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Assistant Professor Aron Meltzner of NTU's Earth Observatory of Singapore speaking to PhD student Tan Fang Yi, while (from left) undergraduates Lynn Ong and Renee Lee En Yee and research team member Zihan Aw cleaned coral microatolls for detailed survey work on Sentosa last week. ST PHOTOS: LIM YAOHUI

What Sentosa corals could tell us about sea level rise

Microatolls off Southern Islands helping NTU research team piece together S'pore's sea level history

Cheryl Tan

It was 6.30am last Wednesday. While most people were still in bed, a research team from the Nanyang Technological University (NTU) had already made their way to Sentosa to study the coral colonies residing there.

These coral species are visible only at low tide, which occurs two to three times a month from May to July during the day, said Assistant Professor Aron Meltzner from NTU's Earth Observatory of Singapore (EOS).

Tide prediction data had suggested that the tides that morning were possibly the lowest in 14 years, he added.

This meant that researchers had only a very small window of opportunity – of around one to two hours – to conduct their field work.

At the cusp of daylight, the vast expanse of beach was carpeted with seagrass, seaweed and small puddles of water with air bubbles and tiny fish – if one looked closely enough. Carpet anemones glistened in greenish-purple hues.

Unassuming and buried under clumps of seagrass, however, were the coral microatolls – unique circular colonies of coral which are natural recorders of sea level change.

These corals usually grow sideways below the intertidal zone where they remain completely submerged even in low tide.

They have dead flat tops, as their upward growth is limited due to exposure to air, heat and sunshine.

Therefore, as living tissue continues to grow along the perimeter, growth rings are formed – similar to those of tree trunks.

These bands, therefore, record sea level change.

The microatolls in Sentosa had been an "accidental discovery" during the Covid-19 pandemic, when border restrictions rendered access to survey sites in Indonesia, the Philippines and Malaysia difficult. The NTU team decided to visit the site on Sentosa in July 2020 after hearing about the coral microatolls residing there, said Prof Meltzner.

He and his team have been studying microatolls in various South-east Asian countries to determine the region's sea level histories.

These geological records of sea levels are important as instrumental records – such as tide gauges – do not go back far enough in time. For instance, tide gauge information in Singapore goes back only to the 1970s.

The lack of sufficient historical data, therefore, makes it difficult for scientists to accurately predict future sea level rise in a given location or region.

"Sea level change is very complex. It is not simply a matter of filling up a bathtub and watching the water uniformly rise in elevation... Some processes could cause the surface of the water to rise higher in one place, while other processes, such as earthquakes, could cause the land to move up and down," said Prof Meltzner.

Having data at multiple locations in South-east Asia – including Singapore – could help researchers to piece together the likely reasons for sea level change in each area and make better predictions for future sea level changes.

Already, coral microatolls found in Mapur Island in Indonesia have shown that sea level rise in Singapore was slower than the global average from 1915 to 1990 – and taking away anthropogenic factors such as the burning of fossil fuels and deforestation – would have meant that the sea level in Singapore would have been essentially stable, or even slightly falling, said Dr Jedrzej Majewski, who was the lead author of the study there.

He told The Straits Times in March that the microatolls there had allowed researchers to narrow down the uncertainty of probable sea levels in Singapore by over 40 per cent for earlier periods and about 30 per cent for a more recent period of time.

And in Singapore, members of Prof Meltzner's research group at EOS, including PhD student Tan Fang Yi at the EOS are slowly piecing together the country's sea level history by looking at coral microatolls in the Southern Islands – which include Lazarus Island, Sentosa, St John's Island and Pulau Tekukor.

To do so, Ms Tan has to study the microatolls found on these islands, by determining their age and elevation.

The fossil coral microatolls were found at a higher elevation, compared with the living microatolls. This means that the sea level was slightly higher in the past, but fell over time, said Ms Tan.

Taking the difference between the two elevations will show the difference in sea level over time, she added.

The fossil coral microatolls on Sentosa are between 1,000 and 3,000 years old, while the corals on Lazarus Island and Pulau Tekukor are much older, at around 7,000 years old, she added.

"I think what's unique about the Sentosa corals is that we have younger fossil corals compared with other sites that we have found in Singapore. So we're able to fill in a part of the historical time period where there isn't a lot of data available at the moment," said Ms Tan.

So far, data from the fossil corals has shown that the sea level has been falling slightly from the past 3,000 years or so.

However, a look at the living corals – which are about a few decades old – indicates modern sea level rise, she noted.

With the study on Sentosa now nearing completion, the team will be focusing on the coral microatolls on the other Southern Islands to complete the picture of Singapore's sea level history.

"Every additional piece of data we get means better models and better forecasts for national projections of sea level rise," said Prof Meltzner.

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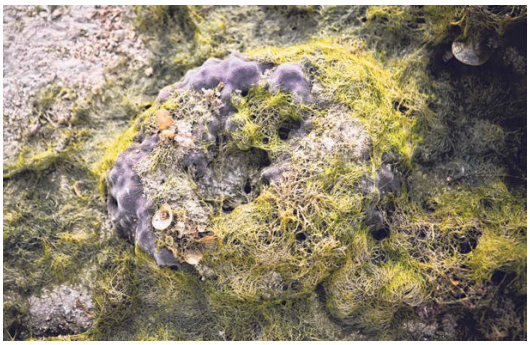

A microatoll seen at low tide on Sentosa. The NTU team studies coral microatolls by determining their age and elevation. Fossil microatolls were found at a higher elevation than living ones, meaning that the sea level was slightly higher in the past, but fell over time.

Research fellow Jennifer Ouye-Sawyer with (from left) undergraduates Audrey Lee Hui Xing and Leong Zi Wei surveying elevations and recording notes about measurements on Sentosa last week. With the Sentosa study now nearing completion, the NTU team will be focusing on coral microatolls on the other Southern Islands to complete the picture of Singapore's sea level history.