



NUS marine biologist Huang Danwei noting down his observations after an Autonomous Reef Monitoring Structure (Arms) was installed on Oct 9. The 42 structures deployed in Singapore's southern waters will be left in place for one or two years, after which they will be taken back to the lab and examined. PHOTO: TOH XING JIE

# 42 'mini-hotels' installed in S'pore waters to study marine life

Located in 7 places, they will shed light on lesser-known coral reef creatures

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Forty-two "mini hotels" have been installed across seven underwater locations in Singapore, as part of a new research effort announced on Oct 28 that aims to help scientists better understand the different types of marine life here.

The structures, known as Autonomous Reef Monitoring Structures (Arms), are stacks of plastic plates that mimic the structure of a coral reef, providing nooks and crannies for sea creatures, including crustaceans, burrowing worms, sponges and encrusting algae, to find homes in.

The units have been anchored to the seafloor with stakes at Raffles Lighthouse, Sisters' Islands Marine Park, St John's and Kusu islands, Pulau Semakau, and two sites near Pulau Hantu.

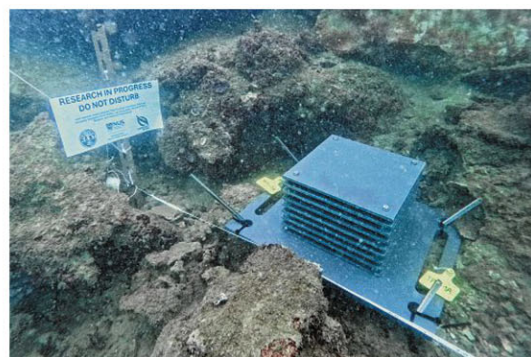
The locations were selected as they represented a range of habitat quality, said NUS marine biologist Huang Danwei, who is deputy head of the university's Lee Kong Chian Natural History Museum and the principal investigator for the study.

For example, the coral reef habitats at Raffles Lighthouse and the marine park are some of the most diverse in the country, while Pulau Semakau has coral reefs that are comparatively more degraded.

Of the 42 Arms that were deployed, half will be left underwater for a year, while the rest will remain there for two years.

After each of those times, researchers will retrieve the structures and take the plates apart in the laboratory to scrutinise the life that had colonised the structures during different periods.

Researchers here want to learn more about the coral's "cryptobiome" – referring to the cryptic life living inside a coral reef that tends to escape attention – as part of the second Comprehensive Marine Biodiversity Survey announced by the National Parks



An Arms unit at Terumbu Pempang Tengah, a submerged reef located near Pulau Hantu, one of Singapore's southern islands, on Oct 9. ST PHOTO: AUDREY TAN



From left: A crab (*Lophozozymus pictor*), a toad fish (*Allenbatrachus grunniens*) and a sea slug from the family Chromodorididae, all part of a coral's cryptobiome discovered during the first trial Arms deployment between 2016 and 2018. PHOTOS: REEF ECOLOGY LABORATORY

Board (NParks) on Oct 28.

The first survey was a five-year effort undertaken from 2010 to take stock of Singapore's marine biodiversity in different habitats.

Now, the second phase, also expected to take about five years, will cover new areas – such as inside a coral reef – and make use of novel techniques, such as Arms, as well as mobile DNA labs that enable scientists to perform genetic analyses on the go.

More than \$2 million has been channelled to the second survey, with funds coming from organisations including Dalio Philanthropies, HSBC, the GSK-EDB Trust Fund and ExxonMobil Asia Pacific.

A coral reef's internal structure, also known as reef matrix – a complex, three-dimensional structure that can provide habitats for animals – is made of calcium carbonate, which is secreted by hard corals as they grow.

NParks and NUS, the organisers of both surveys, said the first one led to several achievements, in-

cluding the discovery of over 37 species new to science and more than 300 species new to Singapore.

But additional information is needed to better inform how marine spaces here are managed, they added.

"One of the (second survey's) objectives is to establish a biodiversity baseline of local key marine areas that may be impacted by future developments, such as land reclamation and coastal protection against sea-level rise," the organisers added.

Establishing a biodiversity baseline refers to the creation of a "checklist" of different types of marine organisms and their abundance within a specific area.

NParks and NUS added that this baseline will enable planners and policymakers to make better informed and scientifically sound decisions on the critical areas to safeguard and prioritise, and phase development plans.

It will also enable them to scope environmental impact studies and

develop necessary mitigating measures.

During an Arms installation dive on Oct 9, Associate Professor Huang told *The Straits Times* that while past studies have indicated that South-east Asia is a hot spot for coral diversity – the popular Coral Triangle region encompasses Indonesia, Malaysia, Papua New Guinea, the Philippines, Solomon Islands and Timor-Leste – there could be many other hot spots in the region for these cryptic reef organisms that are yet to be discovered.

Prof Huang, who also heads the Reef Ecology Laboratory at NUS, said his lab had deployed 12 Arms in Singapore waters between 2016 and 2018.

The aim of that trial was to look for encrusting species growing on the reef skeleton, and models showed there were plenty more species constituting the cryptobiome that had not yet been discovered.

"As we are deploying 42 more units and at more sites, we should be able to find close to all the species for a comprehensive understanding of what is living on and within our reefs," he said.

Prof Huang said he is also keen to see if there is any correlation between the health of a coral reef and its cryptobiome community, such as if a healthier reef had greater cryptobiome diversity and vice versa.

He said that without the units, the study of a coral's cryptobiome would require scientists to chisel off parts of a natural coral reef to take back to the lab, which can be extremely damaging to the habitat.

The units prevent the need for such destructive sampling, he added.

The Arms programme is a global initiative by the US-based Smithsonian Institution – which has a protocol that standardises the size of plates, the procedures involved in dismantling the units and sampling methods.

"This standard census allows researchers to compare one place to another or how one place changes over time, based on these Arms communities," said the Smithsonian's National Museum of Natural History on its website.

Singapore has lost over 60 per cent of its coral reefs over the decades due to early developmental work, with the nation's murky waters today still bearing testament to the coastal reclamation work in the 1960s. Today, most of the country's remaining coral reefs are found in its southern waters.

"The collected data would also hold insights on how over 50 years of development have affected the marine environment," said Prof Huang.

"As countries in the region continue to urbanise, the Singapore case study could offer a good perspective of what happens to the cryptobiome when the marine environment is degraded, and lay the groundwork for us to understand the cryptobiome's role in the marine food web."

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