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Developing a wild salmon policy for Pacific Canada

Laura J. Richards

Fisheries and Oceans Canada
555 West Hastings St.
Vancouver, BC V6B 5G3
Canada

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Abstract

In March 2000, Fisheries and Oceans Canada released a discussion paper entitled "Wild Salmon Policy". The Wild Salmon Policy is one of a series of papers that establish a framework for managing Pacific salmon within Canada. Papers in the series provide operational policies and guidelines for priority issues, such as fishing sector allocations and selective fishing practices. The draft wild salmon policy is a science-based document that identifies the need to conserve the genetic diversity of wild Pacific salmon and to protect their habitat. The policy specifies a management system based on six principles that include the concept of limit and target reference points. With the release of the policy in March, Fisheries and Oceans Canada committed to a six-month period of extensive stakeholder consultations. The consultations will allow discussion of the principles and sharing of information on the impacts of the proposed policy on fisheries management practices. I discuss some of the scientific issues associated with development of the policy, the debates between scientists and fishery managers on the definition of reference points, and preliminary outcomes from stakeholder consultations. These issues are similar to those raised for other species in other jurisdictions. The draft policy and background information are available from www-comm.pac.dfo-mpo.gc.ca/wsp-sep-consult/

1. Introduction

Five major species of Pacific salmon (*Oncorhynchus* spp.) inhabit Canada's Pacific coast and are caught in commercial, recreational and First Nation fisheries. These species exhibit considerable variability in their life history. All are anadromous, spending portions of their life cycle in fresh water and the marine environment, and die after returning to spawn in fresh water.

The late 1980s and early 1990s were periods of high salmon harvests in the North Pacific. By the mid 1990s, however, conservation concerns had been identified for important stocks of sockeye, coho and chinook salmon. Under ocean survival conditions at that time, the abundance of some interior coho stocks was anticipated to continue to decline even without a fishery, putting some individual spawning populations at high risk of extirpation. In 1998, severe restrictions were placed on the Pacific salmon fishery to protect diminished stocks of coho salmon. These problems and other stock collapses worldwide sparked a renewed commitment to conservation and highlighted other problems in the fishing industry, such as overcapacity.

Since 1996, Fisheries and Oceans Canada has reduced the size of the Pacific salmon commercial fleet by nearly 50% and a program of policy development was initiated to lay the foundations for a restructured fishery. On October 14, 1998, the Minister of Fisheries and Oceans Canada released a policy statement entitled a *New Direction for Canada's Pacific Salmon Fisheries* (http://www-comm.pac.dfo-mpo.gc.ca/english/publications/alloc/st9808e.htm). The policy focused on conservation, sustainable use, and changes to the decision making process. Its general principles set out a broad policy framework under which specific operational policies and guidelines for managing Pacific salmon would be developed. The Wild Salmon Policy, which followed as a draft discussion paper in March 2000, is one of a series of papers that specifies these operational policies. Copies of the wild salmon policy are available on the internet at http://www-comm.pac.dfo-mpo.gc.ca/wsp-sep-consult.

With the release of the wild salmon policy in March, Fisheries and Oceans Canada committed to extensive stakeholder consultations. Facilitated sessions with over 20 groups were held in May and June 2000. These sessions included both special interest groups (commercial and recreational fishing, environmental groups, academics) and community forums. In addition, written comments were received via the internet. The consultations focussed on explaining the principles and included discussions on the potential impacts of the proposed policy on fisheries management practices.

In this paper, I review the background of the wild salmon policy and preliminary outcomes from stakeholder consultations. In particular, I discuss some of the scientific issues associated with development of the policy, and the debates between scientists and fishery managers on the definition of reference points. These issues highlight the practical concerns of implementing fishery reference points within a fishery management system as complex as Pacific salmon.

2. Overview of the draft Wild Salmon Policy

Wild Pacific salmon are affected by fisheries and human activities that degrade salmon habitat. Annual environmental variation and climate change also affect production. For example, marine survival of some stocks of coho salmon has declined by more than 50% over the last ten years. In this unpredictable environment, decisions about fishing, habitat development, and salmon cultivation must be made carefully. The wild salmon policy attempts to provide an explicit conservation framework to conserve the genetic diversity in wild Pacific salmon. The policy reinforces the commitment to the *National Policy for the Management of Fish Habitat* (http://www.ncr.dfo.ca/habitat/Policy/english/index_e.htm) to protect salmon habitat from irreversible depletion.

