



National Environmental
Research Program
TROPICAL ECOSYSTEMS *hub*



Australian Government
Department of the Environment



NERP Tropical Ecosystems Hub

Program Highlights 2011-2014

Compiled by RRRC

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National Library of Australia Cataloguing-in-Publication entry:
978-1-925088-73-1

This report should be cited as:

Compiled by the Reef and Rainforest Research Centre (2015) NERP Tropical Ecosystems Hub Program Highlights 2011-2014 (68pp.).

Published by the Reef and Rainforest Research Centre on behalf of the Australian Government's National Environmental Research Program (NERP) Tropical Ecosystems (TE) Hub.

The Tropical Ecosystems Hub is part of the Australian Government's Commonwealth National Environmental Research Program. The NERP TE Hub is administered in North Queensland by the Reef and Rainforest Research Centre Limited (RRRC). The NERP Tropical Ecosystem Hub addresses issues of concern for the management, conservation and sustainable use of the World Heritage listed Great Barrier Reef (GBR) and its catchments, tropical rainforests including the Wet Tropics World Heritage Area (WTWHA), and the terrestrial and marine assets underpinning resilient communities in the Torres Strait, through the generation and transfer of world-class research and shared knowledge.

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This publication is available for download from the NERP Tropical Ecosystems Hub website:
www.nerptropical.edu.au

May 2015

Foreword



The NERP (National Environmental Research Program) Tropical Ecosystems Hub was a regional research program that existed between July 2011 and December 2014. Its purpose was to find solutions for current issues of importance to three iconic environmental assets of North Queensland: namely the ecosystems and people of the Wet Tropics Bioregion, the Great Barrier Reef, and the Torres Strait.

The Tropical Ecosystems Hub was a collaborative research enterprise where major stakeholders (government agencies, natural resource managers, regional industries, non-government organisations, indigenous forums) partnered with researchers in choosing the questions and interpreting the meaning of the results. Every project was required to have a clear pathway to practical or policy outcomes and the Hub operations placed a high premium on communication among the partners.

This document showcases the investment decisions through brief descriptions of 38 research projects and 16 dedicated knowledge-brokering projects. It also includes a description of the eAtlas, which is a unique knowledge repository intended to be an enduring legacy of the NERP TE Hub.

In each geographic region, the Hub supported research across the same broad spectrum from biophysical perspectives to aspects of the relevant social and economic systems. There is something in the program for everyone.

Although the space available in this overview does not allow full description, all projects delivered results of relevance to their intended targets. In the case of the Great Barrier Reef, this relevance was evidenced by uptake of many projects into major reports produced for or by the Queensland and Australian Governments (e.g. 2013 Scientific Consensus on GBR Water Quality, Reef Plan 2013, Outlook Report 2014, two Strategic Assessments in response to referrals under the EPBC Act 1999). In the Torres Strait, updated population assessments of turtle and dugong populations have laid the path for community discussions and bilateral consultation with Papua New Guinea about modifying the boundaries of a critical sanctuary area. In the Wet Tropics Bioregion, the identification of biodiversity hotspots and areas with high resilience to climate change has influenced the acquisition of new properties for Queensland's network of national parks. In addition, some projects produced tools, community training, or guidelines that have strengthened regional capacity for monitoring, management, and governance. A significant number of projects also produced original knowledge that is being published in the international scientific literature including some examples of results at the cutting edge of disciplines.

The overall result has been a highly successful program with a strong portfolio of environmental and social research characterised by diversity, creativity, productivity and applicability. I am proud to have been associated with all participants and their wonderful achievements.

Peter Doherty
Science Leader



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Acronyms

AFMA	Australian Fisheries Management Authority	JCU.....	James Cook University
AIMS	Australian Institute of Marine Science	LGAQ	Local Government Association of Queensland
ARC	Australian Research Council	LTMP	Long-term Monitoring Program
ATH	Australian Tropical Herbarium	MODIS.....	Moderate Resolution Imaging Spectroradiometer
COTS.....	Crown-of-Thorns Starfish	MTSRF	Marine and Tropical Sciences Research Facility
CSIRO	Commonwealth Scientific and Industrial Research Organisation	NERP.....	National Environmental Research Program
DATSIMA ...	Department of Aboriginal and Torres Strait Islander and Multicultural Affairs	NGO	Non-Governmental Organization
DFAT.....	Department of Foreign Affairs and Trade	NQ.....	North Queensland
DNA	Deoxyribonucleic Acid	NRM	Natural Resource Management
DoE	Department of the Environment	OA.....	Ocean Acidification
DSITIA.....	Department of Science, Information Technology, Innovation and the Arts	PARS.....	Pest Adaptation Response Strategy
EPBC.....	Environment Protection and Biodiversity Conservation	PNG.....	Papua New Guinea
ERA	Ecological Risk Assessment	PSII	Photosystem II
FNQROC	Far North Queensland Regional Organisation of Councils	P2R	Paddock to Reef
GBR.....	Great Barrier Reef	QPWS	Queensland Parks and Wildlife Service
GBRMP	Great Barrier Reef Marine Park	RAP	Rainforest Aboriginal People
GBRMPA.....	Great Barrier Reef Marine Park Authority	RDA.....	Regional Development Australia
GBRWhA ...	Great Barrier Reef World Heritage Area	RRRC	Reef and Rainforest Research Centre
GGA.....	Greenhouse Gas Abatement	SELTMP	Social and Economic Long Term Monitoring Program
GOC	Government Owned Corporation	TE.....	Tropical Ecosystems
GU.....	Griffith University	TSRA.....	Torres Strait Regional Authority
IMOS	Integrated Marine Observing System	UQ.....	University of Queensland
IPCC	Intergovernmental Panel on Climate Change	WQIP	Water Quality Improvement Plan
IUCN.....	International Union for Conservation of Nature	WTMA.....	Wet Tropics Management Authority
		WTWhA	Wet Tropics World Heritage Area

National Environmental Research Program

The Australian Government's National Environmental Research Program (NERP) delivered applied public good research. The overall objective of the program was to improve capacity to understand, manage and conserve Australia's unique biodiversity and ecosystems through the generation of world-class research and its delivery to Australian environmental decision makers and other stakeholders.

The NERP built on the knowledge gained from the Commonwealth Environment Research Facilities program, and focused more specifically on biodiversity and improving research delivery to the Australian Government, other research-users and stakeholders.

NERP funding was allocated for biodiversity research and delivered information that the Australian Government needed to better inform environmental management, policy and decision making, both in the short-term and into the future. This included understanding how ecosystems function, monitoring their health, maintaining and building their resilience, using them sustainably and exploring how to better use markets to protect biodiversity. The program attracted \$68.5 million in funding over four years to provide first-class science essential for sustainably managing Australia's environment. The NERP was conducted through five research hubs:

- Tropical Ecosystems
- Environmental Decisions
- Northern Australia
- Landscapes and Policy
- Marine Biodiversity

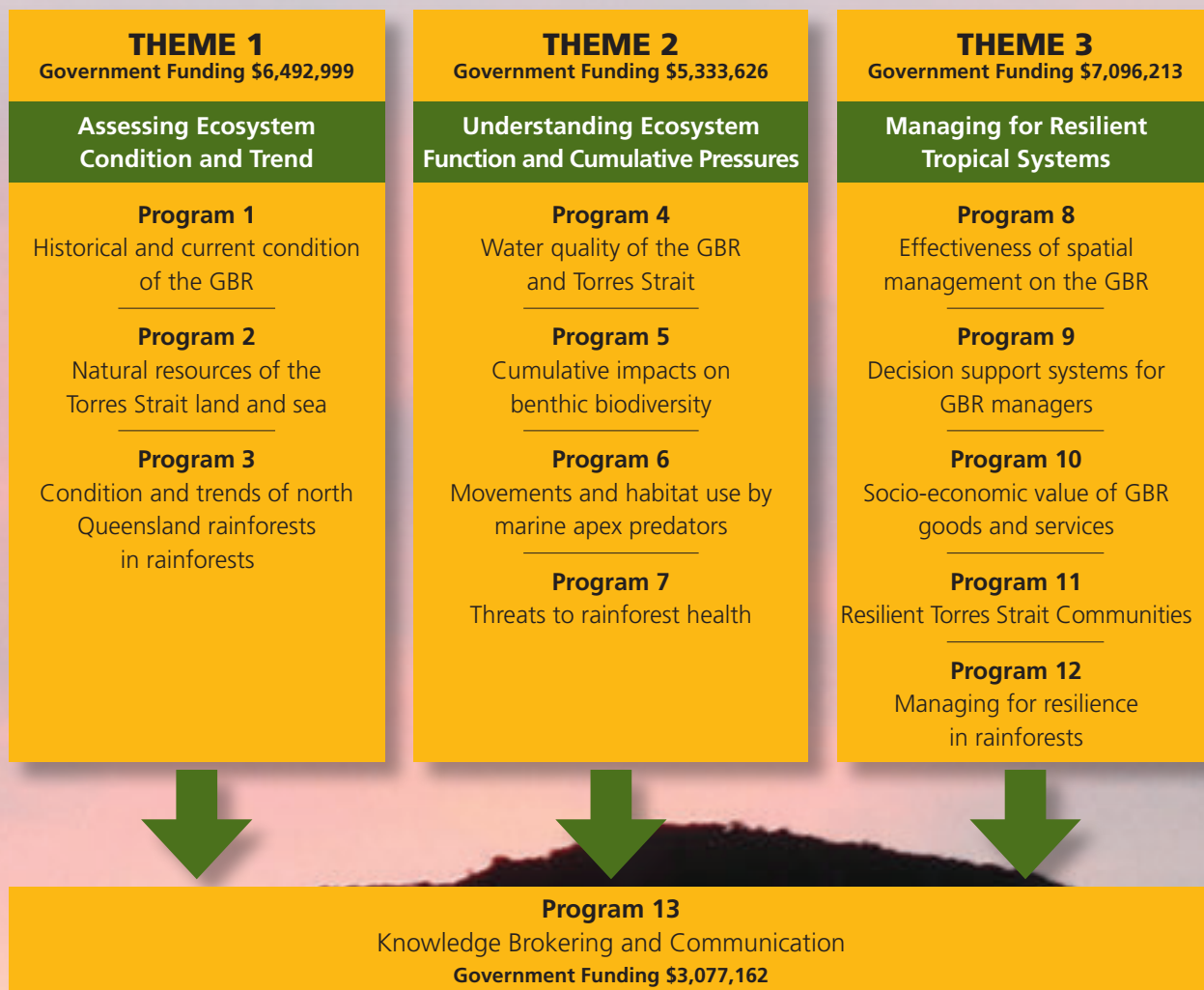
Tropical Ecosystems Hub

The largest of the Hubs, Tropical Ecosystems (TE) was a partnership between research providers with on-ground presence in Queensland, particularly AIMS, CSIRO, JCU, UQ and other research providers and research-users, including government agencies (Federal, State), statutory authorities (GBRMPA, TSRA, WTMA), Natural Resource Management bodies, conservation NGOs, regional industries, Indigenous communities and the general public.

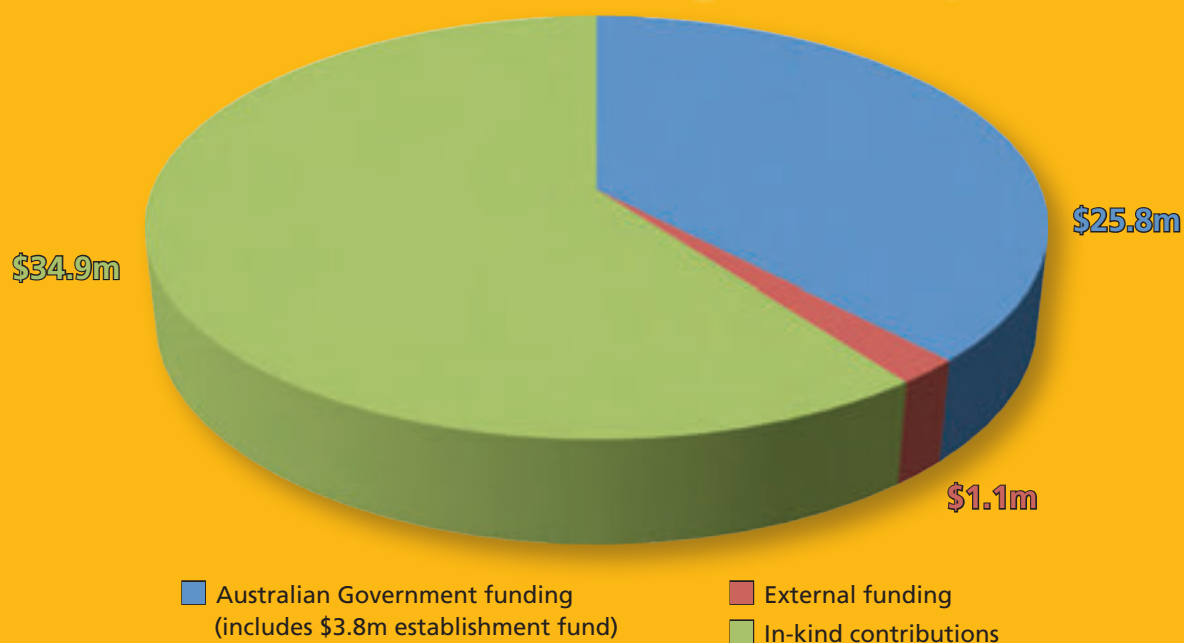
The Tropical Ecosystem Hub addressed issues of concern for the management, conservation and sustainable use of the World Heritage listed Great Barrier Reef (GBR) and its catchments, tropical rainforests including the Wet Tropics World Heritage Area (WTWHA), and the terrestrial and marine assets underpinning resilient communities in the Torres Strait, through the generation and transfer of world-class research and shared knowledge.

The Hub had a matrix structure of three themes and twelve programs designed to deliver the Hub goals on a thematic and geographical basis. While the themes directly addressed the Hub goals, the program structure enabled effective aggregation at the specific ecosystem scale. Table 1 outlines the themes and programs of the Hub.

Themes and programs of the NERP TE Hub



Value of the NERP TE Hub to north Queensland - \$61.8 million



Theme 1

Assessing Ecosystem Condition and Trend

A clear understanding of the ecological condition and trends of environmental assets of the Great Barrier Reef, the Torres Strait, and the Wet Tropics rainforest is fundamental to ecologically sustainable use of these assets by industry and communities, supported by appropriate management and policy settings. Theme 1 is comprised of three inter-related Programs, each of which concentrates on a specific component of north Queensland's natural and cultural heritage, and delivers reports on the condition and trend of key ecosystems and natural living resources.



