Pacific Fisheries Resource Conservation Council

Salmon Conservation in the Central Coast:

Advisory

Prepared by
Pacific Fisheries Resource
Conservation Council

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Pacific Fisheries Resource Conservation Council
Conseil pour la conservation des ressources halieutiques du pacifique

February 2004

The Honourable Herb Dhaliwal
Minister of Fisheries and Oceans
Government of Canada
Ottawa

The Honourable Ed Conroy
Minister of Agriculture, Food and Fisheries
Government of British Columbia
Victoria

Dear Ministers:

My colleagues in the Pacific Fisheries Resource Conservation Council have shared an uneasiness and apprehension for the past two years about conditions that we have observed in the Central Coast Fisheries.

The salmon stocks in that Region have generally been subject to severe declines in abundance and there are worrisome reductions in the quality and the healthiness of fish in their life cycle. In our consultations with British Columbians, we have repeatedly been told about what many people consider to be an overlooked region and a unique array of fisheries problems that have been, until recently, largely unnoticed.

The attached background paper and advisory, formulated by our Council, are meant to contribute to a greater public recognition of Central Coast conditions and provide guidance on what we believe can be done as a positive response. As the report explains, it is a supplement and an elaboration of the background paper and commentary issued by our Council in June 2000.

In the intervening months, your Governments responded to the issues cited in our initial report on the Central Coast. We have noted that important work has recently been undertaken by the task force led by Fisheries & Oceans, resulting in initiatives on several points we have highlighted.

To their credit, BC Government Ministers and other Senior Government Officials have taken a lively and direct interest in dealing with the aspects of the Central Coast Fisheries, such as those related to habitat that are within provincial jurisdiction. Your Governments have been making information more widely available to enable people throughout British Columbia to understand the situation and the trends. At the same time, communities in the Region have risen to the challenges of their fisheries to the extent that they could act effectively with their limited resources.

We hope that this background paper and our advice will contribute to achieving immediate and long-term solutions. A sustained and concerted effort will be required if salmon in the Central Coast region are restored to sustainable levels.

The Honourable John A. Fraser
Chairman

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COUNCIL'S OBSERVATIONS AND RECOMMENDATIONS ON SALMON CONSERVATION IN THE CENTRAL COAST

The current conditions and future prospects of salmon in the Central Coast Region of British Columbia present troubling conservation challenges. Declines in salmon returns, poor spawning results, and reductions in catch opportunities have been among the prevailing trends in recent years, and there are few reasons for optimism about the outlook for any immediate improvement.

In 1999, the Pacific Fisheries Resource Conservation Council commissioned a background paper for its annual report to sort through the available information and provide a perspective on the fisheries resource conditions and practices in the Province's Central Coast. The resulting paper by Allen Wood entitled *State of Salmon Conservation in the Central Coast Area* provided a valuable initial reference to the situation in the region. It explained some of the reasons for the decline of salmon and the inability of government agencies, community groups and fisheries organizations to halt it or make much headway in reversing the trend towards further decline.

Following the release of that background paper in June 2000, the Council requested a follow-up to provide more detailed analysis and fill some of the gaps in information about Chinook and Coho salmon in the region. That paper by the same author, entitled *State of Chinook and Coho Salmon in the Central Coast Area,* looked at conditions in terms of the higher-risk issues and what Council members considered the most immediate challenges.

The background papers presented Council members with a wealth of interesting technical material and suggestions that deserve close attention by everyone with an interest in Pacific salmon. For the Council's purposes, the focus of comments and recommendations was narrowed onto the primary topics and issues that were highlighted in the papers.

Based on the information and analysis contained in those two papers, the Council has made some particular observations and specific recommendations, beyond those about the region already presented in the 1999–2000 Annual Report. In most instances, these observations and conclusions are directly relevant to the Central Coast, but have broader application in some cases to salmon conditions across the entire Pacific Coast.

Credible Measures of Stock Status

Without accurate and reliable measurement of salmon stocks, there is no valid basis for fisheries management decisions or investment in enhancement and habitat protection. It is apparent, particularly in the Central Coast Region, that too little reliable information is available through current data-gathering and trend analysis. As a consequence, the management of salmon stocks is not able to proceed with sufficient regard to the precautionary principle.

For example, the available spawner abundance estimates since 1950 provide a general indication of trends and status of some salmon populations. However, these estimates lack consistency through time, so they are of limited value. Some estimates are in question because of the difficulty in observing and measuring spawners in silty rivers and under adverse conditions. These spawner abundance estimates are not backed up by juvenile enumerations, except for a very few populations. Instead, the main backup measurement is the number of fish being caught. Since most catch data is of mixed populations, it does not provide an accurate population-specific measure. Also, some catch data is not being reliably reported. The lack of monitoring of changes

in habitat capacity and number of hatchery-produced fish that spawn naturally also compromised the reliability of available data.

Not all salmon populations or the habitats are monitored. Consequently, it is important to ensure that those that are monitored each year are representative of the other populations. This requires regular, but not necessarily frequent, monitoring of the general abundance of all populations and conditions of habitat areas to ensure that the monitored populations are representative.

The reductions in monitoring and assessing fish populations and their habitats by both federal and provincial governments during the past decade have resulted in a significant loss of management capacity and knowledge about salmon conditions. Budget cuts in monitoring occurred at a time when the abundance of stocks was in rapid decline and fundamental features of the fisheries were in transition. In retrospect, it is apparent that this situation called for more, not less, investment in salmon information.

Amplifying this problem was the gradual dawning of awareness that ocean factors were having a dramatic effect on salmon survival. In fact, many indicators point to ocean survival as the primary cause of recent widespread salmon declines. It is notable and disturbing that no work on this matter is being conducted in the Central Coast, and only a modest research effort is carried out elsewhere.

It appears that these conditions of incomplete data and information gaps on salmon stocks and habitat status have increased decision-making uncertainty and raised the levels of management risk for species already under severe strain.

Public Information and Awareness

The Council has devoted considerable attention to ensuring that the public becomes more fully informed about Pacific salmon populations and the status of their freshwater and ocean habitat in British Columbia.

The Government of Canada and the BC Government have made significant progress towards making information on salmon and their conditions more widely and conveniently available through their internet websites. The Fish Wizard, Fisheries Project Registry, and Fisheries Inventory provide access to extensive data and maps on freshwater conditions, fish stocks, and salmon-related project activity in the Province. For instance, the North and Central Coast salmon spawner estimates and other information are now easily accessible for public review.

The Council considers this initiative to be an exceptional illustration of the valuable results that can be achieved by governments working together in the interests of salmon conservation. Further development of the information sources is being encouraged to include data on ocean conditions and contributions from communities and from local fishing and conservation groups. It would also be helpful to provide broader availability of detailed catch information and more material on coded wire tagging results, enhancement production and habitat projects.

Complete and Credible Measures of Catch

It was mentioned earlier that the data on the numbers of fish being caught has not been a reliable indicator for purposes of estimating stock status or making fully informed fisheries management decisions. By making the catch data more accurate and dependable, everyone could benefit from the results.

At both the federal and provincial levels, there appears to be limited enforcement with regard to the collection of catch data that is currently expected or nominally required. Little seems to be done in the native, commercial and sport fisheries to ensure that catches are fully accounted and reported.

Commercial catch estimates are made from tallies of sales slip receipts. In some areas, such as those near urban centers, commercial fishermen are taking fish home for personal consumption, gifts for neighbours, or direct sale. Any catch not sold to registered buyers should require a special reporting arrangement and enforcement. Provision of a completed mandatory catch logbook could be a condition for license renewal and could be checked in-season.

Food, social and ceremonial catch is generally accounted for by the Indian Bands as a requirement of their Aboriginal Fisheries Strategy agreement. In some cases, the statistics are comprehensive, detailed and superior to commercial and sport catch statistics. In other cases, these catch statistics are superficial, incomplete and sometimes not reported at all. This is a "rights" fishery, but it has more stringent catch accounting requirements than either the commercial or sport fisheries, and it apparently receives more enforcement attention.

The sport fishery is essentially unregulated, with open access. It was for many years believed that the catch impact of individual sport fishermen was inconsequential. However, it is becoming apparent that sport fishing has grown tremendously, and the effect of so many sport hooks adds up. This situation, combined with the productivity of expert guides and electronic equipment, is having a more dramatic fishing impact than anyone used to believe. In the Central Coast area, most fixed-site lodges provide comprehensive catch and effort statistics. Also, some guides report their client's catch, but unguided anglers generally do not, even though they can take a significant portion of the sport catch. For example, in Rivers Inlet this year unguided anglers may have taken fifty percent of the total. Catch statistics reported within the sport fishery are not standardized, and there is little enforcement.

The Council is proposing a clear policy: With the privilege to harvest fish must come the responsibility to report all catch and kill. This responsibility must apply to all fishers—aboriginal, commercial and recreational. Failure to meet that responsibility should be grounds for sanctioning or canceling the fishing licenses of offenders.

The Council does not have confidence that available data on the sport fishery, in particular, reflects the actual catch, or that fisheries managers are able to know with sufficient accuracy how many fish or which populations are being caught. With the complex mix of salmon populations and the dynamic nature of the fisheries, better monitoring of those fish populations and fisheries is necessary. The setting of more consistency in reporting standards across the fisheries would be a positive first step.

Sport Fishing Industry Information

With so many individual sport fishermen, it would be very costly and difficult to enforce or collect statistics from each of them. Instead, businesses that profit directly from providing services to sport fishermen could collect the catch information and ensure greater public awareness of conservation regulations and reporting. Currently, there are no sport fishing business licenses and, therefore, there are no conditions of license or other means to require sport fishing businesses to provide catch information.

To ensure that essential sport fishing information is made accessible, Fisheries & Oceans and BC Fisheries should work together to implement new licensing requirements for sport fishing lodges and charter boat businesses, including mandatory reporting of catch, effort and mark recovery.

The State of Alaska has requirements for sport fishing businesses that could be considered as a model. It requires a business license and a free registration of fishing guides and businesses. An official logbook is required for all saltwater sport fishing services. Logbooks must be completed daily and be available for inspection. Logbook forms must be returned weekly during the season. All vessels used by sport fishing businesses in Alaska must be licensed, and both boats and operators must meet safety specifications.

The intent of such a licensing requirement is not to limit the number of sport fishing businesses. It is simply to provide a level and quality of reporting that ensures the production of data to enable informed salmon management and effective conservation. The information collected for precautionary management will facilitate decisions to ensure a sustainable fishery.

Salmon Conservation Initiatives

With the shift towards selective fishing comes the need for better information about specific populations in relatively small areas. For selective fishing to work, it involves some level of harvesting activity while still protecting and rebuilding depressed stocks. In the Central Coast and elsewhere, it has become apparent that stock identification and site-specific catch information are crucial in many instances to provide the basis for managing this balance between harvesting and rebuilding.

To increase the protection of fish populations in the Central Coast area, the joint efforts of government agencies, fishermen and local interests should lead towards implementation of the following initiatives:

- *Special local restrictions to limit fishing in or near rivers of populations with conservation concerns.*
- *Live release strategies for all fisheries and species being further improved, implemented and regularly monitored and reported on.*
- *Special protection for resident fish populations.* A concern in all Central Coast areas is over-harvesting of the resident fish populations, such as rockfish and lingcod. For example, in recreational fisheries these species are harvested primarily as bycatch and as a fallback when weather or low salmon returns do not allow an acceptable salmon sport fishing experience. For these resident species, there are no recreational size limits and daily and possession limits are too high to be locally sustainable. Because these species are not migratory, it is essential to manage them and collect catch statistics on a much finer grid than at present.
- *Collection of more complete and accurate sport catch and kill statistics*. Governments and the sport fishing industry should work together to devise methods and programs to monitor and report catch by those anglers not using the services of guides or lodges. For example, there was a site in Rivers Inlet at one time where all sport catch had to be weighed and recorded. There should be mandatory reporting of catch, particularly in areas with trophy quality of fishing. It might be possible to use resorts as catch reporting stations in such areas.

1. EXECUTIVE SUMMARY

The conservation status of chinook and coho salmon populations in the Central Coast has become a matter of growing concern to British Columbians. Poor returns of salmon and other important fish species have undermined the commercial and aboriginal fisheries and affected communities throughout the region.

The recent work of the Pacific Fisheries Resource Conservation Council has been directed towards identifying the factors that have caused these problems. Its sponsorship of this background paper has been intended to provide a factual and analytical basis for the Council members to provide comments and recommendations to federal and provincial government officials. The other purpose of the paper is to provide technical information that can enable the public to understand the situation.

Over the last 50 years, there have been notable shifts and, in many cases, deterioration in: numbers of chinook and coho spawners; numbers and mix of enumerated populations; harvest rates; freshwater and ocean habitat production capacity; and influence of enhanced production. It is difficult to separate these conditions or identify all of the different factors relating to these changes. However, many of the chinook and coho spawning populations in the Central Coast area have declined in abundance. Some have been identified as being at high risk of extinction and others are moving in that direction. To address these declines, chinook and coho spawning populations should be increased to safe levels of abundance that minimize future conservation risks of random natural events, habitat impacts and over-harvesting.

Some of the decrease in abundance is a result of ocean and climate conditions. The decrease in catch became apparent after the ocean regime shift in 1976. Enhanced populations do not show the same declines as wild populations. This suggests that hatcheries have increased production rates and that overall harvest rates have been too high for natural populations to sustain.

To address the shortfall in basic monitoring of populations, governments should work with local fisheries interests to collect catch, tagging, enhancement and related information required for management. It is important that governments make this information more generally available to the public.

Standard performance measures for evaluating the conservation of salmon resources should be developed, adopted and reported. Salmonid Enhancement Program production guidelines should be further developed to address the concerns about hatchery impacts on survival and production of wild populations.

Chinook and Coho salmon rear in coastal areas where they are susceptible to harvest over most of their ocean life. In the ocean, most chinook and coho rear north of their home stream. Consequently, significant portions of Central Coast chinook and coho populations are harvested in Southeast Alaska and Northern BC, as well as in the Central Coast.

The catch in Central Coast fisheries is comprised of many chinook and coho populations, primarily from south of the area. Chinook from Oregon, Columbia River and Washington, as well as southern BC and Central Coast, are caught in the area. The coho catch is primarily of populations from southern BC and the Central Coast. Because of the many populations involved, most chinook and coho fisheries are subject to mixed stock fishery problems. The exceptions are some river mouth or freshwater fisheries that harvest primarily local populations.

The Central Coast Indian fisheries account for a small percent of the total catch of chinook and coho. The combined Indian fisheries account for about 4,000 to 5,000 chinook and 3,000 to 4,000 coho from Central Coast stocks. Existing arrangements for monitoring and reporting Indian catch should be continued and expanded.

The sport fishery has been growing and is now the largest generator of tourism revenue and a significant employer in the Central Coast. Based on reported numbers, the sport catch of salmon is relatively low, at about 9,000 chinook and 15,000 to 20,000 coho. At current amounts of harvest, the sport fishery is a conservation concern where it harvests specific depressed stocks. To address this, local fish populations should get special conservation protection where necessary. This concern also applies to species other than salmon. For example, with current bag limits, the sport fishery on resident species, such as rockfish and lingcod, is excessive.

It is in the interests of the sport fishing industry and governments to sustain both the fish resources and the industry. It is also in their interest to get maximum benefit from the sport catch and to strengthen their position in the tourism sector. Improved accuracy of catch information from this source would be especially useful for management of the salmon resources and the industry.

Commercial catches of coho peaked in the 1960s and early 1970s followed by a long slow decline to zero in the last few years. Chinook catch peaked in the 1970s and declined to current low levels. During that period, the nature, timing and location of commercial fisheries in the Central Coast have changed significantly to reduce the interception of passing stocks. However, most of the decline is a result of decreased abundance of salmon.

For effective management, all fisheries should be more population-specific and should be managed to facilitate harvesting of enhanced stocks at different rates than wild stocks. This would mean limiting harvest in mixed stock fisheries to rates sustainable by natural stocks and having local fisheries on enhanced stocks.

The preferred strategy for selective fishing should be avoidance of harvesting non-target natural populations to stop the handling stress and potential injuries of catch and release. To be effective, avoidance should be population-specific, cooperatively managed between fishermen and managers, and dynamic to address in-season changes. Selective harvesting would require more site-specific catch statistics and stock information than are currently available.

Selective harvest of enhanced stocks may require selective live-release of chinook and coho in fisheries for other species. It appears that properly implemented non-retention of coho has been an effective tool to increase spawner abundance. Applied locally, non-retention of chinook and coho could be an effective way to reduce the harvest of natural populations while maintaining one for enhanced populations.

Monitoring in the Central Coast area has not been adequate to know the actual state of most individual chinook and coho populations or the fisheries' impacts on them. For example, in the 1990s, when populations were dangerously low, many spawner populations were not counted. Basic monitoring is essential to conserve and manage salmon populations.

2. PURPOSE AND PERSPECTIVE

Salmon populations in the Central Coast Region of British Columbia have been the focus of attention of the Pacific Fisheries Resource Conservation Council since the organization's inception two years ago. Council members have taken the view that the Central Coast area provides a particularly important indicator of the current overall state of salmon populations and their management.

A background paper prepared for the Council and published in June 2000 focused primarily on the state of sockeye, pink and chum populations in the area. That paper entitled *State of Salmon Conservation in the Central Coast* presented a basis on which the Council requested a follow-up paper to provide more detail on particular conditions and issues.

The purpose of this follow-up paper is to assemble and assimilate available information on the state of chinook and coho stocks in the area and on the factors that relate to the conservation of those populations. It has been meant to provide a basis for Council members to formulate conservation advice and provide public information.

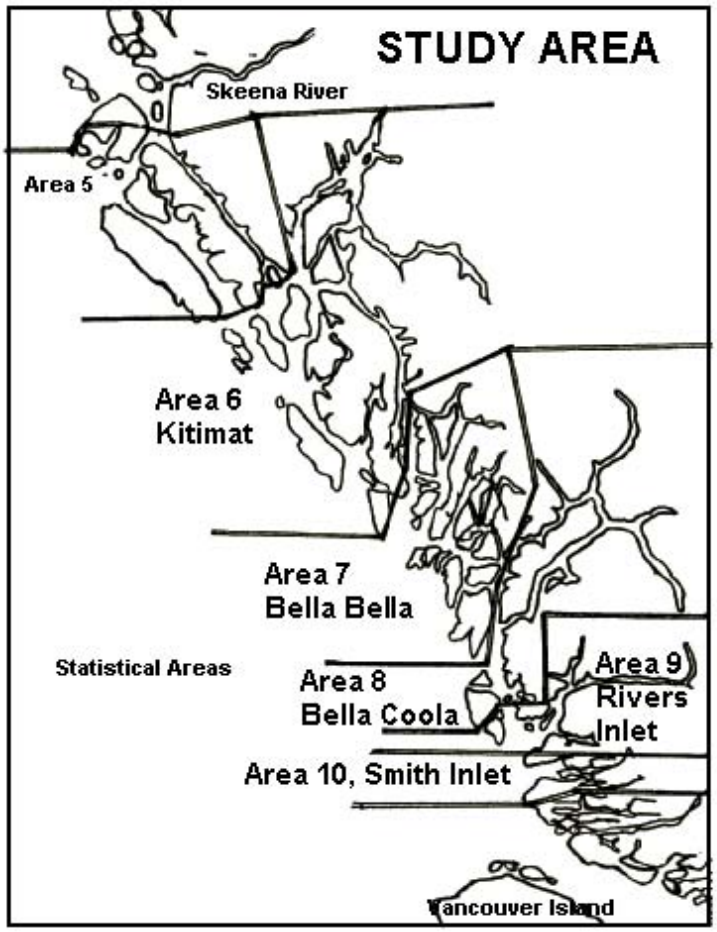
The first part of this paper deals with spawner-related information–the living, reproducing populations and their conservation issues. The second part deals with catch and use trends, and it explains how the salmon populations are impacted.

In terms of geography, the Central Coast area spans 275 kilometers, from Kitimat in the north to Smith Inlet in the south. The area is a maze of islands and inlets that reach from the outer coast into the Coast Mountains. The Central Coast is one of the few relatively undeveloped areas left on the coast. A few areas have been logged, primarily larger watersheds. Industrial and urban development is limited mainly to the Kitimat and Bella Coola Valleys. Logging is planned for more salmon watersheds in the area. A Land and Coastal Resource Management Planning process is underway to prepare for future land and resource use in the area.

The map shown here (Figure 1.) illustrates the five Central Coast management areas designated by Fisheries & Oceans, from Kitimat (Area 6) to Smith Inlet (Area 10). The collection and use of statistics based on these areas is meant to enable fisheries management decisions related to specific local conditions.

In the Central Coast, there are spring, summer and fall run chinook but the populations are primarily composed of summer runs. The major producers in the area are the Kitimat, Bella Coola, and Rivers Inlet systems. Central Coast coho stocks primarily return to spawn from September to November. Some local coho are intercepted in fall fisheries on chum. Many coho return after the net and recreational fisheries in the Central Coast. The major coho producing rivers are the Kitimat, Kitlope, Quaal, Kwatna, Koeye, Kimsquit and Bella Coola River systems.

Figure 1. Study Area



3. Salmon Characteristics in the Central Coast

Chinook and coho feed primarily in coastal areas and become vulnerable to sport and net gear within a year after migrating to the ocean. Throughout their ocean life, chinook and coho remain exposed to fishing by all types of gear. In the marine environment, both species generally travel northward along the coast, with chinook moving more consistently and further than coho. Consequently, ocean fisheries exploit stocks originating in streams south of the harvest area. Chinook from rivers in Oregon, Washington, and southern and central BC, and coho from southern and central BC, are often harvested in Central Coast fisheries.

More than six hundred chinook populations from the Columbia River north through to the Central Coast, and more than fifteen hundred coho populations can be intercepted in outer fisheries in the Central Coast. The populations originating in the Central Coast area are harvested in fisheries in Alaska and Northern and Central BC. The large number of populations in most fisheries makes it extremely difficult to manage to meet the needs of any single population.

As Central Coast fisheries intercept US chinook stocks and US fisheries in Alaska intercept Central Coast chinook and coho stocks, this area has been included in Canada-US salmon treaty negotiations. However, there have been few biological programs to provide information on stocks from the area for those negotiations. Most detailed information on stocks in the Central Coast is from enhancement related projects. The state of stocks in this area is a result of many interacting factors, both domestic and international.

Chinook and coho are the foundations of the recreational fishery and are highly prized in the aboriginal and commercial fisheries. Both species are harvested throughout their marine life and are caught primarily in directed fisheries and incidentally in net fisheries directed at other salmon species. In the Central Coast area, most directed net fisheries on early chinook runs and fall-returning coho have been ended since the 1980s. Most chinook and coho fisheries are managed with annual regulations, not weekly or daily regulations as for sockeye, pink and chum salmon.

