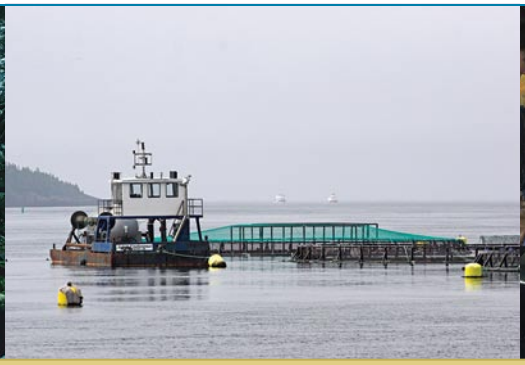




LENFEST OCEAN PROGRAM

RESEARCH SERIES

FEBRUARY 2008

A new study finds a widespread negative impact of aquaculture farms on wild salmon survival.

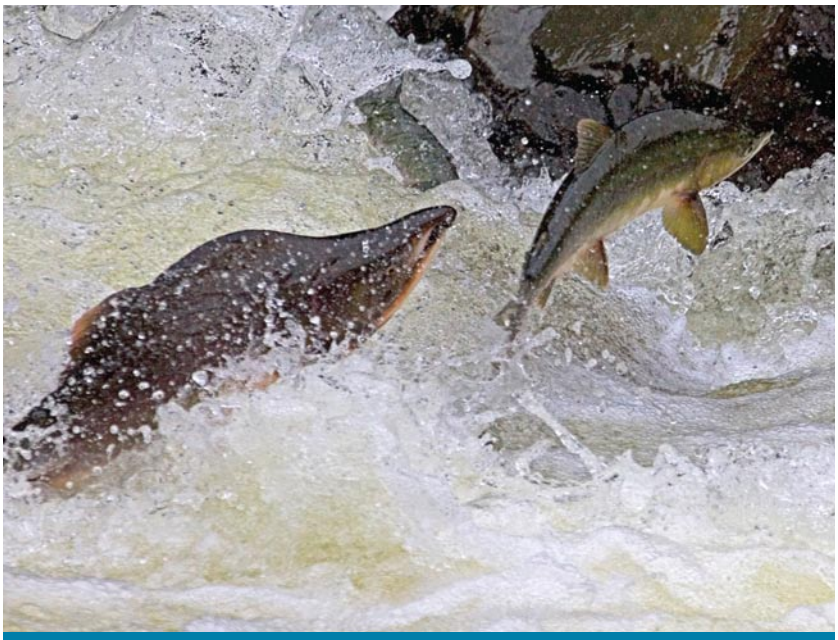
GLOBAL ASSESSMENT OF AQUACULTURE IMPACTS ON WILD SALMON

A SUMMARY OF NEW SCIENTIFIC ANALYSIS:

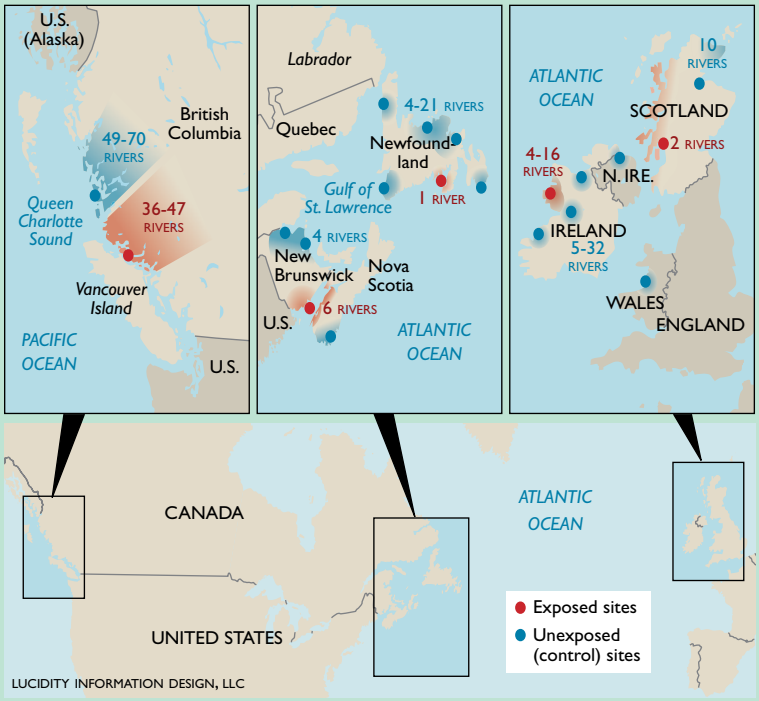
Ford, J.S. and R.A. Myers. 2008. A global assessment of salmon aquaculture impacts on wild salmonids. *PLoS Biology* 6(2): e33. doi:10.1371/journal.pbio.0060033

