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## Fish Farms Drive Wild Salmon Populations Toward Extinction

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Parasitic sea lice infestations caused by salmon farms are driving nearby populations of wild salmon toward extinction. Results show the affected pink salmon populations in British Columbia's Broughton Archipelago have been rapidly declining for four years, says a Canadian research team. The scientists expect a 99% collapse in another four years if the infestations continue.

Newswise — A study appearing in the December 14 issue of the journal *Science* shows, for the first time, that parasitic sea lice infestations caused by salmon farms are driving nearby populations of wild salmon toward extinction. The results show that the affected pink salmon populations have been rapidly declining for four years. The scientists expect a 99% collapse in another four years, or two salmon generations, if the infestations continue.

"The impact is so severe that the viability of the wild salmon populations is threatened," says lead author Martin Krkosek, a fisheries ecologist from the University of Alberta. Krkosek and his co-authors calculate that sea lice have killed more than 80% of the annual pink salmon returns to British Columbia's Broughton Archipelago. "If nothing changes, we are going to lose these fish."

Previous peer-reviewed papers by Krkosek and others showed that sea lice from fish farms can infect and kill juvenile wild salmon. This, however, is the first study to examine the population-level effects on the wild salmon stocks.

"It shows there is a real danger to wild populations from the impact of farms," says Ray Hilborn, a fisheries biologist from the University of Washington who was not involved in the study. "The data for individual populations are highly variable. But there is so much of it, it is pretty persuasive that salmon populations affected by farms are rapidly declining."

According to experts, the study also raises serious concerns about large-scale proposals for net pen aquaculture of other species and the potential for pathogen transfer to wild populations.

"This paper is really about a lot more than salmon," says Hilborn. "It is about the impacts of net pen aquaculture on wild fish. This is the first study where we can evaluate these interactions and it certainly raises serious concerns about proposed aquaculture for other species such as cod, halibut and sablefish."

The data are from the Broughton Archipelago, a group of islands and channels about 260 miles northwest of Vancouver that is environmentally, culturally, and economically dependent on wild salmon. To pinpoint the effect of salmon farms, the study used a large dataset collected by the Canadian federal government's Department of Fisheries and Oceans (Fisheries and Ocean Canada) that estimates how many adult salmon return from the ocean to British Columbia's rivers each year. Extending back to 1970, the data covers 14 populations of pink salmon (*Onchorhynchus gorbuscha*) that have been exposed to salmon farms, and 128 populations that have not.

Sea lice (*Lepeophtheirus salmonis*) are naturally occurring parasites of wild salmon that latch onto the fishes' skin in the open ocean. The lice are transmitted by a tiny free-swimming larval stage. Open-net salmon farms are a haven for these parasites, which feed on the fishes' skin and muscle tissue. Adult salmon can survive a small number of lice, but juveniles headed from the river to the sea are very small, thin-skinned, and vulnerable.

In the Broughton Archipelago, the juvenile salmon must run an 80-kilometre gauntlet of fish farms before they reach the open ocean. "Salmon farming breaks a natural law," says co-author Alexandra Morton, director of the Salmon Coast Field Station, located in the Broughton. "In the natural system, the youngest salmon are not exposed to sea lice because the adult salmon that carry the parasite are offshore. But fish farms cause a deadly collision between the vulnerable young salmon and sea lice. They are not equipped to survive this, and they don't."

Salmon bring nutrients from the open ocean back to the coastal ecosystem. Killer whales, bears, wolves, birds, and even trees depend on pink salmon. "If you lose wild salmon there's a lot you are going to lose with them – including other industries such as fishing and tourism," says Krkosek.

"An important finding of this paper is that the impact of the sea lice is so large that it exceeds that of the commercial fishery that used to

exist here,” says Jennifer Ford, a co-author and fisheries scientist. “Since the infestations began, the fishery has been closed and the salmon stocks have continued declining.”

“In the Broughton there are just too many farmed fish in the water. If there were only one salmon farm this problem probably wouldn’t exist,” Krkosek says.

“Over the years the number of farmed fish has increased,” says Morton. “There used to be only a few farms, each holding about 125,000 fish. But now we have over 20 farms, some holding 1.3 million fish. The farmed fish are providing a habitat for lice that wasn’t there before.”

The researchers observed that when farms on a primary migration route were temporarily shut down, or fallowed, sea lice numbers dropped and salmon populations increased. “Even though they have complicated migration patterns they all have one thing in common – overall, the populations that are declining are the ones that are going past the farms,” says Mark Lewis, a mathematical ecologist at the University of Alberta.

“There are two solutions that may work – closed containment, and moving farms away from rivers,” says Lewis. Closed containment means moving the salmon to pens that are completely sealed off from the surrounding environment in contrast to the open-net pens currently in use. In a May 16, 2007 provincial government report, the B.C. Special Committee on Sustainable Aquaculture recommended a move towards closed containment within 5 years.

“If industry says it’s too expensive to move the fish farms or contain them, they are actually saying the natural system must continue to pay the price,” says Daniel Pauly, Director of the University of British Columbia’s Fisheries Centre, who was not involved with the study. “They are, as economists would say, externalizing the costs of fish farming on the wild salmon and the public.”

Morton, who has been studying the impacts of aquaculture for 20 years, says that, “Wild salmon are enormously important to the ecosystem, economies, and culture. Now it is clear they are disappearing in place of an industry. People need to know this and make a decision what they want: industry-produced salmon or wild salmon.”

Note: Ransom Myers, a highly respected fisheries scientist from Dalhousie University, was a coauthor of this paper. Dr. Myers died of an inoperable brain tumour before this work was published. The authors dedicate this paper to him.