National Environmental Research Program

TROPICAL ECOSYSTEMS *hub*

# NERP TE Hub Research Snapshot: Torres Strait

January to June 2013 Compiled by RRRC

# About the NERP

## National Environmental Research Program

The overall objective of the National Environmental Research Program is to improve our capacity to understand, manage and conserve Australia's unique biodiversity and ecosystems. It will achieve this through the generation of world-class research and its delivery to Australian environmental decision makers and other stakeholders. The Program features five research hubs, including the Tropical Ecosystems Hub.

## The Tropical Ecosystem Hub

The Tropical Ecosystem Hub is a $61.89m investment that address issues of concern for the management, conservation and sustainable use of the World Heritage listed Great Barrier Reef and its catchments; tropical rainforests, including the Wet Tropics World Heritage Area; and the terrestrial and marine assets underpinning resilient communities in the Torres Strait.

www.nerptropical.edu.au

*Image to the left: Ray Berkelmans (AIMS)*

*Front cover Image:* Local rangers, John and Fred, at Moa Island from the Kubin community prepare the boat for deploying temperature loggers. *Ray Berkelmans (AIMS)*

# Contents

# Introduction

## Torres Strait

The TE Hub supports 38 research projects, with six focused on the Torres Strait within three Programs:

- Natural Resources of the Torres Strait land and sea
- Water quality of the Great Barrier Reef and Torres Strait
- Resilient Torres Strait communities

For further information on TE Hub structure please go to:
www.nerptropical.edu.au

*Image: Suzanne Long*

# Programs & Projects

## The NERP TE Hub Torres Strait Node

**Program 2: Natural Resources of the Torres Strait land and sea**
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.

**Program 4: Water quality of the Great Barrier Reef and Torres Strait**
Project 4.4: Hazard assessment for water quality threats to Torres Strait marine waters, ecosystems and public health.

**Program 11: Resilient Torres Strait communities**
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.


*Image: Suzanne Long*

# Researcher Profiles

## Professor Helene Marsh

***James Cook University (JCU)***

Professor Helene Marsh is Distinguished Professor of Environmental Science and the Dean of Graduate Research Studies at James Cook University. She is a Fellow of the Australian Academy of Technological Sciences and Engineering and Co-Leader of the Species of Conservation Concern program of the Australian Government's National Environmental Research Program (NERP) Tropical Ecosystems Hub.

Professor Marsh's extensive research interests include: marine conservation biology; marine natural resource management; Indigenous marine resource management; establishing priorities for conservation intervention; and marine wildlife population ecology, especially life history, reproductive ecology, population dynamics, diet, distribution, abundance and movements of dugongs and coastal dolphins.

Policy outcomes resulting from her work include significant contributions to the science base for the Dugong Sanctuary established in Torres Strait; dugong management in the Great Barrier Reef Marine Park, especially the Dugong Protection Areas and 'no-take' areas to protect dugongs in marine zoning plans; and the establishment of a Commonwealth Ministerial Taskforce to Investigate the Sustainability of Indigenous Hunting of dugongs and turtles.

## Dr. Mark Hamann

***James Cook University (JCU)***

Dr. Hamann is a Principal Research Fellow and Senior Lecturer in James Cook University's School of Earth and Environmental Sciences. He is also a member of the IUCN Marine Turtle Specialist Group and serves as a Regional Vice Co-Chair for the Australasia region. He also has an active role in developing marine turtle conservation programs in Viet Nam and Malaysia.

Dr. Hamann's postdoctoral work included development of community-based projects for the monitoring and management of marine turtles in Torres Strait and his main research interests lie in minimising human impacts on tropical marine wildlife and their habitats, and includes assessment of marine wildlife vulnerability (i.e. marine turtles, dugong and inshore dolphins) to climate change and coastal development, and understanding the role of marine turtles and dugongs in coastal environments. He is also interested in understanding the mechanisms of turtle dispersal and distribution, and impacts of plastic pollution on marine animals.