Chinook Profile

Chinook salmon have a complicated life history with considerable variation in the time of spawning, freshwater residency, ocean dispersal, and age of maturity among stocks. Subgroups have different productivities, as well as optimum escapements and exploitation rates.

The different life history types of Chinook include the following:

- “Stream-type” chinook have an extended freshwater rearing phase of up to one year or more. They usually over-winter in freshwater before migrating to sea. Most stream-type chinook are northern, interior or early spring runs. Stream-type chinook are mainly five-year-olds and tend to have a more seaward ocean distribution than other types of chinook. Chuckwall, Kilbella and Dean river chinook populations are primarily stream-type chinook.

- “Ocean-type” chinook have a limited freshwater rearing phase (60 to 150 days). This is the dominant pattern for chinook, especially in the late summer/early fall “bright” run stocks and some early summer runs. Ocean-type chinook are mainly four-year-olds and tend to have a more coastal distribution in the ocean than stream-type chinook. The Wannock and Atnarko river (Areas 9 and 8) chinook primarily have the ocean-type life history.

- “Immediate-type” chinook bypass the freshwater rearing phase in their early life history and migrate to the estuary soon after emergence. They rear there for three to six weeks before

moving into the marine environment. They are often fall-run stocks that return to the river in dark condition. They may be very productive if supported by a large productive estuary. A portion of Central Coast populations may rear in the estuary and might be “immediate-type”.

Some chinook mature in their third year after one full year at sea as jacks, but the majority spawn in their fourth or fifth year. However, in cold northerly streams where freshwater growth is relatively slow, chinook often rear for two years in freshwater and return in their fifth or sixth year. The different runs of chinook return to the Central Coast area from May to October.

Coho Profile

Coho have a simpler life history than chinook. Most coho spend about one and a half years in freshwater before going to sea. They return to spawn in the fall or winter of their second year in the ocean as 3 year olds. In the north, where freshwater growing conditions are limiting, coho often spend an extra year in freshwater and mature as 4 year olds.

During their ocean residence, some coho range offshore from the coastal zone. They do not range as far in their ocean feeding migration as chinook and, while most coho migrate north, some go south.

Coho are widely distributed and are common to many creeks and river systems in BC. Coho often return to natal streams in small groups over an extended period in the fall and winter. This makes coho enumeration a challenge.

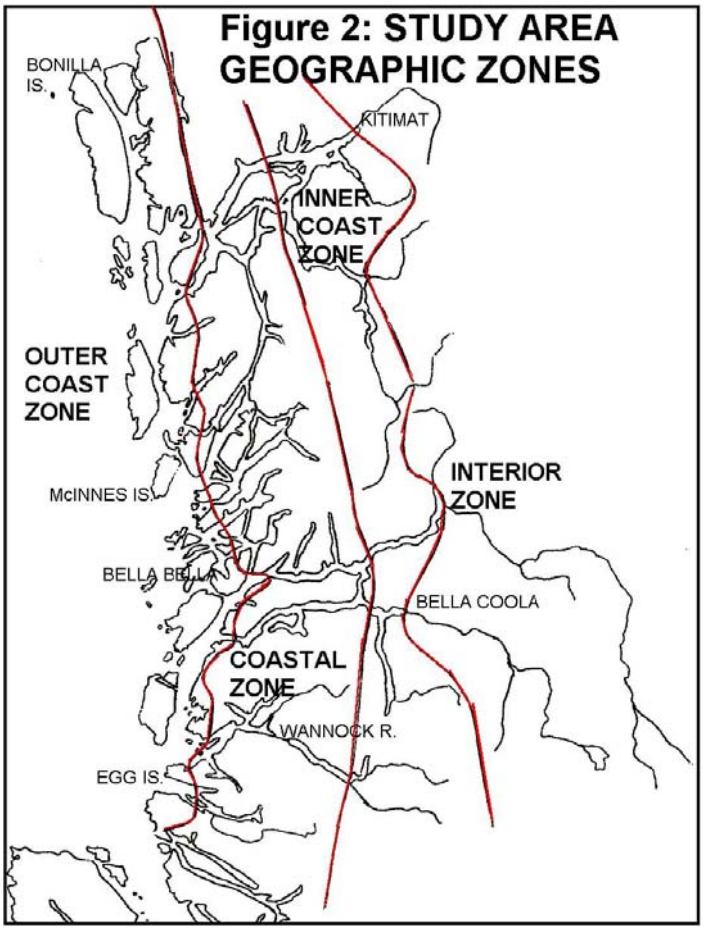
4. Conservation Status Issues

The assessment of the state of stocks can involve several different measurements related to stock abundance at various life stages. The primary information available in the Central Coast area is spawning population abundance estimates. This provides a broad basis for salmon stock measurement criteria to determine status, such as levels of:

- Extinction (no spawners);
- At-risk genetically (too few spawners to have enough genetic diversity to sustain population);
- Abundance trends (declining abundance should be a caution); and,
- Sub-optimal number of spawners (foregoing potential production).

To understand the causes of the state of stocks, it is also important to have an accurate and reliable measurement of catch and other factors such as local habitat development or enhancement effects, as well as the broader climate and ocean conditions impacts. The following sections address these issues using information to the extent that it is currently available. It is important to note that there are significant information limitations for chinook and coho in this region.

Figure 2. Study Area Geographic Zones

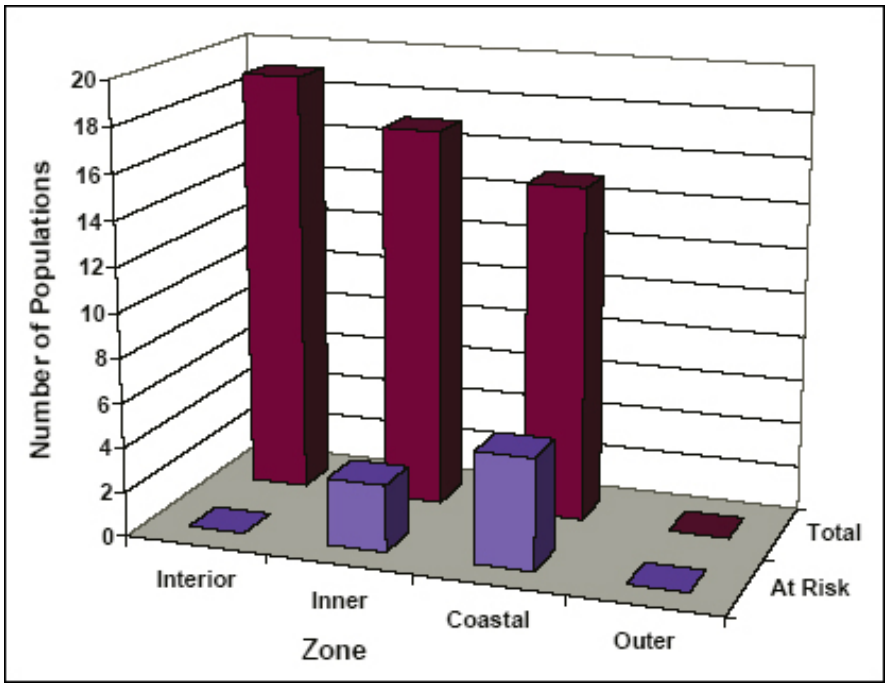


Chinook and Coho Populations at Risk

Annex 1 lists the Central Coast chinook and coho populations that were rated at high risk of extinction in a major study by Slaney et al. No chinook and coho populations were identified as having recently become extinct in the area. However, eight of the more than forty-three chinook populations and fifty-seven of the more than two hundred and twenty-two coho populations were rated at high risk, based on spawner abundance estimates up to and including 1993.

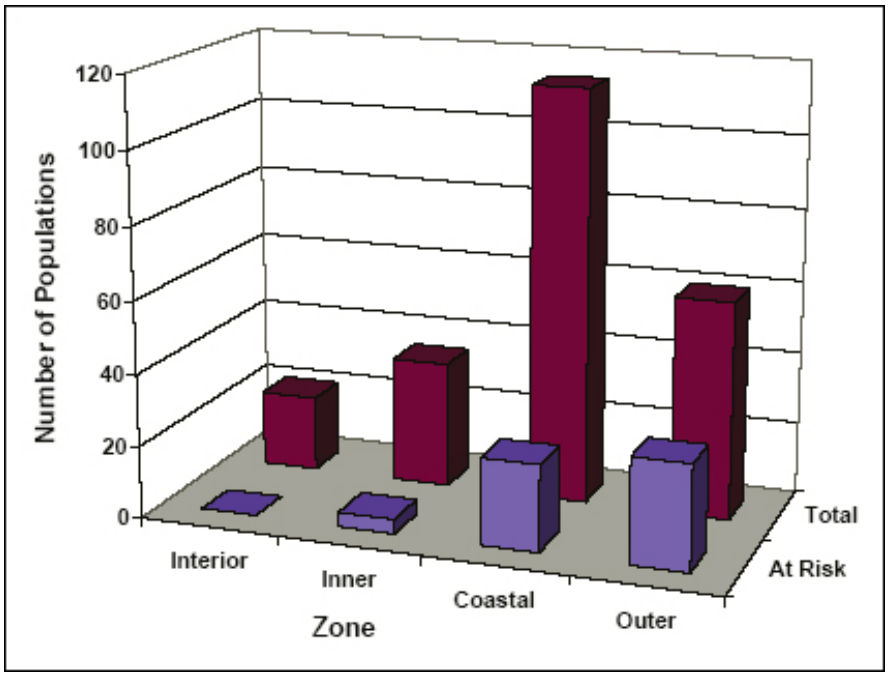
The at-risk stocks are grouped by Interior, Inner Coastal, Coastal and Outer Coast geographic zones, as illustrated in Figure 2. The distribution of total and at-risk chinook and coho populations in these geographic zones is illustrated in Figures 3 and 4 respectively.

Figure 3. Central Coast Chinook



Clearly, there are differences in the distribution of total and at-risk chinook populations, with most populations in the Interior and Inner Coast zones. Those that are primarily at-risk are in the Coastal zone. There are no chinook populations in the Outer Coast zone. The percentages of at-risk populations in each zone are: Interior 0%; Inner Coast 18%; Coastal 33%; and Outer Coast 0%.

Figure 4. Central Coast Coho Populations



The distribution of total and at-risk coho populations also differs significantly. Most coho populations are in the Coastal and Outer Coast zones. The target size of coho populations also varies significantly between areas in the Central Coast, as illustrated in Table 1. A disproportionate number of at-risk populations are in the Outer Coast zone where populations are small and water supplies are seasonal. Also, the criteria used for risk rating stocks require relatively less of a decrease in population size, for a small population to be classified at-risk than for a large population. The percent of coho populations at-risk in each zone is: Interior 0%; Inner Coast 11%; Coastal 21%; and Outer Coast 48%.

Table 1. Distribution and size of total and at-risk coho populations.

COHO	Area 6 N	Area 6 S	Area 6 T.	Area 7	Area 8	Area 9	Area 10	Total
Total Populations	44	70	114	51	27	23	7	222
Ave. Population Size	4,820	891	2,407	653	7,994	2,165	1,529	2,631
Populations At Risk	2	26	28	19	7	2	1	57
% At Risk	5%	37%	25%	37%	26%	9%	14%	26%
T. Target Spawners	212,075	62,800	274,875	33,286	215,850	49,800	10,700	584,511

Spawner Abundance Trends

Spawner abundance is an important measure of the state of populations and their habitat. It is significant for setting meaningful harvest and spawner targets, and a number of factors influence the accuracy of their calculation. The spawner estimates of individual populations are pooled to serve as overall area estimates that can be affected by factors such as:

- **Change in the number of wild spawners**
  The number of chinook and coho spawners is highly influenced by changes in the survival of juveniles in freshwater and the ocean and in resulting adult production. Some freshwater impacts can be local, such as those from stream specific habitat impacts. They can also be global, resulting from weather patterns and climate. Fisheries management, harvest rates and fishing practices can have a big impact on the number of spawners. For both chinook and coho, most of the harvest is in mixed stock fisheries and is based on assumptions of average abundance and productivity of the stocks. This means that populations with low relative productivity are over-fished, and insufficient numbers of fish escape to spawn. Hatchery production increases the average productivity of the populations fished together. This can result in increased harvest rates and over-harvest of wild stocks.

- **Change in the number and mix of populations counted**
  The overall estimated population abundance varies in proportion to the size, number and mix of populations being counted. For example, Area 6 total spawner estimates were low in the 1950s because Kitimat River tributaries were not monitored, and those populations account for more than one third of the local spawners. Also, the number of streams inspected in the Central Coast area has decreased from about 150 streams in the 1950s, to fewer than 100 in the 1990s.

- **Change affecting the continuity of counts**
  The counting methods and the number of counts per season have also changed significantly in some cases. Over the past 50 years, counting access, methods and personnel have changed with limited or no continuity. This makes comparisons over long periods potentially misleading. Improved access to spawning locations has made it observation easier where and if counts are made. Accuracy in assessments of spawner abundance requires a number of visits to streams, often at times of the year when transportation, access and visibility are challenging or, in some cases, impossible.

- **Change in the completeness of population counts**
  The completeness of counts is also affected by different timing and area coverage and by counting conditions, such as high water and turbidity. For example, coho often return to their streams in small groups and spawn over an extended period in the fall and winter, when observation is most difficult. The average number of visits per stream has decreased in all five statistical areas. Most large stocks have a more complete record of estimated spawner abundance than smaller stocks. The larger size of chinook, their preference for larger spawning rivers and the timing of spawning, all should make chinook spawner estimates better than those for coho. With government program cutbacks, spawner surveys have been decreased and mainly focused on larger populations. In 1998, there were special coho fishing restrictions and extra funding to enumerate coho spawner abundance. Consequently, the estimated number of coho spawners increased significantly in all areas in the Central Coast. In Areas 9 and 10, the estimates were the highest on record. This may provide some indication of how much previous statistics could have underestimated spawner abundance and harvest rates simply due to a lack of counting effort.

- **Change in enhanced production**
  Enhancement may increase the overall number of fish spawning in natural areas. There are questions about whether or not progeny of enhanced fish survive as well as wild fish. To assess the abundance and status of wild or natural populations it is important to account for wild and enhanced production separately.

The bottom line is that most estimates of chinook and coho spawner abundance are under-estimated. However, the estimates of some populations have been done consistently over time and probably provide a reliable index of abundance.

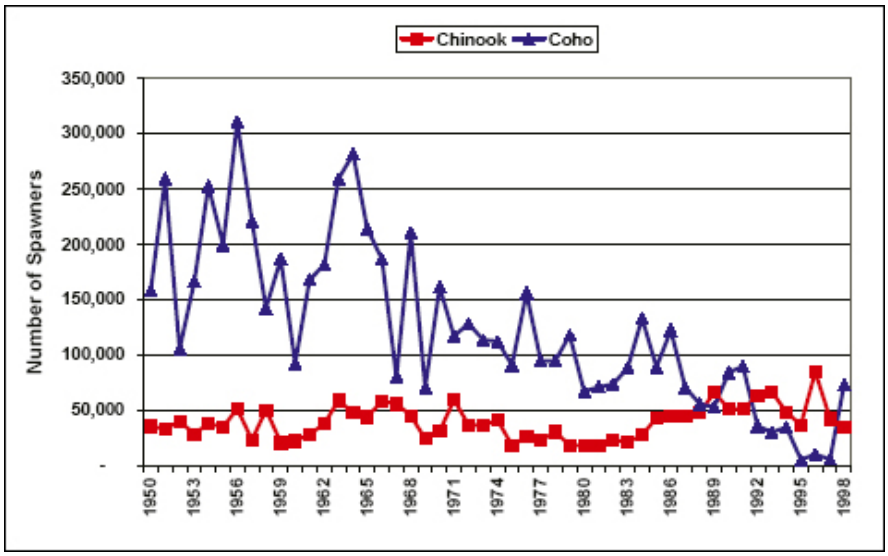
An alternative to trying to deal with all of the counting considerations for all salmon stocks is to use a few populations as indicators of the abundance of other populations in the area. For example, populations that have been consistently monitored might provide an acceptable indication of general abundance trends. The question is: how representative are the counted populations of the other populations? The large, accessible populations have usually been consistently monitored. Small populations may show more variability of returns than large populations because of habitat variation, such as unpredictable water supply. Habitat development and enhancement impacts can also affect the representation of a population.

To provide an overview of stock status, most of the spawner numbers used in this report are pooled estimates of spawners from a broad area. The numbers do not account for streams not counted or the other previously identified factors that affect estimates. However, some figures also include information on the number of populations or streams counted, or provide individual stream counts to try to provide a better perspective on stock status.

Spawner targets have been set by fisheries managers for each population based on observed spawner and/or rearing capacity and past performance. These targets are used in a number of places in this report for comparison with current spawner abundance. The total target number of spawners for the Central Coast area is 142,400 chinook and 584,000 coho.

Figure 5 illustrates the Central Coast chinook and coho spawner abundance trends. The estimated average number of coho spawners has decreased from just under 200,000 in the1950s, to 82,000 in the 1980s and about 40,000 in the early 1990s. The 1989–98 average estimated number of coho spawners in the Central Coast area was 42,000–about 7% of the stated target of 584,000 spawners. The estimated number of chinook spawners has varied from about 20,000 from 1975–84, to about 50,000 from 1985–93–35% of target. These numbers are somewhat misleading because of populations not counted in various periods and enhanced production from the 1980s onward.

Figure 5. Chinook & Coho Spawner Abundance



Location of Fisheries

Both Chinook and Coho stocks are harvested for much of their ocean life over the areas illustrated in Figure 6. They are also harvested in the Central Coast commercial net, recreational and Aboriginal fisheries as adults returning to their spawning streams. The juveniles of a few Central Coast chinook and coho populations have had coded wire tags applied and recovered in fisheries along the Pacific Coast. The recovery information only provides a general indication of the distribution of Central Coast stocks because the distribution may change between years.

Figure 6. Central Coast Tag Recovery Areas

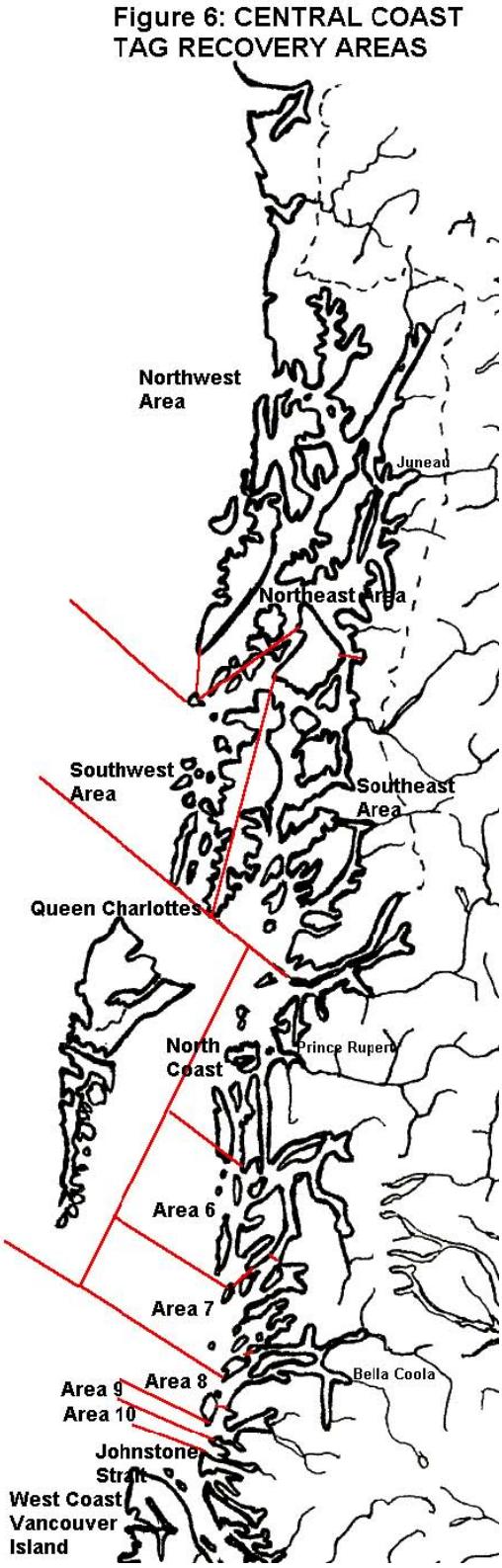
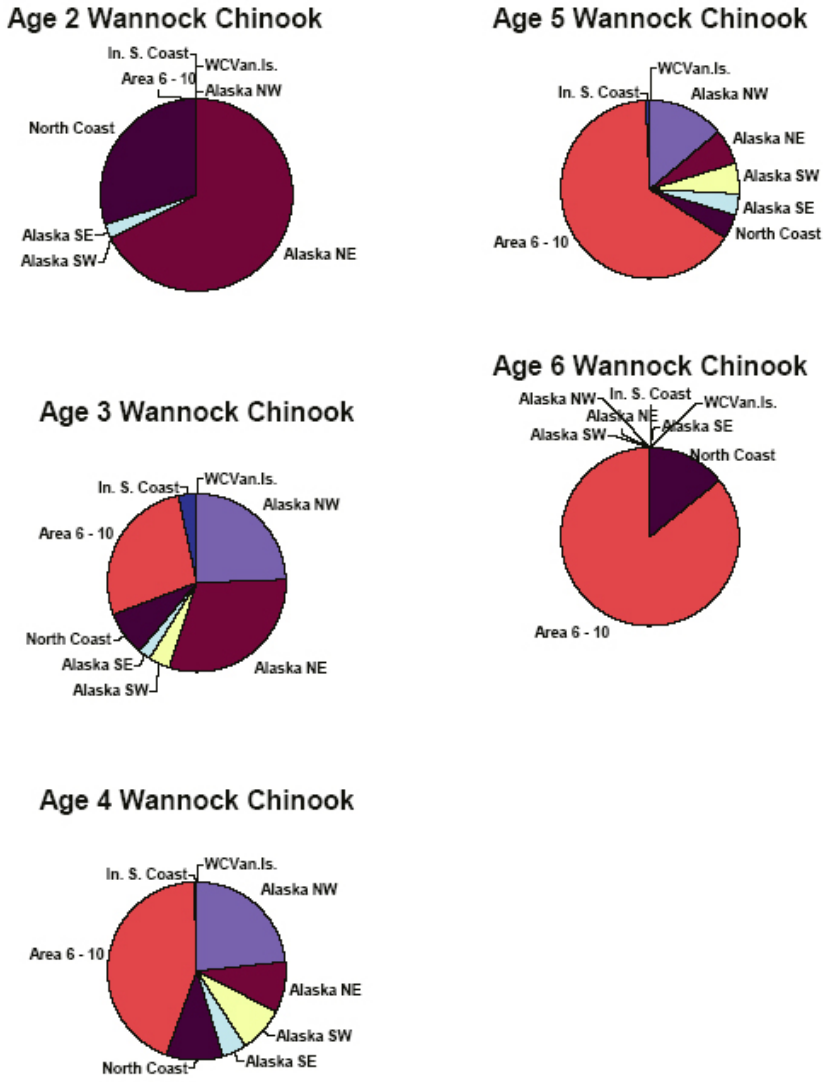


Figure 7. Wannock Chinook, ages 2, 3, 4, 5 and 6



The areas where chinook are caught vary with the age and maturity of the fish. For example, in Figure 7, as two-year-olds, Wannock River [Area 9] chinook migrate northward, they are caught in seine fisheries in the BC North Coast and Alaskan Northeast tag recovery areas (see Figure 6). As two-year-olds, chinook are not big enough for troll or most gillnet gear so they are only caught in seines. Because two-year-olds do not spawn, they are not recovered in Areas 6 to10.