In Canada, the federal government has the responsibility and legislative authority under the federal *Fisheries Act* to ensure that Pacific salmon and their habitat are protected. At the same time, other levels of government have the legislative jurisdiction to control activities on land that can adversely affect fish habitat. Pacific salmon are also caught in fisheries that occur beyond Canada's national boundaries. The 1999 renewal of the Pacific Salmon Treaty with the United States provides greater assurance that conservation requirements for salmon will be met.

The primary goal of the wild salmon policy, consistent with the United Nations *Convention on Biological Diversity*, is to ensure the long-term viability of Pacific salmon populations in natural surroundings and the maintenance of fish habitat for all life stages. Accordingly, the wild salmon policy is intended to apply to all wild Pacific salmon including those mixed with cultivated (enhanced) populations that are able to reproduce in natural surroundings.

The draft wild salmon policy is a high level discussion paper, recognizing that more detail and operational policy will be required for implementation. Six guiding principles specify actions that will be taken to protect wild salmon. These principles form the basis of the policy. The principles and a short explanation follow:

Wild Salmon Principle One: ***Wild Pacific salmon will be conserved by maintaining diversity of local populations and their habitats.***

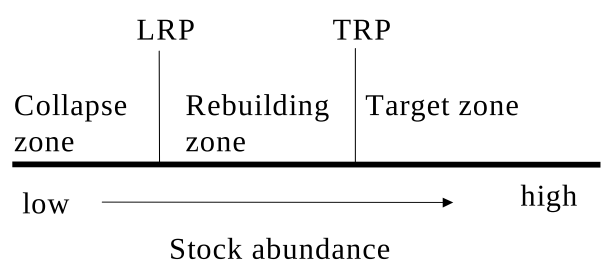
The preservation of the quality and diversity of salmon habitat, and its accessibility to salmon, should be the primary consideration of any strategy to conserve wild Pacific salmon. Implementation will be guided by the existing policy for the management of fish habitat.

Wild Salmon Principle Two: ***Wild Pacific salmon will be managed and conserved as aggregates of local populations called conservation units.***

Conservation units are defined as aggregates of closely related populations with similar productivity and vulnerability to fisheries. Thousands of local populations exist in British Columbia alone and it is logistically impossible to manage each population individually. Thus, the goal of maximizing sustainable benefits from local populations must be balanced against cost and practicality. By managing at the level of conservation units, the genetic diversity of local populations should be conserved. The actual number of conservation units will evolve as more is learned about salmon populations and as factors affecting these populations change.

Wild Salmon Principle Three: ***Minimum and target levels of abundance will be determined for each conservation unit.***

The precautionary approach to fisheries management requires that operational targets and constraints be expressed in measurable terms. Accordingly, a ***limit reference point*** (LRP) and one or more ***target reference points*** (TRP) will be specified for each conservation unit based on estimates of productive capacity. A total abundance above the TRP is in the “target zone”. A total abundance below the TRP but above the LRP implies that the conservation unit is secure but requires “rebuilding” to optimize sustainable production. A total abundance below the LRP implies a stock “collapse” and indicates that the long-term viability of the conservation unit is at risk.



Wild Salmon Principle Four: ***Fisheries will be managed to conserve wild salmon and optimize sustainable benefits.***

Management plans that maintain abundance in the target zone (or rebuild abundance to the target zone) should be specified for each conservation unit through pre-season consultation. Given the uncertainty in returning abundance, plans should include options based on a range of abundance forecasts or in-season measurements for the conservation unit. Objectives and corresponding harvest rules will be developed in consultation with First Nations and stakeholders, and in accordance with other policies.

Wild Salmon Principle Five: ***Salmon cultivation techniques may be used in strategic intervention to preserve populations at greatest risk of extirpation.***

Genetic diversity and fitness are threatened by chance events whenever local population abundance declines to critically low levels. Technologies such as fish culture, broodstock rearing, and gene banking could be used strategically to reduce loss of genetic diversity at critically low abundance. However, strict guidelines are required to ensure that these technologies do not adversely and irreversibly affect the long-term productivity of the conservation unit.

Wild Salmon Principle Six: ***For specified conservation units, when genetic diversity and long term viability may be affected, conservation of wild salmon populations will take precedence over other production objectives involving cultivated salmon.***

Inevitably, some forms of salmon cultivation will lead to ecological or genetic interactions between wild and cultivated salmon. These interactions may affect the genetic diversity and long-term viability of wild salmon. Accordingly, all proposals involving aquaculture and salmon cultivation must be reviewed carefully to minimize adverse effects on natural production.

