Pacific Fisheries Resource Conservation Council

Coast-Wide Coho

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INTRODUCTION

"Coho." Mention that word around any fishing wharf last fishing season, and you would be embroiled in debate. In January of 1998, the Minister of Fisheries and Oceans announced disappointing coastwide coho returns. In late February, he appointed a special Coho Response Team and initiated what may come to be viewed as the most dramatic change in Pacific fisheries management history.

It was time for major changes. Evidence of serious coho stock depletions had been gradually accumulating for over a decade.

Coho do not recognize international borders. Many coho that spend part of their adult life in Canadian coastal waters were born in Washington and Oregon rivers and will return there to spawn. Signs of weakness in these coho populations are potential early warning signs of difficulties ahead for BC stocks.

American coho to the south have been in trouble for a long time. As early as the 1970s, catch and escapement estimates were showing serious signs of weakness. Oregon coastal coho declined an estimated ten percent per year from 1964 to 1979, and in the Columbia River, the decline was estimated to be twice as rapid over the same period. In 1981, the U.S. Federal Court ordered that Washington State fisheries be managed for the conservation of individual stocks.

By 1993, the American National Marine Fisheries Service (NMFS) had been formally petitioned to list coho in Washington, Oregon, California and Idaho under the *Endangered Species Act.* In 1995, NMFS completed a comprehensive assessment of wild coho south of the Canadian border. They divided the coho in this region into six "Evolutionarily Significant Units" (ESU's), segments that embody important ecological and evolutionary traits. The seriousness of losing populations increases with the scope of the loss. The loss of an ESU is an operational definition of calamity. Of these, the southernmost, the Central California Coast, they declared to be in danger of extinction. More than 50 percent of coho streams in that area no longer had spawning runs. All the other ESU's, save the west coast of the Olympic Peninsula, were declared to be likely to become endangered if present trends continued. Widespread habitat degradation was reported in all areas with the notable exception of Olympic National Park.

Official designations under the *Endangered Species Act* followed. Coho in the Central California ESU were declared threatened (likely to become in danger of extinction throughout all or a significant portion of its range) in October of 1996. By the following spring, this status had been extended up the coast to southern Oregon coho, and in August of 1998, it was extended to the entire Oregon Coast. Decisions on official threatened status for two ESU's in Washington State were recently announced. The most northerly of these, the Puget Sound/Strait of Georgia ESU, extends well into Canada.

Canadians have, for some time, also been accumulating evidence of coho conservation concerns in the Strait of Georgia and elsewhere. Indeed, conservation concerns for some Upper Skeena coho stocks were expressed by local fisheries officers in the 1970s. By 1988, the Pacific Stock Assessment Review Committee was recommending management actions to increase coho escapements in the Skeena. Spawning estimates exceeded targets in the next two years, but then fell short in 1991. By May of 1998, a Department study predicted that over half of the Upper Skeena streams would likely be populated by fewer than three females per kilometer, the Department's interim target for protecting against extinction threats. The decline in abundance noted in the 1970s had led to a conservation crisis.

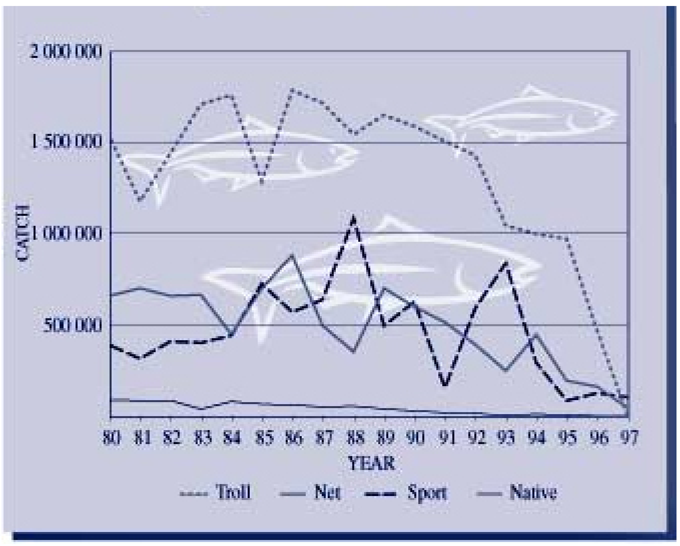
Conservation concerns for Thompson coho were surfacing within DFO in the early 1980s. At that time, the catch of coho in southern BC was fairly stable, perhaps even increasing, and the average catch of coho in the Strait of Georgia alone was close to three-quarters of a million fish a year (Figure 1). Even so, DFO biologists were expressing the opinion that Thompson coho were being over-fished, and had been since the early seventies. In a major Technical Report reviewing the life history, management and exploitation of Fraser chinook and coho published in 1982 (Fraser et al. 1982) the authors note that Thompson coho stocks

> *"show a long-term decline, probably due to over-fishing and habitat loss."*

A few years later, in a Technical Report prepared in support of the Pacific Region Salmon Resource Management Plan released in April, 1985, the authors state

> *"Overall, Fraser River escapements have been erratic, but show a clear decline at rates of one percent per year since 1951, and four percent per year since 1970".*

Figure 1. Southern BC Coho catch.

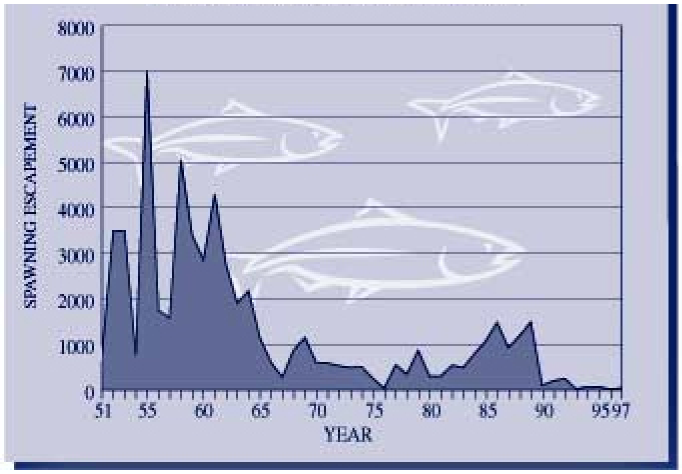


The authors go on to say that the

> *"test fishery... index confirms a significant decline in returns to the Fraser River, at least since 1970...these declines are cause for concern, and indicate that current escapements are well below the goal for Fraser River coho."*

They were probably looking at escapement records such as those for the Adams River (Figure 2). Most biologists are very cautious about interpreting coho escapement data because data quality is highly variable and difficult to assess. Data from the few, more thoroughly monitored index streams left room for optimism. However, these index streams typically contain larger coho populations that might be expected to be more resilient. In any case, declines were large enough for some less rigorously monitored stocks to be cause for concern. By the mid 1980s, it was also clear that exploitation rates for southern BC coho were very high, often over 80 percent, and that catches were fairly stable despite significant increases in hatchery production. Furthermore, it was noticed that while total catch was stable, the percentage of hatchery fish in this catch had risen to 50 percent by the mid-80s. There were strong indications that wild coho abundance was declining.

