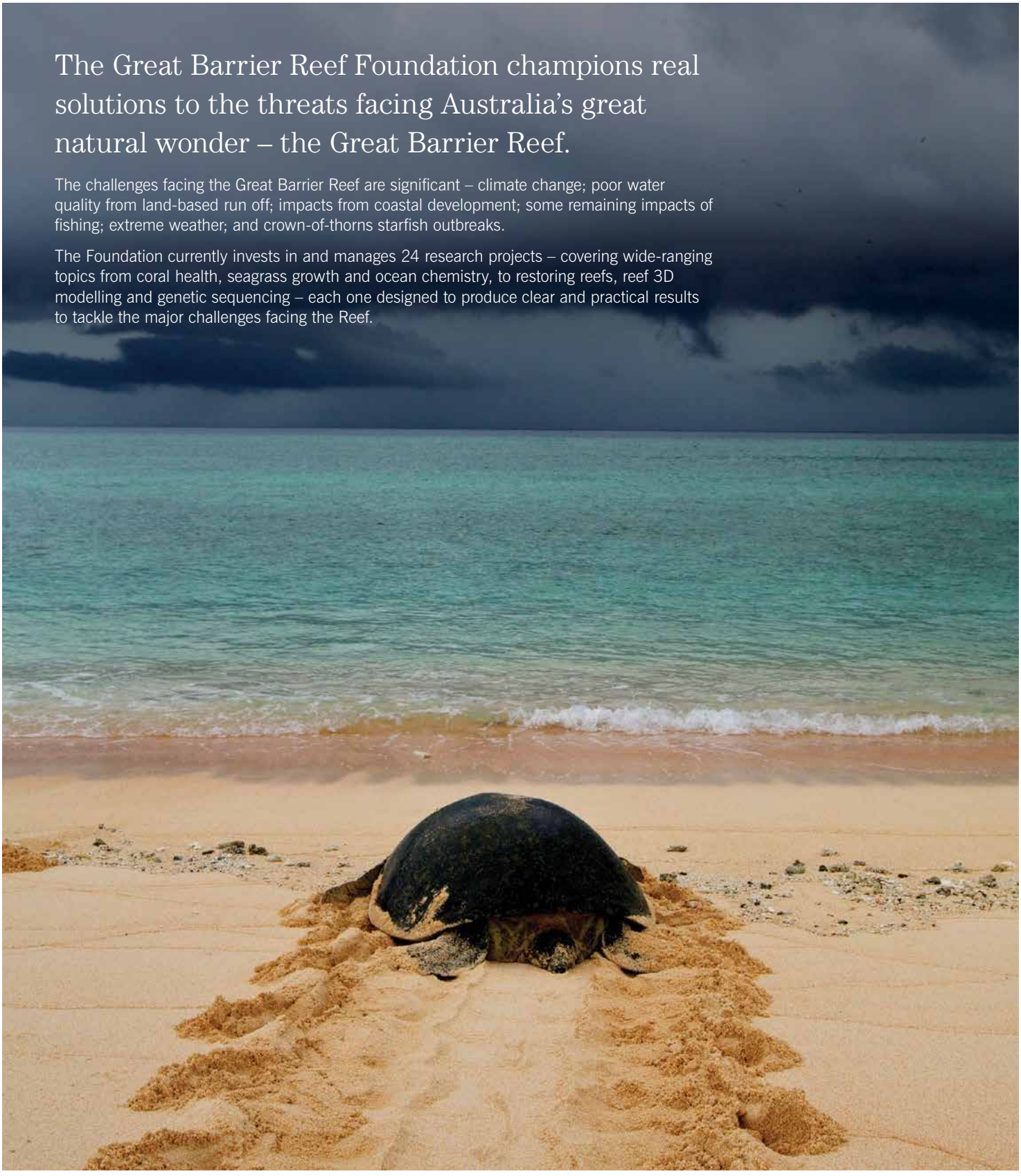
Great Barrier Reef Foundation



The Great Barrier Reef Foundation champions real solutions to the threats facing Australia's great natural wonder – the Great Barrier Reef.

