



Rainforest meets Reef: Joint conference of CRC Reef and Rainforest CRC

**22-24 November 2005
Townsville**

Conference Abstracts

Edited by Louise Goggin¹ and Tim Harvey¹

¹ CRC Reef Research Centre

CRC Reef Research Centre provides research solutions to protect, conserve and restore the world's coral reef ecosystems. CRC Reef Research Centre is a knowledge-based partnership of coral reef managers, researchers and industry. Partner organisations are Association of Marine Park Tourism Operators, Australian Institute of Marine Science, Great Barrier Reef Marine Park Authority, Great Barrier Reef Research Foundation, James Cook University, Queensland Department of Primary Industries and Fisheries, Queensland Seafood Industry Association and Sunfish Queensland Inc. The University of Queensland is an associate member.



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RAINFOREST MEETS REEF - CONFERENCE PROGRAM

Oral presentations


(Underlined speaker is presenting, *student presentation)

Day 1. Tuesday 22 November		
0730 Registration opens		
Time	Speaker	Title
0825	Russell Reichelt (CRC Reef), Nigel Stork (Rainforest CRC)	Welcome
0830	Christine George, (Wulgurukaba)	Traditional Owner welcome
0835	The Hon Warren Entsch MP	Opening Address
Session 1: Maintaining biodiversity in the face of change [Chair: Chris Margules (CSIRO)]		
0845	<i>Keynote talk</i> <u>Stork</u>	The importance of fundamental science to the long-term understanding, monitoring and protection of Australia's tropical forests
0915	<u>Williams*</u> , Johnson, Alford, Waycott	To be or not to be: rarity is the question
0930	<u>Jones*</u> , Maclagan, Krockenberger	Seasonal resource distribution and ranging behaviour in the folivorous green ringtail possum <i>Pseudochirops archeri</i>
0945	<u>Ferraro*</u> , Norman, Latch, Johnson	Population structure and taxonomic status of the mahogany glider <i>Petaurus gracilis</i>
1000	<u>Goosem</u> , Lawson, Gillieson	Faunal connectivity and restoration priorities for remnant riparian rainforest in coastal far north Queensland
1015	<u>Shilton</u> , Latch, McKeown, Westcott	Conservation management: spectacled flying foxes
1030	Morning Tea	
1100	<u>Kanowski</u> , Catterall, Wardell-Johnson	Biodiversity values of reforestation in cleared rainforest landscapes: current knowledge and emerging questions
1115	<u>Mitchell</u> , Dorney	The saga of Eric the feral pig
1130	<u>Moran*</u> , Catterall, Green, Olsen	Frugivores and seed dispersal in fragmented rainforest
1145	<u>Phinn</u> , Ticehurst, Barrett, Held, Scarth, Johansen	Mapping and monitoring Wet Tropics rainforest vegetation condition and structure

1200	<u>Begg</u> , Jones, Williams, Mapstone	Assessing management changes in the reef line fishery of the Great Barrier Reef
1215	Rasheed, Thomas, <u>McKenna</u> , Coles	Long-term seagrass monitoring in Queensland ports – revealing links between regional climate and seagrass change
1230	Lunch	
Session 2: Responding to climate change and building resilience [Chair: Steve Turton (Rainforest CRC/JCU)]		
1330	<i>Plenary talk</i> <u>Marshall</u> , <u>Williams</u>	Climate change and resilience: insights from two World Heritage Areas
1400	<u>Hilbert</u> , Li	Species habitat modeling in conservation biology and climate change impact studies: issues and new advances
1415	<u>Li</u> , Hilbert, Parker, Williams	Predicting the habitats of grey headed robin under different climate change scenarios
1430	<u>Rayner</u> *, Pearson, Pusey, Smithers	Climate change impacts on freshwater fishes of the Wet Tropics
1445	<u>Krockenberger</u> , Congdon	Developing mechanistic models of the effects of climate change on vertebrates: case studies from rainforest and reef
1500	Afternoon Tea	
1530	<u>Schuttenberg</u> *	Implementing resilience: translating science into policy
1545	<u>Wettle</u> , Brando, Dekker, Phinn, Roelfsema	Quantitative coral bleaching detection by satellite remote sensing
1600	<u>Lough</u>	Observed climate variability and change in the vicinity of the Great Barrier Reef
1615	<u>Berkelmans</u>	Coral reefs and climate change: understanding the potential for adaptation
1630	<u>Steinberg</u> , Choukroun, Mason, Bode, Skirving	Physical controls on coral bleaching along the Great Barrier Reef
1645	<u>Johnson</u> , Marshall, Goby	Climate change impacts on the Great Barrier Reef ecosystem: identifying risks and management responses
1700	Close	
1900	 <p>Public forum - The tropics in 2030: how will a changing climate affect our future?</p> <p>Victoria Park Hotel, Boundary St, South Townsville</p> <p>Public Forum organized by the Great Barrier Reef Marine Park Authority</p>	

Day 2. Wednesday 23 November		
Time	Speaker	Title
Session 3: Solutions for water quality issues [Chair: Peter Doherty (AIMS)]		
0815	<i>Keynote talk</i> <u>Morris</u>	Will our current approach to ecosystem science have the impact on the ground that we hope for?
0845	<u>Smajgl</u>	Integrated simulation methodology for the Great Barrier Reef
0900	<u>Clark</u>	The power of collaborative partnerships in achieving positive water quality outcomes for the reef
0915	<u>Brodie</u>	Sources and fate of terrestrially derived nitrogen in the Great Barrier Reef
0930	<u>Webster</u> , Atkinson, Brando, Brooke, Ford, Haese, Hancock, Herzfeld et al	The Fitzroy project – a study of the dynamics of an Australian tropical estuary
0945	<u>Haese</u> , Radke, Smith, Ford, Webster	Tracing nutrient sources and sinks in the Fitzroy estuary
1000	<u>Mitchell</u> , Brodie	Nutrient and suspended sediment conditions in pristine north Queensland streams and changes associated with agricultural and other land uses
1015	<u>Siddique*</u> , Lamb, Schmidt, Engel, Nardoto, Ometto, Martinelli	Nitrogen use and cycling in mixed tree plantings of contrasting functional composition on degraded land in southeast Brazil
1030	Morning tea	
1100	<u>Schaffelke</u> , <u>Haynes</u> , Furnas, Dekker, Muller, Gilbey, Sweatman, Coles, McKenzie, Negri, Mortimer	Monitoring water quality and ecosystem health in the Great Barrier Reef lagoon under the Reef Water Quality Protection Plan: an introduction to the program
1130	<u>Brando</u> , Dekker, Oubelkheir, Marks, Qin, Stevens, Hodge, Farthing	Remotely sensed monitoring of chlorophyll and suspended sediment in the coastal waters of the Wet Tropics region
1145	<u>Dekker</u> , Brando, Qin, Oubelkheir, Marks, Furnas, Slivkoff	Great Barrier Reef lagoon nearshore marine water quality monitoring by satellite remote sensing
1200	<u>Bainbridge</u> , <u>Masters</u> , Rohde, Brodie	Integrating a scientific approach into event-based community water quality monitoring programs: Preliminary results and lessons learnt from the Mackay Whitsunday and Burdekin regions, North Queensland
1230	<u>Mitchell</u> , Brodie	Testing simple sediment and nutrient methods for landholder use

1245	<u>Arthington</u> , Connolly, Kennard, Loong, Mackay, Pearson, Pearson, Pusey, James	Sentinels of change: a test of biological monitoring in wet tropics streams
1300	<u>Connolly*</u> , Pearson	Diversity in adversity: invertebrates weather impacts in streams
1315	Lunch	
Session 3: Solutions for water quality issues (continued) [Chair: Angela Arthington (Griffith Uni)]		
1415	<u>Fabricius</u> , Cooper, Humphrey, Klueter, Uthicke	Water quality specific indicators to assess and monitor the health, status and trends in nearshore marine ecosystems
1430	<u>Cooper*</u> , Fabricius, Humphrey, Neale	Coral-based indicators of the effects of water quality on nearshore reefs of the Great Barrier Reef
1445	<u>Klueter</u> , De'ath, Fabricius	Effects of turbidity and sedimentation of gene expression in the reef-building coral <i>Acropora millepora</i>
1500	<u>Uthicke</u> , Gottschalk, Heimann, Nobes, Fabricius	Small, smaller, smallest: foraminifera, diatoms and bacteria in biofilms as indicators for Great Barrier Reef water quality conditions
1515	<u>Cantin*</u> , Negri, Willis	Effects of long-term herbicide photo-inhibition on coral photosynthesis and reproduction
1530	<u>Markey</u> , Negri, Humphrey, Baird	High sensitivity of coral to insecticides and a fungicide
1545	<u>Lewis*</u> , Shields, Kamber, Lough	The development of coral proxies to assess water quality on the Great Barrier Reef
1600	Afternoon tea	
1630	<u>Slivkoff*</u> , Furnas	Water quality, ocean colour remote sensing validation and algorithm development for the Great Barrier Reef waters
1645	<u>Mahoney</u> , Steinberg, Slivkoff	Remote sensing atlas of the Great Barrier Reef
1700	Raupach, Schetteker, Briggs, Lovell, Oubelkheir, Marks, Brando, Byrne, <u>Dekker</u>	Integration of earth observation to assess land condition in Great Barrier Reef catchments and sediment delivery to the Great Barrier Reef lagoon waters: a feasibility study
1715	<u>Luick</u> , Mason, Hardy, Furnas	Circulation in the Great Barrier Reef lagoon using numerical tracers and <i>in situ</i> data
1730	<u>Saint-Cast</u> , Condie, Harris	The movement of murky waters jeopardizes marine life nurseries: a study of the circulation of water in the Torres Strait marine ecosystem.
1745	Close	

1830	 <p style="text-align: center;">Poster session Savoy room, Southbank Convention Centre (pre-dinner drinks and nibbles)</p> <p style="text-align: center;">Poster session sponsored by CSIRO</p>
1930	<p style="text-align: center;">Conference Dinner Raffles 2, Southbank Convention Centre</p>

Day 3. Thursday 24 November		
Time	Speaker	Title
Session 4: The role of science in conservation planning and management [Chair: Sheriden Morris (CSIRO)]		
0830	<i>Keynote talk</i> <u>Chadwick</u>	The role of science in conservation planning and management
0900	<u>Burrows</u>	The role of coastal wetlands and priorities for their management along the Great Barrier Reef coast
0915	Smith, Brunner, <u>Costen</u> , Rasheed	Science informing management to ensure sustainable ports in Queensland
0930	<u>Coles</u> , Beumer, McKenzie, Rasheed	Seagrass fisheries habitat in Queensland coastal waters and issues for their protection and management
0945	<u>Dutra</u> , Gill, O'Loughlin, Wolfenden	Adaptive stakeholder learning network governance arrangements: managing the impact of reef resilience from agricultural run-off in the Burdekin River catchment
1000	<u>Jones</u> , Williams, Begg, Mapstone, Welch	The benefits of stakeholder-driven research for fisheries management in the reef line fishery of the Great Barrier Reef
1015	<u>Pears*</u> , Williams	Does the scientific evidence support popular beliefs about artificial reefs?
1030	Morning tea	
1100	<u>Gordon*</u> , Seymour	Increasing tourist safety: science, technology and box jellyfish
1115	<u>Seymour</u> , Gordon	Myths, evidence and decision-making: box jellyfish occurrence and stinger net removal
1130	<u>Gershwin*</u>	Managing dangerous jellyfishes: a phylogenetic approach
1145	<u>Harris</u> , Heap, Hinde, Woods	Applications of geological information to the selection of candidates for a representative Marine Protected Area network in northern Australia
1200	<u>Roelfsema</u> , Phinn, Wettle, Dekker, Mumby	Monitoring and management of coral reef benthos: the role of remote sensing applications in eastern Australia, Fiji, Solomon Islands and Belize
1215	<u>Kininmonth*</u> , Schaffelke	Monitoring the monitors: review and assessment of the long-term monitoring activities in the Great Barrier Reef
1230	Lunch	

Session 5: New era of environmental governance and institutional change [Chair: Nigel Stork (Rainforest CRC)]		
1330	<i>Plenary talk</i> <u>Wilkinson</u>	Putting the pieces together: making integrated coastal management work for tropical resource conservation
1400	<u>Ross</u> , Innes, Robinson, Hockings, George	A framework for designing co-management for the Great Barrier Reef World Heritage Area
1415	<u>Ross</u> , Innes, Robinson, Hockings, George, Izurieta	The CRC Reef co-management projects: shaping ways forward for Indigenous peoples and agencies in marine and coastal environmental management
1430	<u>Halliday</u> , Butler	ARC's role in decision-making related to cultural heritage and land management in the Wet Tropics World Heritage Area
1445	<u>Jones</u> , Barnett	Making sense of science – sensitively: protocols, tools and techniques for better communication of science in Torres Strait.
1500	Cinner, <u>Bond</u> , Sutton	The role of socio-economic factors in traditional coral reef management in Papua New Guinea
1515	Afternoon tea	
1545	<u>Marshall</u> *	How institutional change can affect social resilience within the commercial fishing industry
1600	<u>Hempstead</u>	Developers in new locations: partners or plunderers?
1615	<u>Bentrupperbaumer</u> , Reser, O'Farrell	Does it matter whether visitors know whether the site they are visiting is in a World Heritage Area?
1630	<u>Hill</u>	Science for community participation: a tool to engage the community in coral reef conservation
1645	<u>Gooch</u>	Learn and pass it on: learning and networking for community change
1700	<u>McKenzie</u> , Mellors, Yoshida, Coles	Seagrass-Watch: a community-based monitoring program - 1998-2005
1715	Close	

* Student presentation

POSTER PRESENTATIONS	
Bartley, <u>Disher</u> , Keen	Using historical aerial photos to evaluate bank erosion on the Daintree River
Bartley, <u>Keen</u> *, Disher	Bank erosion in the wet tropics: preliminary results from the Daintree River
Bastin, Wallace, Abbott, Chewings	Landscape Leakiness: Monitoring the Health of Grazed Rangelands
Bohnet	Alternative Futures for Great Barrier Reef Catchments
Byrnes*	Roads and mammal movement: implications for dispersal and foraging behaviour
Daniell, Harris, Heap, Hemer	The morphology and mobility of sand banks in north-west Torres Strait
Dawe	If a car passes by a forest – do the critters care? An examination of the effects of highway noise disturbance in a North Queensland rainforest
Dawes-Gromadzki, Cook, Liedloff, Brandis	Healthy Soils, Healthy Water: Managing grazing lands to maximise water use benefits and sustain productivity through maintaining and improving soil health
<u>Faithful</u> , Brodie	Runoff water quality from wet tropics land uses: a comparison of banana, cane and pine plantation watersheds
<u>Fletcher</u> , Wicks	Barron River rejuvenation project - “the green corridor”
<u>Flick</u> *, Caltabiano, Bentrupperbäumer	Retired farmers’ view of riparian forests
Glen, Haenfier, Wallwork	Implementing the Reef Water Quality Protection Plan
<u>Gooch</u> , Hickey	What teachers think about environmental education: conceptions of curriculum held by James Cook University student teachers
Gordon, Bastin, Charmley, Bohnet, Dawes-Gromadzki, McIvor, McLeod, Smajgl, Wallace	Sustainable grazing land management in the catchments adjacent to the Great Barrier Reef
<u>Grech</u> *, Marsh	Protecting dugongs in the Great Barrier Reef World Heritage Area
Hazel*	Vessel-related mortality of sea turtles in Queensland
Heap, Harris, Shipboard Scientific Party	Newly Revealed Active Submerged Coral Reef Province in Northern Tropical Australia, Southern Gulf of Carpentaria
Herr, Smajgl, Roebeling, Lynam	Catchment Futures - Basing water management in the Great Barrier Reef catchments on trans-disciplinary science and integration
Larson	Livelihood systems and wellbeing of the Great Barrier Reef communities

Marion, Jupiter, Hoegh-Guldberg, McCulloch, Dunbar	Mackay Whitsunday water quality and coral-mangrove ecosystem linkages since European colonization
McJannet, Disher, Hartcher, Hawdon, Keen, Stewart, Wallace	The filter functions of wetlands in the Tully-Murray floodplain
Metcalfe, Westcott, Williams	Terrestrial Biodiversity in a Complex Landscape
Morris	The Water for a Health Country Flagship GBR Catchment Theme: Integrating multi disciplinary science outcomes for on-ground solutions
Parsons, Cairns, Johnson, Robson, Shilton, Westcott	Spatial and temporal patterns of resource use by spectacled flying foxes
Pohlman	Internal fragmentation in the rainforest: edge effects of highways, powerlines and watercourses on tropical rainforest understorey microclimate, vegetation structure and seedling regeneration
Rader*	Home range and nesting in a tropical rainforest rodent <i>Melomys cervinipes</i>
Roebeling	Sustainable landscape management and development in the Great Barrier Reef region
Roebeling, Bohnet	Landscapes Toolkit for the triple-bottom-line assessment of future land use scenarios in Great Barrier Reef catchments
Rumsby*	Modelling the flushing of contaminants in the Port of Townsville
<u>Skandries-Martin*</u> , Phinn	Turn down the heat on tropical waters: linking riparian vegetation with thermal range
Spencer	Impact of coconuts on littoral forests in the Daintree region of north Queensland
Steicke, <u>Jegatheesan</u> , Zeng	Reductions in nutrient discharge from aquaculture through recycling of water utilising floating media and activated carbon filtration
Thuesen*	Biological barriers to gene flow and genetic population structure of an endemic rainbow fish <i>Cairnsichthys rhombosomoides</i>
Wallace, Bohnet, Disher, Ford, Gehrke, Hartcher, Hawdon, Henderson, Hodgen, Kroon, McJannet, et al.	Floodplain renewal in catchments adjacent to the Great Barrier Reef
Weston	Helping Herbie (and Rocky et al) cross the road

* Student poster

SENTINELS OF CHANGE: A TEST OF BIOLOGICAL MONITORING IN WET TROPICS STREAMS

Angela Arthington¹, Niall Connolly², Mark Kennard¹, Dominica Loong², Steve Mackay¹, Ben Pearson², Richard Pearson², Brad Pusey¹, Cassie James¹

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River health assessment tools, Task 3 of the joint Rainforest and Reef CRCs' *Catchment to Reef* program, is developing tools to monitor the health of stream systems in the Wet Tropics. This paper describes preliminary results from an extensive field test of methods at approximately 40 sites in lowland streams in the Russell-Mulgrave system, at the centre of the Wet Tropics. The test aims to elucidate the relationships between location along the stream, geomorphology, land use, water quality, riparian integrity, habitat quality and the occurrence of stream plants, invertebrates and fish. These relationships will underpin the development of models from which monitoring tools will be derived. This concentration of effort and the simultaneous sampling of such a wide range of factors and taxa is a first for the Wet Tropics, providing a model for development of monitoring systems elsewhere in Reef catchments. It will contribute substantially to the river health monitoring manual that will be one of the major outputs of the *Catchment to Reef* program.

