Fisheries and Oceans Canada
Pêches et Océans Canada

POLICY COMMITTEE DRAFT

Wild Salmon Policy: A New Direction

Fisheries & Oceans Canada
April 1999

Canada

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INTRODUCTION

On October 14, 1998, the Minister of Fisheries and Oceans Canada established a "New Direction for Canada's Pacific Salmon Fisheries." The New Direction focuses on conservation, sustainable use, and improved decision making. Its 12 general principles set out a broad policy framework under which specific operational policies and guidelines for managing Pacific salmon will be developed. To date, policies have been developed for Salmon Allocation and Selective Fisheries and one on Improved Decision Making will follow later.

A Wild Pacific Salmon Policy is needed to protect and conserve Canada's natural heritage for current and future generations. Wild salmon are affected by many factors including fisheries, habitat loss or degradation, various forms of salmon cultivation, and climate change. Throughout the past century, humans have attempted to artificially increase salmon abundance by intervening in the natural processes that regulate salmon abundance. Despite these efforts, the total abundance of Pacific salmon in the North Pacific has begun to decline and catches are increasingly supported by artificially cultivated salmon. Cultivated salmon are neither a remedy for declining wild salmon abundance nor a substitute for lost wild salmon habitat. A new conservation ethic is needed to protect wild Pacific salmon and their habitat from further irreversible depletion and to conserve their genetic diversity for future generations.

This document describes the approach that Fisheries and Oceans Canada will follow to conserve wild Pacific salmon. It contains: (1) background information about emerging international commitments to conserve the diversity of the world's biological resources; (2) a description of the major factors that are affecting the long-term viability of wild Pacific salmon; (3) overarching principles to guide the conservation and management of wild Pacific salmon; and (4) the work required to turn principle into practice.

DEFINITIONS*

* Sources of the definitions are footnoted in the Glossary appended to this document.

The study and practice of salmon conservation biology has its own language and at times there can be a lack of consensus among experts about the meaning of some words. Consequently, it is difficult to discuss salmon conservation without being specific. To assist readers, a glossary of common terminology is appended to this document and the following key words are defined:

Biological diversity means the variability among living organisms from all sources - including terrestrial, marine, and other aquatic ecosystems - and the ecological complexes of which they are a part. This includes diversity within species, between species and of ecosystems.[1]

Benefit considers the role of wild salmon in ecosystems as well as to humans through consumptive and non-consumptive uses.[2]

Conservation is the planned management of natural resources; the retention of natural balance, diversity and evolutionary change in the environment.[3]

Conservation unit is a group of one or more local populations that share a common genetic lineage and can be managed effectively as a unit by virtue of their common productivity and vulnerability to existing fisheries. [2]

A *cultivated* species or population is one that is propagated completely or in part by ongoing human intervention to increase production or meet other human needs.[2]

Extirpation is the extermination of a population of a species from a given area.[3]

Fish habitat means natural spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes.[4]

Intervention means the application of technology to the objective of artificially increasing salmon survival and abundance.[2]

Local populations are groups of one or more subpopulations that are relatively isolated from other such groups and are likely adapted to the local habitat.[5] Throughout this paper, the use of the word *population*, unless qualified, is equivalent to a local population.

Optimum means the best that can be achieved under the influence of conflicting factors.[2]

Precautionary approach is a concept that was enshrined in Principle 15 of the Rio Declaration of the UN Conference on Environment and Development which states: "*In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*"[6]

Subpopulations are groups of spawners that are partially isolated from other such groups and may be adapted to the local habitat.[5]

Stock is the part of a fish population which is under consideration from the point of view of actual or potential utilization.[7]

Sustainable use means the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.[1] Sustainable is not meant to imply that abundance is constant.

A *wild salmon* is a salmon produced by natural spawning in fish habitat from parents that were spawned and reared in fish habitat.[2]

A *wild salmon population* is a local population comprised of naturally spawning and rearing wild salmon.[2]

Use of fish *stock* is specifically avoided in this document. Scientific and technical advances during the past decade have greatly improved

knowledge of the genetic diversity of salmon populations. Salmon DNA has lasting value because it survives from one generation to the next and serves as the basis for future evolution and adaptation of the species. Changes to the salmon genome affect future generations of salmon. In practice, *stock* was loosely defined for Pacific salmon and did not have a strong genetic emphasis. Stocks were generally groupings of Pacific salmon to be fished, not necessarily conserved. This document focuses salmon conservation on the genetic diversity of local populations. By using the word 'stock' sparingly, if at all, in this paper, the intent is to change the way salmon conservation is viewed.

