Pacific salmon and farmed salmon on the Pacific coast of Canada

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The relationship between Pacific salmon (*Oncorhynchus* spp.) and farmed Atlantic salmon (*Salmo salar*) remains as one of the most contentious issues in the history of the management of Pacific salmon in British Columbia. The issue is fuelled by a decrease in the commercial catch of Pacific salmon and escalating production of farmed salmon. In 2008, for example, the annual production of farmed salmon was about ten times larger than the commercial catch of Pacific salmon (Figure 1). Salmon farming is controversial for scientific reasons and in some cases for ideological reasons. In British Columbia, one major concern is the effect that sea lice produced on farmed salmon have on wild Pacific salmon. British Columbians use the health of Pacific salmon as a measure of their quality of life. Anything that threatens Pacific salmon makes many people uncomfortable. Thus, in 2002, when there was an unexpected poor return of pink salmon (*O. gorbuscha*) in an area of intensive fish farming, the issues relating to salmon farming became a public concern.

In this paper I will review the general state of Pacific salmon in the subarctic Pacific and in British Columbia to show why there is alarm about the health of Pacific salmon in British Columbia. I will take a quick look at the salmon farm issue that includes my interpretation of the sea lice controversy. My conclusion is that farmed and wild salmon can easily coexist. However, aquaculture in general and farmed salmon in particular require long-term research monitoring programs to ensure that farmed salmon will not add to the natural sources of mortality that affect Pacific salmon at the population level. A better understanding of the reasons for the declining marine survival of some species of Pacific salmon could also help.

There are actually 11 species of Pacific salmon but five species (Figure 2) make up virtually all of the commercial catch. In 2007, the total catch of these five species by all Pacific salmon producing countries was the highest in history, exceeding 1 million tonnes. There are indications that in 2009 the catch could be even higher. Most of the catch (about 82%) consists of pink and chum (*O. keta*) salmon and about 40% of these fish originate in hatcheries. There currently are about 4.5 billion Pacific salmon produced in hatcheries each year. This number may increase by about 1.5 billion in 2010, mainly because of the increased production from Russian hatcheries. Japan produces virtually all of their chum salmon in hatcheries resulting in about 65% of the total catch of chum salmon by all countries. Chinook (*O. tshawytscha*) and coho (*O. kisutch*) salmon are important along the west coast of North America, but they represent only 2% of the total catch and their percentage of the total catch has been declining for over 30 years. In general, it appears that the vast habitat for Pacific salmon remains generally favourable for Pacific salmon and may be increasing in the capacity to produce pink and chum salmon.

However, in British Columbia the Canadian catch of Pacific salmon has declined from 24% of the total all-countries catch in the early 1970s to 1% in 2008 (Figure 3). The reasons for the decline are the increasing abundances of pink and chum in other countries, the decreasing abundances of some species in Canada and a reduction in exploitation rates. The total catch of all species of Pacific salmon in 2008 is about 8,000 t (Figure 1). This compares to a long-term average prior to the mid 1990s of about 64,000 t. The decline in catch in recent years is particularly alarming because of our salmon enhancement program that was supposed to be able to double the historic average catch by year 2000.

Salmon farming is an important industry in British Columbia because it provides full time employment to about 2,100 people and is valued at 407.4 million (cultured value in Canadian dollars in 2006). This value compares to a value of 58.8 million for the commercial wild Pacific salmon industry (landed value in 2006). Salmon farming provides employment in coastal communities and reduces the pressure on Pacific salmon (*Oncorhynchus* spp.) stocks at a time when a warming climate is complicating the management of wild Pacific salmon stocks. Salmon farming is also part of an aquaculture industry around the world that is supplying an increasing world demand for seafood. We are told that the current production of farmed salmon in British Columbia does not meet the market demand.

Salmon farming is not popular in British Columbia and recently has been associated with some spectacular collapses of pink salmon in an area in the central coast of British Columbia and a recent failure of sockeye salmon (*O. nerka*) returns to the Fraser River. There is no doubt that a collapse of pink salmon occurred and there is no doubt that the very small pink salmon in the vicinity of the farms become infected with sea lice. Some of the sea lice on the juvenile Pacific salmon obviously result from the sea lice infections on the farmed fish. However, there is no consensus on the linkage among sea lice on farmed fish, sea lice produced outside of the fish farms and the population dynamics of pink salmon in the area. A Pacific Salmon Forum was established to determine if salmon farms were the cause of the decline in pink salmon. After four years of intensive research effort, it has not been possible to show that the sea lice resulting from the salmon farms were significantly reducing the total production of pink salmon in the area (Harvey 2009). A difficulty in reaching a consensus has been the poor understanding of the population dynamics of sea lice. At the beginning of the public concern in 2002, there was very little scientific literature relating to the natural production of the two major species of sea lice and nothing that looked at sea lice production on the farms that had been established in British Columbia. In Norway, Scotland and Ireland, there were a number of studies of sea lice production on farmed salmon and the possible impacts on wild salmon and trout, but it was difficult to apply these studies to the situation in British Columbia. An example of the local complexity of relating sea lice infections to the population dynamics of Pacific salmon is the change in stock composition associated with a spawning channel that was constructed in the area where the sea lice controversy erupted. The spawning channel started in the late 1980s and by the late 1990s it was producing most of the pink salmon in the area in odd-numbered years (Figure 4). In fact, local residents reported that there were only a few grizzly bears feeding on the spawning salmon in the river prior to the building of the channel, but 30 to 40 bears are currently there now.

