

SCIENCE



Of all six reef sites studied, the one at Pulau Semakau – home to Singapore's only landfill – was the most muddy with the worst visibility. Algae were growing on some corals, a sign of a disturbed reef.

Mud from land a threat to survival of corals in S'pore: Study

Reefs face risk of being smothered as coastal development in region is ramped up

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While corals in Singapore live in murky waters, future coastal development and climate change could send more harmful mud to the coral reefs, threatening their long-term survival.

Scientists from Nanyang Technological University (NTU) found that it is mud from land – be it from reclamation or intense rainfall – that could smother corals and later impede their recovery from bleaching events.

The study, which was published in scientific journal *Marine Pollution Bulletin* in March, looked into six reefs in the Southern Islands. The results shed light on the possible dangers that healthy reefs in

the region could face as coastal development ramps up in South-east Asia.

“As coastal development in the region increases, greater amounts of mud are being washed into the sea during rainfall events. Our study finds that even corals which have adapted to living in murky waters will struggle to grow when there is too much sediment,” said Assistant Professor Kyle Morgan from the NTU Asian School of the Environment and the Earth Observatory of Singapore, who led the research.

The research also found that reefs with more mud settled on them exhibited slower recovery after coral bleaching events.

Bleaching is caused by marine heatwaves, where higher sea temperatures stress coral reefs, forcing

them to expel the algae that give them their vibrant colours. This causes corals to turn an ashen white.

“For the very muddy reefs, there would be no or very little bounce-back after bleaching. The mud covers the soil surfaces. No new corals can settle... The corals that are bleached, they're fighting additional stressors from the mud,” said PhD student Marlina Joppien from the same NTU institutes, who is the study's first author.

Singapore's corals, which were gripped by a mass bleaching event between May and October 2024, have mostly recovered, with an estimated 5 per cent of them left dead.

Since climate change is expected to lead to more bleaching events, coastal developments near reefs should pause during a marine heat-wave, said Prof Morgan.

The waters of Singapore and the surrounding region are known to be murky, causing poor visibility for divers. But corals here have survived in such turbid conditions for several thousand years.

Beyond run-off from rainfall, rivers in Sumatra pump sediment towards Singapore.

And over the years, human activities have further discharged sedi-

Reefs are harmed when a high amount of mud – primarily from human activity – settles on the corals, but if the sediment is suspended in the water and can be carried away with strong currents, the habitats can continue to thrive.

ment into Singapore's waters. Land reclamation, regional land-use change, seafloor dredging, and even the trail of waves from ships have elevated the murkiness and intensified sedimentation, stated the paper.

But turbid waters do not indicate that all reefs here are in a poor state, stressed Prof Morgan.

Reefs are harmed when a high amount of mud – primarily from human activity – settles on the corals, but if the sediment is suspended in the water and can be carried away with strong currents, the habitats can continue to thrive.

“Corals are very good at surviving

high turbidity, but they're not very good at surviving high sedimentation,” said Prof Morgan, who observed this first-hand when doing fieldwork in the six reefs, which included those at Pulau Hantu, Pulau Satumu and Pulau Semakau, in 2021.

Pulau Satumu – where Raffles Lighthouse is located – is the farthest southern Singapore island, and a favourite among marine scientists for its highly diverse reefs.

Of the sediment samples later analysed by Ms Joppien, the ones from Pulau Satumu had the lowest trace of mud.

“For Satumu, it's the way the island is oriented. As the tide turns, you get very strong currents that run across the reefs consistently,” noted Prof Morgan.

Pulau Satumu is a good example of a turbid but thriving reef.

The reefs of Pulau Semakau – home to Singapore's only landfill – looked more worrying.

Of the six sites surveyed, the Semakau reef had among the lowest coral cover and the waters there offered the lowest visibility. Sediment samples from Semakau also had the highest mud content.

Ms Joppien noted that Semakau is located around the centre of the Southern Islands cluster, and had

undergone reclamation and development works to build the landfill.

These factors could have contributed to the lower flushing of waters around the island, and mud from land ended up settling on the reefs.

Some of the corals at Semakau also had algae and seaweed growing on them, a sign of a disturbed reef due to high amounts of nutrients in the water.

Over time, the fuzzy algae can outcompete the corals.

Ms Joppien added that further land reclamation and new structures at sea could change the movement of existing currents.

“Land reclamation puts sediment in the water, but it can also hinder or change the direction of currents that actually flush out (muddy areas),” she said.

Commenting on the research, marine biologist Huang Danwei, deputy head of the NUS Lee Kong Chian Natural History Museum, said: “This is the first study to characterise the sediment on coral reefs here in fine detail.

“This is further direct evidence that land reclamation and run-off from land can drive the loss of corals and lower their resilience against climate change impacts.”

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The corals at Pulau Satumu, where Raffles Lighthouse is located. Pulau Satumu is a good example of a turbid but thriving reef. The way the island is oriented, as the tide turns, very strong currents run across the reefs consistently, says Assistant Professor Kyle Morgan, who led the research behind the study. PHOTOS: KYLE MORGAN