GLOBAL CONSERVATION ETHIC

World governments have recognised that humans are affecting the diversity of plant and animal life on Earth. In 1992, the United Nations (UN) *Convention on Biological Diversity* was signed by the Government of Canada and other world nations to ensure the conservation and sustainable use of biological resources. It requires governments to integrate the principles of the Convention into national policies and legislation. **The ultimate goal of the Wild Salmon Policy, consistent with the Convention, is to ensure the long-term viability of Pacific salmon populations in natural surroundings.**

Global efforts to address common fisheries problems have a long history. The UN Convention on the Law of the Sea was adopted in 1982 to provide an international framework for the development and use of global marine resources. Recognition that over-exploitation threatens many of the world's fisheries stimulated a new conservation ethic. International organisations have been developing and promulgating new conventions, policies, and guidelines that promote conservation in the management of domestic and high seas fisheries. As a signatory, the Government of Canada is enacting legislation that reflects these new international agreements.

The *precautionary approach* to fisheries management is a concept that has achieved global recognition. The UN advises that *"management according to*

the precautionary approach exercises prudent foresight to avoid unacceptable or undesirable situations, taking into account that changes in fisheries systems are slow to reverse, poorly understood, difficult to control, and subject to shifts in the environment and in human values." International guidelines for implementing the precautionary approach are now widely accepted and their application to salmon is the subject of considerable interest and debate within the scientific and fisheries management communities. Within Canada, the Oceans Act (1997) provides the legislative framework to apply the precautionary approach to the management of Canada's coastal marine resources through Integrated Management (IM). The goals of IM include:

- conservation, based on an ecosystem approach, for the purposes of maintaining biological diversity and productivity of coastal environments and preserving ecosystem health;
- sustainable use of coastal resources; and
- economic diversification and the generation of wealth for the benefit of all Canadians, and in particular, coastal communities.

Canada played a key role in the development of UN Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries. The Canadian fishing industry is committed to the achievement of sustainability in marine and freshwater fisheries. It has developed a Code of Conduct for Responsible Fishing Operations as an essential step in pursuit of this objective. These codes are non-binding agreements that encourage responsible fishing practices that will contribute to the conservation of stocks and the protection of aquatic environments.

REVIEW OF FACTORS AFFECTING CONSERVATION OF WILD SALMON

Fisheries- Pacific salmon fisheries typically catch maturing salmon that are returning to spawn in rivers and streams. It is generally considered that *within reason* harvests can be sustained without harming the potential for future harvests. This has been reinforced by a common theory about salmon productivity: there can be too many spawners and that reducing the number of spawners may be good for both the salmon and the fishers. Historical catch and escapement data have been combined with theory to estimate an 'optimum' number of spawners, recognizing that any

abundance greater than the optimum may be harvestable. It has also been believed that overfishing could occur if more fish were allowed to spawn at a later date. During the past decade, it has become evident that there is much more to consider.

Salmon play an important role in maintaining ecosystems. Their carcasses bring food and nutrients from the sea to terrestrial and freshwater ecosystems. For example, if half of the fish are caught in fisheries, then half of their nutrients are lost from these ecosystems. The act of spawning cleans the gravel. The juveniles provide food for predators and affect the abundance of their prey populations. The ecosystem linkages among salmon and other species are extensive. This calls into question the common theory regarding the concept of overspawning.

Another problem with salmon fisheries is that they typically catch mixtures of different salmon populations (and species) in the same place. Fisheries that selectively harvest species are being implemented, but it is very difficult to selectively harvest populations within a species unless they have a unique timing or distribution. What might be an optimum harvest rate for productive populations will be excessive for less productive populations when fished in a mixture. Unless it is possible to selectively harvest productive populations, the overall rates of harvest must be reduced to ensure the conservation of weaker populations. Salmon cultivation has the potential to create fisheries on mixtures of wild and cultivated populations (or species). For example, the success of artificial spawning channels to increase the abundance of Skeena River sockeye salmon attracted significant fishing effort which ultimately contributed to the decline of co-migrating upper Skeena River coho. Similar factors may have contributed to the declines of Strait of Georgia coho and upper Fraser coho salmon. The Selective Fisheries paper deals with approaches to this issue in more detail.

