NERP Tropical Ecosystems Projects relevant to Mackay Whitsundays region

This document describes the Climate Change (CC) relevance of National Environmental Research Program Tropical Ecosystems (NERP TE) projects covering the **Mackay Whitsundays** region. These summaries will be used to identify options for project findings to be incorporated into NRM planning and management.

There are **22** NERP TE projects relevant to the **Mackay Whitsundays** region. Their CC relevance is summarised in Section 1. The projects are then classified in relation to *Knowledge sources and systems* and *CC Knowledge needs* (Section 2). A full-page fact-sheet for each project can be found in Appendix 1.

NRM groups will be invited to further discuss their knowledge needs in relation to climate change planning and management and more broadly, and to indicate their interest in particular projects and preferred methods of knowledge integration.

Please direct any queries to Gabriel.Crowley@jcu.edu.au

Section 1. Summaries of NERP projects relevant to the Mackay Whitsundays region

1.1 Monitoring status and trends of coral reefs of the Great Barrier Reef
Project Leader(s)
Dr Hugh Sweatman, Australian Institute of Marine Science

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	Yes	Yes

Relevance of project for Climate Change (CC) planning & management
This project will provide baseline condition assessment of the GBR, and analysis of trends and threats. It will provide information on the impacts of climate change factors (coral bleaching, cyclonic damage), and their interaction other stressors (crown-of-thorns).

1.3 Characterising the cumulative impacts of global, regional and local stressors on the present and past biodiversity of the Great Barrier Reef
Project Leader(s)
Prof Jian-xin Zhao, University of Queensland
Prof John Pandolfi, University of Queensland

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	Yes	Yes

Relevance of project for Climate Change (CC) planning & management
This project will provide baseline information on climate variability and how it has affected the condition of the GBR in combination with other stressors. It will provide information on the likely impacts of climate change on reef health, and the interactions with other factors (e.g. water quality). It will therefore inform action on water quality management under climate change conditions.

3.3 Targeted surveys for missing and critically endangered rainforest frogs in ecotonal areas, and assessment of whether populations are recovering from disease
Project Leader(s)
Dr Robert Puschendorf, James Cook University
Dr Conrad Hoskin, James Cook University

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	Yes	No	No	No	No

Relevance of project for Climate Change (CC) planning & management
This project will identify the current status of cortically endangered and possibly extinct rainforest frogs, as well as refuge areas that currently support any surviving species. This information will assist in the prioritisation of areas with high values for biodiversity protection under climate change planning. It will also provide information on the distribution of chytrid fungus, which will assist in identifying the climatic envelope in which this threat to endangered frog is active.

4.1 Tracking coastal turbidity over time and demonstrating the effects of river discharge events on regional turbidity
Project Leader(s)
Dr Katharina Fabricius, Australian Institute of Marine Science

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	Yes	Yes

Relevance of project for Climate Change (CC) planning & management
This project will provide baseline information on the effects of river discharges on GBR water clarity. It will assist in climate change adaptation planning by identifying areas where poor water quality may be particularly exacerbated by extreme flood events.

4.2 The chronic effects of pesticides and their persistence in tropical waters
Project Leader(s)
Dr Andrew Negri, Australian Institute of Marine Science

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	Yes	Yes

Relevance of project for Climate Change (CC) planning & management
This project will provide baseline information on the effect of agricultural pesticides on water quality and seagrass and reef health, and their resilience under climate change conditions. It will help prioritise climate change adaptation planning by highlighting threats to ecosystem health that may interact with climate stressors.

4.3 Ecological risk assessment for water quality of the Great Barrier Reef
Project Leader(s)
Dr Jon Brodie, James Cook University
Dr Rai Kookana, CSIRO

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	Yes	Yes

Relevance of project for Climate Change (CC) planning & management
This project will develop a tool for identifying the most significant sources of pesticide, nutrient & sediment pollution to the GBR and where they are coming from. This tool will help prioritise climate change adaptation planning by highlighting threats to ecosystem health that may interact with climate stressors. NB. This project will not provide information needed for climate change adaptation planning. This will be done in a separately-funded Stage 2 project which will run the risk assessment tool.

5.1 Understanding Great Barrier Reef diversity: spatial and temporal dynamics and environmental drivers
Project Leader(s)
Dr Glenn De'ath, Australian Institute of Marine Science

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	Yes	Yes

Relevance of project for Climate Change (CC) planning & management
This project will provide baseline maps of Great Barrier Reef diversity and condition. It will provide understanding of the environmental factors and threats (including climatic events) affecting diversity and condition. This information will help identify likely climate change impacts on GBR condition and to prioritise marine areas to be considered in climate change adaptation planning.

5.2 Combined water quality–climate effects on coral and other reef organisms
Project Leader(s)
Dr Sven Uthicke, Australian Institute of Marine Science

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	Yes	Yes

Relevance of project for Climate Change (CC) planning & management
This project will assess individual and interactive effects of water quality (increased nutrients & sediments; reduced light & salinity) and climate change variables (increasing sea temperatures; ocean acidification) on the health of GBR species.

5.3 Vulnerability of seagrass habitats in the Great Barrier Reef to changing coastal environments
Project Leader(s)
Dr Catherine Collier, James Cook University

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	No	Yes

Relevance of project for Climate Change (CC) planning & management
This project will assess the impact of flood events on water quality in seagrass meadows. It will assess individual and interactive effects of water quality on the health of seagrass meadows, and identify critical tolerance thresholds. It will develop indicators to be used in assessing the health of seagrass communities. This work will provide information on stressors that may interact with climate change stressors and should be taken into account in climate change adaptation planning.

6.1 Maximising the benefits of mobile predators to Great Barrier Reef ecosystems: the importance of movement, habitat and environment
Project Leader(s)
Dr Michelle Heupel, Australian Institute of Marine Science

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	Yes	No

Relevance of project for Climate Change (CC) planning & management
This project will provide baseline information on the distribution and abundance of large marine predators of the Great Barrier Reef, and of the factors affecting these species. While not specifically addressing climate change, the baseline information will be important for prioritising actions to maintain populations under climate change conditions.

6.2 Drivers of juvenile shark biodiversity and abundance in inshore ecosystems of the Great Barrier Reef
Project Leader(s)
Prof Colin Simpfendorfer, James Cook University

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	No	No

Relevance of project for Climate Change (CC) planning & management
This project will provide baseline information on the distribution and abundance of sharks in inshore areas of the Great Barrier Reef, and of the factors affecting these species, and provide management recommendations. While not specifically addressing climate change, the baseline information will be important for prioritising actions to maintain populations under climate change conditions.

7.1 Fire & rainforests
Project Leader(s)
Dr Dan Metcalfe, CSIRO

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	Yes	No	No	No	No

Relevance of project for Climate Change (CC) planning & management
This project will provide information on the impacts of cyclones and fire regimes on rainforest margins, key rainforest and mahogany glider habitat, and identify areas requiring fire management to maintain key environmental values. It will assist in prioritising areas for fire management or exclusion under climate change conditions.

7.2 Invasive species risks and responses in the Wet Tropics
Project Leader(s)
Dr Helen Murphy, CSIRO

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	Yes	No	No	No	No

Relevance of project for Climate Change (CC) planning & management
This project will provide information on the potential current and future distributions of existing and emerging weed species in the Wet Tropics, and identify management strategies to reduce future weed impacts and the future cost of weed management. The project will also identify potential high-risk source areas for future weed threats to the Wet Tropics. NB: Although focused on the Wet tropics, bioclimatic modelling of weed species will apply Australia-wide.

8.2 Assessing the long–term effects of management zoning on inshore reef of the Great Barrier Reef
Project Leader(s)
Prof Garry Russ, James Cook University

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	No	No

Relevance of project for Climate Change (CC) planning & management
This project will provide baseline data on factors affecting the distribution and abundance of marine fish communities, and the effectiveness of current management arrangements. It also provides and assessment of reef health and factors affecting health, including coral bleaching.

9.1 Dynamic vulnerability maps and decision support tools for the Great Barrier Reef
Project Leader(s)
Dr Ken Anthony, Australian Institute of Marine Science

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	Yes	No

Relevance of project for Climate Change (CC) planning & management
This project will develop a tool for identifying the most vulnerable, as well as the most resilient, areas of the GBR under combinations of climate change scenarios and local/regional scale stressors and impacts. The project will be critical for (1) identifying areas of the GBR that need priority management action, (2) for identifying key management levers that have the best chance of maintaining reef resilience in priority areas, (3) identifying critical threshold levels for cumulative stress that could push the reef ecosystem beyond a tipping point, and (4) for providing information on the relative importance of climate change action and local scale management practices as we move into a high CO2 era.

9.2 Design and implementation of management strategy evaluation for the Great Barrier Reef
Project Leader(s)
Dr Cathy Dichmont, CSIRO

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	No	No

Relevance of project for Climate Change (CC) planning & management
This project will use stakeholder input to develop and assess management options for the inshore GBR. While not specifically addressing climate change the options will be able to be tested under climate change scenarios.

9.3 Prioritising management actions for Great Barrier Reef islands
Project Leader(s)
Prof Bob Pressey, James Cook University

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	Yes	No	No	No

Relevance of project for Climate Change (CC) planning & management
This project will develop a tool for prioritising conservation management to address climate change, development pressures and other issues affecting Great Barrier Reef islands off the central Queensland coast.

9.4 Conservation planning for a changing coastal zone
Project Leader(s)
Prof Bob Pressey, James Cook University

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	No	No

Relevance of project for Climate Change (CC) planning & management
This project sets out to identify key priorities for protecting and restoring coastal ecosystems in the Great Barrier Reef World Heritage Area (GBRWHA). The work will take into account changing land use, expanding infrastructure and climate change.

10.1 Social and economic long–term monitoring program
Project Leader(s)
Dr Nadine Marshall, CSIRO

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	No	Yes	Yes	No

Relevance of project for Climate Change (CC) planning & management
This project will provide baseline datasets for socioeconomic monitoring and evaluation to underpin resource use planning, which will be a useful resource for climate change adaptation planning.

