Conservation Strategy for Coho Salmon (*Oncorhynchus kisutch*), Interior Fraser River Populations

October 2006
Conservation Strategy for
Coho Salmon (*Oncorhynchus kisutch*), Interior Fraser River Populations

by
Interior Fraser Coho Recovery Team

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Disclaimer:

This Conservation Strategy for coho salmon (*Oncorhynchus kisutch*) in the interior Fraser River watershed was prepared by the Interior Fraser Coho Recovery Team (IFCRT) in consultation with experts and observers.

The strategy identifies recovery goals and objectives that are deemed necessary, based on sound biological principles, to protect and recover the coho salmon designated by COSEWIC as the Interior Fraser River populations. The strategy does not necessarily represent either the official positions of all agencies or the views of all individuals involved in the strategy’s preparation.

Success in the recovery of these fish depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Fisheries & Oceans Canada or any other jurisdiction alone. Fisheries & Oceans Canada will support implementation of this strategy to the extent possible, given available resources and its overall responsibility for conservation.

This strategy may be complemented by one or more program plans that will provide details on specific recovery measures to be taken to support conservation of this species. Fisheries and Oceans Canada will take steps to ensure that, to the extent possible, Canadians interested in, or affected by, these measures will be consulted.

Acknowledgments:

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) provided the original impetus and some of the background information for this report.

Many knowledgeable people were instrumental in assembling the information required to complete this report. In addition to the hard work of the recovery team members, the assistance of several individuals is most appreciated. In particular, the team wishes to thank K. Austin, M. Chamberlain, D. Desrochers, J. Guerin, R. Harding, H. Olynyk, T. Panko, and G. Witzky. Additional thanks are due to M. Krupp of Okanagan University College for preparation of a map for the South Thompson River coho salmon population, and to D. McCullough of Fisheries and Oceans Canada (DFO) for assistance with preparing the report’s map figures.

Sylvia Currie of www.webbedfeat.com was instrumental in establishing a central communication forum for use by all team members. Morley Farwell of Cariboo Fisheries Consulting assembled the efforts of the team and its working groups into this report on behalf of the recovery team.
Executive Summary

Background Information

The endangered status of coho salmon from the interior Fraser River watershed was established by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2002. The Fraser River is the largest salmon producing river in British Columbia (BC) and the interior Fraser River area (i.e. that portion of the watershed upstream of Hells Gate in the Fraser Canyon) constitutes most of the drainage basin of the Fraser River. Interior Fraser River coho salmon are genetically unique and can be distinguished from lower Fraser River coho salmon and from non-Fraser River coho salmon.

Summary of COSEWIC Status Report

Coho salmon are an important species, contributing to catches along the Pacific coast of North America and within the Fraser River. However, coho salmon numbers are declining throughout much of their range, particularly in the northwestern United States and southern BC. A COSEWIC species status report focused on coho salmon from the interior Fraser River of British Columbia (Irvine 2002).

Coho salmon from the interior Fraser River (Interior Fraser Coho) constitute a COSEWIC designated unit. The unit is comprised of five known populations (North Thompson, South Thompson, Lower Thompson, Fraser Canyon, and Upper Fraser). COSEWIC was concerned that if Interior Fraser Coho distribution became too fragmented, genetic exchange within the populations may be insufficient to ensure long-term survival.

On average, North and South Thompson coho salmon declined in numbers by approximately 60% during the 10-year period from 1990-2000. There were four years (1991, 1995, 1997, and 1998) when productivity was so low that some of the populations may not have been able to maintain replacement spawner numbers, even with a zero exploitation rate.

Natural spawning is responsible for producing most of the coho salmon escaping to the interior Fraser River, except for the Lower Thompson population where hatchery fish outnumber those produced from fish spawning in natural stream areas. There is no evidence that the overall distribution of coho salmon within the interior Fraser River watershed has changed, although spawners were observed in fewer streams as spawning abundance declined.

Over-fishing, changing marine conditions, and habitat perturbations have all contributed to declines in numbers of Interior Fraser Coho. Excessive fishing resulted when exploitation rates were not reduced in response to climate-driven reductions in marine survival. Exploitation rates have been reduced since 1998 and this combined with an apparent stabilization in marine survivals has resulted in improved returns.
The outlook for Interior Fraser Coho is highly uncertain and depends on the magnitude of negative impacts due to fishing, habitat perturbations, and climate related changes in survival. A return to higher survivals, combined with continued low exploitation rates, conservation of existing habitat, and habitat restoration, could produce increases in escapments and subsequently population recovery. However, if survival rates are at low levels, such as those recorded in 1998, spawner numbers will continue to decrease, possibly resulting in the eventual extinction of Interior Fraser Coho. Since there is no predictor of future survival rates, a cautious approach to harvest and habitat management will be required to ensure the long-term viability of Interior Fraser Coho.

