SELECTIVE FISHING IN THE CANADIAN PACIFIC COMMERCIAL SALMON FISHERY: AN ANALYSIS OF THE SELECTIVITY OF THE GILLNET SECTOR

by

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ABSTRACT

The Pacific Salmon Fishery is undergoing major changes that are affecting the way it is managed and operated. Issues of conservation, habitat degradation, poor ocean survival and overfishing have led to the introduction of new policy changes by Fisheries and Oceans Canada (F&O) focused on selective fishing.

The "Coho Crisis" of 1998 prompted the adoption of a fleet-wide selective fishing strategy aimed at protecting coho salmon that originated from Upper Thompson and Skeena rivers. Selective fishing refers to the harvesting of target salmon species while avoiding or releasing unharmed, non-target species that may be present in sufficient numbers. It can be practiced through a series of management changes, gear changes and fishing practice changes. The emphasis on selective fishing is re-shaping how fishing is conducted by commercial, recreational and First Nations fishers.

Each of these groups adopted new fishing practices and gear changes. Representatives from all three gear types of the commercial sector, which include seine, gillnet and troll vessels, have undergone a lot of experimentation with new selective fishing techniques or technologies (SFTs).

This research focuses on the efforts of the gillnet fleet. As a gear type, the gillnet fleet is the most numerous of the three, and as a fishing technique, they have been under a lot of scrutiny for their perceived lack of selectivity.

Using data from the 1998 commercial salmon fishery, it will be argued that the gillnet fleet sector was more effective than the other two commercial gear types at adapting to

the "Coho Crisis". It will also be argued that the success of the gillnet sector ought to be given serious consideration in any future management plans.

ACKNOWLEDGMENTS

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Jason A. Hosegood
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1.0 INTRODUCTION

The Pacific salmon fishery is undergoing significant changes in its management and operations. In 1998, sweeping new policy changes were introduced by Fisheries and Oceans Canada (F&O) in response to the decline of coho salmon (*Oncorynchus kisutch*) from the Thompson and Upper Skeena rivers. A conservation based strategy aimed at protecting endangered coho was initiated with the goal of having fishers from all sectors adopt new selective fishing techniques (SFTs) through gear and fishing modifications. It was also hoped that the introduction of SFTs would address the cumulative effects of overfishing and diminishing economic returns that had built-up over a period of several years.

While selective fishing experiments had been conducted on a modest scale for many of the previous years at various locations throughout the province, the 1998 fishing season was the first year in which a comprehensive and industry-wide selective fishing strategy was implemented. Prior to 1997, F&O scientists had noticed that the number of coho salmon originating from the upper Skeena and Thompson river had declined significantly and were in need of special attention if they were to be saved from the possible threat of biological extinction. This issue became known as the "Coho Crisis" and served as the inspiration behind the determined efforts to save these fish, which led to the selective fishing program.

The gillnet sector of the BC commercial fishing fleet contains the largest number of vessels and salmon fishing licenses. They have been perceived by critics as the least selective and therefore the most destructive fishing technique. Part of this stems from the technique of gillnets which entangle fish, often leading to mortality. Gillnets have also been referred to as 'walls/curtains of death' because of the perception that they are indiscriminate in what they capture, and the high mortality rates associated with them.[1]

However, the possibilities for improving selectivity in gillnet fishing are numerous. Besides improvements at the policy level, mechanisms for improving selectivity include the adoption of gear adjustments to net size, mesh size, and net material. The gillnet sector is the gear type upon which the focus of analysis in this research will be based.

Migratory fish, like salmon, are arguably amongst the most difficult and complex natural resources to manage. Their complicated life cycle make stock quantification tenuous, and allocation conflicts between the different interest groups is a continuing problem. Chapter two offers a geographic review of the salmon resource, harvesting locations and some of the complexities involved with management.

Many lifelong salmon fishers are finding it increasingly difficult to fish for a living. Biological changes have affected the amount of wild fish they can catch, and competition from aquaculture-raised salmon has reduced the price they can receive for them. There has also been a considerable increase in competition from other wild salmon producing areas, such as Alaska. These issues are outlined in chapter three.

Selective fishing is not new to the BC salmon fishery. In fact it might be argued that any form of management that aims to curb effort is an example of selective fishing. This includes input control methods, such as gear restrictions, or output control techniques, such as limiting fishing times and areas. Both of these management strategies, along with a comprehensive outline of how selective fishing is defined and practiced are presented in chapter four.

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[1]Beeby, Dean. 1994. "Curtains of death". *Halifax Chronicle Herald*, May 24, pg. A8.
Dugger, Albia. 1990. "Gillnet Fisheries: A Worldwide Concern", *Sea Frontiers*, Jan-Feb, pp. 20-21.

A series of policy initiatives in the form of discussion papers and announcements related to selective fishing were made by F&O in 1998. Some dealt with the direct implementation of selective fishing, while others outlined other conservation measures related to the endangered coho salmon. The first of these, in January, was the release of a paper outlining the desire for new selective fishing measures. Later announcements involved the "Coho Crisis" which served to dictate the sort of selective fishing measures that were needed in the short term.

In chapter five, some of the pivotal initiatives from 1998 will be outlined and analyzed. This will include a summary of the management changes, gear changes, and enforcement and monitoring practices that were adopted for the 1998 season. The information from these initiatives will serve as the context against which the data from chapter six will be analyzed.

In chapter six, the results of the 1998 commercial fishing season will be presented and analyzed. This will include a comparison of the performance of seine, troll and gillnet vessels. Factors that will be examined include: the number of fish captured, number of coho encounters, number of coho mortalities and an overall efficiency comparison whereby the number of coho mortalities and encounters as percentage of total catch will be calculated and compared. There will also be a catch value assessment to determine which gear type had the highest non-target total value and lowest coho value.

A presentation of the data will illustrate that, despite their notorious reputation, gillnet fishing vessels can be a highly selective fishing technique. Furthermore, the data will prove that compared to the other commercial gear types, the gillnet fishers were able to most effectively adapt to the "Coho Crisis" and made significant contributions towards achieving an Optimal Level of Selectivity (OLS) in the salmon fishery. The OLS concept will be defined in chapter six. A series of recommendations will then be put forth advocating the further development of the gillnet sector as a selective fishing technique.

2.0 BACKGROUND-RESOURCE MANAGEMENT COMPLEXITIES

2.1 The Salmon Resource

There are six salmon species indigenous to the rivers of BC. They are: pink (*Oncorynchus gorbuscha*), sockeye (*Oncorynchus nerka*), chinook (*Oncorynchus tschawytscha*), coho (*Oncorynchus kisutch*), chum (*Oncorynchus keta*) and steelhead (*Oncorynchus mykiss*). Salmon are anadromous fish species, which means they begin and end their life cycle in fresh water. In between, they are highly migratory and may swim thousands of miles into the open ocean before returning to their stream of origin where they spawn and die.

Each species is further divided into stocks, referring to their stream of origin, which are then further divided or classified as cohorts, or year-classes. Cohorts are simply age divisions of salmon from the same stock and species. Pink salmon live a fixed two year cycle, which means there are two cohorts in each stock. Chinook can live between two and seven years, so the number of cohorts is variable. Overall, there are approximately 9000 distinct salmon stocks in BC and the Yukon.[2]

2.2 The Geography Of Salmon

As noted, salmon are anadromous fish species, with an extensive range of habitat. Fish from BC waters swim away from their streams of origin and spend a varied length of time in the ocean. During that migration, most salmon swim an approximate route that is shaped like an oblong loop.[3] They begin by going in a northwest direction towards Alaska, then west towards the Alaskan peninsula before 'turning around' to the southwest and then east, and back towards the BC coast and their natal streams or streams of origin

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[2]Wood, Allen. Former Director of Economics and Planning at F&O Pacific Branch, personal communication (pers. com.) Aug 9, 1999.

[3]Some Chinook stocks are known to remain within BC waters (Strait of Georgia) during their entire life cycle.

(see fig. #1).[4] Because of the length of their life-cycle, some swim the loop more than once. The stocks do not swim independently, but are mixed together for the duration of their time at sea. Only when fish head for different river systems, do they begin to separate and swim to their different tributaries of origin. The degree of mix diminishes as the fish swim closer to their natal streams.

The range of spawning habitat varies considerably because natal streams are found all throughout the province. Some are close to the ocean while others extend several hundred miles inland. There are several entrance points along the BC coast where salmon enter on the final leg of their life cycle. While there are hundreds of watersheds (or river systems) in BC, the two most important salmon producing systems are the Skeena river watershed, and the Fraser river watershed (see figures #2 and #3) the latter is the single largest wild salmon producing river system in the world. Each of these systems is made up of large and small tributaries and lakes which serve as the spawning and rearing grounds for salmon.

Each species follows the same general life-cycle pattern which includes: hatching from eggs in a fresh water tributary or lake as alevin and progressing through the stages of growth, from fry to smolt and then full-sized adult (which occurs after swimming out to the Pacific ocean); returning to the natal rivers to spawn and, with the exception of steelhead, die. However, there are some specific differences in size, freshwater residence time, month of ocean entry, ocean residency time and range and spawning habitat range.[5] There are also individual differences within each species.[6]

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[4]Fisheries and Oceans Canada, (F&O) 1998. 'The Incredible Salmonids', produced by Glover Business Communications with contributions by: Groot, C, et al.
[5]Pearcy, William G. 1992. *Ocean Ecology of North Pacific Salmonids*, table 1.3, pg. 12, Washington: University Of Washington Press.
[6]Not all stocks of each species conform to the same pattern. See: Pearcy for specific species anomalies.

Figure 1 Migratory Paths of Salmon

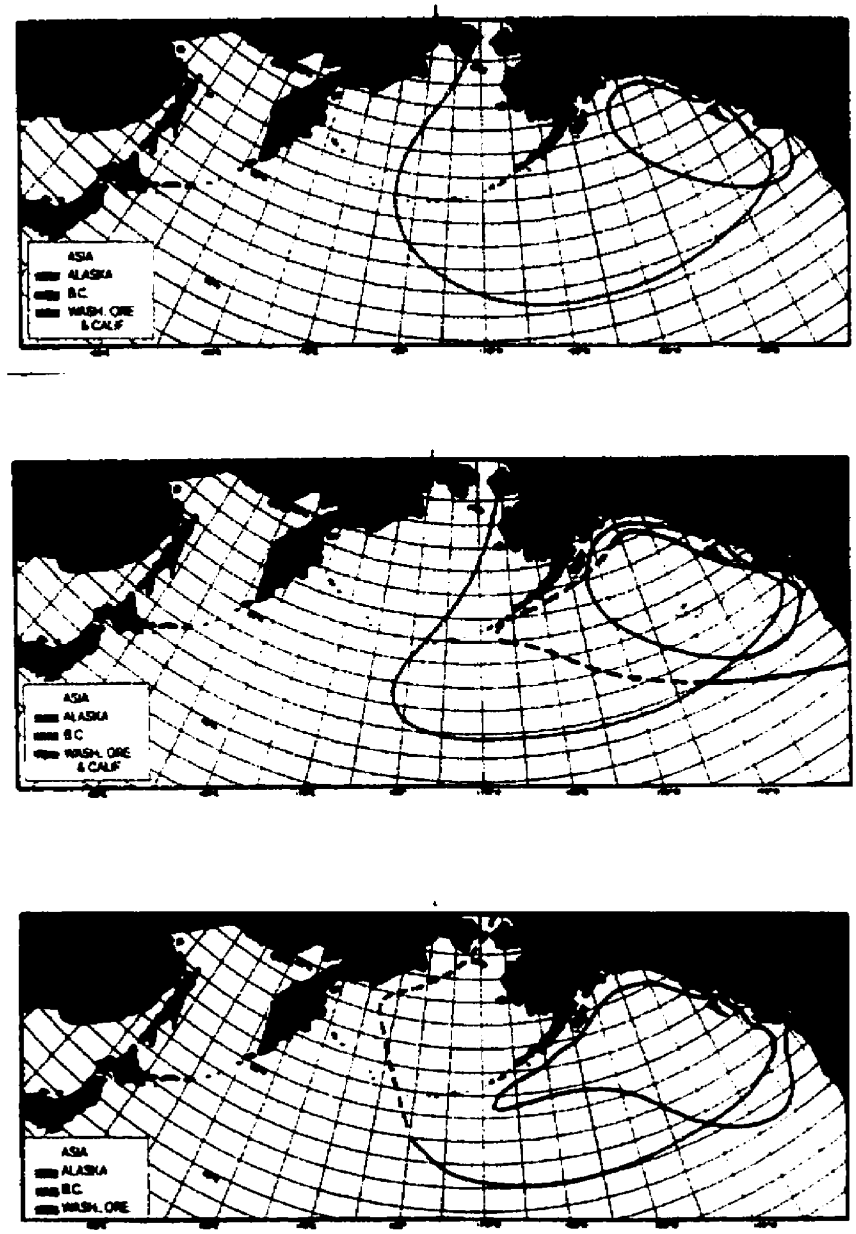
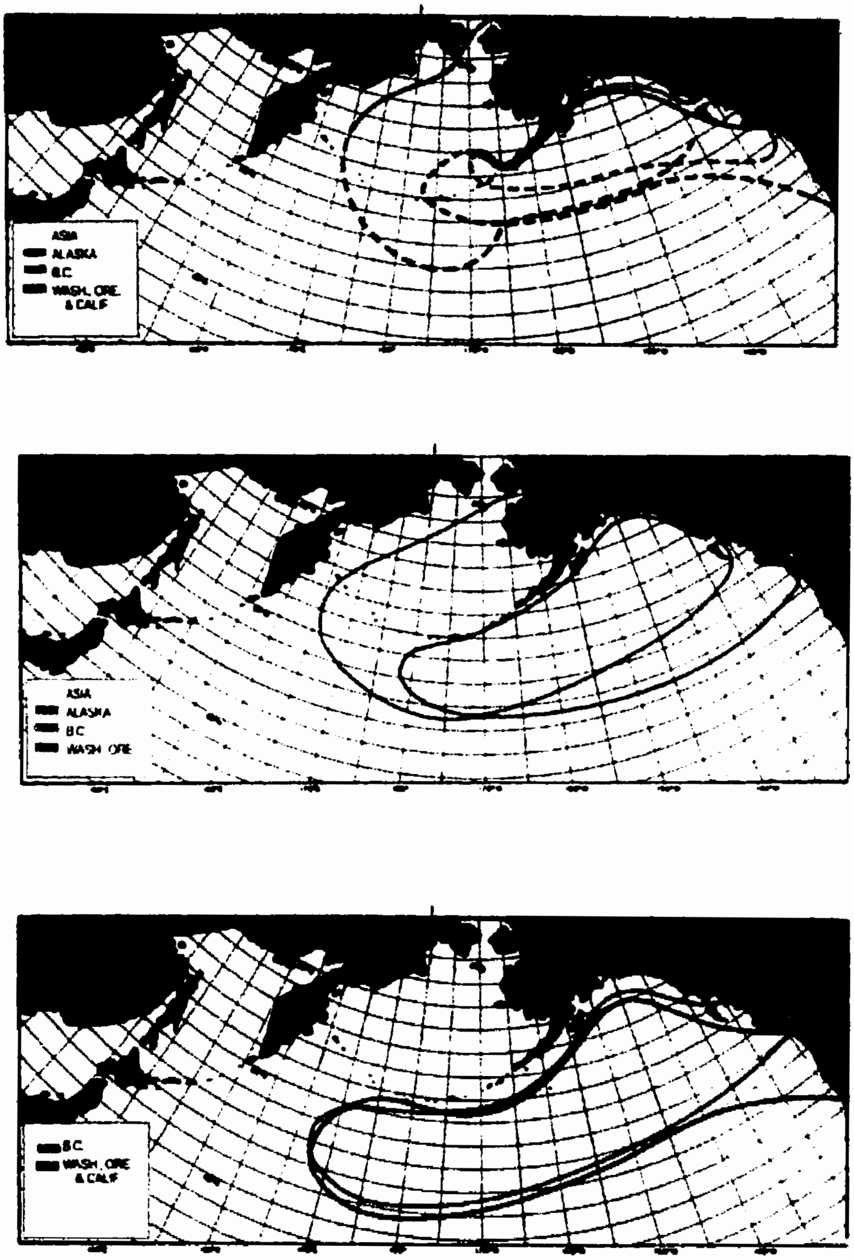
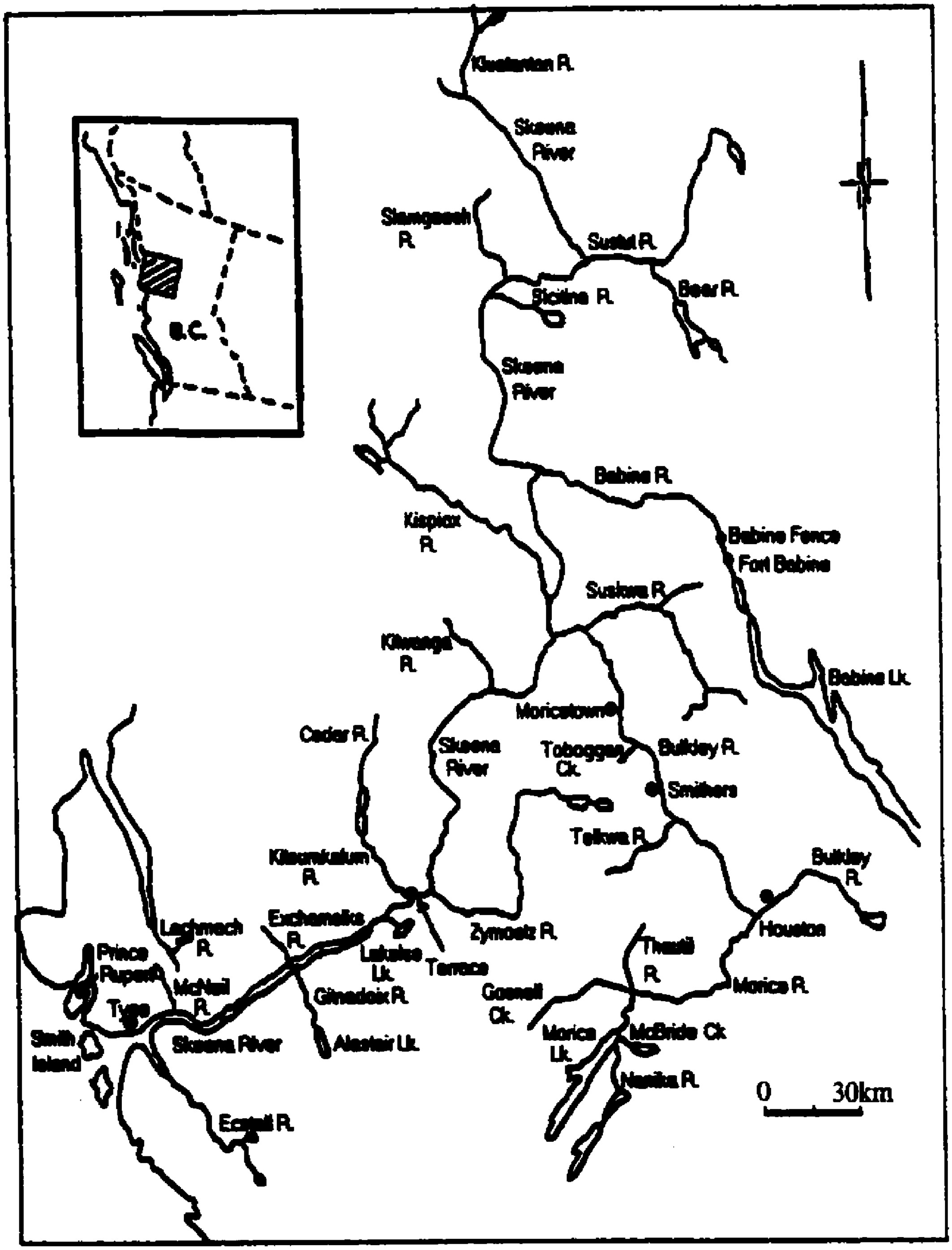


Figure 1 Continued



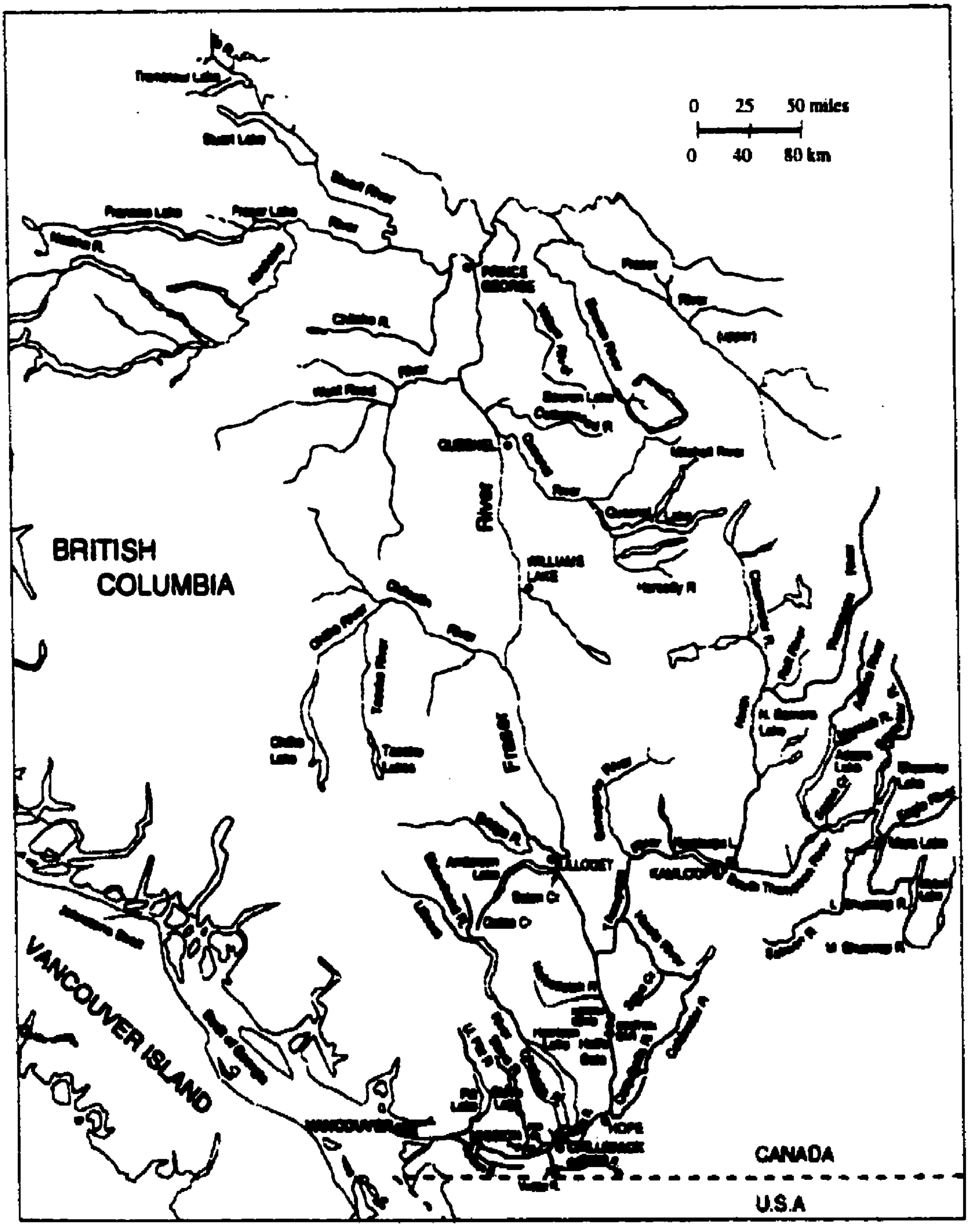
Source: Fisheries and Oceans (F&O). 1998. *The Incredible Salmonids*. pp. 2-7 Artwork by: Lynde, Peter from Glover Business Communications, Vancouver BC.

Figure 2 Skeena River Watershed



Source: *Speaking for the Salmon Workshop Record*. p. 18. Continuing Studies in Science, Simon Fraser University, June 1998.

Figure 3 Fraser River Watershed



Source: *Speaking for the Salmon Workshop Record.* p. 13. Continuing Studies in Science, Simon Fraser University, June 1998.

2.2.1 Pink Salmon

With an average full grown weight between 1.4 and 2.3 kilograms (kg), Pink salmon are the smallest of the six species. After emerging from their birth place as alevin in the April-May, they immediately begin to migrate downstream towards the ocean. This lasts for either a few days or weeks, depending on how far they have to travel. Pink salmon then enter the ocean during May-June where they swim a single 'loop', which takes approximately 1.5 years before re-entering the estuarine environment during September-October towards their final spawning location.[7] The range of ocean habitat is smaller for pinks because of their short life cycle. It typically extends west to 148 degrees west (W) longitude and north-south, between 59 degrees and 38 degrees north (N) latitude meaning that they do not swim as far west as the Alaskan peninsula. The range of spawning habitat tends to be closer to the ocean than the other species, extending from the intertidal zone near the estuarine environment, to large and small streams located further inland.[8]

2.2.2 Coho Salmon

The average weight of a mature coho is between 2.7 and 5.4 kg. After hatching in April, they remain in the freshwater environment for between 1 and 2 years before entering the ocean between May-June where they swim a single 'loop' for 0.5 and 1.5 years before re-entering the river system between September and November.[9] They remain within 40km of the coast during their initial swim north towards Alaska before moving northwest to approximately 59 degrees N latitude, and 154 degrees W longitude. They then 'turn around' and swim as far south as 44 degrees N latitude. During the final leg of their ocean journey, they swim back north and remain within 160 km of the coast. Most return

[7]Hart, J.L. 1973. *Pacific Fishes of Canada*, pp. 108-130, Fisheries Research Board of Canada, St. Andrews, N.B.
[8]F&O, ibid. pg. 4.
[9]While the specifics mentioned are from Pearcy, ibid. and Groot ibid., additional details about the characteristics of salmon can also be found in Hart. (see footnote #7).

as mature three year old adults, while some return as two year old jacks (or juveniles).[10] Their spawning habitat tends to be located in small tributaries and small coastal streams.

2.2.3 Sockeye Salmon

Sockeye range in size between 2.2 and 3.1 kg. They reside in the freshwater for up two years before entering the ocean in the months of May or June. They return to the river entrance between May and October as either three, four or five year old fish after spending two or three winters at sea. They reach their spawning grounds between August and October.[11] Their ocean range of habitat extends west to approximately 178 degrees E longitude, and between 59 and 40 degrees N latitude. Their range of spawning habitat includes streams that are usually connected to lakes located upstream, meaning that they often must swim a considerable length inland before spawning.

2.2.4 Chum Salmon

Chum salmon between 4 and 4.5 kg in size. They remain in freshwater for only a few days or weeks before beginning their seaward journey during March-June. Their duration at sea ranges from 2 and 4 years, after which they re-enter the river during the months of October and November. Ocean habitat range for chum can extend west to 168 degrees W longitude, and between 42 and 59 degrees N latitude.

2.2.5 Chinook Salmon

Chinook are the largest of the six species with some individuals getting up to 55 kg in size. The average size however, is between 6.75 and 25 kg. After hatching, they spend varying lengths of time in freshwater, from a few weeks to up to a year or more. These variations carry over to their entrance time to the ocean which spans over six months

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[10]Groot, ibid. pg. 5.
[11]Groot, ibid. pg. 3.

from May-October. Their subsequent return to the river also extends from spring to winter. Chinook are known to swim northwest beyond the Alaskan peninsula (170 degrees W longitude) and have been found distributed between 41 to 60 degrees N latitude. The length of time spent in the ocean is from 0.5 and 6 years, and the spawning range is primarily limited to large rivers.

2.2.6 Steelhead

Steelhead are the only species that have the ability to spawn more than once. Between six and thirty percent of adult steelhead return to spawn a second time. The average size of mature steelhead is between 3.5 and 4.0 kg, but they can reach sizes of up to 16 kg.[12] Steelhead spawn in the winter or spring in both large and small streams. They can enter the river several weeks or months prior to spawning, or they can deposit their eggs almost immediately upon arrival. After hatching, steelhead can remain in the freshwater environment for between 1 and 3 years before traveling to the ocean as smolts in the spring. They remain in the ocean for two or more years before returning to their natal streams.

2.3 Management Responsibilities

The management responsibilities F&O has over salmon include: the conservation of the stocks by assuring adequate escapement, the allocation of surplus fish to the major stakeholders, and the enforcement of fisheries regulations and management plans.

