The Evolution of Commercial Salmon Fisheries in British Columbia

Report to the Pacific Fisheries Resource Conservation Council

Stuart Nelson and Bruce Turris

December 2004

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INTRODUCTION

"British Columbia's wild salmon stocks are healthy and well-managed."

"B.C. salmon stocks are over-fished and on the brink of collapse."

These diametrically opposed statements are typical of the polarized public discourse surrounding the current state of British Columbia's wild salmon stocks. Which statement is true? Technically neither, though ample support could no doubt be generated for each position. In truth, assessing the state of salmon stocks and understanding the factors influencing salmon abundance are extraordinarily complex. Without doubt, one of the elements impacting BC's salmon stocks is the commercial salmon fishery. As a major user of the salmon resource, the commercial salmon fleet must clearly conduct its fishing operations in a responsible and sustainable manner. Has this been the case? Has the commercial salmon fleet adapted its fishing practices over the past few decades in response to shifting environmental, competitive, and political pressures? Is the commercial salmon fleet now a responsible steward of the resource, as portrayed in some circles, or an un-checked fish-slaughtering gauntlet, as claimed in others? In this paper, we shed light on how the management and operation of the commercial salmon fishery has changed over the past few decades, so that the reader may make an informed assessment of how this key salmon resource user is contributing to, or detracting from, the overall health and diversity of BC's salmon stocks.

Before chronicling changes in the conduct of the Pacific commercial salmon fishery over time, we provide some background information to allow the reader to view the commercial salmon fishery in its proper context.

BACKGROUND

About Pacific Salmon

Lifecycle

The five commercially exploited species of Pacific salmon—sockeye, pink, chum, coho, and chinook—originate in hundreds of British Columbia river systems, migrate to sea to spend their adult lives, and return to their freshwater point of origin to spawn. Fundamental to continuation of the lifecycle are an adequate number of adult spawners, suitable spawning grounds, hospitable freshwater conditions for rearing and the outbound and homeward passages, and an amenable ocean environment (presence of feed, suitable water temperature, currents, and so on). The number of distinct stocks or "races" of salmon is estimated to be greater than 8,000.

Naturally Cyclical

Mother Nature imposes great challenges upon Pacific salmon throughout their lifecycle, resulting in tremendous naturally occurring variance in abundance for each of the countless BC salmon stocks. Cycles occur on both a "micro" basis (stock-by-stock, stream-by-stream, year-by-year), and a "macro" basis, as general climatic and ocean conditions prevailing in the North Pacific influence overall abundance.

When celebrating an impressive return of sockeye to a river system, or lamenting a poor showing of coho in another, casual observers of the fishery are inclined to forget that such variation may be completely natural, and quite independent of the actions or inactions of man.

The Influence of Ocean Conditions

Scientists are increasingly aware that ocean conditions (temperature, currents, feed) exert a strong influence on salmon survival and productivity. In the past, the prevailing notion was that salmon abundance was proportional to the number of spawners. Today we know that the same level of spawners can produce widely variable returns, depending on ocean conditions. For example, in the late 1980s the survival rate (the percentage of juvenile salmon returning as adults) for southern BC coho stocks was approximately 10–15%, and runs were healthy. By the late 1990s, the survival rate was 1% or lower, and dangerously low returns necessitated stock conservation measures. This phenomenon is unrelated to the direct influence of man.

Human Influences on Abundance

Pacific salmon are incredibly resilient animals. During periods when favorable freshwater and ocean conditions coincide and salmon abundance blossoms, they may seem almost immune to the pressures imposed by humans. During less-productive regimes, they are extremely vulnerable to man-made influences.

Mankind imposes a host of challenges upon Pacific salmon, among them loss or degradation of spawning or rearing habitat (dams, urbanization), pollution, logging, noise, traffic, and fishing (commercial, recreational, and First Nations food and societal).

While fishing may impose the greatest direct human impact upon Pacific salmon abundance, it is by no means the only human influence.

Running the Gauntlet

When both natural and man-made obstacles are considered, salmon face a daunting gauntlet, indeed, in completing their life-cycle. Warm water, low water, turbulent water, seals, sea lice, lack of feed, anomalous ocean currents, nets, hooks, eagles, polluted waters, degraded habitat, and weather, are among the factors facing Pacific salmon throughout their long and fascinating journey.

Current State of Stocks

Because Pacific salmon are comprised of so many stocks, with each stock exhibiting substantial short term and long term variation in abundance, a blanket evaluation of the state of BC salmon stocks is impossible.

DFO has developed a "salmon stock outlook" framework, seeking to encapsulate the current-year outlook and prospects for fisheries for key species and stock groupings. Results are summarized in the adjacent table. The Pacific Fisheries Resource Conservation Council observed in its 2001/2002 Annual Report that although "in recent years the focus of public attention on salmon has frequently been on current short-term production problems, poor survival due to ocean conditions, and generally negative circumstances and trends… a rich diversity and abundance of Pacific salmon populations continue to exist in many locations."

Summary of Current Year (2004) Outlook and Prospects for Fisheries for Key Species and Stock Groupings.

This analysis is only for the 2004 cycle; each annual cycle may have an entirely distinct outlook.

Specie	Number of Stock Groupings	Low or Concern	Near Target or Abundant	No Data
Sockeye	29	11	18	0
Chinook	23	6	17	0
Coho	19	6	12	1
Pink	9	1	5	3
Chum	11	5	6	4
Salmon Total	91	29	58	8

It is reasonable to generalize from analyses and commentaries such as these that the current state of salmon stocks is mixed: some stocks are abundant, some are in moderate shape, and some are in poor shape. Are all BC salmon stocks in great shape? No. Are they all in decline? No. The "truth" lies somewhere in between.

A Word on Fraser River Sockeye...

Because of the economic and cultural importance placed on the bellwether Fraser River sockeye run, the public, and fishing industry folks (and even us, in this paper!), sometimes equate "Pacific salmon" with "Fraser sockeye." It is important to remember that Pacific salmon include multiple species in innumerable river systems. Fraser River sockeye comprise merely one important group of stocks.

Competing Demands on the Salmon Resource

The commercial salmon fishery is but one user of the salmon resource. Commercial salmon management has at times been depicted as allowing the fleet to fish to its heart's content, with any fish remaining—*if there are any*—free to spawn. This characterization is far from accurate.

In days gone by, the commercial fishery was not constrained by the requirements of other user groups. With recent expansion in both First Nations and recreational fisheries, commercial fisheries have been curtailed. The salmon resource is now "over-subscribed," meaning that the wishes of all user groups are greater than the available resource.

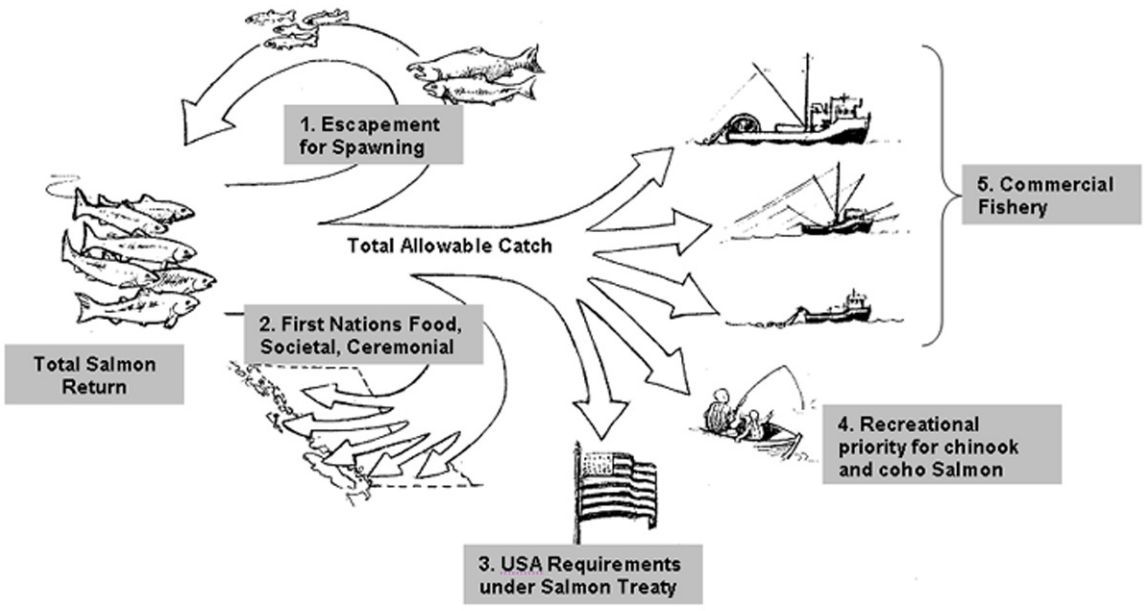
Commercial Fleet: Lowest Priority, Largest User

A key task of fisheries managers is to decide pre-season how the expected salmon harvest will be divided amongst users. Over time, allocation policy has developed to govern this task. In the current scheme of salmon allocation policy, the commercial salmon fleet is the *last* sector to gain access rights to the resource. The graphic below demonstrates the "pecking order" for access to salmon. Prior to the commercial salmon fishery gaining a catch allocation:

1. Escapement to the spawning grounds is set aside;
2. Priority allocations are provided to First Nations "food fisheries;"
3. United States users, under the Pacific Salmon Treaty, gain access to Fraser-bound sockeye and pinks;
4. The recreational fishery is accorded priority for remaining coho and chinook surpluses.