COMMUNITY-BASED WATER QUALITY MONITORING IN THE BURDEKIN RIVER CATCHMENT

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Increased sediment and nutrient inputs from terrestrial runoff are major threats to the Great Barrier Reef lagoon and other downstream environments in north Queensland. The Burdekin River is the largest source of sediment and nutrient discharge into the GBR lagoon, with an estimated average delivery of 3.77 million tonnes of fine sediment each year. Effective runoff management requires that remedial management actions be targeted at locations where the most benefit can be achieved. To determine how sediment and nutrient transport and delivery varies between different parts of the Burdekin catchment, in 2003, we established a water quality monitoring program targeting wet season events at end-of-catchment locations for 20 major waterways. This data will also act as a baseline dataset for examining trends in delivery over time and act to validate modelling such as SedNet. Due to the irregular timing of event sampling and the considerable size of the Burdekin catchment (133,510km²), it was necessary to develop a network of landholder volunteers and cooperating agency staff for sampling. The success of this joint effort was proved during the January 2005 rainfall event, where the most comprehensive set of samples for any one event in the Burdekin region was collected. Suspended sediment and nutrient results so far show considerable variation in concentrations between sub-catchments, ranging from high concentrations in the Bowen and upper Burdekin sub-catchments to low concentrations in the Cape-Campaspe sub-catchment.

** This talk will be delivered in conjunction with the talk by Masters, Rohde and Brodie*

BANK EROSION IN THE WET TROPICS: PRELIMINARY RESULTS FROM THE DAINTREE RIVER*

Rebecca Bartley¹, Rex Keen², Mark Disher²

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There is increasing evidence that the Great Barrier Reef is under threat from excess sediment and nutrient runoff derived from catchments adjacent to the GBR coast. Yet we have a poor understanding of the main processes responsible for the excess sediments and nutrients. Three processes are considered to be responsible for sediment and nutrient loss: sheet, bank and gully/drain erosion. Bank erosion is the most poorly understood of these processes, and very little or no quantitative data on bank erosion exists for the wet tropics.

The main aim of this study is to determine the annual average bank erosion rate along the Daintree River. The methods for measuring bank erosion include: (i) channel measurement and (ii) historical aerial photo interpretation. This poster deals with the results of the first year of channel measurement data.

Two methods were used to assess bank erosion: (i) cross-sectional surveys and (ii) erosion pins. Ten cross-section sites and 14 erosion pin sites were installed on the Daintree in 2004. The results from the first year of measurement suggest that the mean bank erosion rate varies between 4 mm and 26 mm, and at two of the study sites there was net deposition, rather than erosion, recorded. The cross-section data suggests small amounts of bank erosion are occurring at some sites and the majority of cross-sections appeared to be undergoing in-channel bed scouring. This is very preliminary data, and many more years of measurement, particularly from larger flow events, will be required before annual average bank erosion rates can be obtained.

** Poster presentation*

USING HISTORICAL AERIAL PHOTOS TO EVALUATE BANK EROSION ON THE DAINTREE RIVER*

Rebecca Bartley¹, Mark Disher², Rex Keen²

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²CSIRO Land and Water, Davies Laboratory, Douglas, Townsville Qld 4814

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River systems are not static features in the landscape; they migrate across floodplains which results in erosion and deposition in different parts of the river. It is difficult to determine whether a river that is actively moving across a floodplain is doing so as a result of natural hydrological forces, or whether human induced factors (e.g. tree clearing) have accelerated the erosion rate.

One method of assessing the rate at which rivers have moved over time is to use historical aerial photography. Aerial photos only go back to the 1940's, however, this provides a 60 year snap shot of how much a river has changed. The historical data then allows for contemporary erosion rates that have been measured in the field to be put into perspective with the 60 year record. This may help determine if erosion has actually accelerated along the river in response to tree clearing or boating traffic.

This poster presents the preliminary findings of the aerial photo analysis conducted on the Daintree River between the top of the floodplain and the coast. The initial results suggest that channel change has been relatively consistent over time, although there is considerable variation along the river. Further work will look at quantifying the historical erosion rate and comparing it to measured field data.

* *Poster presentation*

LANDSCAPE LEAKINESS: MONITORING THE HEALTH OF GRAZED RANGELANDS*

Gary Bastin, Jeremy Wallace, Brett Abbott, Vanessa Chewings

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A common theme of the Water for Healthy Country flagship is that improved land management is integral to improved water quality, both in the streams draining to the Great Barrier Reef (GBR) and in the lagoon itself.

In order to target and assess management, we need to know where problem areas exist and to monitor responses over time. At present there is no technology to provide this information at management-relevant scales for the GBR catchments.

One concept that should prove useful is the notion of 'landscape leakiness'. Healthy grazed landscapes have a high and uniformly distributed cover of persistent vegetation, particularly perennial grasses. This vegetation retards runoff and associated loss of organic matter, plant nutrients and seed in transported sediment. As perennial cover declines and becomes more patchy, runoff and erosion increase and landscapes become more leaky.

Techniques are proposed to monitor landscape leakiness through time using digital elevation models and satellite imagery. We will test this method, and others, for their effectiveness in monitoring the health of grazed rangelands in parts of the Burdekin catchment. We will then adapt and apply the most effective methods to determine trends through much of the grazed rangelands of the GBR catchment.

* *Poster presentation*

ASSESSING MANAGEMENT CHANGES IN THE REEF LINE FISHERY OF THE GREAT BARRIER REEF

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The reef line fishery of the Great Barrier Reef is the largest coral reef fishery in Australia, both in terms of value and magnitude of harvest. In recent years, the fishery has undergone significant management changes in terms of increased spatial closures and the introduction of an individual transferable catch quota system that have impacted on fisher behaviour and harvest characteristics. We provide insights into assessing the effects of these changes based on our experiences from 10 years of monitoring the reef line fishery as part of the Effects of Line Fishing (ELF) Experiment. We discuss the utility of various sampling methods with respect to measures of population diversity in the fishery and how these relate to management changes. Future monitoring of the fishery must be tuned to specific assessment requirements to effectively inform management decisions.

DOES IT MATTER WHETHER VISITORS KNOW WHETHER THE SITE THEY ARE VISITING IS IN A WORLD HERITAGE AREA?

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The paper addresses this knowledge, awareness, status question in a variety of ways. Firstly it examines the awareness of visitors of the World Heritage Area (WHA) status of the Wet Tropics, their ability to fully appreciate its attributes and qualities, the potential of this awareness to appreciably change the expectations, experience, appreciation, or behaviour of visitors, and how WHA awareness can sensitise and direct attention, perceptions, involvements, and judgements. Secondly, consideration is given to the communication of the World Heritage status of a site, what such status means to the average visitor and local resident, whether this is a necessary and/or important part of the management agency's responsibility to *present* the Area, and whether it is an integral and effective part of managing visitor impacts. Understanding how important and consequential profiling and branding of a protected area as a WHA to broader visitation and use is clearly essential from a management perspective. These topics are addressed through a consideration of research findings from a number of successive surveys of visitors and local residents undertaken in the Wet Tropics bioregion and at visitor sites within the Wet Tropics World Heritage Area (WTWHA). The questions and findings are also considered from an environmental psychological perspective which examines the WHA experience and encounter of the individual visitor, and the importance of a WHA mindfulness to this experience.

CORAL REEFS AND CLIMATE CHANGE; UNDERSTANDING THE POTENTIAL FOR ADAPTATION

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Coral reefs are one of the most sensitive ecosystems to climate change. Research into the ability of corals to acclimatize to warmer conditions has shown limited potential, possibly due to the relatively simple makeup of corals. Recently however, research focused on the symbiosis of corals with zooxanthellae has shown that thermal tolerance in corals is substantially linked to the tolerance of their symbiotic partner. Since there are many types of zooxanthellae and the symbiosis appears to be flexible, there may be substantially more thermal acclimation potential than first thought. However, will it be enough to keep up with climate change? What are the ecological tradeoffs to acclimatization? Latest research findings addressing these questions will be presented.

ALTERNATIVE FUTURES FOR GREAT BARRIER REEF CATCHMENTS*

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The future of the Great Barrier Reef (GBR) catchments and its residents will be shaped by a range of certain and uncertain driving forces. Moving towards a more sustainable future pathway that, for example, reverses the decline in water quality, requires an understanding of the critical issues and dynamics driving change in these catchments. This understanding is essential to planning for a more sustainable future and to develop enabling strategies. A scenario technique will be used to develop sets of alternative futures for the whole of the GBR catchment; further alternative futures will be developed for the Tully-Murray and the Bowen-Broken catchments. The three projects not only allow for consideration of issues that are important at the regional and local scale, but also capture two very different landscapes types in the GBR region, i.e. a coastal landscape dominated by sugarcane and bananas and prone to flooding, and a hinterland landscape dominated by grazing and high rainfall variability. The scenarios will be developed in collaboration with regional stakeholders and local communities respectively to achieve a multitude of goals. These include integration of various kinds of future-orientated data, to raise awareness of environmental risks and uncertainty, to provide a forum where social learning can take place and to expand the mental models of the participants. The future scenarios will also provide fundamental information for the different models being developed in the GBR region.

* *Poster presentation*

REMOTELY-SENSED MONITORING OF CHLOROPHYLL AND SUSPENDED SEDIMENT IN THE COASTAL WATERS OF THE WET TROPICS REGION

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The results are presented of a project undertaken for the Coastal Catchments Initiative (CCI) in the Mossman-Daintree region to assess the utility of satellite remote-sensing for monitoring of chlorophyll and suspended sediment concentrations in the nearshore coastal waters of the Great Barrier Reef. The image data is provided by the two MODIS (MODerate resolution Imaging Spectroradiometer) sensors currently in operation. One objective of this project was to trial and demonstrate the feasibility, utility and accuracy of routine remotely-sensed measurement of suspended sediment and chlorophyll concentration covering the Cairns to Cape Tribulation coastal waters. The second objective was to develop a methodology and derived product(s) that can be used by environmental management agencies to measure compliance of coastal and estuarine waters with specified water quality objectives.

Examples of a full year of MODIS Aqua data (approximately 300 scenes) for chlorophyll and total suspended matter will be presented in the form of daily, weekly, monthly and year images derived products, including water quality compliance maps.

SOURCES AND FATE OF TERRESTRIALLY DERIVED NITROGEN IN THE GREAT BARRIER REEF

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The discharge of nitrogen compounds from rivers draining to the Great Barrier Reef (GBR) lagoon has changed greatly due to agricultural development in the last 150 years. Prior to the introduction of pastoralism and fertilised cropping nitrogen loads would have been low and dominated by dissolved organic nitrogen (DON). With beef grazing came increased soil erosion and a large increase in the quantity of particulate nitrogen (PN) and a moderate increase in dissolved inorganic nitrogen (DIN). With fertilised cropping (sugarcane and horticulture), mainly since about 1960, came a large increase in DIN (mainly nitrate) in river flow. PN, DON and DIN all have very different transport, dispersion and fate after discharge to the marine environment in large river flow events and very different bioavailability characteristics. Most particulate matter, including PN, is trapped through sedimentation close to the river mouth (within 5 km) in flood events. Suspended particulate matter (SPM) concentrations drop from approximately 1000 - 3000 mg l⁻¹ in the river to < 100 mg l⁻¹ in this zone. The small proportion of the SPM and contained PN, which is not trapped near the river mouth, is transported in the flood plume and thus dispersed over large areas of the GBR shelf. Subsequent to the flood the particulate matter may be resuspended by wave action and be transported north along the coast until finally trapped in estuaries, mangroves and northward facing bays. Dissolved nitrogen species (DON and DIN) are transported directly in the flood plume both across and up the GBR shelf for large distances (often hundreds of km). DIN is taken up by biological processes e.g. phytoplankton growth once light levels in the plume are adequate for photosynthesis. DON being, at best, only partially bioavailable may be transported even greater distances before being trapped. This differential transport of the nitrogen species is thus highly significant to their ability to interact with and pose a threat to GBR ecosystems. Similar differences also exist for phosphorus species. As different catchment-based industries generate and leak different nitrogen forms the risk posed by the different forms needs to be considered in the environmental management of the industries.

THE ROLE OF COASTAL WETLANDS AND PRIORITIES FOR THEIR MANAGEMENT ALONG THE GBR COAST

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In recent years, there has been considerable attention paid to restoration of coastal wetlands along the GBR coast, with such efforts now increasing even further. There is much hope for the benefits that this will achieve, especially in regard to reducing runoff to the Great Barrier Reef lagoon, though there is little scientific evidence to show the effect they might have. Different types of wetland will have different effects at different scales of events and depending on the nature of the downstream receiving environment. In this regard, the potential benefits need to be seen in their context and best results will be achieved with a landscape or floodplain-scale planning approach. For the health of the wetlands themselves, removal of aquatic weeds and fish passage barriers are probably the most common issue as these are the main cause of the poor water quality and fish diversity. Examples are provided of projects where although the wetlands in question were surrounded by intensive agriculture and have had their natural riparian zones, aquatic weed management still gave a significant improvement in their ecological value. The lessons from these for the future planning for wetland rehabilitation along the GBR coast will be discussed.

ROADS AND MAMMAL MOVEMENT: IMPLICATIONS FOR DISPERSAL AND FORAGING BEHAVIOUR*

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Roads impact rainforest mammals by directly causing mortality and indirectly causing road avoidance, edge effects and linear barrier effects. These all have implications for the movement of these animals at both small (foraging) and large scales (dispersal). These impacts on movement are poorly understood and it was therefore the aim of this study to examine the influence of roads of varying size, traffic volume and construction on the movement patterns and behaviour of medium-sized, ground-dwelling rainforest mammals. Three species were targeted- giant white-tailed rat (*Uromys caudimaculatus*), long-nosed bandicoot (*Perameles nasuta*) and musky rat-kangaroo (*Hypsiprymnodon moschatus*)- with individuals trapped being fitted with spool-and-line tracking equipment. These cotton trails were then mapped and movement patterns analysed using statistics and fractal analysis to determine potential effects of the roads on animal movement. The results are presented.

* *Student presentation*

* *Poster presentation*

EFFECTS OF LONG-TERM HERBICIDE PHOTOINHIBITION ON CORAL PHOTOSYNTHESIS AND REPRODUCTION*

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Diuron causes photoinhibition within the chloroplasts *Symbiodinium* sp. by binding to the D₁ protein of Photosystem II, subsequently blocking light induced electron transport and reducing the efficiency of photosynthetic processes. Adult coral colonies of *Acropora tenuis*, *A. valida* and *Pocillopora damicornis* were exposed to 1 and 10µg l⁻¹ diuron in flow-through tanks for 2-3 months to investigate the effects of photoinhibition on energy storage and development of gametes. Pulse Amplitude Modulated (PAM) fluorometry indicated photoinhibition within all three species. A reduction in maximum effective quantum yields ($\Delta F/F_m'$) of light adapted symbionts of ~80 % and 25 % was observed for the 1 and 10µg l⁻¹ treatments respectively. A reduction in maximum potential yields (F_v/F_m) of dark-adapted symbionts of ~60-85% (10µg l⁻¹ diuron) indicated significant damage to the D1 protein. Total lipid content as a measure of reproductive investment was reduced in the 10µg l⁻¹ treatment to 25% (*P. damicornis*) and 15% (*A. valida*) relative to the 0µg l⁻¹ colonies. Total egg number per polyp was reduced by 60 % (1µg l⁻¹) and 85% (10µg l⁻¹) within the *A. valida* colonies. These results indicate that coral species with a high dependence on energy from photosynthesis are negatively impacted by photoinhibition and diuron can reduce the reproductive output of reef building corals. Future studies will employ molecular and biochemical techniques to assess even more subtle, sublethal effects of herbicides on the coral host and the symbiotic zooxanthellae.

* *Student Presentation*

THE ROLE OF SCIENCE IN CONSERVATION PLANNING AND MANAGEMENT

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Natural resource management is a complicated business. When we make decisions about how to manage our natural resources we have to consider multiple, and often competing, environmental, social, economic, cultural and political issues. Opinions of different stakeholder groups are often passionately held and diametrically opposed to each other. In seeking common ground and, as far as possible, win-win solutions to environmental problems, we need objective information. We need information on the condition of the environment, the pressures placed on it and potential strategies to mitigate those pressures. In this context, the condition of the environment does not just mean the natural environment, but the human environment as well, including traditional, commercial and recreational uses. The critical basis of this information is science. Many disciplines can contribute valuable information to natural resource management. Anthropology, biology, chemistry, ecology, economics, psychology, sociology and many other disciplines of the social and natural sciences all play a part. In order for science to be understood and used for natural resource management, scientists need to work in partnership with communities, industries and natural resource managers. Only through co-operative efforts can we deliver the management initiatives to protect our natural resources, and our social, cultural and economic activities that depend on them, into the future.

THE ROLE OF SOCIO-ECONOMIC FACTORS IN TRADITIONAL CORAL REEF MANAGEMENT IN PAPUA NEW GUINEA

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Because of their perceived potential to meet conservation goals, traditional management techniques are being revitalized by communities, governments, and conservation groups as an integral part of marine conservation plans in the Pacific. However, it is uncertain whether traditional management can provide a solid foundation for the development of conservation strategies. Little is known about the social, economic, and cultural processes that enable communities to employ traditional management strategies. To examine which socioeconomic factors might influence whether a community employs or maintains traditional management, we compared socioeconomic factors in 14 coastal communities in Papua New Guinea. Rasch modelling was employed to aggregate household-level socioeconomic indicators into thematic interval-level variables. Socioeconomic factors in the communities that employ traditional closures of coral reefs were quantitatively compared with those of the communities that do not. Results showed that the constructs used to measure modernisation, social capital and occupational mobility had a slight but significant relationship to the presence of traditional closures, and the construct of dependence on marine resources was strongly related to the presence of traditional closures.

THE POWER OF COLLABORATIVE PARTNERSHIPS IN ACHIEVING POSITIVE WATER QUALITY OUTCOMES FOR THE REEF

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Drawing on the power of collaborative partnerships, the Consortium of Integrated Resource Management's Reef Catchment Working Group (RCWG) is focussed on improving water quality on the Great Barrier Reef through targeted research and development projects. The RCWG, comprising members from government agencies, research institutes and natural resource management regional bodies, aims to facilitate implementation of the Reef Water Quality Protection Plan (RWQPP) through improved communication and cooperation between policy development officers, resource managers and research providers.

The RCWG has compiled a summary of all R&D projects currently being undertaken, which address diffuse pollution from broadscale land use. The document is a valuable resource for all stakeholders, and will inform natural resource managers, research providers, industry and the community of the breadth of R&D activity currently in progress in Queensland's reef catchments. It will assist in coordinating research activity and facilitate communication between stakeholders.

