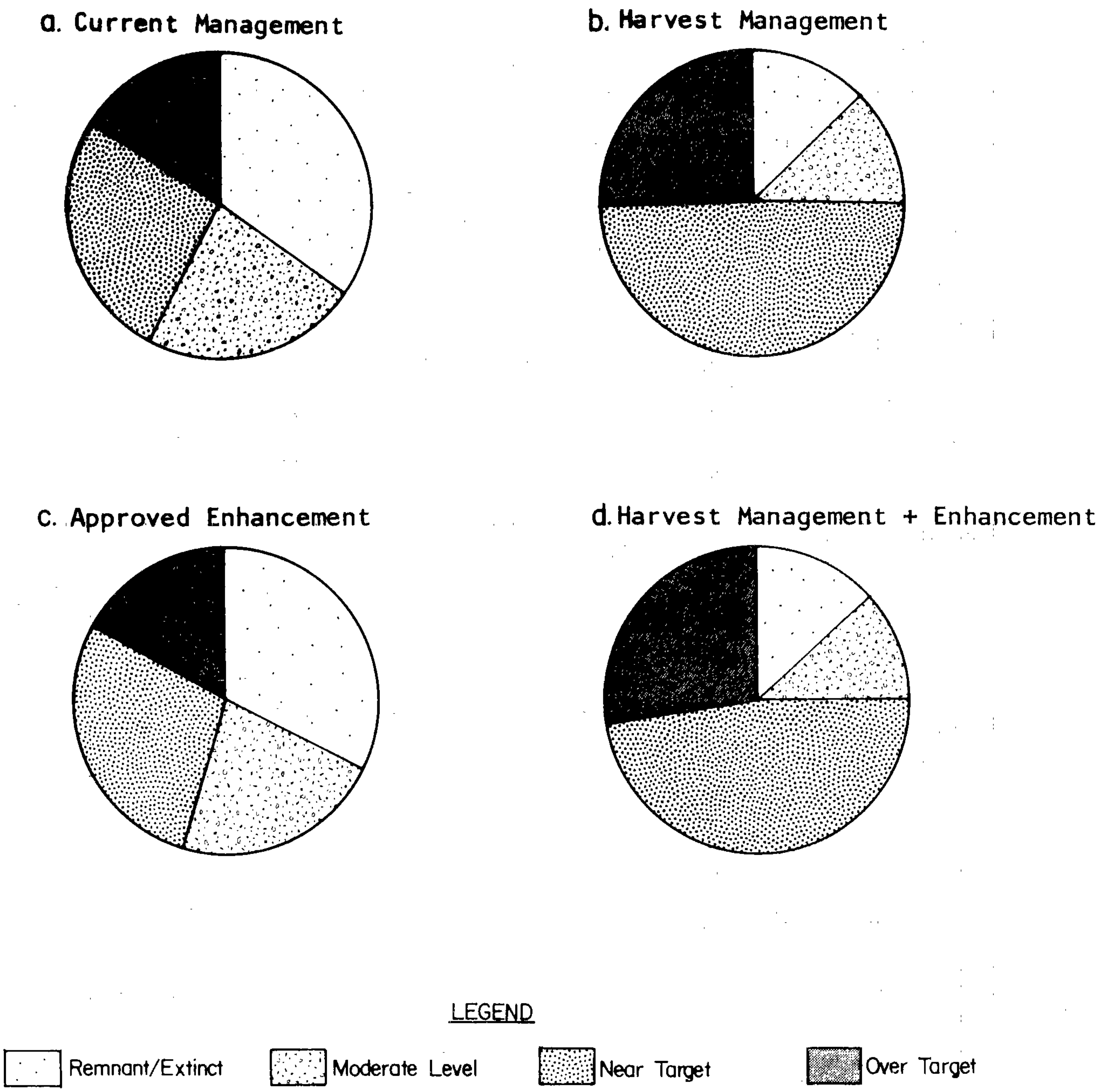

Figure 37. Comparison of stock-level classification for the rebuilding options.

Table 34. Projected total escapement, target and surplus for each stock category (escapement, target and surplus are x 1000 fish).

Option	Category*	Escapement	Target	Target as Percent of Total Target	Number of Stocks	Surplus
Option A - (Current Management)						
	I	1,206	6,210	17.15	31	
	II	10,441	20,587	56.85	20	
	III	6,397	6,456	17.83	24	
	IV	3,870	2,959	8.17	14	911
	Total	21,914	36,212		89	
Rebuilding Option B - (Based on Harvest Management)						
	I	74	969	2.68	12	
	II	719	1,484	4.10	11	
	III	29,194	29,035	80.18	44	
	IV	6,076	4,724	13.05	22	1,352
	Total	36,063	36,212		89	
Rebuilding Option C - (Based on Approved Enhancement)						
	I	1,185	6,008	16.56	29	
	II	10,563	20,445	56.35	20	
	III	6,551	6,726	18.54	25	
	IV	4,125	3,102	8.55	15	1,023
	Total	22,424	36,281		89	
Rebuilding Option D - (Based on Harvest Management with Approved and Conditional Enhancement)						
	I	53	893	2.45	12	
	II	690	1,402	3.85	10	
	III	27,903	28,145	77.34	43	
	IV	7,291	5,949	16.35	24	1,342
	Total	35,937	36,389		89	

*I = low or extinct
II = under target
III = at target
IV = in surplus

large number of stocks at levels I and II indicates that over half of the stocks would not achieve their full potential under Option A. About one third of the stocks would achieve target escapement, while only 17% would exceed the target level with an average surplus of 900,000 fish.

The management strategy to rebuild South Coast stocks (Option B) resulted in a reduction in the number of stocks in Levels I and II and an increase in the number of stocks achieving and exceeding escapement targets (Figure 37). Rebuilding Options C and D involved the management strategies of Options A and B, respectively, as well as the enhancement projects identified for South Coast sockeye, pink and chum stocks. However, the simulation modelling indicated that the effects of Options C and D on stock status were not different from that of management alone. These results reflect the small-scale nature of the identified enhancement projects.

10.3.2 Harvest Implications

The primary objective of the simulation modelling was to determine the implications of various management and enhancement strategies on the commercial fisheries. The projected catches in the commercial fisheries have been totalled for each 4-year period to eliminate variability caused by cyclic dominance.

The projected catches of sockeye and pink salmon under the rebuilding options are presented in Figures 38 and 39, respectively. The lowest projected catch occurred under Option A because the high exploitation rates associated with the typical fishing scenario prevented sockeye and pink stocks from rebuilding to higher levels. The harvest strategy to rebuild stocks (Option B) resulted in substantially higher catch projections in the long term. However, in the short term, catch would be less than with Option A. Catches under the enhancement options (Options C and D) resulted in only slightly higher catches than expected with the corresponding harvest strategies (Options A and B, respectively). This reflects the relative small scale of the proposed enhancement projects compared to the greater potential of rebuilding through harvest management.

Although chum stocks rebuild under all of the options, the rate of rebuilding and final catch levels differed slightly among these strategies (Figure 40). The rebuilding through harvest management (Option B) increased the rate of rebuilding over Option A. When enhancement was added to each of the management strategies,

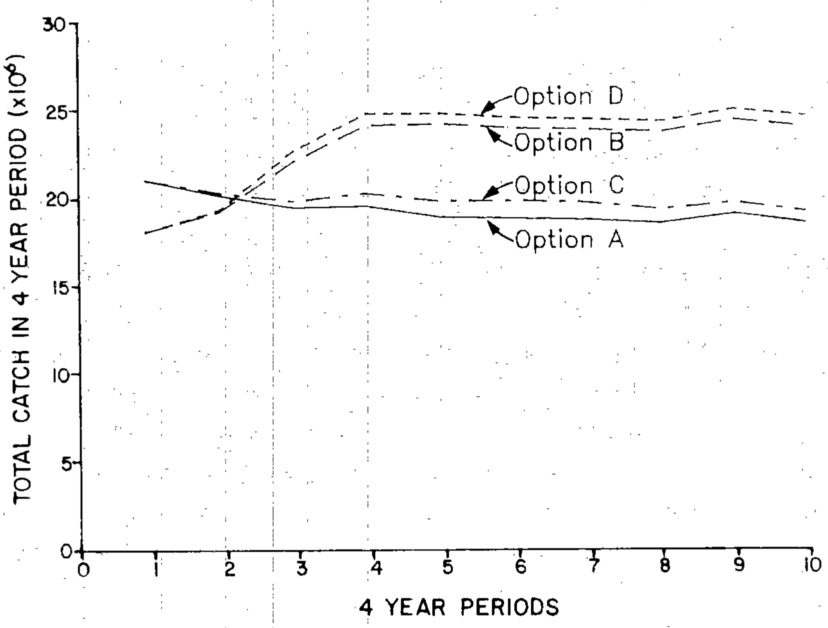

Figure 38. Projected sockeye catches under the rebuilding options (totalled over 4-year periods). Option A = current management; Option B = harvest management; Option C = enhancement; Options D = harvest management and enhancement.

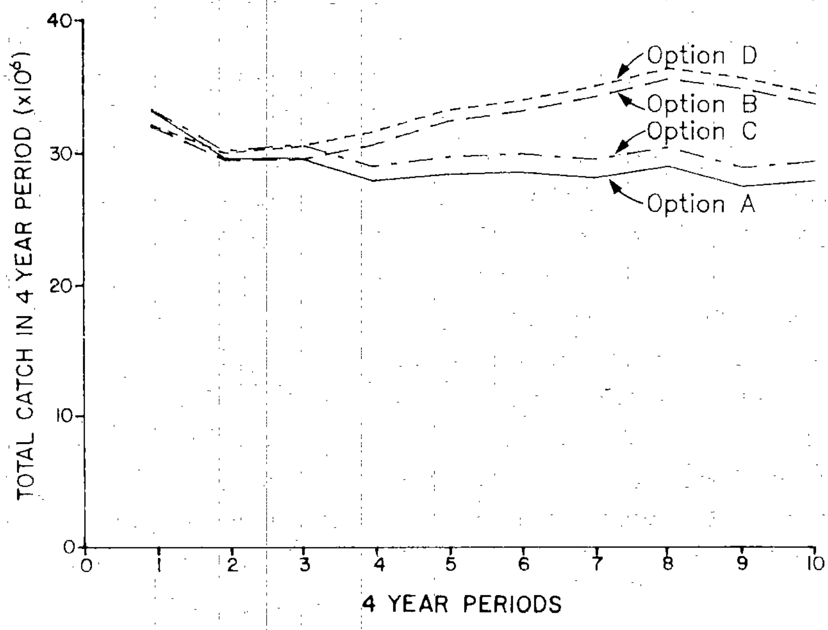

Figure 39. Projected pink catches under the rebuilding options (totalled over 4-year periods). Option A = current management; Option B = harvest management; Option C = enhancement; Option D = harvest management and enhancement.

the rate of rebuilding increased slightly over the corresponding harvest management strategy. In the long term, the chum catch would be slightly larger in the options that include enhancement.

The net present value (NPV)* of the catch of sockeye, pink and chum was estimated for each option. With a 10% discount rate, the NPV* for Options A, B, C and D were 1410, 1456, 1417 and 1410 million dollars, respectively.

10.4 Results of Production Potential Options

Figure 41 indicates that there would be a substantial difference in sockeye catches under the same management scenario depending on whether or not cyclic dominance is assumed to limit the production potential (stock-recruitment parameters vary for each of the four cycle-years vs. a constant relationship independent of cycle-year).

Under Option A sockeye catches exhibited cyclic variability over the 40-year period. Although the catch was larger under Option B, it exhibited the same cycles as in Option A. This suggests that the typical fishing pattern can maintain cyclic abundance in Fraser sockeye independent of the stock-recruitment relationship. Under Option C (constant stock-recruitment relationship and management altered to rebuild the low cycle-years), there was breakdown of the cyclic pattern (Figure 41). Catches increased dramatically under Option C as compared to Option B which was based on the same stock-recruitment assumptions.

There was no difference in projected catches of pink and chum salmon between Options A and B. These options represented the same management strategy only the stock-recruitment parameters for sockeye salmon differed. Although Option C resulted in increased catches of even- and odd-year pink and chum salmon (Figures 42 to 44), catches were initially lower than in Options A and B because reduced harvest rates on sockeye in the low cycle-years resulted in reduced interception of the other species. This allowed pink stocks to rebuild to higher levels than under the typical management scenario and chum stocks to rebuild at a faster rate than in Options A and B.

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*NPV = net present value of the projected 40 years of harvest, discounted at 10% per year.

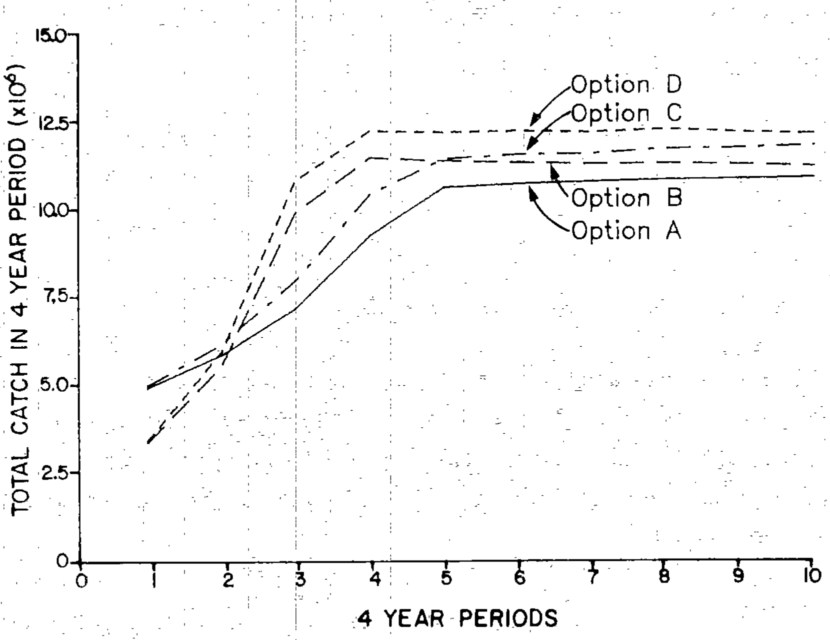

Figure 40. Projected chum catches under the rebuilding options (totalled over 4-year periods).

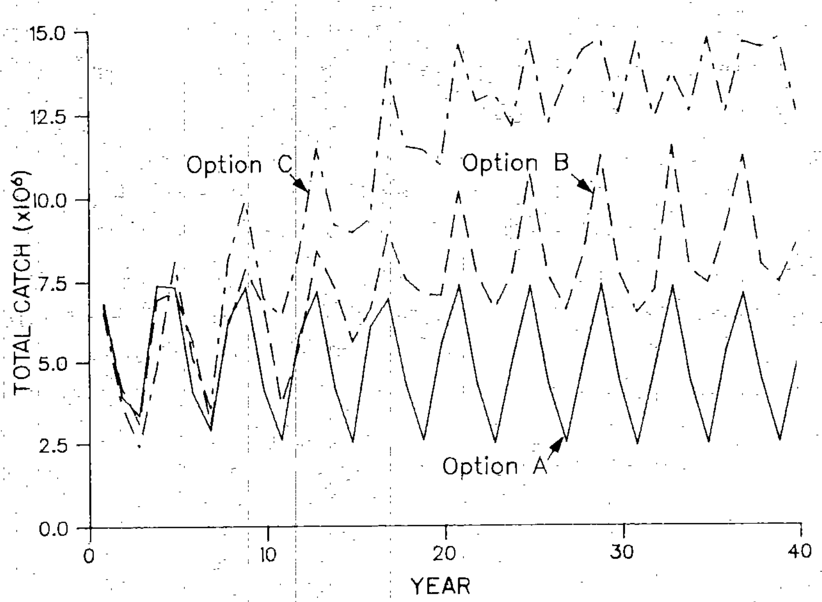

Figure 41. Projected sockeye catches under the production potential options.

The NPV* of the total catch was $1410 million for Option A, $1600 million for Option B and $1762 million for Option C.

10.5 Summary

Table 35 summarizes the average Canadian catch and escapement of South Coast sockeye, pink and chum salmon for each option. The model projections of catch and escapement indicate that there is the potential for 7 to 14 million sockeye, 12 to 17.5 million pink and 4.5 to 6 million chum salmon to return to the Inner South Coast production areas annually, depending on the option.

The NPV* of the catch includes construction and operating costs of the enhancement projects (Table 35). All the rebuilding options would provide a higher NPV than projected in Option A, except for the combined harvest and enhancement option which provides the highest catch in the long term, but also has the highest immediate costs. The greatest benefits are projected for Production Potential Options B and C that assume sockeye salmon production is not limited by cyclic dominance. The highest value occurs when the harvest strategy is directed at rebuilding the low cycles (Option C).

In summary, the analysis suggests that stock rebuilding options are worthwhile in the long term. The analysis also indicates there are substantially higher benefits, specifically for sockeye salmon, with the options that assume there is no cyclic dominance compared to those with cyclic dominance. Given the large difference in projections, the issue of cyclic dominance is worth investigating to determine whether this potential is achievable.

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*NPV = net present value of the projected 40 years of harvest, discounted at 10% per year.

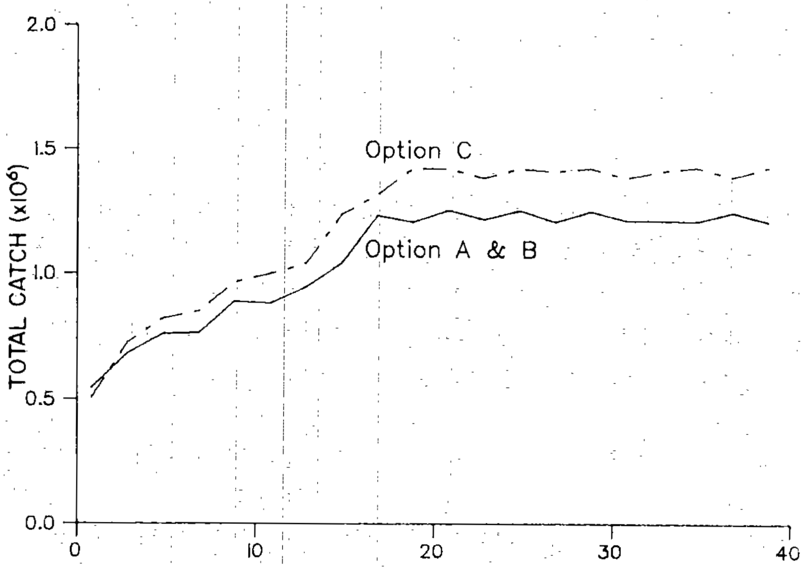

Figure 42. Projected catches of even-year pink salmon under the production potential options.

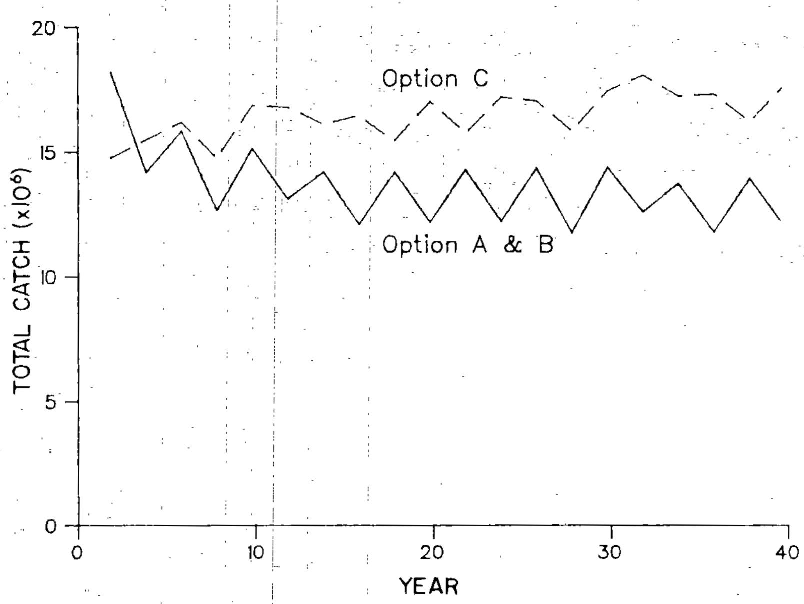

Figure 43. Projected catches of odd-year pink salmon under the production potential options.

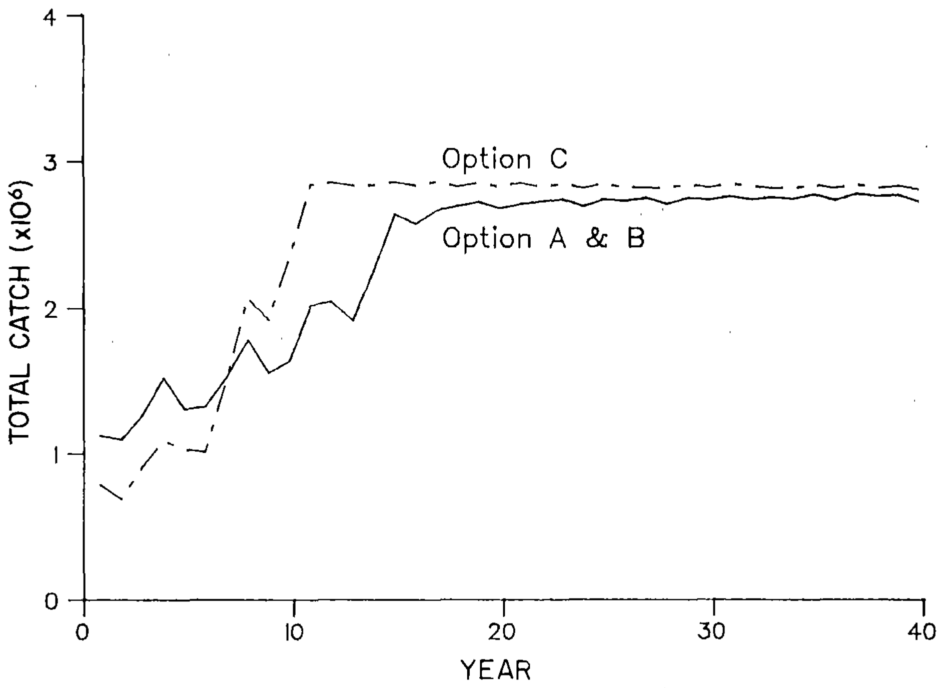

Figure 44. Projected chum catches under the production potential options.

Table 35. Summary of results for options.

Options	Average Catch (thousands)*			Average Escapement (thousands)			Average Total Run (thousands)			Net Present** Value (millions)
	Sockeye	Pink	Chum	Sockeye	Pink	Chum	Sockeye	Pink	Chum	
Option A	4921	7347	2331	2032	4917	2908	6953	12264	5239	1410
Rebuilding Options										
Harvest Managment (B)	5811	8254	2486	3244	8272	3189	9055	16526	5675	1456
Approved Enhancement (C)	5079	7632	2519	2059	5071	2977	7138	12703	5496	1417
Harvest Management and Enhancement (D)	5939	8445	2676	3256	8408	3273	9195	16853	5949	1410
Uncertainty Options										
(Common Stock Recruitment for All Years)										
Typical Management (B)	7366	7347	2331	3489	4917	2908	10855	12264	5239	1600
No Cycle Management (C)	8976	8310	2148	5128	9186	2528	14104	17496	4676	1762

* Reflects Canadian catch and does not include US interceptions of Fraser stocks.
**NPV = Net present value of the projected 40 years of harvest, discounted at 10% per year.

11. REFERENCES

1. Wong, F.Y.C. and M.A. Birch, 1984. Yearly catches of Pacific Salmon in British Columbia, 1951-1982. Canadian Data Report of Fisheries and Aquatic Sciences, No. 453.

2. DFO. 1987. Operational Framework. Port Hardy/Alert Bay Subdistricts. Unpublished Report.

3. Escapement Tables 1950 - 1984 by system. Computer printout from South Coast database.

4. Kadowaki, R., N. Schubert, L. Lapi, T. Perry, K. Pitre, D. Peacock and T. Shardlow. 1986. Assessments of B.C. coho stocks. Can. Tech. Rep. Fish. Aquat. Sci. No. .

5. Tautz, A. 1985. Vancouver Island steelhead. B.C. Fisheries Branch. Pers. comm.

6. Anderson, A.D. and C.N. MacKinnon. 1979. The 1977 return of pink salmon stocks to the Johnstone Strait study area and prospects for 1979. Department of Fisheries and Oceans Technical Report No. 893.

7. Riddell, B., FRB, pers. comm.

8. DFO. 1987. Operational Framework. Campbell River Subdistrict. Unpublished Report.

9. Anderson, A.D. 1977. The 1976 return of chum salmon stocks to the Johnstone Strait - Fraser River study area and prospects for 1977. Technical Report Series Pac/T-77-12.

10. Wong, F.Y.C., G. Serbie and K. Simpson. 1985. Overview of salmon escapements in British Columbia, 1953 - 1983. Part 1. Coho Salmon. Can. Data Rep. Fish. Aquat. Sci. No. 548.

11. Marshall, D.E., R.F. Brown, V.D. Chahley and D.G. Denortier. Preliminary catalogue of salmon spawning escapements of statistical areas 19 and 20 (Victoria to Sooke). Data Report Series Pac/D-77-9.

12. Marshall, D.E., R.F. Brown, V.D. Chahley and D.G. Denortier. Preliminary catalogue of salmon streams and spawning escapements of statistical area 11 (Seymour to Belize Inlets). Data Report Series Pac/D-77-5.

13. Farwell, M.K., N.D. Schubert, K.H. Wilson and C.R. Harrison. 1987. Salmon escapements to streams entering Statistical Areas 28 and 28, 1951 to 1987. Can. Data Rep. Fish. Agri-Sci. 601: 166 p.

14. Vernon, E.H., A.S. Hourston and G.A. Holland. 1964. The migration and exploitation of pink salmon runs in and adjacent to the Fraser River Convention Area in 1959. IPSFC Bulletin XV. New Westminster, B.C. Canada.

15. DFO. 1986. Pacific Region Salmon Stock Management Plan. Discussion Document 1986. Volume L. Coho.

16. Ward, F.J. and P.A. Larkin. 1964. Cyclic dominance in Adams River sockeye salmon. IPSFC Progress Report No. 11. 116 p.

17. Vernon, E.H. 1982. Fraser River sockeye: the stocks and their enhancement.- Mimeo Report, Canada Department of Fisheries and Oceans, Pacific Region. 53 p.

18. Walter, C.J. and M.J. Staley. 1987. Evidence against the existence of cyclic dominance in Fraser River sockeye salmon (Oncorhynchus nerka). In H. Smith, L. Margolis and C. Wood (eds.). Sockeye Salmon (Oncorhynchus nerka) Population Biology and Future Management (Proceedings of the International Sockeye Salmon Symposium - Sockeye '85', held at Nanaimo, British Columbia, Nov. 19-22, 1985). Can. Spec. Publ. Fish. Aquat. Sci. 96.

19. Mysak, L.A. 1986. El Nino, interannual variability and fisheries in the northeast Pacific Ocean. Can. J. Fish. Aquat. Sci. 43:464-497.

20. Serbic, G., A. Alexander, F.Y.C. Wong and M. Birch, 1985. Index of salmon spawning streams of British Columbia. Can. Data Rep. Fish. Aquat. Sci. No. 506.

21. International Pacific Salmon Fisheries Commission. Annual Reports, 1970 to 1984. New Westminster, Canada.

22. International Pacific Salmon Fisheries Commission. Annual Report 1983. New Westminster, Canada.

23. 1985 Canadian Agency Report on Chinook Salmon (correction through June 2, 1986). Prepared for Pacific Salmon Commission. An Appendix to the 1985 Report of U.S./Canada Joint Technical Committee on Chinook Salmon.

24. A. Tautz. 1985. Fraser River Steelhead B.C. Fisheries Branch, pers. comm.

25. English, K.K., W.J. Gazey, T.F. Shardlow and M.A. Labelle. 1987. Development of troll fishery management models for southern British Columbia. Can. Tech. Rep. Fish. Aquat. Sci. No. 1526.

26. Salmonid Enhancement Program. 1984. SEP Annual Report. Prepared for DFO and B.C. Ministry of the Environment.

27. Enhancement Planning Information Control Data Base. DFO VAX.

28. Rosberg, G.E., K.J. Scott and R. Rithaler. 1986. Review of the International Pacific Salmon Commission's sockeye and pink salmon escapement facilities on the Fraser River. Prepared for Bio Program Unit, Enhancement Operations, SEP, DFO, Vancouver, B.C.

29. Paish, H. and Associates. 1985. Summary habitat data prepared under contract for DFO, Vancouver.

30. Lill, A.F., A. Tautz, B. Shepherd, J. Wild, D. Marshall, W. Schouwenberg and B. Tutty. 1983. Opportunities for salmonid enhancement projects in B.C. and the Yukon. S.E.P. December.

31. Gazey, W.J., K.K. English and M.J. Staley. 1987. South Coast management model: Second Edition. Prepared for DFO under contract by LGL Ltd.

32. Beacham, T.D., and P. Starr. 1982. Population biology of chum salmon (Oncorhyncus keta) from the Fraser River, British Columbia. Fish Bull. 80: 813 - 825.

12. GLOSSARY

Actively-Managed Stocks – salmon stocks that receive priority with regard to management decisions governing the fisheries; that is, they will cause a fishery to be altered if conservation measures are required. Actively-managed stocks are usually abundant, economically valuable stocks.

Backplanting – returning artificially-propagated fry/smolt to site of origin (see "satelliting").

Bar fishery – a fishery from a sand bar in a river.

Beach tie-off – securing the end of a seine net by tying the end to a tree or rock on a beach while the net is fed out from the seine boat.

Boat-day – one boat involved in fishing for one day or portion thereof.

Box boundaries – boundaries of an area in an inlet or strait between which fishing is not permitted, to protect pre-spawning adult fish. See also "Stream Boundaries".

Bunt mesh – the bottom strip of mesh in a seine net. Regulations govern the size of the bunt mesh so that (in theory) small fish can escape as the seine is pursed.

Buy-back program – a publicly-funded purchase of existing fishing licences and associated boats for the purpose of retiring the fishing capacity of the vessel from the fleet.

By-catch – catch of non-target species.

Carcass weir – device, usually a fence, across a stream or channel where drifting or spent fish accumulate and can be enumerated and removed.

Cassette incubator – container consisting of numerous compartments, each large enough for one or a few salmonid eggs, enclosed with a porous cover to permit water flow. Used for incubating eggs in a river or lake environment.

Catch ceiling - a regulatory constraint on the maximum number of fish which can be caught by a particular fishery.

Catch per drift - catch during one drift of a gillnet.

Catchability coefficient (q) - the fraction of a fish stock caught by a defined unit of fishing effort.

CEDP - Community Economic Development Project.

Clean-up fisheries - usually terminal, single-stock fishery intended to take fish surplus to escapement requirements at the end of the run.

Closures - termination of a fishery in a specified area during a specified time.

Counting weir - device, usually a fence, used to temporarily stop migrating adult salmonids to permit enumeration.

Cycle - refers to life cycle of salmon from egg to spawning adult.

Cyclic dominance - the tendency for each sockeye spawning area to produce larger numbers of fish in some years and not in others. The dominant cycle years are repeated every four years in the Fraser River. Others have 5 year cycles.

Dead pitching - pitching salmon carcasses on to stream banks to count them and/or recover tags.

Directed fishery - commercial fishery directed at a specific stock by time or space.

Discount rate or **social discount rate** - a factor that is used like an interest rate to reduce values occurring in the future to their equivalent value in the present. Discount rates are used in the calculation of net present values (NPV).

Diversion rate - the proportion of returning salmon (generally referring to sockeye salmon) that returns, for example, to the Fraser via Johnstone Strait.

Donor stocks - particular population of salmonids from which eggs and/or milt are taken for the purpose of enhancing the same population or for transplanting to other streams.

Drifted gill net - a gill net fished without anchor or attachment to shorelines.

Effort response - a change in the number of active fishermen (effort) in response to a change in catch success.

Emergence - stage in salmonid's life when incubation is complete and young fish emerge from the gravel and begin to swim actively in search of food.

Enhancement - techniques used to increase the production of salmonid stocks through intervention by man. May pertain to fish culture techniques, stream improvements, etc.

Enumeration fence - see "counting weir".

Environmental loss - loss of potential escapement causing failure to meet target escapement, because of environmental variability affecting survival rates (ocean processes, flooding, freezing, etc.).

Enzootic - of a disease, peculiar to or constantly present in a locality.

Epizootic - of a disease, temporarily prevalent.

Escapement - number of fish which survive all fisheries and are estimated to be on the spawning grounds.

Exploitation rate - the probability that a fish will die from fishing during a specified period. Also, the proportion of a group of fish (usually total stock) that are removed by fishing during a period.

Exploratory opening - see Test Dip Fishery.

EXPO '86 - transportation and communications exposition held in Vancouver in 1986. It attracted large numbers of tourists to British Columbia.

Fishery - a fish harvesting activity that is defined by some combination of gear, area, time and/or target species.

Fixed catch approach - management strategy used in a mixed-stock fishery where the catch is held to an absolute number (catch ceiling). The underlying assumption is that stock abundance is increasing or stable, otherwise the ceiling has to be adjusted. (The latter strategy then resembles the fixed harvest rate approach.)

Fixed harvest rate approach - management strategy used in mixed-stock fishery. It is assumed that harvest rate can be fixed at a constant level (proportion of the available stocks) by constraining time spent fishing or the amount of fishing gear used in a given area for a given time.

Flow storage works - dam or works to store water during high-flow periods for release during low-flow periods.

Forgone catch - fish in excess of those expected to return to spawn in a given stock, and therefore not caught, resulting in escapement higher than target.

Fry - a stage in the life of a fish from the time it starts actively swimming and feeding to age 14 days.

Gurdie - a winch that is used to raise and lower trollers' lines.

Hails on the grounds - counts made by Fishery Officers on patrol vessels or charter patrolmen hailing commercial fishermen while on fishing grounds.

Hanging lakes - lakes formed by glacial scour, frequently above valley bottom or fjord.

Harvest rate - the harvest proportion of a particular group of fish in a specified area over a specified time (also defined by species, sex, cohort, harvesting fishery, etc.).

Incidental catch - catch of fish other than the target species.

Incubator – a unit constructed to hold fertilized eggs until hatching or emergence.

Index stock – salmon stock deemed to be representative of adjacent salmon stocks. High quality data are usually gathered for this stock.

Indicator stock – see "index stock".

Inside/Outside – refers to inside (e.g., Johnstone Strait) and outside (West Coast and Juan de Fuca Strait) of Vancouver Island.

Interception fishery – a fishery which captures (intercepts) fish from a number of stocks (i.e., is not stock-specific). This term is often used to refer to international interceptions, but in this report it is often defined synonymously with mixed-stock fishery. Although mixed-stock problems may result from interception fisheries the two are not really synonymous. The intentive understanding of interception fishery is that it differs from terminal fisheries in that stocks are intercepted before reaching their natal streams. It could be possible to have an interception fishery on a single stock.

IPSFC – International Pacific Salmon Fisheries Commission.

Key stock – a large or otherwise important salmon stock for which better quality data are available or will be obtained in the future, equivalent to an indicator or index stock.

Key stream – a stream in which one or more key (index) salmon stocks spawn.

Known-stock fishery – commercial fishery targeted on a specific stock of salmon.

Mainstem – principal course of river.

Management to escapement – management of fisheries in a manner that ensures (within technical limits) that the target escapement reaches the spawning area.

Management uncertainty loss – loss of potential escapement to a fishery causing failure to meet target escapement, because of inaccurate estimation of run size or escapement.

Mean return rate – a measure of average spawning yield, (yield may be in juvenile/adult spawners, juvenile/adult catch, etc.). See also productivity.

Migrant releases – release from hatchery of salmonids that are smolted and will migrate downstream.

Mixed-harvest loss-failure – loss of potential escapement to incidental harvest in mixed-stock fishery. This can only be considered a loss if it results in less than target escapement.

Net present value (NPV) – abbreviation for "present value of net economic benefits". Future streams of project benefits and costs are estimated and the difference is the future stream of net economic benefits. This stream is translated into a present value by discounting future values by the social discount rate. The resulting figure is called the "net present value". In the Salmon Stock Management Plan the future stream of benefits and costs are calculated over a period of 40 years. The only costs considered are those for harvesting and processing (management, capital and operating costs are not included).

Objective – a statement of intent about resource use that is specified with respect to species, area, fishery, or resource uses.

Odd/Even – refers to discrete pink runs which occur in either odd or even years.

Open sets – refers to seine sets where a skiff or running line is used to bring the end of the net back to the boat rather than tying off at the shore.

Opening – date and time set by DFO for the commencement of a specific fishery.

Optimum escapement – an estimate of the numbers of spawners that will meet (but not exceed) the capacity of the river system.

Outplanting – see "transplanting".

Passively-managed stocks – salmon stocks not directly managed but affected incidentally as the result of active management of other stocks. The fishery will not be altered to protect these stocks, by definition.

Pathogenesis - the origin and development of a disease.

Pieces - individual fish (in a commercial catch).

Pink corridor - this is a boundary regulation in Johnstone Strait to conserve Johnstone Strait and Strait of Georgia pink stocks while fishing for Fraser River sockeye. A ribbon boundary closes the shore on the mainland side of the strait in a half mile wide strip from tidewater. The ribbon strip switches to the Vancouver Island side of the Strait at Chatham Point, and continues to end of fishing area. This regulation is usually in place during the first three weeks in August.

PIP - Public Involvement Project.

Policy - a statement of intent about resource use that has a national or regional scale.

Pre-migrant - young salmon prior to migration downstream to marine environment.

Presmolt - usually pertains to salmonid species that rear for extended periods of time (one year or more) in fresh water; the stage during which the fish is a yearling but has not yet smolted.

Production - the number of fish produced, often used in a stock-specific sense or for a particular enhancement project.

Production release - release of salmonids, usually high numbers, from an enhancement facility, that have been raised using standard fish culture techniques (as opposed to experimental releases).

Productivity - the rate of production, usually in terms of returning adults per spawner (stock specific).

Qualla - refers to external chum colour (and therefore quality). Falls between brights (high quality) and darks (low quality). Also known as semi-brights.

Raceway - rectangular fish-rearing containers with high exchange rates of water and vertical walls.

Rack fisheries - commercial fishery targeted on excess hatchery stock. This may occur at the hatchery, and does not necessarily require boats.

Ribbon boundary - a specified boundary parallel to a shore of an inlet or pass which is closed to fishing to protect a portion of the migrating salmon.

Satelliting - an enhancement strategy whereby eggs and milt from a particular salmonid stock are incubated and reared in a central facility or different stream, then returned to donor stream.

Scale pattern analysis - analysis of the patterns on scales of fish to distinguish between stocks and to identify age composition.

Sea pen - net enclosures suspended in sheltered saltwater bays containing salmon for rearing purposes.

Semi-bright - see "qualla".

SEP biostandard - criteria used to estimate production of salmonid reproduction in the wild or in various types of enhancement facilities. Includes estimates of fecundity and survival during each life stage for each species.

Shaker abundance - numbers of undersized salmon available for capture by sport and commercial fishermen.

Shaker catch - numbers of undersized salmon caught and released by sport and commercial fishermen.

Shaker mortality - shakers which do not survive the catch and release process.

Silver bright - type of mature salmon (chum) which has a silvery appearance, and is classified as top quality in the fishing industry.

Smolts - a juvenile salmon that has undergone or is undergoing physiological and behavioural changes in preparation for migration from fresh to salt water.

Spawning channel - an artificial channel constructed for returning adults to spawn in, with ideal gravel and flow conditions.

Squishers – undersized fish caught by commercial seine fishermen which are gilled in the net, and then crushed as the net is wound onto the drum.

Stock – fish of a single species that spawn in a particular geographical area at the same time.

Strategy – a collection of management actions for meeting an objective.