Effectively, the commercial fleet has last priority in accessing coho and chinook stocks, and is tied-for-last with the recreational sector in priority access to sockeye, pink, and chum surpluses.

Allocation of Salmon in Order of Priority



In practical terms, the commercial fleet receives very limited access to salmon stocks when:

- Low predicted run sizes mean that the bulk of the run is set aside for spawning escapement;
- Priority uses (First Nations, Canada-US Treaty, and recreational chinook and coho) consume the bulk of any harvestable surpluses; or
- Concern for less productive stocks limits access to more-productive stocks.

Commercial access may be *substantial* when runs are large and/or the requirements of priority users are modest in relation to harvestable surpluses. Indeed, in most years, the commercial fleet accounts for the vast majority of the total salmon catch (in terms of the number of fish harvested). Residual harvester status means, however, that commercial salmon harvests may be heavily weighted to less-valuable pink and chum stocks, and are highly variable and uncertain.

Last in the Pecking Order… But First in the Queue

While the commercial fleet is the last sector to gain a pre-season allocation of salmon stocks, it is, in practice, the first sector to get a crack at fishing them (with a few localized exceptions). Salmon migrate from the open ocean, along the BC coast, and into rivers and streams to the spawning grounds. Unfortunately for fisheries managers, salmon, during their homeward migration, encounter resource users in the *reverse order of their harvest priority*! Commercial fisheries occur further seaward than the others, so that fishery managers face the great challenge of executing commercial fisheries, while being careful that enough fish pass through to meet recreational, US, and First Nations priority allocations, while ensuring that the most important priority—an adequate escapement for spawning—is met.

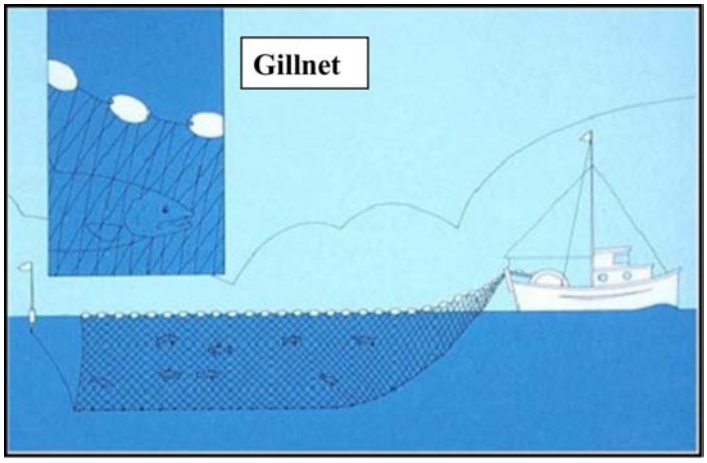
About the Commercial Salmon Fishery

Gear Types[1]

There are three distinct types of fishing gear and vessels involved in the commercial salmon fishery: gillnet, seine and troll.

Gillnetters

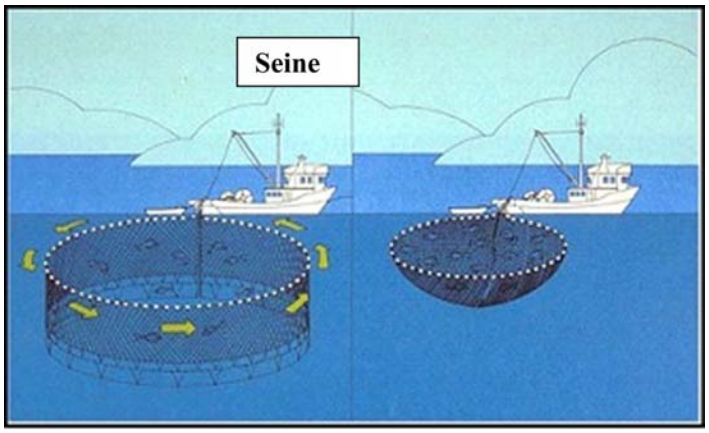
Salmon gillnets are rectangular nets that hang in the water and are set from either the stern or bow of the vessel. Fish swim headfirst into the net, entangling their gills in the mesh. Altering mesh size and the way in which nets are suspended in the water allows nets to target selectively on certain species and sizes of fish. Gillnetters generally fish near coastal rivers and inlets, taking about 25% of the commercial catch.



[1] Gear type information and graphics in this section are gleaned from the Fisheries and Oceans salmon website: http://www.pac.dfo-mpo.gc.ca/ops/fm/Salmon/default_e.htm

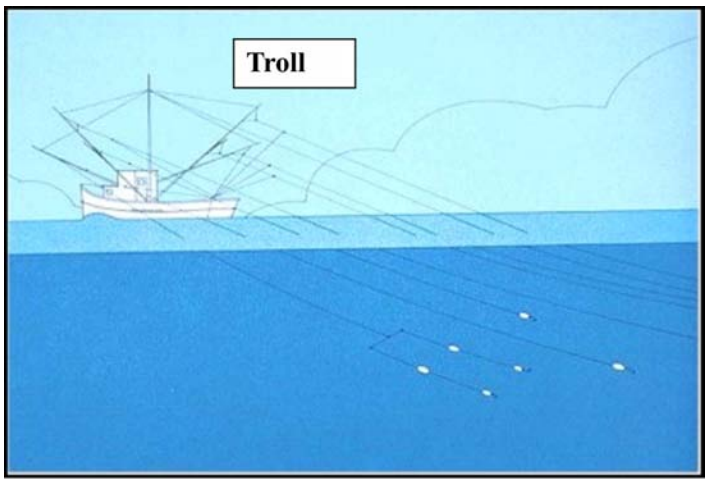
Seiners

Seine nets are set from fishing boats, usually with the assistance of a small skiff. Nets are set in a circle around aggregations of fish. The bottom edges of the net are then drawn together into a "purse" to prevent escape of the fish. Seiners take approximately 50% of the commercial catch.



Trollers

Trollers employ hooks and lines which are suspended from large poles extending from the fishing vessel. Altering the type and arrangement of lures used on lines allows various species to be targeted. Trollers catch approximately 25% of the commercial harvest.



The Salmon Industry

The salmon fishery has historically supported a sizeable industry, including fishing—seine, gillnet, and troll—and processing sectors, and associated services such as shipyards, gear, and fuel suppliers. The fishing industry was long considered to be British Columbia's third largest economic engine, behind forestry and mining, and the salmon fishery was the cornerstone of the fishing industry.

Commonly thought to be a producer of canned salmon, the BC salmon industry has broadened its product mix in recent decades to include an array of fresh, frozen, smoked, and prepared products. The bulk of production is exported to markets such as Europe, Japan, and the USA.

Although the industry strives to become "market-driven" in increasingly competitive global seafood markets, the salmon industry struggles with highly uncertain and increasingly limited access to the resource.

The size and stature of the salmon industry—including the fleet, processing, and service sectors—has withered over time, even as other BC fisheries such as groundfish and shellfish have confronted change, adapted, and prospered.