A gap analysis has also been undertaken to identify research needs and gaps against the RWQPP strategies and set priorities for future research projects to support the RWQPP.

By working together in collaborative partnerships, limited research dollars will be more effectively used to bring out positive outcomes for water quality on the Great Barrier Reef.

SEAGRASS FISHERIES HABITAT IN QUEENSLAND COASTAL WATERS AND ISSUES FOR THEIR PROTECTION AND MANAGEMENT

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Queensland has around 7 000 km² of seagrass meadows in water down to 15 m deep and as much as 40 000 km² is in waters between 15 m and 60 m deep. There are 8 Genera and 15 species. Most of the shallow water seagrass is within Queensland state waters, however some of the deeper water seagrasses are in a Commonwealth or Great Barrier Reef Marine Park jurisdiction. All of the seagrass species in Queensland waters including dead plant material and parts of plants are protected under the Queensland Fisheries Act of 1994. Two approaches to management are used. A high level of protection is provided for approximately 280 km² of seagrass in marine protected areas called Fish Habitat Areas. Seagrasses outside of these areas, except for very small amounts can only be damaged or destroyed if a permit has been issued. We discuss the grounds for issuing a permit, including, rights, benefits, alternatives, mitigation and compensation, and fairness and hardship. We outline the hierarchy of legislation, regulation, management plans, environment management systems, policy, codes of practice and guidelines that are part of or structure the decision making process.

DIVERSITY IN ADVERSITY: INVERTEBRATES WEATHER IMPACTS IN STREAMS*

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Techniques for monitoring the health of freshwater systems include assessment of the biota, especially invertebrates, which indicate the suitability of habitats for their survival. Presence of a fauna that is typical of undisturbed reference sites indicates a healthy system; progressive disappearance of components of the fauna suggests progressive deterioration of habitat and water quality. However, very rarely has there been any attempt to link specific environmental stressors with specific responses of the fauna to provide independent calibration of techniques. This paper presents results of experiments in artificial streams and mesocosms that test the responses of stream invertebrates to elevated levels of nutrients and sediments and to reduced concentrations of dissolved oxygen, all of which can occur as a result of human activity in the wet tropics. The results demonstrate a surprising resistance of the fauna to acute, and in some cases chronic, impacts. This apparent pre-adaptation to human disturbance is explained by the adaptation of species to occasional natural disturbances. The results highlight the need to include such information in the design of monitoring programs.

* *Student presentation*

CORAL-BASED INDICATORS OF THE EFFECTS OF WATER QUALITY ON NEARSHORE REEFS OF THE GREAT BARRIER REEF*

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Simple and cost-effective indicators are required to examine the effects of changes in water quality on corals and to monitor the effectiveness of mitigative strategies implemented under programs such as the Reef Water Quality Protection Plan. The types of indicators that could be used to assess the status of coral reefs range from community-level measures to responses at the organism-level (also possibly at the cellular or molecular level).

The aim of this study is to combine information on physiology, population and community ecology of corals to identify indicators responsive to changes in water quality. To achieve this, we have tested the efficacy of a broad range of indicators within different regions and along gradients of water quality in the Great Barrier Reef.

This talk will summarise the responses of select indicators such as colony colour in massive *Porites*, the concentration of chlorophyll and the density of symbionts in *Pocillopora damicornis*, and changes in coral reef assemblages (i.e. scleractinian, octocoral and macroalgal groups) to differences in water quality among regions in the Great Barrier Reef and along a water quality gradient in the Whitsunday Islands.

* *Student presentation*

THE MORPHOLOGY AND MOBILITY OF SAND BANKS IN NORTH-WEST TORRES STRAIT.

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Sand banks are accumulations of sand, typically in a linear, S-shaped, or barchan form, and are indicative of mobile sediments and strong tidal currents. Investigations into sediment mobility and its potential impact on seagrass habitats have been undertaken around Turnagain Island, as part of the Torres Strait CRC.

Satellite Imagery, Repeat bathymetric surveys, and underwater video were used to observe the ways sand banks respond to tidal current and waves. The sand banks themselves were observed to move, on average, only 20m per year. However smaller sand dunes that are super imposed upon the banks themselves were seen to migrate at up to 1 meter per day and change their orientation with the seasons. Data from these surveys show that while oceanographic processes are a strong influence on the morphology of sand dunes, the positions of the sandbanks themselves change very little over time. These results indicate that migrating sand dunes have the potential to bury seagrass communities but only those that occur in a close proximity to the dunes themselves.

IF A CAR PASSES BY A FOREST - DO THE CRITTERS CARE? AN EXAMINATION OF THE EFFECTS OF HIGHWAY NOISE DISTURBANCE IN A NORTH QUEENSLAND RAINFOREST*

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Anthropogenic noise is an increasingly intrusive component of the acoustic environment of the Wet Tropics bioregion. Traffic noise penetrates tropical rainforest to distances exceeding 200 metres at both ground and lower canopy level (1 & 15 metres above the forest floor).

We examined transformation of the ambient acoustic spectrum in areas of rainforest subjected to road traffic flows of between 6000 and 10000 vehicles per day at the highway edge, 100 and 200 metres from the Kuranda Range Road. Profiles at both heights were derived from diurnal noise samples over 12-hour periods. This 1/3rd octave noise recording along eight 200-metre transects perpendicular to the highway, covered a range of topographic features, seasonal effects, meteorological conditions, commuting traffic peaks and weekend road usage patterns.

Bird habitation adjacent to highways was investigated through species richness and population density surveys of the avian community. Birdsong dominant frequency was analysed to examine whether highway noise causes alterations in birdsong to overcome acoustic blanketing by traffic.

Noise results will be used to calibrate noise models of the proposed Kuranda Range Road upgrade. Effects on bird abundance, species distribution and song from existing acoustic conditions will be considered in amelioration measures incorporated in design of the highway upgrade.

** Poster Presentation*

HEALTHY SOILS, HEALTHY WATER: MANAGING GRAZING LANDS TO MAXIMISE WATER USE BENEFITS AND SUSTAIN PRODUCTIVITY THROUGH MAINTAINING AND IMPROVING SOIL HEALTH*

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Declining soil health has become a critical issue within the Great Barrier Reef Lagoon (GBRL) catchments along north-east Queensland. Within the Upper Burdekin catchment, symptoms included increased soil compaction, reduced water infiltration and nutrient holding capacity, and increased sediment, nutrient and water run-off. A major finding of the 2003 MLA Research Report on 'Reducing Sediment Export from the Burdekin Catchment' was the recognition of the critical importance of maintaining, or recovering, soil hydrological function. The goal of the current project is to significantly improve pasture and livestock production and the quality of water in run-off by reducing sediment, nutrient and water loss from grazing lands through maintaining soil health. To achieve this, our project is addressing the following questions: (1) how does variation in grazing intensity affect water capture by landscapes, productivity, and sediment, nutrient and water runoff? (2) Under what circumstances can livestock enterprises profitably manage stocking rates to improve soil health and enhance water capture? (3) Do catchment-scale hydrological models based on plant cover, need to take into account variation in soil health? (4) What are the most appropriate tools to monitor and assess soil health? We present an overview of the experimental approach implemented and preliminary results.

* *Poster presentation*

GBR LAGOON NEARSHORE MARINE WATER QUALITY MONITORING BY SATELLITE REMOTE SENSING

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Initial results will be presented of this RWQPP involving the acquisition, processing, validation, interpretation and archiving of coastal satellite image products derived from MODIS satellite imagery. The information products to be delivered are: chlorophyll and suspended solids concentrations and Secchi disk depth in lagoonal and coastal waters of the GBRWHA. From these products that are available twice a day at 1 km spatial resolution relevant summaries need to be produced for the GBRWHA from suitable daily imagery data. Validation and parameterisation is carried out through measurements of surface and water column apparent and inherent optical properties as well as chlorophyll a and suspended particle concentration. Examples of information products are presented and issues around product development and dissemination will be discussed.

ADAPTIVE STAKEHOLDER LEARNING NETWORK GOVERNANCE ARRANGEMENTS: MANAGING THE IMPACT ON REEF RESILIENCE FROM AGRICULTURAL RUNOFF IN THE BURDEKIN RIVER CATCHMENT

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This paper will discuss how to collaboratively build a rich systems dynamics picture of the reef as a social, economic, and ecological system incorporating its surrounding agricultural lands in the Burdekin water catchment. A holistic systems picture will enable the various actors to learn about the dynamics, interrelationships and model the impacts of various agricultural practices across the whole reef system. This shared understanding will enable the partnering stakeholders to consider how new practices can deliver win-win outcomes that add to the resilience of the reef system. This methodology seeks to build stakeholder partnerships between local agricultural practitioners, reef researchers and reef managers as an adaptive, learning governance network structure. The second stage will develop a holistic terrestrial runoff management decision support methodology for the GBR management, explicitly connecting environment, communities and economics issues in order to implement whole system, total sustainability, from catchment to reef. This methodology enables a systematic procedure for developing and synergizing knowledge and understanding about system cause and effect relationships. The research output will be a simulator or 'learning laboratory' to explore, develop and test-bed policy options that takes into account a very broad range of implications and impacts.

WATER QUALITY SPECIFIC INDICATORS TO ASSESS AND MONITOR THE HEALTH, STATUS AND TRENDS IN NEARSHORE MARINE ECOSYSTEMS

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Nearshore ecosystems (coral reefs, seagrasses and other seafloor communities) are being exposed to increasing amounts of nutrients and sediments from cleared land and expanding agriculture. We are developing new cost-effective tools and protocols to monitor and assess the health of inshore ecosystems. Our objective is to find specific measures that respond to changes in water quality and distinguish these from symptoms caused by other disturbances. Three groups of measures are being investigated: (1) microbial communities in biofilms (diatoms, foraminifera and bacteria) and other sediment properties; (2) assessing sublethal stress in corals using specific measures in corals (microarrays and other genetic tools, physiology, and morphology) and (3) ecological measures in coral reefs (such as recruitment success, life history parameters in targeted species, species compositions and indicator species). These measures are considered for inclusion into a composite indicator system to detect early warning signs of water quality related stress, and to assess recovery at individual sites after the Reef Water Quality Protection Plan will have become effective. This talk will review and summarise the known responses of inshore ecosystems to terrestrial runoff, present an overview of the main assessment tools tested, and will conclude with an outlook on how water quality specific tools can be incorporated into future marine monitoring programs.

RUNOFF WATER QUALITY FROM WET TROPICS LAND USES: A COMPARISON OF BANANA, CANE AND PINE PLANTATION WATERSHEDS*

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Recent watershed runoff studies in the Wet Tropics have concluded that large amounts of nutrients and sediments are exported to receiving water environments during significant rainfall events within each annual wet season. This presentation will report on the range of nutrient and total suspended solids concentrations in runoff from plot-scale catchments located in banana and cane farm paddocks from two distinct tropical regions in Queensland over the past three years (Tully-Murray Rivers and Granite Creek near Mareeba) and harvested and un-harvested catchments within a pine plantation located near Kennedy over the past two years. Generally, median total nitrogen concentrations were similar for the agricultural runoff but median phosphorus and total suspended solids concentrations were higher from the banana paddocks. Nutrient concentrations varied largely in the plantation catchments depending on the proportion of land use type (e.g. native forest, harvested or un-harvested plantation, etc.) within each sub-catchment. The main difference in water quality between the agricultural and plantation land uses was the primary source of nitrogen comprising the total nitrogen being dissolved inorganic nitrogen from fertilisers (e.g. nitrate and or ammonia) in agricultural runoff and dissolved organic nitrogen (from surface runoff intercepting litterfall and plantation throughfall) in plantation runoff.

* *Poster presentation*

POPULATION STRUCTURE AND TAXONOMIC STATUS OF THE MAHOGANY GLIDER (*PETAURUS GRACILIS*)*

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The Endangered Mahogany Glider has an extremely restricted distribution within far north Queensland, occupying 720 km². Suitable habitat is highly fragmented, with a small proportion of this inside designated nature reserves. Current population size estimates total less than 3,000 individuals.

The focus of this research is the elucidation of taxonomic uncertainty and population genetic structure; factors that will affect future conservation efforts. These will be investigated via the analysis of mitochondrial (NADH-2) DNA sequence comparisons and nuclear DNA (microsatellites) variation.

Historical classifications, based upon morphological characteristics, have classified the Mahogany Glider as both a Squirrel Glider (*Petaurus norfolcensis*) subspecies and distinct species within *Petaurus*. The identification of a possible Squirrel Glider-Mahogany Glider hybrid further suggests incomplete speciation between these taxa. Phylogenetic analysis of mitochondrial DNA sequences will resolve its taxonomic status, while interspecific comparisons of nuclear sequences will identify the extent of hybridisation.

Determination of the Mahogany Glider's genetic population structure will be used to assess the impact of habitat fragmentation on population connectivity, while resolution of inter-/intra-population gene flow rates will identify instances of inbreeding depression. This information will be of use in the identification of potential habitat corridor sites and discovery of physical barriers that currently impede dispersal.

* *Student presentation*

BARRON RIVER REJUVENATION PROJECT - "THE GREEN CORRIDOR"*

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During early 2005, Cairns Port Authority signed a Memorandum of Understanding for the establishment of financial support for an initial 3 year period to the "*The Green Corridor*" initiative managed by the Barron River Integrated Catchment Management Association Inc. (BRICMA). The *Green Corridor* is a 20-year plus initiative that is to be delivered through a partnership between community, landholders, industry and government various projects that include research and rejuvenation along of the extent of the Barron River. This project aims to improve aspects of the biophysical qualities of the catchment, including improving water quality and subsequently enhancing riparian zones.

Cairns Port Authority, as a significant landholder adjacent to the lower Barron River has signed to support the project as an offset for development and operational impacts associated with infrastructure under its control, namely the Cairns Seaport and Airport. This poster presents a summary of Cairns Port Authority's commitments to the project, and an overview of the interactions with environmental management of Cairns International Airport and Cairns Seaport.

* *Poster presentation*

RETIRED FARMERS' VIEW OF RIPARIAN FORESTS*

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The ecological importance of intact riparian forests is well understood by scientists. The degradation and disappearance of these forests on far north Queensland's coastal streams (FNQ NRM Ltd & Rainforest CRC, 2004) is considered a major threat to water quality in the Great Barrier Reef Lagoon and therefore to the health of the Great Barrier Reef. Land care practices that involve draining, clearing and burning has been found to be the predominant reason for the degradation of riparian forests (Productivity Commission, 2003). The question of why landowners with riparian forests have not embraced ecologically sound management practices despite extensive information drives by land care agencies was investigated in a structured-interview survey of retired farmers in the area.

The social psychological approach in this pilot study of attitudes and beliefs towards riparian forests found that respondents have deep-seated and often erroneous opinions. These are based on their subjective observations and practical experiences which appear to moderate the impact of scientific information. The retired farmers also expressed low confidence in information and recommendations from government agencies. However, their responses often included a genuine appreciation of the riparian forests as places of peace and tranquillity, and as refuges for animals.

* *Student presentation*

* *Poster presentation*

MANAGING DANGEROUS JELLYFISHES: A PHYLOGENETIC APPROACH*

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Jellyfishes in the class Cubozoa are species rich and often abundant in Australian waters. They are geographically widespread in tropical and temperate waters and they have global significance both economically and recreationally as dangerous marine stingers. Phylogenetic relationships within the Cubozoa were inferred by comparing parsimony analysis of 31 species scored for 85 morphological characters against Bayesian maximum likelihood analysis of partial 18S rDNA sequences from 42 individuals representing 13-16 species. Numerous patterns are congruent and well supported in both data sets.

Practical application of these results has already begun. The Irukandji clade identified in this study contains at least two assemblages of medical interest, the *Carukia* spp. and the "Pseudo-Irukandji" group. Species from each of these sub-clades have been associated with Irukandji syndrome, the latter linked with a fatal sting event. These two groups are further sorted on numerous macro-morphological features, cnidomes, statoliths, behavioural patterns, and spatio-temporal distribution, and there is some indication that syndrome severity may sort along phylogenetic lines. The link between these species and symptoms remains to be conclusively shown, but the correlative evidence suggests it should be an active area of research.

A sound taxonomy is required as the basis for communication and comparison in all other types of cubozoan studies, such as ecology, toxinology, and basic biology, all of which will, in turn, be necessary for the successful management of Australia's jellyfish problem.

**Student Presentation*

IMPLEMENTING THE REEF WATER QUALITY PROTECTION PLAN

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The Great Barrier Reef (the Reef) is a nationally and internationally significant area with outstanding natural, social and economic values. Extensive modification within the Reef catchments since the beginning of European settlement has led to significant increases in pollutants (sediments, nutrients and chemicals) in waterways entering the Reef lagoon. While the vast majority of the 2900 reefs that make up the Reef are in good condition, this pollution threatens inshore reefs and ecosystems.

Single issue-based actions or policies by individual organisations are no longer an effective way to protect the Reef from this threat. The challenge is to change the behaviour of those whose actions impact on the Reef water quality.

In response to this challenge, the Australian and Queensland Governments, in partnership with a wide range of industry and community groups, developed the Reef Water Quality Protection Reef Plan (the Reef Plan). The Reef Plan was launched in December 2003 and is aimed at improving water quality by addressing diffuse pollution from broadscale land use. The Reef Plan proposes a range of actions by all levels of government, industry and community groups to halt and reverse the decline in water quality entering the Reef within ten years.

To achieve this goal, the Reef Plan has two objectives:

- to reduce the load of pollutants from diffuse sources in the water entering the Reef, and
- to rehabilitate and conserve areas of the Reef catchment that have a role in removing water-borne pollutants.

In particular, the Reef Plan:

- relies on a cooperative, partnership approach and commitment by industry and government to align their resources to achieve the Reef Plan's objectives,
- identifies the most at-risk catchments so efforts can target the areas of most need,
- provides a broad range of strategies and actions to achieve the Reef Plan's objectives,
- allocates milestones to each action and identifies the government agencies, industry and community groups who will implement the action, and
- identifies the monitoring and evaluation activity needed to measure the impact of the Reef Plan.

LEARN AND PASS IT ON: LEARNING AND NETWORKING FOR COMMUNITY CHANGE

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Most of us who teach about the environment realise that environmental education goes beyond classroom walls. This paper examines the results of a phenomenographic study that clearly demonstrates the importance of life-long learning in solving environmental problems. This paper discusses two conceptions that were revealed by a phenomenographic study of catchment volunteers along the east coast of Queensland. The aim was to capture all of the different ways that participants experienced the term 'catchment volunteer'. The study revealed that catchment volunteering was experienced as seeking and maintaining balance; developing/ maintaining an identity; empowerment; learning; networking; and sustainable. The conceptions of learning and networking are the focus of this paper, which builds on previous work linking learning and networking in environmental problem-solving. By promoting opportunities for learning and networking, members of stewardship groups can help whole communities respond to changing environmental conditions.

