4.0 BC Resource Assessment and Issues

A healthy aquatic environment and resource base is important to sustain a viable seafood industry and recreational fishery. This section provides a brief overview of the general health of fish stocks in BC, the impacts of changes in climate and the ocean environment, and the status of and challenges for resource sustainability. Also discussed are: the "precautionary approach", the impacts of the recently enacted federal Species at Risk Act (SARA), and DFO's yet-to-be-released Wild Salmon Policy.

4.1 General Health of Wild Fish Stocks

Exhibit 11 provides an overview of stock assessment status for wild fish in British Columbia with additional details available in Appendix E.

4.1.1 Salmon

Salmon have a particularly complex biology because their anadromous lifecycle includes both freshwater and saltwater (ocean) phases. Five species of salmon spawn in BC waters: sockeye, coho, chinook, pink, and chum.

There are 9,600 distinct salmon spawning runs in BC.

A 1996 American Fisheries Society review identified 9,600 distinct salmon spawning runs in BC (Slaney et al. 1996). The study was able to assess stock status for only about one-half of the runs in BC. Of those assessed, significant concerns were expressed for about 20% of the runs and 142 were found to be extinct.

Variation in Salmon Abundance

The mid-1980s witnessed record landings for many of the commercial salmon fisheries. This was due in part to a period of high ocean productivity, increased production of hatchery fish, and, in some cases, high fishing rates. At the same time, there was considerable growth in recreational fishing effort especially on the West Coast of Vancouver Island and on the Central and North coasts, including the Queen Charlotte Islands, where lodges were developed.

Changing ocean conditions are a major factor in variable salmon abundance.

During the 1990s, some stocks experienced large declines in spawning escapements, notably upper Skeena and upper Fraser coho as well as Rivers and Smith Inlet sockeye. In 1998, DFO banned coho fishing along the entire BC coast to protect weak Skeena River and upper Fraser River coho stocks and for the last several years has closed directed fisheries for Rivers and Smith Inlet sockeye. Changing ocean conditions and poor ocean survival appear to have been key factors in this decline.

A climatic regime shift since 1999 has meant that for many stocks such as coho off the West Coast of Vancouver Island (WCVI) ocean survival rates have improved considerably. Still, specific stocks are considered to be depressed and recovery plans are in place for ones that are critically so. It is too early to conclude that the current favourable ocean conditions will be sustained. However, if these conditions persist and stocks are able to rebuild, the result could be greater commercial and recreational harvest opportunities over the next five to ten years.

Exhibit 11: Overall Health of Wild Fish Stocks in BC

Species	Current Status*	Comments
Salmon		
Chinook	Healthy	Continued improvement from late 1990s; most stocks at or above escapement goals
Coho	Mixed	Continued improvement from late 1990s, particularly in Strait of Georgia; interior Fraser River and some North and Central Coast coho remain weak
Sockeye	Healthy	Increased returns to Nass, Skeena, Barkley Sound and most Fraser River stocks; continued concerns about in-river mortalities in late Fraser River run; Sakinaw Lake, Cultus Lake, Rivers and Smith Inlet stocks depressed
Pink	Healthy	Record returns to Fraser River in 2001; localized concerns for some Central Coast and Broughton Archipelago stocks
Chum	Mixed	Generally stocks in south are strong; some North Coast stocks remain depressed
Herring and Other Pelagics		
Herring	Mixed	Abundance varies regionally
Sardine	Healthy	Distribution and abundance highly influenced by climatic conditions; present in BC waters during warm water conditions
Eulachon	Mixed	Fraser River fishery closed in 1998; listed as "threatened" by COSEWIC; strong recovery of many stocks since 2001 (except Central Coast)
Albacore Tuna	Healthy	Highly migratory species; Canadian catch is small share of total Pacific landings
Groundfish		
Halibut	Healthy	Considered model of international fisheries management
Sablefish	Healthy	Some uncertainty as to current level of recruitment
Pacific Cod	Under Review	Low recruitment during the 1990s; some recent evidence of increased recruitment
Lingcod	Mixed	Stocks vary by area; Strait of Georgia stocks remain depressed
Hake	Under Review	Outside of Strait of Georgia, last survey indicates lowest biomass in past 25 years; some evidence of moderate recruitment since 1999
Inshore Rockfish	Depressed	Conservation concern, particularly in Strait of Georgia, including both commercial bycatch and recreational catch; recent implementation of rockfish conservation areas to protect spawning biomass
Shelf/Slope Rockfish	Mixed	Lack of timely, stock assessment data adds to uncertainly; bocaccio rockfish listed as "threatened" by COSEWIC
Flat fish (Dover, Rock, English sole)	Mixed	Generally low recruitment during 1990s, due to unfavourable ocean conditions
Shellfish and Invertebrates		
Geoducks	Healthy	Need for better biomass and recruitment estimates
Red Urchin	Healthy	Need for improved biological information
Sea Cucumber	Healthy	Lack of biological information for some areas
Abalone	Depressed	Fishery closed; SARA listed species (Threatened)
Dungeness Crab	Healthy	Concerns about oversubscribed fishing effort
Prawns	Healthy	Concerns about oversubscribed fishing effort
Shrimp	Healthy	Concerns about oversubscribed fishing effort
Intertidal Clams	Mixed	Over-harvest of specific beds in Strait of Georgia

** Status classified by consultants under three categories – "healthy", "mixed", and "depressed" – with Pacific cod and hake classified as "Under Review" as both will be subject to biomass surveys in 2004 (there is anecdotal evidence of increased biomass in recent years).*

A Change in Salmon Management Approach

Salmon harvest rates are down substantially, with reduced runs and the adoption of a precautionary approach to management.