Figure 2. Adams System Coho escapements.



By the late 1980s there were widespread concerns that wild coho stocks were declining throughout the Georgia basin and the Fraser River, and this led to a flurry of stock assessment work. Stock assessments submitted to and approved by the Pacific Stock Assessment Review Committee (PSARC) confirmed alarming declines in wild coho stocks, and prompted DFO to begin the ***Strait of Georgia Coho Salmon Resource Status and Management Planning Process.*** This process began in late 1989, and involved extensive consultations with sport, commercial and First Nations fishing interests and the public. This process was designed to develop a rebuilding plan for Strait of Georgia and Fraser River coho stocks and the technical process was completed by early in 1991. Proposed implementation was delayed until 1992 to extend consultations and allow the Pacific Regional Council (PARC, an advisory group of fishing industry representatives) to provide a recommendation to the Minister.

In the introduction to the first of three reports prepared in support of this process, the authors state;

> *"Recent stock assessments by the Department of Fisheries and Oceans (DFO) biologists indicate that the escapement and catch of many Strait of Georgia wild coho stocks are declining at a disturbing rate. These assessments confirm the observations made by local fisheries officers, salmon enhancement staff, and volunteers and members of the public over the last few years. If this decline is to be reversed and greater production from our wild stocks restored, a program which effectively addresses wise resource management objectives needs to be developed."*

The authors also observed that the average catch of wild Strait of Georgia and Fraser River coho declined by over 50 percent between the late 70s and the late 80s, and noted that if the trend continued, wild coho would be commercially extinct around the turn of the century. At the time, few people thought it could happen.

As it turned out, no coho rebuilding plan was implemented in 1992. By 1994, wild coho stocks originating in Washington and Oregon coastal streams reached such low levels that all coho fisheries in southern U.S. waters were closed. The U.S. requested Canada's help in addressing their conservation concerns, because the largest fishery on these stocks was Canada's troll fishery off the West Coast of Vancouver Island (WCVI). Canada took no action in 1994, but in 1995 Canada began to "actively manage" the WCVI coho troll fishery by adjusting the catch ceiling based on forecast abundance. Exploitation rates were reduced, but Canada was still over-exploiting wild coho stocks. At around the same time, DFO closed the troll fishery in the Strait of Georgia, but this only served to reallocate the catch to the sport fishery, and had little effect on spawning escapement. In 1997, coho catches in southern BC were limited to 221,000, 75 percent of these were taken in ocean sport fisheries. Coho escapements to the Thompson system improved over the dismal 1996 levels, but were still well below levels observed in the late 1980s and early 1990s.

In the spring of 1998, both a stock assessment for Thompson River/Upper Fraser River coho and a risk assessment for Thompson River coho were completed and presented. Their conclusions were:

1. Thompson River coho salmon had declined since 1988 at rates of 40–70 percent per generation, and the Eagle and Salmon populations were currently one to two percent of historic levels. Many streams had decreased to zero-counts in three generations.
2. In addition, there was evidence that the proportion of males had increased, and that the size of the returning fish might have been decreasing. Both factors were additional cause for concern that the reproductive potential of the population could be decreasing.
3. The cause of the decline of the Thompson coho populations appeared to be a combination of declining marine survival and overfishing.
4. Under current marine survival forecasts, there was a good probability that Thompson coho salmon would likely continue to decline, even in the absence of fishing.
5. Fishing mortality would increase the rates of decline in these populations, and would increase their exposure to risk, probably at an accelerating rate. A better quantification of risk was possible, but would require substantially more analysis.

The risks and conservation concerns for Thompson coho would be even higher in 1999 and 2000, unless there was a reversal in ocean conditions.

The main problem appeared to be overfishing in the face of a substantial decline in ocean survival. This decline in survival showed no obvious relationship to periods of unusually high sea surface temperatures (El Niño). Figure 4 shows the ocean survival of coho smolts from three major southern BC hatcheries. All monitored wild and hatchery stocks showed declining survival.

It was clearly time to stop fishing these depressed stocks. Although U.S. fisheries traditionally harvested relatively few southern Canadian coho (Figure 3), the impasse over the Pacific Salmon Treaty was a powerful, indirect disincentive to reduce fishing mortality on Thompson River coho. Approximately half the coho harvested in our former coho troll fishery off the West Coast of Vancouver Island originated in U.S. streams. It was thought that fishing hard for these coho off the West Coast of Vancouver Island would provide Canada with leverage in negotiations over the Pacific Salmon Treaty. These coho harvested by Canada were also considered compensation for Canadian sockeye and chinook taken by American fisheries. Thompson River coho also appear to reside in this part of the ocean, and were, along with severely depressed American coho, caught up in the international dispute.

Figure 3. Who caught Thompson Coho? 1984 to 1999 brood years.

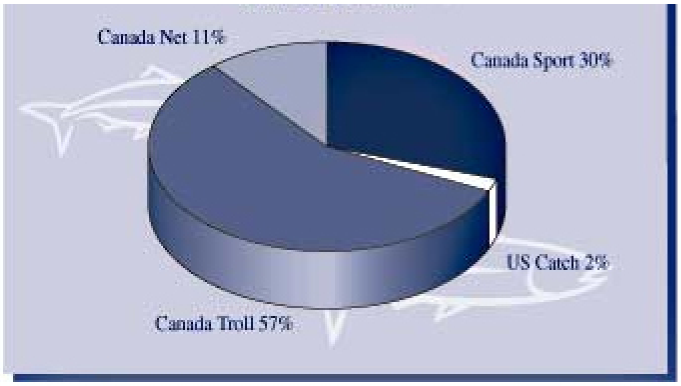
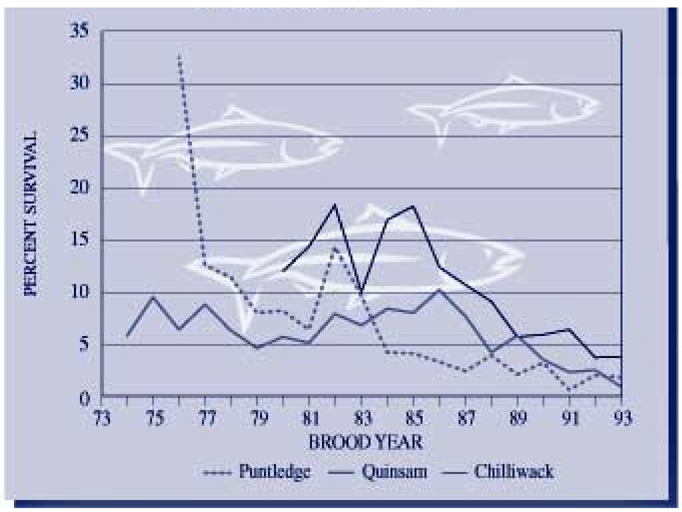


Figure 4. Coho smolt survival.