About the paper

This paper has been submitted to the Australian Journal of Environmental Education. It is derived from the author's doctoral thesis.

Dr Gooch would like to thank her supervisors, Professor John Fien (AES, Griffith University) and Dr Jeni Warburton (School of Social Work & Social Policy, at the University of Queensland), for their help and support in preparing this paper. She also thanks the volunteers who took part in the study, and to CRC for Catchment Hydrology who supported the work.

**WHAT TEACHERS THINK ABOUT ENVIRONMENTAL EDUCATION:
CONCEPTIONS OF CURRICULUM HELD BY JAMES COOK UNIVERSITY
STUDENT TEACHERS***

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This research analyses James Cook University (JCU) student teachers' understandings of curriculum and pedagogy relating to tropical environmental education. The data collection techniques include document analysis (the students' curriculum plans) and interviews.

Research questions include:

- What motivates student teachers to develop curriculum plans that have an environmental focus?
- What conceptions and/or misconceptions about complex environmental issues are evident in the student teachers' curriculum plans?
- What opportunities/barriers do student teachers face in developing unit plans about tropical environmental issues at James Cook University?

* *Poster Presentation*

FAUNAL CONNECTIVITY AND RESTORATION PRIORITIES FOR REMNANT RIPARIAN RAINFOREST IN COASTAL FAR NORTH QUEENSLAND

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Connectivity for wildlife constitutes a major goal for conservation outside protected areas. Many rainforest faunal species may be unable to traverse rural landscapes lacking closed canopy habitat. In sugar-producing coastal areas, closed canopy habitat is often restricted to thin remnant strips of riparian forest preserved by landholders to protect against stream bank erosion. Such riparian strips comprise potential movement 'corridors' for rainforest wildlife and also have important ramifications for water quality. Clearing to the stream edge allows growth of weeds or pasture grasses which are colonised by feral and native fauna of the alien habitat. Linear clearings for roads, powerlines and water-pipes create similar gaps in connectivity where they intersect riparian vegetation. Such gaps in forest cover can restrict movement of rainforest-dependent species and reduce effectiveness of riparian rainforest 'corridors'. Aerial photography, GIS analysis and field survey was used to assess riparian vegetation quality in Douglas Shire. Bird and small mammal abundance were related to riparian quality and faunal mobility. Priorities for restoration along streams were assigned to increase faunal connectivity whilst reducing erosion. Where revegetation is impossible (e.g. across roads), connectivity may be improved in infrastructure retrofitting or upgrades by overpasses for arboreal species, fauna-friendly bridges and culverts that allow passage of terrestrial species.

SUSTAINABLE GRAZING LAND MANAGEMENT IN THE CATCHMENTS ADJACENT TO THE GREAT BARRIER REEF*

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The grazing lands of the Great Barrier Reef (GBR) catchments contribute a substantial proportion of the sediments and nutrients that drain into the GBR lagoon. The basis of the Sustainable Grazing project is that improvements in water quality can best be achieved by demonstrating the productivity and economic benefits of science-based improved grazing management practices, leading to “Win-Win” outcomes for all concerned. The project is part of CSIRO’s Water for a Healthy Country programme and operates via the establishment and strengthening of partnerships with community, industry and government bodies that have a common interest in delivering improved water quality and protection of the GBR. The project has three primary objectives:

1. Develop the tools for the analysis of a ‘Win-Win’ scenario for the grazing production and improved water quality.
2. Quantify the economic and environmental cost /benefit analysis to achieve 60% of grazing lands in the GBR catchments in QDPI&F condition ‘A’ or ‘B’ by 2015.
3. Develop robust monitoring tools capable of demonstrating changes in water quality and landscape condition attributable to changed management practices.

This poster provides an overview of the range of bio-physical and socio-economic work that will be carried out to meet the above objectives.

* *Poster presentation*

INCREASING TOURIST SAFETY: SCIENCE, TECHNOLOGY AND BOX JELLYFISH*

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In coastal waters of Queensland north of Gladstone, the recreational use of near-shore waters for swimming activities revolves around the presence and absence of the box jellyfish, *Chironex fleckeri*. Over the past 20 years, major steps forward have been made into the prediction of the start and end of the season for these animals, however little is known about what drives their numbers and distribution within the season. Recently, a major tourist facility has been placed on a beach where the densities of box jellyfish are abnormally high. It is known that certain areas of a beach can contain significantly higher concentrations of these animals than does the rest of the beach, giving rise to the phrase that "80% of the animals will be found in 20% of the beach".

Using small radio transmitters we have been able to track adult box jellyfish and have shed significant light on to the movement patterns of these animals. By collecting these types of data, we intend to develop a movement model that will allow the determination of areas of beachfront which will theoretically have lower numbers of box jellyfish, hence illuminating theoretically safer areas where tourist attractions such as resorts and stinger enclosures should be placed.

**Student Presentation*

PROTECTING DUGONGS IN THE GREAT BARRIER REEF WORLD HERITAGE AREA*

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Abstract: The Great Barrier Reef Marine Park (GBRMP) Zoning Plan implements the Representative Areas Program by protecting biodiversity through a complex multiple use zoning regime including 33% 'no-take'. The 2004 GBRMP Zoning Plan and the associated zoning of the Great Barrier Reef Coastal Marine Park by Queensland were not designed to protect individual species, and their impact on such species is unknown. With dugongs as a case study, the GBRMP Zoning Plan along with other current management arrangements in the Great Barrier Reef World Heritage Area (GBRWHA) was evaluated on their combined capacity to protect an individual species.

Four activities were identified as potentially threatening to dugongs and their habitats: trawling, indigenous hunting, netting and adjacent land tenure. Based upon expert knowledge, each activities component was rated (high or less than high) on its ability to protect dugongs and their habitats. Netting restrictions in the GBRWHA provide a high level of protection for and estimated 56% of dugongs in the region; trawling restrictions 81%. Under the GBRMP Zoning Plan, 83% of dugongs in the GBRWHA are in an area with a high level of protection at any given time. When compared with the former zoning plan, this is an 11% increase.

* *Student presentation*

* *Poster Presentation*

TRACING NUTRIENT SOURCES AND SINKS IN THE FITZROY ESTUARY QUEENSLAND

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The Fitzroy Contaminants project of the Coastal CRC includes studies on processes affecting the nutrient dynamics within the Fitzroy Estuary and their impact on nutrient export to the Great Barrier Reef lagoon. Like most other tropical Australian estuaries, the Fitzroy encompasses zones where nutrient transformations are important including intertidal mangrove and mudflat areas, tidal creeks, and the turbidity maximum zone. A better understanding of the nutrient processing in these zones will enhance our capability to predict the response to changed land and waterway use. This presentation focuses on the fate of nitrogen species within the estuarine system including dissolved organic nitrogen (DON) and dissolved inorganic nitrogen (DIN) species, NH_4^+ and NO_x . Different biogeochemical processes affect the two fractions within the estuary. Process studies on intertidal mudflats and adjacent intertidal creeks demonstrate that mudflats serve as a major source of DON as well as a substrate for microbenthic algae growth. Presumably related to the tidal resuspension of the microbenthic algae, rates of organic matter decomposition are high in the tidal creeks and lead to an enrichment in DIN. The concurrent transfer of DON into NH_4^+ additionally indicates significant activity of heterotrophic bacteria.

ARC'S ROLE IN DECISION-MAKING RELATED TO CULTURAL HERITAGE AND LAND MANAGEMENT IN THE WET TROPICS WORLD HERITAGE AREA

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Many issues arise out of environmental management and cultural heritage which have a major bearing on decision-making in the management of the Wet Tropics World Heritage Area. This presentation will address, the attempts made by the Aboriginal Rainforest Council to address such issues.

The ARC deals with land management and cultural heritage the ARC facilitates effective interaction between Rainforest Aboriginal people and Wet Tropics Management Authority (WTMA), Environment Protection Authority (EPA), Queensland Parks and Wildlife (QPWS), Department of Natural resources and Mines (DNR&M), and Department of Environment and Heritage (DEH), through the Regional Agreement and advises and reports on land and cultural heritage management policies and programs. The ARC represents 18 tribal groups in the WTWHA and cuts across three NTRB boundaries. The ARC sees its role as a complementary to the governments, however many issues associated with roles and responsibilities still need to be clarified.

The Regional Agreement has widened the door for Traditional Owners to have a more equitable and beneficial role in policy, planning and permitting 'on country'. This opportunity in conjunction with implementing the Far North Queensland Natural Resource Management Board's Aboriginal Plan will deliver long awaited on ground outcomes at both the regional and local level in the WTWHA. It also enables Aboriginal groups to cultivate dialogue between today's contemporary culture providing for greater cross cultural awareness, respect and recognition of Traditional Owners within the wider community, regardless of the outcome of Native Title.

APPLICATIONS OF GEOLOGICAL INFORMATION TO THE SELECTION OF CANDIDATES FOR A REPRESENTATIVE MARINE PROTECTED AREA NETWORK IN NORTHERN AUSTRALIA

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Australia's Oceans Policy was declared in 1998 and is being implemented through the generation of a series of regional marine plans (RMPs), together with the selection of a national representative system of marine protected areas (MPAs). As part of the policy implementation we derived a national marine benthic bioregionalisation to provide planning units based on summaries of biological and geological information. Geoscience information has been used extensively to characterise habitats, bioregions and inform managers of the 'representativeness' of different proposed MPA candidates. Geological information is used because biological information is not available at the scales or broad spatial coverage that is needed by managers. A 'seascape' map (eg. Roff *et al*, 2003, *Marine and Freshwater Ecosystems*, 13(1):77-90) has been produced for the northern region using multivariate analysis, which incorporates geomorphic features, water depth, tidal bed stress, wave-induced bed-stress, and sediment properties. GIS analysis of the seascape map highlights areas of higher heterogeneity of seafloor habitats, which suggests areas of potentially high biodiversity. The results show that geoscience information is useful for identifying areas of seafloor that could be considered for inclusion in a representative system of MPAs.

VESSEL-RELATED MORTALITY OF SEA TURTLES IN QUEENSLAND*

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Within the Great Barrier Reef (GBR) area, threatened species of sea turtles attract considerable public attention and their nesting areas have long been the focus of conservation measures. However, turtles typically spend the major part of their lives far from their breeding locations. Important foraging grounds of GBR-nesting turtles lie both within and beyond GBR waters, and in some of these foraging grounds turtles may suffer significant mortality from a range of human impacts. Consequently populations of GBR-nesting turtles remain at risk despite strong protection of their breeding areas.

Vessel-related mortality has been recognised as one of the important threats to foraging sea turtles in some parts of coastal Queensland, particularly Moreton Bay, Hervey Bay and Cleveland Bay. Nevertheless the level of mortality has remained unclear and the circumstances of individual turtle-vessel collisions have remained a matter of speculation. My research seeks to provide new insights, based on four lines of enquiry.

To quantify turtle mortality from vessel-related causes I analysed stranding records collected by the Queensland Environment Protection Authority, which indicated at least 65 turtles killed annually from 1999 to 2002. To investigate the ability of foraging green turtles to avoid approaching vessels, I conducted experimental trials in clear shallow water and found that turtles' response rate diminished significantly as vessel speed increased. I have also started a series of short-term acoustic tracking sessions to investigate movement and activity of turtles in foraging areas near vessel traffic routes in Moreton Bay. Finally I will gather data on vessel frequency and traffic intensity in the same areas, in order to investigate the relationship between foraging turtle's use of space and exposure to risks from vessels.

* *Poster Presentation*

* *Student Presentation*

NEWLY REVEALED ACTIVE SUBMERGED CORAL REEF PROVINCE IN NORTHERN TROPICAL AUSTRALIA, SOUTHERN GULF OF CARPENTARIA

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A 400 km-wide active submerged coral reef province in southern Gulf of Carpentaria has been revealed by a Geoscience Australia marine survey. The survey, completed in April 2005, indicates that there are probably as many as 50 individual submerged coral reefs in the southern Gulf located on a region of submerged bathymetric highs. A detailed sampling program of six reefs, including shallow cores (<3 m long), revealed that they are comprised of framework corals and reef lagoon deposits. Longer cores show that the reefs have undergone several phases of growth and occur atop older reef deposits and indurated mudstones of the underlying bedrock. Underwater video footage shows that the reefs comprise abundant corals with coverage in places equal to that of patch reefs in the Great Barrier Reef (GBR). Ages for the reefs are not yet available. However, the cores and reef geomorphology indicate that the reefs are quite old, with most growth probably occurring during sea level high stands throughout the last 125,000 years. Modern corals form only a thin (<1 m) mantle over the older deposits. Key questions remain as to the exact age(s) of the reefs and timing of reef development, and why the reefs have not reached present sea level. Our results indicate that Australia's active coral reef province is more extensive than previously recognised.

DEVELOPERS IN NEW LOCATIONS, PARTNERS OR PLUNDERERS?

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As developers set their sights on new and 'pristine' locations, I argue that communities need to be pro-active in working with developers, and not just vainly hoping that some other 'white knight' will act for them and for the environment.

Local Governments see their responsibilities as local authority wide, and the attraction of increased revenue from head works and rates means that they may not always put the wishes of just one area of community or of long term environment management over the short-term financial benefits. Some local Governments also regard land as having owners with unalienable rights, rather than current owners being the current custodians - and in time this land will pass on to others.

On World-Heritage Magnetic Island, the Community Development Association has tried a pro-active approach to seek out developers, make contact and argue our case for them to embrace our values in their developments. Results vary - some first rate win-wins, some not at all successful, but at least the community has advocated its values. It is too late when inappropriate development has actually taken place to say 'we wish we had tried.'

CATCHMENT FUTURES - BASING WATER MANAGEMENT IN THE GREAT BARRIER REEF CATCHMENTS ON TRANS-DISCIPLINARY SCIENCE AND INTEGRATION*

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The Great Barrier Reef Catchment Theme (GBR Theme) has a goal to provide solution science to support landholders, decision makers and the community that underpins the implementation of the Reef Water Quality Protection Plan (Reef Plan): to improve water quality, wetland integrity and productivity, while enhancing regional communities and protecting marine based industries of the GBR from declining water quality. The *Catchment Futures Program* is one of three key program areas in the GBR Theme. It aims to facilitate the implementation of the Reef Plan's core objectives through undertaking integrative and trans-disciplinary science. The Program will identify mixtures of policy instruments that yield the greatest water use benefits for society, while achieving or exceeding the Reef Plan's objectives of halting and reversing the decline in the quality of water entering the Great Barrier Reef Lagoon within 10 years. The Catchment Futures Program integrates floodplain renewal and sustainable grazing research through underpinning science. This poster outlines the objectives of the Catchment Futures Program and highlights projects designed to achieve these.

* *Poster presentation*

SPECIES HABITAT MODELLING IN CONSERVATION BIOLOGY AND CLIMATE CHANGE IMPACT STUDIES: ISSUES AND NEW ADVANCES

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Modelling of the potential habitat of species is frequently used in a number of contexts: e.g., conservation biology, biogeography and forecasting climate change impacts. There are presently a large number of methods that can be applied that differ in several respects. However, there are a number of problems and issues, including data quality and specifics of the various modelling methods. In Australia, the most commonly used method for presence only data is BIOCLIM. While easy to apply this method has a number of drawbacks and there is some question as to its ability to project the impacts of global warming. The presentation will compare BIOCLIM with other methods (DOMAIN etc.) and present a new method called LIVES (Limiting Variable and Environmental Suitability). We will also present results concerning the challenges of using these methods to infer the likely impacts of climate change on species distributions.

SCIENCE FOR COMMUNITY PARTICIPATION: A TOOL TO ENGAGE THE COMMUNITY IN CORAL REEF CONSERVATION

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Government policy from the local to Commonwealth level is calling for genuine participation of the community in natural resource management. This involves community inclusion in the process of environmental monitoring, the interpretation of data and in management decisions.

Providing genuine opportunities for the community to participate in natural resource management has been proven to increase public support of and compliance with management policies. However, ill-informed participants can hamper management progress. Managers face the challenge of how to suitably educate the community so that participation in these activities is constructive and input into management decisions is informed.

Coral reef monitoring programs are still in their infancy, and scientists have a far from comprehensive understanding of how these complex ecosystems respond to human impacts. It is understandable that information collected by non-scientists is treated with caution. However, Queensland has a booming scuba dive industry and a world-leading marine science knowledge base. There is enormous potential to harness local divers and marine science students to assist with reef monitoring.

Reef Check Australia has developed a training system that provides experienced recreational divers with the skills to collect precise information on basic parameters of coral reef health. Coupled with the Reef Futures online reporting tool, this is a powerful way to train our community to participate in coral reef monitoring, and to engage with science and conservation issues.

CLIMATE CHANGE IMPACTS ON THE GREAT BARRIER REEF ECOSYSTEM: IDENTIFYING RISKS AND MANAGEMENT RESPONSES

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Climate change has the potential to affect a range of organisms and habitats on the Great Barrier Reef (GBR), including corals, seabirds, mammals, turtles, fish, plankton and other invertebrates. It is also expected to affect key processes such as currents, connectivity and calcification. To date, research has generally focussed on the consequences of climate change for corals. However, there is an urgent need to understand the full range of implications of climate change, and to identify strategies to mitigate impacts and improve or maintain the resilience of coral reefs. Over the next four years, the Great Barrier Reef Marine Park Authority (GBRMPA) is working with the Australian Greenhouse Office on a program aimed at identifying strategies to support the resilience of the Great Barrier Reef and the communities and industries that depend on it. The GBRMPA will gather and synthesise knowledge on the factors that confer resilience to the GBR ecosystem, and provide a better understanding of how stresses, such as poor water quality and overfishing, interact with climate change. A key part of the program is strong partnerships with reef-dependent communities and industries to assess vulnerability to climate change and identify adaptation strategies. The program will produce a Climate Change Action Plan for the GBR, which will identify and prioritise management strategies; list future research needs, and inform national and international policy.

MAKING SENSE OF SCIENCE - SENSITIVELY: PROTOCOLS, TOOLS AND TECHNIQUES FOR BETTER COMMUNICATION OF SCIENCE IN TORRES STRAIT

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A review of research directions in Torres Strait by Sen (2000) identified past research having limited value for Torres Strait Islanders. The reasons cited were: inadequate involvement of Torres Strait Islanders in the research; and limited dissemination of information from research to Islanders.

Torres Strait Islanders have an increased need for, and interest in, research in Torres Strait to enable them to participate fully in management processes. This places even greater onus on researchers to involve Torres Strait Islanders in the research wherever possible and to better disseminate research information in effective styles to Torres Strait Islanders and other stakeholders.

