Study provides new insights into marine ecosystems and fisheries production

September 30 2009

NOAA and Norwegian researchers recently completed a comparative analysis of marine ecosystems in the North Atlantic and North Pacific to see what factors support fisheries production, leading to new insights that could improve fishery management plans and the ecosystems.

Known as MENU, for Marine Ecosystems of Norway and the U.S., the collaborative project involved scientists at the NOAA Fisheries Service's Northeast Fisheries Science Center and Alaska Fisheries Science Center and colleagues at the Institute of Marine Research in Norway. Results of their analyses, funded by the Norwegian Research Council, were recently published in a special issue of the journal *Progress in Oceanography*.

"We used some innovative statistical methods and approaches, applying these over different space and time scales to compare multiple ecosystems," said Jason Link of the Northeast Fisheries Science Center lab in Woods Hole, Mass., who served as a guest editor of the issue and is a co-author of several of the 17 research articles.

"Other comparative ecosystem studies have been conducted, but most have involved applying a single statistical model to multiple systems or multiple models to one ecosystem. MENU is the first attempt to provide a comprehensive, coordinated and integrated view of a wide range of marine ecosystems."

Researchers involved in MENU and in other comparative analyses found

underlying patterns in the ecosystems that would not have been apparent had only one ecosystem been studied. For example, MENU results revealed that deeper eastern ocean boundary systems, like those off Alaska or in the eastern North Atlantic off Europe, are more strongly influenced by bottom-up mechanisms, known as forcing. These would include broad scale oceanographic systems like the Pacific Decadal Oscillation and the El Nino Southern Oscillation.

Shallower western boundary systems, mainly on continental shelves, like Georges Bank and other areas off the east coast of the U.S. and Canada, are more strongly influenced by top-down processes, such as fisheries exploitation. "Both top-down and bottom-up processes occur in all of these ecosystems, but being able to determine their relative importance is difficult.," Link said.

The researchers compared marine ecosystems in the northern hemisphere and mostly in high latitudes, ranging from the eastern Bering Sea and Gulf of Alaska in the North Pacific to Georges Bank and the Gulf of Maine, North Sea and the Adriatic Sea off Italy. Other ecosystems studied included the Gulf of St. Lawrence, Scotian Shelf, Newfoundland Shelf, Southern New England, Gulf of Finland, and the Baltic Sea. All of these ecosystems support commercially important fisheries.

Fisheries landings in the ecosystems studied appear to have shifted from groundfish to invertebrates, such as squid, shrimp and scallops. In many, the fish community has changed from one dominated by demersal or bottom-dwelling species to one dominated by pelagic or upper water column species. The researchers note that it is unclear if their findings are true of all marine ecosystems, or just those studied. One of the many questions raised by the comparative analyses is whether similar species in different ecosystems react to environmental conditions in similar ways, or whether the local ecosystems override global factors.

Fisheries production varies widely among ecosystems, and is affected by changing natural and human-induced factors such as climate, pollution and fishing effort. With so many factors involved, Link said scientists need to understand the relative importance of each factor in each ecosystem, something that is difficult to achieve but important for an ecosystem approach to fisheries management and conservation.

"We do a lot of science, but rarely have the opportunity to pull it all together to understand the big picture, with basin-scale comparisons, so that we can start to understand processes within an ecosystem as well as between ecosystems," Link said. "Since we cannot conduct experiments in large marine ecosystems, we used the comparative approach in MENU as a natural experiment to address a number of questions. Among these are what is fundamental to ecosystems in general, and what is unique to particular ecosystems?"

Scientists are already undertaking more integrated ecosystem assessments like MENU in the U.S. to build on decades of smaller scale, more focused studies on individual ecosystems. Comparative Analysis of Marine Ecosystem Organization, or CAMEO, is a partnership between NOAA's Fisheries Service and the National Science Foundation to advance understanding of marine ecological systems using a comparative approach. CAMEO funded seven projects for 2008-2009 and is currently soliciting research proposals for 2009-2010.

Source: NOAA