The Minister, in a speech at a Speaking for the Salmon workshop on January 23, 1998, made the following statement (quoted from Workshop Proceedings edited by P. Gallaugher and L Wood, Simon Fraser University):

> *"... I have been pressed frequently ... to use coho as a weapon in the allocation battle; to hit coho hard and to make sure that the Americans respond, feel the hurt, and concede on allocation. ... As long as I am Minister, I will not use conservation as a weapon in the allocation battle."*

The Conservation Council applauds the Minister for this firm position.

Nonetheless, until 1997, Canadians were consistently over-exploiting most of BC's wild coho stocks spawning in inside southern and interior northern regions. Not until 1995 did Canada begin to pay serious management attention to southern coho stocks, and even then, management actions were far too tentative to address the rapid declines in survival. If fisheries had been closed sooner, stocks would be in better shape today.

Canada's management and protection of freshwater coho habitat also leaves much to be desired. The effect of loss and degradation of freshwater coho habitat in the decline of southern BC coho is complex and is discussed in detail elsewhere. There are very few pristine watersheds in southern BC Loss and degradation of freshwater coho habitat is very widespread. Most biologists agree that we have lost productive coho habitat, and that habitat loss represents a significant long-term threat to wild coho production. Although stock declines are too rapid and are occurring over too large an area to be explained simply by freshwater habitat loss, it has certainly contributed to the declines of specific stocks of coho in southern BC. It may well be a major factor in the continuing declines of some stocks.

Summary of 1998 Changes

The Coho Response Team was assembled in February of 1998 to review the status of coho stocks and to conduct extensive consultations on conservation measures. Widespread consultations began with a Multi-Stakeholder Coho Summit Meeting in Vancouver on February 26, 1998 to outline the scope of the coho crisis and to seek direction on how to secure participation and advice from a broad array of interest groups.

The consultation process was thorough. A "1998 Coho Backgrounder" was distributed to 6500 individuals. An Internet site was set up to disseminate information and meeting summaries. Fifty-four formal consultation meetings were held to solicit input on the development of a comprehensive coho plan.

There was agreement in principle by all groups that the coho conservation problem was real and that stringent management measures were required to address it. There was unanimous support by all groups for improved habitat protection, restoration and enhancement and widespread concern that too little was being done to protect fish habitat. All groups supported more selective harvesting methods and opportunities. Most groups advised that more enforcement and monitoring of all salmon fisheries was required. There was general support for additional programs to improve knowledge of coho abundance (stock assessment, escapement monitoring), distribution and migration timing.

Support came from unusual sources. The District of North Vancouver passed unanimously the motion that:

1. The Department is urged to undertake whatever measures necessary to protect coho salmon including conservation measures and closure of the commercial and recreational coho fisheries.
2. Volunteer groups be encouraged to undertake salmon restoration.
3. Enforcement of the Environmental Protection and Preservation Bylaw and Best Management Practices be implemented in District operations.

Unprecedented restrictions were imposed in order to protect Upper Skeena and Thompson coho. To this end, red and yellow zones were identified. In red zones, thought to be areas and times where Upper Skeena or Thompson River coho were prevalent, there was to be no fishing-induced coho mortality. In yellow zones, where these stocks were anticipated to be absent, coho were to be avoided and released when caught. The zone boundaries were to shift to provide protection as the adults migrated up to their home spawning grounds.

All commercial vessels were required to be equipped with revival boxes, containers with salt water pumped through them. Incidentally caught coho were to be placed in these to give them a chance to recover before being returned to the wild. There were also new area and time restrictions. In addition, all seiners were to use large dipnets called brailers to empty the net and sort the catch. Gillnetters were required to clean their nets every 30 minutes, and night fishing was restricted in some areas. Trollers and recreational fishers were required to use barbless hooks. A mandatory observer program was set up, and a variety of new measures was introduced to improve catch monitoring.

Major new opportunities for experimenting with selective fishing methods were created. Fishers using the three main existing gear types were encouraged to explore ways to make their gear more selective. Experiments with alternative gear types including traps, weirs, reef nets, fish wheels, and beach seines were also to be funded. Experiments on post-release mortality in the commercial and recreational sectors were also to be organized.

Concerted efforts were also made in international negotiations. Canada and the United States arrived at two agreements in 1998 that regulated the harvest of salmon. On June 26, Canada's Minister of Fisheries and the Governor of Washington State agreed to fishing arrangements to conserve coho and chinook salmon, and on July 2, Canada and the U.S. agreed on interim fishing arrangements for Fraser River sockeye.

The agreement on southern coho and chinook called for Washington State to reduce its catch of Canadian coho by 22 percent. This agreement recognized the measures already taken by Canada to conserve coho and chinook, and committed Canada to further restrictions in south coast recreational fisheries in April and May of 1999 to protect Nooksack River chinook. The specific details of the restrictions on the Canadian recreational fishery were to be decided following consultations by Washington States Fish and Wildlife Commission.

The sockeye agreement reached on July 2nd restricted U.S. fisheries to operating between July 27th and August 21st. This protected coho returning to the Thompson River through U.S. waters in late August and September from significant by-catch in U.S. sockeye fisheries.

No comparable deal could be struck with Alaska to provide similar protection for Upper Skeena coho. Officials in the Alaska Department of Fish and Wildlife and the Department of Fisheries and Oceans openly disagreed over the scientific evidence for a conservation crisis. The Northern Boundary Technical Committee (a standing, bilateral scientific panel set up under the auspices of the Pacific Salmon Commission) was instructed to reach a scientific consensus, but no formal arrangements to restrict Alaskan catches of BC coho were made.

A meeting of West Coast scientists from Oregon to Alaska was hastily convened at Simon Fraser University to assess the coastwide situation for coho. Scientists from the Alaska Department of Fish and Wildlife were invited, but did not attend. Those attending reached a consensus that Upper Skeena coho were severely depressed. The problem was real; conservation efforts would have to proceed without formal cooperation from Alaska.