Habitat - The health of Canada's fisheries resources depends on the availability of productive fish habitat. Fisheries and Oceans Canada has the legislative authority under the *Fisheries Act* to ensure that fish habitat is

protected. At the same time, the Constitution grants other levels of government control over activities on land that can affect fish habitat such as forestry, mining and urban development. Fisheries and Oceans Canada has a long-term policy objective, outlined in the "Policy for the Management of Fish Habitat", to achieve an overall net gain in the productive capacity of fish habitats. The guiding principle of No Net Loss is a fundamental component of the habitat policy, ensuring that fish habitat is conserved. Nevertheless, it is known that freshwater habitat loss is a major problem that is contributing to the declining abundance of Pacific salmon. However, the extent of the loss is not fully understood. Thus, preserving salmon habitat requires the shared vision, commitment and cooperation of all levels of government, industry, First Nations, and the general public. There is also a growing recognition that there is also a distinct ocean habitat which can limit salmon abundance and which can be affected by human influences on climate.

Salmon cultivation – Cultivation is an important component of both regional salmon fisheries management and salmon aquaculture, but a Wild Salmon Policy must guard against all processes that threaten the long-term viability of wild populations. Culturing of salmon by hatcheries and captive breeding, for example, can influence the evolutionary process and erode the genetic adaptation of salmon to their natural habitat in three different ways - through hybridisation, artificial selection, and inbreeding. Hybridisation of wild and cultivated populations may break up the favourable combinations of genes that have evolved over many generations through natural selection in local habitats. Similarly, relaxed selection or inadvertent domestication in artificial habitats will favour new combinations of genes that are unlikely to be favourable in the natural habitat. Artificial selection poses the greatest threat to genetic diversity where cultivation continues for many generations, affects many life stages, and greatly reduces mortality from levels sustained in nature. Cultivation can erode genetic diversity through inbreeding if too small a fraction of the wild population is used as broodstock.

Although most negative effects of hybridisation and inbreeding can be avoided by careful choice of broodstock and mating schemes during

artificial propagation, it is impossible to avoid some degree of artificial selection during cultivation. Some studies suggest that there are genetic effects after only a single generation in a hatchery. Moreover, stray spawners from large hatcheries can adversely affect the genetic adaptation and genetic diversity of neighbouring wild populations. In short, the conservation of wild Pacific salmon requires a conscientious effort to minimize the potential for interactions between wild and cultivated salmon. This will require careful review of all new proposals involving artificial propagation, with attention to location and scale and strict adherence to guidelines and protocol to minimize adverse genetic impacts for both new and existing projects.

With respect to salmon aquaculture, Pacific salmon (mostly chinook) and Atlantic salmon escape accidentally from net pens in BC and Washington State. They are caught in relatively small numbers throughout the northeastern Pacific Ocean. The distribution of farmed chinook and coho salmon that escape is largely unknown because they can be difficult to distinguish (visually) from wild salmon. Pacific salmon that escape from net pens may compete with wild salmon for food, territory or mates, and interbreeding between wild and domestic Pacific salmon can decrease the fitness of the wild salmon. The effects of interbreeding with farmed Pacific salmon may be greater than the effects of interbreeding with hatchery-reared Pacific salmon because the potential for artificial selection is greater in aquaculture. Farmers are intentionally selecting for characteristics that are more desirable in culture whereas hatcheries have guidelines that attempt to minimize this effect. Escapes of exotic species (Atlantic salmon) in the Pacific Ocean will not have the same genetic implications for Pacific salmon, but they may compete for food or territory if they occur in sufficient numbers.

Climate change – Through much of the past 50 years or more, the environment was assumed to have a random effect on salmon abundance from year to year, lacking trends and sudden shifts. It is now recognized that conditions can change dramatically and that these anomalies tend to persist in a predictable way. The most dramatic change in the climate of the Northeast Pacific occurred during the late 1970s. Evidence of this change is

apparent in almost every historical climate and oceanographic record in the region. At the same time, widespread changes in salmon abundance occurred, particularly in Alaska. Salmon abundance in the North Pacific has been shown to persist at high levels for many years before switching rapidly. How climate change will affect Pacific salmon in BC and the Yukon is not known for certain, but for example, some of the most extreme temperatures and flows in the Fraser River have occurred during the last few years. These extreme events have reduced the number of salmon reaching the spawning grounds.

