Robot monitors toxic red tides

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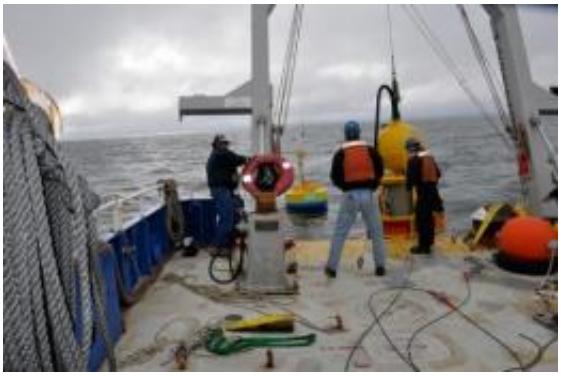

Credit: Copyright Woods Hole Oceanographic Institution

A robotic device suspended under the ocean surface from a buoy off the New Hampshire coast is monitoring seawater for evidence of the red tide, clusters of microscopic plants that release toxins into fish and shellfish, making them poisonous to anyone who eats them.

Named for the color the microorganisms give seawater when stimulated by sunlight, red tides are common seasonal phenomena in coastal waters.

"There are many different types of red tides depending on where you are in the world and many different types of impacts depending on the organism that cause the problems," said Don Anderson, a senior scientist at the Woods Hole Oceanographic Institution in Massachusetts.

The differences stem from different types of plant, also known as

harmful algal blooms, responsible for red tides in different locations.

Eating seafood contaminated with red-tide toxins can cause gastrointestinal, neurological, and cardiovascular symptoms and, in rare cases, death.

To protect consumers, governmental regulators currently test ground-up shellfish and other seafood from coastal sites for the presence of the red-tide toxins. When the level of poisons becomes too high, the authorities close down fishing from the affected area.

"We usually collect between 15-20 blue mussels, which have a tendency to take up the toxin very quickly, and take them to the lab," said Chris Nash, shellfish program manager at the New Hampshire Department of Environmental Services. "Once we see toxicity in the blue mussels we'll take up other species for testing."

The main target for the investigation is an algae species called Alexandrium fundyense, which is the main component of red tides off New England and several other locations worldwide.

The new robotic device, called an Environmental Sample Processor, tests seawater directly for the organisms responsible for Alexandrium fundyense and other toxins.

Scientists emphasize that the technology won't replace tests on shellfish tissue, because the governments of coastal states mandate them. But if the test succeeds the method will give advance notice of incipient red tides and allow more precise location of the poison-carrying algae.

"It doesn't replace our monitoring, but it's certainly useful," Nash said. "More data is great. It's helpful not just generally but also to be able to anticipate what's coming."

The robotic device works by pumping seawater onto a sensor that identifies the microorganisms' DNA and radios the information to scientists at Woods Hole.

"Ours is the only instrument that can robotically filter the water and perform analyses of multiple red-tide species and some of their toxins," Anderson said. "Everything is new about it. We've had to develop new moorings and communications with the shore. We're learning how to use this instrument, how to deploy it, and how to come up with all the details other users will need."

Developed over the past decade by Chris Scholin, a former student in Anderson's laboratory who is now president and CEO of the Monterey Bay Aquarium Research Institute in California, the patented device is built by McLean Research Laboratories of East Falmouth, Massachusetts.

At present each instrument costs about $200,000. The mooring system, which includes a Woods Hole-developed cable resembling a bungee cord atop the buoy that keeps the system stable when large waves and high winds ruffle the surface, adds as much as $100,000 to that figure.

"Of course, this is the earliest stage of the technology," Anderson added. "We fully expect that in time the devices will be much, much smaller and easier to operate."

Anderson and the Woods Hole team plan to place more robotic devices in new locations over the next few years.

"This year there's a single instrument out there; next year we'll have two at different locations," Anderson said. "It's very much a research and development project while supplying information to the states."

Other emerging methods show promise of monitoring red tides.

In some regions of the world authorities use satellite images to monitor and track the tides based on the color of microorganisms. Scientists in Florida are also developing an optical method that identifies microorganisms based on their color pigments.

Another system under development at Woods Hole, the Imaging FlowCytobot, feeds pictures of individual cells in algal blooms to software trained to identify organisms.

Anderson said that the Environmental Sample Processor has other, and potentially more widespread, applications, such as monitoring pathogens in beaches, reservoirs, and drinking water systems.

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