By the time chinook are three-year-olds, they have become recruits for other fishing gear and spread out geographically into ocean areas adjacent to Alaskan Northwest and Southwest tag recovery areas. Also, some three-year-olds are recovered in Areas 6 to 10 as they return to spawn.

As four-and five-year-olds, Wannock chinook are caught in their ocean rearing areas, by troll and sport fisheries in Alaskan Northwest, Northeast, Southwest and Southeast tag recovery areas. At these ages, chinook are also caught in BC as they return to spawn.

The few six-year-old Wannock chinook are caught mainly in BC northern troll and Central Coast sport fisheries. The harvest of Wannock chinook by age groups was 3% as two-year-olds, 15% as three-year- olds, 41% as four-year-olds, 39% as five-year-olds, and 2% as six-year- olds.

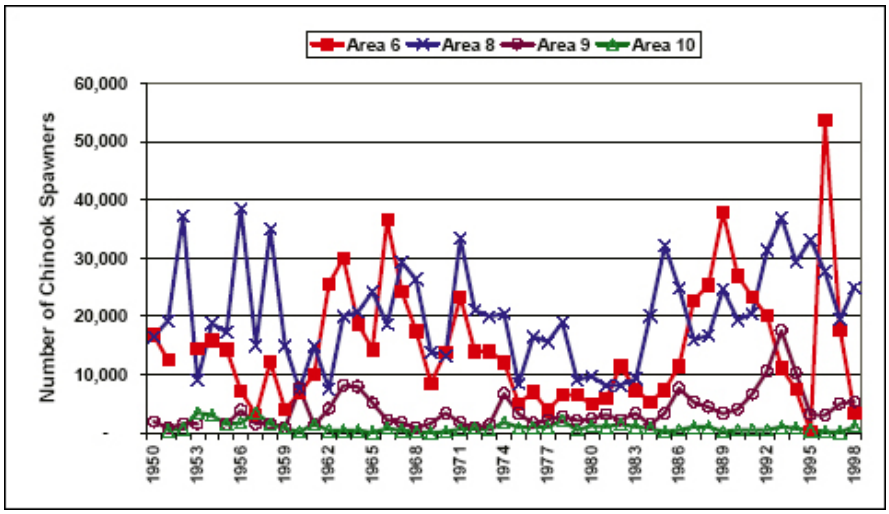
Because only a small percent of coho are harvested before their adult year, they do not have the same age specific distribution and tag recovery as chinook.

It should also be noted that because chinook and coho are harvested in so many areas, and for chinook over multiple years, it is difficult to determine harvest rates for individual populations and in general. Coded wire tagging results can provide such a measure, if all fisheries and spawners are sampled for tags. For the few tagged stocks in the Central Coast, sampling of spawners for marks has been incomplete. This contributes further to an overestimate of harvest rates and under-estimate of survival rates.

4.1 Chinook Populations

Chinook spawner abundance has varied significantly through time (Figure 8) with peaks in the mid- 1960s and early 1990s. However, even the peaks of spawner abundance were significantly below the targets set for the area and individual streams. In the past ten years chinook spawner estimates have been 28% of target in Area 6, 63% in Area 8, 30% in Area 9, and 8% in Area 10. In the same period, inspections were made of 54% of streams in Area 6, 60% in Area 8, 45% in Area 9, and 70% in Area 10.

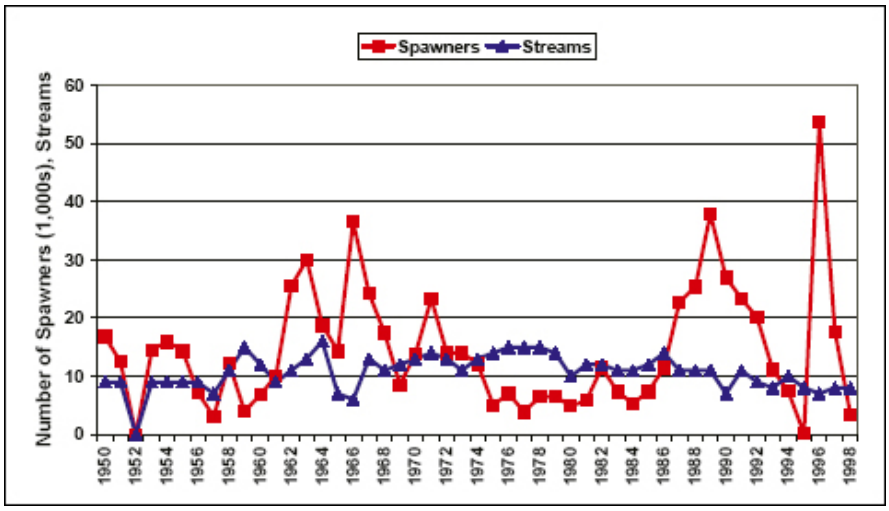
Figure 8. Estimated Chinook Spawner Abundance



Kitimat—Area 6

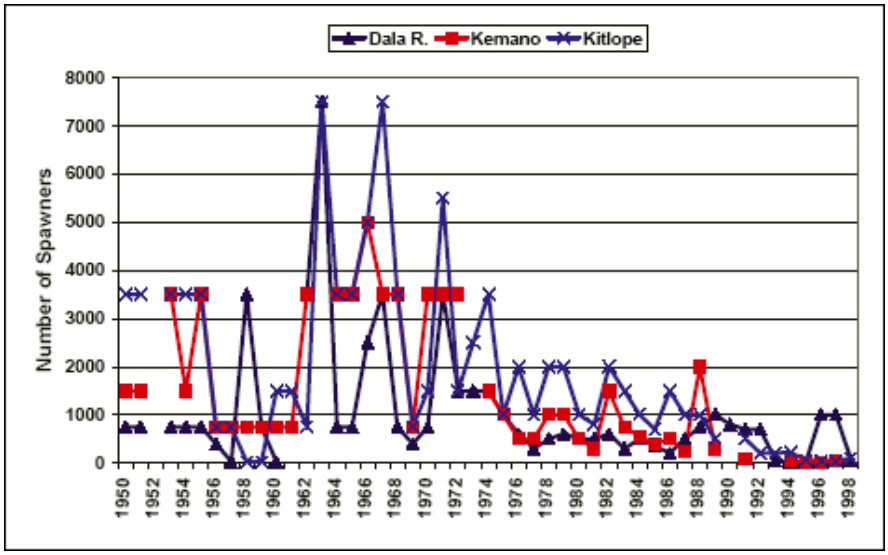
Four of the twenty-three chinook populations in this area were rated at high risk of extinction. The major producing rivers are: Kitimat (20,000 spawner target), Dala, Kemano and Kitlope (each with 10,000 target), and Brim (5,000 spawner target). The other 18 populations have targets from 25 to 2,000 chinook spawners. All the large populations are in Area 6 North, where there are 20 populations with an average target of 3,476 spawners. In the outer coastal Area 6 South, there are only 3 chinook populations with an average target of 367 spawners, and one of those populations is at high risk of extinction. The differences in population size are largely related to river size and water supplies. The Area 6 total target number of spawners is 70,625, but in the recent decade the average number of spawners has been about 20,000.

Figure 9. Area 6 Chinook Spawners & Streams Counted



The total estimated numbers of spawners in Area 6 are presented in Figure 9. Until 1962, important Kitimat River spawning areas that account for more than one third of the spawners were not monitored. Access to spawning areas for monitoring has improved since 1950, and more spawning areas can be viewed now. Since the mid- 1970s, there has been supplemental spawner monitoring for feasibility and later for operation and evaluation of the Kitimat hatchery. Since the 1980s, chinook production has been enhanced, masking declines in wild salmon populations. In the 1990s, cutbacks in the number of streams monitored and visits per stream have made the subsequent estimates more questionable. Allowing for these factors, chinook wild spawners have almost certainly decreased since 1950.

Figure 10. Area 6 Large Chinook Populations



The three large spawning populations in the Dala, Kemano and Kitlope rivers provide another indication of the state of wild chinook stocks in this area. All show the same basic pattern in Figure 10, with standard spawner abundance codes used in the 1950s, peaking in the mid-1960s when monitoring in the area became more intensive. Since then, they show a general decline. The

increased Dala River abundance from the late 1980s is likely a result of supplemental salmon production from the Kitimat hatchery.

Small chinook populations such as in the Brim, Khutz and Wahoo rivers (Figure 11) show similar declines.

A pilot Kitimat chinook hatchery preceded the present one that was constructed in 1983 to enhance Kitimat, Hirsch, Dala, Kildala river chinook populations. The design capacity was for releases of 2,160,000 juvenile chinook and average returns of 32,400 adults with about a 1.5% return rate. The increased number of Kitimat River chinook spawners since the 1980s is probably a result of Kitimat hatchery production.

Figure 11. Small Chinook Populations

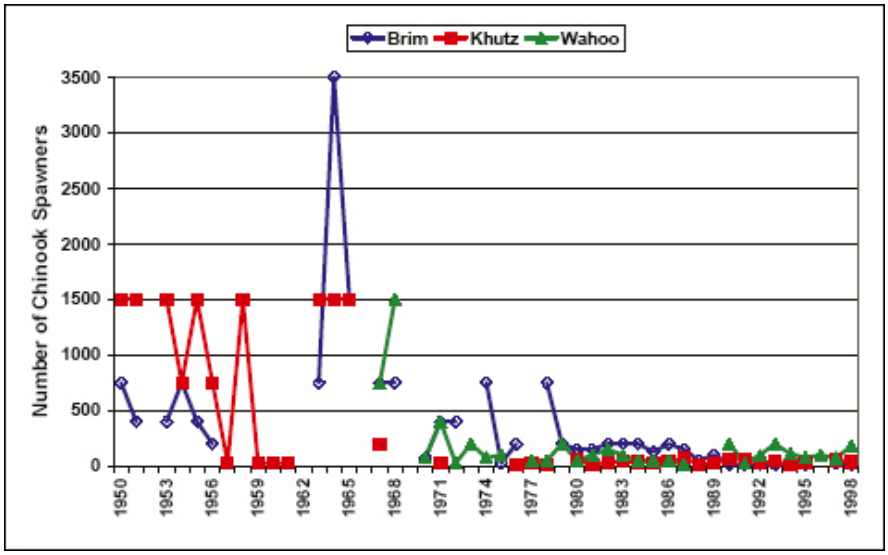
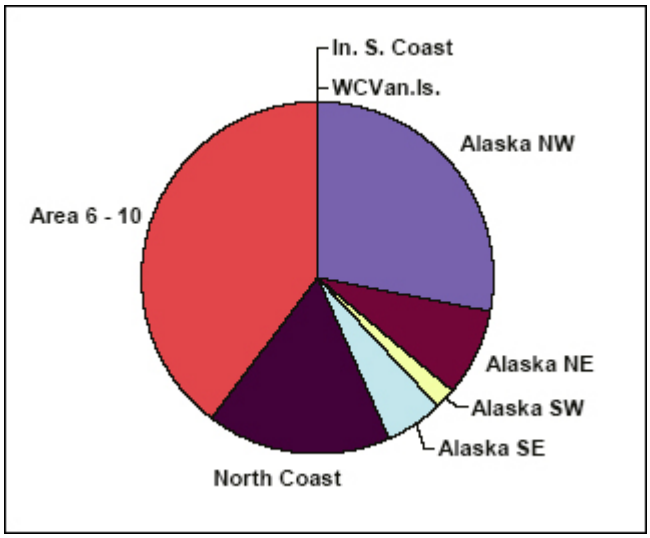


Figure12 illustrates where tagged Kitimat hatchery chinook were recovered. A total of 43 percent were harvested in Alaska, 17 percent in the North Coast area, and 40 percent locally in Areas 6 to10–almost all of those in Area 6.

Figure 12. Kitimat Recoveries



Bella Bella—Area 7

In the 1950s and 1960s there were 25 to 125 chinook spawners reported in this area. There are no chinook spawner targets for this area and no reported spawners recently.

Bella Coola—Area 8

Two of the seven chinook stocks in Area 8 were rated at high risk of extinction. The target escapements of the major producing rivers are 25,000 for the Bella Coola, 12,000 for the Dean and 4,000 for the Kimsquit. The other four populations have targets of 500 or fewer chinook spawners. The total target number for Area 8 chinook spawners is 42,600. The 198998 average number of spawners estimated in this area has been 26,715–about 63% of target, including enhanced production.

Figure 13. Area 8 Chinook Spawners & Streams Counted

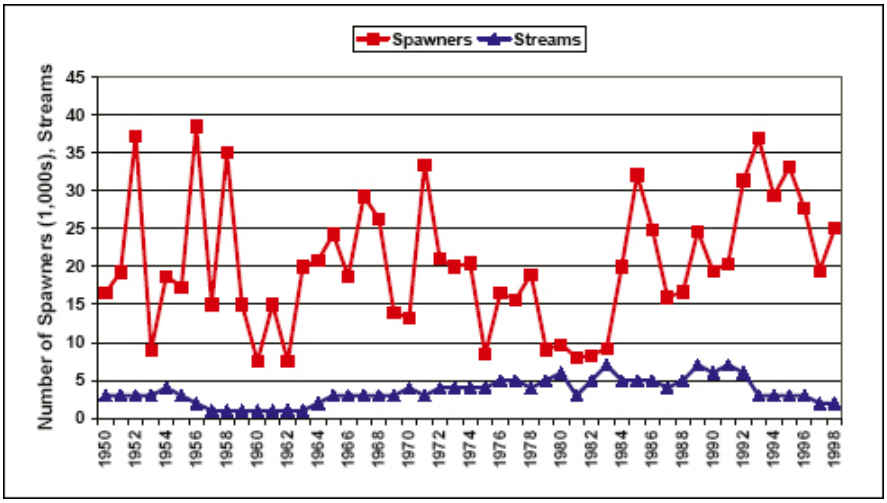


Figure 13 illustrates the spawner abundance trends of Area 8 chinook. In the 1950s and 1960s, spawner estimates averaged about 20,000 chinook, declining to about 9,000 from 1979 to 1983. Since then, spawner abundance has increased, with the highest ten-year average since the start of the records. A part of the increase is a result of local hatchery production and, possibly, the increased enumeration effort associated with collecting hatchery brood stock.

Figure 14. Dean River Chinook Spawners

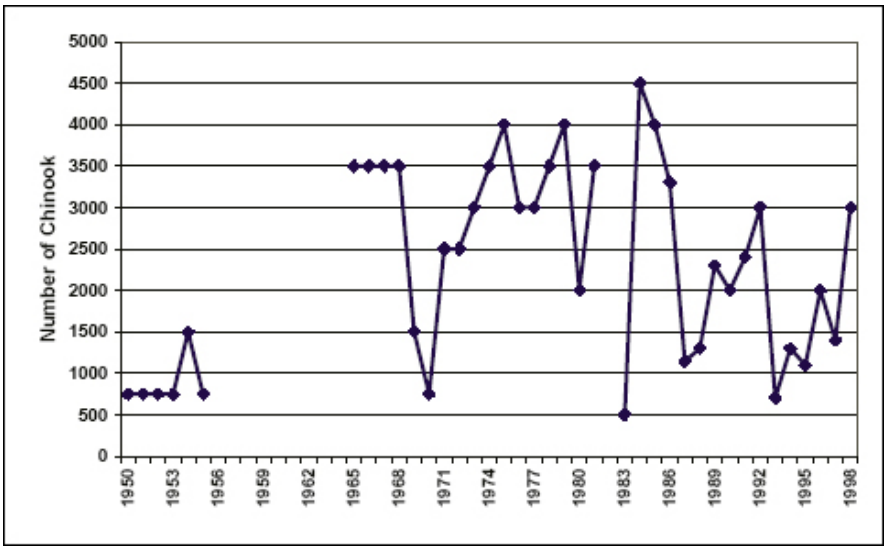


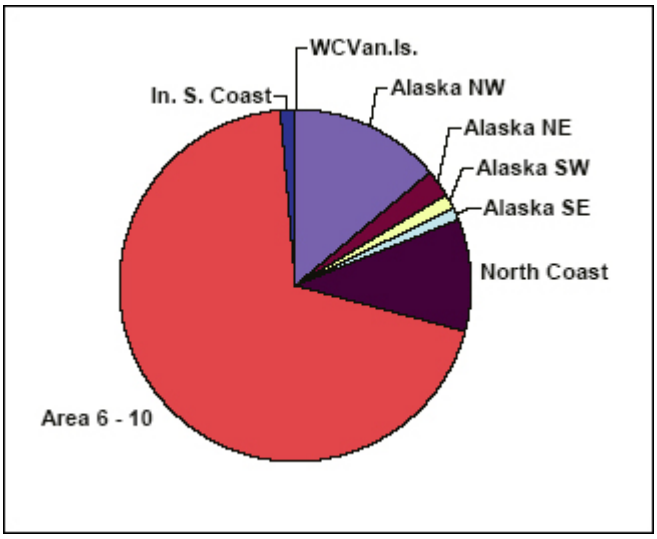
Figure 14 shows the estimated spawner abundance of the Dean River chinook, the largest unenhanced chinook population in Area 8 and the only wild chinook "indicator" stock for the Central Coast. The figure illustrates the limited coverage of this population in the 1950s and 1960s. From the 1970s to the present, the estimated number of spawners has varied widely and declined from about 3,500 to 1,750. This is a significant decrease, but not as much as the decrease in the Dala, Kemano and Kitlope River populations in Area 6 [Figure 10].

As they have in Area 6, wild populations have declined but enhanced populations have maintained overall abundance. This indicates that harvest rates are too high for natural populations to sustain and, consequently, natural spawner abundance has declined. Reductions in overall harvest rates and/or selective harvest of hatchery stock are required to sustain wild chinook stocks. Also, it seems likely that the Atnarko population is more productive than other wild populations. The local targeted fishery on Atnarko chinook is a way to selectively harvest the incremental production, without impacting on other less productive populations in the area.

The Snootli Creek hatchery enhances Atnarko chinook and, to a lesser extent, some populations in smaller tributaries to the Bella Coola River. The hatchery has also done off-site incubation of chinook populations from Rivers Inlet since the 1970s. The design capacity was two million ninety-day chinook smolts with an estimated average return of 30,000 adults. The production increases are apparent in spawner returns.

Figure 15 illustrates where Snootli hatchery-produced Atnarko chinook coded wire tags were recovered. Forty-three percent were harvested in Alaska, 17% in the North Coast area, and 40% locally in Areas 6 to10—most of those in Area 8. Because Atnarko chinook are a stream type population, the ocean distribution could be expected to differ from coastal "ocean-type" stocks.

Figure 15. Atnarko Recoveries



Rivers Inlet—Area 9

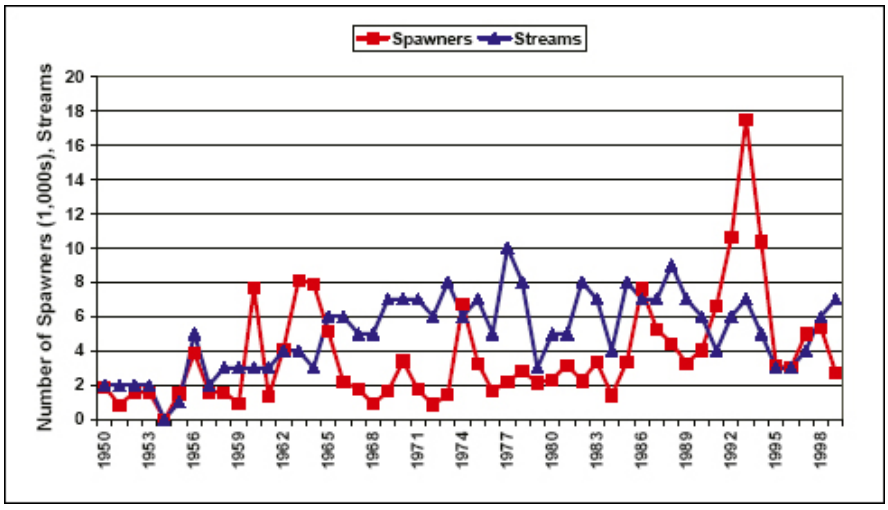
There are at least two genetically distinct chinook stocks in this area—those with white or those with red flesh. In the 1950s, the majority of white chinook were caught in the early part of the season, accounting for more that 30 percent of the chinook catch prior to July 25. After that date, the percent of white chinook dropped to less than 10 percent of the catch. Many white chinook are quite mature in the fishery, suggesting early spawning. It has been suggested that the white chinook spawn in the Chuckwalla, Kilbella, or possibly the Waukwash rivers, all of which have early spawning times. The red fleshed chinook come from the Wannock River where spawning has been observed over an extended period, often in late November or December.

Two of the eleven chinook populations in Area 9 were rated at a high risk of extinction. The target escapement of the Wannock River, the only major producing river in the area, is 10,000 chinook. The other ten populations have targets from 50 to 3,000 chinook spawners. The total target number of spawners is 22,700. The recent 10-year average number of spawners estimated in this area has been 6,900–about 30 percent of target.

Standard visual estimates are made, but the turbidity of the water in some spawning streams limits visual estimation of population size. A number of tagging and enumeration programs have been conducted since the 1950s to enumerate chinook in the Wannock River. These approaches have not yet achieved a credible estimate of spawner abundance. Recently, juvenile abundance has been indexed by trapping to provide a better estimate of the production and population.

