



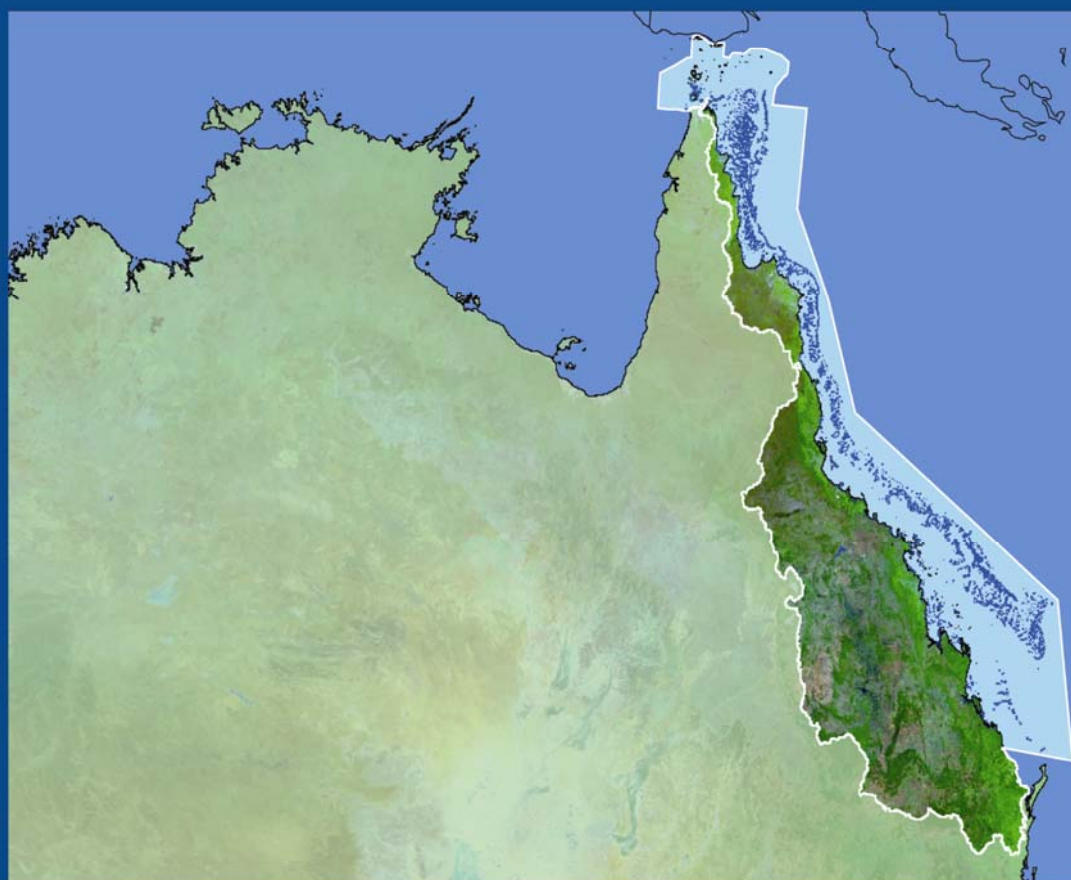
Australian Government

Department of the Environment, Water, Heritage and the Arts



Annual Research Plan 2008-2009

Marine and Tropical Sciences Research Facility



**Revised
March 2009**

PREFACE



It is with much enthusiasm that I introduce the Annual Research Plan for the third year of the Marine and Tropical Sciences Research Facility (MTSRF). MTSRF is a \$40 million component of the Australian Government's \$100 million Commonwealth Environment Research Facilities program. The MTSRF vision is that North Queensland's public environmental assets – particularly the Great Barrier Reef and its catchments, tropical rainforests including the Wet Tropics World Heritage Area, and Torres Strait – maintain or build their health through the generation, transfer and sharing of world-class research and knowledge.

Now more than ever, there are increasing challenges facing our reefs, our rainforests and our fragile coastline. One of the greatest challenges is climate change, with some of the adverse impacts predicted already evident in this area such as the mass bleaching of corals, decline in rainforest biodiversity, and coastal erosion and inundation in the Torres Strait Island regions to name a few. These threats combined with declining water quality and increasing population present a collective challenge to us all.

Through MTSRF over 300 of Australians pre-eminent scientists are working on the issues of climate change, threatened species, declining water quality and sustainable use of the environment.

The program focuses on developing and sustaining partnerships between research institutions, environmental managers and industry. It is through these partnerships that we can collectively benefit from the outcomes of this initiative. The third year of the MTSRF program will utilise \$7.6 million of Australian Government funding and more than \$11 million of cash and in-kind support from leading Australian research institutions.

Research that aspires to influence the management and sustainable use of our environment is a distinguishing factor of MTSRF's work. Stakeholders and end-users of program outcomes are actively involved in setting the direction of research via their participation in MTSRF Steering Committees.

In 2008-09 I am looking forward to seeing researchers build on their results and their findings being applied by policy makers and other organisations with a role to play in the conservation of our unique environment.

Good environmental policy must be guided by the best scientific knowledge and the MTSRF program is delivering us just that.

The Hon. Peter Garrett
Minister for the Environment, Water, Heritage and the Arts
Australian Government

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ACRONYMS

AAC	Advanced Analytical Centre (James Cook University)
ABS	Australian Bureau Of Statistics
ACC	Australian Canopy Crane
ACCSP	Australian Climate Change Science Program
ACTFR	Australian Centre For Tropical Freshwater Research
ADFA	Australian Defense Force Association
AFFFM	Australian Farm Forestry Financial Model
AIATSIS	Australian Institute Of Aboriginal And Torres Strait Islander Studies
AIMS	Australian Institute Of Marine Science
AIMS LTMT	Australian Institute Of Marine Science Long Term Monitoring Team
AMC	Australian Maritime College
AMPTO	Association Of Marine Park Tourism Operators
ANU	Australian National University
ARC	Aboriginal Rainforest Council
ARP	Annual Research Plan
AWS	Automatic Weather Station
BBN	Bayesian Belief Network
BMP	Best Management Practice
BRS	Bureau Of Rural Sciences
CCI	Coastal Catchments Initiative
CEO	Chief Executive Officer
CERF	Commonwealth Environment Research Facility
CHIMS	Cultural Heritage Information Management System
CMM	Centre For Microscopy And Microanalysis
COTS	Crown-Of-Thorns Starfish
CQU	Central Queensland University
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific And Industrial Research Organisation
DAFF	Commonwealth Department Of Agriculture, Fisheries And Forestry
DBH	Diameter Breast Height
DEW	Commonwealth Department Of The Environment And Water Resources
DNA	Deoxyribonucleic Acid
DNRMW	Queensland Department Of Natural Resources, Mines And Water
DSS	Decision Support System
EC	Eddy Covariance
ELF	Effects Of Line Fishing
EPA	Environmental Protection Agency
FNQ	Far North Queensland
FRC,	Fitzroy River Catchment
GBR	Great Barrier Reef
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority

GBRWhA	Great Barrier Reef World Heritage Area
GCM	Global Climate Model
GIS	Geographical Information System
GPS	Global Positioning System
GU	Griffith University
IPCC	Intergovernmental Panel On Climate Change
ITQ	Individual Transferable Catch Quota
JCU	James Cook University
LAI	Leaf Area Index
LTMP	Long Term Monitoring Program
MAC	Ministerial Advisory Council
MATS	Management Action Targets
MBI	Market Based Instrument
MOU	Memorandum Of Understanding
MPA	Marine Protected Area
MTSRF	Marine And Tropical Sciences Research Facility
NASA	National Aeronautics And Space Administration
NGO	Non Government Organisation
NHT	Natural Heritage Trust
NOAA	National Oceanic And Atmospheric Administration
NRM	Natural Resource Management
NSW	New South Wales
PES	Payment For Environmental Services
QDMR	Queensland Department Of Main Roads
QDNRM&W	Queensland Department Of Natural Resources, Mines And Water
QDPI&F	Queensland Department Of Primary Industries And Fisheries
QEPA	Queensland Environmental Protection Agency
QLD	Queensland
QPWS	Queensland Parks And Wildlife Services
QSIA	Queensland Seafood Industry Association
RAP	Representative Areas Program
RCT	Resource Condition Targets
RE	Regional Ecosystems
RIS	Research Investment Strategy
RSES	Research School Of Earth Sciences
RWQPP	Reef Water Quality Protection Plan
SAR	Synthetic Aperture Radar
SES	Social-Ecological System
SST	Sea Surface Temperature
TBA	To Be Advised
TBC	To Be Completed
TEK	Traditional Environmental Knowledge
THE PLAN	Annual Research Plan
TLJV.	Tropical Landscapes Joint Venture
TS	Torres Strait

TSI	Torres Strait Islands
TSRA	Torres Strait Regional Authority
TTNQ	Tourism Tropical North Queensland
UQ	The University Of Queensland
UVC	Underwater Visual Census
VOC	Volatile Organic Carbon
WAMSI	West Australian Marine Science Initiative
WFHC	Water For A Healthy Country
WHA	World Heritage Area
WQ	Water Quality
WQIP	Water Quality Improvement Plan
WTMA	Wet Tropics Management Authority
WTQWHA	Wet Tropics Of Queensland World Heritage Area
WTWHA	Wet Tropics World Heritage Area

INTRODUCTION

The Marine and Tropical Sciences Research Facility (MTSRF) programme is a \$40 million Australian Government initiative. It is a sub-programme of the Commonwealth Environment Research Facilities (CERF) programme which is investing \$100 million in the four years to June 2010.

The CERF and MTSRF programmes aim to improve Australia's capacity to understand and respond to priority environmental concerns affecting national environmental assets. The MTSRF programme is focused specifically on ensuring the ongoing health of:

- The Great Barrier Reef and its catchments
- Tropical rainforests including the Wet Tropics World Heritage Area *and*
- The Torres Strait.

The programme supports world-class research to underpin environmental resource management and policy development. It focuses on collaboration, partnerships, co-investments and on making data and research information freely and publicly available. For more information about the CERF and MTSRF programmes see <http://www.environment.gov.au/cerf>.

Research Investment Strategy

Research funding is guided by the MTSRF Research Investment Strategy (RIS). This strategy is the result of intensive consultation and negotiation on the research and information priorities for understanding and managing North Queensland's public environmental assets. The RIS represents the collective view of scientific experts, business and industry leaders, government agencies, NGOs and community groups.

Stakeholders are actively involved in planning, implementing and reviewing research work. Their engagement is an important part of the MTSRF philosophy, and is intended to ensure that research outcomes are not only scientifically rigorous, but also meet the information needs of environmental managers and policy makers. (For further information about the RIS see <http://www.environment.gov.au/cerf>.)

Annual Research Plans

The RIS guides the development of collaborative, multidisciplinary research projects by identifying the big environmental issues to be addressed. Research projects are then funded and reviewed annually through the MTSRF Annual Research Plans.