Straying – returning adults which stray from normal migration route and spawn in an area different from the one in which they originated.

Stream boundaries – boundaries of an area around the mouth of a river within which fishing is not permitted, to protect pre-spawning adult fish. See also Box Boundaries.

Subdominant year – the second highest production year of a stock (see "cyclic dominance").

Subyearling – stage in salmonid's life during the first year of rearing prior to the end of the calendar year (see "yearling").

Surplus to escapement – the number of returning salmon beyond estimated optimum or target escapement. These fish are available for harvest and therefore constitute the allowable catch.

Systemic – of the bodily system as a whole.

Target – refers to the level of escapement at which management plans are aimed. It is the best estimate of "optimum" currently available.

Terminal fisheries – fishery conducted near the head of inlets or mouths of rivers where discrete stocks can be fished.

Test dip fishery – one-day opening of commercial fishery to assess stock strength.

Test harvest loss – loss of potential escapement causing failure to meet target escapement, because of test fishery operation conducted to estimate run size.

Total stock - catch plus escapement.

Transplanting - releasing hatchery-raised juveniles in a stream other than the one in which the parent stock originated.

Upwelling gravel box - box filled with gravel for incubating salmonid eggs with water flowing through from bottom to top.

Voluntary emergence - pertains to incubation of fish eggs in an artificial container where fry swim out of incubation media of their own volition. In non-voluntary systems, fry are manually transferred from incubating container.

Window - a period of time during which an activity occurs.

Yearling - a stage in a salmonid's life reached when a new calendar year begins during juvenile rearing period (a subyearling becomes a yearling on January 1st).

APPENDIX I

PRESENT STOCK STATUS FOR INNER SOUTH COAST AND FRASER RIVER

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	SEYMOUR / BELIZE INLETS CHUM (passive)						
11	Misc. (16 streams)	9600	2800	9500	1980	1900	165000
					1981	0	
					1982	11000	
					AVG	4300	

Misc. Streams
Bamford / Lee / Whelakis Crs., Chief Nollis Cr., Jap Cr.
Quashella Cr., Rainbow Cr., Waamtz Cr., Warner Bay Cr.,
Taaltz Cr.,Waump Cr.,Seymour R.,Schwartzenberg Lake Cr.,
Pack Lake Cr., Lassiter Bay Cr.,Eva Cr., Driftwood Cr.

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	KINGCOME / WAKEMAN INLETS PINK EVEN (active)						
12	Kingcome R.	25700	14500	117000	1980	20000	100000
					1982	24000	
					1984	2200	
12	Wakeman R.	12100	5400	62200	1980	25000	80000
					1982	35000	
					1984	4000	
12	Embley Cr.	9100	21000	58000	1980	25000	100000
					1982	12000	
					1984	7000	
	PINK EVEN TOTALS (active only)	46900	40900	237200	1980	70000	280000
					1982	71000	
					1984	13200	
					AVG.	51000	
	PINK EVEN (passive)						
12	Carriden Cr.	3500	900	1400	1980	1000	2000
					1982	0	
					1984	0	
	Jennis Bay Cr.	0	100	2000	1980	1000	5000
					1982	1200	
	PINK EVEN TOTALS (passive only)	3500	1000	3400	1980	2000	7000
					1982	2200	
					1984	2200	
					AVG.	2000	
	PINK EVEN TOTALS (passive & active)	50400	41900	240600	1980	72000	287000
					1982	73200	
					1984	15400	
					AVG.	54000	
	KINGCOME / WAKEMAN INLETS PINK ODD (active)						
12	Wakeman R.	29500	26500	173400	1981	180000	80000
					1983	150000	
					1985	105000	
					AVG	145000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	KINGCOME / WAKEMAN INLETS PINK ODD (passive)						
12	Embley Cr.	400	0	100	1981	0	100000
					1983	0	
					1985	50	
12	Kingcome R.	5900	3600	12300	1981	6000	100000
					1983	10000	
					1985	7500	
12	Misc. (5 streams)	0	5	80	1981	0	7000
					1983	0	
					1985	320	

Misc. Streams
Carriden Cr.,Jennis Bay Cr., Bughouse Cr.,Marion Cr.,Huaskin Cr.

PINK ODD TOTALS (passive only)	6300	3600	12500	1981	6000	207000
				1983	10000	
				1985	7900	
				AVG	8000	
PINK ODD TOTALS (active & passive)	35800	30100	185900	1981	186000	287000
				1983	160000	
				1985	112900	
				AVG	153000	

ESCAPEMENTS

KINGCOME / WAKEMAN INLETS
CHUM (passive)

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
12	Embley Cr.	8200	600	100	1980	0	0
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
12	Kingcome R.	19100	11200	22000	1980	10000	150000
					1981	0	
					1982	2300	
					1983	0	
					1984	300	
					1985	400	
12	Mackenzie R.	19100	4000	6600	1980	600	6000
					1981	6000	
					1982	5000	
					1983	3500	
					1984	4800	
					1985	1300	
12	Nimo Cr.	4300	1800	2400	1980	300	5000
					1981	300	
					1982	300	
					1983	400	
					1984	300	
					1985	500	
12	Tsibass Lagoon Cr. (Marion)	6400	400	2700	1980	2500	5000
					1981	3800	
					1982	4500	
					1983	3500	
					1984	400	
					1985	3000	
12	Wakeman R.	8600	2500	5100	1980	500	25000
					1981	1000	
					1982	400	
					1983	400	
					1984	300	
					1985	100	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	KINGCOME / WAKEMAN INLETS						
	CHUM (passive)						
	Misc. (1 stream)	3	100	500	1980	300	5000
					1981	500	
					1982	1000	
					1983	200	
	Misc. Stream				1984	400	
	Huaskin Cr.				1985	500	
	CHUM TOTALS	65703	20600	39400	1980	14200	176000
	(passive only)				1981	11600	
					1982	14500	
					1983	7500	
					1984	6100	
					1985	5300	
					AVG	10000	
	BOND TO KNIGHT INLETS						
	PINK EVEN (active)						
12	Glendale R.	43000	133500	122900	1980	250000	200000
					1982	150000	
					1984	125000	
12	Kakweiken R.	43000	23200	174400	1980	300000	500000
					1982	70000	
					1984	100000	
12	Ahnuhati R.	6200	41500	54600	1980	340000	125000
					1982	85000	
					1984	50000	
	PINK EVEN TOTALS	92200	198200	351900	1980	890000	825000
	(active only)				1982	305000	
					1984	275000	
					AVG	490000	

Stat Area	Stocks	ESCAPEMENTS Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	BOND TO KNIGHT INLETS						
	PINK EVEN (passive)						
12	Ahta Valley Cr.	2300	900	1300	1980	100	20000
					1982	0	
					1984	0	
12	Gilford Cr. (Fraser)	300	400	0	1980	0	0
					1982	200	
					1984	0	
12	Hoeya Cr.	6200	5500	2200	1980	800	10000
					1982	3500	
					1984	400	
12	Kamano Bay Cr.	1900	8400	1000	1980	100	2000
					1982	0	
					1984	0	
12	Klinaklini R.	3500	3900	400	1980	0	0
					1982	0	
					1984	0	
12	Kwalate R.	900	800	0	1980	100	5000
					1982	200	
					1984	200	
12	Lull Cr.	1900	1200	800	1980	600	4000
					1982	700	
					1984	500	
12	Viner Cr.	8100	7200	900	1980	400	2000
					1982	100	
					1984	0	
12	Ahta R. (Waterfall Cr.)	19600	9300	11400	1980	30000	20000
					1982	30000	
					1984	10000	
	Misc. (4 streams)	800	200	300	1980	400	0
					1982	100	

Misc. Streams
McAlister Cr., Matsui Cr., Nigger Cr., Scott Cove Cr.

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	BOND TO KNIGHT INLETS						
	PINK EVEN TOTALS (passive only)	45500	37800	18300	1980	32500	63000
					1982	119800	
					1984	61100	
					AVG	71100	
	PINK EVEN TOTALS (passive & active)	137700	236000	370200	1980	922500	888000
					1982	424800	
					1984	336100	
					AVG	561100	
	BOND TO KNIGHT INLETS PINK ODD (active)						
	Glendale R.	69500	90000	106400	1981	20000	200000
					1983	300000	
					1985	140000	
	Kakweiken R.	56000	45000	299000	1981	600000	500000
					1983	800000	
					1985	500000	
	PINK ODD TOTAL (active only)	125500	135000	405400	1981	620000	700000
					1983	1100000	
					1985	640000	
					AVG	787000	
	PINK ODD (passive)						
12	Ahnuhati R.	5400	12500	7100	1981	7000	125000
					1983	9000	
					1985	13000	
12	Ahta Valley Cr.	3100	1900	1200	1981	2000	20000
					1983	0	
					1985	0	
12	Fraser R.	1900	800	200	1981	1800	0
					1983	0	
					1985	500	
12	Hoeya Cr.	2700	300	2200	1981	800	10000
					1983	2200	
					1985	200	
12	Klinaklini R.	4700	1600	200	1981	0	0
					1983	0	
					1985	200	
12	Kwalate R.	800	300	0	1981	1000	5000
					1983	2300	
					1985	2800	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	BOND TO KNIGHT INLETS PINK ODD (passive)						
12	Lull Cr.	1500	0	1100	1981 1983 1985	300 2600 200	4000
12	Viner R.	1000	300	100	1981 1983 1985	200 1000 100	2000
12	Ahta R. (Waterfall Cr.)	9400	8900	15200	1981 1983 1985	30000 35000 28000	20000
	Misc. (7 streams)	200	100	100	1981 1983 1985	100 300 1300	2000

Misc. Streams
Call Cr., Health Lagoon Cr., McAlister Cr.
Matsui Cr., Nigger R., Scott Cove Cr.,Kamano Bay Cr.

		Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	PINK ODD TOTALS (passive only)	30700	26700	27400	1981 1983 1985 AVG	43200 52400 46300 47300	188000
	PINK ODD TOTALS (active and passive)	156200	161700	432800	1981 1983 1985 AVG	663200 1152400 686300 834000	888000
	BOND TO KNIGHT INLETS CHUM (active)						
12	Viner Cr.	49000	30900	27300	1980 1981 1982 1983 1984 1985	14000 7500 48000 25000 40000 40000	40000

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	BOND TO KNIGHT INLETS CHUM (passive)						
12	Ahnuhati R.	21400	6100	3700	1980	12000	50000
					1981	3000	
					1982	4000	
					1983	7700	
					1984	500	
					1985	0	
12	Ahta Valley Cr.	8200	500	300	1980	800	20000
					1981	100	
					1982	0	
					1983	0	
					1984	0	
					1985	500	
12	Franklin R.	1300	800	300	1980	0	3000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
12	Glendale R.	10200	18900	9700	1980	1000	75000
					1981	300	
					1982	2000	
					1983	2100	
					1984	1500	
					1985	100	
12	Kakweiken R.	18700	3200	4100	1980	3000	75000
					1981	800	
					1982	5800	
					1983	3500	
					1984	3000	
					1985	200	
12	Klinaklini R.	25100	9400	10500	1980	0	100000
					1981	300	
					1982	0	
					1983	700	
					1984	0	
					1985	0	
12	Shoal Hbr. Cr.	5100	1800	1200	1980	400	1000
					1981	300	
					1982	300	
					1983	300	
					1984	5000	
					1985	1000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	BOND TO KNIGHT INLETS CHUM (passive)						
12	Sim R. (Wahshihlas Cr.)	2100	1000	0	1980	0	10000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
12	Ahta R. (Waterfall Cr.)	8100	9400	10400	1980	15000	20000
					1981	200	
					1982	13500	
					1983	300	
					1984	500	
					1985	300	
	Misc. (7 streams)	2000	800	1900	1980	500	2000
					1981	200	
					1982	300	
					1983	600	
					1984	300	
					1985	600	

Misc. Streams
Call Cr., McAlister Cr., Matsui Cr., Nigger Cr.
Scott Cove Cr.. Simoon Sound Cr.. Wahkana Cr.

CHUM TOTALS (passive only)	102200	51900	42100	1980	32700	356000
				1981	5200	
				1982	25900	
				1983	15200	
				1984	10800	
				1985	2700	
				AVG	15000	
CHUM TOTALS (active & passive)	151200	82800	69400	1980	46700	396000
				1981	12700	
				1982	73900	
				1983	40200	
				1984	50800	
				1985	42700	
				AVG	45000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	LOUGHBOROUGH / BUTE SOCKEYE (passive)						
12	Fulmore	2210	1910	4860	1980	100	12000
					1981	800	
					1982	1500	
					1983	1500	
					1984	0	
					1985	1000	
13	Heydon	2290	1960	3800	1980	2000	5000
					1981	4500	
					1982	1000	
					1983	0	
					1984	1000	
					1985	0	
13	Phillips	4340	2420	2420	1980	2500	15000
					1981	5000	
					1982	10000	
					1983	10000	
					1984	1500	
					1985	7100	
	TOTAL SOCKEYE	8840	6290	11080	1980	4600	32000
					1981	10300	
					1982	12500	
					1983	11500	
					1984	2500	
					1985	8100	
					AVG	8300	
	LOUGHBOROUGH / BUTE PINK EVEN (passive)						
13	Apple R.	700	3200	2800	1980	2000	60000
					1982	0	
					1984	0	
13	Cameleon Hbr. Cr.	4900	8200	4000	1980	8000	10000
					1982	1500	
					1984	300	
13	Cumsack R.	700	0	0	1980	0	0
					1982	0	
					1984	0	
13	Teaghahan R. (Eva Cr.)	1000	0	0	1980	0	5000
					1982	0	
					1984	0	
13	Fanny Bay Cr.	100	1100	300	1980	0	0
					1982	0	
					1984	0	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	LOUGHBOROUGH / BUTE PINK EVEN (passive)						
13	Fraser Cr.	800	2300	1500	1980	300	20000
					1982	0	
					1984	0	
12	Fulmore R.	1900	300	0	1980	0	0
					1982	0	
					1984	0	
13	Granite Cr.	8200	6400	400	1980	0	10000
					1982	0	
					1984	0	
13	Grassy Cr.	19300	66300	65000	1980	40000	150000
					1982	40000	
					1984	1000	
13	Gray Cr.	4000	4200	2900	1980	600	10000
					1982	1000	
					1984	300	
13	Heydon Cr.	8200	11100	8900	1980	2500	30000
					1982	1500	
					1984	200	
13	Homathko R.	600	1200	500	1980	0	10000
					1982	0	
					1984	0	
13	Kanish Cr.	2600	5000	1500	1980	0	7000
					1982	0	
					1984	0	
13	Orford R.	400	0	100	1980	0	35000
					1982	0	
					1984	0	
13	Phillips R.	3100	30500	29000	1980	30000	175000
					1982	2500	
					1984	2000	
13	Read Cr.	4200	12300	10100	1980	45000	20000
					1982	3500	
					1984	2500	
13	Stafford R.	2400	10400	2200	1980	1000	20000
					1982	0	
					1984	0	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	LOUGHBOROUGH / BUTE PINK EVEN (passive)						
13	Southgate R.	600	700	0	1980	0	10000
					1982	0	
					1984	0	
13	Wortley Cr. (Forward Hbr.)	1200	24200	11900	1980	75000	75000
					1982	60000	
					1984	8000	
13	Misc. (3 streams)	200	500	0	1980	0	0
					1982	0	
					1984	0	
	Misc. Streams Christie Cr., Thurston Cr., Hemming Lk. Sys.						
	PINK EVEN TOTALS (passive only)	65100	187900	141100	1980	204400	647000
					1982	110000	
					1984	14300	
					AVG	109600	
	LOUGHBOROUGH /BUTE PINK ODD (passive)						
13	Apple R.	19000	22300	25600	1981	5000	60000
					1983	50000	
					1985	1500	
13	Cumsack R.	1500	0	N/O	1981	0	0
					1983	0	
					1985	0	
13	Teaghahan R. (Eva Cr.)	1900	300	N/O	1981	0	5000
					1983	0	
					1985	0	
12	Fulmore R.	900	-	N/O	1981	0	0
					1983	0	
					1985	0	
13	Granite Cr.	0	100	N/O	1981	0	10000
					1983	200	
					1985	0	
13	Gray Cr.	400	200	0	1981	0	10000
					1983	100	
					1985	0	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	LOUGHBOROUGH /BUTE PINK ODD (passive)						
13	Heydon Cr.	700	800	900	1981	0	30000
					1983	100	
					1985	100	
13	Homathko R.	5300	1500	0	1981	0	10000
					1983	0	
					1985	0	
13	Kanish Cr.	0	-	N/D	1981	0	7000
					1983	0	
					1985	0	
13	Orford R.	11200	20700	31100	1981	35000	35000
					1983	2500	
					1985	1500	
13	Phillips R.	32700	35700	71000	1981	70000	175000
					1983	100000	
					1985	21000	
13	Read Cr.	100	100	200	1981	100	20000
					1983	0	
					1985	0	
13	Stafford R.	7400	4400	4000	1981	0	20000
					1983	20000	
					1985	600	
13	Southgate R.	7500	300	1400	1981	0	10000
					1983	2500	
					1985	0	
	Misc.	-	-	0	1981	2000	0
					1983	20000	
					1985	4600	
	PINK ODD TOTALS (passive only)	88600	86400	134200	1981	112100	392000
					1983	195400	
					1985	29300	
					AVG	112300	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	LOUGHBOROUGH / BUTE CHUM (active)						
13	Homathko R.	18500	3300	19600	1980	45000	100000
					1981	1300	
					1982	50000	
					1983	3500	
					1984	10000	
					1985	1500	
13	Orford R.	10300	7600	50600	1980	50000	80000
					1981	100000	
					1982	80000	
					1983	20000	
					1984	15000	
					1985		
13	Southgate R.	8200	6700	36200	1980	100000	250000
					1981	125000	
					1982	150000	
					1983	80000	
					1984	95000	
					1985	75000	
	CHUM (active) TOTALS	37000	17600	106400	1980	195000	430000
					1981	226300	
					1982	280000	
					1983	103500	
					1984	120000	
					1985	76500	
					AVG	167000	
	LOUGHBOROUGH /BUTE CHUM (passive)						
13	Apple R.	1500	1200	7300	1980	5000	20000
					1981	0	
					1982	0	
					1983	100	
					1984	0	
					1985	7500	
13	Cumsack R.	1700	500	0	1980	0	0
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
13	Heydon Cr.	6900	10500	18800	1980	1200	35000
					1981	5500	
					1982	30000	
					1983	3500	
					1984	8000	
					1985	17000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	LOUGHBOROUGH /BUTE CHUM (passive)						
12	Fulmore R.	2800	900	1200	1980	500	10000
					1981	4200	
					1982	0	
					1983	0	
					1984	300	
					1985	6000	
13	Phillips R.	5700	2600	4500	1980	800	20000
					1981	0	
					1982	2000	
					1983	500	
					1984	500	
					1985	400	
13	Stafford R./Fraser Cr.	1200	1400	1400	1980	300	4000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	1000	
13	Village Bay Cr.	3500	1100	1700	1980	4200	5000
					1981	3500	
					1982	0	
					1983	5000	
					1984	300	
					1985	0	
13	Misc. (8 streams)	1600	2200	1900	1980	3400	2000
					1981	14100	
					1982	2300	
					1983	10500	
					1984	11300	
					1985	11900	

Misc. Streams
Chonat Cr., Christie Cr., Evans Cr., Fredrick Arm Cr.
Hemming Lk. Sys., Thurston Cr., Waiatt Cr., White Rock Pass Cr.

		Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	CHUM TOTALS (passive only)	24900	20400	36800	1980	15400	96000
					1981	27300	
					1982	34300	
					1983	19600	
					1984	9100	
					1985	31900	
					AVG	23000	
	CHUM TOTALS (active & passive)	61900	38000	143200	1980	210400	526000
					1981	253600	
					1982	314300	
					1983	123100	
					1984	129100	
					1985	108400	
					AVG	190000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	TOBA INLET & COASTAL AREA PINK ODD (passive)						
15	Brem R.	20800	3000	2800	1981	100	35000
					1983	100	
					1985	0	
15	Klite R.	16900	7200	5800	1981	5000	15000
					1983	200	
					1985	100	
13	Quatum R.	16800	2300	3000	1981	5500	75000
					1983	200	
					1985	1500	
15	Toba R.	36000	21400	7600	1981	0	10000
					1983	0	
					1985	0	
	Misc.	-	-	1600	1981	100	0
					1983	300	
					1985	0	
	PINK ODD TOTALS (passive only)	90500	33900	20800	1981	10700	135000
					1983	800	
					1985	1600	
					AVG	4400	
	TOBA INLET CHUM (active)						
15	Okeover R.	1700	800	2100	1980	3000	6000
					1981	7200	
					1982	5100	
					1983	4500	
					1984	7200	
					1985	6500	
15	Toba R.	30800	7500	4400	1980	0	90000
					1981	0	
					1982	2500	
					1983	10000	
					1984	8000	
					1985	0	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	TOBA INLET						
	CHUM TOTALS (active only)	32500	8300	6500	1980	3000	96000
					1981	7200	
					1982	7600	
					1983	14500	
					1984	15200	
					1985	6500	
					AVG	9000	
	CHUM (passive)						
15	Brem R.	4000	1500	1200	1980	0	15000
					1981	0	
					1982	0	
					1983	100	
					1984	0	
					1985	0	
15	Forbes Cr.	4700	500	900	1980	600	5000
					1981	700	
					1982	0	
					1983	500	
					1984	100	
					1985	400	
15	Klite R.	3300	2500	1100	1980	0	15000
					1981	1000	
					1982	400	
					1983	100	
					1984	600	
					1985	0	
13	Quatum R.	2900	1100	2600	1980	0	8000
					1981	1200	
					1982	2500	
					1983	0	
					1984	0	
					1985	200	
15	Salt Lagoon Cr.	600	100	0	1980	0	0
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
15	Theodosia R.	15800	5700	3800	1980	1000	21000
					1981	4500	
					1982	2000	
					1983	2500	
					1984	3000	
					1985	3500	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	TOBA INLET CHUM (passive)						
15	Little Toba R.	1000	2900	1700	1980	1500	20000
					1981	2000	
					1982	2500	
					1983	0	
					1984	0	
					1985	0	
	Misc. (4 streams)	1000	650	500	1980	1000	0
					1981	1100	
					1982	0	
					1983	0	
					1984	700	
					1985	1000	

Misc. Streams
Pendrell Sound Cr., Refuge Lagoon Cr.,
Small Cr., Tahumming R.

CHUM TOTALS (passive only)	33300	14950	11800	1980	4100	84000
				1981	10500	
				1982	7400	
				1983	3200	
				1984	4400	
				1985	5100	
				AVG	6000	
CHUM TOTALS (passive & active)	65800	23250	18300	1980	7100	180000
				1981	17700	
				1982	15000	
				1983	17700	
				1984	19600	
				1985	11600	
				AVG	15000	

Stat Area	Stocks	ESCAPEMENTS Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	JERVIS INLET SOCKEYE						
16	Sakinaw L.	4840	4510	6320	1980	2800	14000
					1981	3000	
					1982	3400	
					1983	1600	
					1984	1120	
					1985	2300	
					AVG	2370	
	JERVIS INLET PINK ODD (passive)						
16	Brittian R.	3000	1100	100	1981	900	5000
					1983	100	
					1985	300	
16	Deserted R.	29000	6600	11300	1981	7000	20000
					1983	200	
					1985	0	
16	Lang Cr. (Wolfson)	600	200	0	1981	0	6000
					1983	0	
					1985	300	
16	Skwawka R.	97000	102800	11800	1981	20000	75000
					1983	4800	
					1985	6000	
16	Tzoonie R.	900	3200	500	1981	0	3000
					1983	0	
					1985	100	
16	Vancouver R.	2200	1400	600	1981	1500	17000
					1983	1800	
					1985	2500	
	Misc.	-	-	200	1981	0	4500
					1983	100	
					1985	100	
	PINK ODD TOTALS (passive only)	132700	115300	24500	1981	29400	130500
					1983	7000	
					1985	9300	
					AVG	15000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	JERVIS INLET CHUM (active)						
16	Deserted R.	10600	6100	18600	1980	20000	25000
					1981	15000	
					1982	10000	
					1983	7000	
					1984	15000	
					1985	25000	
16	Pender Hbr. Crs.	4500	4100	7800	1980	5400	17000
					1981	3200	
					1982	1100	
					1983	10100	
					1984	17200	
					1985	17000	
16	Saltery Bay Crs.	4500	12600	13100	1980	25000	12000
					1981	15000	
					1982	2200	
					1983	10000	
					1984	8500	
					1985	16000	
15	Sliammon Cr.	13300	4800	7200	1980	11000	14000
					1981	12000	
					1982	8000	
					1983	16000	
					1984	28000	
					1985	45000	
16	Tzoonie R.	17000	15200	11200	1980	20000	25000
					1981	23000	
					1982	19500	
					1983	12000	
					1984	20000	
					1985	30000	
	CHUM TOTALS (active only)	49900	42800	57900	1980	81400	93000
					1981	68200	
					1982	40800	
					1983	55100	
					1984	88700	
					1985	133000	
					AVG	78000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	JERVIS INLET CHUM (passive)						
16	Angus Cr. (Pete)	1300	2200	1300	1980	1600	2000
					1981	1600	
					1982	500	
					1983	600	
					1984	3000	
					1985	2400	
16	Brittian R.	1400	600	200	1980	500	5000
					1981	200	
					1982	0	
					1983	200	
					1984	100	
					1985	300	
16	Carlson Cr. (Chamberlain Cr.)	500	1200	400	1980	0	1000
					1981	1000	
					1982	0	
					1983	400	
					1984	600	
					1985	1500	
16	Chapman R.	N/A	N/A	N/A	1980	500	4000
					1981	600	
					1982	0	
					1983	400	
					1984	200	
					1985	300	
16	Gray Cr. (Shannon)	900	700	500	1980	0	1000
					1981	600	
					1982	0	
					1983	200	
					1984	200	
					1985	200	
16	Jefferd Cr. (Thunder Bay Cr.)	1100	200	1100	1980	0	
					1981	2900	
					1982	0	
					1983	1700	
					1984	0	
					1985	900	
16	Kelly Cr.	400	200	900	1980	1400	
					1981	300	
					1982	1000	
					1983	2600	
					1984	7500	
					1985		

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-57	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	JERVIS INLET CHUM (passive)						
16	Lang Cr. (Wolfson)	5600	2800	1700	1980	0	2500
					1981	3000	
					1982	1000	
					1983	300	
					1984	3500	
					1985	3200	
16	Mouat Cr.	0	700	200	1980	0	
					1981	0	
					1982	0	
					1983	0	
					1984	500	
					1985	900	
16	Myrtle Cr.	600	400	500	1980	500	
					1981	400	
					1982	200	
					1983	2500	
					1984	700	
					1985		
16	Sakinaw Lk. Crs.	1700	1200	200	1980	100	500
					1981	100	
					1982	0	
					1983	100	
					1984	100	
					1985	0	
16	Skwawka R.	2300	1500	2200	1980	2000	25000
					1981	3000	
					1982	1200	
					1983	2000	
					1984	2000	
					1985	11000	
16	Snake Cr.	1100	800	200	1980	500	1500
					1981	1600	
					1982	100	
					1983	400	
					1984	1500	
					1985	900	
16	Storm Cr.	UN	200	300	1980	2200	2000
					1981	2500	
					1982	600	
					1983	400	
					1984	2300	
					1985	5000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	JERVIS INLET CHUM (passive)						
16	Vancouver R.	4100	1400	2100	1980	2500	5000
					1981	2000	
					1982	0	
					1983	0	
					1984	1200	
					1985	3000	
16	Whittal Cr.	200	1100	2700	1980	3800	
					1981	2500	
					1982	2200	
					1983	4500	
					1984	6500	
					1985		
	Misc. (4 streams)	600	700	1500	1980	2800	
					1981	2650	
					1982	1100	
					1983	2300	
					1984	31200	
					1985	12400	

Misc. Streams
Deighton Cr., Doriston Cr., Lois Cr., West Lk. Cr.
* Kelly,Myrtle,Wakefield and Whittal included in misc. in 1985

	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
CHUM TOTALS (passive only)	21800	15900	16000	1980	18400	49500
				1981	24950	
				1982	7900	
				1983	18600	
				1984	61100	
				1985	42000	
				AVG	29000	
CHUM TOTALS (passive & active)	71700	58700	73900	1980	99800	142500
				1981	93150	
				1982	48700	
				1983	73700	
				1984	149800	
				1985	175000	
				AVG	107000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	HOWE SOUND & SUNSHINE COAST PINK ODD (passive)						
28	Ashlu R.	1600	4600	2420	1981	0	7500
					1983	100	
					1985	0	
28	Cheakamus R.	35000	194740	6380	1981	3000	300000
					1983	100	
					1985	100	
28	Mamquam R.	2100	23900	8320	1981	1500	15000
					1983	300	
					1985	100	
28	Squamish R.	106300	30000	23000	1981	9000	100000
					1983	1000	
					1985	400	
	Misc.	1100	80	640	1981	500	-
					1983	100	
					1985	100	
	PINK ODD TOTALS (passive only)	146100	253320	40760	1981	14000	422500
					1983	1600	
					1985	700	
					AVG	5400	
	HOWE SOUND & SUNSHINE COAST CHUM (active)						
28	Cheakamus R.	19800	19300	34000	1980	60000	
					1981	40000	
					1982	20000	
					1983	20000	
					1984	50000	
					1985	130000	
28	Mamquam R.	3600	2700	19700	1980	12000	
					1981	5000	
					1982	6000	
					1983	5000	
					1984	15000	
					1985	25000	
28	Squamish R.	36800	17000	68500	1980	150000	
					1981	75000	
					1982	100000	
					1983	50000	
					1984	50000	
					1985	160000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	HOWE SOUND & SUNSHINE COAST						
	CHUM TOTALS (active only)	60200	39000	122200	1980	222000	218400
					1981	120000	
					1982	126000	
					1983	75000	
					1984	115000	
					1985	315000	
					AVG	162167	
	CHUM (passive)						
28	McNab Cr.	0	N/A	0	1980	1200	10000
					1981	1500	
					1982	500	
					1983	300	
					1984	2000	
					1985	1200	
28	Roberts Cr.	100	700	900	1980	1200	1500
					1981	200	
					1982	100	
					1983	1500	
					1984	6500	
					1985	2000	
28	Whispering Cr. (West Bay Cr.)	0	N/A	500	1980	200	1000
					1981	100	
					1982	0	
					1983	300	
					1984	600	
					1985	200	
28	Wilson Cr.	N/A	0	0	1980	300	1000
					1981	100	
					1982	0	
					1983	400	
					1984	500	
					1985	400	
	Misc. (? streams)	0	UN	100	1980	5500	
					1981	6200	
					1982	6600	
					1983	7100	
					1984	31100	
					1985	53800	

Misc. Streams
Chaster Cr. & ?

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	HOWE SOUND & SUNSHINE COAST						
	CHUM TOTALS (passive only)	100	700	1500	1980	8400	131600
					1981	8100	
					1982	7200	
					1983	9600	
					1984	40700	
					1985	57600	
					AVG	21900	
	CHUM TOTALS (active & passive)	60300	39700	123700	1980	230400	350000
					1981	128100	
					1982	133200	
					1983	84600	
					1984	155700	
					1985	372600	
					AVG	184100	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	BURRARD INLET SOCKEYE						
	Misc. (1 stream)	26100	22100	18300	1980		
					1981	11000	
					1982	63308	
					1983	29800	
	Misc. Stream				1984		
	Seymour R.				1985		
	PINK ODD (passive)						
28	Indian R.	105000	63000	29800	1981	40000	100000
					1983	24000	
					1985	7200	
	Misc. (4 streams)	1100	350	300	1981	1500	
					1983	1100	
					1985	0	
	Misc. Streams Capilano R., Seymour R., Lynn Cr., Cypress Cr.						
	PINK ODD TOTALS (passive only)	106,100	63,350	30,100	1981	41,500	100,000
					1983	25,100	
					1985	7,200	
					AVG	24,600	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	BURRARD INLET						
	CHUM (passive)						
28	Indian R.	13700	5900	16400	1980	15000	
					1981	17500	
					1982	24000	
					1983	26000	
					1984	30000	
					1985	30000	
	Misc. (4 streams)	2100	100	4500	1980	500	
					1981	1400	
					1982	400	
					1983	1100	
					1984	1000	
					1985	600	
	Misc. Streams Capilano R., Seymour R.,Lynn Cr.,Cypress Cr.						
	CHUM TOTALS (passive)	15800	6000	20900	1980	15500	50,000
					1981	18900	
					1982	24400	
					1983	27100	
					1984	31000	
					1985	30600	
					AVG	24583	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	UPPER EAST COAST PINK EVEN (passive)						
12	Cluxewe R.	7500	28700	33400	1980	80000	100000
					1982	10000	
					1984	15000	
12	Keogh R.	77000	79000	70000	1980	35000	100000
					1982	30000	
					1984	25000	
12	Nahwitti R.	10500	37500	28700	1980	0	75000
					1982	0	
					1984	0	
12	Guatse R.	55500	78500	53400	1980	10000	100000
					1982	500	
					1984	13000	
12	Shushartie R.	16400	8400	900	1980	3000	200000
					1982	200	
					1984	0	
12	Songhees Cr.	1000	2500	2200	1980	0	5000
					1982	300	
					1984	0	
12	Stranby R.	8000	30300	20700	1980	3500	75000
					1982	0	
					1984	0	
12	Tsulquate R.	3400	6900	23100	1980	4500	35000
					1982	200	
					1984	1000	
	PINK EVEN TOTALS (passive only)	179300	271800	232400	1980	136000	690000
					1982	41200	
					1984	54000	
					AVG	77100	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	UPPER EAST COAST PINK ODD (passive)						
12	Cluxewe R.	10600	2300	900	1981	0	100000
					1983	500	
					1985	3500	
12	Keogh R.	18500	8500	3100	1981	0	100000
					1983	15000	
					1985	32700	
12	Nahwitti R.	9100	500	100	1981	0	75000
					1983	0	
					1985	0	
12	Quatse R.	1300	1000	600	1981	0	100000
					1983	100	
					1985	200	
12	Shushartie R.	2900	1800	0	1981	0	200000
					1983	100	
					1985	0	
12	Songhees Cr.	500	100	0	1981	0	5000
					1983	100	
					1985	0	
12	Stranby R.	4100	200	200	1981	0	75000
					1983	100	
					1985	0	
12	Tsulquate R.	1600	300	1900	1981	400	35000
					1983	0	
					1985	100	
	PINK ODD TOTALS (passive only)	48600	14700	6800	1981	400	690000
					1983	15900	
					1985	36500	
					AVG	17600	
	UPPER EAST COAST CHUM (passive)						
12	Cluxewe R.	3500	800	200	1980	0	5000
					1981	0	
					1982	0	
					1983	100	
					1984	100	
					1985	100	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	UPPER EAST COAST CHUM (passive)						
12	Keogh R.	5000	1900	400	1980	0	15000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	500	
12	Nahwitti R.	1800	300	100	1980	0	5000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
12	Quatse R.	7800	5100	500	1980	0	10000
					1981	0	
					1982	0	
					1983	200	
					1984	300	
					1985	300	
12	Stranby R.	5100	0	100	1980	0	25000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
12	Tsulquate R.	1200	600	200	1980	0	5000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
12	Shushartie R.	800	300	0	1980	0	2000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
	CHUM TOTALS (passive only)	25200	9000	1500	1980	0	67000
					1981	0	
					1982	0	
					1983	300	
					1984	400	
					1985	900	
					AVG	300	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	JOHNSTONE STRAIT SOCKEYE (active)						
12	Nimpkish R.	90500	88500	55350	1980	24000	250000
					1981	60000	
					1982	60000	
					1983	70000	
					1984	50500	
					1985	75000	
					AVG	56600	
	JOHNSTONE STRAIT PINK EVEN (active)						
13	Amor De Cosmos Cr. (Bear R.)	64000	69000	80100	1980	5700	100000
					1982	500	
					1984	2000	
					AVG	2700	
	PINK EVEN (passive)						
12	Adam R.	21500	16900	46000	1980	20000	70000
					1982	4800	
					1984	4000	
13	Hyacinthe Cr.	300	400	0	1980	100	1000
					1982	0	
					1984	0	
12	Hyde Cr.	2600	2400	100	1980	300	5000
					1982	0	
					1984	0	
12	Kokish R.	4500	3900	400	1980	0	10000
					1982	0	
					1984	0	
13	Menzies Cr.	1200	2100	400	1980	100	4000
					1982	0	
					1984	0	
12	Mills Cr.	900	5900	1400	1980	0	10000
					1982	0	
					1984	0	
13	Mohun Cr.	2100	4500	800	1980	0	4000
					1982	0	
					1984	0	
12	Nimpkish R.	8100	6600	6000	1980	7500	50000
					1982	1500	
					1984	0	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	JOHNSTONE STRAIT PINK EVEN (passive)						
12	Salmon R.	6600	8900	7500	1980	2000	35000
					1982	100	
					1984	500	
12	Tsitika R.	10800	300	2100	1980	600	10000
					1982	0	
					1984	0	
12	Pye Cr.	500	400	200	1980	2000	
					1982	100	
					1984	0	
	PINK EVEN TOTALS (passive only)	59100	52300	64900	1980	32600	199000
					1982	6500	
					1984	4500	
					AVG	14500	
	PINK EVEN TOTALS (passive & active)	123100	121300	145000	1980	38300	299000
					1982	7000	
					1984	6500	
					AVG	17300	
	JOHNSTONE STRAIT PINK ODD (passive)						
12	Adam R.	26700	53200	34800	1981	10000	70000
					1983	15000	
					1985	20000	
12	Kokish R.	900	500	200	1981	0	10000
					1983	0	
					1985	0	
13	Menzies Cr.	600	100	N/D	1981	0	4000
					1983	0	
					1985	0	
12	Mills Cr.	200	400	0	1981	0	10000
					1983	0	
					1985	0	
13	Monun Cr.	600	100	N/D	1981	0	4000
					1983	0	
					1985	0	
12	Nimpkish R.	3500	3900	800	1981	0	50000
					1983	100	
					1985	0	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	JOHNSTONE STRAIT PINK ODD (passive)						
13	Salmon R.	10500	16000	10000	1981	6000	35000
					1983	10000	
					1985	1500	
12	Tsitika R.	13000	1600	2800	1981	0	10000
					1983	100	
					1985	0	
12	Pye Cr.	200	50	100	1981	300	1000
					1983	1600	
					1985	0	
	PINK ODD TOTALS (passive only)	56200	75850	48700	1981	16300	194000
					1983	26600	
					1985	21500	
					AVG	21500	
	JOHNSTONE STRAIT CHUM (active)						
12	Nimpkish R.	58000	24300	12700	1980	14000	100000
					1981	10000	
					1982	55000	
					1983	7500	
					1984	38000	
					1985	70000	
	CHUM (passive)						
12	Adam - Eve R.	3100	800	100	1980	0	5000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
13	Hyacinthe Cr.	3800	1600	2200	1980	2500	10000
					1981	2400	
					1982	0	
					1983	2000	
					1984	7500	
					1985	2000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-57	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	JOHNSTONE STRAIT						
	CHUM (passive)						
12	Kokish R.	2000	400	200	1980	0	5000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
13	Salmon R.	5800	1500	900	1980	500	20000
					1981	0	
					1982	100	
					1983	0	
					1984	0	
					1985	0	
12	Tsitika R.	1000	0	100	1980	0	10000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	0	
	Misc. (3 streams)	1800	1300	1100	1980	400	10000
					1981	0	
					1982	700	
	Misc. Streams Open Bay Cr., Tuna R., Pye Cr.						
	CHUM TOTALS (passive only)	17500	5600	4600	1980	3400	60000
					1981	2400	
					1982	800	
					1983	2000	
					1984	7500	
					1985	2000	
					AVG	3000	
	CHUM TOTALS (passive & active)	75500	29900	17300	1980	17400	160000
					1981	12400	
					1982	55800	
					1983	9500	
					1984	45500	
					1985	72000	
					AVG	35400	

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	MID EAST COAST PINK EVEN (passive)						
13	Campbell R.	3800	2300	4400	1980	1500	30000
					1982	500	
					1984	500	
14	Englishman R.	1300	100	0	1980	100	0
					1982	0	
					1984	0	
14	Oyster R.	82000	2000	1000	1980	5000	35000
					1982	200	
					1984	0	
14	Puntledge R.	16000	2300	1300	1980	6200	15000
					1982	700	
					1984	100	
13	Quinsam R.	7500	1200	10300	1980	18200	120000
					1982	2100	
					1984	3700	
14	Tsolum R.	56000	5100	7700	1980	5000	100000
					1982	0	
					1984	0	
	PINK EVEN TOTALS (passive only)	166600	13000	24700	1980	36000	300000
					1982	3500	
					1984	4300	
					AVG	14600	
	MID EAST COAST PINK ODD (passive)						
13	Campbell R.	100	400	1600	1981	2000	30000
					1983	1500	
					1985	350	
14	Englishman R.	900	0	0	1981	0	0
					1983	0	
					1985	0	
14	Oyster R.	5400	1400	800	1981	100	35000
					1983	200	
					1985	200	
14	Puntledge R.	28200	3600	2700	1981	5500	15000
					1983	4000	
					1985	1000	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	MID EAST COAST PINK ODD (passive)						
13	Quinsam R.	2000	2500	9400	1981	21500	120000
					1983	20940	
					1985	32600	
14	Tsolum R.	52000	4300	3600	1981	5100	100000
					1983	1200	
					1985	100	
	Misc.	U/N	U/N	0	1981	0	
					1983	200	
					1985	300	
	PINK ODD TOTALS (passive only)	88500	11800	15500	1981	34200	300000
					1983	28040	
					1985	35050	
					AVG	32400	
	MID EAST COAST CHUM (active)						
14	Puntledge R.	33000	34300	40600	1980	20000	60000
					1981	82000	
					1982	75000	
					1983	75000	
					1984	40000	
					1985	85000	
14	Big Qualicum R.	41000	55500	113300	1980	93200	96000
					1981	82000	
					1982	116000	
					1983	130000	
					1984	92200	
					1985	105700	
14	Little Qualicum R.	43000	42500	53700	1980	60000	121000
					1981	30000	
					1982	70000	
					1983	55000	
					1984	78000	
					1985	152600	
	CHUM TOTALS (active only)	117000	132300	207600	1980	173200	277000
					1981	194000	
					1982	261000	
					1983	260000	
					1984	210200	
					1985	343300	
					AVG	240300	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	MID EAST COAST CHUM (passive)						
13	Campbell - Quinsam R.	2400	1300	5100	1980	5000	10000
					1981	2000	
					1982	0	
					1983	600	
					1984	4000	
					1985	8700	
14	Cook Cr.	4200	1600	3300	1980	3200	5000
					1981	5900	
					1982	3200	
					1983	500	
					1984	1500	
					1985	7100	
14	Cowie Cr. (Cougar)	4200	800	300	1980	0	2000
					1981	600	
					1982	100	
					1983	1200	
					1984	200	
					1985	300	
14	Englishman R.	8100	3600	4800	1980	4000	4000
					1991	400	
					1982	1700	
					1983	200	
					1984	2500	
					1985	2500	
14	French Cr.	800	500	500	1980	200	1000
					1981	0	
					1982	0	
					1983	0	
					1984	0	
					1985	500	
14	McNaughton Cr.	4400	900	2500	1980	700	2000
					1981	2100	
					1982	600	
					1983	1000	
					1984	500	
					1985	300	
14	Nile Cr.	300	300	100	1980	0	1000
					1981	100	
					1982	0	
					1983	100	
					1984	0	
					1985	100	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	MID EAST COAST CHUM (passive)						
14	Oyster R.	5300	500	400	1980	200	3500
					1981	100	
					1982	100	
					1983	0	
					1984	0	
					1985	100	
14	Rosewall Cr.	3300	1800	1200	1980	5000	2000
					1981	1800	
					1982	1000	
					1983	2000	
					1984	500	
					1985	1400	
14	Tsable R.	7900	6500	4900	1980	6200	7000
					1981	8600	
					1982	1100	
					1983	2000	
					1984	2000	
					1985	1000	
14	Tsolum R.	600	800	100	1980	1000	1500
					1981	11000	
					1982	500	
					1983	11000	
					1984	100	
					1985	200	
14	Waterloo Cr.	1600	600	400	1980	500	2000
					1981	500	
					1982	100	
					1983	200	
					1984	100	
					1985	100	
14	Wilfred Cr. (Coal)	1300	900	1000	1980	1400	2500
					1981	1500	
					1982	100	
					1983	700	
					1984	100	
					1985	300	
	Misc. (3 streams)	200	600	1100	1980	1300	6300
					1981	1100	
					1982	100	
					1983	1500	
					1984	100	
					1985	4600	

Misc. Streams
Hansen Cr., Lymn Cr. (Chef), Trent Cr.