**Project 2.1:** Marine turtles and dugongs of the Torres Strait.
*Project Leaders: Professor Helene Marsh and Dr. Mark Hamann, JCU*

### *Project Background*

The project team is using monitoring, genetics, tracking and remote sensing in the Torres Strait to determine the status of dugongs and turtles, population connectivity between these species in relation to protected and community-based management areas, and threats to populations. The project is also estimating dugong populations, and investigating seasonal differences in the relative abundance of dugongs in the western Torres Strait, especially in the Dugong Sanctuary.

Key outcomes of the project include improving population viability and stability, and stakeholder understanding, capacity and skills to better manage turtle and dugong in the Torres Strait region.

### *Project Progress*

Five female Flatback turtles were fitted with satellite tags and their movements tracked from Warul Kawa, a small island off Cape York. To date, one of the turtles has swum 1,700 km into the Kimberly region of Western Australia; another to the northern coast of Arnhem Land in the Northern Territory, a third is located in the middle of the Gulf of Carpentaria, and the remaining two have swum into Indonesian waters.

Tracking data on dugongs indicates that these animals are found from 5-15 m depth, with most above 10 m. The tracked animals appear to use a core area between Mabuiag and Buru and have large ranges over sand flats/non-reef areas, although this varies between individuals. Similarly, green turtles are found down to 10 m depth with most above 5 m, and have very small, restricted ranges, associated with specific reefs.

Dugong. *Image: GBRMPA*

# Researcher Profiles

## Dr. Norm Duke

***James Cook University (JCU)***

Dr. Norm Duke is a mangrove ecologist and professorial research fellow based at the Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER) at James Cook University. Prior to this, he held research positions with the University of Queensland, the Australian Institute of Marine Science, the Queensland Fisheries Service, and the Smithsonian Tropical Research Institute in Panama, Central America.

Dr. Duke is involved in a variety of research projects including environmental and ecological assessments of mangrove and tidal saltmarsh ecosystems, human impacts on mangrove ecosystems, rehabilitation and planting of degraded mangrove habitats and empowering, and engaging local community volunteers in a science and community partnership program called MangroveWatch.

## Dr. Damien Burrows

***James Cook University (JCU)***

Dr. Burrows has been Director of TropWATER for five years. He specialises in freshwater, estuarine and coastal aquatic ecosystems and catchment management and has 22 years research experience in the tropics. Most of his professional life has been spent studying freshwater and estuarine ecosystems with particular emphasis on applied aspects of their management in relation to development pressures. This has involved extensive work with industry, community and government from grassroots to policy level.

His current work examines the ecology of wetlands, water quality, biological control of weeds, the ecology of fish and invertebrates, grazing management in riparian ecosystems, wetland management in cropping catchments, planning for water resource developments, fisheries management, and catchment planning and management. He has recently focused on developing the coastal ecosystems side of TropWATER, especially mangrove, seagrass and estuarine habitats.

**Project 2.2:** Mangrove and freshwater habitat status of Torres Strait islands.
*Project Leaders: Dr. Norm Duke and Dr. Damien Burrows, JCU*

### *Project Background*

The wetland ecosystems of the Torres Strait region are not well documented, with little information on wetland types (e.g. mangroves, salt marsh and freshwater), or the status or condition of their biota.

Most Torres Strait islands have extensive mangrove margins, and several islands (e.g. Saibai and Boigu) are predominantly intertidal swamps. Freshwater wetlands are rare. Establishment of baseline wetland status and condition is important, especially as many islands are low lying and the predictions of sea-level rise and increased storm surge frequency mean that mangroves and coastal wetlands may be among the most threatened ecological communities in Torres Strait. The project is in the process of visiting 20 islands in the Torres Strait region to document status and condition of mangroves and freshwater wetlands habitats and existing knowledge of selected communities with regard to their use of these habitats. The project team are also surveying freshwater fish and aquatic plants across the islands, particularly looking for exotic species and assessing mitigation options for mangroves, rehabilitation needs, and climate change adaptation strategies.