A central feature of MTSRF research programme is its ability to link and integrate research activity and information across the geographical region and across the full scope of scientific disciplines. This promotes the development of useful solutions to complex and interrelated issues facing the region including:

- Water quality management from the upper catchment through to the reef
- Climate change impacts on ecosystems and water quality *and*
- Managing resource use by multiple industries and interest groups.

The MTSRF research programme's highly collaborative approach brings research staff and students from the leading institutions together with stakeholders to form the research questions which will deliver usable outcomes.

This is the third MTSRF Annual Research Plan (ARP3). It directs \$7.6 million into priority research activities in 2008-09 and builds on the \$15.1 million research investment made through ARP1 and 2.

The following pages set out the research questions, research staff and institutions, the Australian Government funding investment, and the cash and in-kind contributions of research partners. This annual research plan will be implemented through the MTSRF's contracted programme manager in North Queensland, the Reef and Rainforest Research Centre Ltd. (For further information about the implementation of the MTSRF in north Queensland see <http://www.rrrc.org.au>)

Cash and In-Kind Support for MTSRF Research

Theme	MTSRF	Other Cash	In-kind	Total
1. Status of the Ecosystems	\$2,038,000	\$70,000	\$2,805,626	\$4,913,626
2. Risks and Threats to the Ecosystems	\$1,350,000	\$15,000	\$2,640,734	\$4,005,734
3. Halting and Reversing the Decline of Water Quality	\$1,175,000	\$20,000	\$1,601,912	\$2,796,912
4. Sustainable Use and Management of Resources	\$2,258,275	\$352,900	\$3,591,577	\$6,202,752
5. Enhancing Delivery	\$797,500			\$797,500
Total	\$7,618,775	\$457,900	\$10,639,849	\$18,716,524

* Predicted cash co-contribution from Great Barrier Reef Foundation, James Cook University, Terrain NRM, Burdekin Dry Tropics NRM, Port Authorities.

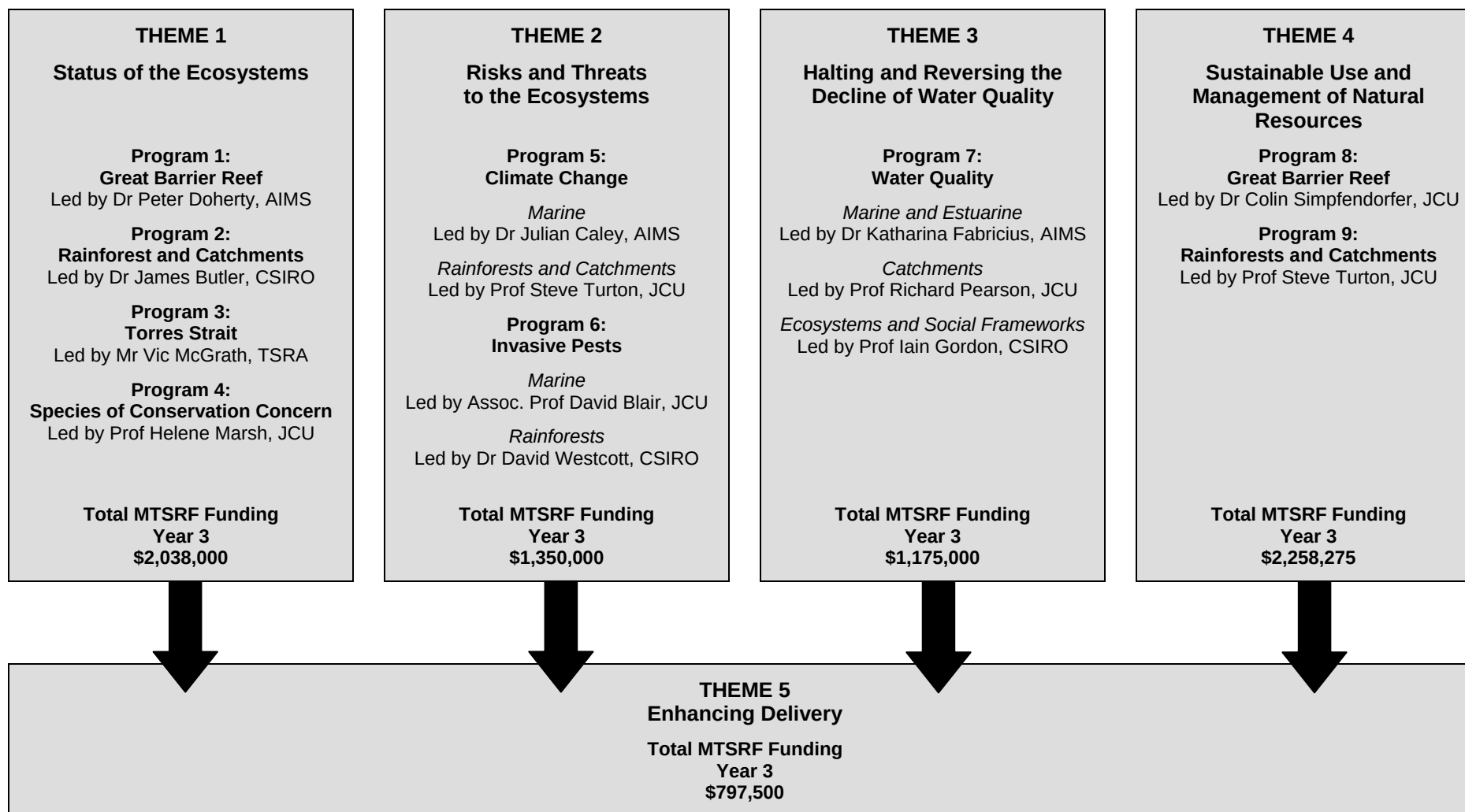


Figure 1: Outline of the MTSRF Research Programme structure.

THEME 1

STATUS OF THE ECOSYSTEMS: UNDERSTANDING THE CONDITION, TREND AND INTERDEPENDENCIES OF ENVIRONMENTAL ASSETS OF NORTH QUEENSLAND

It is important that government, natural resource managers, protected area managers, industry and the national and international community have a clear understanding of the state of North Queensland's key environmental assets. This is particularly important to foster sustainable use by the industries reliant on the environmental assets, to support ongoing management of the assets and to help inform policy direction, both for North Queensland and nationally. To achieve this, the MTSRF will produce reports on the state of key assets, identifying possible threats, the socio-economic values of the assets and, importantly, cost-effective methods for longer-term assessment and management.

Budget Summary

Program	Title	MTSRF	Other Cash	In-kind	Total
Program 1	GBR Status and Trends	\$775,000	\$70,000	\$1,457,737	\$2,302,737
Program 2	Rainforest Status and Trends	\$350,000		\$411,699	\$761,699
Program 3	Torres Strait – Status, Use and Trends	\$393,000		\$448,440	\$841,440
Program 4	Species and Communities of Conservation Concern	\$520,000	0	\$487,750	\$1,007,750
Total		\$2,038,000	\$70,000	\$2,805,626	\$4,913,626

* Final cash co-investment to be confirmed. External cash funding does not appear in Program 1 project schedules.

The total value of Theme 1 is \$4,913,626

PROGRAM 1

STATUS AND TRENDS OF SPECIES AND ECOSYSTEMS IN THE GREAT BARRIER REEF

Program Leader and Host Organisation

Dr Peter Doherty, Australian Institute of Marine Science (AIMS)

Budget Summary

	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
MTSRF	\$775,000		\$775,000
Other	\$70,000	\$1,457,737	\$1,527,737
Total	\$845,000	\$1,457,737	\$2,302,737

* Projects 1.1.1 & 1.1.5 require further brokering; this may lead to a change in in-kind funds in this program.

The Great Barrier Reef (GBR) is Queensland's largest and most valuable environmental asset, deserving of its World Heritage listing, and generating annually \$5.8 billion gross value for Australia (Access Economics 2005¹). The largest industry in the Great Barrier Reef Marine Park is marine tourism, which values environmental quality.

The Program will focus on delivering robust indicators of reef health and identifying threshold of potential concern for the GBR ecosystem. The Program contains two long-term monitoring programs of iconic ecosystems (coral reefs and seagrasses). These reports of condition and response will be linked with research in other MTSRF Programs, notably those for water quality and climate change and will feed into the Risk, Resilience and Response Atlas (MTSRF 1.1.5). The program will also develop an early warning system for outbreaks of crown-of-thorns starfish to allow the tourism industry to prepare tactical responses. Support for community-based monitoring (Reef Check Australia) of tourism intensive sites will also be a feature of the Program.

There will be two broad-scale assessments of the ecological effects of the GBR Zoning Plan on mid-shelf and outer-shelf reefs. These will be linked with GBR Zoning Plan assessments being undertaken by the MTSRF Sustainable Use Program (Program 8) on inshore reefs and shoals, which will also include social and economic indicators of changes associated with the zoning.

The risk mapping and monitoring products generated by the Status and Trends Program are some examples of the information required to inform integrated, proactive management. The full picture of raw information flows is very complex. Thus, the Program will collaborate with the relevant managing agencies and user groups to provide information that will enable the development of Integrated Reports for the GBR by contributing to the Risk, Resilience and Response Atlas (MTSRF 1.1.5), which will utilise a structured framework for assimilating data from multiple sources with an emphasis on quantitative indicators of condition and trend and performance assessment of systems against thresholds of critical concern. Moreover, the Risk, Resilience and Response Atlas (MTSRF 1.1.5) will providing the analytical tools to: model and map ecosystem properties, identify the main risk and resilience factors influencing the GBR and assess their biological, social and economic impacts. This type of information will be used to assist the managing agencies in State of the Environment reporting, particularly the GBRMPA Outlook Report and international obligations for World Heritage

¹ <http://www.accesseconomics.com.au/publicationsreports/showreport.php?id=10&searchfor=2005&searchby=year>

Periodic reporting, and will be a valuable for day-to-day management of the GBR and for policy development. This integration will be a distinguishing feature from work done previously under the Cooperative Research Centre model and is the lead project in this Program. Finally, the Program will strengthen community support for, and use of, this product by linking community-based action programs with the outputs of the data integration and synthesis process.