We have identified ethical protocols and procedures for researchers working in Torres Strait. We have also analysed a variety of communication techniques and media suitable for Torres Strait research. We believe that the effectiveness of research in Torres Strait will be enhanced by researchers following these protocols and using the suggested techniques. This will also increase the value of research to Torres Strait Islanders and provide greater benefits to island communities.

THE BENEFITS OF STAKEHOLDER-DRIVEN RESEARCH FOR FISHERIES MANAGEMENT IN THE REEF LINE FISHERY OF THE GREAT BARRIER REEF

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Cooperative Research Centres (CRCs) have established a new era in applied, user-driven research. The role of CRCs as brokers for partnerships of key stakeholders and research providers has ensured research outcomes are relevant and timely. This shift towards user-driven research has created a new paradigm for both what and how research is conducted.

The Effects of Line Fishing (ELF) Project has conducted applied research on the reef line fishery of the Great Barrier Reef for over 10 years. Key stakeholders in terms of fishers and managers have been actively involved and integrated in the ELF Project from the early design phases through to the communication of results. The assistance provided by fishers to the ELF Project has been essential, including in-kind contributions of vessel time, supply of biological samples, and input into the scope and direction of research. Using examples from the ELF Project, we discuss the benefits derived from a participatory approach to user-driven fisheries research, particularly those related to the reef line fishery of the Great Barrier Reef.

SEASONAL RESOURCE DISTRIBUTION AND RANGING BEHAVIOUR IN THE FOLIVOROUS GREEN RINGTAIL POSSUM (*PSEUDOCHIROPS ARCHERI*)*

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Local temperature increases associated with climate change are expected to elevate the water requirements of the cool-adapted rainforest folivores. Folivores require moisture for evaporative cooling and processing plant toxins, but have limited access to water due to the highly toxic effects of plant secondary metabolites (PSMs) ingested as part of a leaf-based diet. This paper examines the effects of leaf water content on food choice and ranging behaviour by *Pseudochirops archeri* (green ringtail possum), during a dry season (October to December 2004) and wet season (February to April 2005). Three tree species (*Aleurites rockinghamensis* (21%), *Ficus fraseri* (17%) and *Arytera divaricata*) (11%) accounted for half of all trees visited by *P. archeri* (n=524). The water content of mature leaves in these species was significantly higher in the wet season than dry ($P < 0.001$). There was an interaction between forest type and season; possums in small fragments had a larger range in the dry season ($P = 0.034$). We propose that the foraging range (and thus effort required to meet daily maintenance requirements) of *P. archeri* is correlated with foliage quality, in particular foliage moisture, which depends on season and fragment size. This trend provides support for the theory that rainforest folivores will be adversely affected by a warmer, drier climate.

* *Student presentation*

BIODIVERSITY VALUES OF REFORESTATION IN CLEARED RAINFOREST LANDSCAPES: CURRENT KNOWLEDGE AND EMERGING QUESTIONS

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Deforestation of rainforest landscapes in Australia and elsewhere has led to a loss of biodiversity and disruptions to important ecological processes. In response, individuals, communities and governments have invested time, effort and money to restoring rainforest to cleared land in order to recreate habitat, link remnant forest patches and buffer streams. As a result of a collaborative research undertaken within the 'Biodiversity values of reforestation project' of the Rainforest CRC, we now have quantitative information on the outcomes of these efforts, and of other types of reforestation (including regrowth and forestry plantations) for a range of attributes, for both tropical and subtropical Australia. Our results show that, at a site level, the biodiversity value of reforestation generally increases along a gradient of habitat quality, from floristically and structurally simple timber plantations to diverse restoration plantings. However, these results may not hold at a landscape scale, where quantity, configuration and context are also likely to affect biodiversity outcomes. We need to learn more about the biodiversity values of reforestation at broader scales of space and time. This may be achieved through projects which integrate ecological research and monitoring with landscape-scale reforestation schemes.

MONITORING THE MONITORS: REVIEW AND ASSESSMENT OF THE LONG TERM MONITORING ACTIVITIES IN THE GREAT BARRIER REEF REGION*

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Understanding the dynamics and resilience of Great Barrier Reef ecosystems and key biophysical processes is fundamental to mitigating threats posed e.g. by climate change, overfishing and decreasing water quality. Long-term monitoring of the physical, biological and socio-economic conditions of the GBRWHA ranges from large-scale monitoring by government and research organisations, to community monitoring in coastal environments with an educational focus. With the aim of providing decision support for optimisation of future monitoring activities CRC Reef collated metadata information about long-term monitoring projects that have occurred in the GBR World Heritage Area to 2003. Over 120 identified programmes were analysed, both spatially and thematically, within the context of addressing the major threats. Patterns regarding the distance of activity to population centres, effort per bioregion, effort distribution as a function of risk of incidence were complemented with analysis of program focus, duration and frequency. With only a few exceptions the location of sampling sites reflected the cost of access. Key bioregions were disproportionately sampled while the state of others remains unknown. This study identifies gaps in the spatial and thematic scope of past and current monitoring programs and provides a useful information tool for conservation and ecosystem management.

* *Student Presentation*

EFFECTS OF TURBIDITY AND SEDIMENTATION ON GENE EXPRESSION IN THE REEF-BUILDING CORAL *ACROPORA MILLEPORA*

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Deteriorating water quality is a growing threat for coral reefs worldwide. Hence there is an increasing need to establish effective and efficient methods to monitor the state of coral reef health. At present, however, reliable and efficient ways to measure the health of coral reefs are lacking. To develop a deeper understanding of the cellular stress responses concerning sublethal stress in corals, new approaches are required. Changes to cellular protein levels may be preceded by alternations in gene expression, making the study of gene expression patterns a powerful tool for exploring early biochemical pathways involved in stress responses. The aim of this project is to investigate the potential of using a molecular approach to investigate sublethal stress responses in the reef-building coral *Acropora millepora*. Using a tank system with controlled flow rate, light and temperature conditions, corals from inshore and mid-shelf locations were exposed to shaded and non-shaded conditions with and without suspended particulate matter (SPM). Significant changes to photosynthetic acclimation of the coral's symbionts were measured for both locations, but differed between locations. This talk will summarise the results of a large microarray approach, coupled with a physiological analysis, to evaluate the effects of turbidity and elevated levels of SPM on corals. It will conclude with advice on the usefulness of gene expression in *A.millepora* as a new tool for monitoring the health of coral reefs

DEVELOPING MECHANISTIC MODELS OF THE EFFECTS OF CLIMATE CHANGE ON VERTEBRATES: CASE STUDIES FROM RAINFOREST AND REEF

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The evidence for anthropogenically induced, enhanced greenhouse effect global warming is now overwhelming, but the magnitude of temperature change and nature of the impacts on biological systems are far less certain. A number of studies predict substantial impacts of climate change on a variety of systems, but notably Australia's Wet Tropics rainforests and the Great Barrier Reef. Currently there is very little, or no information on the mechanisms of potential effects, making the reliability of predictions difficult or impossible to assess. This paper discusses ongoing research developing mechanistic models of the effects of elevated temperatures on individuals and populations of vertebrates ranging from rainforest to reef.

LIVELIHOOD SYSTEMS AND WELLBEING OF THE GREAT BARRIER REEF COMMUNITIES*

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The proposed project presented in this poster has two main goals:

- a) to enhance understanding of the livelihood systems of individuals and hence the communities they contribute to; and
- b) to enhance understanding of mental models of wellbeing of individuals in the given community.

A livelihood system in this context represents set of activities and structures put in place by people to achieve their personal and/or family goals. Concept of human wellbeing refers to the set of domains that contribute to personal happiness/satisfaction, such as satisfaction of basic material needs, experience of freedom, health and personal security, good social relations or healthy ecosystems.

The project will contribute to the understanding of the major determinants and activities in the GBR catchment livelihood systems and domains of wellbeing, and, consequently, will contribute to advances in the development and application of tools and processes to build capacity to change. Both qualitative and quantitative data collection and analysis methods will be used in this project. The potential of the Bayesian probability model to add value to the data analysis will also be investigated.

** Poster presentation*

THE DEVELOPMENT OF CORAL PROXIES TO ASSESS WATER QUALITY ON THE GREAT BARRIER REEF*

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Large fossil mid-Holocene and modern *Porites* coral colonies from the inner Great Barrier Reef (GBR) at Magnetic Island provide a valuable resource to assess historical environmental change. These massive corals all contain continuous growth exceeding 100 years and faithfully preserve a detailed record of the seawater chemistry over their life spans. Trace element and isotope compositions recorded in the skeletal annual growth bands can be used to trace seawater salinity, terrestrial run-off and land practices after European settlement.

Coral oxygen isotope records suggest that salinity in the region varies naturally over time from relatively drier to wetter periods respectively. Rare earth element distributions (REE) and other geochemical tracers indicate that the mid-Holocene corals were subjected to an enhanced sediment influence and eventually succumbed to sedimentation. These proxies suggest there is no increased threat of sedimentation to the modern corals from Magnetic Island since European settlement in the region (c. 1854). However, there has been a significant rise in the coral Ba/Ca ratios suggesting that there has been an increase in sediment supply to the GBR lagoon since the arrival of Europeans. It is unlikely though that this extra sediment will have an adverse effect on the coral reefs in the Magnetic Island region.

Coral Mn concentrations provide a remarkable record of land use in the adjacent Burdekin River catchment. The coral Mn record fluctuates in sympathy with the fortunes of the first European sheep farmers in the region; rising dramatically with the introduction of intense sheep grazing after 1854, and collapsing in parallel with livestock numbers during harsher times, such as the 1895-1902 federation drought, before rising again during the intensification of agriculture after WWII.

Elevated Ba/Ca ratios and Mn concentrations recorded in the skeletal annual growth bands following European settlement (c. 1854) highlight the intimate connection between the terrestrial and marine environments.

* *Student presentation*

PREDICTING THE HABITATS OF GREY HEADED ROBIN UNDER DIFFERENT CLIMATE CHANGE SCENARIOS

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We predicted the potential habitats of grey headed robin under several climate change scenarios using bioclim, domain, lives and generalised linear model. The first three models were applied to presence-only data, and the last one was applied to abundance data. Climate change scenarios were factorial combination of temperature changed from 0, 1, 3, and 5°C of the current condition and precipitation changed from -20%, -10%, 0, 1%, 20% of the current rainfall. The predicted habitats of this species were compared among climate change scenarios and predictive models. The differences among the models and the overall response to climate change will be discussed.

OBSERVED CLIMATE VARIABILITY AND CHANGE IN THE VICINITY OF THE GREAT BARRIER REEF

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Global and regional climate is already changing due to the enhanced Greenhouse effect. Available instrumental records dating back to the 19th and early 20th century provide insights into climate variability, climate change and recent trends. Although air temperatures over Queensland and sea surface temperatures on the Great Barrier Reef are warming there is, as yet, no evidence of significant changes in the highly variable rainfall and river flow regimes of north Queensland. These are closely connected with variations in El Nino-Southern Oscillation (ENSO) events, decadal oscillations and tropical cyclone activity. Better projections of what may happen to these are required to understand the implications of a warmer world for north Queensland and the GBR.

CIRCULATION IN THE GREAT BARRIER REEF LAGOON USING NUMERICAL TRACERS AND *IN SITU* DATA

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Numerical models of the Coral Sea and Queensland shelf, combined with observed currents at Lark Reef, are used to provide improved estimates of flow trajectories and water residence times in the Great Barrier Reef (GBR) and GBR lagoon. Results are based primarily on a series of tracer experiments, with tracers released close to shore. Those released in the central section of the GBR lagoon during the first half of the year largely remained within 30km of the coast until exiting to the north or south, while up to 70% of those released in the latter half of the year crossed the lagoon to the outer reef; the median time required to do so varied between 20 and 320 days. The fate of neutrally buoyant particles entering the coast at the sites of major rivers is discussed.

REMOTE SENSING ATLAS OF THE GREAT BARRIER REEF

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The Australian Institute of Marine Science (AIMS) Remote Sensing facility provides reception, processing and interpretation of data received by the L-band receiver. It is widely distributed to national and international institutions. CRC Reef has combined with AIMS to develop an Atlas of the Great Barrier Reef (GBR) with the aim to make the data more accessible to local CRC research users.

The atlas consists of daily images of National Oceanic and Atmospheric Administration (NOAA) Advanced Very High Resolution Radiometer (AVHRR) sea surface temperature (SST) archive received at AIMS since 1990. In situ validation is being done by an automated ship-borne radiometer on the FantaSea ferry on a daily transect between Shute Harbour and Hardy Reef.

Ocean colour at approximately 3-day intervals are provided since 1997 from the Orbimage SeaWiFS sensor and since 2002 from NASA MODIS Aqua platform. Ocean colour products are being made through collaboration with NASA Goddard Space Flight Center. Ocean colour validation and algorithm development is also being done by Slivkoff, Furnas and Dekker.

The Atlas covers an area from 7 to 28 degrees South of latitude and 142 to 158 degrees East in longitude and has a spatial resolution of approximately 1 km. Delivery of imagery and data is now over the internet and publicly available. The SeaWiFS collection is however subject to research and educational use terms and conditions by Orbimage.

MACKAY WHITSUNDAY WATER QUALITY AND CORAL-MANGROVE ECOSYSTEM LINKAGES SINCE EUROPEAN COLONIZATION*

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The rapid expansion of agriculture (sugar cane and banana plantations), urban and port development along the Queensland coast of Australia is the most significant influence on inshore water quality in the Great Barrier Reef (GBR) over the past 200 years. In 2001, more than 80% of the GBR catchment (424,000 ha) supported some form of agriculture, and the majority of studies have indicated a 5 to 10 fold increase in nutrient and sediment delivery into the GBR lagoon since European settlement (post-1860). Yet it is often difficult to establish unambiguous linkages between upstream catchment land use change, deterioration of mangrove and estuarine ecosystems, degradation of coastal water quality, and coral reef ecosystem health. Long lived coral skeletons provide in-situ baseline measures of past seawater isotopic composition. Here we present preliminary results from the agricultural Mackay Whitsunday region, central GBR. Coral cores were collected across a representative inshore-offshore transect, from 6km off the mouth of the Pioneer River to midshelf reef sites 60km offshore. Coral luminescent banding patterns indicate that Pioneer flood plumes deliver fine-grained sediment and terrestrially-derived humic matter to the most distant reefs during major floods (~2-4 years), and to the inshore-midshore reefs annually. High-resolution trace metal analysis (Ba/Ca, Sr/Ca, P/Ca, Y/Ca) of the calcareous coral skeleton, and stable isotopic analysis ($\delta^{15}\text{N}$ / $\delta^{13}\text{C}$) of the non-carbonate organic matrix, is used to reconstruct baseline measures of total sediment delivery and nitrogen provenance in coastal GBR lagoon waters. Chemical fertilizers and urban wastewaters are isotopically distinct (enriched $\delta^{15}\text{N}$ values) from unimpacted terrestrial runoff, providing a means of identifying influxes of waste nutrients into the reef environment (Marion et al 2005). An acute mangrove dieback, linked to the incursion of waste herbicides and pesticides over the past 50 years, has resulted in a 30% loss of mangrove cover (Jupiter et al 2005). Coral geochemical records will be assessed within the context of the region's 160 year history of massive agricultural land use change, and the recent mangrove dieback, to develop the first insights into how increasing loads of anthropogenic runoff can influence inshore GBR ecosystem health.

* *Poster presentation*

HIGH SENSITIVITY OF CORALS TO INSECTICIDES AND A FUNGICIDE

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A wide variety of herbicides, insecticides and fungicides are used in catchments that flow into the Great Barrier Reef (GBR) lagoon. While recent research has revealed high sensitivity of coral symbionts and seagrass to herbicides, little is known of the effects insecticides and fungicides may have on these keystone organisms. Coral gametes, larvae and adult branchlets were exposed to four classes of insecticides: organophosphates (chlorpyrifos, profenofos); organochlorine (endosulfan); carbamate (carbaryl); pyrethroid (permethrin) and a fungicide (methylenechloride, MEMC) in a series of laboratory experiments. Fertilisation of gametes was not affected by any of the insecticides at concentrations up to 30µg/l, however metamorphosis was significantly reduced following an 18 hour pre-exposures to very low concentrations (0.03 – 0.10µg/l) of each insecticide class. Little mortality of larvae or adult branchlets was observed in insecticide exposures up to 10µg/l, although 96 hour exposures of adult branchlets to 10µg/l profenofos caused polyp retraction and slight reductions in photosynthetic efficiency of the symbionts. The fungicide MEMC affected all life history stages tested. Fertilisation was reduced at 1µg/l MEMC and metamorphosis at 0.1µg/l MEMC. The tentacles and polyps of adult branchlets became withdrawn at 1µg/l MEMC and reduction of photosynthetic efficiency, bleaching and tissue death was observed at 10µg/l MEMC. These results demonstrate that larval metamorphosis is extremely susceptible to four classes of insecticide used in catchments adjacent to the GBR. MEMC also proved highly toxic across all life histories of coral development tested.

HOW INSTITUTIONAL CHANGE CAN AFFECT SOCIAL RESILIENCE WITHIN THE COMMERCIAL FISHING INDUSTRY*

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Social resilience refers to the ability of people to cope with change and adapt. The concept is particularly useful in the management of natural resources since it can assist in predicting the social consequences of implementing institutional change. Institutional change refers to resource policies that determine who can access a resource, to what extent, when, where, how and under what conditions. Although institutional change is essential for the protection of resource integrity, institutional change has the capacity to erode 'socio-ecological' resilience. There is subsequently an urgent need to incorporate broader knowledge into the policy decision-making process so that conservation goals may be maximized and the social costs of resource protection may be minimized. In this study I examine aspects of institutional change (specifically design and delivery) that might influence social resilience. I develop a conceptual model of social resilience and test its applicability to the commercial fishing industry of North Queensland. One-hundred fishers were quantitatively and qualitatively surveyed. Results suggest that fishers have a multidimensional response to institutional change that is influenced by policy design and delivery. Results are discussed in terms of better understanding the socio-ecological system and in terms of optimizing outcomes for the management of the industry.

* *Student presentation*

CLIMATE CHANGE AND RESILIENCE: INSIGHTS FROM TWO WORLD HERITAGE AREAS

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Climate change is emerging as one of the most significant threats to the long term sustainability of the World Heritage values of the Great Barrier Reef and the Wet Tropics. Yet, we are only just beginning to understand the full implications of climate change, how it interacts with other stresses, and how management structures and strategies can operate to minimise the threat. A collaborative approach to research and management in these neighbouring World Heritage Areas is likely to enhance our understanding of climate change impacts and potential mitigation/adaptation strategies. Within the GBR, climate change is expected to degrade ecosystem condition through loss of habitat due to temperature-induced mortality of corals. In contrast, species losses are expected to overshadow habitat damage from climate change in the Wet Tropics. Despite the contrasting mechanisms of climate change damage to these World Heritage Areas, there are insightful commonalities. In both ecosystems, historical stability of environmental conditions is a strong predictor of vulnerability to future climate change. This knowledge provides an important platform for development of management strategies centred on protecting refugia. Also common to the future of both ecosystems is the importance of resilience-based management. Understanding the factors that underpin the resilience of species and habitats, and focusing management efforts toward local and regional stresses that erode it, are predicted to be critically important strategies for management responses to climate change in both the GBR and Wet Tropics.