Hugh Sweatman



Helene Marsh



Mark Hamann



Jian-xin Zhao



John Pandolfi



Norm Duke



Damien Burrows



Ray Berkelmans



Scott Bainbridge



Steve Williams



Darren Crayn



Conrad Hoskin



Robert Puschendorf



Dave Westcott



Program 1: Historical and current condition of the Great Barrier Reef

Program Leader: Professor John Pandolfi, UQ

Program 1 had three projects assessing the condition and trend of Great Barrier Reef assets. Two of these concerned temporal changes in coral communities: one over timescales of the last 100-200 years and one based on current monitoring of approximately 100 coral reefs representative of the whole system. The latter provided a synoptic view of coral cover and continues a time series that started in 1986. Over 20 years, these surveys have shown that the two main sources of coral mortality are predation by crown-of-thorns starfish and physical damage by severe tropical cyclones. The surveys have also captured the dynamics of recovery and shown the importance of connectivity to upstream spawning sources. The historical project used modern radioactive dating methods to search for temporal shifts in abundance and/or community composition among coral death assemblages. Broad-scale directional change was taken as evidence for changing environmental conditions and was considered to be able to date the recent decline in water quality in some inshore sections of the GBR. The third project continued to monitor the distribution, abundance, and ecology of iconic marine species of high conservation concern, notably dugong, marine turtles, and coastal dolphins. This information directly supported the management of these vulnerable species and was critical to the issue of indigenous use.

Project 1.1: Monitoring status and trends of coral reefs of the GBR

Project Leader: Dr Hugh Sweatman, AIMS

The AIMS Long-term Monitoring Program collected information on the dynamics of coral reef communities and the status and trends in the condition of reefs across much of the GBRWHA. The project surveyed coral reef fishes and benthic organisms in permanent sites in a standard habitat on 47 reefs every second year. At the same time, coral cover and crown-of-thorns starfish numbers on the perimeters of reefs are assessed using manta tow. Survey reefs were selected to account for biophysical gradients from north to south and between the Coral Sea and the Queensland coast. Since its inception in the mid-1980s, the program has documented the southward progress of three waves of starfish outbreaks, numerous other instances of local disturbance from storms, bleaching and coral disease as well as the extent of recovery of coral reef communities and the widely-reported long-term decline of coral cover on GBR reefs. The program provides the GBRMPA with situational awareness of changes and emerging threats across a large area of the GBR Marine Park and provides important input to the GBR Outlook Report that is produced every five years.

Project 1.2: Marine wildlife management in the Great Barrier Reef World Heritage Area

Project Leaders: Professor Helene Marsh and Dr Mark Hamann, JCU

This project focused on a) connectivity and ecosystem role of green turtle and dugong and b) gathering information on the distribution of inshore dolphins of the northern GBRWHA. The purpose of the research was to provide information for the conservation of these species. Following a negotiation and engagement phase between JCU and partner organisations: Girringun Aboriginal Corporation and the Yintjingga Aboriginal Corporation, a range of extension materials and activities relating to the Inshore Dolphin and Dugong project were successfully completed and delivered. This included ArcGIS maps (from the Participatory Mapping Workshop), conference posters, newsletters, presentations, merchandise, a junior ranger art workshop, and a short film/documentary. Dolphin surveys with Lama Lama Rangers (Yintjingga) indicated that humpback dolphins were sighted more often in the Lama Lama sea country than other areas of northern Australia. The Bathurst Heads region of Princess Charlotte Bay is a likely important habitat for snubfin dolphins. Tracking of dugong and green turtles revealed that dugong undertake individual, often wide ranging movements and thus have larger home ranges and thus protection of high quality dugong habitat will also benefit green turtles. The dugong aerial survey of the northern GBR revealed that relative abundance, relative density and percentage of calves were all lower than previous surveys since 2000.

Photo: AIMS LTMP

Photo: Scott Smithers and Steve Lewis (JCU)



Project 1.3: Characterising the cumulative impacts of global, regional and local stressors on the present and past biodiversity of the GBR

Project Leaders: Professor Jian-xin Zhao and Professor John Pandolfi, UQ

Much of our knowledge on the Great Barrier Reef (GBR) comes from spatially and temporally limited studies which hinders our ability to appropriately assess the current state of the reef. The objective of this large scale project was to provide a deep-time, baseline understanding of changes in ecological and environmental condition across the entire length of the inshore GBR. Using palaeo-ecological and –environmental approaches combined with precise geochemical techniques, we provide millennial scale histories of reef development from Cape Grenville in the north to Hervey Bay in the south, with evidence for recent changes in coral community composition in the central region of the GBR attributable to dramatic land use changes since European settlement (c. 1850 AD). Using highly precise U-Th dating methods we have been able to constrain the timing of changes in coral community composition with precisions of up to ± 1 yr, allowing us to pinpoint the likely cause for mortality. The many outcomes from this research are invaluable to reef managers by extending their knowledge of reef dynamics beyond marine monitoring programs, assisting with identifying the timing and drivers of change, as well as the reasons behind the lack of recovery at many inshore reefs.



Top: Clown fish on coral reef at Poruma (Coconut) Island

Middle: JCU PhD candidate Emma Ryan identifying fossil microatolls to sample for sea-level reconstruction at Middle Island, Edgumbe Bay

Bottom: Dugong herd



Program 2: Natural resources of the Torres Strait land and sea

Program Leader: Professor Helene Marsh, JCU

Program 2 had three projects assessing the condition and trend of Torres Strait assets. One project provided information on marine turtles and dugongs that complements the study of these species on the GBR including data on movements and connectivity of populations. Aerial surveys were conducted to estimate abundance as the importance of healthy stocks to Torres Strait communities cannot be overestimated. A second project introduced baseline surveys of mangrove communities and freshwater habitats on Torres Strait islands. The former is important in shoreline stabilisation and as a littoral habitat. The latter provides potential stepping stones for invasive freshwater species from Australia's northern neighbours and represents a long term threat to the freshwater faunas of Cape York and elsewhere in northern Australia. The third project designed and implemented a reef health monitoring program that was delivered by indigenous sea rangers and initiated monitoring of sea temperatures through a combination of remote sensing and real-time monitoring. The latter was requested by the TSRA following the first account of widespread coral bleaching in the Torres Strait in 2010.



Photo: Tristan Simpson

Project 2.1: Marine turtle and dugongs of Torres Strait

Project Leaders: Professor Helene Marsh and Dr Mark Hamann, JCU

The project aimed to improve knowledge on the distribution, abundance and status of marine turtles and dugong in Torres Strait, focusing primarily on dugong, green turtle and flatback turtles. Following standard techniques for surveying dugong the project completed aerial surveys for dugong and green turtles in Torres Strait. Results indicated that the dugong population in western Torres Strait is large and there are no signs of decline. The project then tested the ability of the dugong aerial survey to quantify the abundance of green turtles. The data indicates there are around 400,000 large green turtles in Torres Strait. Seven nesting beach surveys of green turtle were completed in Torres Strait. Both Maizub Kaur and Dauar Island receive between 100 and 3,000 females per year. Turtles have high nesting success and although sample sizes are small it appears that hatchling production is above 50%. The project completed four trips to Warul Kawa to determine the status of flatback turtle nesting. It was found that black rats are impacting turtle nests and eradication programs were begun. Satellite tracking revealed that turtles nesting at Warul Kawa use habitat in PNG and migrate to foraging areas from central Torres Strait to the Kimberley Coast of Western Australia.

Photo: TropWATER

Project 2.2: Mangrove and freshwater habitat status of Torres Strait islands

Project Leaders: Dr Norm Duke and Dr Damien Burrows, JCU

This project explored the condition and biodiversity values of mangrove and freshwater wetlands on 20 Torres Strait islands. The 35 mangrove species found included new records for Queensland and Australia,

Photo: Scott Bainbridge



Top: Green Turtle in the Torres Strait



Middle: Working with a ranger in the mangrove wetlands



Bottom: Maizab Kaur (Bramble Cay) monitoring station

and twice the previous recorded diversity. Most species were already recognised by traditional owners who shared their local language names. Field surveys conducted with TSRA rangers assessed mangrove status, causes of disturbance, local benefits, carbon storage and responses to shoreline change. Data were compiled in a geo-referenced database of aerial imagery of ~500 km of shoreline and wetlands for the 20 islands. The project also measured quantitative metrics for vegetative structure, condition and drivers of change; with notable similarities between islands. Field observations and aerial imagery enabled identification of key processes of change, from direct human disturbances to evidence of other notable drivers. For example, on several islands, mangrove vegetation appears to have responded to rising sea levels. Freshwater wetlands were limited in extent but the project increased the known fish fauna from 31 to 49 species. New records for freshwater turtles and crabs were documented, as was the spread of an Asian freshwater fish – climbing perch – that are now widespread and abundant on the two northerly islands: Saibai and Boigu.

Project 2.3: Monitoring the health of Torres Strait coral reefs

Project Leaders: Dr Ray Berkelmans, CSIRO and Dr Scott Bainbridge, AIMS

There is a dearth of scientific information about the reefs of the Torres Strait, including their biodiversity, current state, and susceptibility to pressures such as thermal stress. The project undertook reef surveys to document the biodiversity and status of reefs in the eastern Torres Strait. It also developed sophisticated satellite temperature products to complement deployed real-time and logged ocean monitoring sensors to understand and predict the risk of thermal stress on corals. The reef surveys recorded 245 species of coral and 301 species of fish including new records for the Torres Strait. The surveys showed that reefs are in a healthy condition with high coral cover, presence of major taxonomic and functional groups, and minimal incidence of coral disease. Minor outbreaks of crown-of-thorns starfish were observed. The ocean monitoring stations and satellite data showed cooler than average sea temperatures over the study period reflecting global weather patterns. As a result no coral bleaching was predicted or observed during the project. A draft coral reef monitoring plan was produced that describes a long-term monitoring program utilising local capacity for the Torres Strait. Regular monitoring, combined with real-time ocean and satellite data, will provide key information for the management of Torres Strait reefs.

Program 3: Condition and trends of north Queensland rainforests

Program Leader:

Professor Steve Williams, JCU

Program 3 had four projects focused on biodiversity drivers of Queensland's Wet Tropics rainforests, particularly rainforest refugia and hot spots of genetic diversity in the World Heritage Area and adjacent Cape York regions. The Program delivered species distribution models and composite biodiversity maps using long term data sets to describe patterns of environmental change. The Program also searched for remnant populations of critically endangered frogs and monitored the abundance of key vertebrate species such as the Cassowary and the Spectacled Flying Fox. Results from Program 2 has contributed to State of the Environment and World Heritage reporting for the Wet Tropics World Heritage Area, and provided information to assist the development assessments under the EPBC Act 1999.

Project 3.1: Rainforest Biodiversity

Project Leader: Professor Steve Williams, JCU

The biodiversity assets of the Wet Tropics are declining and under severe threat from future climate change. Long-term monitoring within this project demonstrated that the distributions and population sizes of many vertebrate species have already declined with many species contracting uphill (e.g. 50% bird species and all ringtail possums). Predictive modelling of both current and future species distributions was further improved using the latest IPCC climate models (improving estimates of relative vulnerability and resilience of species) and then validated by testing against historical climate change. Project data suggests that 88% of the species of rainforest vertebrates will be severely threatened by 2085 under future climate unless significant progress is made on reducing global emissions. Spatial prioritisation analyses using both current and future species distributions have delineated the most important places in the region for conservation both now and into the future in order to inform the prioritisation of management actions. Outputs from this research have already produced significant changes and outcomes in policy and management within the region (restoration projects and inclusion in WTMA policy and planning), across Queensland (Landscape Resilience Program for acquisition of conservation areas) and nationally (inclusion in a suite of protected area and climate change policy and planning instruments). This project has increased our understanding of the factors that drive biodiversity patterns, affect the resilience of species and landscapes and provides a comprehensive, region-wide evaluation of the status and trends in biodiversity and climate.

Project 3.2: What is at risk? Identifying rainforest refugia and hotspots of plant genetic diversity in the Wet Tropics and Cape York Peninsula

Project Leader: Dr Darren Crayn, ATH

Australia's north-eastern rainforests are noted for the diversity of plants and fungi representing key stages in the evolution of life, particularly Gondwanan flora that once dominated this continent. Poorly understood, however, is the spatial distribution of this botanical evolutionary history, and the threat that climate change poses to it; the knowledge that is critical for effective management. This project used genetic analysis and species distribution modelling to locate hotspots of evolutionary diversity, and predict their fate under future climate scenarios. The results confirm that two areas – the Daintree lowlands, and the Tully headwaters/southern Atherton tablelands – are hotspots of evolutionary diversity, meaning that the species they contain are not just many in number, but representative of many diverse evolutionary lineages. Mountains above 1000m elevation harbour unique biomes with many Gondwanan lineages, being



Photo: Gary Wilson

refugia for lineages that evolved during cooler, wetter periods of Australia's history. While our evolutionary diversity analyses showed these to be outside the highest diversity areas, modelling analyses suggest devastating impacts from climate change. By 2080, the habitat of 19 species of plants found only on these mountain tops will have mostly disappeared. Contrary to previous thinking, this research shows that the biodiversity of the mountain tops is among the most threatened of the Wet Tropics.

Top: Rainforest ants have been collected in soil and leaf litter samples by S. Nowrouzi at sites at Mt Lewis. Ants are preserved in ethanol as they fall through the Winkler Sacs

Bottom: *Mycena sp. fungi* collected during surveying

Project 3.3: Targeted surveys for missing and critically endangered rainforest frogs in ecotonal areas, and assessment of whether populations are recovering from disease

Project Leaders: Dr Conrad Hoskin and
Dr Robert Puschendorf, JCU

In the 1980s and early 1990s a frog disease, chytrid fungus, spread through the Wet Tropics and decimated populations of some frog species. Several species appeared to have gone extinct, while others persisted in certain areas, like the lowlands or as tiny populations in the mountains. It was noticed that some of these endangered rainforest frog species appeared to be surviving well in dry forests adjacent to rainforest, including the only known population of the Armoured Mistfrog (*Litoria lorica*). These observations drew attention to the potential importance of peripheral areas around the Wet Tropics – hotter, drier habitats on the western margin of the Wet Tropics rainforest and isolated patches of rainforest around the periphery of the Wet Tropics. This NERP project investigated these areas and found: 1. Several endangered frog species are indeed persisting better in peripheral areas than in 'core' rainforest areas, 2. These populations are persisting despite high prevalence of chytrid, probably due to the hotter temperatures, 3. There is evidence for recovery of frog populations in some areas, 4. A reintroduction of *Litoria lorica* requires continued monitoring to determine whether a second wild population of this critically endangered species will establish, 5. A number of new species in peripheral areas, were described during this project, and 6. Peripheral areas are vital to the long-term resilience of the Wet Tropics bioregion.