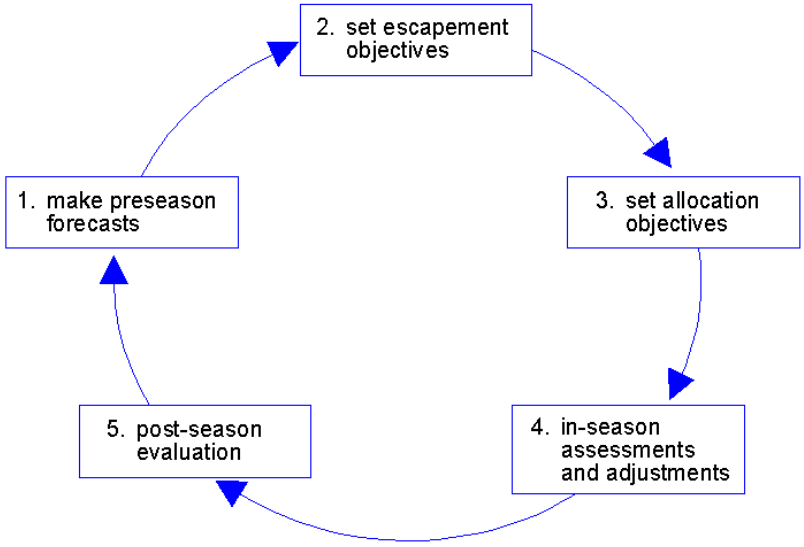
Fishery Management

The commercial salmon fishery is managed by Fisheries and Oceans Canada (DFO). DFO is responsible for all elements of management, including scientific research and stock assessment, regulating fisheries, enforcement and monitoring, and associated activities such as data collection and licensing. DFO is charged with the large and costly endeavor of management of *all* commercial fisheries (for instance herring, groundfish, halibut, shrimp, prawn, crab, and many others), the recreational fishery, and First Nations fisheries. DFO is also involved with: oceans management, aquaculture, coast guard, economic planning and analysis, and economic development initiatives through the Aboriginal Fishing Strategy (AFS). It is a major mistake, commonly made, to equate the annual budget of DFO in the Pacific Region with the cost to manage the commercial salmon fishery. In fact, management of the salmon resource (for all users) consumes less than half of overall DFO expenditures.

Commercial Salmon Fishery Management

It should come as no surprise, given the complexities of salmon described already, that the task of effectively managing commercial salmon fisheries is exceedingly difficult. The adjacent graphic describes the basic cycle of salmon fisheries management, including pre-season forecasting and objective-setting, in-season management and adjustment, and post-season evaluation (which leads to pre-season planning for the next cycle).

Salmon Management Cycle



The salmon fishery management cycle has remained virtually unchanged over many decades, though the means of executing the cycle have changed dramatically.

The Challenge of Mixed Stock Fisheries

As they return from the ocean to their river of origin, salmon stocks frequently travel together as they pass through popular fishing grounds. Some stocks are strong, and able to sustain fishing pressure, while others are weak[2], and unable to maintain their cycle under fishing pressure.

[2] weak stocks are those lacking the productivity to sustain themselves in the face of fishing and other pressures; not all small stocks are weak–some small stocks are highly robust

DFO faces a dilemma when confronted with mixed stock fisheries: if management focuses on optimal harvesting of strong stocks, weak stocks will be depleted (and possibly extinguished); if management focuses on weak stock sustainability or rebuilding, then valuable fishing opportunities on strong stocks must be forgone.

Describing how salmon fishery management has resolved the mixed-stock dilemma (if it has addressed it at all) is a central theme of this report.

Objectives & Influence of Commercial Salmon Fishery Management

DFO has historically managed the commercial salmon fishery with dual objectives: ensuring the ongoing *health of the resource*, while providing the commercial fleet (and other user groups) with *reasonable fishing opportunities* for economic and social purposes.

How DFO priorizes its dual, competing objectives has not always been clearly defined or enunciated, and in fact the emphasis—conservation vs. socio-economic—has shifted back and forth over time.

Fishery management objectives and policy are not shaped in a vacuum, but rather are influenced by a host of forces, including environmental, economic, political, and technological. Over the decades, fishery management has both responded to and shaped external events

How evolving conservation priorities are translated into policy and fishery management practice has a profound influence on the commercial salmon industry.

Changing Societal Values

Salmon conservation has always been important to residents of BC, but as conservation issues have arisen, public concerns have elevated. In the past there was virtually no attention paid to fishing issues by the public. The situation is very different today. There is now much less public tolerance for conservation failure, and this societal shift in values has had a decided influence on political leaders and DFO salmon management.

Background—Summary

To view the state of salmon stocks as a mere by-product of the practices of the commercial salmon fishery is a great exaggeration and over-simplification. Many factors, natural and human-made, affect the abundance of salmon stocks. A multitude of users draw upon the salmon resource, most with a higher management priority than the commercial salmon fleet. Stocks are neither uniformly robust, nor decimated, but current abundance lies somewhere in between. The task of salmon fishery management, considering the complexity and natural variability of the species and the high demands of users, is daunting.

With this background information provided, we turn to the focus of this paper: telling the story of how commercial fishery management and commercial fishing have evolved over the years in response to an ever-changing world.

EVOLUTION OF COMMERCIAL SALMON FISHERIES

Our story is about how the management of the commercial salmon fishery has evolved to meet ever-changing conservation objectives, which themselves are influenced by shifting economic, international and environmental conditions and evolving societal needs. There are more than 8,000 distinct salmon stocks populating lakes, rivers, streams and creeks throughout British Columbia and their abundance, productivity, size and life expectancy vary by species, stock and year. The challenge for fishery managers is to ensure salmon populations return to the spawning grounds to propagate in sufficient numbers each year after running the gauntlet of fisheries by various groups (First Nations, recreational and commercial) and hurdles posed by nature (predation and difficult environmental conditions).

The basic approach for managing salmon hasn't changed much over the years. Estimates of spawning success form the basis for pre-season forecasts of run size and escapement targets. The collection of catch information and samples as the runs start to return are used to confirm or adjust pre-season run size forecasts and estimate surplus fish (surplus to spawning requirements) available for harvest. Estimates of spawning success are then made and the cycle starts all over again.

What has changed significantly over time is the definition and interpretation of conservation, and the stature and role of the commercial fishery in the scheme of salmon management and salmon fisheries. Over time, the "test" of conservation—the height of the conservation bar—has risen, and the place of the commercial fishery has declined. Resource demands from First Nations and the recreational fishery have grown. These shifts occurred, first very gradually, then at an accelerated pace. They occurred in response to a great number of factors.

To convey the context, cause, and effect of changes in fishery management over time, we tell our story over three distinct "eras."

The Early Days (up to the 1950s)

We begin by describing, in extremely general terms, a lengthy era which might be remembered as the "good old days" of salmon management and commercial salmon fishing. The "goodness" of these days refers more to the *simplicity* of the times than it does to fishery management excellence or uniformly strong salmon runs and catches. Fishery management took a pragmatic approach, consistent with the modest catching-power of the fleet. The salmon resource was not yet fully subscribed, meaning generally that there were enough fish to satisfy all the users of the day. Together, DFO and the commercial fishing industry worked to achieve the joint objectives of conservation and commerce.

Pre-Season Planning

Fishery management for the coming season started with the setting of a pre-season forecast of run size. With a run size forecast developed, an escapement target—the number of fish needed to return to the spawning grounds—was set. The difference between the pre-season forecast and the escapement target was the amount of fish available for harvesting.

During this period, these planning activities were conducted primarily by Fishery Officers on the grounds for their given areas.

The Fishing Fleet: Practices and Technology in the Early Days

Seine and gillnet are the predominant gear types. Vessels are made of wood, and the gear is generally worked by hand. Ability to operate in exposed areas or in strong tides is extremely limited. A seiner makes perhaps two sets a day at slack tide. Many gillnetters must be towed to the fishing grounds.

Vessels have limited fish-packing ability, and must deliver each day to tender vessels.

Fishing fleets rely on processing companies to provide on-grounds services such as gear, repairs, stores, and fish tendering.

Fishermen tend to spend their seasons in a favorite fishing area, whether close to the Fraser River, or in a remote Sound or Inlet in the North or Central coast.

Fisheries are lengthy—first 7 days per week, then closures for the weekend are negotiated (by the Fishermen's Union!).

Despite widely dispersed fisheries of long duration, the catching power of the fleet is well within the comfort zone of fishery managers…

Fishery Officers performed this important work using a variety of planning aids, namely:

- Recorded counts of spawners from previous years;
- Accounts of visual assessment of the various areas—how did the streams look, was spawning successful, were the conditions right for survival?
- Comparison with previous years;
- Review of historical escapement and run-size data.

From this information, Fishery Officers applied common sense in developing a forecast for the coming season based on extensive experience in the area, feel, and faith that history would repeat itself.

In-Season Management

As salmon began their migration into coastal waters and rivers, Fishery Officers collected information on the state of returning stocks. This information was used to evaluate actual run size (compared to pre-season estimates), ensure escapement targets could be met, and confirm opportunities for commercial fishing.

Economic Forces in the Early Days

Canned salmon is the predominant product form. BC is a significant world producer of salmon (about 15% of the world's output), and prices to the fleet are largely a function of BC run size: big run, weak prices, small run, better prices. Earnings are reasonably stable, although very poor catches, as occur periodically, bring hardship.

Processing plants are everywhere on the coast, refrigeration is lacking, and proximity to fishing grounds is a pre-requisite to putting up a good pack.

The "cannery in every cove" is not sustainable, and plant closure, and company consolidation take place over the decades. A few big processing firms come to dominate the industry.