3. Implementation issues raised during consultation

In this section, I report on some of the issues raised during consultation. At the time of writing this document (August 2000), First Nation consultations on the draft wild salmon policy are ongoing and will not be complete until late fall. Although consultations have been concluded with other stakeholders, a formal analysis of the results is not yet available. Thus, the statements here are preliminary and reflect some of the messages heard to date, but are not intended to represent a complete summary of the consultations. In particular, I attempt to portray the issues from a narrower scientific perspective and emphasize the issues of greater relevance to the ICES community.

Issue A: What is a conservation unit?

Pacific salmon have a high level of biological diversity, including small reproductively isolated spawning groups that are adapted to fine scale environmental differences. For example, Slaney et al. (1996) identified over 8000 Canadian “stocks” of the five main Pacific salmon species. Salmon “stocks” intermingle in the marine and freshwater environments en-route to the spawning grounds. These “stocks” are currently managed as large single-species aggregates, so that the less productive “stocks” within the aggregate tend to be overexploited relative to the more productive “stocks” in mixed stock fisheries. In the proposed policy, “stocks” are grouped into single-species conservation units that, in general, will be geographically smaller than the existing management units. The intent of the policy is to maintain genetic variation within conservation units by maintaining a network of these distributed local populations (Riddell 1993).

Stakeholders expressed concern about whether the available genetic data can accurately define conservation units and whether the concept provides adequate protection for all local populations. For example, if the conservation unit encompasses aggregates of local populations that differ in productivity, then harvest rules defined for the aggregate average will not provide sufficient protection to low productivity populations. Some critics have used this situation to claim that the policy actually authorizes the extirpation of local populations while pretending to protect wild salmon.

In practise, the geographic extent of a conservation unit requires a trade-off between fish biology and management feasibility and the appropriate number of conservation units has not yet been determined. While smaller units might offer greater protection to wild salmon, they would require greater changes to existing fisheries and significantly higher costs of research and management. Fishing methods are becoming more selective through changes in fishing gear, time and location. However, different conservation units within a given species cannot be visually distinguished. Some bycatch from a neighbouring conservation unit is inevitable in ocean fisheries.

The number of conservation units is also linked to species biology. For example, lake-spawning sockeye salmon exhibit a high degree of local specialization and over 100 conservation units might be required within British Columbia, about five times the current number of management units. In contrast, for pink and chum salmon, 10 to 15 conservation units might be acceptable.

The number of conservation units is expected to increase over time as knowledge improves and better management tools become available. For coho for example, southern British Columbia was considered one unit until the 1990s when management was split into three groups. We now anticipate that these will spit again into six or more conservation units, for a total of up to 25 coho conservation units in British Columbia. In this case, an increased understanding of the differences among local coho populations led to a re-definition of conservation units. Conservation units may continue to be re-defined in future to ensure adequate protection.

Issue B: How reference points are determined

Once conservation units are defined, management plans must be developed for each unit based on limit and target reference points. Limit reference points are one component of the precautionary approach to fisheries management (Richards and Maguire 1998). However, the specific choice of fishery reference points as limits and targets has generated considerable debate within the scientific community (including ICES) as well as among other stakeholders. For example, a buffer to account for uncertainty could be incorporated into the reference point definition, or could be added as an additional buffer reference point. Since reference points are determined through model analysis, different choices of model assumptions can lead to different values of the reference points. A large number of such choices are required for a system as complex as the Pacific salmon fishery (e.g. Schnute et al. 2000).

Classically, for salmon populations, reference points have been determined from stock-recruitment analysis and maximum sustainable yield (MSY) has been the target reference point, generally expressed as a target escapement to the spawning ground. For example, the escapement that produces MSY is identified as a target reference point for some populations under the 1999 agreement between Canada and the United States relating to the Pacific Salmon Treaty. There is general agreement that target reference points should move beyond MSY and encompass ecosystem objectives, but clearly defined methods are lacking in this context. Problems with the MSY approach include the accuracy and availability of current and historical abundance data, as well as recent changes in productivity. For populations at low abundance relative to unfished biomass, the MSY estimate of escapement from current data is often biased low. One alternative under consideration is to use habitat-rearing capacity (Hume et al. 1996) to identify limit and target reference points. This approach has the advantage that it is not linked to recent data time series when abundance has been depressed.

One of the scientific debates has been whether limit reference points should be based on extinction risk (population viability analysis) or on risk of loss of productive capacity. For example, a limit reference point could be defined at an abundance such that the population could rebuild to the target within two generations with a specified probability. Other concerns relate to the inclusion of dynamic variability within what are essentially equilibrium parameters. Recent declines in marine survival rates for some salmon populations have emphasized the possibility of change and recent habitat loss could have reduced productive capacity. Reference points should be sufficiently flexible to account for this variability. For example, Bradford et al. (2000) propose a model that combines freshwater productivity with forecasts of marine survival to produce a limit reference harvest rate.