The challenges facing the Great Barrier Reef are significant – climate change; poor water quality from land-based run off; impacts from coastal development; some remaining impacts of fishing; extreme weather; and crown-of-thorns starfish outbreaks.

The Foundation currently invests in and manages 24 research projects – covering wide-ranging topics from coral health, seagrass growth and ocean chemistry, to restoring reefs, reef 3D modelling and genetic sequencing – each one designed to produce clear and practical results to tackle the major challenges facing the Reef.

Research with Impact 2016

A future with climate change

Higher temperatures. More carbon. Extreme weather. How will our reefs respond to climate change?

Seagrass responds to climate change

Seagrass growth rates and diversity
› James Cook University

Seagrass meadows are critical to the Reef, providing a nursery habitat for reef fish and feeding grounds for turtles and dugongs. Therefore, understanding how climate change affects seagrasses is critical. To date, the research has revealed both positive and negative impacts. Because seagrass can take advantage of higher CO_2 levels as fuel for more photosynthesis, this enables more growth. However, higher water temperatures appear to benefit only some species of seagrass while being harmful to others.

Cementing coral reefs

Calcification rates of crustose coralline algae
› Griffith University

Just as a brick building would collapse without any mortar, so too would coral reefs without their 'cement'. Crustose coralline algae, or CCA, are the critical cement that stabilise reef structures in changing conditions. To determine just how rising temperatures and ocean acidification affect how well CCA calcifies across the Reef, the research team has deployed more than 144 'calcification stations' across 18 reefs. Designed from concrete blocks covered in settlement tiles, these inventive calcification stations are monitoring how CCA calcifies and grows under differing environments.

Images: Cranitch © Queensland Museum

Ship of opportunity

Future Reef MAP › CSIRO

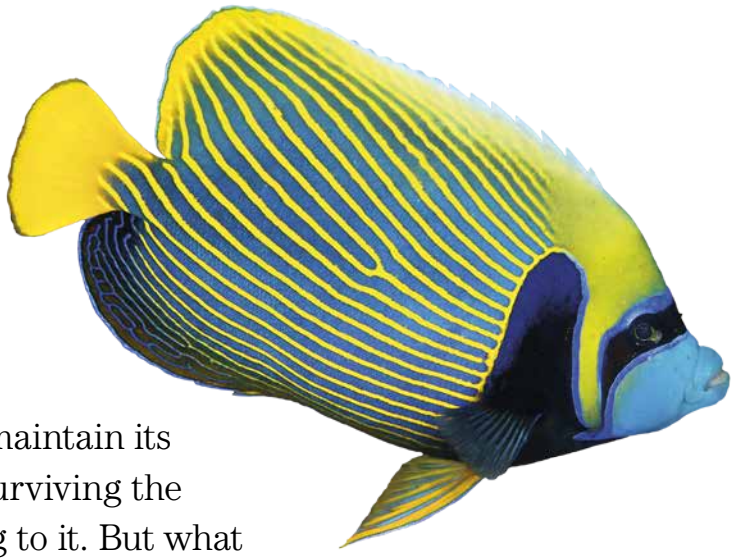
Carbon chemistry
› Australian Institute of Marine Science

The Future Reef project launched the first large-scale observing system for ocean acidification on the Great Barrier Reef.