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	MID EAST COAST						
	CHUM TOTALS (passive only)	44600	20700	25700	1980	29700	49800
					1981	36700	
					1982	8600	
					1983	21100	
					1984	11700	
					1985	27200	
					AVG	22500	
	CHUM TOTALS (active & passive)	161600	153000	233300	1980	202900	326800
					1981	230700	
					1982	269600	
					1983	281100	
					1984	221900	
					1985	370500	
					AVG	262800	

Stat Area	Stocks	ESCAPEMENTS Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	LOWER EAST COAST CHUM (active)						
17	Nanaimo R.	48800	20100	35200	1980	50000	60000
					1981	35000	
					1982	45000	
					1983	46400	
					1984	42000	
					1985	50000	
17	Haslam Cr.				1980		10000
					1981		
					1982		
					1983		
					1984		
					1985		
17	Chemainus R.	37600	9200	13200	1980	15000	50000
					1981	22700	
					1982	40000	
					1983	25000	
					1984	35000	
					1985	40000	
	Active Chum Total	86400	29300	48400	1980	65000	120000
					1981	57700	
					1982	85000	
					1983	71400	
					1984	77000	
					1985	90000	
					AVG	74400	
	CHUM (passive)						
17	Bonsall Cr.	2700	300	800	1980	1200	3000
					1981	100	
					1982	0	
					1983	500	
					1984	300	
					1985	300	
17	Bush Cr.	5400	2300	2400	1980	1300	10000
					1981	1300	
					1982	1700	
					1983	3100	
					1984	10500	
					1985	5600	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	LOWER EAST COAST						
	CHUM (passive)						
17	Bonell Cr. (Brunnel)	7000	2200	2900	1980	0	10000
					1981	5500	
					1982	3200	
					1983	1600	
					1984	8600	
					1985	18900	
17	Holland Cr. (103rd)	7000	4600	2900	1980	1500	10000
					1981	1300	
					1982	3300	
					1983	8000	
					1984	8500	
					1985	10500	
17	Nanoose R.	2300	1000	6000	1980	3000	15000
					1981	2300	
					1982	1500	
					1983	6000	
					1984	7000	
					1985	4800	
17	Stocking Cr.	3600	1700	3000	1980	3000	8000
					1981	2700	
					1982	1000	
					1983	4600	
					1984	8700	
					1985	5000	
17	Walkers Cr.	1600	300	500	1980	600	1500
					1981	400	
					1982	0	
					1983	1300	
					1984	1200	
					1985	200	
	Misc. (9 streams)	U/N	U/N	100	1980	0	2500
					1981	400	
					1982	1000	
					1983	1500	
					1984	0	
					1985	500	

Misc. Streams
Chase R., Beck Ck., Bloods Cr., Departure Bay Ck., Holden Ck., Knarston Ck., Hillstone Ck., Porters Ck., Rocky Ck.

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	LOWER EAST COAST						
	CHUM TOTALS (passive only)	29600	12400	18600	1980	10600	60000
					1981	14000	
					1982	11700	
					1983	26600	
					1984	44800	
					1985	45800	
					AVG	25600	
	CHUM TOTALS (active & passive)	116000	41700	67000	1980	75600	180000
					1981	71700	
					1982	96700	
					1983	98000	
					1984	121800	
					1985	135800	
					AVG	99900	

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	SOUTHERN VAN. ISL. CHUM (active)						
18	Cowichan R.	64000	55500	63100	1980	113500	100000
					1981	70000	
					1982	100000	
					1983	70000	
					1984	75000	
					1985	190000	
					AVG	103100	
	CHUM (passive)						
19	Goldstream R.	6800	7200	7600	1980	26500	20000
					1981	32000	
					1982	12000	
					1983	14000	
					1984	21000	
					1985	16500	
18	Koksilah R.	2500	5300	4600	1980	3500	10000
					1981	2000	
					1982	0	
					1983	5000	
					1984	7000	
					1985	8000	
19	Ayum Ck	2230	668	2329 *			1500
20	DeMamiel	12575	10150	11571 *			8000
20	Sooke R.	25000	17300	31714 *			20000
20	San Juan R.	830	1165	1629 *			5000
20	Gordon R.						2000
	CHUM TOTALS (passive only)	9300	12500	12200	1980	30000	66500
					1981	34000	
					1982	12000	
					1983	19000	
					1984	28000	
					1985	24500	
					AVG	24600	
	CHUM TOTALS (passive & active)	73300	68000	75300	1980	143500	166500
					1981	104000	
					1982	112000	
					1983	89000	
					1984	103000	
					1985	214500	
					AVG	127700	

*1970-1976
Escapements from Marshall et. al. 1977. No current information available.

LOWER FRASER SOCKEYE

	ESCAPEMENT 1982 Cycle Year				ESCAPEMENT 1983 Cycle Year				ESCAPEMENT 1984 Cycle Year				ESCAPEMENT 1985 Cycle Year			
	Average 1938-50	Average 1954-66			Average 1939-51	Average 1955-67			Average 1940-52	Average 1956-68			Average 1941-53	Average 1957-69		
CULTUS/PITT																
Cultus Lake	28,632	20,597	1970	15,149	26,776	32,131	1971	9,145	30,079	17,175	1972	10,660	12,424	11,337	1973	858
			1974	9,814			1975	11,478			1976	4,450			1977	353
			1978	7,265			1979	32,045			1980	1,687			1981	1,159
			1982	17,222			1983	19,952			1984	1,147			1985	571
Upper Pitt River	21,123	16,365	1970	6,675	63,919	14,068	1971	15,469	50,944	21,890	1972	13,412	14,097	13,891	1973	11,928
			1974	20,792			1975	39,942			1976	36,530			1977	13,887
			1978	24,835			1979	37,558			1980	17,135			1981	25,327
			1982	8,725			1983	16,858			1984	15,797			1985	3,574
Widgeon Slough	733	909	1970	364	596	665	1971	394	1,349	905	1972	302	1,123	871	1973	427
			1974	1,643			1975	936			1976	1,391			1977	427
			1978	1,600			1979	599			1980	389			1981	572
			1982	515			1983	943			1984	266			1985	801
CULTUS/PITT TOTAL	50,488	37,871	1970	22,188	91,291	46,864	1971	25,008	82,372	39,970	1972	24,374	27,644	26,099	1973	13,213
			1974	32,249			1975	52,356			1976	42,371			1977	14,667
			1978	33,700			1979	70,202			1980	19,211			1981	27,058
			1982	26,462			1983	37,753			1984	17,210			1985	4,946
			AVG	28,650			AVG	46,330			AVG	25,792			AVG	14,971
HARRISON																
Big Silver Creek	16	293	1970	261	115	88	1971	0	7,093	3,931	1972	2,552	1,633	366	1973	270
			1974	837			1975	31			1976	1,642			1977	349
			1978	1,253			1979	119			1980	610			1981	173
			1982	1,919			1983	230			1984	155			1985	106
Harrison River	12,401	21,084	1970	12,675	11,420	19,255	1971	3,790	20,931	7,014	1972	1,399	20,847	19,158	1973	3,060
			1974	16,920			1975	5,987			1976	5,130			1977	2,246
			1978	19,747			1979	45,706			1980	5,092			1981	3,193
			1982	9,189			1983	4,239			1984	1,267			1985	5,097
Weaver Creek	26,800	23,702	1970	6,373	6,465	15,977	1971	2,887	22,006	4,873	1972	15,505	11,049	20,167	1973	27,807
			1974	42,143			1975	12,195			1976	22,867			1977	22,105
			1978	43,989			1979	28,515			1980	33,244			1981	24,138
			1982	237,542			1983	21,024			1984	14,511			1985	17,621
Weaver Channel	U/K	6,541	1970	4,723	U/K	2,887	1971	2,736	U/K	1,910	1972	11,043	U/K	10,763	1973	22,366
			1974	24,664			1975	19,816			1976	28,211			1977	33,040
			1978	32,248			1979	22,888			1980	41,595			1981	19,655

LOWER FRASER SOCKEYE

	ESCAPEMENT 1982 Cycle Year				ESCAPEMENT 1983 Cycle Year				ESCAPEMENT 1984 Cycle Year				ESCAPEMENT 1985 Cycle Year			
	Average 1938-50	Average 1954-66			Average 1939-51	Average 1955-67			Average 1940-52	Average 1956-68			Average 1941-53	Average 1957-69		
			1982	57,932			1983	19,243			1984	45,859			1985	21,839
Misc. Streams	1,071	U/K	1970	0	U/K	U/K	1971	0	U/K	U/K	1972	0	461	U/K	1973	0
			1974	0			1975	0			1976	0			1977	0
			1978	0			1979	0			1980	0			1981	0
			1982	0			1983	261			1984	216			1985	97
HARRISON TOTAL	40,288	51,620	1970	24,032	18,000	38,207	1971	9,413	50,030	17,728	1972	30499	33990	50454	1973	53503
			1974	84,564			1975	38,029			1976	57850			1977	57740
			1978	97,237			1979	97,228			1980	80541			1981	47159
			1982	306,582			1983	44,997			1984	62008			1985	44760
			AVG	128,104			AVG	47,417			AVG	57,725			AVG	50,791
BIRKENHEAD																
Birkenhead River	65,192	51,884	1970	72,760	60,453	47,287	1971	32,672	71,027	62,626	1972	113,097	70,844	42,083	1973	139,295
			1974	173,463			1975	92,928			1976	108,121			1977	43,139
			1978	99,857			1979	78,088			1980	90,922			1981	65,495
			1982	128,771			1983	48,841			1984	42,849			1985	37,612
			AVG	118,713			AVG	63,132			AVG	88,747			AVG	71,385
LOWER FRASER TOTAL SOCKEYE	155968	141375	1970	118980	169744	132358	1971	67093	203429	120324	1972	167970	132478	118636	1973	206011
			1974	290276			1975	183313			1976	208342			1977	115546
			1978	230794			1979	245518			1980	190674			1981	139712
			1982	461815			1983	131591			1984	122067			1985	87318
			AVG	275000			AVG	157000			AVG	172000			AVG	137000

LOWER FRASER PINK	ESCAPEMENT Average 1961-69	Average 1971-79		
EARLY RUNS				
Main Fraser River	648,863	861,204	1981	2,252,368
			1983	3,307,834
			1985	5,248,742
			AVG	3,602,981
Chehalis River	8,942	10,703	1981	169
			1983	452
			1985	0
Coquihalla River	6,318	10,799	1981	24,029
			1983	29,190
			1985	118,921
Jones Creek	3,306	2,967	1981	4,485
			1983	973
			1985	3,095
Misc. Tributaries (includes tribs in Fraser canyon below Hells Gate)	2,190	3,366	1981	14,720
			1983	16,293
			1985	42,421
EARLY PINK TOTAL	669,619	889,039	1981	2,295,771
			1983	3,354,742
			1985	5,413,179
			AVG	3,687,897
LATE RUNS				
HARRISON				
Harrison River	212,358	169,345	1981	314,519
			1983	146,014
			1985	438,022
Weaver Creek	614	858	1981	1,006
			1983	1,439
			1985	3,310
Weaver Channel	200	767	1981	1,287
			1983	1,887
			1985	4772
Total Harrison	213,172	170,970	1981	316,812
			1983	149,340
			1985	446,104
			AVG	304,085

LOWER FRASER PINK	ESCAPEMENT Average 1961-69	Average 1971-79		
CHILLIWACK-VEDDER				
Chilliwack-Vedder R.	209,005	125,010	1981	68,601
			1983	99,240
			1985	95,556
Sweltzer Creek	13,771	11,698	1981	5,213
			1983	9,134
			1985	14,712
Total Chilliwack	222,776	136,708	1981	73,814
			1983	108,374
			1985	110,268
			AVG	97,485
LATE PINK TOTAL	435,948	307,678	1981	390,626
			1983	257,714
			1985	556,372
			AVG	401,571
LOWER FRASER TOTAL	1,105,567	1,196,717	1981	2,686,397
			1983	3,612,456
			1985	5,969,551
			AVG	4,089,468

LOWER FRASER RIVER CHUM

ESCAPEMENTS

Stat Area	Stocks	Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	Tributaries between New West-Douglas Is.	8700	2600	11600	1980	13200	
					1981	23400	
					1982	25200	
					1983	20500	
					1984	31000	
					1985	66200	
					AVG	29917	
	Tributaries between Douglas Is.- Mission	7300	46600	52000	1980	24600	
					1981	42100	
					1982	28100	
					1983	42100	
					1984	29400	
					1985	119700	
					AVG	47667	
	Hatzic Slough	600	400	900	1980	2700	
					1981	4000	
					1982	2200	
					1983	7100	
					1984	11100	
					1985	7400	
					AVG	5750	
	Nicomen Slough	3900	4300	10900	1980	14500	
					1981	25200	
					1982	12300	
					1983	9800	
					1984	31500	
					1985	17600	
					AVG	18483	
	Harrison Lake	300	200	200	1980	200	
					1981	600	
					1982	18400	
					1983	10100	
					1984	3100	
					1985	11400	
					AVG	7300	
	Harrison River	67100	124600	182800	1980	158700	
					1981	235500	
					1982	156300	
					1983	230400	
					1984	309500	
					1985	501000	
					AVG	265233	

LOWER FRASER RIVER CHUM

Stat Area	Stocks	ESCAPEMENTS Ave. 1950-59	Ave. 1960-69	Ave. 1970-79	1980-85		Target
	Vedder-Chilliwack	26600	70500	75700	1980	94000	
					1981	93200	
					1982	71000	
					1983	39900	
					1984	102700	
					1985	154400	
					AVG	92533	
	Tributaries between Chilliwack Hope	1200	1000	1500	1980	800	
					1981	1400	
					1982	1700	
					1983	2100	
					1984	4900	
					1985	7800	
					AVG	3117	
	Tributaries Above Hope	0	0	0	1980	0	
					1981	100	
					1982	0	
					1983	0	
					1984	300	
					1985	600	
					AVG	167	
	Mainstem Fraser	0	69500	700	1980	3500	
					1981	9800	
					1982	5000	
					1983	3000	
					1984	9600	
					1985	15100	
					AVG	7667	
	L. Campbell (Boundary Bay)	400	0	200	1980	200	
					1981	100	
					1982	200	
					1983	400	
					1984	800	
					1985	300	
					AVG	333	
	TOTAL FRASER	115700	319700	336300	1980	312400	700000
					1981	435400	
					1982	320400	
					1983	365400	
					1984	533900	
					1985	901500	
					AVG	478167	

MIDDLE FRASER SOCKEYE

	ESCAPEMENT 1982 Cycle Year Average 1938-50	Average 1954-66			ESCAPEMENT 1983 Cycle Year Average 1939-51	Average 1955-67			ESCAPEMENT 1984 Cycle Year Average 1940-52	Average 1956-68			ESCAPEMENT 1985 Cycle Year Average 1941-53	Average 1957-69		
SETON-ANDERSON																
Gates Creek	N/A	442	1970	68	N/A	1,869	1971	797	6,883	9,621	1972	1,762	78	812	1973	231
			1974	146			1975	788			1976	2,889			1977	1,176
			1978	931			1979	907			1980	4,354			1981	821
			1982	232			1983	927			1984	2,678			1985	1,140
Gates Channel	U/N	N/A	1970	735	U/N	N/A	1971	1,502	U/N	6,284	1972	6,807	U/N	676	1973	668
			1974	1,645			1975	3,768			1976	14,855			1977	1,713
			1978	1,639			1979	4,118			1980	21,140			1981	3,988
			1982	1,977			1983	7,498			1984	26,394			1985	4,664
Portage Creek	N/A	13,047	1970	3,901	40	1,669	1971	281	U/N	91	1972	1,460	200	1,036	1973	4,272
			1974	8,986			1975	3,829			1976	3,800			1977	7,974
			1978	10,230			1979	3,663			1980	1,998			1981	6,086
			1982	23,965			1983	7,945			1984	1,768			1985	2,083
SETON-ANDERSON TOTAL	0	13,489	1970	4,704	40	3,538	1971	2,580	6,883	15,996	1972	10,029	278	2,524	1973	5,171
			1974	10,777			1975	8,385			1976	21,544			1977	10,863
			1978	12,800			1979	8,688			1980	27,492			1981	10,895
			1982	26,174			1983	16,370			1984	30,840			1985	7,887
			AVG	13,614			AVG	9,006			AVG	22,476			AVG	8,704
CHILCOTIN																
Chilko River	32,213	123,196	1970	145,049	47,164	444,323	1971	161,943	447,032	430,318	1972	564,465	182,386	74,390	1973	61,707
			1974	128,131			1975	220,554			1976	364,311			1977	54,322
			1978	151,835			1979	240,294			1980	468,658			1981	35,909
			1982	242,263			1983	331,510			1984	452,968			1985	86,120
Chilko Lake (South End)	N/A	N/A	1970	0	U/K	N/A	1971	12,323	U/K	N/A	1972	2,132	U/K	U/K	1973	0
			1974	14,464			1975	55,144			1976	23,156			1977	0
			1978	7,339			1979	32,400			1980	30,168			1981	0
			1982	11,288			1983	55,061			1984	127,696			1985	2000
Taseko R. & Lk.	500	3,898	1970	0	500	14,544	1971	10,500	3,647	1,651	1972	2,287	2,261	1,874	1973	0
			1974	0			1975	4,394			1976	634			1977	0
			1978	0			1979	0			1980	679			1981	0
			1982	0			1983	1,630			1984	2,771			1985	0
CHILCOTIN TOTALS	32,713	127,094	1970	145,049	47,664	458,867	1971	184,766	450,679	431,969	1972	568,884	184,647	76,264	1973	61,707
			1974	142,595			1975	280,092			1976	388,101			1977	54,322
			1978	159,174			1979	272,694			1980	499,505			1981	35,909
			1982	253,551			1983	388,201			1984	583,435			1985	88,120

MIDDLE FRASER SOCKEYE

	ESCAPEMENT				ESCAPEMENT				ESCAPEMENT				ESCAPEMENT			
	1982 Cycle Year				1983 Cycle Year				1984 Cycle Year				1985 Cycle Year			
	Average 1938-50	Average 1954-66			Average 1939-51	Average 1955-67			Average 1940-52	Average 1956-68			Average 1941-53	Average 1957-69		
			AVG	175,092			AVG	281,438			AVG	509,981			AVG	60,015
QUESNEL																
Horsefly River	115	1,168	1970	1,350	29	89	1971	171	1,789	6,758	1972	3,385	32,321	287,836	1973	253,388
			1974	4,459			1975	101			1976	2,064			1977	473,008
			1978	7,287			1979	511			1980	3,162			1981	677,389
			1982	30,317			1983	1,998			1984	6,078			1985	1,020,222
Little Horsefly R.	N/A	14	1970	0	N/A	N/A	1971	0	N/A	104	1972	18	U/K	U/K	1973	0
			1974	0			1975	0			1976	32			1977	0
			1978	0			1979	0			1980	0			1981	0
			1982	0			1983	0			1984	45			1985	17,030
Mitchell River	1	75	1970	23	U/K	U/K	1971	0	N/A	48	1972	85	911	5,888	1973	24,673
			1974	0			1975	0			1976	101			1977	42,396
			1978	1,237			1979	0			1980	14			1981	66,106
			1982	3,829			1983	119			1984	63			1985	204,579
QUESNEL TOTAL	116	1,257	1970	1,373	29	89	1971	171	1,789	6,910	1972	3,488	33,232	293,724	1973	278,061
			1974	4,459			1975	101			1976	2,197			1977	515,404
			1978	8,524			1979	511			1980	3,176			1981	743,495
			1982	34,146			1983	2,117			1984	6,186			1985	1,241,831
			AVG	12,126			AVG	725			AVG	3,762			AVG	694,698
MIDDLE FRASER SOCKEYE TOTAL	32829	141840	1970	151126	47733	462494	1971	187517	459351	454875	1972	582401	218157	372512	1973	344939
			1974	157831			1975	288578			1976	411842			1977	580589
			1978	180498			1979	281893			1980	530173			1981	790299
			1982	313871			1983	406688			1984	620461			1985	1337838
			AVG	201000			AVG	291000			AVG	536000			AVG	763000

MIDDLE FRASER PINK	ESCAPEMENT Average 1961-69	Average 1971-79		
SETON-ANDERSON				
Seton Creek	136,110	308,813	1981	519,393
			1983	407,791
			1985	163,337
Upper Seton Channel	3,975	8.358	1981	10,402
			1983	9,691
			1985	4.485
Lower Seton Channel	14,868	28,803	1981	33.846
			1983	31,045
			1985	33.807
Portage Creek	4,882	23.128	1981	18.733
			1983	10,202
			1985	4.116
Bridge River	10,311	26,983	1981	43,940
			1983	41,909
			1985	61,755
Gates Creek	0	687	1981	88
			1983	0
			1985	0
SETON-ANDERSON TOTAL	170,146	396,772	1981	626.402
			1983	500,638
			1985	267,500
			AVG	464,347

THOMPSON SOCKEYE

	ESCAPEMENT				ESCAPEMENT				ESCAPEMENT				ESCAPEMENT			
	1982 Cycle Year				1983 Cycle Year				1984 Cycle Year				1985 Cycle Year			
	Average 1938-50	Average 1954-66			Average 1939-51	Average 1955-67			Average 1940-52	Average 1956-68			Average 1941-53	Average 1957-69		
NORTH THOMPSON																
Raft River	2588	8657	1970	4474	5513	6400	1971	840	9700	7114	1972	11151	4423	6696	1973	2729
			1974	2396			1975	2664			1976	8684			1977	648
			1978	2500			1979	1708			1980	5418			1981	873
			1982	2992			1983	2857			1984	19098			1985	3638
Barriere River	0	5	1970	0	108	70	1971	5	N/A	128	1972	94	N/A	129	1973	22
			1974	0			1975	0			1976	85			1977	16
			1978	0			1979	0			1980	133			1981	0
			1982	0			1983	0			1984	86			1985	0
Fennell River	U/K	N/A	1970	9	N/A	462	1971	1300	N/A	367	1972	1931	U/K	52	1973	205
			1974	243			1975	4127			1976	4090			1977	355
			1978	675			1979	15590			1980	8437			1981	2113
			1982	1139			1983	5018			1984	11021			1985	1620
North Thompson R.	N/A	68	1970	270	N/A	70	1971	888	N/A	38	1972	465	N/A	225	1973	0
			1974	343			1975	123			1976	500			1977	1372
			1978	0			1979	1009			1980	36			1981	0
			1982	0			1983	750			1984	31			1985	1883
NORTH THOMPSON TOTAL	2588	8730	1970	4753	5621	7002	1971	3033	9700	7647	1972	13641	4423	7102	1973	2956
			1974	2982			1975	6914			1976	13359			1977	2391
			1978	3175			1979	18307			1980	14024			1981	2986
			1982	4131			1983	8625			1984	30236			1985	7141
			AVG	3760			AVG	9220			AVG	17815			AVG	3869
SOUTH THOMPSON																
Seymour River	5517	47923	1970	11991	11531	36722	1971	19028	2896	3118	1972	2889	4217	8550	1973	2856
			1974	45189			1975	37024			1976	8489			1977	5911
			1978	62929			1979	49321			1980	8390			1981	11529
			1982	63306			1983	29838			1984	17172			1985	6435
Lower Adams R.	1364875	1363123	1970	1297990	86550	269240	1971	280176	8140	3591	1972	4325	62119	104090	1973	33312
			1974	889613			1975	148187			1976	5013			1977	57964
			1978	1493473			1979	275616			1980	2560			1981	31097
			1982	2070813			1983	201669			1984	4183			1985	10715
Upper Adams R.	0	116	1970	4	0	3	1971	0	0	81	1972	31	U/K	U/K	1973	0
			1974	13			1975	23			1976	40			1977	0
			1978	0			1979	0			1980	560			1981	0
			1982	124			1983	0			1984	3502			1985	83
Scotch Creek	N/A	233	1970	304	U/K	U/K	1971	0	102	75	1972	47	610	2064	1973	6235

THOMPSON SOCKEYE

	ESCAPEMENT 1982 Cycle Year				ESCAPEMENT 1983 Cycle Year				ESCAPEMENT 1984 Cycle Year				ESCAPEMENT 1985 Cycle Year			
	Average 1938-50	Average 1954-66			Average 1939-51	Average 1955-67			Average 1940-52	Average 1956-68			Average 1941-53	Average 1957-69		
			1974	464			1975	0			1976	41			1977	13586
			1978	2056			1979	0			1980	205			1981	18952
			1982	4709			1983	239			1984	428			1985	3442
Little River	342500	240170	1970	168881	13459	26770	1971	2821	1566	182	1972	81	12371	13333	1973	6689
			1974	122112			1975	7268			1976	175			1977	8684
			1978	81055			1979	10443			1980	32			1981	8169
			1982	239278			1983				1984	49			1985	972
South Thompson R.	66750	57557	1970	5931	300	197	1971	40	100	0	1972	0	6310	3930	1973	545
			1974	14466			1975	16			1976	0			1977	432
			1978	9986			1979	144			1980	0			1981	182
			1982	73603			1983				1984	0			1985	0
Lower Shuswap R.	N/A	20671	1970	29074	0	3338	1971	6117	U/K	U/K	1972	0	U/K	876	1973	7452
			1974	86396			1975	11652			1976	0			1977	14695
			1978	187167			1979	10092			1980	0			1981	7358
			1982	513925			1983	7308			1984	0			1985	3123
Middle Shuswap R.	0	707	1970	4559	0	U/K	1971	0	U/K	U/K	1972	0	U/K	U/K	1973	0
			1974	3064			1975	0			1976	0			1977	0
			1978	10890			1979	0			1980	0			1981	0
			1982	40302			1983	27			1984	0			1985	190
Eagle River	U/K	123	1970	23	U/K	U/K	1971	0	U/K	U/K	1972	0	U/K	U/K	1973	0
			1974	263			1975	0			1976	0			1977	0
			1978	189			1979	0			1980	0			1981	0
			1982	1642			1983	580			1984	0			1985	263
Anstey River	U/K	77	1970	196	U/K	U/K	1971	0	U/K	U/K	1972	0	U/K	U/K	1973	0
			1974	666			1975	0			1976	0			1977	0
			1978	886			1979	0			1980	0			1981	0
			1982	776			1983	382			1984	0			1985	0
Momich-Cayenne Cr.	U/K	U/K	1970	0	U/K	U/K	1971	0	N/A	813	1972	1003	U/K	U/K	1973	0
			1974	0			1975	0			1976	1998			1977	0
			1978	0			1979	0			1980	3345			1981	0
			1982	0			1983	0			1984	5854			1985	56
Misc. Streams	U/K	U/K	1970	0	U/K	U/K	1971	0	U/K	U/K	1972	0	U/K	338	1973	0
			1974	0			1975	0			1976	0			1977	0
			1978	0			1979	0			1980	0			1981	101
			1982	0			1983	346			1984	0			1985	0
Misc. Late Runs	U/K	42146	1970	50389	U/K	4994	1971	1169	U/K	U/K	1972	0	U/K	U/K	1973	0
			1974	41882			1975	1442			1976	0			1977	0
			1978	117832			1979	3418			1980	0			1981	0
			1982	123337			1983	1912			1984	0			1985	0

THOMPSON SOCKEYE

	ESCAPEMENT				ESCAPEMENT				ESCAPEMENT				ESCAPEMENT			
	1982 Cycle Year				1983 Cycle Year				1984 Cycle Year				1985 Cycle Year			
	Average 1938-50	Average 1954-66			Average 1939-51	Average 1955-67			Average 1940-52	Average 1956-68			Average 1941-53	Average 1957-69		
SOUTH THOMPSON TOTAL	1779642	1772846	1970	1569342	111840	341264	1971	309351	12804	7860	1972	8376	85627	133181	1973	57089
			1974	1204128			1975	205612			1976	15756			1977	101272
			1978	1966463			1979	349034			1980	15092			1981	77388
			1982	3131815			1983	242301			1984	31188			1985	25269
			AVG	1967937			AVG	276575			AVG	17603			AVG	65255
THOMPSON TOTAL SOCKEYE	1782230	1781576	1970	1574095	117461	348266	1971	312384	22504	15507	1972	22017	90050	140283	1973	60045
			1974	1207110			1975	212526			1976	29115			1977	103663
			1978	1969638			1979	367341			1980	29116			1981	80374
			1982	3135946			1983	250926			1984	61424			1985	32410
			AVG	1972000			AVG	286000			AVG	35000			AVG	69000

THOMPSON PINK	ESCAPEMENT			
	Average 1961-69	Average 1971-79		
THOMPSON				
Thompson River & Tributaries	257,227	575,893	1981	1,166,348
			1983	512,398
			1985	193,448
			AVG	624,065

UPPER FRASER SOCKEYE

	ESCAPEMENT 1982 Cycle Year Average 1938-50	Average 1954-66			ESCAPEMENT 1983 Cycle Year Average 1939-51	Average 1955-67			ESCAPEMENT 1984 Cycle Year Average 1940-52	Average 1956-68			ESCAPEMENT 1985 Cycle Year Average 1941-53	Average 1957-69		
NECHAKO																
Endako River	411	379	1970	0	312	1387	1971	284	39	11	1972	27	458	110	1973	0
			1974	0			1975	192			1976	40			1977	0
			1978	0			1979	1294			1980	25			1981	0
			1982	0			1983	583			1984	0			1985	0
Nadina River (Early & Late)	527	1756	1970	4017	208	4819	1971	15747	854	1765	1972	3529	15169	36798	1973	10656
			1974	2930			1975	4494			1976	380			1977	2063
			1978	227			1979	16283			1980	263			1981	1845
			1982	194			1983	4372			1984	1465			1985	1534
Nadina Channel (Late)	U/K	N/A	1970	0	U/K	N/A	1971	0	U/K	N/A	1972	0	U/K	N/A	1973	8786
			1974	895			1975	11306			1976	1394			1977	16286
			1978	2555			1979	41212			1980	3021			1981	17892
			1982	2156			1983	23843			1984	6413			1985	12291
Nithi River	45	26	1970	0	51	687	1971	1796	23	25	1972	58	815	377	1973	54
			1974	0			1975	1144			1976	0			1977	150
			1978	0			1979	1300			1980	54			1981	100
			1982	0			1983	990			1984	0			1985	0
Ormonde Creek	247	374	1970	0	80	23	1971	0	299	188	1972	54	987	450	1973	0
			1974	0			1975	0			1976	30			1977	0
			1978	0			1979	0			1980	0			1981	0
			1982	0			1983	0			1984	0			1985	0
Stellako River	110360	120271	1970	45876	40447	90414	1971	39726	15589	34703	1972	36771	43978	43731	1973	30735
			1974	41473			1975	176079			1976	150741			1977	23452
			1978	60421			1979	290116			1980	72073			1981	22021
			1982	69434			1983	121739			1984	60973			1985	42296
			AVG	54301			AVG	156915			AVG	80140			AVG	29631
NECHAKO TOTAL	111590	122806	1970	49893	41098	97330	1971	57553	16804	36692	1972	40439	61407	81466	1973	50251
			1974	45298			1975	193215			1976	152585			1977	41951
			1978	63203			1979	350205			1980	75436			1981	41858
			1982	71784			1983	151527			1984	68851			1985	56121
			AVG	57545			AVG	188125			AVG	84328			AVG	47545
EARLY STUART																
Ankwil Creek	67	223	1970	220	N/A	U/K	1971	0	U/K	U/K	1972	0	1672	11339	1973	21790
			1974	544			1975	0			1976	0			1977	6287
			1978	1363			1979	0			1980	0			1981	8497
			1982*	46			1983	44			1984	0			1985	12012

UPPER FRASER SOCKEYE

	ESCAPEMENT				ESCAPEMENT				ESCAPEMENT				ESCAPEMENT			
	1982 Cycle Year				1983 Cycle Year				1984 Cycle Year				1985 Cycle Year			
	Average 1938-50	Average 1954-66			Average 1939-51	Average 1955-67			Average 1940-52	Average 1956-68			Average 1941-53	Average 1957-69		
Bivouac Creek	N/A	0	1970	0	U/K	U/K	1971	0	U/K	U/K	1972	0	5474	2954	1973	1884
			1974	40			1975	0			1976	0			1977	952
			1978	157			1979	0			1980	0			1981	285
			1982	0			1983	927			1984	0			1985	937
Crow Creek	U/K	126	1970	396	U/K	U/K	1971	0	U/K	U/K	1972	0	U/K	U/K	1973	0
			1974	981			1975	0			1976	0			1977	0
			1978	467			1979	0			1980	0			1981	0
			1982	40			1983	181			1984	0			1985	1839
Driftwood Creek	50	700	1970	1983	25	17	1971	335	38	42	1972	0	3043	42108	1973	131172
			1974	1894			1975	20			1976	0			1977	54568
			1978	4903			1979	247			1980	0			1981	47298
			1982	29			1983				1984	0			1985	93959
Dust Creek	1125	1350	1970	963	U/K	U/K	1971	0	U/K	U/K	1972	0	6211	7719	1973	17850
			1974	934			1975	0			1976	0			1977	16200
			1978	657			1979	0			1980	0			1981	5044
			1982	165			1983	133			1984	0			1985	5459
Felix Creek	N/A	828	1970	2866	U/K	U/K	1971	0	U/K	U/K	1972	0	805	4362	1973	7465
			1974	3201			1975	0			1976	0			1977	2160
			1978	5575			1979	0			1980	0			1981	6200
			1982	454			1983	1412			1984	0			1985	20606
15 Mile Creek	54	73	1970	0	U/K	U/K	1971	0	U/K	U/K	1972	0	250	429	1973	1090
			1974	0			1975	0			1976	0			1977	452
			1978	0			1979	0			1980	0			1981	815
			1982	0			1983	23			1984	0			1985	352
5 Mile Creek	262	42	1970	0	U/K	U/K	1971	0	U/K	U/K	1972	0	809	1374	1973	2408
			1974	0			1975	0			1976	0			1977	907
			1978	0			1979	0			1980	0			1981	369
			1982	0			1983	15			1984	0			1985	638
Fleming Creek	3	0	1970	106	U/K	U/K	1971	0	U/K	U/K	1972	0	U/K	U/K	1973	0
			1974	20			1975	0			1976	0			1977	0
			1978	590			1979	0			1980	0			1981	0
			1982	2			1983	21			1984	0			1985	1687
Forfar Creek	4483	5219	1970	6476	3897	1454	1971	25178	2153	1857	1972	835	26853	10929	1973	18924
			1974	5495			1975	6818			1976	1249			1977	3628
			1978	9579			1979	15805			1980	2328			1981	12228
			1982	676			1983	3591			1984	6848			1985	19433
Forsythe Creek	N/A	67	1970	187	U/K	U/K	1971	0	U/K	U/K	1972	0	1900	3756	1973	10907
			1974	270			1975	0			1976	0			1977	3677
			1978	381			1979	0			1980	0			1981	2386