**Summary of Conservation Strategy Report**

- **Population Structure and Abundance**

  Studies of the genetic structure of Interior Fraser Coho indicate that there are five distinct populations within COSEWIC’s designated unit; three populations within the Thompson (North Thompson, South Thompson, and Lower Thompson regions) and two populations within the Fraser (the area between the Fraser Canyon and the Thompson-Fraser confluence, and the Fraser River and tributaries above the Thompson-Fraser confluence). Moreover, due to the vast areas of the Fraser River basin, additional demographically independent groups (sub-populations) may also exist. The existence of two to three sub-populations within four of the five genetically defined populations is proposed. The exception is the Fraser Canyon population, where the majority of the spawning and rearing areas are within one river. A total of 11 sub-populations are identified and described in detail in the text (see Section 1.4).

  Over the period of record (1975-2003) the 3-year mean escapement for Interior Fraser Coho peaked in the mid-1980’s at over 70,000 fish, and declined to a running average of less than 18,000 individuals in the late 1990’s. Similar trends are observed in total abundance (i.e. catch plus escapement), which declined from over 200,000 in the late 1970’s and 1980’s to less than 30,000 in recent years.

  Trends in escapement for each of the five distinct populations are similar to those shown by aggregate total. The populations differ greatly in abundance; however, the North Thompson has consistently been the largest, and the Upper Fraser and Lower Thompson populations are typically smaller.

- **Habitat Issues**

  The definition of habitat for Interior Fraser Coho includes spawning grounds and nursery, rearing, food supply, migration, and any other areas on which the population depends, directly or indirectly, in order to carry out their life processes. This broad definition means that anywhere that Interior Fraser Coho
are currently found, or historically existed, is considered to be coho salmon habitat.

Within the geographic range of Interior Fraser Coho, there may be specific areas that, if damaged or destroyed, would jeopardize the survival or recovery of the COSEWIC designated unit or any of its constituents. These specific areas constitute important habitat for Interior Fraser Coho.

Important habitat is the minimum extent and configuration of habitat throughout the life history of each population of Interior Fraser Coho that is necessary to provide an acceptable probability that these fish will survive or recover according to specified recovery objectives. Although it follows that certain quantities of habitat at each life history stage are important, in practice it is difficult to identify these habitats.

Fisheries and Oceans Canada’s understanding of important habitat for Interior Fraser Coho will improve as more effort and time is spent studying the interior Fraser River watershed. For the survival and recovery of the designated unit, populations and sub-populations must not become isolated from each other and habitats suitable for coho salmon rearing and reproduction must remain connected.

Given these requirements, three areas were identified by the IFCRT to initially focus on when important habitat is identified in a program planning stage; future work may identify other areas:

- That portion of the Nahatlatch River above Frances Lake to the confluence of the Nahatlatch River and Mehatl Creek,
- The Fraser Canyon in the vicinity of the Hells Gate fishways, and
- The North Thompson River in the vicinity of Little Hells Gate.

The Fraser Canyon population would lose more than 90% of its spawning habitat, and may no longer be viable if the Nahatlatch River above Frances Lake was damaged. Similarly the viability of one or more populations would be threatened if coho were unable to access spawning areas upstream of Hells and Little Hells Gate. Additional studies are needed to determine whether these and other freshwater, estuarine, and marine areas constitute important habitat.

The habitat protection goal is the maintenance of the function of these areas rather than simply maintaining the particular physical attributes of the landscape needed by the individual species. All habitat identified as important is essential to the survival and recovery of a species. Also, the full spectrum of protection and management measures will be required to ensure that there is no negative impact upon important habitat. Important habitat should be further identified during future phases of recovery planning.

In this context, protection has been defined as those measures and mechanisms that can reasonably be expected to protect important habitat from alterations that would reasonably be expected to reduce the capacity of important habitat to provide for the recovery and survival of a species.
It is important to clearly understand the distinction between the definitions of “habitat” and “important habitat” as noted above.

ł Feasibility of Recovery
It is stated in a draft policy on the feasibility of recovery that recovery feasibility shall be based on specific criteria and must be defensible (Government of Canada 2004). It also states that the recovery of a species is feasible if:

- individuals capable of reproduction are currently available to improve the population growth rate or population abundance;
- sufficient and suitable habitat is available to support the species or such areas can be made available through habitat management or restoration;
- significant threats to the species or its habitat can be avoided or mitigated through recovery actions; and
- necessary recovery techniques exist and are effective.