10.2 Socio-economic system and reef resilience
Project Leader(s)
Dr Natalie Stoeckl, James Cook University

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	Yes	Yes	Yes	Yes	No

Relevance of project for Climate Change (CC) planning & management
This project will provide baseline information on community values of, and income generated by, the Great Barrier Reef. It assesses how locals and visitors to the region value environmental features (e.g. key species, wetlands, mangroves & reefs) as well as how these contribute to land and sea based tourism and fishing operations. It establish baseline information about the region's climate and water quality based on historical records, and elicits community perception of changes, their responses to predicted changes, their capacity to cope with change, and the financial implication of change. It uses these responses to identify community priorities for conservation efforts.

12.4 Governance, planning and the effective application of emerging ecosystem service markets: climate change adaptation and landscape resilience
Project Leader(s)
Dr Allan Dale, James Cook University

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	Yes	No	No	No	No

Relevance of project for Climate Change (CC) planning & management
This collaborative project will identify effective governance arrangements to plan for climate change adaptation to ensure social and ecosystem resilience. It will assist NRM groups to incorporate climate change considerations in NRM plans, specifically by supporting regions to negotiate national policy on this front. This will also include the identification of opportunities for ecosystem service delivery, including carbon farming, and working towards regional progression of these markets.

13.1 e-Atlas
Project Leader(s)
Dr Eric Lawrey, Australian Institute of Marine Science

Environmental domain	Mainland	Islands	Coast/inshore	Offshore	Terrestrial impacts on marine
	No	Yes	Yes	Yes	No

Relevance of project for Climate Change (CC) planning & management
This project will develop and populate a website for accessing spatial data about the Great Barrier Reef and Torres Strait. It will be a useful tool for climate change adaptation planning.

Section 2. Assessment of Climate Change relevance of NERP TE projects

Natural Resource Management groups in the Wet Tropics Cluster and Monsoonal North Cluster (Figure 1) were consulted about their CC planning information priorities. These were subdivided into *Knowledge systems and sources* (Table 1) and *CC Knowledge needs* (Table 2, Table 3). NERP TE Projects were then classified accordingly to help identify their relevance to CC planning and management in each region.

NERP TE projects focus on the Mackay Whitsundays, Great Barrier Reef and Wet Tropics rainforests. Therefore, their greatest relevance will be to the Wet Tropics Cluster. However, Monsoonal North Cluster priorities have also been included to allow an integrated approach to developing NRM knowledge systems across northern Australia.

Figure 1. Northern NRM Clusters
The Wet Tropics Cluster includes the Mackay Whitsundays, Cape York, Wet Tropics, Mackay Whitsundays regions. The Monsoonal North Cluster includes the Burdekin Dry Tropics, Mackay Whitsundays, Southern Gulf and northern parts of Northern Territory and Western Australian Rangelands.
Source: http://www.climatechange.gov.au/government/initiatives/regional-nrm-planning-and-climate-change-fund/element-2-factsheet.aspx

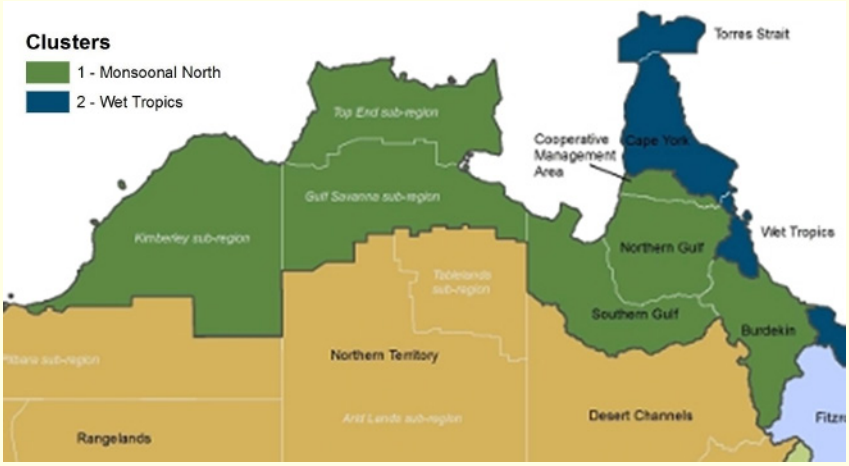

Table 1. Knowledge sources and systems
This table presents *Knowledge sources and systems* used or developed in each NERP TE projects as classified on the basis of consultation with northern NRM clusters.

Priorities indicated by shading:	Wet Tropics Cluster	Monsoonal North Cluster	Both Clusters

KNOWLEDGE SOURCES	NERP TE projects drawing on:
Indigenous knowledge	
Other community knowledge & experience (e.g. pastoral)	10.2, 12.4
Science & social science	1.1, 1.3, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 7.1, 7.2, 8.2, 9.1, 9.2, 9.3, 9.4, 10.1, 10.2, 12.4, 13.1
DATA, RESOURCES & TOOLS	**NERP TE projects developing or applying:**
Bibliographic search & display	9.4
Mapping & regional planning	1.1, 3.3, 4.1, 4.3, 5.1, 6.1, 6.2, 7.1, 7.2, 9.1, 9.3, 9.4, 10.1, 12.4, 13.1
Scenario modelling	7.2, 9.1, 9.4, 10.2
Prioritisation	4.3, 9.1, 9.2, 9.4, 10.2
Monitoring & evaluation	1.1, 1.3, 4.1, 5.3, 10.2
SYNTHESIS & ASSESSMENT	**NERP TE projects producing or applying:**
Knowledge synthesis	1.3, 7.2, 9.1, 9.3, 9.4, 10.2, 12.4
Availability & access	10.1, 12.4, 13.1
Adequacy & gap analysis	9.1, 9.3, 12.4

Table 2. Project focus in relation to NRM Climate Change knowledge needs
This table presents NERP TE project focus in relation to the knowledge needed for CC planning and management as identified in consultation with northern NRM clusters.

NERP Project #	PROJECT FOCUS	Baseline information	CC impact assessment (incl. socioeconomic)	Adaptation planning	Management options	Interactions with CC (incl. carbon farming)
	CLIMATIC & ENVIRONMENTAL CONDITIONS					
1.3	GBR water quality & CC	Yes	Yes			Yes
4.1	End-of-catchment water clarity	Yes				Yes
4.2	Pesticide impacts	Yes				Yes
4.3	GBR pollutions risks	Yes				
5.1	GBR diversity		Yes			
5.2	Water quality & CC impacts		Yes		Yes	Yes
5.3	Seagrasses		Yes			
7.1	Fire and rainforests		Yes			
8.2	Assessing inshore GBR zonation		Yes			
9.3	Island planning			Yes		
10.2	GBR socioeconomic values	Yes				
	BIODIVERSITY					
1.1	Coral status & trends	Yes	Yes			
1.3	GBR water quality & CC	Yes	Yes			Yes
3.3	Rainforest frogs &mahogany glider	Yes				
4.2	Pesticide impacts	Yes				
5.1	GBR diversity	Yes	Yes	Yes		
5.2	Water quality & CC impacts	Yes	Yes		Yes	
5.3	Seagrasses	Yes				
6.1	Large marine predators	Yes				
6.2	Shark nurseries	Yes			Yes	
7.1	Fire and rainforests		Yes			
7.2	WT weeds & pests	Yes	Yes		Yes	
8.2	Assessing inshore GBR zonation	Yes	Yes		Yes	
9.1	GBR vulnerability mapping	Yes	Yes	Yes	Yes	
9.2	GBR planning				Yes	
9.3	Island planning			Yes		Yes
9.4	Coastal planning			Yes	Yes	
10.2	GBR socioeconomic values	Yes				
12.4	Adaptation planning & governance			Yes		
13.1	Map tools	Yes				
	COMMUNITIES & ORGANISATIONAL ARRANGEMENTS					
9.1	GBR vulnerability mapping				Yes	
9.2	GBR planning	Yes				
9.4	Coastal planning			Yes	Yes	
10.1	Socioeconomic data	Yes				
10.2	GBR socioeconomic values	Yes	Yes			
12.4	Adaptation planning & governance			Yes		
	INDUSTRIES & LIVELIHOODS					
9.1	GBR vulnerability mapping				Yes	
9.3	Island planning					Yes
10.1	Socioeconomic data	Yes				
10.2	GBR socioeconomic values		Yes			
12.4	Adaptation planning & governance			Yes		
	INFRASTRUCTURE					
9.3	Island planning					Yes
9.4	Coastal planning			Yes		
10.2	GBR socioeconomic values	Yes				
	RESOURCE ACCESS & COST					
9.4	Coastal planning			Yes		

Table 3. Full assessment of focus in relation to NRM Climate Change knowledge needs
This table presents NERP TE projects relevant to the knowledge needed for CC planning and management as identified in consultation with northern NRM clusters.