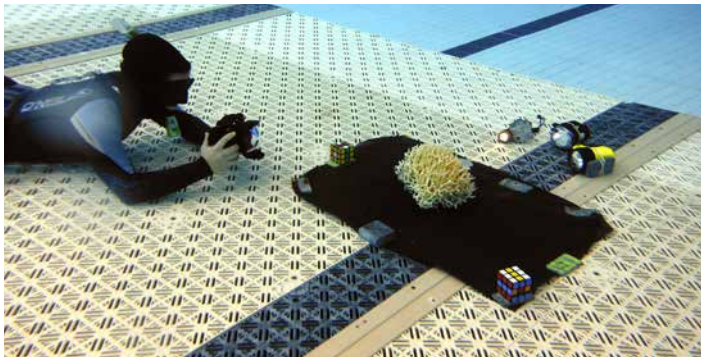
Monitoring the changing ocean chemistry along the entire length of the Reef is made possible through specially-engineered water sensors mounted on the Rio Tinto vessel RTM Wakmatha. As this 'ship of opportunity' travels along the Queensland coast in the ordinary course of business, CSIRO scientists are collecting vital data used to gain insights as to how ocean chemistry is changing across Reef habitats.

Combined with the Carbon Chemistry project, an initiative gathering similar data across the breadth of the Reef using the Australian Institute of Marine Science's vessel RV Cape Ferguson, these projects are providing, for the first time, a picture of ocean acidification from a 'whole-of-Reef' perspective.

What makes a reef resilient?



Resilience is the inherent ability of a reef to maintain its health in the face of pressures and change, surviving the odds by either resisting its effects or adapting to it. But what does a resilient reef look like and how can you test it?



Reef in 3D

Habitat structure › University of Sydney

The more complex a coral reef habitat is, the more resilient it tends to be. Coral reef ecologists are teaming up with experts in robotics and stereo-imaging systems to develop a novel new system for surveying reef complexity in 3D. Using robots to map the seafloor in 3D allows changes in resilience to be measured over larger areas than traditionally possible.

Image: T.Vidrio at University of Sydney

Report card for resilience

Reef Resilience Index › University of Maryland

There is no universally agreed set of tools and measures that can identify resilient reefs and monitor and report on shifts in reef resilience over time. So the Foundation has teamed up with reef scientists and managers to develop a Reef Resilience Index to fill that gap and complement the existing Great Barrier Reef report card.

