NEW YORK CITY

VIRGINIA BEACH

Climate Change and Fisheries

Silver hake offer a glimpse into how shifting currents impact Atlantic fish stocks

Researchers Young-Oh Kwon, Terry Joyce and Xujing Jia Davis.

The North Atlantic's most powerful currents, the warmer Gulf Stream (depicted in red) and the colder Atlantic Meridional Overturning Circulation (depicted in blue) may play critical roles in determining and predicting the behavior of fish stocks in the region.

Scientist Emeritus Terrence Joyce likes a nice silver hake, not so much for eating as for studying.

Hake make good study subjects because they are predictable; they prefer to hang out on the slope of the East Coast's Continental Shelf, where the water is a comfortable (for them) 46 degrees F. Hake also are popular with landings in 2007 exceeded 6,000 metric tons, at a value of more than $7 million. This commercially important fish has been monitored by the National Marine Fisheries Service for more than 40 years.

Because of the silver hake's predictability and popularity, Joyce and his team found the fish to be an excellent proxy for better understanding how fauna react to changes in the North Atlantic's most powerful currents: the Atlantic Meridional Overturning Circulation (AMOC) and the Gulf Stream (GS). With funding from OCCI and the Ocean Life Institute, Joyce and fellow physical oceanographers Xujing Jia Davis and Young-Oh Kwon found that silver hake move north and south along the U.S. East Coast in response to fluctuations in the path of the Gulf Stream. These findings provide needed scientific data to explain the significant amount of observed

changes in both the location and biomass (density in a given area) of the fish.

"We've used the GS path as a leading indicator of conditions at the shelf break," Joyce explained, "but in reality the silver hake and the Gulf Stream are responding to processes 'upstream' from our study area arising in the Labrador Sea and reflecting large-scale circulation changes associated with the AMOC."

When flow into the region from the Labrador Sea decreases, the northeast U.S. shelf is warmer, the GS is closer to the shelf, and the preferred habitat of the silver hake is shifted northward. Conversely, when the flow from the Labrador Sea increases, the shelf is cooler and the GS moves away from it, and the silver hake shift south. There is a clear suggestion, Joyce, Kwon and their co-authors wrote in a paper published in *Nature Communications*, "that climatic signals influence the bottom waters over the shelf and that silver hake are responding to this remote forcing."

Of equal interest to Joyce and his team are two other findings with far-reaching implications. First, their data shows that the GS path changes appear to lead changes in hake distribution by about a year, which could allow fisheries managers to use the GS to predict where hake fishing might be most productive. Second, they believe that silver hake—traditionally classified as two separate stocks (northern and southern)—might not be as independent as previously thought.

"We're not doing the fish any favors," Kwon explained, "because we're explaining where they are, what they are and where they will likely migrate. However, this is important data for managing fisheries."

Joyce believes that as the silver hake continue to shift north, they may largely disappear from their largest fishery, the southern part of the mid-Atlantic. The economic implications are obvious; less evident but equally important is how this shift might impact ecosystems. The fish is an important prey and predator in the ocean food chain, so shifts in distribution may be reflected in other Atlantic fish stocks.

As the team continues to analyze its data, Joyce envisions extending this study to other commercially important fish found in New England waters.

OCCI and the Ocean Life Institute granted $74,978 to Joyce and his team for the project, "Can Changes in Silver Hake Be Related to and Forecast by Changes in the Gulf Stream Path?"