UPPER FRASER SOCKEYE

	ESCAPEMENT				ESCAPEMENT				ESCAPEMENT				ESCAPEMENT			
	1982 Cycle Year				1983 Cycle Year				1984 Cycle Year				1985 Cycle Year			
	Average 1938-50	Average 1954-66			Average 1939-51	Average 1955-67			Average 1940-52	Average 1956-68			Average 1941-53	Average 1957-69		
			1982	2			1983	13			1984	0			1985	3262
Frypan Creek	69	156	1970	130	50	U/K	1971	0	U/K	U/K	1972	0	1772	4476	1973	5799
			1974	362			1975	0			1976	0			1977	4383
			1978	448			1979	0			1980	0			1981	1864
			1982	40			1983	48			1984	0			1985	3044
Gluske Creek	5215	2663	1970	5702	1994	391	1971	14305	2470	1748	1972	591	31339	8603	1973	19450
			1974	5548			1975	10370			1976	966			1977	4646
			1978	4295			1979	10040			1980	1049			1981	10741
			1982	452			1983	3781			1984	6943			1985	17381
Kynock Creek	7503	8957	1970	4676	11358	2748	1971	22932	5371	3917	1972	2534	53464	11227	1973	22485
			1974	10652			1975	25124			1976	6727			1977	5893
			1978	10649			1979	34228			1980	10661			1981	13452
			1982	1170			1983	7822			1984	16933			1985	20347
Leo Creek	N/A	0	1970	41	U/K	U/K	1971	0	U/K	U/K	1972	0	2687	3234	1973	1390
			1974	32			1975	0			1976	0			1977	646
			1978	34			1979	0			1980	0			1981	78
			1982	0			1983	27			1984	0			1985	29
Narrows Creek	677	1392	1970	144	103	207	1971	3467	365	340	1972	104	10391	7801	1973	5726
			1974	486			1975	1704			1976	244			1977	2844
			1978	709			1979	1575			1980	257			1981	3583
			1982	78			1983	895			1984	1568			1985	4209
Paula Creek	N/A	194	1970	565	U/K	U/K	1971	0	U/K	U/K	1972	0	1406	2548	1973	2787
			1974	2059			1975	0			1976	0			1977	918
			1978	1604			1979	0			1980	0			1981	1626
			1982	68			1983	813			1984	0			1985	3219
Rossette Creek	2460	3526	1970	7664	4317	2498	1971	16445	1269	2473	1972	834	41782	3703	1973	4156
			1974	5675			1975	8543			1976	2090			1977	2261
			1978	7452			1979	15893			1980	2054			1981	8018
			1982	1300			1983	3304			1984	8147			1985	15704
Sakeniche River	234	512	1970	0	U/K	U/K	1971	0	U/K	U/K	1972	0	1177	3078	1973	4175
			1974	51			1975	0			1976	0			1977	288
			1978	123			1979	0			1980	0			1981	6
			1982	0			1983	0			1984	0			1985	2839
Sandpoint Creek	N/A	407	1970	358	U/K	U/K	1971	0	U/K	U/K	1972	0	2092	6459	1973	3178
			1974	599			1975	0			1976	0			1977	1519
			1978	493			1979	0			1980	0			1981	1224
			1982	4			1983	585			1984	0			1985	1577
Shale Creek	250	323	1970	34	95	U/K	1971	0	207	162	1972	0	1772	1196	1973	3026

UPPER FRASER SOCKEYE

	ESCAPEMENT				ESCAPEMENT				ESCAPEMENT				ESCAPEMENT			
	1982 Cycle Year				1983 Cycle Year				1984 Cycle Year				1985 Cycle Year			
	Average 1938-50	Average 1954-66			Average 1939-51	Average 1955-67			Average 1940-52	Average 1956-68			Average 1941-53	Average 1957-69		
			1974	345			1975	0			1976	0			1977	1672
			1978	470			1979	0			1980	0			1981	1630
			1982	19			1983	127			1984	0			1985	1678
Takla Streams	U/K	U/K	1970	0	U/K	U/K	1971	0	U/K	19	1972	143	U/K	U/K	1973	0
			1974	0			1975	0			1976	1120			1977	0
			1978	0			1979	0			1980	428			1981	0
			1982	0			1983	0			1984	2774			1985	0
25 Mile Creek	521	213	1970	0	U/K	U/K	1971	0	U/K	U/K	1972	0	1822	654	1973	744
			1974	0			1975	0			1976	0			1977	164
			1978	0			1979	0			1980	0			1981	923
			1982	0			1983	0			1984	0			1985	583
Misc. Streams	2362	226	1970	236	121	317	1971	13271	1775	488	1972	15	1129	4333	1973	14013
			1974	456			1975	13188			1976	252			1977	3952
			1978	148			1979	14975			1980	249			1981	3231
			1982	15			1983	112			1984	2034			1985	3737
EARLY STUART TOTAL	25335	27197	1970	32747	21960	7632	1971	95933	13648	11046	1972	5056	197850	142282	1973	300419
			1974	39644			1975	65767			1976	12648			1977	118017
			1978	50097			1979	92763			1980	17026			1981	129498
			1982	4560			1983	23874			1984	45247			1985	234531
			AVG	31762			AVG	69584			AVG	19994			AVG	195616

LATE STUART

LATE-STUART DISTRICT SOCKEYE TOTALS

Kazcheck Creek	77	168	1970	74	68	120	1971	40	97	65	1972	65	2595	9682	1973	2909
			1974	239			1975	0			1976	33			1977	720
			1978	122			1979	100			1980	0			1981	6872
			1982	410			1983	11			1984	0			1985	1955
Kuzkwa Creek	N/A	295	1970	90	U/K	U/K	1971	0	U/K	U/K	1972	0	3686	26905	1973	20124
			1974	718			1975	0			1976	0			1977	9031
			1978	742			1979	0			1980	0			1981	20520
			1982	1237			1983	700			1984	0			1985	2624
Middle River	1040	7078	1970	12115	1030	2477	1971	873	250	647	1972	972	97319	190031	1973	91879
			1974	8990			1975	6704			1976	330			1977	80420
			1978	4061			1979	18111			1980	198			1981	125630
			1982	7450			1983	639			1984	184			1985	114122
Pinchi Creek	N/A	310	1970	0	U/K	U/K	1971	0	U/K	U/K	1972	0	72	2558	1973	1271
			1974	0			1975	0			1976	0			1977	1719
			1978	74			1979	0			1980	0			1981	1494
			1982	133			1983	43			1984	0			1985	0

UPPER FRASER SOCKEYE

	ESCAPEMENT				ESCAPEMENT				ESCAPEMENT				ESCAPEMENT			
	1982 Cycle Year				1983 Cycle Year				1984 Cycle Year				1985 Cycle Year			
	Average 1938-50	Average 1954-66			Average 1939-51	Average 1955-67			Average 1940-52	Average 1956-68			Average 1941-53	Average 1957-69		
Tachie River	107	6404	1970	2776	100	2028	1971	360	192	898	1972	7527	32289	111050	1973	97445
			1974	4680			1975	7525			1976	2637			1977	54282
			1978	8028			1979	10940			1980	756			1981	94050
			1982	7528			1983	853			1984	810			1985	155655
Sakeniche River	N/A	U/K	1970	0	U/K	U/K	1971	0	N/A	131	1972	0	104	843	1973	0
			1974	0			1975	0			1976	0			1977	0
			1978	0			1979	0			1980	0			1981	0
			1982	0			1983	0			1984	0			1985	286
Misc. Streams	U/K	U/K	1970	0	U/K	U/K	1971	0	U/K	U/K	1972	0	U/K	11	1973	715
			1974	0			1975	0			1976	0			1977	457
			1978	0			1979	0			1980	0			1981	1133
			1982	0			1983	0			1984	0			1985	0
LATE STUART TOTAL	1224	14255	1970	17025	1198	4625	1971	1273	539	1741	1972	8564	136065	341080	1973	214343
			1974	16601			1975	14229			1976	3000			1977	146629
			1978	15005			1979	29151			1980	954			1981	249699
			1982	18740			1983	2246			1984	994			1985	274642
			AVG	16843			AVG	11725			AVG	3378			AVG	221328
BOWRON																
Bowron River	6587	8604	1970	1341	13656	23860	1971	25497	12554	4938	1972	4138	10273	6515	1973	4700
			1974	1850			1975	29700			1976	2250			1977	2500
			1978	3150			1979	35000			1980	2894			1981	1170
			1982	1647			1983	6451			1984	10461			1985	6395
			AVG	1997			AVG	24162			AVG	4936			AVG	4000
UPPER FRASER TOTAL	144736	172862	1970	101006	77912	133447	1971	180256	43545	54417	1972	58197	405595	571343	1973	569713
			1974	103393			1975	302911			1976	170483			1977	309097
			1978	131455			1979	507119			1980	96310			1981	422225
			1982	96731			1983	184098			1984	125553			1985	571689
			AVG	108000			AVG	294000			AVG	113000			AVG	468000

APPENDIX II

HABITAT STATUS
FOR INNER SOUTH COAST AND FRASER RIVER

INTRODUCTION

The habitat information tables were prepared by Howard Paish and Associates under contract to the Department of Fisheries and Oceans. Each table summarizes habitat status for one species in one Sub-area (e.g., Rivers Inlet Sockeye, Gardner Canal Pink, Cumshewa Chum). These sub-area summaries form the basis for the Habitat Overview in the Salmon Stock Management Plan.

The purpose of the Habitat Overview is to link stock and escapement information to information on habitat status and development. Each table has five sections:

1. Stock Group
2. Stock Data
3. Management Style
4. Habitat Notes
5. Summary

The Stock Group section identifies the stock or group of stocks by species and management unit covered in the table. The Stock Data section summarizes current, target, and maximum recorded escapements in an attempt to link stock status, (current escapement) to habitat status and potential (target and maximum recorded escapements). The Management Style Section indicates whether the stock is actively or passively managed.

The Habitat Notes describe the historic and current status of habitat and the future outlook. This information facilitates interpretation of the Stock Data linking actual and potential stock production to habitat status. The production potential of the natural habitat, and of only improved habitat are also indicated. Source materials for the Habitat Notes are given in parentheses and elaborated upon in the Data Source sheets that follow the tables.

The Summary section contains subjective gradings of habitat in terms of ability to achieve current targets, current status and future outlook, and the production potential from natural and improved habitat.

DATA SOURCES FOR STREAM HABITAT MATRIX AND SUBSTOCK SUMMARY MATRIX SHEETS

UPPER EAST COAST OF VANCOUVER ISLAND

Maximum Recorded Escapement

MRE's were derived from Stream Catalogue modified as described in the Introduction.

Marshall, D.E.; Brown, R.F.; Chahley, V.D.; and Demontier, D.G.

Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 12 (Port Hardy - Alert Bay)

Pac/D-77-1 Pacific Region

Target/Optimum Escapement

Sockeye and Pink:

Targets provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney. Subarea targets represent a sum of stream-specific targets, of streams above and below MRE cutoff.

Chinook, Coho and Chum:

Stream-specific and habitat subarea targets not available.

Current Average Escapement

Sockeye: Nimpkish current escapement data for 1980-84 provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

Remaining stream-specific and subarea 5 year averages (1979-83), were derived from data provided by DFO, Pacific Research Station, July 1985. (See Information Sources.) This data does not indicate cyclic years.

Chinook & Coho: Stream-specific current average escapement data (1979-83) were derived from data provided by DFO, Pacific Research Station, July 1985. Subarea current average escapement represents a sum of stream-specific data for streams above and below MRE cutoff.

Pink: Odd- and even-year current escapement data (1980-85) for Habitat Matrix and Substock Summary sheets were provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

If stream-specific data were not available from this source, the space has been left blank, since other available data do not indicate an odd/even-year escapement differentiation.

Management Style

Active/passive management status for pink, chum and sockeye was provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

Number of Streams and Stream Lists

Number of streams and stream lists were compiled from information provided in the Stream Catalogues.

Habitat Notes

Habitat information for the matrix descriptions was derived from the following sources:

Stream Catalogues (see listing for MRE sources)

- Information from these sources was not referenced on the matrix sheets. All unreferenced notes therefore have a Stream Catalogue source.

GWG/SEP Habitat Matrices and Summary Notes for South Coast

- Information from this source is referenced as GWG/SEP on the matrix sheets.

Pacific Region Salmon Resource Management Plan - 1985

- Information from this source is referenced as SRMP on the matrix sheets.

DFO Staff Interviews

- Information from this source is referenced as I on the matrix sheets.

Habitat Review Authors' Personal Knowledge or Judgement

- Information from the authors' personal knowledge or judgements made by the authors is referenced as P on the matrix sheets.

DATA SOURCES FOR STREAM HABITAT MATRIX AND SUBSTOCK SUMMARY MATRIX SHEETS

JOHNSTONE STRAIT

Maximum Recorded Escapement

MRE's were derived from Stream Catalogue modified as described in the Introduction.

Marshall, D.E.; Brown, R.F.; Chahley, V.D.; and Demontier, D.G.

Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 13 (Campbell River)

Pac/D-77-1 Pacific Region

Target/Optimum Escapement

Chinook, Coho and Chum:

Stream-specific and habitat subarea targets unavailable.

Pink: Targets provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney. Subarea target represents a sum of stream-specific targets of streams above and below MRE cutoff.

Current Average Escapement

Chinook & Coho: Stream-specific current average escapement data (1979-83) were derived from data provided by DFO, Pacific Research Station, July 1985. Subarea current average escapement represents a sum of stream-specific data for streams above and below MRE cutoff.

Pink: Odd- and even-year current escapement data (1980-85) for Habitat Matrix and Substock Summary sheets were provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

If stream-specific data were not available from this source, the space has been left blank, since other available data do not indicate an odd/even-year escapement differentiation.

Management Style

Active/passive management status for pink, chum and sockeye was provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

Number of Streams and Stream Lists

Number of streams and stream lists were compiled from information provided in the Stream Catalogues.

Habitat Notes

Habitat information for the matrix descriptions was derived from the following sources:

Stream Catalogues (see listing for MRE sources)

- Information from these sources was not referenced on the matrix sheets. All unreferenced notes therefore have a Stream Catalogue source.

GWG/SEP Habitat Matrices and Summary Notes for South Coast

- Information from this source is referenced as GWG/SEP on the matrix sheets.

Pacific Region Salmon Resource Management Plan - 1985

- Information from this source is referenced as SRMP on the matrix sheets.

DFO Staff Interviews

- Information from this source is referenced as I on the matrix sheets.

Habitat Review Authors' Personal Knowledge or Judgement

- Information from the authors' personal knowledge or judgements made by the authors is referenced as P on the matrix sheets.

DATA SOURCES FOR STREAM HABITAT MATRIX AND SUBSTOCK SUMMARY MATRIX SHEETS

MID EAST COAST OF VANCOUVER ISLAND

Maximum Recorded Escapement

MRE's were derived from Stream Catalogue modified as described in the Introduction.

Brown, R.F.; Chahley, V.D.; and Demontier, D.G.

Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 14 (Comox-Parksville).

Pac/D-77-12 Pacific Region

Target/Optimum Escapement

Coho and Chinook:

Targets unavailable.

Pink: Targets provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney. Subarea targets represent a sum of stream-specific targets of streams above and below MRE cutoff.

Current Average Escapement

Chinook & Coho: Stream-specific current average escapement data (1979-83) were derived from data provided by DFO, Pacific Research Station. Subarea current average escapement represents a sum of stream-specific data for streams above and below MRE cutoff.

Pink: Odd- and even-year current escapement data (1980-85) for Habitat Matrix and Substock Summary sheets were provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

If stream-specific data were not available from this source, the space has been left blank, since other available data do not indicate an odd/even-year escapement differentiation.

Management Style

Active/passive management status for pink, chum and sockeye was provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

Number of Streams and Stream Lists

Number of streams and stream lists were compiled from information provided in the Stream Catalogues.

Habitat Notes

Habitat information for the matrix descriptions was derived from the following sources:

Stream Catalogues (see listing for MRE sources)

- Information from these sources was not referenced on the matrix sheets. All unreferenced notes therefore have a Stream Catalogue source.

GWG/SEP Habitat Matrices and Summary Notes for South Coast

- Information from this source is referenced as GWG/SEP on the matrix sheets.

Pacific Region Salmon Resource Management Plan - 1985

- Information from this source is referenced as SRMP on the matrix sheets.

DFO Staff Interviews

- Information from this source is referenced as I on the matrix sheets.

Habitat Review Authors' Personal Knowledge or Judgement

- Information from the authors' personal knowledge or judgements made by the authors is referenced as P on the matrix sheets.

DATA SOURCES FOR STREAM HABITAT MATRIX AND SUBSTOCK SUMMARY MATRIX SHEETS

LOWER EAST COAST OF VANCOUVER ISLAND

Maximum Recorded Escapement

MRE's were derived from Stream Catalogue modified as described in the Introduction.

Marshall, D.E.; Brown, R.F.; Chahley, V.D.; and Demontier, D.G.

Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Areas 17 and 18 (Nanaimo-Ladysmith-Duncan).

Pac/D-76-6   Pacific Region

Target/Optimum Escapement

No stream-specific and habitat subarea targets available.

Current Average Escapement

Chinook, Coho and Chum:

Stream-specific current average escapement data (1979-83) were derived from data provided by DFO, Pacific Research Station, July 1985. Subarea current average escapement represents a sum of stream-specific data for streams above and below MRE cutoff.

Additional, stream-specific current escapement data for chum were provided during interviews with regional staff.

Pink: Odd- and even-year current escapement data (1980-85) for Habitat Matrix and Substock Summary sheets were provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

If stream-specific data were not available from this source, the space has been left blank, since other available data do not indicate an odd- even-year escapement differentiation.

Management Style

Active/passive management status for pink, chum and sockeye was provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

Number of Streams and Stream Lists

Number of streams and stream lists were compiled from information provided in the Stream Catalogues.

Habitat Notes

Habitat information for the matrix descriptions was derived from the following sources:

Stream Catalogues (see listing for MRE sources)

- Information from these sources was not referenced on the matrix sheets. All unreferenced notes therefore have a Stream Catalogue source.

GWG/SEP Habitat Matrices and Summary Notes for South Coast

- Information from this source is referenced as GWG/SEP on the matrix sheets.

Pacific Region Salmon Resource Management Plan - 1985

- Information from this source is referenced as SRMP on the matrix sheets.

DFO Staff Interviews

- Information from this source is referenced as I on the matrix sheets.

Habitat Review Authors' Personal Knowledge or Judgement

- Information from the authors' personal knowledge or judgements made by the authors is referenced as P on the matrix sheets.

DATA SOURCES FOR STREAM HABITAT MATRIX AND SUBSTOCK SUMMARY MATRIX SHEETS

SOUTHERN VANCOUVER ISLAND

Maximum Recorded Escapement

MRE's were derived from Stream Catalogue modified as described in the Introduction.

Marshall, D.E.; Brown, R.F.; Chahley, V.D.; and Demontier, D.G.

Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Areas 19 and 20 (Victoria-Sooke).

Pac/D-77-9 Pacific Region

Target/Optimum Escapement

No stream-specific and habitat subarea targets available.

Current Average Escapement

Chinook, Coho and Chum:

Stream-specific current average escapement data (1979-83) were derived from data provided by DFO, Pacific Research Station, July 1985. Subarea current average escapement represents a sum of stream-specific data for streams above and below MRE cutoff.

Pink: Odd- and even-year current escapement data (1980-85) for Habitat Matrix and Substock Summary sheets were provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

If stream-specific data were not available from this source, the space has been left blank, since other available data do not indicate an odd/even-year escapement differentiation.

Pink current average escapements do not differentiate between odd and even years.

Management Style

Active/passive management status for pink, chum and sockeye was provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

Number of Streams and Stream Lists

Number of streams and stream lists were compiled from information provided in the Stream Catalogues.

Habitat Notes

Habitat information for the matrix descriptions was derived from the following sources:

Stream Catalogues (see listing for MRE sources)

- Information from these sources was not referenced on the matrix sheets. All unreferenced notes therefore have a Stream Catalogue source.

GWG/SEP Habitat Matrices and Summary Notes for South Coast

- Information from this source is referenced as GWG/SEP on the matrix sheets.

Pacific Region Salmon Resource Management Plan - 1985

- Information from this source is referenced as SRMP on the matrix sheets.

DFO Staff Interviews

- Information from this source is referenced as I on the matrix sheets.

Habitat Review Authors' Personal Knowledge or Judgement

- Information from the authors' personal knowledge or judgements made by the authors is referenced as P on the matrix sheets.

DATA SOURCES FOR STREAM HABITAT MATRIX AND SUBSTOCK SUMMARY MATRIX SHEETS

MAINLAND INLETS

Maximum Recorded Escapement

MRE's were derived from Stream Catalogues modified as described in the Introduction.

Marshall, D.E.; Brown, R.F.; Chahley, V.D.; and Demontier, D.G.

Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 11 (Seymour-Belize Inlets).

Pac/D-77-5 Pacific Region

Marshall, D.E.; Brown, R.F.; Chahley, V.D.; and Demontier, D.G.

Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 12 (Port Hardy - Alert Bay).

Pac/D-77-2 Pacific Region

Marshall, D.E.; Brown, R.F.; Chahley, V.D.; and Demontier, D.G.

Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 13 (Campbell River).

Pac/D-77-2 Pacific Region

Marshall, D.E.; Chahley, V.D.; and Shannon, L.L.

Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 15 (Powell River).

Pac/D-77-2 Pacific Region

Marshall, D.E.; Chahley, V.D.; and Shannon, L.L.

Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 16 (Pender Harbour).

Pac/D-76-1 Pacific Region

Marshall, D.E.; Brown, R.F.; Chahley, V.D.; and Shannon, L.L.

Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 28 (Howe Sound - Burrard Inlet).

Pac/D-76-4 Pacific Region

Target/Optimum Escapement

Sockeye: Sakinaw target provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney. Habitat subarea targets were unavailable for Seymour/Kingcome/Knight and Loughborough/Bute Sockeye.

Chinook and Coho:

Targets unavailable.

Chum: Targets for Seymour/Kingcome/Knight; Toba, Jervis, Howe Sound and Burrard subareas were provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

Subarea target is not available for Loughborough/Bute.

Stream-specific targets, where available, are taken from the April 1985, SRMP (See Information Sources).

Pink: Stream-specific and subarea targets were provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

Subarea targets represent the sum of available stream-specific targets, for streams above and below the MRE cutoff.

Current Average Escapement

Sockeye: Stream-specific current average (1980-84) escapements for Fulmore, Heydon, Phillips and Sakinaw sockeye were provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

Remaining stream-specific and subarea 5-year averages (1979-83), were derived from data provided by DFO, Pacific Research Station, July 1985. (See Information Sources.) These data do not indicate cyclic years.

Chinook and Coho:

Stream-specific current average escapement data (1979-83) were derived from data provided by DFO, Pacific Research Station, July 1985. Subarea current average escapement represents a sum of stream-specific data for streams above and below MRE cutoff.

Pink: Odd- and even-year current escapement data (1980-85) for Habitat Matrix and Substock Summary sheets were provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

If stream-specific data were not available from this source, the space has been left blank, since other available data do not indicate an odd-even year escapement differentiation.

Management Style

Active/passive management status for pink, chum and sockeye was provided by DFO, Pacific Region, November 1985, personal communication from Kaarina McGivney.

Number of Streams and Stream Lists

Number of streams and stream lists were compiled from information provided in the Stream Catalogues.

Habitat Notes

Habitat information for the matrix descriptions was derived from the following sources:

Stream Catalogues (see listing for MRE sources)

- Information from these sources was not referenced on the matrix sheets. All unreferenced notes therefore have a Stream Catalogue source.

GWG/SEP Habitat Matrices and Summary Notes for South Coast

- Information from this source is referenced as GWG/SEP on the matrix sheets.

Pacific Region Salmon Resource Management Plan - 1985

- Information from this source is referenced as SRMP on the matrix sheets.

DFO Staff Interviews

- Information from this source is referenced as I on the matrix sheets.

Habitat Review Authors' Personal Knowledge or Judgement

- Information from the authors' personal knowledge or judgements made by the authors is referenced as P on the matrix sheets.

DATA SOURCES FOR STREAM HABITAT MATRIX AND SUBSTOCK SUMMARY MATRIX SHEETS

FRASER RIVER DRAINAGE

Maximum Recorded Escapement

MRE's were derived from Stream Catalogues modified as described in the Introduction.

Hancock, M.J. and D.E. Marshall, 1985.
Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 29 New Westminster Subdistrict.

Can. Da. Rep. Fish and Aquatic Sciences No. 495.

Hancock, M.J. and D.E. Marshall, 1985.
Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 29 Mission-Harrison.

Can. Da. Rep. Fish and Aquatic Sciences No. 618.

Hancock, M.J. and D.E. Marshall, 1985.
Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 29 Chilliwack-Hope.

Can. Da. Rep. Fish and Aquatic Sciences No. 521.

Brown, R.F.; Musgrove, M.M.; and D.E. Marshall, 1979.
Catalogue of Salmon Streams and Spawning Escapements of Lillooet-Pemberton Subdistrict.

Can. Da. Rep. Fish and Aquatic Sciences No. 161.

Manzon, C.I. and D.E. Marshall, 1980.
Catalogue of Salmon Streams and Spawning Escapements of Cariboo Subdistrict. -

Can. Da. Rep. Fish and Aquatic Sciences No. 211.

Marshall, D.E. and C.I. Manzon, 1980.
Catalogue of Salmon Streams and Spawning Escapements of Prince George Subdistrict.

Fisheries and Marine Service, Data Rep. No. 79.

Brown, R.F.; Musgrove, M.M.; and D.E. Marshall, 1979.
Catalogue of Salmon Streams and Spawning Escapements of Kamloops Subdistrict.

Fisheries and Marine Service, Data Rep. No. 151.

Target/Optimum Escapement

No target/optimum escapements have been developed by DFO for the Fraser drainage.

Current Average Escapement

For all systems, the most current available escapement data were used.

Sockeye: Stream-specific current average escapements for all cyclic stocks are calculated as the average of the last two or three dominant cycle years, as recorded in the Stream Catalogues. The years of record are given on each stream sheet. Average escapement figures provided by DFO, Pacific Research Station, did not account for cyclic abundance and were therefore not used.

Chinook and Coho:

Stream-specific current 5-year (1979-83 or 1980-84) average escapement data were taken from current Stream Catalogues for Lower Fraser system, and 1979-83 averages taken from DFO Fisheries Research Station data for other systems.

Chum: Stream-specific 5 year average escapements (1980-84) were taken from current Stream Catalogues for Lower Fraser system.

Pink: In Lower Fraser system, stream-specific average escapements for odd-year pink were calculated from last two cycles (1982 and 1984) as recorded in current Stream Catalogues. The DFO Fisheries Research Station data did not consider cyclic abundance and were not as current as Catalogue data.

In Mid Fraser and Thompson systems, DFO Fisheries Research Station data five-year averages (1979-83) were used, but as these data did not consider the cyclic abundance of pink in these systems, the average figures were multiplied by 2 to provide more accurate estimates of average escapements. Stream Catalogue information was not used as it is not as recent.

Management Style

Management style (Active or Passive) was not given for Fraser River Drainage stocks.

Number of Streams and Stream Lists

Number of streams and stream lists were compiled from information provided in Stream Catalogues.

Habitat Notes

Habitat information for the matrix descriptions was derived from the following sources:

Stream Catalogues (see listing for MRE sources)

- Information from these sources was not referenced on the matrix sheets. All unreferenced notes therefore have a Stream Catalogue source.

GWG/SEP Habitat Matrices and Summary Notes for South Coast

- Information from this source is referenced as GWG/SEP on the matrix sheets.

Pacific Region Salmon Resource Management Plan - 1985

- Information from this source is referenced as SRMP on the matrix sheets.

DFO and ISPFC Staff Interviews

- Information from this source is referenced as I on the matrix sheets.

Habitat Review Authors' Personal Knowledge or Judgement

- Information from the authors' personal knowledge or judgements made by the authors is referenced as P on the matrix sheets.

HABITAT INFORMATION TABLE

STOCK GROUP Upper East Coast Vancouver Island Chinook Area 12

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	16.15	(not avail.)	.75

MANAGEMENT STYLE

Active ___

Passive 4

No. of Streams 4

No. of Significant Streams 3

(99.8% of MRE)

HABITAT NOTES

Historic Status	Most production is from Nimpkish River. Logging has been the dominate development activity, but effects have been mainly minor. Some moderate to high effects on Adam River (I). Forest spraying in Nimpkish River may have affected chinook (I).
Current Status	Logging is continuing in all systems; in Nimpkish, further from river (I). Ongoing enhancement at Nimpkish and Willow Creek facilities (SRMP).
Future Outlook	Stabilization and habitat improvements are expected with forest regeneration (I).
Natural Habitat Production Potential	Unused habitat available on Nimpkish River (I).
Improved Production Potential	Proposed addition to gravel to side channels, Adam River (SRMP). Proposed expansion of Willow Creek and Cheslake facilities (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	High	High	High	

HABITAT INFORMATION TABLE

STOCK GROUP Upper East Coast Vancouver Island Sockeye Area 12

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	159	250*	48.85 10 (SRMP)

MANAGEMENT STYLE

Active 1*

Passive 4

No. of Streams 5

No. of Significant Streams 4

(99.8% of MRE)

HABITAT NOTES

Historic Status	Almost all production (including total target) is from Nimpkish River. Logging has been the major development in these systems, with mainly low or unknown effects on sockeye (I). Forest spraying may have affected sockeye in Nimpkish River (I). Urban development effects on Quatse River (I).
Current Status	Logging is continuing; but in the Nimpkish system, further from the river (I). Hatchery and lake fertilization in Nimpkish system (SRMP).
Future Outlook	Logging will continue into the future (I).
Natural Habitat Production Potential	Considerable unused available habitat, particularly in Nimpkish River. Unknown if the fry rearing capacity of the lake is adequate to support target escapements, without fertilization (I).
Improved Production Potential	Potential fertilization of Woss and Vernon lakes in Nimpkish system (SRMP). Suggested improvements to Quatse estuary (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	High	High	High	High

* Nimpkish.

HABITAT INFORMATION TABLE

STOCK GROUP Upper East Coast Vancouver Island Coho Area 12

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	113	(not avail.)	2.24

MANAGEMENT STYLE

Active ___

Passive 16

No. of Streams 16

No. of Significant Streams 12

(96 % of MRE)

HABITAT NOTES

Historic Status	Largest producers are Nimpkish, Keogh and Kokish rivers. Overfishing of coho has been suggested for Adam, Keogh, Kokish, Nimpkish and Quatse river populations (I). Logging has taken place on 9 of these systems; mostly with low impact (I). Forest spraying has reportedly affected Nimpkish coho (I). Flow fluctuations are a problem in 2 streams, and flood-gate operation may hinder coho use of Quatse estuary (I).
Current Status	Logging is continuing on at least 6 streams, with some stabilization reported (I). Nimpkish, Cluxewe and Quatse coho are enhanced from fry outplantings from several facilities (SRMP).
Future Outlook	Logging is expected to continue on several systems, but improved conditions should be realized overall (I).
Natural Habitat Production Potential	Underutilized habitats reported on Adam, Keogh, Nimpkish, Quatse, and Tsitika rivers (I).
Improved Production Potential	Suggested improvements included: addition of gravel in Adam River side channels (SRMP), dam improvements to increase Nahwitti River flows (SRMP), expansion of Cheslake and Willow Creek facilities on the Nimpkish (SRMP) and estuary improvements on Quatse River (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	High	High	High	

HABITAT INFORMATION TABLE

STOCK GROUP Upper East Coast Vancouver Island Chum Area 12

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	165	(not avail.)	18

MANAGEMENT STYLE Active 1* Passive 15

No. of Streams 16

No. of Significant Streams 5

(86 % of MRE)

HABITAT NOTES

Historic Status	Most production is from Nimpkish River. Logging has been carried out on 4 streams, with mainly low impacts (I). Forest spraying has reportedly affected fish in Nimpkish River (I).
Current Status	Logging is continuing on 2 streams (I). Enhancement facilities have augmented Nimpkish and Quatse chum (SRMP).
Future Outlook	Some logging.
Natural Habitat Production Potential	Underutilized habitat is reported for Nimpkish River (I).
Improved Production Potential	Expansion of Willow Creek and Cheslake facilities for Nimpkish chum has been suggested (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	High	High	High	

All streams other than Nimpkish have minimal potential because of stock interception problems (I).

* Nimpkish.

HABITAT INFORMATION TABLE

STOCK GROUP Upper East Coast Vancouver Island Pink Area 12

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	699	587 - even 134 - odd	93 - even 40.9 - odd

MANAGEMENT STYLE

Active 1*

Passive 13

No. of Streams 14

No. of Significant Streams 14

(100 % of MRE)

HABITAT NOTES

Historic Status	Largest producers are Adam, Keogh, Quatse rivers. Logging has taken place on 11 streams, with mainly low impacts (I). Forest spraying reportedly affected fish in Nimpkish system (I). Over-fishing of pinks has been reported for Cluxewe, Keogh, Nahwitti, Quatse and Shusharte river stocks (I).
Current Status	Logging is continuing on 5 streams (I). Cluxewe and Quatse rivers have been enhanced from Quatse facility (SRMP).
Future Outlook	Increased stability is expected (I).
Natural Habitat Production Potential	Unused habitat is reported for Cluxewe, Keogh, Nahwitti, Shusharte and Stranby rivers (I).
Improved Production Potential	Suggested improvements include: gravel additions to Adam River (SRMP), water storage for Cluxewe River (I), expanded Quatse facility for Quatse, Cluxewe, and Keogh rivers - then recolonize barren systems (SRMP), and expanded dam to increase flows in Nahwitti River (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
Medium-High	Medium-High	Medium-High	High	High

* Nimpkish - odd.

HABITAT INFORMATION TABLE

STOCK GROUP Johnstone Strait Chinook Area 13 (Island)

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	11.97	(not avail.)	2.7 (includes enhanced stocks)

MANAGEMENT STYLE

Active ___

Passive 4

No. of Streams 4

No. of Significant Streams 4

(100 % of MRE)

HABITAT NOTES

Historic Status	Most production is from Campbell River. Logging has occurred on 2 streams, with moderate effects on Salmon River. Hydro dam regulation on Campbell River has affected habitat downstream (I). Stabilization of flows may have had some beneficial effect (GWG/SEP). Possible water quality effects in Campbell River from metal mine discharge upstream (GWG/SEP).
Current Status	Campbell and Quinsam Rivers both enhanced by Quinsam Hatchery (SRMP). Logging is continuing in Salmon River system; with scouring (I). Water quality improvements in Campbell River from bettern mine waste disposal (P).
Future Outlook	Campbell and Quinsam river wild stocks may be replaced by hatchery stock (I). Campbell River habitat may decline (I). Continued logging in Salmon River system. Risk of water quality problems from proposed coal development in Quinsam system (I).
Natural Habitat Production Potential	Natural production potential may be decreased by loss of gravel recruitment and flow regulations on Campbell River (P).
Improved Production Potential	Improved hatchery operation, with channel and gravel addition planned for Campbell River (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	High

HABITAT INFORMATION TABLE

STOCK GROUP Johnstone Strait Coho Area 13 (Island)

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	32.5	(not avail.)	21.39 (includes enhanced returns)

MANAGEMENT STYLE

Active ___

Passive 8

No. of Streams 8

No. of Significant Streams 8

(100 % of MRE)

HABITAT NOTES

Historic Status	Largest producers are Quinsam and Salmon rivers. Logging has affected 2 streams; moderate effects on Salmon River system. Hydro dam and flow regulation has affected downstream habitat in Campbell River. Stabilization may be beneficial (GWG/SEP). Low flows and urban development have affected 3 streams. Overfishing has reportedly affected Salmon River stocks (I). Log storage may be affecting estuary on Salmon River (I). Possible water quality effects in Campbell River from metal mine effluent upstream (GWG/SEP).
Current Status	Logging is continuing on Salmon River system. Quinsam Hatchery is enhancing Quinsam and Campbell river stocks (SRMP). Fry release above falls on Quinsam River (I). Water quality improvements in Campbell River from mine waste control (P).
Future Outlook	Potential water quality risk from proposed coal mine development on Quinsam River (I).
Natural Habitat Production Potential	Underutilized coho habitat in Salmon River (I). Production potential of Campbell River may be reduced by flow regulation and loss of gravel recruitment (P).
Improved Production Potential	Expanded hatchery operation planned on Quinsam River (SRMP). Small-scale enhancement possibilities tied to urban development of Simms Creek (P).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	High

HABITAT INFORMATION TABLE

STOCK GROUP Johnstone Strait Chum Area 13 (Island)

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	42.94	(not avail.)	23.59

MANAGEMENT STYLE

Active ___

Passive 9

No. of Streams 9

No. of Significant Streams 6

(94 % of MRE)

HABITAT NOTES

Historic Status	Largest producers have been Salmon and Campbell rivers. Hydro dam and flow regulation on Campbell River may have degraded chum habitat in lower river (I). Stabilization may have had some positive effect (GWG/SEP). Falls on 3 streams, but unknown useable habitat above. Logging on Salmon River has resulted in rapid flow fluctuations and scouring.
Current Status	Logging and its effects on Salmon River is continuing (I).
Future Outlook	Potential for continued degradation of habitat on Campbell River from flow regulation (I). Potential water quality effects from proposed coal mine on Quinsam River (I).
Natural Habitat Production Potential	Overall potential may have been reduced by flow regulation and loss of gravel recruitment on Campbell River (P).
Improved Production Potential	Not known.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	

HABITAT INFORMATION TABLE

STOCK GROUP Johnstone Strait Pink Area 13 (Island)

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	182	129.5 - even 21.8 - odd	15.48 - even 32.25 - odd

MANAGEMENT STYLE

Active 1*

Passive 8

No. of Streams 9

No. of Significant Streams 5

(97 % of MRE)

HABITAT NOTES

Historic Status	Enhanced stocks: Amor de Cosmos (e), Quinsam (e and o). Logging has affected Salmon River; through scouring and flow fluctuations. Hydro-dam flow regulation and loss of gravel recruitment may have affected pink habitat in Campbell River (I) Stabilization may be positive (GWG/SEP). Impassable falls on 2 streams; unknown useable habitat above. Potential habitat above falls on Quinsam River (I). Low flows in Salmon River reportedly result in high mortality (GWG/SEP).
Current Status	Logging and its effect on Salmon River is continuing (I). Hatchery production on Quinsam River (I).
Future Outlook	Potential for continued degradation of habitat on Campbell River (I). Potential water quality effects from proposed coal mine on Quinsam River (I).
Natural Habitat Production Potential	Considerable unused habitat available Salmon River (I).
Improved Production Potential	Potential pink habitat in upper Quinsam River (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	

HABITAT INFORMATION TABLE

STOCK GROUP Mid East Coast Vancouver Island Chinook Area 14

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	7.73	(not avail.)	6.99
	(pre-enhancement)		(includes enhanced return)

MANAGEMENT STYLE

Active ___

Passive 5

No. of Streams 5

No. of Significant Streams 3

(98 % of MRE)

HABITAT NOTES

Historic Status	All enhanced stocks, with wild stocks dominated by hatchery returns (I). Concerns for overfishing wild stocks (I). Controlled temperature and flows in Big Qualicum River. Some scouring and silting of habitat in Little Qualicum River from logging. Puntledge River flow controlled by Hydro dam; some problems with release regime (I).
Current Status	Logging and urban development continuing along Little Qualicum River. Continued problems with flow release regime on Puntledge River (I). Hatcheries operating on Big Qualicum, Little Qualicum and Puntledge rivers.
Future Outlook	Potential water supply and quality problems on Little Qualicum River (P).
Natural Habitat Production Potential	Available habitat to support MRE level (P).
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium-High	Medium-High	Medium-High	