### *Project Progress*

The mangrove biodiversity of the surveyed islands appears greater than previously documented. A mangrove forest (*Pemphis acidula*) was found on Masig (Yorke Island) and the number of mangrove species documented on Sassie and Zagai increased from three to 16 and 19 species, respectively. These islands are of high cultural and biological importance to the central island region of the Torres Strait. No significant freshwater habitats were observed although a small freshwater spring was found on Gebbar. A seasonal stream on Iama did not contain any freshwater macrofauna or aquatic plants.

Shoreline video surveys undertaken on Masig, Geber, Iama, Zagai and Sassie showed that storm damage and lightning strikes are the major drivers of change for mangrove habitats on the central islands and that there is little human disturbance on uninhabited islands, apart from accumulated sea-borne debris. Mangrove habitats on Iama have been disturbed by cutting, nutrient inputs, altered hydrology and increased sediment runoff, and significant erosion is occurring on the north-east shoreline of Masig, with deposition and mangrove development on the south-east shoreline. Mangrove habitats in the central island group are smaller than those on Boigu and Saibai although they still contain significant carbon stores, with fringing forests storing about 377 t carbon/Ha with inner mangrove forests storing about 594 t carbon/Ha.

Mangroves. *Image: Damien Burrows*

# Researcher Profile

## Dr. Ray Berkelmans

***Australian Institute of Marine Science (AIMS)***

Dr. Ray Berkelmans worked for the Great Barrier Reef Marine Park Authority (GBRMPA) from 1986 to 1999 on impact assessment, and research procurement to assist management of the Great Barrier Reef Marine Park. He joined AIMS in 1999 to undertake research into climate change impacts and adaptation of coral reefs, with this period including a PhD (2002) in marine biology and aquaculture at the School of Marine Biology, James Cook University.

Dr. Berkelmans' research interests focus on climate change effects on coral reefs and in particular thermal stress causing a breakdown in the symbiosis between corals and their algal symbionts: zooxanthellae. As a physiological ecologist, he is interested in the large-scale picture as well as the finer-scale science behind coral bleaching. Adaptation to climate warming, resilience of reef communities and upwelling are current research pursuits. He also runs a long-term temperature monitoring program in Australia's tropical and subtropical coral reefs.

Real-time observing station at Madge Reef, Torres Strait.
*Image: Ray Berkelmans, AIMS*

## **Project 2.3:** Monitoring the health of Torres Strait coral reefs.

*Project Leader: Dr. Ray Berkelmans, AIMS*

### *Project Background*

Coral reefs of the Torres Strait are the northern expression of the Great Barrier Reef (GBR). Comparatively few biodiversity surveys have been undertaken on these reefs despite their ecological connection to the GBR, importance to Torres Strait communities, and threats to ecological integrity from climate change, crown of thorns starfish, disease, storms, and pollution from river runoff and shipping.

This project has established a monitoring program to enable resource managers to keep abreast of key indicators of coral health and to train local rangers to undertake monitoring. The project aims to help managers better predict, prepare for, and respond to major changes to their coral reefs, especially as a result of climate change.

### *Project Progress*

The Torres Strait coral monitoring program was established in February 2013 with biodiversity surveys of coral communities and reef fishes at multiple sites in five locations between Poruma (Coconut Is.) and Mer (Murray Is.). Two hundred and eighty species of corals were recorded, with communities on the three central reefs dominated by *Porites* spp. and those at the two eastern locations having more *Acropora* spp. Coral cover averaged >30% and up to 60% at some sites. There was low-level coral bleaching near Erub and Mer, with a relatively high proportion of coral disease on reefs around Mer. Crown-of-thorns starfish were seen at many sites, present at "incipient outbreak" densities (>=0.2 COTS/tow).