CURRENT STATUS

During the summer, reports of locally abundant coho in such areas as the north coast of the Queen Charlotte Islands and the San Juan River on the Lower West Coast of Vancouver Island left some people wondering if the measures had been too stringent. Some coho stocks certainly were abundant. One would expect some stocks to be more abundant in the absence of fishing, but it was too early to tell whether the most seriously depressed stocks had rebounded. Firm conclusions on this year's return of adults could not be made until the results of the fall and winter spawning surveys were available, and then only if the data were reliable and covered a representative cross-section of the coho spawning grounds. Furthermore, southern coho generally have a three-year life cycle with very little mixing between adjacent year-classes. Further north, they have a mixed three and four-year life cycle. Coho stocks cannot be rebuilt in a single year.

Following is the Council's assessment of the current conservation status for the two highest-profile coho populations, the Thompson and Upper Skeena coho, followed by a coastal overview. This review focuses primarily on wild coho, although key information is often available only for hatchery populations.

Thompson River Coho

There are approximately 70 identified coho spawning areas in the Thompson River and its tributaries. Spawning abundance estimates showed a spotty response to the reduction in fishing mortality. The appropriate comparison is with the spawning levels in the parent population, in 1995. The most accurate estimates come from counting fences. Of these, the Eagle River and Dunn and Lemieux creeks increased over the brood year, whereas the Salmon River (at Salmon Arm), Deadman River, and Louis Creek, declined. The extent to which human impacts (including agricultural development) are depressing the recovery of these stocks is not well understood. It is widely accepted that ocean survival has declined steadily for Thompson River and other southern coho stocks, and that this is contributing to the reduction in overall productivity. However, local observers are also expressing concerns over freshwater habitat quality. Unfortunately, there are insufficient data on juvenile coho survival in the region to be able to rigorously assess these concerns. Department scientists are looking for evidence that might link weaker stocks to specific freshwater habitat concerns. This is important work. It is clearly not enough just to reduce the fishing pressure and hope that the stocks will recover.

In addition, it is difficult to obtain accurate estimates of the actual changes in spawning abundance between 1998 and the 1995 parent generation for other stocks that were surveyed on foot or by helicopter. These surveys were given considerably more attention this year than in the recent past. As a result, field staff had a better opportunity to survey the streams near the peak of the spawning runs. This would in turn lead to more complete spawner counts, and potentially false evidence of an increase in abundance. DFO scientists have attempted to account for this bias by trying to estimate what the counts would have been this year had the surveys been comparable to previous years. The results suggest that average spawning abundance in the North Thompson tributaries was about the same as it was in 1995, but that it continued to decline in the South Thompson tributaries. In both years, close to 25 percent of the streams had estimates of zero coho.

The difficulty in interpreting these data emphasizes the importance of building and maintaining a stable system of stock assessments. Progress was made in the past year or two in overcoming past deficiencies, but it will be several years before the results will be easily interpretable, and there is at present no firm commitment to maintaining the existing level of activity.

Upper Skeena Coho

Most coho in the Upper Skeena have a four-year life cycle, and appear to have increased in abundance over the 1994 parent generation. The three most reliable indicators of abundance are the Tyee test fishery and fence counts on the Babine River and on Toboggan Creek, a tributary of the Bulkley River near Smithers. The Tyee test fishery appears to intercept primarily Upper Skeena coho up to August 25th. Coho catch up to this date is used as an index of Upper Skeena coho abundance. In 1998, this index increased by 37 percent over 1994.

Counts at the Babine fence show a modest, ten percent improvement in 1998 over 1994. Long-term comparisons are not as easy to make. Counts in former years were terminated before the end of the spawning run. The annual count to September 13 can be used, however, as an index of overall abundance.

The Toboggan Creek fence also showed a modest 1998 increase, four percent, over 1994. Estimates of marine survival rates for both the Toboggan Creek and Fort Babine hatcheries were around one percent, slightly better than the all-time lows in 1997, but well below the ten percent estimate for the healthier Lachmach stock in Work Channel near Prince Rupert. Hence, it appears that the severe fishing restrictions have stopped the decline, but have done little to begin a rebuilding process. Furthermore, spawning levels from 1995 through 1997 were even lower than they were in 1994. Levels in 1997 were particularly low. For these stocks to have a chance to rebuild, severe fishing restrictions will have to be maintained for at least another two coho generations.

Other BC Coho Stocks

These are summarized by conservation assessment units as set forth in a 1998 Pacific Stock Assessment Review Committee discussion paper.

Coastal Georgia Basin (including the Lower Fraser)

Despite a few notable successes, these stocks generally showed continuing signs of weakness. Although spawner abundances in 1998 appeared to many local observers to be better than in 1996 and 1997, comparisons to the 1995 parent generation are not favourable. For coastal stocks with spawning ground estimates for both 1995 and 1998, average spawning levels were only about half the brood year. Although coho spawning estimates are generally unreliable, this evidence of continuing declines cannot be taken lightly, particularly given the stringent restrictions on fishing mortality in place last year. The declines would have been even more severe had these restrictions not been imposed.

An important exception was Black Creek on the east side of Vancouver Island, where 8,200 spawners were counted passing the fence. Yet marine survival for this stock appears to have fallen from around 12 percent in the late 1980s to about four percent for the past four years. For the hatchery stocks at Quinsam and Big Qualicum, preliminary 1998 marine survival estimates are two percent and 0.3 percent. The cause of these low survival rates is uncertain. For reasons that are also largely unknown, these stocks have abandoned their traditional ocean rearing grounds in the Strait of Georgia in favour of the West Coast of Vancouver Island.

In the Lower Fraser River, the situation was similar. There are two carefully monitored wild stocks. The Pitt River showed a gain of over 60 percent over 1995, whereas the Salmon River in Langley declined by around 30 percent. There were no other unenhanced Lower Fraser streams (excluding the Chilliwack watershed) with coho spawning estimates for both 1995 and 1998. Marine survival estimates for the hatchery stock in Inch Creek between Mission and Harrison have declined steadily over the past four years to an alarming low in 1998 of half of one percent. Survival of coho returning to the Chilliwack hatchery in the lower Fraser declined to 1.4 percent in 1998, down from 2.25 percent in 1997.

The evidence, though mixed, is compelling. The majority of Coastal Georgia Basin coho stocks for which sufficient data exist appear unable to sustain any fishing mortality under present conditions.

West Coast of Vancouver Island

Spawning estimates were generally higher than in 1995. Some stocks were remarkably strong, particularly in the southern half of the region. Carnation Creek recorded the second highest estimate in 28 years; the Robertson Creek hatchery, the highest in 24 years. Available data on other spawning populations also show evidence of recoveries, some very strong. However, some of the apparent increase may be attributable to increased survey effort in the last two years. Furthermore, there is a shortage of small-stream data for making comparisons between 1995 and 1998, especially for the region to the south of Estevan Point. Of approximately 65 spawning populations in this region, eight have coho spawning estimates for both these years. However, these include Carnation and Robertson creeks and six other spawning areas with estimates generated through a modified chinook enumeration project initiated in 1995. Chinook typically require larger watersheds than do coho. Hence in this region, there is no direct evidence on the relative abundance of coho between 1995 and 1998 on the smaller, potentially more vulnerable streams that do not support chinook.