‘Stress test’ for corals

Biomarkers of coral health › James Cook University

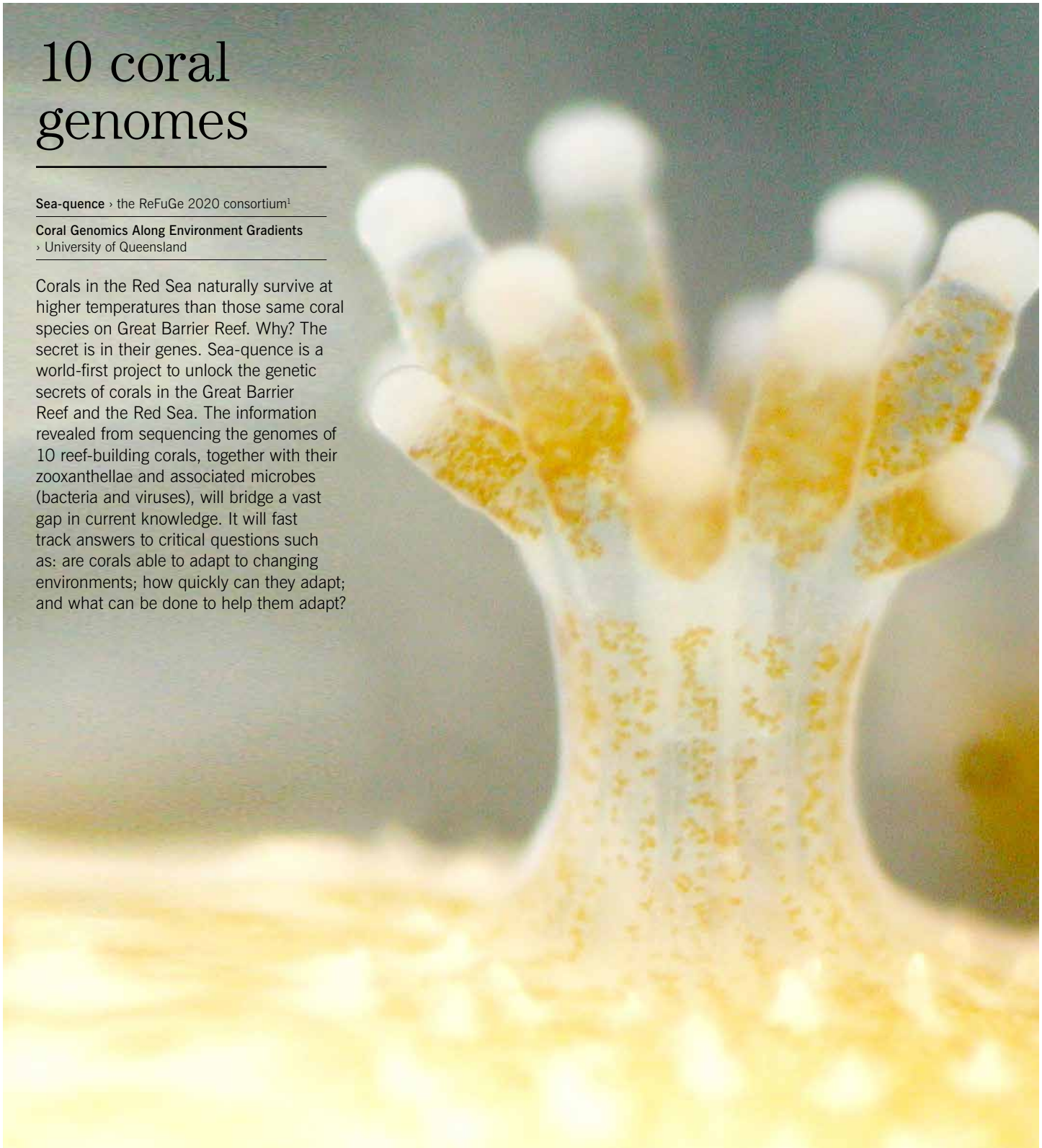
A new and innovative approach at the frontier of reef science could help create an early warning system for coral reefs under stress before any physical signs are visible. Metabolomics is being used to develop tests that can diagnose coral stress and the likelihood of recovery and survival.

10 coral genomes

Sea-quence › the ReFuGe 2020 consortium[1]

Coral Genomics Along Environment Gradients › University of Queensland

Corals in the Red Sea naturally survive at higher temperatures than those same coral species on Great Barrier Reef. Why? The secret is in their genes. Sea-quence is a world-first project to unlock the genetic secrets of corals in the Great Barrier Reef and the Red Sea. The information revealed from sequencing the genomes of 10 reef-building corals, together with their zooxanthellae and associated microbes (bacteria and viruses), will bridge a vast gap in current knowledge. It will fast track answers to critical questions such as: are corals able to adapt to changing environments; how quickly can they adapt; and what can be done to help them adapt?