For practical reasons, conservation units will sometimes include local spawning populations that differ in productivity. In these cases, stakeholders questioned whether limit reference points would be based on average productivity or whether different reference points could be established for each local population. Limit reference points derived from average productivity might fail to protect less productive populations, and conversely, might be overly conservative for the more productive populations. An approach to this dilemma is to measure the distribution of productivities for local populations within the conservation unit and assign reference points to protect a specified (high) percentage of local populations (e.g. Bradford et al. 2000).

Issue C: Determining harvest rules

Once reference points are defined, management actions must be linked to these reference points. Obviously, the appropriate management action is related to the particular choice of conservation unit and reference points. If conservation units are broadly defined, encompassing a range of local populations, then more conservative management actions will be required than if the conservation unit includes populations all known to be highly productive.

Management actions must follow other legal and policy requirements. Within British Columbia, there are 197 First Nations who, under Canada’s Constitution Act, have priority access to salmon for food, social, and ceremonial purposes once conservation needs are met. Under the proposed wild salmon policy, the definition of “conservation” would be incorporated into the definition of reference points.

Another issue is bycatch. Fishing techniques can be improved to minimize bycatch of non-target salmon stocks, but bycatch cannot be realistically eliminated unless all fisheries occur on the spawning grounds. Thus, while no directed fishing should occur when abundance is lower than the limit reference point, some bycatch is inevitable and must be acknowledged in the management plan. This poses a difficult trade-off between conservation and economic returns from productive populations.

Under any management scenario, mechanisms must be established to monitor success of the fishing plans. Basic data needs include fishery catch and spawning ground escapement. More detailed information could be collected for representative local populations within each conservation unit. However, as the number of conservation units increases, the number of monitored populations must also increase, adding to the cost of assessment and management.

Issue D: Need for a risk assessment framework

The six principles of the draft policy are intended to establish a risk assessment framework and stakeholders requested a more precise framework that also acknowledges social and economic values. Stakeholders also expressed a desire to be consulted on the specifics of implementation, including the definition of conservation units and reference points as well as harvest rules. Actual implementation is intended to follow a phased approach as more knowledge is gained.

Stakeholders recognize that some components of the framework are data intensive and at present, scientific information is insufficient to implement the policy precisely. Collection of new data will be expensive and other costs will be associated with ongoing consultation, data analysis, fishery management, and audit. Stakeholders expressed some cynicism about the implementation because a funding commitment was not announced with the document release. Without additional funds, government was not interpreted as sincere.

The choice of limit reference point is related to the level of acceptable risk. An outstanding question is who should determine this risk. Scientists can provide the risk management framework, but the actual choice should reflect a societal decision about the level of acceptable risk. Often, scientific technical experts are expected to specify fixed reference points through application of analytical models. Once a limit reference point is fixed, however, the relative level of risk is determined. An alternative is for scientists to provide a suite of reference points linked to a range of levels of risk, so that the final choice can be determined through consultation.

4. Conclusions

The consultations provided a strong endorsement for conservation. Most of the specific issues raised relate to the lack of details in the draft policy document. The document was intended to provide a high level overview, prior to development of a detailed implementation plan. However, stakeholders need to understand how they are personally affected in order to comment meaningfully on the policy.

Stakeholders are also skeptical about past commitments to conservation, given major stock collapses on both the Atlantic and Pacific coasts of Canada (Glavin 1996, Harris 1998). Closed fisheries and the resulting social upheaval have eroded public confidence in government resource management, although the situation in Canada appears to be improving (Richards and Mentzelopolous 1999). For example, many of the stakeholder groups are now developing the necessary scientific capacity to contribute to ongoing discussions and implementation.

Clearly, more research is needed in some areas. For example, we need to clarify how the policy relates to the commitment to maintain biodiversity. While the policy is intended to operationalize the precautionary approach, fundamental decisions are required on acceptable levels of risk. More broadly, reference points should be considered in the context of the ecosystem approach and more work is required to reach this next step. We also need a better understanding of the factors affecting salmon survival and productivity, given potential climate change impacts. These will be important research areas for the next few years.

5. Acknowledgements

I would like to thank the teams of Fisheries and Oceans Canada staff who prepared the draft policy document and participated in the consultations.

6. **References**

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