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Coral reefs in Singapore could have been growing for 7,000 years

Study of cores from Southern Islands can shed light on corals from long ago

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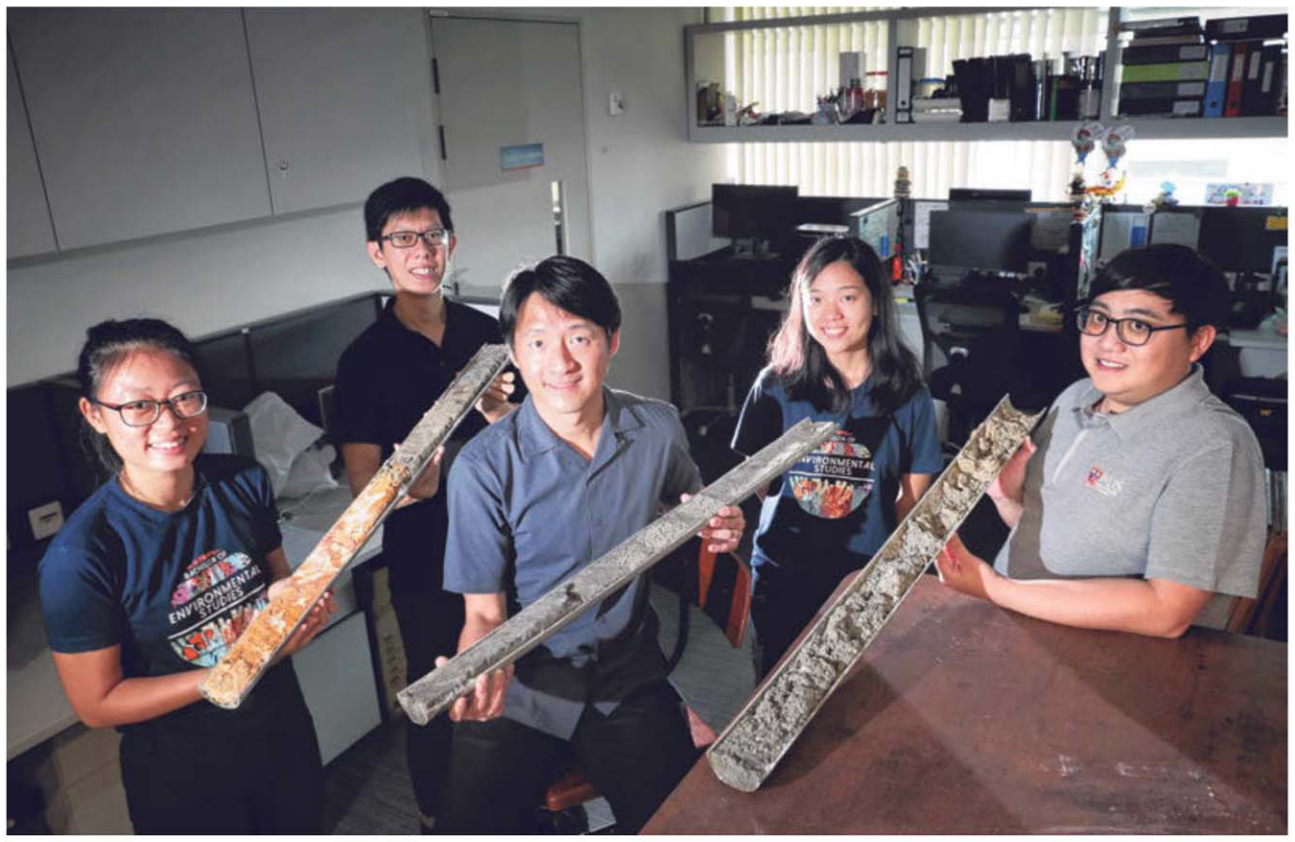

The study's principal investigator Huang Danwei (centre) and core members of his National University of Singapore team – (from left) research assistant Oh Ren Min, 24; PhD student Samuel Chan, 29; undergraduate Choo Min, 23; and research assistant Ambert Ang, 31 – with the coral cores. ST PHOTO: KELVIN CHNG

As Singapore evolved from a sleepy coastal village into the world's second busiest port, the coral reefs around it were keeping a silent record of the changes underwater.

And they go beyond just the past 200 years or so. In fact, scientists from the National University of Singapore (NUS) have found that coral reefs here could have been growing for 7,000 years.

By diving into the history of the corals, the scientists believe they will be able to piece together a better picture of the resilience of the reefs, and determine how they can be better managed in the face of threats such as climate change.

There have been studies on how recent events have affected the corals.

For example, scientists examined how the corals have been affected by sediment stirred up by intensive land reclamation works since the 1960s, and how warmer waters during extreme climate events can affect their reproductive cycles.