Adequate escapement refers to the number of fish that are required to maintain a specific

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[12]Hart, ibid. The F&O website also has a detailed summary of the biology of each salmon species. See: <www.pac.dfo-mpo.gc.ca>

stock population. This is achieved by allowing a certain percentage of salmon to return to their streams of origin. The percentage required to insure the survival of the stock varies among stocks. The surplus fish are those left over after the appropriate spawning population species is assured and thus permitted for harvest. After the conservation needs are met, the surplus is quantified and a total allowable catch (TAC) is established for each species. The TAC is then divided among three major groups by priority: first priority is for First Nations, and the remainder is shared by commercial and recreational fishers.

Escapement requirements are determined by examining the previous year's catch statistics, and by conducting a series of test fisheries and fish counts which take place prior to fishing, and then continue throughout the season. Fish counts are conducted at the entrances to major rivers or at pre-determined terminal river locations on an annual basis. Test fisheries are carried out in the ocean environment by a small number of commercial vessels. The size of the year-class, or cohort, is also taken into consideration. The numbers of fish that return and the amount of eggs that are deposited on their spawning grounds will fluctuate each year; hence the year-classes are categorized as either weak or strong in relation to the capacity of their spawning grounds. A weak stock would contain lower numbers while a strong stock would be composed of a larger number of fish. Escapement levels and TAC are therefore adjusted according to the size of the cohort.

The amount of fish that is appropriated by F&O to be caught from a stock is stated as a percentage and is called the exploitation rate. For example, the exploitation rate set for a stock of sockeye may be 75%, meaning that 25% of the stock is needed for escapement and 75% can be captured. Depending on target species and fishing location, harvesting takes place from early March through to the end of November because different stocks may return at different times. However, the time allowed for fishing is not continuous during this period. Rather, it occurs as a series of time and area openings and closures which are overseen by F&O personnel, who use the information they gather from ongoing test fisheries to determine when, where and how long a specific opening can take place.

Enforcement and monitoring is accomplished through the utilization of 125 full-time and 50 seasonal fisheries officers[13] whose responsibilities range from ensuring the compliance of time and area mechanisms, to the enforcement of catch limits. Some of the specific duties of enforcement officers include:

- maintaining an enforcement presence at fishery openings, checking vessels to ensure compliance, issuing warnings, tickets and appearance notices to violators;
- collecting evidence and preparing information with respect to changes;
- recommending, coordinating and forwarding changes to regulations;
- advising on enforcement requirements;
- monitoring and assessing enforcement activities;
- training of fisheries officers; and
- coordinating with other enforcement agencies.[14]

Enforcement officers also work in conjunction with community-based independent monitors (who may be local citizens and/or consulting firm personnel hired on a temporary or seasonal basis), who either observe individual vessels, or work as part of a dockside monitoring program, where they observe the unloading of catch. Additional components of monitoring and enforcement include overflights by charter aircraft, and a Charter Patrol Program which is used for a variety of purposes, including estimating

[13]In 1998, there were 125 enforcement officers, and in 1999, an additional 20 were added.
[14]obtained from F&O website: <www.pac.dfo-mpo.gc.ca/enforcement>

catches, direct observation of fleet activities, liasing with fishers and inspecting salmon streams and habitat.[15]

2.4 The Geography of Management

The jurisdiction of F&O with respect to Pacific salmon management encompasses the entire BC coastline, (which- measured north to south- is over 7000 km long[16]) and extends throughout the Exclusive Economic Zone (EEZ).[17] Their jurisdiction also includes the approximately 1,500 BC salmon bearing streams located within the province.

For each gear type, the coast is divided into a number of salmon fishing areas, and each is assigned a letter (see fig. #4). For Seine vessels, the coast is divided into two zones, designated A and B. Zone A extends south from the Alaska-BC border in Dixon Entrance to the 'middle' of the BC coast, just north of Vancouver Island. Zone B extends south from that point to Juan De Fuca Strait.

For Troll and Gillnet vessels, the coast is divided into three salmon fishing zones, (C, D and E for Gillnet, and F, G, and H for Troll). Zones C and F encompass an area similar to Zone A. For Troll vessels, zone G extends south and west from that point, and encompasses the entire west coast of Vancouver Island and part of the western entrance to Juan De Fuca Strait. Zone H includes the east coast of Vancouver Island from Johnstone Strait in the north, to the eastern section of Juan De Fuca Strait in the south.

The coast is also divided into a set of management or fishing zone areas (numbered 1-29 and 101-111; 121,123-127; 130 and 142 see fig. #5) Each fishing zone can be further

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[15]ibid.

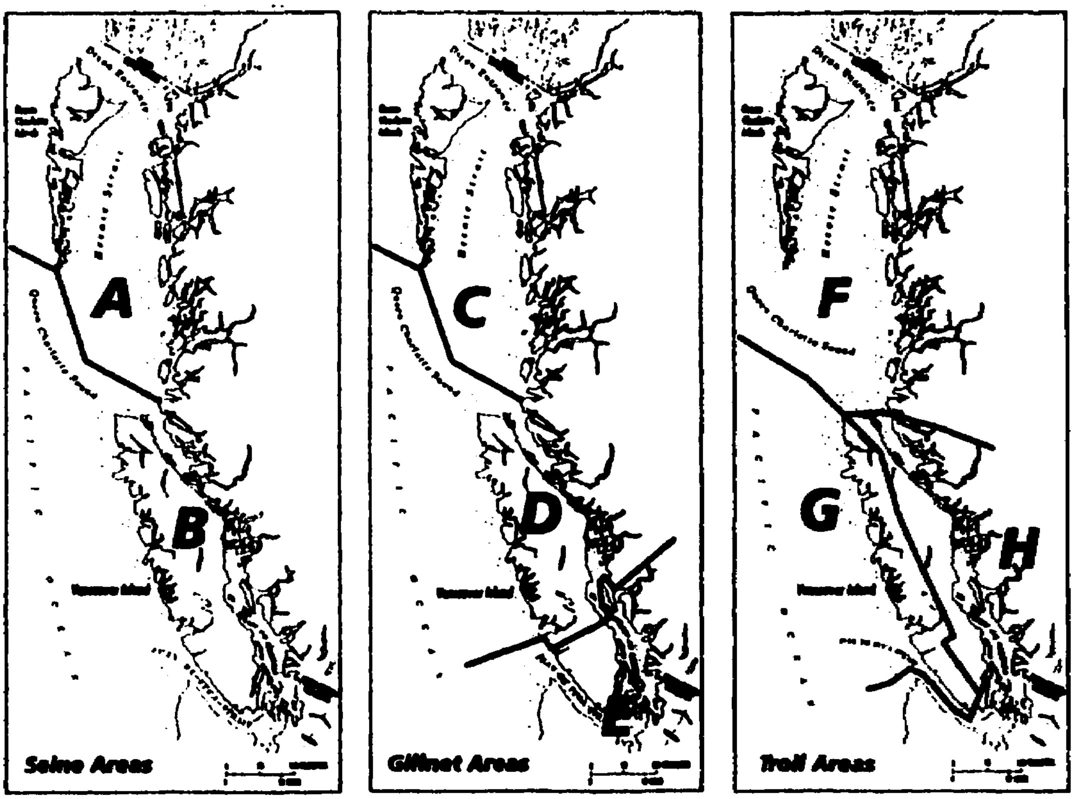
[16]Zuehlke, Mark 1995. *The B.C. Fact Book.* Vancouver: Whitecap Books, pp. 50 & 207.

[17]In 1977, Canada claimed control of coastal waters up to 200 miles offshore. This declaration was authorized and subsequently adopted by many other nations at the United Nations Conference on the Law of the Sea in 1982. The area of control became known as the Exclusive Economic Zone (EEZ).

sub-divided into an area covering only a few square kilometres.[18]

According to area divisions, the break down of gillnet fishing areas is as follows (from North to South): Gillnet Area C includes statistical areas numbered 1-10, (9,10) Gillnet Area D includes statistical areas numbered 11,12,13,14,15, and 23, 24, 25, 26, and 27. Gillnet Area E includes statistical areas numbered 16, 17, 18, 19, 20, 21, 22, 28, 29 and 121.[19]

Figure 4 Fishing Areas by Gear Type



Source: ARA Consulting Group Inc. 1996 *Fishing for Answers: Coastal Communities and the BC Salmon Fishery: Final Report*, section 7.2. Vancouver BC.

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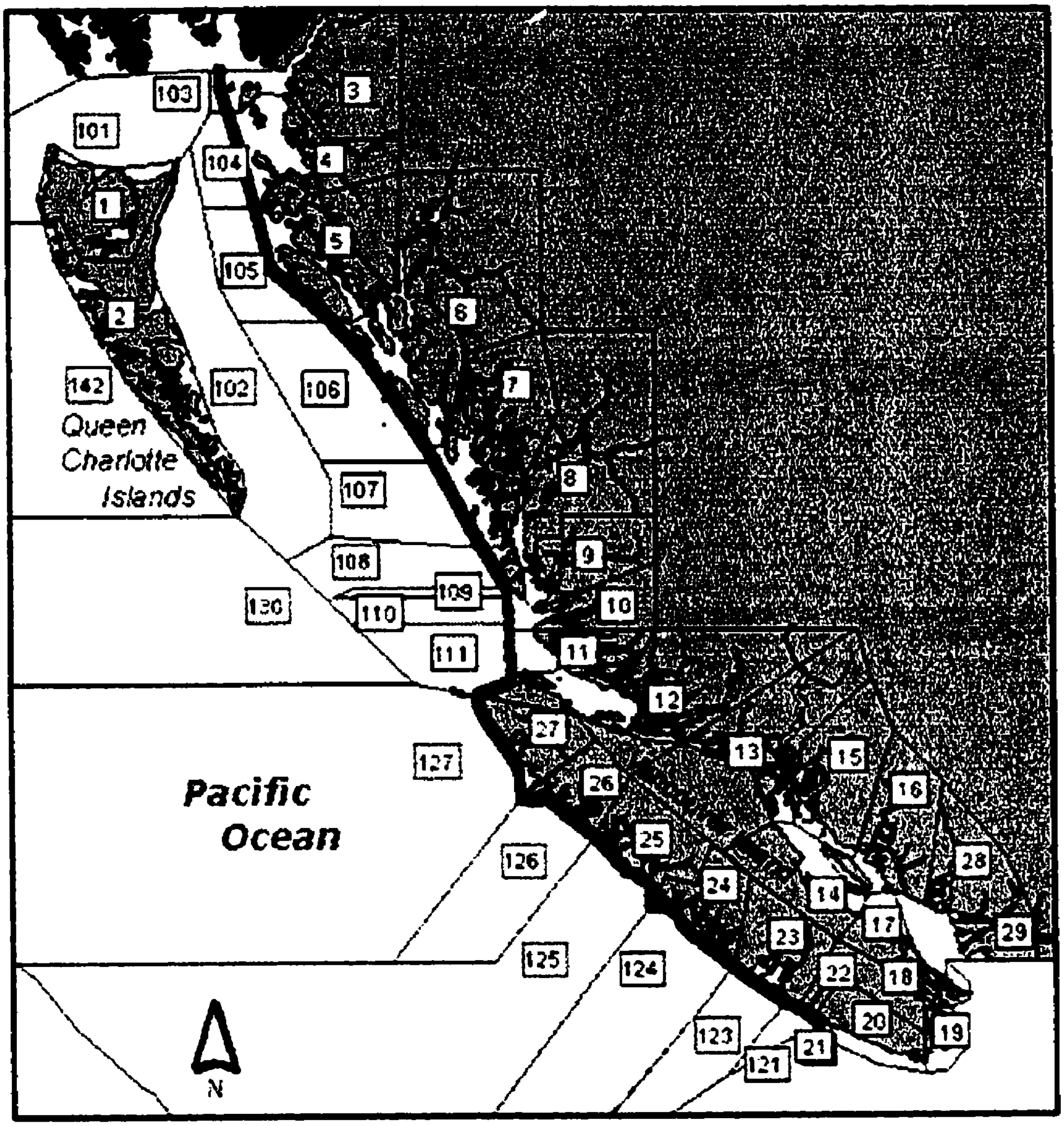
[18]The Fisheries and Oceans website: <www.pac.dfo-mpo.gc.ca/ops/fm/mplans/plans00/NSalm_ap6.PDF> includes a comprehensive map of each of the fishing zone areas for all three of the commercial gear types.
[19]The underlined numbers are areas where there were no fishery openings for the gillnet sector during the 1998 season.

Figure 5 Management Areas



Source: F&O website address: <www.pac.dfo-mpo.gc.ca/ops/fm/Areas/areamap.htm>

2.5 The Geography of Harvesting

The locations of harvest varies according to stakeholder and gear type. It is conventionally understood that salmon fishing can be categorized as either terminal or non-terminal. Terminal fishing refers to fishing that occurs upstream, away from the intertidal zone which includes the area around the river entrance. Most terminal fishing is done by First Nations groups who often have resource extraction rights to land that straddles the river.

Non-terminal fishing zones encompass all other areas, and extend from the intertidal zones out to the ocean. The commercial fishing industry is generally categorized as a non-terminal fishery because the three vessel types primarily harvest fish in these areas. More geographic specifics of each commercial vessel type are outlined in chapter four, however figure #6 does offer a general indication of where some major sockeye salmon harvesting areas are located.

2.6 Licensing Regulations

Beginning in 1969, F&O categorized each fishing licence by letter, with the earliest being category A for salmon fishers, B for fishers of salmon and all other species, and C licence for fishers of all non-salmon species.[20] While this system of categorization did not make a distinction between the gear types, it did distinguish between Native and Non-native fishers. It also distinguished between individual and communal Aboriginal fishers, whereby an 'F' communal licence was given to a specific Aboriginal community for ceremonial and fishing for food purposes, later guaranteed by the Canadian Constitution.

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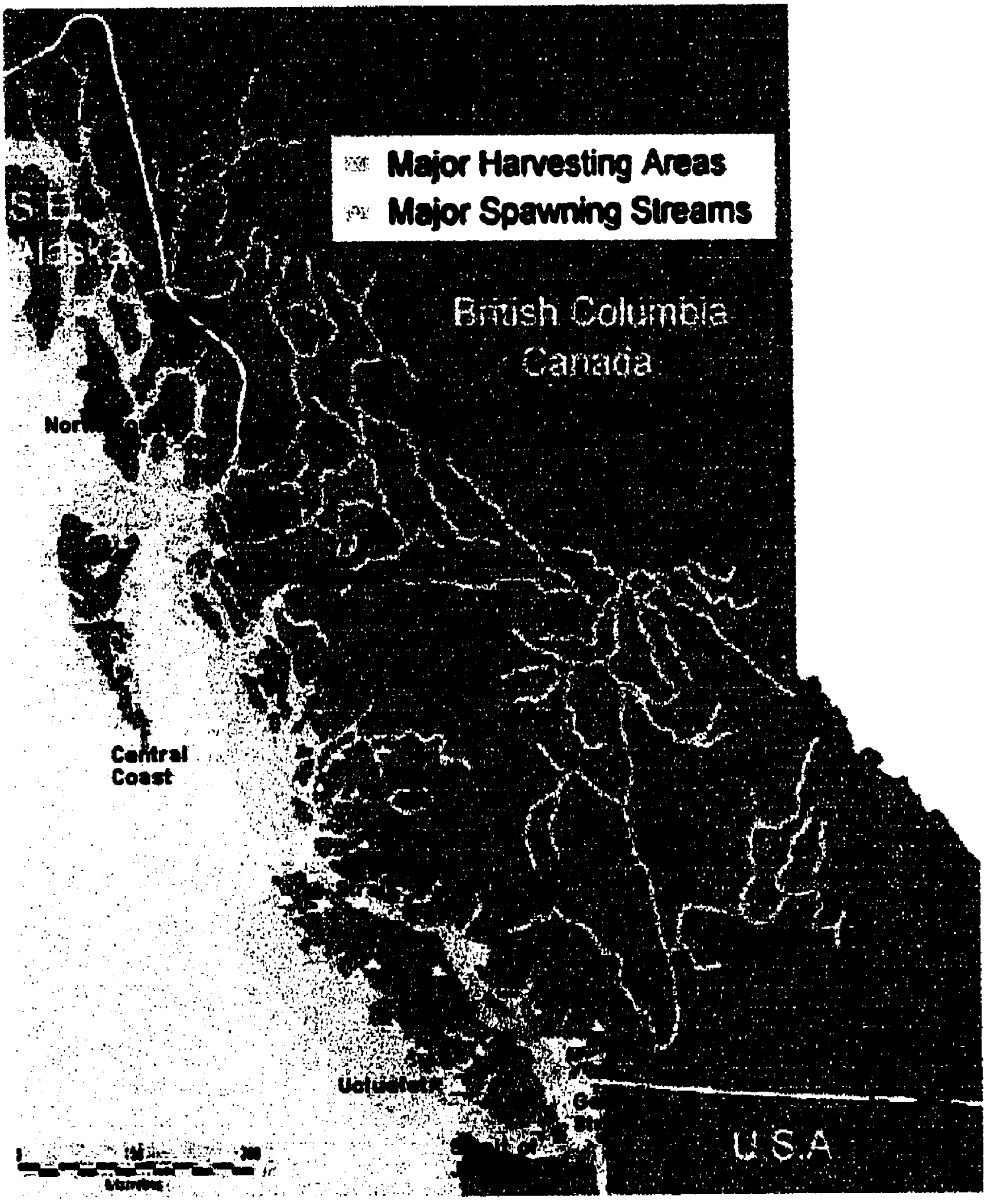
[20]Cruickshank, Don. 'A Commission of Inquiry into Licensing and Related Policies of the Department of Fisheries and Oceans- The Fisherman's Report', pp. 60-61, 2nd Ed, United Fishermen and Allied Workers' Union, Vancouver, BC, 1995.

Figure 6 Major Harvesting Areas for Sockeye



Source: Canadian Fishing Company website address: <www.canfisco.com/images/bc_map2.jpg>

An 'N' category licence is a second type of licence issued to Aboriginal fishing companies located in the north, and was also used for ceremonial and fishing for food purposes. Licence categorization has since changed to become more specific according to gear type, species fished and location. Non-aboriginal salmon fishing by gillnet is licenced as AG, by seine AS, and by troll AT. Aboriginal fishing licenses include: FAG, referring to salmon fishing by gillnet, FAS, which refers to salmon fishing by seine; and FAT, which refers to salmon fishing by troll.[21]

The fees paid also vary, and are based on vessel type, length and tonnage. While vessels from the three sectors may be given an A licence, the fee that each pays does vary. For example, the owner/operator of a vessel that is less than thirty feet in length pays a $430 fee, while a vessel that is over thirty feet but less than fifteen net registered tons pays approximately $710. These fees would presumably cover most gillnet and troll vessels because their size fits into these categories.

Seine vessels pay $3,880 no matter what their size, as does any vessel that is over fifteen net registered tons in weight. Native fishers pay lower licence fees for their vessels, and are categorized as either A-I, N or B licenses depending on the gear used. The cost for each of these is $20. Finally, there is a category F licence which is given as an Aboriginal communal fishing licence, defined in the previous paragraph. All vessels, no matter what type, must also pay a $10 Registration of Vessel fee (Commercial Fishing Vessel or CFV fee). [22]

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[21]F&O website: <www-ops2.pac.dfo-mpo.gc.ca/ops/vrndirectory/PrefixDsc.cfm>
[22]Cruickshank, ibid. These were the licensing costs in 1995. As part of the $400 million restructuring program, these fees were expected to be reduced. The vessel fees given reflect the fees charged for the 1998 season. In 1997, the fees were substantially higher; 'short' gillnet and troll vessels paid $730, 'long' gillnet and troll vessels paid $1,390 and purse seine vessels paid $5,750. See press release NR-PR-98-08E from Feb 19, 1998 found at the F&O website:
<www-comm.pac.dfo-mpo.gc.ca/english/release/p-releas/index/pr98.htm>

With the new area management changes that were implemented in 1996, it is possible for a seine vessel operator/owner to pay over $7500 in fees (one licence for each of the two areas assigned to Seine vessels in addition to the $10 CFV fee), and for Gillnet and Troll vessels to pay between $1300 and $2140 ($430 to $710 for each zone depending on vessel size, plus the $10 CFV fee). The major difference in fees paid between the seine vessels and the other two can be attributed to their size difference because seine vessels are significantly larger in size and catch capacity.

2.7 Management Challenges

Ensuring adequate conservation and surplus stock allocation is challenging for several reasons. Salmon inhabit an underwater environment and are highly migratory. Thus keeping track of the biomass or number of salmon is difficult. As mentioned, there are over 9000 distinct stocks from BC and the Yukon. Ideally, each should be managed as specifically as possible, however the reality is that the largest salmon producing rivers are given the bulk of attention. F&O does not have the resources to keep track of the status of every one of the 9000 stocks.[23]

The mixed nature of stocks make customized management difficult. The largest percentage of salmon are captured while the salmon stocks are in a highly mixed state, usually several days or even weeks before the fish re-enter the rivers and separate. The risk of incidental bycatch therefore is very high.[24]

Weak non-target stocks are often mixed with strong target stocks, and F&O officials must

[23]Wood, Allen. pers. com.

[24]The average total catch taken by the commercial fleet is around 90% of the biomass. See: Coastal Community Network. 1996. *Coastal Communities: Building the Future* Simon Fraser University: Press.

determine how best to protect weaker stocks while still allowing commercial fishing opportunities to continue. If the risk to weak stocks is perceived to be great, the fishery may be closed. If and when this occurs, groups that have not caught their allocation of the TAC may lose it completely for the season. The groups which are most adversely affected by a closure depends on when the closure occurs.

If the fishery is closed during the First Nations only fishery time, then they will be the only group who loses some of their fishing opportunities (although it does not affect their fish for food allocation) because commercial fishers will have already completed their fishing. If the fishery is closed during a commercial opening, then all groups that are expecting an opportunity to fish will be adversely affected.

Another management complexity is that the priority of surplus allocation is in reverse order of when the groups harvest the fish geographically. After conservation needs are met, priority allocation goes to First Nations for food and ceremonial purposes. They typically harvest at in-river locations, well after the commercial and recreational fishers have had access to the stocks in the ocean or near the river mouths. As Dr. Peter Pearse stated it in 1992: "meeting the allocation needs of these groups represents somewhat of a paradox for the DFO."[25] Based on these facts, it can be stated that the salmon fishery is not an equal opportunity resource.

Enforcement of fishing practices, gear and fishing time and areas is a significant challenge. As noted, F&O personnel establish a TAC for the stakeholders. Fishers are then expected to adhere to those harvest levels using gear that is approved in the proper areas. However, incidences of illegal fishing and poaching can occur because the size of

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[25]F&O Report by: Pearse, Peter. "Managing Salmon in the Fraser-Report to the Ministry of Fisheries and Oceans on the Fraser River Salmon Investigation", pg. 6. Vancouver, BC, 1992.

the coast, number of vessels and the number of fisheries enforcement officers makes 100% monitoring coverage virtually impossible.[26]

In the case of salmon, illegal fishing refers to the capture of fish outside of allowable harvest areas and times, and poaching refers to the harvesting of fish without authorization. If an opening is allowed for only twelve hours in one specific area, and a vessel either harvests outside of that time or area and captures fish, then it would be illegal fishing. The undetected private sale of fish refers to fish that are caught and not officially accounted for prior to sale. A fisher might practice poaching by capturing fish and selling them before they are counted. These problems interfere with the efforts of F&O staff to attain accurate stock size information because catch statistics do not include dead biomass or fish sold illegally. A record of these 'phantom fish' is therefore never kept. It is not known whether F&O has a model in place to account for bycatch loss.

[26]As noted earlier, there are 125 full-time and 50 seasonal enforcement officers in the Pacific region. They are responsible for overseeing all commercial, recreational and First Nations fisheries.

3.0 THE PROBLEMS

3.1 Missing Fish and Endangered Coho

On three separate occasions during the 1990s, fish have appeared to go missing. First in 1992, it was believed that over 480,000 sockeye bound for the Fraser river 'went missing'.[27] Second in 1994, when spawning sockeye escapement estimates, plus aboriginal catch estimates for Early Stuart (the Stuart river is a tributary of the Fraser watershed), Early Summer and Summer runs on the Fraser were 1.3 million lower than the number anticipated,[28] and then again in 1997, when it was discovered that the number of coho from the Upper Skeena and Upper Thompson rivers had declined to the point of being endangered (the Thompson river is a tributary of the Fraser river watershed).[29]

After the1992 experience, F&O commissioned an independent advisor, Dr. Peter Pearse, to investigate and make recommendations for improvements in management, and following the summer of 1994, the Minister of Fisheries and Oceans established the Fraser River Sockeye Public Review Board, chaired by the Honourable John Fraser, to review the causes of the 1.3 million shortfall in 1994.

Each review resulted in suggestions for improvements in management, including a modest amount of selective fishing experimentation. This set the stage for 1998, when the discovery of endangered coho stocks solidified a commitment from F&O to initiate an industry-wide selective fishing strategy.

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[27]F&O Report by Pearse, ibid. pg. 21.
[28]F&O Report by: Fraser River Sockeye Public Review Board. 1995. "Fraser River Sockeye 1994: Problems and Discrepancies".
[29]Kadowaki, Ron. 1998. 'Speaking for the Salmon-Workshop Record', pp. 10-11, Simon Fraser University.

3.1.1 Coho Salmon Stock Declines

Prior to 1997, scientific studies done by the Pacific Stock Assessment Review Committee (PSARC) commissioned by F&O, indicated that: "Upper Skeena and Thompson river coho stock aggregates are extremely depressed...(and)...will continue to decline in the absence of any fishing mortality under current marine survival conditions, and that some individual spawning populations are at risk of biological extinction."[30] The same study stated that research had shown that most BC coho salmon stocks had been in decline for a number of years, and that escapement to spawning grounds was particularly low in 1997. Because coho is the primary target fish of the recreational fishery, it is believed that overfishing by this sector was one of the major reasons why coho have diminished so substantially.[31]

There are a number of indicators which offer an idea of the historical aggregate status of all salmon species, including coho. These include escapement estimates based on test fisheries and fish counts. Data from test fisheries is presented as an index. One such escapement index, known as the 'Adjusted Skeena Test Fishery Index' (ASTFI) which is done annually from late June to August 25 at Tyee, is located at the mouth of the Skeena. The ASTFI began in 1955 and continues to the present.[32] It is conducted by gillnet vessels and was developed to provide daily estimates of sockeye and pink escapements through the commercial fishery. The numbers represent the average number of fish that are caught per hour during the test fishery. While it does not measure the daily estimates of other species such as coho, the relative abundance and timing of this and other species is determined by comparing the calculated indices for a given year to those recorded in

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[30]F&O: "Science Supports a Conservation-based Fishery" pg. 1, June 1998. Reprinted from F&O website: <www.pac.dfo-mpo.gc.ca/english/release/bckgrnd/1998/science.htm>
[31]Glavin, Terry. 1998. "A fish tale: featuring Glen Clark, David Anderson, a misinformed public, and too few coho" *Canadian Dimension*, v.32(6), pp. 13-17.
[32]Holtby, Blair, F&O North Coast Salmon Stock Assessment, Pacific Biological Station, Nanaimo, BC, Presentation Notes on the Status of Coho Salmon, March 26, 1998.

previous years.[33]

The ASTFI chart (see fig. #7) indicates there was a significant decline in 1972 season followed by what was referred to as '...a period of relative stability at the lower level, which persisted until 1997' followed by '...the unprecedented low value in 1997.'

The second indicator, fish counting, is where adult salmon are counted upon their return to natal streams. A second chart (see fig. #8) showing the Babine fence count, portrays the historical number of coho that have passed through the fence at the outlet of Babine lake, located in the Skeena river. In the summary that accompanied the chart, it was noted that it was only a partial count because the fence was operated to count sockeye which are through by early September. As indicated, the numbers continually declined from the early 1970s to the present.

Other mechanisms that are used to calculate abundance include: Juvenile densities in the Skeena river drainage, Fishery officer visual counts in the Skeena, Skeena escapement trends, Standardized Fisheries Officer Escapement Estimates, and Ocean Survival rates for wild coho from two Skeena tributaries. Data from all of these indicate the same pattern of decline.