Johnstone Strait (including Queen Charlotte Sound and Mainland Inlets)

This area contains 115 known coho spawning systems. Here also, there were some remarkably strong returns, particularly in Queen Charlotte Sound. Returns to the Keogh, Nimpkish and Tsitika rivers were strong. However, returns were less encouraging in other areas, and in 15 of 29 systems that were surveyed anywhere in the area in both 1995 and 1998, estimated abundances were down.

Central Coast

Spawning estimates are very difficult to interpret for the Central Coast. The available evidence is sparse and often inconsistent. For example, traditional visual survey estimates for the Dean, Koeye, Martin, and Bella Coola rivers in the vicinity of Bella Coola were very small compared to 1980–1997 averages. Yet for the Atnarko River, a Bella Coola tributary, the estimate of coho passage at a counting tower was a remarkable 40,000. Estimates in Rivers and Smith Inlets to the south were also very high. Yet traditional visual estimates from streams to the west, around Bella Coola, provide a different impression for that part of the region. There are 51 known spawning systems in this region, 20 of which were surveyed in 1998. Of these 20, there are records for 17 streams from the 1960s and 70s. These records suggest that coho spawning abundance declined by about 50 percent between the 1960s and 1970s, and that 1998 levels are similar to the reduced values in the 1970s.

It is very difficult to discern trends from these estimates. For example, this was the first year that coho were counted at the fence in Smith Inlet, and it was also the first year in recent years that a targeted effort was made to survey coho in the Chuckwalla and Kilbella rivers in Rivers Inlet.

Some stocks in the south and east of the region appear to have been remarkably strong in 1998. Yet other stocks, some of them potentially large, may be seriously depleted. The inconsistent and sparse data make it impossible to provide a definitive assessment of the stock status in this large area.

North Coast (excluding Upper Skeena and Nass rivers)

There is a shortage of reliable information on much of this region. Available evidence suggests that the northern coastal populations are moderately depressed but relatively stable. Marine survival in the Lachmach River was estimated at just under ten percent—about ten times larger than the estimates for the Upper Skeena hatchery stocks. The long-term record of estimates for spawning areas to the south indicates that stocks in the Kitimat area are severely depressed. This problem appears to be most severe in smaller streams closer to the outer coast. It is not possible to determine its north-south extent.

Queen Charlotte Islands

Spawning levels in some of the larger systems in the north appear to have been strong, but many of the smaller stocks, especially those in the south, appear to have declined to dangerously low levels. The national park covers roughly the southern third of the coast, extending for about 100 kilometers from north to south. Within this large region, there are 71 identified coho spawning areas, all but six of which are on the eastern side. Of these 71, there are records of 36 survey results from 1998, all from the eastern side. In 21 of these 36, no coho were found. That is, no coho were found in over half the surveyed spawning areas in the proposed park. There are 30 of the 71 streams that were surveyed in both 1998 and 1988. Within this group, the proportion of zero counts increased from 30 percent in 1988 to 50 percent in 1998. Despite the potential unreliability of such visual estimates, this increase in the rate of zero counts points to a serious conservation concern in this proposed national park.

Lower Nass River

Available evidence suggests that these populations are moderately depressed but relatively stable.

Upper Nass River

Passage of spawners through the fishway at Meziadin Lake was low in 1998. By September 21, only 1378 coho had been counted vs. 3409 in 1994 and 1476 in 1995. Thus the stocks above the fishway appear to have declined from parent-generation levels. This is cause for concern especially in light of the significant reduction in fishing mortality in 1998.

Interior Transboundary Rivers

There are three major rivers in this group: the Alsek, Taku, and Stikine. These northern coho have a mixed three to four-year life cycle. The spawning estimate for the Klukshu, in the Alsek watershed, was approximately 1,400—close to the 1994 level, but around a third of that for 1995. The Taku River estimate was 41,000—well under both parent generation levels, yet above the target. Estimates for the Stikine were below average.

FISHING MORTALITY ESTIMATES

The Minister set a goal of zero percent fishing mortality on Thompson and Upper Skeena coho. How close did the management system come to achieving this target? In an ironic twist, the restrictions aimed at producing dramatic reductions in coho fishing mortality also made it more difficult to estimate the size of these reductions. Key information on assessing fishing mortality usually comes from small coded wire tags that are inserted into the heads of fry or smolts, from which the adipose fin is also removed. Catches are sampled, and when a coho is observed with a missing fin, the head is removed, and sent along with information about the date and place of capture, to a laboratory where the tag is removed and the code is recorded. If the fish is released, the coded wire tag cannot be removed. In 1998, fishers were required to release all coho.

There are other problems in producing a reliable estimate. (The first can be illustrated by the large recreational fishery in the area to the north of the Queen Charlotte Islands. The Council has been given two estimates of the number of coho encounters: 45,000 and 131,000. There were an estimated 33,000 coho encounters in recreational fisheries on the rest of the BC coast north of Vancouver Island. The existence of such widely divergent estimates for this major fishery raises doubts about the accuracy of encounter-rate estimation procedures. Catch and encounter-rate estimation procedures in the recreational fishery need to be improved.

Some of these fish will have died as a result of being caught. The death rate depends on gear type and fishing method, and is not well understood. For the recreational sector, the standard rate used by the Department of Fisheries and Oceans has been ten percent, but a 1998 experiment in Work Channel produced an estimate of 26 percent. Furthermore, these fish were carefully handled, and some experienced guides believe that the real mortality rate may exceed 50 percent in some instances. The ten percent rate, when applied to the recreational fishery on the North Coast of the Queen Charlotte Islands, would produce estimates of somewhere between 4,500 and 13,100 mortalities. Depending on the prevalence of fishing practices that encourage the fish to swallow the hook more deeply and on the care with which the fish were handled, the actual value could be substantially larger.

Finally, because no coded wire tags could be processed from these fish, all of which were released, valuable information on their place of origin was unavailable. DNA analysis may help, but the numbers of fish that can be analyzed from many fisheries will likely be too small, especially for the depressed stocks, to provide accurate estimates.

The following DFO estimates of coho exploitation rates do not include deaths of caught and released fish. Real exploitation rates (and associated marine survival rates) will be higher. The Conservation Council is unable to estimate the extent of the bias at this time.