COMMUNITY-BASED WATER QUALITY MONITORING IN THE MACKAY WHITSUNDAY REGION

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Event flows have been attributed as the major source of increased sediment, nutrient and pollutant runoff to the Great Barrier Reef lagoon and other downstream environments. In the Mackay Whitsunday region (9 000km²) these events are short lived and require intensive sampling to adequately capture the change in the nature and levels of contaminants. This resulted in the establishment of a community-based water quality monitoring program. In January 2005 two events were sampled at 22 catchment and subcatchment sites. Catchment sites were selected at gauged sites and grab samples were then collected across the hydrograph to calculate pollutant export loads to the reef lagoon. Subcatchment sites were determined on the basis of dominate land use (forest, urban/development, sugar cane and grazing), and at most sites were ungauged. Grab samples were also collected across the hydrograph to enable comparison of concentrations from the different land uses in rising and falling stages of the event. The resulting flood plume was also monitored to determine the fate of the terrestrial materials. To date results indicate linkages between land use, water quality and contribution to the reef, and will provide an important information platform for natural resource management planning in the region. Results showing loss of fertilizer from cropping areas, high suspended solid concentrations from urban development sites and the export of herbicides and nutrients to inner-shelf fringing reefs are of particular interest. The 24 community volunteers (canegrowers, graziers, etc) and local and state government staff in this program demonstrate the vital role of community-based monitoring programs in addressing natural resource management challenges.

** This talk will be delivered in conjunction with the talk by Bainbridge and Brodie*

THE FILTER FUNCTIONS OF WETLANDS IN THE TULLY-MURRAY FLOODPLAIN*

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This poster describes a project that will provide a means to assess the ability of wetlands to make a significant difference to the loads of sediment and nutrient reaching the GBR lagoon. This project will therefore assist in the identification and prioritisation of sites for the rehabilitation of natural wetlands and construction of artificial wetlands. The project is part of the CSIRO Water for a Healthy Country Floodplain Renewal program and will involve a combination of complementary measurement and modelling exercises. The measurements will provide an insight into the filtering processes taking place in a naturally occurring wetland on the Wet Tropics coast, while the modelling component will involve two phases, 1) calibration and testing of a wetland model using measured data, and 2) use of the calibrated model to assess the filter function of different wetland scenarios. These wetland scenarios will include variations in wetland size, location and sediment and nutrient inputs. The wetland work also has important links to the floodplain sediment and nutrient transfer and floodplain connectivity studies and will form an important component of the integrated bio-physical and socio-economic 'Landscape Toolkit'.

* *Poster presentation*

SEAGRASS-WATCH: A COMMUNITY-BASED SEAGRASS MONITORING PROGRAM - 1998-2005

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Seagrass-Watch was developed in 1998 as a volunteer, community based monitoring program to provide a reliable early warning system on the condition of near-shore seagrasses throughout Queensland, Australia. Now in its seventh year of operation, Seagrass-Watch is active in 12 countries and territories throughout the Indo- and western Pacific and has evolved into an international environmental program.

Monitoring is conducted by over 500 people at approximately 150 sites throughout Queensland and the western Pacific. The Seagrass-Watch network brings together diverse groups from all sectors to work together towards a common goal of seagrass conservation. Seagrass-Watch has raised public awareness about seagrasses and their threats.

Seagrass-Watch has provided information about the health of seagrass ecosystems for local management agencies. The program has shown clear seasonal patterns in abundance across the Pacific, detected loss and subsequent recovery of seagrasses in relation to climatic events including flooding, has provided an early alert to detrimental effects from poorly managed coastal developments, and used to track the possible consequences of global climate change. The findings from the program have also contributed information for World Heritage Area listing assessments, regional and local Plans of Management, and have recently been adopted by the LMMA network and the GBRMPA as accepted protocols for monitoring seagrass and water quality condition. By working with both scientists and local communities, it is hoped that many anthropogenic impacts on seagrass meadows which are continuing to destroy or degrade these coastal ecosystems and decrease their yield of natural resources can be avoided.

TERRESTRIAL BIODIVERSITY IN A COMPLEX LANDSCAPE*

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Sustainable landscapes require a whole-of-systems understanding rather than managing individual system components in isolation.

A whole-of-systems understanding enables the manageable framework of equitable tradeoffs between a variety of values, eg, economic, social and environmental values. Incorporating biodiversity into such a management framework requires:

- 1) Knowledge of the spatial and temporal dynamics of biodiversity and ecosystem processes within human-dominated landscapes; and,
- 2) A means of integrating the knowledge of biodiversity values and ecosystem services into planning decision support tools.

While progress has been made on both these fronts we are still at an early stage in developing a systems understanding of biodiversity and ecological process in tropical landscapes and are currently unable to adequately integrate knowledge that ensures improvement in Great Barrier Reef Catchment floodplain water quality, and also maximise biodiversity values and ecosystem services. The bridging of this knowledge gap in the context of maximising biodiversity outcomes, is the goal of this project. In this poster, we outline our approach for addressing the field and integration components of the terrestrial biodiversity research within the CSIRO Water for a Healthy Country Floodplain Renewal project and present some preliminary field results.

* *Poster presentation*

NUTRIENT AND SUSPENDED SEDIMENT CONDITIONS IN PRISTINE NORTH QUEENSLAND STREAMS AND CHANGES ASSOCIATED WITH AGRICULTURAL AND OTHER LAND USES

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Data sets previously only published in the 'grey' literature, typically technical reports of government or research organisations, were examined for sites having little or no human development in order to define the levels of nutrients and suspended sediment associated with pristine conditions. A recently published land-use GIS (QLUMP) was used to provide an objective definition of land use in the catchment upstream from each site. For comparative purposes, the land use was summarised into five broad categories, 'natural', 'forestry', 'grazing', 'cropping/horticulture' and 'urban'. Aquatic and coastal marine areas were excluded so that percentage areas of the above five broad categories could be calculated. At pristine sites, N typically averaged just 0.045 mg/L Dissolved Inorganic Nitrogen, 0.126 mg/L Dissolved Organic Nitrogen and 0.066 mg/L Particulate Nitrogen, far less than the levels seen at disturbed sites. The levels of P at pristine sites were similarly low, averaging 0.005 mg/L Dissolved Inorganic Phosphorus, 0.008 mg/L Dissolved Organic Phosphorus and 0.011 mg/L Particulate Phosphorus.

TESTING SIMPLE SEDIMENT AND NUTRIENT METHODS FOR LANDHOLDER USE

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It has been argued that if farmers could directly measure the effects of their activities or that of rainfall events on their farm run-off and drain water, that the resulting improved understanding might assist them to design better management protocols. To this end, a number of inexpensive and simple to use field techniques for measuring water quality in farm runoff water have been tested for their usefulness and reliability. Preference was given to measuring the concentrations of suspended sediment and nutrients, particularly nitrate, since these measurements may help farmers understand the impacts of soil manipulation activities and fertilizer mobilisation.

Good replication and calibration have been obtained with the turbidity tube, a simple device for making estimations of suspended sediment concentrations. A number of approaches to nutrient measurement have been tried, including test strips, colour comparators and simple colorimeters. These investigations are in progress. It is anticipated that a manual of landholder methods will be produced from this project.

THE SAGA OF ERIC THE FERAL PIG

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Twelve years of research into the ecology of feral pigs within the wet tropics rainforests has been summarised by following the life cycle of a fictitious feral pig called Eric. A broad range of completed feral pig research projects have been used to develop this summary of research data. Eric's life cycle will highlight information obtained from research into the biology and ecology of feral pigs including reproduction patterns, diet, movements, life history and social structure. The impacts Eric has on the ecology and biodiversity of the rainforest and his economic impact to surrounding agricultural industries will also be presented. Current and future control techniques and management principles that have been, or need to be implemented to reduce Eric's ecological impacts will also be discussed.

FRUGIVORES AND SEED DISPERSAL IN FRAGMENTED RAINFOREST*

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Forest fragmentation leads to changes in species distribution. In the case of fruit-eating fauna, these changes may in turn result in altered patterns of seed dispersal. We have conducted research into frugivores and seed dispersal in a fragmented rainforest landscape in subtropical southeast Queensland. We have surveyed the abundance and distribution of 45 species of frugivorous bird and bat in extensive, remnant and regrowth sites. Decreased, tolerant and increased response patterns between these habitats were documented for different species. We examined differences between the frugivores that showed each response pattern in terms of their morphology, behaviour and diet selection and developed predictions about the consequences of changes in the frugivore assemblage in fragmented habitats for seed dispersal. Here, we will discuss the implications of our research findings for management aimed at the conservation of frugivore populations and the ecological process of seed dispersal in fragmented landscapes. We will also identify issues emerging from our research that provide opportunities for future study.

* *Student presentation*

WILL OUR CURRENT APPROACH TO ECOSYSTEM SCIENCE HAVE THE IMPACT ON THE GROUND THAT WE HOPE FOR? INTEGRATING MULTI-DISCIPLINARY SCIENCE OUTCOMES FOR ON-GROUND SOLUTIONS

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The challenge to water quality issues in the Great Barrier Reef is a 'whole of system' approach. The main science focus needs to shift to the integration of disciplinary understandings of the biophysical processes and socioeconomic and institutional structures that exist in GBR Catchments. At first glance this looks like a simple task, however the integration of spatially, temporally and culturally differing science disciplines to find robust options for solution pathways is complex science that tests the capabilities of our current ecosystem and socioeconomic systems understanding.

The Reef Water Quality Protection Plan (Reef Plan) represents a strategic alliance between the Australian and Queensland government's, industry groups and the community to address the decline in Reef water quality. The development of the Reef Plan was driven by the recognition that declining water quality was affecting GBR ecosystems and a better understanding of the industries of the GBR catchment and their impact on declining water quality. The Reef Plan's goal is to 'halt and reverse the decline in water quality entering the Reef within 10 years'.

The goal will be achieved through the implementation of a range of strategies designed to realign and focus the efforts of all sectors of the community, including government, industry and individuals. Management actions need to focus on the key points of intervention, with a goal to assist decision makers build resilience in Reef ecosystems and coastal communities through improved water quality entering the Reef.

**THE WATER FOR A HEALTHY COUNTRY FLAGSHIP GBR CATCHMENT
THEME: INTEGRATING MULTI DISCIPLINARY SCIENCE OUTCOMES FOR
ON-GROUND SOLUTIONS***

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The *Water for a Healthy Country Flagship* is a CSIRO initiative targeted at improving economic, social and environmental outcomes for Australia. The Great Barrier Reef Catchment is one of four regional areas in Australia.

The *Great Barrier Reef Catchment Theme* (GBR Theme) has a goal to provide solution science to support landholders, decision makers and the community that underpins the implementation of the Reef Water Quality Protection Plan (Reef Plan): to improve water quality, wetland integrity and productivity, while enhancing regional communities and protecting marine based industries of the GBR from declining water quality.

The GBR Theme has been structured to take a 'whole of system' approach. The main science focus is on **integration** of disciplinary understandings of the biophysical processes, socioeconomic and institutional structures that exist in GBR Catchments. This integrated knowledge can be synthesised into options for solution pathways at local and landscape scale, with a strong focus of providing knowledge in a form that is of increased utility to decision makers. The challenge is to identify the key science required to meet the objectives of the Reef Plan and maximises water benefits in the most effective way.

Water for a Healthy Country will be developed in partnership with stakeholders and research collaborators. Opportunities for developing joint programs and collaborative projects will be actively pursued to increase the reach and potential impact of the Flagship Program.

* *Poster presentation*

SPATIAL AND TEMPORAL PATTERNS OF RESOURCE USE BY SPECTACLED FLYING FOXES*

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The diet and degree of specialisation of the Spectacled Flying Fox, *Pteropus conspicillatus*, was examined at four camps (communal roosts) in the Wet Tropics bioregion, Queensland, Australia. This study found temporal and spatial variation in resource use by *P. conspicillatus*. At each camp, *P. conspicillatus* displayed unique dietary signatures and utilised a wider breadth of resources than has previously been shown. Furthermore, *P. conspicillatus* made substantial use of habitats other than rainforest, indicating that this species is more of a dietary generalist, and is more similar in foraging habit to three other mainland Australia flying foxes, than previously thought. As well as seeds and pollen, viable bryophytes were found in *P. conspicillatus* faecal samples, implicating *P. conspicillatus* as a disperser of a wider range of organisms other than the propagules of angiosperms. The results of this study have broadened our knowledge of the feeding ecology of *P. conspicillatus* and raise new questions about the dispersal role of flying foxes for angiosperms and other plants. For conservation management of this species, patterns of resource use by camps of *P. conspicillatus* should be considered individually.

* *Poster Presentation*

DOES THE SCIENTIFIC EVIDENCE SUPPORT POPULAR BELIEFS ABOUT ARTIFICIAL REEFS?*

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The view that artificial reefs enhance fishing and tourism has vocal support by some stakeholders, although reviews in both Australia and overseas question this notion. Interest in the possible creation of artificial reefs on the Great Barrier Reef (GBR) for recreational fishing or diving purposes prompted our review of the science behind artificial reefs.

Our review indicates that creation of artificial reefs in relatively healthy ecosystems involves a range of potential environmental costs and risks, and any benefits will be socio-economic, not environmental. We found that some popular expectations of benefits arising from artificial reef creation are not well supported by the scientific literature. For example, suggested benefits of enhanced fishing are inadequately justified by available evidence, may be only short-term or may be better provided by alternative measures with less risk.

We recommend an informed approach to the assessment of proposals for artificial reef creation in the GBR based on good science and careful, evidence-based, risk assessment and cost-benefit analysis. Currently, much of the information required for this assessment is either very limited or unavailable.

* *Student presentation*

MAPPING AND MONITORING WET TROPICS RAINFOREST VEGETATION CONDITION AND STRUCTURE

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State of environment reporting and monitoring for a number of state government programs and scientific activities requires access to regularly updated, accurate maps of selected environmental parameters in the wet tropics. Our project has assessed a variety of operational and next generation imaging sensors for mapping selected environmental parameters of the wet tropics. This paper reports on our final two CRC Rainforest activities, mapping regional scale changes in vegetation cover from MODIS data and local to regional scale changes in vegetation structural properties from Synthetic Aperture Radar (SAR) data. The MODIS (MODerate Resolution Imaging Spectroradiometer) satellite sensors allow the collection of moderate spatial resolution data, twice daily, over the entire wet tropics. These data are processed into map-products (e.g. land cover, vegetation indices) at spatial resolutions ranging from 250 meters up to one kilometre. Although extensive and coordinated international validation has been applied to these MODIS products, the enormous scale of this task means representative sites are chosen around the world to characterize each major environment, so local distortions may be apparent. To give confidence in the operational use of MODIS data for the Wet Tropics, this presentation reports on the use of high and medium resolution imagery for validating local MODIS vegetation products representative of vegetation cover and its change over time. Results indicate that MODIS images are more sensitive to vegetation cover than traditional AVHRR-NDVI images and can also be examined from a seasonal context. Synthetic Aperture Radar's unique response to vegetation structure has also been tested for mapping structurally different communities and detecting canopy changes due to disturbances. Our results showed that a relationship exists between radar interferometry and rainforest biomass for Complex Mesophyll Vine Forest; canopy damage can be mapped using radar interferometry once topographic influences have been corrected for; and combining SAR and optical remote sensing can improve landcover mapping including the distinction between wet and dry forests. Together these findings illustrate that MODIS vegetation indices are ready for implementation and that the next generation of imaging radar to be launched by Japan later this year will be a key data set in mapping and monitoring rainforest vegetation condition and structure.

INTERNAL FRAGMENTATION IN THE RAINFOREST: EDGE EFFECTS OF HIGHWAYS, POWERLINES AND WATERCOURSES ON TROPICAL RAINFOREST UNDERSTOREY MICROCLIMATE, VEGETATION STRUCTURE AND SEEDLING REGENERATION*

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Human activities have resulted in the loss and fragmentation of rainforest habitat around the world's tropics. Linear clearings for road and powerline infrastructure are widespread within rainforests of northeastern Australia and substantially increase disturbed areas within remaining tracts of rainforest. I am comparing edge effects from these anthropogenic linear clearings with those from canopy openings associated with natural watercourses. Factors being investigated include variation in the understorey light environment and vegetation structure and composition.

** Poster presentation*

**HOME RANGE AND NESTING IN A TROPICAL RAINFOREST RODENT,
*MELOMYS CERVINIPES****

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This study investigated the factors influencing the home range size of a tropical Australian rodent, *Melomys cervinipes*. *Melomys* nested both above and on the ground and seven of the eight *M. cervinipes* nest sites were central to their range. Home range size did not significantly differ between the sexes with an average home range size of 0.42 +/- 0.06 ha and core area of activity size of 0.08 +/- 0.006ha. *M. cervinipes* did not maintain exclusive home ranges and overlapped with both other focal individuals and other individuals not fitted with tracking devices. By using height records, *Melomys* home ranges in 3 dimensions were calculated and compared to the traditional 2 dimensional home range areas.

* *Poster Presentation*

* *Student Presentation*

LONG-TERM SEAGRASS MONITORING IN QUEENSLAND PORTS - REVEALING LINKS BETWEEN REGIONAL CLIMATE AND SEAGRASS CHANGE

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Long-term seagrass monitoring programs have been established in several ports in tropical Queensland, Australia over the last 10 years. Programs have been developed as a partnership between Queensland port management agencies the Queensland Department of Primary Industries and Fisheries and CRC Reef. These monitoring programs have the dual aims of collecting long-term condition and trend data for the state's seagrass communities and of facilitating effective planning for port development and maintenance operations with minimal impacts on marine habitats.

Monitoring has been established in coastal ports throughout the length of the GBR. Substantial changes to seagrass meadows have occurred with significant declines and recovery in biomass and area occurring at all of the monitoring locations. Changes to seagrass meadows were often consistent between geographic locations with strong evidence to suggest that regional climate rather than local anthropogenic influences were the driving force behind seagrass change. By providing information on how these systems vary naturally we are in a better position to assess the impacts from port and urban activity as well as the health of coastal environments in the GBR.