New boulder frog found at Cape Melville



Photo: Conrad Hoskin

Adult Cassowary



Juvenile Cassowary



Photos: Dave Westcott

Project 3.4: Monitoring of key vertebrate species

Project Leader: Dr David Westcott, CSIRO

This project focused on providing baseline monitoring data on two of the regions key threatened species, the Southern Cassowary and the Spectacled Flying-fox. Both species are the subject of conservation concern and to varying extents are the foci of conflict over management needs. At the core of these debates is the question of their status and population trends. In the case of the Southern Cassowary there was no current data and in the case of the spectacled flying-fox there was the need to continue data collection in order to describe population trends. The project estimated the abundance and distribution of the Southern Cassowary using a combination of field surveys and non-invasive DNA fingerprinting. Cassowaries were found across the region with the greatest abundance in the large forest tracts of the central Wet Tropics. The estimated population is 4,300 individuals in the region. The research suggests that the population has remained relatively stable since the 1988 surveys and highlights the need to monitor the Cape York population. Monthly Spectacled Flying-fox monitoring shows a long-term trend of population decline at a rate of c. 4-6% per annum. Examination of the monthly data however suggests that this may in part be a function of animals moving in and out of the population. The research suggests that while it is still too early to be certain about the trend, treating it as a real decline until we can be certain, is sensible.

Theme 2

Understanding Ecosystem Function and Cumulative Pressures

Theme 2 built on research undertaken through the MTSRF and other programs that have identified many of the primary risks and threats to the environmental assets of North Queensland. These pressures do not occur in isolation to each other and it was clear that a greater understanding of the cumulative and synergistic impact of these pressures is required for improved management. These pressures are not static therefore predicting and preparing for change was a significant challenge for environmental decision makers charged with stewardship of Queensland's natural environment. Changing climates, extreme natural events, changes in natural resource use and population growth are some of the pressures facing these ecosystems. Theme 2 was comprised of four Programs that would increase the understanding of ecosystem function and the impact of synergistic and cumulative pressures on the system. This understanding was essential in developing effective management responses that promote ecosystem resilience.



Britta Schaffelke



Katharina Fabricius



Andrew Negri



Jon Brodie



Rai Kookana



Glenn De'ath



Sven Uthicke



Catherine Collier



Michelle Heupel



Colin Simpfordorfer



Brad Congdon



Dan Metcalfe



Helen Murphy



Justin Welbergen



Program 4: Water quality of the Great Barrier Reef and Torres Strait

Program Leader: Dr Britta Schaffelke, AIMS

Program 4 had four projects assessing risks to biodiversity from current water quality in the inshore Great Barrier Reef and another desktop hazard study for water quality outlook in the Torres Strait. The latter concerned flood plumes from the Fly River, one of Papua New Guinea's largest rivers, which regularly reaches the eastern margins of the Torres Strait. Significant expansion of mining activity forecast in PNG's western province was considered to result in new threats to the water quality of the region but the hazard assessment also concerned local declines in water quality near home islands affected by erosion and run-off. The GBR projects focused on two components of terrestrial runoff discharged into coastal receiving waters. One project measured the transport and settlement of fine sediments carried by river plumes and subsequently resuspended by winds. The new knowledge sought to understand impact of these processes on light availability to benthic communities. A second project established the half-lives of common agricultural chemicals in the marine environment and studied the impacts on biodiversity of chronic low-level exposure to these pollutants. This information contributed to the Reef Water Quality Protection Plan (Reef Plan) and was designed in consultation with the Reef Rescue Program. The final project was a methodological pilot study recommending how to conduct a formal risk analysis of the threats from multiple stressors in water quality that would be used to prioritise future investment decisions in the catchments (i.e. what is the relative risk from sediments, excess nutrients, and contaminants?).

Project 4.1: 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

Water clarity is a key parameter affecting the health of coastal marine systems and their tourism values. The project investigated the relationship between discharges of major rivers and the water clarity in the GBR waters of the Fitzroy, Whitsundays, Burdekin, Wet Tropics and Cape York NRM Regions. The project used daily 11-years (2002-2013) MODIS-Aqua remote sensing data at 1 km² resolution, to investigate time scales and processes affecting water clarity in these regions. In all coastal, inshore and lagoonal regions except for Cape York, photic depth was strongly negatively related to the freshwater discharge of the main rivers. The declines started with the onset of river floods, and water clarity typically took 150–260 days until complete recovery. The relationship between photic depth and rivers was strongest in the Northern Wet Tropics, the initiation area of outbreaks of crown-of-thorns starfish, where effects were strong even on the outer shelf. Previous conclusions that river runoff predominantly affects the inshore of the GBR have therefore had to be revised for the Central and Northern GBR. The results were used in the setting of regional ecologically relevant targets for fine sediment in the Burnett-Mary and Wet Tropics WQIPs, and will likely be used for other WQIPs.

Project 4.2: The chronic effects of pesticides and their persistence in tropical waters

Project Leader: Dr Andrew Negri, AIMS

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 have been under debate with little information on the impacts of cumulative pressures on GBR ecosystems, with a particular focus on seagrasses. This project has examined the effects of 8 PSII herbicides on up to 5 species of seagrass. The effects of the herbicides on photosynthesis were performed in standard acute tests, chronic flow-through tests and finally in the last 6 months miniature assays were developed for rapid toxicity assessment. These phytotoxicity data is now able to contribute to the development of new water quality guidelines and to assess the protection afforded to seagrass by the current guidelines. The sensitivity of seagrass to herbicide exposures increased at both high and low temperatures and high and low light levels, indicating that the cumulative effects of multiple pressures may increase risks posed by herbicide exposure under certain flood-plume conditions. In addition, this project developed a new method to accurately measure seagrass growth and successfully applied this method to chronic herbicide-exposed plants.

Project 4.3: Ecological Risk Assessment for the GBR

Project Leader: Jon Brodie, JCU and
Dr Rai Kookana, CSIRO

This project developed a robust methodology for an ecological risk assessment (ERA) of nutrients, fine suspended sediments, and pesticides to the GBR ecosystems for use by resource managers, including industry groups, Australian Government, Queensland Government and regional natural resource management bodies. The project reviewed existing methodologies and synthesised available data that could be used in a proposed risk assessment. The project was designed to fit with timelines for Reef Rescue 2013 and Reef Plan 2013. Liaison with research users adopted existing structures such as the Reef Partnership Committee, the Independent Science Panel, and the Paddock to Reef (P2R) Coordination and Advisory Group. Project outcomes include: the selection of a systematic, objective and transparent approach to assess the relative ecological risks posed by nutrients, pesticides and suspended sediments to GBR ecosystems; a guaranteed approach which will give more usable and much more robust results than the previous approaches; and direct engagement with strategic stakeholders.



Photo: NASA, processed by Matt Slivkoff

MODIS-Aqua Image of the Burdekin Region during a moderate flood discharge event (10th February 2007)

Project 4.4: Hazard assessment for water quality threats to Torres Strait marine waters, ecosystems and public health

Project Leader: Jon Brodie, JCU

The Torres Strait marine environment is of national and international significance. The project undertook a qualitative assessment of water quality threats on the Torres Strait region using previous studies, analysis of remote sensing imagery, a new 3D hydrodynamic model and island site inspections. The conclusions were that the current hazards to the environmental values of the region from water quality are relatively minor, and are specific to local areas. However, a number of important future threats were identified. Most importantly, the potential hazards from the transit of large ships through the region, including oil or chemical spills and groundings, are of greatest concern. Large-scale development in Papua New Guinea including gas platforms, oil palm expansion and port development may also be significant. Project recommendations for monitoring and/or addressing these potential impacts include measurement of the influence of the Fly River through analysis of remote sensing imagery and heavy metal analysis using water quality loggers, oysters and artificial bivalves at locations across the region. This study is the first regional hazard assessment of water quality risks and provides guidance for managers to make decisions regarding the relative importance of pollutant sources from local to regional scales.

Sewage outfall pipeline on Erub Island (8 August 2011)



Photo: Jane Waterhouse

Program 5: Cumulative impacts on benthic biodiversity

Program Leader:

Dr Katharina Fabricius, AIMS

Program 5 had three projects designed to assess the impacts of cumulative pressures on coastal biodiversity in the GBR. One was a synthesis and analysis of spatial and temporal patterns of inshore biodiversity seeking to partition the influence of different environmental drivers (water quality, crown-of-thorns starfish, cyclones, and connectivity) and identify synergistic interactions between stressors. The other two projects were multi-factorial experiments exposing corals and seagrasses to different combinations of stressors in order to incorporate cumulative hazards into quantitative risk models.

Project 5.1: Understanding diversity of the GBR: spatial and temporal dynamics and environmental drivers

Project Leader: Dr Glenn De'ath, AIMS

There is increasing concern about anthropogenic risks to the GBR, including mortality of the reef-building corals due to rising seawater temperatures, water pollution from terrestrial runoff and dredging, destructive fishing, over-fishing, and coastal development. Coral reef degradation is a world-wide problem, yet specific causes of regional-scale decline and options to assist recovery have rarely been identified. Based on an extensive time series data on reef condition (AIMS LTMP: 2258 surveys of 214 reefs over 1985-2012), the project has shown a major decline in coral cover from 28.0% to 13.8% (0.53% per yr); a loss of 50.7% of initial coral cover. Tropical cyclones, coral predation by crown-of-thorns starfish (COTS) and bleaching accounted for mortality of 1.42, 1.62 and 0.34% per year (42%, 48% and 10%) respectively, giving a mean total mortality of 3.38% per year. Given the estimated rate of decline of 0.45% per year for 1985-2011, the estimated net growth of coral cover was 2.93% per year for coral cover levels of 20%. Since this does not take into account any losses due to other agents (e.g. reduced calcification, diseases), this estimate can be interpreted as a lower bound of the increase in coral cover for the period 1985-2012. At the current rate of decline, coral cover will fall to 5.2% (CI=2.9%, 8.7%) by 2025.

Project 5.2: Combined water quality and climate effects on corals and other reef organisms

Project Leader: Dr Sven Uthicke, AIMS

Water quality affected by terrestrial runoff has significantly altered Great Barrier Reef ecosystems, especially on inshore reefs. Global stressors such as increasing temperatures and ocean acidification (OA) will increase pressure on reefs over the coming decades. Cumulative effects of these global and local stressors are poorly understood. Project 5.2 conducted over 15 experiments to assess individual and cumulative impacts of water quality, ocean warming and ocean acidification. The project assessed the effects of nutrients, salinity, turbidity/light/sedimentation, in combination with elevated temperature and OA induced stress. Organisms investigated included key species of corals, algae, seagrasses, foraminifera and echinoderms. In many cases, the combination of stressors showed additive effects, thus clearly suggesting that land-management can ameliorate impacts of climate change. Future work on cumulative impacts contributes to the development of measurable climate- and regionally adjusted water quality targets and cumulative impact guidelines. Results were included in the Scientific Consensus Statement, which was used in support of the revision of ReefPlan 2013. The consensus statement was used to inform various chapters of the GBR Strategic Assessment.

Project 5.3: Vulnerability of seagrass habitats in the GBR to changing coastal environments

Project Leader: Dr Catherine Collier, JCU

Floodwaters have low salinity, high nutrient concentrations (triggering “green water”), toxicants and both dissolved (“coloured water”) and particulate matter (“brown water”) that creates low light conditions. Flood plumes were detected using satellite imagery. Coastal seagrasses were exposed to brown water for ~20% and green water for ~50% of the wet season months (November to April) from 2005–2013. This flooding caused extensive seagrass loss throughout the GBR in 2009–2011. The project tested seagrass responses to flooding, starting with low salinity and found that these have broad hypo-salinity tolerance. Therefore, testing the effects of

low light (simulating muddy water or green water in flood waters) was prioritised. Seagrasses provide an early warning of light stress, including shoot loss and changes in nutrient and sugar content. The project also developed light thresholds that can be used to set water quality guidelines for seagrass meadow protection. All species required more light in summer temperatures compared to winter, and some species died quickly (<1 month) in low light while others were more tolerant (>3 months). This study has contributed to management outcomes, including identifying seagrass meadows at high risk of exposure to flood waters; developing new environmental thresholds for light and salinity; and confirmed indicator selection for long-term marine monitoring.

Collecting seagrass for experiments



Photo: Catherine Collier

Program 6: Movements and habitat use by marine apex predators

Program Leader:

Professor Colin Simpfendorfer, JCU

Program 6 had three projects designed to monitor the movements of apex predators in the GBRMP using widespread arrays of acoustic receivers installed and maintained by other funding programs (e.g. IMOS, ARC). One project focused on the movement and habitat use of large predatory fishes (e.g. sharks and coral trout) in reef environments. New knowledge about the scale of daily and seasonal movements established a minimum viable size for no-take areas to offer effective protection to these mobile animals. The second project focused on the movement and habitat use of coastal fish populations, with an emphasis on inshore shark populations. The latter are under considerable pressure from commercial netting and the study sought to identify critical habitats (e.g. juvenile shark nurseries) that may require higher levels of protection to ensure sustainable populations. The third project mapped the movements and habitat use of pelagic environments by foraging seabirds seeking an oceanographic explanation for the decline in seabird numbers observed in many breeding colonies.



Project 6.1: Maximising benefits of mobile predators to GBR ecosystems: the importance of movement, habitat and environment

Project Leader: Dr Michelle Heupel, AIMS

Concern about the status of reef predators is increasing around the globe. Understanding the efficacy of spatial management zones for predators within the Great Barrier Reef is crucial to successful management and conservation of these populations. This research examined the movement ecology of reef predator species to examine how much time was spent at individual reefs and within management zones. Data indicated that different species have different movement patterns resulting in some species receiving greater protection under current management arrangements than others. For example, most fish species were highly resident at a single reef indicating closure at a reef scale is protecting a portion of those populations. Some reef shark species, such as the grey reef shark, spent the majority of their time at a single reef, but did move between reefs indicating moderate protection for these slightly more mobile individuals. Several other sharks (e.g. bull, tiger, silvertip), moved widely between reefs and zones and appear to receive limited benefit from reef-based spatial management. These results indicate current marine protected areas will benefit some species more than others and that mobile species require additional management measures such as catch limits to ensure their populations remain viable.