The feasibility of recovery of the Interior Fraser Coho designated unit is based on the background information presented in the COSEWIC status report (Irvine 2002), further information presented in this report, and the professional opinions of Interior Fraser Coho Recovery Team members.

Following the review of the available data, the recovery team concluded that there are enough coho salmon, capable of reproduction, to increase the abundance of the Interior Fraser Coho populations, and that there is sufficient and suitable habitat available to support Interior Fraser Coho. The IFCRT also concluded that the significant threats to Interior Fraser Coho and its habitat can be avoided or mitigated through recovery actions, and that recovery techniques exist and are effective. Thus, it is feasible to recover Interior Fraser Coho.

ł Recommended Scope of Recovery
The scope of recovery of Interior Fraser Coho will be determined by the willingness of affected persons, communities, and industrial operations to undertake those measures required for recovery at the population and sub-population levels. If it is possible to maintain the functions of sufficient habitat within the range of each of the 11 sub-populations, then it may be feasible to recover the entire designated unit to a level where all populations and sub-populations are able to maintain themselves through periods of poor ocean survival. Conversely, without ongoing commitments to provide adequate water and functioning habitats, the recovery of some of the sub-populations is unlikely.
Recovery Goal

The recovery goal is to secure the long term viability of naturally spawning coho salmon within the interior Fraser River watershed.

Recovery Principles

To guide the development of recovery objectives, three principles apply:

- **Principle 1**: The recovery of Interior Fraser Coho will require the maintenance of sufficient levels of abundance and spatial diversity to achieve the recovery goal.
- **Principle 2**: The spatial structure and distribution of Interior Fraser Coho will be considered at the level of populations and sub-populations.
- **Principle 3**: The recovery goal is considered achieved when there are one or more viable sub-populations in each of the five populations.

The term “viable” in Principle 3 means that the abundance and productivity of the individual sub-populations are sufficient for them to persist over the long term, i.e. an average human life time. Viability is achieved by establishing minimum population abundance levels and by ensuring that habitat conditions and fishing mortality are adequate to sustain long-term productivity.

A provisional operational rule for application of Principle 3 is that for each of the five populations, at least half of the sub-populations within each population must be viable.

Recovery Objectives

The following objectives need to be achieved in order for Interior Fraser Coho to be considered to have met the recovery goal.

**Objective 1**: The 3-year average escapement in at least half of the sub-populations within each of the five populations is to exceed 1,000 wild-origin spawning coho salmon, excluding hatchery fish spawning in the wild. This represents a total Interior Fraser Coho spawning escapement of 20,000 to 25,000 wild-origin coho. This objective is designed to provide the abundance and diversity required to satisfy the recovery goal.

Bradford and Wood (2004) review the literature and theory involved in establishing minimum viable population sizes and recovery objectives.
Objective 2: Maintain the productivity of Interior Fraser Coho so that recovery can be sustained. This objective is designed to ensure that the threats to recovery are addressed.

This objective may be met by addressing the causes for the decline that were identified by COSEWIC:

- Development of a harvest management plan to ensure that exploitation rates are appropriate to changes in productivity caused, for example, by fluctuations in ocean conditions.
- Identification, protection, and, if necessary, rehabilitation of important habitats.
- Ensure that the use of fish culture methods is consistent with the recovery goal.

Possible Longer Term Objectives: Over the long term it may be desirable to recover Interior Fraser Coho so that other societal objectives can be achieved. Examples of this type of objective have been identified, but determination of the appropriateness of such is beyond the mandate of the Recovery Team (see Section 3.3)

Genetic Issues

There are genetic consequences to small population sizes that might affect the long-term viability of Interior Fraser Coho. Reductions in population size can result in the loss of genetic diversity, and small populations can suffer from the cumulative effects of inbreeding. There is scientific debate over the number of effective breeders required in a population to maintain long-term genetic variation, but the range is approximately 500 to 5,000 individuals. Under ideal conditions, an abundance level of 1,000 spawners in each of the five populations of Interior Fraser Coho would likely be adequate.

However, some Interior Fraser Coho populations encompass a large geographic area and a population of 1,000 spawners could be fragmented into small groups isolated by distance. Because of the fragmentation of Interior Fraser Coho populations into small groups, the 1,000 spawner recommendation may be too small to maintain genetic diversity.

