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Technology and Collaboration Critical to Monitoring Winter Spawning Activity of Atlantic Cod in Massachusetts Bay

On December 1, two underwater gliders were deployed in Massachusetts Bay to study winter spawning activity of Atlantic cod. The gliders, a type of autonomous underwater vehicle that uses buoyancy-based propulsion and wings to move up and down through the water and conserve power, will follow programmed track lines heading south from Salem toward Plymouth during the three-week project, recording both natural and man-made sounds.

The gliders will provide additional information to that collected by six underwater recording units deployed in the Bay in October that have been passively recording sounds and other active sensor and tagging efforts. Using these combined systems, scientists hope to confirm the location and duration of known coastal cod spawning grounds as well as identify possible new spawning areas in both state and federal waters.

“We are excited about adding new technologies to identify historic and perhaps new spawning grounds of cod,” said Sofie van Parijs, who heads the passive acoustics group at the Woods Hole Laboratory of NOAA’s Northeast Fisheries Science Center (NEFSC). “The gliders will cover areas that stationary recorders and active sensors don’t reach, giving us a better sense of where and when fish are in the area. This work builds upon our existing knowledge and adds another piece to the puzzle.”

This latest deployment is one of several research efforts undertaken in a collaborative multi-year program to study the reproductive behavior of Atlantic cod in the wild. For several years, researchers from the passive acoustics group at NOAA’s Northeast Fisheries Science Center (NEFSC) have been working with Stellwagen Bank National Marine Sanctuary (SBNMS), the Massachusetts Division of Marine Fisheries (DMF), the University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST), and local fishermen. The Woods Hole Oceanographic Institution (WHOI) and The Nature Conservancy (TNC) joined the group in this latest study.

Atlantic cod are known to gather in high concentrations in very small areas to spawn, sometimes forming vertical columns or “haystacks”. They often return annually to the same location to spawn, a behavior known as spawning site fidelity.

During the spawning season, male cod produce low frequency sounds, called grunts, which are thought to serve as a courtship display to females or as an aggressive display to competitors. The grunts are picked up by bottom-mounted Marine Autonomous Recording Units (MARUs) that collect and store acoustic data for weeks or months. By analyzing these data, scientists are able to characterize ocean noise, study the acoustic behavior of marine mammals and fish, and gain a better understanding of the abundance and distribution of different species.

A pilot project initiated in spring 2011 used a single MARU in northern Massachusetts Bay and successfully recorded grunts from spawning cod, which are protected by the Commonwealth of Massachusetts, in a seasonal conservation area known as the Spring Cod Conservation Zone. Cod were also captured near the MARU as part of a tagging study conducted at the same time by Massachusetts DMF, confirming that cod were present.

In spring 2012, researchers deployed nine MARUs in the same area as the 2011 pilot study and beyond to record cod acoustically through an entire spawning season. These studies provided the basis for the current multi-year program to explore the size and extent of known cod aggregations in both state and federal waters during the winter.

Five MARUs were deployed in late 2013 and retrieved in spring 2014. Analysis of the sounds from this effort is now underway. The NOAA Saltonstall-Kennedy program and the NOAA Fisheries Service Cooperative Research Program provided two more years of funding to continue this work.

Year two of the project began this October with the deployment of six MARUs placed alongside the Massachusetts DMF “active acoustics” receivers, which record signals from cod tagged with acoustic transmitters. The study of winter cod spawning aggregations in Massachusetts Bay includes an area known as the Winter Cod Conservation Zone, where cod are known to spawn during this season.

Because cod vocalizations can be detected only within 50-100 meters (165-330 feet) of the source, the gliders deployed December 1 will help identify possible cod spawning activity in areas outside the range of the stationary MARUs, including an area to the east that extends into the Stellwagen Bank sanctuary.

The two gliders, operated by WHOI, are following a programmed track line, one 12 hours behind the other, recording both day and night. The gliders are equipped with a variety of instruments, including acoustic receivers that can detect cod grunts and other receivers that can detect tagged fish in the vicinity. Both gliders, weather permitting, will be recovered December 22. For this work, several receivers were loaned by John Kocik and colleagues at NEFSC's Orono Field Station in Maine, where the receivers are normally used to track tagged Atlantic salmon.

An added bonus on both gliders is a separate passive acoustic device that records whale vocalizations in the area. Every two hours, real-time sound detections of humpback, right, fin, and sei whales are relayed to Van Parijs and other scientists on shore.

The cod spawning project is one of a series of projects involving passive acoustics that will be undertaken in the next three years by the NEFSC passive acoustic group with a variety of partners.

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Related links:

Acoustic Behavior of Fish:

<http://www.nefsc.noaa.gov/psb/acoustics/psbAcousticBehaviorFish1.html>

Studying Marine Mammals Using Autonomous Acoustic Technology:

<http://www.nefsc.noaa.gov/psb/acoustics/psbAcousticsGliders.html>

Acoustic Monitoring of Atlantic Cod Reveals Clues to Spawning Behavior:

http://www.nefsc.noaa.gov/press_release/2013/SciSpot/SS1301/

Spawning Cod Glider Mission, December 2014:

<http://dcs.who.edu/sbnms1214/sbnms1214.shtml>