During this trip Torres Strait Regional Authority Land and Sea Management Unit (TSRA LSMU) Rangers also received training in two reef monitoring techniques: the AIMS manta tow surveys and the GBRMPA Reef Health and Impact Surveys. Another temperature and depth logger was also deployed at Erub, with the help of TSRA LSMU Rangers, taking the total number of long-term monitoring stations to sixteen.

The project team also developed models of current and forecast bleaching risk for integration with real-time data displays along with the climatology data. Monthly updates of current ocean conditions were circulated and show that Torres Strait Sea surface temperatures (SST) were at or below average during the 2012/13 year, with only March and April experiencing above average SST. The satellite view for MODIS satellite imagery was also enlarged to include northern and western Torres Strait, at 1km resolution.

Temperature logger deployed on a concrete block at Mer (Murray) Island in the far eastern Torres Strait.
*Image: Ray Berkelmans, AIMS*

# Researcher Profile

## Jon Brodie

***James Cook University (JCU)***

Prior to taking up the position of Water Quality Scientist at JCU, Jon Brodie spent some years as a lecturer in chemistry at Queensland University of Technology (Brisbane) and at the University of the South Pacific (Suva, Fiji). For the past 30 years, his interests have been in environmental research and consultancy and the management of marine and freshwater pollution in Australia and overseas.

Mr. Brodie's primary area of research involves water quality issues on the GBR, from the catchment to the GBRWHA itself. Work includes estimation of water composition, pollutant loads and source areas as well as modelling, catchment monitoring and target setting for suspended sediments, nutrients and pesticide loads. He is also involved in projects aimed at understanding the dynamics, distribution and land-use specific composition of river plume waters discharging into the Great Barrier Reef lagoon, and assessment of exposure of GBR ecosystems to terrestrial pollutants. Pollutants are also traced from the catchment to the GBR to help prioritise targeted areas for catchment management initiatives and investigations are underway on best management practices for rangeland grazing and sugarcane cultivation in order to improve water quality management. Finally, his team is assessing best management practices in palm oil plantation development to protect off farm aquatic ecosystems (in PNG).

Good water quality is important to the health of the Torres Strait community and the environment. *Image: Suzanne Long*

**Project 4.4:** Hazard assessment for water quality threats to Torres Strait marine waters, ecosystems and public health.
*Project Leader: Jon Brodie, JCU*

*Project Background*

An understanding of the status of water quality in Torres Strait is important, particularly with regard to its influence on marine foods, human health, marine ecosystems and ecological processes in the region. Potential water quality issues include regional pollution such as discharge of metal and other pollutants from the Fly River associated with mining, the port at Daru, other mines in PNG and land clearing. Local pollution sources include sewage and stormwater discharges and pollution associated with shipping (e.g. dredging, oil spills, ship groundings, shipyards). No detailed water quality issues hazard analysis has been done for the region.

*Project Progress*

The project team assessed and described all existing and potential sources of pollution to the Torres Strait marine environment, and the hazard (and risk) of these pollutant sources to marine ecosystems and public health. Uptake of project outputs and outcomes was facilitated for key end-users and stakeholders, and the team designed a basic monitoring program to allow reporting on the status of water quality in the Torres Strait and assessments to be made as to the success of pollution management.

This project was completed in December 2012 and a final project report will shortly be circulated to regional stakeholders and made available on the NERP TE Hub website.

On the beach at Masig talking about sewage outfall with island councillor Fraser Nai and John Rainbird (TSRA). *Image: Jane Waterhouse (JCU)*

# Researcher Profile

## Dr. James Butler

***Commonwealth Scientific and Industrial Research Organisation (CSIRO)***

Dr. James Butler has a multi-disciplinary background in agricultural economics, terrestrial, freshwater and marine ecology gained in southern Africa, northern Europe and Australia.

