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March 31, 2009  
SS09.05

## **European Atlantic Salmon Population Governed by Ecosystem Change** *Warming Temperatures Could Affect Future of Stock*

Atlantic salmon (*Salmo salar*) may be the latest species found to be severely affected by a changing environment. Like the North American stock, the European stock of Atlantic salmon has been in decline for decades despite reduced fishing pressure and efforts to protect its critical habitats, and scientists say predicted climate changes in Europe during the next century could determine its survival.

In a paper published in the March 2009 issue of the *ICES Journal of Marine Science*, lead author Kevin Friedland of the Northeast Fisheries Science Center of NOAA's Fisheries Service and international colleagues say warming conditions in the Northeast Atlantic Ocean over the past four decades have meant decreased growth of Atlantic salmon at a critical stage in their life cycle. The article is entitled "The Recruitment of Atlantic Salmon in Europe."

The European Atlantic salmon population is at its lowest observed level since 1970. Recruitment of the stock is dependant on the survival of the juvenile salmon during their marine stage, when the fish are referred to as post-smolts. The scientists said the marine phase has been difficult to study until recently because the post-smolts were rarely caught in fishing gears. Surface fishing techniques developed in the 1990s to catch salmon during their post-smolt stage have enabled scientists to begin to understand their distribution in the ocean.

"The shift in climate conditions, foodweb composition, and predators have been similar to those affecting stocks of salmon in the Pacific and Gulf of Alaska," Friedland said. "The big question is whether the stocks will return to former states as climate shifts, or whether climate change will result in a shift in distribution, which could lead to the potential for extinction as less and less of the environment is suitable for their growth and survival."

Friedland, who has also studied North American salmon populations in the Northwest Atlantic Ocean, conducted the study with colleagues from Scotland, Norway, Sweden, Canada, Ireland and the U.S. The researchers studied physical factors, biological interactions and the resulting growth response of post-smolt salmon, the key life stage for Atlantic salmon, from six rivers of origin in Ireland, Scotland, Norway and

Sweden as well as samples caught in West Greenland, to determine what controlled their recruitment.

They analyzed a variety of climate data over the past four decades, including sea surface temperatures and longer term oceanic-atmospheric processes like the North Atlantic Oscillation (NAO) and Atlantic Multidecadal Oscillation (AMO). Both the NAO and AMO have shifted dramatically over the past four decades, but the scientists found the AMO “appears to have had a greater effect on changes in salmon recruitment in the Northeast Atlantic Ocean.”

Studies utilizing climate indices like NAO and AMO help determine how big a role climate change is playing in salmon mortality by altering conditions in their freshwater and oceanic habitats and affecting the abundance of plankton and populations of smaller fish, their primary food source while at sea.

Climate predications for the next century indicate that temperature increases over land could be larger than those over the ocean surface, with much of Europe experiencing temperature increases of as much as nine degrees Celsius (16 degrees Fahrenheit). Most of the regions where European salmon are found could experience changes of about four degrees Celsius (seven degrees Fahrenheit).

Given the changing climate and these predictions, the study concluded that changes in the marine environment could force changes that control the productivity of the salmon stock. However, changing fresh water conditions may be more important in controlling the distribution and viability of the species.

“It is clear from our ongoing studies that many factors affect the growth and survival of Atlantic salmon,” Friedland said. “We need to look at the whole picture, the entire ecosystem, and where the Atlantic salmon fits into that ecosystem to fully understand the impacts of these changes on the salmon stock.”

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*ICES Journal of Marine Science* article:

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Signals from the Atlantic Salmon Highway (2008 news release):

[http://www.nefsc.noaa.gov/press\\_release/2008/SciSpot/SS0814/index.html](http://www.nefsc.noaa.gov/press_release/2008/SciSpot/SS0814/index.html)