HABITAT INFORMATION TABLE

STOCK GROUP Mid East Coast Vancouver Island Coho Area 14

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	120.92	(not avail.)	75.81
	(pre-enhancement)		(includes enhanced returns)

MANAGEMENT STYLE

Active ___

Passive 27

No. of Streams 27

No. of Significant Streams 13

(95 % of MRE)

HABITAT NOTES

Historic Status	Control dams have provided benefits on Big Qualicum and Tsolum rivers, but release regime has been a problem for Puntledge River (I). Agriculture use and urban development have had low to moderate effects on 6 streams, and moderate to high impact on Black Creek. Logging has had moderate effects on Englishman and Little rivers, and moderate to high impact on Oyster River (I). Low summer flows affect 4 streams. Seepage from old mines affects water quality of Tsable and Tsolum rivers (I).
Current Status	Agriculture, urban development, logging, low flow and mine seepage problems are continuing (I). Enhancement facilities are located on Big Qualicum, Little Qualicum, Puntledge rivers and Rosewall Creek.
Future Outlook	Few changes are expected (I); but more protective controls can be expected (P).
Natural Habitat Production Potential	Habitat is available to support MRE in Big Qualicum, and Puntledge rivers, and French Creek (I). Mine waste seepage may limit potential in Tsable and Tsolum rivers (I).
Improved Production Potential	Habitat is available above falls or dam on Englishman, Little Qualicum, Oyster and Puntledge rivers (I). Water storage can improve production on Black and Cougar Creek (I) and Englishman River (GWG/SEP). Improved releases from dam on Puntledge (I). Incubation box proposed in French Creek (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium-High	Medium-High	High	High

HABITAT INFORMATION TABLE

STOCK GROUP Mid East Coast Vancouver Island Chum Area 14

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	287.48	(not avail.)	240.78*

MANAGEMENT STYLE

Active ___

Passive 21

No. of Streams 21

No. of Significant Streams 10

(94 % of MRE)

HABITAT NOTES

Historic Status	Control dams have provided benefits on Big Qualicum and Tsolum rivers, but release regime has been a problem on Puntledge River (I). Logging has had moderate effects on Englishman and Little Qualicum rivers, and moderate to high impact on Oyster River (I). Agriculture and urban development have had low to moderate effects on Englishman, Little Qualicum and Tsolum rivers. Dyking for flood protection has had some affect on Oyster River (I). Seepage from old mines affects water quality on Tsable and Tsolum rivers (I). There are impassable falls on 7 streams, but no identified habitat above.
Current Status	Logging, agriculture and urban developments are continuing (I). Enhancement facilities are located on Big Qualicum, Little Qualicum and Puntledge rivers.
Future Outlook	Logging, agriculture and urban development are expected to continue; but perhaps with more protective controls (P).
Natural Habitat Production Potential	Underused habitat is reported for Puntledge River (I). Potential probably reduced by scouring on Englishman and Oyster rivers, and McNaughton Creek (P). Potential probably limited by mine waste on Tsolum and Tsable rivers (P).
Improved Production Potential	Water storage recommended for Cougar Creek (I), and better regulated flows for Puntledge River (I). Flow stabilization suggested for Englishman and Oyster rivers (I). Control of mine waste on Tsable and Tsolum rivers (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	Medium-High

HABITAT INFORMATION TABLE

STOCK GROUP Mid East Coast Vancouver Island Pink Area 14

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	224.5	23.9 - even 19.3 - odd	9.93 - even 8.95 - odd

MANAGEMENT STYLE

Active ___

Passive 13

No. of Streams 13

No. of Significant Streams 3

(96 % of MRE)

HABITAT NOTES

Historic Status	Logging and dyking have had a moderate to high impact on habitat in Oyster River. Flow control on Puntledge River; some areas underutilized. Seepage from old mine affects water quality in Tsolum River (I).
Current Status	Continued logging in Oyster River. Enhancement facility on Puntledge River (SRMP). Tsolum hatchery not operating in last few years due to egg shortage (SRMP).
Future Outlook	Logging will continue on Oyster River; some past impacts may be difficult to overcome (I).
Natural Habitat Production Potential	Some underutilized habitat on Puntledge River; but probably lost habitat in Oyster River and potential limited by mine waste problems on Tsolum River (P).
Improved Production Potential	Better regulated flows suggested for Puntledge River (I). Control of mine waste problem suggested for Tsolum River (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
Low	Low-Medium	Low-Medium	Low-Medium	Medium

HABITAT INFORMATION TABLE

STOCK GROUP Lower East Coast Vancouver Island Chinook Area 17

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	7.7	(not avail.)	2.79

MANAGEMENT STYLE

Active ___

Passive 2

No. of Streams 2

No. of Significant Streams 2

(100 % of MRE)

HABITAT NOTES

Historic Status	Most production is from Nanaimo River. Logging has affected stability and flow fluctuations in Nanaimo and Chemainus rivers.
Current Status	Logging is continuing, but some regeneration and improved stream stability has been noted (I). Hatcheries in operation on Nanaimo and Chemainus rivers.
Future Outlook	Forest regeneration and river stabilization will continue on Nanaimo and Chemainus rivers.
Natural Habitat Production Potential	Probable unused habitat on Nanaimo River (I). Chemainus River may be near capacity (P).
Improved Production Potential	Limited habitat above canyon on Chemainus River.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium-High	Medium-High	

HABITAT INFORMATION TABLE

STOCK GROUP Lower East Coast Vancouver Island Chinook Area 18

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	16	(not avail.)	5.73

MANAGEMENT STYLE

Active ___

Passive 2

No. of Streams 2

No. of Significant Streams 2

(100 % of MRE)

HABITAT NOTES

Historic Status	Most production from Cowichan River. Logging has had moderate to high impacts on Cowichan and Koksilah rivers (I). Low flows and dyking have affected lower Cowichan River. Agricultural and urban development on Cowichan and Koksilah rivers have had low to moderate affects. Impassable falls on Koksilah River.
Current Status	Logging has decreased, but channelling and dyking continue to be problems. Fishway on Cowichan River aids in access to upper reaches. Hatchery on Cowichan River in operation (SRMP).
Future Outlook	Both rivers will recover from logging effects, and habitat improvements are expected (I). Dyking, agricultural and urban developments will continue.
Natural Habitat Production Potential	Unused habitat on Cowichan River (I). Both rivers can accommodate historic high production (I).
Improved Production Potential	Additional habitat potentially useable above falls on Koksilah River; fishway required to provide access.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium-High	High	High

HABITAT INFORMATION TABLE

STOCK GROUP Lower East Coast Vancouver Island Coho Area 17

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	25.21	(not avail.)	5.88

MANAGEMENT STYLE Active ___ Passive 15

No. of Streams 15

No. of Significant Streams 7

(93 % of MRE)

HABITAT NOTES

Historic Status	Largest producer has been Nanaimo River. Logging and resulting instability and flow fluctuations have affected Nanaimo and Chemainus rivers. Agriculture and urban development have channelled and dyked portions of Bonsall, Holland and Walkers creeks, and resulted in water shortages. Impassable falls on Chemainus, Nanoose, Bush and Holland creeks, and culvert barriers on Bonsall and Walkers creeks. Potentially useable habitat has been identified above the barrier only on Chemainus.
Current Status	Logging, agriculture and urban development are continuing, with stabilizing effects on regeneration noticable on Chemainus and Nanaimo rivers (I). SEP hatchery in operation on Nanaimo River, small facility on Nanoose Creek.
Future Outlook	Forest regeneration and river stabilization will continue on Chemainus and Nanaimo Rivers (I). Agriculture and urban development will continue (I).
Natural Habitat Production Potential	Underutilized habitat in Nanaimo River.
Improved Production Potential	Several km of potentially useable habitat above canyon on Chemainus River. Fishway needed for access (I). Fry release to underutilized channels on Nanaimo River (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium-High	Medium-High	High

HABITAT INFORMATION TABLE

STOCK GROUP Lower East Coast Vancouver Island Coho Area 18

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	110	(not avail.)	26.85

MANAGEMENT STYLE

Active ___

Passive 4

No. of Streams 4

No. of Significant Streams 2

(99.5% of MRE)

HABITAT NOTES

Historic Status	Logging has had moderate to high impacts on Cowichan and Koksilah Rivers (I). Low flows and dyking have affected Cowichan River and its tributaries. Agricultural and urban development on Cowichan and Koksilah systems have had moderate effects. Mainly impassable falls on Koksilah River.
Current Status	Logging has decreased, but channelling and water withdrawal and water quality continue to be problems, particularly from agricultural and urban development. Fishway and side channel development have improved Cowichan River utilization. Hatchery on Cowichan River.
Future Outlook	Both rivers will recover from logging effects and improvements to coho habitats are expected (I). Dyking, agriculture and urban development will continue.
Natural Habitat Production Potential	Habitat is available to support historic high escapements on both Cowichan and Koksilah rivers (I).
Improved Production Potential	Additional habitat potentially useable above falls on Koksilah River; fishway required to provide access. Opportunities for increased production by utilizing presently inaccessible reaches of side channels and tributaries of Cowichan River (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium-High	High	High

HABITAT INFORMATION TABLE

STOCK GROUP Lower East Coast Vancouver Island Chum Area 17

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	230	(not avail.)	82

MANAGEMENT STYLE

Active ___

Passive 15

No. of Streams 15

No. of Significant Streams 7

(96 % of MRE)

HABITAT NOTES

Historic Status	Most production has been from Nanaimo River. Logging and resulting instability and flow fluctuations have affected Nanaimo and Chemainus rivers. Gravel removal has affected spawning grounds in Chemainus River. Impassable falls on all streams, with useable chum habitat identified above falls only on Bush Creek.
Current Status	Logging is continuing on Nanaimo River with some regeneration and improved stability noted (I). Urban development on Bonsall Creek may affect chum (I). Enhancement facilities in Nanaimo River (hatchery), Chemainus River (channels).
Future Outlook	Forest regeneration and river stabilization will continue on Nanaimo and Chemainus rivers (I).
Natural Habitat Production Potential	Habitat available to support historic high escapements on most streams (I) (P).
Improved Production Potential	Useable chum habitat above falls on Bush Creek.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium-High	High	

HABITAT INFORMATION TABLE

STOCK GROUP Lower East Coast Vancouver Island Chum Area 18

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	261	(not avail.)	99 (includes enhanced returns)

MANAGEMENT STYLE

Active 1*

Passive 2

No. of Streams 3

No. of Significant Streams 2

(99 % of MRE)

HABITAT NOTES

Historic Status	Cowichan River produces almost all chum in this sub-stock. Logging has probably had moderate to high impacts on chum habitat from scouring and flooding (I). Channelling and dyking have affected chum habitat, particularly in Cowichan River. Impassable falls on Koksilah River.
Current Status	Logging has decreased, but channeling dyking continue to be the chief problems for chum production. Hatchery in operation on Cowichan River.
Future Outlook	Both rivers will stabilize from logging effects (I). Dyking for flood protection will continue.
Natural Habitat Production Potential	It is not known whether habitat is available to support historic high escapements.
Improved Production Potential	May be suitable habitat above falls on Koksilah River, fishway required. Need for additional chum is questioned (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Unknown	

* Cowichan.

HABITAT INFORMATION TABLE

STOCK GROUP Southern Vancouver Island Sockeye Area 20

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	1.5	(not avail.)	0.3

MANAGEMENT STYLE

Active ___

Passive 1

No. of Streams 1

No. of Significant Streams 1

(100 % of MRE)

HABITAT NOTES

Historic Status	San Juan River is the only sockeye producer. Flood damage in 1960's. Logging throughout watershed; unknown effects on sockeye habitat (P).
Current Status	Some headwater areas being logged, some in second growth (P). No specific habitat problems noted.
Future Outlook	Should be improved stability as forest regeneration progresses (P). Logging will continue, mainly in headwater areas (P).
Natural Habitat Production Potential	Not known.
Improved Production Potential	Not known.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Unknown			

HABITAT INFORMATION TABLE

STOCK GROUP Southern Vancouver Island Chinook Area 19

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	.025	(not avail.)	.016

MANAGEMENT STYLE

Active ___

Passive 1

No. of Streams 1

No. of Significant Streams 1

(100 % of MRE)

HABITAT NOTES

Historic Status	Chinook spawn up to falls; 4 km from mouth, on Goldstream River. Flow controlled by dams on system (water supply to Victoria); flow problems for spawning in some years (I).
Current Status	Continued flow problems for spawning fish; arrangements with Water District (I). Enhanced via fry releases into river.
Future Outlook	No change expected (P, I).
Natural Habitat Production Potential	Not known, but probably near maximum (P).
Improved Production Potential	Not known.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	

Probably very limited production potential.

HABITAT INFORMATION TABLE

STOCK GROUP Southern Vancouver Island Chinook Area 20

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	8.5	(not avail.)	.72

MANAGEMENT STYLE

Active ___

Passive 3

No. of Streams 3

No. of Significant Streams 3

(100 % of MRE)

HABITAT NOTES

Historic Status	Logging has been extensive in the Gordon River and San Juan watersheds, but effects on chinook are unknown. Flood damage to gravels in San Juan River in 1960's reported. Flow regulation on Sooke River since 1970.
Current Status	Logging is continuing on two streams (P). No specific habitat problems noted.
Future Outlook	Some stabilization will be likely with forest regeneration, and logging will continue on Gordon and San Juan rivers (P).
Natural Habitat Production Potential	Current escapements suggest some underutilization of available habitat; but not known if historic high escapements can be supported.
Improved Production Potential	Not known.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium		

HABITAT INFORMATION TABLE

STOCK GROUP Southern Vancouver Island Coho Area 19

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	3	(not avail.)	0.14

MANAGEMENT STYLE

Active ___

Passive 4

No. of Streams 4

No. of Significant Streams 4

(100 % of MRE)

HABITAT NOTES

Historic Status	Urban/agricultural development has had moderate effects on coho habitat on 3 of the 4 streams (I, P). Flow regulation on Goldstream River is a problem for spawning and summer rearing in some years (I, P).
Current Status	Small-scale habitat enhancement on 2 streams.
Future Outlook	No changes are anticipated (I).
Natural Habitat Production Potential	Low summer flows in most streams probably limit production; historic high escapements may not be accommodated (P).
Improved Production Potential	Improved summer flows would probably increase coho production (I, P).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Low-Medium	Low-Medium	Low-Medium	Medium

Past habitat loss (mainly low flows) limits coho production.

HABITAT INFORMATION TABLE

STOCK GROUP Southern Vancouver Island Coho Area 20

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	99.75	(not avail.)	10.28

MANAGEMENT STYLE

Active ___

Passive 8

No. of Streams 8

No. of Significant Streams 5

(97 % of MRE)

HABITAT NOTES

Historic Status	Most historic production has been from San Juan River. Logging and flow regulation by dams have been the most obvious activities affecting coho habitat; although there is little information on level of impact.
Current Status	Logging and flow regulation are continuing.
Future Outlook	Some stabilization will likely occur on some streams with forest regeneration, but at least one stream will continue to be unstable.
Natural Habitat Production Potential	There is probably underutilized habitat on at least 2 streams, but it is not known if historic high escapements can be supported (P). Flooding and flow regulation limit production on 2 streams.
Improved Production Potential	40 km of potentially useable spawning and rearing habitat above falls on Sooke River. Fishway required to gain spawner access.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	Medium-High

HABITAT INFORMATION TABLE

STOCK GROUP Southern Vancouver Island Chum Area 19

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	46.4	(not avail.)	20.8 (includes enhanced returns)

MANAGEMENT STYLE

Active ___

Passive 4

No. of Streams 4

No. of Significant Streams 2

(91.5% of MRE)

HABITAT NOTES

Historic Status	Most historic production is from Goldstream River. Flow regulation on Goldstream River has occasionally been a problem for spawner access to the river (I).
Current Status	Small-scale enhancement on Goldstream River. Current average escapement includes enhanced returns.
Future Outlook	No changes are anticipated (I).
Natural Habitat Production Potential	Current (enhanced) habitat may support historic high escapement levels (P).
Improved Production Potential	Not known.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium-High	

HABITAT INFORMATION TABLE

STOCK GROUP Southern Vancouver Island Chum Area 20

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	131	(not avail.)	15.55

MANAGEMENT STYLE

Active ___

Passive 8

No. of Streams 8

No. of Significant Streams 8

(100 % of MRE)

HABITAT NOTES

Historic Status	Largest historic producers are De Mamiel Creek and Sooke River. Logging and storage dam regulation have been the most significant activities in this area; although with the exception of flow control on Jordan River, impacts have not been measured. Logging has taken place on 4 systems, and flow control on 2. Production eliminated by flow regulation in Jordan River.
Current Status	Logging is continuing on San Juan and Gordon rivers; mainly in headwater areas and away from chum spawning grounds (P).
Future Outlook	Logging will continue on San Juan and Gordon Rivers; mainly in headwater areas (P). No other changes are anticipated.
Natural Habitat Production Potential	Underutilized habitat is apparent on De Mamiel Creek, Gordon River, Kirby Creek, Muir Creek, San Juan River, Sooke River, and Tugwell Creek. Overall MRE may be supported by presently available habitat. Flooding and scouring may limit production in De Mamiel Creek(P).
Improved Production Potential	Not known: flow releases may improve production in Jordan River (P).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium-High	

HABITAT INFORMATION TABLE

STOCK GROUP Southern Vancouver Island Pink Area 20

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	10.5	(not avail.)	.165

MANAGEMENT STYLE

Active ___

Passive 3

No. of Streams 3

No. of Significant Streams 3

(100 % of MRE)

HABITAT NOTES

Historic Status	Most of the historic pink production has been from Jordan River, however, flow regulation and mining effects have eliminated further production from the river since 1971.
Current Status	Logging continues in Gordon and San Juan river watersheds; mainly in headwater areas (P).
Future Outlook	Logging will continue in Gordon and San Juan systems (P). No other changes are anticipated.
Natural Habitat Production Potential	Most of the historic capacity has been eliminated by flow regulation and mining effects on Jordan River. Remaining systems can probably support higher escapements than current average (P).
Improved Production Potential	Not known.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Low-Medium	Low-Medium	Low-Medium	

HABITAT INFORMATION TABLE

STOCK GROUP Seymour/Kingcome/Knight Sockeye Area 11/12 - Mainland

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	60	(not avail.)	1.39

MANAGEMENT STYLE: Active ___ Passive 10

No. of Streams 10

No. of Significant Streams 6

(99 % of MRE)

HABITAT NOTES

Historic Status	Most spawn in Fulmore, Kakweiken and MacKenzie Sound systems. Logging and related siltation and instability have affected all streams (GWG/SEP). Natural flow fluctuation is also a problem on at least one stream (GWG/SEP).
Current Status	Some improvements from logging effects.
Future Outlook	Increased logging (GWG/SEP), but some recovery is expected on largest producers (I).
Natural Habitat Production Potential	Not known.
Improved Production Potential	Lake fertilization on Fulmore Lake once stocks increased by catch regulation (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium		

HABITAT INFORMATION TABLE

STOCK GROUP Seymour/Kingcome/Knight Chinook Area 11/12 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	30	(not avail.)	2.0

MANAGEMENT STYLE

Active ___

Passive 9

No. of Streams 9

No. of Significant Streams 9

(100 % of MRE)

HABITAT NOTES

Historic Status	Klinaklini and Kingcome rivers are largest historic producers. Logging and related siltation and instability have affected all streams (GWG/SEP). Effects on chinook unknown. Overfishing reported on Franklin, Kingcome and Wakeman rivers (I).
Current Status	Logging is continuing on most streams (GWG/SEP) with improved stabilization on some. Enhancement facility on Devereaux Creek (tributary) (SRMP).
Future Outlook	Future logging is expected (I).
Natural Habitat Production Potential	Unused habitat on Franklin, Kingcome, Klinaklini and Wakeman rivers (I). Total capacity is unknown.
Improved Production Potential	Not known.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium-High	

HABITAT INFORMATION TABLE

STOCK GROUP Seymour/Kingcome/Knight Coho   Area 11/12 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	206	(not avail.)	14.53

MANAGEMENT STYLE   Active ___   Passive 67

No. of Streams 67

No. of Significant Streams 35

(96 % of MRE)

HABITAT NOTES

Historic Status	Kakweiken and Kingcome rivers are the largest producers. Falls on 10 streams limit access to lower reaches; fishways on two streams. Logging and related siltation and instability have affected all streams (GWG/SEP), with mainly low to moderate impacts (I). Debris jams have also been a problem on 7 streams.
Current Status	Logging is continuing on most streams (GWG/SEP), with improving conditions on some. Hatchery in operation on Wakeman River. Fry planting on Scott Cove Creek (SRMP).
Future Outlook	Future logging is expected to have low to moderate effects on at least 4 streams (I).
Natural Habitat Production Potential	Some unused habitat noted on streams (I), although total capacity not known.
Improved Production Potential	Debris removal, and rehabilitation would improve production (GWG/SEP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	Medium

HABITAT INFORMATION TABLE

STOCK GROUP Seymour/Kingcome/Knight Chum Area 11/12 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	506	Kingcome 113 Knight 220	84

MANAGEMENT STYLE

Active ___

Passive 63

No. of Streams 63

No. of Significant Streams 26

(90 % of MRE)

HABITAT NOTES

Historic Status	Largest producers are Jap Creek, Seymour River, Ahnuhati River, Ahta River, Glendale River, Kakweiken River, Kingcome River, Klinaklini River, Viner Sound Creek, Wakeman River. Impasssable falls on 11 streams; fishway on Kakweiken River. Logging and related siltation and instability have effected 14 streams; including most of the major producers, with mainly moderate impacts (GWG/SEP) (I).
Current Status	Logging is continuing on most streams (GWG/SEP), with improving conditions on some (I).
Future Outlook	Future logging is expected in the future on at least 4 streams, and continuing improvements on Glendale and Kakweiken Rivers (I).
Natural Habitat Production Potential	Unused habitat reported on Ahta Valley Creek and Fullmore River (I). Total capacity is not known.
Improved Production Potential	Possible SEP channel on Kakweiken River (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium		Medium-High

HABITAT INFORMATION TABLE

STOCK GROUP Kingcome/Knight Pink Area 12 - Mainland Inlets

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	1,737	521 - even 579 - odd	E: 1980- 993 1982- 410 1984- 307
			O: 1979- 174 1981- 849 1983- 1,312

MANAGEMENT STYLE

Active 4*

Passive 34

No. of Streams 38

No. of Significant Streams 13

(98 % of MRE)

HABITAT NOTES

Historic Status	Most production from actively managed systems. Logging and related siltation and instability have affected 8 streams (GWG/SEP). Most logging effects are moderate, with some high effects on Glendale and Kakweiken rivers. Impassable falls on Klinaklini and Glendale (Tom Brown Creek) system.
Current Status	Logging is continuing on 5 streams, but generally further away from pink habitat (I). Logging is finished on 3 streams (I). Improving conditions on Glendale River (I). Fishways in operation on Kakweiken and Kingcome rivers.
Future Outlook	Further logging expected on 4 streams, but recovery on important Glendale and Kakweiken systems (I).
Natural Habitat Production Potential	Unused habitat reported on Ahnuhati and Embly rivers and Ahata Valley Creek (I).
Improved Production Potential	Suggested fishway on Embly River and channels and flow control on Kanweiken River (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
High	Medium-High	High	High	High

* Only Glendale, Kakweiken, Kingcome and Wakeman rivers actively managed **(with odd and even years).**

HABITAT INFORMATION TABLE

STOCK GROUP Lough Borough/Bute Sockeye Area 13 - Mainland Inlets

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	23.4	(not avail.)	9.34

MANAGEMENT STYLE

Active ___

Passive 7

No. of Streams 7

No. of Significant Streams 2

(96 % of MRE)

HABITAT NOTES

Historic Status	Logging and related siltation and instability have affected both streams (GWG/SEP). Natural flow fluctuation is also a problem on Phillips River.
Current Status	Natural instability and logging effects (I).
Future Outlook	Logging will continue (I).
Natural Habitat Production Potential	Some habitat available above slide on Phillips River.
Improved Production Potential	Controlled harvest and lake fertilization (SRMP). Proposed channel on Phillips River (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	Medium-High

HABITAT INFORMATION TABLE

STOCK GROUP Loughborough/Bute Chinook Area 13 - Mainland Inlets

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	22.3	(not avail.)	4.4

MANAGEMENT STYLE

Active ___

Passive 9

No. of Streams 9

No. of Significant Streams 9

(100 % of MRE)

HABITAT NOTES

Historic Status	Homathko and Southgate rivers are largest historic producers. Logging and related siltation and instability have affected all streams (GWG/SEP) with unknown effects on chinook. Chinook reportedly overfished on 2 streams.
Current Status	Logging is continuing on most streams.
Future Outlook	Future logging is planned on most streams (I).
Natural Habitat Production Potential	Reported unused habitat on Apple River.
Improved Production Potential	Proposed planting of Homathko, Orford and Southgate rivers from Southgate River hatchery (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential

HABITAT INFORMATION TABLE

STOCK GROUP Loughborough/Bute Coho Area 13 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	81.43	(not avail.)	13.88

MANAGEMENT STYLE

Active ___

Passive 32

No. of Streams 32

No. of Significant Streams 15

(95 % of MRE)

HABITAT NOTES

Historic Status	Impassable falls on 3 streams. Logging and related siltation and instability have affected all streams (GWG/SEP), with mainly moderate impacts (I). High turbidity on most streams makes escapement counts and habitat observations difficult.
Current Status	Logging is continuing on most streams, with low to moderate impacts expected on at least 4 streams (I).
Future Outlook	Future logging is planned on at least 6 streams (I).
Natural Habitat Production Potential	Unused habitat is noted on 4 streams; including 12 km on Quatam River (I). No total capacity known.
Improved Production Potential	Catch regulation to increase number of spawners has been suggested for 2 streams, and improved flow stability on another (I). Storage facility on Shannon Lake (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	Medium

HABITAT INFORMATION TABLE

STOCK GROUP Loughborough/Bute Chum — Area 13 - Mainland Inlets

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	443	(not avail.)	199 (SEDS) 217 (SRMP)

MANAGEMENT STYLE — Active 2* — Passive 37

No. of Streams 39

No. of Significant Streams 12

(87 % of MRE)

HABITAT NOTES

Historic Status	Most production from Homathko, Orford, Phillips and Southgate rivers. Logging and related siltation and instability have affected 9 streams, including the major 4 rivers (GWG/SEP). Effects have been moderate to high (I). There are impassable falls on Orford and Quatam rivers, however no records of suitable habitat above.
Current Status	Logging is continuing on at least 4 streams; including Orford and Phillips rivers, with moderate to high impacts (I). Logging completed on 2 streams (I). Incubation facility on Hyacinthe Creek (SRMP).
Future Outlook	Logging is expected on 4 systems; including Orford, Phillips and Southgate rivers (I).
Natural Habitat Production Potential	Total capacity not known.
Improved Production Potential	Suggested improvements include: barrier removal on Heydon Creek (I), clearing debris from slough on Homathko River (I), stabilizing measures on Orford River (I), and proposed channel in Orford River to increase chum to 100,000 (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium		

HABITAT INFORMATION TABLE

STOCK GROUP Loughborough/Bute Pink Area 13 - Mainland Inlets

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	585	206 - even 176 - odd	E: 1980- 204 1982- 110 1984- 14 O: 1979- 50 1981- 110 1983- 170

MANAGEMENT STYLE

Active

Passive 33

No. of Streams 33

No. of Significant Streams 18

(97 % of MRE)

HABITAT NOTES

Historic Status	Most production from Grassy Creek, Orford River and Phillips River. Logging and related siltation and instability have affected 14 streams, including the major Orford and Phillips rivers (GWG/SEP). Effects have been moderate, with moderate to high effects on Orford and Phillips rivers (I). There are impassable falls on Orford and Quatam rivers, however no records of suitable habitat above.
Current Status	Logging is continuing on 7 streams, and improving conditions reported on 2 streams (I). Enhancement facility on GraniteBay Creek (SRMP).
Future Outlook	Further logging planned on 6 streams; including all the major producers (I).
Natural Habitat Production Potential	Unused habitat is reported on Quatam River, Wortly Creek, Grassy Creek and Orford River (I).
Improved Production Potential	Potential projects include: barrier removal on Haydon Creek; clean slough on Homathko River; storage on Read Creek and stabilization of Orford River (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
High	Medium-High	Medium-High	Medium-High	

HABITAT INFORMATION TABLE

STOCK GROUP Toba Inlet Chinook Area 15 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	28.5	(not avail.)	.82

MANAGEMENT STYLE

Active ___

Passive 4

No. of Streams 4

No. of Significant Streams 4

(100 % of MRE)

HABITAT NOTES

Historic Status	Toba and Little Toba rivers are largest historic producers. Some streams are unstable and subject to massive slides (GWG/SEP) with logging compounding instability problems in the Toba River system (I). Production is limited by glacial origin (GWG/SEP).
Current Status	Logging continuing, but stability is recovering (I).
Future Outlook	Stability will continue to improve in most systems (I).
Natural Habitat Production Potential	Escapement record suggests underutilized habitat (P).
Improved Production Potential	Not identified.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium-High	

HABITAT INFORMATION TABLE

STOCK GROUP Toba Inlet Coho Area 15 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	69.64	(not avail.)	1.2

MANAGEMENT STYLE

Active ___

Passive 13

No. of Streams 13

No. of Significant Streams 6

(95 % of MRE)

HABITAT NOTES

Historic Status	Some streams are unstable and subject to massive slides (GWG/SEP) with logging compounding instability problems in the Toba River system (I). Production is limited by glacial origin (GWG/SEP). Logging has had moderate to high impacts on 4 streams, low on one stream (I). Diversion of Theodosia River to Powell Lake creates some low flow problems (I).
Current Status	Logging problems are continuing on Theodosia and Toba rivers; whereas some recovery is occurring on Brem, Klite and Little Toba rivers (I). Coho enhancement (hatchery) on Sliammon Creek (SRMP).
Future Outlook	Recovery from logging effects is expected on most streams (I).
Natural Habitat Production Potential	Historic high excapements can be accommodated on Klite and Brem rivers (I). Additional habitat above falls on Brem River (I).
Improved Production Potential	Not known.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium-High	

HABITAT INFORMATION TABLE

STOCK GROUP Toba Inlet Chum — Area 15 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	172	136	25 (SEDS 1981-84) 14 (SRMP 1980-83)

MANAGEMENT STYLE — Active ___ Passive 12

No. of Streams 12

No. of Significant Streams 5

(94 % of MRE)

HABITAT NOTES

Historic Status	Productivity in all streams is limited by natural turbidity (GWG/SEP). Upper watershed of Toba system is unstable and subject to slides (GWG/SEP). Logging has accentuated instability problems on 5 streams, including the major producing Toba, Little Toba and Theodosia rivers; with moderate to high impacts (I). Falls on Brem, Forbes, Sliammon, and Theodosia rivers.
Current Status	Logging is continuing in most systems. Recovery is taking place on at least 2 streams, with remaining instability on 2 (I). CEDP project on Sliammon Creek.
Future Outlook	Continued recovery is expected on 3 streams, with some remaining instability on Little Toba River and Brem River (I).
Natural Habitat Production Potential	Total capacity not known; but escapement record suggests some unused habitat, particularly on Toba, Theodosia, Little Toba rivers (P).
Improved Production Potential	50 km of useable habitat above falls on Brem River; proposed facility to overcome falls (SRMP). Small-scale enhancement is possible on Toba River (GWG/SEP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
Medium-High	Medium-High	Medium-High	Medium-High	High

HABITAT INFORMATION TABLE

STOCK GROUP Toba Inlet Pink — Area 15 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	193	88.5 - odd	10 - 1979 11 - 1981 2 - 1983

MANAGEMENT STYLE

Active ___

Passive 11

No. of Streams 11

No. of Significant Streams 4

(93 % of MRE)

HABITAT NOTES

Historic Status	Productivity in all systems is limited by natural turbidity (GWG/SEP). Upper watershed of Toba system is unstable and subject to massive slides (GWG/SEP). Logging has accentuated the natural instability and flashy nature of all streams; with mainly moderate impacts (I). Falls on Brem River are a barrier to pinks in most years.
Current Status	Logging is continuing on most streams. Recovery is taking place, but with some instability remaining on 2 streams (I).
Future Outlook	Logging is expected to continue throughout, with some recovery and instability on 2 streams (I).
Natural Habitat Production Potential	Unused habitat reported on Klite River (up to MRE), and Toba River (I).
Improved Production Potential	50 km of pink habitat above falls on Brem River (SRMP). Small scale enhancement is possible on Toba River (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
Medium-High	Medium-High	Medium-High	High	High

HABITAT INFORMATION TABLE

STOCK GROUP Jervis Inlet Sockeye Area 16 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	24.25	7.5	4.36*

MANAGEMENT STYLE

Active ___

Passive 2

No. of Streams 2

No. of Significant Streams 2

(100 % of MRE)

HABITAT NOTES

Historic Status	
Current Status	
Future Outlook	
Natural Habitat Production Potential	
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
High**	Medium	Medium	Medium	Medium-High

* If Nimpkish sockeye (Upper East Coast Vancouver Island) productivity increases through lake fertilization, then this stock will decrease to zero, if not enhanced (SRMP).

** Target achieved with enhancement.

HABITAT INFORMATION TABLE

STOCK GROUP Jervis Inlet Chinook Area 16 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	.5	(not avail.)	0

MANAGEMENT STYLE

Active ___

Passive 2

No. of Streams 2*

No. of Significant Streams 2

(100 % of MRE)

HABITAT NOTES

Historic Status	Not a significant chinook producing area. Some streams are unstable and subject to massive slides (GWG/SEP) with logging compounding instability problems particularly in Tzoonie River system (GWG/SEP). Logging also resulted in impacts on Vancouver River with loss of gravels. Cottage development on Sakinaw Lake has been a water quality risk (I).
Current Status	Logging is continuing on Tzoonie River (I). Outplantings from Capilano Hatchery to Sechelt Creek and Vancouver River (SRMP).
Future Outlook	Recovery is expected on some streams (I).
Natural Habitat Production Potential	Unused habitat not identified.
Improved Production Potential	Debris clearing suggested for Tzoonie River (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Low	Low	Medium	

* (Plus 2 streams receiving enhancement outplantings).

HABITAT INFORMATION TABLE

STOCK GROUP Jervis Inlet Coho Area 16 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	50	(not avail.)	8

MANAGEMENT STYLE

Active ___

Passive 23

No. of Streams 23

No. of Significant Streams 8

(93 % of MRE)

HABITAT NOTES

Historic Status	Impassable falls on 5 rivers. Some streams are unstable and subject to massive slides (GWG/SEP) with logging compounding instability problems, particularly in the Deserted and Tzoonie river systems (GWG/SEP). Logging has also resulted in high impacts on Brittain and Vancouver rivers with loss of gravels. Cottage development on Sakinaw Lake is a water quality risk (I).
Current Status	Logging is continuing with ongoing problems on Tzoonie River (I). Some recovery is occurring on Brittain River (I).
Future Outlook	Recovery from logging effects is expected on some streams (I).
Natural Habitat Production Potential	Unused habitat not identified.
Improved Production Potential	CEDP coho incubation facility planned for Lang Creek (SRMP). Debris clearing suggested for Tzoonie River (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium		

HABITAT INFORMATION TABLE

STOCK GROUP Jervis Inlet Chum Area 16 - Mainland Inlets

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	228	149	61 (SEDS) 75 (SRMP 1980-83)

MANAGEMENT STYLE

Active ___

Passive 21

No. of Streams 21

No. of Significant Streams 10

(87 % of MRE)

HABITAT NOTES

Historic Status	Major production in Deserted River, Saltery Bay Creeks, Skwawka River and Tzoonie River. Some streams are unstable and subject to massive slides (GWG/SEP) with logging compounding instability problems on 7 streams, including the major Deserted, Skwawka and Tzoonie Rivers (I). Effects have been moderate to high (I). Impassable falls on 6 streams, but no record of useable habitat above.
Current Status	Logging is continuing on 4 streams, including Deserted and Tzoonie rivers with recovery on Deserted River and 2 minor streams (I). CEDP hatchery on Deserted River. Vancouver River outplantings to Deserted River, Skwawka River (SRMP).
Future Outlook	Recovery from logging impacts is expected on 2 streams (I). Logging will continue at least on Vancouver River (GWG/SEP).
Natural Habitat Production Potential	Capacity not reported.
Improved Production Potential	Small scale enhancement is possible on Brittain River, Vancouver River, Tzoonie River (GWG/SEP). Spawning channel can be built in Vancouver River. Clear logging debris in Tzoonie River. Enhancement facility for Deserted, Skwawka river stocks (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium-High		

HABITAT INFORMATION TABLE

STOCK GROUP Jervis Inlet Pink Area 16 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	255	88 - odd	13 - 1979 29 - 1981 7 - 1983

MANAGEMENT STYLE

Active ___

Passive 12

No. of Streams 12

No. of Significant Streams 4*

(95 % of MRE)

HABITAT NOTES

Historic Status	Some streams are unstable and subject to massive slides (GWG/SEP) with logging compounding instability problems on all 4 streams (I). Impassable falls on Deserted and Skwawka rivers.
Current Status	Logging is continuing on Tzoonie River with moderate effects (I). Pink eggs are taken from Skwawka River to Vancouver River for planting.
Future Outlook	Most streams should be recovering from logging effects (I).
Natural Habitat Production Potential	Unused habitat reported on Deserted River, Tzoonie River and Skwawka River with historic highs achievable at least for Deserted and Tzoonie Rivers (I).
Improved Production Potential	Potential spawning habitat above falls on Deserted River. Small-scale enhancement is possible on several streams (GWG/SEP). Increased enhancement at Skwawka River recommended (SRMP). Flow stability needed in Skwawka River (I). Clear logging debris on Tzoonie River (I). Proposed side channel development on Deserted River (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
High	Medium-High	High	High	

* Vancouver River included because its enhanced escapement meets "significance" threshold.

HABITAT INFORMATION TABLE

STOCK GROUP Howe Sound Chinook — Area 28 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	20.7	(not avail.)	2.94

MANAGEMENT STYLE

Active ___

Passive 4

No. of Streams 4

No. of Significant Streams 4

(100 % of MRE)

HABITAT NOTES

Historic Status	All chinook production is from the Squamish system. Natural winter flood problems have been accentuated by logging in the headwaters of Squamish, Mamquam and Cheakamus Rivers. Dyking for flood protection has altered the lower reaches of most rivers, with unknown effects on chinook. Port development and training wall construction have resulted in estuary loss (P).
Current Status	Logging and dyking continue (P), but some improved stabilization is being reached, at least in Mamquam River system. Hatchery on Cheakamus system provides outplants for Ashlu, Cheakamus, Mamquam and Squamish rivers (SRMP).
Future Outlook	Logging will continue on most systems. Proposed port expansion could result in further estuary loss (P).
Natural Habitat Production Potential	Total capacity is not known. Apparent underutilization of habitat (P).
Improved Production Potential	Expansion of hatchery on Cheakamus River system proposed (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium		

HABITAT INFORMATION TABLE

STOCK GROUP Howe Sound Coho   Area 28 - Mainland Inlets

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	99	(not avail.)	4.57

MANAGEMENT STYLE
Active ___
Passive 12
No. of Streams 12
No. of Significant Streams 5
(98.5% of MRE)

HABITAT NOTES

Historic Status	Production is all from Squamish system and Stawamus Creek. Natural winter flood problems have been exacerbated by logging in headwaters of Squamish, Mamquam and Cheakamus rivers. Dyking for flood protection has altered the lower reaches of most streams, with unknown effects on coho. Port development and training wall has resulted in some estuary loss (P).
Current Status	Logging and dyking are continuing (P), but some improved stabilization is being reached, at least on Mamquam River. Hatchery on Cheakamus system produces coho for Mamquam, Cheakamus, and Upper Squamish rivers (SRMP).
Future Outlook	Logging will continue in most systems. Proposed port expansion could result in further estuary loss (P).
Natural Habitat Production Potential	Capacity not known, but apparent underutilized habitat (P).
Improved Production Potential	Not identified.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium		

HABITAT INFORMATION TABLE

STOCK GROUP Howe Sound Chum Area 28 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	257	157	111

MANAGEMENT STYLE

Active ___

Passive 14

No. of Streams 14

No. of Significant Streams 4

(92 % of MRE)

HABITAT NOTES

Historic Status	All production is from Squamish system. Natural winter flood problems have been accentuated by logging in the headwaters of Squamish, Cheakamus, Mamquam and Ashlu rivers. Impacts from scouring have been high on Squamish, Mamquam and Cheakamus rivers in some years (I) (P). Dyking for flood protection has altered the lower reaches of most of these rivers, with unknown effects on chum salmon. Port development and training wall construction has resulted in some estuary loss (P).
Current Status	Logging and dyking continuing (P), but some improved stabilization is being reached on Mamquam River. Channel facilities constructed in Squamish, Cheakamus and Mamquam rivers (SRMP).
Future Outlook	Logging will continue on most systems. Proposed port expansion could result in further loss of estuary habitat (P).
Natural Habitat Production Potential	Capacity is not known. Flood and scour risk and river channelling and dyking may have reduced natural capacity (P).
Improved Production Potential	Proposed addition of small channel (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
High*	Medium	Medium		

* With channels.