Fishery Officers' primary source of information was catch data from the commercial fishery, which during the period, was comprehensive in its ability to provide continuous catch information: seven days a week, and throughout the season. Because commercial fishery catch data was vital to in-season management, Fishery Officers developed both a feel for their area, and relationships with the fishermen and fishing company representatives. A major source of catch information came through Fishery Officer observation on the fishing grounds, and reports from the fleet and companies. To complement strong on-the-grounds communication, senior DFO officials and the heads of fishing companies engaged in informal but effective consultation. This information was supplemented with official landings data from the industry.

During the period, there were few curbs on the fleet, other than opening and closing of the fishery. There was no limit on the number of vessels and minimal gear restrictions. For much of the period, fisheries were continuous (7 days per week). From time to time, as obvious conservation issues arose (for example the Hells Gate slide of 1913 which decimated that years' Fraser River sockeye stocks), Fishery Officers would apply additional restrictions on fishing opportunities based on common sense principles.

Post-Season Assessment

To complete the cycle of fishery management Fishery Officers engaged in a process of assessment and evaluation, asking:

- Were pre-season forecasts accurate?
- Were in-season adjustments to run size and escapement targets appropriate?
- Were escapement/spawning objectives met?

To do this, they walked the key streams to estimate spawning returns, and noted stream conditions. Stream counts, plus post-season tallying of the catch, allowed overall run size to be calculated.

This post-season evaluation provided the starting point for planning on the next cycle.

Summary of the "Early Days" Era

On the grounds experience and knowledge was important, as was the provision of continuous catch information from the commercial fisheries. During the period, there were very few restrictions on the fleet, other than opening and closing of the fishery. Conservation was based on overall returns and escapement of salmon, not on groups of stocks or discrete stocks. So long as

run size and escapement conditions in the major fisheries remained consistent with levels observed in the past, then general conservation objectives were being achieved.

Clearly, this was not a very sophisticated process, but relied on individual experience and effective communication and exchange of information amongst all participants. The overall health and productivity of salmon stocks, combined with rudimentary harvesting practices of the fleet, left a safety margin for management error. While conservation objectives were generally met, the standards of conservation were far less demanding than they would later become… the conservation "bar" was set at a low level.

Were these early days truly the "good old days," as remembered fondly by old-timers and recounted in the archives? In reality, no. The natural cycles of salmon imposed periodic run collapses. Business failures were commonplace. Meeting modest conservation hurdles does not imply that all was well with the salmon resource. In reality, these were simpler days, and it is likely this simplicity that has been sorely missed as the world has grown more complex.

Growing Capacity, Growing Controls (early 1960s to 1998)

The next "era" of salmon fishery management was characterized by a relentless build-up in fishing capacity, increasingly restrictive management measures to conserve stocks, and periodic programs to ensure fleet viability. This period, beginning in the 1960s and ending in the late 1990s, saw tremendous physical changes in the fishing fleet—vessels were larger, faster, and able to catch and pack more fish in less time than ever before. As this increased catching power was evolving, the fleet enjoyed an unprecedented period of flexibility and mobility. Fisheries moved seaward, beyond "historical" fishing areas. Mixed stock fisheries were at their peak. The ability of this fleet to detrimentally impact salmon stocks was quickly realized, and fisheries began to be pulled back, in terms of area (more restricted), time (duration of openings), and gear. Technology played an increasing role in fishing, but also in fishery management. Science, statistics, and computer models gained favor as predictive and management tools. The conservation "bar" rose steadily throughout the period. Stocks were managed more discretely, and less in aggregate. A higher level of precision in fishery management was sought, though results remained elusive. Greater appreciation for stock complexity and diversity yielded the recognition that some stocks were at depressed levels. "Making more fish" through hatchery and other enhancement programs, and reduction in fishing pressure, were seen as the major means of contributing to conservation objectives. Reduced fishing pressure was accomplished through increasingly restrictive fishing plans, and also through sweeping fleet reduction and rationalization programs. "Fish Wars" waged with the United States leading up to 1985 and 1999 Pacific Salmon Treaties worked at odds with conservation objectives. In the 1990s, a marked decline in the productivity of some salmon stocks exacerbated the effects of fishery practices. In spite of management and fleet reduction measures, heightened conservation objectives were not being met… in the "pull" between conservation and fleet economic viability, conservation criteria were becoming more prominent…

Pre-Season Management

The objectives of pre-season management remained largely unchanged: to develop a run size forecast, set escapement targets, and establish allowable harvest levels. The process, including how it was done and by whom, changed dramatically throughout this period.

From an original process reliant on fishery officer experience, observation, and application of judgment, the forecasting of salmon run sizes became a biological modeling exercise fed with scientifically advanced data collection techniques. The pre-season forecasting function was no

longer in the hands of on-the-grounds managers, but became increasingly entrusted to fisheries scientists. Science was tasked with providing the most objective and statistically sound stock estimates. Stream-counts and on-grounds observation provided the basis for forecasts and escapement targets in days gone by. Data from a growing variety of sources—including hydro-acoustics, scale analysis, fence counts, test fisheries, tagging, stream counts, and visual inspection of the spawning grounds—were factored in to increasingly sophisticated computer models throughout this period. Where forecast used to be on overall run size, they were now broken-down into groups of stocks and in special circumstances, focused on single species or discrete stocks. New strategies aimed at rebuilding damaged stocks, and bolstering already healthy ones, were attempted. Reduced harvest rates and increased escapement targets were the primary pre-season measures for achieving these conservation ends.

The Fishing Fleet: Practices and Technology—60s-70s

Small, antiquated vessels are starting to be replaced, or displaced, by larger vessels with increased capabilities. Mechanical and hydraulic winches and eventually drums on seiners and gillnetters perform the work of many men. Larger, more powerful vessels can work in a variety of weather and tide conditions. Packing ice in larger fish holds, allows more fish to be packed aboard, with less need to be serviced daily by tender vessels. Vessels are increasingly mobile—not stationary in a single favorite hot-spot, but moving from spot-to-spot to exploit a range of fishing opportunities.

As the catching capacity and range of the fleet grows, so does its ability to impact stocks, and fisheries are curtailed in terms of both time and area. The "race for fish" has begun… with less fishing time and smaller fishing areas, the onus is on catching more fish, faster…

With a surge in salmon prices and development of the lucrative roe herring fishery, fishing is becoming more of a business, and a chunk of profits is re-invested in the boat and fishing gear. Licences now possess substantial value. Hydraulic pullers on trollers give this fishery "industrial" potential. Steel, fiberglass and aluminum vessels are replacing wooden ones.

While establishing catch targets remained a simple matter of subtracting escapement targets from forecasted run size, the number of players demanding a share of the catch increased, as did their demands. The pace of change in First Nations and recreational fisheries was dramatic during the period. The First Nations fishery grew from a subsistence (food and ceremonial) fishery to one including a commercial allocation, and accounting for a substantial portion of the total Fraser River sockeye harvest. The recreational fishery, traditionally focused in Georgia Strait, expanded to far-flung coastal areas, placing recreational and commercial fleets in conflict over stocks. The period saw the emergence of recreational fishery enterprises such as fishing lodges, resorts, and guide-outfitters. Both First Nations and recreational fisheries grew in stature, ability to impact salmon stocks, and influence in resource management. Further complicating the exercise of setting catch targets were increasingly difficult allocation disputes between Canada and the United States, internally between First Nations, recreational, and commercial sectors, and amongst domestic commercial gear groups (seine, gillnet, troll).

Economic Forces—60s-70s

Fresh and frozen markets and product forms are developing, and Japan aggressively enters as a major buyer of BC fishery products.

The price of sockeye soars, as do values for coho and chinook. Sockeye becomes the target species of the net fleets, while the troll fleet expands, working offshore areas for coho and chinook.

Many salmon fishermen are also participating in the new, lucrative roe herring fishery.

Industry structure is changing… the dominance of a few canneries has diminished, as a plethora of new, small, nimble firms producing fresh or frozen salmon enter the business.

Canneries must compete for raw material with firms with a much lower cost structure. Fortunes of the salmon industry are linked to both canned and fresh/frozen markets.

In-Season Management

In-season management still sought to confirm actual run size and ensure that escapement targets were met, but now faced the increasingly difficult task of delivering each country and domestic sector (First Nations, recreational, commercial) their share of the catch, while ensuring the sustainability of less-productive stocks.

Historically, comprehensive commercial fisheries were the vehicle for capturing run-size data. What we mean by this is that the commercial fishery occurred on a regular basis (daily, weekly, throughout the migration) along near-shore migration routes providing plenty of representative information about stock migration routes, timing and abundance. Lots of data, collected consistently over time, was a great aid in assessing run sizes.