Projects

1.1.1	Identification of indicators and thresholds of concern for ecosystem health on a bioregional scale for the Great Barrier Reef	\$60,000
1.1.2	Condition and trend of the GBR ecosystem: Indicators and thresholds of potential concern, and ecological effects of the GBR Zoning Plan on mid and outer reefs.....	\$320,000
1.1.3	Condition, trend and risk in coastal habitats: Seagrass indicators, distribution and thresholds of potential concern	\$200,000
1.1.4	Dating and mapping historical changes in GBR coral communities	\$50,000
1.1.5	GBR data synthesis and integration for reporting.....	\$145,000

PROGRAM 1: STATUS AND TRENDS OF SPECIES AND ECOSYSTEMS IN THE GREAT BARRIER REEF***Project 1.1.1: Identification of indicators and thresholds of concern for ecosystem health on a bioregional scale for the Great Barrier Reef*****Project Leaders and Host Organisations**

Associate Professor Michelle Waycott, James Cook University
 Dr Hugh Sweatman, Australian Institute of Marine Science

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Dr Michelle Waycott	JCU	Project leader, indicators, reporting, communication	0.1
Prof Helene Marsh	JCU	Marine ecology, dugong	0.05
Ms Alana Grech	JCU	Marine ecology	0.05
Mr Len McKenzie	QDPI&F	Seagrass ecology and water quality monitoring	0.05
Prof David Blair	JCU	Marine pests	0.05
Dr Jane Mellors	QDPI&F	Seagrass and Water Quality Monitoring	0.05
Dr Ivan Lawler	JCU	Marine ecology, dugong	0.05
Dr Hugh Sweatman	AIMS	Reef ecology, monitoring	0.1
Biostatistician	AIMS	Numerical analysis	0.2

Summary Table of Research Users

Organisation	Organisational Contact
GBRMPA	Lawrence McCook
DEWHA	Kevin Gale

Project Duration

Start Date: July 2008

End Date: 30 June 2010

Project / Task Objectives

1. Identify available indicators of condition and trend in biodiversity, ecosystem health and thresholds of concern or triggers for management action for non-reefal coastal systems (seagrasses) (with reference to the GBR Bioregions, 2003) that are appropriate for reporting the condition and trend in the health of the GBR ecosystem.
2. Develop a conceptual approach to testing the further development of indicators of condition and trend in the health of the GBR ecosystem as new information becomes available.
3. Assess currently used indicators for the links between reef water quality and the condition and trend in the health of the GBR and develop new indicators if appropriate.
4. Develop prospective approach to identifying thresholds of concern for coastal marine plant community health indicators for the GBR.

5. To extend previous syntheses of data from the AIMS LTMP (MTSRF 1.1.1 milestone report March 2008) in two ways:
 - a. By incorporating information on benthic communities of inshore reefs of the GBR collected by AIMS under the Reef Plan Marine Monitoring Program. A general conclusion of the previous report was that reefs in inshore regions of the GBR were most at risk and relative ecosystem health was generally poorer, though the limited coverage of inshore reefs in the LTMP surveys meant that reliability of these estimates was low compared with mid-shelf and outer shelf regions where sampling was more extensive. Though these inshore surveys do not include counts of fishes, the incorporation of the data on diversity and cover of benthic organisms would strengthen the previous analyses of spatial variation in relative reef health on the GBR.
 - b. By synthesizing available data on distribution and abundance of juvenile corals. As well as estimating cover of various classes of benthic organisms, the surveys of hard and soft corals on inshore reefs have also included counts of colonies by genera and size-class. In the past two survey years, the LTMP have collected information on numbers of small colonies (<10cm across) classified by genera on the core survey reefs, which are mainly mid-shelf and outer shelf reefs. The presence of small colonies at a site indicates that local conditions allow the survival of recruits – a prerequisite for recovery and central to concepts of reef resilience. Mapping of the relative abundance of recruits would arguably give a broad picture of spatial variation in the regenerative capacity of GBR reefs. Inclusion of measures of the abundance of recruits may extend the usefulness of multivariate indices of reef health. Note that these data are collected in different ways in the different monitoring programs, so combining the datasets for synthesis will not be straightforward.
6. Synthesise and map selected variables from these datasets (1) to identify regions with values exceeding thresholds (where these can be identified from knowledge of ecological processes) or, in most cases, regions with extreme values and (2) to allow overlay of summarised data for potential drivers of reef ecosystem health (e.g. water quality).

Project Methods

Objectives a-d will be led by JCU and will be achieved by:

- Convening a workshop on indicators of condition and trend in health of non-reefal coastal GBR systems (seagrasses and potentially mangroves) (seeking a broad base of expertise);
- Reviewing existing data sets that are available for analysis to evaluate the indicators arising from the workshop listed above (link to MTSRF Project 1.1.3);
- Reviewing the efficacy of indicators of ecosystem health (non-reefal) where current data is available (identify links to MTSRF projects monitoring biodiversity and the health of the GBR ecosystem where future opportunities for field testing may occur);
- Convening a working group to evaluate the outcomes of the first workshops, and through links to MTSRF Projects 1.1.3, review data sets available to develop a set of threshold levels that represent threshold points (of 'concern' and/or for triggering management action) and identify areas of concern with a lack of data availability; and
- Synthesizing the results of steps 1, 2, 3 and 4 into a report on "Indicators and thresholds of concern for the status and trends of the health of the Great Barrier Reef".

Objectives e and f will be led by AIMS and will involve four stages:

1. Extending this project's previous work, AIMS monitoring data will be used for modelling spatial and temporal distributions of values for the benthic variables, combining inshore and offshore monitoring data sets. These distributions will be presented in a format similar to the report "The Spatial, Temporal and Structural Composition of Water Quality of the Great Barrier Reef and Indicators of Water Quality", by Glenn De'ath. The indicators will include measures of abundances, demography, biodiversity and community structure;
2. In most cases, underlying ecological processes on coral reefs are not sufficiently well understood to allow identification of thresholds or tipping points for ecosystem health from prior knowledge or theory. In this situation, the approach will be to identify extremes within the range of values for that indicator that have been recorded in similar habitats;
3. Spatial summaries for the indicators and an overall synthesis will give an overview of current status of coral reefs of the GBR as well as areas of relative risk will be reported for the MTSRF and presented to the relevant stakeholder groups (e.g. GBRMPA Outlook Report Taskforce) for comment; and
4. Final data products will be delivered to Project 1.1.5 for integration into the GBR Risk Atlas.

Project Targeted Activities

Objective	Targeted Activity	Completion Date
a	Workshop on the utility of GBR Marine Monitoring Program indicators with broad participation [JCU/GBRMPA/QDPI&F]	October 2008
b	Review of existing data sets and assessment of efficacy of potential indicators where data is available.	February 2009
c	Working group meeting on thresholds of concern and management triggers for reef health indicators involving consultation with stakeholders; GBRMPA, EPA, DPI&F	March 2009
d	Report on "Developing new potential indicators and thresholds of concern for the status and trends of the health of the Great Barrier Reef"	June 2009
e	Review and synthesis of data sets and indicators	Feb 2009
f	Presentation of draft results to MTSRF (via RRRC) and the GBRMPA Outlook Report Taskforce and any other relevant stakeholders (to be discussed with RRRC)	May 2009
f	Report on spatial patterns of selected indicators of coral community health and relative risk for inshore and offshore regions of the GBR in relation to thresholds of concern for the identified indicators	June 2008

Project 1.1.1 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Report 1 submission (with appropriate attribution of MTSRF funding): • Report of Workshop on non-reefal coastal GBR systems (seagrasses) indicators of Reef Health (October 2008) [JCU]; • Progress report on selection of variables and potential indicators from the data sets [AIMS] • Summary of any communication activities undertaken, including minutes of meetings/workshops if applicable [AIMS & JCU].	15 Dec 2008
Pathway to Impact Report for end user relevance [AIMS & JCU]	31 Dec 2008
Report 2 submission (with appropriate attribution of MTSRF funding): • Summary of discussion outcomes from working group assessment of available data and consultation with stakeholders to identify and analyse available data and the methods appropriate to setting threshold and targets for management action [JCU]; • Draft report to include spatial and temporal summaries of variables associated with benthic communities that may be indicators of ecosystem health, thresholds of concern identified from prior knowledge or extreme values from the observed range for the selected variables, and integrated summaries of relative coral reef ecosystem health for bioregions and for NRM regions [AIMS].	30 April 2009
• Feedback from stakeholders and RRRC/MTSRF provided to AIMS for development of final report [AIMS]	31 May 2009
Final report submission (with appropriate attribution of MTSRF Funding): • Report describing new potential indicators and thresholds of concern for the status and trends of the health of the Great Barrier Reef in non-reefal areas [JCU] • Final report describing spatial and temporal summaries of variables associated with benthic communities that may be indicators of ecosystem health, thresholds of concern identified from prior knowledge or extreme values from the observed range for the selected variables, and integrated summaries of relative coral reef ecosystem health for bioregions and for NRM regions; and reviews and feedback from consultation process [AIMS]; • Delivery of finalized products for integration into the Reef Atlas (1.1.5) [AIMS & JCU]	10 Jun 2009
Total MTSRF Funding	\$60,000*

* Total includes \$1,000 Visual Documentation Allocation.

Project 1.1.1 Budget***Year 1 – 2008/2009 Project Funding and Partnerships***

Contributing Organisation	Cash	In-kind	Total
MTSRF	59,000	-	59,000
MTSRF Visual Documentation*	1,000	-	1,000
JCU	-	59,000	59,000
AIMS	-	25,000	25,000
Total	60,000	84,000	144,000

* A total of \$1,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

JCU Project 1.1.1 Budget 2008/2009

Item	MTSRF Funds	JCU In kind	Total Cost
Salaries	13,500	29,500	43,000
Operating	5,000		5,000
Travel	6,000		6,000
Communication / Extension	5,000		5,000
Capital			0
Institutional overheads		29,500	29,500
Total	29,500	59,000	88,500

AIMS Project 1.1.1 Budget 2008/2009

Item	MTSRF Funds	AIMS In kind	Total Cost
Salaries	24,000	25,000	49,000
Operating	2,500		2,500
Travel	3,000		3,000
Communication / Extension			
Capital			
Institutional overheads			
Total	29,500	25,000	54,500

Indicative Budget Summary – Years 4,5

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	60,000		84,000			144,000
Total	60,000		84,000			144,000

PROGRAM 1: STATUS AND TRENDS OF SPECIES AND ECOSYSTEMS IN THE GREAT BARRIER REEF

Project 1.1.2: Condition and trend of the GBR ecosystem: indicators, thresholds of potential concern, and ecological influence of GBR Zoning Plan on mid and outer shelf reefs

Project Leader and Host Organisation

Dr Hugh Sweatman, Australian Institute of Marine Science (AIMS)

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Dr Hugh Sweatman	AIMS	Task Leader (AIMS)	0.3
AIMS Long Term Monitoring Team	AIMS	Reef ecologists	4.2
Ms Jos Hill	Reef Check	Task Leader (Reef Check)	0.2

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
Reef Water Quality Partnership	Rachel Eberhard
AMPTO	Col McKenzie
Queensland Canegrowers	Tim Wrigley
GBRMPA	Laurence McCook

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project will deliver regular reports on the broad-scale status and relative health of coral reefs in the GBR including information about regional and global resilience to natural disturbances (e.g. cyclones, crown-of-thorns starfish, coral disease and coral bleaching). These reports of condition and response will be linked with research in other MTSRF Programs, notably those for water quality and climate change, and will feed into the Integrated Reporting processes for the MTSRF. The program will develop an early warning system for crown of thorns starfish (COTS) to allow the industry to prepare tactical responses. The Program will also measure the influence of the GBR Zoning Plan (2003) upon reef biodiversity and support community-based monitoring of tourism intensive sites in order to foster the concept of local environmental stewardship.

