JOINT NEWS RELEASE

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Coral reefs, marshes, and mangroves might be destroyed within 30 years from rising sea levels, finds international group of scientists

- *Such a catastrophic event last happened in the last Ice Age 10,000 years ago*

A team of international scientists led by **Nanyang Technological University, Singapore (NTU Singapore)** and **Macquarie University** in Australia has found that rising seas will once again devastate coastal habitats within the next 30 years, based on analysis of data on sea levels since the last Ice Age.

Seventeen thousand years ago, a person could walk from Singapore to Indonesia or the Philippines, Germany to England, Russia to America, or mainland Australia to Tasmania, as sea levels were about 120 metres lower than today. However, as the last Ice Age ended, increasing temperatures caused the oceans to rise rapidly, by one metre a century on average.

This catastrophe wiped out vast swathes of coastal habitats globally, and it took thousands of years for nature to recover from the rapid loss. The team of scientists said that a catastrophe of a similar scale would happen again if warming levels rose above Paris Agreement targets.

The scientists say coastal habitats, such as mangroves, marshes, coral reefs and coral islands, are essential to protect coastlines, trap carbon, nurture juvenile fish and help sustain millions of coastal residents.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C.

The findings from a team of researchers from 17 institutions in Australia, Singapore, Germany, the US, Hong Kong and the UK are published today in the journal *Nature*.

It describes how coastal habitats retreated and adapted as the last Ice Age ended and how they are likely to cope with this century's predicted sea level rises.

Second author Professor Benjamin Horton, Director of NTU's Earth Observatory of Singapore, said: "The study of past sea levels is one of the most important fields of climate science study and is the basis for sea-level projections. Rising sea levels pose substantial risks to coastal populations, economies, infrastructure, and ecosystem services. Of the approximate one billion people worldwide living in low-elevation coastal zones, around 70 per cent are in Asia. Improving our understanding of past and present sea-level changes is crucial in minimising the effects of sea-level rise through appropriate coastal planning, adaptation, and mitigation strategies based on sound reasoning."

Lead author Professor Neil Saintilan from Sydney's Macquarie University, a coastal wetlands specialist, said: "Coastal ecosystems exist where our oceans meet the land, including mangroves, coastal marshes, and the fringes of sandy coral islands – the low-lying areas flooded and drained by tidal salt water. Our research shows these coastal habitats could likely adapt to some degree of rising sea levels but will reach a tipping point beyond sea-level rises triggered by more than 1.5 to 2°C of global warming. Without mitigation, relative sea-level rises under current climate change projections will exceed the capacity of coastal habitats such as mangroves and tidal marshes to adjust, leading to instability and profound changes to coastal ecosystems."

Mangroves grow in the tropics, predominantly in Bangladesh, southeast Asia, northern Australia, equatorial Africa and low-latitude Americas. Smaller mangrove colonies can be found further south, such as at Sydney's Olympic Park and Towra Point in Botany Bay, listed as internationally significant under the Ramsar Convention.

Coastal marshes grow in intertidal zones further away from the equator, most common along North America and Northern Europe's Atlantic shores. Australia has more than one million hectares of coastal marshes, most abundantly found in the Northern Territory, Queensland, and Western Australia, and the third highest area of mangroves globally, behind Indonesia and Brazil.

Co-author Dr Timothy Shaw, Senior Research Fellow at NTU's Earth Observatory of Singapore, said: "Coastal ecosystems provide numerous benefits to local communities and the global environment, including storm protection, food security, water quality regulation, and recreation. Protecting and restoring these ecosystems is crucial for combating climate change and providing healthy coastal environments for people."

Co-author Associate Professor Simon Albert from Australia's University of Queensland said: "Reefs protect coral islands by forming a coastal ecosystem that protects the inner, liveable land from the powerful impacts of the open sea. "Beyond 1.5-2°C of global warming, you'll start to see these islands disappear when the waves overtop the coral reefs that protect them. In the short term, coastal ecosystems can

play a vital role in helping us humans mitigate climate change by taking carbon dioxide out of the atmosphere and offering protection against ocean storms -- but we've got to help them as well."

The scientists analysed the conversion of coastal ecosystems to open water and reviewed how the ecosystems adapted to sea level rise following the last Ice Age.