HABITAT INFORMATION TABLE

STOCK GROUP Howe Sound Pink Area 28 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	218	422 - odd	4.7 - 1979 0 - 1981 1.4 - 1983

MANAGEMENT STYLE

Active ___

Passive 8

No. of Streams 8

No. of Significant Streams 4

(95 % of MRE)

HABITAT NOTES

Historic Status	All production is from the Squamish system. Natural winter flood problems have been accentuated by logging in the headwaters of Squamish, Mamquam, Ashlu, and Cheakamus rivers. Impacts from scouring have been high on Mamquam, Squamish and Cheakamus river pinks in some years (I, P). Dyking for flood protection has altered the lower reaches of most of these rivers, with unknown effects on pink salmon. Port development and training wall construction has resulted in some estuary loss (P).
Current Status	Logging and dyking are continuing (P) but some improved stabilization is being reached on Mamquam River.
Future Outlook	Logging will continue on most systems. Proposed port expansion could result in further loss of estuary habitat (P).
Natural Habitat Production Potential	Capacity is not known. Flood and scour risk and river channelling and dyking may have reduced original capacity (P).
Improved Production Potential	Proposed temporary incubation box to test pink production and increase brood stock for larger facilities (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Low-Medium		

HABITAT INFORMATION TABLE

STOCK GROUP Burrard Inlet Chinook — Area 28 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	.77*	(not avail.)	2.0 (including enhanced returns)

MANAGEMENT STYLE

Active ___

Passive 2

No. of Streams 2

No. of Significant Streams 1

(98 % of MRE)

HABITAT NOTES

Historic Status	Capilano River provides almost all chinook production. Enhanced stock - Big Qualicum River origin. Most of river heavily modified; storage dam and extensive channelling and dyking in lower reaches.
Current Status	Hatchery production (SRMP).
Future Outlook	No changes expected.
Natural Habitat Production Potential	Little natural production potential.
Improved Production Potential	Already enhanced.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Low	Low	Low	High

* Before enhancement.

HABITAT INFORMATION TABLE

STOCK GROUP Burrard Inlet Coho   Area 28 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	.77*	(not avail.)	2.0 (includes enhanced returns)

MANAGEMENT STYLE

Active ___

Passive 6

No. of Streams 6

No. of Significant Streams 3

(98 % of MRE)

HABITAT NOTES

Historic Status	Cleveland Dam blocked most natural spawning on Capilano River (1954). Channelling in lower Capilano and Seymour rivers probably removed rearinig capacity (P). Logging in Indian River watershed; effects unknown.
Current Status	Hatchery production on Capilano and Seymour rivers (SRMP).
Future Outlook	No changes expected.
Natural Habitat Production Potential	Limited by storage dams on Capilano and Seymour rivers.
Improved Production Potential	Capilano and Seymour stocks already enhanced.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Low	Low	Low	High

* Before enhancement.

HABITAT INFORMATION TABLE

STOCK GROUP Burrard Inlet Chum — Area 28 - Mainland Inlets

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	40	35	18.7

MANAGEMENT STYLE

Active ___

Passive 4

No. of Streams 4

No. of Significant Streams 1

(87 % of MRE)

HABITAT NOTES

Historic Status	Indian River is only significant producer. River is subject to severe water level fluctuations. Logging, hydro line and road construction have altered river channel.
Current Status	Logging is continuing (P).
Future Outlook	Some stabilization should occur in future (P).
Natural Habitat Production Potential	Some production capacity may have been lost (P).
Improved Production Potential	Not known.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	

HABITAT INFORMATION TABLE

STOCK GROUP Burrard Inlet Pink Area 28 - Mainland Inlets

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	110	100 - odd	22.5 - 1979 23 - 1981 23 - 1983

MANAGEMENT STYLE

Active ___

Passive 4

No. of Streams 4

No. of Significant Streams 2

(95 % of MRE)

HABITAT NOTES

Historic Status	Almost all production is from Indian River. Logging, power line construction and road construction have had effects on Indian River. Also, extreme flow fluctuations. Channelling of lower Capilano River for flood protection has probably affected pink habitat (P).
Current Status	Logging continuing in Indian river watershed (P).
Future Outlook	Some stabilization of Indian River system can be expected (P). No change expected in Capilano River (P).
Natural Habitat Production Potential	Indian and Capilano Rivers have probably lost some productive habitat; not known if target can be achieved (P).
Improved Production Potential	Proposed side channel development in Indian River, with no stated production (SRMP).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Low-Medium	Medium	Medium	

HABITAT INFORMATION TABLE

STOCK GROUP Lower Fraser Sockeye

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	556*		229*

MANAGEMENT STYLE

Active ___

Passive ___

No. of Streams 14

No. of Significant Streams 6

(99.6% of MRE)

HABITAT NOTES

Historic Status	Mostly Harrison system streams, and Cultus Lake. Major forestry effects on three streams.
Current Status	Logging is ongoing in upper reaches of most sockeye streams. Weaver Creek spawning channel currently provides most escapement.
Future Outlook	Logging will continue, but some stabilization should be reached with forest regeneration (I) (P).
Natural Habitat Production Potential	Habitats can support MRE levels on most major streams (I). Weaver Creek will be assisted by channel production.
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium-High	Medium-High	

Habitat has not been a major factor in stock declines.

* Including Weaver Creek spawning channel.

HABITAT INFORMATION TABLE

STOCK GROUP Lower Fraser Chinook

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	46		16

MANAGEMENT STYLE Active ___ Passive ___

No. of Streams 12

No. of Significant Streams 8

(99.8% of MRE)

HABITAT NOTES

Historic Status	Major chinook streams are large rivers and streams of the Pitt, Harrison and Chilliwack River systems. Forestry has had moderate to severe impacts on most systems (except Harrison River).
Current Status	Logging is continuing. Hatchery in operation on Chilliwack and Chehalis rivers.
Future Outlook	Logging will continue on most systems, but probably under greater protective control (I) (P). Improved habitats should result from forest regeneration.
Natural Habitat Production Potential	MRE levels probably not attainable on some streams until stream stabilization is reached and greater logging controls applied (I, P). MRE attainable on Harrison and Chehalis rivers (I, P).
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium-High	Medium-High	

Habitat has not bee the major factor in stock declines on all streams.

HABITAT INFORMATION TABLE

STOCK GROUP Lower Fraser Coho

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	206		31

MANAGEMENT STYLE

Active ___

Passive ___

No. of Streams 82

No. of Significant Streams 24

(91.1% of MRE)

HABITAT NOTES

Historic Status	Coho streams include both large rivers and small streams, with greatest production from Harrison and Pitt river systems and Chilliwack River. Logging has taken place on half the streams, with mainly low to moderate impacts. Channelling and dyking have resulted in lost rearing habitat on seven streams. Water contamination and low summer flows are problems on most streams on the south side of the Fraser; the result of urban and agricultural development. Drainage pump mortality has been a problem on some streams.
Current Status	Logging is continuing on most streams. Drainage pump mortality. Water quality and low flows are the major problems with smaller streams (I, P). Logging-induced instability and channelling are the major problems on larger streams and rivers (I, P). Hatcheries in operation on Chilliwack, Chehalis and Little Campbell Rivers and Kanaka Lake.
Future Outlook	Logging will continue, but likely under greater protective control (I). Some improved stability should result from forest regeneration (P).
Natural Habitat Production Potential	Overall production near MRE levels is attainable; however, will be reached only with re-stabilization of some logging-affected streams. Some permanent loss of rearing habitat; mainly in streams subjected to channelling and dyking (I, P).
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium-High	Medium-High	

HABITAT INFORMATION TABLE

STOCK GROUP Lower Fraser Chum

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	871		358

MANAGEMENT STYLE

Active ___

Passive ___

No. of Streams 46

No. of Significant Streams 15

(86 % of MRE)

HABITAT NOTES

Historic Status	Greatest production in Harrison system, Chilliwack-Vedder and Stave rivers. Logging has had only low impact on chum habitat on most streams, a major effect in Chilliwack-Vedder. Channelling and dyking has resulted in permanent loss of habitat, particularly side-channel spawning in Chilliwack-Vedder River (I).
Current Status	Logging is continuing. Hatchery in operation on Chilliwack and Chehalis rivers, Kanaka Creek.
Future Outlook	Logging will continue; but greater habitat protectioin and forest regeneration should improve stream stability (P).
Natural Habitat Production Potential	Overall MRE level is attainable with present habitat, despite some permanent losses from dyking (I, P) and inappropriate flow releases from Stave River dam.
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium	

Habitat has not been a major factor in stock declines.

HABITAT INFORMATION TABLE

STOCK GROUP Lower Fraser Pink

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	4,488		3,116

MANAGEMENT STYLE

Active ___

Passive ___

No. of Streams 46

No. of Significant Streams 18

(99.7% of MRE)

HABITAT NOTES

Historic Status	Dominated by Fraser mainstem production (73% of total MRE). Most of the remaining production from Harrison and Chilliwack-Vedder systems. Logging has had severe effects on production on four streams. Channelling and dyking has removed habitat in the Chilliwack River. Dam discharge regime has affected Stave River production (I). Gravel removal operations in mainstem Fraser probably contributed to stock declines in 1960's (I).
Current Status	Logging is continuing. Some streams with no current escapements have available habitat (I). Gravel operation on mainstem Fraser has ceased (I).
Future Outlook	Logging will continue, but presumably under greater control. Forest regeneration should improve stream stability (P).
Natural Habitat Production Potential	MRE levels are attainable for most streams. Some additional production is possible from Chehalis, Chilliwack, and several small streams, but not MRE levels because of long-lasting effects of logging and dyking.
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	High	High	High	

Habitat condition had been a factor in stock declines (particularly the mainstem Fraser), but does not now prevent attainment of MRE.

HABITAT INFORMATION TABLE

STOCK GROUP Mid Fraser Sockeye

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	1,157		655

MANAGEMENT STYLE: Active ___ Passive ___

No. of Streams 7

No. of Significant Streams 6

(99.9% of MRE)

HABITAT NOTES

Historic Status	Large lake systems. Natural turbidity limits production in some systems (I). Logging has had a major effect on temperatures and egg survival in the Horsefly River; partially corrected by storage dam (I). Additional habitat available above falls on Horsefly River.
Current Status	Lower logging intensity, some regeneration in Horsefly River system (I). SEP planned enrichment of Chilko Lake on hold. Spawning channels major producer in Seton River.
Future Outlook	Logging will continue but effects should diminish on Horsefly River (P). No changes expected on other systems (I).
Natural Habitat Production Potential	MRE levels are attainable on all systems.
Improved Production Potential	Fishway over falls would increase production of Horsefly River.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium-High	Medium-High	High	High

HABITAT INFORMATION TABLE

STOCK GROUP Mid Fraser Chinook

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	21		9.6

MANAGEMENT STYLE: Active ___ Passive X

No. of Streams 16

No. of Significant Streams 13

(99.7% of MRE)

HABITAT NOTES

Historic Status	Most production in larger rivers; Chilko, Quesnel and West Road rivers. Logging has had moderate effects on five streams. Agriculture has had minor effects on one stream. Flow releases from Seton Dam has had moderate effects on two streams. Historically unused habitat available on several rivers (I). Additional habitat above falls on Horsefly River.
Current Status	Most streams are relatively stable, with logging effects diminishing (I).
Future Outlook	Stream stability should improve with forest regeneration; little new activity is foreseen (I).
Natural Habitat Production Potential	Overall MRE is attainable, and greater than MRE levels are possible with historically unused habitat (I).
Improved Production Potential	Fishway over falls would increase production of Horsefly River.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium-High	Medium-High	High	High

Habitat condition has not been a major factor in stock declines, and will not preclude attainment of MRE or higher levels of production.

HABITAT INFORMATION TABLE

STOCK GROUP Mid Fraser Coho

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	4.5		1.5

MANAGEMENT STYLE

Active ___

Passive ___

No. of Streams 6

No. of Significant Streams 4

(94.1% of MRE)

HABITAT NOTES

Historic Status	
Current Status	
Future Outlook	
Natural Habitat Production Potential	
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium-High	Medium-High	High	

Habitat condition has not been a major factor in stock decline. Available habitat can accommodate higher than MRE levels.

HABITAT INFORMATION TABLE

STOCK GROUP Mid Fraser Pink

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	148		372*

MANAGEMENT STYLE

Active ___

Passive ___

No. of Streams 3

No. of Significant Streams 3

(100 % of MRE)

HABITAT NOTES

Historic Status	Restricted to the Seton River system. Logging has had low impact on five streams.
Current Status	Spawning channel production dominates overall production.
Future Outlook	No further development activity is anticipated.
Natural Habitat Production Potential	Natural MRE is attainable, although enhanced production from the spawning channels dominates the natural escapements.
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium-High	Medium-High	High	

* Enhanced returns.

HABITAT INFORMATION TABLE

STOCK GROUP Thompson Sockeye

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	2,127		1,817

MANAGEMENT STYLE — Active ___ Passive ___

No. of Streams 16

No. of Significant Streams 11

(99.8% of MRE)

HABITAT NOTES

Historic Status	Most production from Shuswap system. Logging impacts have affected 30% of streams (low to moderate impacts mainly). Dam releases on Lower and Middle Shuswap rivers have had moderate impacts in some areas. Protected status placed on Adams River (P). Additional unused habitat on Upper Adams River and other Shuswap tributaries and shoreline (some used in years of high escapement) (I).
Current Status	Spawning streams are relatively stable (I). Some logging impacts.
Future Outlook	Logging will continue (I). Risk of spills of hazardous materials from rail or highway accident (P).
Natural Habitat Production Potential	Currently producing near MRE. Available, unused and underutilized habitat on Adams River and Shuswap Lake tributaries and shoreline (I).
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	High	High	High	

Habitat is available for higher than MRE production.

HABITAT INFORMATION TABLE

STOCK GROUP Thompson Chinook

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	70		21

MANAGEMENT STYLE — Active ___ Passive ___

No. of Streams 25

No. of Significant Streams 17

(97.4% of MRE)

HABITAT NOTES

Historic Status	Logging has taken place on 6 of the spawning streams, with low and moderate impacts. Low flows and agriculture has affected 6 streams (I). Dams releases have had moderate effects on Lower and Middle Shuswap Rivers.
Current Status	Most streams are fairly stable but some logging and agricultural (mainly low flow) problems (I).
Future Outlook	Logging will continue (I). Risk of spills of hazardous materials from rail and highway accident (P).
Natural Habitat Production Potential	Available habitat can accommodate MRE level overall, but logging and agricultural effects preclude MRE on some streams (I). No unused habitat reported.
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium-High	Medium-High	High	

Habitat is available for MRE level production.

HABITAT INFORMATION TABLE

STOCK GROUP Thompson Coho

STOCK DATA	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	77		8.7

MANAGEMENT STYLE Active ___ Passive ___

No. of Streams 50

No. of Significant Streams 29

(96.1% of MRE)

HABITAT NOTES

Historic Status	Logging has had low to moderate impact on 11 streams, and high impact on one. Agricultural impacts, mainly low flow problems, have affected rearing habitat on 8 streams (I). Flow releases from dams on Duteau Creek and M. Shuswap River have had moderate effects. Potential habitat above falls on Bonaparte Riiver.
Current Status	Logging impacts and low flows limit rearing capacity (I).
Future Outlook	Continued logging and irrigation withdrawals. Risk of spills of hazardous materials from rail or highway accident (P).
Natural Habitat Production Potential	Overall MRE may be attained with available habitat, but may require stabilization of logged streams and correction of low flow problems (I).
Improved Production Potential	Cooperative arrangements with water users could improve low flow rearing conditions (P). Additional rearing habitat can be developed from wetlands adjacent North Thompson River and Nicola River.

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium	Medium	Medium-High	Medium-High

Habitat may limit attainment of MRE level of production.

HABITAT INFORMATION TABLE

STOCK GROUP Thompson Pink

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	1,909		1,004

MANAGEMENT STYLE

Active ___

Passive ___

No. of Streams 8

No. of Significant Streams 4

(99.9% of MRE)

HABITAT NOTES

Historic Status	Almost all production from Thompson River. Unused habitat in Thompson River.
Current Status	Major problem is migration difficulty in Fraser Canyon and Thompson Rapids (I). Fishway once considered for Thompson River to aid weak swimmers.
Future Outlook	Risk of spills of hazardous materials from rail or highway accident (P).
Natural Habitat Production Potential	Potential for much higher production from unused habitat in Thompson River (I).
Improved Production Potential	Fishway on Thompson River would improve access for weaker swimmers, and thereby increase total production (I).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	High	Medium-High	High	

Habitat is available to accommodate more spawners than MRE.

HABITAT INFORMATION TABLE

STOCK GROUP Upper Fraser Sockeye

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	1,241		776.9

MANAGEMENT STYLE

Active ___

Passive ___

No. of Streams 45

No. of Significant Streams 20

(95.6% of MRE)

HABITAT NOTES

Historic Status	Most production has been from Stuart and Nechako systems. Low to moderate logging effects on 70% of significant spawning streams; with instability and resulting loss of spawning gravels the major impacts. Little gravel recruitment in some streams (I).
Current Status	Logging effects and gravel loss is the major concern (I). Much unused habitat.
Future Outlook	Logging will continue; may be permanent loss of spawning gravel in some streams (I).
Natural Habitat Production Potential	MRE may be attained with habitat currently available. Driftwood River has capacity for 1 million spawners.
Improved Production Potential	

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium-High	Medium-High	High	

Habitat has not been a major factor in stock declines.

HABITAT INFORMATION TABLE

STOCK GROUP Upper Fraser Chinook

STOCK DATA

	Maximum Recorded Escapement	Target/ Optimum Escapement	Current Average Escapement
Thousands	26		12

MANAGEMENT STYLE

Active ___

Passive ___

No. of Streams 27

No. of Significant Streams 17

(98 % of MRE)

HABITAT NOTES

Historic Status	No large dominant producer. Logging has had low to moderate impacts on nearly 90% of significant spawning streams; mainly from flow instabiliity, sedimentation and gravel loss. Dam on Nechako River has had unknown effects on chinook. Additional habitat available above falls on Fraser River mainstem, McGregor River (Herrick Creek) and Morkill River.
Current Status	Logging effects. Unused, apparently suitable habitat available.
Future Outlook	Logging will continue, with low to moderate impacts expected (I). Long range hydro-electric development possibility on McGregor River.
Natural Habitat Production Potential	MRE can be attained with habitat currently available (P).
Improved Production Potential	Improved production can be attained from habitat above falls on Fraser and Morkill rivers and Herrick Creek (need fishway).

SUMMARY

Current Target Achievability	Current Status	Future Outlook	Natural Production Potential	Improved Production Potential
	Medium-High	Medium-High	High	High

Habitat has not been a major factor in stock declines.

APPENDIX III

DISTRIBUTION OF IMPORTANT SALMONID DISEASE AGENTS AND PARASITES IN STATISTICAL AREAS 12 TO 20, 28 AND 29

DISTRIBUTION OF IMPORTANT SALMONID DISEASE AGENTS AND PARASITES IN STATISTICAL AREAS 12 TO 20, 28 AND 29[1]

An introduction to the analysis of the distribution of salmonid disease agents and parasites in British Columbia is provided in Volume A. The introduction includes a discussion of data sources and notes on all of the important salmonid disease agents and parasites included in the analysis.

In the South Coast Area, over 2400 cases have been analysed for disease agents or parasites at fewer than 300 different locations. The large number of cases reflects a high concentration of fish culture facilities in the area. Their distribution is shown in Figure III-1 and summarized below by Statistical Area.

Statistical Area 12 (Table III-1)

In the Keogh River system near Port Hardy, the bacterial kidney disease (BKD) agent and *Henneguya* cysts were found in pinks and the BKD agent was found in coho. The infectious hematopoietic necrosis (IHN) virus was found in sockeye taken from O'Conner Lake in the same system. No important disease agents or parasites were found in large samples of steelhead and small samples of Dolly Varden, rainbow and cutthroat trout.

No disease agents or parasites were found in small samples of coho and steelhead from the Quatse River and hatchery near Port Hardy or in small samples of pink salmon from the Adam River near Sayward.

At Mills Creek (Bear River), the furunculosis bacterium was found in pink salmon. The IHN virus was found in sockeye taken from the Nimpkish River and from the Nimpkish Hatchery. Sockeye taken from Nimpkish and Woss Lakes were found to contain the furunculosis bacterium.

In the Knight Inlet area, furunculosis bacteria were found in pink salmon from the Ahnuhati River and chinook from Devereux Creek. The latter system also had agents for furunculosis and IHN in sockeye, but no important disease agents or parasites in kokanee. In the Glendale River, agents were found for furunculosis in pinks and chums, BKD in pinks and chums, IHN in cutthroat and pinks and enteric redmouth disease (ERM) in pinks.

In the Kakweiken River at the head of Thompson Sound, pink salmon were found to have the furunculosis bacterium. No important disease agents or parasites were found in small samples of Dolly Varden, sockeye, cutthroat trout, coho and chinooks.

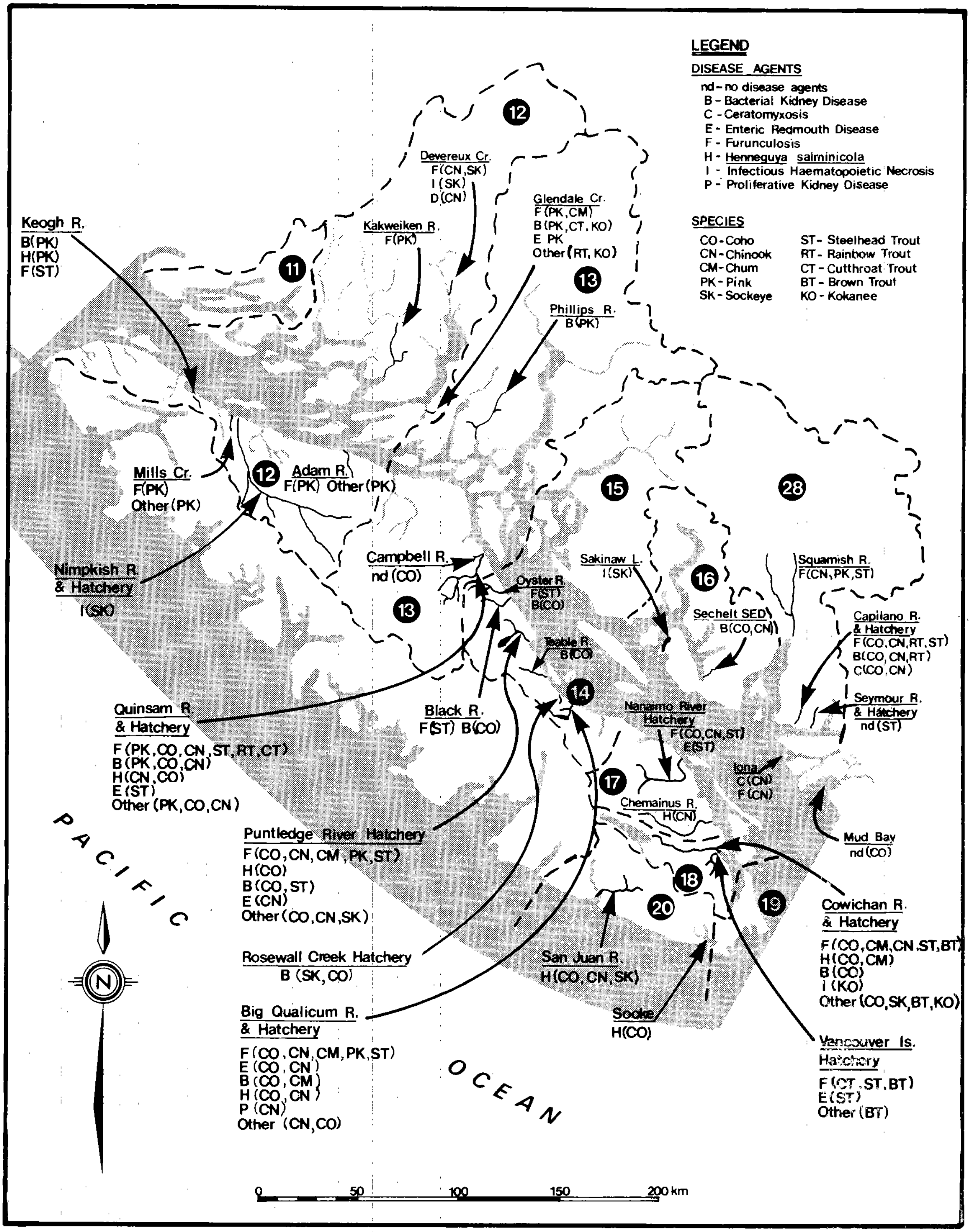

Figure III-1. Distribution of salmonid disease agents and parasites in the South Coast area.[2,3]

Table III-1. Distribution of salmonid disease agents and parasites in Statistical Area 12.[2,3]

Location			Findings* By Species**								
Area	Sample Site	Total No. Examined	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
12	Adam River	47	PK								PK
12	Ahnuhati River	60	PK	PK							PK
12	Alert Bay General Area										CT
12	Alert Bay General Area										SK
12	Alert Bay General Area	3	RT								RT
12	Alert Bay General Area	5	DV								DV
12	Alert Bay General Area	2	CO								
12	Devereux Creek	13	(No HEN in CN)								
12	Devereux Creek	31	(No HEN in KO)								
12	Devereux Creek	30	SK	SK			SK				SK
12	Devereux Creek	45	CN	CN							CN
12	Devereux Creek	3	CO								CO
12	Devereux Creek	60	KO								KO
12	Fish Farms	25				CO					CO
12	Glendale River	25	(No HEN in PK)								
12	Glendale River	176	PK	PK		PK			PK		PK
12	Glendale River	92	CT			CT					CT
12	Glendale River	2									SK
12	Glendale River	2	DV								DV
12	Glendale River	8	KO			KO					KO
12	Glendale River	14	CM	CM							CM

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - *Ceratomyxa shasta*
HEN - *Henneguya salminicola*
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-1. cont'd

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
12	Kakweikan River	151	PK	PK							PK
12	Kakweikan River	24									DV
12	Kakweikan River	12									CT
12	Kakweikan River	5									SK
12	Kakweikan River	9	CO								
12	Kakweikan River	4									CN
12	Kakweikan River	1	CM								
12	Kakweikan River	25	(No HEN in PK)								
12	Keogh River	38	CO			CO					CO
12	Keogh River	1	CM								
12	Keogh River	6	DV								DV
12	Keogh River	15	CT								CT
12	Keogh River	129	PK			PK				PK	
12	Keogh River	4	SK								
12	Keogh River	16	RT								RT
12	Keogh River	93									ST
12	Mills Creek (Bear R.)	4	CT								
12	Mills Creek (Bear R.)	6	DV								
12	Mills Creek (Bear R.)		CO								
12	Mills Creek (Bear R.)	477	PK	PK							PK
12	N.V.I.S.E.P.	10	CO								

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - <u>Ceratomyxa shasta</u>
HEN - <u>Henneguya salminicola</u>
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-1. concluded

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
12	Nimpkish Hatchery	36									CN
12	Nimpkish Hatchery	23					SK				
12	Nimpkish Hatchery	29									CO
12	Nimpkish L. & Woss L.			SK							
12	Nimpkish River	56	(No HEN in SK)								
12	Nimpkish River	100	SK				SK				SK
12	O'Conner L. (Keogh R.)	74	ST								ST
12	Port Hardy		CT								
12	Quatse R.	16	ST								
12	Quatse R. & Hatchery	15	CO								
12	Quatse R. & Hatchery	20									CM
12	Salmon R. (Alert Bay)	82									CO
12	Salmon R. (Alert Bay)	11									DV
12	Salmon R. (Alert Bay)	2									CT
12	Salmon R. (Alert Bay)	30									RT
12	Stephen's C. Hatchery	30	CO								CO
12	Tsitika R.		PK								
12	Tsitika R.										DV
12	Tsitika R.		RT								
12	Tsitika R.										CM

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - <u>Ceratomyxa shasta</u>
HEN - <u>Henneguya salminicola</u>
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

Statistical Area 13 (Table III-2)

Most cases in this area are from the Quinsam Hatchery. Agents were found for furunculosis bacteria in rainbow trout, steelhead, cutthroat trout, chinooks and chums, BKD in coho, chinooks and chums and Henneguya in coho and chinooks. The BKD agent was found in pink salmon from Phillips River. No Henneguya was found in a sample of 50 pinks from Amor de Cosmos Creek.

Statistical Area 14 (Table III-3)

In the Oyster River system, furunculosis bacteria were found in steelhead and the BKD agent was found in coho. Black Creek steelhead had furunculosis bacteria and coho had the BKD agent, but cutthroat trout had no important disease agents or parasites. One coho taken from the Tsolum River was found to have Henneguya cysts.

At the Puntledge River hatchery, agents found include those for: furunculosis in steelhead, chinooks, coho and chums, PKD in steelhead and coho; BKD in coho; ERM in chinooks; and Henneguya in coho. In the Puntledge River system, furunculosis bacteria were also found in pinks and the PKD virus was found in coho. No important disease agents or parasites were found in Dolly Varden, cutthroat or rainbow trout.

The Trent River Hatchery has had no disease agents or parasites found in coho to date, although one coho from Tsable River to the south had the BKD agent. The Rosewall Creek Hatchery has also had the BKD bacteria in coho and sockeye, but no important disease agents or parasites in steelhead, rainbow trout, chums or chinooks.

At the Big Qualicum Hatchery, fish health surveys has have the furunculosis bacterium in rainbow trout, steelhead, chinooks, and coho, the BKD agent in coho and chums. Ceratomyxa shasta in chinooks and the ERM bacteria and Henneguya cysts in chinooks, chums, and coho. The PKD bacterium was also found in Big Qualicum River coho.

The Little Qualicum Hatchery has had no important disease agents or parasites in steelhead or chinooks. However, Henneguya cysts have been found in coho and chums from the Little Qualicum River. No important disease agents or parasites have been found in steelhead from Englishman River.

Statistical Area 15 and 16 (Table III-4)

No major sampling has been undertaken in the Toba Inlet area except for the Sliammon River near Powell River, which had no Henneguya cysts in chum. The

Table III-2. Distribution of salmonid disease agents and parasites in Statistical Areas 13.[2,3]

Area	Sample Site	Total No. Examined	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
13	Amor De Cosmos River	50	(No HEN in PK)								
13	Bute Inshore South	2	CO								
13	Campbell R. Area	9	CO								
13	Campbell R. Area	14									CT
13	Campbell R. Ins.&Isles	7									RT
13	Campbell R. Ins.&Isles	8	CO								CO
13	Campbell River	8	CO								
13	Campbell River Estuary	26	CO								
13	Church House	1	CN								CN
13	Church House	11	CM								CM
13	Church House	1				DV					
13	Church House	7	CO								
13	Fish Farms	20									CO
13	Fish Farms	90	CN			CN					
13	Mohum Lake	53									CT
13	Mohum Lake	59									KO
13	Orford River	7	(No HEN in CM)								
13	Phillips River	100	PK			PK					PK
13	Quinsam Hatchery	310	RT	RT							RT
13	Quinsam Hatchery	286	ST	ST					ST		ST
13	Quinsam Hatchery	20									CM
13	Quinsam Hatchery	69	CT	CT							
13	Quinsam Hatchery	12,580	CO	CO		CO				CO	CO
13	Quinsam Hatchery	12	DV								DV
13	Quinsam Hatchery	1,470	CN	CN		CN				CN	CN

Location — Findings* by Species**

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - *Ceratomyxa shasta*
HEN - *Henneguya salminicola*
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-2. concluded

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
13	Quinsam Hatchery	381	PK	PK		PK					PK
13	Quinsam Hatchery	10	SK								
13	Quinsam R. Hatchery	103								CO	
13	Quinsam R. Hatchery	103								CN	
13	Quinsam R. Hatchery	100	(No HEN in PK)								
13	Quinsam River	8	PK								
13	Quinsam River	111	CO								
13	S. Boundary Bute Inlet										
13	S. Boundary Bute Inlet	7	CN								
13	S. Boundary Bute Inlet	4	CM								CM
13	S. Boundary Bute Inlet	5	SK								
13	S. Boundary Bute Inlet	20	CO								CO
13	S. Boundary Bute Inlet	2									CN

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - *Ceratomyxa shasta*
HEN - *Henneguya salminicola*
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

Table III-3. Distribution of salmonid disease agents and parasites in Statistical Area 14.[2,3]

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
14	B. Qualicum Hat. & R.	11 c	RT	RT							RT
14	B. Qualicum Hat. & R.	28 c	CN	CN				CN	CN	CN	CN
14	B. Qualicum Hat. & R.	5 c	CM			CM					CM
14	B. Qualicum Hat. & R.	50 c	CO	CO		CO			CO	CO	CO
14	B. Qualicum Hat. & R.	8 c	ST	ST							ST
14	Big Qualicum River										CO
14	Big Qualicum River										CN
14	Big Qualicum River	20	CM								
14	Big Qualicum River	7	ST								
14	Big Qualicum River	56	CO		CO						CO
14	Big Qualicum River	3	RT								
14	Black Creek	82	CO			CO				CO	
14	Black Creek	146	CT								
14	Black Creek	14	ST	ST							
14	Courtenay Area	24	RT								RT
14	Courtenay Area	27	CT								
14	Courtenay Area	6									CO
14	Englishman River	27	ST								
14	Fish Farms										CO
14	Fish Farms										CN
14	French Creek										CO
14	Little Qualicum	70								CM	
14	Little Qualicum	62								CO	

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - Ceratomyxa shasta
HEN - Henneguya salminicola
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-3. cont'd

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
14	Little Qualicum H.	5 c	ST								ST
14	Little Qualicum H .	6 c	CN								CN
14	Oyster R. Res. Farm	28									RT
14	Oyster River	20				CO					CO
14	Oyster River	11	CT								
14	Oyster River	50		ST							
14	Puntledge River H.	38	(No HEN in CN)								
14	Puntledge River H.	92									CT
14	Puntledge River H.	20 c	PK								PK
14	Puntledge River H.	49 c	ST	ST	ST						ST
14	Puntledge River H.	53 c	CN	CN					CN		CN
14	Puntledge River H.	102	RT								RT
14	Puntledge River H.	70 c	CO	CO	CO	CO				CO	CO
14	Puntledge River H.	8 c	CM	CM							CM
14	Puntledge River H.	25									SK
14	Puntledge River H.	19									DV
14	Puntledge R. System	2 c	DV								
14	Puntledge R. System	3 c	PK	PK							PK
14	Puntledge R. System	4 c	CO		CO						CO
14	Puntledge R. System	4 c	CN	CN							CN
14	Puntledge R. System	20	ST								
14	Puntledge R. System	2	RT								

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - *Ceratomyxa shasta*
HEN - *Henneguya salminicola*
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-3. concluded

Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
14	Qualicum Exptl. Sites	39 c	CO	CO		CO					CO
14	Qualicum Exptl. Sites	5 c	CN								CN
14	Qualicum Exptl. Sites	7 c	ST			ST					ST
14	Qualicum Area	24	CO								
14	Qualicum Area	6	SK								
14	Qualicum Area	13	RT								
14	Qualicum Area	3	CN								
14	Qualicum Area	2									CT
14	Qualicum Area	5									CO
14	Qualicum Inshore & Is.	5 c									CO
14	Qualicum R. Hatchery	150								CO	
14	Qualicum R. Hatchery	96								CM	
14	Qualicum R. Hatchery	117								CN	
14	Rosewall Creek	34	(No HEN in CM)								
14	Rosewall Cr. Hatchery	11 c	ST								ST
14	Rosewall Cr. Hatchery	23 c	CO			CO					CO
14	Rosewall Cr. Hatchery	3 c	RT								RT
14	Rosewall Cr. Hatchery	5 c	CM								CM
14	Rosewall Cr. Hatchery	56 c	SK			SK					SK
14	Rosewall Cr. Hatchery	7 c	CN								CN
14	Trent River Hatchery	20	CO								CO
14	Tsable River	1				CO					
14	Tsolum River	2								CO	

*Disease/Agents and Parasites:

F – Furunculosis
PKD – Proliferative kidney disease
BKD – Bacterial kidney disease
IHN – Infectious hematopoietic necrosis
CS – *Ceratomyxa shasta*
HEN – *Henneguya salminicola*
ERM – Enteric redmouth disease

**Salmonid Species:

CN – Chinook
CM – Chum
CO – Coho
SK – Sockeye
PK – Pink
ST – Steelhead Trout
RT – Rainbow Trout
DV – Dolly Varden
BR – Brown Trout

Table III-4. Distribution of salmonid disease agents and parasites in Statistical Areas 15 and 16.[2,3]

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
15	Powell R. In. Waters	1	CO								
15	Powell River Area	16									CM
15	Powell River Area	2	KO								
15	Sliammon Hatchery	45	CO								
15	Sliammon River	74	(No HEN in CM)								
16	Fish Farms	23 c	CO			CO					
16	Fish Farms	3 c	CM	CM							CM
16	Fish Farms	48 c	CN			CN					CN
16	Lang Creek	18									RT
16	Lang Creek	6	CO								
16	Pender Harbour	1	CM			CM					CM
16	Pender Harbour	1									CO
16	Sakinaw Lake	59	(No HEN in SK)								
16	Sakinaw Lake										CN
16	Sakinaw Lake	41					SK				
16	Sechelt Area	30	CO								
16	Sechelt Area	3	CN								
16	Sechelt Area	10	CO								CO
16	Sechelt In. Waters										
16	Sechelt SEP	50				CN					CN
16	Sechelt SEP	150	CO			CO					CO

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - *Ceratomyxa shasta*
HEN - *Henneguya salminicola*
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

Sliammon Hatchery had no disease agents or parasites in several small samples of coho.

Sockeye in Sakinaw Lake were found to have the IHN virus, but no Henneguya cysts.

Fish farms in the Sunshine Coast area have had the furunculosis bacterium in chum and the BKD agent in coho and chinooks. One chum taken from Pender Harbour also had the BKD agent and the Sechelt Community Development Project (Sechelt SEP) at Porpoise Bay had the BKD agent in chinooks and coho.

Statistical Area 17 and 18 (Tables III-5 and III-6)

The Nanaimo River Hatchery was found to have the furunculosis bacterium in chinook, steelhead and coho, and the ERM bacterium in steelhead. Two moderate-sized samples of chums and chinooks from the Nanaimo River showed no signs of Henneguya cysts.

The aquaculture facility at the Pacific Biological Station had agents for furunculosis and BKD in steelhead, coho, chums, pinks, and chinooks and furunculosis in sockeye. Fish farms in the area have had BKD bacteria in chinooks.