In the 'Speaking for the Salmon' workshop proceedings from June 1998, F&O Biologist, Ron Kadowaki emphasized their research findings in his report on the status of southern BC Coho stocks. He first stated that the decline in southern BC coho stocks had led the DFO to reduce exploitation rates, from 70-80% between 1977 and 1994, to 20-25% by 1997. Kadowaki noted that there had been a decrease in catch as a result of the decreased exploitation rates and stock abundance, but that survival and escapement rates had not

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[33]F&O website: <www.pac.dfo-mpo.gc.ca/ops/northfm/skeena/tyeetest.htm>

recovered. Instead he said that they had continued to fall since 1994, with an all time low being reached in 1997. Historically, this species has had an ocean survival rate of eight to fifteen percent. In recent years, however, that rate has dropped to below five percent. The marine survival of Georgia Strait wild coho stocks went down from 12-13% in the early 1980s to less than 5% in recent years. Inside Georgia Strait rearing stocks had a variable abundance from 1984 to 1992, but had begun to show a dramatic decline in abundance from 1993 to 1997.[34]

During the same workshop, F&O Research Scientist, Jim Irvine outlined the status of the Thompson River Coho. He pointed out that according to data that had been compiled during the past 22 years, escapements from both the North and South Thompson systems were moderate from the mid-70s to the early 80s, relatively high in the mid-80s but since then had shown a persistent and steep decline. In 1996, there were apparently no adult coho observed in nearly half of all the South Thompson streams inspected.[35]

In addition to the two major coho runs from the upper Skeena and Thompson rivers being at risk of extinction, the Strait of Georgia was also noted to be at risk. It was predicted that coho returns from each of those three groups, (as well as others from around the province) were expected to remain 'very low' at least through 2001.[36]

[34]Kadowaki, Ron. ibid.
[35]Irvine, Jim. 'Speaking for the Salmon-Workshop Record', ibid.
[36]see F&O website: <www-comm.pac.dfo-mpo.gc.ca/english/release/p-releas/index/pr98.htm>

Figure 7 Adjusted Skeena Test Fishery Index

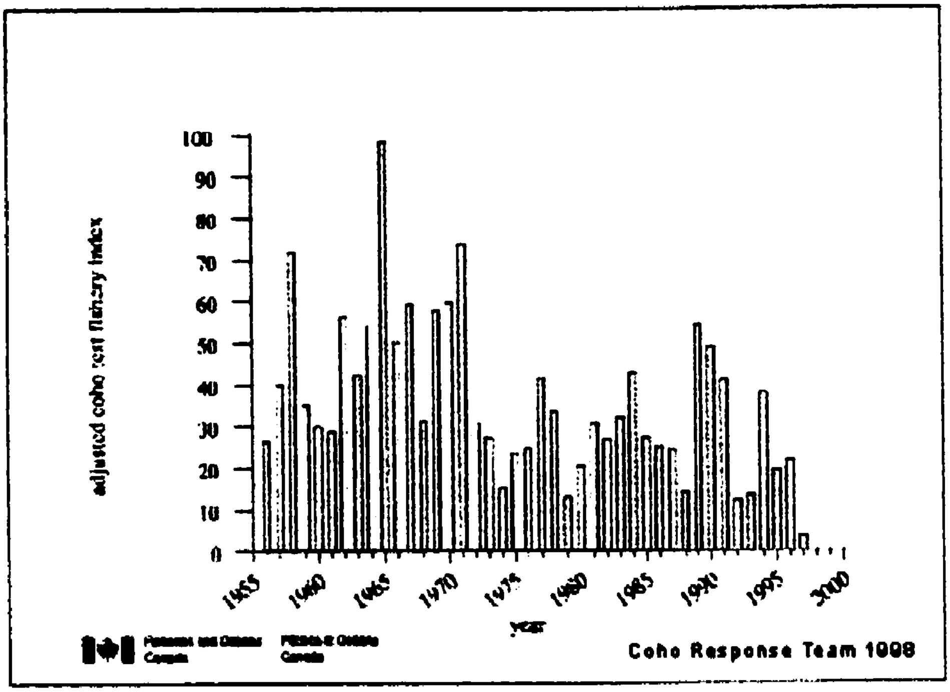
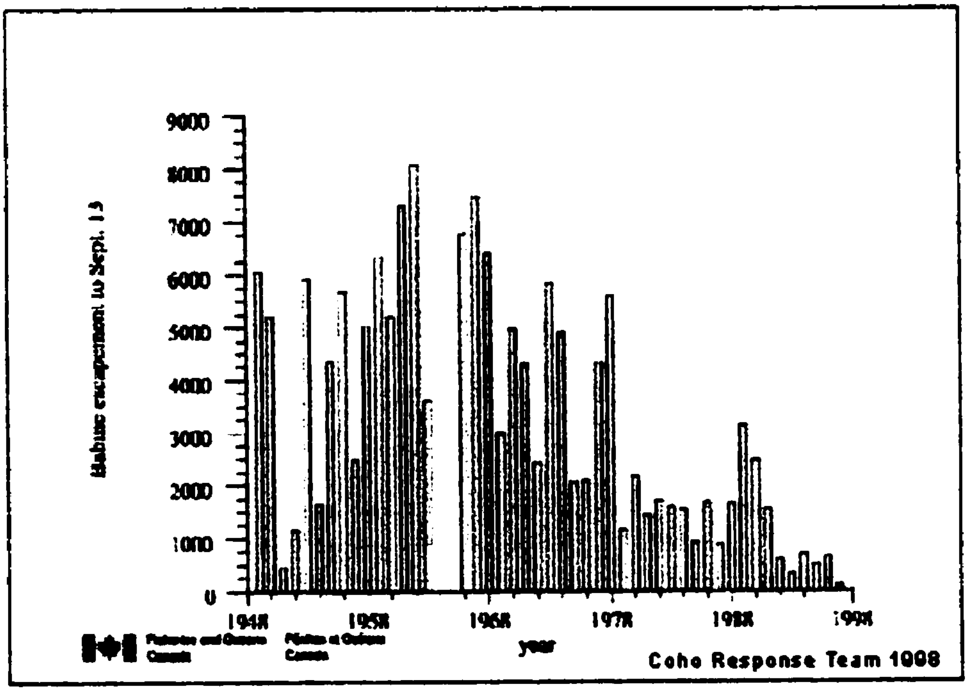


Figure 8 Babine Fence Count



Source: Holtby, B, F&O, *Northern BC Coho Stock Status and Outlook for 1998*, slide #2, from slide presentation given on March 26, 1998.

3.1.2 Causes of Decline

The decline of coho salmon stocks was attributed by F&O scientists to a combination of interrelated conditions that included:

- Habitat degradation;
- Poor marine survival and;
- Overfishing in mixed stock fisheries.

3.1.2.1 Habitat Degradation

As mentioned in chapter two, coho are anadromous fish that begin their life cycle in freshwater before migrating to the ocean. When they return to their natal stream after three years in the ocean, they are supposed to be able to spawn and die. Unfortunately, many stocks of coho tend to originate from small streams that are susceptible to the impacts of degradation that may result from urban and industrial development, including logging erosion and pollution discharge.[37]

One such example occurred at the beginning of the twentieth century where railway development was taking place along the Fraser river about 80 km east of Vancouver. A railway embankment was created along the northern bank of the Fraser, which was followed by loggers who cut down many of the surrounding trees and land was cleared for pasture. As a result, it was estimated that thousands of hectares of spawning beds were destroyed.[38] It is well understood that the cumulative effects of damage of this sort has contributed substantially to the coho stock decline.

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[37]For an excellent account of the destruction of some of BCs prime salmon habitat, see: Hume, Mark. 1992. *The Run of the River* Vancouver: New Star Books.
[38]Glavin, Terry. 1997. "Coho in the culvert: seeking ancestral spawning beds [salmon are returning to urban streams in BC]" *Canadian Geographic*, v. 117 (3) pp. 46-52.

3.1.2.2 Poor Marine Survival

According to the Pacific Stock Assesment Review Commitee (PSARC), poor marine survival is one of the major factors that has affected coho. Changes to ocean conditions is suspected to be the primary cause for this decline, and may be related to the ocean phenomena known as El Nino, which is where the normally western flowing Pacific equatorial currents are replaced by east flowing counter currents, which bring flows back towards the shores of South America, and sometimes as far north as California.[39] This in turn raises the temperature of water along the BC coast allowing non-native predators such as mackerel and hake-which are normally found further south-to prey on salmon. [40]

3.1.2.3 Overfishing

Overfishing of weak stocks in mixed stock fisheries has also contributed to the decline of some stocks. F&O initiated a fleet capacity reduction program on March 29, 1996 when Federal Minister of Fisheries and Oceans, Fred Mifflin, announced a Pacific Salmon Fleet Rationalization Program. The 'Mifflin Plan' as it became known, had three stated objectives:[41]

- conservation-to conserve and protect the fisheries resource and its habitat in trust for future generations;
- economic viability- to make the commercial fishery economically viable and organized around sound business principles; and
- partnerships-to share with stakeholders responsibility for resource development and fishery management, including management costs, decisions and accountability.

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[39]Gabler et al. 1997. *Essentials of Physical Geography-fifth edition*, Forth Worth, Texas: Harcourt Brace College Publishers.

[40]Canadian Press Newswire. 1996. "Scientists believe hake driving coho from Georgia Strait" May 21.

[41]The ARA Consulting Group Inc. 1996. "Fishing For Answers-Coastal Communities and the BC Salmon Fishery-Final Report" pg. S-2, Vancouver, BC.

3.2 Fleet Capacity

A major development in many fishing regions throughout the world, including the west coast of Canada, has been a massive post World War II increase in catch capacity. In their 1997 Review of the World Fisheries report, the Food and Agriculture Organization of the United Nations estimated that all salmon species found in the Northeast Pacific region (an area that encompasses the BC coast, also referred to as statistical area 67) were either fully utilized or overexploited, and that Canadian salmon stocks were starting to show declining trends (see fig. #9).[42] Also, it had been estimated that at that time the BC salmon fishery had up to 50% more capacity than was required to capture the appropriate number of fish needed to achieve sustainability.[43]

The growth in catch capacity and the decline in stock abundances are interlinked because the growth in catch capacity clearly has contributed to the decline in stocks. This resulted from a combination of policy developments initiated by the federal government over a period of several years, and industry pressure to maintain unsustainably high catch levels.

3.2.1 Early Capacity Development

The abundance of salmon in BC waters has been known since the late 1700s, and a salmon trade with local natives was well-developed by the early 1800s. However, it was not until the mid-1800s when the Hudson's Bay Company, who had trading rights with natives at that time, began fishing activities in the San Juan Islands.[44] In conjunction with

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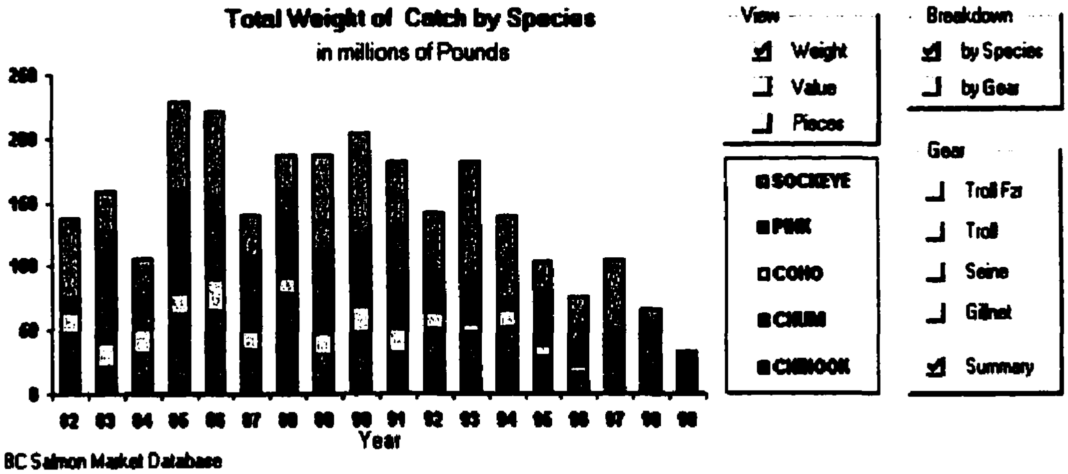
[42] FAO Fisheries Department. 1997. FAO Fisheries Circular No. 920 FIRM/C920- 'Review of the State of the World Fishery Resources: Marine Fisheries-part 11: Northeast Pacific, FAO Statistical Area 67.' Rome.

[43] In 1995, F&O Minister Fred Mifflin established a Pacific Policy Roundtable with representatives from all sectors to advise on the issues of over-capitalization and allocation. In response, The Roundtable recommended a 25-50% reduction in the size of the commercial fleet. See: 'The Pacific Salmon Fishery: A 15-Year Perspective' -which can be found at the F&O website: <www-comm.pac.dfo-mpo.gc.ca/english/release/bckgrnd/1998/face.htm>

[44] Forester, J. & A. Forester. 1975. *Fishing- British Columbia's Commercial Fishing History*, Saanichton BC: Hancock House Publishers.

Figure 9 Recent Salmon Catch Trends



Weight of Catch in Millions of Pounds

Year	CHINOOK	CHUM	COHO	PINK	SOCKEYE
—	———	———	———	———	———
82	13.86	33.12	18.12	8.67	63.88
83	10.44	10.74	20.22	85.36	31.30
84	12.11	19.71	19.35	25.78	28.20
85	10.66	51.57	17.57	80.57	68.48
86	9.74	54.94	25.71	64.51	65.72
87	10.04	24.13	16.21	57.02	32.43
88	11.32	66.41	13.56	69.37	26.10
89	10.23	20.37	16.98	65.24	74.23
90	10.11	37.76	20.32	56.47	79.05
91	9.88	22.40	19.25	75.24	54.06
92	10.22	39.42	14.04	32.10	45.82
93	9.29	37.77	8.30	33.79	92.17
94	6.87	44.67	14.90	7.22	65.64
95	2.93	26.33	9.32	41.74	23.07
96	1.00	14.31	7.43	18.45	34.16
97	3.25	19.08	1.46	26.29	54.30
98	2.65	43.72	0.03	8.61	10.70
99	1.28	7.73	0.02	20.39	3.55

Source: BC Salmon Market Database website address:

<www.bcsalmon.ca/database/catch/wtspyrs0.htm>

the discovery of gold in 1852, news about the abundance of salmon reached back to Europe. While the gold fever that had inspired many to come to BC diminished a few years later, many of the people who had come for the gold converted their interest to salmon and started fishing.[45]

During this time, the BC fishery was conducted under conditions of open access to the resource. What this meant was that anyone who wanted to enter the salmon fishery could do so as long as they had a vessel and purchased a licence. During the late 1800's while the industry was still growing, a lot of capacity was introduced and canneries that owned and operated most of the fishing vessels, placed the burden of harvesting costs on individual fishing vessel operators.[46] This strategy was adopted by the cannery owners in order to increase their profits because profits could no longer be made through an expansion of production.[47] As a result, new individual private fishers entered the fishery and competed with each other in order to sell their catch to the canneries.

By the 1950's under the open access regime, the number of vessels in the fleet pursuing salmon had grown to approximately 6000. As a result the F&O was forced to begin to gradually reduce the amount of fishing time. Fishing times went from 189 days in the early 1950s, down to only one day by 1999.[48] This development of over-capacity occurred because open access conditions led to more fishers entering the fishery where profits were seen to be had.

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[45]Meggs, Geoff. 1998. *Salmon: The Decline Of The Industry*, Vancouver: Douglas & McIntyre.
[46]Meggs, Geoff. ibid. pg. 38.
[47]For a more detailed account of the early years of the BC salmon industry, see Meggs in previous footnote, chapters 1-4 and Forester et al.
[48]Drouin, M. & A. Regier. 2000. *Fifty Years of Selectivity in the Fraser River Gillnet Fishery*, Fisheries Renewal BC.

3.3 F&O Policy Initiatives

As a result of these developments, the Federal Government established a Royal Commission to explore methods to improve the economic management for the BC fisheries. The Report prepared by Dr. Sol Sinclair from the University of Manitoba, recommended licence limitation and levies on catch as means to improve the economics of the fish harvesting sector of the industry.[49] His recommendations on fleet rationalization became the basis of the governments first fleet rationalization plan known as the 'Davis Plan', introduced in 1968 by the Honourable Jack Davis who was the Minister of Fisheries at that time.

3.3.1 The Davis Plan

With the problems of overcapacity well recognized, Davis announced his plan to: "increase the earning power of British Columbia salmon fishermen and to permit the more effective management of the salmon resource by controlling entry of fishing vessels into the fishery;" by:

1. Freezing the number of vessels licensed;
2. Buying out and retiring excess vessels and licenses;
3. Improving vessel standards and product quality; and by
4. Relaxing some of the restrictions on the fishing effort of the reduced fleet.

In theory, the Davis plan offered a lot of promise because of its direct attempts to reduce the overcapacity that had built up since the late 1800's. Unfortunately, three critical developments arose which led to its eventual downfall. These were: the expectations trap, the transitional gains trap and capital stuffing.

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[49]Macleod, Ron. Sociological and Political Factors in Canada's Pacific Fisheries Management -notes for an address- at Simon Fraser University, Oct. 24, 1995.

During the early stages of the Davis Plan, high salmon prices and increased catches created the appearance that the scheme was working. However, what this did was make vessel owners who were looking to sell out, escalate their buy-out prices in anticipation of better returns in the future. Their action was based on the belief that there would be fewer vessels in the fleet chasing the same number of fish, and therefore greater profits would be realized. As Parzival Copes stated in his review of the Davis Plan: "The expectation of a stream of future rents to be earned by a salmon licence resulted in the capitalization of these rents in the licensed vessel's sale price. The rent component of this price consisted of the discounted aggregate value of the stream of future rents anticipated."[50] As the price demanded by licensed vessel owners increased, the buy-back authority lost its ability to purchase vessels because of the inflated prices.

The transitional gains trap affected the price of licenses and occurred because licenses were made transferable. The government had to compete with other buyers whose expectations were raised by the prospect of higher profits and government could not afford to pay the price for the licenses at the price determined by the market. What resulted was that the anticipation of additional earnings (expectations trap) attributed to the reduced number of licenses became capitalized in the value of the licenses. By inflating the value of their licenses, licence holders were capturing the present value of future earnings when they sold them. The financial burdens this placed on licence purchasers caused them to fish with more intensity in order to earn back the money they paid for the licence. This also led to 'capital stuffing', where fishers invested additional money in more sophisticated gear to try and gain a competitive advantage over other fishers.

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[50]Copes, ibid.

When it became known that the rationalization plan would be taking place, a massive renewal and technological upgrading of the remaining fleet took place. As a result, rather than being reduced, catch capacity actually increased by 36% between the period 1969-1975.[51] Prior to the plan, the fleet consisted of thousands of vessels that varied in size, gear type and catch capacity. The plan was supposed to have reduced the number of vessels and catch capacity, but instead low capacity vessels were replaced by more efficient, capital stuffed vessels.

Fishers increased their inputs of capital and labour in order to compete for a higher percentage of the catch. This resulted in higher costs per unit of catch, thus causing dissipation of resource rents that the fishery could yield.[52] In other words, fishers started investing more money into their vessels through gear improvements, engine size increases and anything else that could give them a competitive advantage during harvest time. Eventually, most fishers were making the same investments, and the cost of fishing was raised.

Licence stacking (or pyramiding, as it was known then) occurred because smaller vessels with licenses could be replaced by a larger vessel combining their tonnages and licenses. Only the vessels were bought back, while the licenses were sold on the open market to the highest bidder. Those who purchased the licenses were allowed to combine them onto a single vessel. As a result, several licenses were combined onto a single vessel with the capacities of each combined together. Pyramiding was abandoned in 1975 after Jack Davis lost his seat in parliament.

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[51]This was despite the fact that the Davis Plan had reduced the number of vessels by about 30%. See Macleod, Ron, ibid. pg. 16.

[52]Copes, Parzival. "The Attempted Rationalization of Canada's Pacific Salmon Fishery: Analysis of Failure", pg. 1. Institute of Fisheries Analysis and Department of Economics, Simon Fraser University, Burnaby, BC.

3.3.2 The Mifflin Plan

The Mifflin Plan was initiated in 1996 by Former F&O Minister Fred Mifflin. It aimed to reduce the number of vessels in the fishing fleet by 50% by cutting the seine fleet in half and the small-boat gillnet-troll fleet by 80% by requiring vessels to buy licenses off other vessels in order to continue fishing coast-wide (known as area stackable licensing).[53] A provision to change the fishing zones was also introduced where the coast was divided into a certain number of zones for each gear type (see previous section: **Geography of Management** for details). Fishers were also required to purchase a licence for each of the zones where they wanted to fish.(see following section: **Fishing Zone Changes** for details).

While the need to reduce fleet capacity was readily acknowledged by most industry participants, some components of the Mifflin plan have received substantial criticism because of their perceived negative impacts to small coastal communities. In a report written for the BC Ministry of Agriculture, Fisheries and Food, the Coastal Community Network (CCN) outlined some major concerns with the Mifflin plan over how it affected small community fishers.[54] In particular, the CCN criticized the licence stacking initiative, and the fishing zone changes.

3.3.3 Fishing Zone Changes

The division of the coast into a separate number of zones for each gear type places additional costs on the operators of gillnetters and trollers because of the additional number of licenses they must purchase if they wish to continue fishing all of the waters

[53]Coastal Community Network (CCN). "Effects of the 'Mifflin Plan' on Coastal Communities", Victoria BC, June 19, 1996. The report was viewed on Coastal Community Network website at:
<www.coastalcommunity.bc.ca/html/reports/report1.htm>
[54]CCN report, ibid.<www.coastalcommunity.bc.ca/html/reports/report1.htm>

along the coast.[55] While seine vessels must purchase one additional license, trollers and gillnetters must purchase two additional licenses at a cost of around $80,000 for each licence. For combination gillnet-troll vessels, additional licenses must also be acquired for each gear type. In effect, a gillnet-troll vessel operator would need to have five licenses in order to continue fishing with both gear types along the entire coast.

The major issue with these changes is the implication they have for industry control and distribution. Many of the 1000+ gillnetters are owned and operated by a single individual or group of individuals (often family members) that are unable to afford additional licenses and who are already struggling economically. Furthermore, the distribution of home port locations of each vessel type suggests the majority of gillnet and troll vessels are operated out of small communities where opportunity costs are low and fishing income is limited.[56] Opportunity costs are the monies that can be obtained in the next possible area of economic generating activity. If they are low, then establishing a new economic livelihood is not possible. Many seine vessels on the other hand are owned and operated by processing companies from the lower mainland that are able to afford the area licensing changes because they are wealthy enough to do so.

Thus the increased costs associated with the area licensing changes have forced many fishers out of business. In a press release by the Pacific Salmon Alliance, it was stated that fishing with a single license under the Mifflin plan was not economically viable. Therefore many small community fishers who can not afford to purchase additional licenses, are left to either continue fishing at a loss, or sell their license, which leads to the second major issue: license stacking.

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[55]CCN Report, op cite.

[56]ARA Consulting Group Inc. 1996. "Fishing For Answers: Coastal Communities and the BC Salmon Fishery-Final Report", Appendix A, Vancouver, BC.

Licence stacking is a major concern to many because of the way it allows for the concentration of fishing capacity into fewer numbers of vessels and license owners who are primarily based out of urban centres. In their report, the CCN argued that the stacking initiative only benefits operators who can afford to purchase licenses. Specifically, it states: "(area stackable licensing)...will drive the industry into the hands of those with the most capital, the large fishing companies and wealthy multi-license holders based in urban areas."[57] This trend towards an urbanized fishery is a great concern to small community fishers because of the limited employment opportunities in small coastal communities.[58] Despite these protests, area stackable licensing was permitted to continue in 1997.[59]

3.4 Increased Competition and Decreased Prices

British Columbia fishers have recently had to contend with depression in global salmon prices. The BC salmon industry is small in the context of worldwide production, and BC fishers do not have the ability to 'set' prices for salmon because of much higher levels of wild salmon harvested in Alaska and by increased yields of salmon produced by the rapidly expanding salmonid aquaculture industry. Thus the price for BC salmon has decreased substantially in recent years. The total value of the catch in figure #10 divided by the total weight of the catch in figure #9 indicates there is a significant downward trend in the average price of all salmon species (see fig. #10).

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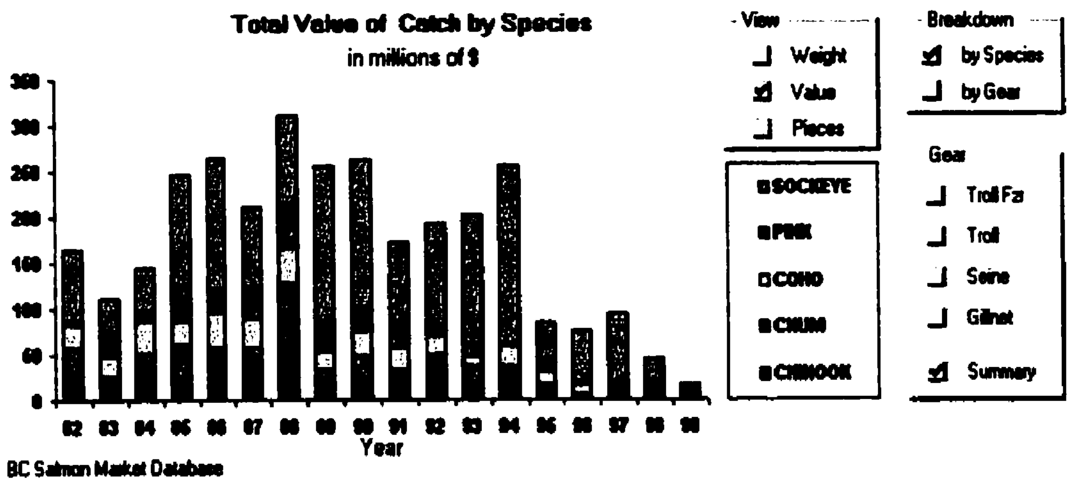
[57]CCN Report ibid.

[58]In a section outlining community impacts of the Mifflin plan, the CCN report stated that some communities like Alert Bay were being adversely affected by policy changes because it was expected that the community would lose forty-eight (80%) of its sixty seine vessels.

[59]See Copes, Parzival. 1998. Coping with the Coho-Crisis: a Conservation-Minded, Stakeholder-Sensitive and Community -Oriented Strategy. A Report for the Minister of Fisheries of British Columbia. Department of Economics and Institute of Fisheries Analysis, Simon Fraser University.

Figure 10 Declining Salmon Value Trends



Value of Catch in Millions of Dollars

Year	CHINOOK	CHUM	COHO	PINK	SOCKEYE
82	31.23	25.53	26.14	3.20	78.83
83	17.62	7.60	22.51	26.65	36.61
84	37.31	14.93	35.53	10.74	45.97
85	25.56	34.75	26.55	38.97	120.42
86	19.65	37.61	39.26	25.69	143.27
87	30.52	26.77	33.74	33.47	87.38
88	43.79	84.62	37.68	49.30	96.40
89	20.15	13.77	19.33	33.48	169.27
90	20.48	27.05	28.06	26.98	160.73
91	19.63	12.88	25.26	29.97	84.64
92	24.44	25.52	20.60	10.80	110.38
93	14.58	23.34	10.91	11.53	140.63
94	14.13	21.99	22.61	2.34	195.20
95	5.46	11.81	13.42	14.29	40.68
96	1.23	4.92	9.69	5.02	55.66
97	5.33	6.95	1.71	5.72	74.01
98	5.04	12.74	0.02	1.89	24.42
99	2.89	2.68	0.01	4.73	6.10

Source: BC Salmon Market Database website address:

<www.bcsalmon.ca/database/catch/vlspyrs0.htm>

3.5 Salmon Aquaculture Production

The rapid expansion of global aquaculture production for salmonids (salmon and trout) in the past fifteen years has had a direct effect on salmon prices. In a Worldwatch report on fisheries, Anne McGinn noted that fish farmers often "dump" their farmed salmon on the market just before the wild species become available for capture, thereby distorting prices.[60]

Globally, aquaculture salmonid production (which includes salmon and trout species) has increased from under 250 000 metric tonnes in 1984, to over 900 000 MT in 1995.[61] The share of cultured or farmed salmon species to total world salmon landings increased from around 25% in 1984 to over 45% in 1995 (see fig. #11). According to the International Salmon Farmers Association, world production of farmed salmon eclipsed wild salmon production in 1998, with a total of over 800 000 MT compared to under 750 000 MT of wild salmon production (see fig. #12).[62]

Atlantic salmon aquaculture production- which competes directly with wild BC salmon on the market- accounts for close to half of all cultured salmonid production; Norway, Chile and the UK produce 83% of that total. Canada ranks fourth in farmed salmon production. The production of farmed Atlantic salmon has increased at an annual rate of 29% between 1984 and 1995.