During this period, the race for fish by the fleet began in earnest. An increasingly mobile and efficient fleet moved to non-traditional seaward areas like the west coast of Vancouver Island and the north & west coasts of the Queen Charlotte Islands to get first crack at the stocks. Fish were being intercepted in areas where historical catch data did not exist, and where run-size estimation tools were untried. In some favored fishing locations, for instance Milbanke Sound on the Central Coast, substantial mixing of stocks occurred. The intermingling of all five species, bound for a multitude of streams, made for great fishing, but a stock assessment nightmare.

Fishing Fleet Practices and Technology—80s-90s

Technological developments and economic incentives through the 1980's quicken the escalation in catching capability. Fisheries are becoming increasingly competitive, so speed, power, and packing capacity are keys to success.

Refrigerated and insulated fish holds, sophisticated electronics, stern ramps on seiners (allowing large sets to be pulled aboard in a matter of minutes instead of brailed-aboard in hours), freezer installations on trollers allow blast-freezing and storage of the catch, high-speed gillnetters with tanks for holding fish… are all increasing the range, capacity, and efficiency of fishing vessels.

Strong catches and record prices in the mid-late eighties fuel a new vessel construction boom and unrealistic expectations that the salmon fishery can sustain profitable year-round operations.

By the early 90's the fleet has reached its peak of efficiency… the seine fleet working in Johnstone Straits catches millions of fish in just a few hours… more than it caught in months of fishing in the early days…

A mobile, efficient fleet was now applying heavy pressure to mixed stocks in a variety of coastal areas. The unmanageability of this situation, and in particular, the potential for harm to less abundant stocks, became apparent. Commercial fishery openings became shorter, less frequent, and unable to provide sufficient information to assess run size. These shifts meant that new fishery independent run size estimation techniques were required, such as:

- Test fishing—hired vessels fishing in various points along migration routes using specified gear and following repeatable protocols for the purposes of collecting catch data to assist in determining run timing, route, and abundance;
- Scale sampling to help determine stock composition;
- Hydro-acoustic counting devices to count fish as they pass into river systems.

Information collected from the commercial fishery and other sources was fed into computer models, yielding constantly revised estimates of run size, escapement requirements, and harvestable surpluses. None of this necessarily led to more *precise* forecasts and estimates. With computer assessment models relying on a range of data inputs, considering a host of variables, and applying sound statistical methodology, the precision of the product—a run size forecast—was often lacking. Wide ranging forecasts resulted. The tendency was to adopt estimates at the lower end of the range.

The Spread and Pull-back of Commercial Fisheries

In the early days, fishermen tend to hunker in to a favorite coastal spot—a protected inlet or not too far from the river mouth. "The fish are coming to us… why go chase them? What's the hurry"?

Modernization and mechanization of the fleet, along with growing prices for the catch, enables and motivates fishermen to go seaward, to intercept the salmon long before they reach the river mouth. Intercepting the stocks at sea, and "working them" along their migration routes becomes an effective competitive strategy. "There's a race for fish on, and I'm going to get my share!"

The seaward spread of a powerful fleet is a shock to the fishery management system. Harvests are occurring outside of traditional assessment areas. Co-migrating stocks are bound for a multitude of river systems. Catching power is substantial, and catch rates are uncertain.

"What stocks are being fished? What are run sizes? What is the catch so far? What is the impact on minor stocks? Will we achieve escapement targets? Allocation targets?"

Fishery restrictions follow. The duration of fisheries is shortened. Areas are closed: first, outside interception fisheries where traditional stock assessment is frustrated, later inside areas where significant mixing of stocks occurs. Fisheries are pulled back closer to river mouths, and to a few large-scale fisheries such as Johnstone Strait and Juan de Fuca Strait.

Coho and chinook conservation measures focus efforts on three species, but particularly on sockeye. Fishing area, time, and the number of target species are all being narrowed down. Increasing fishery restrictions fail to reduce fishing effort, but rather focus and intensify it…

External pressures like the Canada-US Salmon Treaty, United Nations fishing protocols for responsible fishing, international agreements on biodiversity, and the growing influence of the environmental sector, contributed to an ever-rising conservation bar throughout the period. Management moved from overall run objectives to managing stock groups, species of concern, and increasingly, small discrete (single) stocks. Policies limiting exploitation rates and increasing escapement targets were imposed.

Many seaward mixed stock fisheries were closed, with commercial fisheries pulled-back to more traditional areas. An evolution from fisheries targeting strong stocks towards protection of less-abundant stocks was underway.

The combination of greater conservation demands, uncertainty about run sizes and harvest rates, and the need to deliver catches to more user groups throughout the system, resulted in fisheries managers adopting a more cautious approach to commercial fisheries.

During this era we shifted from on-the-grounds Fishery Officer assessment and management, to a much more scientific approach. Scientists became heavily involved in the management of salmon. With that came the consideration of more variables affecting salmon abundance, such as:

- Effects of climate change;
- Shifting ocean conditions;
- Effects of predation;
- Habitat degradation;

- Interaction of enhanced and wild stocks;
- Impacts of finfish aquaculture on juvenile salmon.

The result? The more information brought into the model, the wider the range of possible outcomes. In other words, the more we learned, the less sure we were of what we knew!

Economic Forces—Recent History (80s-90s)

The peaks and valleys of the salmon fishery are becoming more pronounced, as the industry is increasingly impacted by global economic forces and pronounced fluctuations in available harvest levels.

Double-digit interest rates and a canned salmon botulism incident in Europe contribute to financial crisis in the early 80's.

Strong salmon catches and markets in the mid to late 80's mean an unprecedented boom for the industry.

By the early 90's, the salmon picture has worsened dramatically: growth of wild salmon volumes in Alaska, Japan, and Russia render BC a bit player… farmed salmon is going head-to-head against BC in all major markets… and winning… and BC salmon abundance has taken a downturn…

Concerns for fleet and industry viability trigger periodic calls for restructuring: a Royal Commission is launched in 1982, and major fleet reduction and rationalization programs are implemented in 1996 and 1998. The resulting fleet is less than half the size… but with severely restricted fisheries and soft markets, financial performance is still dismal…

The processing and service sectors shrink along with the fleet and dwindling salmon revenues… British Columbia Packers, a pillar of the industry since the turn of the century, withdraws from the fishing industry.

Post-Season Assessment

In the old days, confirming the number of fish reaching the spawning grounds relied on visual observation by Fishery Officers and guardians. Ongoing DFO staffing cuts throughout the 80s and 90s meant fewer staff available for this rudimentary and vital stream inspection function. Increasingly, on grounds inspection was complemented by more advanced assessment tools (hydro-acoustic counters, tagging, test fishing).

Summary of the "Growing Capacity, Growing Controls" Era

Throughout this era, growth in commercial salmon fleet capacity was met with increasing controls and restrictions on time, area, and gear. By the mid-1990s many truths were becoming evident:

1. that DFO's salmon management objectives, though not yet clearly enunciated, were tilting toward conservation (the bar was ever-rising);
2. that the task of managing salmon fisheries was becoming more difficult, given competing, growing demands of USA, First Nations, recreational, commercial and environmental interests;

3. that increased use of scientific tools and computer modeling was raising as many questions about the "right" way to manage salmon as it was providing answers;
4. DFO fiscal constraints dictated that fewer resources be applied to an ever-larger, more complex task;
5. that a higher fishery profile brought any management errors or allocation disputes into the public realm;
6. that the much-reduced volume and value of salmon available to the commercial fleet could not sustain economically viable operations;
7. that uncertainty—about run size, escapement targets, or delivery of fish to priority users—increasingly led to *caution* in how commercial fisheries were managed.

Still, during this period, DFO lent weight to its objectives to provide for the economic viability of the commercial salmon fleet. With the federal government programs, *Mifflin Plan* in 1996 and *Pacific Fleet Adjustment and Restructuring Initiative* (PFAR) in 1998, millions of dollars were applied to voluntary retirement of fishing licences ("the buyback"), re-alignment of fishing effort (area licensing and single gear licensing[3]), and re-training and education programs. The commercial salmon fleet was reduced, in terms of the number of vessels, by over 50%. Government and industry clung to the premise that, under a restrictive commercial fishing regime, and with a "right-sized" fleet, the dual objectives of conservation and fleet economic viability could be met.

Re-alignment of Fishing Effort: Area Licensing and Single Gear Licensing

No. of Licences	Pre-1996	Post-Mifflin	Post-PFAR (Current)
Seine	536	488	268
Gillnet	3,583	1,826	1,087
Troll		990	527
Total	4,119	3,304	1,882

The Sparrow Decision

In 1990 the Supreme Court of Canada renders a decision having a significant impact on the commercial salmon fishery. Sparrow confirms that there is an aboriginal right to catch fish to meet "food, social and ceremonial needs", and that they enjoy first priority after conservation. Sparrow transforms a general policy intent into a constitutionally protected obligation. First Nation needs have to be met. No longer is it acceptable to close aboriginal fisheries if DFO miscalculates escapement into the river. If the Department is to meet escapement targets, and First Nation needs, then coastal fisheries have to be managed more carefully. This decision has a very significant impact on the conduct of harvesting activities in approach waters.

