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Potential Western Atlantic Spawning Area Found for Atlantic Bluefin Tuna

Scientists from NOAA's National Marine Fisheries Service (NOAA Fisheries) and the University of Massachusetts Boston have found evidence of Atlantic bluefin tuna spawning activity off the northeastern United States in an area of open ocean south of New England and east of the Mid-Atlantic states called the Slope Sea.

The findings, published March 7 in the *Proceedings of the National Academy of Sciences*, suggest that the current life-history model for western Atlantic bluefin, which assumes spawning occurs only in the Gulf of Mexico, overestimates age-at-maturity. For that reason, the authors conclude that western Atlantic bluefin may be less vulnerable to fishing and other stressors than previously thought.

Prior to this research, the only known spawning grounds for Atlantic bluefin tuna were in the Gulf of Mexico and the Mediterranean Sea. The evidence for a new western Atlantic spawning ground came from a pair of Northeast Fisheries Science Center (NEFSC) research cruises in the Slope Sea during the summer of 2013.

"We collected 67 larval bluefin tuna during these two cruises, and the catch rates were comparable to the number collected during the annual bluefin tuna larval survey in the Gulf of Mexico," said David Richardson of NOAA's Northeast Fisheries Science Center (NEFSC), lead author of this study. "Most of these larvae were small, less than 5 millimeters, and were estimated to be less than one week old. Drifting buoy data confirmed that these small larvae could not possibly have been transported into this area from the Gulf of Mexico spawning ground."

Larvae collected during the cruises were identified as bluefin tuna through visual examination and genetic sequencing. To confirm the identification, larvae were sent to the Alaska Fisheries Science Center laboratory in Juneau, where DNA sequences verified that the larvae were Atlantic bluefin tuna.

A single bluefin tuna can spawn millions of eggs, each of which is just over a millimeter in diameter, or the size of a poppy seed. Within a couple of days these eggs hatch into larvae that are poorly developed and bear little resemblance to the adults. Larval bluefin tuna can be collected in plankton nets and identified based on their shape, pigment patterns and body structures.

Atlantic bluefin tuna (*Thunnus thynnus*) is a high value species with a unique physiology that allows it to range from the tropics to the sub-arctic, in coastal to international waters. As a highly migratory species, Atlantic bluefin tuna is assessed by the Standing Committee on Research and Statistics (SCRS) of the International Commission for the Conservation of Atlantic Tunas (ICCAT) as distinct eastern and western stocks separated by the 45 degree west meridian (or 45 w longitude). The U.S. fishery harvest from the western Atlantic stock is managed through NOAA Fisheries' Atlantic Highly Migratory Species Fishery Management Plan.

For many years, global overfishing on this species was prevalent, resulting in substantial population declines. However, recent international cooperation in managing catches has contributed to increasing trends in the abundance of both the eastern and western management stocks. The western stock, targeted by U.S. fishermen, is harvested at levels within the range of the SCRS' scientific advice.

This research may help to resolve a longstanding debate in Atlantic bluefin tuna science. It had long been assumed that bluefin tuna start spawning at age 4 in the Mediterranean Sea and age 9 in the Gulf of Mexico. Electronic tagging studies begun in the late 1990s revealed that many bluefin tuna, assumed to be of mature size, did not visit either spawning ground during the spawning season as expected. This led some to propose that these larger fish were not spawning, and instead the age-at-maturity for western Atlantic bluefin tuna was 12-16 years, rather than 9 years, as was assumed in the stock assessment.

Molly Lutcavage at the Large Pelagics Research Center of the University of Massachusetts Boston, a co-author on the study, was a consistent supporter of an alternate hypothesis—fish that did not visit the Gulf of Mexico and Mediterranean Sea were spawning elsewhere. The research team used electronic tagging data from the Lutcavage lab to present an alternate model of western Atlantic bluefin tuna spawning migrations.

Only the largest bluefin tuna, those over about 500 pounds, migrate to the Gulf of Mexico spawning area. After these fish exit the Gulf of Mexico, they swim through the Slope Sea rapidly, on their way to northern feeding grounds. On the other hand, smaller fish, ranging in size from 80 to 500 pounds, generally spend more than 20 days in the Slope Sea during the spawning season, a duration consistent with spawning.

"Last year, we demonstrated using endocrine measurements that bluefin tuna in the western Atlantic mature at around 5 years of age. That study, and ones before it, predicted that these smaller fish would spawn in a more northerly area closer to the summertime foraging grounds in the Gulf of Maine and Canadian waters," Lutcavage said. "The evidence of spawning in the Slope Sea, and the analysis of the tagging data, suggests that western Atlantic bluefin tuna are partitioning spawning areas by size, and that a younger age at maturity should be used in the stock assessment."

Researchers also found that individual tuna occupy both the Slope Sea and Mediterranean Sea in separate years, contrary to the prevailing view that individuals exhibit complete fidelity to a spawning site. Reproductive mixing between the eastern and western stocks may occur in the Slope Sea and the authors contended that population structure of bluefin tuna may be more complex than is currently thought.

"Past analyses of Atlantic bluefin tuna population structure and mixing between the western and eastern Atlantic stocks may need to be revisited because they do not account for

the full spatial extent of western Atlantic spawning," Richardson said. "So much of the science and sampling for Atlantic bluefin tuna has been built around the assumption that the Gulf of Mexico and Mediterranean Sea are the only spawning grounds. This new research underscores the complexity of stock structure for this species and identifies important areas for future research."

The authors expect these findings could potentially lead to a lower estimated age-at-maturity, a critical component of the stock assessment, and could reopen consideration of the nature and level of mixing between the western and eastern Atlantic populations. This new information will be considered along with other pertinent research as part of the regular ICCAT SCRS stock assessment process.

The scientific team for this study comprises researchers from NOAA's Northeast Fisheries Science Center (NEFSC) and Alaska Fisheries Science Center (AFSC), the Large Pelagics Research Center at the University of Massachusetts Boston, the School of Marine Science and Technology at the University of Massachusetts Dartmouth, and NOAA's Greater Atlantic Regional Fisheries Office (GARFO). The sampling for this study was supported by NOAA, the Bureau of Ocean Energy Management, and the US Navy through interagency agreements for the Atlantic Marine Assessment Program for Protected Species (AMAPPS).

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PNAS article: http://www.pnas.org/content/early/2016/03/04/1525636113.full?sid=a03f6d77-51ee-4209-a5e3-7f43e2f32228

Western Atlantic bluefin tuna: http://www.fishwatch.gov/profiles/western-atlantic-bluefin-tuna

Atlantic Highly Migratory Species – Tunas:
http://www.nmfs.noaa.gov/sfa/hms/species/tunas/index.html

Large Pelagics Research Center, UMass Boston: https://www.umb.edu/tunalab