Knowledge priorities indicated by shading:	Wet Tropics Cluster	Monsoonal North Cluster	Both Clusters

TOPICS		Baseline information	CC impact assessment (incl. socioeconomic)	Adaptation planning	Management options	Interactions with CC (incl. carbon farming)
A	CLIMATIC & ENVIRONMENTAL CONDITIONS	NERP Projects addressing topic				
A.1.	At-risk areas					
A.2.	Rainfall &/or temperature	1.3, 10.2	1.3, 5.2			5.2
A.3.	Climate variability	1.3, 10.2	1.3			
A.4.	Extreme events (cyclones, storms, droughts, floods, bleaching)	1.3, 10.2	1.3, 5.1, 5.2, 5.3, 7.1, 8.2			5.2
A.5.	Fire (frequency, intensity & extent)		7.1			
A.6.	Sea-level rise	1.3	1.3			
A.7.	Hydrological cycles	4.1				
A.8.	Water quality (pH, salinity, sediment, nutrients, pesticides)	1.3, 4.1, 4.2, 10.2	1.3, 5.2, 5.3		5.2	1.3, 4.1, 4.2, 5.2
B	BIODIVERSITY	NERP Projects addressing topic				
B.1.	At risk areas/ecosystems	4.2, 7.2, 8.2, 9.1, 10.2	7.1, 8.2	9.4	9.1, 9.2	
B.2.	At risk species	3.3, 6.1, 6.2, 8.2, 9.1, 10.2	8.2	9.4	6.2, 8.2, 9.1	
B.3.	Corridors, connectivity & refugia	3.3, 9.1	8.2	9.4		
B.4.	Distribution & abundance of species & communities	1.3, 3.3, 5.1, 5.2, 6.1, 6.2, 9.1, 10.2	1.3, 5.1, 5.2		9.1	
B.5.	Ecological function, processes, critical thresholds (resilience)	1.1, 1.3, 4.2, 5.3, 6.1, 9.1	1.1, 1.3, 5.2, 7.1, 8.2, 9.1	9.1, 9.4, 12.4	5.2, 9.1, 9.2, 9.4	1.3

Assessment of the Climate Change relevance of NERP TE projects for the Mackay Whitsundays region

TOPICS		Baseline information	CC impact assessment (incl. socioeconomic)	Adaptation planning	Management options	Interactions with CC (incl. carbon farming)
B.6.	Ecosystem health (condition monitoring)	1.1, 1.3, 5.1, 5.2, 5.3, 7.2, 8.2, 9.1	1.1, 1.3, 5.1, 5.2		9.1	
B.7.	Disease and disease vectors	3.3				
B.8.	Invasive species and emergent risks	7.2			7.2	7.2
C	COMMUNITIES & ORGANISATIONAL ARRANGEMENTS	NERP Projects addressing topic				
C.1.	At risk social systems & communities		10.2			
C.2.	Indigenous people, communities & cultural sites					
C.3.	Well-being & resilience	10.2	10.2	12.4	9.1	
C.4.	Livelihoods and culture	10.2	10.2			
C.5.	Capacities, capabilities, interests & aspirations	9.2, 10.2				
C.6.	Motivations & barriers to adaptation					
C.7.	Governance systems			9.4, 12.4	9.4	
D	INDUSTRIES & LIVELIHOODS	NERP Projects addressing topic				
D.1.	Rural and primary industries		10.2			
D.2.	Carbon and ecosystem services (terrestrial & marine)			12.4	9.1	
D.3.	Indigenous land & sea management					
D.4.	Tourism		10.2			
D.5.	Other industries					

Assessment of the Climate Change relevance of NERP TE projects for the Mackay Whitsundays region

TOPICS		Baseline information	CC impact assessment (incl. socioeconomic)	Adaptation planning	Management options	Interactions with CC (incl. carbon farming)
E	INFRASTRUCTURE	NERP Projects addressing topic				
E.1.	General infrastructure					
E.2.	Coastal infrastructure			9.4		
E.3.	Urban centres			9.4		
E.4.	Population growth and distribution	10.2				
F	RESOURCE ACCESS & COST	NERP Projects addressing topic				
F.1.	General resources					
F.2.	Land (tenure & use)			9.4		
F.3.	Water			9.4		
F.4.	Energy					
F.5.	Food security					
F.6.	Indigenous traditional resource base					

Appendix 1. NERP Project factsheets

NERP Tropical Ecosystems Hub Project Factsheet

Monitoring status and trends of coral reefs of the Great Barrier Reef

Project leader: Dr Hugh Sweatman (AIMS)

Project summary

This project will continue a unique data set that documents long-term trends in coral reef communities of the Great Barrier Reef (GBR). Regular surveys of fish, coral and coral predators such as crown-of-thorns starfish on 47 reefs since 1992, provide the 'big picture' on the condition of reefs on the GBR and how they are changing over time. This project will employ a range of surveying techniques to detect events likely to have large-scale impacts on reef health, such as coral bleaching, coral disease, cyclones or crown-of-thorns starfish outbreaks.

Why this research is needed

Documenting patterns of reef decline and determining the factors influencing reef recovery is critical to the long-term persistence of the GBR. The surveys show that crown-of-thorns starfish and cyclones have been the leading causes of damage to coral reefs since the early 1990s when surveys began. These kinds of disturbances affect different areas of the GBRMP and their effects persist from years to decades, so long-term data sets are critical for understanding the ecology of coral reefs and for formulating policies to best protect them.

Research-user focus

This project provides information on condition of coral reefs over a large area of the Great Barrier Reef Marine Park and will contribute to the 2014 Great Barrier Reef Outlook Report to be produced by the Great Barrier Reef Marine Park Authority (GRBMPA) and the Department of Sustainability, Environment, Water, Population and Communities. Regular updates on reef status and crown-of-thorns starfish are provided to the Association of Marine Park Tourism Operators to provide early warning of any increases in crown-of-thorns starfish activity.

Research Provider:

Australian Government | Australian Institute of Marine Science

Healthy populations of herbivorous fish are important for coral reef resilience.

Coral cover and counts of crown-of-thorns starfish are collected around the reef perimeter by a snorkel diver towed behind the boat.

Photos: AIMS reef monitoring.

Outcomes

- Updates on status and temporal trends in coral, fish and crown-of-thorns starfish populations on survey reefs.
- Report on recovery rates and resilience of reefs after cyclones in 2009-2011.
- Report on crown-of-thorns starfish outbreaks on the GBR.
- Publications on coral and fish dynamics in relation to management and environmental drivers.

Find this project at www.nerptropical.edu.au
Theme 1: Assessing ecosystem condition and trend
Program 1: Historical and current condition of the GBR
Project: 1.1

For more information about this project, contact:
Dr Hugh Sweatman (Australian Institute of Marine Science)
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National Environmental Research Program | Australian Government Department of Sustainability, Environment, Water, Population and Communities | Reef & Rainforest Research Centre

NERP Tropical Ecosystems Hub Project Factsheet

Characterising the cumulative impacts of global, regional and local stressors on the present and past biodiversity of the GBR

Project leaders: Prof. Jian-xin Zhao & Prof. John Pandolfi (UQ)

Project summary

Using pioneering high-precision geological dating and palaeoecological techniques, combined with high-resolution geochemical analysis of coral records, this project will investigate how coral communities have historically responded to acute (e.g. cyclones) and chronic (e.g. water quality) disturbances.

Why this research is needed

Nutrient loading and discharge from agricultural and other land uses are putting increasing pressure on coral communities. More recent threats to the Great Barrier Reef (GBR) include global warming, coral bleaching, ocean acidification and coral disease. This research will provide valuable knowledge that can be used to assess the effects of existing management strategies on the GBR ecosystem.

Outcomes

Key outcomes of the project will include:

- Long-term records of coral reef community structure along the length of the GBR to evaluate the ecological effects of run-off from agricultural activities and changes in climate.
- High resolution chronological records of parameters such as sea-level, sea-surface temperature, salinity, pH value, and cyclone frequency on different time scales over the past 1-2 millennia which will enable us to predict future climate scenarios and the responses of coral communities to such changes.
- Long-term trends in coral calcification in response to changes in climate and water quality over the past hundreds to thousands of years.

Dead coral fragments are dated using uranium-series at the Radiogenic Isotope Facility, The University of Queensland, to determine the timing of coral mortality events and other important ecological changes in reef communities.

To understand how coral communities have changed over time we use reef cores collected at approximately 5m depth by a team of divers using a percussion coring technique. These cores can retrieve up to 3000 years of reef development.

Photos (from top): J. Zhao; T. Clark.

Research-user focus

The project will deliver outcomes that are useful to a range of stakeholders including local, State and Australian Government bodies, the tourism sector and conservation planners/managers. Specific research-users include the Department of Sustainability, Environment, Water, Population and Communities, the Great Barrier Reef Marine Park Authority and the Queensland Department of Environment and Heritage Protection.

Project Partners:

The University of Queensland Australia · James Cook University Australia · TropWATER Centre for Tropical Water and Aquatic Ecosystem Research · Australian Government Great Barrier Reef Marine Park Authority · The University of Western Australia Achieving International Excellence

Find this project at www.nerptropical.edu.au
Theme 1: Assessing ecosystem condition and trend
Program 1: Historical and current condition of the GBR
Project: 1.3

For more information about this project, contact:
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National Environmental Research Program · Australian Government Department of Sustainability, Environment, Water, Population and Communities · Reef & Rainforest Research Centre

NERP Tropical Ecosystems Hub Project Factsheet

Targeted surveys for missing and endangered rainforest frogs in ecotonal areas, and assessment of whether populations are recovering from disease

Project leaders: Dr Robert Puschendorf & Dr Conrad Hoskin (JCU)

Project summary

This project will survey dry forest sites that border rainforest in the Wet Tropics and Eungella regions for missing and endangered frogs and other vertebrates.

This project will also:

- Determine if and how threatened frogs are recolonising upland rainforest sites where they once occurred.
- Determine if the few minute populations of Northern Tinker-Frog (*Taudactylus rheophilus)* recorded after disease outbreaks have persisted.
- Provide management recommendations and a list of critical dry forest refuges for critically endangered rainforest frogs, and areas of importance for other vertebrate species.

Why this research is needed

Outbreaks of amphibian chytrid fungus in the late 1980s and early 1990s resulted in the disappearance of ten frog species from the upland rainforests of the Wet Tropics and Eungella in central Queensland. This is a significant loss, representing 25% of the frogs endemic to the Wet Tropics and all of the Eungella endemics. The recent discovery of the presumed extinct Armoured Mist frog (*Litoria lorica*) in high elevation dry forest close to rainforest sites, and the discovery that this population is co-existing with the chytrid fungus suggests that there is a high probability that other missing frog species may well exist in dry forests bordering rainforests.

Research-user focus

This project will facilitate conservation and management by local, state and Australian Government bodies, EPBC, Wet Tropics Management Authority (WTMA), Terrain NRM, Australian Wildlife Conservancy (AWC) and others.