Protecting against climate change

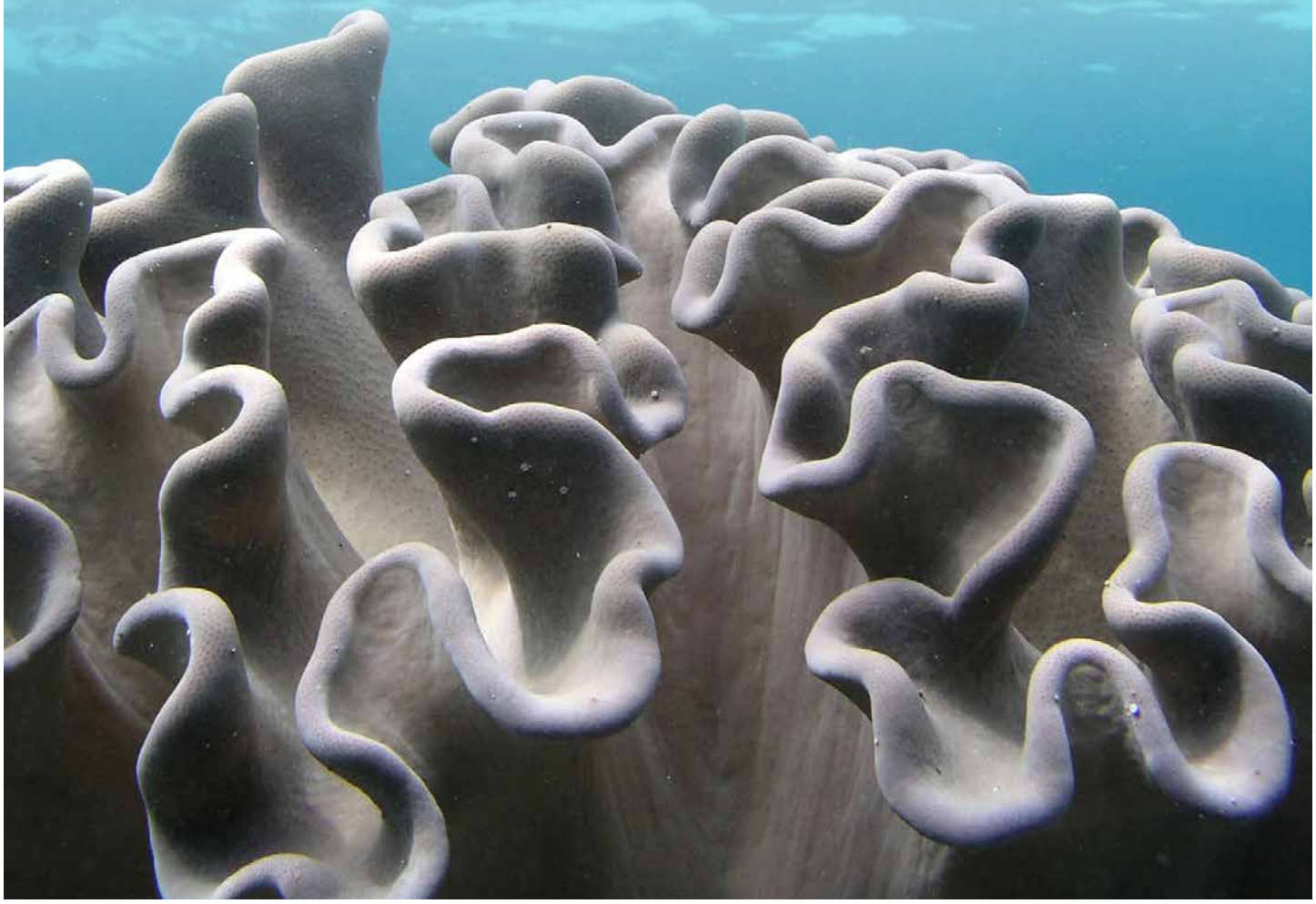
Pushing the boundaries of innovation.

Sunscreen for the Reef

Surface films
› CRC for Biopolymers, University of Melbourne

Image: Andy Lewis

What if there was a way to stop heat and light before it enters the water and adversely affects the Reef? Scientists are testing biodegradable surface films, just one molecule thick, as a way to control the amount of light entering the water they're applied to. In theory, this represents an innovative solution to combat coral bleaching at a local scale and this project is exploring the feasibility of this solution.



Novel surfaces to restore reefs

Novel surfaces › Southern Cross University

Finding the ideal surface for coral larvae to settle on and grow is an important step towards being able to restore and regenerate damaged coral reefs. Unlike mature corals which are immobile, coral larvae swim freely before they 'settle down', using environmental cues to seek out suitable places to live.

The Novel Surfaces project is using artificial surfaces embedded with micro-crevices of differing sizes to determine which physical characteristics are most appealing to coral larvae.