But Assistant Professor Huang Danwei, who is the principal investigator of the latest study, explained: "What we know of the reefs today only reflects environmental processes in one snapshot in time. To see how they had responded to earlier environmental changes, we have to go back in time."

They did that by analysing the remains of corals from long ago.

About 20 coral cores were obtained from 2018 to last year from five sites in Singapore's Southern Islands, where most of the country's reefs are located.

The scientists drilled into the reefs in places such as Kusu Island, the Cyrene reefs and Sisters' Islands, and retrieved cores from the depths of each reef's calcium carbonate framework.

The lengths of the cores vary from 40cm to almost 4m. Because reefs grow so slowly, even the shortest core could provide insights from 4,000 years ago, said Mr Samuel Chan, a PhD student involved in the study.

The cores were dated by a technique known as radiocarbon dating.

Commonly used to date archaeological finds such as fossils, the technique measures the amount of radioactive carbon-14 – which all living things absorb from their environments – left in the fossil.

Because carbon-14 decays over time, measuring it in a specimen can help scientists determine how long ago the organism died.

Prof Huang, who heads the Reef Ecology Laboratory at NUS, said: "A coral reef grows when individual coral animals build on top of one another. The reef structure grows upwards as they accrete, so the core holds a record of the corals that have been growing over time."

This means that scientists could obtain a glimpse into the types of corals growing in the past by studying the "layers" in the coral core – similar to how tree scientists determine the ages of trees by looking at the rings in their trunks.

This is the first time that scientific reef coring work has been done in Singapore, although this technique has been used to study other coral reefs in the Caribbean, and in the Great Barrier Reef in Australia.

In the NUS study, after a core was retrieved, it was split into two, lengthwise.

One half went into storage at NUS' Lee Kong Chian Natural History Museum, while the other provided a longitudinal section for detailed examination.

The scientists pored over the contents, identifying coral fragments and extracting traces of other organisms – such as shells from molluscs or foraminifera, a diverse group of marine organisms. Their presence could reveal information about environmental conditions through the ages.

Corals require light to grow, but different types of corals may have different thresholds for light.

For instance, plating coral, which spreads out over a wide surface area, may thrive better in low light conditions than branching coral.

So fragments of branching coral in a specific part of the core may indicate better light conditions, due to lower sediment levels at that time, for example.

The presence of other marine organisms could support the findings.

For example, certain species of foraminifera may rely on photosynthetic algae to produce food. Their presence also indicates better light conditions.

But the presence of predatory foraminifera species could imply lower light conditions, leading to a greater abundance of organisms that could find food in other ways.

RECORD OVER TIME

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ASSISTANT PROFESSOR HUANG DANWEI, who heads the Reef Ecology Laboratory at the National University of Singapore, on dating coral cores.

NOTHING MUCH HAS CHANGED

One preliminary finding was that the types of corals in Singapore did not change much over the millennia, although their numbers may have.

For instance, the researchers found more fragments of *Pachyseris speciosa*, a plating coral, in recent years.

"This shows that the corals have been here for a long time, and that they have adjusted to local conditions, such as the murky waters here," said Prof Huang.

What is less clear is how global stressors, such as ocean warming due to climate change, could affect them, but ongoing studies of how the abundance of the corals varies with past temperatures are chipping away at this problem, he added.

As part of the study, Prof Huang is collaborating with Dr Jani Tanzil, a senior research fellow of the Tropical Marine Science Institute at NUS, who is looking into how certain types of corals grow over time.

Dr Tanzil is also studying the coral cores for geochemical clues to how the marine environment has changed over time.

She said: "Layers in the coral skeletons provide a chronology for determining the age and growth rates of the coral, and also temporal records of trace elements incorporated into the skeleton as the coral grows."

The coral cores also help scientists reconstruct the environment in which they lived, said Dr Tanzil.

For instance, skeletal luminescence or the isotopic ratios of elements such as oxygen could be a gauge for the salinity of the sea.

Explained Dr Tanzil: "This could give insights into past regional flood or drought events and their drivers."

The coring work was funded by the National Research Foundation (NRF) under its Marine Science Research and Development Programme.

An NRF spokesman said that despite the stress faced by corals in Singapore, reefs here continue to support diverse and resistant coral communities.

"The project led by Assistant Professor Huang will determine how these reefs have persisted and thrived in one of the most urbanised marine environments in the world," the spokesman said.

The $25 million Marine Science Research and Development Programme, launched in 2016, has funded 34 projects so far.

Asked if NRF will continue the programme beyond its five-year tenure, the spokesman said marine science research is important for Singapore. "Discussions on the next stage... are still ongoing."

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