Chemainus River has had Henneguya cysts in coho, chinooks, and kokanee, but not in chums. Bonsall Creek had had Henneguya cysts in coho and chums. Small samples from Goldstream River showed no disease agents or parasites in cutthroat trout and no Henneguya cysts in coho.

In the Cowichan River system, the furunculosis bacterium was found in chums, chinooks, brown trout and steelhead. The BKD bacterium was found in coho from Robertson Creek, a tributary to Cowichan Lake. The IHN virus was found in kokanee taken from Cowichan Lake in 1973 and 1978. An outbreak of IHN in Cowichan Lake kokanee also occurred in early May 1985 (Traxler, in prep.). Henneguya cysts were recorded in mainstem chums, and chinooks, Robertson Creek coho, and Mesachie Creek coho. No important disease agents or parasites have been recorded at the Cowichan Hatchery, although the Vancouver Island Hatchery in Duncan has had agents for furunculosis in cutthroat trout, steelhead and brown trout and ERM in steelhead.

Statistical Areas 19 and 20 (Table III-7)

San Juan and Sooke rivers were the only systems in this area that have received any extensive sampling, and these were limited to testing for Henneguya

Table III-5. Distribution of salmonid disease agents and parasites in Statistical Area 17.[2,3]

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
17	Bonsall Creek	3								CM	
17	Bonsall Creek	13								CO	
17	Chemainus River	16								CO	
17	Chemainus River	47	(No HEN in CM)								
17	Chemainus R. & Trib.	100	CM								CM
17	Chemainus R. & Trib.	14								CN	CN
17	Georgia St. Galiano S.	100									CM
17	Georgia St. Galiano S.	15	CT								
17	Georgia St. Galiano S.	1	CN								
17	Malaspina College	11									RT
17	Nanaimo Area	5				CO					CO
17	Nanaimo Area	6	PK								
17	Nanaimo Area	10									CT
17	Nanaimo Area	2	CN								
17	Nanaimo Area	31	RT								
17	Nanaimo Area	1									CM
17	Nanaimo R. Hatchery	15 c	CN	CN							CN
17	Nanaimo R. Hatchery	17 c		ST					ST		ST
17	Nanaimo R. Hatchery	27 c	CO	CO							CO
17	Nanaimo R. Hatchery	4 c									CM
17	Nanaimo R. Hatchery										CT
17	Nanaimo River	34	(No HEN in CM)								
17	Nanaimo River	48	(No HEN in CN)								
17	Nanoose Holding Site	9 c	ST	ST		ST					

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - *Ceratomyxa shasta*
HEN - *Henneguya salminicola*
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-5. concluded

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
17	PBS Aquaculture	132 c	CO	CO		CO					CO
17	PBS Aquaculture	3 c	AS								
17	PBS Aquaculture	34 c	CM	CM		CM					CM
17	PBS Aquaculture	64 c	PK	PK		PK					PK
17	PBS Aquaculture	65 c	SK			SK					SK
17	PBS Aquaculture	70 c	RT	RT		RT					RT
17	PBS Aquaculture	72 c	CN	CN		CN					CN
17	PBS Microbiology	1 c	CN								
17	PBS Microbiology	3 c	CO								
17	PBS Microbiology	5 c		ST							
17	PBS Microbiology	5 c				PK					
17	PBS Microbiology	9 c				SK					

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - Ceratomyxa shasta
HEN - Henneguya salminicola
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

Table III-6. Distribution of salmonid disease agents and parasites in Statistical Area 18.[2,3]

Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
18	Cowichan Chum Hat.	10 c	CN						CN		
18	Cowichan Chum Hat.	2 c	CM						CM		
18	Cowichan Chum Hat.	3 c	CO						CO		
18	Cowichan Area	17		CO					CO		
18	Cowichan Area	6	CM								
18	Cowichan Area	13							CN		
18	Cowichan Area	5									
18	Cowichan Hatchery	40									CN
18	Cowichan L. Net Pens	20	ST								
18	Cowichan L., R.&Trib.	18	CO								CO
18	Cowichan L., R.&Trib.	26									RT
18	Cowichan L., R.&Trib.	36	CT								CT
18	Cowichan L., R.&Trib.	13									DV
18	Cowichan L., R.&Trib.	23	SK								SK
18	Cowichan L., R.&Trib.	47	BT	BT							BT
18	Cowichan L., R.&Trib.	200		CM						CM	CM
18	Cowichan L., R.&Trib.	18				KO					KO
18	Cowichan L., R.&Trib.	120		CN						CN	CN
18	Cowichan L., R.&Trib.	420	ST	ST							
18	Cowichan Lake Hatchery	20	ST								
18	Cowichan R. (Mesachie)	51									CO
18	Cowichan River	19		ST							
18	Cowichan R. Mainstem	17								CM	
18	Cowichan R. Mainstem	78								CN	
18	Cowichan R. Mainstem	31	CO								

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - Ceratomyxa shasta
HEN - Henneguya salminicola
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-6. concluded

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
18	Fish Farms	1 c									ST
18	Fish Farms	14 c	CT								
18	Fish Farms	16 c	CN			CN					CN
18	Fish Farms	2 c									RT
18	Goldstream River	13	(No HEN in CO)								
18	Goldstream River	13	CT								
18	Mesachie Creek	25								CO	
18	Robertson Creek	60		CO		CO					CO
18	Robertson Creek	406		CO		CO				CO	CO
18	Van. Is. Hat. Duncan	11 c	CT	CT							
18	Van. Is. Hat. Duncan	27 c		ST					ST		
18	Van. Is. Hat. Duncan	90		BT							BT
18	Van. Is. Hat. Duncan	9									CO

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - Ceratomyxa shasta
HEN - Henneguya salminicola
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
BR - Brown Trout
DV - Dolly Varden

Table III-7. Distribution of salmonid disease agents and parasites in Statistical Areas 19 and 20.[2,3]

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
19	Colquitz Creek	41	CT								
19	Craigflower Creek	4	CO								CO
19	Craigflower Creek	18	CT								CT
19	In. Saanich-Jordan R.	2								SA	
19	In. Saanich-Jordan R.	4				CO					CO
19	In. Saanich-Jordan R.										SK
19	In. Saanich-Jordan R.										CN
19	In. Saanich-Jordan R.	1									RT
19	In. Saanich-Jordan R.	6	CT								
19	UVIC	2 c	CM								CM
19	UVIC	2 c	CO								CO
19	UVIC	5 c	RT								RT
19	Victoria Fish Insp. Lab.	1				PK					
19	Victoria Area	2 c								CM	CM
19	Victoria Area	2 c	RT								
19	Victoria Area	8 c	CO							CO	CO
19	Victoria Area	9 c	CT								CT
19	Victoria Area	2									CN
20	Fish Farms	1 c								CO	
20	Fish Farms	5 c		CN		CN					CN
20	Pt. Renfrew Area	3 c	CN								
20	Pt. Renfrew Area	4 c								CO	CO
20	San Juan River	201								CO	
20	San Juan River	139								SK	
20	San Juan River	26	(No HEN in PK)								
20	San Juan River	75								CN	
20	Sooke River	129								CO	

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - <u>Ceratomyxa shasta</u>
HEN - <u>Henneguya salminicola</u>
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

cysts only. Henneguya cysts were found in coho, sockeye and chinooks, but not in pink salmon, taken from San Juan River or in coho taken from Sooke River.

Colquitz Creek had no disease agents or parasites in small samples of cutthroat trout. No important disease agents or parasites were reported in a number of other cases with small samples from general locations. Fish farms in the area have had furunculosis and BKD bacteria in chinooks, and Henneguya cysts in coho.

Statistical Area 28 (Table III-8)

Squamish River had the furunculosis bacteria in chinooks, pinks and steelheads, but no important disease agents or parasites in large samples of chums and small samples of pinks. The Tenderfoot Hatchery had no important disease agents or parasites in chinooks and coho.

The Capilano River Hatchery had agents for furunculosis in rainbow trout, steelhead, coho, and chinooks, BKD in rainbow trout, coho and chinooks and ceratomyxasis in coho and chinooks. Samples of coho and chinooks did not show signs of Henneguya cysts.

The Seymour River and hatchery had n important disease agents or parasites in coho or steelhead. No Henneguya cysts were found in a sample of 50 pink from Indian River and no important disease agents or parasites were found in a number of small samples of rainbow and cutthroat trout or coho, chums and chinooks in the Lower Mainland general area.

Fish farms in the area have had the furunculosis bacterium in rainbow trout and coho and the BKD agent in rainbow trout, coho and chinooks.

Statistical Area 29 (Table III-9)

In Statistical Area 29, 690 samples have been taken at approximately 100 different locations (Table III-9). The distribution of these sites and the findings of fish health surveys are shown in Figures III-1 and III-2.

In the Fraser River watershed below Hope (Figure III-2), the Serpentine River was found to have the enteric redmouth disease (ERM) bacteria in steelhead. The Little Campbell River and hatchery had agents for furunculosis in coho and steelhead and bacterial kidney disease (BKD) in steelhead. The BKD agent was also found in chinooks and coho taken from False Creek.

Table III-8. Distribution of salmonid disease agents and parasites in Statistical Area 25.[2,3]

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
28	Capilano Hat. & R.	10 c	RT	RT		RT					
28	Capilano Hat. & R.	121 c	CO	CO		CO		CO			CO
28	Capilano Hat. & R.	17 c	CN	CN		CN		CN			
28	Capilano Hat. & R.	4 c	ST	ST							ST
28	Capilano Hat. & R.		SK								
28	Capilano Reservoir	5									CT
28	Capilano R. Hatchery	53	(No HEN in CO)								
28	Capilano R. Hatchery	75	(No HEN in CN)								
28	Cheakamus River	7	(No HEN in PK)								
28	EVS North Van	9									RT
28	EVS North Van	20	CO								
28	Fish Farms	15 c		RT		RT					
28	Fish Farms	14	CN								CN
28	Fish Farms	3 c	CN			CN					CN
28	Fish Farms	41 c	CO	CO		CO					CO
28	Indian Arm-Squamish R.	10				CN					
28	Indian Arm-Squamish R.	74		PK							
28	Indian River	50	(No HEN in PK)								
28	Iona Sewage Treat. Pl.	22	CO								CO
28	Iona Sewage Treat. Pl.	226	CN	CN				CN			CN
28	Lower Mainland Area	184	RT								
28	Lower Mainland Area	91	CN								CN
28	Lower Mainland Area	69									CT
28	Lower Mainland Area	11	ST								
28	Lower Mainland Area	2	CM								

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - Ceratomyxa shasta
HEN - Henneguya salminicola
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-8. cont'd

Location: Area	Location: Sample Site	Total No. Examined (c=case)	Findings* by Species**: No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
28	Mossom Creek	46	CM								
28	North Vancouver Inshore	11	CO								
28	Seymour River	10									ST
28	Seymour River & Hat.	11									CO
28	Seymour River & Hat.	16	ST								
28	Squamish River	7	(No HEN in CN)								
28	Squamish River	8	(No HEN in PK)								
28	Squamish River	8	(No HEN in CM)								
28	Squamish River	81		CN							CN
28	Squamish River	17		PK							PK
28	Squamish River	200									CM
28	Squamish River	23	ST	ST							
28	Tenderfoot Hatchery	2 c	CN								
28	Tenderfoot Hatchery	4 c	CO								CO
28	West Vancouver Labs	11 c	CM	CM							CM
28	West Vancouver Labs	12 c	SK	SK		SK					SK
28	West Vancouver Labs	18 c	PK	PK		PK					PK
28	West Vancouver Labs	22 c	RT	RT							RT
28	West Vancouver Labs	3 c	ST								ST
28	West Vancouver Labs	30 c	CN								CN
28	West Vancouver Labs	46 c	CO	CO		CO					CO

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
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SK - Sockeye
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DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-9. Distribution of salmonid disease agents and parasites in Statistical Area 29 (Fraser River).[2,3]

Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
29	Adams River	140	(No HEN in SK)								
29	Adams River	191	SK								
29	Adams River	7	CO								
29	Allouette R. Hatchery	3 c	CM								CM
29	Allouette R. Hatchery	5 c	CO								CO
29	Allouette River	1	CT								
29	Allouette River	19	ST								
29	Allouette River	25	CM								
29	Allouette River	36	CO	CO		CO					
29	Aylmer Lake	166	BK								
29	B.C. Research	4 c		RT							RT
29	B.C. Research	6 c	CO								CO
29	B.C. Research										PK
29	B.C. Research	5									CM
29	B.C.I.T. Deep Cove	24									CO
29	Badger Lake	27	RT								
29	Bakerview Incubation	19	RT								RT
29	Birkenhead River	100					SK				
29	Birkenhead River	209	CN			CN		CN			CN
29	Birkenhead River	68	(No HEN in SK)							SK	
29	Birkenhead River	33	(No HEN in CN)							CN	
29	Blaney Cr.	10									CM
29	Bonaparte River	21	(No HEN in CN)								
29	Bonaparte River	8	ST					ST			
29	Bonaparte River	31	CN					CN			CN

Location; Findings* by Species**

*Disease/Agents and Parasites:

F - Furunculosis
PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - *Ceratomyxa shasta*
HEN - *Henneguya salminicola*
ERM - Enteric redmouth disease

**Salmonid Species:

CN - Chinook
CM - Chum
CO - Coho
SK - Sockeye
PK - Pink
ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-9. cont'd

Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
29	Bowron River	25	(No HEN in CN)								
29	Bowron River	100					SK				
29	Bowron River	73	CN					CN		CN	CN
29	Canim Lake	11									KO
29	Centre Creek Camp	12	CO								
29	Chambers Lake	8									KO
29	Chehalis R. & Sal. Ha	1 c									CT
29	Chehalis R. & Sal. Ha	12 c	CO		CO						
29	Chehalis R. & Sal. Ha	2 c									
29	Chehalis R. & Sal. Ha	5 c	CN								CN
29	Chehallis River Ha.	20 c	CN	CN		CN	CN	CN			CN
29	Chehallis River Ha.	4 c	CT								CT
29	Chehallis River Ha.	6 c		ST				ST			ST
29	Chehallis River Ha.	8 c	CO		CO						CO
29	Chehallis River Ha.		CM								CM
29	Chilcotin River	10									CN
29	Chilcotin River	10	ST								
29	Chilko Lake	65	(No HEN in SK)								
29	Chilko River	670	SK				SK				SK
29	Chilko River	4	ST								
29	Chilliwack Hatchery	10 c	CN	CN							CN
29	Chilliwack Hatchery	12 c			CO	CO		CO		CO	
29	Chilliwack Hatchery	13 c	CM								CM
29	Chilliwack Hatchery	8 c	ST		ST						ST
29	Chilliwack R. Ha.	360	CO								
29	Chilliwack R. & L.	52	CO								CO
29	Chilliwack River & L.	2	RT								

*Disease/Agents and Parasites:

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PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - Ceratomyxa shasta
HEN - Henneguya salminicola
ERM - Enteric redmouth disease

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ST - Steelhead Trout
RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-9. cont'd

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
29	Chilliwack River & L.	30	CO								
29	Coquihalla River	17	RT								
29	Coquihalla River	47	ST					ST			ST
29	Coquihalla River	36									
29	Coquihalla River	8	ST								
29	Cultus Lake										
29	Cultus Lake										RT
29	Cultus Lake										RT
29	Cultus Lake										
29	Cultus Lake	464	SK	SK		SK	SK				
29	Cultus Lake	49									PK
29	Cultus Lake	28		CN							CN
29	Cultus Lake	17				PK					PK
29	Deadman River	13		RT							
29	Deadman River	19	CN					CN			
29	Deadman River	21	ST								
29	Dragon Lake	56	RT								
29	Dunn Lake	91	CO	CO				CO			CO
29	Eagle River Hatchery		CO								CO
29	Eagle River Hatchery		CN								CN
29	False Creek	81	CN			CN					CN
29	False Creek	47	CT								CT
29	Fennel Creek	73	CO	CO		CO		CO			CO
29	Finn Creek	25		CN				CN			CN
29	Finn Creek (Blue R.)	25	(No HEN in CN)								
29	Fish Farm	94 c	RT						RT		RT
29	Fish Farms	3 c	CT								CT

*Disease/Agents and Parasites:

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PKD - Proliferative kidney disease
BKD - Bacterial kidney disease
IHN - Infectious hematopoietic necrosis
CS - <u>Ceratomyxa shasta</u>
HEN - <u>Henneguya salminicola</u>
ERM - Enteric redmouth disease

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RT - Rainbow Trout
DV - Dolly Varden
BR - Brown Trout

continued . . . . . .

Table III-9. cont'd

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
29	Fish Farms	48 c	RT						RT		RT
29	Forfar Creek						SK				
29	Fraser V. Tr. Hat.	27 c	ST								ST
29	Fraser V. Tr. Hat.	29 c	CT	CT							CT
29	Fraser V. Tr. Hat.	49 c	RT								RT
29	Fraser V. Tr. Hat.	1 c									
29	Fraser V. Tr. Hat.	22 c	RT	RT							RT
29	Fraser V. Tr. Hat.	28 c	CT	CT				CT	CT		CT
29	Fraser V. Tr. Hat.	30 c	ST	ST				ST	ST		ST
29	Fraser V. Trout Hat.	1 c									KO
29	Fraser V. Trout Hat.	10 c	RT	RT							RT
29	Fraser V. Trout Hat.	4 c	ST								ST
29	Fraser V. Trout Hat.	5 c	CT					CT			CT
29	Fraser V.T.H. (Res)	10 c	CT								CT
29	Fraser V.T.H. (Res)	17 c	RT	RT					RT		
29	Fraser V.T.H. (Res)	5 c	ST								
29	Fraser V.T.H. (Res)		CO								
29	Gates Creek	100					SK				
29	Gates Cr. (Shuswap R.)	50	(No HEN in SK)								
29	Harrison River	61							CM		
29	Harrison River	6						CN		CN	
29	Harrison River	5						CO		CO	
29	Harrison River	600	No Parasites in CM								
29	Head of Fraser R. N.	20									CN
29	Horsefly River	39	CN	CN							
29	Horsefly River	30	KO								
29	Horsefly River	877		SK		SK	SK				SK

*Disease/Agents and Parasites:

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IHN - Infectious hematopoietic necrosis
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BR - Brown Trout

continued . . . . . .

Table III-9. cont'd

Location: Area	Sample Site	Total No. Examined (c=case)	Findings* by Species**: No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
29	Horsefly River	92	(No HEN in SK)								
29	Inches Creek	107							CM		
29	Inches Hatchery	3 c	CM								
29	Inches Hatchery	8 c	CO								CO
29	Inches Hatchery	10	CT								
29	James Creek	4						CN			
29	Kanaka Cr. Hat.	2 c									CT
29	Kanaka Cr. Hat.	6									CO
29	Kawkawa Lake	35	KO								KO
29	Lemieux Creek	42	CO	CO				CO			CO
29	Little Cambell R.&Hat.	6 c	CO	CO							CO
29	Little Cambell R.&Hat.	8 c	ST	ST		ST					ST
29	Loon Lake	11									RT
29	Loon Lake										RT
29	Loon Lake Hatchery		CN					CN			CN
29	Loon Lake Hatchery		ST			ST					ST
29	Loon Lake Hatchery		RT								RT
29	Lower Fraser River	2									CO
29	Lower Fraser River	1	CT								
29	Lower Fraser River	6	RT								
29	Marshall Creek	7	ST								
29	McGregor River	1									CN
29	McGregor River	2									RT
29	Mid Fraser River										LT
29	Mid Fraser River	10	RT								
29	Middle River	80	(No HEN in SK)								
29	Nadina River	300	SK				SK				

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IHN - Infectious hematopoietic necrosis
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continued . . . . . .

Table III-9. cont'd

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
29*	Nechako R. (Kenny Dam)	111							RT		
29*	Nechako River	118						CN			
29*	Nechako R. (Kenny Dam)	87							KO		
29	Nechako River	67	CN					CN			
29	Nechako River	24	(No HEN in CN)								
29	Nicola River	62									CN
29	Nicola River	110					KO				
29	Nicola River	14	ST	ST				ST	ST		
29	North Fraser R.Area	7	CN					CN			
29	North Fraser R.Area	18	SK								SK
29	North Thompson R.										SK
29	North Thompson R.	4									LT
29	North Thompson R.	7	RT								
29	North Thompson R.	53	CN								
29	North Thompson R.	119	CO	CO				CO			CO
29	Pennask Lake	89	RT								RT
29	Penny Creek Hatchery	60	CN								CN
29	Quesnel Area	22	CN								
29	Quesnel Area	33	RT								
29	Quesnel Area	19	SK								
29	Quesnel River	199	CN				CN	CN			CN
29	Quesnel River	60	(No HEN in CN)								
29	Salmon R. (L. Mainland)	9	CO								CO
29	Salmon R. (L. Mainland)	19		ST							
29	Salmon R. (Thompson)	20						CN			CN
29	Salmon River	21	(No HEN in CN)								
29	Salwein C. (Vedder R.)	39								CO	
29	Sayres Lake	4	DV								

*Disease/Agents and Parasites:

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HEN - <u>Henneguya salminicola</u>
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continued . . . . . .

Table III-9. cont'd

Location: Area	Sample Site	Total No. Examined (c=case)	Findings* by Species**: No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
29	Sayres Lake	17	RT								
29	Sayres Lake	15	CT								
29	Sayres Lake	20	RT								RT
29	Sayres Lake	15	BK								
29	Serpentine River	6									CO
29	Serpentine River	1							ST		
29	Shuswap Lake	27	CN								
29	Shuswap Lake	1	SK								
29	Shuswap River	15	CN								
29	Slim Creek	25	(No HEN in CN)								
29	Slim Creek	164						CN			CN
29	South Thompson River									CM	
29	South Thompson River	2	RT								RT
29	Spahomin River	30							RT		
29	Spius Creek & Hat.	4 c	CN	CN				CN			CN
29	Stave L. (Sun Valley)	117	RT								
29	Stave River	5	RT								
29	Stellako River	25	(No HEN in SK)								
29	Stellako River	100	SK								
29	Stuart River		CN								
29	Stuart River						SK				
29	Stuart River Pilot		CN								
29	Suskwa River	11	ST								
29	Thompson R. Area	4		RT							
29	Thompson R. Area		RT								
29	Thompson R. Area	30	BK								
29	Thompson R. Area	30	RT								RT

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continued . . . . . .

Table III-9. concluded

Location			Findings* by Species**								
Area	Sample Site	Total No. Examined (c=case)	No Disease	F	PKD	BKD	IHN	C.S.	ERM	HEN	Other Disease
29	Thompson R. Area	28	RT								
29	Thompson R. Area	2									BK
29	Thompson R. Area	1									ST
29	Thompson R. Area	11	RT								
29	Thompson R. Area		RT								
29	Tunkwa Lake	24	RT								
29	University of B.C.	2 c	CO								
29	University of B.C.	3 c	RT								RT
29	University of B.C.	3 c	CM								CM
29	University of B.C.	34		RT							
29	University of B.C.	22	DV								
29	University of B.C.	60	SK				SK				
29	University of B.C.	11									CN
29	Upper Fraser River	4	CT								
29	Vedder River	22	RT								
29	Vedder River	153	CO	CO				CO		CO	CO
29	Vedder River	58	ST						ST		ST
29	Vedder River	27						CT			CT
29	Vedder River	100	CM	CM							
29	Weaver Creek	34	CO							CO	
29	Weaver Creek	6	(No HEN in CN)								
29	Weaver Creek	5	(No HEN in CO)								
29	Weaver Creek	100								CM	
29	Weaver Creek	326		SK			SK			SK	
29	Weaver Creek	108								PK	
29	Weaver Creek	20	RT								
29	Willow River	46	CN					CN			CN

*Disease/Agents and Parasites:

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IHN - Infectious hematopoietic necrosis
CS - *Ceratomyxa shasta*
HEN - *Henneguya salminicola*
ERM - Enteric redmouth disease

**Salmonid Species:

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ST - Steelhead Trout
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BR - Brown Trout

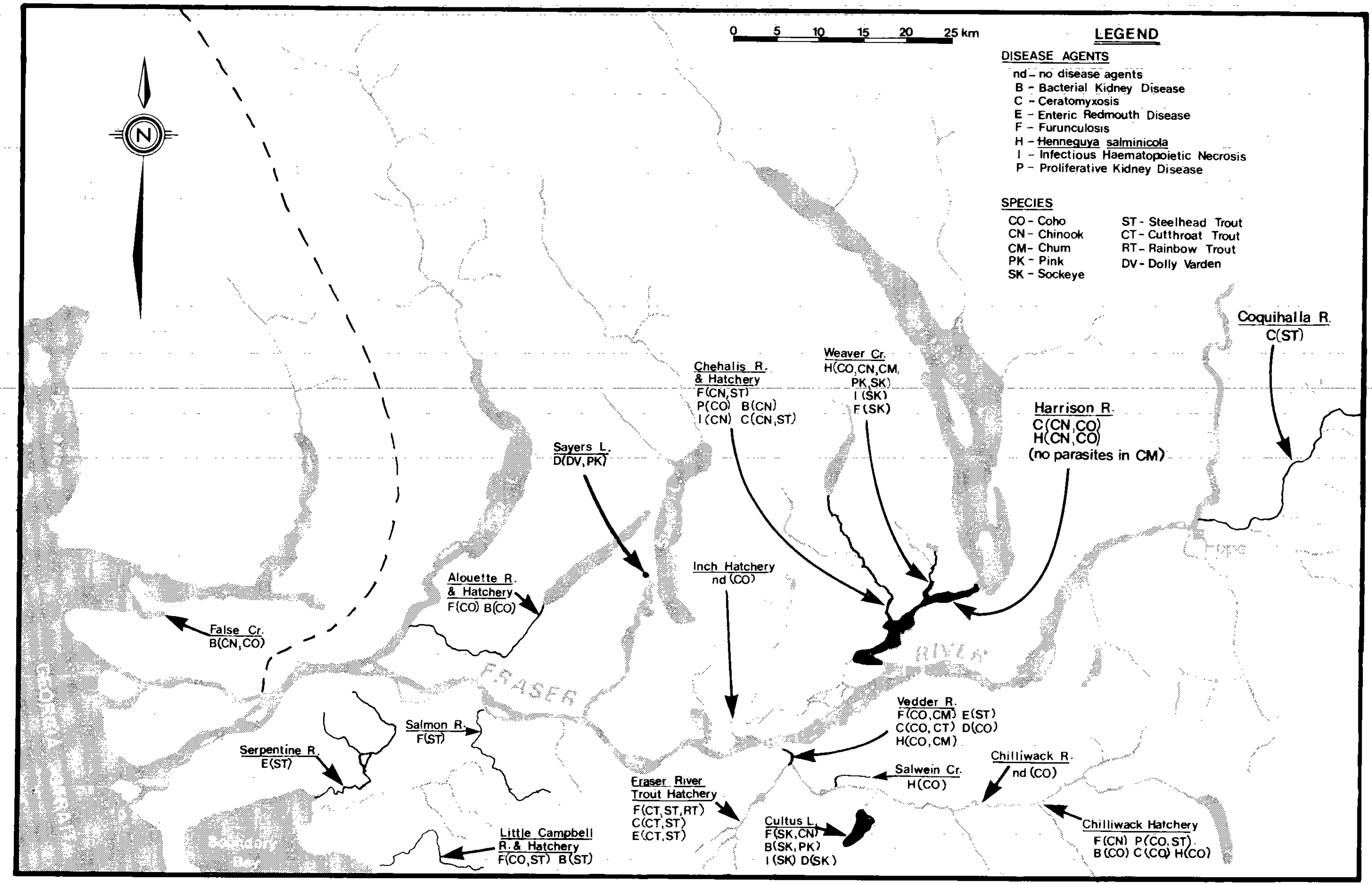

Figure III-2. Distribution of salmonid disease agents and parasites in Statistical Area 29 (Fraser River downstream of Hope).

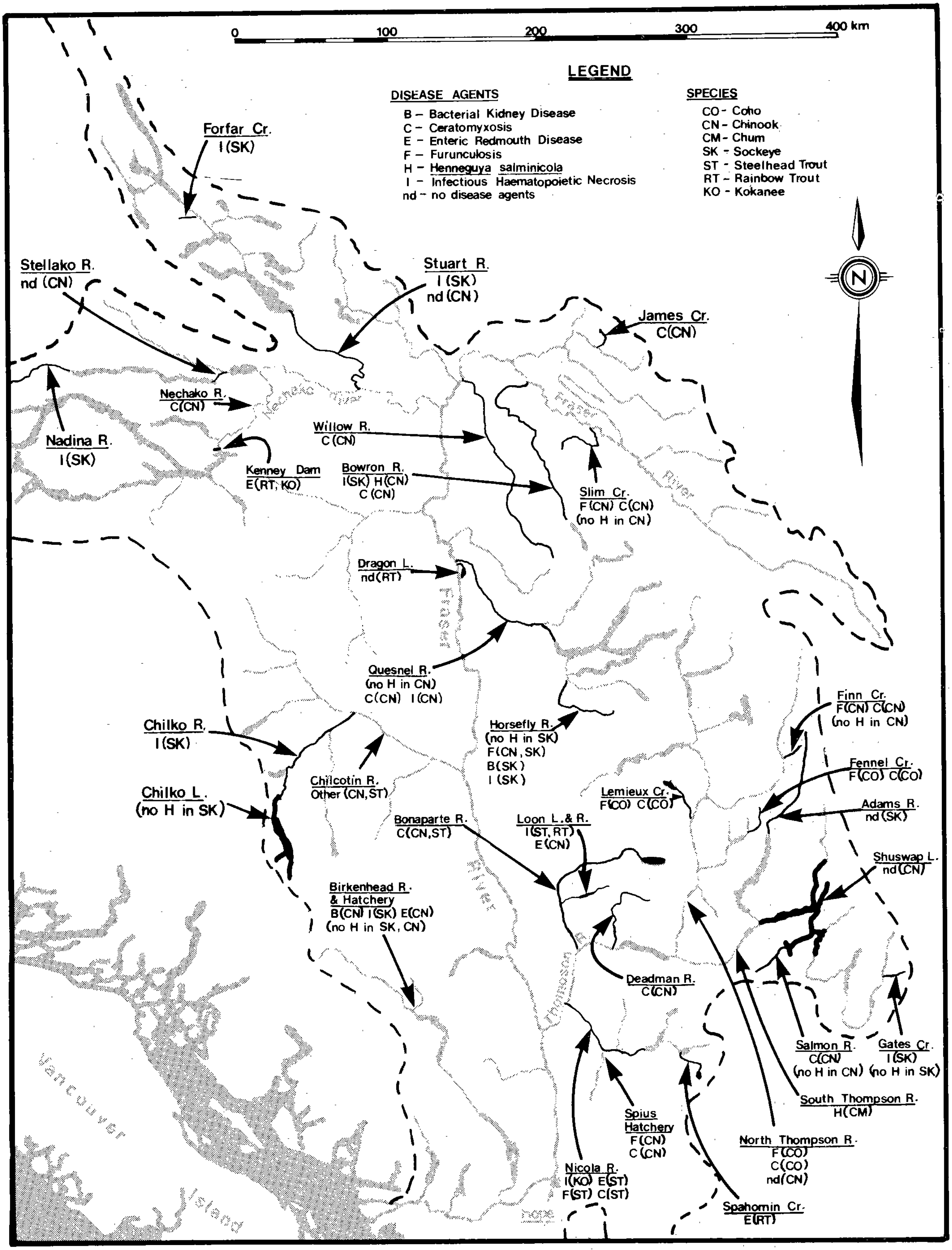

Figure III-3. Distribution of salmonid disease agents and parasites in Statistical Area 29 (Fraser River upstream of Hope).

Proceeding upstream in the Fraser River system, the Alouette River and hatchery was found to have the furunculosis and BKD bacteria in coho and the Salmon River had the furunculosis agent in steelhead. No disease agents or parasites were found in Inch Creek Hatchery coho.

In the Chilliwack-Vedder system, the Vedder River had agents for furunculosis in coho and chums, ERM in steelhead, ceratomyxosis in coho and cutthroat trout, and Henneguya in coho and chums. Henneguya cysts were also found in Salwein Creek coho, but no disease agents or parasites were found in Chilliwack River coho. At Cultus Lake, agents were found for furunculosis in sockeye and chinooks, BKD in sockeye and pinks and infectious hematopoietic necrosis (IHN) in sockeye. The Fraser River trout hatchery and related facilities have had agents found for furunculosis in cutthroat trout, steelhead and rainbow trout, ceratomyxosis in cutthroat trout and steelhead and ERM in cutthroat trout and steelhead. The Chilliwack Hatchery found agents for furunculosis in chinooks, proliferative kidney (PKD) in coho and steelhead and BKD, ceratomyxosis and Henneguya in coho.

In the Harrison River system, Weaver Creek and the IHN virus and the furunculosis bacterium in sockeye and Henneguya cysts in coho, chinooks, chums, pinks, and sockeye. The Harrison River had C. shasta and Henneguya in chinook and coho, but no parasites were found in a sample of 600 chums. Agents found in the Chehalis River and hatchery include the furunculosis bacterium and C. shasta in chinooks and steelhead, and the BKD agent and the IHN virus in chinooks, and the PKD bacterium in coho.

The Coquihalla River had C. shasta in steelhead.

In Fraser River above Hope (Figure III-3), the Birkenhead River and hatchery have had the BKD and ERM bacteria in chinook and the IHN virus in sockeye. No Henneguya cysts were found in sockeye or chinook at this site.

In the Thompson River system, agents found include those for IHN in steelhead and ERM, furunculosis and ceratomxyosis in steelhead in the Nicola River. Spahomin Creek had the ERM bacteria in rainbow trout and the Spius Hatchery had agents for furunculosis and ceratomxyosis in chinooks. Bonaparte River had C. shasta in chinooks and steelhead, and Loon Lake and River had the IHN virus in steelhead and rainbow trout and the ERM bacterium in chinook. Deadman Creek had C. shasta in chinook.

Agents for furunculosis and ceratomyxosis were found in coho from the North Thompson River, Lemieux Creek and Fennel Creek. These two agents were also found in chinooks from Finn Creek, but not in chinooks from the North Thompson River. No Henneguya cysts were found in chinooks from Finn Creek.

The South Thompson River had Henneguya cysts in chums. No disease agents or parasites were found in Adams River sockeye or Shuswap Lake chinooks. C. shasta was found in Salmon River chinook and the IHN virus was found in Gates Creek sockeye, but Henneguya cysts were not found in either.

No Henneguya cysts were found in sockeye taken from Chilko Lake and Horsefly River or chinooks from Quesnel River and Slim Creek, but they were found in chinooks from Bowron River. The IHN virus was found in sockeye taken from Chilko River and Horsefly River and in chinooks from Quesnel River; the latter also had C. shasta. The Horsefly River also had agents for furunculosis in chinooks, and sockeye and BKD in sockeye.

Ceratomyxa shasta was found in chinooks from Willow River, James Creek, Bowron River and Slim Creek. The furunculosis bacterium was found in chinooks from Slim Creek and the IHN virus was found in sockeye from Bowron River.

In the Nechako River watershed, the IHN virus has been found in sockeye from Stuart River, Forfar Creek and Nadina River. Other agents found include C. shasta in Nechako River chinooks and the ERM bacterium in rainbow trout and kokanee from the Kenney Dam area (Envirocon Ltd. 1984).

References

1. McDougal, R.D. and Associates. 1986. Distribution of important salmonid disease agents and parasites in the Queen Charlotte Islands. Prep. under contract for DFO in consultation with Fish Health and Logistics Section, Pacific Biol. Sta., Nanaimo, B.C.

2. DFO. 1985. Fish health data base. Updated September 1985. Can. Dep. Fisheries and Oceans, Vancouver, B.C.

3. Boyce, N.P., Z. Kabata and L. Margolis. 1985. Investigations of the distribution, detection, and biology of Henneguya salminicola (Protozoa, Myxozoa), a parasite of the flesh of Pacific salmon. Can. Tech. Rep. Fish. Aquat. Sci. 1405:55 p.

4. Traxler, G.S. (in prep.). An epizootic infectious hematopoietic necrosis in two year old kokanee (Oncorhynchus nerka) at Lake Cowichan, British Columbia, J. Fish. Disease.

5. Envirocon Limited. 1984. Environmental studies associated with the proposed Kemano Completion Hydroelectric Development. Volume 7 - Fish disease and parasites baseline information. Vancouver.

APPENDIX IV

EVALUATION OPTIONS FOR THE NIMPKISH STOCK

EVALUATION OPTIONS FOR THE NIMPKISH STOCKS

Harvest Strategies

This analysis was conducted prior to development of the South Coast models. Rebuilding of Nimpkish sockeye salmon was simulated using a small scale computer model which only considered the Nimpkish stock. Since timing of this stock is earlier than most other Fraser stocks, and the harvest area would be in the north half of Area 12 above Johnstone Strait, management strategies for this stock would only affect other early sockeye runs and pink stocks. The impacts on these stocks are dependent on the harvest locations and restrictions which are discussed in Section 1.1. The Nimpkish stock is projected to rebuild if the current low harvest rates (10%) were maintained (Figure IV-1). Once stocks attained target level, harvest rates could be increased in terminal areas to catch the surplus production.

It was predicted that the stocks would rebuild to the target escapement (250,000) within 10 years. During this period the catch would average about 40,000 pieces. After 10 years, catches were projected to increase dramatically and maintain a level between 200,000 i nd 300,000 pieces annually. This scenario might involve minor decreases in the harvest rate of offshore troll fisheries and possibly minor changes to the Johnstone Strait net fisheries.

The Nimpkish sockeye system has been enhanced starting in 1981 through lake fertilization. If the fertilization program in the Nimpkish system is successful in increasing productivity by a factor of 2.5 and the fisheries are maintained at the current 10% harvest level until stocks are rebuilt, it is expected that the Nimpkish sockeye should attain target within two years (Figure IV-2). Catch would increase dramatically after the first five years and stabilize between 900,000 and 1,500,000 pieces annually.

The model projections indicated that rapid rebuilding of the stocks is possible, assuming that lake fertilization would increase productivity as expected. However, there are other options which would rebuild Nimpkish sockeye and provide more harvest each year than the 10% harvest rate resulting from interception fisheries. The current approach of maintaining a total closure until the stock has reached its target escapement has the disadvantage of not providing information for management of fisheries once the large returns of Nimpkish sockeye occur. This necessary information (run timing, migration routes, estimates of stock abundance) can only be obtained through operation of fisheries for several years.