Research Provider

JAMES COOK UNIVERSITY AUSTRALIA

Armoured Mist frog (*Litoria lorica*)

Adeline falls, Mt. Windsor

Photos: Robert Pushendord & Conrad Hoskin

Outcomes

This project will assist in determining:

- Whether the 'extinct' frogs of the Wet Tropics and Eungella are indeed extinct.
- Whether the dry forest/rainforest border areas of the western Wet Tropics and Eungella harbour overlooked populations of these and other critically endangered species.
- How widespread chytrid fungus is across the study regions and environments, and how frogs are currently coping with this threat.
- The value of peripheral areas for other Wet Tropics endangered vertebrates.

This project will contribute to the continuing conservation and management of Queensland's World Heritage listed rainforests.

Find this project at www.nerptropical.edu.au
Theme 1: Assessing Ecosystem Condition and Trend
Program 3: Condition and trends of North Queensland rainforests
Project: 3.3

For more information about this project, contact:
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National Environmental Research Program

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Reef & Rainforest RESEARCH CENTRE

NERP Tropical Ecosystems Hub Project Factsheet

Tracking coastal turbidity over time and demonstrating the effects of river discharge events on regional turbidity in the GBR

Project leader: Dr Katharina Fabricius (AIMS)

Project summary

Turbidity is a measure of water clarity that quantifies the amount of small particles suspended in the water, and is a fundamental environmental parameter influencing coastal marine ecosystems. Turbidity reduces the light needed for photosynthesis by corals and seagrasses, and suspended particles also transport nutrients, pollutants and diseases. Previous research based on 3 years of turbidity data collected from 15 inshore reefs by the Reef Rescue Marine Monitoring Program has shown that it can take several months for water clarity to improve after river floods. This project will analyse a 12-year data set to demonstrate the explicit link between variations in discharge (sediments and nutrients) from the major rivers in each Natural Resource Management (NRM) region adjacent to the Great Barrier Reef (GBR) and seasonal and annual variations in water clarity in the inshore GBR.

Why this research is needed

Quantification of the relationship between terrestrial run-off and turbidity is critical to demonstrate that water quality in the inshore GBR can be improved through improved land management in adjacent catchments. The new knowledge generated by this project will improve the scientific basis underpinning the Australian Government's Reef Rescue program, Reef Plan and the refinement of water quality targets. The project will also determine the spatial extent of declining water quality on the inshore GBR and allow validation and calibration of a Receiving Waters Model.

Research-user focus

Specified research-users include the Great Barrier Reef Marine Park Authority, Department of Sustainability, Environment, Water, Populations and Communities, Queensland Department of Premier and Cabinet, Queensland Department of Environment and Heritage Protection, Queensland NRM bodies adjacent to the GBR, the agricultural industry and WWF.

Satellite images will be used to determine spatial and temporal patterns in water clarity. Here a Modis satellite image taken on 10 February 2007, when moderate river floods reduced water clarity along the GBR coast.

High water clarity is important for healthy inshore coral reef ecosystems.

Photos (from top): Modis Imagery, processed by M. Slivkoff; K. Fabricius

Outcomes

- Specific quantitative relationships between river discharges and seasonal and annual variation in inshore water clarity on the GBR adjacent to each NRM region.
- Strengthened scientific basis for Reef Rescue and Reef Plan and the refinement of water quality targets.
- Data to assist validation and calibration of the Receiving Waters Model and a WQ Risk Analysis.

Project Partners:

Australian Government | Australian Institute of Marine Science | The University of Queensland Australia | James Cook University Australia

Find this project at www.nerptropical.edu.au
Theme 2: Understanding Ecosystem Function and Cumulative Pressures
Program 4: Water quality of the GBR and Torres Strait
Project: 4.1

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National Environmental Research Program | Australian Government Department of Sustainability, Environment, Water, Population and Communities | Reef & Rainforest Research Centre

NERP Tropical Ecosystems Hub Project Factsheet

The chronic effects of pesticides and their persistence in tropical waters

Project leader: Dr Andrew Negri (AIMS)

Project summary

Pesticides, and particularly herbicides from agricultural sources, have been detected in nearshore sites of the Great Barrier Reef (GBR) all year round. The actual impacts from these concentrations of herbicides is under debate and information on cumulative impacts is required. To address this, a series of experiments will examine how plants and corals are affected by herbicides in the water in conjunction with other stressors such as temperature, low salinity and low light. An important source of herbicides in coastal waters is flood plumes from river runoff. By creating experimental conditions similar to GBR flood plumes we will determine how long herbicides persist and how they are transformed as they travel into coastal waters.

Why this research is needed

We lack fundamental knowledge about the fate and persistence of herbicides on the GBR. There are few data to explain the extent to which sensitive tropical organisms such as corals, and especially seagrass, are affected by chronic exposure to herbicides combined with increased sea temperature and/or declines in salinity and light.

Research-user focus

Research knowledge from this project will contribute to Queensland and Australian Government policy development to protect the GBR from the effects of pollution and climate change. Data will inform Reef Rescue projects and Reef Plan and facilitate management of the GBR by the Great Barrier Reef Marine Park Authority (GBRMPA). Other research users include the Department of Sustainability, Environment, Water, Population and Communities, Queensland Department of Environment and Heritage Protection, Terrain NRM, Burdekin Dry Tropics NRM, Fitzroy Basin Association, Canegrowers and WWF.

NERP PhD student Phil Mercurio and Florita Flores prepare herbicides for persistence experiments.

Florita Flores and NERP PhD student Jonathan Craft collect seagrass from Gladstone.

Photos (from top): Phil Mercurio; Cecilia Villacorta Rath

Outcomes

- Threshold concentrations for chronic effects of herbicides on seagrass.
- An assessment of whether managing chronic herbicide exposures can protect seagrasses and corals from climate change pressures (e.g. thermal stress).
- Identification of half-lives of herbicides at multiple temperatures.
- Quantification of herbicide breakdown products and their potential toxicity.

Project Partners:

Australian Government | Australian Institute of Marine Science | The University of Queensland Australia | James Cook University Australia

Find this project at www.nerptropical.edu.au
Theme 2: Understanding Ecosystem Function and Cumulative Pressures
Program 4: Water quality of the GBR and Torres Strait
Project: 4.2

For more information about this project, contact:
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National Environmental Research Program | Australian Government Department of Sustainability, Environment, Water, Population and Communities | Reef & Rainforest Research Centre

NERP Tropical Ecosystems Hub Project Factsheet

Understanding diversity of the Great Barrier Reef: Spatial and temporal dynamics and environmental drivers

Project leader: Dr Glenn De'ath (AIMS)

Project summary

Our current knowledge of the mechanisms that affect diversity of plants and animals on the Great Barrier Reef (GBR) is minimal. This project will map the diversity of groups of organisms and environments of the GBR using existing long-term and large-scale data, and relate biotic diversity to spatial, environmental and temporal drivers. These relationships will be interpreted in the context of risk, zoning and management.

Why this research is needed

Over-simplified definitions of diversity have limited our understanding and precluded the capacity to relate diversity to complex environmental drivers. A new statistical model of diversity, called the multinomial diversity model, can relate change in diversity to multiple predictors and their interactions. The new model now allows us to address questions such as:

- How does diversity change over time?
- Do rates of change vary between regions?
- What are the projected levels of diversity for future years?

Research-user focus

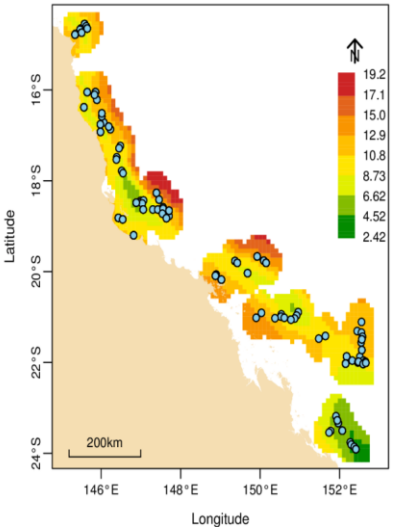
This project will address high priority research needs of local, state and Australian Government bodies by providing an increased understanding of the patterns and drivers of biodiversity over a large area of the Great Barrier Reef Marine Park. It will contribute to the 2014 Great Barrier Reef Outlook Report produced by the Great Barrier Reef Marine Park Authority (GRBMPA) and the Department of Sustainability, Environment, Water, Population and Communities.

Research Provider:

Australian Government | Australian Institute of Marine Science

Photo: Katharina Fabricius

A reef with high diversity of corals and fishes.



Mapping diversity of corals of the GBR. Diversity is estimated as the number of effective species and takes into account their relative abundances.

Outcomes

- Online interactive maps of the diversity of fishes, corals, other organisms and environments of the GBR.
- Quantification of changes in diversity in space and time for GBR organisms and environments.
- Identification of the main drivers of diversity on the GBR and greater understanding of how diversity changes in response to disturbances and threats.
- Diversity-based indicators of reef and seafloor condition.
- Assessment of the effects of the rezoning on diversity on GBR reefs and seafloor.

Find this project at www.nerptropical.edu.au
Theme 2: Understanding ecosystem function and cumulative pressures
Program 5: Cumulative impacts on benthic biodiversity
Project: 5.1

For more information about this project, contact:
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National Environmental Research Program

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Reef & Rainforest Research Centre

NERP Tropical Ecosystems Hub Project Factsheet

Combined water quality-climate effects on coral and other reef organisms

Project leader: Dr Sven Uthicke (AIMS)

Project summary

This project will use complementary laboratory and field experiments to investigate the combined impacts of declining water quality (increased nutrients and sediments, and reduced light and salinity), increased sea temperature and ocean acidification on key reef species groups such as corals, foraminifera, crown-of-thorns starfish and rock-boring sea urchins.

Why this research is needed

Increasing sea temperatures, ocean acidification and reduced water quality from terrestrial run-off are likely to significantly alter marine and coastal ecosystems over the next few decades. To date, research investigating the impacts of these threats has considered each threat individually, but their interactions and cumulative impacts are as yet poorly understood and potentially more damaging than each threat in isolation. The outcomes of this research will demonstrate how management of local stressors such as reduced water quality is critical to maintaining the resilience of coral reefs to global stressors (increasing sea temperatures, ocean acidification), which are more difficult to manage.