INTEGRATION OF EARTH OBSERVATION TO ASSESS LAND CONDITION IN GBR CATCHMENTS AND SEDIMENT DELIVERY TO THE GBR LAGOON WATERS: A FEASIBILITY STUDY

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Results are presented of an exploratory study using the multi-decadal observational record from remote sensing and *in-situ* data to relate observed environmental drivers in the GBR (climate, management) to observed responses (land condition and sediment yield). The focus area for addressing these questions was the Burdekin and Fitzroy basins, and the coastal waters in the GBR lagoon which receive their runoff.

The dataset used comprises AVHRR (available from 1981 to present), MODIS (2000 to present) and MERIS (2002 to present) satellite products, together with in-situ climate and water-quality data. From the remotely sensed products, two measures were relevant: (1) the normalised difference vegetation index (NDVI) as a measure of vegetation greenness and thus of land condition, and (2) measures of sediment level in water.

Initial findings are: The maximum NDVI anomaly occurs about 3 months after major rain events. The standard deviation of NDVI is an index of cropping as a land use. There is only a weak association between major discharge events and observations of sediment concentrations. Most of the observed sediment activity is driven by resuspension.

There is significant potential for remote sensing to contribute to knowledge of sediment fluxes to the GBR lagoon and their temporal evolution, but it can only be fully realised with quantitative assessment.

CLIMATE CHANGE IMPACTS ON FRESHWATER FISHES OF THE WET TROPICS*

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The freshwater fish fauna of the Wet Tropics region has faced substantial, and often dramatic, climatic changes in the past. For example, during the early to mid Holocene (9.5 – 6ka BP), a dramatic rate (>1cm/yr) and amount (~60-70m) of sea level rise resulted in a major loss of floodplain habitats, accompanied by the reworking of coastal soils and a corresponding reduction in water quality. These changes may have increased the potential resilience of the Wet Tropics fish fauna to the effects of future human-induced climate change. However, certain areas have been buffered from past climatic variability and are now characterised by high levels of endemism. In particular, the Bellenden Kerr and Bartle Frere mountain ranges have provided relatively stable hydrological conditions for a number of endemic riffle dwelling gobies, such as the undescribed Mulgrave River goby *Glossogobius* sp. 4, scaleless goby *Schismatogobius* sp. and the very rare *Stiphodon alleni*. If future climate predictions are correct, such species may be lost and overall species richness in individual river basins is expected to decline, due to a reduction in dry-season base flows and catchment area due to sea level rise. For the first time, the Wet Tropics fish fauna faces major climate change coupled with the additive pressures of anthropogenic disturbance.

* *Student presentation*

SUSTAINABLE LANDSCAPE MANAGEMENT AND DEVELOPMENT IN THE GREAT BARRIER REEF REGION*

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The objective of CSIRO's Water for a Healthy Country National Research Flagship is a ten-fold increase in water benefits by 2025. Additionally, the Reef Water Quality Protection Plan aims at "halting and reversing the decline in water quality by 2015". To meet these objectives, we need to know to what extent we should decrease water pollution and how to achieve that in time and space. This project aims at the development of an integrated suite of explorative and predictive socio-environmental economic approaches to determine sustainable landscape management and arrangements futures as well as to identify and evaluate corresponding sustainable development pathways. We propose a three staged methodology. First, we peruse sustainable resource use and water pollution control targets that maximize water benefits while halting and reversing the decline in water quality, based on the systems' principal agro-ecological and socio-economic attributes, processes and dynamics. Second, we identify landscape management (i.e. way in which land is used and managed) and arrangement (i.e. spatial distribution of land use and management) options that comply with the above determined targets. Finally, we evaluate instruments, regulations and institutional changes, to identify those that are most efficient in providing incentives to economic agents to change their landscape management and arrangements accordingly.

** Poster presentation*

LANDSCAPES TOOLKIT FOR THE TRIPLE-BOTTOM-LINE ASSESSMENT OF FUTURE LAND USE SCENARIOS IN GREAT BARRIER REEF CATCHMENTS*

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The Great Barrier Reef (GBR) catchments are of high economic importance and exceptional environmental value, containing the highest biological diversity in Australia, supporting a World Heritage rainforest area and directly influencing the GBR. To ensure that future development in the GBR catchments addresses economic and social issues, while enabling remediation of landscape and ecosystem degradation, a Landscapes Toolkit (LsT) is being developed as part of the CSIRO Water for a Healthy Country, GBR Theme. The LsT integrates disparate disciplinary approaches, knowledge and data, to allow for the spatially explicit analysis of the triple-bottom-line impacts of changes in land use and management. The LsT is being developed for use in a participatory process with stakeholders, to develop future land use scenarios and assess triple-bottom-line information that aid the community in deciding among multiple choices. The Douglas and Cardwell Shires in North Queensland serve as case studies to further refine and test the LsT approach. In the short term the LsT will allow for the dynamic evaluation of user-defined scenarios, while in the long-term the LsT will allow for active linkages between disciplinary models to account for processes that are endogenous to the system.

* *Poster presentation*

MONITORING AND MANAGEMENT OF CORAL REEF BENTHOS: THE ROLE OF REMOTE SENSING APPLICATIONS IN EASTERN AUSTRALIA, FIJI, SOLOMON ISLANDS AND BELIZE

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Management of marine parks and protected areas requires regularly updated spatial information on the type and condition of benthos. Images collected from airborne, satellite or boat based sensors are providing a potentially useful source of this information. The remote sensing approaches, i.e., type of image data and processing approach, used for monitoring the benthos of reef systems varies with the monitoring and management questions asked, the type of environment. These characteristics of the monitoring or management issue will determine the type of image data required and the form of image processing algorithm to be used to produce a map of the relevant benthic features. Additional controls on image type and processing approach to use include environmental factors, such as water clarity, water depth, cloud cover and water surface roughness together and benthic cover characteristics, e.g., rugosity, species composition and abundance. This paper presents the results from a number of coral reef locations around the world, where remote sensing approaches were applied for mapping benthos under a variety of management requirements and environmental conditions. Each of the cases presented is unique due to variation in: benthic cover characteristics, environmental factors, sensor types and processing approaches. What and who are driving monitoring and management in each of these are outlined, leading to demonstration of suitable image data sets and processing approaches. This provides an overview of the suitability of current remote sensing techniques for mapping and monitoring coral reef benthos. The focus of the work is the Capricorn Bunker Group of reefs in the southern Great Barrier Reef Marine Park, with smaller case studies from the western Pacific and Caribbean. Results from the case studies demonstrate the variety of remote sensing approaches that can be used and their limitations for mapping reef benthos under variable environmental conditions and management information requirements.

A FRAMEWORK FOR DESIGNING CO-MANAGEMENT FOR THE GREAT BARRIER REEF WORLD HERITAGE AREA

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The Great Barrier Reef World Heritage Area is an iconic marine location, internationally renowned as a conservation area and tourism attraction. Two sets of property rights and responsibilities overlap in the Marine Park: Indigenous Australians' sea country; and Australian national and State shared governance of the area as a World Heritage Area and marine national park. There are also elements of an 'open access' regime (under managed restraints such as zoning and fisheries legislation) in the access of a wide variety of stakeholders including commercial and recreational fishers, tourism businesses and tourists, recreational users, scientists and conservation interests. Coastal Indigenous peoples are calling for a co-operative management regime (or localized regimes) to be established over the park, and the Great Barrier Reef Marine Park Authority is also interested in exploring the potential. This paper presents a framework for potential co-management of the Great Barrier Reef Marine Park, capable of accommodating the variety of forms of co-management possible (wildlife and fisheries, habitat, and regional) and local variations in demand and circumstances. It offers the Indigenous and agency parties designing co-management a series of cultural, legal, managerial, and geographical issues to consider in order to create an effective and mutually acceptable regime. These issues can be worked through in steps, in any order the parties wish. Each issue is documented as a 'design space'. There will be some non-negotiable outlines given by the nature of the two cultures, the fixed aspects of Indigenous and non-Indigenous laws, and the space and scale of the Great Barrier Reef environment. Between each of these pairings, however, is a space in which a wide range of possibilities can be entertained. The framework is intended to assist parties in their discussions, by simplifying their task and allowing them to avoid time-consuming identification of issues prior to substantive discussions. It is far from a technical framework however: it encourages a focus on relationship building and the finding of common purpose, and focuses on processes as much as on desired outcomes.

THE CRC REEF CO-MANAGEMENT PROJECTS: SHAPING WAYS FORWARD FOR INDIGENOUS PEOPLES AND AGENCIES IN MARINE AND COASTAL ENVIRONMENTAL MANAGEMENT

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This presentation reports two closely related projects conducted through CRC Reef, concerning the opportunities for co-management (partnerships) between Aboriginal Traditional Owners and government agencies concerned with the management of the Great Barrier Reef Marine Park. The first project explained the concept of co-operative management and its potential usefulness, documented the aspirations towards co-management of three organizations and Traditional Owner groups, and developed a framework for the design of co-management using conflict resolution theory. This framework focuses on the idea of a negotiation or design 'space', bounded by the legal, cultural and administrative features of each party's existence, which are not easily changed. The space defines the possible: it is an area of common interest in which there are flexible opportunities for the parties to create their own preferred shared arrangements.

The second project, conducted at a time when political opportunities had shifted from reef-wide to local, examined the practicalities and realities of developing co-management at a regional or local scale. It combined co-management with adaptive management, a concept from ecology that involves a cyclical, hypothesis-testing approach to environmental management actions with considerable emphasis on evaluation. This project concluded that an adaptive management approach is a fruitful way of building partnerships step by step, without the pressures of advance negotiation.

MODELLING THE FLUSHING OF CONTAMINANTS IN THE PORT OF TOWNSVILLE*

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The main environmental concern for ports is the release of waterborne pollution, the management of which requires knowledge of the pollutant's residence time in the harbour. Residence time of a pollutant is the time it spends in the harbour, from release until escape into the ocean. This investigation used a state-of-the-art 3D computational model, forced with a real wind data set and five tidal constituents, to quantify the residence times of water within the Port of Townsville. Neutrally buoyant particles were used to represent water. The spatial variation of the residence times of water throughout the harbour was investigated, followed by a more detailed analysis of the effects of release time, tide, wind and location of release, on residence times of water in specific areas of interest. These results were summarised in a form that is simple to use by port managers. The results show that residence time depends strongly on location of release and phase of the neap/spring tidal cycle at release. The effects of wind are only important close to the mouth of the harbour.

* *Student Presentation*

* *Poster Presentation*

THE MOVEMENT OF MURKY WATERS JEOPARDIZES MARINE LIFE NURSERIES: A STUDY OF THE CIRCULATION OF WATER IN THE TORRES STRAIT MARINE ECOSYSTEM

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A model of Torres Strait has been developed by Geoscience Australia and CSIRO Marine Research to investigate the interactions of currents and sediment movements with the ecosystem, with a view to better understand the significant dieback of sea-grasses in northern parts.

The most recent atmospheric and oceanographic reanalysis products have been used to force the latest release of the hydrodynamic code. This model has been calibrated to obtain the best quality correlations with available data, including temperature and salinity profiles, tidal predictions, and long term tide gauge records.

The resulting 5-year simulation provides time series sufficient to investigate the seasonal variability of the circulation. The results reveal that seasonal currents are typically around 10% of the tidal current magnitude, with westward flow prevailing for more than 9 months of the year and producing a net inflow into the Gulf of Carpentaria. The seasonal flow across the strait is southward during the monsoon and northward during the trade, with a potential 'stagnation zone' in the north of the Strait near Kai reef. This zone is likely to define the southernmost latitude reached by turbid waters encroaching along the coast of Papua New Guinea. This hypothesis appears to be supported by field measurements and remote sensing observations, and will be further tested using a sediment transport model currently under development. Future work will focus on analysing the variability of modelled suspended sediment in northern Torres Strait to assess the potential for sustained encroachment of high turbidity water and its likely impact on the light environment and seagrass health.

MONITORING OF WATER QUALITY AND ECOSYSTEM HEALTH IN THE GBR LAGOON UNDER THE REEF WATER QUALITY PROTECTION PLAN; AN INTRODUCTION TO THE PROGRAM*

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Some GBRWHA coastal areas are now receiving substantial amounts of material originating from human activities on the catchment. The primary framework through which this decline in water quality from diffuse sources is to be addressed is outlined in the Reef Water Quality Protection Plan (Reef Plan) that was released by the Queensland and Australian Governments in December 2003. As part of its role in implementing the Reef Plan, the Great Barrier Reef Marine Park Authority recently established a Marine Monitoring Program to track trends in the amount of sediment, nutrients and other pollutants entering GBR waters, the status of water quality within receiving waters, and the condition of key biological communities influenced by water quality. This program builds upon a number of previous and current long-term research and biological or water quality monitoring projects, which provide essential baseline information about the status of water quality in reef and regional river waters and of marine ecosystems. The monitoring program is carried out by a consortium of agencies, coordinated by CRC Reef:

Task 1: River Mouth Monitoring (AIMS, NR&M, UQ)

Task 2: Nearshore Marine Water Quality monitoring (AIMS, CSIRO, UQ)

Task 3: Marine Biological Monitoring (AIMS, DPI&F, Sea Research)

Task 4: Pollutant Bioaccumulation Monitoring (AIMS, EPA, UQ)

* 30 minute presentation – two speakers

IMPLEMENTING RESILIENCE: TRANSLATING SCIENCE INTO POLICY*

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Over the last decade, managers and reef users have become increasingly alarmed by the impacts of mass coral bleaching caused by elevated sea temperatures. In many regions, bleaching has led to extensive coral mortality causing serious impacts. Because reef managers cannot control sea temperature, the ability to address mass bleaching through a strategy of supporting coral reef resilience has attracted significant attention.

A series of world-class science efforts are focused on better understanding the ecological principles of resilience. This paper considers the possible management and policy implications that follow from evolving resilience science. It will first review a new publication, *The Reef Manager's Guide to Coral Bleaching*. The *Guide* explores how managers can respond during mass bleaching events and how they can take steps to build long-term reef resilience.

Initiatives to integrate resilience principles into MPA management are underway in the Great Barrier Reef and the Florida Keys. These experiences provide important opportunities to learn how managing for resilience is compatible or at odds with existing policy frameworks. An early examination of this experience will be presented.

* *Student Presentation*

MYTHS, EVIDENCE AND DECISION MAKING; BOX JELLYFISH OCCURRENCE AND STINGER NET REMOVAL

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In far North Queensland, the use of waters around coastal beaches for leisure activities is driven predominantly by the presence or absence of box jellyfish. In the early eighties, stinger nets were first employed to decrease the interaction between swimmers and box jellyfish, and have, on the whole, been a success, with no fatal stings occurring within the nets since their inception. These nets have historically been placed in the water in early November of each year and removed on the May-day long weekend, presumably corresponding with the start and end of the box jellyfish season. The decision for net insertion and removal were based more on anecdotal reports rather than hard evidence. However, since the 2001-2002 season, the end of the season has been determined by results generated from a real time computer model. Since that time, the model has accurately predicted the end of the season (supported by intensive manual sampling for animals) to within periods of 2 days to 1 week and has shown that the box jellyfish season can end as early as late February or continue through until early July. The results from this model, which incorporates growth rate of box jellyfish, water temperatures, time since last major rainfall event and time of year, has been employed by the Cairns City Council in making the decisions as to when stinger nets should be removed. As a result, the decision process is now driven by evidence, and has contributed to an increased swimmer safety in the region.

CONSERVATION MANAGEMENT: SPECTACLED FLYING FOXES

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Conservation management of the Spectacled Flying Fox, *Pteropus conspicillatus*, is a pressing and contentious issue facing natural resource management in the Wet Tropics. Recognised as an important component of World Heritage values, and listed as Vulnerable under the EPBC Act, this species also damages commercial fruit crops causing economic losses to primary production in northern Queensland. Damage mitigation by means other than exclusion netting is of limited success, but netting is prohibitively expensive for many growers. Our project will provide data that is needed to inform appropriate management. This requires sound knowledge of *P. conspicillatus* i) population size, ii) roosting sites (camps), iii) foraging range and iv) seasonal behaviour. Fly-out counts, used to estimate *P. conspicillatus* population size since 1998, are sufficiently accurate to indicate numbers of flying foxes at individual camps. However, many *P. conspicillatus* camps are seasonal, so the proportion of the *P. conspicillatus* population counted is not known. This project is the first to i) attempt monthly counts at *P. conspicillatus* camps across the Wet Tropics and ii) track individuals using radiotelemetry and satellite technology. By combining this effort our data reveals simultaneous changes in *P. conspicillatus* camp size and camp switching by individuals.

NITROGEN USE AND CYCLING IN MIXED TREE PLANTINGS OF CONTRASTING FUNCTIONAL COMPOSITION ON DEGRADED LAND IN SOUTHEAST BRAZIL*

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The aim of this study was to evaluate nitrogen use by prominent trees in mixed native plantings with high versus low legume abundance, to compare how they affect, and are affected by, N cycling.

After a grass-dominated citrus orchard had been abandoned in a former Atlantic forest area on an infertile Acrisol, two adjacent 6-year-old reforestation treatments were compared: (1) Direct seeding of two early-successional legume species, now forming a closed canopy; *versus* (2) High-diversity mixture of all successional groups with few legumes and persistent, grass-dominated gaps.

Mean foliar N concentrations were high, and degrees of N retranslocation during leaf senescence low, in all four tree species occurring in both treatments, relative to expected levels for their respective ecological groups. The only abundant tree to strongly nodulate, *Enterolobium contortisiliquum*, exhibited the lowest degree of retranslocation relative to its foliar nutrient concentrations. Its lower foliar $\delta^{15}\text{N}$ values in the legume-poor, compared to the legume-dominated, plots indicate a higher reliance on N_2 -fixation in plantings dominated by non-fixers.

While the prominent tree species showed distinct responses to, and effects on, the different N cycling patterns between treatments, nitrogen is unlikely to be the primary factor limiting tree growth in this strongly weathered soil.

* *Student presentation*

TURN DOWN THE HEAT ON TROPICAL WATERS: LINKING RIPARIAN VEGETATION WITH THERMAL RANGE*

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The controversy about the exact width of riparian vegetation zones so as to protect stream conditions needs an alternative. A potential approach is to incorporate lateral and longitudinal models based on variables affecting water quality at plot to subcatchment level (riparian width ratio, riparian tree height and vegetation rating) and use canopy and shade as measures for thermal protection to stream biota. To test this idea, twelve stream segments within three ecotone site types were selected for analysis: rainforest/stream edge, regrowth/stream edge and grazed/stream edge in two tropical headwaters in North Queensland, the Barron and North Johnstone River. Within each 1-ha site microclimatic measures were captured simultaneously at paired midstream and orthogonal transects (water and air temperature, RH, solar radiation). Thermal environments along grazed stream edges were found to be significantly hotter than those existing in regrowth forests (higher level of radiant energy and more light reaching the stream channel for a larger part of the day). In contrast, native tropical rainforest-stream edges were quite dynamic and often unpredictable.

