
Maintaining biodiversity in mixed-stock salmon fisheries in the Skeena watershed

A 130-year history

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Principle: Mixed-stock transboundary fisheries impose special requirements on management of within-species and between-species genetic diversity.

Experience: 130 years of commercial and aboriginal fisheries on six species of Pacific salmon in one watershed.

Most important lesson learned: Artificial enhancement of stocks exploited by fisheries that also catch less productive species and wild stocks is incompatible with preservation and sustainable use of genetic diversity.

Best practices: 1) New government Wild Salmon Policy places priority on biodiversity, 2) by allowing selective release of non-target species, live capture fisheries help to conserve species diversity but typically fail to protect stock diversity within-species.

Pacific salmon biodiversity

Pacific salmon utilize virtually every freshwater environment accessible from the Pacific Ocean. Their ability to home to natal streams where they spawn and die results in partial or complete reproductive isolation of spawning sites. Most salmon are still harvested commercially in coastal waters before individual stocks have segregated to their natal streams. These “mixed-stock fisheries” remain entrenched because they are logistically expedient and because salmon are commercially most valuable in tidal waters (coast and river). Fisheries managers are thus faced with a trade-off that remains unresolved – how to reap the benefits from commercially valuable stocks while maintaining the diversity essential for sustainability.

In some stocks, natural reproduction is supplemented by artificial propagation in hatcheries or spawning channels. Salmon “enhancement” has important implications for fisheries management. By increasing the abundance and productivity of target stocks, enhancement provides an opportunity for increased fishing effort but amplifies natural variations in productivity. Mixed-stock harvest of wild and enhanced salmon stocks greatly complicates the conservation of salmon diversity. Unless it is possible to selectively harvest productive populations, the overall harvest rate must be reduced to ensure the conservation of the less productive stocks in a mixed-stock harvest.

Skeena River salmon

In Canada, the Skeena River is second only to the Fraser River in its capacity to produce sockeye salmon. An additional six related species inhabit the Skeena River, including four Pacific salmon (pink, chum, coho, and chinook), plus two anadromous trout (steelhead and coastal cutthroat). Skeena sockeye salmon are harvested by Canadian aboriginal communities, and in an extensive Canadian and Alaskan commercial fishery.

From a production perspective, Skeena sockeye appear to be in good shape. However, the diversity of the Skeena sockeye escapement has changed dramatically. Stocks that have not been “enhanced” have suffered an overall decline as they have been caught in the mixed stock fishery. Escapements of other salmon species have also declined dramatically during the history of the fishery for Skeena sockeye. Fishery management actions have restored species diversity, but have been less successful in restoring stock diversity within-species.

Management history

Skeena sockeye stocks had begun to be chronically overfished by 1925. As early as 1958, it was evident that non-Babine stocks had declined more than the Babine stock. During this period, Fisheries Research Board scientists began to recognize that there were significant differences in life history and run timing among runs (“stocks”) arising from different lakes. The Babine Lake Development Project was started in 1965 to enhance fry recruitment. This ambitious project involved building large artificial spawning channels as well as other structures. “Enhanced” sockeye began to return in 1970.

Overall sockeye abundance in the Skeena increased as production from spawning channels in Babine Lake increased, but escapements to other sockeye lakes continued to decrease. This trade-off was initially viewed as acceptable because managers had little flexibility to avoid harvesting non-target stocks. Abundance of other species, including chinook, coho and steelhead salmon, was affected by fisheries on enhanced sockeye, prompting impositions of catch ceilings and protracted international negotiations between Canada and the United States. The Canada-US Pacific Salmon Treaty was not always successful in limiting harvest pressure on non-enhanced stocks and non-target species due to interception in Alaskan waters.