The recent failure of sockeye salmon to return to the Fraser River resulted in the worst return in recorded history. The collapse was totally unexpected because one of the major populations contributing to this return had the highest production of juvenile sockeye salmon on record. In 2007 these juvenile sockeye salmon needed to pass by an area of salmon farming and they were observed to be infected with sea lice. This association with sea lice and failed return was blamed on salmon farming by conservation groups. However, the juvenile sockeye salmon are more than ten times the size of the pink salmon that are susceptible to sea lice in the central coast area and it is most unlikely that sea lice caused the collapse.

The reasons for the trend in declining survival of Pacific salmon may relate to the general warming of the area in the ocean where they grow in their first four months. The Strait of

Georgia for example has warmed about 1ºC in the past 40 years. In recent years there has been an alarming decline in the marine survival in the first four months of some species. A decline from about 15% survival in the late 1990s to about 1% survival in recent years may be related to increased metabolic stress resulting from a combination of the warmer temperatures and reduced prey abundances. The actual cause of death may be a combination of predation and disease. Thus, the decline in production of some populations of some species appears to be linked to changes in their ecosystems.

In summary, there is no evidence of a relationship between the low catches of Pacific salmon and the development of salmon farms. However, for public opinion to change, there will need to be a better understanding of the factors that cause the early marine mortality of Pacific salmon, including the impact of sea lice produced naturally and on fish farms.

Reference

Harvey, B. 2009. Sea lice and salmon farms: A second look. An update of "Science and sea lice: what do we know?". Report for the BC Pacific Salmon Forum. http://www.pacificsalmonforum.ca. 31p.

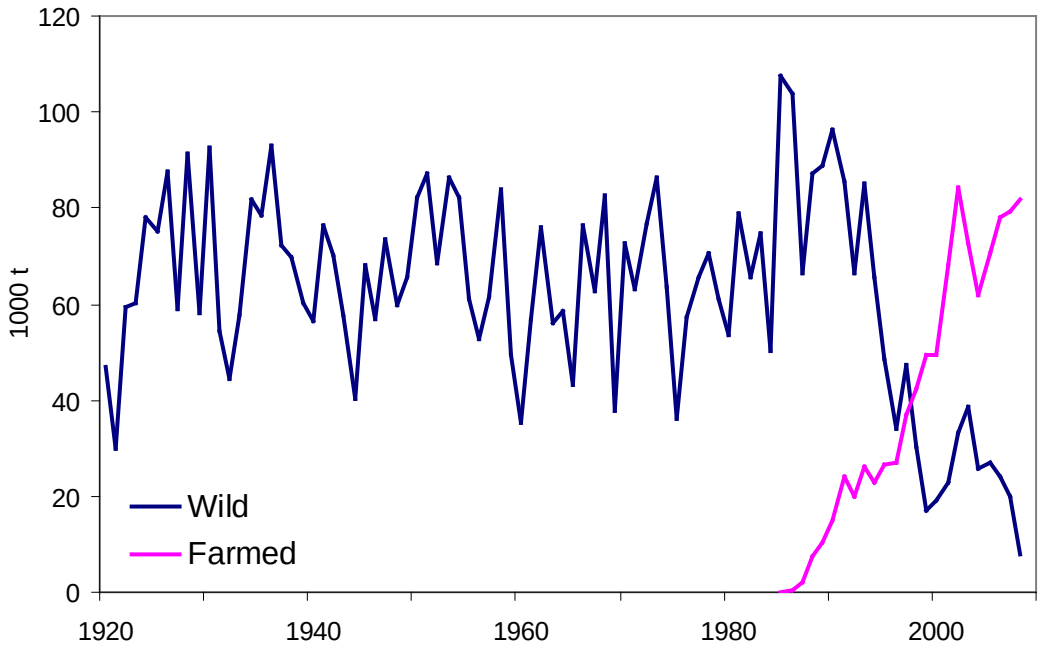

Figure 1. Wild Pacific salmon catch and farmed salmon production in British Columbia.