Lack of information - There are several major areas where a lack of information threatens the conservation of wild salmon. In the face of uncertainty, decisions that affect wild populations need to be made very cautiously such that errors will not compromise the achievement of conservation objectives.

Each year, the abundance, timing, and migration routes of hundreds of salmon populations are uncertain. Fisheries & Oceans Canada has been able to recognize and adjust to this uncertainty when the conservation objectives were fairly simple and fisheries focused on the production from large salmon producing rivers. However, conservation success will increasingly be measured by how well smaller (or once large) populations are managed and conserved. Increasing complexity in the rules of harvest and uncertainty about the nature of the harvest can threaten conservation.

The interactions between wild and hatchery salmon are largely unknown and the long-term consequences of human attempts to increase the abundance of salmon have not been adequately evaluated. Although their objectives have changed since 1980, the original primary objective of the Salmonid Enhancement Project (to double salmon abundance by 1990) was not met, and attempts to reach it may have had some undesirable side effects. If hatchery salmon are replacing wild salmon, they constitute a threat to wild salmon conservation. However, the basic information needed to thoroughly assess this is not generally available because of technical difficulties in identifying wild and hatchery salmon and limited

resources to study the issue. The magnitude of genetic changes to wild populations from human intervention is also unknown.

What is the best way to manage wild salmon populations when the coastal climate and environment is more extreme than previously observed? This largely depends on whether the changes are beneficial or not. The most recent years have been characterized by extremes in ocean temperature (high), sea levels (high), river discharges (high and low), and river temperatures (high). Uncertainty about effects of climate change adds substantial risk to salmon conservation.

BIODIVERSITY AND WHAT TO CONSERVE?

Pacific salmon are anadromous fishes. They begin life in freshwater, migrate to sea to feed, and return to spawn in the lake, river or stream where they were hatched. Their remarkable ability to return to their natal stream is called homing. Precise homing creates local populations, affording an opportunity for genetic adaptation whereby inherited traits improve survival (productivity) in the local environment. These local adaptations can be very important and explain why it is so difficult to establish new populations by transplanting eggs or juveniles from one location to another. The evolution of local genetic adaptations gives the conservation of Pacific salmon its uniquely complex character.

On the other hand, homing is not perfect and small numbers of salmon are known to stray to locations other than their natal streams. The magnitude and extent of straying partially determines a population's genetic structure - who shares what genes. Much of today's research on population structure in Pacific salmon is concerned with where to draw the line that separates one local population from another. Where the line is drawn can influence the intensity of conservation efforts. A recent publication summarizes the current views:

> There is no "correct" answer to the question of precisely how much biological diversity and population structure should be maintained or can be lost to provide a long-term future for salmon. Scientific estimates–

> including uncertainties associated with them, are only part of the argument. Society must decide what degree of biological security would be desirable and affordable if it could be achieved, i.e., the desired probability of survival or extinction of natural populations, over what time and what area, and at what cost. Nonetheless, biological diversity and the structure of salmon populations are being lost at a substantial rate, and this loss threatens the sustainability of naturally reproducing salmon populations in the Pacific Northwest. (taken from *Upstream: salmon and society in the Pacific Northwest*, 1996, Committee on Protection and Management of Pacific Northwest Anadromous Salmonids, National Academy Press, Washington D.C.).

The ultimate goal of a Wild Salmon Policy is to ensure the long-term viability of Pacific salmon populations in natural surroundings. Accordingly, this paper includes overarching principles designed to protect the genetic adaptations that are the basis for the long-term viability of naturally-spawning Pacific salmon populations and to support existing salmon habitat policies which guard against the irreversible loss of fish habitat.

PRINCIPLES FOR WILD SALMON CONSERVATION

The principles outlined below were developed to guide decisions and activities that will affect the future conservation of wild Pacific salmon. These principles describe a fundamental commitment by the Fisheries and Oceans Canada to protect a valuable national resource and its habitat for the benefit of current and future generations of Canadians. The interpretation and implementation of these principles will be based on emerging knowledge in conservation biology, population genetics and risk management.

WILD SALMON PRINCIPLE ONE: WILD PACIFIC SALMON WILL BE CONSERVED BY MAINTAINING THE GREATEST DIVERSITY OF LOCAL POPULATIONS IN THEIR HISTORICAL RANGE.

