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New Survey of Ocean Floor Finds Juvenile Scallops are Abundant in Mid-Atlantic

NOAA researchers are getting a comprehensive view of the ocean floor using a new instrument, and have confirmed that there are high numbers of young sea scallops off of Delaware Bay.

Unofficially dubbed the "Seahorse" because of its curved and spiny profile, the instrument is the latest and most sophisticated version of a survey system developed at the Woods Hole Oceanographic Institution (WHOI) and used on sea scallop resource surveys conducted by NOAA's Northeast Fisheries Science Center (NEFSC). This is the first year that the sea scallop survey has used both a dredge and the Seahorse's multisensory, integrated, benthic ecosystem sampling capability concurrently.

"The Seahorse results from nearly a decade of commitment to research and development by the fishing industry, our academic partners, NMFS, and other specialists working toward a mutual goal using a variety of funding sources," said Bill Karp, science and research director at the NEFSC. "Joint efforts like this take advantage of each party's strengths. We get good results, and I intend to continue engaging fishermen, academia, and other experts to help us make progress on a range of scientific and technical issues important to better managing our fisheries."

The Seahorse is equipped with stereo cameras and strobes (to take color images), a CTD (to measure conductivity, temperature and depth), fluorometer (to measure chlorophyll), spectrometer (to measure water color and trace chemicals in the water), dissolved oxygen sensors, and a high resolution side scan imaging system, among other instruments.

"We are excited about this new system because it gives us a way to make a significant leap forward in understanding scallop biology, ecosystem effects, and how well resource management is working," said Deborah Hart, a mathematical biologist at the NEFSC's Woods Hole Laboratory who also leads the agency's sea scallop stock assessment effort.

Towed behind a ship at around six knots (about 7 miles per hour) and flying about two meters (roughly six feet) above the sea floor, the Seahorse provides a view of the ocean floor more detailed than any obtained to date by the NEFSC's resource surveys. Initially the Seahorse is only being used for surveying sea scallop abundance and distribution, but investigations of other species, benthic habitat, and ecosystems studies are among other potential uses of the technology.

“The applications of this integrated technology are nearly limitless,” said Scott Gallager, a WHOI scientist and co-developer of the Seahorse. “By integrating optical imaging with very

high spatial resolution with side scan acoustics imaging, we can greatly expand our knowledge of seafloor characteristics and biological community structure."

This year's NEFSC sea scallop survey of the Mid-Atlantic area and Georges Bank was conducted aboard the 146-foot Research Vessel *Hugh R. Sharp,* operated by the University of Delaware, and used for the annual NEFSC surveys since 2008. The survey left June 1 on the first of three legs and started off of the Delmarva Peninsula. It then worked its way north off of New Jersey and Long Island and finished up on Georges Bank, east of Cape Cod. The third and final leg returned to NEFSC's Woods Hole Laboratory July 7.

Results were positive not only for the Seahorse's performance but also for what the survey found -- lots of juvenile "seed" scallops in portions of the Mid-Atlantic. Especially high numbers of seed were seen in the "Elephant Trunk" area off of Delaware Bay. The largest numbers of juvenile scallops ever recorded in the NEFSC scallop survey were observed in this area during the 2002 and 2003 surveys; the value of these scallops when they were harvested between 2007 and 2011 was around $500 million at the dock. According to Hart, the 2012 observations appear similar to those from 2002, which bodes well for the future.

The observations from the NEFSC were complemented by similar findings from surveys conducted by the Virginia Institute of Marine Sciences (VIMS) and the scallop industry in the Hudson Canyon and Delmarva areas. These surveys were done on commercial fishing vessels, using the same type of 8-ft dredge used by NEFSC surveys. The NEFSC survey team and the VIMS scientists are encouraged by what they have seen, especially since scallop recruitment in the Mid-Atlantic has been poor for the last three years.

Many of the juveniles observed in these surveys could grow to commercial size in about three years if given the chance to grow before they are harvested. Rotational area closures are successfully used in the Northeast to maintain a profitable and sustainable scallop fishery.