[3] Area licensing–the seine fleet was split into two areas, and gillnet and troll fleets into three areas; a licence could hereafter participate in only one of the areas, whereas a licence allowed coastwide participation previously.

While a greatly reduced commercial fishing fleet, further dispersed by area licensing restrictions, faced improved prospects for achieving viability, there was still tremendous uncertainty about where, officially, the commercial fleet stood relative to other resource users and in the overall scheme of DFO conservation policy. The Coho Recovery Plan, launched in 1998 and bringing coast-wide, fleet-wide coho conservation measures into effect, was a harbinger of more formal and restrictive conservation policies to come.

DFO Fiscal Restraint—Trying to Do More With Less

From the mid-80s until the present, DFO (and government generally) is beset by fiscal restraint. With a higher conservation bar, increased demands from users, and the need for more and better fisheries data, the job of management has gotten larger and more difficult… but financial and human resources have not kept up with demand…

Chronology of Key Events in Fisheries Management during the Period[4]

1969—Davis Plan limits licences and reduces fleet size… but inadvertently increases fishing power

Early-70s—Emerging Japanese presence in markets—more money in the industry

1971—First test fishery in Juan de Fuca Strait

1972—Establishment of First Nations food fishery as 2nd priority to conservation

1973—First hydro-acoustic counting mechanism in Fraser River at Massey Tunnel, expanded to Mission in 1975

1977—Salmon Enhancement Program—make more fish!

1981—Limited fleet buyback program reduces fleet by less than 1%; period of record-high interest rates

1982—Royal Commission into the Pacific Fisheries (Pearse) recommends sweeping management and fleet reforms

1982—Canada and US implement Chinook conservation measures in an Annex to the Treaty

1983–4—Back to back El Nino events… Fraser sockeye migrate through the inside passage, out of reach of the US fleet

1985—Pacific Salmon Treaty governs catch shares between nations, and includes many conservation and enhancement measures; new focus on less-productive stocks and species

1987, 1988—DFO policies require higher escapement targets and cap harvest rates at 65%

1990—The Sparrow Decision transforms policy into constitutionally protected obligation

1992—Aboriginal Fishing Strategy gives First Nations commercial allocations separate from the commercial fishery

1992–1994—Missing sockeye scares prompt external inquiries (Pearse and Fraser)

1995—Conservation of late-run Fraser sockeye becomes a focus

[4] these include DFO policies, external events, and third party or stakeholder processes

Mid-90's—DFO pulls-back commercial fisheries over concern for weak stocks and Chinook and coho by catch

1996—"Mifflin Plan"—major program in support of conservation and fleet economic viability; objective to reduce fleet by 20% (achieved); licence buyback and area licensing

1997—Commercial fleet shares (seine, gillnet, troll) set

1998—Pacific Fisheries Adjustment and Restructuring Program—fleet reduced by a further 30%

Conservation, Conservation, Conservation (1999 to present)

Beginning in 1998, after substantial commercial fleet restructuring was complete, DFO set into policy and practice its official objectives and priorities for Pacific salmon management. This marks the beginning of the third era in our story. The new priorities came to be summarized simply as: "conservation, conservation, conservation." The conservation bar had now risen to new heights.

The "cycle" of fisheries management remained essentially unchanged from the early days—pre-season planning, in-season management, and post-season evaluation—but a conservation mandate embedded in written policy, and a diminished role for commercial fisheries in the cycle, emerged.

Three important policy papers were issued back-to-back during the period, and are described briefly here because they mark a turning point in our story about evolving commercial salmon fisheries. Up until this time, a skeptic of fisheries management could claim that DFO's commitment to conservation was not clear, and periodically compromised by commercial industry pressures. With these policy papers, DFO's conservation ethic and priority became irrefutable, at least in principle.

New Directions—Policy

A policy paper entitled *A New Direction for Canada's Pacific Salmon Fisheries* issued in the fall of 1998 did not really herald a new direction at all, but rather served as a confirmation of the direction taking shape over the last couple of decades. From the perspective of the commercial fishing fleet, the Paper served notice that:

- Conservation of the stocks would take precedence in managing the resource;
- A precautionary fisheries management approach would be applied;
- An ecological approach would guide fisheries and oceans management in the future;
- Any trade-offs between current harvest benefits and long term stock well-being would be resolved in favor of the long term;
- Selective fishing methods would be used to harvest salmon;
- First Nations requirements for food, social, and ceremonial purposes would continue to have first priority after conservation requirements;
- Recreational fisheries would be provided with more reliable and stable fishing opportunities;
- The commercial fishery should diversify into other species, and reduce dependence on the salmon resource.

New Directions sent a strong message to the fleet that it possessed "residual harvester" status, meaning access to the resource only after priority uses were met. It also represented a break from DFO's longstanding practice of managing the fishery with one eye on fleet economic viability. The paper suggested that, to attain viability, the fishing fleet should gain participation in a variety of fisheries, with salmon comprising a contribution to—but not the foundation of—economic operations.

New Directions was followed in the fall of 1999 by a policy paper partially clarifying the allocation of salmon amongst user groups. *An Allocation Policy for Pacific Salmon* again confirmed conservation of Pacific salmon stocks as the precedent objective in managing the resource, and First Nations food, social, and ceremonial requirements as the second priority. The *Allocation Policy* set out that, after conservation and First Nations priorities were met, recreational fisheries would have priority for chinook and coho salmon, and stable and predictable access to sockeye, pink, and chum stocks (up to 5% of the combined commercial-recreational allocation).

The *Allocation Policy* then set out target catch allocations within the commercial fleet (gear types and licence-areas). The *Allocation Policy* brought some certainty to the commercial fleet, specifically in defining recreational-commercial catch shares, and shares within the commercial fishery. But, it left the commercial sector unable to definitively assess its share of the available catch, since priority allocations to First Nations for food and ceremonial purposes, or pilot sales, or Treaty Settlements, were not quantified.

A Policy for Selective Fishing in Canada's Pacific Fisheries was issued in January, 2001, though discussion versions of the document had been circulating for a couple of years. *Selective Fishing* advised all sectors using the salmon resource—First Nations, recreational, and commercial—that selective fishing would be a requisite element of conservation-based fisheries. While the *Allocation Policy* had set allocation guidelines, *Selective Fishing* advised that ongoing fishing opportunities and resource allocations would be shaped by the ability of all harvesters to fish selectively. Resource allocations would shift to those sectors able to meet selective fishing standards.

Fundamental strategies for achieving catch selectivity were identified, in order of preference:

1. Avoidance of non-target species and stocks through time and area restrictions;
2. Avoidance through gear design;
3. Release live and unharmed before being brought aboard or ashore through gear design;
4. Release live and unharmed from the deck of the vessel or landing site.

In previous eras of fishery management, it could be said that commercial fisheries were managed with best efforts to ensure that conservation objectives would be met. When taken together, the "new direction" policy papers made it clear that, from now on, commercial fisheries would only be mounted when, and if, DFO was fully satisfied that all conservation objectives were assured.

DFO Policy and Priority Enunciated

Coho Recovery Plan

A New Direction for Canada's Pacific Salmon Fisheries

Selective Fishing Policy

Salmon Allocation Policy

Pacific Salmon Treaty

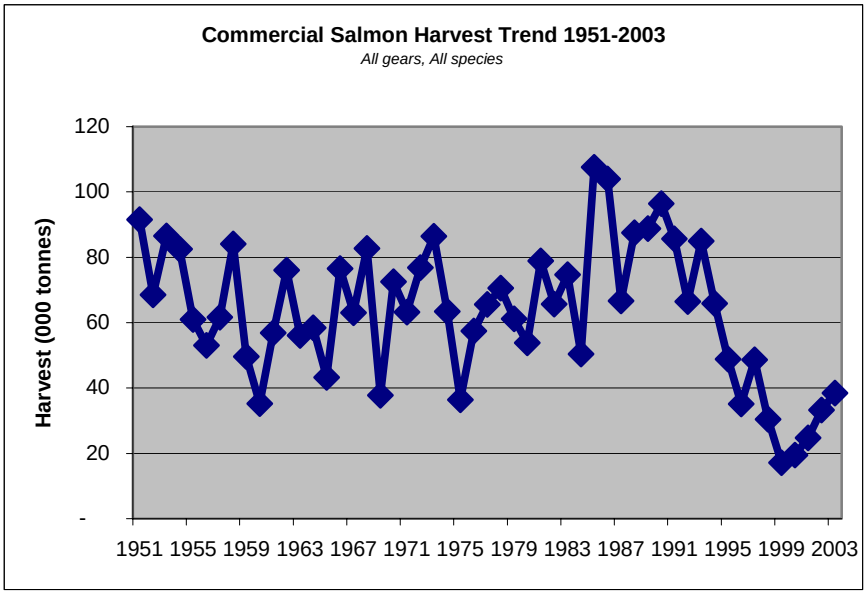
New Directions—Practice

The *New Directions* policy series saw DFO most definitely "talking the conservation talk." But was the introduction of policy accompanied by changing management practices?