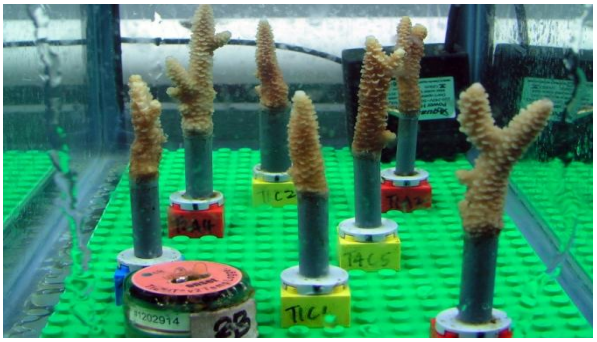
Research-user focus

Knowledge from this project will contribute to Queensland and Australian Government policies to protect the Great Barrier Reef (GBR) from the effects of climate change and declines in water quality. The outcomes of this project will inform Reef Rescue, Reef Plan and facilitate management of the GBR by the Great Barrier Reef Marine Park Authority (GBRMPA).

Research Provider:

Australian Government | Australian Institute of Marine Science

Aquarium setup for an experiment exposing corals, crustose coralline algae, foraminifera, biofilms and sea urchins to near-future CO_2 conditions.



Corals (*Acropora millepora*) in an experiment manipulating CO_2 and salinity. Corals are mounted on Lego blocks allowing access during physiological measurements.

Photos: Andrew Negri

Outcomes

- Quantification of changes in the tolerances of key reef species to global stressors (temperature increase, ocean acidification) due to increased local stressors, (increased nutrients, increased turbidity, decreased salinity).
- Greater knowledge of the individual and synergistic effects of declining water quality and global stressors on reproduction, larval development and settlement of key coral reef invertebrates (e.g. corals, echinoderms).
- Improved understanding of how changes in availability of carbonate in seawater as a result of ocean acidification will influence skeleton formation in calcifying reef organisms such as corals.

Find this project at www.nerptropical.edu.au
Theme 2: Understanding ecosystem function and cumulative pressures
Program 5: Cumulative impacts on benthic biodiversity
Project: 5.2

For more information about this project, contact:
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National Environmental Research Program

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Reef & Rainforest Research Centre

NERP Tropical Ecosystems Hub Project Factsheet

Vulnerability of seagrass habitats in the Great Barrier Reef to changing coastal environments

Project leader: Dr. Catherine Collier, JCU

Project Summary

Seagrass meadows are a vital habitat in tropical marine ecosystems. Along the coast they trap sediments and absorb contaminants which would otherwise pollute the Great Barrier Reef (GBR). Seagrasses are highly affected by water clarity and so are negatively impacted by run-off and other factors that increase turbidity (water cloudiness). This project will provide information about how seagrass responds to the interactive effects of different levels of light, nutrients and salinity and will contribute to the development of thresholds for the water quality parameters most likely to affect seagrasses.

Why this research is needed

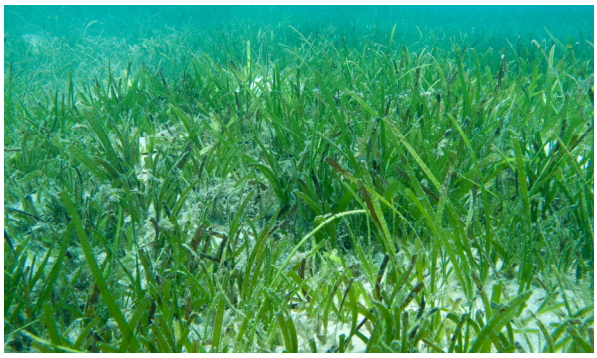
Apart from the direct impact of tropical cyclones, declines in seagrass abundance and distribution can be attributed to decreasing water quality, particularly caused by the direct and indirect effect of sediments carried by flood plumes. Research on the interactive effects of changing light, nutrients and salinity levels on seagrasses is required to establish water quality thresholds in order to effectively manage and conserve these essential GBR habitats. The outcomes of the research will also help with the interpretation of the cause of changes in seagrass abundance, and therefore, management priorities.

Research user focus

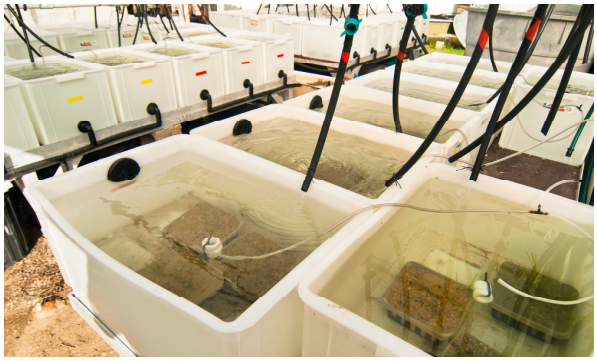
The outcomes of the project will be useful for state and Australian Government agencies, NRM bodies, NGOs, local government and industry, including fishing, mining and agriculture. Research users include the Great Barrier Reef Marine Park Authority (GBRMPA), DSEWPaC (particularly the Reef Rescue initiative), the Queensland Department of Environment and Heritage Protection, Queensland Department of Agriculture, Fisheries and Forestry, Reef Plan and Terrain NRM.

Research Provider:

JAMES COOK UNIVERSITY AUSTRALIA



Seagrass meadow at Green Island in the northern GBR.



Aquaria system used to experimentally test water quality impacts on seagrasses.

Photos: Catherine Collier

Outcomes

- Quantified level of exposure of seagrass meadows to broad-scale changes in water quality associated with flood plumes in GBR coastal regions.
- Improved knowledge of seagrass responses to the interactive effects of light, nutrients and salinity.
- Refined thresholds of concern for seagrass health, contributing to the development of water quality guidelines in relation to light, nutrients and salinity.
- Experimentally tested indicators of seagrass status adopted by the Reef Rescue Marine Monitoring Program (RRMMP) in response to changes in water quality.
- Improved understanding of likely future trends for GBR ecosystems, which will contribute to risk assessment reports for the GBR.
- Experimental verification of water quality response models.

Find this project at www.nerptropical.edu.au
Theme 2: Understanding ecosystem function and cumulative pressures
Program 5: Cumulative impacts on benthic biodiversity
Project: 5.3

For more information about this project, contact:
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National Environmental Research Program
Australian Government
Department of Sustainability, Environment, Water, Population and Communities
Reef & Rainforest RESEARCH CENTRE

NERP Tropical Ecosystems Hub Project Factsheet

Maximising the benefits of mobile predators to GBR ecosystems: the importance of movement, habitat and environment

Project leader: Dr Michelle Heupel (AIMS)

Project summary

This project will determine the movement and habitat use of large predatory fishes such as sharks and coral trout in reef and coastal environments of the Great Barrier Reef. Individual fish are fitted with acoustic transmitters that are detected by an array of acoustic monitoring stations. These monitoring stations record the presence and movement of fish between the coast and the reef, and between reefs. Predator presence and movement will be integrated with habitat mapping and environmental monitoring data to identify factors that lead to changes in movement patterns and to define any preferred locations or conditions that can be targeted for conservation or management.

Why this research is needed

Results of this research will inform managers about residency patterns of predatory fish, their movements between and preferences for various habitat types, and how these are related to the zones of the Great Barrier Reef Marine Park. This information is critical for balancing the competing demands of fisheries and ecosystem sustainability.

Research-user focus

The project will support the conservation and management of mobile predators by federal and state government bodies including the Great Barrier Reef Marine Park Authority (GBRMPA), the Department of Sustainability, Environment, Water, Population and Communities, the Department of Agriculture, Fisheries and Forestry, and the Queensland Seafood Industry Association.

Project Partners:

Red throat emperor fitted with an acoustic transmitter being released.

A tagged blacktip reef shark fitted with an acoustic transmitter.

Photos: Michelle Heupel

Outcomes

- Greater understanding of habitat use and the extent of movement of mobile predator species in coastal and reef ecosystems.
- Greater understanding of the factors that lead to changes in the residency and movement of mobile predators, such as habitat, developmental stage and environmental conditions.
- A more comprehensive understanding of the scale of daily and seasonal movements of marine predators in relation to marine park zoning and the efficacy of zones in providing protection to mobile predators.

Australian Government | Australian Institute of Marine Science | James Cook University Australia | Centre for Sustainable Tropical Fisheries & Aquaculture

Find this project at www.nerptropical.edu.au
Theme 2: Understanding Ecosystem Function and Cumulative Pressures
Program 6: Movements and habitat use by marine apex predators
Project: 6.1

For more information about this project, contact:
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National Environmental Research Program | Australian Government Department of Sustainability, Environment, Water, Population and Communities | Reef & Rainforest Research Centre

NERP Tropical Ecosystems Hub Project Factsheet

Drivers of juvenile shark biodiversity and abundance in inshore ecosystems of the Great Barrier Reef

Project leader: Dr Colin Simpfendorfer (JCU)

Project summary

This project is investigating changes in the biodiversity of sharks in inshore nursery areas along the Great Barrier Reef (GBR) coast. The aim is to understand how different factors, such as habitat, season, zoning and environmental parameters, such as discharge from rivers and streams, affect the abundance and diversity of sharks along the central GBR coast.

Why this research is needed

Sharks are facing increasing threats from fishing and other human activities. Inshore areas, which are important nursery areas for sharks, are also popular for fishing and are influenced by freshwater discharge from coastal streams and rivers. If shark populations are going to be sustainably managed into the future, a better understanding of the impact of these pressures on juvenile sharks and critical nursery habitats is required.

Research-user focus

Results from the project will be used to improve the information available to fisheries and marine park managers on the relative importance of inshore habitats, the role of areas closed to fishing and the sustainability of inshore shark populations. Research users include the Great Barrier Reef Marine Park Authority (GBRMPA), Queensland Department of Agriculture, Fisheries and Forestry, Queensland Department of Environment and Heritage Protection, and the Queensland Seafood Industry Association.