The amount of salmon available for harvest has decreased in recent years for at least two reasons. First, as mentioned above, in the late 1990s there was a decline in the numbers of salmon returning to BC streams. Second, the adoption of a precautionary approach to salmon management by DFO meant that, where weak and strong salmon stocks intermingle, only selective fishing would be allowed i.e., traditional mixed stock fisheries were curtailed.

Many salmon stocks have rebuilt and may be able to withstand increased fishing pressure.

The result is that salmon exploitation rates that were previously in the range of 60% to 80% are now between 20% and 40% range (see Exhibit 12 on Fraser River sockeye). The recent rebound in salmon stock abundance, together with industry's increased ability to fish stocks selectively, suggests that salmon exploitation rates may be able to be increased.

Fraser River Sockeye

Fraser River sockeye is a very important component of BC commercial and aboriginal salmon fisheries, and a growing part of the recreational fishery. In recent years, Fraser sockeye runs have experienced significant natural in-river mortality on return to spawning grounds, mortality attributable for early run stocks to stress and high river water temperatures, and mortality attributable for late run stocks to the effects of an endemic parasite. In 2002, fisheries managers severely curtailed fishing opportunities in anticipation of continued high in-river mortality, but the expected high mortality did not occur and substantial fishery benefits were foregone.

A DFO review recommended management changes for Fraser River sockeye.

DFO subsequently launched a review of the 2002 management of Fraser River sockeye. The review produced 14 recommendations, including further research on in-river mortality and stock assessment, all of which were accepted by the Department. One recommendation was the development of a new policy advisory process involving First Nations, commercial and recreational fishing sectors, conservation organizations, community groups, and the provincial government.

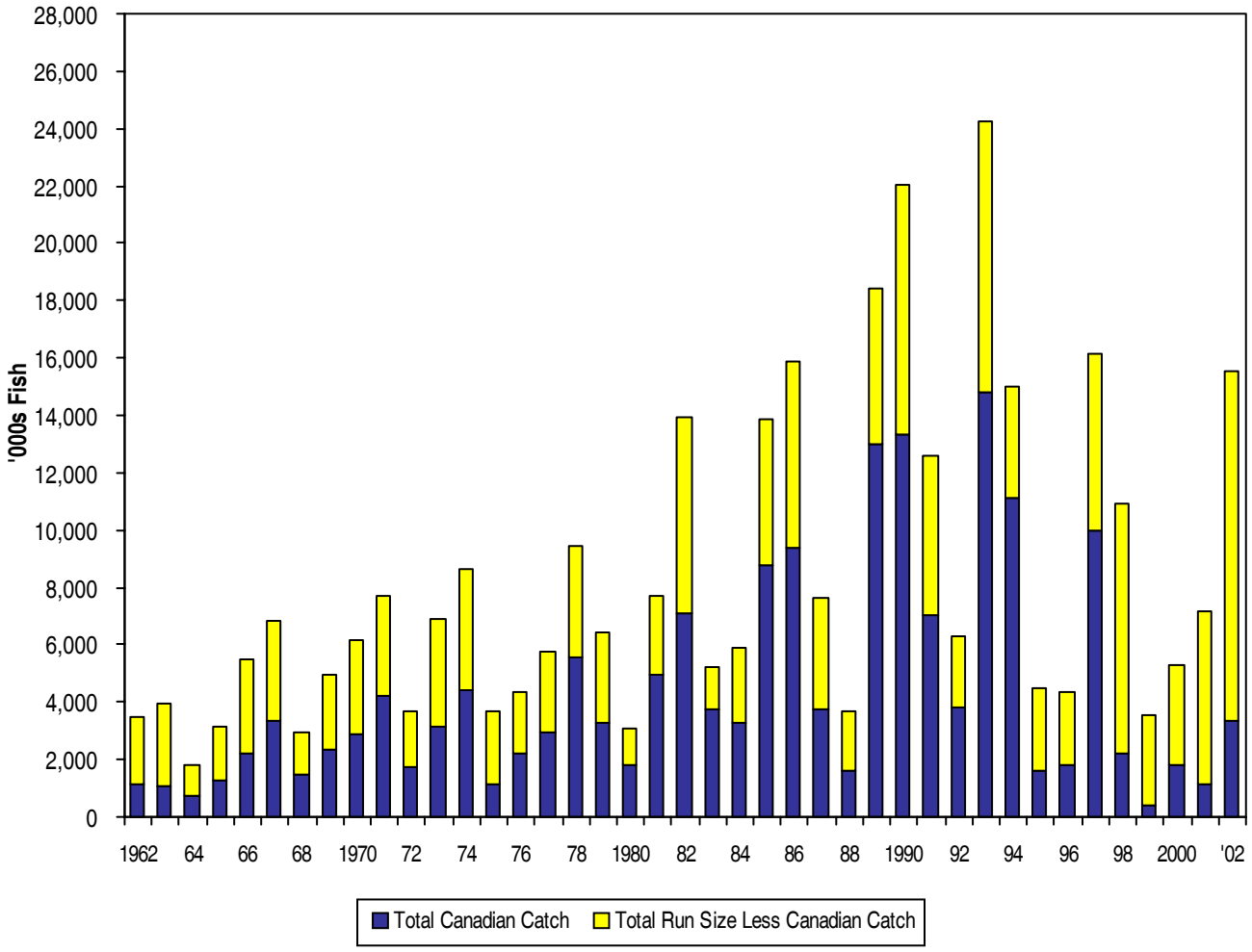
Key Issues and Research Areas

There are a number of key issues and research areas that need to be addressed for Pacific salmon:

- declining government funding for core stock assessment;
- definition of management conservation units;
- determinants of marine survival;
- protection and restoration of salmon habitat;
- role of salmon enhancement in stock rebuilding and augmentation; and
- interaction of wild and farmed salmon.

DFO has launched policy initiatives and research programs in some of these areas.

Exhibit 12: Fraser River Sockeye Run Size and Canadian Catch Estimates



Note: Catch is sum of commercial, recreational, and aboriginal catches.