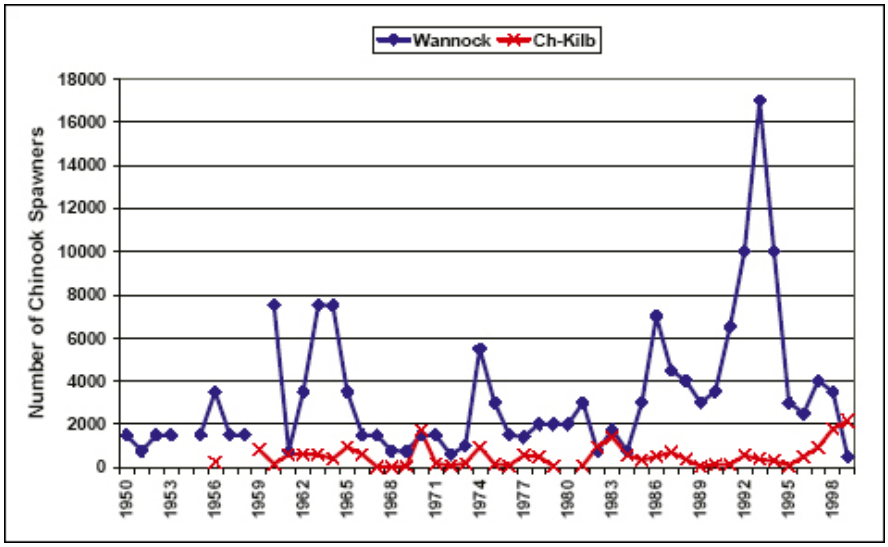
Although hatchery staff reported more than 1,000 chinook spawners in the Waukwash River in the 1930s, recent reports are of ten or fewer. However, stream counts in this river are oriented to sockeye, so many of the chinook that spawn earlier may be missed. All populations except those Counted in the Wannock, Kilbella and Chuckwalla rivers are reported to be down to remnant abundances. Although the Area 9 spawner estimates (Figure 16) have increased from those in the 1950s, it is misleading because the Chuckwalla and Kilbella Rivers were not enumerated until 1959 and other enumeration was done incidental to sockeye counts. Since the 1980s, enhancement has resulted in more comprehensive spawner counts of donor populations as well as increased production.

Figure 16. Area 9 Chinook Spawners & Streams Counted



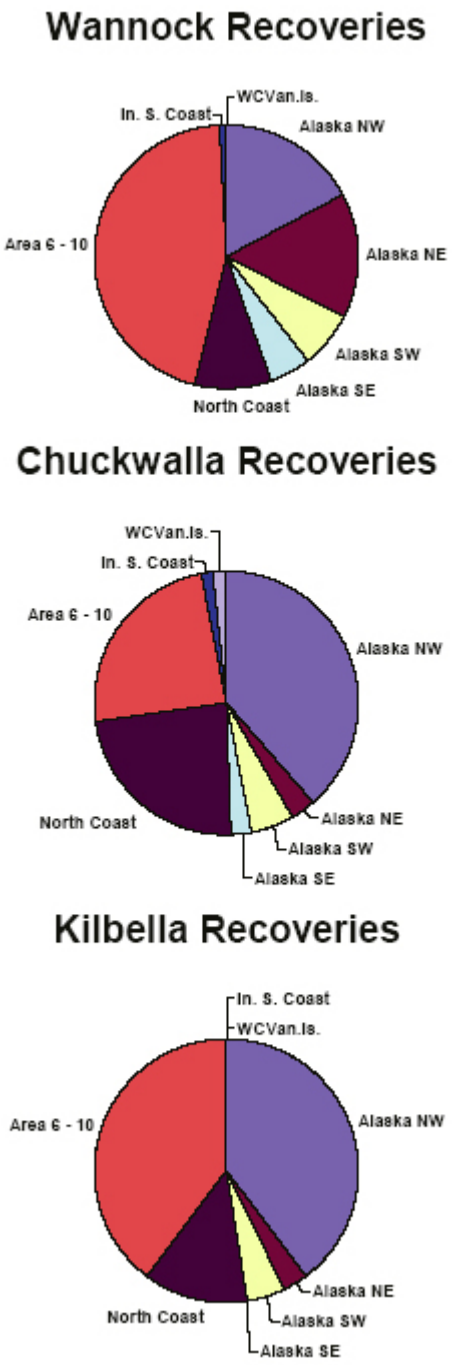
The spawner abundance trends of Wannock and Chuckwalla-Kilbella rivers in Figure 17 account for most spawners in Area 9 and show a similar pattern as in Figure 16. The decline of Wannock chinook to a new low in 1999 is a concern. The apparent rebuilding of the Chuckwalla-Kilbella chinook might be attributable to enhancement.

Figure 17. Area 9 Large Chinook Populations



The Wannock River chinook have been enhanced by both the Oweekeno Band and Snootli Creek hatcheries. The Shotbolt Bay and Snootli Creek hatcheries have enhanced the Chuckwalla chinook. The Kilbella River chinook have been enhanced by the Shotbolt Bay hatchery. Enhancement that started in 1982 has been small scale, but probably contributed to the increased number of spawners in the area in the late 1980s and early 1990s. It is likely that the decreased chinook returns later in the 1990s were a result of decreased ocean survival.

Figure 18. Recoveries: Wannock, Chuckwalla, Kilbella



A relatively large 45 percent of Wannock chinook were recovered in the Central Coast area and only 44 percent in Alaska. This compares with 24 percent of Chuckwalla chinook recovered in the Central Coast and 49 percent in Alaska. Kilbella chinook were different again with 40 percent local and 48 percent in Alaska. These differences may be related to stock differences. For example, the white chinook return and spawn early. Consequently, their ocean distribution might be different than the red flesh chinook.

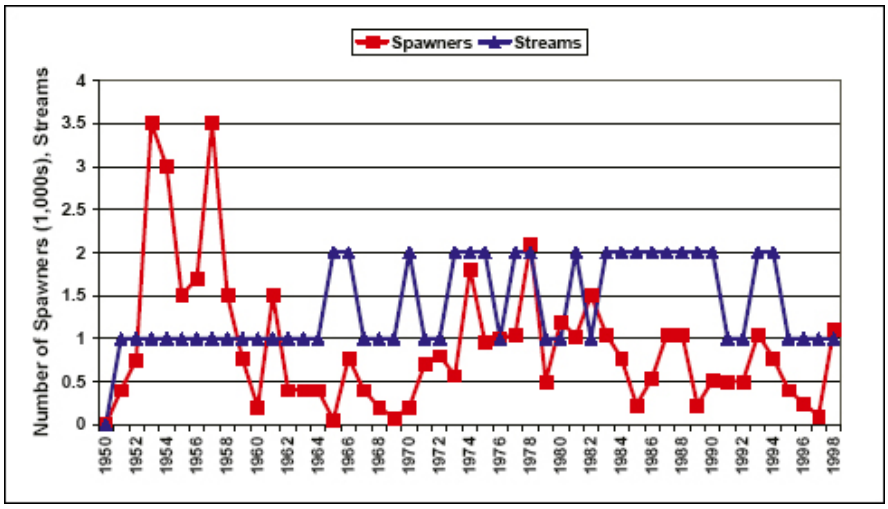
The Chuckwalla and Kilbella rivers share a common mouth and estuary. However, the Kilbella chinook arrive in freshwater earlier than the Chuckwalla population and spawning starts and peaks later [mid-August and early September respectively]. The calculation of these differences is based on a limited number of tags and sampling periods and on enhanced fish, so it might not fully reflect actual natural distributions.

Smith Inlet—Area 10

Neither of the two chinook stocks in this area was rated at a high risk of extinction. The target escapements of the two stocks are 3,500 in the Nekite River and 3,000 in the Docee River. The recent average number of spawners in this area has been 540, less than 10% of the 6,500 target. With more intensive monitoring since 1998, spawner abundance estimates have increased.

Figure 19 shows the estimated number of chinook spawners and the number of streams counted in Area 10. Almost all of the spawners are in the Docee River. This area is relatively easy to access, so the quality of spawner counts probably has not changed as much there as in other areas. The exception was from 1998 onward, when the Docee fence was operated for a longer time for coho counts, and more intensive surveys were conducted. Also, this stock has not been directly enhanced, but it might have been affected by lake enrichment for sockeye. There are no chinook tag groups for this area for use in determining location of catch of local chinook stocks.

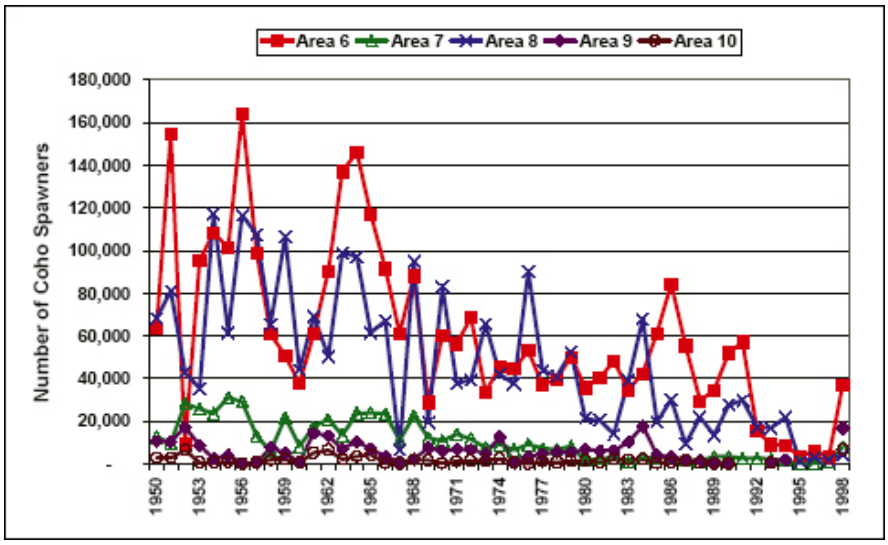
Figure 19. Area 10 Chinook Spawners & Streams Counted



4.2 Coho Populations

Coho spawner abundance has varied significantly through time as illustrated in Figure 20. However, there has been a definite decline in estimated coho abundance. Abundance patterns differ between areas, but all have been significantly below target spawner abundance levels.

Figure 20. Estimated Coho Spawner Abundance



Kitimat—Area 6

The major producing rivers and their coho spawner targets are: 40,000 for the Kitimat; 35,000 for the Kitlope; 20,000 each for the Brim, Kemano and Quaal; and 15,000 for the Bish. The other one hundred and eight populations have targets from 50 to 5,000 coho spawners. All the large populations are in Area 6 North, the inner portion of the area, where there are forty-four populations with an average target of 4,820 spawners. In outer coastal Area 6 South, there are seventy coho populations with an average target number of spawners counted at 891.

The total target number of coho spawners is 274,425 in this area. From 1989 to 1998, the average estimated number of spawners counted in this area has been 22,718.

Figure 21. Area 6 Coho & Streams Counted

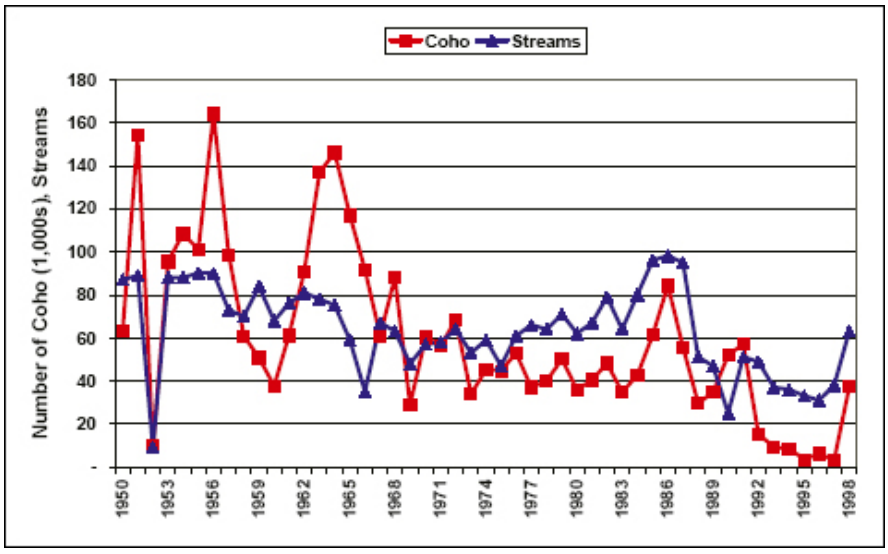


Figure 21 shows the decrease in estimated coho spawner abundance from over 100,000 in the 1950s to an average of 22,700 in the 1990s (less if 1998 counts with increased monitoring effort

are not included). These declines are reflected in the number of at-risk stocks in the area (see Table 1).

Improved access for enumeration has probably made recent estimates better than earlier ones. In the 1990s, reductions in the number of streams enumerated and the extent of enumeration have significantly reduced the estimated number of spawners. The reduced coho harvest and increased enumeration effort and coverage in 1998 had the effect of increasing the estimated number of spawners in Area 6 to 37,246. It is difficult to compare that estimate with previous ones because of the increased effort put into enumeration. In any case, the long-term trend has been a significant decrease in the number of coho spawners in Area 6.

In some years, the impact of the number of streams inspected seems apparent. For example, the low number of populations counted in 1952 almost certainly accounted for the low estimated number of coho spawners in that year. Similarly, with increased numbers of populations counted in 1982 and from 1984 to 1987, the estimated number of coho spawners increased. With this variation, it is difficult to know how much the actual number of coho spawners has changed through time.

Figure 22 is a plot of the contribution of each Area 6 coho population to the cumulative total population, from the largest population on down. For example, the largest coho population accounts for about 15% of the total target population of Area 6. The two largest populations account for about 27% of the total target. The figure illustrates that, based on spawner targets, it only takes the 5 largest spawning populations to account for 49% of the total capacity. If estimates of any of these 5 large stocks were missed, the impact on the overall estimated number of spawners would be significant.

Figure 22. Area 6 Large vs Total Coho Populations

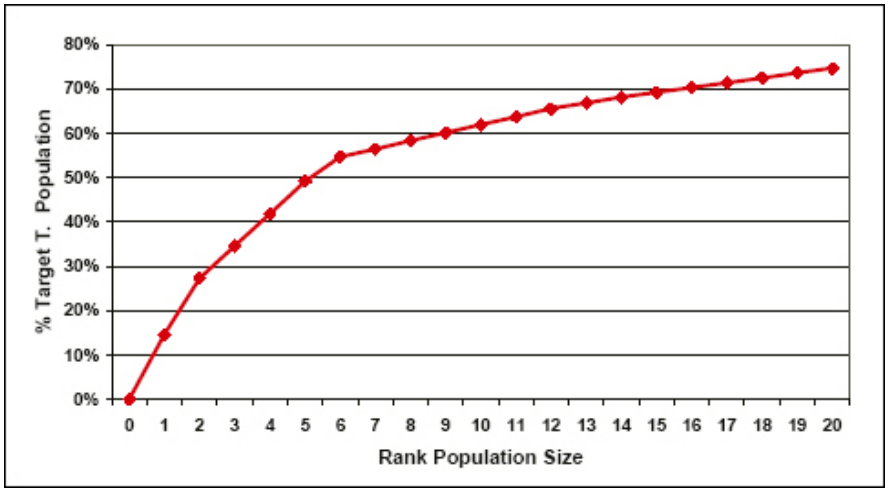
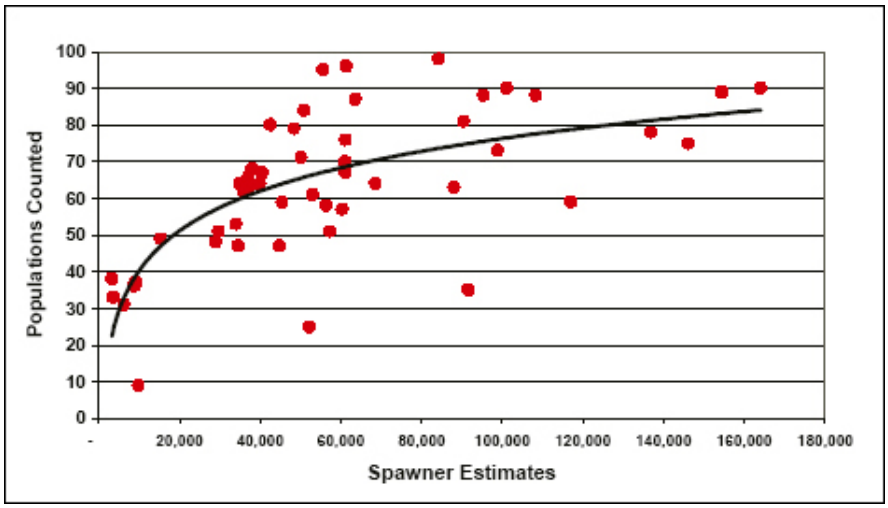


Figure 23 is a plot of the estimated total number of coho spawners versus the number of populations counted. It is the same basic pattern as Figure 22, but, as it is most likely that small populations were not counted, more populations would have to be missed to achieve a significant reduction in the overall estimated abundance.

Figure 23. Coho Spawners vs Population Counted



A more reliable estimate of natural coho population might be provided by Figures 24 and 25 that present estimated spawner abundance for individual populations that have fairly complete spawner records. Figure 24 presents the large coho populations in the Kitlope, Brim, Kemano, and Quaal rivers. Kitlope spawner target is 35,000, and the others are 20,000 each.

Figure 24. Area 6 Large Coho Popuations

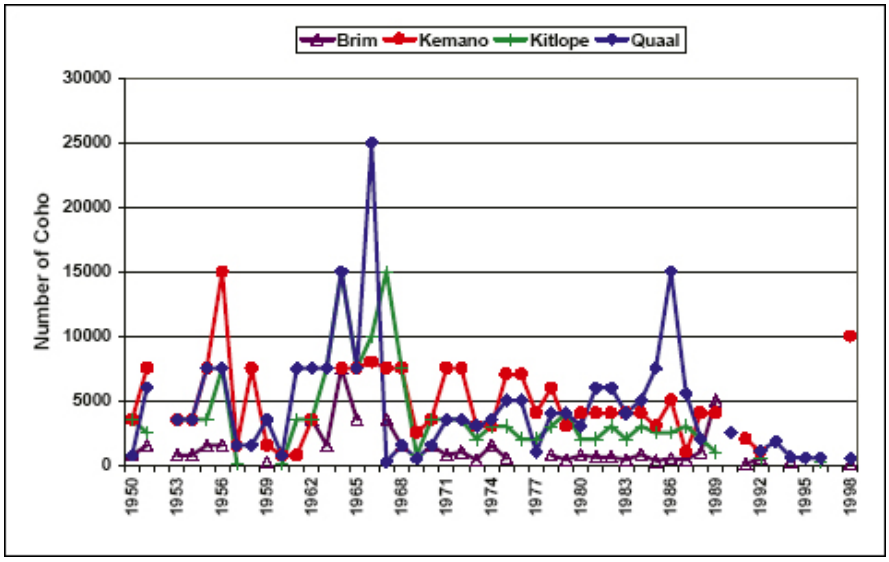
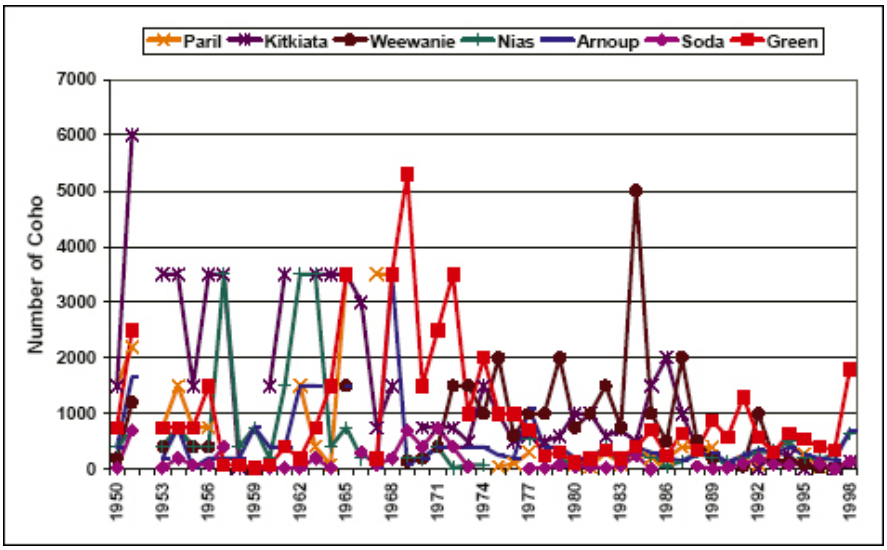


Figure 25 presents the spawner estimates for smaller populations in the Paril, Kitkiata, Weewanie, Nias, Arnoup, Soda, and Green rivers with spawner targets ranging from 3,000 to 500. These populations were selected because they had spawner counts in most years. Although collectively they give a message of general decline in abundance, individually many of these populations have high and low periods with no clear trend. Collectively there have been fewer high periods in recent years.

Figure 25. Area 6 Small Coho Populations

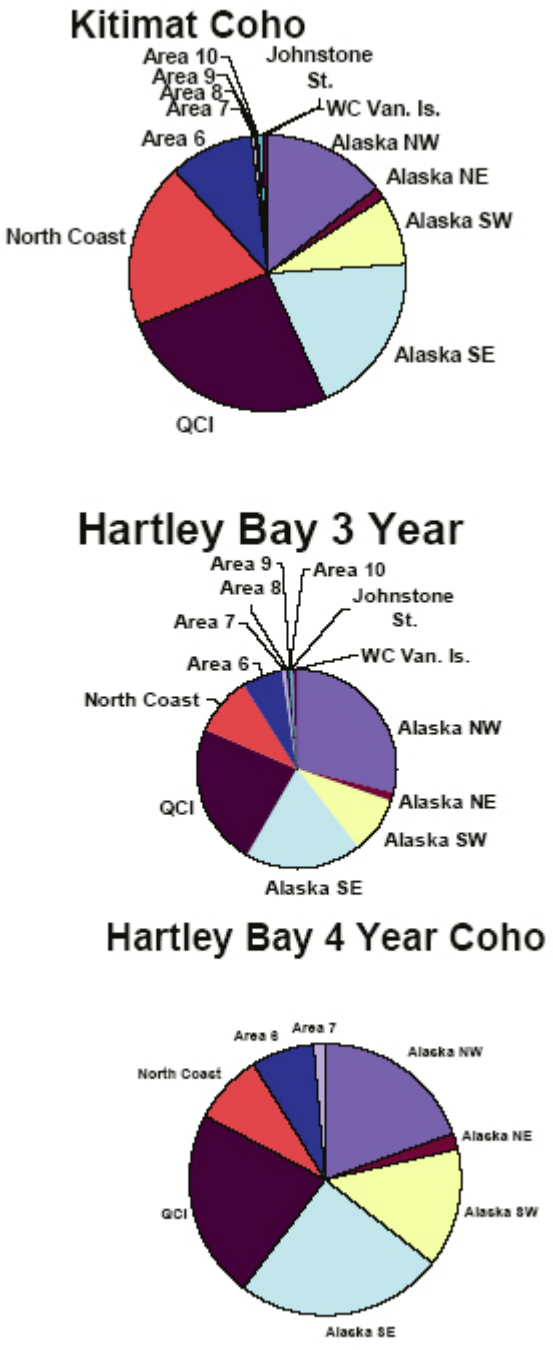


Coho enhancement also affects spawner abundance in the area. The Kitimat hatchery is the major producer in Area 6, with designed capacity for releases of 405,000 coho and an expected return of 60,700 adults. Most of the returns to the Kitimat River hatchery are escaped to meet the spawning needs of the total river system. Off-site incubation of a number of tributary populations also increases the spread of hatchery returns through the system. The contribution of hatchery production to natural spawning populations is unknown. Also in Area 6, the Hartley Bay hatchery has a design capacity of 160,000 juvenile coho and an expected return of 2,400 adults. The production from these hatcheries contributed to the increased spawner abundance from the 1980s to the early 1990s. There are thought to have been changes in ocean survival at about the same time, so it is difficult to separate these two factors. Similarly, it is difficult to assess the last few years because of the impacts of decreased ocean survival and decreased spawner counts.