Research Provider:

JAMES COOK UNIVERSITY AUSTRALIA

Inshore waters are important nursery habitats for many shark species, including this Great Hammerhead that was tagged and released during nursery surveys.

PhD student Audrey Schlaff releases a juvenile blacktip reef shark fitted with an acoustic transmitter at Orpheus Island to study how changes in environmental conditions affect their movement patterns.

Photos (from top): Andrew Chin; Colin Simpfendorfer

Outcomes

Outcomes of the project will include reports on:

- The distribution of inshore shark biodiversity along the central GBR coast.
- Temporal changes in inshore shark biodiversity along the central GBR coast and the factors that drive these changes.
- The effects of environmental factors, such as salinity and temperature, on the movement, distribution and habitat use of juvenile sharks and implications for their conservation and management.

Find this project at www.nerptropical.edu.au
Theme 2: Understanding ecosystem function and cumulative pressures
Program 6: Movements and habitat use by marine apex predators
Project: 6.2

For more information about this project, contact:
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National Environmental Research Program
Australian Government
Department of Sustainability, Environment, Water, Population and Communities
Reef & Rainforest RESEARCH CENTRE

NERP Tropical Ecosystems Hub Project Factsheet

Fire and rainforests

Project leader: Dr Dan Metcalfe (CSIRO)

Project summary

Little is known about the impacts of fire on rainforest vegetation or the animals which depend on it. Fire can control vegetation regrowth after cyclones and help regeneration of eucalypt species, but it may also be important in determining succession in drier rainforest types. Fire also poses a threat to animals relying on forest canopy habitat or sheltering in fallen timber. This project will investigate the positive and negative impacts of fire on rainforest vegetation and wildlife.

Why this research is needed

The information generated by this project will help in developing management strategies that consider the environmental impacts of fire on the rainforest in the Wet Tropics. Particularly, it will provide an evidence-base to underpin policy in relation to managing fire on the margins of rainforest.

Outcomes

The project will provide new data about the problems posed and solutions offered by fire. This information will underpin future policy advice and rainforest management approaches. Specific outputs will include:

- Initial assessment and potential long-term monitoring of impacts of Tropical Cyclone Yasi on mahogany glider habitat, levels of rainforest invasion, and impacts of fire on new vegetation.
- Mapping, assessment of areas of greatest concern, and understanding of impacts of fire on littoral rainforest and coastal vine thickets of eastern Australia; and advice on management.
- Assessment of the likelihood of fire and its impacts on threatened Mabi rainforest.
- Identification of key criteria to be used in assessing where and whether expansion of rainforest is desirable, together with mapping and assessment of where critical impacts of fire may occur.

Research Provider:

Is Mabi forest understorey dry enough that fire will be carried through the litter layer? Wilting turkey bush (*Hodgkinsonia frutescens*) on Hallorans Hill, Atherton.

Photos: DJ Metcalfe

Blady grass (*Imperata cylindrica)* invading littoral rainforest after canopy stripping by Severe Tropical Cyclone Yasi at Yandalinga Beach. Do fires in littoral rainforests promote regeneration or change the direction of succession?

Research-user focus

The project will deliver outcomes that are useful to a range of stakeholder organisations including local and state government bodies and conservation planners and managers. Research-user organisations include the Department of Sustainability, Environment, Water, Population and Communities, the Wet Tropics Management Authority, Terrain NRM and the Cassowary Coast Regional Council.

Find this project at www.nerptropical.edu.au
Theme 2: Understanding ecosystem function and cumulative pressures
Program 7: Threats to rainforest health
Project: 7.1

For more information about this project, contact:

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National Environmental Research Program

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Reef & Rainforest RESEARCH CENTRE

NERP Tropical Ecosystems Hub Project Factsheet

Invasive species risks and responses in the Wet Tropics

Project leader: Dr Helen Murphy (CSIRO)

Project summary

This project focuses on understanding the current and future risks and responses of invasive species in the Wet Tropics. The aim is to develop a strategic approach to pest management that considers the complexity of ecological processes involved with establishment and spread and takes account of the values and assets in the region. The project will contribute to the management of invasive plants and animals by providing prioritisation tools that align with existing regional pest management frameworks.

Why this research is needed

Pest management planning in the Wet Tropics is primarily based on knowledge about current pest distributions and risks. Land managers in the region have identified the need to also consider potential future risks in strategic planning, taking into account pathways of spread, climate change and emerging or sleeper weeds and pests. However, there is a gap in our understanding about how to forecast future risks and responses and how to integrate them in existing management planning. This research project addresses this gap and provides tools for pro-active and strategic management of pests, considering current and future risks and responses.

Research-user focus

The project will address high priority research needs of state and Australian Government agencies as well as providing information for conservation planners/managers. Research-user organisations include the Department of Sustainability, Environment, Water, Population and Communities, Biosecurity Queensland, Queensland Parks and Wildlife Service, the Wet Tropics Management Authority, Far North Queensland Regional Organisation of Councils and Terrain NRM.

Research Provider:

CSIRO

Stevia ovata along a powerline easement near Ravenshoe.

Collecting samples of invasive *Miconia calvescens*.

Photos (from top): Andrew Ford, CSIRO; Helen Murphy, CSIRO.

Outcomes

This project will improve understanding of how invasive species become established and spread in the Wet Tropics and identify strategic approaches for prioritising management activities at a regional scale, and allocating resources and effort on the ground.

Specifically, the project will identify:

- Networks of weed and pest animal spread throughout the Wet Tropics.
- Geographic areas and natural assets particularly at risk from invasive species
- Emerging weed threats in the Wet Tropics as a result of climate change.
- Strategic management options for minimising current and future impacts from invasive species.

The project has the potential to reduce the long-term cost of pest management in the Wet Tropics by forecasting future risks and responses and establishing pro-active and strategic management approaches for minimising future impacts.

Find this project at www.nerptropical.edu.au
Theme 2: Understanding ecosystem function and cumulative pressures
Program 7: Threats to rainforest health
Project: 7.2

For more information about this project, contact:
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National Environmental Research Program
Australian Government
Department of Sustainability, Environment, Water, Population and Communities
Reef & Rainforest Research Centre

NERP Tropical Ecosystems Hub Project Factsheet

Assessing the effects of management zoning on inshore reefs of the Great Barrier Reef Marine Park

Project leaders: Professor Garry Russ & Dr David Williamson (JCU)

Project summary

This project has provided convincing evidence that no-take marine reserves have significantly improved the status of fished species in the Great Barrier Reef Marine Park (GBRMP). The project has also established the basis for assessing the role of no-take marine reserve networks in protecting biodiversity, sustaining ecosystem goods and services and providing a buffer against natural disturbances, such as extreme weather events and the cumulative impacts of climate change.

Why this research is needed

Following major changes to the zoning of the GBRMP in 2004, a large number of no-take marine reserves were established. It is important for the Great Barrier Reef Marine Park Authority (GBRMPA) and fisheries managers to have accurate information describing the effects that this increase in the number and area of no-take reserves has had on biodiversity and fish populations in the GBRMP.

Research-user focus

The project will deliver important information for fisheries managers in Queensland and other states about the impact of no-take zones on target fish populations, as well as conservation planners/managers and tourism bodies. These research-user organisations include the GBRMPA, the Department of Sustainability, Environment, Water, Population and Communities and the Queensland Department of Agriculture, Fisheries and Forestry.

Project Partners:

JAMES COOK UNIVERSITY AUSTRALIA

ARC Centre of Excellence Coral Reef Studies

Diver conducting underwater visual surveys of reef fishes on the Great Barrier Reef.

A bar-cheek coral trout (*Plectropomus maculatus*) in the Keppel Islands, Great Barrier Reef.

Photos (from top): D. Williamson; P. Mantel

Outcomes

This project will provide a direct assessment of the ecological effects of multiple-use zoning on inshore reefs of the GBRMP. Long-term surveys of reef fish and coral communities within no-take reserves and in areas that have remained open to fishing will provide information on:

- The effects of no-take reserves on populations of both species that are fished and other non-fished species.
- Variations in structure of fish communities due to the reserves and natural disturbances.
- Structure and dynamics of marine species on the sea bed.
- Coral health, bleaching, incidence and severity of coral disease and coral predators.

Find this project at www.nerptropical.edu.au
Theme 3: Managing for resilient tropical systems
Program 8: Effectiveness of spatial management on the GBR
Project: 8.2

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National Environmental Research Program

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Reef & Rainforest RESEARCH CENTRE

NERP Tropical Ecosystems Hub Project Factsheet

Dynamic vulnerability maps and decision support tools for the Great Barrier Reef

Project leader: Dr Ken Anthony (AIMS)

Project summary

To support management of the Great Barrier Reef Marine Park, coral reef managers need decision support tools that can integrate physical and biological information at a variety of spatial and temporal scales. In this project we will construct vulnerability maps for the Great Barrier Reef (GBR) that combines our knowledge of ocean warming, hydrodynamics, ocean chemistry with ecological responses of coral reef organisms. By combining reef vulnerability maps with social and financial criteria reef managers can optimise management planning under different environmental scenarios.

Research-user focus

This project will facilitate coral reef conservation and management by Australian government bodies, particularly Great Barrier Reef Marine Park Authority and the Department of Sustainability, Environment, Water, Population and Communities.

Why this research is needed

One of the greatest challenges for management planning of the GBR is to understand how to best protect reef ecosystems from different types of threats. Developing research based tools for reef managers will help identify reef areas of potentially high resilience and sensitive areas that need extra protection.

Outcomes

- A novel, innovative framework for reef vulnerability assessments;
- The development of dynamic vulnerability maps for the GBR; and
- The project will help deliver resilience-based decision support for the GBR.