Source: Pacific Salmon Commission, Pacific Fisheries Resource Conservation Council and GSGislason & Associates Ltd. "The 1999 Fraser River Sockeye Fishery: A Lost Year", prepared for MAFF, October 1999.

4.1.2 Herring and Other Pelagics

Pelagic fish stocks are prone to boom and bust cycles.

Pelagic fish such as herring and sardines tend to be relatively fast growing and short-lived. Many of these species occur in large schools; are important forage for birds, mammals, and larger fish like salmon; and migrate close to shore to spawn. While their schooling behaviour makes them vulnerable to overfishing, many stocks can recover in a relatively short period. Thus, these species often undergo "boom and bust" cycles.

Herring

The herring fishery is sustainable, with some regional ups-and-downs.

Herring has been managed conservatively for more than 20 years. Herring stock status varies by management area, and continued variation in stock status between areas is expected. The historic pattern of herring abundance is one of geographic variation rather than coast-wide cycles of abundance. Therefore, on a coast-wide basis fishing opportunities should be sustained and remain relatively stable, but regional fisheries closures and quota variation are expected. The fishery is fully exploited.

Sardines

Currently, Pacific sardines are one of the few under-utilized fishing opportunities on the coast. In 2002/03, less than 1,000 tonnes of 5,040 tonne quota were taken. Pacific sardines appear to be abundant in BC waters during periods of warm surface water temperature conditions (El Nino). Therefore, long-term, sustained fishing opportunities cannot be expected although some short term fishing opportunities may be available.

Tuna

Albacore tuna represent the only large, predatory pelagic species harvested in BC. Fishing effort has grown substantially over the last decade and the stock appears healthy. However, there is mounting concern about the state of large pelagic fish stocks globally due to expanded fishing effort. Landing only 3% of the Pacific albacore catch, Canada has little control over exploitation rates in international waters where most of the fish are harvested.

4.1.3 Groundfish

With limited resources for stock assessment, stock status is uncertain for many groundfish species.

Groundfish is a complex fishery. A wide array of species and stocks is harvested and many factors influencing life history and population status are not fully understood. Limited resources for stock assessment mean that, for many species, stock status will remain uncertain. This problem is being addressed through the fisheries observer program, which since 1996 has produced a comprehensive catch and biological (length, sex, age) dataset for the full groundfish trawl fleet. Nonetheless, resources for timely data analysis continue to be an issue.

Most Species are Fully Exploited

The known stock status of groundfish species varies from healthy (halibut) through mixed (many species) to depressed (petrale sole, Pacific cod, inshore rockfish). Almost all species are considered to be either fully exploited or overexploited. Bocaccio, a shelf rockfish species, has recently been listed as "Threatened" by COSEWIC (see Section 4.6.2).

Substantial Progress in Sustainability

Management practices for the halibut, sablefish, and groundfish trawl fisheries are internationally recognized.

Various fisheries have made substantive progress towards sustainable fishing practices and effective co-management processes over the past ten years. Halibut, sablefish, and the groundfish trawl fisheries are notable examples. These fisheries are gaining global recognition for their management initiatives.

A decade of extremely low recruitment has led to the introduction of conservative quotas for many groundfish species. The low recruitment is usually attributed to unfavourable ocean conditions, but the actual causes are unknown. Since many species take five to ten years to "recruit" to the fishery, conservative quotas are anticipated over the short term. As more is learned about the effects of climate on fisheries and other risk factors, it may be possible to manage these fisheries more sustainably in the future.

Environmental Concerns Remain

Information on total catch – harvest plus discards – is important for stock assessment purposes.

Recovery planning for inshore rockfish and bocaccio will impact management of virtually all groundfish fisheries. Seabird bycatch concerns in groundfish hook and line fisheries (halibut, rockfish and sablefish) can likely be mitigated by using new technology and better fishing gear. There is growing environmental concern about destructive fishing methods and levels of discard, particularly in trawl fisheries. The BC fleet has been progressive in this area, moving towards fuller utilization (e.g., turbot). All discards are accounted for and incorporated into stock assessment processes. In addition, particularly sensitive areas (i.e., sponge reefs, inshore rockfish habitat) have seen voluntary and mandatory fishing closures.

Nevertheless, concerns persist about catches of species that are not under quota management such as rex sole and some rockfish species. The groundfish industry, DFO, and MAFF are working towards integrated management of groundfish, which should provide for improved bycatch and non-quota species management.

4.1.4 Shellfish and Invertebrates

Dive Fisheries

Conservative management, using individual quotas, is key for dive fisheries.

The shellfish dive fisheries (geoduck, sea urchins, and sea cucumbers) started in the 1970s. The potential for overharvest by dive fisheries was demonstrated as they expanded rapidly through the early 1980s. By 1990, the abalone fishery had collapsed and it remains closed today. Geoduck landings peaked in 1987 at three times their current harvest levels.

In the 1990s, the dive fisheries moved to a more conservative management regime, including individual quota management. Given the potential for overharvesting using diving methods, conservative management and reliable biological data are essential in these fisheries.

Trap Fisheries

Crustacean fisheries (Dungeness crab and prawn) appear to have sustained themselves reasonably well without a quota system. However, effort limitation and compliance are important management issues in these non-quota managed fisheries. Reliable catch data for the recreational fishery is a key issue in managing the prawn and Dungeness crab fisheries.

PSP Testing

The lack of PSP testing on the North and Central coasts is a constraint on shellfish fisheries.

Harvests of bivalve shellfish require Paralytic Shellfish Poison (PSP) testing for "red tide". Intertidal clams (littleneck, manila, and butter clams) on the North and Central coasts represent one of the few expansion opportunities for species currently fished commercially. However, the lack of PSP laboratory facilities in the North coast constrains development. The lack of access to PSP testing is also a constraint to shellfish culture in the North.