For the Upper Skeena, Canadian exploitation was estimated at three percent, vs. an average for the last decade of 42 percent. Alaskan exploitation was estimated at around 25 percent and 60 percent for the Bulkley and Babine rivers, two components of the Upper Skeena system. The latter was up from about a 40 percent long-term average. This continuing Alaskan exploitation of stocks that Canada has identified as seriously depressed underscores the importance of obtaining a Canada/U.S. agreement—an agreement that not only settles the catch-sharing dispute but that also leads to an effective conservation partnership. Last summer, Alaska and Canada could not even agree on the status of Upper Skeena coho. Since then, Alaskan and Canadian scientists have, in long and difficult discussions, reached consensus on most of their previous differences. It is time for both sides to complete the consensus and to move forward to a full catch-sharing and conservation agreement.

Much attention has been focused on the recreational fishery on the North Coast of the Queen Charlotte Islands. This red zone fishery accounted for an estimated 0.43 percent exploitation on Upper Skeena coho. Next to the aboriginal food, social and ceremonial fishery, this was the largest component of the estimated exploitation on these stocks. Recreational fisheries closer to the mouth of the Skeena contributed an estimated 0.24 percent exploitation. These extremely low exploitation rates indicate the success of conservation measures in 1998 to protect Upper Skeena coho. The Council has not had the time to undertake a thorough review of the estimation procedures. Nonetheless, there is clearly considerable room for inaccuracy. Given the expanded role envisaged for recreational fishing and the stated goal of zero percent Canadian fishing-induced mortality on Upper Skeena coho, there is a need for a review of both estimation accuracy and regulations under which anglers can catch (and release) up to 50 coho per day in areas where Upper Skeena coho are likely to be encountered. Nonetheless, the need for a full conservation agreement with Alaska is of overriding importance.

In the south, the 1998 exploitation rates for wild stocks were estimated through estimates of exploitation rates for hatchery stocks, excluding any targeted terminal fisheries. These estimates ranged from 1.1 percent for the Chilliwack hatchery to 3.3 percent for the Big Qualicum hatchery. On March 12th, the Department announced their estimate for Thompson River coho at five percent (two percent Canadian, three percent American). The Conservation Council has not undertaken an assessment of the accuracy of this estimate.

SELECTIVE FISHING INITIATIVES

Selective fishing means avoiding, or releasing alive and unharmed, non-target stocks or species of concern. Its purpose is to ensure that conservation objectives are met, while allowing safe harvest of target stocks or species.

The enthusiasm and ingenuity that developed over selective fishing in 1998 were astounding. Aboriginal communities began reconstructing old technology with traps and weirs. Fish wheels began replacing gillnets in aboriginal fisheries. Beach seining initiatives were given a substantial boost. Experiments were hastily assembled to assess alternative ways to handle fish in troll, seine, and gillnet operations, and to assess catch-and-release mortality in the recreational fishery. A major experiment in Barkley Sound involved commercial fishers and both government and university scientists.

Though some fishers participated reluctantly in the new move to more selective fishing, many showed genuine excitement at the challenge of exploring new ways to fish selectively. This major shift in attitude was perhaps the most positive development in the 1998 season.

What was learned? Many fishers gained practical experience with new or forgotten technology, as did research scientists in running new kinds of experiments. The commercial fleet looked to the Barkley Sound experiment to answer questions about the value of new regulations in reducing by-catch mortality for coho. The experiment was aimed at evaluating not only short and longer-term survival rates, but also the capability of released coho to spawn successfully. In addition, researchers examined the fishes' energy reserves, waste product accumulation, and ability to maintain a general chemical equilibrium.

Although many key questions remain unanswered, the experiment provided valuable insight. Specifically, it indicated

- that coho remained highly stressed in the recovery boxes that were made mandatory on all commercial fishing vessels,
- that these recovery boxes could be redesigned to reduce this stress,
- that careful brailing of a seine net under unhurried conditions can reduce the short-term coho mortality rate to around three percent,
- that under the procedures tested on troll and gillnet vessels, the short-term coho mortality rates were around 19 percent and 61 percent of relatively low numbers of coho that were caught, and
- that there were potentially some differences between the different fishing methods tested, but that more research is needed before definitive recommendations can be made. For example, there was some evidence that immediate coho mortality was reduced through the use of shorter gillnet sets (30 vs. 60 minutes), but after 24 hours, increased numbers of deaths from shorter sets brought the overall differences down to levels that could easily have been attributed to chance fluctuations.

Some of these findings confirmed the results of previous studies, while many questions remain unanswered. Trollers in particular remain uncertain about the value of recovery boxes for their gear type. Many of them believe that the mortality rate would be reduced if the fish were released without removing them from the water.

The value of different methods and gear for sorting fish on seine boats also remains uncertain. In addition, although real gear types and fishing methods were tested, they were not tested in a real fishery. Coho mortalities could well be higher on a boat pitching in a heavy sea in Juan de Fuca Strait with a crew that is racing to maximize catch in a short opening. They would of course also have been lowered had the crews been actively trying to avoid coho. Since the purpose of this experiment was to assess the mortality rate on fish that were caught, fishers were actively trying to intercept coho, not avoid them. Strategies for avoiding coho were not evaluated in the experiment. These appear to be the best strategies for reducing coho mortality in gillnetting and trolling, and warrant further investigation. Furthermore, the impact of multiple catch-and-release events was not assessed.

Unfortunately, problems in the tagging component of the experiment made it impossible to gain much information on the most important question for coho conservation: What fraction of the fish that were caught and released were able not only to swim away from the boat, but lived to spawn successfully? Other key questions such as, “How much time must a captured coho be allowed to recover before it is able to swim fast enough to avoid predators?” remain unanswered.

In recreational fishing, there is also a growing body of evidence that fishing methods that entice the fish to become hooked in tissue other than around the edge of the mouth cause higher short-term death rates—well above the Department estimate of ten percent. An experiment conducted on motor mooching in Work Channel on the North Coast last summer found mortality rates of 26 percent, with most of the deaths occurring in fish that were hooked deeply in the mouth. These findings call for surveys of fishing methods that are currently used, and for a reassessment of regulations, especially those related to the use of bait and to catch-and-release fisheries. Here also, there remain many unanswered yet vital questions. Very little is known about long-term survival through to the spawning grounds, about mortality rates for fish that “get away” before being landed, and about the effects of different methods of releasing fish. Some experienced fishing guides believe that the mortality rate may be much higher than 26 percent, especially for poorly handled fish. Precise estimates are not easily made. Yet they are important. It is also important that recreational fishers be educated on how best to reduce coho catch-and-release mortality. It was possible for a guided party on the North Coast to catch and release over 50 coho in a single day last summer. Furthermore, in the Work Channel experiment, almost 50 percent of the fish that were hooked “got away”.