Local salmon populations have evolved in different habitats to be genetically different from each other. Scientists have identified direct evidence of genetic differences among populations by examining their DNA. Differences among populations also appear in the variability of many biological characteristics (body size, shape, age at maturity, run timing, etc.). Natural selection tends to favour salmon that are best adapted to their habitat and different characteristics are favored in different habitats. Therefore, the diversity of habitats and the diversity of genetic adaptations of salmon to those habitats are the basis of their future survival, adaptation and evolution. The potential for sustained benefits to the people of Canada is maximized by maintaining the greatest genetic diversity of salmon populations in the greatest number of habitats. This will guard against the potential consequences of a changing climate and an uncertain future. Preservation of the quality and diversity of salmon habitat, and providing access to it, should be the primary consideration of a strategy to conserve the diversity of wild salmon.

Anadromous Pacific salmon are not known to have occurred in every river, stream or lake. Clearly, there are many examples where Pacific salmon were known to have occurred but they disappeared for any number of reasons. Wild salmon conservation may include re-introducing salmon species into ecosystems where they were formerly known. Wild salmon conservation will not extend to introducing Pacific salmon into ecosystems where they have not been known to occur. The latter is an intentional introduction of an exotic fish into a natural ecosystem. The consequences of introductions and re-introductions must consider more than the harvestable salmon biomass that may result from such introductions.

WILD SALMON PRINCIPLE TWO: WILD PACIFIC SALMON WILL BE MANAGED AND CONSERVED AS AGGREGATES OF LOCAL POPULATIONS CALLED *CONSERVATION UNITS*.

Because wild salmon populations intermingle in rivers and oceans, most salmon fisheries harvest mixtures of populations and species. The Selective Fishery paper describes new initiatives to selectively harvest different species. However, local populations within a species can differ markedly in

their ability to tolerate harvest. Therefore, uncertainty about the composition and productivity of salmon populations in a mixture that is being fished is a threat to conservation. It is very difficult to selectively harvest one wild population from a mixture of wild populations unless they have unique timing or distribution. Conserving wild salmon in the presence of fishing must consider the consequences of imperfect knowledge of the composition and productivity of co-migrating populations so that fisheries can be regulated in a precautionary manner to meet conservation goals.

Conservation units will be defined by considering: (1) the genetic diversity of wild salmon populations; (2) variations in productivity among local populations; and (3) the characteristics of fisheries and the feasibility of management. Because the biology and diversity of wild salmon differs among and within species, and because the fisheries that exploit them are also variable in nature and scope, conservation units will differ in size and complexity. A conservation unit may vary from a single local population (Harrison River white chinook) to more broadly-defined aggregates of local populations (West Coast Vancouver Island coho), or they may focus on a certain unique life history type (river-type sockeye). Identifying conservation units for each species will be the subject of ongoing investigation and will be modified in future as appropriate.

WILD SALMON PRINCIPLE THREE: MINIMUM WILD SALMON ABUNDANCE LEVELS WILL BE ESTABLISHED FOR POPULATIONS WITHIN EACH CONSERVATION UNIT TO AVOID EXTIRPATION OF LOCAL POPULATIONS.

Sufficient reproduction must occur annually in each conservation unit and the reproductive effort must be adequately distributed within the conservation unit. In the language of the precautionary approach, the minimum abundance level is a Limit Reference Point (LRP) defined as the minimum abundance that must be maintained to ensure conservation. Any human activity that reduces wild salmon abundance below an LRP is not consistent with ensuring conservation. Sufficient access to fish habitat must be ensured for reproduction and rearing.

Key decisions about the conservation of wild salmon will frequently be based on estimates of the magnitude of the annual number of spawners or some similar indicator of abundance. This number is known reliably for only a few populations. Obtaining precise and accurate counts of the number of spawners is a challenging task. A system of indexing abundance must be developed to estimate abundance where populations are not measured or poorly measured. Exercising the precautionary approach requires greater limitations on consumptive uses of the resource when a lack of information prevails.

WILD SALMON PRINCIPLE FOUR: ABOVE THE LIMIT REFERENCE POINT, ABUNDANCE TARGETS IN EACH CONSERVATION UNIT WILL BE ESTABLISHED AND FISHERIES WILL BE MANAGED TO OPTIMIZE BENEFITS TO THE PEOPLE OF CANADA.