SALMON AQUACULTURE, the practice of raising fish in open net pens, fills at least 60 percent of consumer demand for salmon and occurs in many parts of the world. A number of studies have examined specific effects of aquaculture on wild fish in certain locations, such as the impacts of disease and pollution. No studies to date, however, have analyzed the collective impacts of these risks to wild salmon on a global scale.

Jennifer Ford and Ransom Myers filled this gap by comparing survival of wild salmon in areas with salmon farms to similar areas without salmon farms. Examining these paired comparisons in multiple locations in Canada and Europe, the authors found that in many cases, the presence of salmon farms reduced wild salmon survival by more than 50 percent per generation. This *Lenfest Ocean Program Research Series* report is a summary of the study's findings.



MAP OF REGIONS STUDIED



AQUACULTURE IMPACTS ON WILD FISH

Aquaculture impacts wild salmon populations in several ways. Large concentrations of fish can increase the presence of diseases and parasites that can be transmitted to nearby wild populations, and such transmission has been documented in all areas where salmon farms and wild salmon or trout co-exist. A recent study confirmed that wild salmon in British Columbia are negatively impacted by sea lice emanating from fish farms (Krkošek et al. 2007). Farmed salmon also can escape from aquaculture farms. The escapees may compete with wild salmon for resources and may also interbreed, reducing the genetic diversity of wild populations and producing hybrids with low survival. Finally, salmon farming uses large volumes of processed wild fish for feed, meaning that salmon farming results in a net loss of fish, rather than a net gain.

STUDY DETAILS

In order to estimate the collective effects of aquaculture on wild salmon populations, Ford and Myers used existing data on the abundance of five species of wild salmon and trout in five regions of Europe and Canada before and after aquaculture was established in each region (see map). The authors examined regions where they could pair data on wild salmon exposed to aquaculture farms with those populations not exposed. Exposed study sites were those where juvenile wild salmon migrated past salmon farms and unexposed (or control) study sites were those where juveniles did not migrate past farms. Exposed and unexposed sites were similar in climate and levels of human development. This design allowed the researchers to control for factors other than aquaculture that might influence salmon survival.

Ford and Myers compared the survival and returns (number of salmon returning to natal spawning grounds) of exposed and unexposed populations of wild salmon in each geographic region using mathematical models. The authors then combined all of these calculations to estimate the global impact of aquaculture farms on wild salmon.

REGIONAL DIFFERENCES

The Atlantic populations examined in the study, including Atlantic salmon and Irish sea trout, generally experienced greater mortality than many of the Pacific populations. Because almost all farmed salmon are the Atlantic salmon species, the authors hypothesized that Atlantic salmon may be more vulnerable to negative effects from interbreeding with escaped farmed salmon. Irish sea trout spend much of their time in coastal areas, which may increase their exposure to disease or parasites.

