

New techniques for estimating Atlantic bluefin tuna reproduction

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Atlantic bluefin tuna mature at a considerably younger age than currently assumed, say researchers led by fisheries oceanographer Molly Lutcavage at UMass Amherst, with Gilad Heinisch of Israel. Findings could lead to changes in how fisheries scientists estimate the population. Credit: Large Pelagics Research Center, UMass Amherst

Using a new approach for determining the age at sexual maturity for wild stocks of western Atlantic bluefin tuna, researchers led by Molly Lutcavage of the University of Massachusetts Amherst and Gilad Heinisch of Israel's Oceanographic and Limnological Research Center, suggest that these fish mature at a considerably younger age than currently assumed. These findings could lead to changes in how fisheries scientists estimate the population.

Lutcavage says, "Whether a [bluefin tuna](#) or cod, for realistic [fish](#) stock assessments it's important to know at what age, where, when and how often fish spawn. Here in Gloucester and New England, it's painfully clear from the groundfish management crisis that fisheries scientists and managers must get these basics right."

In their study published on Nov. 28 in Nature's online open-access journal *Scientific Reports*, Lutcavage, a fisheries oceanographer and director of the Large Pelagics Research Center at UMass Amherst's Gloucester Marine Station, with her two former doctoral students Heinisch and Jessica Knapp at the University of New Hampshire, introduce a new endocrine-based approach to determine timing of sexual maturation in one of the most important commercial tuna species in the Atlantic.

Until now, sexual maturity for bluefin tuna was determined by observing fish sizes on the known spawning grounds during the known spawning season. Since bluefin tuna aggregate roughly by size for reproduction, this is like searching for expectant mothers only in hospital delivery rooms, Lutcavage says. Spawning bluefin using locations and times other than those observed in the northern Gulf of Mexico would be overlooked. This would lead to underestimating the spawning stock biomass, and bias estimates of the population's reproductive potential.

She adds, "We needed to analyze sexual maturity in bluefin of different

sizes where they mix, on their feeding grounds such as the Gulf of Maine. But since this is not a breeding location, fish lack the obvious characteristics of those in spawning condition. We had to come up with a novel approach to determine maturity. Endocrine tools, recently developed in Israel for bluefin aquaculture, were just what we were looking for."

The authors state that "determining accurate maturity schedules for western Atlantic bluefin tuna is necessary for precise determination of spawning stock biomass, a proxy of reproductive potential." A major bias for determining the age of sexual maturity is the potential for biased sampling on spawning grounds, they add, but their new endocrine-profiling technique provides alternative, direct and accurate information.

Experts currently recognize two major spawning basins, the Mediterranean Sea and the northern Gulf of Mexico/Florida Straits for eastern and western Atlantic bluefin tuna stocks, Lutcavage explains. But researchers are uncertain about annual migrations, stock structure and age at sexual maturity for these fish. While the age at first reproductive cycle of eastern Atlantic bluefin tuna is well documented and occurs in three to five year-old fish the prevailing assumption for western Atlantic bluefin is that these fish do not breed before reaching nine years of age.

Lutcavage and colleagues investigate and challenge the assumption and long-held belief that such a large discrepancy exists between the two groups. "Recent studies show that bluefin in the eastern and western Atlantic grow at the same rates, eat similar prey, and can mix on the same Atlantic feeding grounds early in life. With similar life histories, it's hard to see how they could then maintain vastly different maturity schedules."

For their study, Lutcavage and colleagues sampled 110 total, (48 female, 45 male and 17 young-of-the-year (YOY)) Atlantic bluefin tuna caught

in United States and Canada during May through November, 2008 to 2010.

For each fish, the researchers took the standard size measure, curved fork length (CFL) and removed and froze the pituitary gland. They also weighed the gonads with nearby fat body. Later, in the laboratory, the researchers measured luteinizing hormone (LH) and follicle-stimulating hormone (FSH) in the pituitary. Briefly, they found that "the current paradigm of widely different maturity schedules for eastern and western Atlantic bluefin tuna is incorrect."

The FSH/LH ratio, an indicator for [sexual maturity](#) in vertebrates, was, as expected, higher than 2 in the immature YOYs and lower than 0.4 in the mature large fish (greater than or equal to 185 cm CFL). In the intermediate group (134-185 cm CFL), fish that are currently assumed immature, the ratio was less than 0.4, similar to the mature fish, they report. These results are also in agreement with results from Mediterranean bluefin as well as in other vertebrates, the authors say.

Overall, the endocrine results "demonstrate that Atlantic bluefin tuna of sizes 134-185 cm CFL sampled in the northwest Atlantic are sexually mature, and consequently alternative reproductive behavior scenarios for spawning locations and times should be considered." The authors conclude that "growing physiological and behavioral evidence" show maturity and reproduction markers for western Atlantic bluefin [tuna](#) must be revised, "which would contribute to more accurate stock assessments and estimates of spawning stock biomass."

More information: *Scientific Reports*,
www.nature.com/srep/2014/14112.../full/srep07205.html

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