The area-based management of the Atlantic sea scallop fishery depends heavily on survey data. In addition to the NEFSC sea scallop survey, other important sources of data include area-specific cooperative surveys with the fishing industry and academic institutions. Among those are surveys conducted using the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST) video survey system, which captures video footage at specific locations.

The move toward an integrated survey began in 2007 when the NEFSC started calibrating dredge tows made by different vessels using the HabCam system. Hundreds of these "joint tows" were conducted between 2007 and 2011, providing a baseline for integrating scallop abundance data collected by HabCam into the survey.

The 2011 NEFSC sea scallop survey was conducted in three legs from May through June. The first leg was a dredge survey covering the Mid-Atlantic (Virginia to Long Island) region, the second leg was a dredge survey covering Georges Bank. The third leg was a HabCam survey only and was conducted over parts of Georges Bank covered by the earlier dredge surveys. It was the first large-scale HabCam survey, intended as a prototype for future surveys and used an earlier version of the HabCam system. More than 2.5 million photographs were taken by the instrument during the 8-day cruise. These promising results encouraged the NEFSC to transition to a survey that combines the strengths of more than one sampling system.

"Dredges collect sea scallops that we can measure, weigh, and collect biological samples from, in order to determine age and growth rates, and to examine other biological characteristics," said Hart. "A towed camera and oceanographic sensor system doesn't collect animals, but documents everything it sees and measures the environment continuously as the vehicle moves along. The combination of physical samples and continuous imaging are giving us a more complete understanding of both scallop populations and how they interact with their environment."

The Seahorse takes up to 10 overlapping, high resolution digital still images per second, creating a continuous underwater image "ribbon" or mosaic of the seafloor. Navigation and other systems data are displayed on a series of monitors for the pilot, who controls the towed system with a joystick. Hundreds of thousands of real-time optical and acoustic images as well as oceanographic and environmental data are collected each day by the vehicle, helping researchers to document the ways in which commercially valuable stocks like sea scallops and their habitats change over time.

The HabCam concept has been developed over about a decade by the HabCam group, with assistance from NEFSC scientists. The HabCam group includes WHOI scientists, engineers, and commercial fishermen. The various HabCam models have been funded by different sources over time, through the sea scallop fishery management plan's Research Set-Aside Program, the Northeast Consortium, NOAA Fisheries Service, the WHOI Ocean Life Institute, MIT Sea Grant, and NOAA's Integrated Ocean Observing Systems Program.

The Seahorse version of HabCam, version 4, was supported by research and development funds provided by NOAA Fisheries Service's Office of Science and Technology specifically to develop this technology.

"It is a great example of collaboration and cooperation between NEFSC, the HabCam group, and the crew of the research vessel *Hugh Sharp*," Hart said of the recently-completed 2012 at-sea survey, which produced more than 7 million stereo images in 30 days at sea.

Calculating abundance and biomass from HabCam data requires more sophisticated model-based estimation methods than those used for data collected in the dredge-only survey. Hart and NEFSC colleague Burton Shank are now working on that aspect of the project. Dredge surveys provide several hundred stations or data points of information, while the Seahorse HabCam system provides millions of continuous samples.

"It is perfect for ecosystem-based management since it puts data into context," Hart said. "The Seahorse takes an unbroken series of stereo camera images that can help answer, or raise, questions about how things relate to each other. Although we are focused on sea scallops, these data can be mined for many other projects, including estimates of fish abundance, estimating the impacts of fishing and other human activities on the sea floor, and understanding the dynamics of and interrelationships between organisms that live at the bottom of the sea.

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Related links:

HabCam Part I – An Innovative Way to Survey Scallop Habitat:
http://www.nmfs.noaa.gov/stories/2012/07/07_11_12hab_cam.html
HabCam Part II – A Closer Look at Our Science and Technology:
http://www.nmfs.noaa.gov/stories/2012/07/07_hab_cam_part_two.html
About HabCam: http://habcam.whoi.edu/habcamIV.html
Research Vessel *Hugh Sharp* and the Scallop Survey:
http://www.ceoe.udel.edu/marine/rvSharpScallopSurvey.aspx