There are two tagged populations in Area 6 from the Kitimat and Hartley Bay hatcheries. The distributions of the tag recoveries of these two coho populations are somewhat different. For both stocks, very few coho were recovered south of Area 6. More of the Kitimat coho are taken in B.C., particularly in the North Coast area. Twenty nine percent of Hartley Bay coho were caught in the Northwest tag recovery area in Alaska (see Figure 6), as compared to 14 percent of Kitimat coho. In total, 58 percent of Hartley Bay coho tags were recovered in Alaska as compared to 43 percent of Kitimat coho tags.

No appreciable numbers of Kitimat coho were recovered as four-year-olds. About 8% of Hartley Bay coho were recovered as four-year-olds. None were recovered south of Area 7. A lower percent of four-year-olds than three-year-olds were recovered in the Northwest area in Alaska, but more in the Southwest and Southeast areas in Alaska.

Figure 26. Coho: Kitimat, Hartley Bay 3 Year, Hartley Bay 4 Year



Both Kitimat and Hartley Bay hatchery coho are harvested primarily by the Alaskan and northern BC troll fisheries. Area 6 fisheries only take about 10% and 7% respectively of the total catch of Kitimat and Hartley Bay coho. Much of the Area 6 catch is incidental in fisheries not targeted on local populations. The low percent of the catch taken in local fisheries provides limited flexibility for adjusting local fisheries to meet spawner goals. Species selective harvesting is required in

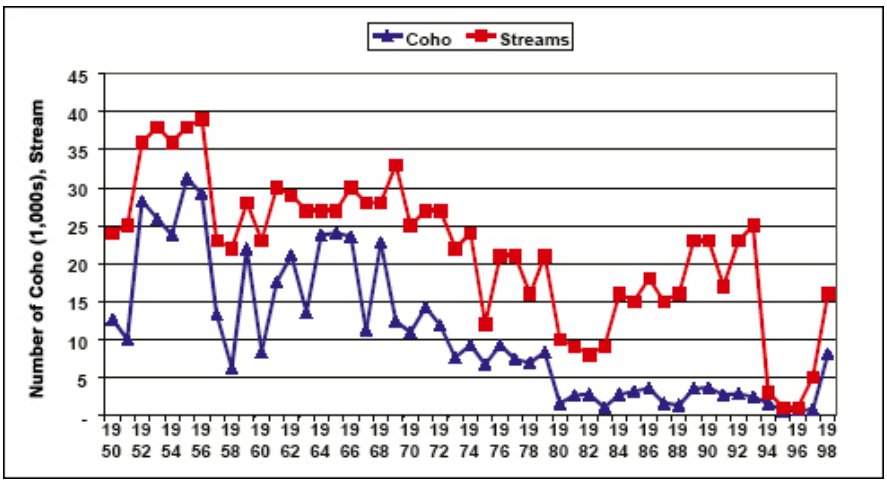
non-target fisheries and careful management in the targeted troll, sport and Aboriginal coho fisheries.

Bella Bella—Area 7

The spawner targets for coho populations in this area ranged from 10 to 4,000 with an average target of 640 coho. As in Area 6 South, the small average population size is related to the small streams with variable water supplies in the area.

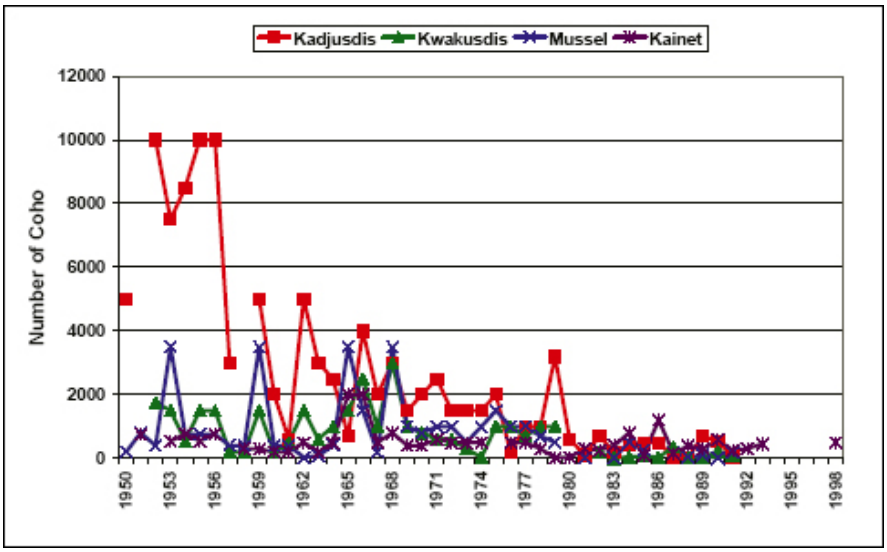
The total target number of coho spawners for 39 monitored populations is 33,286. From 1989 to 1998, the average number of spawners in this area was estimated at 2,649 coho.

Figure 27. Area 7 Coho Spawners & Stream Counts



Estimated spawner abundance has declined from an average of 20,000 coho in the 1950s to less than 2,600 in the 1990s. The number of counted populations declined from more than 35 in the 1950s, to an average of 28 in the 1960s, 22 in the 1970s, and 14 in the 1980s. In the years 1994, 1995, 1996 and 1997 the numbers of coho populations counted were 3, 1, 1, and 4 respectively. Figure 27 shows that the state of populations and spawner statistics has deteriorated badly. The number of streams monitored and the estimated number of spawners follow each other fairly closely until the mid-1980s when the estimated number of spawners stayed low, even with an increased number of populations counted. As in all areas, the decline in estimated numbers of spawners is probably a result of both decreased coho abundance and, to a lesser extent, decreased enumeration coverage.

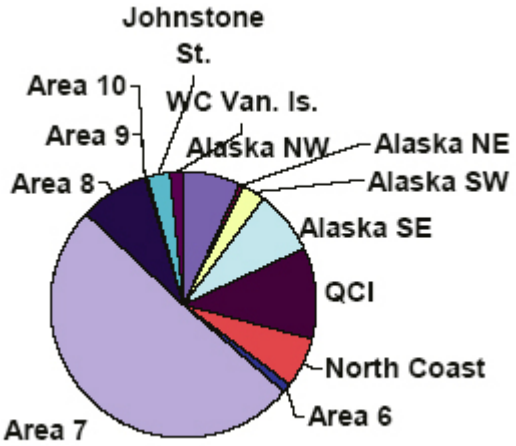
Figure 28. Area 7 Large Coho Populations



Individual coho populations with a fairly complete set of spawner counts are plotted in Figure 28. They show a sharp decline for Kadjusdis, a general decline for Kwakusdis and Mussel, and a slight decline for Kainet River coho. The figure also shows the gap in the 1990s when there were no counts.

The Bella Bella and Klemtu CEDP hatcheries have a designed release capacity of 100,000 and 60,000 coho respectively with an expected return of about 4,650 adults. As these hatcheries are on small streams, any returns surplus to stream and hatchery needs have been harvested terminally. There might have been some straying of hatchery fish to other small streams in the immediate area.

Figure 29. Bella Bella Coho



The distribution of Bella Bella coho recoveries (Figure 29) is significantly different than those of Kitimat and Hartley Bay coho. Only 18 percent of Bella Bella coho were recovered in Alaska as compared to 43 percent and 58 percent of Kitimat and Hartley Bay coho. Fifty one percent of tags were recovered in Area 7 fisheries, most in directed terminal fisheries on hatchery stocks. Also, about 13 percent were recovered south of Area 7 as compared to one percent for both Kitimat and

Hartley Bay coho. Clearly, Bella Bella coho rear in more southerly areas than the Area 6 marked stocks.

It is unclear whether the relatively low harvest rate outside of Area 7 is a consequence of more Bella Bella coho rearing offshore, away from coastal fisheries. A contributing factor might also be the high terminal harvest of hatchery returns. In other systems, excess hatchery returns are allowed to spawn in natural river systems. If naturally spawning hatchery returns are not counted, it would under-estimate returns to the home area.

The high percent of catch of local populations in Area 7, particularly in the directed fishery on hatchery production, provides management flexibility to vary harvest rate to meet spawner targets, and to harvest the enhanced population somewhat selectively from other coho populations.

Bella Coola—Area 8

The Coho spawner targets of the major producing rivers are: Bella Coola at 80,000, Kimsquit at 40,000, Koeye at 25,000, Kwatna at 15,000, and Dean at 10,000. The other 23 populations range in target size between 100 and 8,000. The average target for the area is 8,050 spawners. The total target escapement for Area 8 is 215,850. The 1989–98 average estimated escapement was 13,800.

Figure 30. Area 8 Coho Spawners & Streams

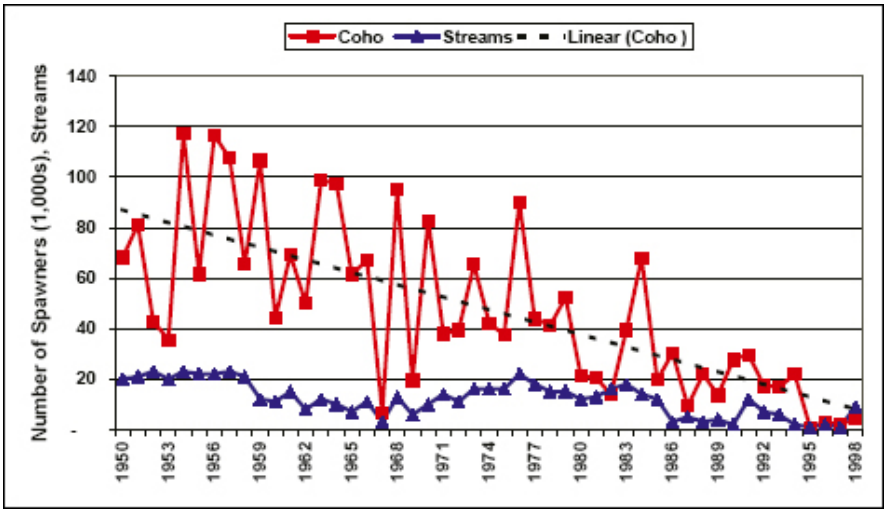
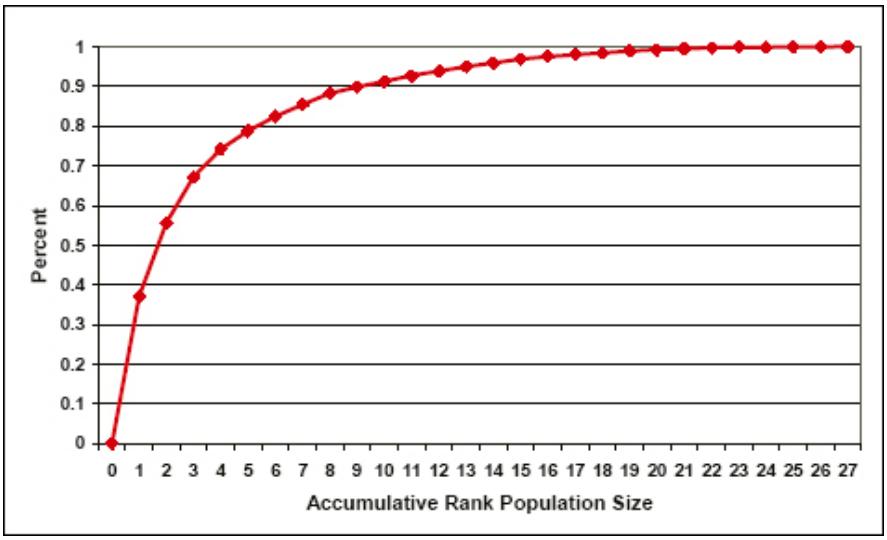


Figure 30 illustrates the decline in the total number of coho spawning in Area 8 and the number of streams that were surveyed for coho spawners. In the 1950s, the estimated average number of coho spawners in Area 8 was over 80,000, with an average of 21 populations counted. In the 1990s, with an average of fewer than 5 of the largest populations counted, the average number of spawners was less than 14,000 coho. It is likely that a part of the decline in the estimated number of spawners is result of a limited number of populations counted. It reflects the trend of the total number of spawners decreasing over the last 50 years. For example, the number of streams counted in the 1950s and 1970s is not much different, but by the 1970s the average number of spawners had decreased to almost half. Also, although coho were counted in few streams in the 1980s and 1990s, the streams counted were the ones with the largest coho populations. Figure 31 illustrates that the five streams with the largest spawner targets account for almost 80 percent of the overall spawner target.

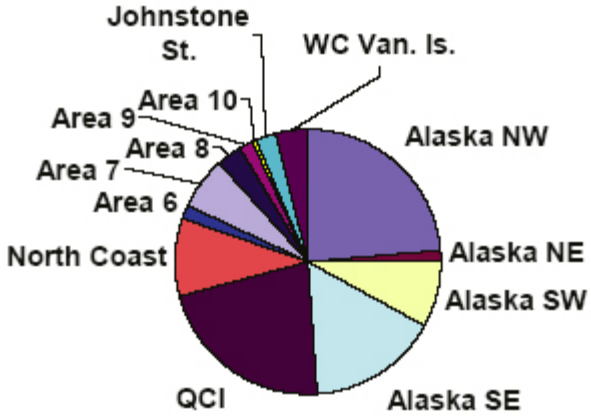
Figure 31. Area 8 Percent of Spawner Target



From the 1980s to the present, coho production has been supplemented by Snootli Creek hatchery production. The hatchery design capacity is for 130,000 releases and 2,000 adult returns. This level of production made no apparent impact on Area 8 total spawner abundance.

Most hatchery-produced returning adults that are surplus to Snootli hatchery needs are escaped for natural spawning in the Bella Coola River system. Off-site incubation of tributary populations also distributes hatchery returns through the system.

Figure 32. Bella Coola Coho

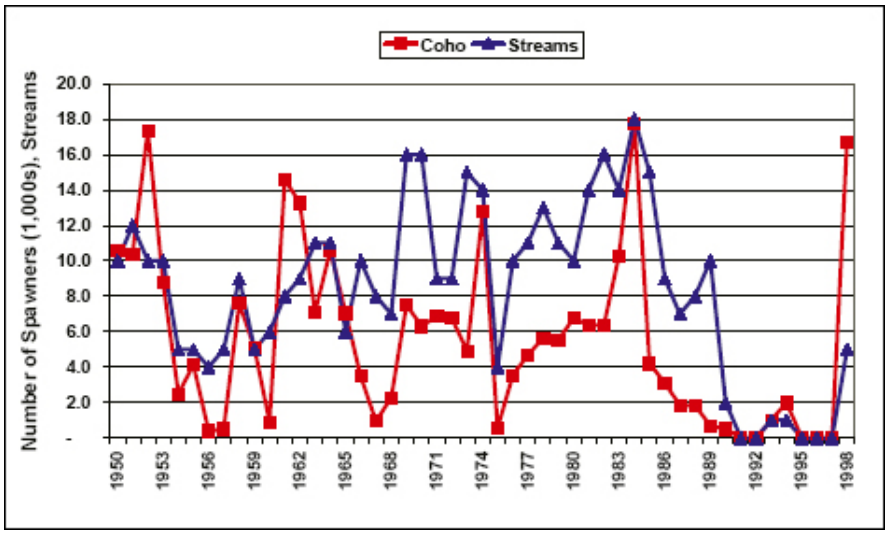


The recovery rate of Bella Coola tagged coho in Alaska (49%) was similar to Kitimat (43%) and Hartley Bay (58%) and much higher than in Bella Bella (18%). About nine percent of Bella Coola coho were recovered south of Area 8, compared to thirteen percent for Bella Bella.

Rivers Inlet—Area 9

Johnston Creek has the largest coho spawner target of 8,000 in Area 9. The other twenty-two populations range in target size from 50 to 5,000. The average target for the area is 2,165 spawners. Total target escapement for Area 9 is 49,800.

Figure 33. Area 9 Coho Spawners & Streams Counted



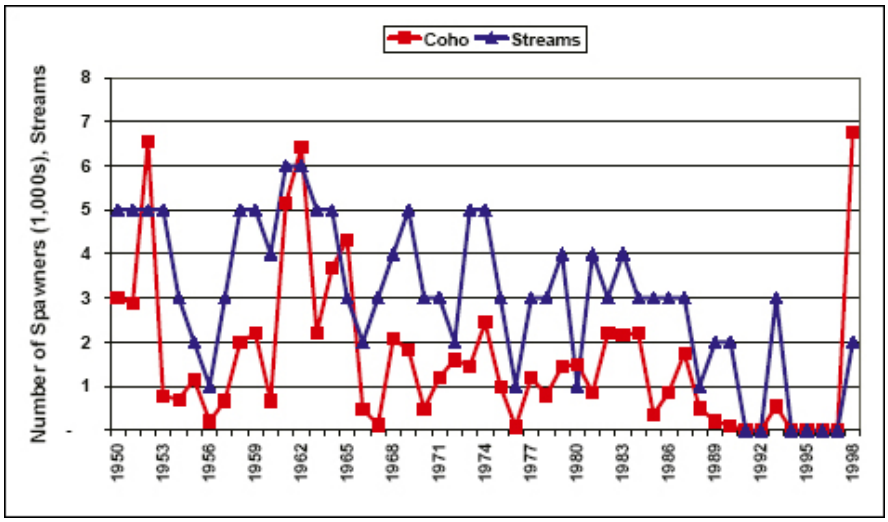
The estimated number of Area 9 coho spawners has varied, in part reflecting the extent and coverage of counts (Figure 33). There were no coho spawner counts in 1991, 1992, 1995, 1996, and 1997. In 1993 and 1994 the estimates were 1,000 and 2,000 respectively. In 1998, with an intensive enumeration effort and reduced catch, 16,720 coho spawners were counted. Allowing for the changes in enumeration effort, records show a decrease in the average number of spawners in Area 9. If the increased abundance estimates in 1998 resulted from increased counting effort, the coho populations may be in better shape than earlier spawner counts indicate.

The Shotbolt hatchery produces about 12,000 of coho in this area. There are no coho tag groups from this area to determine the location of catch.

Smith Inlet—Area 10

The Nekite and Smokehouse Rivers have the largest Area 10 coho spawner targets of 3,500 and 3,000 spawners respectively. The other five populations range in target size from 1,500 to 300. The total target escapement for Area 10 is 10,700. The 1980s estimated average number of spawners in the area was 1,260.

Figure 34. Area 10 Coho Spawner & Stream Counts



There appears to have been a slight decrease in spawner abundance since the early 1960s and a large decrease in the 1990s (Figure 34). There were no spawner counts in 1991 to 1992 and 1994 to 1997. Docee fence counts of adult coho were 6,500 in 1998, 4,413 in 1999 and 9,697 in 2000. These counts might give some indication of how much previous visual counts underestimated actual abundance–probably at least by a factor of 2 or 3. The number of streams monitored for coho spawners decreased from 5 in the 1950s, to 3 in the 1980s, and 2 or less in the 1990s. There is no coho enhancement in Area 10 and no marked coho to determine the location of catch of local populations.

4.3. Conservation Issues

Credible Measures of Stock Status

Without credible measures of stock status, there is no clear basis for habitat protection or fisheries management. The chinook and coho spawner abundance estimates since 1950 provide a general indication of spawner abundance trends and population status, but the lack of consistency through time makes this data of limited value. Also, the difficulty of estimating the abundance of spawners in silty rivers and under adverse conditions puts some estimates into question. The failure to monitor changes in habitat capacity also compromises the value of available data.

The enumeration of juvenile chinook and coho in freshwater or as smolts leaving freshwater may offer a more reliable measure of stock status. It would incorporate spawner inputs and habitat capacity and provide a base from which to measure ocean survival. In conjunction with reliable spawner counts, it would measure freshwater survival. Juvenile counts are expensive, so only a few populations could be monitored. Hopefully, monitored populations could be representative of others in the area so that the measures could be applied broadly. Regular, but not necessarily frequent, monitoring of the general abundance of the other populations would be required to ensure that monitored populations have remained representative.

Government program cutbacks in the 1990s have saved money, but they have also resulted in a disproportionate loss of service and decreased effectiveness. Reduced monitoring occurred at a time when stocks were down and the fisheries were changing–both of which require more, not less, coverage. These shortfalls are amplified by the shortage of specific knowledge about ocean factors that affect fish survival. All indications are that ocean survival is the primary cause of

recent widespread declines in salmon survival and production. However, there has been no work conducted on this issue in the Central Coast area and only very general work elsewhere. In short, the knowledge of ocean survival factors is extremely limited, and current research programs are doing very little to fill in the numerous holes. The basic monitoring of spawners and/or juveniles has not been adequate to be confident about stock status and therefore, about conservation and wise management. The impacts of these shortfalls are incomplete information on stock status.

On a positive note, DFO should be commended for making the available Central Coast salmon spawner estimates and other information easily accessible on the internet. DFO should be encouraged to also work with local fisheries interests to make detailed catch information available, as well as other related information, such as coded wire tagging results and enhancement production and habitat information.

Habitat Conservation Issues

In general, the Central Coast has relatively few habitat development-related conservation issues. The most watershed development has occurred in the Kitimat Valley, followed by Bella Coola, and Kemano watersheds. Logging has also been conducted in a number of smaller watersheds.