These results indicate that closed forest-stream edges provide thermal protection to headwater streams, reducing in-stream channel thermal conditions by up to 1.5 degrees compared to just 30m of exposure without substantial tree cover. Improvements in water quality, using macroinvertebrate communities as surrogate, are most strongly linked to decreases in water temperature. Thus suggesting healthy stream biota is strongly linked to canopy closure with long riparian buffers and protection of headwaters. Expectations of riparian buffer zones, to uphold stream conditions, needs to be moderated by knowledge about the (1) quality and dynamics of the riparian vegetation and (2) spatial arrangement of riparian networks within a catchment.

* *Poster presentation*

* *Student poster*

WATER QUALITY OCEAN COLOUR REMOTE SENSING VALIDATION AND ALGORITHM DEVELOPMENT FOR THE GREAT BARRIER REEF WATERS*

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Modern airborne and satellite remote sensors can perform sensitive visible radiometric measurements of the ocean to allow quantitative estimates of water constituent concentration over a synoptic scale.

Globally derived ocean colour band ratio algorithms have been employed to interpret satellite ocean colour measurements to provide estimates of chlorophyll concentration, total suspended solids and Chromophoric Dissolved Organic Matter (CDOM) in surface layers for the last 25 years, with limited performance in coastal areas where region specific spatially and temporally-variable terrigenous inputs to the water column can often dominate the reflected signal.

In order to develop algorithms to interpret remote sensing reflectance (ocean colour) measurements in an optically complex coastal environment, it is important to understand the optical properties and the optical variability associated with independently varying in-water constituents. It is widely accepted in the ocean colour community that such studies be performed regionally.

This presentation will briefly outline the physical basis of ocean colour remote sensing, show ocean colour satellite validation instrumentation and activities to date and discuss the field data collection regime for the development of a GBR - tuned ocean colour algorithm for the extraction of biologically relevant information from satellite.

* *Student presentation*

INTEGRATED SIMULATION METHODOLOGY FOR THE GREAT BARRIER REEF

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The political mandate defined in the Reef Water Quality Protection Plan sets focus on developing decision support for the Great Barrier Reef (GBR) region. Many experiences in managing coastal zones showed that a partial view often just shifts the problem from one domain into another. This may result in contradicting partial recommendations. This may paralyse the decision making process or limit the view to short-term outcomes. Therefore, an effective decision support tool should take an integrated whole-of-system perspective.

The CSIRO *Water for a Healthy Country* flagship is developing such integrated methodology for the GBR region. It links ecological, economic and hydrological system elements and integrates their response functions in a dynamics modelling approach. As many of these dynamics occur on different scales and as system boundaries differ according to the scope of the analysis, the research approach combines top-down and bottom-up methodology. The top-down perspective quantifies in what-if scenarios ecological, economic and hydrological indicators for whole catchments. The farm scale bottom-up perspective simulates in a GIS-based framework land-use decisions and ecological, physical and economic consequences. This paper presents the integrated methodology and first proof-of-concept simulations for the GBR region.

SCIENCE INFORMING MANAGEMENT TO ENSURE SUSTAINABLE PORTS IN QUEENSLAND

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Ports have provided an essential service to the Queensland industry and communities since the 1880s. A number of these ports are located within or adjacent to the Great Barrier Reef World Heritage Area and the Great Barrier Reef Marine Park.

Government and port managers have a joint responsibility to ensure sustainable economic activities through appropriate cooperative protection of the environment. A range of tools including Legislation, Policy, MOU, Port Environmental Management Plans and Environmental Management Systems, Permits, Communication, Research and Monitoring are used.

Government and port managers now place greater emphasis on environmental management processes that facilitate a clear and transparent commitment to sustainable port operations based on sound scientific research and comprehensive environmental monitoring programs. This paper describes how these processes are integrated so that science drives the management of sustainability.

IMPACT OF COCONUTS ON LITTORAL FORESTS IN THE DAINTREE REGION OF NORTH QUEENSLAND*

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Coconuts (*Cocos nucifera*, comprising at least six recognised cultivars) were introduced to the Daintree coast from about 1940 onwards by leaseholders, 'humpy-house' builders and "hippies", with a peak of plantings in the 70's (L Mason pers com).

Coconuts have fully colonised at least 15 percent of the available littoral forest from the Daintree River to the Bloomfield River and beyond and this colonisation is proceeding at an accelerating rate through natural recruitment. Prior to 1940, there are no substantiated reports of coconuts growing on these beaches; the N to S flow of the water in the GBR Lagoon ensuring that only propagules from southern areas (where they don't occur) could in fact reach these shores.

Counts of adult coconuts were made from aerial photographs (BPA 1974, 1987 and 2003), and this has revealed increases of over 16-fold in coconut densities (this does not include juveniles, which cannot be detected on aerial photographs, and whose increase probably exceeds 100-fold).

In order to assess the impact of coconuts on native littoral vegetation, CTTRS conducted quadrat surveys in November-December 2003. Nineteen 100m² random quadrats were sampled along a 500 meter strip of Myall Beach (Cape Tribulation). All individuals of each species encountered were counted and the total area covered by that species was estimated. Juveniles (native plants other than coconuts), less than 500mm high, were counted without specific identification. Volunteers, students and Station Staff took part in this survey.

Unsurprisingly, the survey showed a very strong inverse relationship between coconut densities and native vegetation densities and native recruitment rates. Additionally areas where there has been a drastic reduction in overhanging native vegetation (particularly *Sophora*, *Scaevola* and *Hibiscus*) through coconut infestation and beach clearing, have experienced severe coastal erosion, as the 'shock-adsorbing' role of this vegetation on storm driven waves is largely missing. Coconuts with their small root bundles, tend to channel water flow and so enhance beach erosion.

It is evident that despite their 'tropical paradise' iconic status to many, coconuts represent a major threatening process to the littoral forests of the Wet Tropics.

* *Poster Presentation*

REDUCTIONS IN NUTRIENT DISCHARGE FROM AQUACULTURE THROUGH RECYCLING OF WATER UTILISING FLOATING MEDIA AND ACTIVATED CARBON FILTRATION*

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Nutrient discharge into coastal areas, such as the Great Barrier Reef can result in the degradation of coastal ecosystems. For example, excess nitrogen and phosphorus can damage corals through inducing algal bloom and subsequent shading. Excessive phosphorus can further weaken coral skeletons making them susceptible to damage. Land based industries such as aquaculture can contribute to such problems. This study set out to develop a system whereby water from aquaculture can be constantly reused resulting in minimized waste discharge. A three-stage filtration system utilizing floating media and activated carbon was designed to harness bacterial processes that could reduce both particulate and dissolved compounds to the extent whereby approximately 100% reuse of the wastewater became possible. This involved efficient and effective particulate and biological removal mechanisms in both aerobic and anaerobic zones of the filtration system. This design reduced dissolved nitrogen levels by up to 70% and maintained low phosphorus levels, which allowed the reuse of water for the successful culture of barramundi with a survival rate of 97% over 25 days. This pilot scale study demonstrated the potential of reusing aquaculture wastewater from the viewpoint of reducing nutrient input into coastal environments. Future research will refine these processes and assess the performance of the system at several commercial scale applications.

* *Poster presentation*

PHYSICAL CONTROLS ON CORAL BLEACHING ALONG THE GREAT BARRIER REEF

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Coral bleaching is recognised as a major problem for the health of coral reef ecosystems in the Great Barrier Reef (GBR) and worldwide. Developing a good understanding of the phenomenon is important if management practices are to be effective in minimizing the detrimental impacts of coral bleaching.

A combination of hydrodynamic and thermodynamic models is being applied to a wide variety of coral reef types to help explain observed bleaching responses. The tools help explain GBR wide to sub-reef scale variation of thermal stress on coral in 3 dimensions. Complex sea surface temperature patterns observed from satellite imagery are primarily due to the presence or absence of mixing due to tidal currents interacting with the complex topography of the reef.

Conditions experienced in the 1998 and 2002 events are hindcast and the events are compared. A vertical water column model is used to predict the formation and deepening of the hot surface layer agrees with observations. By applying these models where weather stations are located enables the severity of the thermal stress to be assessed.

THE IMPORTANCE OF FUNDAMENTAL SCIENCE TO THE LONG-TERM UNDERSTANDING, MONITORING AND PROTECTION OF AUSTRALIA'S TROPICAL FORESTS

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Over the last fifteen years, our understanding has rapidly improved of both the distribution of biodiversity in Australia's World Heritage listed tropical rainforests and the dynamic nature of these forests with changing climate. This has resulted in policy changes and on site management of protected species and ecosystems, and general landscape management. However, here as in most parts of the world, we lack long-term data that will enable us to monitor more insidious and rapid changes. How will our forests be affected by rapid climate change and rapidly increased CO₂ levels?

This paper will describe some of the science and the infrastructure as part of a proposed 'forest observatory' that will be needed to answer questions about the fate and future of Australia's tropical forests. It will also describe how these plans fit into international efforts to establish networks of such forest observatories.

**BIOLOGICAL BARRIERS TO GENE FLOW AND GENETIC POPULATION
STRUCTURE OF AN ENDEMIC RAINBOW-FISH *CAIRNSICHTHYS*
*RHOMBOSOMOIDES****

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The potential for the biological processes of competition, predation and/or philopatry (natal homing) to restrict gene flow and promote population divergence in an obligate stream fish, was examined in *Cairnsichthys rhombosomoides*, a range restricted endemic species of the Australian Wet Tropics region. Sequence variation in the mitochondrial control region (Part I) indicated significant divergence between freshwater linked populations, with no obvious physical barriers to gene flow (eg. waterfalls) over distances as small as 5 -10kms. No one biological process could be identified as the sole mechanism responsible for restricting gene flow. Strong philopatry, augmented by competition from a closely related rainbow-fish and predation from a large assemblage of piscivorous predators that inhabit main river channels, combined with intense genetic drift in small seasonally impacted headwater populations best explained the population structuring observed.

The present study is the first to demonstrate the potential for any combination of biological processes alone to restrict gene flow and promote divergence in an obligate stream fish. Only lake-based studies on philopatric rock-dwelling cichlids have consistently found genetic divergence between populations with no physical barriers to gene flow, over distances as short as in the present study. *C. rhombosomoides* inhabits similar background environments through out its range and displays little variation in morphology associated with feeding behaviour or sexually selected traits. This suggests that unlike lake cichlids, divergence in this system has not evolved through disruptive selection associated with differential resource use reinforced by assortative mating.

* *Student Presentation*

* *Poster Presentation*

SMALL, SMALLER SMALLEST: FORAMINIFERA, DIATOMS AND BACTERIA IN BIOFILMS AS INDICATORS FOR GREAT BARRIER REEF WATER QUALITY CONDITIONS

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Nearshore coral reefs are subjected to increased nutrient and sediment loads. We are investigating the use of biofilms as rapid indicators for status and trends of coral reef health. A variety of genetic, physiological and classical taxonomic tools are used to determine presence and abundance of biofilm organisms from different phyla: Foraminifera (>63 to ca. 2000µm), benthic diatoms (about 5 to 200µm) and benthic bacteria (< 2µm). Initially, we quantified their densities and community composition along previously described nutrient and turbidity gradients. Foraminifera showed a distinct shift in species dominance towards larger species from turbid inner-shelf towards clearer outer shelf reefs. Benthic diatoms are highly diverse, with about 300 taxa observed. Diatom densities decreased towards the outer shelf, and showed significant differences in community composition among regions. Initial results of bacterial diversity analysis (using DNA sequencing) indicated that nearly all bacterial sequences obtained represent new species, and that diversity in the reefs sediments is high. These survey data and previous experimental work show that three groups of biofilm organisms have potential as indicators for changing water quality. In the next phase, the project will focus on a subset of the most promising target organisms, quantify their responses to changes in water quality experimentally and investigate rapid and cost effective ways to detect and quantify these organisms.

FLOODPLAIN RENEWAL IN CATCHMENTS ADJACENT TO THE GREAT BARRIER REEF*

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The floodplains of the GBR catchments require sustainable solutions for future development that address economic and social change while enabling remediation of water quality, ecosystem and landscape degradation. This poster describes a project whose goal is the development of land-use and landscape management solutions for the coastal lowlands of the GBR catchments which drive growth in the prosperity of regional industry and communities, while supporting protection of the Great Barrier Reef through higher water quality and healthier ecosystems. The project is part of CSIRO's Water for a Healthy Country programme and operates via the establishment and strengthening of partnerships with community, industry and government bodies that have a common interest in delivering improved water quality and protection of the Great Barrier Reef. The project has four primary objectives:

1. understanding of the *processes* controlling inter-linkages between catchments, ecosystems and protection of the marine environment;
2. Identification of *land management* practices which create and amplify water-use benefits;
3. Development of *tools for analysis* of economic, social, hydrological and ecological impacts of land-use change;
4. Enabling *implementation* of improved landscape management in the coastal lowlands of the Great Barrier Reef catchments.

This poster provides an overview of the range of bio-physical and socio-economic work that will be carried out to meet the above objectives.

* *Poster presentation*

THE FITZROY PROJECT - A STUDY OF THE DYNAMICS OF AN AUSTRALIAN TROPICAL ESTUARY

Ian Webster¹, Ian Atkinson², Vittorio Brando¹, Brendan Brooke², Phillip Ford¹, Ralf Haese², Gary Hancock¹, Mike Herzfeld³, Rhys Leeming³, Charles Lemckert⁴, Nugzar Margvelashvili³, Alan Marks¹, Bob Noble⁵, Kadija Oubelkheir¹, Lynda Radke², Andy Revill³, Barbara Robson¹, Dave Ryan², Christie Schacht⁴, Craig Smith², Peter Verwey⁵, Vicky Vicente-Beckett⁶

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After the Burdekin, the Fitzroy River supplies the second largest load of sediments and nutrients to the lagoon of the Great Barrier Reef. With Coastal CRC funding, a multi-agency team has studied the hydrodynamics, fine-sediment dynamics and biogeochemistry of the Fitzroy Estuary and adjacent Keppel Bay over the last 6 years. The main aims of the project are to assess the impact that catchment loads have on the Fitzroy Estuary itself and the role that the estuary plays in mediating the delivery of material from the river to the GBR lagoon. The discharge of the Fitzroy is highly episodic; its discharge usually occurs as a series of high-flow events during the summer months with virtually no discharge occurring during the rest of the year. Interannual variability is also very high with total annual discharges varying by a factor of 100. The variability in the discharge poses significant challenges for studies of the estuarine dynamics and we have chosen a combined measurement, remote sensing, and modelling approach to address this issue. In my talk, I will present an overview of the project together with some of the significant results achieved so far.

HELPING HERBIE (AND ROCKY *ET AL*) CROSS THE ROAD*

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The ecological effects of roads and other linear barriers on wildlife are many and varied and much work done has been done to ameliorate them. This poster features information on the use of new technologies aimed at reducing roadkill and restoring habitat connectivity, especially for arboreal wildlife species. Until recently, little had been known about the effectiveness of mitigation measures for arboreal fauna, despite research suggesting that the barrier effect of roads is exacerbated for tree-dwelling mammals especially. Our investigations have revealed that simple, inexpensive overpass structures for arboreal fauna (canopy bridges) have been used since at least 1963, when the 'Nutty Narrows Bridge' was erected in Longview, a small town in Washington State in the United States, to allow safe passage for squirrels. Since then, canopy bridges - ranging from simple rope bridges to elaborate tunnel-like structures - have been erected for a variety of arboreal mammals in at least eleven other countries. At least three studies, including one in the Wet Tropics, have documented their effectiveness. There is good evidence that canopy bridges enhance the safety and movement of arboreal mammals during the continued operation of roads and other linear barriers.

* *Poster presentation*

QUANTITATIVE CORAL BLEACHING DETECTION BY SATELLITE REMOTE SENSING

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In order to determine the feasibility of detecting coral bleaching on a whole of GRB scale a study was initiated by CSIRO in collaboration with the University of Queensland. For this study we have performed in situ optical characterisation of reef waters and adjacent ocean waters and substratum type and cover. Next we developed an inversion optimisation method to infer water column composition, bathymetry and per pixel unmixing of substratum type and/or cover using Hyperion imagery over Heron Island. In order to scale this work up to whole of Great Barrier Reef or other reef scale we adapted the inversion optimisation model to MERIS Full Resolution scenes (at 300 m pixel resolution). We were able to discriminate bathymetry, major coral reef classes and benthic micro-algae concentrations using MERIS. Although the results are preliminary it means that MERIS Full Resolution imagery may have the capacity to map coral reefs, and their changes such as bleaching events, worldwide on a twice weekly basis. This could become a precursor to a global coral bleaching mapping system.

PUTTING THE PIECES TOGETHER: MAKING INTEGRATED COASTAL MANAGEMENT WORK FOR TROPICAL RESOURCE CONSERVATION

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Integrated coastal management has been developed as a working strategy to conserve coastal resources, especially coral reefs, mangrove forests, seagrass beds and the associated fisheries. However the 'tragedy of the commons' continues with the steady degradation of tropical and sub-tropical coastal areas, in spite of many success stories. The degradation results from excess sedimentation and pollution from activities in catchment areas, as well as major over-exploitation of the resources, especially the fisheries. The pressures of growing populations, increasing poverty and development, are negating the successes at resource conservation; and the new threat of global climate change further increases the pressures.

Clearly, remedial action is needed through the use of integrated coastal management based on the lessons of many success and failures and a paradigm shift to remove the burden of proof from demonstrating that conservation is effective, to placing the burden on exploiters and polluters to reduce their impacts and pay for resource access.

There are many pieces and players in this 'puzzle', but information is not being adequately exchanged and communicated. Stronger partnerships are needed between the providers of the information (the disciplines of natural and social sciences, economics and law) and those required to implement the necessary change to conserve the resources (resource managers, policy makers and politicians, the media and the public. Suggestions for improvements are advanced based on case studies from Thailand and Australia.

TO BE OR NOT TO BE: RARITY IS THE QUESTION*

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Eleven species of microhylid frog of the genus *Cophixalus* are endemic to the Wet Tropics of North Queensland. While some of these species occur across most of the Wet Tropics region, a majority are restricted to single mountain ranges in this region.

This project investigates the ecological reasons behind the geographical rarity of these species. That is, comparing the ecological characteristics of restricted and wide-spread species in a genus that is known to have persisted for a long time. I have investigated the potential versus realised habitat distribution of each frog species to look at climatic and vegetation requirements. Additionally, I compared the diet, dispersal ability and habitat requirements of geographically restricted and widespread species.

Preliminary results suggest that:

- there is a negative relationship between geographical rarity and local abundance
- there is no relationship between geographical rarity and body size
- all species have very low dispersal ability
- species differ in their calling microhabitat and climatic niche.

These results and their implications for what allows rare species to persist through time will be discussed in this presentation.

* *Student Presentation*