4.2 New and Emerging Fisheries

In 1995, the federal and provincial governments signed a MOU on new fisheries development. In 1999, DFO designated a phased assessment approach that was initially developed for new invertebrate fisheries. There are three development phases:

- **Phase 0 Initial Assessment** – a review of existing information on the biology, management, and ecological interactions for the species of interest in BC as well as a review of similar fisheries in areas outside the province;
- **Phase 1 Experimental Stage** – a limited experimental fishery designed to address data gaps identified in the initial assessment, including abundance (biomass), distribution and appropriate harvest technologies; and
- **Phase 2 Exploratory Stage** – a larger experimental fishing stage, using a precautionary approach, generating fisheries management data and limited to existing licence holders.

DFO is currently developing a National Policy on New and Emerging Fisheries which will include clarification of how a fishery goes from Phase 2 to full-scale implementation.

The experience to date in BC suggests that the information requirements for Phase 0 and Phase 1 assessments can be lengthy and cost-prohibitive to fulfil, thereby inhibiting the fisheries development process.

Some crab and other invertebrates could support small sustainable fisheries.

The current status of emerging fisheries is summarized in Exhibit 13. Most new and emerging fisheries opportunities rest with invertebrates such as Tanner crab and varnish clams. Although these opportunities appear modest in terms of catch volume, some (e.g., Tanner crab) could support small but lucrative fisheries.

4.3 The Ocean Environment and Climate Change

Recent evidence indicates that ocean productivity is highly influenced by climatic conditions. Three of the most important factors are: 1) El Nino and La Nina effects, 2) decadal scale cycles, and 3) climate change. Understanding of these climatic influences is developing rapidly and will be key to sustainable fisheries management.

4.3.1 El Nino and La Nina

El Nino events are generally associated with warm climatic conditions in the eastern North Pacific and North America. La Nina events are characterized by cooler conditions. The frequency and intensity of El Nino events were unprecedented in the 1990s. La Nina conditions have generally persisted since 1999, with a rather modest El Nino in 2002.

Exhibit 13: Status of Emerging Fisheries by Species in the Pacific Region*

Species	Fishing Gear Type	Status/Comments
Box Crab *(Lopholithodes forminatus*)	Trap	Initial Assessment completed. The cost of determining biomass is considered prohibitive, not generally an economically viable fishery in other areas (i.e., Oregon).
Purple Sea Urchin (*Stongylocentrotus purpuratus*)	Hand harvest	Intertidal species in high energy environments. Initial assessment completed, no experimental fishing activity planned due to concern about harvesting in abalone habitat.
Tanner crab (*Chionoecetes tanneri and C. angulatus*)	Trap	Deeper water crab species, prefers mud bottoms. Phase 1 experimental fisheries underway since 2000, experimental program expected to continue until 2005.
Gooseneck Barnacles	Hand Harvest	Intertidal species in high energy environments. Reliable bioestimates not possible or cost prohibitive due to patchy distribution. Limited experimental fisheries planned in part due to disturbance of high energy intertidal communities. Some work is underway with Nuu-chah-Nulth Tribal Council (funded by the Province).
Pacific Venus Clam (*Compsomyax subdiaphana*)	Subtidal Harvest Methods (Dive/Mechanical)	Subtidal clam species in sand substrates. Phase 0 assessment completed, no further experimental fishing planned due to habitat impact concerns with mechanical harvest.
Sea Mussel (*Mytilus californianus*)	Hand	Intertidal species in high energy environments. Initial Assessment complete, recommendation not to proceed due to disturbance of high energy intertidal communities.
Varnish (Savoury) Clam *(Nuttallia obscurata)*	Hand dig	Recently introduced intertidal species found in habitat similar to Manila clams. Clam lease holders can now harvest and sell to a limited market, intertidal clam licence holders will be given the opportunity to harvest if market demand exists.
Oceanic Squid Species	Hook and line jig	Primarily Neon Flying squid (*Ommastrephes bartrami*), found offshore warm surface waters. Has yet to be proven an economically viable fishery in Canadian waters, no current interest in fishing opportunities.
Pacific Sardine	Purse seine	Pelagic schooling fish found off west coast of Vancouver Island under favourable ocean conditions. Integrated commercial fishing plan completed, with 5,000T allocation to a commercial fishery and additional quota to experimental fisheries.

** In addition, two dive fisheries (pink/spiny scallop and octopus) previously operating under commercial licences have been converted to scientific permit fisheries. The fisheries are operated on an experimental basis with specific research goals and objectives. The scientific permits are limited to previous commercial licence holders.*

Source: www.pac.dfo-mpo.gc.ca/ops/fm/toppages/newspecies.htm.

El Nino/La Nina events affect the distribution of fisheries resources.

The primary impact of El Nino/La Nina on fisheries resources relates to distribution (north/south, onshore/offshore) rather than to abundance or overall biomass. For example, during strong El Nino events in the 1980s, mackerel moved farther north to Barkley Sound while offshore pelagic species such as albacore tuna and sunfish (*Mola mola)* were observed closer to coastal areas. As voracious salmon predators, mackerel caused very high mortality for juvenile salmon and herring from southern BC stocks during the last two extreme El Nino events of 1982/83 and 1997/98.

The distribution of both hake and sardine in Canadian waters is influenced by El Nino/La Nina cycles. Smaller proportions of the biomass are found in Canadian waters under La Nina conditions.

4.3.2 Decadal Scale Cycles

Ocean productivity changes with decadal scale climate regime shifts.

Increasingly, decadal scale variability in climate conditions is recognized as triggering shifts in marine productivity. This has an impact on successful juvenile rearing for many marine species, including salmon. Decadal scale variability is measured by a number of indices, including the Pacific Interdecadal Oscillation index (PDO), a measure of sea surface pressure and temperature.

