



Science and the Great Barrier Reef

Just as science has helped the world understand and appreciate the incredible richness and diversity of the Great Barrier Reef, it is at the heart of our efforts to manage and protect it as part of our World Heritage.

The more we learn about the reef, the better equipped we are to ensure it remains healthy. All reef policy and programmes, from the development of our \$40 million Reef Trust through to every day management, are supported by science.

This critical information comes from a wide range of sources—research institutions, government agencies, universities, commercial companies and consultants, stakeholders, traditional owners and the community.

The Australian Government has been funding reef research since 1972, with the establishment of the Australian Institute of Marine Science. Hundreds of millions of dollars have been invested in our scientific knowledge of the reef and how to translate that into action.

As well as research into tackling direct threats like the deadly crown-of-thorns starfish, Australia draws on its world-leading expertise in meteorology and climate science to monitor and address the impact of climate change and severe weather events like cyclones and floods.

Science and management

The Great Barrier Reef Marine Park Authority has managed this national treasure for 40 years, working with scientists as members of boards, on research teams and in one-on-one communication between staff and scientists.

The authority uses science to:

- measure the effect of impacts on the reef (including cumulative impacts)
- identify emerging risks to the reef
- define objectives (including targets)
- set triggers for management intervention
- develop policy and management strategies and assess performance
- provide expert advice
- make decisions (for example on permits and environmental impact assessments).

Scientific information about the reef comes from a range of sources including:

- research institutions and government agencies such as the Australian Institute of Marine Science, CSIRO, James Cook University, the ARC Centre of Excellence for Integrated Coral Reef Studies, the Centre for Marine Studies at the University of Queensland, and the Queensland Department of Agriculture, Fisheries and Forestry
- reef-based industries
- members of the community
- traditional owners.

Domestic and international partnerships are central to our success. For example in 2013–2014 alone, Australian Institute of Marine Science partnerships involved:

- 168 projects
- 21 countries
- 145 Australian scientists
- 48 Australian organisations
- 84 overseas colleagues
- 67 overseas organisations.

Federal programmes contributing to science for management include:

- the Cooperative Research Centre for the Great Barrier Reef World Heritage Area (CRC Reef)
- the Tropical Ecosystem Hub, as one of the key investments under the National Environmental Research Programme (NERP)
- in the near future, the National Environmental Science Programme's Tropical Water Quality Hub
- Reef Programme Research and Development.

The authority uses scientific information to prepare its five-yearly Outlook Report which examines the Great Barrier Reef's health, pressures and likely future. The Outlook Report was based on a three year strategic and scientific assessment of the Great Barrier Reef (the largest assessment of its kind in the world), and has been central to informing the Reef 2050 Long-Term Sustainability Plan. The next Outlook Report will underpin a review of the plan in 2020.

National funding for environment research

Much of our new knowledge about the reef will be generated through the Australian Government's \$142.5 million National Environmental Science Programme which includes a \$31 million Tropical Water Quality Hub. The hub's research over six years will help maintain and improve coastal and marine water quality in Australia's tropical regions, particularly the Great Barrier Reef.

It covers risk abatement for the impacts of infrastructure, agriculture, extreme events and biosecurity threats; management, monitoring and reporting for coastal species including status, trends and threatening processes; and tropical water quality trials. It builds on work by the National Environmental Research Program's Tropical Ecosystems Hub. It saw almost \$13 million invested between 2011 and 2015 in Great Barrier Reef research partnerships between academia and governments, statutory authorities, natural resource management bodies, non-government organisations, industries, Indigenous communities and the public.

Delivering results

Research by the hub has found that:

- green zones (marine reserves) within the Great Barrier Reef Marine Park can increase populations of targeted fish species, improve coral health and protect biodiversity, although they cannot prevent reef degradation from such larger-scale disturbances as cyclones, floods, coral-bleaching events, declining water quality and increasing sedimentation
- the increase in frequency of outbreaks of the deadly crown-of-thorns starfish is linked to the impacts of degraded water quality
- data about the human use and values of the reef contribute to better informed decisions about the reef as a complex socio-ecological system subject to competing demands.

Reef Trust

The Reef Trust is one of the mechanisms which will help to deliver on the Reef 2050 Long-Term Sustainability Plan. Investment priorities for the Reef Trust, informed by hub research and other science projects include:

- improving water quality to increase the health and resilience of the reef
- improving the health and resilience of coastal habitats
- protecting threatened and migratory species, particularly dugong and turtles, and reducing crown of thorn starfish.