The next four fishing seasons (1999–2002) saw lower annual commercial volumes of salmon harvest than had been registered in the previous 50 years. The Canadian commercial fleet harvested 49,000 Fraser River sockeye salmon in 1999, representing 1.3% of the total run size that year. The commercial fleet, although downsized dramatically through restructuring, saw extraordinarily limited access to salmon stocks.

With the bar of conservation at new heights, fishery managers and commercial fleet representatives, consulting with other user groups, worked to identify and execute commercial fishing opportunities, largely in vain.

Commercial Salmon Harvest Trend 1951–2003



In 2002, a greater-than-expected return of sockeye salmon to the Fraser River, combined with grave concern about pre-spawn mortality in late-run fish migrating up the river, set the stage for controversy. A commercial catch of about 2.3 million fish out of a return of over 15 million fish sparked the ire of the commercial sector, and prompted calls for an external review of fishery

management[5]. This episode typified the current-day mandate of fishery managers, faced with a conservation vs. exploitation dilemma, to choose the path of conservation.

By this time, some positive signs and trends had been noted in salmon abundance, particularly in coho and chinook stocks which had been subject to long-standing conservation initiatives.

The stock assessment tools utilized by DFO in assessing run strength have continued to increase in technological sophistication. DNA testing of tissue samples can determine specific stock of origin with new precision. Radio-tagging allows collection of data as fish pass from open sea to the spawning beds. High-tech data collection and interpretation has increasingly replaced information collected through commercial fisheries.

Also during this current period, the commercial fleet has developed its acumen for accessing small or opportunistic fishing prospects by utilizing new harvesting practices.

The Fishing Fleet: Practices and Technology—Current Focus

Until the late 1990s the focus of salmon fishermen was on how to catch more fish in less time. As the "conservation, conservation, conservation" mantra has sunk in, however, the ingenuity of fishermen, and the application of technology, have been turned to ways to harvest target stocks selectively.

Both fishing strategies and fishing gear have seen changes under "selective fishing." Fishery openings are carefully timed and placed to minimize encounters with non-target stocks. Fishing gear is designed and deployed to minimize the chances of capturing non-target species. Protocols are in place for returning any non-target species captured back to the water, live and unharmed.

For the first time, fishing practices are geared to slowing down the harvest. Use of stern ramps on seiners is no longer permitted. Barbless hooks are required. Gillnetters cannot leave their nets in the water for extended periods.

As fishermen come to believe that their access to stocks is predicated upon selectivity, these old dogs are learning new tricks!

Summary of the "Conservation" Era

During the current era of commercial salmon fishery management, DFO has put into policy and practice an extremely strong conservation-based fishery management approach, whereby conflicts between conservation of the resource and socio-economic ends are resolved, as a matter of policy, in favor of the resource.

For a couple of years, particularly in 1999 and 2000, application of this approach virtually brought the commercial salmon industry to a stand-still. Some commercial sectors (for example, Fraser River gillnetters) saw entire seasons go by without a single fishery opening.

Over time, the fleet's ability and willingness to harvest selectively has been demonstrated and gradually accepted by DFO fishery managers. The fleet has also shown innovation in mounting small "bite" fisheries, whereby only a few vessels actively fish on small surpluses (surpluses which could not sustain pressure from the whole fleet), but a larger number of vessels share in the

[5] As this paper is completed, a sizeable *shortfall* in returns to the spawning grounds for Fraser River sockeye in 2004 has become evident; although fishery managers set-aside an escapement they *deemed* adequate in 2004, and assessment tools confirmed escapement levels, an apparent anomalous in-river mortality resulted in too few fish reaching spawning beds. Cause and effect is yet to be determined, but this episode highlights the enormous complexities involved with managing salmon under public scrutiny and a host of difficult constraints.

proceeds of the catch. Gradually, fishing opportunities have crept back, with commercial fleet aggregate landings in 2003 about twice that recorded in 1999.

This is not to say that DFO is relaxing its conservation program, nor is it to suggest that the commercial fleet is satisfied with its current level of salmon resource access and influence. Some in the fleet argue that the conservation bar has risen unreasonably high, with some escapement targets beyond the carrying capacity of the spawning grounds, and a level of fishery risk-aversion beyond that which is reasonably required. Some believe that undue restrictions on the fleet comprise *de facto* re-allocation of the resource to other user groups. A catch mix heavily weighted to pinks and chums brings business challenges.

However these conflicts are resolved, it seems clear that any growth in access by the commercial fleet to the salmon resource will be predicated on use of selective and innovative harvesting methods.

Species at Risk Act—Raising the Bar Even Higher

The Species at Risk Act (SARA) was brought into effect in 2003. The act is intended to encourage the protection and recovery of threatened or endangered species. Potential impacts on fisheries are great. DFO resources required to accommodate SARA will be substantial. Both DFO and fishery resource users share a concern that they must abide by a process over which they exert little influence…

As we conclude this chronology of evolving commercial salmon fisheries management we observe that, to a great extent, the commercial fleet has gone from being a lead player to a smaller and less influential player in the overall salmon management process. As the conservation bar has risen in response to changing pressures, commercial fleet participation has declined.

In making this observation we do not seek to elicit pity for the commercial fleet. Nor do we imply that the fishery has no future. We are merely describing an evolution in commercial fishery management where the role, priority, stature, and impact of the commercial fishery has inarguably declined over time.

SUMMARY OF COMMERCIAL SALMON FISHERY EVOLUTION

In the preceding section we have attempted to encapsulate 100 active years of salmon management history into a few pages. This obviously necessitated some generalizations and omissions. We now attempt to cull the story down to a few paragraphs with the purpose of leaving the reader with the key themes and "flavor" of the story.

The test or definition of conservation—or the height of the conservation bar as we have referred to it—has evolved over time. Conservation objectives were very general in the early days, with overall returns of salmon of primary concern. Conservation and economic considerations were balanced, given a simple definition of conservation. Over time, the conservation bar has risen, to the extent that not just strong stocks or major river systems are deemed important, but minor systems and less-abundant stocks as well. Preservation of the biodiversity of salmon is now of key importance. Protection and recovery of declining stocks is entrenched in legislation. Conservation now takes precedence over economic considerations. Weak stock management means that fishing opportunities on more-abundant stocks are routinely forgone.

As the conservation bar has risen fishery management has evolved substantially. In early years, commercial fishing was a key source of fishery management information. Seven-day per week fisheries throughout salmon migrations generated constant and consistent catch feedback, which helped fishery managers forecast, manage, and evaluate the runs. Working cooperatively with the commercial fleet and monitoring escapements were key functions. Meeting today's heightened conservation objectives necessitates far more active management and fewer commercial fisheries. Salmon stocks are managed on discrete bases, whether groups of stocks or individual stocks. This refinement makes it more challenging to identify and organize fisheries where target stocks are harvested without undue impact on non-target stocks. As fisheries have become more constrained, fishery managers have come to rely on run-size and escapement information sources other than the commercial fishery. Test fisheries, scale samples, hydro-acoustic counting devices, and DNA tissue samples are tools utilized. Fishery management, once the domain of on-grounds local fishery officers, is increasingly driven by scientific considerations. As the body of scientific knowledge has grown, it has become apparent that we still have much to learn to effectively manage salmon.

Contributing to the complex web of variables faced by fishery managers has been the growth in the number of groups seeking to utilize, or influence use of, salmon stocks. The days when there were plenty of salmon to satisfy everyone are long gone. In recent decades the competing demands of First Nations and recreational fisheries, combined with the requirements of the commercial fleet, exceed the total allowable catch. This is most acute for sockeye, coho, and chinook, less so for lower-valued pinks and chum. Pacific Salmon Treaty obligations to the US must be met. Over-subscription of the salmon resource—not enough fish to meet the combined demands of users—makes for on-going friction between sectors. An increasingly vocal and influential environmental sector often posits that the best use of salmon stocks is not to use them at all, but rather allow them to spawn. As the environmental ethic of the public at large has developed, the tolerance for conservation failures has diminished. Salmon fishery managers are unlikely to satisfy all interests.