The aquaculture industry in BC is also expanding and competing with local wild salmon

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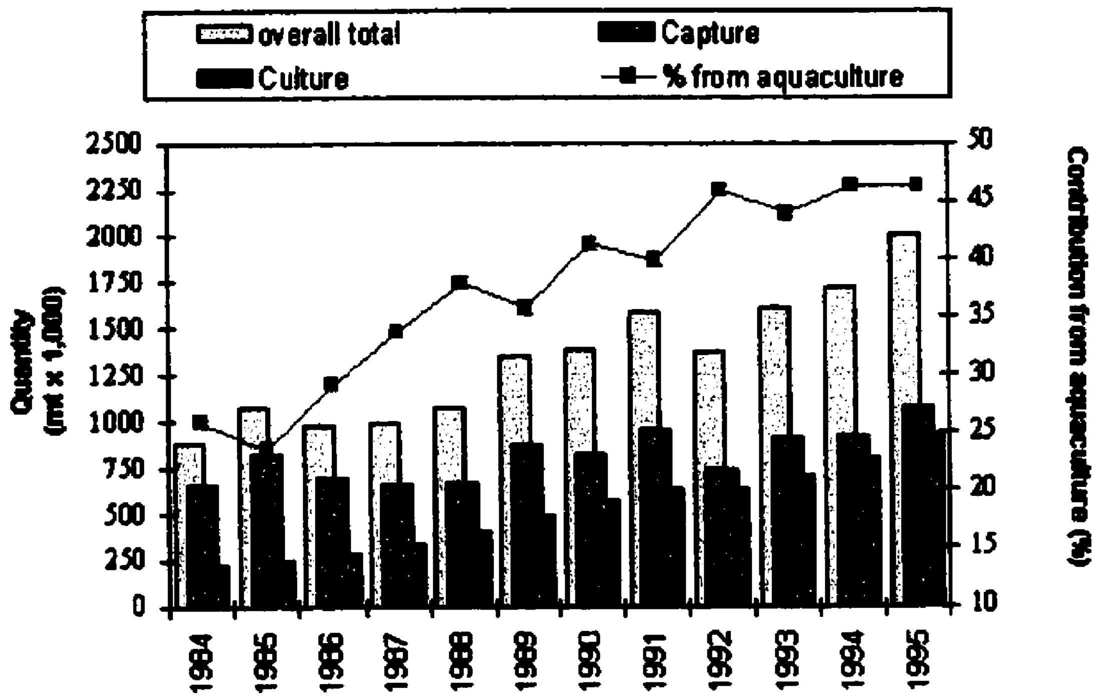
[60]McGinn, Anne P. 1998. "Rocking the Boat: Conserving Fisheries and Protecting Jobs", *Worldwatch Paper #142*, Worldwatch Institute.
[61]Krishen, R. and A. Immink. 'Trends in Global Aquaculture Production 1984-1996', Food and Agriculture Organization (FAO) of the United Nations website: <www.fao.org/fi/trends/aqtrends/aqtrend.asp> These numbers refer to all salmonids.
[62]BC Salmon Farmers Association. 1999. "Salmon Farming Overview: 1998- Presentation to the BC Salmon Farmers Association Annual General Meeting" Vancouver, BC.

Figure 11 Cultured vs. Wild Salmon Production



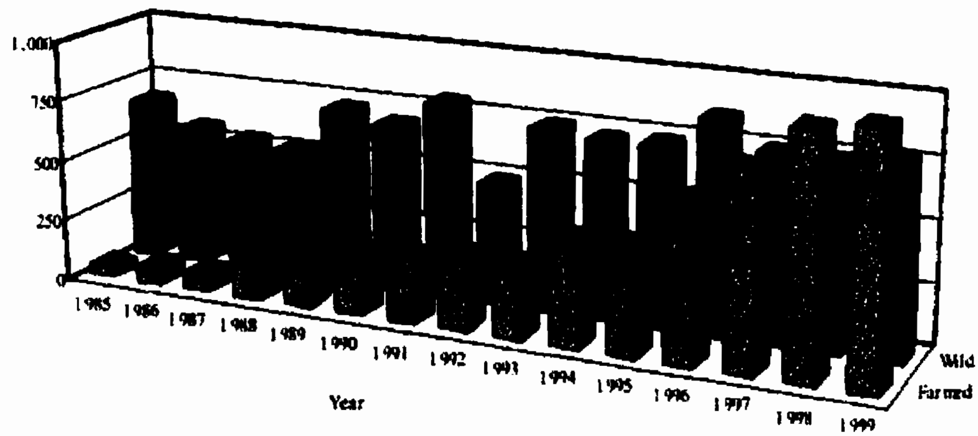
Source Fisheries and Agriculture Organization of the United Nations (FAO) website

address: <www.fao.org/fi/publ/circular/c886.1/image50.asp>

Figure 12

World Production of Salmon[1]

(000's metric tonnes)



[1] includes farmed sea trout production

Sources: International Salmon Farmers Association, the University of Alaska, Bill Atkinson's News Report, and *Pacific Fishing*

Source: BC Salmon Farmers Association website address:

<www.salmonfarmers.org/News%20Releases/AGM%20Pres.pdf>

fishers. The value of BC aquaculture salmon was gauged at $347 million in 1999, with a total production of 46,738 tonnes. In 1988, the total value of all BC farmed salmon was just over $39 million, compared to the value of over $300 million for wild salmon that same year.[63]

However, as with global aquaculture, the aggregate value of BC farmed salmon has risen dramatically, while that of wild salmon has decreased. In 1996, the total value of BC farmed salmon was over $170 million while the total value of wild salmon catch for the same year was around $70 million. In 1998 the value of farmed salmon from BC that was imported by the US was over $250 million, while the value of wild salmon had diminished to less than $50 million. These numbers indicate a production pattern which shows that fish harvesting is becoming more focused on regulated and controlled productive conditions, and moving away from the uncertainty that wild salmon fishers must contend with.

A review of these data clearly indicates that the growth of salmonid aquaculture production has 'overtaken' the wild salmon fishery. Ten years ago, it could be stated that the wild salmon fishery was the primary producer of salmon and that aquaculture had existed only to subsidize it. Today the reverse is true, and becoming more apparent with each passing season. Salmon aquaculture now provides more fish to the market than the wild salmon fishery.

The growth of aquaculture production in general on a global scale, particularly in underdeveloped nations, has occurred for several reasons. In many underdeveloped nations, consumption of fish protein is much higher than in the developed nations. Many of these nations have already overfished their own waters because regulations and

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[63] ibid.<www.salmonfarmers.org/News%20Releases/AGM%20Pres.pdf>

enforcement are difficult to implement due to cost. Furthermore, the natural population growth rate of many nations exceeds their ability to feed themselves with the wild fish that are available for them to capture.

There is a lot of appeal for underdeveloped nations to engage in 'cash-crop' aquaculture in order to earn much needed capital. Shrimp farming that occurs in Thailand and Vietnam is one such example. Aquaculture shrimp are popular in developed nations, so these countries harvest shrimp and export it to the wealthier nations for the money is brings. It is believed that shrimp aquaculture depletes fishing resources because of the high amount of fish protein needed to feed them.[64]

Aquaculture development has grown rapidly because of its controllable production capabilities. A particular appeal that aquaculture has for underdeveloped nations with growing populations is that aquaculture production is easier to control and predict. Unlike the conventional small boat fishery, fish farms are stationary and relatively easy to keep track of in terms of production. In an underdeveloped nation like China- which is the largest fish consuming nation in the world- aquaculture of any species offers an attractive method of being able to provide fish protein to a large population.

However, opponents argue that there are several ecological risks associated with salmon aquaculture production including: fallowing, effluent discharge, mortality disposal, plankton blooms, waste disposal, ecosystem contamination, escaped fish interaction with wild salmon and drug usage, including antibiotic residues. A complete analysis of each of these issues is beyond the scope of this chapter, however a brief review of some of the more well-known components are presented below.

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[64]Trei, Lisa. 1998. "Shrimp and salmon aquaculture depletes worldwide fishing resources, new study finds", *Stanford News Service* website: <www.stanford.edu/dept/news/relaged/981104shrimp.html>

To begin with, because fish farms are often located in waters native to local wild salmon species, there is a possibility of escapement of farmed salmon, which may then breed with wild stocks, causing genetic defects for the offspring which may affect their ability to survive in the wild. Furthermore, farmed salmon that escape may compete for habitat with wild salmon stocks, posing another threat to the wild salmon's ability to reproduce.

A second risk associated with salmon aquaculture is the possibility of disease transfer from farmed salmon into the wild population. If a diseased farmed salmon mixes with wild salmon, there is the possibility that it may infect the wild salmon with a disease to which the latter has no natural defence.[65]

In a studies done in Norway and Ireland during the 1990s, it was noted that sea lice infestations in wild populations were a direct result of escaped farmed salmon invading the habitat of native fish. One study specifically noted that 48-86% of wild salmon smolts captured at sea were killed as a result of sea lice infestations.[66]

In many salmon farming operations, disease is a common and mostly treatable problem. If a stock becomes infected, they are fed with a special food supplement that is laced with antibiotics. However, what can happen is that some of the feed drifts to the bottom

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[65]During a workshop on Aquaculture and the Protection of Wild Salmon held on March 2-3 2000, research was presented which firmly established the legitimacy of these concerns. See: Whoriskey, F. *Infectious Salmon Anaemia: A Review and the Lessons learned for Wild Salmon on Canada's East Coast*, St. Andrews N.S, as produced in: Gallaugher, P, and Orr, Craig, Eds. 2000. 'Speaking for the Salmon Workshop Proceedings-Aquaculture and the Protection of Salmon' Continuing Studies in Science at SFU, June 2000. pp. 46-51.
[66]Gargan, P. 2000. *The Impact of the Salmon Louse on Wild Salmonid Stocks in Europe and Recommendations for Effective Management of Sea Lice on Salmon Farms*, Dublin, Ireland, as produced in: 'Speaking for the Salmon Workshop Proceedings-Aquaculture and the Protection of Salmon' ibid. pg. 43.

of the water with the antibiotics still intact. It can then be washed out into the open water where wild salmon are located and incidentally ingested by one of them. The ingestion of antibiotics by wild salmon can reduce their immune system and expose them to the risk of disease.[67] While the data are not conclusive, it does suggest that the uptake of antibiotics can decrease the resistance levels of the fish.

Advocates of salmon aquaculture argue that these risks are either negligible or not proven, and that the benefits of having a constant supply of good quality salmon, jobs for local operators and export revenues far outweigh any possible health risks that the industry may pose to the environment or to people. Based on the rate of expansion that is occurring in the global salmon aquaculture industry, it appears that many members of society believe the same.

The debate surrounding the BC salmon aquaculture industry was renewed in early 1998, when the new F&O Minister Herb Dhaliwal suggested that the moratorium on aquaculture expansion be revoked in order to create employment for people in small communities who are already suffering the effects of the declining wild salmon fishery.[68]

3.6 The Alaskan Salmon Fishery

The success of the Alaskan salmon fishery has compounded the problem facing the BC salmon fishery. In the previous fifteen years, annual statewide harvests ranged between 100 and 200 million salmon, which is equivalent to over three-quarters of the total wild salmon harvests for the Northeast Pacific Ocean region, and over five times that caught

[67]David Ellis and Associates, a report for the David Suzuki Foundation. 1996. *Net Loss-The Salmon Netcage Industry in British Columbia*, Vancouver, BC. Chapters 5,7 and 8 offer complete details of the ecological issues associated with Netcage salmon aquaculture.

[68]Vancouver Sun. 1999. 'Dhaliwal's scolded over call to lift fish farms ban: The new fisheries minister offers to meet with critics over his suggestion that moratorium be lifted' *Vancouver Sun* August 5, pg. A6.

annually by BC salmon fishers during the same period (see appendix #1).

Since 1988, the annual number of salmon caught by Alaskan fishers has been no less than 100 million fish. The largest catch by BC salmon fishers during the same period was just over 40 million fish in 1990 and 1991. In 1997- BC fishers caught around 20 million fish while Alaskan fishers caught over 120 million fish.[69]

3.7 SUMMARY OF IMPLICATIONS

The cumulative effect of these problems have jeopardized the long term viability of Canada's Pacific salmon fishery which has led to major changes in fishing management and operations. The primary goal of F&O became the formulation and implementation of new fishing methods to conserve non-target species and stocks under commercial fishing conditions. The three fishing sectors were expected to develop and adopt new ways of avoiding non-target fish. Selective fishing has become the new paradigm of management which all stakeholders are being forced to incorporate into their fishing practices.

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[69]For an historical account of Alaskan salmon harvests, see Appendix #1. For complete details of the Alaskan salmon fishery, see the Alaskan Department of Fish and Game website at: <www.cf.adfg.state.ak.us>

4.0 SELECTIVE FISHING DEFINED

Simply stated, the term 'selective fishing' for salmon refers to capturing fish in a manner that is non-invasive to non-target stocks or species, and includes two elements: avoidance and live release. A non-target stock, as defined in the Stock Selective Salmon Harvesting Workshop proceedings: "...is one that the fishery is not intended to catch. This usually means that the non-target species or stocks cannot sustain the likely harvest rate in a fishery and therefore need protection..."[70] In the salmon fishery, this means that fishers aim to harvest as much target fish as possible and capture as few non-target fish as possible. Where non-target fish are incidentally caught, the goal is to revive them if necessary and release them with minimal stress.

Selective fishing can be accomplished through the utilization of a series of applied selective fishing technologies (SFTs) and selective management techniques (SMTs). For these selectivity measures to be successfully implemented, several key elements of the current salmon fishery must first be modified; including management practices, fishing practices and fishing gear. Hence, the incorporation of effective SFTs and SMTs into the Pacific Salmon Fishery is dependent on participation by Fisheries and Oceans, Non-Native commercial fishers and First Nations groups.

The industry wide experimentation with SFTs does not necessarily reflect a new vision by F&O with regards to fishing selectively. Arguably, SMTs have been in place for some time.[71] The 1996 fleet rationalization plan, coupled with time and area control mechanisms are examples. However, the 1998 salmon fishing season is the first one that a comprehensive industry wide selective fishing strategy was introduced.

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[70]Stock Selective Salmon Harvesting Workshop (SSSHW) proceedings, held at Simon Fraser University at Harbour Centre, Vancouver BC, May 8, 1998.

[71]A thorough review of selective gillnet fishing on the Fraser river can be found in the Drouin & Regier report. Drouin, M. & A. Regier 2000. *Fifty Years of Selectivity in the Fraser River Gillnet Fishery* Fisheries Renewal BC.

In regulating any fishery, policy makers have two options: they can adopt measures based on placing limits or controls on the 'industry inputs' which include fish catching methods and techniques and fishing area and time restrictions. They may also adopt 'output control' measures which include regulating aspects that relate to the fish caught, such as placing direct limits on the number of fish that can be harvested and catch quotas.

The contributions to selective fishing made by Non-native commercial fishers involve changing current fishing practices and developing gear that can be more selective. First Nations fishers can contribute by merely introducing traditional methods into the fishery. At the policy level, F&O must implement management changes by developing a selective fishing strategy that incorporates SMTs into their existing management framework. This includes the establishment and enforcement of new selectivity standards that will encourage the use of SFTs.

4.1 SELECTIVE FISHING PRINCIPLES- INDUSTRY

For commercial fishers who operate from a conventional fishing vessel, incorporating selective fishing practices means modifying their existing fishing operations by developing changes to their fishing techniques and making gear improvements. These can be classified as Vessel Selective Fishing Techniques (Vessel SFTs) because the modifications are applied to existing fishing vessels. Fishing technique changes also involve new ways of handling non-target fish in a manner that is less harmful to them in order to allow bycatch to be released relatively unharmed. Gear improvements include developing ways to modify conventional vessel gear such that it minimizes bycatch of fish requiring protection.

During the Stock Selective Salmon Harvesting Workshop (SSSHW) on May 8, 1998 commercial fishing representatives established a set of selective fishing principles that outlined some changes they felt would be needed in order to expedite the process of introducing large scale selective fishing practices to the Pacific salmon fishery.

Salmon fishery participants from all sectors met to discuss and initiate plans for implementing new ways that they could harvest salmon more selectively. Seven ideas for accomplishing more selective fishing were introduced and defined.[72] They were:

(1) minimize the stresses that fish face following capture.

There are a series of stress factors that can cause delayed mortality and/or reduce reproductive capacity even when the fish is released alive. They include: handling, confinement, crowding, air exposure, loss of scales and mucous, strenuous swimming, gill damage, poor water quality, and increased water temperature.[73] If a salmon suffers excessively from any of these stress factors, their survival and fecundity is jeopardized.

To reduce the stress factors, industry participants outlined two critical initiatives. First, they suggested the need for increased education and awareness for fishers to make them aware of the impact of abrasive handling techniques. Second, they suggested a need for basic education for fishers on the handling of fish for live release.

(2) smaller fishing areas and shorter times.

Workshop participants noted that local needs and opportunities for selective fishing differ from place to place, and that as such, 'knife edge' management could occur. The idea here is that management can be focused to a point that critical weak stocks can be

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[72]The names of the individual fishers who put forth these ideas was not recorded, however the ideas represents a summary of what was suggested by audience members.
[73]SSSHW proceedings, ibid.

separated from target stocks to such a fine level that no opportunities to capture stronger fish stocks need be lost.

One of the ongoing contentious issues amongst members of the salmon fishery is the way managers are criticized for suspending fishing operations in a single area because of apparent danger to a weak stock that is mixed with several strong stocks. While the one stock may be at risk, when operations are suspended opportunities to capture others that happen to be mixed within the weak stock are lost. It is believed by industry participants that smaller fishing areas and shorter openings would allow for increased stock specific harvest which could effectively eliminate this problem.[74]

(3) Spot closure and area preserves

This is an extension of 'knife-edge' management. The aim is to keep a close watch on the status of certain fishing areas that are suspected to have an abundance of weak or non-target stocks. Adopting co-operative reporting and mapping where such information would be shared amongst fishers was one way it was suggested that this idea could be carried out.

(4) Slowing down the fishery

Previous policy measures had gradually reduced the amount of time allowed for fishers, who, pressured by uncertainty, were led to capture as much fish as quickly as possible in the time they had. It was this problem that prompted fishers at the sustainability workshop to suggest slowing down the fishery through measures such as catch quotas so that fishers could live release non-target species more carefully and effectively. By slowing down the fishery, it was suggested that fishers would not have to rush to catch

[74]During the 1997 Skeena fishery, two million surplus sockeye escaped capture to protect steelhead and coho.

fish, but could give more attention to the conservation and preservation of incidental bycatch.

(5) Changes in legislation and policy

An audience member argued that changes in legislation and the development of new policy are necessary components needed to assist in the broad implementation of a selective fishing program. Some of the changes suggested included new directions in management practice and co-management partnerships, penalties for those who sell illegal gear, financial assistance to develop stock selective gear, and adequate funding to assure full monitoring and assessment.

(6) Collecting and sharing more information on stock identification, run timing and migration routes were strategies also suggested to facilitate selective fishing.

(7) Co-management partnerships

The need to work together was strongly emphasized. Co-management implies a sharing of control and management of the fishery between industry participants and government. A major concern of commercial fishers has been what they feel is the failure of effective communication to take place. They have often voiced their frustration over the fact that they feel policy is dictated to them 'from-the-top-down', without consultation. Participants feel co-management partnerships could foster better relations between themselves and F&O.

4.2 SELECTIVE FISHING PRACTICES-INDUSTRY

With these basic selectivity principles outlined, industry participants from the different sectors are left with a variety of selective fishing practices to implement. One of the fundamental ways fishers can fulfill this is through modifications to gear and refined fishing practices. Seiners, Trollers and Gillnetters are three commercial fishing vessel types that can be modified. The traditional use of each vessel and their applicable selectivity modifications are defined below.

While there are several types of stationary and vessel SFTs, primary attention will be on the gillnet fleet. The number of gillnet vessels in the salmon fishery is large enough to warrant special attention because of the potential broad range of applicability that can occur from the 1998 selective fishing experiments.[75]

4.2.1 SEINE VESSELS

There are now approximately 272 seine vessels in the BC salmon fleet.[76] Seine fishers mostly target sockeye and chum stocks and their vessels are the largest of the three vessel types (60-90 ft. in length, see fig. #13). They require the most crew to operate (3-6 crew members), and they tend to have the highest volume of catch per hour of set time by virtue of their catch method. The technique is as follows: "In purse seining, a school of fish is encircled by a long length of net edged by a corkline and a leadline above and below. The purse line which runs through brass rings attached by bridles to the bottom of the net, is pulled up under the water, entrapping the fish in a giant purse held afloat by the corkline at the top edge of the net."[77]

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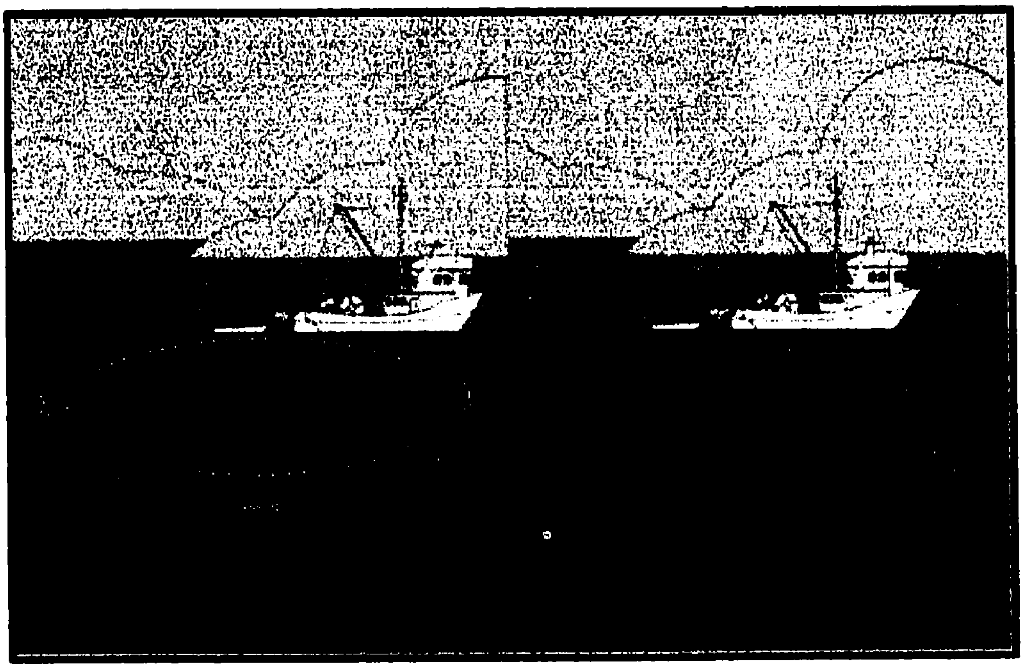
[75]Even after two phases of the buyback component of the Canadian Fisheries Adjustment and Restructuring Program that was launched in 1998, approximately 1,100 of the 2,542 eligible salmon licenses that remained were for gillnets.(F&O press release #NR-PR-99-17E, available at the F&O website:
<www-comm.pac.dfo-mpo.gc.ca/english/release/p-releas/index/pr99.htm>
[76]The number 432 represents the number of vessels that were licenced to fish for the 1998 season and includes the reduction of 99 vessels that were purchased in the first round of the Volunteer Licence Retirement Program. As of 2000, after the third and final stage of the program was conducted, 272 remained.
[77]Forester, Joseph, & Anne Forester. ibid. pg. 66.

In the salmon fishery, seine vessels are accompanied by a small auxiliary boat called a skiff, which takes one end of the purse seine net and encircles a school of salmon while the main vessel remains stationary with the other end of the net attached at the stern of the vessel. The fish are then entrapped in the 'bunt'(circle) of the net as the purse line is drawn in from the large vessel. The catch then becomes concentrated enough to be pulled into the large vessel with the use of a v-shaped power block which reels in the net and is pulled on board over a power drum.

Figure 13 Seine Vessel in Operation



Source: F&O website address

< http://www.pac.dfo-mpo.gc.ca/ops/fm/Salmon/fishing_examples.htm#Seining%20Example>

4.2.1.1 Existing Selectivity

With selective fishing being defined as the harvest of target species with no or minimal interference to non-target species and stocks, it is worthwhile to briefly consider how seine vessels were selective prior to the mandatory measures that were implemented in 1998. As noted, seine vessels encircle a school of fish and then draw them together into a net. Seine vessels tend to be operated in open-ocean areas where there can be a significant degree of stock mixing. As a result, a single set of fish caught can consist of fish from several different species, including coho.

However, seine vessels are moderately selective in that many of the fish caught in the purse do not come in contact with the mesh of the net, and therefore do not suffer the same degree of stress and physical damage that they would if they were trapped in the net itself (like gillnets). Seine fishing therefore, can be understood to allow for the better opportunity of post-release survival of incidental bycatch.[78]

4.2.1.2 Seine Vessel Issues

Since recent concerns over the status of the salmon fishery have emerged, Purse Seining has been under intense scrutiny and fishers have been accused of indiscriminately taking large amounts of bycatch while fishing. Despite the seine vessels moderate degree of selectivity outlined in the previous paragraph, bycatch can often perish because seine fishers do not have time to carefully sort through the catch and release non-target fish or to practice more thorough selective fishing techniques. Furthermore, fish that are at the bottom of the net are often crushed against the power drum as it reels in the net. The phrase 'time is money' ideally characterizes the conditions under which fishers must contend with in a highly competitive intense fishery.

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[78]Copes, Parzival, pers.com. November 27, 2000.

4.2.1.3 Selective Seine Modifications

Seining can be made more selective through a series of gear changes and new fishing practices. Direct release of fish with the use of dip nets, soft brailing, and holding non-target species in a resuscitation box are all methods that can be practiced manually, while gear changes include: net size adjustments (the use of selectivity grids) and the use of non-abrasive material (knotless web). Selectivity grids are simply a grid device woven into the seine net that include spaces that are large enough for juvenile fish to escape from the bunt. Knotless web is net that does not have knots at the junction of the webbing. Adjustments to the number of panels or net sections can also be made in order to avoid some fish. For example, panels can be removed from the lower portion of the net to allow fish to swim underneath it. These efforts, when combined with the new area and time management changes that could allow fishers to work at a slower pace, are ways that seine vessels can be made more selective.

4.2.2 TROLL VESSELS

There are now approximately 530 troll vessels remaining in the BC salmon fleet. [79] Troll fishers mostly target chinook, coho and sockeye stocks. Heralded by their users as the most selective gear of the three types, trollers use a series of lines with multiple hooks to catch fish much the same way that recreational fishers do. The vessel sets a number of lines (usually six to twelve), with each line holding a number of hooks (see fig. #14). The troll vessel then glides over the surface with hooks in tow, and captures fish that grab onto the lure. The fish are then power-reeled into the vessel.