	AVERAGE AGE	RANGE
pink salmon (*O. gorbuscha*)	2 years	(2 years)
chum salmon (*O. keta*)	4 years	(3 – 6 years)
sockeye salmon (*O. nerka*)	4 years	(4 – 6 years)
coho salmon (*O. kisutch*)	3 years	(2 – 4 years)
chinook salmon (*O. tshawytcha*)	4 years	(1 – 7 years)

Figure 2. Pacific salmon species that make up most of the British Columbia commercial catch.

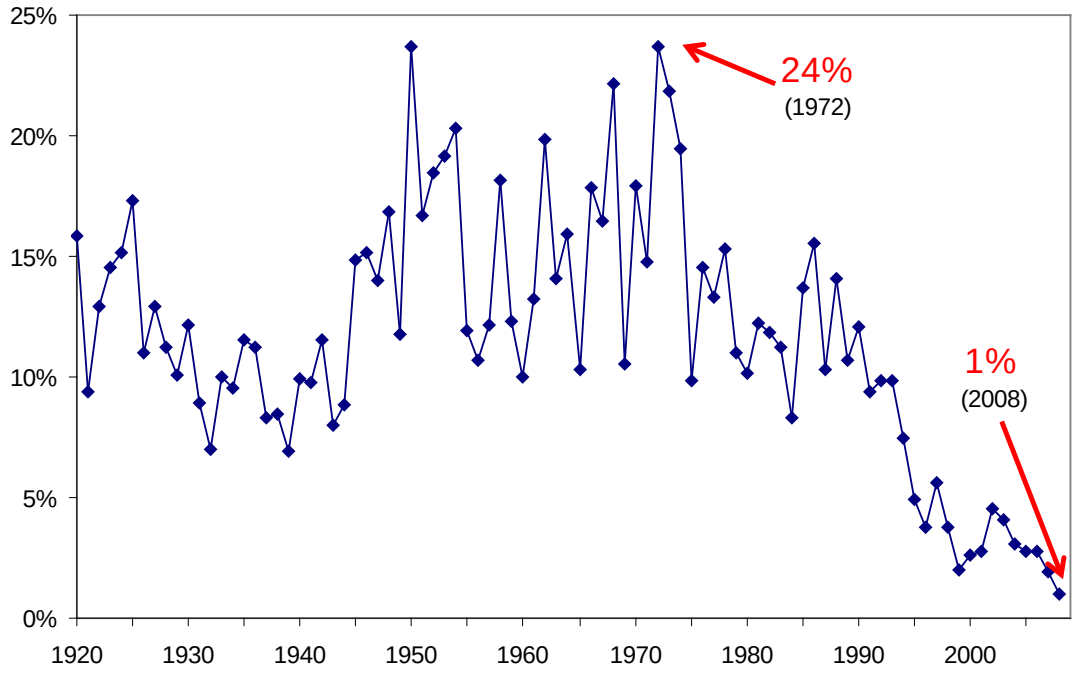

Figure 3. The percentage of the total catch of Pacific salmon taken in commercial fisheries in the subarctic Pacific that is landed by Canada

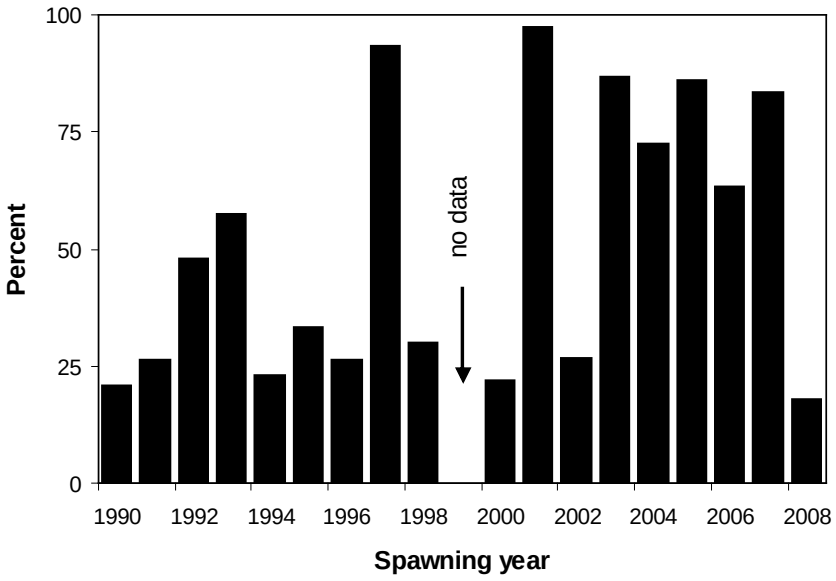

Figure 4. The percentage of all pink salmon produced in all rivers in the Central Coast area of British Columbia (Broughton Island area) that enter the Glendale River and spawning channel. The very high percentages in some years indicate that most juvenile pink salmon from all rivers in the area originated from the Glendale River and spawning channel in the previous year.