Significant regime shifts in the eastern North Pacific appear to have occurred in 1977, 1989 and 1998. From 1989 to 1998, warm surface waters and poor upwelling resulted in low ocean productivity. There is now strong evidence of a general regime shift since 1998 to cooler surface waters and stronger upwelling, resulting in increased ocean productivity. Improved ocean survival since 2000 for most salmon species suggests that the current climatic regime will have a positive impact on salmon stocks in upcoming years.

The impact of today's cooler climatic conditions varies across species.

However, different species and stocks may respond differently to these regime shifts. Shrimp appear to respond positively to the current cooler climatic conditions but less is known about the impacts on Dungeness crab, prawns, and other invertebrates. Although herring do not seem to be as directly influenced by climatic cycles as other species, the association varies regionally. On the West Coast of Vancouver Island, good herring recruitment is generally associated with cooler conditions, while the pattern is opposite in the Strait of Georgia.

With the persistence of the current climate regime, recruitment is expected to improve for many groundfish species including Pacific cod, sablefish, various flatfish, and rockfish. However, as many species recruit to the fishery after 5-10 years, it is too early to assess whether this is actually happening. The impact of variation in ocean climate on fisheries resources is a rapidly developing field and further understanding of these influences will be one of the key factors affecting our ability to manage fisheries in a sustainable manner.

4.3.3 Climate Change

Climate change includes a variety of factors that operate on longer-term cycles than El Nino/La Nina events or decadal scale cycles. The influence of these trends on fisheries resources is less evident than for the shorter-term cycles outlined above.

Climate change may affect spawning success and aggravate El Ninos/La Ninas and decadal cycles.

A current concern on the Pacific Coast is increased summer temperatures in spawning rivers. This is particularly the case for Fraser River sockeye salmon, since spawning success is reduced by water temperatures that exceed 18°C. In addition, climate change may contribute to increased variability or amplitude of change in El Nino/La Nina events or decadal cycling in ways that are, at present, poorly understood.

4.4 Sustainability in the BC Seafood Sector

Many jurisdictions have recognized that the majority of wild fish stocks are either fully exploited or overexploited by commercial fishing fleets. As a result, initiatives have been introduced at the global, national, and regional levels to develop responsible, sustainable fishing practices.

Source: International Institute for Sustainable Development 2002

This section describes some of the key principles underlying sustainability and efforts to support it in BC. The discussion draws heavily on a paper prepared for the BC Seafood Alliance entitled *Progress Towards Environmental Sustainability in British Columbia's Seafood Sector* (Archipelago Marine Research Ltd. 2001).

4.4.1 Sustainability Defined

A Sustainability Model

Sustainability encompasses both environmental and economic objectives.

A general model of sustainability combines human and ecological well-being as its desired outcomes (see graphic). Governance (i.e., management), market economics, and non-market factors (e.g., NGOs, communities) are identified as the means to achieve the desired outcomes.

Engagement by all stakeholders links the means to the desired outcomes, and the entire model is framed in a network of continuous learning (i.e., adaptive management). The BC roe herring fishery is one example of a fishery that operates within this model and is sustainable both environmentally and economically (see Case Study 2).

Case Study 2: Managing for Sustainability – The BC Roe Herring Fishery

Issue

Dating from the early 20th century, BC's commercial herring fisheries were geared for reduction into animal feed and fertilizer. Conservation concerns caused this reduction fishery to close in the late 1960s, but the stock quickly rebounded and a small group of vessel owners launched a pilot herring for roe fishery under a DFO experimental licence, in 1971. The roe herring fishery expanded rapidly to meet the needs of the Japanese delicacy market motivating DFO to impose limited entry of licences in 1977 with 252 seine and 1,327 gillnet licences coastwide. Catches for this fishery were less than half those under the former reduction fishery.

The roe herring fishery of the 1970s developed several important features:

- fishery openings in February to April when test fishing showed the roe content was maximized;
- a predictable annual cycle of science, consultation, and reporting activities;
- the separation of herring science, and management functions within DFO, with science residing with the Pacific Biological Station (PBS) and management with the Fisheries Management Branch; and
- a meaningful, formal consultation process between DFO and industry, and the launch of the Herring Industry Advisory Board.

Herring fishery management continued to evolve in the 1980s. Area licensing was introduced for three areas in 1983 and another two in 1985. These five areas are Prince Rupert, the Queen Charlotte Islands, Central Coast, Strait of Georgia, and the West Coast of Vancouver Island. Starting in 1983, a total allowable catch was set for each area based on a conservative 20% harvest rate of each spawning population. Nevertheless, by the mid-1990s, the fleet was becoming unmanageable and plagued by an inability to meet the total allowable catch. Overages in the seine fleet were common.

Response

In 1996, a pilot pool fishery was implemented for seine vessels. By 1999, pools had become mandatory for all seine and gillnet vessels, with a minimum of 8 seine licences per pool and 4 gillnet licences per pool. Each pool licence received the same quota, and the pool decided how many boats were needed to fish the aggregate pool quota.

Results

The pool fishery has led to a significant reduction in the fleet size, much better adherence to the TAC, decreased costs, and improved product quality. Industry pays for mandatory 100% dockside catch monitoring and, since 1996, has funded herring science initiatives (e.g., stock assessment, juvenile herring surveys) through an allocation of the TAC to the industry-run Herring Resource Conservation Society (HRCS). The HCRS also manages the test fishery under a joint project agreement with the Department. Today, about 100 seine vessels and 300 gillnet vessels/punts fish, representing an 80% decline in fleet size from the late 1970s. The fishery is profitable to commercial fishing licence holders and processors.

Lessons Learned

The BC roe herring fishery is a success story of a fishery that is sustainable and meets the needs of industry and the market. Both DFO and industry have been willing to change and innovate, and have demonstrated leadership and trust. Co-management has been fostered. In the first of a series of report cards on BC fisheries, the Sierra Club of Canada's BC Chapter awarded the Strait of Georgia roe herring fishery a "B", deeming it well managed and a sustainable fishery overall.

