Project 6.2
Restoring ecosystems from catchment to reef

Tropical Water Quality Hub

National Environmental Science Programme

Project Summary

A range of NESP TWQ Hub funded projects have delivered insights into improved ways of restoring and evaluating ecosystem restoration efforts, from catchments through to the reef and other coastal and marine environments. A wide range of projects have focused on reducing sediment and nutrient runoff and restoring wetland, estuarine, seagrass and coral reef ecosystems. This project provides an overarching perspective of the diversity of findings and key learnings across the range of ecosystem restoration projects through an integrated synthesis report. This synthesis of research findings and learnings provides knowledge to inform investments in ecosystem restoration and environmental improvements in the Great Barrier Reef (GBR) and its catchments and guide the development of environmental policies and major GBR programs and initiatives.



ABOVE: Researcher delivering bags of coral larvae for coral restoration experiment. (Image: Ian McLeod)

Problem

The loss of values and functions provided by healthy coastal ecosystems has been identified as one of the major threats to the GBR. Ecosystem restoration can contribute to water quality improvements while providing additional hydrological, biodiversity, cultural and social benefits, however, the most cost-effective solutions are still in development and can require significant resources and long-term commitment to be successful. To date, research effort into effective restoration techniques for maintaining or improving ecosystem values and function has been sporadic, and typically focused on very small-scale, short-term projects. A whole-of-catchment approach is required to support ongoing efforts, as demonstrated in the findings from the NESP TWQ Hub research.

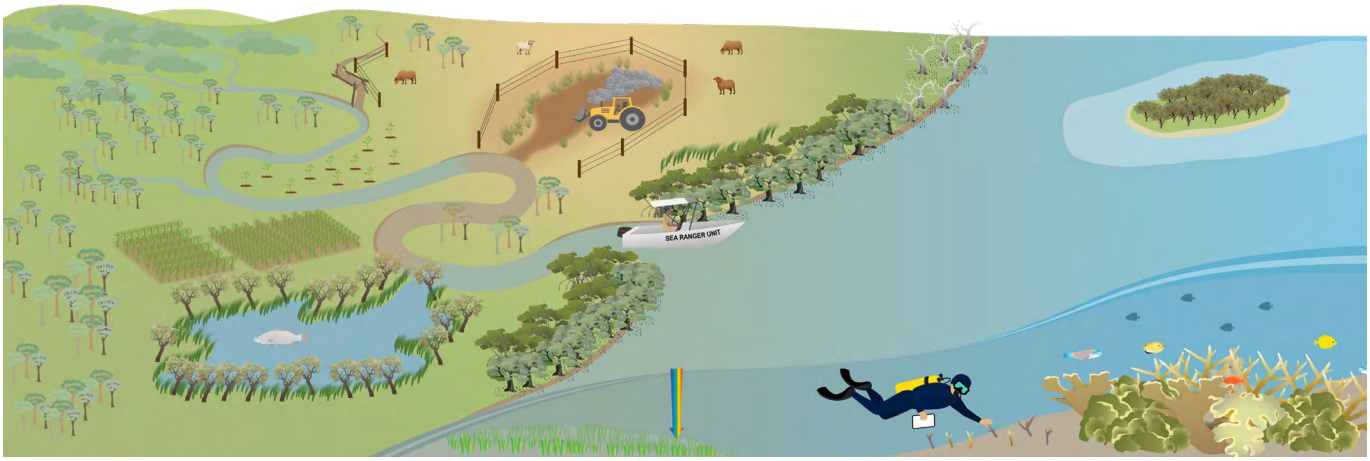

Diagram illustrating a hypothetical catchment with symbols representing the restoration-focus research topics (i.e. gully and riparian restoration, freshwater and tidal wetlands and mangroves, seagrass meadows and coral reef restoration) (Illustration: Kate Hodge)

How Research Addresses Problem

Throughout the NESP TWQ Hub, a cluster of research projects were completed to assist in the development and implementation of practical solutions for ecosystem restoration, across the full scope of the GBR and its catchments including freshwater, estuarine and marine ecosystems. The research was specifically designed in the context of achieving long-term outcomes in a changing climate, from research to action.



Image: Damon Telfer

Key Findings

The outcomes of these NESP TWQ Hub projects have:

- Investigated and trialled remediation methods for gully and streambank erosion, including the establishment of best practice guidelines; and developed a range of techniques for identifying, characterising, prioritising and evaluating future investments;
- Explored and identified potential cost-effective options for land use transition of high dissolved inorganic nitrogen risk marginal cane areas to alternative land uses to reduce nitrogen losses in wet and dry tropical catchments;
- Highlighted the need to incorporate long-term maintenance and protection of the restoration asset within the planning and funding of all restoration projects (e.g., removal of aquatic weeds from wetlands will likely be an on-going challenge);
- Developed monitoring programs and contributed to improve local technical skills to assess mangrove recovery in remote areas of the Gulf of Carpentaria. Proposed management strategies to mitigate the adverse impacts of future extreme climatic events in tidal wetland ecosystems;
- Developed a Mangrove Management Plan with Traditional Owners in the southern GBR. Built essential capacity amongst the Gidarjil Development Corporation Rangers and the local community to conduct ecological monitoring and assessment of key local estuarine resources;
- Contributed to guide seagrass conservation planning through prioritisation of at-risk communities that are continuing to fail desired states; Specifically, acute management thresholds (suited to compliance guidelines for managing short-term impacts) were proposed, from 2 to 6 mol quanta m^{-2} d^{-1} depending on species. Similarly, long-term thresholds (suited to the setting of water quality guidelines for catchment management) were suggested at around 10 to 12 mol quanta $m^{-2}{\cdot}d^{-1}$ depending on species. This new knowledge is critical for assessing seagrass resilience, for deciding whether active seagrass restoration may be required or not and for identifying suitable donor sites if intervention is warranted;
- Identified the features of successful small-scale seagrass restoration projections and the technologies required to up-scale them in Australia. Suggested techniques included physical planting of seagrasses, distribution or planting of seagrass seeds, or coastal engineering to modify sediment regimes. New tools identified included buoy-deployed seeding systems, dispenses injection seeders, artificial in-water structures to protect restoration sites, and land-based nurseries for propagation;
- Identified and trialled several coral restoration intervention types, with coral restoration at small scales (e.g., coral nursery and gardening projects), macroalgae removal, and COTS control being among the most successful strategies to improve the health of local reefs while educating the general public and providing stewardship opportunities. However, substantial scaling-up of these techniques would be required for restoration to be a useful tool to support the recovery and persistence of reefs on the GBR;
- Trialled methods for coral adaptation (through the Reef Restoration and Adaptation Program -RRAP), including the identification of the traits of corals that have survived bleaching (e.g., *sacsin* gene within *Acropora millepora*);
- Established that using existing methods, coral restoration and adaptation in Australia can at best restore local-scale sites, and buy time while urgent global action on climate change increases; and
- Contributed to building indigenous livelihoods and co-management opportunities in the Cape York Peninsula, with a focus on potential ecosystems services (particularly in water and catchment management).

It is important to note in all of these findings that restoration to historical ecosystem condition is not the goal of this research. Rather, the focus was on how restoration can be used to help regain and maintain ecosystem values and services and facilitate adaptation to increasing frequency and/or intensity of disturbances under future climate change and burgeoning human impacts.

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