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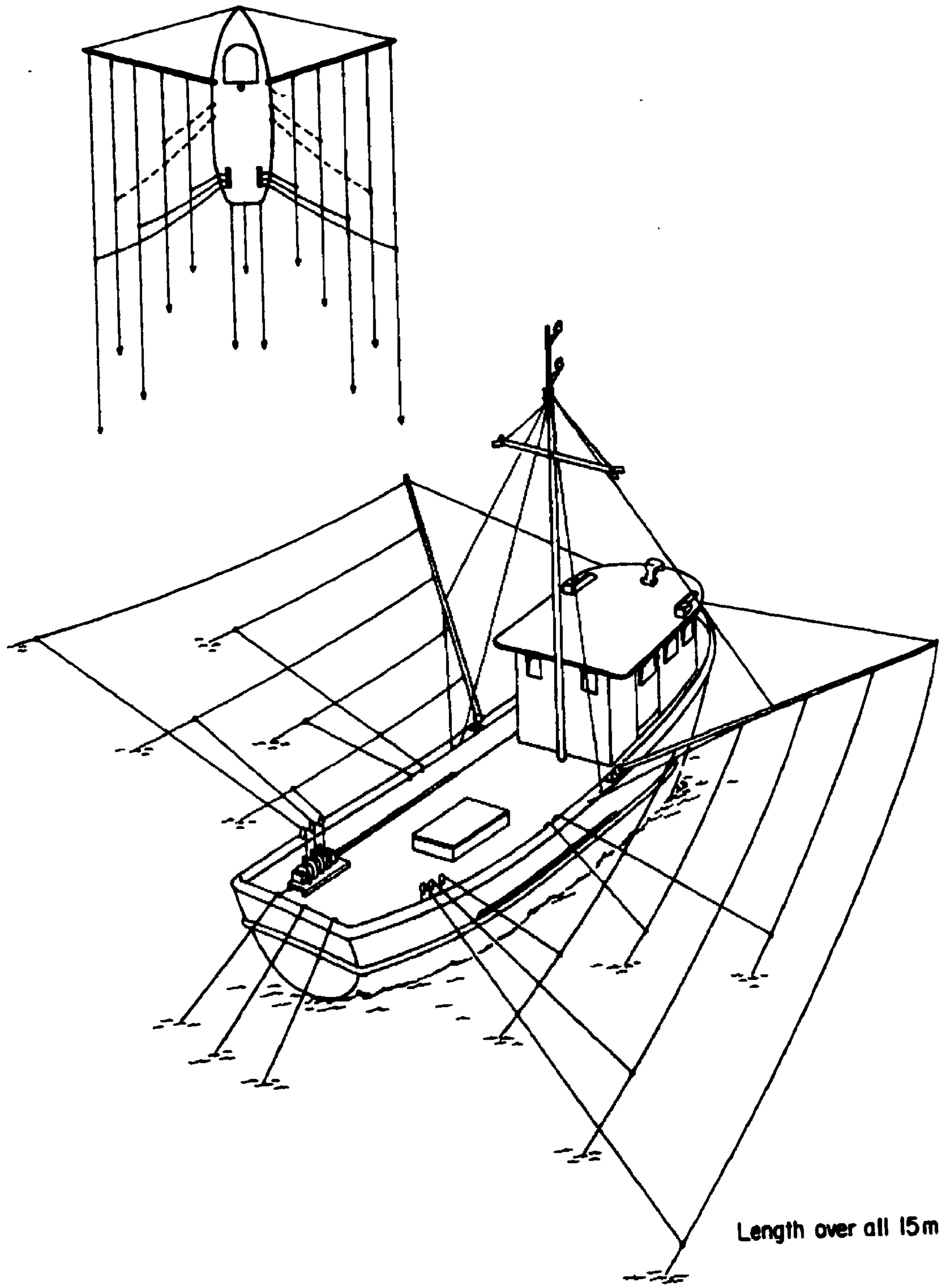
[79]As with the seine vessels, the number 530 represents the number that remain after the third and final stage of the Volunteer Licence Retirement Program.

Figure 14 Troll Vessel



Source: FAO Fisheries Technical Paper 267, 1985. *Definition and classification of fishery vessel types*. p. 26. Rome, Italy.

4.2.2.1 Troll Vessel Issues

While trollers are different from other gear types in that they capture fish individually as opposed to in bunches, there are concerns over the risks they can pose to salmon that are caught on hooks. The main risk factors outlined by the troll sector of the ITC include:[80]

1. strenuous movements and swimming;
2. prolonged period on hooks;
3. sudden water temperature change;
4. excessive scale loss;
5. mouth tissue and gill damage;
6. blood loss and;
7. spine damage resulting from handling.

4.2.2.2 Selective Troll Modifications

Eliminating these risk factors is the primary way which trollers can be more selective to ensure the survivability of non-target salmon species and stocks. Specific changes that can be introduced by the troll sector of the ITC include:

1. Experiments on corrosion rates for black hook vs. stainless steel hook;

The importance of corrosion rates for different hooks relates to the survivability of non-target stocks that are released from a line with the hook still attached. While the removal of the hook would seem to be the best and most obvious way to eliminate the problem, there are considerable risks associated with attempts to remove a hook from the fish, including tissue damage.

2. Use of barbless hooks;

A barbed hook is a basic fishing hook that has an additional slanted hook attached at the

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[80]ITC paper ibid.

end. The purpose of this barb is to prevent fish from releasing itself from the hook once it is caught. The use of a barbless hook could reduce tissue damage to the fish once it is released.

3. The design of depth released hook covers;

The idea of depth released hook covers is a sophisticated method of attempting to ensure that only specific species are caught. Because different species of salmon have different swimming patterns, (some swimming deeper than others during migration) the depth of the hook can effectively target one species or stock over another.

Additional selectivity techniques for trollers include the use of single hooks rather than treble hooks, and the use of different lures to attract target species or stocks. In the same ITC report, a recommendation was made to develop an improved fish revival tank that would be designed to: 'eliminate all physical handling of the fish, thereby reducing overall fish stress and virtually eliminating scale loss and spine damage...(this will) enhance their survivability...'[81].

4.2.3 GILLNET VESSELS

Currently, there are approximately 1,060 gillnet fishing vessels in the BC salmon fleet.[82] Gillnets have been used in the BC Salmon fishery for over 130 years. The earliest gillnets were set from canoes, before the advent of the skiffs in the 1880s. The majority of early gillnet fishers were native people who were hired on a daily basis to fish cannery owned gillnet boats.[83]

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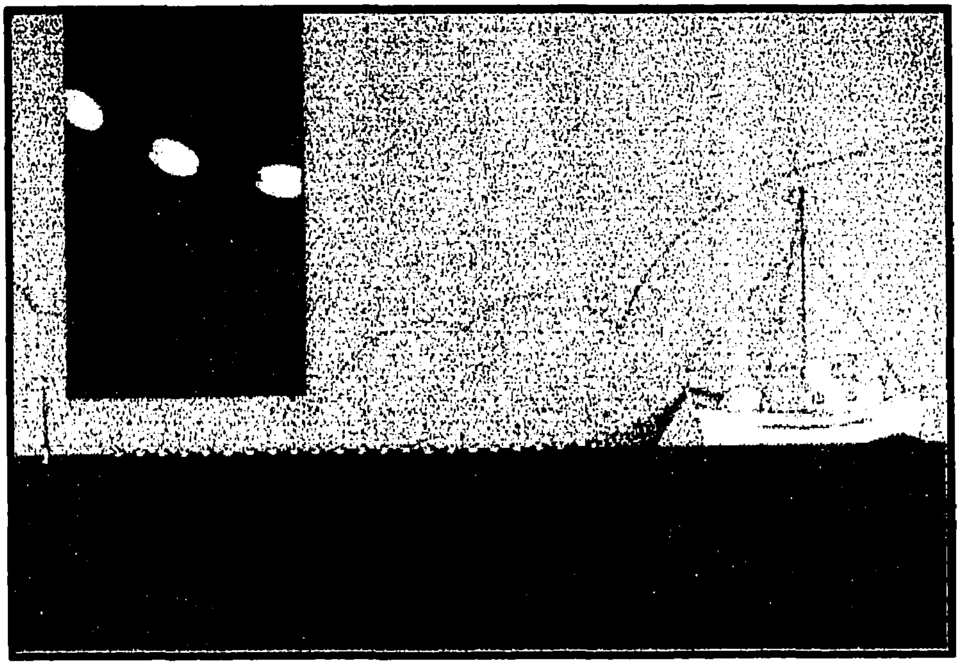
[81]Industrial Technical Committee (ITC) report. 1998. 'Fishing Salmon Selectively-British Columbia', a paper submitted to F&O, Vancouver BC.
[82]Post third-round of Volunteer Licence Retirement Program.
[83]Meggs, Geoff. 1991. *Salmon: The Decline of the B.C. Fishery* Vancouver: Douglas & McIntyre.

Figure 15 Gillnet Vessel in Operation



Source: F&O website address

<http://www.pac.dfo-mpo.gc.ca/ops/fm/Salmon/fishing_examples.htm#Gillnetting%20Example>

Gillnet vessels mostly target sockeye, pink and chum salmon. As the name implies, gillnets use of a net configuration that catches salmon by their gills as they swim into the net. Conventional gear consists of a net that is hung in the water over a length of cork line with a certain depth and mesh size (see fig. #15). The average length of a gillnet is around 375 metres or 205 fathoms, with a mesh size that varies according to species and area fished. The standard mesh sizes used to harvest the target species are: approximately 4 1/2 inches for pink; between 4 3/4 and 5 1/4 inches for sockeye; 6 inches for chum and 8 inches for chinook.[84] As noted earlier, coho is not a target species.

[84] Kandt, Paul. pers.com. June 25, 1998.

The mesh size refers to the amount of space between the webbing. The average depth that the net is sunk is around 90 meshes, (450 inches, or 42 feet). The average hang ratio, which is the amount of webbing hung per length of corkline, is around 2.15:1 which would be the equivalent to around 440 fathoms or 806 metres per 205 fathoms of cork line. There are also differences in mesh strength and size, and are gauged by number. Smaller (or finer) and weaker mesh are assigned low numbers, while larger and stronger mesh is assigned a bigger number. Gillnet fisher Paul Kandt noted that the largest mesh he had seen was #43 and the smallest he had seen was a #12 mesh.[85]

4.2.3.1 Existing Selectivity

Placement of the gillnet is pivotal to its success for harvesting salmon. Typically, gillnet fishers place their net in close proximity to a river mouth and near the shore where they are certain to encounter target fish that will be traveling during the latter portion of their migration. Individually, gillnet vessels have been regarded as moderately selective because of how they are able to target particular sized salmon from particular stocks and avoid others. While salmon stocks are mixed, gillnets are able to go to locations where non-target species are not located and thus avoid them all together.

4.2.3.2 Gillnet Vessel Issues

However, gillnet fishers must also fish under the same sort of pressure and highly competitive circumstances that troll and seine fishers deal with. While gillnets are somewhat selective because they may be used in areas where salmon stocks are less mixed with other species than in open-ocean conditions, current fishing time constraints coupled with the large number of vessels in the fishery have diminished the degree of selectivity that gillnets are able to achieve. Furthermore, many fish that are left entangled by gillnets suffer a high degree of stress and either do not live long enough to be released,

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[85] Kandt, Paul. pers. com. January 2000.

or do not have sufficient energy to swim away after being released live.

Gillnet vessels have gained a reputation for being the most harmful gear type, being referred to as 'Curtains of death' by some environmental groups.[86] What is not mentioned however, is that these 'curtains of death' are more in reference to the driftnet gillnets used by some fishing nations on the high seas.

In an article entitled: 'Gillnet fisheries: A worldwide concern', Albia Dugger presents the findings of Dr. Jon Lien of Memorial University in which he found that "monofilament gillnet is the fishing gear which is the least selective and produces the largest incidental bycatch....Other concerns raised include 'ghost-fishing' the continued unmonitored killing by lost nets; and 'fallout', the unknown number of fish that escape, damaged, from the nets that later die or are killed due to their injuries."

Damage to fish tissue, lost nets getting entangled with other sea vessels, and delayed net picking are the other hazards mentioned. The article then goes on to summarize some problem areas in the world where gillnets have been particularly destructive.[87]

While there are some similarities between the conventional gillnets used in the Pacific salmon fishery and the driftnet gillnets used in other fisheries, such as tuna and swordfish, there are critically important differences which need to be clarified.

The similarities are obvious. Like driftnets, pacific gillnets are strung out in the water, and rely on the target fish to swim into the net, getting caught by its gills. Opponents of gillnets have argued that gillnets are indiscriminate about what they catch, and that they are a hazard not only to bycatch, but to other species, including birds and mammals.

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[86]Beeby, Dean. 1994. "Curtains of death". *Halifax Chronicle Herald*, May 24, p. A8.
[87]Dugger, Albia. 1990. "Gillnet Fisheries: A Worldwide Concern", *Sea Frontiers*, Jan-Feb, pp. 20-21.

However, the driftnet gillnets referred to in the article are much larger (36-58 km in length, and 15 metres deep in the South Pacific), they are placed out at sea where monitoring is extremely difficult, and the set times can last for several hours, or even days.

Gillnet vessels used in the Pacific salmon fleet use nets that are much smaller, they are placed within well defined fishing areas, and the set times are now usually only a few minutes. These short set times do not allow for the gillnet to be left unchecked for hours at a time.

The destructive potential of salmon gillnets relates more to its technique When and if a large number of non-target fish come into contact with a gillnet, the fish tend to have a low rate of survival because their gills get entangled in the webbing. Fish require the use of their gills to breathe, and if this is affected, they can suffocate from lack of oxygen. If a gillnet is set for a long period of time, then the chance of survival of any fish is low because the net is not checked or 'picked'. If the net is not checked, then fish can struggle for a long period of time, eventually leading to mortality.

Unfortunately, the wording used in the articles (referring to driftnets as gillnets/ and gillnet driftnets) has led to the perception that Pacific salmon gillnets are just as harmful and destructive to the salmon fishery as driftnets are to the ocean environment. It is important to also note the nature of driftnetting as outlined above does not permit much possibility for selectivity, whereas there are many ways that salmon gillnets can be made more selective.

The nature of salmon gillnetting is different from high-seas driftnet fishing. Salmon gillnets are not left unchecked for long periods of time, they are placed in areas where concentrations of non-target species are low, net designs are being refined to assist with avoiding non-target species and fishers are learning using revival equipment and learning proper release techniques. These selectivity measures are outlined below.

4.2.3.3 Selective Gillnet Vessel Modifications

There are several harvesting techniques and gear modifications that can be implemented in order to make gillnets more selective. The Gillnetters Association of BC identified a series of ideas that could be used to develop 'an optimal gillnet capable of reducing to zero the capture of non-target species and sizes of fish when targeting specific species of salmon.'[88] These measures can be grouped into four categories:[89]

1. Management measures designed to increase fleet selectivity through avoidance;
2. Gear modifications designed to reduce post-release mortality;
3. Techniques for deploying the gillnet in the water, and;
4. Handling and release practices designed to reduce post-release mortality.

4.2.3.4 Management Measures

Management avoidance techniques refer to the use of time/area closures as a selectivity tool. An example of 'real time' management, time/area closures can be implemented by F&O officials at a moments notice to close areas where non-target species of concern are present in sufficient numbers, which is determined through ongoing stock monitoring efforts. By closing the fishery, target and non-target species are allowed to pass through. A second example of time management is permitting fishing during daylight only. This technique dictates that vessels only be allowed to catch fish during the daylight as it is an effective avoidance measure for coho and chinook salmon because it is believed they

[88]ITC report, ibid.
[89]Edwin Blewlitt & Associates, ibid. pg. 84

have relatively good eyesight compared to other species and can therefore avoid swimming into the nets. Daylight only fishing is only effective in clear water because no fish can see a gillnet in cloudy water, regardless of the amount of light.

4.2.3.5 Gear Modification Measures

Different construction modifications include: Mesh size, net material (comparing an Alaska twist net with a multi-strand net, and a monofilament net) the use of weedlines (including dropped weedlines) and web spacing.

Different mesh size is used to target species of different size and may be used to increase catchability or selectivity, as long as there are significant differences in size between the target and non-target species. Alaska twist type net is a six strand net that is much stiffer and bulkier than the standard thirty strand net but is more visible than a monofilament (single strand) net. Multi-panel nets combine mesh size and web characteristics of different types into a single net. A multi-panel net can be used as to determine the swimming characteristics of fish caught. This information can then be used to set a net with the best level of selectivity.

A weedline is a rigging technique that suspends the gillnet at a certain depth below the corkline, allowing species that migrate close to the surface to swim above the net and avoid capture. This is particularly important because pink, chum and sockeye, the primary target species, swim at a deeper depths than do coho or steelhead.

Differences in web spacing affect how a fish is caught and held in the net. While the standard five inch web catches salmon by their gills, experiments done with a 3 1/2 inch web that capture fish by their teeth (known as a tangle tooth net) combined with weedlines have shown to be an effective way of selectively harvesting chum salmon on the Fraser River, while allowing steelhead to escape unharmed and to reduce the bycatch of coho, chinook, sockeye and pink salmon.[90]

4.2.3.6 Deployment Techniques

The deployment techniques used include altered hang ratios and soak times. Modifying the hang ratio affects the amount of net a fish encounters. A high hang ratio (perhaps 3:1 as opposed to 2:1), where additional net is strung along a cork line, results in a baggier net; the reverse is true for a low hang ratio. The reason a higher hang ratio would be used is because it would reduce the chances of the fish getting caught by its gills. Like the 3 1/2 inch net, a baggier net might catch a fish by its teeth,[91] which allows it to continue breathing while in the net, thus increasing its chances of survival after being released.

Soak time (or set time) is the amount of time the gillnet remains in the water during a single set and directly affects how long a fish remains in the webbing once caught. The longer the set time, the greater the potential that a fish caught early in the set will remain in the net for an extended period before being harvested or released. The longer a fish remains in the net, the lower the survival rate.

4.2.3.7 Handling and Release Practices

Release techniques are designed to reduce post-release mortality and refer to how non-target species are handled and released. The actual physical handling of the fish and the use of revival boxes (a.k.a. 'blue-boxes') are its two main components. Establishing appropriate handling techniques requires educating the fishers operating the gillnet. A revival box is simply a 'box' resembling a cooler that is used to revive non-target species before release. It is initially filled with water that is kept fresh through the use of a pump

[90] ITC report, ibid. pg. 15

[91] A tangle-tooth net experiment with chum has been underway on the Fraser river for four years now by a gillnet fisher named Mark Petrunia.

which serves to continuously keep the water in the box flowing. When a non-target fish is captured, it is manually placed in the box for a certain length of time so that is can 'recover' from the stress of incidental capture. The fish is then removed from the box and released back into the water.

4.2.4 RECREATIONAL FISHING

In recreational fishing, the primary target species are chinook, coho and steelhead salmon. Coho salmon is of course the very species that was at risk of extinction and in need of protection. If coho are to continue to be caught, then the fishers must practice selectivity by catch and release, whereby they must release the fish live after capture.

Other gear and operational changes that can make the sport fishery more selective include:[92]

1. The use of barbless single hooks instead of barbed treble or tandem hooks;
2. Trolling instead of mooching;
3. A ban on bait and downriggers;
4. Mandatory release of target species using a learned technique to ensure survival.
5. Encourage sport fishers to capture what for them are non-target species such as sockeye and pink.[93]

The use of barbless single hooks is an important gear change because they cause less damage to fish. A barbed single hook is a 'J' shaped hook with a second curled hook protruding from the end bent inwards. When a fish bites into it, the barb keeps the hook from sliding back through the hole it has created in the fish's mouth. The only way it can be removed is with a pair of pliers which can tear the flesh, causing severe damage.

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[92]SSSHW proceedings, ibid. pp. 5-6.
[93]Copes, Parzival. pers. com. November 18, 2000.

Treble hooks are three hooks that are joined together, which like a barbed single hook, can do significant damage to a fish that grabs it. A tandem hook is two hooks in a row, one for the head of the fish, and the other further back.[94] As with the barbed and treble hooks, a tandem hook causes tissue damage because it is embedded in the fish causing severe bleeding.

Trolling is when the bait or lure is towed through the water in a forward motion. Mooching is when the boat is not under power and therefore not moving much.[95] It is believed that mooching increases the incidents of 'swallow' captures, where the fish takes the hook into its throat, which increases the risk of bleeding and gill damage.[96]

Downriggers are a mechanical wing-like device that carries the lure to a certain depth and then frees the line when a fish strikes. Banning downriggers is a simple way to avoid capturing species that swim deep such as chinook. The use of bait attracts fish to the line, making them easier to capture. Banning the use of bait would reduce the likelihood of fish grabbing the hook, thereby making the recreational fishers attempts more challenging.

Mandatory release of non-target species is already in practice, but it must be done properly to ensure maximum post-release survival. The following handling techniques are outlined:[97]

- do not exhaust a salmon when "playing" it on the line, bring it in quickly.
- for salmon under 30cm, unhook it at the water surface with a minimum of handling.

[94] Wood, Allen. pers. com. April 8, 1999.
[95] Wood, Allen. ibid.
[96] Edwin Blewitt & Associates Inc., ibid. pp. 98-99.
[97] F&O Pacific Communications Branch: "Releasing Your Fish", website: <www-comm.pac.dfo-mpo.gc.ca/english/default.htm>

- for larger salmon, bring it onboard , remove the hook quickly and release it. This will cause less stress and damage.
- to minimize scale loss use a soft knotless mesh net. Handle the fish securely. Keep it immobile while the hook is removed.
- to avoid injury, support the fish when lifting by placing one hand around the base of its tail and the other under its belly. Do not lift the tail as this will stretch the vertebrae.
- to return the fish to the water, release it at a 45 degree angle with the head pointing down and just above the water line.
- Use large lures or artificial baits to reduce the incidental catch of undersize fish.
- If the hook is deep inside the mouth, cut the line as close to the hook as possible and leave it in. The hook will erode in time.

These selectivity measures must be examined within the context of how the recreational could be defined in the future, based on what was mentioned in point number five. If coho are going to continue to be targeted, then these measures must be carried out with as much diligence as possible. However, if traditionally non-target species become the new target species of recreational fishers, then the selectivity measures defined above would be minimal because there it would not be necessary to release the fish caught. This could become an issue in the future of course if the status of any particular stock where recreational fishing occurs is threatened.

4.2.5 FIRST NATIONS- SELECTIVE FISHING

First Nations groups have a unique approach to selective fishing. While Non-native commercial fishers have been working towards a functional definition of selective fishing through gear changes and fishing practice improvements, First Nations groups already have well established fishing techniques that have been developed and passed down through the generations. Because most of these traditional fishing techniques utilize gear that are set up at fixed locations, they can be classified as Stationary SFTs. While stationary SFTs can be moved to different locations, they remain stationary while in operation.

To achieve selectivity, Native fishers simply re-apply what they already know are effective fishing techniques. Selectivity was never an issue with Coastal First Nations because the techniques used effectively selected target fish. Selective fishing is not new for BC's Coastal First Nations; they have been able to fish selectively for thousands of years prior to the arrival of the first European settlers over 300 years ago.

Ironically, First Nations fishing techniques were initially seen as a threat to the survival of salmon because they were accused of taking fish away from the newly developed vessel fishery.[98] Interestingly, many non-aboriginal fishers recognize the effectiveness of these selective fishing techniques and have chosen to forego conventional fishing gear modifications in order to utilize Stationary SFTs. Commercial fishers are now attempting to use techniques that had long been mastered by Coastal First Nations fishers.[99]

Discussing selective fishing from the perspective of First Nations is essentially a review of traditional fishing methods as opposed to a survey of developments of new fishing techniques or modifications to conventional gear. Fishing gear traditionally used by Coastal First Nations are selective to begin with because they offer the opportunity to capture fish alive so that non-target species or stocks can be released unharmed. Thus, they require no substantial modifications to the way they are used to capture salmon.

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[98] Meggs, Geoff. ibid. pg. 53.
[99] i.e.: Floating trap. Many of the experimental selective fishing techniques that have received funding from F&O are of this type. See F&O website: <www.pac.dfo-mpo.gc.ca>

Coastal First Nations have used several fishing techniques in the past which are beginning to gain recognition and acceptance in the mainstream commercial fishing industry; they include: Fishtraps, fish weirs, (or fish fences) with dip nets and spears being used either individually, or in conjunction with all three.

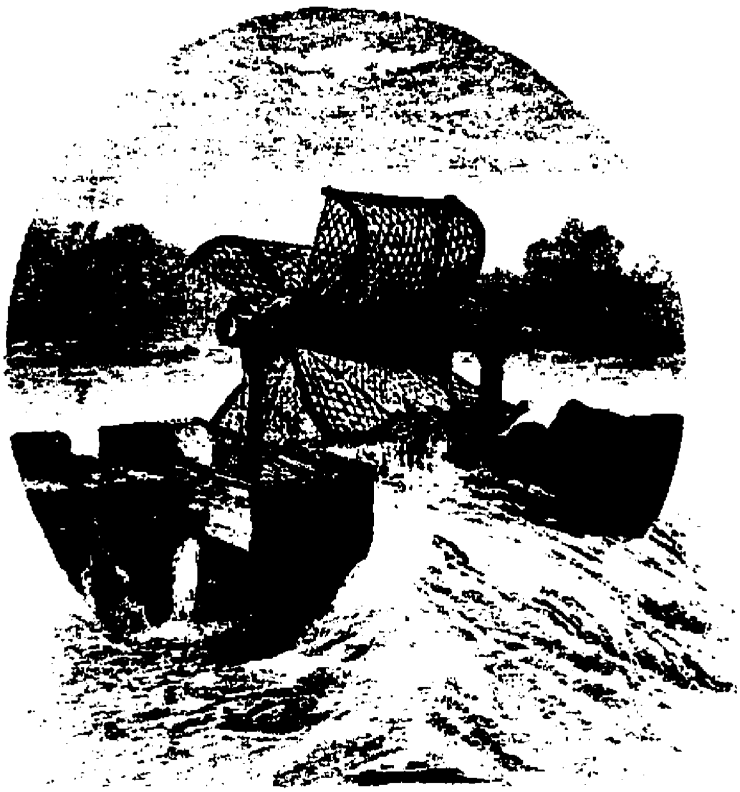
4.2.5.1 FISHWHEELS

First discovered in the eastern US during the 1700s, fishwheels have been in use on the west coast of Canada and Alaska since the 1870's.[100] Though not a First Nations fishing method, the essence of the fishwheel's technique is similar to other stationary SFTs and is thus included in this section. A fishwheel is a device shaped like a watermill that is set on two pontoons, one on each side, with three or four baskets attached at equal spacing on the wheel (see fig. #16). When positioned in a flowing river, the force of the water propels the baskets and hence creates the turning of the wheel to which they are attached. In order to get fish to swim towards it and subsequently into one of the baskets, a lead is used to direct the fish towards it. The lead is simply a net or fence of some sort that is attached to the base of the fishwheel, extending at an angle across the river. When positioned correctly, the lead will successfully make the fish swim towards the wheel where it then becomes scooped up in one of the revolving baskets.

Once caught in a basket, the fish is lifted up out of the water and as the wheel rotates, the fish slides out of the basket into a holding area that is set in the river. This method of capture eliminates handling and minimizes stress for non-target species because the fish is contained in a natural environment prior to its release. Because the fishwheel is stationary and requires constant monitoring, operators can easily identify non-target species as they are caught so that they may be released with minimal delay and stress.

[100]Donaldson, Ivan J, and Frederick K. Cramer. 1971. *Fishwheels of the Columbia.* Portland: Binfords and Mort.

Figure 16 Traditional Fishwheel



Source: Donaldson, Ivan J, and Cramer, Frederick, K. 1971. *Fishwheels of the Columbia.* p. 8. Portland: Binfords and Mort.

4.2.5.2 FISHTRAPS

Like the fishwheel, the fishtrap device is as it sounds: a trap (see fig. #17). The principle workings of fishtraps relied on the salmon's inherent journey back to its natal stream. While the structure of fishtraps varied greatly, their principal operating mechanism was to trap salmon as they entered the river. The different types of traps utilized the habits of returning salmon in order to capture them. For example, a box trap was used at locations where salmon needed to jump over an obstacle in order to continue up stream. An obstacle would be positioned at the location where the salmon needed to jump, and then after it went over the obstacle, it was unable to continue because it had jumped into a box like structure with a roof that kept them from advancing or retreating. Other types of trap devices relied on the motion of the tides in order to trap salmon when the tides receded.[101] The following is a descriptive account of the mechanisms of stone fish traps as reproduced from: 'Indian fishing' by Hilary Stewart:[102]

"Salmon often congregate at the mouth of a stream or creek so that spring runoff or late summer rains may swell the river and make it deep enough for their passage upstream. As the tide receded, they became trapped behind the stone walls, unable to retreat to deeper water."

A modification that has occurred with the traditional basket trap is with its placement. In an experimental fishery during the 1998 season, a group developed a mobile fish trap that was similar to the one outlined above, but could be floated and moved to different locations. It also utilized a lead in order to direct the fish towards the trap opening.