This past summer represented a bold new beginning. Yet much remains to be learned. The pilot studies and experiments must continue. The 1998 experiments should be thought of as preliminary, first attempts, put together under immense time pressure given the late authorization for funding. In addition, good experiments lead to as many new questions as they answer, and the most valuable insight typically comes from addressing these unforeseen questions. Finally, the partnerships that were forged among government scientists, fishers from all three sectors, and university researchers were crucially important, and should continue to be fostered. Each of these groups brings unique, important expertise to the venture. Their continued collaboration is vital.

The effectiveness of all initiatives that show promise needs to be subjected to thorough scientific scrutiny. These assessments must be conducted according to normal scientific standards. These need to be applied throughout the process from the proposal evaluation stage through to the dissemination of the findings.

The selective fishing proposals must be evaluated objectively. All evaluation procedures must be free of the politics related to who is allowed to catch the fish. Lobby groups must certainly not be given the authority to screen proposals. Proposal evaluations must be conducted by panels of independent, qualified personnel with the authority to make binding decisions. Canada’s Natural

Sciences and Engineering Research Council's internationally renowned procedures are a good model to emulate.

The ultimate goal of these experiments is to generate new scientific knowledge leading to practical recommendations for improving selective fishing methods. They may well have a major impact on fishing practices. The final evaluation of the results must again be conducted by independent, qualified personnel in a process similar to that used by scientific journals.

SUMMARY OF INFORMATION GAPS

Very little is known about the health of many coho populations. In many areas there is virtually no firm evidence available even on spawning abundance let alone marine survival or fishing-induced mortality. Although many of the traditional foot surveys were reinstituted in 1998, these are particularly unreliable for coho. Furthermore, because they were suspended until last year, there are virtually no comparable parent-generation data that is needed to assess recent trends.

Resource management agencies also gain vital information from long, uninterrupted series of reliable estimates of spawner, smolt, and adult-return abundances for individual spawning populations. The few such sets of observations that have been made on wild coho are short, and these are under constant threat from budget cuts. Furthermore, the streams managed are typically the more productive ones, and are not necessarily indicative of what is happening in smaller systems.

Nathan Creek Example

As an example of the current information gaps, consider Nathan Creek, a moderately sized creek flowing into the Lower Fraser east of Fort Langley. This past year a DFO survey produced an estimate of 147 spawning coho. How does this compare to the parent generation of spawners in 1995? No one knows because the surveys were discontinued. There are no DFO-generated estimates for 1995, or for any of the next two years. Even if the DFO surveys are continued for the next two years, no one will know how well the stock is faring relative to its parent generation.

How is the stock faring relative to its potential? Previous DFO surveys report an average of 880 spawners in the 1970s. It looks as if the population has declined six-fold from the 1970s, but the real decline could be much different. Coho spawner surveys are very hard to perform, and the results are unreliable.

There is also anecdotal evidence of a major decline. Fishers at the mouth of the creek in 1997 reported greatly reduced catches from what they could recall from previous years. In the early 1980s, a graduate student reported abundant coho leaping over beaver dams after the first fall storms. In 1997, a team of Environmental Science students from Simon Fraser University encountered only a half-dozen coho in an intensive foot survey of approximately two kilometers of the creek.

This is enough information to warrant concern, but it is not precise enough for scientists to determine whether the stock is currently in decline. The region has one indicator stream that is, by chance, close by: the Salmon River that flows into the Fraser at Fort Langley. It might provide indirect evidence of the health of Nathan Creek coho. Yet there are important differences. The lower reaches of Nathan Creek have been heavily diked. The middle section flows through a small canyon where it is actively eroding creekside gravel cliffs. The upper section of the watershed borders an industrial park.

There are numerous creeks the size of Nathan Creek and smaller. Individually, they have always produced a small number of coho. Yet collectively, they play an important role. In 1987, streams of this size and smaller contributed an estimated 20 percent of the wild and hatchery spawning escapement to the Lower Fraser. A more carefully crafted monitoring system for these small streams is needed, one that can take advantage of volunteer labour from community groups and educational institutions.

SUMMARY

The Minister's decision to put conservation of coho salmon ahead of short-term economic considerations was crucially important. This initiative needs to be continued, and the Department needs to develop strategy to avoid the practice of awaiting a future crisis before taking conservation action.

Coho Index Streams with Ongoing Estimates of Spawners and one of Smolts or Catch

			Year Component Added		
Proposed Assessment Units	**Stream**	**Wild/ Hatchery**	**Smolts**	**Catch**	**Spawners**
Coastal Georgia Basin	Black Creek	Wild	85	86	85
	Chase River	Mixed		89	88
	Cowichan River	Wild	87		86
	Craigflower Ck.	Mixed	95		92
	Salmon River	Wild	97	88	87
Interior Fraser and Thompson	Coldwater River	Mixed		88	98
	Spius Creek	Hatchery		88	98
	Deadman River	Hatchery		89	88
	Louis Creek	Mixed&		88	88
	Lemieux Creek	Mixed		86	85
	Dunn Creek	Hatchery		85	85
	Salmon River	Mixed		86	86
West Coast Vancouver Is.	Robertson Creek	Hatchery	*	*	*
	Carnation Creek	Wild	71		71
	Kirby Creek	Mixed	98		97
Johnstone Strait	Keogh River	Wild	78		98
Central Coast	Thorsen Creek	Mixed		88	98
North Coast	Zaul Zap Creek	Wild	93	94	*
	Lachmach River	Wild	87	88	88
Interior Skeena and Nass	Toboggan Creek	Mixed	96	88	88
Queen Charlotte Is.	Deena Creek	Wild	94	95	95
Interior Transb. Rivers	Taku River	Wild		91	87

THE ORIGINS OF THOMPSON RIVER COHO

During the last ice age, almost all of British Columbia's salmon streams were scoured by massive ice sheets. Only a few remnant salmon populations survived in small coastal refuges. The closest large refuge was to the south, in the Lower Columbia River.

About 10,000 years ago, warmer air masses began to erode the great ice sheets. First to succumb, were the southern ice front and the exposed flanks far from supplies of new snow in the higher mountains. The Upper Columbia became free except for a massive ice dam in the Rockies in northern Idaho. The dam formed a lake in Montana that was over 300 kilometers long and 150 kilometers wide. It eventually gave way catastrophically. The entire lake drained in two weeks. The great flood left boulders and giant "ripple" marks the size of large sand dunes over a 150 kilometers wide swath through central Washington.