Photo: Michelle Heupel

Project 6.2: Drivers of juvenile shark biodiversity and abundance in inshore ecosystems of the GBR

Project Leader: Professor Colin Simpfendorfer, JCU

Nearshore waters play important roles in the early life history of many shark species that live within the Great Barrier Reef Marine Park. This study examined spatio-temporal variation in the functioning of

Photo: Brad Congdon



Photo: Commons Wikimedia

Top: Blacktip reef shark

Middle: PhD student Mario Espinoza releasing a small grey reef shark

Bottom: Adult shearwater



nearshore areas to better understand their role in maintaining shark biodiversity and abundance. Seasonal surveys (dry, early wet and wet seasons) of sharks in five bays on the central GBR coast demonstrated the importance of these habitats for both juvenile sharks and the adults of some small shark species. The importance to individual species of sharks varied between bays, demonstrating that each bay played different roles, potentially leading to greater stability within shark populations due to portfolio effects. Environmental drivers such as salinity, turbidity and temperature appear to be the main reasons for differences in function between bays. There were significant differences in the abundance, size and community structure between survey locations open and closed to fishing, demonstrating that inshore protected areas are important for maintaining the biodiversity of sharks within the Great Barrier Reef. The sustainability of the shark take by the East Coast Inshore Finfish Fishery may be enhanced by the improved understanding of the role of nearshore areas for sharks generated by this project.

Project 6.3: Critical seabird foraging locations and trophic relationships for the GBR

Project Leader: Dr Brad Congdon, JCU

Effective management of seabirds on the GBR requires detailed information on foraging areas, resource use and links to oceanography. Without this information, it is not possible to identify or manage anthropogenic threats outside of nesting colonies. This study mapped core foraging areas for southern GBR seabirds at multiple spatial scales over a three-year period. When provisioning chicks, adults are restricted to near-colony foraging grounds (<200km). On longer self-provisioning trips some species routinely travel to distant foraging grounds in the Coral and Tasman Seas. Foraging success at all sites is linked to local upwelling driven by steep bathymetric change and large-scale fronts and eddies. Some near-colony foraging sites are also influenced by river outflows and associated small-scale fronts. Many important foraging sites are outside of the GBR management zone and foraging activity overlaps significantly with commercial fishing activity. When not breeding, GBR shearwaters are trans-equatorial migrants that overwinter in Micronesia in a region known globally for its commercial tuna catch. These results provide a basis for predicting how future climate variation and/or other anthropogenic stressors may influence breeding success. Importantly, it also demonstrates the dynamic nature of oceanic features that are important to these wide-ranging taxa.

Program 7: Threats to rainforest health

Program Leader: Dr Dan Metcalfe, CSIRO

Program 7 had three projects addressing different threats to rainforest health. A generalised analytical toolkit for assessing vulnerability to extreme climatic events, particularly the sensitivity of Wet Tropics fauna to temperature extremes, was developed. The role of fire as a driver of rainforest distribution (particularly on the threatened ecosystem of the Mabi forest) was determined. The Program also delivered maps of weed populations identifying sources of invasive propagules and rainforest areas that are particularly susceptible to invasion or re-invasion because of their connectivity to these source populations. This information is critical for invasive weed control programs, identifying high priority areas for control, and guiding surveillance. The Program also provided a qualitative and operational assessment of alternative management strategies for feral pig management.

Project 7.1: Fire and rainforests

Project Leader: Dr Dan Metcalfe, CSIRO

Rainforest habitat is typically thought of as rarely impacted by fire, or even at risk from fire resulting from human activities such as forest clearance and agriculture. These impressions largely stem from understandings of the impacts of fire in South-East Asia and South America, and it was proposed that in the continent of Australia where most vegetation burns naturally on a regular basis, fire may be less of a threat, and sometimes of benefit. Case studies considered three communities where fire appears to be a significant threat to rainforest (endangered littoral and coastal rainforest), where fire may be a valuable management tool to maintain rainforest resilience at a time of environmental change (endangered Mabi rainforest), and where fire is critically needed to exclude rainforest species from lowland woodlands which support the critically endangered Mahogany Glider. In all three cases, traditional ecological knowledge suggests that fire was a known management tool for thousands of years before European colonisation, and so reintroduction of traditional fire management approaches is likely to be beneficial to protecting and maintaining these vegetation types in the future.

Photo: Dan Metcalfe

Project 7.2: Invasive species risks and responses in the Wet Tropics

Project Leader: Dr Helen Murphy, CSIRO

The aim of this project was to assess current and future invasive species risks and responses in the Wet Tropics and provide managers with tools for prioritising management activities at a regional scale, and allocating resources and effort on the ground. The project has described the likely consequences of climate change for invasive species risks and responses in the Wet Tropics. Of particular note is that the interacting effects of increasingly intense cyclones and an increasing number and diversity of invasive species is likely to result in significant changes in the composition and structure of tropical forests. Among these likely changes are a decrease in diversity of native species, slower rates of forest succession, increasing degradation of forest fragments, and ultimately a decrease in ecosystem function. In the assessment of alternative strategies for managing weed invasions it was shown that while containment is commonly perceived as a valid fall-back option for when eradication has failed, many infestations are no more amenable to containment than to eradication. Crucially, there is a threshold invasion size below which it will be better to eradicate than contain, and above which the opposite is true. The project synthesised outcomes in the form of a Pest Adaptation Response Strategy (PARS). The PARS indicates in which parts of the landscape future investment is likely to need to increase in order to minimise future weed impacts, where it will need to remain stable, or where it may potentially decrease over time as the risk of spread or establishment is low.

Photo: CSIRO



Photo: CSIRO



Above: Field work in the rainforest

Left: Semi-deciduous Mabi rainforest on basalt

Bottom: Golden bowerbird



Project 7.3: Climate change and the impacts of extreme events on Australia's Wet Tropics biodiversity

Project Leader: Dr Justin Welbergen, JCU

It is widely recognised that knowledge of the relative vulnerability of biodiversity to extreme events is crucial for sound conservation action in the face of climate change. Tropical rainforests are the hotbed of the world's biodiversity. Yet the vulnerability of tropical biota to extreme events is largely unknown. Extreme heat events are of special concern because although the increase in temperature variability will be more pronounced at higher latitudes, tropical species may already be living closer to their maximum thermal tolerances. This project focused on all rainforest vertebrates of the Australian Wet Tropics. The team conducted the first quantitative assessment of the vulnerability of a suite of tropical biota to extreme heat events and integrated detailed information on the exposure and sensitivity of species to such events to model this vulnerability into the future. Outputs include high-resolution maps of exposure to temperature extremes experienced by organisms in-situ, as well as accurate estimates of the sensitivities of organisms to temperature extremes. In addition, the project identified the areas in the Wet Tropics where vertebrate biodiversity is most vulnerable ('thermal hotspots') and least vulnerable ('thermal refugia') to extreme heat events, both in the present and in the future. The value to managers is that the project provides spatially-explicit and species-specific foci for efficient conservation and habitat restoration management. Efficient management of the most vulnerable species and areas will improve the resilience of wildlife populations to the increasingly extreme temperature events that are expected in the Wet Tropics.

Theme 3

Managing for Resilient Tropical Systems

Research undertaken within Theme 3 provided knowledge and options to assist key decision makers in government, industry and the community in managing the complex ecosystems of the Great Barrier Reef, the Wet Tropics rainforest (including the World Heritage Area) and the Torres Strait. Theme 3 drew on the assessment of ecological condition and trends undertaken in Theme 1 and the improved understanding of ecosystem function and cumulative pressures from Theme 2. Theme 3 provided tools and information for evidence-based decision making that address the pressures and sustains resilient ecological, social and economic systems.



Hugh Sweatman



Garry Russ



David Williamson



Geoff Jones



Bob Pressey



Ken Anthony



Cathy Dichmont



Marcus Lane



Nadine Marshall



Natalie Stoeckl



James Butler



Sue Laurance



Ro Hill



Carla Catterall



Luke Shoo



Allan Dale



Program 8: Effectiveness of spatial management on the GBR

Program Leader: Dr Hugh Sweatman, AIMS

Program 8 had three inter-linked projects that tested the effectiveness of spatial management arrangements (differential use zones) for conserving exploited fish populations in the GBRMP. One project compared the abundance of fish, corals, and the incidence of coral disease between fringing reefs in the coastal zone that have been closed to fishing at different times in the past with adjacent areas that remain in use by the recreational fishing sector. A second project in the southern GBR applied genetic parentage analysis to estimate the recruitment subsidies to fished areas that are contributed by protected fish stocks spawning in no-take areas. The third project was started with the major rezoning of the GBR in 2004 and tracked a suite of biodiversity indicators across 26 closely matched pairs of reefs offering fished/unfished contrasts. Since these 52 reefs are spread through the mid-shelf from Cairns to Gladstone, this new design covered the area with the highest incidence of crown-of-thorns starfish outbreaks. The strong experimental design was the best chance yet to determine whether fishing has any impact on the frequency and/or severity of starfish outbreaks. If there was a positive association this would be further evidence that the starfish and its huge effect on coral cover may be unnatural and require further management intervention to restore the resilience of coral populations.

Project 8.1: Monitoring of ecological effects of the GBR zoning plan on mid and outer shelf reefs

Project Leader: Dr Hugh Sweatman, AIMS

The current zoning plan for the GBR Marine Park greatly increased the number of reefs that were closed to fishing when it came into effect in 2004. AIMS has monitored the effects of this major management action on offshore reefs by surveying pairs of similar neighbouring reefs where one reef in each pair was closed to fishing in 2004. Over the last 10 years, prevention of fishing has led to a general increase in the number and size (and hence the weight) of coral trout and other exploited species, though the extent of the change has been markedly greater in southern regions of the GBR and has fluctuated through time. Herbivorous fishes are not subject to fishing on the GBR and their numbers are similar on reefs that are open and those that are closed to fishing. Concerning possible indirect effects that closure to fishing has on other components of reef communities, there was no clear difference in coral cover or in the numbers of coral recruits or diseased coral colonies between open and closed reefs. There is an indication that reefs that are closed to fishing may be less likely to have outbreaks of crown-of-thorns starfish.

Photo: AIMS LTMP

Project 8.2: Assessing the long term effects of management zoning on inshore reefs of the GBR

Project Leader: Professor Garry Russ and Dr David Williamson, JCU

No-take marine reserves (green zones) are widely embraced as a tool for conserving biodiversity, enhancing ecosystem resilience and sustaining fisheries. In the Great Barrier Reef Marine Park (GBRMP), networks of green zones have been the cornerstone of management since the late 1980's. In this study, the ecological effects of green zones using underwater visual census to monitor fish communities on inshore reefs of the GBRMP between 1984 and 2014, and belt transects to monitor coral health in 2012 were assessed. Abundances of fishery-targeted species (eg. coral trout) have increased significantly on most green zone reefs, while populations on non-reserve reefs have remained relatively stable. In contrast, abundances of non-targeted fishes were similar between green zones and non-reserve reefs. Strikingly, coral diseases were two to seven times more prevalent on non-reserve reefs than within green zones. Although green zones can effectively increase populations of targeted fishes, enhance coral health, and protect biodiversity, they cannot prevent reef degradation from a range of acute and chronic disturbances such as cyclones, floods, and coral bleaching events, declining water quality and increasing sedimentation. These stressors must be addressed through effective coastal catchment and water quality management, as well as decisive global action on climate change.

Photo: Phil Woodhead



Project 8.3: Significance of no-take marine protected areas to regional recruitment and population persistence on the GBR

Project Leader: Professor Geoff Jones, JCU

It is well known that we can expect an increase in stocks of exploited fishes within marine reserves (green zones). It is hoped that reserves can also benefit fish stocks in a larger seascape, by supplementing fish populations in fished areas (blue zones) and promoting population connectivity and resilience across networks of reserves. However, the potential scale of larval dispersal sourced from adults in reserves has been hard to measure. In this study we used a new genetic parentage approach to directly measure larval retention within and dispersal among coral trout populations at three clusters of reefs separated by over 200km near the southern Great Barrier Reef. The project found high levels of coral trout larval exchange among reefs within regions (dispersal < 50km) and exchange between regions (50 – 250km). Large-scale connectivity appears to be multi-directional, but with net larval dispersal from south to north. Observed dispersal trajectories closely matched a biophysical model predicting larval dispersal of coral trout in the region. Although implementing reserves reduces the area available for fishing, our modelling suggests that in the long-term, increasing fish stocks in green zones provide a sufficient supply of juveniles to avoid recruitment overfishing and maintain fishery yield.



Top: Reef surveying

Left: A bar-cheek coral trout (*Plectropomus maculatus*) hunting with an olive sea snake (*Aipysurus laevis*). Bar-cheek coral trout are common on inner-shelf reefs of the GBR Marine Park and they are a primary target species of recreational fishers

Below: Sunset over Middle Island (foreground) and Great Keppel Island in the Keppel Island group, southern GBR Marine Park. The fringing coral reefs surrounding Middle Island have been protected within a no-take marine reserve (green zone) since the late 1980's



Program 9: Decision support systems for GBR managers

Program Leader: Professor Bob Pressey, JCU

Program 9 had four projects designed to develop new tools for GBR managers. One project developed methodology to allow managers to evaluate alternative management scenarios and choose between options. It focused on tools to assist in the management of the inshore region for biodiversity outcomes, particularly inshore multi-species fisheries management, using a stakeholder driven approach. A second project created vulnerability maps for coral reef communities and allowed managers to prioritise the conservation of subregions with high natural resilience to coral bleaching from extreme sea temperatures. A third project created a modelling framework suitable for exploring alternative futures for the coastal zone considering climate change, changes in land use and infrastructure, and the effects of land uses on water quality in the Great Barrier Reef lagoon. The fourth project developed a framework and tools to allow managers to prioritise investment decisions for the day-to-day management of GBR islands. In addition, drivers of visitor (tourism) usage, particularly relating to reef health and economic and social impacts of reef-related tourism to northern Queensland were assessed.