Key objectives:

- (a) Broad-scale surveys of coral reef health including the development of indicators and thresholds of concern for reef health and COTS Alert – early warning of a fourth wave of starfish outbreaks.
- (b) Determine the influence of the GBR Zoning Plan (2003) upon coral reef biodiversity.
- (c) Conduct crown-of-thorns starfish in the region of outbreak initiation – COTS Alert early warning of new outbreaks of starfish.

(d) Conduct community monitoring of GBR coral reefs.

Project / Task Methodology

Objective (a): Broad-scale surveys of coral reef health including development of indicators and thresholds of concern for reef health and COTs Alert – early warning of a fourth wave of starfish outbreaks.

AIMS LTMT (Long Term Monitoring Team) has conducted annual surveys of approximately 100 coral reefs for 15 years. Although this is a small sample of the ~3,000 reefs that make up the GBR, the survey reefs are widely distributed by latitude and longitude and cover all major sectors of the GBR Marine Park. The annual surveys follow standard operating procedures described on the AIMS website, <http://www.aims.gov.au/pages/publications.html#sop> and consist of a mixture of fine- and coarse-scale surveys. The fine-scale surveys conducted by SCUBA divers revisiting fixed transects provide detailed repeated measures of quantitative indicators of reef health; notably coral cover and composition, reef fish diversity and abundance, and periodically outbreaks of coral disease and/or coral bleaching. The coarse-scale monitoring achieved by towing snorkel divers around the entire perimeters of all reefs is particularly designed for detecting large disturbances like pest outbreaks (e.g. crown-of-thorns starfish), coral bleaching and cyclone damage to reef coral communities provides a broader picture that can augment the fine scale surveys.

Annual coverage of the entire GBR is accomplished by 5-6 voyages using AIMS vessels. Results from the broad-scale surveys are posted within a month of the end of each voyage (see example at <http://www.aims.gov.au/pages/research/reef-monitoring/lrm/lrm200601.html>). Results from the fine-scale surveys are also posted to the website once the coral data are extracted from the permanent video records captured by the field teams (see the latest results at <http://www.aims.gov.au/monmap/monmap.htm>). While all results are made available on the Internet as soon as they become available, the LTMT produces major Status Reports at regular intervals; see the following links for examples at regional and global level:

[AIMS Reef Monitoring survey archives](#)

[AIMS Reef Monitoring Status Report number 7](#)

While these links provide transparent timely results to the public, the project reports delivered directly to DEWHA and to the GBRMPA on a regular basis to ensure they are regularly updated on the condition of the GBR shortly after the completion of each voyage.

The LTMT will be a major source of data and information for the evolving Risk, Resilience and Response Atlas being developed for the GBR through the MTSRF (Project 1.1.5). The process will provide a structured framework for assimilating data from multiple sources with an emphasis on quantitative indicators of condition and trend for the purpose of examining the performance of systems against thresholds of critical concern. A workshop in November 2006 identified a large number of potential indicators of stressors and status of reefs and potential sources of relevant data, but concluded that there were very few broadly accepted or readily identified indicator values that indicated serious degradation from human disturbance.

AIMS reef ecologists will work with the developers of the Risk, resilience and Response Atlas to identify and develop feasible indicators of coral reef health from the information that is available and provide relevant data as Reporting and Integration needs evolve.

Objective (b): Influence of the GBR Zoning Plan (2003) upon biodiversity of mid and outer shelf coral reefs

In the first year of MTSRF (2005/06), the AIMS LTMT realigned its sampling plan to assess the performance of the 2004 re-zoning plan for the GBR marine park in terms of protecting biodiversity. The new sampling plan consisted of comparisons between six pairs of matched reefs (similar size, complexity, cross-shelf position, exposure, etc.) in each of four regional clusters between Yeppoon and Cairns plus an additional four pairs in the Capricorn-Bunker group of reefs off Gladstone. One of the reefs in each pair was rezoned in 2004 from blue to green (i.e. from fished to 'no-take' category). The other was a similar reef in terms of size, distance from shore, exposure and morphology that remained open to fishing. These reefs were surveyed with the standard protocols used by the LTMT for its broad-scale surveys. Preliminary results for the primary target species, coral trout, showed an effect of protection only 18-22 months after the rezoning, complementing similar surveys of inshore sites by researchers from James Cook University (see <http://www.environment.gov.au/programs/cerf/publications/pubs/rap-rezoning-trout-report.pdf>).

Following the strategy of alternating broad-scale assessments of reef health (Objective (a)) with the assessments of zoning performance (Objective (b)) in successive years, the reef pairs selected for assessing the effects of rezoning will be re-surveyed in 2007/08 and 2009/10 providing biodiversity assessments at 1-2, 3-4, and 5-6 years after the rezoning in July 2004. This will close an important gap in our understanding of the time-scales of changes in biodiversity and other ecological responses to spatial closures ('no-take' zones). Unlike previous blue-green comparisons, which have concentrated on the populations of line-caught fishes, this task will also measure biodiversity across a spectrum of taxa in order to follow potential trophic cascades. The latter could include changes in the abundance of small species of fish, changes in the rates of herbivory, and changes in the dynamics of coral assemblages. This will be a particular focus of the 2007-08 surveys.

Objective (c): Crown-of-thorns starfish early warning surveys

Marine park tourism operators have a particular interest in crown-of-thorns starfish outbreaks. These occur in waves that appear to be initiated in the area between Cairns and Cooktown. The last three waves have occurred at approximately 15 year intervals, with the last being detected in 1992, suggesting that another is due. The LTMT conducted special surveys of COT populations on 41 reefs in the source area in 2006-07 and found no evidence a build up in adult starfish densities that might produce secondary outbreaks. Given that starfish spawn in summer and take about two years to reach a size to be obvious on the reef, the COTS Alert surveys will be repeated in 2008-09 which should still give lead time in which to organise a response before any outbreaks become evident in the Cairns region or further south.

Objective (d): Community monitoring of GBR coral reefs

Reef Check Australia (RCA) is one node of an international marine conservation NGO that operates in 82 countries. RCA trains and supports volunteers to conduct community-based assessments of condition and trend of coral reefs and has a strong international outreach program. In the GBR, RCA has established strong partnerships with marine parks tourism operators who provide logistic support for Reef Check volunteers to visit their operations in exchange for status reports on the condition of reef resources. Over the life of the MTSRF, Reef Check proposes to train additional volunteers (bringing the total pool to around 50) and to coordinate community monitoring and reporting of the status and trends of 25 key tourism sites. Through regular visitation, this program is able to resolve temporal (seasonal) patterns of change in biodiversity and more closely observe emerging phenomena such as outbreaks

of pests and disease. A program of fine-scale surveys on tourism sites (based on protocols validated by CRC Reef) will be developed together with local operators to inform businesses with early warning about local outbreaks of crown-of-thorns starfish (COTs Alert). RCA surveys augment long-term monitoring surveys by increasing the number of sites and the number of target species surveyed by recording the abundance of rare biota such as clams and large fish as they are not restricted to fixed transects. RCA will communicate MTSRF outcomes from its own and other programs through its volunteer “message-carriers” and its established communication channels that include online scientific and lay reports, brochures, and community education events / public forums. Data and information obtained through Reef Check surveys funded through the MTSRF programme will also contribute to the development of the Risk, Resilience and Response Atlas. All information and capacity will be shared as best practice with the international Reef Check network of 90 countries.

Project Targeted Activities 2008/2009

Objective	Targeted Activity	Completion Date
(a)	40% of LTMP reefs to be completed (weather permitting)	Dec 2008
	Progress report on the contributions of the AIMS LTMP to the GBR Reporting for the GBRMPA Outlook report	Dec 2008
	Fieldwork completed; preliminary summaries posted on-line within one month of voyage completion (www.aims.gov.au) and delivered to the Risk, Resilience and Response Atlas.	Jun 2009
(b)	No field work component in 2008-09	-
(c)	COTS early warning surveys planned for 2008-09	Jun 2009
(d)	Reef Check Surveys: a) Survey and report on findings of 25 dive sites conducted in 2008/9 b) Train 16 new community volunteers to join current RCA survey teams. c) Data transferred to the Risk, Resilience and Response Atlas	Jun 2009
	Dive Industry Workshops/Meetings a) Feedback on communication materials developed during 2007/8.	Mar 2009
	Extensive communication through quarterly newsletters, web updates	Jun 2009
	Report on Reef Check training	Mar 2009

Project 1.1.2 Milestones 2007/2008

For 2008/2009 outputs only	Date
Milestones	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Report 1 (with appropriate attribution of MTSRF funding) [AIMS]: Progress update for objective (a) (above): preliminary findings, schedule of proposed fieldwork for areas still to be surveyed. Delivery of on-line regional assessments for voyages to date (with appropriate attribution of MTSRF funding).	30 Nov 2008
Report 2 (with appropriate attribution of MTSRF funding) [Reef Check]: Progress report for objective (d): Reports on finalized operator interpretation materials (with appropriate attribution of MTSRF funding)	15 Dec 2008
Pathway to Impact Report for end user relevance.	31 Dec 2008
Report 3: Progress report (with appropriate attribution of MTSRF funding): - Progress report on objective (a) fieldwork: sites visited, schedules for sites still to survey with appropriate attribution of MTSRF funding) [a, AIMS]. - Report on evidence of effects of the rezoning of the GBRMP in 2004 on patterns of biodiversity on survey reefs after 3-4 years [b, AIMS] (with appropriate attribution of MTSRF funding). - Reports describing outputs of workshops/individual meetings with operator managers to acquire feedback on communication/interpretation materials [d, Reef Check]	31 Mar 2009
Report 4 (with appropriate attribution of MTSRF funding): - Report on areas surveyed for objective (b) including summary of salient results for surveys undertaken in 08/09 (with appropriate attribution of MTSRF funding) [a, AIMS] - Data transferred to the Risk, Resilience and Response Atlas - Report on contributions from LTMT to MTSRF projects related to Integrated Reporting for the GBR [a, AIMS] Progress report for objective (d): - Report describing results and sites visited for 25 surveys completed, data transferred to the Risk, Resilience and Response Atlas [d, Reef Check]	15 Jun 2009
Total MTSRF Funding	\$320,000

Project 1.1.2 Budget

Year 1 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF (a, b) (d)	316,000	-	316,000
MTSRF Visual Documentation*	4,000	-	4,000
AIMS (a, b)	-	600,000	600,000
AMPTO (d)	-	5,000	5,000
Total	320,000	605,000	925,000

* A total of \$4,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

AIMS Project 1.1.2 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	266,000	300,000	566,000
Operating	-	300,000	300,000
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	266,000	600,000	866,000

Reef Check Project 1.1.2 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	35,000	-	35,000
Operating	5,000	5,000*	10,000
Travel	5,000	-	5,000
Communication / Extension	5,000	-	5,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	50,000	5,000	55,000

*\$5,000 from AMPTO 3rd party co-investment

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	350,000	-	600,000	-	5,000	955,000
Total	350,000	-	600,000	-	5,000	955,000

PROGRAM 1: STATUS AND TRENDS OF SPECIES AND ECOSYSTEMS IN THE GREAT BARRIER REEF***Project 1.1.3: Condition, trend and risk in coastal habitats: Seagrass indicators, distribution and thresholds of potential concern*****Leader and Host Organisation for Project 1.1.3 objectives**

Associate Professor Michelle Waycott, James Cook University – objectives (b) and (c)
 Len McKenzie, Queensland Department of Primary Industries and Fisheries (QDPI&F) – objective (a)

Project 1.1.3 has three major objectives:

- (a) Status and trend of GBR seagrasses: - Community monitoring: Seagrass-Watch.
- (b) Understanding the drivers of seagrass change, indicators of seagrass health and thresholds of potential concern.
- (c) Risk assessment for coastal seagrass habitats: values, threats and vulnerabilities.