Increasingly, mixed-stock fishery management issues became complicated by the demands of various fishing groups with highly divergent views on where, how, and by whom Skeena salmon should be caught. To help resolve these issues, the Canadian Department of Fisheries and Oceans (DFO) in 1993 encouraged a new public process for developing management strategies to protect weaker stocks while achieving sustainable fisheries (“Skeena Green Plan”). The Skeena Green Plan worked by a consensus-based process involving aboriginal people, commercial fishing groups, recreational fishing groups, DFO, and the Province of British Columbia. Significant new funding was committed to improve assessments of selected stocks and capability for in-season management. New research was supported to assess the productive potential of non-enhanced stocks of sockeye, coho and steelhead trout. Special

emphasis was also given to evaluating more selective harvesting techniques and new opportunities for terminal harvest.

The Skeena Watershed Committee process was initially hailed as a great success because of renewed co-operation among stakeholders and significant progress on many issues. However, the commercial fishing sector withdrew in 1996. Most research and monitoring activities were discontinued after 1997. The progressive spirit of the Green Plan languished in the Skeena but later became entrenched in broader policy.

In 1998, DFO released a *New Direction for Canada's Pacific Salmon Fisheries* which proclaimed the start of a "risk averse, conservation-based fishery". A draft *Wild Salmon Policy* (WSP) was released for public consultation in 2000. The primary goal of the draft WSP, consistent with the 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 for the sustainable benefit of the people of Canada". It includes six principles, the first of which states that "wild Pacific salmon will be conserved by maintaining diversity of local populations and their habitats". DFO has pledged to implement the WSP pending revision to reflect public consultation.

Pacific salmon management has always involved finding acceptable trade-offs between extracting economic benefits from productive stocks while protecting unproductive stocks from extirpation. Although this trade-off remains unresolved, the WSP promises to provide explicit limits to these trade-offs based on stewardship ethics and conservation principles. Canada's proposed *Species At Risk Act* (SARA, scheduled for proclamation by early 2002) will also provide automatic protection for distinct biological populations listed as threatened or endangered. Thus, the WSP and SARA have been designed to play complementary roles in protecting Pacific salmon. If implemented effectively, the WSP should keep Pacific salmon off the endangered species list so that the heroic, but expensive, salvage measures mandated by SARA will not be required.

Lessons

The Skeena sockeye fishery still depends on a monoculture of enhanced fish that has become visibly vulnerable. The Skeena case study has shown that enhancement within a mixed-stock fishery is incompatible with the conservation of wild salmon diversity. DFO has recognized this problem and has not authorized any new production enhancement facilities since 1983. New policies have shifted the focus towards more appropriately scaled shorter-term supplementation to rebuild wild stocks. The most important lesson from the last 30 years is that non-selective mixed-stock fishing in tidal waters must be reduced to conserve salmon diversity in the Skeena and elsewhere. The resulting increase in escapements should allow un-enhanced Skeena populations to rebuild, leading to increased total returns in the future.

Scientific research has played a crucial role in the evolution of Skeena salmon fisheries and in the protection of salmon diversity from commercial exploitation. Research helps identify

diversity, monitor status against reference points to determine when special conservation actions are required, and provide options for reducing the social and economic cost of conservation actions. On the other hand, research alone is clearly not sufficient to ensure conservation. The decline of the non-Babine sockeye populations in the Skeena was identified as early as 1958, and the cause was understood by 1968. Yet the non-Babine populations continued to decline and remained at low abundance until the late 1980 and 1990s.

Conservation actions in the Skeena have been most successful in response to crises where DFO has had support from stakeholders, especially in response to declining abundance in highly-valued species rather than chronic declines in less-valued weak stocks within species. DFO has clearly had more difficulty reacting to conservation issues involving trade-offs between short-term and long-term economic interests, or conflicts between extraction and stewardship ethics. These decisions are complicated by considerations of catch allocation both internationally under the Pacific Salmon Treaty, and domestically in treaty negotiations with aboriginal people, and disputes among commercial and recreational fishery sectors. Conservation in these cases ultimately depends on a strong conservation ethic being defined in policy.