A series of fixed harvest rates (25%, 40% and 60%) were modelled to evaluate the potential for increased fisheries on the Nimpkish sockeye during the rebuilding

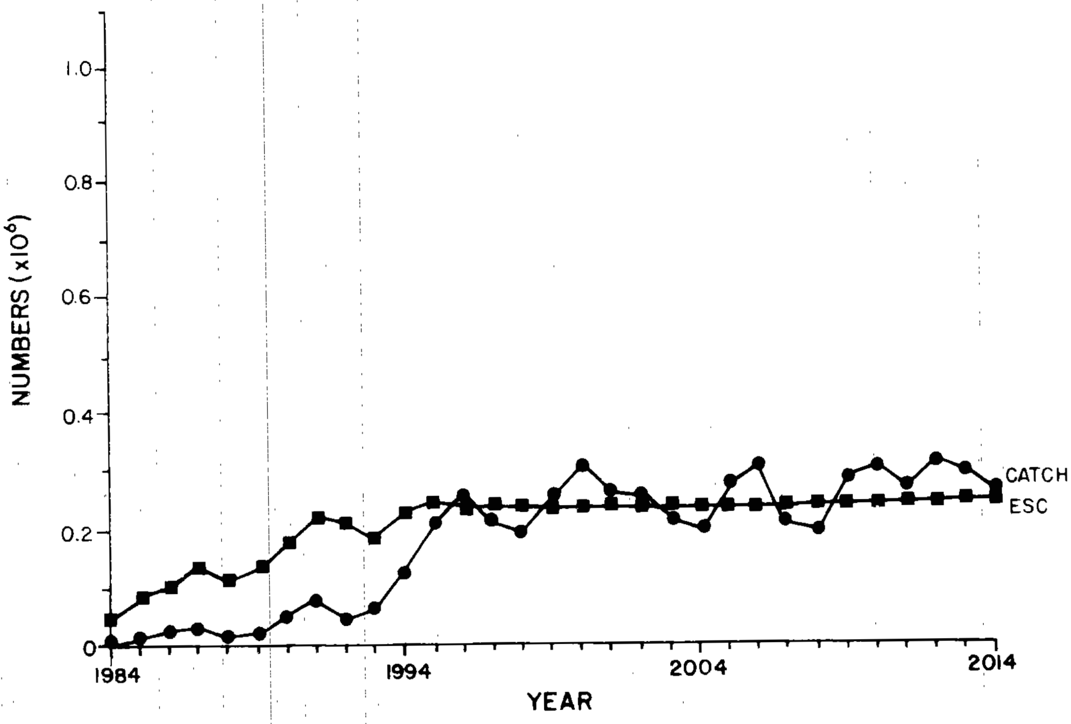

Figure IV-1. Catch and escapement projections for a 10% harvest rate of Nimpkish sockeye with no lake fertilization.

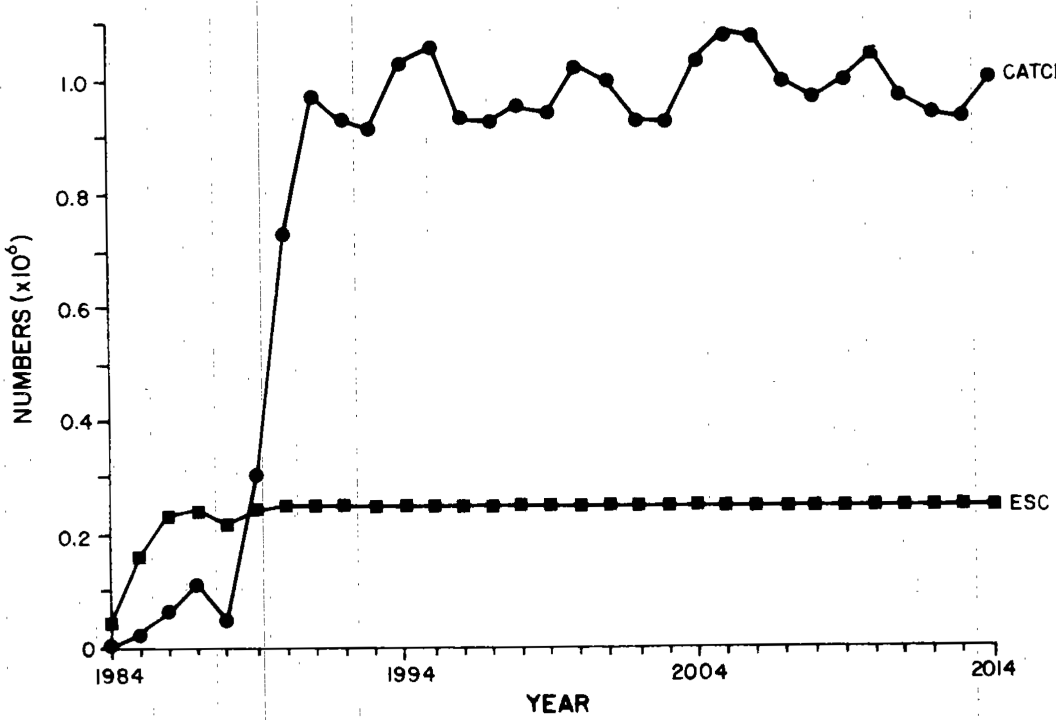

Figure IV-2. Catch and escapement projections for a 10% harvest rate of Nimpkish sockeye with lake fertilization.

Table IV-1. Summary of model projections for various harvest rates during rebuilding of Nimpkish sockeye with lake fertilization.

	Harvest 10%	Rates 25%	During 40%	Rebuilding 60%	Periods
Estimated number of Years to Reach Target	2	3	7	11	
Average Catch in First 10 Years	410,000	392,000	335,000	240,000	
NPV					

process (Table IV-1). Although a fixed-catch approach may be more reasonable over the longer term, until the fertilization program has demonstrated low variability in total returns, a fixed harvest rate is likely the best strategy. In evaluating these different scenarios, it will be necessary to compromise rebuilding stocks as rapidly as possible versus marginally increasing the time required to rebuild stocks (with a lower average catch), but increasing the capability to manage future fisheries. If this management capability is not developed the predicted catches by future fisheries may not be achievable.

The average catch in the first 10 years is only slightly higher for the current management approach than the option with a harvest rate of 25% (Figures IV-1 and IV-3). The harvest rates of 40% (Figure IV-4) and 60% (Figure IV-5) offer immediate benefits for fishermen; however, rebuilding is slower and the average catch is considerably lower.

The option of increasing the target escapement to 500,000 and assuming the same productivity (5 to 1) and a 25% harvest rate during the rebuilding period was also modelled (Figure IV-6). This approach of increasing the target escapement to identify the optimum is being used successfully in Barkley Sound. The model predicted that escapement built to 500,000 in 7 years with the first 10-year average catch of 333,000 sockeye. Potential production after that time would be large with average catches of about 100,000 pieces.

An accurate estimation of stock size entering the fishery and escapement is necessary to achieve the goals outlined above. Obtaining this information is not possible now, but methods can be developed over time. It is expected that at least five years are required to develop an indexing system which allows accurate determination of total stock size in the fishing area. The preliminary requirement

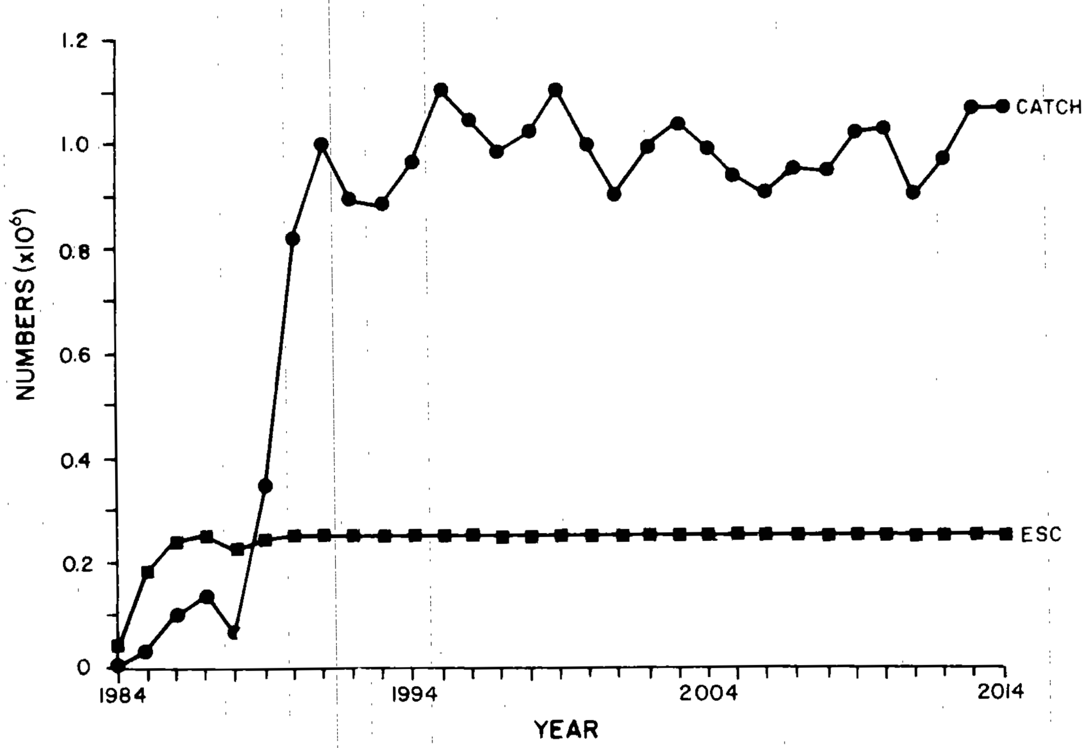

Figure IV-3. Catch and escapement projections for a 25% harvest rate of Nimpkish sockeye, with lake fertilization.

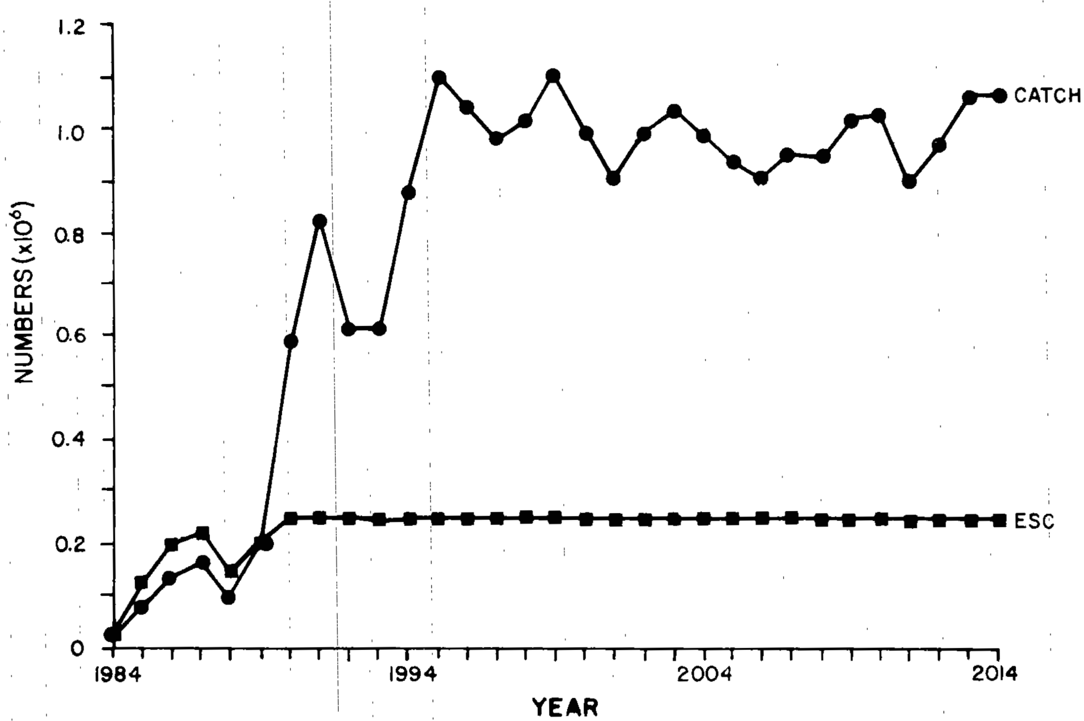

Figure IV-4. Catch and escapement projections for a 40% harvest rate of Nimpkish sockeye, with lake fertilization.

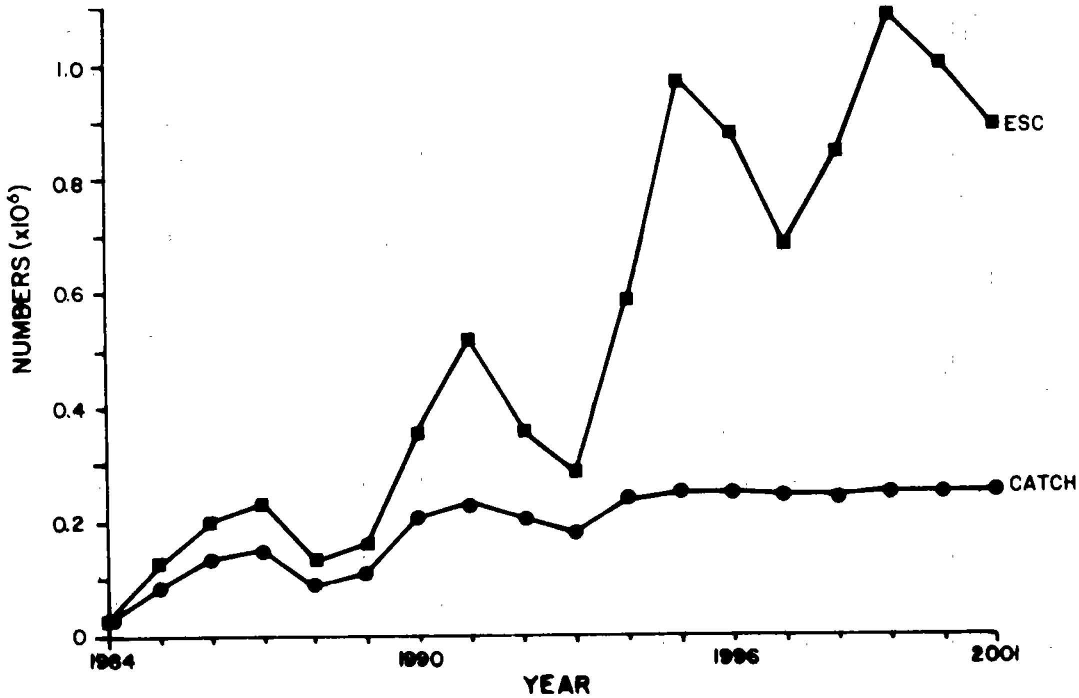

Figure IV-5. Catch and escapement projections for 60% harvest rate of Nimpkish sockeye, with lake fertilization.

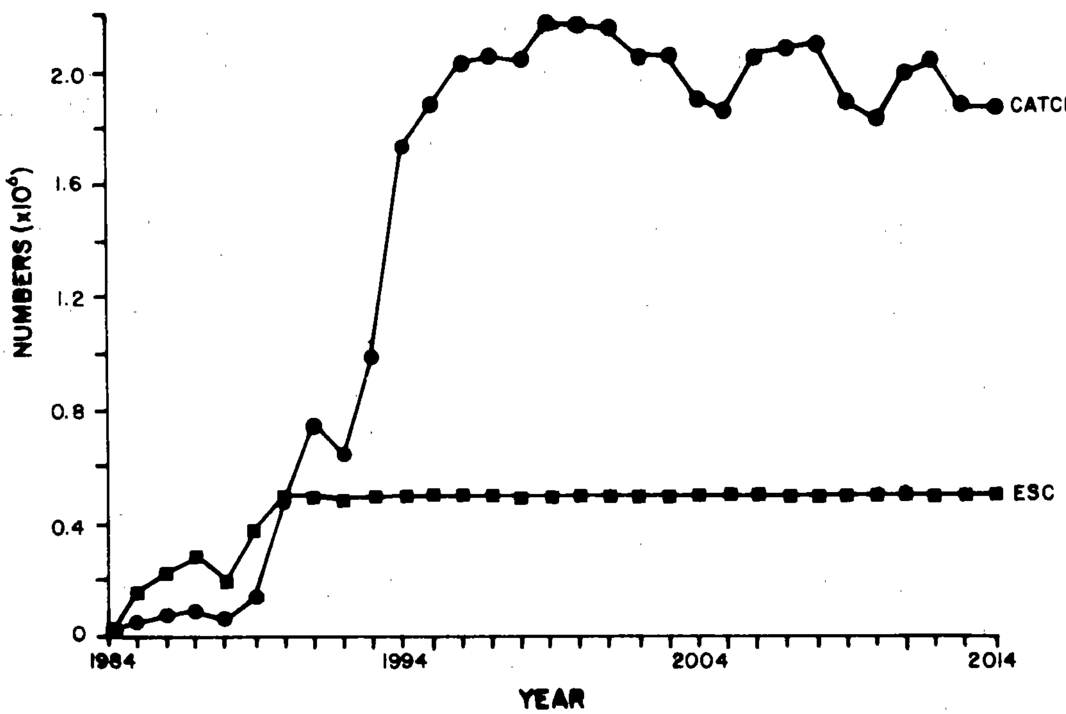

Figure IV-6. Catch and escapement projections for 25% harvest rate of Nimpkish sockeye and target escapement of 500,000 with lake fertilization.

is a means of estimating the total stock size by counting sockeye entering the river, either through a side-scanning sonar system or a fish-counting fence. Other more traditional methods are not adequate. For example, spawning ground enumeration gives a conservative estimate of the total population size, but this is 2 - 3 months after the fish have left the fishing area. Therefore, spawning ground enumerations cannot be used to manage the Nimpkish sockeye fishery in-season and at best may be useful for summarizing the total annual production. Stock identification methods such as scale analysis or parasites may be useful, but cost and analysis time make this an expensive approach.

Harvest Locations and Restrictions

While developing methods to estimate harvest rates accurately in-season, there are several areas where surpluses could be harvested. Nimpkish sockeye enter upper Queen Charlotte Strait through Gordon Channel (M.U. 12-12 and 12-11) and through Goletas Channel (M.U. 12-15 and 12-16). The majority of Nimpkish sockeye then pass through Broughton Strait to the Nimpkish River estuary. It has been estimated that the proportion passing through Broughton Strait is approximately 80-90% of the total returning stock. The remaining 10-20% move east along the north shore of Malcolm Island, through Blackfish Sound and the Double Bay area and then west to the Nimpkish estuary. In past years, the primary areas for harvesting Nimpkish sockeye have been in the upper portions of Area 12 in Queen Charlotte Strait. To rebuild Nimpkish sockeye under the current management scheme, the approach areas of Gordon and Goletas Channel, Port Hardy Bay, and the north shore of Malcolm Island have been kept closed to fishing. In anticipation of substantial surplus sockeye being available, several options for harvesting Nimpkish sockeye in various areas are outlined below.

1. Open the areas north of Lewis Point to the Area 11 and 12 boundary

The advantage of opening the upper portion of Areas 12 is that it will provide a large area in which the gillnet and seine fleet can fish for more than one days's migration of Nimpkish sockeye. It is estimated that 200-300 seiners and approximately the same number of gillnetters could operate in this area. The disadvantage of the option will be that the increased harvest rate for Nimpkish sockeye which return to the same geographic area, the passing Bond/Knight and Kingcome/Wakeman pink stocks in both odd and even years. It is anticipated that current pink harvest would increase by 200-400% if full Nimpkish sockeye harvests were initiated. There would also be a substantial interception of chinooks since their migration coincides with the timing of early sockeye. In addition, increasing harvest rates for Nimpkish sockeye in upper Queen Charlotte Strait would have the same result for Heydon, Phillip, Fulmore, and Sakinaw early Fraser sockeye stocks. These other early sockeye stocks are currently at low levels and could not sustain higher harvest rates.

2. Restrict the harvesting to M.U. 12-9 and 12-8 (for gillnetters only)

Although M.U. 12-9 and 12-8 are common migration areas for both pinks and sockeye, by utilizing gillnetters only the harvest rate for pink could be substantially reduced. Under this option, seiners would be limited to fishing in the terminal areas of M.U. 12-17, 12-18 and 12-19. The advantage of this option would be that it would eliminate pink interceptions in all areas, and therefore maintain the current rebuilding schedule for pinks. It would also provide a means of separating fishermen by gear to avoid gear conflict, and would restrict (if not eliminate) the harvesting of other area and Fraser River sockeye stocks (why?). One disadvantage of this option is it will limit the working area of seiners. The total number of seine boats able to fish in the prescribed area would be limited to 50-150. Another disadvantage is that the fleet would be limited to an area in which there will be returning pink stocks (Keogh and Cluxewe). A modified version of this option would provide for a greater area for seine harvesting by changing the current M.U. 12-8 boundary to run from Boyles Point across to the north shore of Malcolm Island (likely Lizard Point). Seiners could then fish a potentially greater proportion of the migration route, while avoiding a separate area for gillnetters. It is anticipated that utilizing the terminal area and revising the M.U. 12-8 boundary to Boyles Point would provide a fishery for up to 250 seine vessels. However the rest of the disadvantages described above apply to this modified option.

3. Restrict harvesting to M.U. 12-17 and 12-19 with seiners and gillnetters

This option restricts harvest of Nimpkish sockeye to the terminal area. The obvious disadvantage is that the area in which the fleet can operate is limited. However, more days of fishing could be provided and the catch total would be similar. Due to the confined space, all surplus may not always be harvested; however, additional harvesting could be conducted by gillnetters in Nimpkish Lake to achieve the total allowable catch. The approach of harvesting the lake after the marine fishery has taken its catch has the advantage of maximizing any potential returns above the target escapement of Nimpkish sockeye. It also reduces the need for management precision in estimating the total stock size in the outside marine fisheries. Theoretically, this is the best option, since it maintains the current harvest rate for all other species and stocks that pass through the upper portion of Johnstone Strait with the exception of the Cluxewe and Keogh stocks which will likely be intercepted because of the proximity to the Nimpkish River. Costs of this option are that gillnetters would be required to retool to harvest sockeye in the lake, and trailers and launching sites would have to be constructed.

If either option 1 or 2 is recommended, the potential effects on other stocks should be quantified using the integrated South Coast model.

Enhancement Strategies

The proposed enhancement opportunities for UECVI pink salmon stocks were simulated using a small scale model. Each of the options takes into account the interaction of the UECVI pink salmon stocks with the enhanced Nimpkish sockeye. Fertilization of Nimpkish Lake is anticipated to continue and the enhanced production is expected to support a local fishery which does not exist now. Depending on the harvest area (see Section 10.1.2) the UECVI pink salmon stocks would be intercepted at various rates. Since the fishery for Nimpkish sockeye is not currently operating, a "Potential Management" scenario was developed to provide a basis for comparison with the enhancement options. This management scenario could change if another harvest strategy is taken for management of Nimpkish sockeye. Since this decision has not yet been made, the option involving 25% harvest of Nimpkish sockeye during the rebuilding period was arbitrarily chosen.

This Potential Management scenario includes an outside troll fishery which intercepts 5% of the pink salmon stocks. This scenario differs from current management since it involves moving the Gordon Channel fishery for Nimpkish sockeye salmon south into Queen Charlotte Strait, where the actively-management pink stocks are only partially (50%) vulnerable. This fishery would be managed to produce 25% exploitation rate for Nimpkish sockeye. The additional surplus of sockeye salmon would be captured in a terminal fishery in Broughton Strait, which also intercepts actively-managed pink salmon stocks, specifically the Keogh and Cluxewe stocks. Actively-managed pink salmon stocks (south of Port Hardy) would be controlled by escapement goals in terminal fisheries near the river mouths, and passively-managed pink stocks (north of Port Hardy) would be fished to produce target escapements in Goletas Channel. Additional production of 20,000 pink salmon from the CEDP enhancement project in the Quatse River was accounted for in this scenario.

Escapements of actively-managed pink salmon stocks were anticipated to increase rapidly to within 60% of target escapement, and then stabilize at about 50% of target (Figure IV-7). The rise and fall in the escapements of actively-managed pink salmon stocks was attributed to their interaction with sockeye salmon. The Nimpkish sockeye salmon stocks did not achieve target escapement for about 8 years; therefore, the terminal fishery for these stocks would be closed for this period and the pink stocks could begin to rebuild. However, once sockeye salmon achieve target escapement, the terminal fishery would be open to capture the surplus and more pink salmon would be intercepted, resulting in fewer escaping to their spawning streams. The effect of this interaction is also evident in the following enhancement options, since the pink stocks do no achieve target escapement before the sockeye salmon fishery was open. Escapements of passively-managed pink salmon stocks (north of Port Hardy) remained well below target levels, gradually increasing from less than 1% to 13% in 40 years (Figure IV-8). Catch of

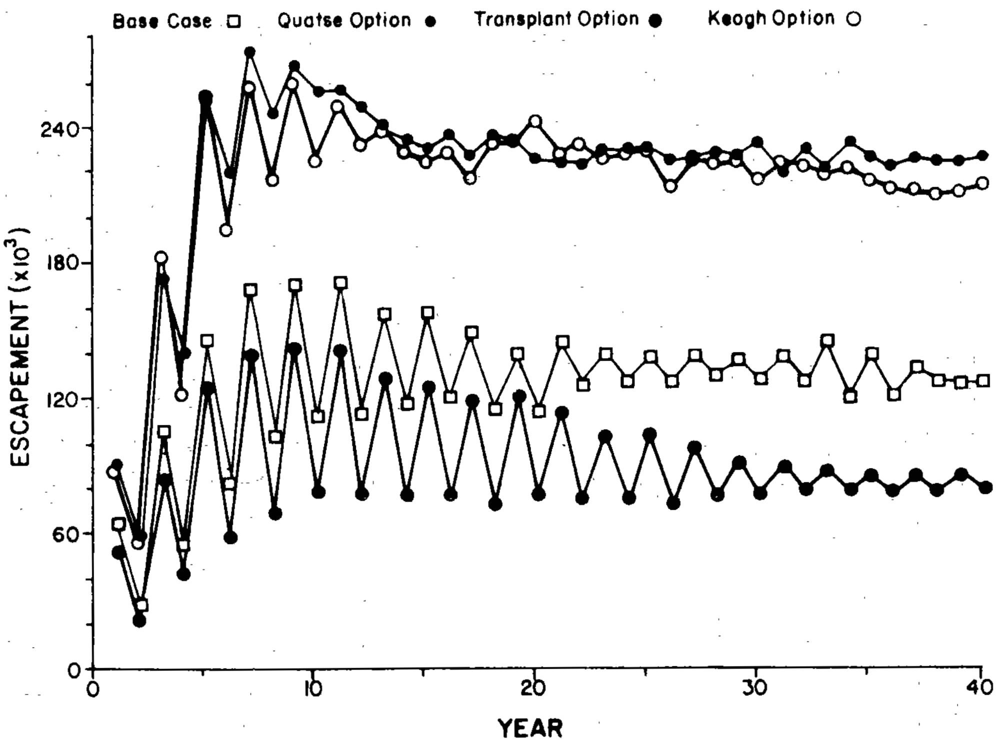

Figure IV-7. Predicted results of enhancement options for actively-managed UECVI pink escapements.

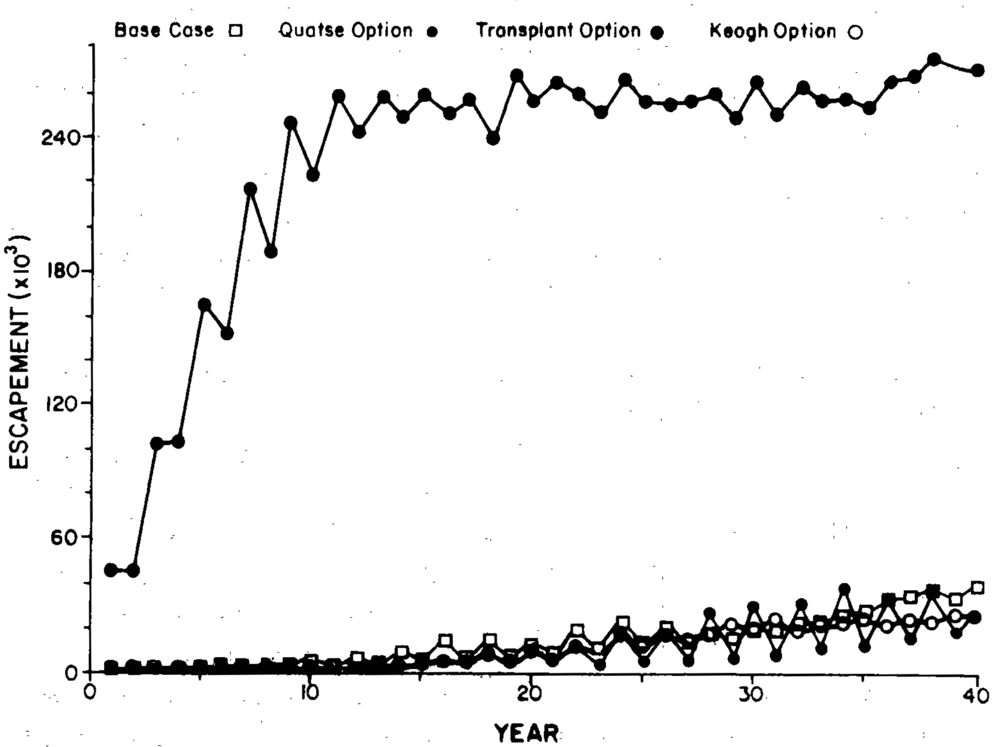

Figure IV-8. Predicted results of enhancement options for passively-managed UECVI pink escapement.

UECVI pink salmon stocks increased in the first 10 years and then fluctuated between 100,000 and 140,000 pieces (Figure IV-9). The NPV of the projected pink salmon catch in this scenario was estimated at $5.2 million.

The enhancement proposal to expand the Quatse facility (Option 2) and increase production of the Quatse River by 60,000 pink salmon was evaluated under the same management regime as in the Potential Management scenario. Escapement of the actively-managed pink salmon stocks was predicted to rapidly increase to 95% of target, and then decline slightly and stabilize at about 80% of target (Figure IV-7). This enhancement proposal is not anticipated to change passively-managed pink salmon escapements from those observed in the Base Case (Figure IV-8). Catches of UECVI pink salmon were predicted to increase quickly and fluctuate between 200,000 i nd 280,000 pieces annually. The NPV of these catches was estimated at $10.5 million.

Another enhancement option (Option 3) involves expansion of the Quatse facility to accommodate eggs from the actively-managed pink stocks, which could then be transplanted into streams supporting the passively-managed pink salmon stocks. This option was estimated to produce an additional 60,000 pink salmon. Surplus returns were assumed to apwn in the streams to which they were transplanted, and to have a productivity that is slightly lower than the natural stocks. The lower productivity of the transplanted stocks accounts for possible straying. Under this option, the escapement of actively-managed pink salmon salmon stocks was predicted to inititally increase as rapidly as with the Potential Management scenario, but then escapements declined to 20% of target (Figure IV-7). This decline in the escapement of actively-managed pink stocks can be attributed to fisheries targeting on enhanced, passively-managed pink stock in the Goletas Channel as well as interceptions in the Nimpkish terminal fishery for sockeye salmon. Escapements of passively-managed pink salmon escapements were projected to increase rapidly to between 80-90% of target escapement (Figure IV-8).

Total catch of UECVI pink salmon was expected to increase in the first ten years and then fluctuate between 150,000 i nd 300,000 (Figure IV-10). The NPV of the pink catches with the transplant option was estimated at $9.0 million.

Option 4 involved expansion of the Quatse facility to incubate eggs of Keogh River pink salmon and transplant unfed fry back into the Keogh River. The anticipated production from this option was 50,000 pink salmon. Escapement of actively-managed pink salmon stocks was predicted to increase rapidly to within 90% of target in the first 10 years, then then to stabilize at about 75% of target (Figure IV-7). Escapements of passively-managed pink salmon stocks gradually increased at the same rate as predicted with the Potential Management scenario (Figure IV-8). Catch of UECVI pink salmon was expected to increase in the first 10 years and then

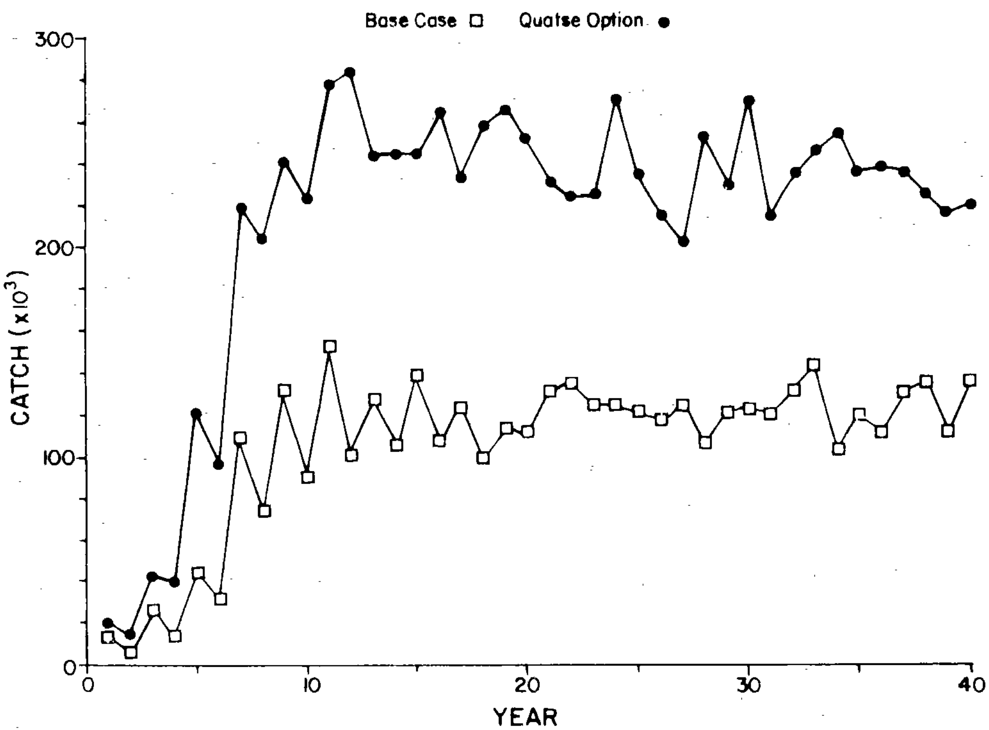

Figure IV-9. Predicted results for catch of UECVI pink salmon under the Base Case (Option 1) and Quatse enhancement option (Option 2).

fluctuate between 200,000 and 300,000 (Figure IV-10). The NPV of pink salmon catch with this option was estimated at \$10.0 million.

Each of the proposed enhancement options rebuilds either the passively-managed or actively-managed pink salmon stocks. Two enhancement options (transplanting to the passively-managed pink salmon systems and enhancing the Keogh system) were combined in an effort to rebuild both actively-managed and passively-managed stocks. Hatchery capacity would have to be expanded to about twice that proposed with any single option. Since brood stock from the odd years was limited, only half the capacity of the facility could be achieved in the first odd year. The available brood stock was divided equally between the passively-managed streams and the Keogh River. The model predicted that full capacity of the facility could be achieved with one odd-year cycle. Escapements for both passively-managed and actively-managed pink salmon stocks were predicted to increase significantly over those observed with the Potential Management scenario (Figure IV-11). The actively-managed stocks were expected to stabilize at about 70% of target, and passively-managed stocks at about 85% of target. Catch was projected to fluctuate between 300,000 - 450,000 pieces annually, an increase over that observed in the individual options (Figure IV-10). Pink salmon catches for this combined option was predicted to have an NPV of \$16.4 million.

Based on this analysis, the highest benefits in terms of catch and escapements would be achieved by enhancing both the actively-managed and passively-managed pink salmon stocks simultaneously. If only one group is enhanced, the total catch is less than in the combined option and escapement of the other stock groups is kept at low levels. Therefore, a combined project which enhances both passively-managed and actively-managed stocks is recommended.

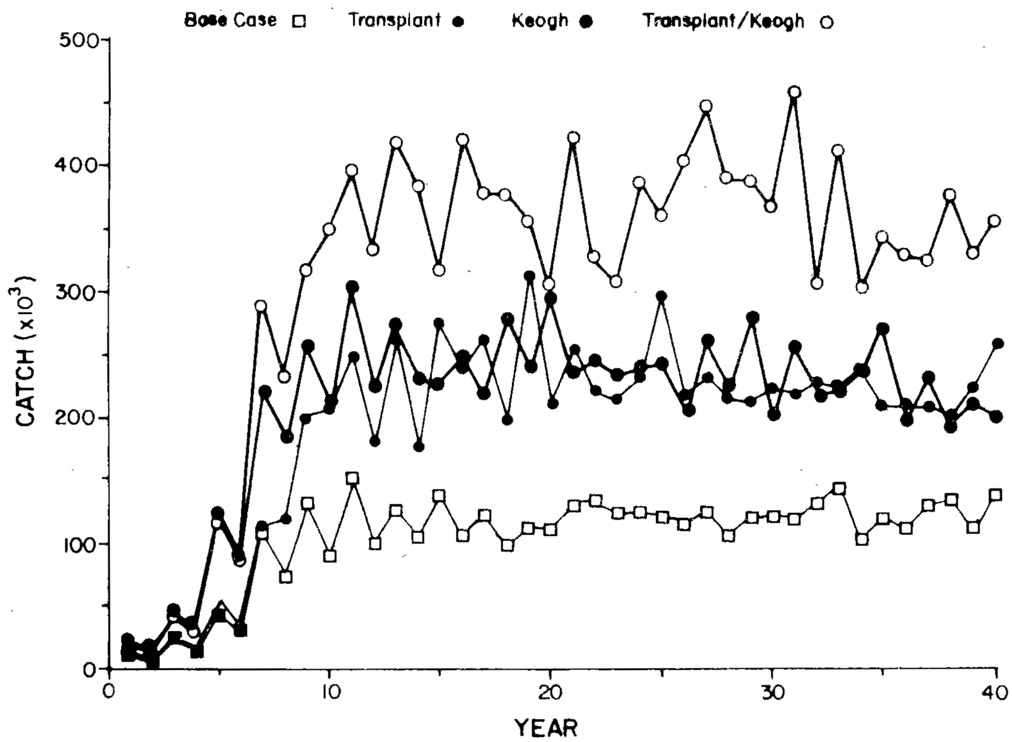

Figure IV-10. Predicted results for catch of UECVI pink salmon under the Base Case (Option 1) and Keogh and/or transplant option (Options 2, 3 and 4).

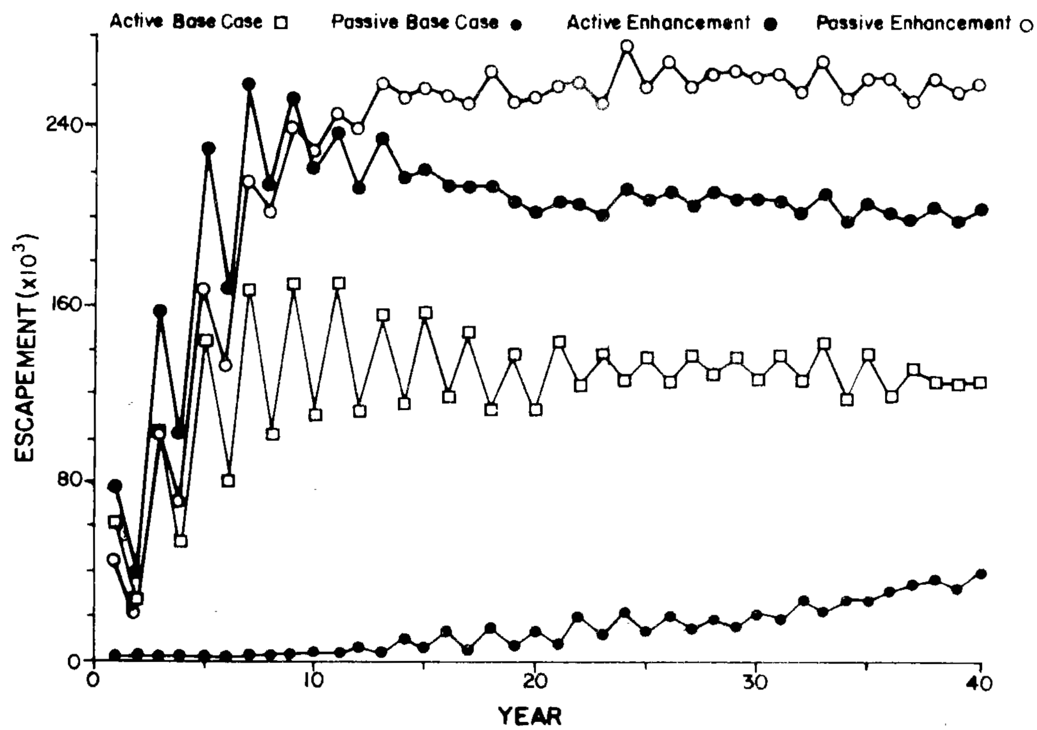

Figure IV-11. Predicted results for escapement of UECVI pink salmon under the Base Case (Option 1) and combined Keogh/Transplant Option (Option 4).