Demographic Issues

Small populations are at risk of becoming extirpated because of chance events, or because of their reduced capacity to survive periods of poor environmental conditions. The analyses conducted to date suggest that if a sub-population has a reasonable expectation for growth, an initial size of 1,000 spawners annually would be adequate for survival and recovery. However, salmon populations are inherently variable and it is unlikely that all 11 sub-populations would have the same status at any one time. The application of Recovery Principle 3 and Objective 1 (see above) suggest that at least half of the
sub-populations within each of the five Interior Fraser Coho populations should be viable in order to meet demographic needs.

- **Application of Abundance Recommendations to the Recovery Objectives**
  
  There are additional factors when considering an abundance-based recovery goal for Interior Fraser Coho. These are:
  
  - The 11 sub-populations are different in geographic size, and historically have differed considerably in abundance. Thus, some sub-populations are more likely to recover than others.
  - The recovery objective is to be expressed as the number of spawners for the whole designated unit (DU). This number is greater than a minimum value of 7,000 spawners (the minimum number of fish in the minimum number of viable sub-populations).

  An evaluation of the performance of Objective 1 was undertaken using historical data. In particular, the relation between the abundance of fish in individual sub-populations and the total DU abundance was examined. An analysis of the geometric mean wild-origin spawner abundance for the 11 Interior Fraser Coho sub-populations for the period 1998 through 2003 indicates that while there has been considerable variation in the average size of each sub-population, nearly all have been near, or above, the 1,000 fish objective. Over that same period, with the exception of the Upper Fraser population, there appears to be at least one relatively dominant sub-population within each population. These data provide evidence that Recovery Objective 1 has, on average, been achieved. The data also indicate that Recovery Objective 1 is realistic and may be achievable if Recovery Objective 2 is implemented.

- **Performance of Recovery Objective 1 using 1975-2003 Data**

  The historical data can also be used to find the total abundance level that will lead to the achievement of Recovery Objective 1 of having at least half of the sub-populations in each population with a 3-year mean escapement of at least 1,000 wild-origin spawners. An analysis of these data shows that the number of sub-populations that falls below 1,000 individuals increases significantly when aggregate DU abundance is less than 20,000 to 25,000 individuals. The analysis also suggests that when there were fewer than approximately 20,000 coho salmon spawners (3-year running geometric mean) in the DU, the recovery goal would not be met.

  Thus, the historical data suggest that a level of abundance of 20,000 to 25,000 wild-origin spawners in the Interior Fraser coho salmon designated unit is required to achieve Recovery Objective 1.
Approaches to Meeting Recovery Objectives

Approaches to addressing each of the potential threats to recovery are discussed below. The key threats to recovery are harvest, climate change, habitat change, and hatchery production (see section 1.7). Approaches to minimize the impact of each of these threats are:

- **Harvest.** Establish exploitation rates based on survival and abundance forecasts and define conservative escapement goals.
- **Climate change.** Recover all sub-populations so that the probability of remaining viable during periods of climate-related low marine and freshwater productivity is increased.
- **Habitat Change.** Maintain functionality and productivity in as many habitats as is feasible. In addition, investigate the relationship(s) between habitat types and coho salmon throughout their life history in order to assist in the determination of important habitat requirements.
- **Hatchery Production.** Where appropriate, use hatchery production as part of the conservation strategy, as well as for assessment of abundance and survival. Hatchery production should be monitored and minimized to reduce possible genetic and competitive impacts, and, finally, mass marking of selected hatchery releases should be continued to assist in addressing harvest concerns.

Control of exploitation

Southern BC origin coho salmon, particularly those from the interior Fraser River, were at a low level of abundance in 1997 and a series of comprehensive fishery management measures were implemented. In 1998, Fisheries and Oceans Canada (DFO) announced that the objective of their fishery management actions would be to produce no mortality on Thompson River coho salmon, a sub-set of Interior Fraser Coho. The reductions in exploitation initiated in 1997 have been maintained; however, even at the relatively low current exploitation rates (approximately 13%, Canada and U.S. combined) and recent survival rates, the long term probability of wild escapements falling below recent levels is greater than 50%, while, over the short term, the probability of positive growth is 64%. The survival potential for Interior Fraser Coho increases marginally if exploitation is decreased from the current level; however, a decrease in current Canadian exploitation rates would have very little impact upon recovery. The recovery of Interior Fraser Coho to historical levels is highly sensitive to marine survival rates. Specific fisheries management actions to ensure that exploitation rate ceilings are not exceeded (including specific selective fishing practices for Interior Fraser Coho) are currently set out in the Pacific Salmon Integrated Fisheries Management Plan on an annual basis. Restrictions on exploitation rates should continue until there is an increase in survival rates and an increase in the numbers of spawning Interior Fraser Coho.
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