Project 9.1: Dynamic vulnerability maps and decision support tool for the GBR

Project Leader: Dr Ken Anthony, AIMS

The GBR is under pressure from multiple stressors ranging from coastal development and run-off to climate change and ocean acidification. Understanding which areas of the GBR can be made more resilient and allowed to persist under global and local pressures are high management priorities. This project has made two significant steps towards addressing those priorities: (1) The first model of spatial resilience and vulnerability of GBR corals under environmental change scenarios, and (2) tools to identify the most cost-effective management actions to sustain coral cover GBR-wide, regionally and locally. The project demonstrated that climate change is projected to be a significant pressure on the GBR as we approach year 2050, partly due to its global zone of influence. However, targeted local and regional actions can have positive flow-on effects on coral resilience. Specifically, strategic reductions in nutrient and sediment export from northern catchments combined with smart control of COTS at key source and sink reefs can lower GBR vulnerability. The project provides new decision support capability for reef managers and policy makers. Specifically, resilience analyses linked to scenarios, management options and environmental, economic and social objectives provided a clear and transparent process for effective decision support of The Reef 2050 Plan.

Project 9.2: Design and implementation of management strategy evaluation for the GBR

Project Leader: Dr Cathy Dichmont, CSIRO

Stakeholder engagement is important for successful management, both to make effective decisions and to obtain support. However, in the context of coastal management, questions remain on how to effectively link decisions made in the catchment with objectives for marine biodiversity and fisheries productivity. Moreover, there is much uncertainty on how to best inform and elicit community input in a rigorous manner. A decision support process is described that elicits management objectives, priorities and management options using two case studies. The case studies show that demand for local input and regional management is high. A big contributor to success is the provision of local information to the community group and embedding managers and influencers within the group. Of great value to positive outcomes were that scientists, managers and community members were prepared to work together. The project uncovered a conundrum that does challenge the effectiveness of management: there can be a significant gap between what managers think is happening or resulting from their actions and the perception of the community as to the effectiveness (and wisdom) of the management action(s). A semi-quantitative generic elicitation

framework that ultimately provides a prioritised list of management options in the context of clearly articulated management objectives for use by others was developed.

Project 9.3: Prioritising management actions for GBR islands

Project Leader: Professor Bob Pressey, JCU

Managers of Great Barrier Reef islands face difficult decisions when it comes to prioritising conservation management actions. The islands contain a wide variety of natural and cultural values, which face multiple and dynamic threats. The threats have to be managed within a fixed budget, using actions with varying levels of effectiveness and costs. Working closely with the Great Barrier Reef Marine Park Authority and the Queensland Government, the project has developed a prototype of a decision support tool. The information used to parameterize the tool is comprised of the best available information on species distributions, current island threats, management actions possible to mitigate threats and the cost and effectiveness of these actions. This tool will help managers to identify management priorities within and between islands. It allows managers to maximize conservation outcomes, defined by specific objectives for diverse natural features (native animal species, vegetation assemblages, breeding aggregations). The project delivers results that are useful to a range of stakeholder organisations including state and Australian Government bodies, the tourism sector, and conservation planners and managers. Research-user organisations include the Queensland Government, the Commonwealth Department of the Environment, and the GBRMPA.

Project 9.4: Conservation planning for a changing coastal zone

Project Leader: Professor Bob Pressey, JCU

Increasing development of the Great Barrier Reef coastal zone is inevitable in the coming decades. Development will increase shipping, intensive agriculture, urban development, and tourism. To inform management, planning, and policy, it is therefore necessary to assess potential scenarios of coastal development and their cumulative impacts on marine species and ecosystems. Along the Great Barrier Reef coastal zone, eight spatially-explicit scenarios of coastal development for 2035, covering land uses and related marine activities using Geographic Information Systems were produced. The range of 2035 scenarios incorporated uncertainty around demand for food, mineral resources, tourism, and environmental services, and took into account technical advances, preference for coastal living, and governance. The project used Bayesian belief networks with elicitation to capture both data and expert opinion on the related factors linking land-use changes in the coastal zone to impacts on specific marine species and ecosystems, taking account of related changes to water quality and activities in the Reef's lagoon. This approach provided a quantitative understanding of cause-and-effect relationships under a range of future scenarios and greatly improves understanding of cumulative impacts. It provides a large-scale planning and decision-support tool for managers and policy-makers to explore and minimise the impacts of coastal development. This approach can be adapted easily to investigate small parts of the coastal zone, including sites of individual developments, and to estimate the cumulative impacts of government policies.

Curtis Island gas plant development and boat traffic, November 2012



Photo: Mirjam Maughan, JCU

Program 10: Socio-economic value of GBR goods and services

Program Leader: Dr Marcus Lane, CSIRO

This program had two projects designed to capture social and economic information from GBR industries and coastal communities. One project was the start of a long-term compilation and tracking of essential socio-economic indicators to detect spatial and temporal trends in human uses of the region and to monitor variations in economic activity. Both are useful in forecasting trends and providing the human dimension to scenario planning by coastal managers. The design of the database was determined through close consultation with managers and other end users including all levels of government. The second project explored the social and economic valuation of environment assets in the GBRMPA from the point of view of the ecosystems ability to supply sustainable ecological goods and services.

Project 10.1: Social and economic long-term monitoring program

Project Leader: Dr Nadine Marshall, CSIRO

The Great Barrier Reef is a complex socio-ecological system with very many competing demands upon it. Management decisions require science-based evidence for transparency and very little data is available to help Reef managers effectively consider the human dimension of the region. The Social and Economic Long Term Monitoring Program (SELTMP) for the Great Barrier Reef was set up to provide essential data to Reef managers about the human dimension of the Great Barrier Reef. Data from primary and secondary sources were compiled on each of the following: i) how people use the Reef, ii) how people are vulnerable to changes in the Reef, iii) the wellbeing that is derived from the Reef, and iv) contextual information that describes important socio-cultural drivers such as perceptions, attitudes, values, experiences, knowledge, concerns, behaviours and norms. The value of many data-sets, such as SELTMP's, increases with repetitive sampling. The baseline primary dataset currently contains responses from 8,300 coastal residents, Australians, tourists, tourism operators and commercial fishers. Anticipated annual updates of this baseline will mean that current conditions and trends can be reported and integrated into important decision-making processes. The data can also be used in scientific models to refine our understanding of the human dimension of the region.

Photo: Matt Curnock

Green Island on the Great Barrier Reef



Photo: Wayne Spencer



Recreation on the Great Barrier Reef



Project 10.2: Socio-economic systems and reef resilience

Project Leader: Professor Natalie Stoeckl, JCU

Multiple lines of evidence suggest that residents of, and visitors to the GBRWHA feel that environmental non-use values are more important than recreational values which are, in turn, more important than market-based values. Degradation of those values is likely to have real financial impacts in the tourism industry; it could also have a financial impact on non-tourism related businesses, particularly if the very high recreational values of the region are 'subsidising' current wage costs. It is also clear that different groups of people have different values. Changes to the economic and demographic composition of the region will thus change social constructs of values, affecting priorities and decisions about the future. Moreover, direct links between the economy and the environment also exist: changes in the broader economy (e.g. higher beef prices) affect sediment loads, albeit with a lag. Monitoring systems should thus keep track of: the demographic composition of the population, and its economic structure; the 'values' of different demographic groups and of those associated with different industries; changes in the broader economy; and variables that describe key linkages between the economy and the environment.

Program 11: Resilient Torres Strait Communities

Program Leader: Dr James Butler, CSIRO

Program 11 had two projects designed to assist key decision makers in the Torres Strait community to build a resilient future based on sustainable environmental use and the detection and prevention of wildlife diseases in the Torres Strait. The program delivered information on the value of ecosystem services underpinning Torres Strait livelihoods within the cultural frame of the region. The program delivered information on resource sharing with Treaty Villages in the Western Province of PNG and improved methodologies to support emerging sustainable industries in the region. A mechanism to repatriate knowledge in culturally appropriate ways continues to be developed and used to raise awareness of environmental issues and build community resilience in Torres Strait. The Program also worked with existing biosecurity arrangements to enhance the methodologies for detection and prevention of wildlife disease incursions.



Vic McGrath (TSRA) and the Erubam Elders discussing an historical timeline for the island

Project 11.1: Building resilient communities for Torres Strait futures

Project Leader: Dr James Butler, CSIRO

Rapid change in the Torres Strait region requires the ability to predict potential changes and plan proactively. Through participatory scenario planning with Torres Strait communities and regional stakeholders, informed by integrated ecosystem services, climate and resilience modelling, this project identified 'no regrets' strategies to protect livelihoods and achieve sustainable economic development. Priority strategies identified were: cultural renewal strategy; improved garden production; enhanced community communication, particularly between central islands; marine resource management focusing on turtles; and ecotourism, fisheries and aquaculture development. Participants compared these strategies with current development programs. The greatest implementation gaps were identified for cultural renewal, marine resource management, and economic development. Improving garden production requires significantly more investment. The project's approach and tools are informing TSRA's community-based climate adaptation planning process for the region. The TSRA is now adapting and implementing the project's planning approach and tools. Additionally, the Queensland Government (DATSIMA)'s community consultation process in the Torres Strait is being modified to include the project's approach. Project results have been incorporated into the joint Australia-PNG Torres Strait Treaty process, and DFAT has included sustainable development forums as an annual event at the meetings.



Photo: James Butler

Project 11.2: Improved approaches for the detection and prevention of wildlife diseases in the Torres Strait

Project Leader: Dr Susan Laurance, JCU

Emerging infectious diseases are on the rise with future outbreaks predicted to occur in frontier regions of tropical countries. Disease surveillance in these hotspots is challenging because sampling techniques often rely on vector-attractants that are either unavailable in remote localities or difficult to transport. The project trialled a novel method of capturing mosquitoes using yeast-baited traps in villages and native habitats and compared their efficacy with standard sampling methods. The new sampling method was more robust, efficient and cheaper. The traps captured >11,000 mosquitoes of 27 species. Three times more mosquitoes were caught in natural vegetation compared to villages, which may be partly due to mosquito habitat preference and prevailing wind intensity in coastal villages. Mosquito species occurring in villages tend to be more human-preferring (anthropophilic), which is an important finding from a disease risk perspective. Mosquito communities on the four Torres Strait islands varied between natural vegetation and villages and also between the islands. The two low-lying islands (Saibai and Boigu) situated close to Papua New Guinea (PNG) shared a very similar mosquito community but distinctly different from the two continental islands (Badu and Moa) that are located further from PNG. Important disease vectors were captured almost exclusively in villages, for example disease vectors for malaria (*Anopheles* spp.) were more frequently captured in village on the northern islands whereas vectors for dengue and chikungunya were more frequently captured in the southern island group. Furthermore, two of the most important disease vectors in this region are invasive species (*Aedes albopictus*, *Aedes aegypti*), which is one of the key causes of emerging infectious disease expansion globally. Management of vector breeding habitat in towns is the highest priority for managing disease outbreaks in Torres Strait.

Rangers John Wigness and Erimiah Manas and Dagmar Meyer Steiger from JCU Cairns testing a novel sampling method to capture mosquitoes on Moa



Photo: Susan Laurance

Program 12: Managing for resilience in rainforests

Program Leader: Dr Rosemary Hill, CSIRO

Program 12 had four projects designed to assist environmental managers, industry, indigenous, and community groups to manage the Wet Tropics bioregion. This is a complex and often highly contested landscape with many competing interests. The four projects determined the most effective approaches to collaborative governance, planning and co-management of biodiversity within Indigenous Protected Areas; the most appropriate ways to develop a carbon market within the Wet Tropics region; the best approaches to managing and accelerating revegetation including potential management interventions particularly in the rainforest uplands; and the social and economic value of environmental icons of the Wet Tropics rainforest and their contribution to northern Queensland.

Project 12.1: Indigenous peoples and protected areas

Project Leader: Dr Rosemary Hill, CSIRO

Rainforest Aboriginal peoples' knowledge of wet tropics country, collected and handed down over generations, is an invaluable asset to managing biodiversity and cultural values in our rainforests. The findings of a participatory evaluation of the current status, and potential ways to improve, Indigenous co-management for looking after wet tropics country, including the World Heritage Area were identified. The evaluations identified Rainforest Aboriginal peoples' roles on country generates multiple benefits including: employment; enhanced job-readiness and transition from school to work; moving from welfare dependency to business development; improved disaster readiness and response; mobilizing people out of passivity and empowering leadership; biodiversity protection and restoration; enhanced reconciliation between local Indigenous and non-Indigenous communities; intergenerational knowledge transfer; and cultural renewal and reconnection. The evaluations identified that a collaborative governance approach was the best overall strategy to further effective partnerships. However, both Indigenous and their partners' governance of wet tropics country is currently underdeveloped, and the outcomes from agreement-making are sub-optimal. The project presented several exciting directions that will better support engagement of Rainforest Aboriginal knowledge and values including a transformative knowledge network, improved agreement-making processes and the delivery of value-added Indigenous Protected Areas.



Photo: Michelle Esparon



Vegetation in the interior of a rainforest regrowth patch in retired pasture, estimated age 8-20 years; in the Wet Tropics uplands (pink tape on tree marks a research site)

Project 12.2: Harnessing natural regeneration for cost-effective rainforest restoration

Project Leader: Professor Carla Catterall, GU and Dr Luke Shoo, JCU

This project investigated the potential of naturally regenerating rainforest (regrowth) to provide an economically efficient means of achieving lower-cost restoration of biodiversity and ecosystem services to disused agricultural land, when compared with intensive biodiversity plantings. The team reviewed studies elsewhere to reveal a range of emerging technologies (other than tree planting) for accelerating rainforest regrowth, and also established new 'kickstart' trials on three North Queensland sites (in collaboration with WTMA and others). The team then measured the rate of recovery of biodiversity and ecological attributes in 29 regrowth sites, which were compared with data from old-growth forest and ecological restoration sites, to show that biodiverse restoration plantings accelerated recovery of some components of forest biodiversity, while others remained recalcitrant and restricted to old-growth forest remnants. Lastly, the project developed a framework to assist planners and practitioners in decision-making about how to allocate financial investment towards the most appropriate restoration methods and areas of restoration action. The core findings of this project are communicated in an 8-page downloadable Fact Sheet, in six scientific journal papers and seven other user-focused articles, together with 13 other papers published on closely-related subjects, and numerous scientific and public talks.

