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Stanford-affiliated sea-faring robot searches for toxic algae

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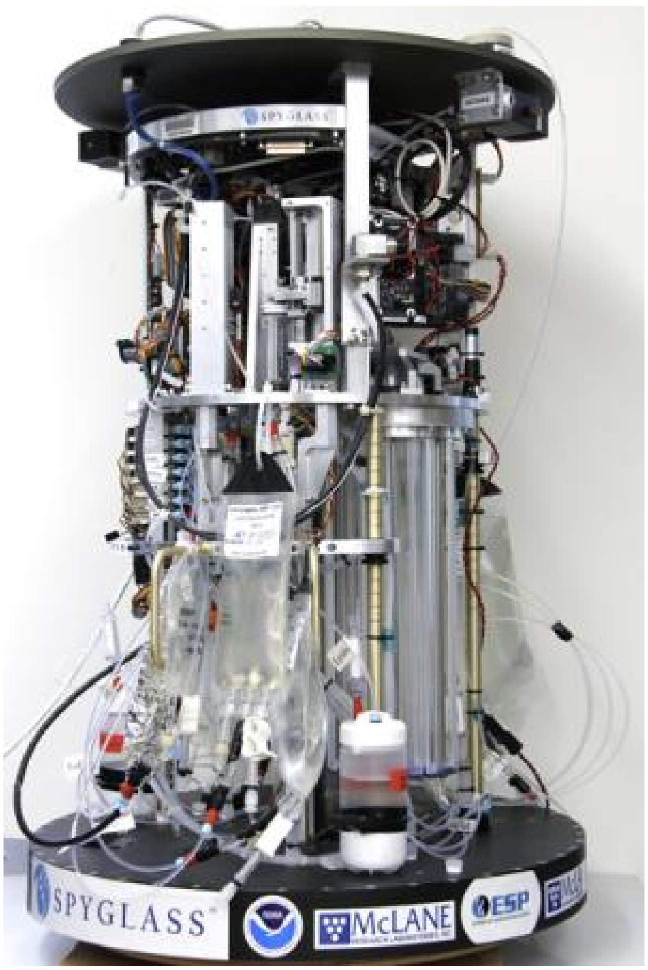

The Environmental Sample Processor, or ESP, shown here without its protective casing, is an autonomous water-sampling robot that detects microorganisms using DNA probes and remotely relays the results to scientists over the Internet. Credit: National Oceanic and Atmospheric Administration

(Phys.org) —A robotic sensor placed in Puget Sound searches for signs of toxic algae and bacteria that contaminate seafood. A successful test run of the Stanford-affiliated project could lead to a network of robots patrolling the area, providing early warnings that could save millions of dollars annually.

The summer waters that fill Puget Sound often attract more than just swimmers and recreational boaters: The warmer than usual currents can encourage widespread toxic algae and bacteria growths throughout the sound.

Scientists can typically determine whether the algae or bacteria are harmful within two days of the bloom, but by then the damage might already be done. If shellfish and other seafood were harvested during a bloom, or shortly before it, the toxin could have made its way to fish markets and dinner plates by the time scientists identify it, prompting public health alerts and expensive recalls of potentially tainted food.

Near the end of July, a group led by Stanford-affiliated marine scientists launched a robotic sensor into Puget Sound's Samish Bay to sniff out the early signs of algal and bacterial blooms in near real time.

When the trial operation wraps this month, the results could provide the framework for a full-time early-warning operation that fishermen could rely on to determine when harvesting conditions are safe, potentially saving millions of dollars in damages each year.

Traditional methods for sensing waterborne toxins rely on collecting samples at sea and then analyzing them in a lab on land. This process can take up to two days, said Kevan Yamahara, an early career fellow focusing on water quality research at the Center for Ocean Solutions, a branch of the Stanford Woods Institute for the Environment.

The new robotic sensor, called an Environmental Sample Processor (ESP), contains automated instruments that can perform the tests on the go.

"Basically, it's a lab in a can," Yamahara said of the tubular robot. "With the ESP, we can have results within four to six hours."

The ESP sucks up water samples and isolates any microbes. Next, the on-board lab uses heat and chemicals to break open the cells and extract their DNA and RNA. The 'bot then runs this genetic material through one of two processes to identify the species and provide an estimate of how much of the stuff is in the water.

This information is beamed by a cellular modem to the Monterey Bay Aquarium Research Institute (MBARI) – which developed the ESP – to be interpreted by Yamahara's group. A positive test for toxic algae, bacteria or fecal pollution lets scientists identify when a hazardous bloom might be forming. That warning will be posted to the project's website and emailed to fishermen. (Future versions of the system could be mobile and fitted with GPS equipment to pinpoint a bloom's location.)

Because the ESP senses toxins at a point when they could infect seafood, but before they expand into a full bloom, the NOAA Northwest Fisheries Science Center, which co-led the project, estimates that a network of the 'bots could save millions of dollars annually simply by restricting fishing until an episode has passed.

"Sometimes the blooms occur without any warning, which is costly for recalling contaminated product," Yamahara said. "We can hopefully provide an early warning system so that the fishermen know that the microorganisms are present, which can maybe help them make decisions about how to harvest."

So far the fishing industry and health departments have been very supportive of the program, Yamahara said, and both will play a role in establishing a full-time program if the current results are promising.

Yamahara is working with MBARI on the next generation of ESP, which will be smaller and provide results faster. In addition to collaborating with the fishing industry, Yamahara's group is working with the Southern California Coastal Water Research Project on a similar project to monitor water conditions near popular recreational beaches.

Provided by Stanford University

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