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01 An embayment at East Coast Park overrun with corals, photographed by Nathaniel Soon (@ourseas.ourlegacy).

02 Underwater photographer Shinto K Anto (@floodedcamera) captured the fungia in Singapore waters.

Corals are Super. Please Protect Them

Singapore waters are home to a surprising amount of marine life.

Whenever coral scientist Kyle Morgan dives in Singapore's waters, it is a surreal experience for him. Ships bigger than a building pass all too often, sending underwater vibrations he can feel in his chest. In the distance, a petrochemical plant looms.

Morgan has dived in many of the most remote and pristine areas on the planet, and is still awed to find coral reefs thriving in one of the world's busiest ports, next to a major megacity. Amid close encounters with sea snakes, turtles and the occasional glimpse of pink dolphins, he has discovered a breed of hardy, resilient "super corals" that has been able to survive in hostile and extreme conditions.

A principal investigator at the Earth Observatory of Singapore (EOS) and an assistant professor at Nanyang Technological University's Asian School of the Environment, Morgan and a team of scientists have been tracking the growth and measuring the environmental conditions of corals in Singapore for the last 14 months in hopes of saving the threatened marine ecosystem.

Their efforts were highlighted in the documentary *Changing Ocean Asia*, written and directed by Australian filmmaker Liz Courtney, who is the artist-in-residence at EOS.

There are 100,000 sq km of coral reefs in South-east Asia with more than 70 percent of the world's coral species, and

one-third of the world's corals. Despite its global importance as a coral biodiversity hotspot, Morgan notes that the region lacks long-term standardised data sets and infrastructure to support this research.

Singapore's water conditions are typically murky and full of sediment, which restricts coral growth by limiting light penetration. But contrary to popular belief, Singapore's coral reefs are home to an incredible variety of marine life.

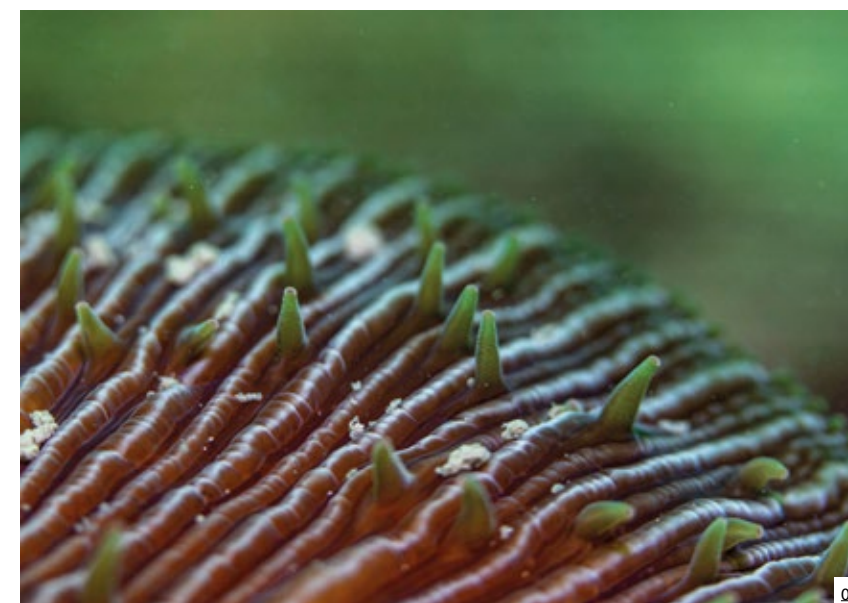
NParks reports that there are more than 250 species of hard corals from 55 genera that range from brain corals, bubble corals, mushroom corals, cauliflower corals to anemone corals, over 200 species of sponges, 120 species of fish and an undetermined number of gorgonians,

nudibranchs, and other invertebrates inhabiting those reefs.

Fisheries, tourism, and coastal protection depend on healthy reefs. However, rising global ocean temperatures have led to mass coral bleaching events that decimate entire coral reefs. Among the casualties, according to the United Nations Environment Programme, is the Great Barrier Reef, which during the unprecedented global bleaching event of 2014 to 2016 saw 90 per cent of its reefs bleached with 20 per cent of its corals killed.

Sedimentation from land reclamation, dredging of shipping channels, and land-use changes in the region may further degrade Singapore's reefs.

"People usually picture coral in beautiful, clear waters like on an island holiday, but what I want to share is that some corals can thrive in more urban areas that are not as picturesque."



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03, 04 Kyle Morgan and a team of Earth Observatory of Singapore scientists have been tracking the growth and environmental conditions of corals in Singapore.

05 The favites coral photographed by Shinto K Anto (@floodedcamera) at Pulau Hantu.

06 A sea fan photographed by diver Kevin Li (@lkevyn) at Keppel Marina.

SINGAPORE'S SUPER CORALS

A few times each month, Morgan and a small team of researchers travel by boat to the Southern Islands. It takes meticulous double- and triple-checks on all equipment and field gear, from construction materials and underwater cameras to data loggers that measure light, temperature, and turbidity of the waters, before diving under.

In the murk and gloom, they've made some unexpected discoveries. Including spotting corals that normally exist in dark deep reef habitats growing near the water's surface. Despite the low levels of sunlight in shallow reef areas, you can still "find corals just growing there", reveals Morgan.

These super corals have adapted to the low light conditions by extending long, tentacle-like polyps to feed in the nutrient-rich waters all day long, whereas they would typically utilise sunlight for food and feed only at night. The corals also adapt their shape to tolerate the extreme conditions by growing in a distinctive flat and branching shape across the ocean floor, which Morgan describes as "crusting".

"Just like a tree canopy, corals also



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attempt to take up as much space to capture sunlight for photosynthesis. The flatter shapes allow the water currents to remove sediment that accumulates on the corals, too. It's fascinating to observe how corals can change their growth based on the environment they live in," he says.

As well as observing coral growth, the team uses photogrammetry to stitch multiple photographs together, resulting in 3D models of corals, so that researchers could study their shape and structure. "Photogrammetry is commonly used in other scientific fields, but for coral research, it's a relatively new approach because of the difficulties of working underwater. Since

the method is non-destructive, we can extract a lot of information without having to bring corals back to the lab," he explains.

Morgan and his team also do the "less glamorous" part of fieldwork, such as scrubbing algae off the corals, so they stay alive.

RACING AGAINST TIME

Corals are degrading at an alarming rate, so it often feels like researchers are constantly playing catch-up, says Morgan.

In contrast to some coral reefs, where a lot of information is currently available, the basic knowledge about corals near urban environments in South-east Asia is still lacking. A systematic approach to charting this out for countries across the region could provide hope for the future of coral conservation.

During the next five years, Morgan will concentrate his research efforts on collecting important regional data. He plans to study corals across South-east Asia, including Thailand, Malaysia, and Indonesia with local partners.

To this day, he still encounters people who think corals are simply coloured rocks or are surprised to discover they are living creatures. "I've met people who are shocked to learn they can go see living corals here. When you live and work in a city, it's easy to be disconnected from the natural environment even though it's really close."

It's a tricky balancing act between commercial activity and progress versus conservation in land-scarce Singapore, he observes.

Morgan is determined to see his mission through despite the uphill challenge. "People usually picture coral in beautiful, clear waters like on an island holiday, but what I want to share is that some corals can thrive in more urban areas that are not as picturesque.

"Urban reefs are still important ecological systems to protect, especially in a place like Singapore with a relatively small reef marine environment. These coral reefs are precious ecosystems and something to be treasured." 🌊



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