Research provider:

Australian Government | Australian Institute of Marine Science

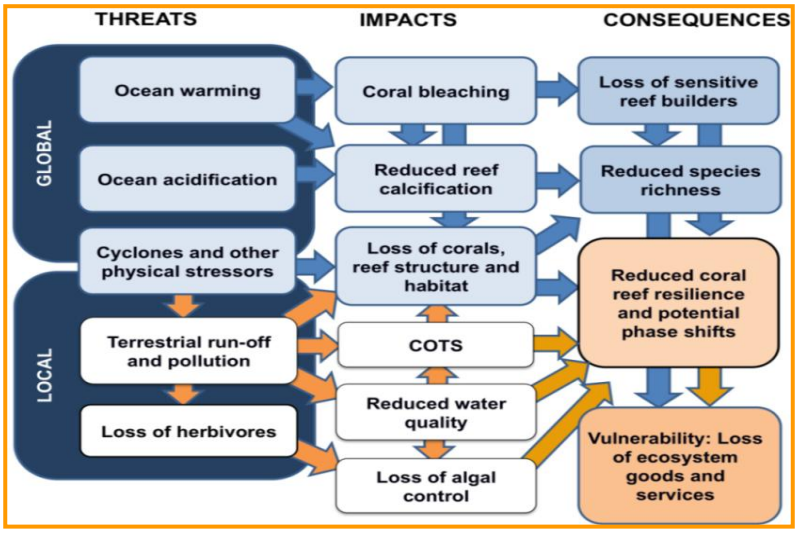

Fig.1 Linkages between global **drivers** (climate change, ocean acidification and partly storms) and local/regional drivers on the resilience and vulnerability of coral reefs. Anthony and Marshall 2012

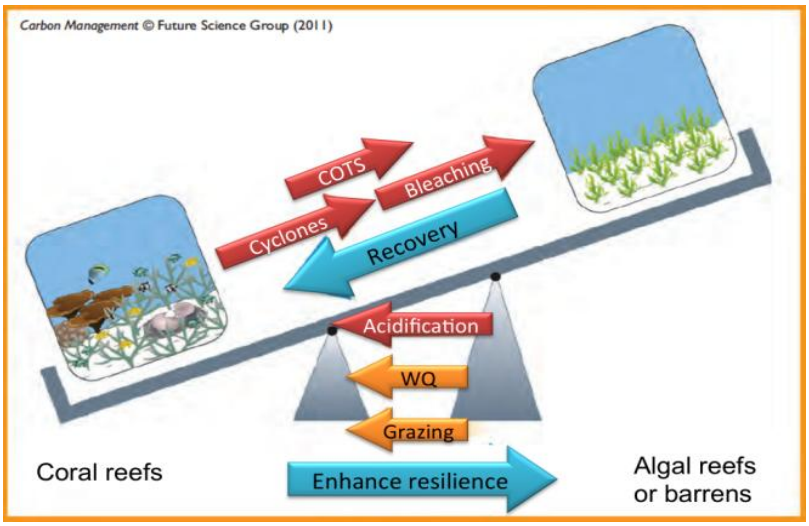

Fig. 2 Conceptual resilience model: managing disturbances such as the Crown-of-Thorns starfish supports reef resilience. Anthony and Marshall 2012 with thanks to John Bennett.

Find this project at nerptropical.edu.au
Theme 3: Managing for Resilient Tropical Systems
Program 9: Decision support systems for GBR managers
Project 9.1

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National Environmental Research Program

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Reef & Rainforest Research Centre

NERP Tropical Ecosystems Hub Project Factsheet

Design and implementation of Management Strategy Evaluation for the Great Barrier Reef inshore

Project leader: Dr Cathy Dichmont (CSIRO)

Project summary

This project will develop a Management Strategy Evaluation (MSE) framework to build understanding of the key human uses and drivers of change in the inshore Great Barrier Reef (GBR), and to inform GBR stakeholders of the likely consequences, costs and benefits of particular management decisions that aim to minimise the impacts on biodiversity, particularly from inshore multi-species fisheries.

Why this research is needed

The participatory approach used in the development of the MSE framework will build a common understanding of how the socio-economic and ecological components of the inshore GBR system function and interact, and will assist stakeholders to formulate management objectives. The resulting MSE framework will be used to identify which policies and practices have the potential to meet the stated objectives of stakeholders and to assess trade-offs between social, economic and environmental outcomes.

Research-user focus

The project will deliver outcomes that are useful to a range of stakeholder organisations including local, state and Australian Government bodies, the fishing and other sectors, and conservation planners/managers. These organisations include the Great Barrier Reef Marine Park Authority, the Department of Sustainability, Environment, Water, Population and Communities, the Queensland Departments of Environment and Heritage Protection and Agriculture, Fisheries and Forestry and the Queensland Seafood Industry Association.

Photos: State of Queensland, Department of Agriculture, Fisheries and Forestry; CSIRO.

Outcomes

- An understanding of the relative importance of different social, ecological, economic and governance objectives of each stakeholder group and for all stakeholders combined within the inshore GBR region.
- A qualitative model built using stakeholder input to develop a common understanding of the interactions between the various components of the inshore GBR system.
- Stakeholder driven development of alternative strategies for the management of the inshore GBR region.
- An assessment of the relative impacts of different management strategies compared with present management systems to provide clear direction about the pros and cons of different management strategies for the inshore region and their impacts on different stakeholder objectives.
- Management options aimed at biodiversity outcomes, focusing on inshore multi-species fisheries management.

Project Partners:

CSIRO | James Cook University Australia | Australian Government Great Barrier Reef Marine Park Authority | Queensland Government

Find this project at www.nerptropical.edu.au
Theme 3: Managing for resilient tropical systems
Program 9: Decision support systems for GBR managers
Project: 9.2

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NERP Tropical Ecosystems Hub Project Factsheet

Prioritising management actions for Great Barrier Reef islands

Project leader: Professor Bob Pressey (JCU)

Project summary

Managers of the Great Barrier Reef's (GBR) 900 islands face difficult decisions when it comes to investing in conservation management. Where should they invest limited funds to achieve the best outcomes? This project aims to address this problem by developing a decision making framework for investing cost-effectively in management actions across the GBR islands.

Brown boobies at Gannet Cay.

Weeds on Magnetic Island.

Images: Malcolm Turner, GBRMPA

Why this research is needed

The GBR faces a number of pressures including climate change, invasive species, fishing, industry and tourism. In the face of these threats, environmental managers need a framework with specific objectives to guide their conservation investments.

Research-user focus

The project will deliver outcomes that are useful to a range of stakeholder organisations including state and Australian Government bodies, the tourism sector and conservation planners/managers. Research-user organisations include the Queensland Government, the Department of Sustainability, Environment, Water, Population and Communities and the Great Barrier Reef Marine Park Authority (GBRMPA).

Outcomes

Working closely with GBRMPA and the Queensland Government, this project will develop a cost-effective approach for prioritising management actions across GBR islands. The approach will be broad-based and include pest control, adjustment of fire regimes, biosecurity measures and monitoring. A decision-support tool with GIS capability will help managers to identify management priorities within and between islands.

Project Partners:

Australian Government | Australian Institute of Marine Science | Australian Government Great Barrier Reef Marine Park Authority

Find this project at www.nerptropical.edu.au
Theme 3: Managing for Resilient Tropical Systems
Program 9: Decision support systems for GBR managers
Project: 9.3

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NERP Tropical Ecosystems Hub Project Factsheet

Conservation planning for a changing coastal zone

Project leader: Professor Bob Pressey (JCU)

Project summary

Using a conservation planning approach, this project sets out to identify key priorities for protecting and restoring coastal ecosystems in the Great Barrier Reef World Heritage Area (GBRWHA). The work will take into account changing land use, expanding infrastructure and climate change.

Why this research is needed

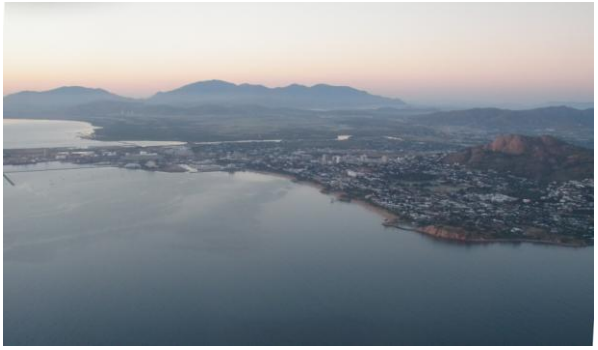
This project will address limitations of previous conservation planning research. It will take into account the dynamic nature of biodiversity and land uses. It will also consider the interactions between land and sea which are sometimes ignored in planning. The project will link cutting edge methods for conservation planning to analysis of governance and closely collaborate with stakeholders in multiple sectors.

Research-user focus

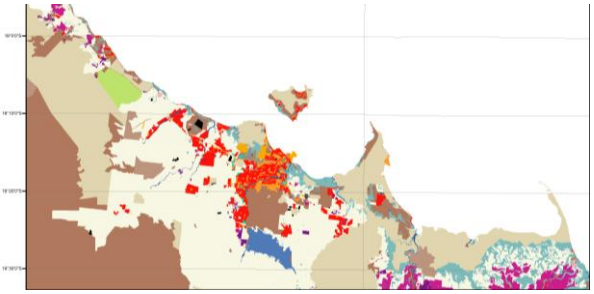
The results of this project will guide planners and managers in resolving trade-offs between conservation objectives for terrestrial, freshwater and marine environments. Research-users include the Department of Sustainability, Environment, Water, Population and Communities, the Queensland Department of Environment and Heritage Protection, Great Barrier Reef Marine Park Authority, the Association of Marine Park Tourism Operators, Traditional Owners, Reef Rescue, Terrain NRM and WWF.

Project Partners:

Australian Government | Australian Institute of Marine Science | ARC Centre of Excellence Coral Reef Studies



Example of a changing coastal zone in the GBRWHA: Townsville, Queensland. Spatially explicit decision-support tools can help resolve conflicts between goals.



Land use and habitat mapping are used to produce coastal development scenarios to determine alternative futures for the GBR coastal zone.

Images (from top): Amélie Augé; data from the QLUMP Project.