International and National Initiatives

The Food and Agricultural Organization (FAO) has led sustainability initiatives at the global level, producing a code of conduct for responsible fishing (FAO 1995), technical guidelines for responsible fishing (FAO 1996, 1999), and guidelines for responsible aquaculture (1997). Canada has responded to international initiatives by producing a Code of Conduct for Responsible Fishing (DFO 1998), which has been ratified by almost all fishing industry associations in BC.

In addition, industry and non-profit partnerships have initiated a number of certification processes, generally known as "eco-labelling". These initiatives are designed to support sustainable fishing practices through the use of market forces and consumer purchasing power (Marine Stewardship Council 1998, 2001).

Harvest rates and methods, as well as management systems, must support sustainability.

The above documents define and address criteria for assessing sustainable fishing practices. They contain three common principles:

1. **Sustainable harvest of target species and stocks** – Harvest rates and techniques should aid in the maintenance or recovery of a stock's health so that present and future generations can benefit from the resource.
2. **Limiting impacts of the fishery on non-target species, habitats, and ecosystems** – Harvests should use techniques to minimize the amount of unintended bycatch and impacts on the ecosystem and habitat.
3. **An effective fisheries management system** – A solid management system, emphasizing scientific principles, credible and reliable data gathering systems, co-management principles and transparency, monitoring and surveillance, and adherence to national and international law, is essential to ensure that the first two principles are observed.

4.4.2 Progress and Challenges to Sustainability in BC

Substantial Progress

BC has made notable progress in a number of sustainability areas.

There has been substantial progress towards sustainability in BC with respect to the three principles above. Initiatives include (see Exhibit 14):

- better biomass and stock assessments (e.g., sablefish, sea cucumber) and conservative harvest rate management (herring, salmon);
- dockside monitoring of commercial catches (e.g., geoduck) and at sea observer coverage on vessels to monitor both retained and discarded catch (100% observer coverage in the groundfish trawl fleet);
- adoption of selective fishing techniques to reduce bycatch (e.g., restricting the salmon gillnet fleet to daytime fishing to reduce bycatch of coho) and adoption of Individual Quotas (IQ) and pool fishery management that have reduced overages to the total allowable catch (e.g., halibut, herring);
- development of environmental codes of practice in the salmon and shellfish aquaculture sectors; and
- effective co-management and international agreements.

Exhibit 14: Examples of Progress Towards Sustainability in BC

Principle #1: Sustainable Harvest of Target Species and Stocks

1.1 Informed Stock Assessment
- sablefish tagging and groundfish biological sampling
- annual biomass surveys for dive fisheries – geoducks, urchins, sea cucumbers

1.2 Limiting and Measuring the Catch of Target Species
- conservative quotas and harvest rate management, e.g., 1% for geoduck, 2% for red sea urchins, 20% for herring (subject to a threshold)
- third party dockside monitoring programs (DMP) of IQ and pool fisheries, e.g., groundfish trawl, halibut, sablefish, herring
- input controls, e.g., crab trap limits (subject to electronic monitoring in Queen Charlotte Islands)

Principle #2: Limiting Impacts on Non-Target Species and on Habitats and Ecosystems

2.1 Moving from Landings to Catch Data
- 100% observer coverage on groundfish trawl (retained and discards)
- sample observer coverage: halibut, sablefish, rockfish (ZN), salmon

2.2 Addressing Administrative Barriers
- transferability of rockfish bycatch holdings for halibut fleet
- increasing the number of quota species (including turbot) in the groundfish trawl fishery
- movement toward integrated groundfish management in the trawl, rockfish (ZN), and halibut fisheries

2.3 Adopting Selective Fishing Techniques
- exclusion grates / excluder nets on shrimp trawlers (to reduce eulachon bycatch)
- gillnet revival tanks and seine brail systems in salmon
- barbless hooks in the recreational fishery and commercial troll fishery
- use of seaboard avoidance devices, e.g., tori lines
- "red" (no fishing) and "yellow" (selective fishing) zones for coho in 1998

2.4 Minimizing Impacts on the Ocean Bottom
- avoidance of glass reefs by shrimp trawlers

2.5 Sustainable Aquaculture Practices
- acceptance by the Province of 49 recommendations in the Salmon Aquaculture Review (SAR) Report
- codes of practice for salmon farming and shellfish aquaculture
- measures adopted by the Province and industry include:
  - re-siting of problematic fish farms
  - reduced farm losses (escapes)
  - performance-based management of waste discharges
  - fish health database, fish health management plans
- vastly improved feed conversion rates on salmon farms

Principle #3: Ensuring Effective Management and Regulations

3.1 Effective Co-management and Individual Responsibility
- Cohesive industry associations embraced co-management, e.g., halibut, sablefish, geoduck
- IQ management has reduced overages to TAC

3.2 Negotiating International Agreements
- International Pacific Halibut Commission (since 1923)
- Pacific Salmon Treaty (renewed in 1999)
- Pacific Whiting / Hake Treaty (signed in November 2003)

Source: Archipelago Marine Research, "Progress Towards Environmental Sustainability in BC's Seafood Sector", Prepared for the BC Seafood Alliance, May 2001.

Remaining Challenges

Significant challenges remain for sustainability in fisheries and aquaculture.

A number of challenges and issues surrounding sustainability in the seafood sector have recently emerged:

- weak stock salmon fisheries management and the implications of SARA for both wild fisheries and aquaculture operations;
- lack of comprehensive, verifiable catch – retained and discards – from certain fisheries (e.g., salmon and groundfish longline);
- possible interaction with and impact of marine farmed salmon netpen operations on fish stocks and marine habitat;
- development of an effective co-management structure in the salmon fisheries
- evolution of an effective integrated fisheries management regime for the groundfish fisheries (ZN, halibut, sablefish, and trawl)
- need for a transparent, harmonized regulatory regime for aquaculture; and
- acknowledgement of the need to address uncertainty and risk through precautionary and adaptive management (see Section 4.5).