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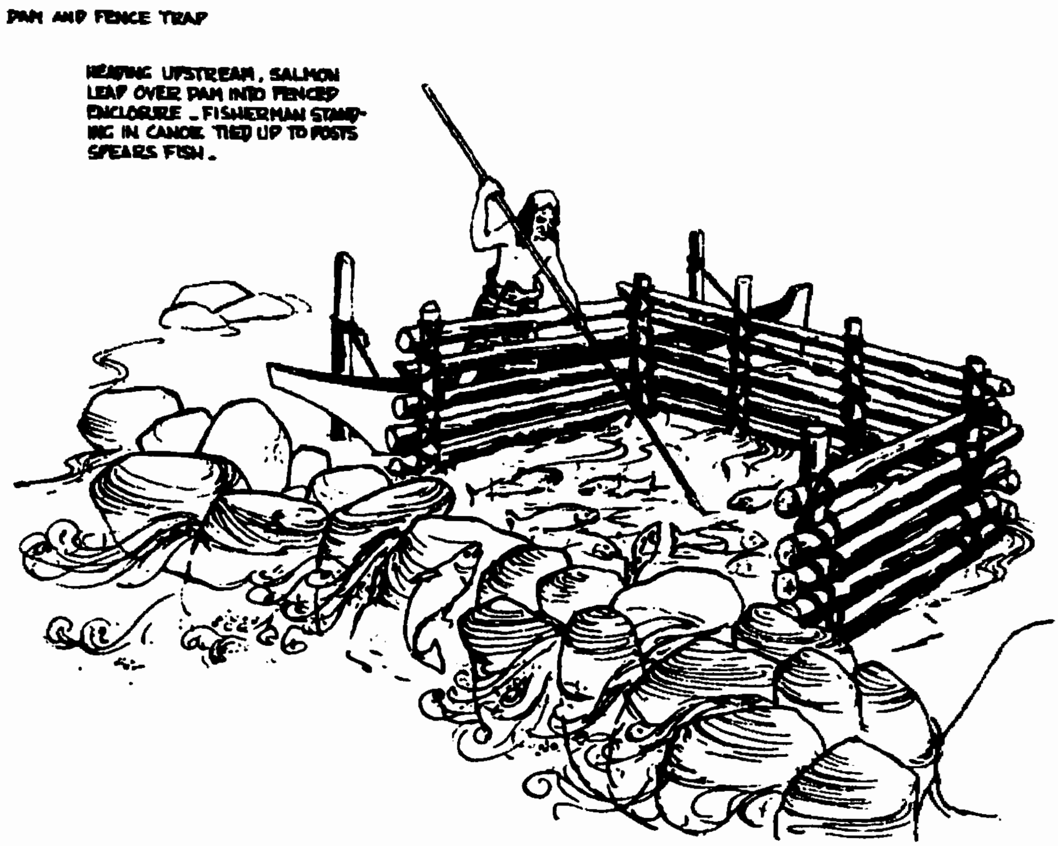
[101]In the chapter on Traps and Weirs, Hilary Stewart identified eleven different types. Apparently, variations in trap devices depended on the species of fish, the type of environment, the building materials available, and the cultural background of the people.
[102]Stewart, Hilary. 1977. *Indian Fishing*. pg.119. Vancouver: Douglas & McIntyre Ltd.

Figure 17 Traditional Fishtrap

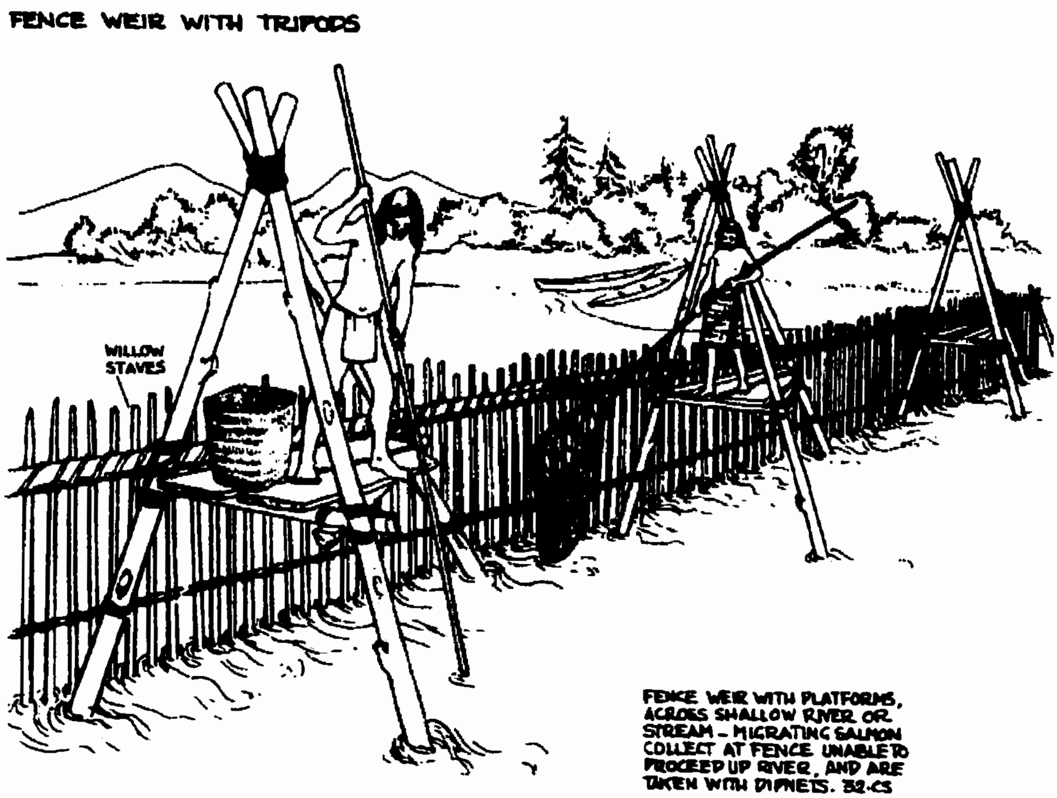


Source: Stewart, Hilary. 1977. *Indian Fishing: Early Methods on the Northwest Coast*. p. 108. Washington: University of Washington Press.

4.2.5.3 FISHWEIRS

Fishweirs also rely on the behavioral patterns of salmon to be effective. Quite simply, a fishweir is a fence-like device that extends across a river and halts the salmon from advancing further upstream (see fig. #18). Again from Stewart: "Weirs were built in shallow estuaries, rivers and streams, either to block the upstream passage of salmon or to guide the fish into a trap-or towards the fisherman with waiting spear. Some fence weirs consisted of...latticework sections lashed to the upstream side of a sturdy framework in the river."

Figure 18 Traditional Fishweir



Source: Stewart, Hilary. 1977. *Indian Fishing: Early Methods on the Northwest Coast*. p. 104. Washington: University of Washington Press.

4.2.5.4 BEACH SEINES

A beach seine involves the use of a seine net that is operated primarily from a land based position. One end is fixed on shore while the other is dragged into the water by a boat encircling a school of fish. Beach seines are smaller than conventional seine nets and are not as mobile. These factors allow for more selectivity because each set is smaller and therefore easier to sort. Fish are able to be handled with more care because power drums are not used. They can also be monitored more easily because of their shore-based placement.

4.2.5.5 DIPNETS

Dipnets were a device that was used to select salmon out of an area where they had been captured by one of the aforementioned devices. A dipnet looks like something between a lacrosse stick and large tennis racket. A long handle held by the fisherman is fitted with a large round net at the end (see fig. #18). A fisher holds it at one end and dips the net portion into the water where the fish is held and scooped up and out of the water. Dipnets allow for more useful observation because only one fish is removed at a time. The fish can then be assessed and kept or returned to the water depending on what information is learned.

4.2.5.6 SPEARS

Fishing spears could be described as a long, narrow two or three-pronged spear where the one or two outer spears are bent in at the tip. These outer prongs keep the fish from sliding off once it has been speared. As with the dipnet, a spear would often be used in conjunction with other devices to remove fish from the river. A fishing spear is simply a long stick or pole with a sharp pointed end. The end would be used to stab a single fish and remove it from the water. Both dip nets and spears were used historically to 'single out' fish that were caught by a trap or weir. Spears were also often used on their own without the use of traps and weirs. Fishers would simply stand above a section of river and 'stab' at fish that swim by.

5.0 1998 F&O Policy Initiatives- A Chronology

The new F&O approach to selective fishing involved the development of new selective management techniques (SMTs) so as to foster the integration of new selective fishing techniques (SFTs) into the salmon fishery.

These practices have already been introduced on a small-scale and some are showing signs of success at reducing the interception of non-target species. The 1998 "Coho Crisis" expedited the development of new gear and alternative methods of fishing. F&O published many papers and several plans and announcements were made during 1998 that influenced and reflected the direction they wanted SF policy to take for the future.

The compilation of initiatives presented below is by no means an exhaustive list of every paper, press conference and press release given by Honorable Minister David Anderson (former F&O Minister; Anderson was replaced by Herb Dhaliwal in 1999). It is simply a compilation of those deemed relevant to the initiation of SFTs in the commercial salmon fishery.[103] It was hoped that there would be an opportunity to compile some industry response to each initiative, however during a review of public media from 1998, it was discovered that most of the news articles dealt with the Pacific Salmon Treaty controversy with the Alaskans, which occupied much of the media's attention in 1997 as well.[104] After each announcement summary, there is a brief examination of its relevance to selective fishing and related issues.

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[103]For a complete list of every 1998 press release, minister statement and backgrounder given by F&O, see the F&O website:
<www-comm.pac.dfo-mpo.gc.ca/english/release/p-releas/index/pr98.htm>

[104]During a search of the Canadian news index for 1998 and 1997, using the key words: 'salmon', 'fishery/ies' and 'pacific', 95% of the articles were about the Pacific Salmon Treaty, and issues that had arisen from the dispute between BC and Alaskan fishers.

5.1 Initiative #1 -Discussion Paper

On January 9, 1998, the Pacific Region of F&O published a plan-oriented discussion paper introducing the need for incorporating selective fishing more broadly into the Pacific salmon fishery beyond presently existing small-scale experiments. The purpose of the paper was to introduce selective fishing ideals and encourage commercial and Aboriginal fishers to develop individual selective fishing techniques so they could reduce the impact on non-target species and stocks. There were two reasons why this initiative was taken.

First, during the previous ten years, commercial salmon fishers had been increasingly subject to reductions and changes to time and area openings, observer programs and a variety of adjustments to fishing gear, which ultimately led to reduced commercial fishing opportunities. F&O officials felt that the incorporation of SFTs would allow fishers the chance to regain some of those lost opportunities.

The second reason SFTs were proposed, was that the inadvertent interception of weaker salmon stocks continued to occur, especially in the commercial sector, despite efforts to minimize impact on weaker stocks that mixed with target stocks. In addition, conservation concerns for many weaker, non-target salmon species remained high, particularly for coho.[105]

The paper offered a summary of the issues pertaining to the need for selective fishing, including a list of objectives, guiding principles and possible options. It not only represented the first step taken by the F&O to adopt an industry wide selective fishing strategy, but also laid the groundwork for the development of rules and regulations that

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[105]F&O discussion paper. 1998. 'Selective Harvesting In The Commercial Salmon Fisheries' published by F&O Pacific Region.

could be used to assess proposals for selective harvesting methods.[106] There also was an invitation for partnerships between the F&O and industry participants to develop an effective selective fishing management strategy. The partnership factor is important because the paper invited local stakeholder input in the areas of gear modifications and fishing practice changes. This invitation appeared to represent a break from past policy initiatives where the DFO had utilized a more 'top-down' style of management.[107]

It is important to note that the nature of selective fishing and the changes it brings to the operations of salmon fishing offers an ideal opportunity for grass roots involvement that extends beyond consultation. In its January discussion paper, F&O indicated that it wanted to: 'obtain input on how to evaluate individual proposals for selective fishing techniques (and) encourage and support their development.'

This statement indicates two critical things. First, by placing the responsibility on fishers to develop SFTs, F&O is actively involving the very stakeholders whom the policy applies to; second, such an invitation could lay the groundwork for effective cooperative management[108] partnerships to develop in the future because the effectiveness of selective fishing is contingent on the ability of fishers to make tangible modifications to their gear and fishing practices. In summary, the new selective fishing paradigm can not be dictated by F&O without direct stakeholder participation and this has positive

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[106]F&O discussion paper, ibid.

[107]The most recent example being the Mifflin Plan, where despite community consultation in the form of round table discussions, F&O minister developed a fleet rationalization plan based on industrialization of the fleet through centralization and consolidation. See chapter 3.

[108]Cooperative management refers to the sharing of responsibility of some aspects of the salmon fishery. The degree of responsibility can fluctuate, and such a definition of these is beyond the scope of this paper. See Pinkerton, Evelyn. 1989. *Co-operative management of local fisheries: new directions for improved management and community development* Vancouver: UBC Press, for a comprehensive definition of the various levels of co-management.

implications for the future because co-operation would likely ensure compliance to future policy.

5.2 Initiative #2 -Announcement

On February 26, 1998, Federal Fisheries Minister, David Anderson announced the creation of a special Coho Response Team (CRT) to deal with the decline in coho stocks.[109] The team consisted of experts from the areas of fisheries management, enforcement, science, and habitat and enhancement. Their mandate was to determine the best course of action to conserve and rebuild the coho populations in British Columbia by working in consultation with First Nations, the commercial and recreational sectors, environmental groups, communities and the public.

The "Coho Crisis" (see section **3.1.1.1 Coho Salmon Stock Declines**) was arguably the decisive event that brought about the development of a broad based, industry wide selective fishing strategy. The coho recovery plan was deemed necessary by all affected parties and was readily supported. The only concern of F&O that could develop would be with whether the recommendations made would be endorsed as strongly.

As noted earlier, there are several groups representing fishers from all over the province, each with different mandates. As a result, obtaining consensus on any recommendation made by F&O or expert panel can be very difficult to achieve. For example, if it were recommended that all salmon fishing be canceled for fishers of the Skeena watershed for a season, then fishers of the area would obviously be prepared to dispute the findings of the report because of the ramifications it would have on them as fishers who are dependent on that area.

[109]F&O News release: 'Minister Announces Pacific Coho Response Team', #NR-PR-98-09E, February 26, 1998. See website address: <www-comm.dfo-mpo.gc.ca/english/release/p-releas/index/pr98.htm>

5.3 Initiative #3-Announcement

On April 24, 1998, the Minister presented his plans to incorporate a series of pilot projects for SFTs in to the commercial salmon fishery as part of a more conservation based management strategy.[110] "More selective harvesting methods gives the commercial salmon fleet increased opportunity to fish, while allowing us to protect weaker stocks of salmon, particularly coho, chinook and steelhead," Mr. Anderson said.

The goals of the new selective fishing pilot program were to:

- develop new and improved selective fishing technology and equipment;
- improve knowledge on more selective fisheries (harvest timing, fish behavior, geographic areas)
- achieve specific conservation goals for 1998;
- promote partnerships and coordination among fishermen with DFO.[111]

This announcement gave the go-ahead for fishers to use their ingenuity and experience to develop selective methods of fishing. The motivation for volunteering to develop selective fishing techniques includes two components. First, it allowed fishers a guaranteed opportunity to fish in a red zone while being funded by the government. In the opinion of the author, the second and perhaps more significant motivation, was that it gave the fishers the opportunity to develop techniques before the rest of the industry had a chance to use them. This is important because if a SFT developed by a fisher was chosen by F&O to be adopted industry-wide at a future date, the fisher who developed it would not have to go through the process of learning about the technique and purchasing

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[110]DFO News release: 'Selective Harvesting in Commercial Salmon Fisheries Moves Ahead', #NR-PR-98-23E, April 24, 1998, from website address: <www-comm.pac.dfo-mpo.gc.ca/english/release/p-releas/index/pr98.htm>
[111]When this statement was made, F&O was referred to as the DFO (Department of Fisheries and Oceans).

the necessary equipment because these things would have already been done during the testing phase of the SFT. This would give the fisher a competitive fishing advantage during the early stages of their SFT being introduced industry-wide.

Following this announcement, F&O issued a call for selective fishing proposals to be used as pilot projects in determining how successful each sector could be at protecting non-target salmon species.[112] A series of selectivity parameters were then established to assess the selectivity of experimental fishing proposals.[113] These were:

Gear Improvements: including adjustments to mesh size, hang ratio and weed lines for gillnets, modified bunts for seine nets and restrictions on hook size or lure type for troll fisheries.

Management Changes: including a better understanding of the biology and behavior of the target and non-target species. Time and area closures, ribbon (very small) boundaries, spot closures in holding areas and time sequence closures.

Fishing Practice Changes: including brailing from purse seines, picking gill nets more frequently and using live boxes to increase the chances of survival of released fish.
Some ranking criteria were established as a guide for choosing from among the selective fishing proposals. Each of the following criteria also included a series of questions.[114] In descending order of importance, they were:

- Conservation- this was the most important consideration of any selective fishing

[112] 90 pilot project proposals were received by F&O up to July 3, 1998.
[113] The sectors include the sport fishery, Native fishery, and commercial fishery which can be further sub-divided by gear type, including: troll, gillnet and seine.
[114] For a complete list of the questions that were included in the criteria, see appendix #2.

proposal. Its maximum assigned point value was 130, which was 50% of the total possible.

- General Manageability- Its maximum assigned point value was 20.
- General Future Applicability to the commercial sector- This section examined the question: to what extent will the proposal result in information and knowledge that can be broadly applied in the commercial sector? Its maximum assigned point value was 25.
- First Nations- This section examined the question: to what extent will the proposal result in information and knowledge that can be broadly applied to First Nations? Its maximum assigned point value was 25.
- Likelihood of Success- This section examined addressed the question: how likely is the project to succeed? Its maximum assigned point was 25.
- Additional Benefits- This section asked: what additional potential benefits will the method likely provide? Its maximum assigned point value was 20.
- Project Design- This final section was assigned a maximum point value of 20.
- Support Required- This section examined the question: how much financial, DFO staff or other resources support is required? Its maximum assigned point value was 20.

The total number of points that could be attained was 260. In order for any project to be given consideration, it had to score a minimum of 130- at least 50% of the point total.

A brief examination of these parameters reveals the factors considered important by the F&O with respect to SFTs. It is clear that conservation is first and foremost on the list; it accounts for almost 50% of the point total, the total of the points for the remaining seven factors was just under 50%. Conservation is critically important; every industry participant realizes that.

The remaining factors, however, indicate no real hierarchy of importance. Future applicability, First Nations applications, and Likelihood of success were each assigned a 25 point value; five more than the remaining four factors, Project design, General manageability, Additional benefits and Support required, which were assigned 20 points each.

Based on previous press releases, it is clear F&O and Minister Anderson wanted to see selective fishing become an integral part of any future management plans, but that immediate conservation was the most important goal.

5.4 Initiative #4-Announcement

On May 21, 1998, Fisheries Minister David Anderson announced some specific conservation objectives to protect and rebuild BC coho stocks. Anderson cited information he received from the Pacific Stock Assessment Review Committee (PSARC), who stated that Upper Skeena and Thompson river coho stock aggregates were extremely depressed and would continue to decline in the absence of any fishing mortality under current marine survival conditions, and that some individual spawning populations were at high risk of biological extinction.

Two conservation objectives were then stated:

"1. Zero fishing mortality for critical upper Skeena and Thompson coho stocks.

2. Where upper Skeena and Thompson coho stocks are not prevalent, I will entertain proposals for selective fisheries which can demonstrate that the risk of coho bycatch mortality will be minimal."[115]

Anderson went on to say that these two objectives would be used as a guide to develop

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[115]F&O news conference, #NR-PR-98-36E, May 21, 1998, Vancouver, BC, from website address: <www-comm.dfo-mpo.gc.ca/english/release/p-releas/index/pr98.htm>

harvest management plans for 1998 and beyond. He further stated that the two objectives would not address all the challenges that face the BC salmon fishery, but that:

- More action would be needed to protect and restore salmon habitat.
- More action would be needed to address structural problems in the commercial fishery, including over-capacity and economic viability.
- More action would be needed to help fishing communities find a prosperous future.

Stating a zero mortality objective for all Thompson and Upper Skeena river coho was a bold initiative. It also led to reduced fishing areas for the entire season, though Anderson said in the accompanying press release, that he could have closed fishing for the entire season, which would have ensured zero mortality.[116] The avoidance of Coho was the primary selectivity goal for the 1998 season. As a result, all of the selectivity plans for 1998 focused on modifying gear and fishing practices so as to avoid or release unharmed, any incidental Coho catch.

5.5 Initiative #5-Announcement

Less than four weeks later, on June 19, 1998 Anderson announced a comprehensive Salmon Management Plan and Coho Recovery Plan which included $400 million to be spent over five years in order to address the issues that had been outlined in the previous announcements, including:[117]

- changes to harvesting practices;
- increased efforts in habitat protection and restoration;
- strategic stock enhancement programs for coho stocks most at risk; and

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[116]At least from Canadian fishers. The dispute with the Alaskans was at issue here because they were accused of capturing coho salmon originating from the Upper Skeena river system.

[117]F&O: 'Announcement of Canada's Coho Recovery Plan and Federal Response Measures', #NR-PR-98-49E ,Vancouver BC, June 19, 1998, from website: <www-comm.dfo-mpo.gc.ca/english/release/p-releas/index/pr98.htm>

- strengthened stock assessment and enforcement.

A Salmon Management Program was designed within the confines of Anderson's May 21st announcement where he divided the entire coast into either red or yellow zones, based on the abundance of coho. The main elements of the plan were as follows:

- no directed wild coho salmon fisheries would be permitted and there would be a mandatory non-retention of coho for all areas of BC;
- First Nations fisheries for food, social and ceremonial purposes would be respected;
- in Red Zones, a small number of highly restricted, experimental fisheries for commercial, Aboriginal and recreational sectors would be conducted. Restrictive regulations would be enforced and monitored;
- in Yellow Zones, a limited number of selective fisheries for salmon species, other than coho, would be allowed. These fisheries would involve modifications to traditional gear and careful management using time and area restrictions;
- barbless hooks would be required for all trolling, and recreational fishermen in BC;
- there would be increased monitoring, observer programs and enforcement to ensure strict compliance in all fisheries; and
- in all cases, if significant coho encounters occurred, fisheries would be closed.

Anderson made the point that to achieve zero mortality for coho, he could have chosen to keep the fishery closed for the season. However, he wanted to allow fishing opportunities to continue, by allowing fishers to: "fish in a new way." He then outlined three areas of new federal measures addressing the effects to communities, restructuring the fishery, and protecting and rebuilding salmon habitat, as a fulfillment of policy goals outlined on May 21, 1998. They included investment in the following:

- the protection and rebuilding of salmon habitat;
- restructuring the commercial fishing industry by moving to selective harvesting, diversifying fishing income, and further reducing the fleet;

- and assisting people and communities to adapt to the changing fishery.

The monetary distribution to each of the three areas was as follows:

- $100 million investment for salmon habitat.
- $200 million for restructuring the fishery, which included a fleet reduction program.
- $100 million to assist people and communities to adjust to the changing fishery

The $100 million earmarked for salmon habitat would be invested over a five year period, and used to accomplish the following:

- establishing a permanent fund to provide financing for habitat initiatives;
- fostering community based watershed stewardship through Habitat Stewardship Coordinators and Auxiliary officers to increase awareness and protect habitat from further damage;
- extend successful programs for community habitat restoration partnerships;
- build on the Salmonid Enhancement Program with a stronger emphasis on strategic stock enhancement; and
- increase public awareness of factors affecting salmon stocks.

Anderson also committed $100 million in a series of measures to help people and communities adjust to the changing fishery. The key component would be to assist individuals from all sectors through the use of programs by Human Resources Development Canada, with a focus on helping them find work outside the fishery.

Two other departments were also involved with the community assistance measures; they were: Western Economic Diversification (WED) and the Department of Indian Affairs and Northern Development (DIAND). WED was expected to provide economic support in communities affected by restructuring, including small and remote centres. Areas of assistance included: expanding opportunities for ocean based businesses, eco-tourism and other local priorities. DIAND would be responsible for much the same thing, but with a particular focus on Aboriginal peoples.

As part of the restructuring element, Anderson committed $200 million to:

- restructure the fishery by starting a new license retirement program- known as the 1998 Canadian Fisheries Adjustment and Restructuring Program in order to reduce the number of licenses in the commercial fleet, which would theoretically reduce fishing capacity;
- make the remaining vessels fish more selectively;
- invest to diversify the fishery through value added initiatives. This also included the exploration of new and experimental fisheries and aquaculture for new species.

Minister Anderson increased the responsibility of local communities over habitat restoration by establishing a framework to allow the building of partnerships between the public, the private sector and all levels of government. The responsibility for fleet restructuring would remain with F&O, although Anderson did say that consultation with industry would take place and that they would work together to continue developing SFTs. Finally, the community assistance initiative would utilize the assistance of outside agencies to work with individuals from communities to re-establish themselves economically.

The summary of responsibilities for each component indicates some important facts with regards to future policy directions, particularly with the amount of participation by industry, government and communities in the areas of control and management.

5.6 Initiative #6-Announcement

On July 8, 1998 Minister Anderson stated his directive on selective fishing, which included the following:[118]

- Experimental projects would test modifications of existing gear and test new gear methods.
- Experimental pilot fisheries would be conducted in North and South Coast/Fraser areas.
- Any experimental projects in a Red Zone would have to have a near zero mortality for Coho stocks of concern.
- Experimental pilots in a Yellow Zone would have a minimum risk to Coho.
- Number of projects would be limited, and would have to generate important and credible information.
- Area licensing would be maintained.
- Experimental selective fishing pilots would be limited to existing license holders.

Allowing experiments to occur in red zone areas would provide the ideal environment for SFTs to be tested albeit with considerable risk. The guidelines under which they were launched does represent an amalgamation of current time and area controls with new gear and fishing techniques. It could also be considered an advancement in holistic management approach involving a more comprehensive combination of input and output controls. However, a concern with a 'near zero' interception target for coho, is the high risk of not being able to meet that goal. Furthermore, the target of 'near zero' is ambiguous, meaning that determining what constitutes a success may be difficult and subject to interpretation.

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[118]F&O minister announcement: <www-comm.pac.dfo-mpo.gc.ca/english/release/p-releas/index/pr98.htm>

5.7 Initiative #7-Announcement

As a continued part of Anderson's efforts to assist individuals affected by the coho conservation measures and long term restructuring, a voluntary tie-up program was announced on June 19. It stated that vessel owners who were prepared to forego fishing in 1998 would not have to pay salmon licence fees for the year and would receive payments to offset costs incurred prior to the fishing season. The tie-up payments were $6,500 for gillnet and troll boat owners and $10,500 for seine boat owners. Nearly 37 percent of vessel owners took advantage of the program. According to the numbers given in a July 31 news release, there were 2,135 gillnet licenses prior to the tie-up and 1,433 after, 494 seine licenses prior to the tie up and 426 after, and 1,003 troll licenses prior to the tie-up and 607 afterwards. In total, there were 3,632 licenses prior to the vessel tie up and 2,466 afterwards.[119]

5.8 Initiative#8-Discussion Paper

On October 14, 1998, F&O released a discussion paper to stakeholders describing the broad policy issues associated with the new approach to management and conservation of Pacific salmon fisheries.[120]

The paper defined twelve principles of management in three categories- conservation, sustainable use and improved decision making- covering the full range of activities involved in the management of the resource, and included many of the principles that had been operationalized during the 1998 season. However, it also established a framework for continued policy refinement: "...a detailed set of operational policies for the management of the salmon resource will be developed...details of operational policies on

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[119]F&O Press Release #NR-PR-98-63E from website address: <www-comm.pac.dfo-mpo.gc.ca/english/release/p-releas/1998/nr9863e.htm>

[120]F&O Backgrounder: 'A new direction for Canada's Pacific Salmon Fisheries'. Oct 14, 1998. Obtained from DFO Pacific Region website: <www-comm.pac.dfo-mpo.gc.ca/english/release/bckgrnd/1998/bg9816e.htm>

salmon allocation are required..."

5.9 Summary Of Initiatives

All of the initiatives were about policy outlines, definitions, goals, targets, strategies, etc....and how they could improve the status of the Pacific salmon fishery in some way. As noted, F&O officials partitioned the BC coast into two zones, yellow or red, based on the abundance of coho. This example of area management was also accompanied by a series of mandatory measures for all of the commercial gear types. These included mandatory observer programs, onboard revival tanks, logbooks in certain areas, hail in procedures, and dockside monitoring programs.[121]

5.9.1 Mandatory Selectivity Measures for 1998

For gillnets, the mandatory measures that were incorporated for 1998 included: a specific net design which varied by area, depending on the abundance and size of the coho encountered, maximum soak/set times of 30 minutes and daylight only fishing in some areas. Seiners had to brail their catch, and trollers had to use barbless hooks. All sectors had mandatory 'blue-boxes' for non-target species revival. These fish were carefully pulled from the net and placed in a box with flowing water. After observed recovery, they were then lifted from the box and placed back in the water.

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[121]Blewitt et. al. ibid. pg. 44.

6.0 DATA and ANALYSIS

The following is a presentation of the results of the 1998 commercial salmon season. The data is going to be used to do a comparison on selective fishing between the three commercial gear types. The numbers will be used to analyze the effectiveness of the selective fishing measures of each gear type with respect to coho conservation.

The data presented will include the number of vessels that fished from each gear type, the zone in which each fished, the numbers of fish caught, the number of coho that were encountered, the location of encounter, the number of coho mortalities and the number of coho mortalities and encounters in relation to target fish. There will also be a catch value analysis whereby the average price per pound for each species will be calculated for each gear type. It is not possible to examine the results against any previous targets; rather, the results need to measured against what was hoped for, which was of course the avoidance and non-retention of all coho, with the exception of a limited number of hatchery coho that were allowed to be retained by some First Nations groups and recreational fishers.