RAPA workshop



Project 12.3: Relative social and economic values of residents and tourist in the WTWHA

Project Leader: Professor Natalie Stoeckl, JCU

The different valuation approaches used in this study generated different types of information (e.g. the amount people are willing to contribute to a fund to control weeds and pests, the relative importance of different ecosystem services), but the 'big picture' conclusions were consistent. Residents of, and visitors to the WTWHA feel that family and friends are more important than environmental values, which in turn are more important than market-based values (e.g. jobs and income associated with industry, café's and restaurants). Degradation of the environment is thus likely to have real financial impacts in the tourism industry; it could also have a financial impact on non-tourism related businesses, particularly if the very high recreational values of the region are 'subsidising' current wage costs. Protection and promotion of Indigenous cultural values could enhance quality of life for Indigenous and non-Indigenous residents alike; it might also encourage tourists to stay in the region for longer, thus generating a tourism 'premium'. Aesthetic values are all but inseparable from environmental values; maintaining the health and integrity of the ecosystem will thus likely help maintain aesthetic values. Different groups of people have different values. Changes to the economic and demographic composition of the region will thus change social constructs of values, affecting priorities and decisions about the future.

Project 12.4: Governance, planning and the effective application of emerging ecosystem service markets: climate change adaptation and landscape resilience

Project Leader: Professor Allan Dale, JCU

The literature on ecological and agricultural systems has long argued the importance of securing landscape resilience in the face of climate change. Emerging market-based Greenhouse Gas Abatement (GGA) programs present a real opportunity to secure adaptation to climate change through enhanced landscape resilience. However, little guidance is available about how to build healthy governance and planning systems to assist these market opportunities to transform management at landscape-scale. This project explored the potential for the nation's emerging GGA programs to support landscape adaptation in the face of climate change. The Landscape-Based Greenhouse Gas Abatement Domain is hence a hybrid governance domain that straddles the historically separate worlds of GGA and NRM governance. The project was able to review this emerging governance domain by partnering with Far North Queensland's key stakeholders. The project helped both researchers and practitioners to evaluate the most effective governance foundations for the application of GGA opportunities for landscape scale adaptation. In doing so, the project focused on several practical efforts: designing/securing the most appropriate regional governance systems needed to support regional scale adaptation to climate change; designing/ securing the most effective and integrated NRM planning arrangements for regional scale adaptation for biodiversity and other natural assets; and guiding and enhancing the carbon and other emerging ecosystem market investments towards priority biodiversity outcomes within the regional landscape.

Accessibility to the Wet Tropics World Heritage Area (WTWHA) is important to many stakeholders however development goals such as building more roads may impact on the values of the area



Photo: iStock

Program 13: Knowledge Brokering and Communication

The success of the NERP TE Hub, in part, was due to how information developed during the life of the Hub helped facilitate real improvements in sustaining the ecosystems of the Great Barrier Reef, the Wet Tropics rainforest and the Torres Strait regions. Accordingly, a substantial knowledge brokering, communication and engagement framework supported the Hub research activities. There were two primary outputs for knowledge brokering and communication. The first was the establishment and maintenance of a research-user engagement framework and the second, a suite of communication products and reporting tools including web based communication, technical reports, newsletters, email updates and peer reviewed publications.



Eric Lawrey

Project 13.1: eAtlas

Project Leader: Dr Eric Lawrey, AIMS

The eAtlas is a data repository, an innovative website (<http://eatlas.org.au>) and mapping system for preserving, sharing and facilitating reuse of environmental data. It promotes greater use and application of this information by environmental managers, scientists and the general community. Its core role within the NERP TE program was to work with researchers to ensure their research products were captured, documented, made easily accessible and discoverable via the web. During the NERP, many of the eAtlas systems were redeveloped or improved to allow integration with national data management standards and services, improved scalability for handling more datasets, better documentation of datasets and support for multiple subsites tailored for different regions or topics. These new capabilities were used to allow the development of a regional eAtlas for Torres Strait (<http://ts.eatlas.org.au>) and a topic based eAtlas for the Social and Economic Long Term Monitoring Program (SELTMP) (<http://seltmp.eatlas.org.au>). This project dedicated significant time in the development of improved Torres Strait regional maps including detailed reef and island mapping and an improved satellite and aerial image basemap. These have a broad community appeal and provided the basic reference maps for the Torres Strait eAtlas. The eAtlas content continues to grow and now contains over 2,500 map layers, 140 datasets, 370 photos and 85 articles. The eAtlas now contains an extensive library of reference and research data.

Shipping in Queensland map showing the density of shipping traffic as measured by the Automatic Identification System (AIS)

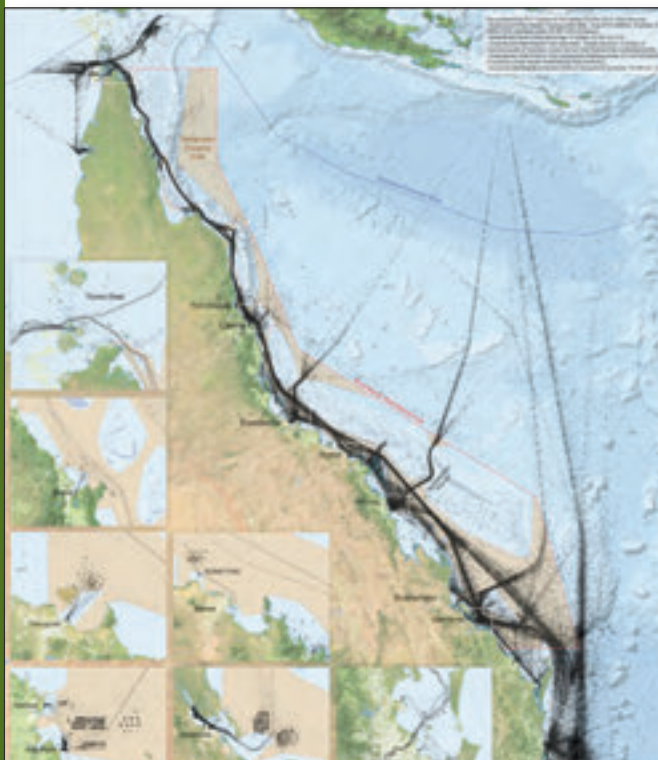


Photo: Eric Lawrey

Contestable Funds for Knowledge Transfer

In endorsing the Science Communications Plan, the Hub Steering Committee set aside more than \$550,000 for knowledge transfer opportunities that would be allocated to projects through a competitive process throughout the life of the program. In March 2012, the Hub Steering Committee approved eligibility and assessment criteria for evaluating proposals seeking contestable funds and recommended that an independent Assessment Panel assess each of the proposals. Successful projects were those that competitively satisfied criteria that included 'Pathway to Impact', 'Value for Money', 'Plans to Promote', 'Likelihood of Influencing' and the track record of the proponent.

Project CF1: Update of the Reef Plan Scientific Consensus

Project Leader: Jon Brodie, JCU

The project aimed to support the 'Marine Ecosystem Impacts' chapter of the Reef Plan Scientific Consensus Statement Update in 2012. The project found that the impact of activities within the catchments affect the condition of Great Barrier Reef coral reefs and seagrass meadows, which has declined severely in the period since the last Reef Plan Scientific Consensus Statement in 2008. The understanding of the causes, nature and trajectory of these declines became much clearer, especially for coral reef systems. The scientific consensus presented in this project confirmed: (i) that marine water quality continues to be negatively affected by the discharge of excess nutrients, fine sediments and pesticides from the adjacent catchments; and (ii) that poor marine water quality is a major cause for the currently poor state of many of the key marine ecosystems of the GBR. The project found that there is strong evidence that improving water quality within the catchments of the Great Barrier Reef will contribute to enhancing the resilience of freshwater, estuarine, mangrove, coral reef and seagrass ecosystems to other disturbances. The most significant impact would be achieved by removing the water quality effect that triggers more frequent crown-of-thorns starfish outbreaks.

Project CF2: Ensuring NERP science informs next generation NRM Plans and Regional Development planning across North Queensland

Project Leader: Professor Allan Dale, Cairns Institute

Under a \$44 million Commonwealth initiative, all of north Queensland's Regional Natural Resource Management Bodies commenced development of their next generation regional plans over the next three years. This aligned with NERP delivery timeframes, enabling direct integration of NERP outputs within this unfolding plan review process. There is a collaborative approach to this among NQ's regional bodies. Also, Regional Development Australia committees are required to update their roadmaps, which underpin negotiations between the RDAs, the State and Commonwealth over major development issues facing both regions. NERP research guided development of planning to implementation. This project directly informed the two most relevant planning and decision making processes underway in NQ, resulting in a purpose-built bridge between NERP science and real world planning and decision making in the NRM and regional development fields. The project facilitated the development of collaborative bids research brokerage for Wet Tropics and Monsoon Rangelands clusters to the value of \$1.75m. A key impact of this project is the explicit placement of the entire NERP TE Hub research outputs within the emerging frameworks for next generation NRM planning and RDA Roadmap development.

Project CF3: Targeted delivery of NERP research to the sugar cane industry

Project Leader: Matt Kealley, QLD Canegrowers Association

This project aimed to target delivery of NERP research to the sugar cane industry through the publication of NERP related water quality outcomes in the CANEGROWERS magazine. The Australian Canegrower magazine is distributed to all CANEGROWERS members (80% of growers) as well as industry, government and research stakeholders within and external to the Australian sugar industry. The Australian Canegrower magazine has achieved excellent results in communicating the latest technology and practices to growers and is credited for accelerating adoption on-farm. Articles were: Two research programs uncovering secrets of the Reef: why growers should keep informed – published 12 November 2012; Flood plumes: what makes seagrass meadows vulnerable? – published 27 May 2013; New research on the impact of farm chemicals and the reef – published 4 February 2013; and Great Barrier Reef coral loss and crown-of-thorns starfish – published 18 March 2013. The articles captured the research results emanating from the NERP and delivered those results to a key stakeholder group in non-technical language.

Project CF4: Disseminate knowledge from rainforest projects to the business and needs of local government through FNQROC and LGAQ mechanisms

Project Leader: Travis Sydes, FNQROC

The uptake of research knowledge by end-users is influenced by three key components: an operational spokesperson who can frame the language of the research in that of the 'doer'; concrete recommendations that provide a basis for a decision process within the limitations of the research; and dissemination of research results in outputs other than published articles (map products, decision tools) that are accessible, available and of interest/utility to end users. The project developed a research project output navigator to assist local government practitioners to explore the outputs of the NERP TE Hub 'Wet Tropics Rainforest' node that are most relevant to their needs and area of business. The navigator provides a summary and overview table with direct links to individual project summary resources hosted on the NERP TE and RRRC website. The navigator provides analysis and subsequent recommendations of the relevance and applicability of individual projects to local government. The product has been circulated via FNQROC and LGAQ email media. The key outcomes of the project are: improved capacity of researchers to understand the relevance of their work to local government end-users; and improved uptake of research results by local government end users.





Project CF5: Rainforest Aboriginal People Traditional Owner knowledge brokering

Project Leader: Professor Stewart Lockie, JCU

The Wet Tropics is characterised by at least 120 Clans and hundreds of extended family groups. The Rainforest Aboriginal People's Alliance includes Traditional Owner corporations and organisations, companies, Native Title Representative Bodies, Registered Native Title Body Corporates, Prescribed Body Corporates, Cultural Heritage Bodies, land trusts, etc. There are around 20,000 Rainforest Aboriginal people that are contiguous custodians and managers of the land. Extending NERP TE Hub research to this network in a form that is accessible, useful and culturally appropriate is this project's challenge. The project sought to establish knowledge brokering capability between NERP TE Hub agencies and researchers, and the Traditional Owner community. Through the construction of research synopses that were made available through presentations, the project team matched the relevance of NERP research to the agenda themes of: culture and heritage; land management; waters; economic development; and planning. The project also promoted research community and RAP awareness and understanding of: the principles of Indigenous engagement in cultural and natural resource management; and research protocols including Indigenous cultural and intellectual property, and emerging Indigenous research.

Project CF6: NERP research informing policy

**Project Leaders: Hub Liaison Officers, DoE and
Dr Peter Doherty, AIMS**

The primary objective of this project was to provide funding for researchers within the Hub to travel to Canberra to meet with relevant Australian Government research users throughout the life of the program. The funding allowed researchers to meet one-on-one with research users, hold small workshops both with research users and across NERP hubs over consecutive years of the program. The first visit, which took place in November 2012, was by the Project Leader for the eAtlas, which is an important tool for the preservation and presentation of new knowledge generated by the Hub. Another example of sponsored travel was the invitation to selected Hub researchers to contribute their expertise on seabirds and marine turtles to a workshop on transboundary collaboration between Australia and New Caledonia for enhanced protection of Coral Sea biodiversity. Another group of experts from the Hub visited Canberra to present new knowledge on the relationship between water quality and seagrass degradation in coastal marine receiving waters. These results are of interest to the Chemical Assessment Unit in the Environment Quality Division and the Reef Rescue Team from the Biodiversity Conservation Division. The project also provided funding assistance to the Torres Strait Forum. The project provided a direct line of communication to a wide variety of Australian Government research users, adding substantial value to the research.

Project CF7: Evaluation of NERP TE Hub generated knowledge uptake by research users

Project Leader: Dr Julie Carmody, RRRC Ltd

This project measured the success of the NERP TE Hub in influencing the decision making of managers, policy makers, industries and community groups in regards to the condition, threats and management options for North Queensland's environmental assets. The project was undertaken at the mid point of the program. A mixed approach involved the reporting of both quantitative and qualitative results in the initial baseline report (2012-13), which was followed by a final evaluation at the end of the NERP TE Hub (2014-15). This project sought to: identify the level of awareness of the NERP TE Hub; investigate the level of use of the research produced by the NERP TE Hub; and evaluate the acceptance of the NERP TE Hub research. The project reported on statistics based on the number of visitors to the NERP TE Hub website; the number of document downloads from the NERP TE Hub website; the number of peer-reviewed publications; media uptake of research project results; and various other measures of impact.