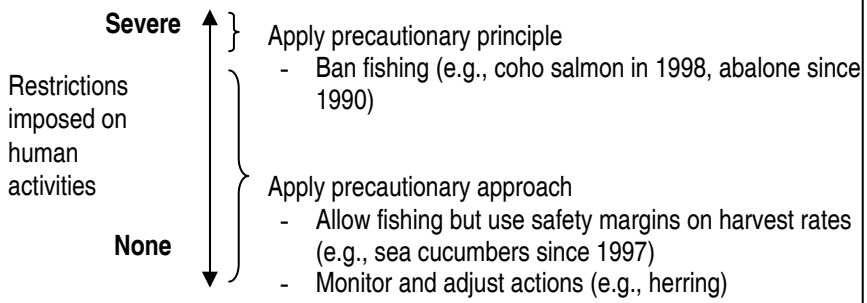
The concept of sustainability is a moving target, with increasing expectations and more stringent standards over time. The "burden of proof" is shifting to industry to demonstrate and support sustainable fishing practices for consumers and the public. To be financially sustainable in the long term, the BC seafood industry (capture and aquaculture) must also be environmentally sustainable.

4.5 Precautionary Approaches to Fisheries Management

Most fisheries management regimes are data-limited. Often, not enough is known to enable sustainable fisheries management at a sufficiently productive level for maintaining economically viable industries and communities. Data are limited for: estimates of stock size; life history parameters such as age of sexual maturity, rates of recruitment, and natural mortality; landings and catch composition; and catch per unit effort and other dynamics of the fishing process.

The Precautionary Approach

In addition, despite efforts to address these limitations, considerable uncertainty always persists in resource management. This uncertainty includes factors over which there can be little human influence such as the impact of decadal regime shifts (Section 4.3.2) on fish populations. The general term "precautionary" is used to describe current approaches to addressing data limitations and uncertainty in fisheries management.



Source: Dr. Randall Peterman, Simon Fraser University, personal communication, June 2003

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The precautionary approach is a risk management tool.

The precautionary approach involves application of prudent foresight to account for uncertainty and incomplete knowledge, in order to reduce risk to an acceptable level. It is a tool for managing uncertainty and risk. FAO guidelines for application of the precautionary approach recognize this risk management focus (*Precautionary Approach to Capture Fisheries and Species Introductions.* FAO 1996, p. 7, emphasis added):

1. *All fishing activities have environmental impacts and it is not appropriate to assume that these impacts are negligible.*
2. *The precautionary approach may require cessation of fishing activities which have potentially serious effects but* ***it does not imply that no fishing can take place until potential impacts have been assessed and found to be negligible****.*
3. The precautionary approach requires that all fishing activities are subject to prior review, and active management including defined objectives, assessment, and monitoring.
4. ***The standard of proof used in decisions should be commensurate with the potential risk to the resource, while also taking into account the expected benefit of the activities.***

The precautionary approach and precautionary principle are often confused by the public and fisheries managers.

The precautionary approach combines consideration of uncertainty (the incompleteness of knowledge) with consideration of risk of occurrence (the severity, duration and reversibility of the risk as well as associated probability). Frequently, the general public and resource managers do not distinguish between the precautionary approach and its extreme application – the precautionary principle. Under the precautionary principle, risk assessment suggests that serious or irreversible damage may occur, even though there may be considerable uncertainty due to incomplete knowledge.

Challenges to Implementing the Precautionary Approach

Due to the data deficiencies in most fisheries, the precautionary approach is an essential tool for sustainable fisheries management. On the other hand, considerable challenges remain for its effective implementation, including:

- Misunderstanding and misapplication of the precautionary approach and precautionary principle by the public and resource managers.
- While many fisheries management plans now include catch targets and limit references, there is an overall lack of operational guidelines for applying the precautionary approach in BC's fisheries and aquaculture sectors.

Operational guidelines are needed for applying the precautionary approach to BC fisheries and aquaculture.

BC Sea Cucumber: An Example of the Precautionary Approach

In 1997 the sea cucumber harvest total allowable catch was reduced to a more conservative level, as little was known of its biology or abundance. Commercial harvesting was also restricted to 25% of the BC coast. Surveys done since 1997 have demonstrated actual sea cucumber density to be three to four times higher than originally estimated. As a result of better stock assessment data, the TAC has increased by 80% from 1997 levels.

4.6 Federal Policies and Legislation

4.6.1 New Directions for the Salmon Fishery

The New Direction policy makes conservation the key objective for managing Pacific salmon fisheries.

In 1998 DFO released *A New Direction for Canada's Pacific Salmon Fisheries* outlining the broad policy direction for a new approach to salmon fisheries management (DFO 1998). The New Direction document contains 13 supporting principles under three key components: conservation, sustainable use and improved decision-making. In particular, conservation is the primary objective that will take precedence in managing the resource, and a precautionary approach to fisheries management will be adopted. All sectors – First Nations, recreational, and commercial – will use selective methods to harvest salmon in the future.

4.6.2 Species at Risk Act

COSEWIC

COSEWIC designates the status of wildlife species at risk.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is a group of scientists with representation from federal, provincial, territorial, and independent agencies. It has been assessing the status of species at risk and providing status designations (e.g., Endangered, Threatened) since 1978. In 1999 COSEWIC adopted updated status designation criteria based on criteria developed by the International Union for the Conservation of Nature.