The Central Coast has a number of unique ecosystems that should be protected. It is important to act now to protect key land and ocean areas before use levels increase or those areas become committed for further development. Even temporary protection now, which can be adjusted later with more complete inventories and assessments, would be preferred to no protection now.

Habitat assessment to identify freshwater rearing and over-wintering areas, and estuarine and marine rearing, staging and migration areas is essential for planning site developments and applying conditions. For example, salmon farms should not be sited in known salmon migration routes and holding areas because of the possibility of disease transfer in both directions and predation by farmed salmon on wild juveniles.

Ecosystems have many interacting and interdependent parts. Arbitrary siting of developments, such as salmon farms, floating lodges, log dumps, and sewer out-falls, at locations that are merely convenient, may compromise resident populations such as rockfish, lingcod and shellfish. It might also compromise migration, rearing and holding areas for migrant species, such as chinook, coho, halibut and herring. Development permits for foreshore and coastal use should only approve sites that will not put local fish populations at risk. Industrial uses can be relocated and modified, but natural use and production can be only degraded or lost.

Ocean habitat conditions have changed dramatically over the last fifty years. Two types of impacts have affected survival of chinook and coho. Long-term oceanic regime shifts have affected the general productivity. The impacts of El Nino events have been short-term and often intense. The 1976 to 1998 ocean regime was a period of general warming and relatively low survivals for chinook and coho in the south and high in Alaska. The Central Coast has been near the north-south dividing line of low and high productivity. Since 1970, there have been four El Nino events in 1972–73, 1976–77, 1982–83, [strongest] and 1987–88. The first three El Ninos had the biggest impacts on chinook.

If production rates increase with the recent ocean regime shift, it is expected that survival and production will increase. This will tend to divert the attention away from a number of important issues such as: reducing interception and bycatch by stock specific harvest; getting adequate information for fisheries and habitat management; meeting an acceptable risk for inseason management; managing enhanced production to protect wild stocks; and minimizing hatchery genetic impacts.

Fisheries Management Conservation Issues

The Central Coast area typifies the fisheries management dilemma–a bounty of different populations, but with many differing needs. If the overall goal is to maintain optimum salmon production from the local habitat, then careful consideration of current fisheries and habitat management and enhancement strategies is required. Current fisheries management strategies tend to treat all stocks of a species in an area the same way. However, we know that populations have different freshwater survivals and production. We also know that different populations have different ocean distributions and, therefore, different fisheries and harvest rates. One of the biggest impediments to managing for these differences is lack of specific stock information.

To achieve optimum production, the fish in an area must be distributed in proportion to the capacity and productive potential of the habitat. Putting all the fish into a few streams does not realize the potential of the area and compromises the basic diversity of the stocks. Achieving this distribution is a fisheries management challenge of harvesting to escape the appropriate amount of each population.

Mixed stock fisheries are a major problem for chinook and coho. There is a range of production rates and sizes of natural populations. There are also numerous highly productive enhanced populations. By allowing harvest rates in mixed stock fisheries to respond to the abundance of chinook and coho, many populations are over-harvested. As these populations are fished together in many fisheries along the coast, the mixed stock fishing pressures are applied over much of ocean life of chinook and coho. The result in the Central Coast has been a long-term decline in most naturally spawning stocks that have not been supplemented by enhancement.

The options to address the mixed stock fisheries problem include:

- Reducing overall harvest to levels sustainable by natural stocks, even if it means foregoing enhanced production. Ideally, mixed stock harvest rates would be maintained at low enough levels to leave some fish for harvest in local population specific fisheries when the population abundance is clear. With less than 50% of both chinook and coho taken in Alaska, this is theoretically feasible. However, the low percent of local populations taken in some local fisheries limits management flexibility. For example, only 2.9% of Bella Coola coho are taken in Area 8, 6.7% of Hartley Bay and 9.9% of Kitimat coho are taken in Area 6. It means that in order to significantly increase the number of spawners of those populations, other Canadian fisheries would have to be limited. This was done to protect Upper Skeena and Thompson coho populations. It is less of a problem with Areas 6, 8 and 9 chinook where about 40+% of recoveries were in Central Coast fisheries, primarily local fisheries.

- Altering existing enhancement production strategies to facilitate selective harvest of production. Enhancing production could help to address mixed stock fishery problems, if the population enhanced is a weak stock and if the production rate is only enhanced to the average of other stocks it is fished with. If it is enhanced beyond the average, it will aggravate the problems, unless the production can be harvested selectively.

- Adopting prescriptive enhancement production strategies to help to equalize production rates between populations. Habitat maintenance and restoration or supplemental production might help to achieve this.

Past management approaches have pushed many stocks to their limit. In the Central Coast, it is clear that wild stocks have been in general decline, while production of enhanced populations has been sustained. The basic conservation needs of wild stocks are not being met.

The longer-term effects of recent management changes are uncertain. There is a concern that with program redirection and cutbacks, natural populations will be maintained at sub-optimally low levels of abundance. At such low levels, the populations are more susceptible to over-fishing and other impacts, such that they are likely to be at conservation risk more frequently.

Wild Salmon and Hatchery Production Issues

A concern has been expressed that hatcheries can exert genetic selection that domesticates the fish produced. Much of the concern is based on the US experience where long-term hatchery production has been pursued as an alternative to sustaining natural stocks. The newer hatcheries in BC operate under clear operational guidelines, expressly implemented to minimize adverse genetic selection.

Wild salmon are those that are subject to and can survive natural selective processes throughout their life. Individual wild salmon die under natural conditions, but the diverse capabilities of the population mean that many fish survive. Collectively, wild salmon are physically and behaviorally fit to address the many and diverse challenges to survive in nature. They can cope with predators, and variable water levels, temperatures and qualities. Wild salmon compete aggressively for food to grow as quickly as possible. In a hatchery situation, different factors are selected. After many generations of such selection, a hatchery population may have much less genetic diversity. Consequently, they don't survive as well in the more challenging natural environment. To maintain genetic diversity, it has been suggested that hatcheries and their operations should be changed to be less selective or, ideally they should be changed to apply the same genetic selection that is applied to natural populations.

In the Central Coast area, there are two basic hatchery strategies: multi-stock enhancement in the Kitimat and Snootli hatcheries; and local stock enhancement at the smaller Hartley Bay, Klemtu, Bella Bella, Oweekeno, and Shotbolt Bay hatcheries. The multi-stock approach draws brood stock from a number of spawning populations in the area, incubates them and then replants them back into their rivers or areas of origin. In this way, a number of stocks are supplemented, but the amount of supplementation is limited to minimize fisheries management interactions and to prevent overwhelming natural production. All of these hatcheries operate to DFO's Salmon Enhancement Program production guidelines.

There are guidelines on most aspects of operating a hatchery, starting with genetic practices for hatcheries. These guidelines provide direction on brood stock selection and mating, rearing and release practices. It is recognized that many factors can cause artificial selection. However, as much as possible, human interventions are controlled to minimize adverse selection. For example, in selecting brood stock, the guidelines indicate random stratified selection using fish of all body sizes, including jacks, from the entire run, in proportion to their abundance in the total stock rather than the river escapement. This means that more large fish might be taken as brood stock to compensate for selective harvest of larger and older salmon.

A portion of enhanced production is marked to provide information on distribution in various fisheries and spawning areas. When selecting brood stock, the guidelines are clear and specify taking a representative cross-section of the population, including marked fish. This means that hatchery-produced fish may be used as brood stock in proportion to their abundance in returns.

In the US, there are guidelines contained in the document entitled *"A Conceptual Framework For Conservation Hatchery Strategies For Pacific Salmonids"*. This framework is to serve as a technical vision to guide changes in hatchery design and operations, intended to reduce domestication impacts on hatchery fish and the impacts of hatchery production on wild stocks.

The conservation hatchery strategy deals with issues, such as the following:

- *Inbreeding, outbreeding, domestic selection and other genetic considerations:* to provide fish with minimal genetic divergence from natural.
- *Broodstock sourcing:* using locally adapted broodstock to maintain long-term fitness traits;
- *Broodstock maturity and reproduction:* maintaining appropriate seasonal timing and maturation and quality of gametes.
- *Enriched environments:* adding habitat complexity for more natural behavior and higher survival when released.
- *Growth rate modulation:* controlling growth to match natural rates.
- *Rearing density:* keeping density low to improve survival to adults.
- *Anti-predator conditioning:* increasing predator avoidance and survival to adults.
- *Release size:* the same as wild.
- *Release time and volitional release:* letting fish leave the hatchery on their own volition at the same time as the wild population.
- *Imprinting and homing:* using onsite rearing and imprinting to reduce straying.
- *Habitat carrying capacity:* matching production to accommodate wild fish populations.
- *Hatchery monitoring and evaluation:* ensuring guidelines are used and working.

Testing the current strategies and practices in the Central Coast hatcheries against these Conservation Hatchery criteria might help to identify areas for improvement in the current production guidelines.

Over the last 50 years, there have been changes in the number of wild chinook and coho spawners, the number and mix of populations enumerated, the harvest rates, the freshwater and ocean habitat production capacity, and the amount of enhanced production. It is difficult to separate the different factors to give a definitive statement on state of stocks and on causes of any changes. However, it appears that the number of wild chinook and coho spawners have decreased. The largest decrease has been for coho. As the decrease became apparent after the ocean regime shift in 1976, some of the decrease was likely a result of changing ocean and climate conditions. Over-harvest of wild stocks has also likely contributed to the decline. Hatcheries have probably increased the production.

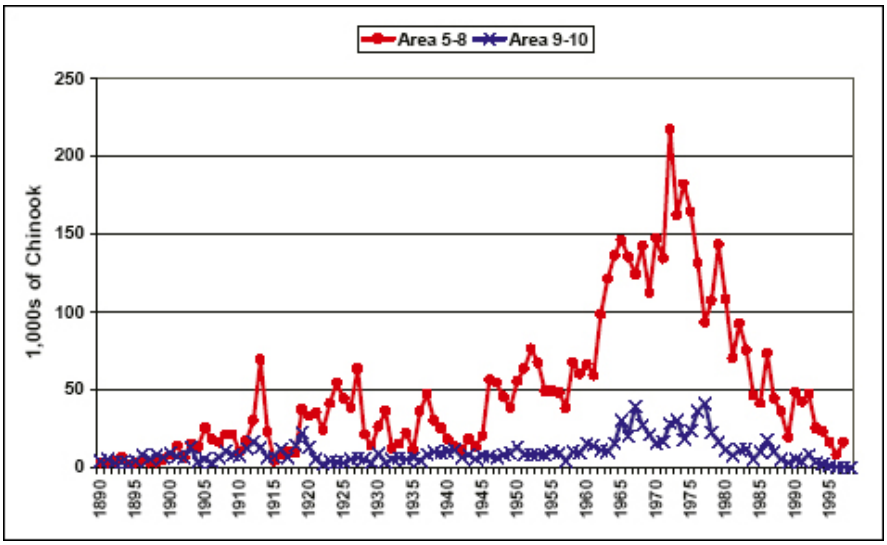
5. Chinook and Coho Catch Trends

Most Chinook and Coho fisheries are on mixed stocks comprised primarily of populations from other areas and a small number of local stocks. Consequently, catch in most fisheries is not an effective indicator of local stock status. The exceptions are terminal and freshwater fisheries that harvest primarily local populations.

Catch History

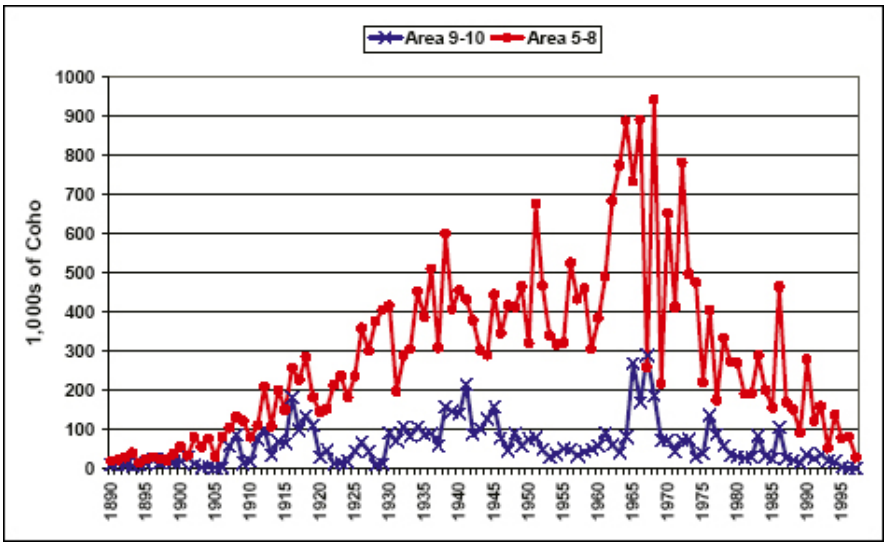
A long-term perspective of Central Coast chinook and coho catches is provided for the combined Areas 5–8 and Areas 9–10 commercial catch shown in Figures 35 and 36.

Figure 35. Study Area Chinook Catch



Commercial fisheries of chinook and coho started in the 1890s. Chinook catch remained relatively low until 1960, when it increased rapidly. Coho catch increased to about 400,000 in the 1930s and stayed at that level until 1960, when it increased rapidly. Both chinook and coho have been in decline since the early 1970's. The high catches in the 1960s and 1970s have been attributed to a combination of factors including favorable ocean conditions, increased hatchery production and intensive harvesting. The low catches in the 1990s have been attributed to unfavorable ocean conditions, but over-harvesting of wild stocks and consequent reduced spawner abundance are also important factors.

Figure 36. Study Area Coho Catch



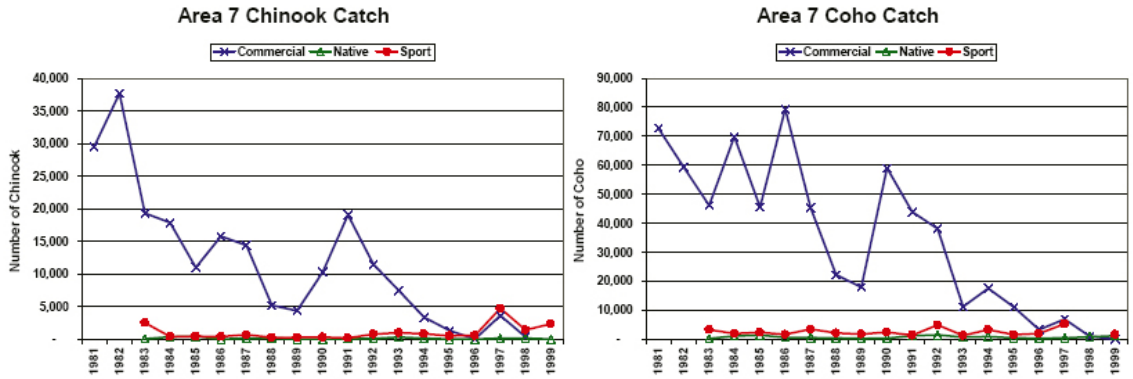
Over the past 25 years, the nature, timing and location of Central Coast fisheries has been changed significantly to limit the interception of passing stocks. The fishing season was reduced from six months to three or less. This reduced the local impact on chinook early and coho late. During the same period, the Alaskan catch of coho increased and, almost certainly, the interception of Central Coast stocks increased. Also, sport fisheries in Alaska and Canada have grown in that period.

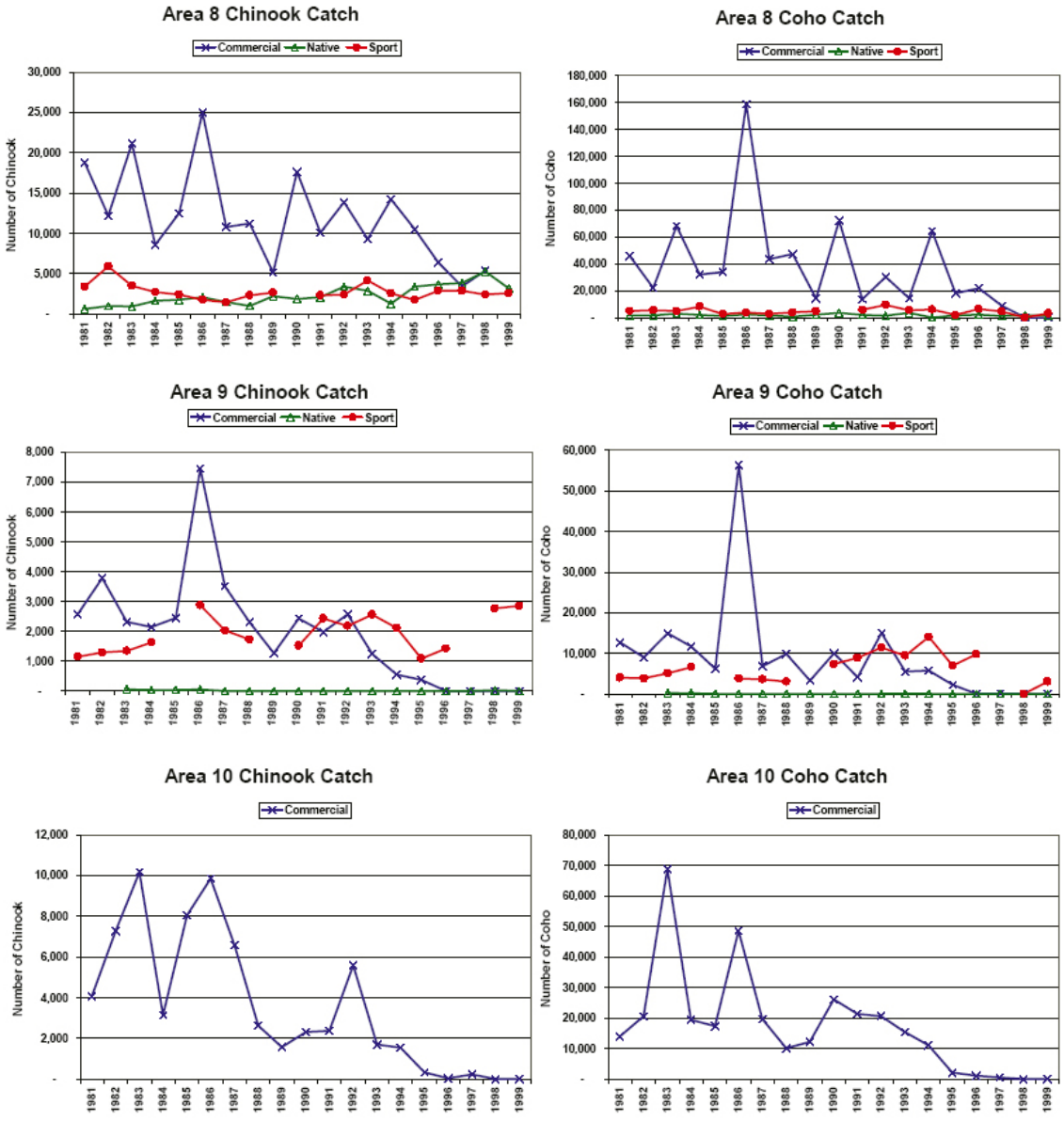
Area Fisheries

The three types of fisheries on chinook and coho are: Aboriginal fisheries to meet food, social and ceremonial needs; sport fisheries for recreation; and commercial fisheries for sale. There is a economic component in all three, but particularly in the recreational and commercial sectors.

The commercial fishery took most of the chinook and coho catch until the recent downturn in production and change in allocation policy. The new allocation policy puts first priority on meeting Aboriginal needs. The second priority for chinook and coho is to provide sport fishing opportunities. Commercial catch is the lowest priority use of chinook and coho, but would increase with the supply of chinook and coho available for capture.

Figure 37: Commercial, Aboriginal and sport catch of chinook and coho.





Aboriginal Fisheries

The traditional Aboriginal food fishery is regulated to meet both subsistence and ceremonial needs. The food fisheries generally occur in localized areas adjacent to or within traditional fishing areas. However, some fisheries involve the use of commercial gear in marine interception areas and, more recently, surplus hatchery returns have been harvested by local Aboriginal bands for food purposes.

These fisheries take a diverse mix of species that varies somewhat in response to availability. In most areas, sockeye is the preferred species. With the downturn in sockeye abundance in the region, there has been increased reliance on other species, particularly on coho, chum and chinook. The fisheries seek a continuous supply of fish through the season–chinook early, sockeye and chum, and then coho. Shortfalls in fish force aboriginal peoples to either do without or seek alternate sources.

These fisheries are generally managed to meet local conservation needs by fishing time and area and by species non-retention. If an annual fishing plan agreement can be reached, the First Nation implements, monitors and reports on its fisheries. If agreement on a plan cannot be reached, then DFO dictates the plan.

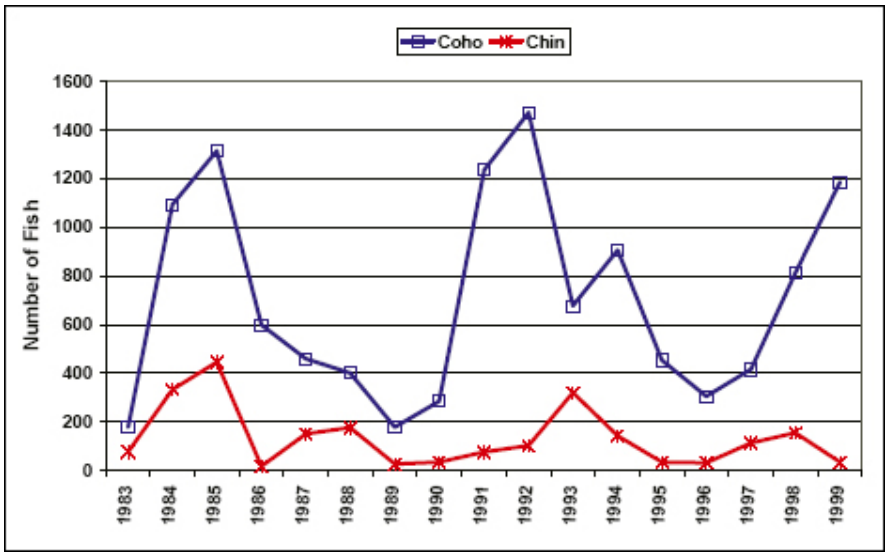
There are a number of different methods of collecting catch information, ranging from formal reporting of catch by commercial gear, to estimating catch by individual fishermen after the season. In some cases, the estimates are from local DFO employees or contractors. The accuracy of these estimates is uncertain, and they are probably somewhat understated. Chinook and coho comprise a variable percentage of the Aboriginal fisheries catch, often ranging from less than one percent for the Oweekenos, to more than fifty percent for the Nuxalk. The species mix changes between years and areas, with the following proportions: Ulkatcho 1731% chinook; Nuxalk 40–58% chinook, 9–11% coho; Oweekeno 0% chinook; Kitasoo 21–23% coho, 0–4% chinook; Hartley Bay 35% coho, 2% chinook; Haisla 8% coho, 2% chinook; and Heiltsuk 7% coho, 1% chinook.