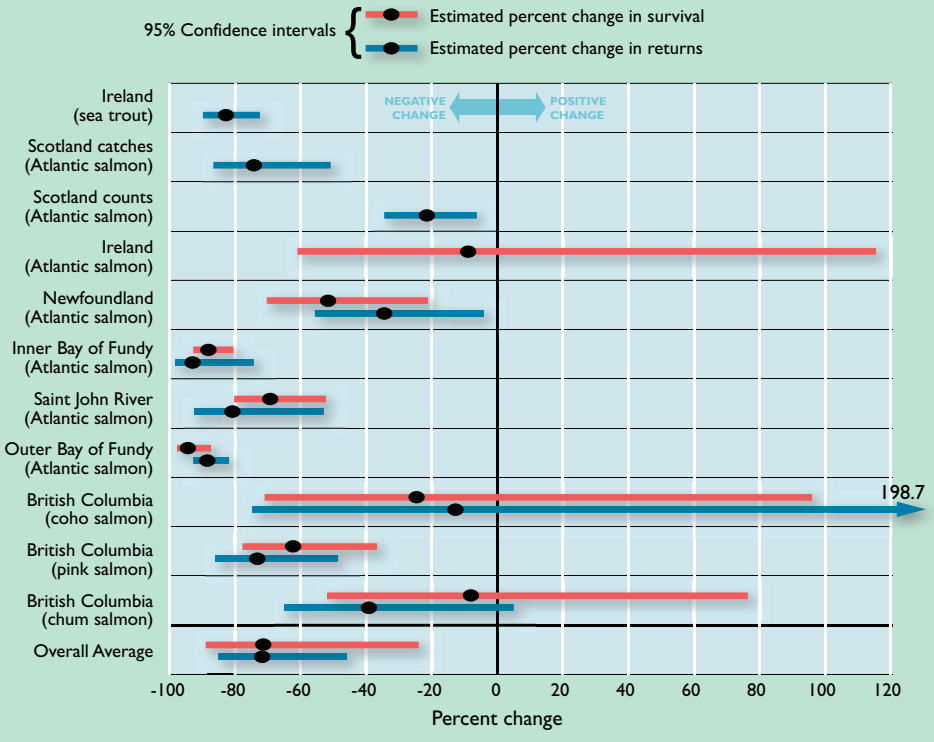
RESULTS

Most of the paired comparisons showed that survival rates and returns to natal spawning grounds of wild salmon exposed to fish farms decreased compared to the unexposed fish, and these decreases were often 50 percent or greater per generation (see graph below). Although the differences between the exposed and unexposed groups were not large enough to be statistically significant in every comparison, when the paired comparisons were averaged across all the regions and populations, large and statistically significant declines in survival and returns were observed.

The authors also concluded that alternative explanations for the differences between the exposed and unexposed wild populations were less likely than the impacts of aquaculture. First, the authors observed that while wild salmon populations in many of their study regions (both exposed and control) had declined before the start of farming, since the start of salmon farming, declines in exposed regions were faster than those in unexposed sites. Second, exposed areas did not appear to differ significantly in human development from the control, or unexposed, study sites. Third, there were no large differences among study sites due to climate, because differences in latitude among study sites were small and many of the wild populations used in the study appear to respond similarly to changes in climate.

The study's observed negative impacts of aquaculture did not correlate linearly with the amount of salmon produced at each farm, perhaps because improvements in aquaculture management may decrease the impacts of farming on a per ton basis. Nevertheless, the authors conclude that their estimates of large negative effects of fish farms on wild salmon indicate that as the industry continues to grow, aquaculture management practices must be improved to reduce impacts on wild salmon.

ESTIMATED PERCENT CHANGE IN SURVIVAL AND RETURNS



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Literature Cited

Krkošek, M., J.S. Ford, A. Morton, S. Lele, R.A. Myers, and M.A. Lewis. 2007. Declining wild salmon populations in relation to parasites from farmed salmon. *Science* 318 (5857): 1772.

About the Authors

JENNIFER S. FORD is a fisheries scientist at the Ecology Action Centre in Nova Scotia, Canada. RANSOM A. MYERS was Professor of Biology and Killam Chair in Ocean Studies at Dalhousie University. Dr. Myers passed away in March 2007.

This study was funded by the Lenfest Ocean Program, the Census of Marine Life, and the Natural Sciences and Engineering Research Council of Canada.

The Lenfest Ocean Program was established in 2004 by the Lenfest Foundation and is managed by the Pew Environment Group. For more information about the Program or a copy of the Public Library of Science Biology *paper, please visit www.lenfestocean.org or contact us at info@lenfestocean.org.*

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Lenfest Ocean Program: Protecting Ocean Life Through Marine Science

The Lenfest Ocean Program supports scientific research aimed at forging new solutions to the challenges facing the global marine environment.

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