

Climate change causing significant shift in composition of coastal fish communities

Invertebrates and warm-water species increase, bottom feeders decrease



A detailed analysis of data from nearly 50 years of weekly fish-trawl surveys in Narragansett Bay and adjacent Rhode Island Sound has revealed a long-term shift in species composition, which scientists attribute primarily to the effects of global warming.

According to **Jeremy Collie**, professor of oceanography at the University of Rhode Island's Graduate School of Oceanography, the fish community has shifted progressively from vertebrate species (fish) to invertebrates (lobsters, crabs and squid) and from benthic or demersal species – those that feed on the bottom – to pelagic species that feed higher in the water column. In addition, smaller, warm-water species have increased while larger, cool-water species have declined.



Dr. Jeremy Collie

"This is a pretty dramatic change, and it's a pattern that is being seen in other ecosystems, including offshore on Georges Bank and other continental shelf ecosystems, but we're in the relatively unique position of being able to document it. These patterns are likely being seen in estuaries around the world, but nowhere else has similar data," said Collie.

Results of the research by Collie and URI colleagues Anthony Wood and Perry Jeffries will be published in the July issue of the *Canadian Journal of Fisheries and Aquatic Sciences*.

The weekly trawl survey by URI scientists began in 1959 and continues to the present, making it one of the longest data sets of fish species composition available. The survey has recorded 130 species, though the analysis focused only on the top 25 species, which accounted for 96 percent of the total number of animals collected.

Collie said that while most of the changes occurred slowly, an abrupt change appeared to take place in 1980 and 1981 when benthic species like winter flounder and silver hake declined and pelagic species including butterfish and bluefish increased.

"We think there has been a shift in the food web resulting in more of the productivity being consumed in the water column," Collie explained. "Phytoplankton are increasingly being grazed by zooplankton, which are then eaten by planktivorous fish, rather than the phytoplankton sinking to the bottom and being consumed by bottom fish. It's a rerouting of that production from the bottom to the top."

Collie noted that the increase in the numbers of lobsters and crabs is a result of their taking advantage of the benthic habitat abandoned by the bottom-feeding fish species.

Overall, the survey analysis found huge changes in the abundance of some species. Butterfish and bluefish, for instance, have increased in abundance by a factor of about 100 times while cunner has decreased by almost 1,000 times.

The analysis also found that while the total number of fish caught in each trawl increased over time, peaking in the 1990s, the size of those fish decreased.

"While we're catching more fish now, we're also catching smaller fish," said Collie, "and that corresponds with how the preferred temperatures of the fish here have changed. The fish community now is dominated by warm-water adapted species compared with what we started with, and fish that live in warmer water are smaller."

Collie added that fishing may also be a factor in the decline in fish size, since fishing removes the largest individuals from a population while leaving the smaller ones. However, he believes that climate is "the dominant signal." Sea surface temperature in the area of the trawls has increased by 2 degrees Centigrade since 1959, and the preferred temperature of the fish caught in the trawls has also increased by 2 degrees C.

"That seems to be direct evidence of global warming," he said. "It's hard to explain any other way."

The shift in species composition also correlates with the winter North Atlantic Oscillation index and with chlorophyll concentrations, which declined by 50 percent, both of which are related to warmer sea temperatures.

What do these changes mean for the future of Narragansett Bay?

"Our overall prediction is that Narragansett Bay is soon going to resemble estuaries to the south of us – Delaware Bay, Chesapeake Bay – so we'll experience what they are experiencing now," Collie said. "It will continue to get warmer and attract more southern species, such as blue crabs. Species that couldn't complete their life cycle here before may be able to do that now."

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