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MONDAY OCTOBER 2, 2006

## Salmon Farms Kill Wild Salmon

### Up to 95% of wild juvenile salmon killed by parasites from salmon farms

New research has confirmed that sea lice from salmon farms can have severe impacts on wild salmon. Sea lice are natural parasites of salmon, but sea lice transmission is altered by fish farms, which eliminate a disease refuge for juvenile fish.

“Fish farms raise sea lice infections from near zero to lethal levels in wild juvenile pink and chum salmon,” said the study’s lead author Martin Krkošek, of the University of Alberta. “Under natural conditions, adult salmon - the primary sea lice hosts - are far offshore while the juveniles are migrating out to sea. Fish farms eliminate this disease refuge by placing farm fish on wild fish migration routes.”



Sea lice on a juvenile salmon.

Photo credit: Alexandra Morton.

Mortality from farm-origin lice can be high. “Everyone knows that only a small fraction of juvenile salmon survive to return as adults,” said study co-author Dr. Mark Lewis of the University of Alberta. “Our work shows that of those that would otherwise survive, 9-95% will be killed by sea farms.”

Juvenile pinks and chums are especially vulnerable to sea lice because they are small – only about one inch long. “It only takes one or two lice to kill a juvenile,” said Krkošek

The study combined field surveys, survival experiments, and cutting-edge mathematical modeling to reach its conclusions. “The work is of an impeccably high standard, and will be very difficult to refute,” said Dr. Andy Dobson, an epidemiologist from Princeton University who specializes in infectious diseases of wildlife.

“The analysis in this paper almost certainly underestimates the total mortality of juvenile salmon,” said co-author Dr. Neil Frazer of the University of Hawai‘i. “We considered only the direct effects of sea lice on fish survival. We did not include the secondary effects of increased predation on infected fish.”

Fish farms may have severe implications for salmon stocks. “This sustained high mortality caused by farms, combined with the highly variable natural mortality of wild salmon, leads to a very precarious situation for wild salmon,” said study co-author Dr. John Volpe of the University of Victoria. “Even the best case scenario of an additional 10% mortality could push a fish stock into the red zone.”

The research results are a major contribution to the contentious question of fish farm impacts. “The debate is over,” said study co-author Alexandra Morton of the Raincoast Research Society. “This paper brings our

understanding of farm-origin sea lice and Pacific wild salmon to the point where there is a clear severe impact.”

Although the study was conducted in British Columbia, the results apply globally. “We expect the same increase in mortality to occur in all areas around the world where there is large scale net-pen aquaculture,” said Dr. Ransom Myers, a fisheries biologist at Dalhousie University. “And sea lice are a pathogen we can see, but what about all the other diseases?”

“This study really raises the question of whether we can have native salmon and large scale aquaculture – as it is currently practiced – in the same place,” said Myers.

The study also sheds new light on how humans and wildlife interact to alter disease dynamics. “We often worry about wildlife making humans sick, but here is a case where humans make wildlife sick,” said Lewis.

“This is the tip of the iceberg,” said Dobson. “Aquaculture has created the potential to massively amplify diseases in wild fish. It also raises the more distant spectre of when are we going to see the first human disease caused by aquaculture?”

The study will be published during the week October 2-6 in the prestigious peer-reviewed scientific journal, Proceedings of the National Academy of Sciences of The United States of America.

## **Background**

The study’s conclusions are based on three components. The first estimated sea lice transmission using field surveys of over 14,000 wild juvenile pink and chum salmon migrating past salmon farms along more than 180 km of migration routes in the Broughton Archipelago, British Columbia. The second estimated the impact of sea lice from survival experiments of over 3,000 infected juvenile salmon. The third combined these two elements, using cutting-edge mathematical models of sea lice transmission and impacts, to estimate the total mortality of wild salmon caused by sea lice from fish farms.

Krkosek, M., Lewis, M.A., Morton, A., Frazer, L.N., & Volpe, J.P., 2006. Epizootics of wild fish induced by farm fish. Proc. Natl. Acad. Sci. USA., 103: 15506-15510.

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## **Author contact information:**

Neil Frazer University of Hawai’i, (808) 956-3724, neil@soest.hawaii.edu

Martin Krkošek University of Alberta, (250) 415-7368, mkrkosek@ualberta.ca

Mark Lewis University of Alberta, (780) 492-0197, mlewis@math.ualberta.ca

Alexandra Morton Raincoast Research Society, 250-949-1664, wildorca@island.net

John Volpe University of Victoria, (250) 472-4298, jpv@uvic.ca

Press release by Marjorie Wonham, Centre for Mathematical Biology, University of Alberta

Images are available, <http://www.math.ualberta.ca/~mlewis/SeaLice.htm>

## **SOEST Media Contact: Tara Hicks Johnson**

Phone: (808) 956-3151, hickst@hawaii.edu

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School of Ocean and Earth Science and Technology <http://www.soest.hawaii.edu>

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