

Coral reefs are in trouble

Climate change is widely recognised as the most significant threat to the world's coral reefs. The negative impacts of climate change threaten to overwhelm natural rates of reef adaptation. These impacts include:

- increasingly frequent and severe coral bleaching
- increasingly frequent and severe weather events, such as cyclones and floods
- ocean acidification.

Global temperatures are already 1°C above pre-industrial levels. The Intergovernmental Panel on Climate Change projected in 2018 that the world's coral reefs will decline by a further 70 to 90 percent with a 1.5°C increase in global mean temperature from pre-industrial levels. Even if the world manages to stabilise global warming at 1.5°C above the pre-industrial average, mass bleaching events are predicted to increase in frequency and severity in the coming decades¹.

We are facing the very real prospect that, within a generation, without concerted action to reduce emissions, and help drive adaptation and faster recovery from damage, the world's coral reefs, as we know them, will cease to exist.

The case for coral restoration and adaptation

It is vitally important to continue to control local drivers of coral reef decline such as overfishing, coastal development and pollution. However, there is a growing realisation that, in this warming world, no matter how much we refine and improve current management approaches, on their own they may not be enough to protect coral reefs.

In this context, coral restoration and adaptation is increasingly advocated as a complement to more traditional management approaches such as establishing marine protected areas, pollution reduction and fisheries management.

The following definitions of restoration and adaptation are utilised:

- Restoration – any activity to restore an aspect of ecological function in a degraded reef location.
- Adaptation – any activity to increase the rate of coral reef adaptation to changing environmental conditions (for example increasing the rate of reefs adapting to sea surface temperature increases). It could be as simple as restocking using existing heat tolerant corals to engineering and deploying enhanced corals or symbionts.

Note that adaptation does not necessarily equate to methods such as engineered corals, it could for example be as simple as assisting the reproduction of already heat tolerant corals.

Since the adoption of ICRI Resolution on Artificial Coral Reef Restoration and Rehabilitation in 2005, international reef restoration activities across the United States, South East Asia and the Red Sea are growing in scale and are improving in efficiency and effectiveness^{2,3}. However, progress is slow and, at present, unlikely to achieve restoration at ecologically relevant scales, or assist reefs to adapt to future conditions. Considering the global decline in coral reefs and increasing threats from climate change, there is an urgent need to develop new methods and breakthroughs in the scale and rates of deployment and cost to meet current and future challenges.



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Examples from Australia

In Australia, coral reefs on the Great Barrier Reef have suffered unprecedented mortality following two back-to-back bleaching events in 2016 and 2017⁴. Not only have these events led to widespread loss of coral cover, but the resilience of the Great Barrier Reef system may also be already significantly impaired. Rates of coral recruitment in 2018, following the recent bleaching events, were reduced by up to 89 percent in some areas, compared with rates during 1996-2016⁵.

Australia has established a Reef Restoration and Adaptation Program (RRAP) to develop new interventions and delivery methods to assist the Great Barrier Reef to recover from major disturbances and to assist its adaptation to a changing climate (Box 1). The resulting technology is expected to be used to help coral reefs worldwide. The program is currently in the concept feasibility and design phase, with a targeted research and development program commencing in 2019.

THE REEF RESTORATION AND ADAPTATION PROGRAM (RRAP)

The Reef Restoration and Adaptation Program (RRAP) is a collaboration of Australia's leading experts to create a suite of innovative measures to help preserve and restore the Great Barrier Reef.

These interventions must have strong potential for positive impact, be socially and culturally acceptable, ecologically-sound, ethical and financially-responsible. They would be implemented if, when and where it was decided action was needed.

RRAP's first phase, the Concept Feasibility Program, funded by the Australian Government, recently concluded. It found that it may well be possible to protect the Great Barrier Reef (and other reefs around the world) and help it adapt to climate change by intervening at scale.

Modelling showed that an integrated package of interventions would be the most efficient and effective way to sustain the health of the Reef. These interventions would work together, reinforcing each other to protect and restore the Reef, as well as help it adapt to climate change.

A bold, breakthrough, research and development (R&D) effort is recommended over the long term to make intervention at scale feasible, safe, acceptable and affordable. RRAP modelling found under best-case emissions scenarios (RCP 2.6), RRAP interventions could help protect and retain environmental, social and economic values of the Great Barrier Reef indefinitely. Under unchecked emissions and continued climate change (RCP 8.5), RRAP interventions could help protect and retain core environmental, social and economic values of the Great Barrier Reef for another 20-30 years, increasing the window for global emissions reduction.

The recommended research and development effort would strike a balance between minimising risk and maximising opportunity to save Reef species and values by:

- driving early deployment of smaller-scale interventions as soon as feasible, to help protect high-value reef
- quickly identifying and focusing on interventions with the highest likelihood of success
- reducing uncertainty around the benefits, risks and costs of those interventions
- managing resources in a flexible and cost-efficient way.

The substantial risks to intervening would be managed using:

- more sophisticated reef modelling
- targeted ecological research to fill knowledge gap
- a bespoke decision support system.

The Reef Restoration and Adaptation Program R&D effort brings together the best and brightest from Australia, and internationally, in the world's largest effort to help a significant ecosystem survive climate change.

This ambitious, unique undertaking will require not only our best minds working in partnership across many organisations and fields of expertise, but importantly, the input and support of the wider community.

The program found that for it to be effective in the long term, best practice reef management must continue as well as global greenhouse gas emissions reduction.

Goals of this project

The goal of this project is to develop a virtual working group, under the auspices of ICRI, to advance the research of coral restoration and adaptation initiatives, and develop collaborations. In the face of the current coral reef crisis, it is essential to join forces, exchange knowledge, and collaborate to maximise outcomes in the minimum amount of time.

The initial phase of this project aims to identify areas of common development interests at the policy and planning level. These would then be used in subsequent phases to guide more detailed and focused discussions on identifying and establishing joint research and development programs.

Chaired by Australia, an ad-hoc committee will gather experts from the ICRI Membership across reef-bearing regions of the world to:

- assess and document global needs and priorities for current and future reef restoration and adaptation programs
- assess and document global research and development priorities to deliver the methods, productivity and cost breakthroughs needed to support restoration and adaptation program objectives
- assess and document the priority drivers and areas for reef investment
- identify mechanism(s) to improve joint planning and delivery of reef restoration and adaptation research and development
- identify (at a high level) opportunities to partner on reef restoration and adaptation research and development activities.

Virtual meetings will be organised to surveys ICRI members' current and future capacity for restoration and adaptation. The surveys will aim to elicit indepth thinking about what might be required within different global regions/contests and how this translates into important technicalities such as methods, scale, timelines, and type of engagement available for intervention.

These can then be assessed to determine overlapping policy and technical drivers and hence the largest opportunities for global research and development programs. Results will be presented as a report during the General ICRI meeting in December 2019. The report will also present the potential for the creation of a working group and co-investment in restoration and adaptation research and action.



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