His research interests are social-ecological systems resilience, adaptive co-management, ecosystem services and human well-being as concepts and tools for evaluating and mitigating current and future trade-offs and conflicts in natural resource management and sustainable livelihood development. His current focus is diagnosing community vulnerability to global change, including climate change, and designing multi-scale adaptation and strategies using participatory methods in tropical Australia and islands in the Asia-Pacific region.

The 'Best Case' future scenario depicting the Torres Strait in 2090 under conditions of a stable local population, strong culture and community cohesion, and favourable natural resource condition, combined with sustainable global economic growth, resulting in moderate climate change and sustainable development in adjacent PNG. *Image: James Butler*

**Project 11.1:** Building resilient communities for Torres Strait futures.
*Project Leader: Dr. James Butler, CSIRO*

### *Project Background*

The Torres Strait is a region of rich natural and cultural values, with strong linkages between its environmental assets, ecosystem services and the livelihoods of communities that rely upon them. The Torres Strait Treaty explicitly aims to protect these communities' livelihoods, and improve them through sustainable economic development. As Australia's northern border with Papua New Guinea (PNG), however, the region is under increasing pressure from PNG population growth, mining development, and exploitation and pollution of shared Torres Strait resources. Global pressures such as peak oil, shipping traffic and climate change will also have complex impacts on environmental assets, particularly when combined with human pressures. This uncertain future will present challenges for achieving resilient Torres Strait communities, but may also provide opportunities for sustainable economic development (e.g. ecotourism, aquaculture). Through participatory scenario planning with Torres Strait communities and stakeholders, informed by integrated ecosystem and climate modelling, this project aims to explore potential future scenarios for the region, and identify 'no regrets' strategies to protect livelihoods and achieve sustainable economic development.

### *Project Progress*

A series of three island community scenario-planning workshops were planned in March 2013 to address future scenarios and adaptation strategies. The first of these was held on Masig (Yorke Is) in July 2013, the second on Erub at the end of August and the third is to be held on Boigu in the near future.

Twenty-one community members attended the two-day scenario planning workshop on Masig, and brought together the project team's downscaled climate change and sea level rise projections, ecosystem services modelling and other scientific information, with local community members' knowledge. The workshop was split into five sessions with each addressing a specific question and delivering the following outcomes: 1) What are the drivers of change for livelihoods on Masig? 2) What are the desired and possible futures for the Masig community? 3) What impact will the Business as Usual future have on human well-being? 4) What is the resilience of the Masig community today? 5) What are the priority adaptation strategies to build a resilient Masig community? These results will be combined through integration and policy evaluation workshops in 2014 with those of other case study communities, and government stakeholders.

The Masig workshop report is available on the NERP TE Hub website.

Workshop participant drawing a scenario picture and creating a narrative. *Image: James Butler*

# Researcher Profile

## Dr. Susan Laurance

***James Cook University (JCU)***

Dr. Susan Laurance completed a PhD at the University of New England followed by a postdoctoral fellowship at the NASA Large-scale Biosphere Atmosphere Experiment in the Amazon (2002-2004) and the Andrew Mellon Foundation, Smithsonian Tropical Research Institute, Panama (2004-2006). She is currently a Research Associate at the Smithsonian Tropical Research Institute and has been a Tropical Leader and Senior Lecturer based at the School of Marine and Tropical Biology at James Cook University in Cairns since 2010.

Dr. Laurance's research is primarily focused on assessment of vulnerability and responses of tropical communities to environmental change. She is especially interested in the impacts of habitat fragmentation and climate change on community composition and dynamics, particularly with reference to key affected groups such as rainforest plants, birds, mammals and mosquitoes.