This is important because it was noted earlier that part of the long term challenge of the entire BC salmon fleet will be their ability to respond to short term conservation issues that are bound to arise again in the future. In other words, the 1998 season results for selectivity will be able to illustrate which gear was best able to cope with the coho conservation crisis.

Success or effectiveness must be defined. With the 1998 season to consider, successful selectivity encompasses two components. First and foremost, the ability to avoid coho, and second, the survivability of the coho that were incidentally captured and released. The number of coho that were estimated to have been encountered by each gear will be compared and contrasted, as will the number of coho mortalities. As noted, the coast was divided into yellow or red zones. F&O wanted a 'near zero' catch for coho in red zones, and a 'minimal risk' for coho in yellow zones. While a precise definition of the terms 'near zero' and 'minimal risk' is ambiguous, the essence of the whole idea is to not catch (or avoid) coho as much as possible.

6.1 Data Notes and Terms of Use

The following data were obtained from various F&O documents that were received through the mail, from the F&O website, or from the proceedings of workshops sponsored by F&O.

The data relating to the numbers of coho encounters and mortalities that were caught were categorized as preliminary. During the research period, it was discovered that it takes 2-3 years after a fishing season for data to be verified as final. When questioned about the completeness of the data, personnel at the catch statistics branch of F&O were unable to state with any degree of confidence, how complete they were.

However, the coho encounter and catch data that is used was presented at a February 1999 workshop, and had not been updated as of December 2000. It can be therefore be reasonably understood that any further changes to the data would not make a significant difference to the overall performance patterns that are presented.

The terms, 'encounters' and 'mortalities' are used to make a distinction between the two categories of coho caught. Encounters refers to the number of coho that were encountered by the gear but released live. Mortalities refer to coho that were encountered but could not be revived.

6.2 Season Summary

6.2.1 Vessel Numbers

A total of 3,254 salmon fishing licenses were issued just before the 1998 season. In 1998 there were 1,789 A licenses issued to the gillnet sector, 956 A licenses to the Troll sector and 442 A licenses to the Seine sector. There were 48 category F Gillnet licenses, 10 category F Troll vessel licenses, and 6 category F Seine vessel licenses issued prior to the 1998 season (see section **2.3 Licensing Regulations** for details about licence classification). There were also 254 category N Gillnet vessels issued. In total, 3,505 salmon licenses were issued to fish for salmon for the 1998 season, of which 2,091 were gillnet licenses.[122]

However, as noted earlier, there was a voluntary tie-up program initiated for vessel owners who did not want to fish the 1998 fishing season. After this program there were a total of 1,433 gillnet licenses, 426 seine vessels and 607 troll vessels.

6.2.2 Commercial Catch Summary

The pre-season forecasted total allowable catch of all species excluding coho, was 9.3 million fish and the actual catch was 9.2 million.[123] The total number of each species caught from the south coast, including the Fraser river was as follows: 1.3 million sockeye, 104,000 pink, 3.6 million chum and less than 12,000 coho, including fewer than 200 coho from the stocks of concern of the Thompson River and the upper Fraser. Due to conservation concerns over chinook, only limited commercial opportunities early in the season were permitted.

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[122]Fisheries and Oceans,"1998 Commercial Licence Status Report-Pacific Region" December 1998, from "Vessel and Personal Licenses Analysis Report and Licence Report".
[123]F&O, "Details of the 1998 Salmon Season Catch" March 1999. Obtained from the F&O website: <www-comm.pac.dfo-mpo.gc.ca>

Table 1 Commercial Catch Summary

1998 Salmon Fishery Review
CDN Commercial - Gill Net

LICENCE AREA	SOCKEYE	COHO LANDED	COHO MORT.	PINK	CHUM	CHINOOK	TOTAL
AREA C	195,000	-	15,000	140,000	687,000	9,000	1,046,000
AREA D	223,000	-	1,000	13,000	296,000	-	539,000
AREA E	234,000	-	<1,000	-	187,000	4,000	425,000
TOTAL	650,000	-	16,000	153,000	1,170,000	13,000	2,810,000

1998 Salmon Fishery Review
CDN Commercial - Seine

LICENCE AREA	SOCKEYE	COHO LANDED	COHO MORT.	PINK	CHUM	CHINOOK	TOTAL
AREA A	57,000	1,000	29,000	1,922,000	956,000	1,000	2,966,000
AREA B	456,000	2,000	5,000	51,000	2,983,000	0	3,497,000
TOTAL SN	513,000	3,000	34,000	1,973,000	3,939,000	1,000	6,463,000

1998 Salmon Fishery Review
CDN Commercial - Troll

LICENCE AREA	SOCKEYE	COHO LANDED	COHO MORT.	PINK	CHUM	CHINOOK	TOTAL
AREA F	85,000	-	16,000	33,000	10,000	117,000	261,000
AREA G	219,000	-	2,000	21,000	1,000	7,000	250,000
AREA H	129000	-	<1,000	18,000	105,000	1,000	254000
TOTAL	433,000	-	18,000	72,000	116,000	125,000	765,000

Source: F&O website address:

<www.pac.dfo-mpo.gc.ca/comm/english/fishery_updates/post_season/salmon_review>

The total number of each species from the north coast included: 336,000 sockeye,(no commercial fishery was permitted for sockeye from the central coast due to depressed numbers) 2.1 million pink, 1.6 million chum, 127,000 chinook and approximately 60,000 coho mortalities.[124]

6.3 The Gillnet Sector

Approximately 1,433 A gillnet vessels were licensed to fish during the 1998 season. 570 in area C, 305 in area D and 558 in area E. Prior to 1998, there were 1,826 that were eligible, however 19 were retired prior to the commencement of the fishing season and approximately 300 chose not to fish during the 1998 season, but remain docked. This occurred because of the voluntary vessel tie up program that was made available by F&O officials for fishers who may have felt that they would not have been able to harvest enough fish to earn adequate money. Fishers who chose not to fish the 1998 season did not have to pay the annual licence fee, and received a modest payment for keeping their vessels tied up.[125]

These vessels captured a total of 2,010,000 salmon during the 1998 season from areas C, D and E (refer to table #1). In area C, there were 195,000 sockeye harvested, 140,000 pink, 687,000 chum, 9,000 chinook and 15,000 coho by 570 vessels. In total, there were 1,046,000 salmon captured in Area C by the gillnet sector (see table #1). 1.4% of the total catch in Area C was coho.[126]

In area D, there were 229,000 sockeye, 13,000 pink, 296,000 chum harvested and 1,000 coho mortalities by 305 vessels. The total catch of coho as a percentage was less than

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[124]ibid.
[125]see initiative #8 in previous chapter.
[126]F&O: "1998 Salmon Fishery Review", from F&O website address: <www.pac.dfo-mpo.gc.ca/comm/english/fishery_updates/post_season/salmon_review>

one-tenth of one percent. In area E, there were 658,000 sockeye, 153,000 pink, 187,000 chum and 4,000 chinook harvested by 558 vessels. Fewer than 1,000 coho were captured. Overall, the percentage of coho caught to the number of other species caught was .8% (16,000 coho mortalities out of 2,010,000 million total).[127] It is not known whether these low percentages of captured coho were the result of a low number of coho returning or effective avoidance.

6.4 The Seine Sector

Approximately 426 category A Seine vessels, and 6 category F seine vessels captured 6,463,000 salmon in areas A and B. In area A, there were 57,000 sockeye, 1,922,000 pink, 956,000 chum, 1,000 chinook landed and 30,000 coho mortalities by 153 vessels. It must be noted that 1,000 of the landed coho were permitted for retention where hatchery surpluses were available. Slightly less than 1% (.98%) of the total number of fish captured in area A by seine vessels were coho (29,000 coho divided by 2,966,000 total).

In area B, there were 456,000 sockeye, 51,000 pink, 2,983,000 chum, 0 chinook and captured and 7,000 coho mortalities by 273 vessels for a total of 3,497,000 salmon caught in area B (see table #1). Of the 7,000 coho mortalities in Area B, 2,000 were permitted for retention because of hatchery surpluses. Only .14% of the total number of salmon harvested in area B were non-retention coho (5,000 coho divided by 3,497,000 total).

6.5 The Troll Sector

607 category A troll vessels landed a total of 765,000 salmon in areas F, G and H. In area F, 85,000 sockeye, 33,000 pink, 10,000 chum, and 117,000 chinook were captured along with 16,000 coho mortalties by 191 troll vessels. In area G, 219,000 sockeye, 21,000 pink, 1,000 chum, 7,000 chinook were captured along with 2,000 coho mortalities. In

[127] ibid.

area H, 129,000 sockeye, 72,000 pink, 116,000 chum, 125,000 chinook were caught and there were fewer than 1,000 coho mortalities (see table #1).

6.6 Sector Comparison

In absolute numbers, the gillnet sector had the fewest number of coho mortalities (16,000 compared to 18,000 for troll and 34,000 for seine). The percentage of coho caught compared to the total number of salmon caught was very low for each sector. Unfortunately, it is not known whether the low percentage of coho is the result of very low returns, or highly effective selectivity. The numbers must be examined within the context of where they were captured. Areas A, F, and C as defined earlier, all encompass a similar geographic area that includes the north coast of BC extending from Dixon entrance in the north, down to just north of Vancouver Island.

The Skeena river is located in statistical area number 4 which is inside areas A, C and F and is, as mentioned, the river of origin for some of the coho stocks that were listed as having critically low population levels. Furthermore, the area around the entrance of the Skeena river was categorized as a Red Zone, meaning that zero mortality was the target for coho salmon in that area.

6.7 Coho Mortalities

In these areas, gillnet vessels caught 15,000 coho mortalities, troll vessels captured 16,000 and seine vessels captured 29,000. If a coho mortality proportionate index (CMPI) can be established and calculated as being the number of coho mortalities per vessel divided by the number of target fish caught per vessel, then the 29,000 coho taken by 153 seine vessels, represents a CMPI of .97% per seine vessel. In comparison, 570 gillnet vessels caught the 15,000 coho, for a rate of 1.4% per gillnet vessel and 191 troll vessels caught 16,000, for a rate of 6.1% per vessel. This suggests that the seine sector was the most effective and efficient at not killing coho in this geographic area.

6.8 Coho Encounters

A second set of numbers worth comparing is the rate of estimated coho encounters by each gear type in the same area. As noted earlier, the North coast encompass statistical areas 1-11. In areas 2E, 2W,3,4,5,6,7 and 8, a net monitoring program was conducted by F&O to provide an estimate of encounter rates of each sector for the 1998 fishing season (see table #2).

Combining the numbers of coho encountered in all of these areas by gear type, seine vessels were estimated to have encountered a total of 117,936 coho, and gillnet vessels were estimated to have encountered 25,220 coho. In the data set, a ratio of some of the target species to coho was given for each sector in geographic area.

The seine vessel coho encounter estimate divided by the total number of fish harvested in those areas gives an encounter rate of .0481 or 4.81%. The gillnet encounter rate divided by the total number of fish harvested in those areas gives an encounter rate of .022 or 2.2%. These numbers represent a summary of the data from table two.
Troll vessels were monitored in a separate program that was conducted in area 2W where it estimated that, based on the data gathered, that 68,918 coho were encountered.[128] Unfortunately, this area is too small to do a similar comparison.

More definitive data measuring coho encounter and mortality rates for all three sectors was available from the South Coast, which included coho encounters and mortalities for

[128] F&O, "North and Central Coast Net Monitoring Program: Statistical Areas 2 east, 2 west, 3,4,5,6,7 and 8."Obtained from: "The Selective Fisheries Program Pacific Salmon Fisheries-Record of the Selective Fisheries Multi-Stakeholder Workshop" pp. 41-43, Feb 1 and 2 1999, Richmond, BC.

Table 2 North and Central Coast Coho Encounters

Area 2 West:	Seine
Sockeye	11
Pink	66,070
Chum	1
Coho	38
Ratio Pink : Coho	1,739 : 1

Area 2 East:	Gillnet	Seine
Sockeye	0	9
Pink	492	196,386
Chum	30,006	58,567
Chinook	1	
Coho	916	2,000
Ratio Chum : Coho	33 : 1	29 : 1
Ratio Pink : Coho		98 : 1

Area 3:	Gillnet	Seine
Sockeye	122,572	22,944
Pink	57,437	405,267
Chum	77,756	165,561
Chinook	2,254	110
Coho	13,543	10,665
Ratio Chum : Coho	26 : 1	16 : 1
Ratio Pink : Coho	6:1	38 : 1

Area 4:	Gillnet
Sockeye	66,220
Pink	17,834
Chum	17,263
Chinook	5,004
Steelhead	758
Coho	No data

Area 5:	Gillnet	Seine
Sockeye	3,376	27
Pink	1,339	75
Chum	1,599	31
Chinook	29	0
Coho	No data	No data

Area 6:	Gillnet	Seine
Sockeye	13,889	13,304
Pink	55,461	446,915
Chum	241,974	157,951
Chinook	257	215
Coho*	4,367	34,782
Ratio Chum : Coho	55 : 1	5 : 1
Ratio Pink : Coho		13 : 1

*Included in the data above is the 6-1 gillnet fishery which encountered an estimated 2,989 coho and harvested 117,133 chum (Ratio of 39 : 1)

Area 7:	Gillnet	Seine
Sockeye	15	95
Pink	240	7,844
Chum	28,369	87,443
Chinook	0	22
Coho	711	16,071
Ratio Chum : Coho	40 : 1	5 : 1

Area 8:	Gillnet	Seine
Sockeye	6,404	12,581
Pink	42,169	358,570
Chum	296,514	331,456
Chinook	5,269	364
Coho	5,683	54,400
Ratio Chum : Coho	52 : 1	6 : 1
Ratio Pink : Coho		7 : 1

Source: F&O, *The Selective Fisheries program Pacific Salmon Fisheries-Record of the Selective Fisheries Multi-Stakeholder Workshop*. pp. 42-43. Feb 1-2 Richmond BC, 1999.

areas G and H for troll vessels, B for seine vessels and D and E for Gillnet vessels. Troll vessels encountered a total 8,831 coho, with 2,296 mortalities, seine vessels encountered 10,235 coho with 5,270 mortalities and gillnet vessels encountered 2,202 coho with 1,321 mortalities (see table #3). A coho released to fish kept ratio was given in the data set for each gear and was calculated as being .02 or 2% for troll vessels, .003 or 0.3% for seine vessels and .002 or 0.2% for gillnet vessels.[129]

The gillnet sector had the highest rate of coho mortality to coho encountered, 60%, while the seine and troll sector had mortality rates of 51% and 26% respectively. If the number of coho mortalities is divided by the total number of coho encounters plus non-coho total, then the percentage is 0.46 for troll, 0.15 for seine and 0.14 for gillnet. This indicates that the gillnet and seine sectors had the lowest percentage of coho mortality to fish kept, while the troll sector had a rate that was considerably higher.

Table 3 South Coast Coho Encounters by Commercial Gear Type

Commercial	Total Coho Encounters	Est. Coho Mortalities	Non-Coho Total	Coho Released to Fish Kept Ratio
Troll-Area G	7,369	1,916	247.540	0.03
Troll-Area H	1,462	380	252,100	0.01
Troll SubTotal	8,831	2,296	499,640	0.02
Seine-Area B	10,235	5,270	3,490,047	0.003
Seine SubTotal	10,235	5,270	3490,047	0.003
Gillnet-Area D	1,992	1,195	538,481	0.004
Gillnet-Area E	210	126	422,603	0.000
Gillnet SubTotal	2,202	1,321	961,084	0.002
Commercial Total	21,268	8,887	4,950,771	0.004

Source: F&O, *The Selective Fisheries program Pacific Salmon Fisheries-Record of the Selective Fisheries Multi-Stakeholder Workshop*. pp. 47. Feb 1-2 Richmond BC, 1999.

[129] ibid. pp. 46-47.

6.9 Value Comparison

The number of target fish harvested compared to the number of coho that were encountered or killed can also be analyzed economically in order to give an idea of catch value. This can be obtained by taking the average price per pound for each species from the 1998 season, multiplied by the average size of each species, multiplied by the number of pieces harvested. The value of coho can then be compared to the value of the target species to determine which sector was able to achieve the goal having as low a value of coho as possible compared to the value of the rest of the catch.

According to 1998 price figures, the average value of sockeye salmon was $2.28 lb., chinook $1.90 lb., coho $0.64 lb., chum $0.29 lb. and pink were valued at $0.21 lb.[130] The average weight of sockeye salmon is 5.83 lb.., chinook 34.9 lb.., coho 9 lb.., chum 12.1 lb.. and pink have an average weight of 4 lb..[131]

Combining these numbers with the numbers of fish caught by each sector gives the following information. The total value of the sockeye caught by the gillnet sector was $8,746,399; chinook $862,030; coho $92,160; chum $4,105,530 and pink had a total value of $128,520. The total value of all fish caught including coho was $13,934,639. The percentage value of coho compared to the value of all fish caught was 0.66%.

The total value of sockeye caught by the seine sector was $6,819,001; chinook $66,310;

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[130]These figures are the average given for the value each species caught in all statistical areas because the value of the fish is partially based on where it was harvested. See the BC Salmon Council website address for further details: <www.bcsalmon.ca/database/price/area/fishpric.htm>

[131]These numbers are based on the weight in kilograms multiplied by 2.2. Where the average size of a species was within a certain range, the numbers were added together and divided by two before being multiplied. If sockeye weigh between 2.2-3.1 kg, the average weight in pounds would be 5.83. See F&O website: <www.pac.dfo-mpo.gc.ca/ops/fm/salmon/biology.htm> for further details.

coho $195,840; chum $13,821,951 and pink had a total value of $1,657,320. The total value of all fish caught including coho was $22,560,422. The percentage value of coho compared to all fish caught was 0.86%.

The total value of sockeye caught by the troll sector was $5,755,609; chinook $8,288,750; coho $103,680; chum $407,044 and the total value of pink was $60 480. The total value of all fish caught including coho was $14,615,563. The percentage of coho value to the total value of all fish caught was 0.71%.

6.10 Effects on the Status of Salmon Spawning Levels

The following is a brief presentation of coho escapement levels that were gathered at different in-river locations where coho conservation was of primary importance. These numbers were presented by F&O Official Blair Holtby during a post season review session in Vancouver on March 12, 1999.[132]

At a test fishery located at the mouth of the Skeena river, known as the Tyee test fishery, the coho test fishery index was at 52.3 as of August 25th 1998 (see figure #19). This level is over ten times that of 1997 and is significantly larger than the ten year average of 39.2 between 1987-1996. The Babine fence count on the upper Skeena was 4291 as of Nov 30th (see figure #20). This number was only 453 at the same time last year. It was also higher than the 1990-1999 average cumulative escapement of 4229. The South Thompson Coho escapement index has also increased from 1997 when it was .06. In 1998, that level was 0.11, while the ten year average between 1987-1996 was .35 (see figure #21). In the North Thompson, the index was .14, compared to .12 from 1997 and the ten year average of .22 (see figure #22).[133]

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[132]F&O website address:
<www.pbs.dfo.ca/comm/english/fishery_updates/post_season/salmon_spawn/sld001.htm>
[133]F&O Post Season Review-Status of Spawning Levels. A presentation of 12 slides by

Figure 19 Tyee Test Fishery Index

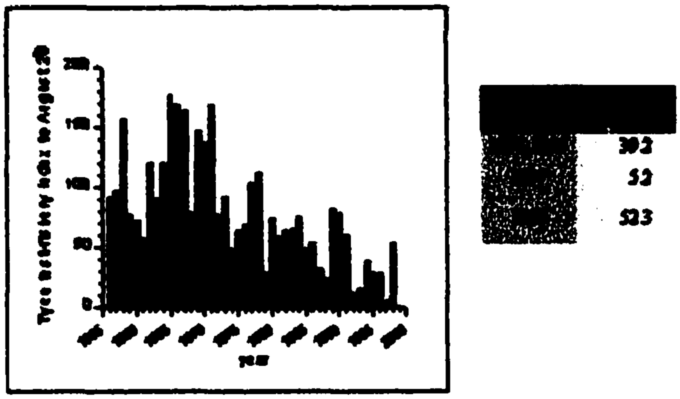
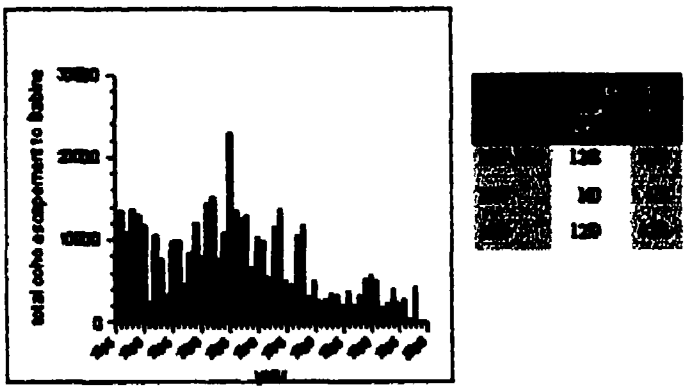


Figure 20 Upper Skeena Coho Babine Fence Count



Source: F&O website:

<www.pbs.dfo.ca/english/fishery_updates/post_season/salmon_spawn/sld001.htm>

Blair Holtby. See previous footnote for website address.

Figure 21 South Thompson Coho Escapement Index

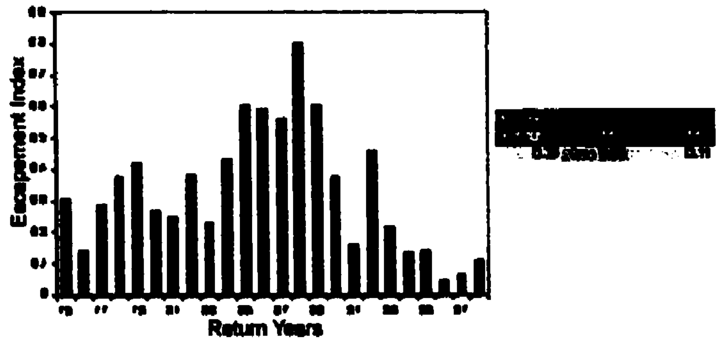
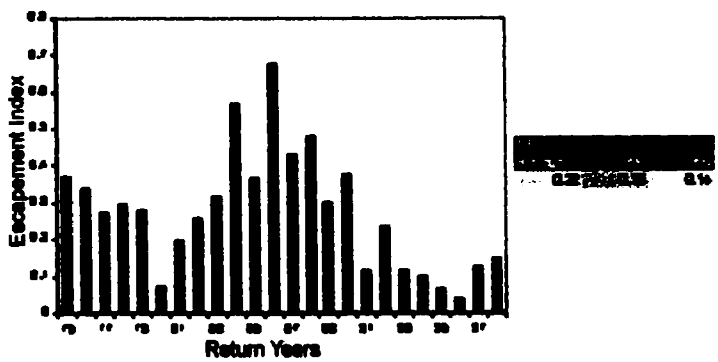


Figure 22 North Thompson Coho Escapement Index



Source: F&O website:

<www.pbs.dfo.ca/english/fishery_updates/post_season/salmon_spawn/sld001.htm>

6.11 Interpretation and Analysis

The data can not only be analyzed within the obvious context of coho conservation, but also within the context of government and industry goals. As noted earlier, the number of vessels permitted to harvest has steadily declined over the previous several seasons. Of course one of the goals of F&O of the 1998 selective fishing strategy was to create a smaller more economically diverse fishing fleet and for this to be accomplished without sacrificing conservation.

According to the numbers given, the gillnet sector had the lowest coho encounter rate on the north coast, the lowest encounter rate on the south coast and the lowest rate of coho mortality to target fish kept on the south coast. Furthermore, the total value of the coho catch of the gillnet sector as a percentage of their total catch was proportionately smaller than the seine and troll sectors.

With regards to the encounter rates, it must be noted that the numbers given for gillnets and trollers account only for the fish that were captured and released live. In the case of gillnetters, the numbers do not account for coho which may have come into contact with the net and then dropped out before being caught and released. In the case of the troll sector, the encounter numbers do not account for coho which may have struggled while on the hook and then fallen off prior to being counted and released. A report for the Minister of Fisheries and Oceans in 1992 suggested that this number could represent a substantial proportion of the catch.[134]

The drop out problem may still be an issue of concern, but it must also be noted that the selectivity measures utilized by the gillnet sector during the 1998 season (mandatory blue

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[134]see Larkin, P.A. 1992. Analysis of possible causes of the shortfall in sockeye spawners in the Fraser River. A technical appendix to "Managing salmon in the Fraser" by Peter H. Pearse. Department of Fisheries and Oceans, Vancouver, BC.

boxes, thirty minute soak times and daylight only fishing in some areas) were not in place during the 1992 season. As a result, the calculation on the number of possible drop outs made in 1992, would clearly not be an accurate reflection of the possible number of drop outs in the 1998 season.

Either way, the data given suggests that the gillnet sector was able to avoid coho most effectively while harvesting target species, and was thus more selective with regards to the avoidance component of selective fishing. The coho value harvested by the gillnet sector suggests that they were most effective at being able to harvest a higher proportion of the value of their catch with species other than coho, although it must be noted that all sectors had a total value of coho equal to less than 1% of the total value of their catch.

The areas where the gillnet sector did not show the best results was with coho mortality on the south coast and coho mortality proportionate index on the north coast. The gillnet sector had a very high rate of coho mortality as a percentage of those released or encountered (60% compared to 51% for seine and 26% for troll). This suggests that once a coho salmon is caught in a gillnet, it had a lower chance of survival, even with the selectivity measures in place. This can be attributed to the nature of the gillnet fishing technique, which as noted earlier entangles fish by their gills which does not allow them to breathe properly. Furthermore, the fish must be removed from the net and handled before they can be released and this handling may have induced additional stress on the fish.

The CMPI of gillnets in area A, which was categorized as a red zone, had a rate that was slightly higher than the seine fleet, (1.4% compared to .97%) although the troll sector had a rate that was substantially higher than both the gillnet and seine sectors (6.1%). The conventional selectivity of seine vessels was that all bycatch did not have the same probability of coming into contact with the webbing and suffering tissue damage and stress because of the 'scooping' nature of seine fishing. Furthermore, the gills of the fish were allowed to keep functioning while in the seine net. Seine vessels do not have the same problem of encounter loss either because the fish that are caught in the net do not have a chance to drop out and go unaccounted for.

The data from 1998 supports the fact that seine vessels do have a greater survivability success than gillnetters and that gillnet vessels must improve at being able to live release fish. However, in a fishery where avoidance is the goal, live release success be recognized as secondary when compared to avoidance figures. The best live release methods can not match the effectiveness of avoidance.

If selective fishing is going to be actualized as the new fisheries management paradigm for the future, crisis response plans to future potential conservation issues-such as the current coho problem-will need to be part of the overall management scheme. In other words, a long term selective fishing strategy must include provisions for adaptation.

There is the issue of enforcement and monitoring though. It is clearly more difficult to monitor and enforce control measures when there are a high number of vessels to monitor. Therefore, this needs to be addressed by F&O officials. The 1998 season had a much higher degree of monitoring committed by F&O which can certainly be a contributing factor to the success of the season.

F&O officials believe that this intensified enforcement and monitoring program from 1998 played a pivotal role in assuring industry compliance, which can no doubt be attributed to the improvements in coho avoidance and mortality rates that were indicated in the previous section. While the long term success of the 1998 programs will not be known until 2001, when the coho from 1998 will mature and return as spawning adults, after which the escapement will be known, the numbers indicate that a significant improvement in coho conservation efforts has occurred.

6.12 Recommendations

Based on what F&O wants to accomplish with regards to selective fishing and what sector participants were able to accomplish during the 1998 commercial salmon fishing season, the following are some recommendations that would enhance the development of selective fishing for gillnet fishers in the commercial salmon fishery. They address the primary issues that all industry participants have agreed are critical to the sustainability of the salmon fishery, and are also based loosely on the 'scoresheet' that F&O used for evaluating selective fishing experiments.

F&O wanted to allow maximum commercial fishing opportunities while protecting coho salmon stocks that were shown to be at dangerously low levels. They invested over $400 million into developing a more selective and economically efficient salmon fishery by reducing the number of fishing vessels, fostering selective fishing techniques, assisting small fishery communities, increasing enforcement and monitoring and enhancing salmonid enhancement programs. Underlying all of this was the recognition that salmon are of cultural and regional importance to British Columbians.