Overall, the Aboriginal fishery accounts for a small percent of the total catch of chinook and coho, even in the Bella Coola–Atnarko where it can exceed fifty percent of the total food fishery catch. For the combined Central Coast stocks, it probably accounts for about 4,000 to 5,000 chinook and 3,000 to 4,000 coho.

The Hartley Bay, Kitasoo and Kitimaat Bands fish for food, social and ceremonial purposes in Area 6. The Bands issue permits to their members and collect catch information to provide to DFO. The Hartley Bay Band members generally fish in Douglas Channel adjacent to Hartley Bay, Laredo Channel and Campania Sound. The Kitasoo Band is located at Klemtu in Area 7, but also fishes in Laredo Sound, West Higgins Pass, Fraser/Graham Reach and Kitasoo Bay in Area 6. The Kitimat Band (Haisla) members fish in Kitimat Arm, Douglas Channel, Verney Pass and Gardner Canal. Chinook are harvested in Kitimat arms, coho in Kitimat and Kildala Arms and Paril River. About 100 chinook and 1000 coho are taken in the Area 6 aboriginal catch.

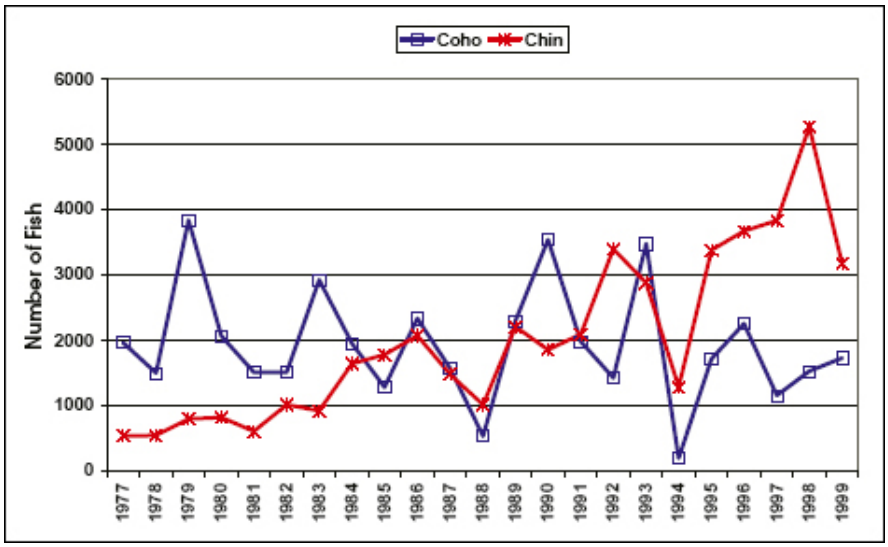
The Hieltsuk (Bella Bella) and Kitasoo First Nations fish in Area 7. The catch is summarized in Figure 38. Communal licenses are issued to both bands after allocation agreements have been negotiated with DFO. Each Band issues licenses to band members and collects and reports catch statistics. In Area 7, the Heiltsuk Band fishes primarily in the Lama Pass, Seaforth and Spiller Channel areas. The Kitasoo Band fishes in Finlayson and Mathieson Channel areas and East Higgins Pass. The Kitasoo people also harvest surplus hatchery returns.

Figure 38. Area 7 Aboriginal Catch



The Nuxalk (Bella Coola), Ulkatcho (Anahim Lake) and Heiltsuk Bands fish in Area 8 (Figure 39). The Nuxalk Band fishes for chinook and coho, in the Bella Coola River and North Bentinck Arm and Burke Channel. The lower Bella Coola River native catch averaged 1,906 coho over the period 1977 to 1997. The catch has declined from an average of about 2,200 in 1970s to less than 1,500 in the 1990s. The Ulkatcho people fish in the Atnarko (Bella Coola River tributary) and Takia Rivers (Dean River tributary) for chinook. The Heiltsuk Band members fish in Fitzhugh Sound and Fisher Channel for chinook and coho.

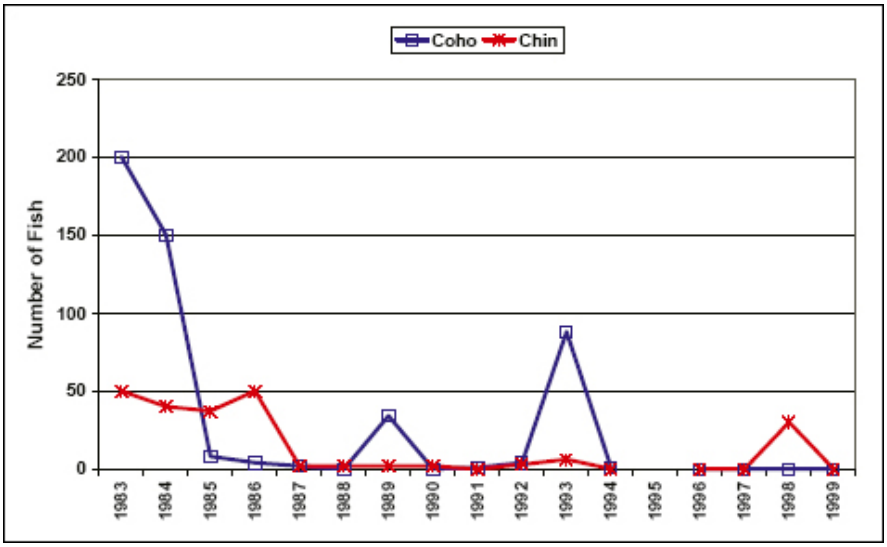
Figure 39. Area 8 Aboriginal Catch



The Oweekeno Nation, the only band in Area 9, has a small population resident in this area. They fish mainly in the Wannock River, at the head of Rivers Inlet, and in the lower end of Owikeno Lake. They take primarily sockeye and very few chinook and coho in the food fishery.

The Gwa'Sala-Nakwaxda'xw Band traditionally occupied the Smith Inlet area but were relocated to Port Hardy, where they currently reside. They have had communal licences issued for food, social and ceremonial fishing in this area, but have not had a regular fishery there.

Figure 40. Area 9 Aboriginal Catch



Although in some years aboriginal communities have not met their food, social and ceremonial needs for chinook and coho, these have generally been met. This is the case when there are inadequate salmon returns locally. For example, Oweekeno people normally rely on local sockeye but, with the recent very low returns of all salmon species to their area, the catch is not sufficient. With downsizing of the commercial fleet, many communities have fewer, if any, commercial vessels to use to meet their collective needs.

Sport Fisheries

The sport fisheries in the region have changed significantly during the past twenty years. In the 1960s and 1970s, the sport fishery was by local people and others on their own boats. The focus of visitors was on chinook in Rivers Inlet. Since then, the number of floating and land-based lodges and charter services has grown and now accounts for most of the ocean sport fishery. The lodge fisheries are generally near the outer-coastal areas and rely on mixed stock fisheries. The charter boats operate from several communities. There is also a freshwater sport fishery, primarily in the Kitimat, Bella Coola-Atnarko and Dean rivers. Fishing effort has increased significantly in most areas. The sport fishing industry is now the largest generator of tourism revenue in the Central Coast. It also provides much local employment.

The permanent lodges regularly report their catch. The catch by private fishermen is usually unreported and not regularly surveyed for in this area. At current levels, catch from the outer highly mixed stock fishing areas should be of limited conservation concern. However, harvest of specific local populations in tidal or non-tidal areas is a potential conservation issue if the targeted population is small, declining, or under habitat stress.

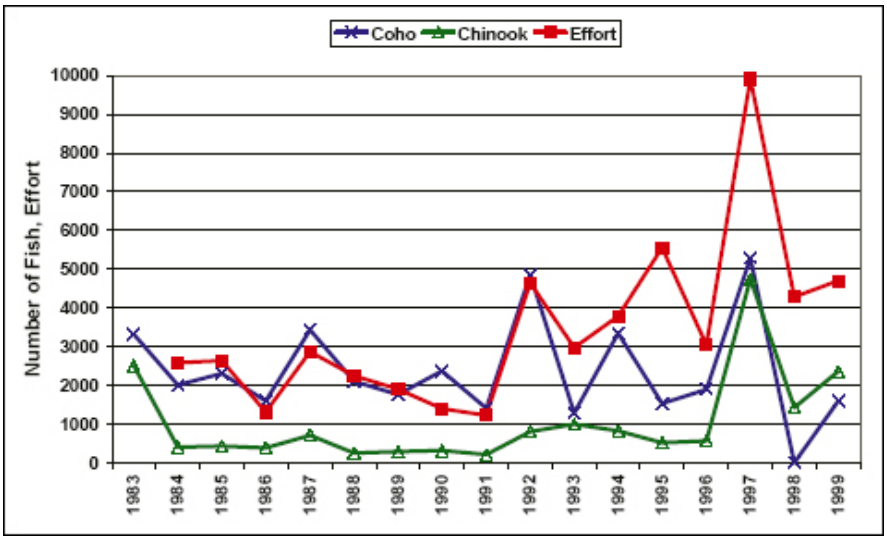
The tidal sport fishery is primarily in Kitimat Arm and Douglas Channel, near Kitimat. About forty-five recreational charter vessels operate out of Kitimat. There are also six sport fishing lodges in Area 6, serving primarily the tidal sport fishery. A non-tidal sport fishery occurs mainly in the Kitimat River and, to a lesser extent, in the Dala, Kildala, Kemano, Kitlope and Quaal

rivers. The Kitimat River fishery is a major non-tidal sport fishery on chinook, coho and increasingly chum salmon. In 1996, an estimated 5,800 chinook, 8,200 coho and 1,300 chum were caught in Area 6. Much of the Kitimat River catch is of hatchery origin. The fishing effort is probably over 10,000 angler days. Sport catch statistics in this area are incomplete for most years.

The effort in the Area 7 sport fishery has more than doubled in the past ten to fifteen years. The Chinook catch is relatively low in the area but increasing. The Coho catch has been variable with no clear trend.

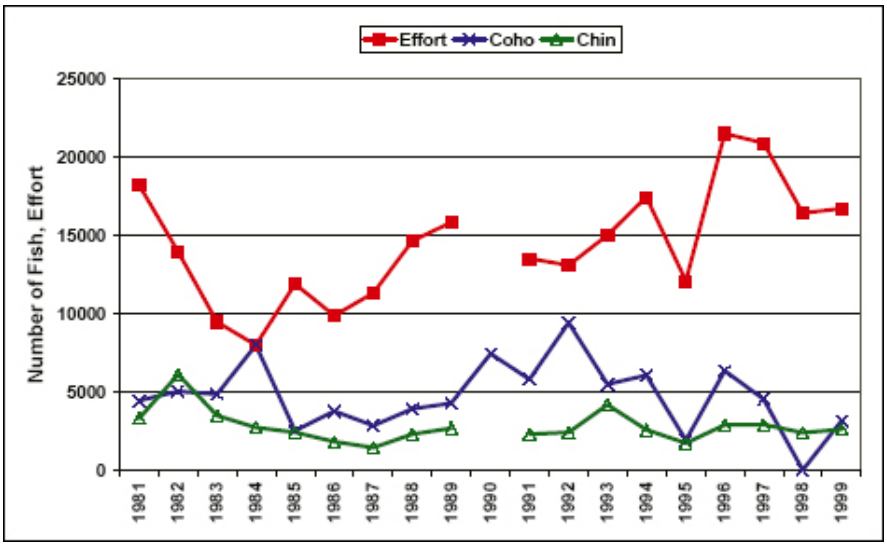
Most of the sport catch and effort in Area 7 is by clients of charter operators and sport fishing lodges. Private anglers also operate throughout Area 7. Most sport fishing activity takes place in Milbanke Sound off St. Johns Harbour, Seaforth Channel between St. Johns and Idol Point, and the Tinkey River area.

Figure 41. Area 7 Sport Fishery



The effort in the sport fisheries in Area 8 has shown an increase in the last fifteen years, but catches of chinook and coho have not shown any clear trend. There are significant non-tidal sport fisheries on the Atnarko and Dean Rivers. However, most of the sport catch is from the tidal fishery. The main tidal sport fishing effort is in the Hakai Pass area where nine lodges operate. In Hakai Pass in 1981–99, catch averaged 3,500 coho and 1,400 chinook. Lodge fishermen also fish in the ocean in Fisher Channel, near the Koeye River (for coho) and in Burke Channel (for chinook). There is a tidal fishery near Bella Coola that involves primarily unguided fishermen. That fishery took an average of 311 coho from 1979 to 1997. Fishermen from lodges in Rivers Inlet and Area 7 also fish in Area 8.

Figure 42. Area 8 Sport Fishery

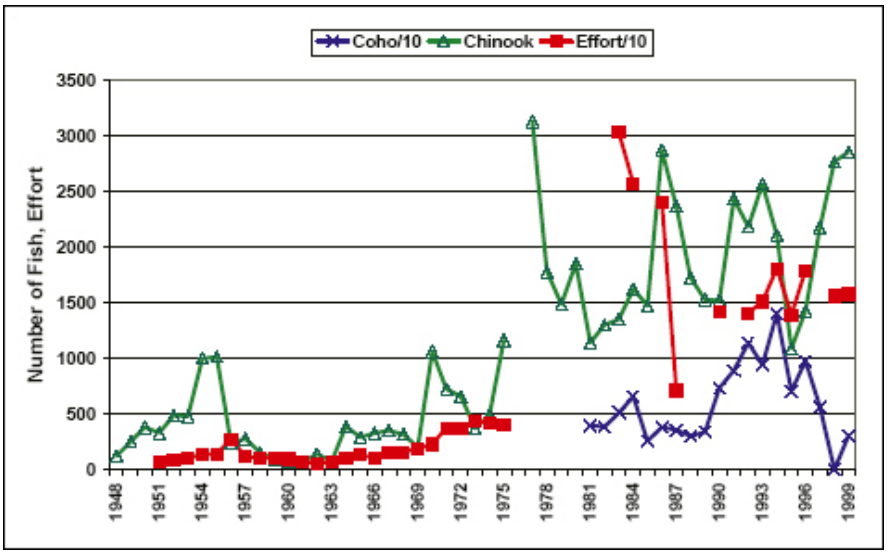


The non-tidal salmon fisheries in the Atnarko, Dean, Kimsquit and Bella Coola rivers are primarily for chinook and increasingly for coho, pink and chum. These non-tidal sport fisheries took an average of 1,000 to 2,000 chinook and 300 to 700 coho annually in the 1990s.

The Rivers Inlet chinook fishery has been a high profile fishery for trophy-sized chinook for many years. Catch statistics have been recorded since 1948 (Figure 43). A special permit area for the chinook fishery was introduced in 1956. Regulations required each angler fishing within the boundaries to acquire a license supplied at no cost by DFO. Fishermen were also required to provide information daily on the number of fish caught.

For a number of years, a chinook weigh-in station operated in Kilbella Bay. In 1955, each fish landed by sport fishers was sampled for length, weight, sex, colour of flesh, stomach contents, and a scale sample. Also reported were the hours fished, type of lure used, and area of catch. In that year, a total of 1,014 spring salmon averaging 43.9 pounds were sampled. Limit catches were not unusual during the peak of the migration.

Figure 43. Area 9 Sport Fishery



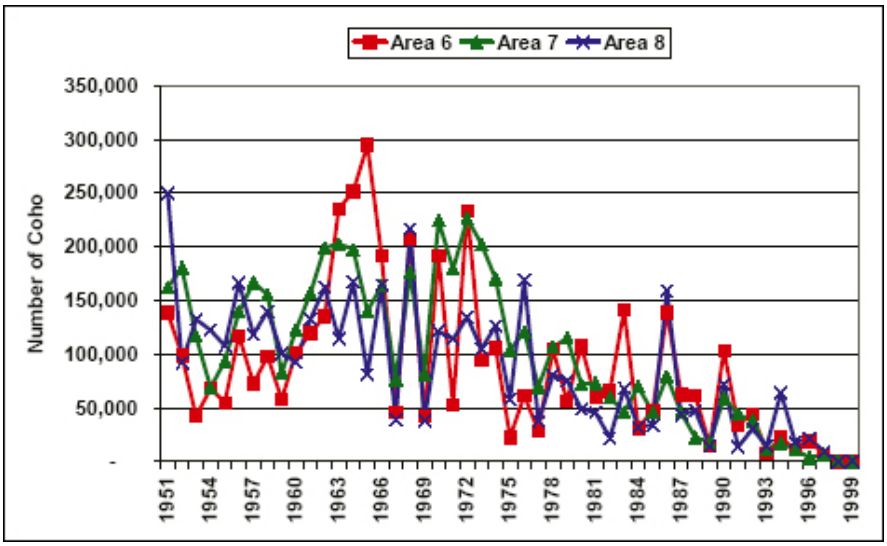
Until the 1980s, the Rivers Inlet sport fishery was mainly by private fishermen. Since then, the number of charter or lodgebased fishermen has increased to be the majority. Most recently, lodge clients have caught about fifty percent of Area 9 chinook catch. The sport fishing season generally lasts from early June to early September.

The minor recreational fishery that occurs in Smith Inlet involves local and non-resident anglers. There are no lodges and no permanent guides operating in the area. The sport fishing effort is very low, most from local logging camps. Occasionally private boats fish the inlet. The non-tidal fishery is small and mainly by fly-in to the Nekite River for coho (>50) in the fall and steelhead in the spring.

Commercial Fisheries

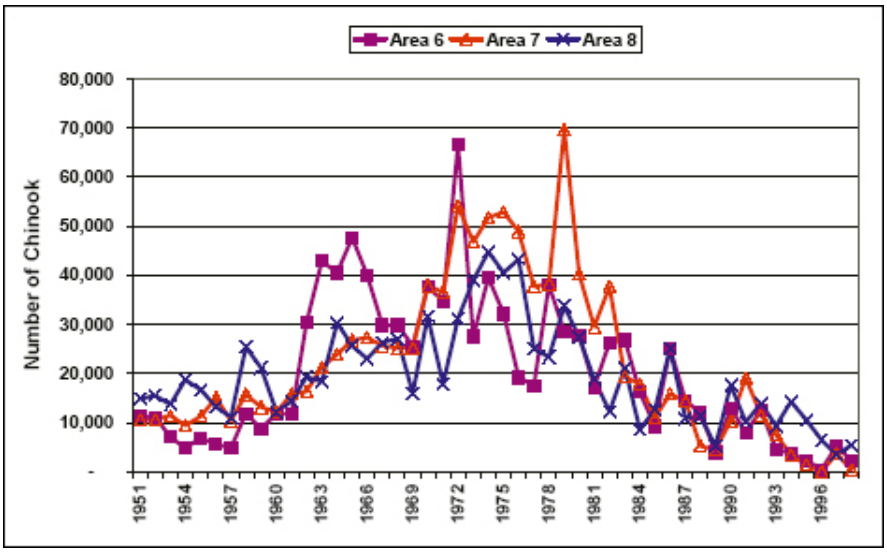
Commercial catch of coho in Areas 6, 7 and 8, illustrated in Figure 44, shows a peak of production in the 1960's and early 1970s, followed by a long decline to zero with special restrictions in the last few years. The peak and decline are probably related to a number of factors, including changing ocean survivals, increasing hatchery production and changing fishing effort. The catch in each of these areas is comprised of many different stocks, mostly from the south. The spawner abundance in the Central Coast shows a similar decline.

Figure 44. Area 6–8 Commercial Coho Catch



The Chinook catch in Areas 6, 7 and 8 commercial fisheries is plotted in Figure 45. The Area 6 catch increased from an average of about 8,000 chinook in the 1950s to about 40,000 in the late 1960s and early 1970s, and it subsequently declined to an average of 5,600 in the 1990s. The Are a 7 chinook catch averaged about 12,000 in the 1950s, 47,600 in the late 1960s and early 1970s, and 6,000 in the 1990s. The chinook catch in Area 8 averaged 16,000 in the 1950s, 33,000 in the 1970s, and 9,600 in the 1990s. The recent very low levels in Areas 6 and 7 are, in part, a result of reduced fisheries on pinks and chum and resultant lower bycatch of chinook and coho. The Area 8 catch is partly interception fishery and partly terminal fisheries on local stocks.

Figure 45. Area 6–8 Commercial Chinook Catch

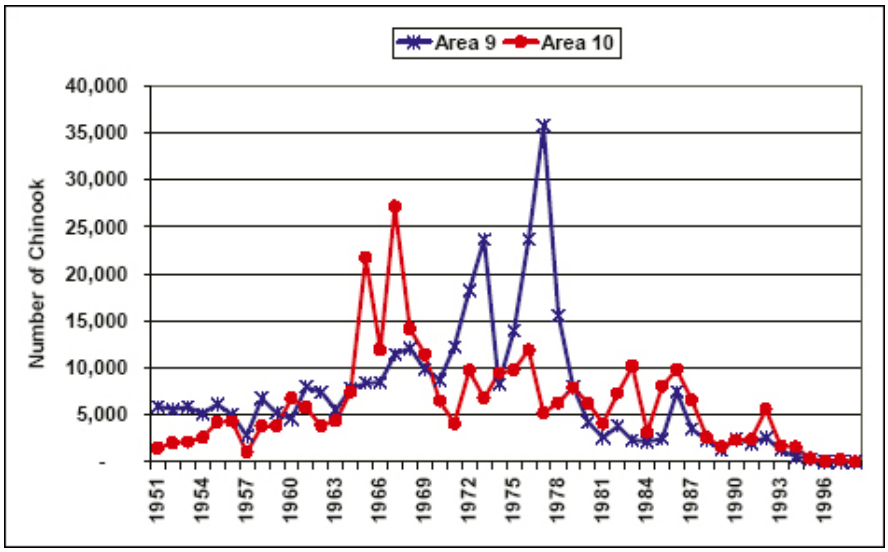


The time and area of fisheries were changed to reduce incidental catch of chinook and coho in Central Coast fisheries. Delayed openings and movement of net fisheries to more inside waters significantly reduced bycatch. For example, in 1983, the Milbanke Sound fishery was closed to net fishing. However, there is still a significant portion of the chinook and coho catch in Central Coast fisheries that did not originate in that area.