Salmon abundance below the minimum LRP should not be the result of fishing. Above minimum LRP levels, *abundance targets* will be established in each conservation unit through consultation with interested parties, ultimately to achieve levels that meet the objective of optimal productive capacity. The rate at which these targets are achieved may vary among conservation units. The establishment of these targets should consider: (1) the factors that limit salmon production in freshwater and marine ecosystems; (2) the social and economic value to humans; and (3) the precautionary approach.

WILD SALMON PRINCIPLE FIVE: STRATEGIC INTERVENTION MAY BE USED WHEN NECESSARY TO PRESERVE POPULATIONS AT GREATEST RISK OF EXTINCTION.

Genetic diversity and fitness are threatened by chance events whenever local population abundance declines to critically low levels. Under these circumstances, short-term intervention to increase abundance will be beneficial if the genetic changes that result from the intervention are less detrimental than the genetic changes that occur from continued low abundance. Technologies such as captive broodstock, gene banking, and

culture may be used strategically to prevent loss of genetic diversity at critically low abundance. Strict guidelines are required to ensure that these technologies do not result in irreversible negative impacts.

WILD SALMON PRINCIPLE SIX: CONSERVATION OF WILD SALMON POPULATIONS WILL TAKE PRECEDENCE OVER OTHER PRODUCTION OBJECTIVES INVOLVING CULTIVATED SALMON.

Humans have attempted to increase their harvest of salmon by, for example, building hatcheries and spawning channels and by fertilizing lakes. These interventions are considered important components of fisheries resource management in the region, and total annual releases of hatchery-reared salmon throughout the North Pacific are measured in the billions. However, artificial salmon production can have ecological effects on naturally rearing wild salmon and can affect the genetic diversity of populations. Theory and recent evidence suggest that the potential for adverse impacts is more serious than previously recognized. *"We are unaware of rigorous research designed to detect genetic impacts that has failed to find them."* (Busack & Currens, American Fisheries Society Symposium, 1995). Given this uncertainty, a precautionary approach is necessary.

The greatest increases in world salmon harvests have come from aquaculture. In 1998, wild plus hatchery salmon catches in BC were approximately equivalent to farmed salmon harvests. The intentional releases of cultivated salmon from hatcheries are currently orders of magnitude greater than the accidental releases from salmon farms although the consequences of the latter have attracted more public attention. The Environmental Assessment Office (EAO) of the Government of BC recently concluded that there is no reason to expect that Atlantic salmon are having a significant effect on Pacific salmon at current levels of abundance. Should this situation change, the Convention on Biological Diversity advises that introductions of alien species that threaten ecosystems, habitats or species should be controlled or eradicated. The EAO also noted that the fate of farmed chinook and coho salmon after escaping is not well known and may constitute a greater threat to wild salmon than Atlantic salmon

because they are native and can successfully interbreed. Therefore, abundant escapes of farmed Pacific salmon should be considered a threat to wild salmon conservation.

NEXT STEPS

INFORMING THE PUBLIC

This Wild Salmon Policy document is being widely distributed to stakeholder groups and made available to the general public. Copies of the document are available on the internet at _____ and at Fisheries and Oceans Canada offices throughout BC and the Yukon. Comments from all interested parties are welcome and can be provided through e-mail to _____ or in writing to _____.

REGIONAL REVIEW OF GUIDELINES

Fisheries and Oceans Canada will undertake a review of all existing regional operational guidelines as they relate to the Wild Salmon Policy including for example, guidelines relating to enhancement, genetics, captive broodstock, and transplants. New guidelines will be developed as required.

Cultivation of salmon through artificial propagation has been a major component of fisheries resource management in British Columbia for the past 25 years. Delivered primarily through the Salmonid Enhancement Program (SEP), enhancement has been used as a tool for conservation and stock rebuilding, and for maintaining and contributing to fishery opportunities. Taking a precautionary approach, the role of enhancement in conserving and rebuilding populations or in providing fishing opportunities will be assessed within the context of the Wild Salmon Policy. Guidelines relating to enhancement will be reviewed and made consistent with the Wild Salmon Policy and the New Directions for the Pacific Region.

ADDRESSING UNCERTAINTIES THROUGH SCIENTIFIC RESEARCH

The measures outlined in the Wild Salmon Policy have been developed with the objective of ensuring the long-term viability of Pacific salmon populations in natural surroundings. However, the ultimate effectiveness of the policy in the long-term depends on how accurately today's knowledge reflects the state of nature and anticipates the future. Judgements about the relative magnitude of factors that can affect Pacific salmon conservation in the region are uncertain. The principles described in this document represent consensus views of fisheries scientists and managers, fish culturists and habitat managers about conserving wild salmon, but they still may be inadequate to provide long-term protection. As more is learned about the interacting effects of salmon cultivation, fishing, habitat and climate change, different approaches may be needed.