After the third and final round of the Voluntary Licence Retirement Program was completed, the number of vessels that remained in the fleet was around 1,893 down from the 4,112 that existed prior to the Mifflin Plan in 1996.[135] Just over 1,000 of those are gillnet vessels, many of which are based in mixed or aboriginal communities.[136] It can

[135]F&O Canada Backgrounder: <www-comm.pac.dfo-mpo.gc.ca/english/release/p-releas/index/pr98.htm>
[136]Robert Brown and Allen Wood developed a very useful community classification

only be hoped that further fleet or capacity reducing measures will not be required; that the number of vessels that remain will not be threatened in the future.

However, the risk of further vessel reduction plans will depend to a large degree on how successful the remaining fleet can be at fishing in a sustained selective manner. For the gillnet fleet, this translates into the ongoing evolution of selectivity measures so as to be able to eventually achieve an optimal level of selectivity (OLS).

OLS is an idea developed by the author and is based on the selectivity ideals which have already been established, incorporating industry and environmental objectives. However, a conceptual definition might be that it is a level of selective fishing that exists within a mixed-stock fishery (like salmon) whereby the risk to non-target stocks is small enough that pre-mature time and area closures during the fishing season and additional fleet reductions are minimized to 'near zero'. To be effective, it necessitates the development of a series of selectivity measures which could be implemented prior to each fishing season according to the conservation needs of the time.

The way this may work would be that F&O officials would announce prior to a fishing season, that a certain stock was at risk and would require a prescribed set of selectivity measures. Fishers from all sectors would then have enough knowledge and selectivity skill developed that they would be able to make the necessary gear adjustments. F&O officials would then have enough confidence in the effectiveness of the measures implemented that fishers would be assured prior to the season that they would have an opportunity to fish.

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scheme which categorized communities as either urban, mixed (rural-mixed native/non-native) or aboriginal. See Brown, R.C., et al., 2000. "Community Fisheries Licence Banking Trust", Webbed Feat Consulting, Lac Le Jeune, BC.

Achieving OLS would require ongoing SFT development as well as a multidimensional policy plan encompassing not only conservation, but the social and economic elements of the salmon fishery as well. Furthermore, it would require not only having enough selectivity options available, but strict compliance on the part of fishers and accurate stock assessments by F&O.

The idea of a multidimensional approach is the focus of attention in a paper by Parzival Copes entitled, "The Need for a Balanced Fisheries Policy". In his paper, Copes notes that policy measures of the past have too often been unidimesional, lacking the multi-dimensional perspective needed in the salmon fishery where there is a need for the incorporation of all three elements of fisheries management: biological conservation, economic efficiency and social equity.[137] He argues that unidimesional approaches which focus too heavily on only one of these elements has resulted in negative impacts on the others, and cites several examples of where such unidimensional policies have been carried out.

Achieving OLS may be overly optimistic. It has clearly not been achieved in the Pacific salmon fishery yet, but with ongoing development such as what occurred in 1998, it might be something to be strived for. The performance of the gillnet fleet during the 1998 season has proven that as a gear type, it deserves to be a part of any long term sustainable OLS commercial salmon fishery. If this is to occur, then certain requirements should be met. The following is a list of some recommendations that would not only facilitate the development of a selective gillnet fleet, but preserve the economic basis of many fishing dependent communities.

[137]Copes, Parzival. 1999. "The Need for Balance in Canada's Fisheries Policy". Discussion Paper. Institute of Fisheries Analysis, Simon Fraser University.

Recommendation #1- Acknowledge the success of 1998 and work to improve in the area of non-target species revival

The number one question asked under the ranking criteria for selective salmon harvest proposals was: does the proposed method avoid non-target fish? The answer for what gillnets were able to do for 1998 is a resounding 'yes'. It would be a good idea for F&O to consider and acknowledge what each sector was able to accomplish and build upon what worked. However, improvements must also be made.

While the gillnet sector was most successful at avoidance, data suggested that revival procedures need to be improved. While thirty minute set times were made mandatory for the 1998 season, (compared to normal set times of around two hours) these may need to be reduced further. Improved revival boxes may also need so as to increase the chance of live release. In fact, research from 1999 suggests that significant improvements to 'blue-boxes' have been made.

Research was conducted in Alberni Inlet during September 1999 with modified recovery boxes designed for a single fish with two water flow chambers and an exit chute. The water chambers forced water directly into the fishes mouth (known as forced ventilation) and the exit chute reduced the need to handle the fish a second time after recovery. Instead, the fish is released back into the water through a water filled chute.

The results of this research showed that with the newly designed revival box, known as a Fraser recovery box, mortality rates were in the range of 1-2%, compared to mortality rates of 45-60% for the blue box used in 1998.[138]

[138]Farrell et al. 'Physiological evaluation of coho recovery using the Fraser Recovery Box and netpen holding after capture by commercial gillnet fishing in Alberni Inlet, BC.' - DRAFT COPY- July 2000, Dept. of Biological Sciences, Continuing Studies in Science, Simon Fraser University, Burnaby BC. Forthcoming in the September 2000 Issue of Canadian Journal Of Fisheries and Aquatic Sciences.

The first step would be to acknowledge the avoidance success of the gillnet fleet. The conservation concerns of salmon and the need for greater stewardship are well publicized, and many locally based groups all over the province have taken a pro-active role in 'stream keeping'. It is important to make the results of the season known to the public so that people can understand how selective gillnetters can be and learn what they were able to accomplish.

Recommendation #2-Maintained enforcement and monitoring

One of the major issues that was outlined earlier was the problem of enforcement of regulations. However, as noted, enforcement and monitoring efforts were significantly enhanced for the 1998 season. This was mentioned as one of the main reasons why the conservation efforts resulted in 'dramatically reduced coho mortalities'[139]

Enforcement efforts used in 1998 should be maintained. The inspiration for maintaining such levels of monitoring are seen in the results of the fishery itself and by the fact that the salmon fishery is seen as a cultural icon of British Columbia that has a value which is arguably measurable beyond its economic return. Furthermore, fishers have stated that they are willing to do what is necessary to keep fishing. With this in mind, it is plausible to consider that enhanced monitoring efforts would be welcomed by fishers who see that any forms of non-compliance would seal the downfall of their livelihoods.

However, this latter point must be qualified. As noted earlier, enforcement and monitoring encompasses keeping track of the location and catches of individual vessels that fish somewhere along the BC coast. It could be argued that the industrialization

[139]Commercial salmon fishery review, pg. 1, obtained from F&O website: <www.pac.dfo-mpo.gc.ca/comm/english/fishery_updates?post_season/salmon_review>

strategy that F&O is accused of attempting to introduce would simplify monitoring because fewer vessels would need to be monitored. However, it must be considered that the owners of many large seine vessels do not have a vested interest in the long term health of the local salmon fishery because they are not owned and operated by individuals and families but by large fish processing companies that are based out of the lower mainland of BC.[140]

A fleet of small vessels that have a local interest would undoubtedly require more monitoring efforts; however it is possible that the fleet could eventually monitor itself, especially when it is considered that many of the monitoring efforts were conducted by local community inhabitants already. There is also the possibility that satellite monitoring could be introduced into the salmon fishery whereby each vessel would have a satellite tracking mechanism onboard. Satellite tracking systems for fisheries was introduced as a direct response to the high costs and difficulty of monitoring a fishing fleet.[141] Its use could offset the need for personal monitors on every vessel and could be used to keep tabs of where vessels are located and the amount of catch that is in the hull of the vessels.

Another monitoring option proposed by the author is the use of closed-circuit cameras onboard vessels. With the use of existing internet technology, it is possible that a camera could be positioned on the vessel in such a location that an enforcement or monitoring official could watch several crews from a central location. This may be seen as invasive, but certainly no more so than having someone onboard which has been one of the standard monitoring practices. On the other hand, having a camera may be welcomed for

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[140]After the initial phase of the Mifflin Plan in 1996, processors owned 35% of all seine licenses, which totaled 182 licenses at that time. As of 1995, 346 out of the 536 seine licence holders lived in the lower mainland. See ARA Consulting ibid. pg. 14-4.
[141]see Marshall, P. and Matthews, P. in 'Proceedings of the International Coference on Integrated Fisheries Monitoring', pp. 285-290 and 303-315. Sydney, Australia. Feb 1-5, 1999.

the very reason that it would mean no monitoring personnel would need to be onboard. Each of these monitoring options would likely be less expensive because they would require a one-time investment rather than repeatedly paying the cost of labour for one individual monitor.

Funding for community based enforcement, satellite monitoring or cameras could come from part of the $200 million that was slated for rebuilding the resource and community economic development and adjustment. There is no reason why community assistance measures could not include ongoing enforcement and monitoring training for individuals from the community. Having local residents continue to be involved with enforcement and monitoring may enhance compliance among small vessel owners because of the closer relationship they may have with each other.

As noted, F&O have also gone to great lengths to enhance community-based salmonid enhancement projects in order to foster the rebuilding of diminishing salmon stocks. It therefore stands to reason that the people who are responsible for enhancement are likely to go to greater efforts to monitor and maintain the resource than a someone who may be completely detached from these efforts.

Recommendation #3-Include criteria for conservation crisis adaptability

As part of the restructuring component of the program, $8.6 million has been spent on the selective fisheries projects aimed at promoting selective fishing. The criterion for selection of projects were outlined in chapter 4 and did include the consideration of future applicability and encompassed several questions (see appendix #2). It would be worthwhile to include a consideration that addresses future conservation uncertainties because these were the circumstances for the introduction of selective fishing in 1998. The ability of fishers to adjust to potential future conservation problems is important because conservation concerns with other stocks and species may be encountered in the future, and the gear mechanisms required for avoidance and live release may be different.

Recommendation #4-Address the drop out problem

Biologically, the gillnet sector proved to be the most effective gear type at avoiding coho salmon. This was proven through the sector comparison of the numbers and by the escapement figures given. However, it must be noted that gillnets were more destructive to fish caught than the other gear types. F&O should foster the continued development of the selectivity of gillnets by offering support in the development of methods to deal with this issue.

Recommendation #5-Maintain gillnet numbers

It must also be restated that the majority of the gillnet sector are based outside of the lower mainland in small fishing dependent communities.[142] Based on this fact and on the effectiveness at coho avoidance, it would be worthy for F&O to consider how best to maintain the gillnet fleet. Again it must be remembered that part of the overall management goal was to increase fishing opportunities and help fishing communities find a prosperous future. Assuring the maintenance of the remaining number of gillnet vessels would certainly be a measure that would contribute to this goal.

Recommendation #6-Support Ongoing Research

The time frame laid out for establishing a selective fishing regime was five years, (1998-2002) however if improvements are to continue to be realized, F&O should support ongoing research beyond the five year prescribed length of time, especially in light of the fact that the circumstances in the salmon fishery can change dramatically from year to year. This refers to the OLS ideal which would require an open-ended support

[142]ARA Consulting ibid. Appendix A.1

mechanism where funding would be available until all possible improvements were made.

The level of selectivity has clearly improved. Gear adjustments, time and area controls and enforcement measures all contributed to the better selectivity performance of the commercial fleet. Many of these improvements were realized through the efforts of researchers from a variety of backgrounds who continue to work at refining different areas of selectivity. Besides selective fishing, research has also been done on methods to maintain the number of fishing licenses in fishing dependent communities.[143]

Summary of Recommendations

The suggestions put forward would allow fishing dependent communities to fish at an increased rate. If the success of avoidance is maintained and stocks recover as a result of these efforts, it is possible that harvest opportunities will begin to increase. It is unfortunate that any gear type had to be diminished but the conservation concerns coupled with issues that are outside of the control of F&O (global salmon production competition, aquaculture production, poor ocean survival conditions, etc.) forced them to take action.

The 1998 season proved that gillnets are an effective SFT because of their ability to avoid non-target species. This does not mean that changes or improvements can not be made with respect to non-target fish revival, but clearly avoidance is the better of the two components of selective fishing and should be examined closely because conservation concerns for species such as steelhead, have and will continue to arise in the future.

[143]see Brown et al. ibid pp. 11-20.

7.0 CONCLUSION

The 1998 season was a watershed year in fishing management and operations. An industry wide focus on conservation was initiated by the collective efforts of Fisheries and Oceans officials, commercial, recreational and First Nations fishers, and resulted in a new level of operation in the areas of management, gear and enforcement and monitoring. The critical status of coho from the Upper Skeena and Thompson rivers served as a wake-up call to the entire industry that changes needed to be made if they were going to be able to continue a tradition of fishing that has been in place for over 100 years.

Poor ocean survival conditions, competition from Alaskan fishers, a growing salmonid aquaculture sector on both a local and international scale, and increased catch capacity have eroded the viability of the commercial salmon fishery. The first three of these factors can not be affected by commercial fishers. The issue of catch capacity has been a growing issue and the commercial sector has faced intense scrutiny for their perceived poor fishing practices. This was addressed by F&O through three rationalization plans prior to the 1998 season, the Davis Plan in 1968, the Mifflin Plan in 1996 and most recently, the 1998 Canadian Pacific Fisheries Adjustment and Restructuring program However, the results of the Mifflin plan raised a new issue of distribution and fairness.

Criticism was leveled at F&O for their perceived focus on trying to industrialize the fishing fleet into a small number of corporate controlled seine vessels. However, the gillnet fleet can, and have, made important changes to their gear which have, when combined with the management changes, proven that they can enhance and not diminish the status of critical BC salmon stocks. If F&O are committed to employing the maximum number of people in the fishery, they should consider maintaining the presence of those who can best steward the resource in the areas of harvesting and enhancement, which includes the strong participation of the gillnet sector whose owners and operators are based largely out of small communities.

1998 was also a test year. A test for the commercial fishers to determine how they could best adapt to the coho conservation crisis. All commercial sectors implemented the necessary changes, and each showed signs of improvement in selectivity. The numbers of incidental mortality and encounters had decreased and the numbers of spawning fish that had returned, indicated that a higher level of selectivity had been achieved.

Despite their notorious reputation, the gillnet sector proved to be a highly selective fishing technique under commercial fishing conditions. As a commercial gear type, it deserves credit for how it was able to successfully avoid coho more effectively than the other two gear types. Furthermore, they captured fewer coho mortalities. As a result, F&O should make an effort to foster the development of the remaining gillnet fleet. This would not only prove their commitment to a selective fishing fleet, but it would give gillnet fishers who operate out of small communities a measure of assurance that they are a valued part of the commercial salmon industry.

APPENDICES

Appendix 1. Historical Alaskan Catch Statistics

YEAR	SPECIES	NUMBER	WEIGHT	AVG WT
1970	Salmon, Chinook	645,000	11,554,000	17.9
	Salmon, Sockeye	27,622,000	152,703,000	5.53
	Salmon, Coho	1,524,000	11,879,000	7.8
	Salmon, Pink	31,096,000	117,389,000	3.77
	Salmon, Chum	7,476,000	53,717,000	7.18
	1970 Total	68,364,000	347,241,000	
1971	Salmon, Chinook	661,000	12,073,000	18.25
	Salmon, Sockeye	14,177,000	91,437,000	6.45
	Salmon, Coho	1,444,000	11,505,000	7.97
	Salmon, Pink	23,539,000	86,247,000	3.66
	Salmon, Chum	7,679,000	57,037,000	7.43
	1971 Total	47,499,000	258,299,000	
1972	Salmon, Chinook	554,000	9,747,000	17.6
	Salmon, Sockeye	6,999,000	43,650,000	6.25
	Salmon, Coho	1,834,000	13,010,000	7.09
	Salmon, Pink	15,913,000	51,521,000	3.24
	Salmon, Chum	6,655,000	53,817,000	8.09
	1972 Total	31,945,000	171,745,000	
1973	Salmon, Chinook	550,000	10,929,000	19.86
	Salmon, Sockeye	4,448,000	35,217,000	7.9
	Salmon, Coho	1,455,000	10,711,000	7.36
	Salmon, Pink	9,805,000	36,608,000	3.73
	Salmon, Chum	5,928,000	50,914,000	8.58
	1973 Total	22,186,000	144,380,000	
1974	Salmon, Chinook	559,000	9,627,000	17.24
	Salmon, Sockeye	4,789,000	31,995,000	6.66
	Salmon, Coho	1,860,000	13,722,000	7.38
	Salmon, Pink	9,857,000	40,106,000	4.07
	Salmon, Chum	4,698,000	39,484,000	8.4
	1974 Total	21,762,000	134,935,000	

YEAR	SPECIES	NUMBER	WEIGHT	AVG WT
1975	Salmon, Chinook	455,000	7,190,000	15.8
	Salmon, Sockeye	7,458,000	42,856,000	5.75
	Salmon, Coho	1,014,000	7,687,000	7.58
	Salmon, Pink	12,987,000	49,962,000	3.85
	Salmon, Chum	4,323,000	32,070,000	7.42
	1975 Total	26,237,000	139,765,000	
1976	Salmon, Chinook	531,000	8,948,000	16.84
	Salmon, Sockeye	11,779,000	75,674,000	6.42
	Salmon, Coho	1,432,000	11,176,000	7.8
	Salmon, Pink	24,755,000	102,409,000	4.14
	Salmon, Chum	5,924,000	47,661,000	8.05
	1976 Total	44,422,000	245,868,000	
1977	Salmon, Chinook	620,000	12,101,000	19.52
	Salmon, Sockeye	12,465,000	89,771,000	7.2
	Salmon, Coho	1,789,000	15,274,000	8.54
	Salmon, Pink	28,647,000	129,742,000	4.53
	Salmon, Chum	7,326,000	60,561,000	8.27
	1977 Total	50,847,000	307,450,000	
1978	Salmon, Chinook	836,000	16,304,000	19.5
	Salmon, Sockeye	18,140,000	116,766,000	6.44
	Salmon, Coho	2,821,000	19,978,000	7.08
	Salmon, Pink	53,852,000	183,992,000	3.42
	Salmon, Chum	6,677,000	52,599,000	7.88
	1978 Total	82,326,000	389,638,000	
1979	Salmon, Chinook	779,000	14,114,000	18.11
	Salmon, Sockeye	28,696,000	171,649,000	5.98
	Salmon, Coho	3,122,000	23,023,000	7.37
	Salmon, Pink	50,137,000	186,843,000	3.73
	Salmon, Chum	5,608,000	43,533,000	7.76
	1979 Total	88,342,000	439,163,000	

YEAR	SPECIES	NUMBER	WEIGHT	AVG WT
1980	Salmon, Chinook	675,000	12,501,000	18.53
	Salmon, Sockeye	33,295,000	186,699,000	5.61
	Salmon, Coho	3,115,000	22,425,000	7.2
	Salmon, Pink	63,304,000	217,944,000	3.44
	Salmon, Chum	9,603,000	71,804,000	7.48
	1980 Total	109,991,000	511,373,000	
1981	Salmon, Chinook	823,000	15,738,000	19.13
	Salmon, Sockeye	36,348,000	225,956,000	6.22
	Salmon, Coho	3,416,000	25,847,000	7.57
	Salmon, Pink	60,089,000	244,967,000	4.08
	Salmon, Chum	12,613,000	99,540,000	7.89
	1981 Total	113,289,000	612,048,000	
1982	Salmon, Chinook	877,000	16,898,000	19.27
	Salmon, Sockeye	28,954,000	188,538,000	6.51
	Salmon, Coho	6,040,000	46,508,000	7.7
	Salmon, Pink	64,859,000	219,159,000	3.38
	Salmon, Chum	10,994,000	90,604,000	8.24
	1982 Total	111,725,000	561,706,000	
1983	Salmon, Chinook	828,000	15,685,000	18.94
	Salmon, Sockeye	52,875,000	305,646,000	5.78
	Salmon, Coho	3,636,000	26,742,000	7.35
	Salmon, Pink	60,359,000	194,126,000	3.22
	Salmon, Chum	10,222,000	79,118,000	7.74
	1983 Total	127,921,000	621,317,000	
1984	Salmon, Chinook	667,000	12,526,000	18.79
	Salmon, Sockeye	38,450,000	222,833,000	5.8
	Salmon, Coho	5,405,000	44,919,000	8.31
	Salmon, Pink	76,343,000	276,751,000	3.63
	Salmon, Chum	13,096,000	104,052,000	7.95
	1984 Total	133,960,000	661,080,000	

YEAR	SPECIES	NUMBER	WEIGHT	AVG WT
1985	Salmon, Chinook	721,000	13,477,000	18.69
	Salmon, Sockeye	38,983,000	221,641,000	5.69
	Salmon, Coho	5,749,000	47,422,000	8.25
	Salmon, Pink	90,335,000	303,802,000	3.36
	Salmon, Chum	10,570,000	83,393,000	7.89
	1985 Total	146,358,000	669,736,000	
1986	Salmon, Chinook	616,000	11,714,000	19.01
	Salmon, Sockeye	32,208,000	194,564,000	6.04
	Salmon, Coho	6,293,000	46,607,000	7.41
	Salmon, Pink	77,320,000	259,303,000	3.35
	Salmon, Chum	12,510,000	97,094,000	7.76
	1986 Total	128,949,000	609,287,000	
1987	Salmon, Chinook	680,000	13,285,000	19.53
	Salmon, Sockeye	35,431,000	224,832,000	6.35
	Salmon, Coho	3,493,000	25,312,000	7.25
	Salmon, Pink	46,493,000	164,812,000	3.54
	Salmon, Chum	10,527,000	80,363,000	7.63
	1987 Total	96,626,000	508,612,000	
1988	Salmon, Chinook	589,000	10,916,000	18.54
	Salmon, Sockeye	30,038,000	188,553,000	6.28
	Salmon, Coho	4,473,000	35,458,000	7.93
	Salmon, Pink	50,358,000	177,900,000	3.53
	Salmon, Chum	15,105,000	121,653,000	8.05
	1988 Total	100,564,000	534,486,000	
1989	Salmon, Chinook	572,000	11,314,000	19.79
	Salmon, Sockeye	44,139,000	260,672,000	5.91
	Salmon, Coho	4,650,000	33,178,000	7.14
	Salmon, Pink	96,869,000	331,468,000	3.42
	Salmon, Chum	7,896,000	61,628,000	7.8
	1989 Total	154,129,000	698,281,000	

YEAR	SPECIES	NUMBER	WEIGHT	AVG WT
1990	Salmon, Chinook	666,000	11,481,000	17.24
	Salmon, Sockeye	52,693,000	305,521,000	5.8
	Salmon, Coho	5,478,000	40,019,000	7.31
	Salmon, Pink	88,208,000	271,866,000	3.08
	Salmon, Chum	8,010,000	62,722,000	7.83
	1990 Total	155,058,000	691,626,000	
1991	Salmon, Chinook	613,000	10,740,000	17.51
	Salmon, Sockeye	44,646,000	255,646,000	5.73
	Salmon, Coho	6,153,000	43,879,000	7.13
	Salmon, Pink	128,336,000	349,300,000	2.72
	Salmon, Chum	9,769,000	69,685,000	7.13
	1991 Total	189,517,000	729,250,000	
1992	Salmon, Chinook	606,000	10,768,000	17.78
	Salmon, Sockeye	58,283,000	343,260,000	5.89
	Salmon, Coho	7,095,000	53,798,000	7.58
	Salmon, Pink	60,597,000	203,693,000	3.36
	Salmon, Chum	10,223,000	76,155,000	7.45
	1992 Total	136,803,000	687,673,000	
1993	Salmon, Chinook	667,000	11,299,000	16.95
	Salmon, Sockeye	64,314,000	378,577,000	5.89
	Salmon, Coho	6,050,000	38,439,000	6.35
	Salmon, Pink	109,631,000	334,729,000	3.05
	Salmon, Chum	12,238,000	82,984,000	6.78
	1993 Total	192,900,000	846,027,000	
1994	Salmon, Chinook	640,000	11,552,000	18.06
	Salmon, Sockeye	52,816,000	294,389,000	5.57
	Salmon, Coho	9,551,000	75,284,000	7.88
	Salmon, Pink	116,720,000	364,844,000	3.13
	Salmon, Chum	16,135,000	120,103,000	7.44
	1994 Total	195,861,000	866,172,000	
1995	Salmon, Chinook	663,000	12,683,000	19.15
	Salmon, Sockeye	63,532,000	350,493,000	5.51
	Salmon, Coho	6,471,000	49,818,000	7.69
	Salmon, Pink	128,333,000	435,481,000	3.39
	Salmon, Chum	18,796,000	145,667,000	7.74
	1995 Total	217,795,000	994,141,000	

Source: Alaska Department of Fish and Game 'Alaska Commercial Salmon Harvests, 1970-1995' October 1996, as reprinted from ADF&G website: <www.cf.adfg.state.ak.us/geninfo/finfish/salmon/salmhome.htm>

Appendix 2 Selectivity Criteria

PROJECT SCORING WORKSHEET FOR SELECTIVE SALMON HARVEST PROPOSALS		
Project #: Project Name:		
Potential Ranking Criteria		
Tier 1		
Conservation: (ALL PROJECTS MUST RATE 50 % TO BE CONSIDERED)	Possible Score	Assigned Points
1) does the proposed method avoid non-target fish?		
2) does the method allow live release of non-target fish?		
3) to what extent does the method reduce post-release mortality?		
4) to what extent does the method support assessment of or enable information to be obtained on mortality of non-target species?	.	
a) encounter rates:		
b) pre-release mortality:		
c) post-release mortality:		
5) ECOSYSTEM MANAGEMENT BENEFITS		
Total points for Conservation criteria:	130	0
Tier 2		
A) General Manageability		
1) to what extent will the fishing operations be easily monitored?		
2) can it be easily determined that fishing is proceeding as approved?		
3) can the catch levels be easily monitored and verified?		
4) other General Manageability criteria?		
Total points for General Manageability criteria:	20	0
B) General Future Applicability (Note: rank under either Commercial or First Nations, but not both)		
a) Commercial: to what extent will the proposal result in information and knowledge that can be broadly applied in the commercial sector?		
1) does the project depend on a unique site or circumstances?		
2) how much investment in new industrial infrastructure is required?		
3) does the method harvest economically viable quantities of fish?		
4) can the method be scaled up to harvest commercial quantities?		
5) what total quantity of fish will be harvested by the proposal?		
6) will the method require ongoing govern. employment assistance?		
7) will the technique provide sustainable employment opportunities?		
Total points for General Future Applicability for Commercial criteria:	25	0

Appendix 2 Continued

C) First Nations: to what extent will the proposal result in information and knowledge that can be broadly applied by First Nations?		
1) does the project depend on a unique site or circumstances?		0
2) how much capital investment or new infrastructure is required?		0
3) what quantity of fish will be harvested?		0
4) does the method improve the communities' ability to manage the fishery?		0
5) will the method provide additional potential benefits (e.g. employment)?		0
6) will the method require ongoing govern. employment assistance?		0
Total points for General Future Applicability for First Nations criteria:	'25	0
D) Likelihood of Success: how likely is the project to succeed?		
1) does the proposal have clear objectives and reasonable time frames?		
2) is there any previous demonstrated success using this method?		
3) does the proponent have previous experience or demonstrated capability?		
4) are any of the key elements of the proposal missing or unclear?		
5) is any required support fully documented (technical, First Nations, community)?		
Total points for Likelihood of Success criteria:	25	0
E) Additional Benefits: what additional potential benefits will the method likely provide?		
1) does the project provide useful new data for Fish Management/Science?		
2) could the method result in development of a new support industry?		
3) does the method provide tourism, educational or other indirect benefits?		
Total points for Additional Benefits criteria:	20	0
F) Project Design:		
1) is there an assessment/evaluation plan?		
2) Does the design include clear objectives and structured to get the supporting data?		
Total points for Experimental Design criteria:	20	
TOTAL POINTS AWARDED FOR PROPOSAL UNDER ALL RANKING CRITERIA:	110	0

Appendix 2 Continued

					Tier 3			
Support Required: how much financial, DFO staff or other resources support is required?								
	1) how much DFO staff support does the method require?							
	2) how much government financial support is required?							
	3) how much allocation of fish is requested in the proposal?							
	4) other Support Required criteria?							
Total points for Support Required criteria:							20	0
	GRAND TOTAL						250	

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3) Voluntary Commercial Salmon License Retirement Contributes to Sustainable Salmon Fishery: #NR-PR-99-17E;

4) Minister Announces Pacific Coho Response Team: #NR-PR-98-09E;

5) Selective Harvesting in Commercial Salmon Fisheries Moves Ahead: #NR-PR-98-23E;

6) Anderson Signals Change with Far-Reaching Conservation Objectives: #NR-PR-98-36E;

7) Ministers Announce Canada's Coho Recovery Plan and $400 Million for Pacific Salmon Fishery: #NR-PR-98-49E, from F&O Canada website addresses: <www-comm.pac.dfo-mpo.gc.ca/english/release/p-releas/index/pr98.htm> and <www-comm.pac.dfo-mpo.gc.ca/english/release/p-releas/index/pr99.htm>

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