Aspects of the project that relate to the delivery of Objectives (b) and (c) are to be led by James Cook University. Aspects of the project that relate to the delivery of Objective (a) are to be led by Queensland Department of Primary Industries and Fisheries and both are described below.

Project 1.1.3 Research Team commitment 2008/2009

Title	Organisation	Role	FTE*
A Prof Michelle Waycott	JCU	Task leader (b) and overall project Task collaborator (all tasks)	0.25
Dr Catherine Collier	JCU	Postdoctoral Researcher (b)	1.0
A Prof Joseph Holtum	JCU	Task collaborator (b)	0.1
Dr Ivan Lawler	JCU	Task collaborator (b)	0.05
Dr Rob Coles	QDPI&F	Task collaborator (a & c)	0.2
Mr Len McKenzie	QDPI&F	Task leader (a) Task collaborator (b & c)	0.5
Dr Michael Rasheed	QDPI&F	Task collaborator (a & c)	0.1
Dr Jane Mellors	QDPI&F	Researcher – (a) Task collaborator (b & c)	0.3
Mr Rudi Yoshida	QDPI&F	Technician – (a & b)	0.6
Ms. Alana Grech#	JCU	Task leader (c)	0.25
Prof Helene Marsh	JCU	Task collaborator (c)	0.05

* FTE from all sources including associated third party projects in-kind and MTSRF.

based at JCU with in kind from JCU to support this position

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
QDPI&F	John Beumer
AMPTO	Col McKenzie
GBRMPA	TBA
Queensland Canegrowers	Tim Wrigley
DEWHA	TBA

Project 1.1.3 Duration (all objectives)

Start Date: 1 July 2006

End Date: 30 June 2010

Description of Project / Task Objectives for Project 1.1.3 Objectives

The components below will deliver cost effective research and assessment of the region's seagrasses including assessment of the threats from human impacts to be coupled against findings from Objective (a) of this project (1.1.3) to improve knowledge of the distribution of seagrass habitats. The project has strong links to the threatened species theme as these seagrass habitats provide a key food resource for the nationally threatened species of marine turtles and dugong. Outputs of the project will have a strong spatial component including production of GIS layers. A research objective (partly experimental and recommended by the MTSRF Great Barrier Reef Steering Committee) to generate a better understanding of the drivers of seagrass change is included in the information presented here.

The 15 species of seagrasses occurring in the GBR can be found in bays, estuaries lagoons and reef platforms growing in intertidal, subtidal, and deep-water environments (Carruthers 2002). The greatest meadow area is found in estuarine and coastal waters and these are the most at risk from both point and diffuse sources of human-related impacts (Carruthers 2002). Although gaps in our knowledge of seagrass distribution do still remain, these distributions have been relatively well described. These mapping efforts, combined with ongoing community monitoring (SeagrassWatch, focus of Objective (a) of this project) have highlighted that seagrass meadows are ephemeral; they come and go on time-scales of months to years (www.seagrasswatch.org; Coles et al. 1993, Birch and Birch 1984, Waycott et al. 2005). In other regions, fluctuations in seagrass distribution and biomass have been observed with seasonal fluctuations in temperature, light and nutrient availability (Alcoverro et al. 1997, Dunton 1994, Moore et al. 1997, Perez 1992). However, the interrelationship between human mediated influences and normal population changes in seagrass distribution in the GBR are poorly understood (e.g. Inglis 2000). The objectives described here will address questions that will enhance our understanding.

Project / Task Methodology

Objective (a): Status and trend of GBR seagrasses: community monitoring

This task will build and continue support of the established technical/scientific core of the intertidal seagrass assessment program (Seagrass-Watch), which has a significant community based component. This is a cost effective program employing the skills of scientists and utilising community resources. The program has expanded rapidly across Queensland and interest is high within the GBRWHA to initiate additional long term assessment sites in many other areas (e.g. North of Cooktown and Bowen) to improve knowledge of the distribution of biota and their associated habitats within the region. This

task is essential to continue support of not only the existing 22 sites of the GBR Reef Water Quality Plan Marine Monitoring Program but also the larger geographic spread of sites (currently 122) including those in Dugong Protected Areas and other areas of community interest. Seagrass-Watch is also one of the most detailed datasets currently available on which several research programs/investigations (including objective b) are based.

Objective (b): Understanding the drivers of seagrass change

Historically, seagrass habitats of the GBR would have been characterised by having low nutrient availability and being primarily nitrogen limited (Udy 1999). Since European settlement, human activities in the catchments and coastal zones have greatly increased turbidity and nutrient concentrations and many coastal seagrass habitats are now characterised by low light availability (Carruthers 2002). These meadows are threatened by chronic reductions in water quality as well as physical disturbance from storms, floods, swell and human activities and acute short-term water quality reductions associated with flood events and coastal construction associated with urbanisation (e.g. marina's) and changing land use patterns (e.g. bridges, stream flow). Climate change predictions also indicate that seagrasses will face rising sea temperatures and in shallow intertidal meadows, localised intense increases in temperature could lead to seagrass burn-off (Waycott *et al.*, 2007). These climate change predictions also indicate that increased storm intensity and wind speeds could exacerbate the impacts of low light availability. For these reasons, light and temperature are the drivers proposed for further investigation in the current proposal.

Strategies adopted by environmental managers to mitigate the impacts of human activities on seagrass meadows are largely based on information taken from other well studied areas, such as the northern hemisphere or Australian temperate meadows. In developing our understanding of the drivers of seagrass meadows, we will identify threshold levels of change that limit the biomass, growth and reproductive capacity of coastal seagrasses. These outcomes will provide management authorities with experimentally based targets that can be applied during monitoring programs to enforce management actions, i.e. triggers.

Existing projects can contribute to the outcomes of this work. Recent workshops (MTSRF and RWQMP) and publications (Johnson and Marshall GBRMPA Climate Change, 2007) have identified these studies as priorities. The Water Quality Monitoring component of GBRMPA's Marine Monitoring Program includes detailed sediment and seagrass tissue nutrient analysis, *in situ* temperature data, biomass and seed density at sites throughout the GBR (Schaffelke 2006-RWQMP Report). This supporting information will considerably strengthen the proposed field and experimental work by providing long-term and historical data sets. Seagrass species that dominate in coastal and estuarine waters (*Halophila*, *Halodule*, *Zostera*, *Cymodocea*) will be the focus of the work, as these meadows are the most vulnerable to changes in temperature and light availability.

Objective (c): Risk assessment for coastal seagrass habitats: values, threats and vulnerabilities.

Coastal and deepwater seagrass are threatened by various anthropogenic activities such as trawling and other impacts, regulatory decisions to manage these activities are typically made with incomplete scientific information. However, a good management decision rule should not require large numbers of precise estimates to trigger warranted management actions. The risks to seagrasses need to be assessed using the best available data in the face of the high social, economic and political costs of eliminating the environmental effects of human activities and the ecological consequences of postponing action. Decision-support tools, such as spatial risk assessments in geographical information systems (GIS), can assist in rapid assessments of risks to seagrass by incorporating spatially explicit models of species distribution with qualitative and quantitative information on the distribution of

resources and anthropogenic impacts. A spatial risk assessment approach, therefore, enables management efforts to be targeted to areas identified by the assessment as requiring action.

Currently, there is limited information on risk to seagrasses from anthropogenic activities across various areas of the GBRWHA. We will evaluate the risks to seagrasses based on modelling of changes in seagrass distribution under different ecosystem stress scenarios. Our approach will utilise current data available through various broad scale mapping and monitoring schemes to evaluate risks to seagrasses across a range of GBR regions. Further work to refine models to encompass more functional models of seagrass habitat associated with different community structures and ecosystem service values is planned once baseline models are evaluated.

Project 1.1.3 Targeted Activities

Objective	Targeted Activity	Completion Date
(a)	A 1. Undertake Seagrass-Watch community monitoring for intertidal seagrass abundance, community structure, distribution, physical parameters at agreed regularly monitored sites throughout the GBRMP.	1 Dec 2008
(a)	A 2. Undertake Seagrass-Watch community monitoring for intertidal seagrass abundance, community structure, distribution, physical parameters at agreed regularly monitored sites throughout the GBRMP.	28 May 2009
(a)	A 3. Seagrass-Watch newsletter completed every 4-6 months from 1 July 2008 (min. two for year ending June 2009).	1 ea. at minimum of 30 Nov 08, 31 May 09
(b)	B 1. Test seagrass responses to drivers of seagrass change through field data collection.	1 Dec 2008
(b)	B 2. Conduct mesocosm experiments on temperature and light effects on seagrass growth.	10 Jun 2009
(b)	B 3. Analyse and report <i>in-situ</i> light and temperature measurements at seagrass monitoring sites in objective (a).	10 Jun 2009
(c)	C 1. Review the case study risk assessment model of seagrass habitat in the GBRWHA	1 Dec 2008
(c)	C 2. Working group convened to assess applicability of the case study approach to seagrass habitat across the GBR	1 March 2009
(c)	C 3. Model output for more regions of the GBR than case study	1 May 2008

Project 1.1.3 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
<i>Report 1 submission QDPI&F</i> (with appropriate attribution of MTSRF Funding): • Report on Seagrass-Watch intertidal: locations, abundance, community structure and distribution at agreed sites (newsletter) (obj a) • Plan of any communication products/events for Year 2 and summary of any communication activities undertaken to date, including minutes of meetings/workshops as applicable (obj a) <i>Report 1 submission JCU</i> (with appropriate attribution of MTSRF Funding) describing: • Experimental results from initial mesocosm experiments (b2) • Summary of data outputs from light loggers at field sites (b3) • Evaluation of the effectiveness of the risk assessment case study and its applicability to a wider range of locations (c1) • Plan of any communication products/events for Year 2 and summary of any communication activities undertaken to date, including minutes of meetings/workshops as applicable (b) and (c) • Pathway to Impact Report for end user relevance.	1 Dec 2008
<i>Report 2 submission QDPI&F</i> (with appropriate attribution of MTSRF Funding): • Findings of Seagrass-Watch intertidal: locations, abundance, community structure and distribution at agreed sites (newsletter) (a) • Assist with maintenance of light loggers at selected field sites (b3) • Host, attend and assist in the organization of the risk assessment working group meetings <i>Report 2 submission JCU</i> (with appropriate attribution of MTSRF Funding): • Progress report on experimental work and the development of spatial risk assessments via working group activities (b and c)	28 May 2009
<i>Report 3 submission QDPI&F</i> (with appropriate attribution of MTSRF Funding): • Summary report on findings from Seagrass-Watch monitoring to date at agreed sites. (a) • Final summary describing communication and collaboration activities completed to date. (a) <i>Report 3 submission JCU</i> (with appropriate attribution of MTSRF Funding): • Final report describing the results and analysis of temperature and light mesocosm experiments (b 2) • Summary of outputs from risk assessment working group activities (c3) • Final summary describing communication and collaboration activities completed to date (b and c) • Proposed work plan for 2009/10 (a-c)	11 June 2009
Total MTSRF Funding	*200,000