Seaweed solution

Biological buffering › CSIRO

Scientists are investigating the potential to use seaweed to mitigate ocean acidification impacts at a local scale. Optimally placed seaweed farms could remove up to four tonnes of carbon per day from seawater. Using Heron Island as a modelling case study, this could offset between 7 and 21 years of ocean acidification for more than 80% of the Island's reef, depending on future emissions scenarios.

Seagrass cuts carbon

Seagrass pH buffering › James Cook University

Could CO_2-loving seagrasses help save reefs from the adverse effects of ocean acidification? Could seagrasses be used to reduce carbon levels and pH in the waters surrounding vulnerable reefs? Scientists are working out in the field and in the lab to assess the relationship between seagrass abundance, the relative amount of CO_2 in the water and pH as a significant step towards answering these questions.

Image: C.Collier at James Cook University

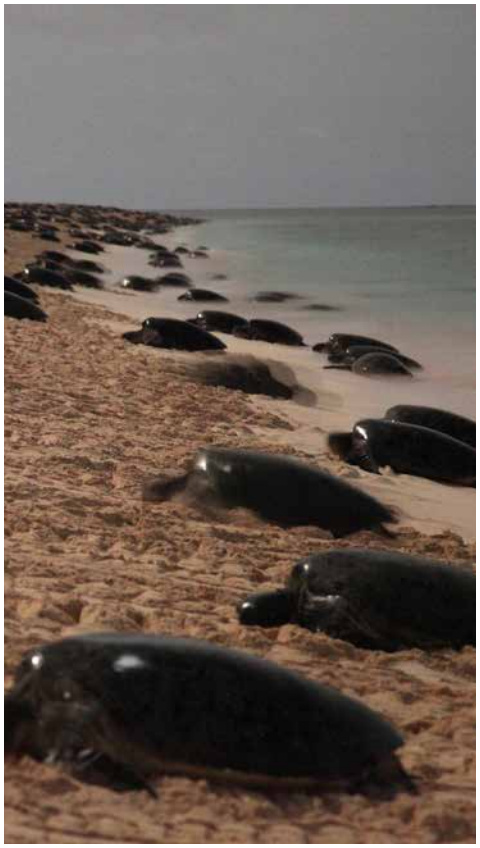
Restoring the world's largest green turtle rookery

Protecting and restoring Raine Island

Where green turtles Raine

Raine Island Recovery Project
› Queensland Government

The site of the world's largest green turtle rookery and focus of one of the greatest animal migrations on Earth, remote Raine Island is globally recognised for its environmental significance. The Raine Island Recovery project is a five year, $7.95M collaboration between the Queensland Government, BHP Billiton, the Traditional Owners and the Foundation to protect and restore the island's critical habitat to ensure the future of key marine species including green turtles and a major seabird population.



People powered science

Anyone can help collect reef data.

Crowdsourcing science

Great Barrier Reef Citizen Science Alliance

Citizen science groups across the Great Barrier Reef are a powerful force, collecting important information on everything from mangroves to manta rays, and coral to coastal habitats. To maximise the impact for scientists and reef managers, the Great Barrier Reef Citizen Science Alliance brings many of these groups from across the state together with a vision for a coordinated approach to citizen science across the Reef. Facilitating quality data reaching the hands of scientists and decision makers will enhance both community and Reef outcomes. Citizen science provides an opportunity for everyone to work together to help protect the Reef.

Image: Cranitch © Queensland Museum

The big picture

To effectively protect and preserve the Great Barrier Reef, you first have to know and understand what's there.