Further north, as the Okanagan and the Thompson River valleys began to emerge, another giant ice dam blocked the lower end of the Thompson. Silt-laden flood waters backed up 300 kilometers from the Thompson's confluence with the Fraser at Lytton, all the way past Shuswap Lake to the low divide with the Okanagan valley near Armstrong. There, it spilled south into the Okanagan Valley and eventually into the Columbia. The offspring of coho that had survived the ice age in the Columbia extended their range northward up the Okanagan Valley and into the Thompson. When the ice dams fed by glaciers near the Fraser canyon finally gave way, coho smolts from the Thompson found a new route to the ocean. The modern Thompson River coho run was reborn.

How do we know this? The story of the glacial retreat is written in the landscape. Drive through the North Okanagan, and you can see the remains of the old river course. Drive west from Salmon Arm toward Kamloops, and you can see where the present river has cut great, banded cliffs through clay deposits left when the river was backed up. Continue down through the Thompson and Fraser canyons, and you can see gravel deposits left from old glaciers. Hike up into the mountains, and you can find remnants of the glaciers themselves.

Evidence of the coho's return to the Thompson is written in their genetic code. Thompson River coho are more similar to those in the Lower Columbia than to any other coho population. They might be expected to be even more similar to Upper Columbia coho. It's a hollow question. Upper Columbia coho are extinct. Thompson River stocks will most likely play a key role in any attempt to reestablish coho in the Upper Columbia. If Thompson River stocks are allowed to slip away, there will be no closely related inland coho left.

COMMENTARY

DFO must strive toward rebuilding coho stocks in areas where they remain depressed. The coho need continuing relief from heavy fishing-induced mortality. Managers need more reliable information on freshwater and marine habitat. Fisheries management turned an important corner in 1998, but much hard work and sacrifice will continue to be needed. Coho typically live for three to four years before they are ready to reproduce. Depressed stocks most certainly cannot rebuild in a single year. Therefore, the firm restrictions reducing the total fishing mortality on Thompson River and Upper Skeena coho to near zero must continue for at least another five years (i.e., for at least a total of two coho generations). Other stocks should also be added to this list if they are deemed to face comparable conservation risks.

Some have argued that we do not need to impose such restrictions in advance of the fishing season—that adjustments can be made in-season once shortfalls in abundance are detected. Such a strategy may be feasible in locations where fishing effort is concentrated near terminal spawning areas where the abundance of the returning stock can often be monitored in-season. This in turn provides an opportunity to limit fishing effort in time to avoid serious overfishing.

This strategy is not practical in mixed-stock ocean fisheries because it is extremely difficult to identify fish from small stocks in-season, and to obtain reliable, timely estimates of their abundance. It is hard enough to do this for major sockeye stocks returning to the Fraser River, let alone minor coho stocks. This makes the strategy inherently risk-prone. Fishing would proceed until evidence of a shortfall is observed, but this evidence is almost impossible to obtain. Therefore, fishing must not proceed on such severely depressed, genetically valuable stocks, as for example, the Thompson River coho, until there is strong evidence that they have recovered. The precedent set last year of announcing firm pre-season plans for protecting weaker stocks should continue.

DFO must strive toward rebuilding coho stocks in areas where they remain depressed. However, rebuilding may be affected by various environmental factors. The North Pacific, like much of the rest of our planet, has been warming, and El Niño events have been increasing in both intensity and frequency. There were record temperatures in the Fraser River last year, and freshwater habitat continues to be lost. These factors point to continuing conservation concerns, not only for coho but also for chinook salmon. For example, along with eight other U.S. salmon populations, Puget Sound chinook were listed as threatened on March 16 of this year by the National Marine Fisheries Service. There are also serious conservation concerns for Strait of Georgia coho and other Canadian salmon populations in the area. To protect the genetic information of such important populations, DFO must be able to delineate what scientists call Evolutionarily Significant Units (or ESU's) for each salmon species. DFO has made a first attempt at this task for coho, but many key information gaps remain. Until these gaps are filled, it is important to err on the side of caution in identifying population groups that must be protected.

DFO also needs to develop specific operational goals to ensure that the genetic information within these Evolutionarily Significant Units is preserved. These may include, for example, minimum escapement targets for a specified proportion of the spawning populations. Managers should also consider the potential role of such emergency procedures as temporary artificial enhancement operations (i.e., strategic enhancement) and gene banking to protect wild stocks from extinction and to preserve essential genetic information.

DFO must develop the capacity to monitor success in achieving these conservation goals, a key element of which is stock assessment. Effective stock assessment requires many years of reliable data. Coho stock assessment efforts have improved significantly in the last year, but still suffer from the long-term effects of *ad hoc* reactions to administrative reorganizations and financial cutbacks. There is virtually no reliable information on coho abundance on the entire Central Coast north of Rivers Inlet, and not a single, unbroken, long-term series of reliable smolt, returning adult, and spawning abundance estimates for any wild stock anywhere in the entire Pacific region. Important time-series, such as for Black Creek and Lachmach River coho, were established in consequence of the 1985 Pacific Salmon Treaty, and hence can be used only for evaluating trends over the last ten to 15 years.

Stock assessment and mortality estimation systems should be developed to greatly improve the capacity to monitor progress. The existing system will clearly have to be overhauled to provide clear signals of any declines within every Evolutionarily Significant Unit. The present network of indicator streams and counting fences leaves major gaps in vast areas. In addition, DFO needs a program in place to monitor other streams in each ESU. To expand the coverage, this should entail marshalling all available volunteer sources, some of whom may need to be trained to utilize professionally designed sampling standards.

DFO has a strong record of working with volunteer groups through the Streamkeepers Program and other initiatives to monitor stocks and habitat. The Council encourages this work. Nonetheless, DFO also needs to ensure that the monitoring system provides a representative overview of the region, including remote, unpopulated areas. Furthermore, the system design must incorporate the need for increased monitoring capacity for stocks heavily impacted by harvesting or by habitat developments.

The methods for estimating fishing-induced mortality also need to be improved. DFO's policy of increasing the relative role of the sport fishery for coho and chinook calls for a major reassessment of methods used for estimating catch, encounter rates, and catch-and-release mortality rates for the sport fishery. The larger the exploitation rate exerted by the sport fishery, the greater the need for accurate estimates of its impact.

There is a need to develop rebuilding goals and operational strategies for moving toward them. For example, the goals would define what a rebuilt Upper Skeena or Thompson River coho population should be, and would lay out interim goals for moving toward that objective.

Many important research questions also need to be addressed. For example, there is a need for a better understanding of:

- the effects of habitat degradation,
- the reasons for recent declines in marine survival,
- the potential impact of marked-only fisheries for coho stock assessment,
- the risks associated with widespread depressed abundances, and
- the effects of stress from catch-and-release on reproductive success.

Valuable research initiatives were begun in the last two years in response to the coho crisis and these should be continued over the long-term. Furthermore, the selective fishing experiments of last year demonstrated the importance of fostering co-operative effort.

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