* Total includes \$3,000 for Visual Documentation Allocation and \$2,000 to support collaboration with QDPI&F Project 1.1.3 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Total payment summary	JCU	QDPI&F	Total
MTSRF funds	102,000	95,000	\$197,000
In-kind	183,490	158,308	\$341,798
Total	\$285,490	\$253,308	\$538,798

Project 1.1.3 Budget 2008/2009

Contributing Organisation	Cash	In-kind	Total
MTSRF specifically against research objective (b)	125,000		125,000
MTSRF specifically against research objective (c)	20,000		20,000
MTSRF to support collaboration	2,000		2,000
MTSRF Visual Documentation*	3,000		3,000
MTSRF specifically against research objective (a)	50,000		50,000
JCU support		183,490	183,490
QDPI&F support		158,308	158,308
Total	\$200,000	\$341,798	\$541,798

* A total of \$3,000 is held by the Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

JCU Objective (a) Project 1.1.3 Budget 2008/2009

Item	MTSRF Funds	In-kind and third party contracts	Total Cost
Salaries		4,877	4,877
Operating			
Travel			
Communication / Extension			
Capital			
Institutional overheads		5,164	5,164
Total	0	10,041	10,041

JCU Objective (b) Project 1.1.3 Budget 2008/2009

Item	MTSRF Funds	In-kind and third party contracts	Total Cost
Salaries	75,000	57,848	132,848
Operating	19,000	15,000	34,000
Travel	6,000	4,000	10,000
Communication / Extension			
Capital			
Institutional overheads		61,251	61,251
Total	100,000	138,099	238,099

JCU Objective (c) Project 1.1.3 Budget 2008/2009

Item	MTSRF Funds	In-kind and third party contracts	Total Cost
Salaries		17,170	17,170
Operating	1,000		1,000
Travel	1,000		1,000
Communication / Extension			
Capital			
Institutional overheads		18,180	18,180
Total	2,000	35,350	37,350

DPI&F Objective (a) Project 1.1.3 Budget 2008/2009

Item	MTSRF Funds	In-kind and third party contracts	Total Cost
Salaries	44,000	44,631	88,631
Operating	3,000		3,000
Travel	3,000		3,000
Communication / Extension			0
Capital			0
Institutional overheads		49,711	49,711
Total	50,000	94,342	144,342

DPI Collaboration with JCU for all objectives Project 1.1.3 Budget 2008/2009

Item	MTSRF Funds	In-kind and third party contracts	Total Cost
Salaries			
Operating			
Travel	2,000		2,000
Communication / Extension			
Capital			
Institutional overheads			
Total	2,000		2,000

DPI&F component of Objective (b) Project 1.1.3 Budget 2008/2009

Item	MTSRF Funds	In-kind and third party contracts	Total Cost
Salaries	15,000	5,030	20,030
Operating	6,000		6,000
Travel	4,000		4,000
Communication / Extension			0
Capital			0
Institutional overheads		5,602	5,602
Total	25,000	10,632	35,632

DPI&F component of Objective (C) Project 1.1.3 Budget 2008/2009

Item	MTSRF Funds	In-kind and third party contracts	Total Cost
Salaries	10,000	25,231	35,231
Operating	8,000		8,000
Travel			
Communication / Extension			
Capital			
Institutional overheads		28,103	28,103
Total	18,000	53,334	71,334

Indicative Budget Summary – Years 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	200,000		300,000			500,000
Total	200,000		300,000			500,000

PROGRAM 1: STATUS AND TRENDS OF SPECIES AND ECOSYSTEMS IN THE GREAT BARRIER REEF***Project 1.1.4: Dating and mapping historical changes in GBR coral communities*****Project Leader and Host Organisation**

Associate Professor Jian-xin Zhao, The University of Queensland (UQ)

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Assoc. Professor Jian-Xin Zhao	UQ	Project Leader	0.2
Professor John Pandolfi	UQ	Co-investigator	0.2
Dr Terry Done	AIMS	Co-investigator	0.1
Dr. Kefu Yu (ARC Research Fellow)	UQ	Co-investigator	0.1
PhD student (geochronology) – Miss Tara Clark	UQ	Co-investigator	1.0
PhD student (mainly ecology) - Mr George Roff	UQ	Co-investigator	1.0
Potential PhD student (mainly cyclone history) - Mr Alberto Rodriguez	UQ	Co-investigator	1.0

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
DEWHA	Kevin Gale
AMPTO	Col McKenzie
Queensland Canegrowers	Tim Wrigley
GBRMPA	Laurence McCook

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

A large number of dead branching corals and massive coral heads, representing individual life spans up to hundreds of years, exist among the coral communities of coastal reefs. Modern dating methods using the TIMS Uranium-series allow us to know the age of dead coral colonies *in situ* on the GBR at a resolution of 1-3 years over several hundred years of history. This allows temporal bracketing of significant mortality events back to the time of early European settlement of Queensland and beyond. Knowledge of the age structure of the death assemblages can be related to major human developmental events and recent mass bleaching events related to global warming, so that the sources of the mortality can be identified; management can be directed toward ameliorating those sources. If the coral mortality has resulted in substantial changes in reef coral community structure, then management is in a position to understand what the previous state of the reef was, so we can overcome the 'shifting baseline syndrome' whereby each new generation of managers and scientists has a different view of what constitutes 'natural'. GBRMPA has already invested in this historical perspective through its 'Historical Photographs' initiative, and we intend to expand this perspective to inform the Authority about the natural state of the coral reef.

Project 1.1.4 has six main objectives:

- (a) Determine the decadal death rate of both massive and branching corals over the last 200 years (since European settlement).
- (b) Determine the variation in coral community structure over the past 200 years.
- (c) Correlate rates of coral mortality with major human development and recent El Niño events.
- (d) Reconstruct coral mortality rates and community change over the past millennium leading up to European settlement using short cores from back reef environment.
- (e) Reconstruct cyclone history and frequency over the past millennium through precise dating of transported reef blocks and lagoon sediment cores.
- (f) Distinguish the impact of human developmental events and anthropogenically-induced global warming from natural variability.

Project / Task Methodology

Objective (a): Determine the decadal death rate of massive and branching corals over the last 200 years (since European settlement)

The first question that we address is has there been any change in the decadal death rate of nearshore GBR corals over the last 200 years. An abundance of large massive coral heads spanning multiple centuries now characterises the coral communities of nearshore GBR reefs. Are these communities similar in community structure to ones from hundreds to thousands of years ago? Or have the massive corals survived the longest, whilst large-scale mortality of branching acroporid species has occurred? In northern areas of the GBR such as Princes Charlotte Bay, nearshore reefs have abundant and diverse branching coral communities along with their large massive counterparts; in many parts of the central and southern GBR only the massive corals are conspicuous. Our U-Th dating of surface branching coral rubbles from inshore reefs of Mackay in southern GBR shows that 15 of the 25 samples dated between 1750 to 1930 AD, whereas the remaining 10 samples died either prior to 1811 AD (4 samples) or after 1963 AD (6 samples) (Quaintance, 2006, Honour's thesis, UQ; Clark et al., unpublished). In a separate study, we dated 28 branching coral rubbles from three transects on Pelorus Reef in central GBR. The results, again, show a long-term decline of previously dominant acroporoid corals since the onset of European settlement.

Objective (b): Determine the variation in coral community structure over the past 200 years

The second question that we will address is: has there been any change in coral community structure in nearshore GBR coral reefs since European settlement? Methodologies for addressing this question have been well-developed by John Pandolfi and his team (Pandolfi *et al.*, 2003, *Science*)[†], and their work was highly influential in convincing GBRMPA and the government in 2004 to make an historic, landmark decision to re-design their zoning plan by setting aside > 35% of the Great Barrier Reef as no-take areas. Our results from Keswick and Pelorus Reefs show that community structure of the death assemblages in the sites dominated by dead coral rubbles with low coral cover is significantly different from sites where live corals are dominant.

Objective (c): Correlate coral mortality ages with major human developmental and recent El Niño events.

The third question we wish to answer is: are any correlations between coral mortality ages (or age population distribution of branching coral rubbles) and major human developmental and El Niño events over the past 200 years. In our previous studies, we have demonstrated that massive *Porites* corals in the southern South China Sea (within the SW Pacific Warm Pool) died many times over the past two centuries, most correlated precisely with historic El Niño events (Yu et al., 2006)[‡]. We expect that a similar phenomenon may be present in the GBR. For instance, we have dated one dead *Porites* colony on Magnetic Island which shows the coral died in 1983±2 AD, probably in response to the 1982-1983 AD El Niño. The ages of many dated pieces of coral rubble appear to cluster in groups that may be related to major events.

We initially planned to embark upon an ambitious dating program of coral death assemblages from heavily impacted reefs of the Wet Tropics and lightly impacted reefs from further north. We also planned to systematically census the coral death assemblages to compare community structure between life assemblages present today and previous assemblages living in the past. There are over 20 sites that Dr Terry Done visited over the past 25 years that are suitable for such a study and contain vital information on life assemblage composition. Ideally, we should census and sample coral death assemblages from several key sites for comparison between the northern and central-southern GBR, e.g. Princess Charlotte Bay in the northern GBR and corals from the Wet Tropics coast because these geographical regions are presumed to have different water quality (greater runoff from agricultural and urban sources in the Wet Tropics catchments) and markedly different intensity of human use. The AIMS has an extensive collection of cores from massive corals from these two regions and elsewhere, which will provide a logical starting point for our analyses. We also intended to piggyback on AIMS voyages for our sampling and census of the death assemblages, especially in northern GBR, but this is highly dependent on the availability of such voyages. Sampling death assemblages from lower latitudes in the northern GBR also provides an opportunity to investigate the impact of El Niño-related SST anomaly on coral reefs across a latitudinal gradient, especially in the low-latitude region.

Apart from sampling across a latitudinal gradient, the other plan is to sample several key sites along an increasing water quality gradient from both the Townsville and/or Mackay regions, to enable us to examine the discordance between living and death assemblages as evidence for anthropogenic ecological change, and to assess the impact of river runoffs on reef health.

It must be noted that sampling a water-quality gradient in Townsville/Mackay areas is logistically more viable than sampling the northern GBR.