Image credit: GBRMPA

Lethal injection for crown-of-thorns starfish

Science has made a breakthrough in the control of venomous, coral-eating crown-of-thorns starfish with the development of a single injection method. Previous control involved multiple injections to kill the starfish. This new method is non-lethal to other marine life and provides a vastly more effective means to protect coral in specific high value tourism sites. Through the year teams of divers are in the water culling hundreds and thousands of crown-of-thorns starfish.

The injection produces an allergic reaction in the starfish causing it to break apart and die within 24 hours. Previously divers had to inject these starfish more than 20 times to get the same effect. It's delivering great results. For example more than 27 000 starfish were removed in just eight days at Arlington Reef and 9000 at Batt Reef, as well as 14 000 at Spitfire Reef near Cooktown.

Citizen science

Stretching along 2300 kilometres and covering an area roughly the size of Italy, the Great Barrier Reef presents a huge challenge for scientists studying its marine life. Marine animals don't stay in one place, which makes it even more difficult to collect information about their habitats and habits.

Tourism operators and visitors to the reef are becoming citizen scientists, helping collect information through the Australian Government-supported Sightings initiative, which is part of the Great Barrier Reef Marine Park

Authority's Eye on the Reef monitoring programme. Beginning in 2007 by tourism staff, Sightings was quickly taken up by other visitors and has gone one step further thanks to an ingenious solution suited to the age of social media.

A free smart phone app can be downloaded so that anyone on the reef—whether they're on a boat, snorkelling, diving, or fishing—can record and report what they're seeing in real time. It also uploads pictures so the photographer can share sightings with Facebook friends.

With more than 12 000 sightings of 300 different species throughout the reef, the app has listed over 270 species, capturing their GPS position, habitat, behaviour and size as well as images and videos.

eReefs

The eReefs project uses the latest technologies to collate data and new integrated modelling to produce powerful visualisation, communication and reporting tools for the Great Barrier Reef. It draws on the expertise of the Great Barrier Reef Foundation, Bureau of Meteorology, CSIRO, Australian Institute of Marine Science and Queensland Government.

Just as the Bureau of Meteorology provides weather information, it provides integrated and interactive information on the reef at a scale and detail that hasn't been available for governments, reef managers, policy makers, researchers, industry and local communities.

Its Marine Water Quality Dashboard combines daily satellite images of the reef's water colour with more than 10 years of records relating to sea surface temperature, chlorophyll levels, suspended sediments, and dissolved organic matter. By integrating data already available on water quality, the dashboard is helping to document and respond to potentially devastating environmental events like coral bleaching.



Image credit: GBRMPA

Science and water quality

Multiple sources of science and data are helping governments take quick and practical action. For example, data on how a change in farming practices is impacting on nutrient and pesticide levels in the water is used to help land managers reduce pesticides and fertilizers flowing from catchments into the reef. This is a top priority for both the **Australian Government Reef Programme**, and the **Reef Water Quality Protection Plan 2013**. These initiatives area underpinned and informed by the world-class Reef Plan Paddock to Reef monitoring, modelling and reporting programme, which quatifies reduction in pollutant loads entering the reef.

The **Scientific Consensus Statement**, an independent document reflecting the views of approximately 40 scientists from different disciplines, outlines the latest science relating to land use impacts on water quality in the Great Barrier Reef. It has provided the foundation for decisions on reef investment and was fundamental in the development of the Reef Water Quality Protection Plan 2013. It is also informing the investment decisions under the \$40 million Reef Trust.

Combined list of References of the Great Barrier Reef Region Strategic Assessment Report and Great Barrier Reef Outlook Report 2014 (Harvard referencing style)

The Great Barrier Reef Region Strategic Assessment and Great Barrier Reef Outlook Report 2014 include more than 1500 references—most are government reports and peer-reviewed scientific literature, including from research organisations and institutions like the Australian Institute of Marine Science, CSIRO, Australian universities and leading marine scientists.

The information used in the reports is only a small portion of the tens of thousands of scientific papers that have been published over the years. It is drawn from the best available and is based on relevance to the assessment needs.

The combined list of references is available at www.environment.gov.au/marine/gbr/publications/factsheet-science-and-great-barrier-reef

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