Just as conservation tests, fishery management complexity, and competing demands on the salmon resource have all evolved substantially over time, so too has the commercial salmon fleet. From a period of equilibrium in the early days, where passive fishery regulation was offset by benign fishing capacity, the catching power of the fleet, and its actual and potential impact on stocks, has grown exponentially in recent decades. Fishermen, enabled by technology, motivated

by the prospect of economic gain, and frustrated by increasing restrictions on fishing time and area, implemented ingenious vessel and gear designs and fishing strategies tailored to catch as much fish in as short a time as possible. A "cat and mouse" game was played out over decades: increased fleet catching power was dealt with through further fishing restrictions, leading to increased fleet catching power, dealt with through further fishing restrictions… the loop was repeated over and over. Periodic blooms in resource abundance or spikes in salmon market prices brought periods of prosperity, concealing the truth that the "game" was not sustainable. In spite of dramatic fleet downsizing, the remaining fleet still possessed substantial catching power—the most successful fishermen, possessing modern and efficient vessels and gear, were still in the game. The amount of salmon available to the commercial fleet declined. DFO decreed that the commercial salmon fleet would be unleashed upon harvestable surpluses of salmon *only* if there was *no risk of over harvest*. Few such opportunities presented themselves. Unable to tame the salmon fleet through decades of piecemeal restrictions, DFO, in order to fulfill its increasingly complex conservation mandate, caged it instead. Presently, commercial fishing opportunities are predicated on balancing potential fishing pressure with harvest opportunities. An entirely new mindset is emerging.

As we conclude our historical account of the evolution of the commercial salmon fishery in British Columbia, we trust that readers have gained an appreciation for the magnitude of changes having occurred in the fishery. As scientific knowledge, societal values, technology, and the definition of conservation have evolved, DFO has implemented a great many policies and practices in the name of conservation. Results at times seemed elusive, but conservation is now embedded as the over-riding objective of fishery management. Implementation of the conservation ethic has had a dramatic impact on user groups reliant on the fishery.

In this paper we describe an *evolution* in commercial salmon fishery management while avoiding *evaluation* of fishery management. Our purpose is to convey the magnitude of changes made in the interests of conservation, not to render our opinions on the appropriateness or effectiveness of these changes.

We now offer a brief outlook for commercial salmon fishery management and fisheries in the future, a future where a high conservation bar and meaningful commercial fisheries need not be mutually exclusive.

THE OUTLOOK FOR COMMERCIAL SALMON FISHERIES

A quick inventory of strengths and weaknesses now facing the commercial fishing fleet as it seeks to gain back a measure of economic viability in the Pacific salmon fishery at first blush seems heavily weighted to the negative side of the ledger:

- A highly precautionary and conservative approach to managing the commercial fleet is now the status quo;
- The level of scientific research and assessment needed to support salmon fisheries is increasing, but funding for this work is on the decline;
- The fleet ranks low on the allocation priority list, with very limited access to coho and chinook, a shrinking share of coveted sockeye surpluses, and predominant access to pink and chum stocks possessing limited commercial value;
- There remains a lingering perception that the commercial fleet cannot be controlled in terms of harvest rate and catch composition, and indeed, the fleet still possesses considerable catching power;
- The growth of aquaculture and the forces of seafood globalization make the competitive environment facing the salmon industry extremely challenging;
- The salmon fleet and the salmon industry in general are weakened from years of poor performance; industry infrastructure is diminished, and the business attracts little capital for market or product development.

Effectively, the salmon fleet faces enormous hurdles, and faces them in a weakened condition.

There are positives, however:

- The extent to which the fleet can harvest selectively is growing and demonstrable;
- Shifting consumer preferences toward wild salmon are beginning to reflect in growing market demand and firming prices;
- A major study jointly commissioned by the federal and provincial governments entitled "Treaties and Transition" has made important recommendations to improve the certainty and security under which commercial salmon resource users operate;
- Another major study, "Our Place at the Table: First Nations in the B.C. Fishery", prepared by the First Nations Panel on Fisheries, also explores options for improving manageability and allocation certainty;
- A task force to pursue implementation of these two reports has been formed by DFO;
- Commercial salmon fishermen have proven incredibly resourceful, and resilient, over the ages.

Selective Fishing Strategies

Avoidance is the favored approach: using traditional and newly gained knowledge, non-target stocks are often avoided through timing of openings and location of openings. Depth fished, time of day, and duration of opening may all be adapted to the individual circumstance.

Gear Modification enables many fish not avoided to pass through the gear. Mesh size, escapement grids, barbless hooks, and knotless web are examples of gear allowing fish to be freed without being brought aboard.

Catch and Release, although a last resort, has proven extremely successful. Non-target species brought carefully aboard and placed in aerated revival tanks show an amazing ability to fully recuperate.

Modified fishing techniques, combining the above strategies, and premised on **slowing down the harvest,** change the emphasis from catching target species in a hurry… to slowing down to ensure careful treatment of any non-target encounters…

All of these strategies are integral to the commercial salmon fisheries of today and tomorrow.

Having offered a brief synopsis of the current situation facing the commercial fishery, we next glimpse into our crystal ball and formulate the following predictions:

- The conservation bar will continue to rise over time, with implementation of the *Species at Risk Act*, and as more precise science leads to increasingly refined (stock-specific) management initiatives;
- Public scrutiny of fisheries will remain at high levels;
- Given the philosophy and funding realities of government, the commercial salmon industry will increasingly be called upon to fund management, science, and enforcement. To support fisheries there will be *more* work to do, and DFO will be *less* able/willing to pay for it.
- Efforts will be made to implement the reforms called for in *Treaties and Transition*, and *Our Place at the Table* (rationalization of the fishery, integration of First Nations and commercial fisheries);
- As the expiry of the Canada-US Treaty in 2008 approaches some "bumps" will be encountered prior to renewal or re-negotiation;
- Salmon productivity and abundance will, as always, be cyclical, waxing and waning due to environmental conditions;
- New issues and complexities, not even contemplated today, will emerge.

We do not see the business environment facing commercial fishery participants getting easier, or current challenges abating. If anything, the constraints upon the fleet will further tighten.

Commercial salmon fishery participants hoping for, or waiting for, a return to the fishery of old, will be disappointed. Selective fishing and precautionary management are not fads. Improving stock abundance will not trigger a return to large-scale mixed stock fisheries. In the face of an unflinching conservation mandate, the fleet must fundamentally change its philosophy and practices. Many commercial salmon fishery participants have recognized this reality, a few have embraced it, while others resist it.

If a return to large-scale, "industrial" fisheries is not likely, then what does the future hold for commercial salmon fisheries? Because fisheries management is now "risk averse," the commercial fishery must remove the perceived risk of mounting fisheries. Reducing the *competitive* element of fisheries, although it goes against the grain of many, seems necessary. Non-competitive fisheries imply that fishermen know how much fish they are entitled to catch before a fishery starts, so that fishing harder or faster has no benefit. Non-competitive fisheries are generally accompanied by a host of constraints, for example selectivity requirements, on-board fishery observers, and catch validation to ensure conservation objectives are adhered to. A higher level of catch reporting is also implied. The skill and ingenuity of the vessel operator in this environment is turned to ways of meeting fishery regulations while maximizing catch value and economic benefit. Non-competitive fisheries are commonplace in other fisheries (in BC and abroad) and small-scale pilots have already been effected in the salmon fishery.

Through fleet-wide, coast-wide implementation of non-competitive fisheries, the fleet may access a host of smaller harvest surplus opportunities. This can mean more small-scale fisheries throughout the migration, rather than large, intense fisheries near the peak of the run. A low-volume, long-duration fishery is better suited to current market requirements and remaining commercial salmon industry infrastructure. Such a fishery also allows fishery managers to keep catches safely within allowable limits. By applying light fishing pressure over a prolonged time frame, the fishery of the future may actually mimic on a smaller scale the dynamic seen in the early days. The commercial fishery may again provide consistent, ongoing catch data to fishery managers.

A non-competitive fishery, combining appropriate fleet incentives with penalties for non-compliance, effectively "tames" the commercial fishing fleet. This paves the way for improved cooperation between industry and DFO, and frees industry to cast its attention to strategies of maximizing value, rather than maximizing volume. Technology and innovation will be directed to the challenge of exploiting strong-stock opportunities with minimal or no impact on non-target stocks.

Our purpose in this Outlook section is not to design the commercial salmon fishery of the future, since this must be done by industry stakeholders, but rather to indicate that there is economic hope for the future, and an ongoing role for the commercial salmon fleet in salmon fishery management if reform is implemented.

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Bruce Turris holds a Masters of Arts degree in Economics from Simon Fraser University and has been involved in the management of commercial fisheries for 20 years having worked with the Department of Fisheries and Oceans from 1984 to 1997 and as President of Pacific Fisheries Management Incorporated since 1998. His work has focused on finding solutions to overcapitalization in fisheries, designing and implementing sustainable and viable commercial fishing regimes, and developing co-management arrangements, programs and relationships between government and industry.