Project CF8: Developing an Indigenous Engagement Strategy for the NERP TE Hub

Project Leader: Dr Julie Carmody, RRRC Ltd

The geographical focus areas of the NERP TE Hub are strongly connected to the region's Aboriginal and Torres Strait Islander peoples. There are 20 Traditional Owner Groups identified, 120 clans and at least six language groups within the Wet Tropics region alone. There are approximately 70 Traditional Owner clan groups whose sea country includes the Great Barrier Reef Marine Park. The Torres Strait has 20 Traditional Owner groups (19 Torres Strait Islander Corporations, and one Aboriginal Native Title Corporation). Indigenous ecological knowledge is a fundamental pillar for the sustainable environmental management of the natural resources of north Queensland. The NERP TE Hub recognised the importance of Indigenous engagement in the understanding and management of north Queensland's natural assets. The overall goal of the Indigenous Engagement Strategy was to ensure a meaningful two-way engagement relationship for the NERP TE Hub that will recognise the interests, rights and Indigenous ecological knowledge of Traditional Owners in land and sea country and was developed through a working partnership of Indigenous groups and Hub representatives. The aim of this strategy was to encourage research leaders to consider opportunities for the engagement of Traditional Owners into the existing NERP TE Hub research projects. The strategy is available on the NERP TE Hub website: <http://nerptropical.edu.au/publication/nerp-te-hub-indigenous-engagement-strategy-and-implementation-plan-january-2013-%E2%80%93-2014>.

Project CF10: Torres Strait annual research exchange forum

Project Leader: Damian Miley, TSRA

The primary objective of this project was to provide a vehicle for researchers to engage with key research users in Torres Strait who have important decision-making roles in the region and to communicate their main research findings. A secondary benefit of the activity was to establish relationships between researchers and key stakeholders for ongoing dialogue in the future. The Torres Strait Forum allowed for transfer of new knowledge and information generated by all the NERP Torres Strait projects that covered a range of fields of interest to decision-makers in the region. The Forum was attached to the TSRA Board meeting and included a dinner for informal networking between Hub scientists and local traditional owners. This delivery style allowed for targeted extension of NERP project findings to an audience that is often difficult to reach collectively, as well as providing for informal discussion and longer-term interactions. The forum was additionally useful for numerous Australian government personnel, including those from Sustainable Water Resources; Strategic and Indigenous Policy; Migratory Species; Christmas Island Natural Resources; International section; Environment Management and Policy-north east (Department of Prime Minister and Cabinet); Torres Strait Fisheries Section (AFMA); Papua New Guinea Development and Solomon Islands Branch (Department of Foreign Affairs and Trade).



Project CF12: NERP TE Hub rainforest research informing management of the Wet Tropics World Heritage Area

Project Leader: Andrew Maclean, WTMA

The project facilitated communication of NERP TE Hub rainforest research to the Queensland Government with the aim of maximising uptake. There were five Project Partners all of whom are members of WTMA's Scientific Advisory Committee and Project Leaders from the Wet Tropics Rainforests geographic node of the TE Hub. The project was delivered in two stages. The first stage comprised a workshop held in Cairns in May. It was an opportunity for the Project Partners to present their research to Queensland Government officials and representatives of relevant Government Owned Corporation (GOC) infrastructure providers, and to collaboratively discuss potential management implications. There were 23 attendees representing nine government departments and GOCs. The second stage was delivered via a symposium held in Brisbane in September. Co-organised with RRRC, the purpose of the symposium was to inform Queensland Government agency staff and industry and non-government stakeholders of the Hub's research and to demonstrate potential applicability. Sixty-five attendees from over 15 different organisations participated. The second stage also included a deputation by the Project Partners to the Hon. Andrew Powell, Minister for Environment and Heritage. This was an opportunity for the researchers to brief the Minister on their research and to discuss management opportunities and challenges.

Project CF13: Biocultural knowledge sharing between GBR Traditional Owners and JCU researchers to inform the management of inshore dolphins in the GBRWHA

Project Leader: Dr Helen Penrose, JCU

Within the Northern Peninsula Area of Cape York there are significant gaps in the scientific understanding of the distribution, habitat-associations and conservation status of inshore marine mammals and elasmobranchs. A participatory mapping workshop with the Apudthama Land and Sea Rangers/Traditional Owners was conducted during October 2014 following a two year engagement and consultation phase and the formalising of a Research Partnership Agreement between parties. The workshop occurred on Atambya Country, at the headwaters of the Jackson River. Indigenous Knowledge of inshore dolphins, dugongs and elasmobranchs from the Skardon River on the west Cape, north around the Peninsula to Captain Billy's Landing within the northern GBRWHA was

recorded during this workshop. This included the occurrence, distribution, and habitat-associations of three species of inshore dolphin (the Australian snubfin dolphin: *Orcaella heinsohni*, Australian humpback dolphin: *Sousa sahalensis*, and Indo-Pacific bottlenose dolphin: *Tursiops aduncus*), the Dugong (*Dugong dugon*), and 20 species of elasmobranch that are registered on the IUCN Red List of Threatened Species. These include the 'Critically Endangered' sawfish (*Pristis pristis*) and Green sawfish (*Pristis zijsron*), and the 'Endangered' Dwarf sawfish (*Pristis clavata*) and Great Hammerhead Shark (*Sphyrna mokarran*). Cultural information, such as marine wildlife language names, stories and resource use, was also provided by the Apudthama Land and Sea Rangers and Traditional Owners.

Project CF14: Ongoing integration of NERP TE science into regional planning

Project Leader: Professor Allan Dale, Cairns Institute

This project aimed to ensure development of northern Australia is based on sound understanding of environmental, cultural and social values and economic opportunities, and that the economic benefits of development are equitably shared. Early and ongoing involvement of stakeholders as co-investors, research partners or end-users was considered essential, with appropriate Natural Resource Management (NRM) and Regional Development Australia Boards (RDAs) input into prioritisation and design; project delivery and assessment; product evaluation; and dissemination and uptake of research findings. Engagement requirements included: agreed terminology and definitions; adequate time and resources; respect and incorporation of different world views; working across all relevant sectors (not artificially limited by geographic area); strategic-level steering committees, advisory groups, MoUs and milestone agreements; co-location of researchers with NRM groups; co-supervision of research students; and prioritised Indigenous engagement. Eleven NRM groups and seven RDAs from across northern Australia were consulted to ascertain their post-NERP environmental research priorities and the mechanisms required for delivering them. These were collected through face-to-face meetings wherever possible using semi-structured interview technique based on 11 questions, which were circulated in advance. Where face-to-face meetings were not possible, groups responded through a combination of phone calls and emails. A report was compiled synthesising these responses, in which 12 research themes were identified, along with a range of engagement processes.

Project CF15: Consensus workshops for GBR Outlook Report 2014

Project Leader: Dr Kirstin Dobbs, GBRMPA

The Outlook Consensus Workshop was organised and convened by the Great Barrier Reef Marine Park Authority (GBRMPA) in Townsville on 14-16 October 2013. The objective of the workshop and surrounding process was to secure an independent set of expert judgements about condition, trends and risks in the Great Barrier Reef Region that could be used to inform GBRMPA's preparation of the 2014 Great Barrier Reef Outlook Report. The workshop involved 31 GBRMPA-invited experts (28 attended the workshop and an additional three submitted their opinion as a set of score sheets prior to the workshop), selected because of their independence from GBRMPA, their expertise across a range of the types of issues that were expected to be encountered, and because of their long-standing experience of field work in the Region. The workshop outcomes reflected the combined and consensus judgement of these experts. The workshop was conducted and moderated by Trevor Ward, an external expert independent of GBRMPA with extensive experience in the conduct of independent marine performance assessment processes. The findings provided a strong basis for the development of a robust 2014 Outlook Report, which was the primary target for use of the outcomes of this workshop.

Project CF16: Science Roadshow

Project Leader: Dr Julie Carmody, RRRC Ltd

The Reef and Rainforest Research Centre (RRRC), in conjunction with the Wet Tropics Management Authority (WTMA), hosted a symposium in Brisbane in September 2014 showcasing research from the Great Barrier Reef, the Wet Tropics and the Torres Strait regions. The purpose of the symposium was to inform Queensland Government agency staff and industry and non-government stakeholders of the Hub's research and to demonstrate policy, planning and management applicability. The one-day event provided a synthesised snapshot, focusing on research outputs, tools and other potential applications, particularly as they apply to Queensland Government interests. Sixty-five attendees from more than 20 different agencies participated. Amongst some of the organisations attending were the Department of Environment and Heritage Protection, the Department of the Premier and Cabinet, the Office of the Coordinator-General, QPWS, the Department of Natural Resources and Mines, the Department of Agriculture Fisheries and Forestry, the Department of Transport and Main Roads, DSITIA, CSIRO, the Queensland Tourism Industry Council, the Queensland Resources Council and the World Wildlife Fund. The symposium was an excellent opportunity for the researchers to meet with and present their research to an expanded audience in Brisbane.

Photo: Wayne Spencer





Annual Conferences

NERP Tropical Ecosystems Hub Conference 2013

The first NERP TE Hub Annual Conference was held from 7-10 May 2013 and attended by around 300 delegates from research, government, industry and community.

A selection of the NERP TE Hub projects were highlighted during seven interactive forums at the first Conference of the NERP TE Hub, which in 2013 was a joint event with the Reef Rescue Research and Development Program. A shared conference reflected the complementary investments by both programs in research aimed at the goal of Reef Plan (2003-13) to "halt and reverse the decline in water quality entering the Great Barrier Reef Lagoon". This common interest was explored on Day 3, while forums on the first two days addressed other topical issues, including biodiversity, natural resource management, and sustainability, in all three geographic domains covered by the NERP TE Hub research program.

The preference for forum discussions over the standard style of oral presentations reflected the importance that the NERP TE Hub assigned to effective knowledge sharing and the practical uptake of its research results. Consequently the focus of the forums was on defining the issues, identifying the knowledge gaps, and exploring possible solutions. All stakeholders had something to contribute to this conversation and their active participation was encouraged.

NERP Tropical Ecosystems Hub Conference 2014

The second and final NERP TE Hub Annual Conference was held from 5-7 November 2014 and received registrations from 159 delegates from research, government, industry and community on Day 1; 183 on Day 2; and 127 on Day 3. The conference was a successful event. It was implemented smoothly and in accordance with the budget.

The 2014 Conference was a final report from the whole program to a broad audience. To accommodate the range of interests, the Conference presented in themed sessions; each based on 3-4 aligned projects. Sessions were convened by a nominee from each of the main research user groups, who bookended the science presentations and then elicited a forward-looking discussion from the audience. Delegates were urged to participate in the discussions with thoughts about "where do we go from here"?

The conference sessions were designed to continue the Hub's approach of the last four years, namely distilling the key findings of recent research and discussing these findings with users, and then jointly providing advice for ongoing priorities. Throughout the conference there were many opportunities to relax, network and meet new colleagues.

In terms of conference organisation, RRRC Ltd was tasked by the Steering Committee to coordinate a subcommittee that would determine the location, timing, scope, structure and budget for the conference. This was achieved via two teleconferences and presented to the Steering Committee at the August 2014 meeting.

RRRC Ltd, in conjunction with the Science Leader, organised the content of the sessions with the session conveners and the Project Leaders within each session. RRRC Ltd also assembled and printed a Conference Handbook for distribution at the event, undertook all event promotion, logistics, event and sub-event organisation prior to and during the conference. The event was well attended and feedback from stakeholders was very positive.



Publications

Final Reports / Final Factsheets

Project 2.1	Hamann, M., Smith, J. Preston S. (2015) Flatback turtles of Torres Strait . ISBN 978-1-925088-63-2
	Hamann, M., Smith, J. Preston S., Fuentes, M.M.P.B. (2015) Nesting green turtles of Torres Strait . ISBN 978-1-925088-62-5
Project 2.2	Duke, N.C., Burrows, D., Mackenzie, J.R. (2015) Mangrove and Freshwater Wetland Habitat Status of the Torres Strait Islands. Biodiversity, Biomass and Changing Condition of Wetlands . ISBN 978-1-925088-33-5
Project 2.3	Bainbridge, S.J., Berkelmans, R., Sweatman, H, Weeks, S. (2015) Monitoring the health of Torres Strait Reefs – Final Report . ISBN 978-1-925088-65-6
	Sweatman, H.P.A., Johns, K.A., Jonker, M.J., Miller, I.R., Osborne, K. (2015) Final report on coral reef surveys in Torres Strait . ISBN 978-1-925088-64-9
Project 3.1	Williams, S.E., Scheffers, B.R., VanDerWal, J., Roslan, N., Anderson, A., Storlie, C., Brunner, R., Welbergen, J., Parsons, S. (2014) Species resilience: the key to understanding biodiversity in the rainforests of the Australian Wet Tropics .
Project 3.2	Costion, C., Bransgrove, K., Simpson, L., Schulte, K., Abell-Davis, S., Metcalfe, D., Rossetto, M., Lowe, A. J., Williams, S., Crayn, D. M. (2014) What is at risk? Identifying rainforest refugia and hotspots of plant genetic diversity in the Wet Tropics bio-region .
Project 3.3	Hoskin, C.J., Puschendorf, R. (2014) The importance of peripheral areas for biodiversity conservation: with particular focus on endangered rainforest frogs of the Wet Tropics and Eungella . ISBN 978-1-925088-54-0
Project 3.4	Westcott, D., McKeown, A. (2014) Spectacled flying-fox monitoring in the Wet Tropics Region . ISBN 978-1-925088-52-6
	Westcott, D., Metcalfe, S., Jones, D., Bradford, M., McKeown, A., Ford, A. (2014) Estimation of the population size and distribution of the southern cassowary, Casuarus casuarus, in the Wet Tropics Region of Australia . ISBN 978-1-925088-51-9
Project 4.1	Logan, M., Fabricius, K., Weeks, S., Rodriguez, A., Lewis, S., Brodie, J. (2014) Tracking GBR water clarity over time and demonstrating the effects of river discharge events Progress Report: Southern and Northern NRM Regions . ISBN 978-1-925088-69-4
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Project Factsheets