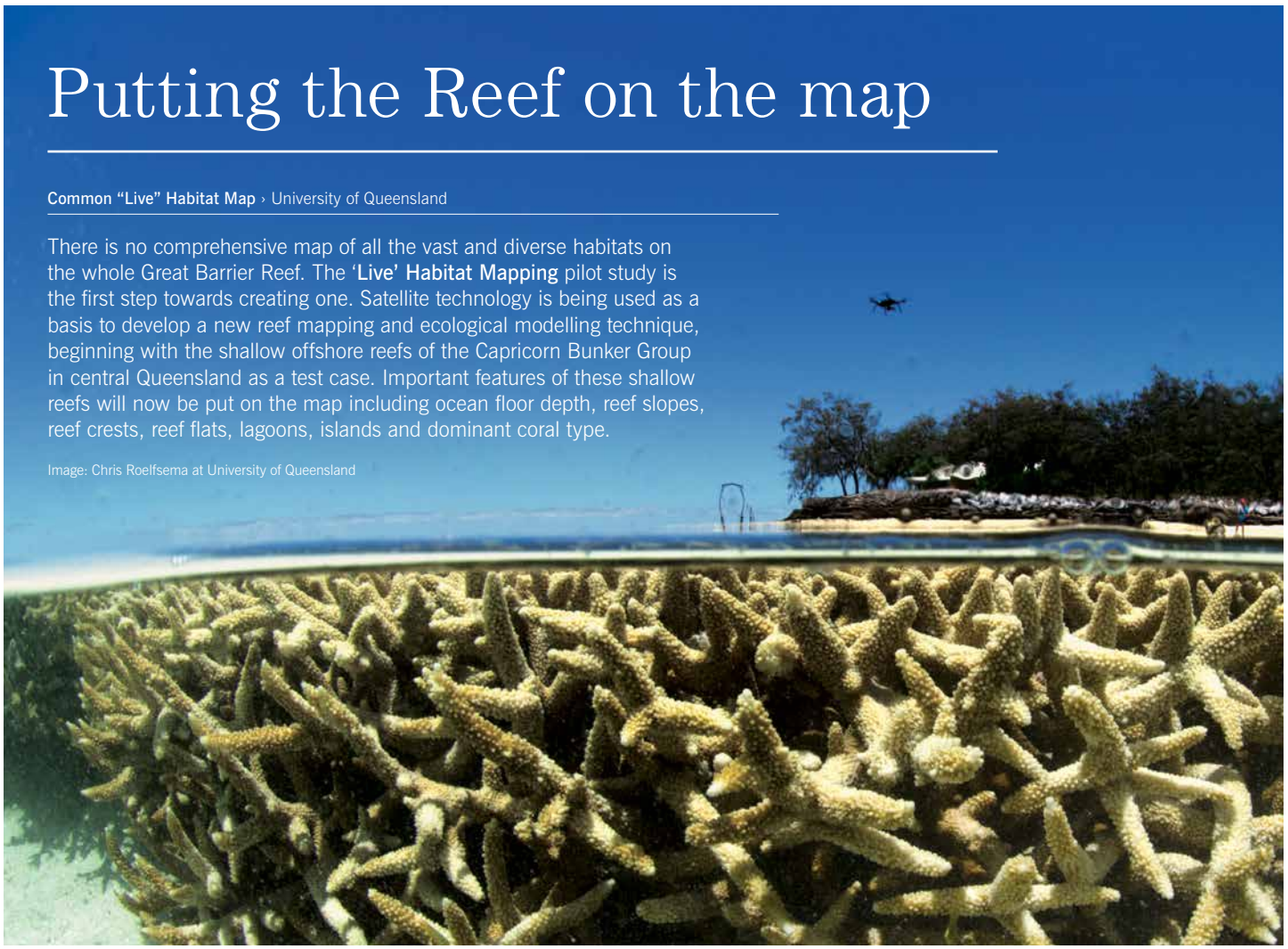
But how do you visualise and map something that spans 2,300km, is made up of over 2,900 individual and complex reefs, and is located up to 2,000 metres underwater?

Putting the Reef on the map

Common "Live" Habitat Map › University of Queensland

There is no comprehensive map of all the vast and diverse habitats on the whole Great Barrier Reef. The '**Live' Habitat Mapping** pilot study is the first step towards creating one. Satellite technology is being used as a basis to develop a new reef mapping and ecological modelling technique, beginning with the shallow offshore reefs of the Capricorn Bunker Group in central Queensland as a test case. Important features of these shallow reefs will now be put on the map including ocean floor depth, reef slopes, reef crests, reef flats, lagoons, islands and dominant coral type.