The Area 9 and 10 chinook catch has a similar pattern to that in Areas 6 to 8, with a peak in the 1960s and 1970s followed by a decline to very low levels in the 1990s. The 1960s peak catch was in Area 10 and 1970s was in Area 9. The Area 10 peak was at about the same time as the early peak in Area 6. The later peak was about the same timing as that in Areas 6 to 8.

The Area 9 commercial catch of chinook (Figure 46) averaged about 5,300 in the 1950s and increased to about 10,000 by the end of the 1960s. Catch peaked in 1977 at more than 35,000. Catch then declined to about 3,000 in the 1980s, then to a few hundred and fishery closures occurred from 1996 to the present. An average of 3,200 chinook was harvested in the Area 10 commercial net fishery during the 1950s. The Area 10 catch peaked at 27,000 chinook in 1967 and then declined to 1,400 average in the 1990s with net closures since 1997.

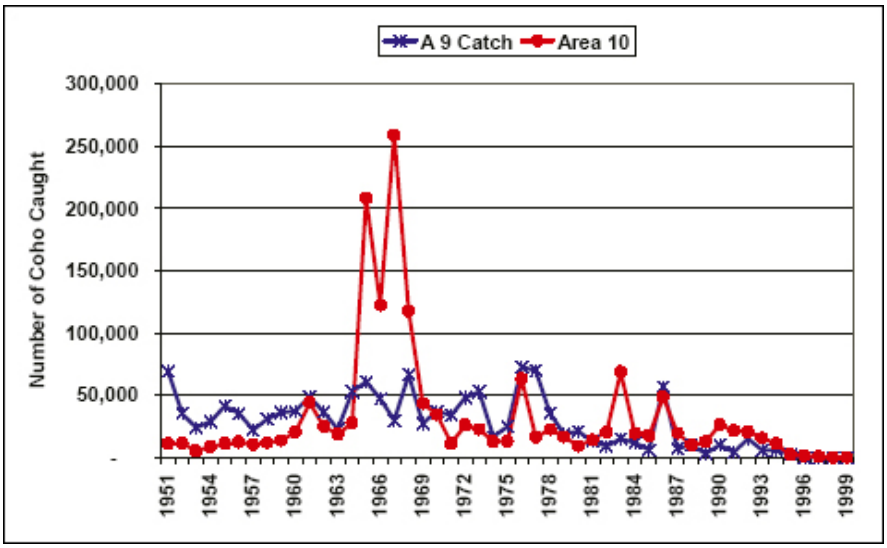
Figure 46. Area 9–10 Chinook Commercial Catch



The Area 9 and 10 commercial coho catch is presented in Figure 47. Area 9 averaged about 40,000 coho catch annually until the 1980s when it dropped to an average of about 15,000. The decline continued to zero, with closure of the fishery in 1996. Area 10 catch increased from an average of 12,000 in the 1960s to a peak of 259,000 in 1967. The catch averaged 24,000 in the 1970s and 1980s, and then declined in the 1990s until the fishery was closed in 1997.

In both areas, the coho catch was primarily taken incidentally in the sockeye, pink and chum fisheries. The decline in coho catch is a result of a number of factors, including the change in fishing times and areas for conservation and the overall decrease in coho abundance.

Figure 47. Area 9–10 Coho Commercial Catch



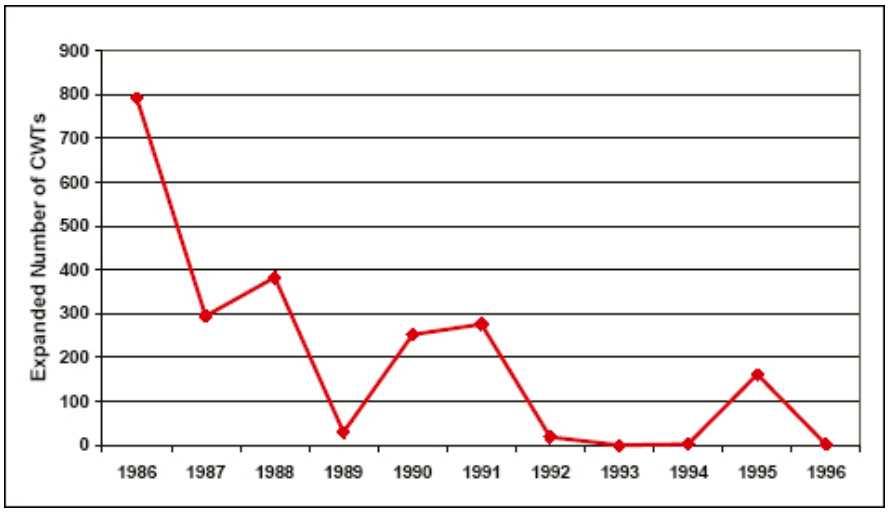
In Area 10, the spikes in catch of coho in 1965 to 1968 and chinook in 1965 to 1969 were almost entirely harvested by gillnets, with only a slight increase in troll catch. However, there were no apparent increases in the number of gillnet catch deliveries, a measure of fishing effort. The coho gillnet catch per effort increased by eight to ten times above average during the spike in 1965 to 1967. This probably means that there were proportionately more coho in the fishing area.

The spikes of both chinook and coho occurred early in the fishing season, so were most likely passing stocks. In 1967, 43,889 coho were landed by July 1st in Area 10. From 1965 to 1969, much of the coho catch had been taken by mid-July. In 1970, the high early coho catches continued in the troll fishery. However, the gillnet fishery missed these coho because it did not open until mid-July. From 1971 onward, the abundance of coho taken in the early period dropped off, with most of the catch occurring later in the season. From 1971 onward, gillnet fishing outside of Smith Sound in the Egg Island area was limited. This reduced the opportunity for gillnetters to intercept passing coho stocks. The troll fishery continued in Area 10 from mid-June to mid-September, but the early catches had decreased to what they were in the early 1960s.

Population Composition of Central Coast Catch

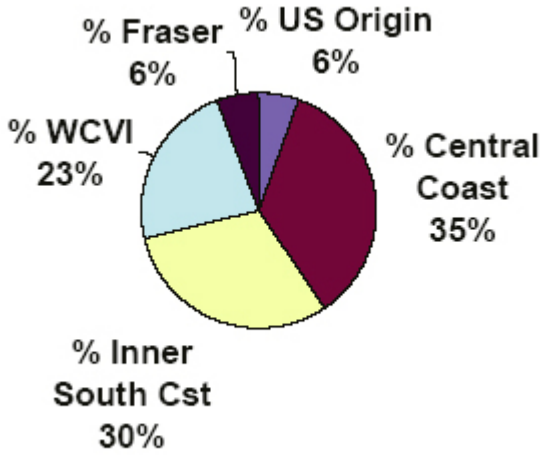
It is important to note that the composition of chinook and coho stocks harvested in the Central Coast changes with the abundance of various populations harvested there. The decline in chinook and coho production can be attributed to various factors. The survival to adult of hatchery-produced fish declined following the oceanic regime shift in 1976 and a series of El Nino events in the late 1970s and early 1980s. In the US, the resulting reduced escapement, in conjunction with new egg transfer restrictions, meant that hatchery egg targets could not be met, so production decreased. Production was further decreased by reduced budgets. The overall result was that US hatchery production was reduced. This combination of impacts accounts for the reduced number of US origin chinook in Central Coast fisheries.

Figure 48. US Origin CWTs in Area 8 Commercial Chinook Harvest



In the 1970s, it was estimated that the US origin chinook stocks comprised about 22 percent of Central Coast fisheries catch. The Washington and Oregon production doubled from 1970 to 1985. In the 1986 to 1996 period, the number of US origin chinook with coded wire tags recovered in Area 8 (Figure 48) accounted for as much as 50% of the tags recovered. The incidence of US origin chinook was high in 1986 and 1987 (50% and 48% respectively) and decreased to almost none in the early 1990s. From 1992 to 1997, US origin chinook were 6%, as illustrated in Figure 49.

Figure 49. Catch Composition



In the 1970s, it was estimated that 50 percent of the Central Coast coho catch was of southern stocks. Coded wire tag recoveries of southern coho from 1986 to 1997 ranged from more than 50 percent early in the period to 0% late in the period. It is not clear if this decrease was a result of decreased survival or changes in ocean distribution. The interception of southern coho was highest in years of big pink harvests, and the number of recoveries decreased with overall pink catch.

6. FISHERIES MANAGEMENT

There are different approaches for collecting information for Aboriginal, commercial, and sport fisheries. Each of the approaches has its strengths and weaknesses. Collectively, they probably provide an order of magnitude estimation of overall impact on the stocks. The big unknowns are stock mix, escapement, and sport fishery release mortality.

The sport fishery is the one that presents the most immediate challenges and opportunities, and that requires attention in terms of conservation interest. The sport fishery is providing a high value use of fish resources and important local sources of employment in the Central Coast area. It should be in the interests of both the sport fishing industry and governments to: ensure that conservation needs are met to sustain the fish resources and the industry; get the maximum benefit from the sport catch; and, strengthen the sport fishing industry.

Sport Fishing Conservation

The sport catch of salmon in the Central Coast area is relatively low, at about 9,000 chinook and 15,000 to 20,000 coho. At current amounts of harvest, the primary conservation concern is the impact of the sport fishery on individual depressed fish populations. With the complex mix of populations involved and the dynamic nature of the fisheries, better monitoring of fish populations and fisheries is necessary to ensure that population-specific conservation needs are met. A related conservation concern is the need for more population-specific harvesting to allow the sport fishery to provide a quality experience, while still protecting and rebuilding depressed populations.

There are no conditions of licence or other means to require sport-fishing businesses to provide sport catch information. In the Central Coast area, most long-term fixed site lodges provide comprehensive catch and effort statistics that serve as a form of index of catch and catch per effort that can be applied generally to the rest of the fisheries in an area. However, reporting is not standardized across the industry. For example, there have been a number of different measures of sport fishing effort collected, including: the number of permits issued, boat days, angler days, rod days, and rod hours. It would be helpful to agree on standard measures and for all groups to use them. Similarly, there should be further assessment of induced mortality and spawning performance impacts on released sport caught fish.

To meet these conservation needs, sport fishing statistics in the area should be improved**.** There should be an independent statistical design expert working with the local sport fishing industry to create a sampling program. This program should provide maximum relevant and meaningful information without excessive cost or disruption of clients.

To increase protection of fish populations in the area, the following conservation actions should be taken. Government, sport fishing and local interests should work together to implement special local restrictions to limit fishing in, or near, rivers of populations with conservation concerns. Restrictions should be introduced to meet pre-season anticipated or inseason actual conservation spawning stock shortfalls.

Live release strategies for sport fisheries should be further improved. The sport fishing industry should be encouraged to discuss live release strategies with commercial fishermen involved in recent live release experiments. For example, the resuscitation box developed for gillnetters has been demonstrated to revive 85% of the coho that were classified as being effectively dead. It

might be possible to modify techniques and the recovery box for use in the sport fishery, particularly for charter boats.

There should be special protection for resident fish populations. A concern in the Central Coast area is over-harvesting of the resident fish populations, such as rockfish and lingcod. These species are harvested primarily as bycatch and as a fallback, when weather or low chinook and coho returns don't allow an acceptable salmon fishing experience. For these resident species, there are no size limits. Also, daily and possession limits are too high to be locally sustainable. The rockfish limits are eight per day and sixteen in possession. The lingcod limits are three per day and six in possession. As these species are resident, it is essential to manage and collect catch statistics on a much finer grid than at present. Areas where populations have been over-used should be protected until restored, and then managed sustainably. All uses of these resources should be coordinated to avoid over-use of accessible populations. For example, some areas in proximity to communities and traditional fishing sites could be protected for aboriginal food, social and ceremonial use. Other areas that can be sport fished under adverse weather conditions could be earmarked for recreational use.

Marine protected areas should be formally designated in the Central Coast area to protect resident species and to help re-seed adjacent areas.

Local co-management processes, involving sport fishing businesses, fisheries managers and others, should be strengthened for improved conservation, stock rebuilding and management. Sport fishing business staff should be encouraged to be involved in local comanagement to capitalize on their knowledge and local experience, and to protect their interests by conserving fish populations to ensure their future availability. The Rivers Inlet/Hakai Pass Sport Fishing Association, representing some of the sport fishing businesses in the area, is actively involved in co-management processes.

Maximizing Benefits From the Sport Catch

Some of the possible activity that could increase the benefits from the current sport catch include the following measures:

- Programs should recognize trophy size catch, as well as catch and release. Alaskan programs should be reviewed with the purpose of implementing something similar in the Central Coast, to increase the value of the fish and fishery, and to reinforce sport fishing experiences. Alaska issues trophy fish certificates to give special recognition to anglers who catch trophy sized fish. The fish must be weighed on a certified scale by a designated official and must be witnessed. An official affidavit and a clear side view photograph of the fish, with a size-reference object, must be submitted. Alaska also issues catch and release trophy certificates and jacket patches for trophy-sized fish. The Alaskan catch and release program is for freshwater species, but could be applied to salmon in the ocean.

- Programs should involve sport fishing and eco-tourism clients in local co-management. Fisheries agencies and sport fishing businesses should work together to consider the potential of lodge clients being involved in local co-management activities, such as counting adult or juvenile salmon, sampling catch, or conducting special studies. The potential to enrich the client experiences and contribute to conservation and improved management should be actively pursued.

- A program should sustain and increase quality angling opportunities for anglers and a sustainable sport fishing industry. This could be an extension of the existing BC "Quality

Waters/Rivers Strategy" to focus on the premium marine sport fishing areas. This could involve a special licence to fish in a designated trophy sport fishing area. It could also include a trophy area guardian program, similar to that for the Dean River. The guardian program might be paid, at least in part, from a premium on the trophy licence fees. The guardians would address primarily data needs, education and stewardship. Guardians would work with resort/lodge staff, charter boat operators, guides and private fishermen to meet the management and assessment information needs. Guardians could also be involved in joint programs to address issues such as catch and release stress and mortality studies, angler use patterns and compliance with regulations. They could also work with Community Advisors and local groups to encourage and facilitate involvement of the sport fishing industry and clients in stock assessment, habitat inventory and restoration. Guardians could also have a role in informing, educating and consulting with sport fishermen and the sport fishing industry.

Strengthening the Sport Fishing Industry

To strengthen the sport fishing industry, the BC government and DFO should work together to implement new licensing requirements for sport fishing lodges and charter boat businesses, including mandatory reporting of catch, effort and marks recovered**.** Many of the Alaskan requirements for sport fishing businesses should also be considered for BC businesses. Alaska requires a business licence and a free registration of fishing guides and businesses. An official logbook is required for all saltwater sport fishing services. Logbooks must be completed daily and be available for inspection. Logbook forms must be returned weekly during the season. All vessels used by sport fishing businesses must be licensed, and boat and operator must meet safety specifications.

The intent of the proposed new licensing requirements is not to implement an absolute limit on sport fishing businesses. Rather, it is to control development to ensure that the industry meets basic conservation requirements and is sustainable. The information requirements are for the same purpose–precautionary management and a sustainable industry. This will also allow management agencies to make allocation decisions, not possible with uncontrolled growth.

Aboriginal Food Fisheries Management

There are no specific Aboriginal food fishery concerns with regard to chinook and coho. Current programs for monitoring and reporting of this catch should be continued and expanded.

The potential for fixed site local fisheries to be used as index fisheries should be considered. This now occurs in the Bella Coola River.

There are potential conservation concerns if Aboriginal fisheries harvest small populations where there is potential for over-harvesting.

Commercial Fisheries Management

Wild Chinook and Coho populations should be harvested at a different rate than enhanced populations. The harvest in mixed stock fisheries should be limited to rates sustainable by natural stocks, with subsequent local fisheries on enhanced stocks. Avoidance of harvest of natural non-target populations should be the preferred strategy, as it avoids the fish handling stress and potential injuries of non-retention. Population specific avoidance is preferred to blanket avoidance of a species. To be effective, avoidance should be implemented cooperatively between fishermen and managers. Avoidance should probably be somewhat dynamic as situations change

in-season. More site specific catch statistics and sampling for stock identification would be required for more population selective harvesting.

Selective harvest of enhanced stocks may require selective live-release of chinook and coho in fisheries for other species. It appears that non-retention of coho has been an effective tool to increase spawner abundance. Applied locally, non-retention of chinook or coho could be an effective way to reduce harvest of natural populations, while maintaining harvest of enhanced populations.

7. CONCLUSIONS

Many of the chinook and coho populations in the Central Coast region have declined in abundance. Some have been identified as being at high risk of extinction and others are moving in that direction. More work on determining migration routes and timing of wild chinook and coho stocks would be valuable. Defining stocks of each species is also an urgent need.

Every effort should be made to increase chinook and coho spawning populations beyond the absolute minimum, to safe production levels to minimize the risk of random natural events, habitat impacts and over-harvesting putting these populations at conservation risk.

Enhanced populations generally are being better sustained than wild populations.

The apparent differences in spawner abundance between enhanced and natural populations suggest that overall harvest rates have been too high for natural populations to sustain.

The sport fishery has been growing in the region, but its catch of salmon is relatively low. At current amounts of harvest, the sport fishery is only a conservation concern where it targets specific depressed stocks. Improved management of the sport fishing industry could help to prevent over-development in the Central Coast area. With current bag limits, the sport fishery on resident species such as rockfish and lingcod is a concern in high use areas.

The Indian fishery catch of chinook and coho in the area is relatively low.

The harvest of chinook and coho in all fisheries should be made more population specific.

Standard performance measures for evaluating the conservation of salmon resources should be developed, adopted, monitored and reported.

Monitoring of populations in the Central Coast region has not been adequate to identify their actual condition and the impacts of fisheries or habitat factors on population abundance. For example, in the 1990s when populations were dangerously low, many spawner populations were not counted. A core program of basic monitoring is essential to ensure that populations are conserved and adequately managed.

8. REFERENCES

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ANNEX 1. CHINOOK AND COHO POPULATIONS AT RISK OF EXTINCTION

The following table lists the Central Coast chinook and coho populations that were rated at high risk of extinction in a major study by Slaney et al. No chinook and coho populations were identified as having recently become extinct in the area. However, eight of the more than forty-three chinook populations and fifty-seven of the more than two hundred and twenty-two coho populations were rated at high risk, based on spawner abundance estimates up to and including 1993.

The at-risk stocks are grouped by statistical area [Area], by sub-area [Sub] and by geographic zone [e.g., Interior, Inner Coastal, Coastal, Outer Coast as illustrated in Figure 2]. The numbers in the "Chinook" and "Coho" columns indicate that the population was rated at high risk and the number is the target number of spawners for that population. For example, in the left column, "Crab River" has a number in the "Coho" column indicating that coho population is at risk and the number "200" is the coho spawner target[1]. There is no number in the "Chinook" column indicating that either there is no chinook population there or that it wasn't rated at-risk.

[1] Estimated maximum number of spawners for stream.

Table 2. Central Coast chinook and coho populations rated at high risk of extinction

Spawning Areas	Area	Sub	Chinook	Coho	Spawning Areas	Area	Sub	Chinook	Coho
AREA 6 NORTH					AREA 7				
Interior			-	-	Coastal (Continued)				
Inner Coast					Deer Pass Cr.	7	GS		500
Crab R.	6	GC		200	Duthie Cr.	7	FM		1,000
Kiltuish R.	6	GC	400	3,000	Green/Bolin Bay Cr.	7	FM		250
Tsaytis R.	6	GC	500		Kwakusdis/Yeo R.	7	GS		2,500
Coastal					Mary Cove Cr.	7	FM		400
Quaal R.	6	DU	500		Mussel R.	7	FM		1,500
AREA 6 SOUTH					Outer Coast				
Coastal					Choke Pass Crs.	7	SG		400
Busey Cr.	6	LS		500	Howyete/Cooper Cr.	7	SG		1,000
Head/Dome Cr.	6	FG		500	Kadjusdis Cr.	7	GS		4,000
Fury Cr.	6	LC		500	Kildidt Cr.	7	SG		500
Khutze R.	6	FG	1,000		Sally Cr.	7	GS		500

Spawning Areas	Area	Sub	Chinook	Coho	Spawning Areas	Area	Sub	Chinook	Coho
Klekane R.	6	FG		1,000	Ship Point Cr.	7	SG		1,000
Marshall Cr.	6	FG		500	Sound Pt/Yaaklele L.	7	GS		500
McKay Cr.	6	FG		300	Stewart	7	SG		500
Pyne Cr.	6	LS		500	Tankeeah R,	7	SP		3,000
Scow Bay Cr.	6	FG		500	Tuno Cr.	7	GS		300
Tuwartz Cr.	6	LC		500	Tuno Cr. West	7	GS		300
Outer Coast					AREA 8				
Argyh Cr.	6	LC		100	Interior			-	-
Cartwright Cr.	6	LC		800	Inner Coast				
Clifford Cr.	6	AW		500	Necleetsconnoy R.	8	NB		2,500
Dallain Cr.	6	LS		200	Noeick R.	8	SB	500	
Devil Cr.	6	AW		100	Skowquiltz R.	8	UD		1,000
Douglas Cr.	6	LC		1,000	Coastal				
Duffey Cr.	6	AW		1,000	Eucott Bay Cr.	8	DC		500
Eagle Cr.	6	AW		2,000	Jenny Bay Crs.	8	DC		1,000
Flux Cr.	6	AW		1,000	Kwatna R.	8	BC	500	
Gull Cr.	6	LS		500	Namu R.	8	FF		3,500
Kwakwa Cr.	6	LS		2,000	Nootum	8	BC		2,500
Linnea Cr.	6	AW		1,500	AREA 9				
McDonald Cr.	6	AW		200	Coastal				
Penn Cr.	6	LC		200	Allard Cr.	9	RI		500
Salmon Cr.	6	AW		50	Clyak R.	9	RI	500	
Sentinal Cr.	6	AW		1,000	Dallery Cr.	9	OL	500	
West/Fish Cr.	6	AW		500	Outer Coast				
AREA 7					Beaver Cr.	9	RI		3,500
Coastal					AREA 10				
Bottleneck Cr.	7	FM		400	Coastal				
Carter R.	7	FM		200	Coho/Boswell Cr.	10	SI		??
Deer Pass Lag.Crs.	7	GS		300					
					TOTALS			8	57

Sub-Area Codes
AW= Aristazabal West
BC= Burke Channel
DC= Dean Closed
DU= Douglas-Ursala
FF= Fisher Fitzhugh
FG= Fraser-Graham
FM= Finlayson-Mussel
GC= Gardner Channel
GS= Gunboat-Seaforth
LC= Laredo Campania
LS= Laredo Sound
NB= North Bentinck
OL= Owikeno Lake
RI = Rivers Inlet
SI = Smith Inlet
SB = South Bentinck
SG = Southern Group
SP = Spiller
UD = Upper Dean

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