Objective (d): Reconstruct coral mortality rates and community change over the past millennium leading up to European settlement using short cores from back reef environment.

The fourth question we wish to address is: has there been any change in coral community structure in nearshore GBR coral reefs over the past millennium leading up to European settlement? To answer this question, we have collected 40 cores (2-5 meters) from the back reef environment of Pandora and Havannah Reefs (central GBR). Precise dating of over 30 coral fragments found within the cores enable us to establish detailed chronological framework, with more dating still in progress. The results reveal surprisingly high accretion

rates (4 times greater than expected), implying prolific coral growth in such environment whereas the space in reef flat areas has been fully occupied. Preliminary analyses of cores reflect some interesting changes in the community structure, which could be related to natural causes such as cyclones.

Objective (e): Reconstruct cyclone history and frequency over the past millennium through precise dating of transported reef blocks and lagoon sediment cores.

This part of the project aims to use natural archives to reconstruct extreme wave events (mainly tropical cyclones, but may have tsunamis) that impacted the Great Barrier Reef (GBR) over the past millennium and to distinguish recent anthropogenic trend in intensity and frequency from longer-term natural variability. This study will specifically focus on the establishment of a precise chronology for wave-transported coral blocks and lagoon sediments from Heron/Wistari reefs, southern GBR and Trunk/Bramble reefs, central GBR, and the combined use of transported coral blocks and grain-size distributions of lagoon sediments for cyclone event reconstruction, which has been demonstrated in the PIs' previous studies in the South China Sea and Heron/Wistari reefs (Yu et al., 2004, 2008; Zhao et al., 2008)[§].

Objective (f): Distinguish the impact of human development events and anthropogenically-induced global warming from natural variability.

We plan to synthesis data collected for Objectives (a) to (e) to assess the extent of anthropogenic impact on coral mortality and community structure and separate this from that expected as part of a natural variability and trend. Only by removing that attributable to natural process can we confidently predict the trend in the near future under scenarios of global warming and increased coastal development.

Project Outputs/ Milestones

Objective	Output / Milestone	Completion Date
(a)-(f)	Fieldwork completed in southern/central Great Barrier Reef*	Dec 2008
(a)-(f)	Laboratory analysis completed on most cores	April 2009
(a)-(f)	Fieldwork completed in northern Great Barrier Reef *	May 2009
(a)-(f)	Laboratory analysis completed	Sept 2009
(a)-(f)	Theses completed	Jan 2010

* The date of this fieldwork is highly dependent upon weather and laboratory progress.

** This part of the fieldwork is highly dependent upon logistic viability. We expect to pig-back on AIMS' exploration vessel to complete this task.

Project 1.1.4 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Report 1 submission: - Plan for conduct of year three activities including planned laboratory and field sample collection schedule [UQ] - Plan of communication outputs and products for Year 3 and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable [UQ]	8 Oct 2008
Pathway to Impact Report for end user relevance.	31 Dec 2008
Report 2 submission: - Report on collection of coral rubbles, dead <i>in situ</i> massive corals, wave-transported coral blocks and short cores from back-reef and lagoon settings in central and southern GBR [UQ] - Dating results for coral rubbles, <i>in situ</i> dead massive corals, and short cores from back-reef and lagoon environments in central/southern GBR (with appropriate attribution of MTSRF funding) [UQ]	28 Jan 2009
Information transfer between agencies: Provision of data on coral mortality ages and ecological implications to Risk, Resilience and Response Atlas. Responsible officers: Zhao and Pandolfi from UQ.	19 May 2009
Report 3 submission: - Description and interpretation of results obtained for surface rubbles and cores from central GBR with appropriate attribution of MTSRF funding [UQ] - Report on fieldwork in northern GBR [UQ] - Final summary of communication activities undertaken through the course of Year 3 of project [UQ] - Plan for completion of out year activities [UQ]	2 June 2009
Total MTSRF Funding	\$50,000

Project 1.1.4 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	50,000	-	50,000
AIMS**	-	20,000	20,000
UQ	70,000	240,000	310,000
Total	120,000	260,000	380,000

* UQ's cash contribution is by provision of 2.5 Ph.D scholarships to Mr Roff & Rodriguez and Miss Clark (\$50,000), as well as project money (\$20,000) toward reconstruction of cyclone history in the GBR (to Drs Yu and Zhao). UQ's in-kind contribution is related to staff's time commitment to the MTSRF project (\$~160,000), tuition waiver to overseas student Mr Rodriguez (~\$27,000), and analytical discount to UQ staff and students (~\$43,000).

** AIMS' in-kind contribution is related to Dr Done's time commitment as well as provision of logistic support through AIMS exploration voyages.

UQ Project 1.1.4 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total
Salaries*	20,000	150,000	170,000
Operating*	20,000	80,000	100,000
Travel*	10,000	20,000	30,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	50,000	250,000	300,000

* Figures for these three items are only indicative and may vary according to unforeseeable circumstances

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	20,000	30,000*	160,000	15,000	-	225,000
Total	20,000	30,000	160,000	15,000		225,000

* This cash contribution is by provision of scholarships to Miss Clark and Mr Rodriguez. Mr Roff will have graduated in late 2009.

PROGRAM 1: STATUS AND TRENDS OF SPECIES AND ECOSYSTEMS IN THE GREAT BARRIER REEF

Project 1.1.5: Reef Atlas: Risk, Resilience and Response

Project Leader and Host Organisation

Katharina Fabricius, AIMS

Project Team

Title	Organisation	Role	FTE
Dr Katharina Fabricius	AIMS	Project leader, marine ecology, reporting, communication	0.3
Dr Glenn De'ath	AIMS	Statistics & spatial / risk modelling	0.5
Programmer	(contract)	Web delivery	0.2
Data Centre	AIMS	Metadata and data management	0.05

Summary Table of Research Users

Organisation	Contact
DEWHA	Kevin Gale
GBRMPA	David Wachenfeld
QDPI-F	
AMPTO	Col McKenzie

Project Duration

Start Date: July 2007

End Date: 30 June 2010

Project / Task Objectives

The Reef Atlas aims to become the principal repository for spatial data and risk analysis tools for the GBRWHA. In recent years, large-scale and long-term data and new powerful modelling tools have become available, which, in combination, enable us to describe spatial properties of the GBR and model the main forms of risks. The data are based on diverse sources, including large-scale and long-term surveys, real-time monitoring and remote sensing, experimental studies, theoretical models and expert opinion. Integration and interpretation of these data requires the use of modern modelling techniques, and given the spatial and temporal scales involved, effective expression and representation through mapping tools. The Reef Atlas project is developing the conceptual, computational and statistical frameworks needed to integrate and interrogate these data sets. The Reef Atlas will generate maps of environmental conditions, distributions of taxa on the GBR, including biodiversity hot spots, and risk factors, as well as scientific reports. This work will include models that relate biota to the spatial distributions of environmental drivers, and will develop risk thresholds.

The four components of the Reef Atlas will be:

- (1) Maps and mapping tools, displaying distributions, data reliability and 'hotspots';
- (2) Web pages with summary text;
- (3) Reports and publications; and
- (4) Metadata and data.

In Year 1, we have completed a preliminary identification of user needs and data availability, and have developed a framework for the web delivery based on a combination of Arcinfo, Google Earth, and downloadable reports in pdf format. We will have also provided a proof of concept for the risk mapping, focusing on biodiversity maps, risk mapping based on water quality and temperature distributions, and we will have started testing proposed thresholds and indices for WQ. Work on the Atlas is therefore progressing simultaneously in several areas and have met existing milestones. Achievements to date are:

1. A web-based GIS prototype based on Arc GIS, Google Earth and Google Map have been developed;
2. Several of the most important data sets namely geographic information, bathymetry, water quality parameters, biodiversity components such as hard coral, soft coral, and macro-algae, and sea surface temperature have been processed, and converted into gridded data and are available through the Atlas GIS prototype as interactive maps. These maps include presentation of uncertainty and 'hot spot' regions (e.g. highest biodiversity, poorest water quality etc);
3. We have started to develop a new and fully integrated systems design based on open-source software;
4. The structure and appearance of the Reef Atlas website has been developed, and demonstration pages, including the home page, are now available;
5. Text pages have been developed for three 'stories' on water quality and the biodiversity of the GBR;
6. A Reef Atlas logo has been developed;
7. Large-scale data storage and cataloguing is being organized using accepted data and metadata standards.

Efforts to develop the Reef Atlas can be separated into two essential components:

1. The science to improve understanding of ecosystem resilience and response, that will determine much of the content displayed by the Atlas; and
2. The design, development and integration of the technical components of the Atlas such as the GIS, content management and the web delivery systems. Each of these components will be developed at AIMS.

Here we propose to further investigate large-scale and long-term data sets to further improve understanding of ecosystem resilience and response. This requires both ecological knowledge of the systems involved and high-level mathematical and statistical skills. We have developed statistical modelling techniques for modelling biodiversity, environmental drivers and their inter-relationships. These have been used for mapping risk, biodiversity, water quality and temperature distributions. Based on this approach, we have also proposed risk thresholds and indices for water quality and mapped them for the GBR. We will continue to process data for sound ecological interpretation and effective display through a web-based GIS system and through the novel use of animations (e.g. changes in GBR coral cover over time, distribution of COTS outbreaks over time). We will focus on two forms of modelling:

1. Spatial mapping of individual parameters;
2. Statistical predictive models of environmental – biotic relationships (e.g. biodiversity and bleaching risk etc). Such research of interactive risks will likely lead to the formulation of new research questions as priority questions are examined and data deficiencies identified.

In Year 2, we will progress in the following priority areas:

1. Process and add new data on a range of topics, including spatial and temporal variation in coral calcification, water quality risks to reef biota, environmental drivers of macroalgal cover on reefs, and models of biodiversity and species turnover;
2. Publish on priority issues in forms of technical reports, scientific publications, atlas maps and web pages;
3. Engage a range of potential users to contribute to and operationalize the Atlas;
4. Develop new tools to display and analyse risk and distribution data;
5. Develop and refine web pages describing key topics concerning the GBR; and
6. Position the Reef Atlas to assist with new management initiatives such as the GBRMPA Outlook report, and the Australian Government's Reef Rescue Package.

The Project will be linked to MTSRF Projects 1.1.1. and 2.5i.4, as well as to the climate and water quality programs. Where applicable, models and outputs produced by these projects will be incorporated into the Atlas.

In the longer term, process and scenario models (e.g. hydrodynamics-environmental-ecological models) together with effective science communications, will also become an essential component of the Reef Atlas.