Outcomes

- Compilation of all available data on coastal ecosystems and their biodiversity patterns and processes and key socio-economic variables.
- Models of alternative futures for the coastal zone, considering climate change, change in land use and infrastructure and effects of land uses on water quality in the Great Barrier Reef lagoon.
- A set of goals for coastal ecosystems and their biodiversity patterns and processes and for development, access and use of the coastal zone.
- An assessment of the strengths and limitations of governance in the coastal zone, with insights into how governance can be better coordinated and recommendations on the feasibility and potential effectiveness of new instruments for management.
- Application of decision support tools to involve stakeholders in resolving issues over land and water use.

Find this project at www.nerptropical.edu.au
Theme 3: Managing for Resilient Tropical Systems
Program 9: Decision support systems for GBR managers
Project: 9.4

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National Environmental Research Program | Australian Government Department of Sustainability, Environment, Water, Population and Communities | Reef & Rainforest Research Centre

NERP Tropical Ecosystems Hub Project Factsheet

Social and economic long-term monitoring program

Project leader: Dr Nadine Marshall (CSIRO)

Project summary

This project will engage with stakeholders in the region to design and implement the initial stages of a long-term social and economic monitoring program. The program will provide information for coastal planners and managers about local and regional communities, traditional owners, marine tourism, commercial and recreational fishing, catchment industries, ports and shipping. The addition of a long-term social and economic monitoring program will augment existing long-term biophysical monitoring of the Great Barrier Reef (GBR) and increase the effectiveness of it s management .

Why this research is needed

Long-term social and economic monitoring helps reef managers understand the current status of marine park users, industries and communities. It also helps build a picture of how industries and communities are likely to respond and cope with changes associated with environmental degradation, climate change, regulatory frameworks, and changes in culture. It can also assist in evaluating the effectiveness of management interventions.

Research-user focus

This long-term program will provide a wealth of information for state and Australian Government agencies, conservation planners/managers, industry bodies, local communities and others. These groups include the Great Barrier Reef Marine Park Authority, the Queensland Seafood Industry Association, the Association of Marine Park Tourism Operators, the Fisheries Research and Development Corporation, Queensland Department of Environment and Heritage Protection, Queensland Department of Agriculture, Fisheries and Forestry, Tourism Queensland and the Queensland Parks and Wildlife Service.

Fishing family in Innisfail.

Grazier from the Burdekin

Photos: N. Marshall, CSIRO

Outcomes

Outcomes of the project include:

- Providing GBR management and industries with better access to social and economic information necessary for planning purposes.
- Strong liaison with GBR stakeholders on the social and economic status of the region.

Project Partners:

CSIRO

JAMES COOK UNIVERSITY AUSTRALIA

GREAT BARRIER REEF foundation

Find this project at www.nerptropical.edu.au
Theme3: Managing for Resilient Tropical Systems
Program 10: Socio-economic value of GBR goods and services
Project: 10.1

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National Environmental Research Program

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Reef & Rainforest RESEARCH CENTRE

NERP Tropical Ecosystems Hub Project Factsheet

Socio-economic systems and reef resilience

Project leader: Dr Natalie Stoeckl (JCU)

Project summary

The Great Barrier Reef (GBR) is famous for its spectacular coral, rich biodiversity and natural beauty. However, none of these important assets are bought or sold in the marketplace, so none are explicitly 'valued' with a price. Recognising that absence of price does not mean absence of value, this project seeks to improve our understanding of these non-market 'values' to a variety of different stakeholders. How important are pristine beaches, iconic marine mammals or healthy coral reefs to the community, tourists and the tourism industry? How would people feel if some of these 'values' were degraded (e.g. if water clarity declined, or if fish were less abundant)?

Photo: GBRMPA

What a great catch!

Why this research is needed

Today's business leaders and policy makers need information that helps them deal with complex problems affecting those living in and around World Heritage Areas. They may need to answer questions such as:

•Would residents be happier, and/or would more tourists come to the region if there were more opportunities to enjoy a region's non-market values?

•What losses would different stakeholder groups suffer if development eroded some of the region's values?

The project will provide vitally important information that will help people in and around the GBR answer questions such as these. It will also help to improve methods for assessing non-market values which can be used throughout the world.

Photo: Matt Curnock

Exploring the deep blue

Research-user focus

The project will deliver outcomes that are useful to a range of stakeholders including local, state and Australian government bodies, the tourism sector and environmental managers. Identified research users include the Great Barrier Reef Marine Park Authority, the Queensland Government, Tropical Tourism North Queensland, the Queensland Seafood Industry Association and the Alliance for Sustainable Tourism.

Outcomes

Information generated from this project will help research-users assess conservation, management and marketing priorities and to make predictions about the way in which changes in population and tourist numbers might affect those priorities.

JAMES COOK UNIVERSITY AUSTRALIA

Australian National University

AQUAENERGIELLC

Australian Government
Great Barrier Reef Marine Park Authority

Find this project at nerptropical.edu.au
Theme 3: Managing for Resilient Tropical Systems
Program 10: Socio-economic value of GBR goods and services
Project: 10.2

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National Environmental Research Program

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Reef & Rainforest RESEARCH CENTRE

NERP Tropical Ecosystems Hub Project Factsheet

Governance, planning and the effective application of emerging ecosystem service markets: climate change adaptation and landscape resilience

Project leader: Dr Allan Dale (JCU)

Project summary

This project will work with a range of stakeholders to identify the most effective governance systems for managing climate change adaptation in the Wet Tropics through the emergence of new ecosystem service markets. The project will directly contribute to:

- Regional climate change adaptation policies and planning processes.
- Regional Natural Resource Management (NRM) organisations' role in guiding emerging carbon markets in Australia and the region.

Photos (from top): CSIRO Image library; Suzanne Long

Why this research is needed

Emerging carbon farming legislation is driving the need for new arrangements to guide carbon-based and other ecosystem services markets. In the face of climate change, we need to better understand how we can better integrate landscape planning with biodiversity conservation to take advantage of these markets. The project will provide stronger regional partnerships and knowledge to guide these emerging ecosystem services markets and build capacity within the region to capitalize on these markets.

Research-user focus

The outcomes of the project will be useful to a range of stakeholder organisations including regional NRM bodies and state and Australian Government agencies. Research-users include Terrain NRM, Cape York Peninsula NRM, Wet Tropics Management Authority, the Department of State Development, Infrastructure and Planning, Far North Queensland Regional Organisation of Councils and the Department of Sustainability, Environment, Water, Population and Communities.

Outcomes

This project will deliver tangible benefits that will:

- Result in higher-quality regional NRM plans over the next three years.
- Guide the emerging ecosystem services market
- Build capacity within the region to mobilise access to this market.
- Contribute to national and state policy on NRM planning and ecosystem services markets.

Research Provider:

JAMES COOK UNIVERSITY AUSTRALIA

Find this project at www.nerptropical.edu.au
Theme 3: Managing for Resilient Tropical Systems
Program 12: Managing for Resilience in Rainforests
Project: 12.4

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National Environmental Research Program

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Reef & Rainforest RESEARCH CENTRE

NERP Tropical Ecosystems Hub Project Factsheet

e-Atlas

Project leader: Dr Eric Lawrey (AIMS)

Project summary

The e-Atlas is a website, mapping system and set of data visualisation tools for presenting research data in an accessible form that promotes greater use of this information. The e-Atlas will serve as the primary data and knowledge repository for all NERP Tropical Ecosystems Hub projects, which focus on the Great Barrier Reef, Wet Tropics rainforest and Torres Strait. The e-Atlas will capture and record research outcomes and make them available to research-users in a timely, readily accessible manner. It will host meta-data records and provide an enduring repository for raw data. It will also develop and host web visualisations to view information using a simple and intuitive interface. This will assist scientists with data discovery and allow environmental managers to access and investigate research data.

Why this research is needed

Existing research data is often underused. Much of it is not readily accessible or else not in a form useful for potential end-users, limiting the ability for science to inform environmental decision making and policy development, or inform the wider community. By providing a data catalogue and repository, the e-Atlas will ensure the knowledge gained is safely stored and made accessible, encouraging collaboration and knowledge sharing. In addition, by providing a web-accessible mapping system and a set of data visualisation tools, the e-Atlas is able to display a wide variety of spatial data, ensuring broad discoverability and easy comprehension.

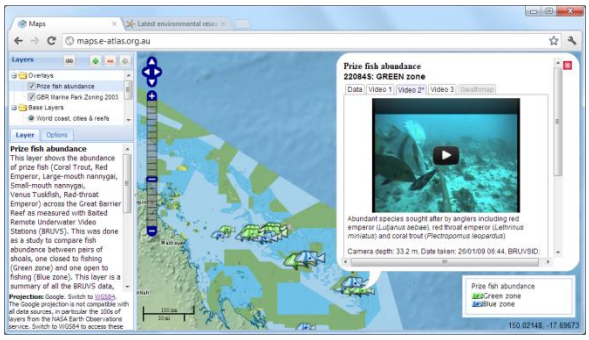
Research-user focus

The e-Atlas will deliver timely, rich content that will communicate research outcomes from the NERP TE Hub to government, scientists, community groups and the general public.

Project Partners:

Australian Government | Australian Institute of Marine Science | CSIRO

Find the latest research data and all existing content through the front page of the e-Atlas website.



Preview and investigate a wide range of research data through the e-Atlas mapping portal.
Map data: BRUVS (AIMS), Zoning (GBRMPA)

Outcomes

- Maintain existing content on the e-Atlas website www.e-atlas.org.au.
- Develop new content from NERP TE Hub projects, to ensure projects are documented and the data safely stored.
- Provide a catalogue of NERP TE Hub projects to Research Data Australia (meta-data records).
- Develop a Torres Strait e-Atlas for NERP TE Hub research as well as Torres Strait Regional Authority (TSRA) data holdings and priority historical Torres Strait research data.

Find this project at www.nerptropical.edu.au
Program 13: Knowledge Brokering and Communications
Project: 13.1

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