Project 1.1	Monitoring status and trends of coral reefs of the Great Barrier Reef.
Project 1.2	Marine wildlife management in the Great Barrier Reef World Heritage Area.
Project 1.3	Characterising the cumulative impacts of global, regional and local stressors on the present and past biodiversity of the GBR.
Project 2.1	Marine turtles and dugongs of the Torres Strait.
Project 2.2	Mangrove and freshwater habitat status of Torres Strait islands.
Project 2.3	Monitoring the health of Torres Strait coral reefs.
Project 3.1	Rainforest Biodiversity.
Project 3.2	What is at risk? Identifying rainforest refugia and hotspots of plant genetic diversity in the Wet Tropics and Cape York Peninsula.
Project 3.3	Targeted surveys for missing and endangered rainforest frogs in ecotonal areas, and assessment of whether populations are recovering from disease.
Project 3.4	Monitoring of Key Vertebrate Species.
Project 4.1	Tracking coastal turbidity over time and demonstrating the effects of river discharge events on regional turbidity in the GBR.
Project 4.2	The chronic effects of pesticides and their persistence in tropical waters.
Project 4.4	Hazard assessment for water quality threats to Torres Strait marine waters, ecosystems and public health.
Project 5.1	Understanding diversity of the Great Barrier Reef: Spatial and temporal dynamics and environmental drivers.
Project 5.2	Combined water quality-climate effects on coral and other reef organisms.
Project 5.3	Vulnerability of seagrass habitats in the Great Barrier Reef to changing coastal environments.
Project 6.1	Maximising the benefits of mobile predators to GBR ecosystems: the importance of movement, habitat and environment.
Project 6.2	Drivers of juvenile shark biodiversity and abundance in inshore ecosystems of the Great Barrier Reef.
Project 6.3	Critical seabird foraging locations and trophic relationships for the Great Barrier Reef.
Project 7.1	Fire and rainforests.
Project 7.2	Invasive species risks and responses in the Wet Tropics.
Project 7.3	Climate change and the impacts of extreme climatic events on Australia's Wet Tropics biodiversity.
Project 8.1	Monitoring the ecological effects of GBR zoning plan on mid and outer shelf reefs.
Project 8.2	Assessing the effects of management zoning on inshore reefs of the Great Barrier Reef Marine Park.
Project 8.3	Significance of no-take marine protected areas to regional recruitment and population persistence on the GBR.
Project 9.1	Dynamic vulnerability maps and decision support tools for the Great Barrier Reef.
Project 9.2	Design and implementation of Management Strategy Evaluation for the Great Barrier Reef inshore.
Project 9.3	Prioritising management actions for Great Barrier Reef islands.
Project 9.4	Conservation planning for a changing coastal zone.
Project 10.1	Social and economic long-term monitoring program.
Project 10.2	Socio-economic systems and reef resilience.
Project 11.1	Building resilient communities for Torres Strait futures.
Project 11.2	Improved approaches for detection of disease and prevention of spread in Torres Strait.
Project 12.1	Indigenous co-management and biodiversity protection.
Project 12.2	Harnessing natural regeneration for cost-effective rainforest restoration.
Project 12.3	Relative social and economic values of residents and tourists in the Wet Tropics World Heritage Area.
Project 12.4	Governance, planning and the effective application of emerging ecosystem service markets: climate change adaptation and landscape resilience.
Project 13.1	eAtlas.

Project Factsheets for the Torres Strait

Project 2.1	Marine turtles and dugongs of the Torres Strait.
Project 2.2	Mangrove and freshwater habitat status of Torres Strait islands.
Project 2.3	Monitoring the health of Torres Strait coral reefs.
Project 4.4	Hazard assessment for water quality threats to Torres Strait marine waters, ecosystems and public health.
Project 11.1	Building resilient communities for Torres Strait futures.
Project 11.2	Improved approaches for detection of disease and prevention of spread in Torres Strait.

Project Factsheets for Traditional Owners

Project CF5	Traditional Owner Knowledge Translation.
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Results Factsheets

Project 10.1	<p>Marshall, N. (2014) The Social and Economic Long Term Monitoring Program for the Great Barrier Reef Region.</p> <p>Bohensky, E., Curnock, M., Gillet, S., Goldberg, J., Gooch, M., Marshall, N., Pert, P., Scherl, L., Stone-Jovicich, S., Tobin, R. (2014) SELTMP 2013: Drivers of Change in the Great Barrier Reef.</p> <p>Bohensky, E., Marshall, N., Curnock, M., Gillet, S., Goldberg, J., Gooch, M., Pert, P., Scherl, L., Stone-Jovicich, S., Tobin, R. (2014) SELTMP 2013: Coastal Communities in the Great Barrier Reef.</p> <p>Curnock, M., Marshall, N., Tobin, R., Stone-Jovicich, S., Bohensky, E., Pert, P., Goldberg, J., Gooch, M., Gillet, S., Scherl, L. (2014) SELTMP 2013: Tourism in the Great Barrier Reef.</p> <p>Goldberg, J., Marshall, N., Curnock, M., Tobin, R., Gooch, M., Pert, P., Bohensky, E., Stone-Jovicich, S. (2014) SELTMP 2013: A national survey about the Great Barrier Reef.</p> <p>Stone-Jovicich, S., Marshall, N., Bohensky, E., Curnock, M., Goldberg, J., Gooch, M., Pert, P., Scherl, L., Tobin, R., Lankester, A. (2014) SELTMP 2013: Commercial Fishing in the Great Barrier Reef – a case study.</p> <p>Tobin, R., Bohensky, E., Curnock, M., Goldberg, J., Gillet, S., Gooch, M., Marshall, N., Nicotra, B., Pert, P., Scherl, L., Stone-Jovicich, S. (2014) SELTMP 2013: Commercial Fishing in the Great Barrier Reef.</p> <p>Tobin, R., Bohensky, E., Curnock, M., Goldberg, J., Gillet, S., Gooch, M., Marshall, N., Pert, P., Scherl, L., Stone-Jovicich, S. (2014) SELTMP 2013: Recreation in the Great Barrier Reef.</p>
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Synthesis Products

[NERP TE Hub Program Outcome Summary 2013.](#)

[NERP TE Hub GBR Biodiversity Research Snapshot - July-December 2013.](#)

[NERP TE Hub GBR Water Quality Research Snapshot - July-December 2013.](#)

[NERP TE Hub Rainforest Research Snapshot - July-December 2013.](#)

[NERP TE Hub Torres Strait Research Snapshot - July-December 2013.](#)

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[NERP TE Hub Annual Highlights Report 2012.](#)

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Project 5.3 [Towards water quality thresholds for healthy seagrass habitats in the Great Barrier Reef.](#)

Project 10.2 [Summary Sheet for Socioeconomic systems and reef resilience.](#)

Technical Reports

Project 1.1 [Miller, I., Sweatman, H. \(2013\) The status of crown-of-thorns starfish populations on the Great Barrier Reef from AIMS surveys. ISBN 978-1-921359-77-4](#)

Project 1.2 [Beasley, I., Golding, G. and Giringun Rangers. \(2013\) Looking for Palangal \(dolphins\) and Balangal \(dugongs\) in Giringun Sea Country.](#)

[Sobtzick, S., Hagihara, R., Grech, A., Marsh, H. \(2012\) Aerial survey of the urban coast of Queensland to evaluate the response of the dugong population to the widespread effects of the extreme weather events of the summer of 2010-11. ISBN 978-1-921359-75-0](#)

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Project 2.3 [Osborne, K., Miller, I., Johns, K., Jonker, M., Sweatman, H. \(2013\) Preliminary report on surveys of biodiversity of fishes and corals in Torres Strait. ISBN 978-1-921359-78-1](#)

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Project 4.4 [Petus, C. \(2013\) Application of MODIS remote sensing imagery for monitoring turbid river plumes from Papua New Guinea in the Torres Strait Region: a test study.](#)

[Waterhouse, J., Brodie, J., Wolanski, E., Petus, C., Higham, W., Armstrong, T. \(2013\) Hazard assessment of water quality threats to Torres Strait marine waters and ecosystems. ISBN 978-1-921359-85-9](#)

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Project 7.1	Metcalfe, D.J., O'Malley, T., Lawson, T.J., Ford, A.J. (2014) Mapping Littoral Rainforest & Coastal Vine Thickets of Eastern Australia in the Wet Tropics: Mission Beach Pilot Study. ISBN 978-1-925088-03-8
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Project 10.1	<p>Bohensky, E., Curnock, M., Gillet, S., Goldberg, J., Gooch, M., Marshall, N., Pert, P., Scherl, L., Stone-Jovicich, S., Tobin, R., Lankester, A. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2013. Drivers of Change in the Great Barrier Reef.</p> <p>Bohensky, E., Marshall, N., Curnock, M., Gillet, S., Goldberg, J., Gooch, M., Pert, P., Scherl, L., Stone-Jovicich, S., Tobin, R. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2013. Coastal Communities in the Great Barrier Reef.</p> <p>Bohensky, E., Curnock, M., Gillet, S., Goldberg, J., Gooch, M., Lankester, A., Marshall, N., Newlands, M., Pert, P., Tobin, R., Scherl, L., Stone-Jovicich, S. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2014, Drivers of Change in the Great Barrier Reef.</p> <p>Bohensky, E., Curnock, M., Gillet, S., Goldberg, J., Gooch, M., Marshall, N., Pert, P., Tobin, R., Scherl, L., Stone-Jovicich, S. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2014, Coastal Communities in the Great Barrier Reef.</p> <p>Curnock, M., Marshall, N., Tobin, R., Stone-Jovicich, S., Bohensky, E., Pert, P., Goldberg, J., Gooch, M., Gillet, S., Scherl, L. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2013. Tourism in the Great Barrier Reef.</p> <p>Curnock, M., Marshall, N., Tobin, R., Stone-Jovicich, S., Bohensky, E., Pert, P., Goldberg, J., Gooch, M., Heindler, F., Parker, J., Gillet, S., Scherl, L. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2014, Tourism in the Great Barrier Reef.</p> <p>Curnock, M., Parker, J., Marshall, N., Tobin, R., Stone-Jovicich, S., Bohensky, E., Pert, P., Gooch, M., Goldberg, J. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2014, Ports and Shipping in the Great Barrier Reef.</p> <p>Goldberg, J., Marshall, N., Gooch, M., Birtles, A., Bohensky, E., Curnock, M., Parry-Husbands, H., Pert, P., Stone-Jovicich, S., Tobin, R., Villani, C. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2013. The Great Barrier Reef National Survey.</p> <p>Marshall, N.A., Bohensky, E., Curnock, M., Goldberg, J., Gooch, M., Pert, P.L., Scherl, L., Stone-Jovicich, S., Tobin, R.C. (2013) The Social and Economic Long Term Monitoring Program for the Great Barrier Reef. Key Findings, SELTMP 2013.</p> <p>Marshall, N., Bohensky, E., Goldberg, J., Gooch, M., Lankester, A., Pert, P., Scherl, L., Tobin, R. (2013) The Social and Economic Long Term Monitoring Program (SELTMP) 2012. Social and Economic Conditions Great Barrier Reef.</p> <p>Marshall, N., Bohensky, E., Goldberg, J., Gooch, M., Lankester, A., Pert, P., Scherl, L., Tobin, R. (2012) The Social and Economic Long Term Monitoring Program (SELTMP) 2011. Social and Economic Conditions Great Barrier Reef.</p> <p>Scherl, L.M., Gillet, S., Bohensky, E., Curnock, M., Goldberg, J., Gooch, M., Marshall, N., Pert, P., Stone-Jovicich, S., Tobin, R. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2014, Community Well-being in the Great Barrier Reef.</p> <p>Stone-Jovicich, S., Marshall, N., Bohensky, E., Curnock, M., Goldberg, J., Gooch, M., Pert, P., Scherl, L., Tobin, R., Lankester, A. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2013. Commercial Fishing in the Great Barrier Reef - a case study.</p> <p>Tobin, R., Bohensky, E., Curnock, M., Goldberg, J., Gillet, S., Gooch, M., Marshall, N., Nicotra, B., Pert, P., Scherl, L., Stone-Jovicich, S. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2013. Commercial Fishing in the Great Barrier Reef.</p> <p>Tobin, R., Bohensky, E., Curnock, M., Goldberg, J., Gooch, M., Marshall, N., Nicotra, B., Pert, P., Scherl, L., Stone-Jovicich, S. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2014, Commercial Fishing in the Great Barrier Reef.</p> <p>Tobin, R., Bohensky, E., Curnock, M., Goldberg, J., Gooch, M., Marshall, N., Nicotra, B., Pert, P., Scherl, L., Stone-Jovicich, S. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2014, Recreation in the Great Barrier Reef.</p> <p>Tobin, R., Bohensky, E., Curnock, M., Goldberg, J., Gooch, M., Marshall, N., Nicotra, B., Pert, P., Scherl, L., Stone-Jovicich, S. (2014) The Social and Economic Long Term Monitoring Program (SELTMP) 2013. Recreation in the Great Barrier Reef.</p>

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2013	May	June	August	November
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Project 7.2	Fletcher, C.S., Westcott, D.A., Murphy, H.T., Grice, A.C., Clarkson, J.R. (2014) Geometric insights into managing breaches of containment and eradication of invasive plants.
	Murphy, H.T., Clarkson, J.R., Grice, A.C. (2014) Operationalising the triage concept in invasions management.
	Sydes, T.A., Murphy, H.T. (2014) Pest adaptation response planning: a practical application of species distribution science in forecasting strategic planning for weed managers.
Project 9.3	Conference Proceedings: A Genetic Algorithm Solver for Pest Management Control in Island Systems.
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	Farr, M., Stoeckl, N., Sutton, S. (2013) Taking a closer look at Boating, Fishing and Fish in the GBR: Implications for policies.
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	Stoeckl, N. (2014) A preliminary exploration of tourists as a key stakeholder in climate change impact management.
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	Stoeckl, N. (2013) Measuring regional well-being, options and challenges.
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	Torres Strait Futures: Community Locations.
	Torres Strait Futures: Department of Foreign Affairs and Trade.
	Torres Strait Futures: EGS Torres Strait Regional Meeting.
	Torres Strait Futures: IBIS Infrastructure Investment.
	Torres Strait Futures: Livelihoods Impacts.
	Torres Strait Futures: NAQS Overview.
	Torres Strait Futures: Socio-Economic Trends.
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Videos

Project 10.1	Measuring the human dimension of the Great Barrier Reef.
Project 11.1	Building resilient communities for Torres Strait futures. Fisheries under threat - PNG & Torres Strait. Wanem you see the future for Torres Strait?.
Project 12.4	Risk Analysis Across Governance Systems: Great Barrier Reef Case Study - Allan Dale

Workshop Summaries

Project 9.4	Report on land use change and scenarios technical working group December 2012. Report on Scoping Workshop April 2012. Spatially explicit scenarios for conservation planning in the Great Barrier Reef coastal zone, Australia.
Project 11.1	Torres Strait Futures Workshop Summary
Project CF2	Science to inform Climate Change Planning in North Queensland.



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