Aquatic Species in BC Designated by COSEWIC as Endangered or Threatened

Endangered	Interior Fraser Coho
	Cultus Lake Sockeye
	Sakinaw Lake Sockeye
	North Pacific Right Whale (recovery strategy underway)
	Blue Whale
	Sei Whale
	Salish Sucker
	Speckled Dace
Threatened	Bocaccio (a rockfish species)
	Humpback Whale

SARA and Its Impact

The federal Species at Risk Act (SARA) aims to prevent wildlife species from becoming extinct, provides for the recovery of species that are at risk as a result of human activity, and helps to prevent species of concern from becoming endangered or threatened. The act covers all wildlife species at risk nationally and their critical habitats, and applies to all federal lands in Canada as well as all aquatic habitats and migratory bird habitat. Complementary provincial and territorial initiatives are facilitated through the Federal-Provincial/Territorial Accord for the Protection of Species at Risk (1996). Under SARA, the Minister of Fisheries and Oceans is responsible for aquatic species.

The process for listing species under SARA involves a political (federal Cabinet) decision.

SARA came into force in June 2003, with sections related to protection and enforcement taking effect in June 2004. Under SARA, COSEWIC was established as an independent body of experts responsible for assessing and identifying species at risk. The 233 species designated by COSEWIC as extirpated, endangered, threatened, or of special concern as of December 2002 became the initial List of Wildlife Species at Risk under SARA. Steps to add species to this list are outlined below:

1. **Assessment and Status Designation** – COSEWIC assesses species status and makes a designation consisting of, in decreasing order of concern, Extirpated, Endangered, Threatened, or Special Concern.
2. **Listing under SARA** – Species with a COSEWIC status are automatically considered for listing under SARA. The Minister of Environment is required to forward the COSEWIC assessment within 90 days to the Governor in Council or Cabinet for a decision. If the Cabinet does not make a decision within nine months, the species is automatically added to the legal list as recommended by COSEWIC.
3. **Endangered or Threatened Species** – For those species legally listed, there is an automatic prohibition on harming individuals or their residences in areas of federal jurisdiction (including the ocean), and mandatory development of recovery strategies and action plans.
4. **Special Concern Species** – Management plans must be developed for these species.

There is also a provision for emergency-listing of a species as Endangered if the species is deemed to be in imminent danger of extirpation.

Recovery plans are required for endangered or threatened species.

Protection (prohibition) and recovery planning is legally mandated for species listed as Endangered or Threatened. SARA mandates timelines for this process, provides for stakeholder involvement and public comment, and requires socio-economic analysis within the recovery action plan. (More information on SARA can be found at *www.sararegistry.gc.ca.)*

Mixed stock fisheries could be severely affected by SARA listing of endangered salmon stocks.

Three BC salmon stocks have been designated as Endangered by COSEWIC (Sakinaw Lake sockeye, Cultus Lake sockeye, Interior Fraser coho). These stocks have yet to be added to the List of Species at Risk under SARA. However, if they are listed, recovery planning for them could severely impact mixed stock salmon fisheries. Alternatively, fisheries including terminal fisheries that employ selective fishing techniques may be affected minimally.

DFO has indicated that it has established teams to develop recovery strategies for all three salmon populations that may be legally listed. These teams will solicit stakeholder and public input.

In addition, fisheries that non-selectively capture a variety of species (i.e., trawl and longline fisheries) would be impacted by listing of COSEWIC designated species such as bocaccio. Mitigation technologies and monitoring could prove to be effective means of reducing bycatch of seabird, mammal, and turtle species that may eventually be listed under SARA.

BC Aquatic Species Listed as Endangered or Threatened under SARA

Endangered	Killer Whales – southern resident group
	Pacific Leatherback Turtle (recovery strategy and action plan underway)
	Several Freshwater Stickleback species (recovery strategy underway)
	Nooksack Dace
	Morrison Creek Lamprey
Threatened	Sea Otter (recovery strategy underway)
	Northern Abalone (recovery strategy completed, action plan underway)
	Killer Whales – northern resident group, transient group
	Several freshwater sculpin species (shorthead and Cultus pygmy)
	Cowichan Lake lamprey

Note: Olympia (native) oysters, offshore killer whale population, and Mottled Sculpins are species of "Special Concern" that do not require protection or recovery plans.

If Fraser River Basin salmon stocks like Cultus Lake are SARA-listed, it is unclear how DFO will address its obligations to protect them in 2004. (Such protection could involve one or more of fisheries management changes/closures, habitat restoration, environmental controls, and enhancement). What is clear is that, if fisheries management bears the brunt of recovery planning, SARA listing could have a severe negative impact.

Definition of a Species

SARA defines a wildlife species to include a species, subspecies, or genetically distinct population (i.e., a stock). This definition provides a broader context than the generally accepted biological definition of species as the category or rank immediately below genus or sub-genus. Under SARA:

> *"Wildlife species" means a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and*
>
> *(a) is native to Canada; or*
>
> *(b) has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.*

SARA's impact will depend on how the term "species" is applied.

The impact of SARA on BC seafood and recreational fishing operations will depend in large part on how the term "wildlife species" is defined operationally.

4.6.3 Wild Salmon Policy

In March 2000, Fisheries and Oceans Canada released a draft Wild Salmon Policy Discussion Paper, part of a series of New Direction initiatives (DFO 2000). The Wild Salmon Policy (WSP) provides an explicit framework for conserving the genetic diversity of wild Pacific salmon and for protecting their habitat. Its primary goal is to ensure the long-term viability of salmon populations in their natural surroundings and the maintenance of habitat for all life stages.

The Wild Salmon Policy will aim to avoid conservation crises.

The draft discussion paper was the subject of extensive consultations, the results of which have since guided the development of a revised policy. Work is underway on operational guidelines for fisheries management, habitat, enhancement, and fish culture, as well as a decision framework that links these guidelines to policy principles. One of the WSP objectives is to avoid the listing of species under SARA by facilitating action in advance of a conservation crisis.