Global warming compounds Atlantic cod fishing industry problems

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Two recent scientific studies point to the effects of global warming on Atlantic cod populations, which were already reduced to historically low sizes by decades of overfishing during the 20th century.

Government attempts to regulate catches off the eastern coasts of Canada and New England over the past 25 years have had serious economic consequences.

While the stock off the coasts of Labrador and Newfoundland—particularly in the Hawke and Notre Dame channels and the Bonavista Corridor—are rebounding, further south in the Gulf of Maine the stock is small, sickly and vulnerable to the effects of global warming.

A crisis in the Canadian stock in 1992 led the national government to declare a moratorium on commercial cod fishing, and 35,000 people lost their jobs. The entire population of Newfoundland and Labrador at the time was about 570,000 people. The 1992 moratorium was considered the largest industrial shutdown in Canadian history.

New Bedford, Massachusetts, one of the most active fishing ports in the United States, was hit hard when groundfishing (cod are classified as a groundfish) on Georges Bank began to collapse in the 1980s. At the beginning of the 1990s the city's unemployment rate was above 12 percent. While a transition to the harvesting of sea scallops has ameliorated New Bedford's losses, other Massachusetts ports continue to suffer.

In June 2013 the *Boston Globe* reported on boat captains in Gloucester and Scituate who were supplementing their fishing income with unemployment and Social Security. Citing National Oceanic and Atmospheric Administration statistics, the *Globe* wrote that "from 2001 to 2011, the number of federally licensed groundfishing boats working in the Northeast" dropped from 1,019 to 344. The number of active boats in Massachusetts dropped by more than a third between 2009 and 2013, from 312 to 200.

For centuries, cod (*Gadus Morhua)* were so plentiful in the northwestern Atlantic that boats would travel by sail from as far away as Spain and Portugal to catch them. In his book *Cod*, Mark Kurlansky gives examples of the extent of the industry, including that at the end of the 16th century Plymouth, England, already had a fleet of 50 Newfoundland fishing ships.

In the middle of the 20th century, according to Kurlansky, the industry was so important that shots were fired between the British Navy and Iceland's Coast Guard when Iceland began to impose a zone within which it did not want other nations fishing.

The fishery was still so plentiful that in the 1960s factory trawlers from around the world—capable of catching, cleaning, and freezing the fish—were landing hundreds of thousands of metric tons per year. The highest yearly catch—800,000 metric tons in 1968—was nearly four times the total current biomass of Newfoundland's remaining cod stock.

The collapse of the northwestern Atlantic stocks because of overfishing was so drastic that tight controls remain on groundfishing off the coasts of Maine and Massachusetts. In the summer of 2014 the federal National Oceanic and Atmospheric Administration (NOAA) estimated that the number of reproductive age cod in the Gulf of Maine was only 3 to 4 perccent of what would be needed for a sustainable fishery. On May 1 of this year the US federal quota for Gulf of Maine cod was cut by 78 percent.

A report in the November 13, 2015 issue of the journal *Science* (volume 350, issue 6262) details the effects on the Gulf of Maine fishery of rapidly rising temperatures in the northwestern Atlantic. Using sea

surface temperatures (SST) from the decade 2004-2013, the report calculates that the Gulf of Maine warmed faster than 99.9 percent of the world's oceans.

Effects of greenhouse gases and global warming on the Gulf Stream—a strong current that originates in the Gulf of Mexico and brings warm water northward in the Atlantic off of North America—correlate strongly with this heating. While the Gulf Stream does not enter the Gulf of Maine directly, it has shifted northward and this change is "associated with reduced transport of cold waters southward on the continental shelf."

The *Science* report describes an 18-month-long "ocean heat wave" that peaked in 2012. Even if that phenomenon does not repeat, climate change will likely have recurring effects that include warming of the waters earlier each year and cooling later.

In biology, recruitment means the survival of juveniles to adulthood. For cod in the Gulf of Maine, increasing ocean temperatures have had drastic impacts on recruitment. There are likely several effects, according to *Science*, including fewer zooplankton that larval cod eat, immigration of predators that feed on young cod, and metabolic processes in the fish. While this last factor has not been proven, "the average weight-at-age of cod in the Gulf of Maine region has been below the long-term mean since 2002, and these poorly conditioned fish will have a lower probability of survival."

Using three possible warming scenarios, the report estimates that severely limiting fishing until 2030 would result in a sustainable Gulf of Maine yield of only 1,800 metric tons if warming occurs at the severest rate, compared to more than 5,000 metric tons if warming occurs at a slower rate.

More factors affect the dynamics of cod populations than simply migrating northward as ocean temperatures rise. However, the October 27, 2015 issue of the *Canadian Journal of Fisheries and Aquatic Sciences* reports on a dramatic comeback in the populations off of Newfoundland. Capelin, a member of the smelt family, is a staple food of adult cod, containing nutrients that can even restore sickly fish to good health. Capelin prefer warmer waters.

The article notes that cooler ocean waters severely reduced the number of capelin off of Newfoundland at the time of the cod population crash in the early 1990s. Waters in that area have since warmed again, leading to a revival of the capelin stock. The authors write that a revival of cod populations has paralleled this growth. Where the largest remaining stock of cod had been in Smith Sound, there are now three stocks displaying healthy behavior. Not only has the total number of cod increased, but so have the number of older (6 years and up), longer (than 1 meter), and spawning age fish.

Nonetheless, this localized revival may be limited. The total biomass is estimated at 200,000 tons, compared to the 1990 biomass of 450,000 tons for this area before the crash. The Newfoundland and Labrador cod fishery used to support a catch of 200,000 to 400,00 tons per year.

References

Kurlansky, Mark. (1997). *Cod: A Biography of the Fish That Changed the World.* New York: Penguin. page 59, pp. 162-167.

Pershing, Andrew J., et al. (2015). *Science*, volume 350, issue 6262, pp. 809-812.

Rose, George A. & Rowe, Sherrylynn. (2015). Northern cod comeback. *Canadian Journal of Fisheries and Aquatic Sciences*, 72, 1789-1798.