The Limit Reference Point is a new concept in salmon fisheries management and the methods of identifying an LRP to minimize the risk of extinction will be the subject of ongoing scientific research and development. Developing LRPs for salmon populations and metrics for determining population status will be challenging tasks. These elements are essential components of assessment frameworks that will be required for each conservation unit. DFO will undertake the development of assessment frameworks for all conservation units as resources permit. Interim *conservation units* and LRPs have been established to conserve coho salmon. Fisheries and Oceans staff will apply a similar process to the other species. These will be reviewed through PSARC (Pacific Scientific Advice Review Committee). In the interim, existing conservation goals may be used.

To reduce the uncertainty about annual salmon run strength and timing, Fisheries and Oceans staff will investigate new ways of integrating environmental and climate change data into predictive models.

Fisheries and Oceans staff will investigate the threat to wild populations associated with variations in the magnitude, frequency, location, and species of farmed fish escapes.

An international scientific symposium is being planned to review the most current information on factors affecting wild salmon conservation in the Pacific.

MONITORING, ASSESSING AND REPORTING

There is considerable uncertainty about factors that affect the abundance, survival and distribution of wild salmon. Thus, there must be some flexibility in the policy to allow for adjustments as new things are learned. There must also be a monitoring program that facilitates an ongoing evaluation of the effectiveness of the principles and to determine whether LRP or abundance targets have been achieved. A report on the state of wild salmon will be prepared for review every 3 years. The report will assess the impacts of freshwater and marine habitats on wild salmon, as well as an estimate of the percentages of hatchery and wild salmon in the ocean. The wild salmon policy is an adaptive policy that provides the stewardship to ensure that Pacific salmon can respond to natures challenges unencumbered by human intervention.

GLOSSARY

Anadromous[2] refers to the life history characteristic of some fish species that return from the sea to reproduce in freshwater.
Artificial selection – selection by humans; domestication; selective breeding…see also *Selection* (below).
Aquatic [3] Living in or near water.
Domestication[3] The adaptation of plants and animals for life in intimate association with man.
Ecosystem[3] is a community of organisms and their physical environment interacting as an ecological unit.
Fecund[3] means producing offspring, fruitful, proliferating.
Fitness[3] The relative competitive ability of a given genotype conferred by morphological, physiological or behavioural characters, expressed and usually quantified as the average number of surviving progeny of one genotype compared with the average number of surviving progeny of competing genotypes.
Genome[3] is the total genetic constitution of an organism.
Genotype[3] is the hereditary or genetic constitution of an individual.
Hybridisation[3] is any crossing of individuals of different genetic composition resulting in hybrid offspring.
Inbreeding[3] Mating or crossing of individuals more closely related than average pairs in the population.
Marine[3] Pertaining to the sea.
Migration[3] means the movement of an organism of group from one habitat or location to another.
Ocean ranching[2] is the release of cultivated juvenile salmon into the ocean to produce salmon for human use.
Reference point[6] is an estimated value derived from an agreed scientific procedure and/or and agreed model which corresponds to a state of the resource and/or of the fishery and can be used as a guide for fisheries management. Some reference points are general and applicable to many fish stocks, others should be stock-specific. A distinction should be made between *target* references points and *limit* references points, or thresholds, the latter representing low states of the stock to be avoided.

Refugia[3] Areas that escaped major climatic changes typical of a region as a whole and acts as a refuge for biota previously more widely distributed.
Selection[3] Non-random differential reproductive success of different genotypes in a population.
Spawning[3] The release of gametes or eggs into the water.
Species[3] A taxon of the rank of species; in the hierarchy of biological classification the category below genus; the basic unit of biological classification; the lowest principal category of zoological classification.
Terrestrial[3] Pertaining to, of living habitually on, the land or ground surface.

Sources of Definitions

1. United Nations Convention on Biological Diversity (1992).
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3. A Dictionary of Ecology, Evolution & Systematics, 2nd edition, Lincoln, Boxshall, Clark., 1998.
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5. Defining Conservation Units for Pacific salmon using Genetic Survey Data. Wood & Holtby, 1998, In Action before Extinction, World Fisheries Trust.
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