Prof Saintilan and the study's co-authors applied three types of evidence to assess the vulnerability and exposure of coastal ecosystems to the higher rates of sea-level rise projected under global warming scenarios by the Paris Agreement.

The scientists analysed the extent to which contemporary coastal ecosystems show conversion to open water under a range of settings with varying rates of rising sea levels, and documented elevation trends for mangroves and tidal marshes in relation to current rising sea levels.

Co-author Professor Torbjörn Törnqvist from the Department of Earth and Environmental Sciences at Tulane University in the US said: "Subsidence – a gradual sinking of land – exacerbates the exposure of ecosystems to rising sea levels. The most vulnerable coastal regions within the USA are in Louisiana and Texas. These states have the highest subsidence rates, partly due to the pumping of oil, gas, and groundwater from the subsurface."

They also reviewed the behaviour of coastal ecosystems over the range of sea-level histories encountered following the peak of the last Ice Age, 19,000 years ago.

Prof Horton added: "The study of the past helps us to understand the mechanisms regulating sea level and, therefore, to correctly attribute the relative importance of the many factors contributing to sea-level rise, including natural and anthropogenic (human-induced) force. Sea levels are rising because of climate change. As humans burn fossil fuels, we release carbon dioxide and other greenhouse gas emissions, which warm the Earth and the oceans. Because water expands as it warms, the oceans rise as they heat up. Climate change also melts glaciers and ice sheets, adding more water to the oceans."

The study was funded by the Singapore government, the National Aeronautics and Space Administration (NASA), Horizon 2020, the EU's Framework Programme for research and innovation and the Australian Research Councill.

The implications of rising seas for inhabited coral islands

Coral islands, a type of island formed from coral detritus and associated organic material, are found in the Pacific and the Caribbean, several of which are inhabited by

people. The team of scientists warns that the rising seas would implicate these islands, as well as the natural ecosystems they host.

The rising seas would also implicate Australia's mangroves, which occur in small pockets around the country's northern coastline.

The Earth Observatory of Singapore is now providing the first quantification of the survival thresholds and ecological tipping points for mangrove and coral reefs in Singapore. It will use this information to assess the long-term viability of nature-based solutions. This project is funded by the Marine Climate Change Science (MCCS) Programme.

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Notes to Editor:

The research paper titled *"Widespread retreat of coastal habitat is likely at warming levels above 1.5°C" was* published in *Nature* in Aug 2023. DOI 10.1038/s41586-023-06448-z

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About Nanyang Technological University, Singapore

A research-intensive public university, Nanyang Technological University, Singapore (NTU Singapore) has 33,000 undergraduate and postgraduate students in the Engineering, Business, Science, Medicine, Humanities, Arts, & Social Sciences, and Graduate colleges.

NTU is also home to world-renowned autonomous institutes – the National Institute of Education, S Rajaratnam School of International Studies, Earth Observatory of Singapore, and Singapore Centre for Environmental Life Sciences Engineering – and various leading research centres such as the Nanyang Environment & Water Research Institute (NEWRI) and Energy Research Institute @ NTU (ERI@N).

Under the NTU Smart Campus vision, the University harnesses the power of digital technology and tech-enabled solutions to support better learning and living experiences, the discovery of new knowledge, and the sustainability of resources.

Ranked amongst the world's top universities, the University's main campus is also frequently listed among the world's most beautiful. Known for its sustainability, NTU has achieved 100% Green Mark Platinum certification for all its eligible building projects. Apart from its main campus, NTU also has a medical campus in Novena, Singapore's healthcare district.

For more information, visit www.ntu.edu.sg

About Macquarie University, Australia

Macquarie University was established in 1964 as a bold experiment in higher education. Built to break from traditions and work in tandem with industry, we strive for the extraordinary by challenging convention and embracing different views.

Led by our academics and researchers, we continue our pioneering approach – from inventing Wi-Fi with the CSIRO, to enhancing graduate employability through personalised degrees and degrees co-designed with industry.

In recognition of the Aboriginal country on which Macquarie University is situated, our main campus in Macquarie Park is known as the Wallumattagal Campus.

For more information, visit www.mq.edu.au.