Image: Chris Roelfsema at University of Queensland



Mapping ocean chemistry

Ocean acidification visualisation
› Australian Institute of Marine Sciences

Ocean acidification is a major concern for the Great Barrier Reef into the future. Having an accurate picture of the changing ocean chemistry on the Reef is vitally important. The Ocean Acidification Visualisation project will take all the data collected from the Foundation-funded carbon chemistry monitoring programs, and use innovative tools and technology to create maps of carbon chemistry and vulnerability for the whole of the Great Barrier Reef. This will be a critical tool for prioritising management actions to protect the Reef.

Taking a step back. How do you bring everything known about the Great Barrier Reef – its diversity of organisms, habitats and pressures – and use it to protect the Reef as a whole, or better yet, reefs globally?

Image: Cranitch © Queensland Museum

Real-time Reef status tools

eReefs [2] › Bureau of Meteorology, CSIRO, Australian Institute of Marine Science, Queensland Government

The latest technologies and scientific data are combining in the six year, eReefs project[1] to create a suite of visual, communication and reporting tools for Reef managers. Just as the Bureau of Meteorology does for weather, eReefs will deliver Reef water quality information online in near real time, enabling anyone to track the effects of storms, cyclones, floods and other impacts. The first of the eReefs tools, the Marine Water Quality Dashboard, is now live on the Bureau of Meteorology website and more innovative tools are in development.

Carbon transforms the ocean

Carbon budget › Australian Institute of Marine Science

Rising carbon levels are transforming our ocean waters, but the impacts are not consistent across the Great Barrier Reef which is vast and diverse. The Carbon Budget project is using state-of-the-art modelling to pinpoint the major drivers of carbonate chemistry and ocean acidification across key reef habitats.

Roadmap to resilience

Resilience framework

The work of the Foundation and its partners is leading the way for reef research world-wide. The Reef Resilience Framework project is developing a broader roadmap for monitoring and managing reef resilience that will provide a template applicable to reefs globally.

Cumulative impact

Spatially-realistic system model
› University of Queensland

Predicting how (or if) reef management decisions will influence what the Great Barrier Reef looks like into the future is the challenge set for this pilot study. Starting in the Capricorn Bunker group, researchers are working to develop the first spatially-realistic model of reef dynamics for the Great Barrier Reef.

Predicting coral larvae travel connections

Larval dispersal processes › CSIRO

Coral larvae travel about the Reef on water currents before settling on a new reef to grow. This helps sustain the flow of new life and genetic diversity across all the individual reefs that make up the highly interconnected Great Barrier Reef. But young larvae are far too small to accurately track. The only effective way to predict their travel habits is through scientific modelling. This research will add new features to, and improve the accuracy of, an existing online larval modelling tool known as Connie (short for Connectivity Interface). The Great Barrier Reef Marine Park Authority already uses Connie to help predict and manage the spread of crown-of-thorns starfish. Extending Connie's capability to better predict the movement of larvae will help managers see where the biggest suppliers of larvae are located and which reefs rely on them for survival.

Research supporters

Research collaborators

1 ReFuGe 2020 is a collaboration between the Great Barrier Reef Foundation, Australian Institute of Marine Science, Great Barrier Reef Marine Park Authority, Bioplatforms Australia, James Cook University, King Abdullah University of Science and Technology, University of Queensland, and Australian National University supported by Rio Tinto, Bioplatforms Australia, a private family Foundation and the Australian Government.

2 eReefs is a collaboration between the Foundation, Bureau of Meteorology, CSIRO, Australian Institute of Marine Science and the Queensland Government supported by funding from the Australian Government's Caring for our Country, Queensland Government, BHP Billiton Mitsubishi Alliance and the Science Industry Endowment Fund.

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