Dagmar Meyer Steiger, JCU Masters Student, studying disease vectors.
*Image: Susan Laurance*

**Project 11.2:** Improved approaches for detection of disease and prevention of spread in Torres Strait.
*Project Leader: Dr. Susan Laurance, JCU*

### *Project Background*

The Torres Strait has long been recognised as a biological bridge to mainland Australia, including for emerging infectious diseases, and there is concern regarding its potential to facilitate disease movement to the mainland. These diseases represent serious threats to human health, agriculture and biodiversity. This project focuses on improving understanding of how diseases move across the Torres Strait and what methods are best for detecting disease incursions and managing outbreaks within the region, particularly on the frontiers, predicted to be outbreak hotspots. 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. This project is trialling a novel method of capturing mosquitoes using yeast-baited traps in villages and native habitats and compared their efficacy with standard sampling methods.

### *Project Progress*

A novel sampling method has been developed that is more robust and efficient in remote locations. The project sampled mosquito communities on four Torres Strait islands: Saibai, Boigu, Moa and Badu, within villages and in bush habitat, using standard BG traps and the novel method of yeast-baited traps. The novel method of sampling mosquitoes worked successfully in villages and in the field but the standard BG trap failed to work successfully in the field due either to problems with power supply or the flimsy structure. The mosquitos sampled represent 21 species – with eight known to be disease vectors – and are being tested for disease identification. Resampling in the 2013/14 wet season aims to validate these results.

PBT with CO2 derived from sugar, yeast and water. *Image: Susan Laurance*

# Researcher Profile

## Dr. Eric Lawrey

***Australian Institute of Marine Science (AIMS)***

Following completion of a PhD on modelling improved techniques for wireless communication, Dr. Lawrey took up the position of Chief Technical Officer at Code Valley; a software engineering company researching a new way of developing software using distributed computing. In 2008 Dr. Lawrey joined AIMS as the e-Atlas developer and in 2011 took over as project leader for the e-Atlas, where he now focuses on data processing and stakeholder engagement.

Dr. Lawrey's current research interest is in design and development of the e-Atlas web platform, enabling knowledge developed through environmental science to be spatially visualised and told as data driven stories. This work includes development of web technology for delivery of the content, tools for processing environmental data and base-maps for the Great Barrier Reef, its catchments and the Torres Strait.

**Project 13.1:** e-Atlas. *Project Leader: Dr. Eric Lawrey, AIMS*

*Project Background*

This project is further developing the e-Atlas which is a website, mapping system and set of data visualisation tools for presenting research data in an accessible form that promotes greater use of this information. The e-Atlas serves as the primary data and knowledge repository for all NERP Tropical Ecosystems Hub projects, which focus on the Great Barrier Reef, Wet Tropics rainforest and Torres Strait. The e-Atlas captures and records research outcomes, making them available to research-users and hosts meta-data records, providing an enduring repository for raw data. It is also developing and hosting web visualisations to allow viewing of information using a simple and intuitive interface. In doing so the e-Atlas is assist scientists with data discovery and allowing environmental managers to access and investigate research data.

*Project Progress*

The e-Atlas (http://e-atlas.org.au) has a new front page, revised meta-database and individual project pages have been established as have links with the NERP TE Hub website. The project leader has now received data contributions from many NERP projects and is working closely with TSRA to integrate e-Atlas with their Integrated Management Strategy.

Additions and updates include shearwater seabird feeding tracks (Project 6.3 Brad Congdon); long term monitoring program (LTMP) COTS density modeling, update and animation; a new version of Atlas mapper (http://code.google.com/p/atlasmapper) and Torres Strait monitoring reef pages (http://e-atlas.org.au/ts/nerp-te/aims-monitoring-health-torres-strait-reefs-2-3).

National Environmental Research Program

TROPICAL ECOSYSTEMS hub

www.nerptropical.edu.au

The Reef and Rainforest Research Centre (RRRC) administrates the Australian Government's National Environmental Research Program Tropical Ecosystems (NERP TE) Hub.

Australian Government | Australian Institute of Marine Science

Griffith University

James Cook University Australia

The University Of Queensland Australia

CSIRO

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Reef & Rainforest Research Centre

**RRRC**
PO BOX 1762, Cairns QLD 4870
07 4050 7400
enquiries@rrrc.org.au