

Robot kayak joins fight against algae

Algal blooms have caused great harm to Singapore's fish farms

Carolyn Khew

If you chance upon an empty canoe moving by itself off Seletar Island, do not be alarmed.

The yellow robot kayak roaming the Strait of Johor looking for signs of trouble is the latest weapon in the war against killer algae.

It is armed with sensors that measure water temperature, salinity and chlorophyll, among other things. Scientists are using it to monitor waters for harmful algal blooms which have killed fish and marine life en masse here in the past.

Scientists simply programme the robot to survey a designated area and collect data in real time that can then be used to map out patches of algae so scientists know how they are spreading.

Since 2010, scientists from the Tropical Marine Science Institute (TMSI) at the National University of Singapore and the Singapore-MIT Alliance for Research and Technology (Smart) Centre for Environmental Sensing and Modelling (Censam), have been harnessing advanced technologies to monitor environmental stressors, including algal blooms.

The project is funded by the National Research Foundation.

"The sea, as a research field, is a very challenging environment to collect data. Autonomous fleet of vehicles are able to collect relatively more data, more accurately as opposed to traditional methods," said Mr Tawfiq Taber, a senior research manager at Smart Censam.

"Due to the harsh nature of the sea, the robots are required to be robust and resilient to the extreme weather conditions."

Local fish farms here have been badly hit by algal blooms in recent years. Just two years ago, 77 farms were affected by the blooms which wiped out 500 to 600 tonnes of fish – about one-tenth of local farms' yearly produce that year.

There are 118 Singapore coastal fish farms in the East and West Johor Strait, and the southern waters, where most rear fish in net cages in the sea. There are another seven fish farms on land.

Last year, the farms produced about 5,000 tonnes of fish, accounting for about 10 per cent of the fish eaten here.

Dr Sandric Leong, a senior research fellow with TMSI who is co-leading the project, noted that algal blooms are linked to many factors, including slower or warmer water, high nutrient levels and discharge from land agriculture.

Tracking deadly algae

Local farms have been badly hit in recent years by algal blooms killing their fish stock. The Straits Times looks at how scientists here are using technology to detect and track these blooms more efficiently.

Robot Kayak

Fitted with sensors (below), the autonomous robot can measure water temperature, salinity and dissolved oxygen levels – all of which are indicators for harmful algal blooms.



The kayak is pre-programmed to survey a designated area and sensors can be fitted to measure different parameters.

Once the kayak feeds the information back to the computer, scientists are able to use the data to map out patches of algae and observe how they are spreading.

On average, each device costs under \$10,000



Deep underwater camera

The camera can capture real-time images of algae species from 2km deep. This enables researchers to identify algae on site.



A real-time PCR machine

Scientists can use it to identify algae species on-site, in about two hours compared to conventional methods which take a few days. Rapid identification is important especially if toxic algae species are present.

Source: MR TAWFIQ TAHER, DR SANDRIC LEONG. PHOTOS: STFILE, STRAITS TIMES GRAPHICS



Dr Sandric Leong (centre) and his team from the Tropical Marine Science Institute are using technology to track and monitor algae with higher efficiency. They use a machine which can identify the algae species within a few hours, instead of days. ST PHOTO: KEVIN LIM

"Advanced technologies assist in finding the blooms which are still in the early development stage so that the public can be alerted," he said.

Dr Leong and his TMSI team are also using other technologies to help track and detect algal blooms with greater efficiency.

They include a machine which can identify algae species in a few hours instead of days.

An underwater camera is also able to operate at depths of up to 2km, to capture images of algae lurking deep in the sea.

National water agency PUB is also using technology to monitor reservoirs and waterways. It has developed a life-sized robot swan, with the NUS Environmental Re-

search Institute and TMSI, to measure chlorophyll levels and water quality in reservoirs.

The Agri-Food and Veterinary Authority of Singapore (AVA) said it monitors the water quality around the nation's fish farming areas.

"The use of autonomous surface vehicles (ASV) is relatively new in Singapore but such technologies can help to complement AVA's monitoring efforts," added a spokesman.

"On some occasions, we have tapped on the water quality data from NUS' ASV trials to assist in our assessment of water quality in the East Johor Strait."

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WATCH THE VIDEO
Yellow robot kayak out at sea.
<http://str.sg/45Ts>

Harmful algae in nearby waters

There are 270 known algae species found in coastal waters off Singapore. Here are some:

KARLODINIUM

Commonly found in the Johor Strait, it has toxic compounds that are known to cause massive fish kills during blooms.

During the mass fish death in 2015, the Agri-Food and Veterinary Authority of Singapore found elevated levels of *Karodinium veneticum* in seawater samples.

ALEXANDRIUM

The genus consists of more than 40 species and a third of them are toxic.

Four *Alexandrium* species occur in Singapore waters. One produces a toxic compound that kills young sea bass and seahorses, while another causes paralytic shellfish poisoning, which can be fatal.

KARENIA

This genus is known to have 12 species and can release toxins into the environment as aerosols, which can cause respiratory problems in humans.

Recreational beaches have been forced to close due to blooms caused by such species.

Eating shellfish contaminated with the algae may also result in neurotoxic shellfish poisoning, which causes headaches and aching muscles, among others.

An undetermined species was observed in the Singapore Strait in a study published last year. CREDIT: SANDRIC LEONG