Project Outputs / Milestones 2008/2009

Objective	Targeted Activity	Completion Date
(a)	Web delivery: complete the development of an integrated system that incorporates content management, indexing and data processing systems that facilitates the delivery of web pages, maps, reports and model outputs.	Dec 2008
(b)	Mapping: complete the development of a framework for integrated web-based mapping of spatial and process-based data from GBR related research, and compile and upload priority data sets.	June 2009
(c)	Modelling: Statistical analysis and synthesis of selected GBR data sets, with particular emphasis on risks, and the biological implications of management actions such as water quality improvement or the GBR zoning system.	June 2009

Project 1.1.5 Milestone Payments 2008/2009

For 2008/2009 outputs only	Date	Payment due
Milestones		
Signing of contract		\$ 40,000
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09	
Progress Report 1 submission: Progress update for objectives (a), (b) and (c) (above) (with appropriate attribution of MTSRF funding) [AIMS]	15 Dec 2008	\$ 51,500
Pathway to Impact Report for end user relevance	20 Dec 2008	
Report 2 submission (with appropriate attribution of MTSRF funding) [AIMS]: - Summary of new contents for the GBR Atlas - Summary of the newly developed tools for mapping and modeling for the GBR Atlas	11 June 2009	\$ 51,500
Total MTSRF Funding		\$ 143,000

Project 1.1.5 Budget

Year 1 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	143,000	-	143,000
MTSRF Visual Documentation*	2,000	-	2,000
AIMS	-	166,939	166,939
Total	145,000	166,939	311,939

* A total of \$2,000 is held by the Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

AIMS Project 1.1.5 Budget 2008/2009 (without Programmer)

Item	MTSRF Funds	Funds from AIMS Contribution	Total Cost
Salaries	113,000	11,067	124,067
Operating (including contracts)	25,000	0	25,000
Travel	5,000	0	5,000
Communication / Extension	0	0	0
Capital	0	0	0
Institutional overheads	0	155,872	155,872
Total	143,000	166,939	309,939

Background Intellectual Property

This project will utilise and refer to a substantial body of background data owned by the Research Provider (AIMS) and other third parties. These background data sets will be characterised as 'Existing Material' for this project because the data sets existed prior to the commencement of this project. Notwithstanding Clause 16 of the contract between the Research Provider and the RRRC, this Existing Material may be cited or incorporated into the project for delivery of the project needs but will not be supplied as stand alone data sets as part of the project. Ownership of the Existing Material will vest within the Research Provider. For the purpose of clarity, the parties agree that the Research Provider will contribute findings, reports and other outputs based on the Existing Material but nothing in this agreement requires the Research Provider to contribute and distribute the raw data. At this preliminary stage, it is not possible to identify all of the Existing Materials that may be included in this project during its three year lifespan. The Research Provider retains ownership of the all data sets referenced in project reports submitted to the RRRC including, but not limited to, data sets derived from surveys and long-term monitoring data of hard and soft corals, algae, fish, crown-of-thorns starfish, coral calcification, and water quality, and sea surface temperature data.

PROGRAM 2

STATUS AND TRENDS OF SPECIES AND ECOSYSTEMS IN THE WET TROPICS RAINFORESTS

Program Leader and Host Organisation

Dr James Butler, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Budget Summary

	<i>Cash</i>	<i>In-kind</i>	Total
MTSRF	\$350,000	-	\$350,000
Other	-	\$411,699	\$411,699
Total	\$350,000	\$411,699	\$761,699

Program 2 will continue to report on the condition and trend of key environmental assets, including ecosystem processes and biodiversity, in the Wet Tropics rainforests and catchments. This Program will collate and evaluate current knowledge on biodiversity and other environmental assets delivered by ecosystem processes. To provide further data, targeted gap filling will now take precedence and the baseline developed for comprehensive condition monitoring and reporting of the North Queensland rainforest environmental assets will be used to focus on a report card for the biodiversity asset.

The Program will continue to build on the existing metadata banks developed under the Rainforest CRC, with an increased focus on the lowland rainforest areas that are experiencing increased threatening processes. The Program is linked to projects within Theme 2 (Program 5ii: Climate Change – Rainforests and Catchments), Theme 4 (Program 9: Sustainable Use, Planning and Management of Tropical Rainforest Landscapes). The Program will continue to develop rainforest monitoring methods and implement the refined monitoring protocol on existing and newly focused monitoring sites. Tools for measuring, monitoring and reporting have been developed and identify priorities for management action. The mining of existing data sets and the focused monitoring program will produce a flow of complex ecosystem information. Thus, the Program will collaborate with the relevant managing agencies and user groups to provide information that will contribute to Integrated Reporting for the Wet Tropics World Heritage Area and North Queensland's coastal catchments by assimilating data from multiple sources with an emphasis on quantitative indicators of condition and trend and performance assessment of systems against thresholds of critical concern. This approach will be developed in collaboration with Program 10, and the results will be used to assist management agencies in State of Environment reporting, including international obligations for World Heritage Periodic reporting.

Despite a number of attempts to do so, there has never been an integrated monitoring program across the Wet Tropics World Heritage Area that satisfies the reporting requirements of the Wet Tropics Management Authority and the Department of the Environment and Water Resources; nor has one been available for the coastal catchments outside the World Heritage Area. In part, this is because it has always been seen as too costly, which in turn has been partly because no one has been able to pin down a set of indicators that are both affordable and sufficiently robust for reporting.

Projects

1.2.1 Status and trends of biodiversity and ecosystem processes \$350,000

PROGRAM 2: STATUS AND TRENDS OF SPECIES AND ECOSYSTEMS IN THE WET TROPICS RAINFORESTS***Project 1.2.1: Status and trends of biodiversity and ecosystem services*****Project Leader and Host Organisation**

Dr James Butler, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
James Butler	CSIRO	Social ecologist, project leader	0.15
Dan Metcalfe	CSIRO	Tropical plant ecologist	0.20
David Westcott	CSIRO	Ecologist, project design	0.07
Leanne Cullen	CSIRO	Human ecologist (CSIRO postdoc, in-kind)	0.25
Andrew Ford	CSIRO	Botanist and taxonomic support	0.23
Matt Bradford	CSIRO	Plant ecology research support	0.10
Caroline Bruce	CSIRO	GIS and data management	0.30
Tina Lawson	CSIRO	GIS and data Management	0.32
Petina Pert	CSIRO	GIS and data Management	0.25
Luis Laredo	CSIRO	GIS and data Management	0.05
Professor Nigel Stork	Uni Melb	Entomologist/Ecologist	0.10
Dr Judy West	CSIRO	Botanist; Rainforest Plant Key	0.05
Steve Williams	JCU	Biodiversity specialist	0.15
Jeremy VanDerWal	JCU	Spatial ecologist	0.10

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
WTMA	Steve Goosem, Ellen Weber
Terrain NRM Ltd	Kath Shurcliff, Rowena Grace, Deb Harrison
EPA	TBA
Alliance for Sustainable Tourism	TBA

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

To provide the knowledge and methods needed for accurate and up-to-date state of the region reporting on the key biodiversity and ecosystem services assets of north Queensland, to support future iteration of NRM planning and the management of the Wet Tropics WHA, through:

- (a) A synthesis of current knowledge and identification of gaps for key biological and environmental assets;
- (b) Filling knowledge gaps in conjunction with field surveys being carried out in Project 1.4.3 (*Threatened species and communities*), Project 2.6.2 (*Identification and impact of invasive pests in the Wet Tropics Rainforest*) and completion of the *Interactive Key to Australian Rain Forest Plants*;
- (c) Design and test a monitoring program to track status and trends of key environmental assets and ecosystem services.
- (d) To examine how insect abundance and diversity vary across time and space in the Wet Tropics using the most diverse insect taxon, beetles, as an indicator group. Insects are vital for ecosystem processes and are food for many vertebrates. What is uncertain is how insect diversity and abundance varies across the Wet Tropics and therefore how other organisms are affected by these differences.

Project / Task Methodology

This project will proceed as a co-research partnership between CSIRO, JCU, UniMelb, MTSRF, WTMA and Terrain NRM Ltd. It is not possible to separate science and end users roles clearly because knowledge, management, monitoring and reporting are all joint responsibilities. The methods are introduced below, under two headings, knowledge synthesis and gap filling, and the design of a monitoring program. In fact, the monitoring program will depend critically on the data base available from synthesising knowledge and filling any gaps, and the monitoring program will in turn provide data back to the data base to improve knowledge in an iterative way. The project will provide a synthesis of current knowledge and databases on key biological and environmental assets in the Wet Tropics World Heritage Area, and design and trial of a potentially suitable and cost-effective monitoring program to track the status and trends of key indicators of ecological health and ecosystem services. The project is linking with nine other relevant MTSRF projects in the Rainforest & Catchments theme (Table 1), and monitoring and evaluation projects in other MTSRF themes, with particular reference to the Torres Strait (Project 1.3.5) and Great Barrier Reef (Project 1.1.2). In addition, parallel projects not funded by MTSRF will continue to feed into the social and community-based facets of the project, including projects investigating Indigenous knowledge and approaches to monitoring biodiversity and human well-being (Table 2).

Objective (a) and (b): Knowledge synthesis and gap filling

The Wet Tropics NRM region, which includes North Queensland's eastern coastal catchments and much of the Wet Tropics World Heritage Area (WHA), supports a range of complex and diverse ecosystems and a large number of rare, endemic or iconic species. These natural assets provide a broad range of ecosystem services to the local community and society at large. Whilst years of research at various scales, geographical extents and taxonomic levels have been carried out within the region, there is no central repository for this information, and there has been no coordinated attempt to establish a baseline dataset. Biological data from existing CSIRO plant and animal collections have been compiled and managed in a data base, but there are gaps in the coverage of the region and of the biota. Socio-economic data have also been compiled and are managed in a similar way, but again, there are gaps in coverage. Establishment of a suitable baseline provides the foundation for comprehensive condition monitoring, allows the range of existing work to be assessed and

promotes integration or linkages between projects, and will highlight areas where gaps in existing data coverage remain.

To provide further data, targeted gap-filling will continue to enable a good quality baseline to be completed which will provide a foundation for monitoring. This will continue to focus on coastal lowland communities on putative upland refugial areas that are remote from the main road network and have been chronically under-surveyed, and on the distribution of non-scheduled weeds, for which there is no legislative requirement for monitoring. Targeted gap filling in conjunction with Project 1.4.3 commenced early in Year 1 of this project. There will be regular scrutiny of the gap-analysis models as gaps are filled to ensure priority areas are being targeted. Reporting of baseline data to support the design and monitoring phase of the project will occur as significant gaps are filled. Data generated will also feed into Projects 2.6.2 and 4.9.6.

Concurrently with the collation of the metadata, one of the most important gaps will be filled, namely the final sections of the *Interactive Key to Australian Rain Forest Plants*. Completion of grass and forb modules will supplement the existing tree, shrub and vine modules, and should run to completion at the same time as an Australian Biological Resources Study funded project to complete the fern module, and ongoing work on a key to the orchids. Consequently the entire vascular plant community would then be covered by a single key, a unique achievement for any rainforest in the world, and an invaluable tool for managers, scientists and decision makers.

WTMA and Terrain NRM Ltd will continue to work with the research team to develop GIS layers of key environmental assets utilising both species data sets and environmental and socio-economic data sets.

Objective (c): Design and implementation of a monitoring program

Year 3 of this project builds upon the work conducted in Years 1 and 2 in terms of objective (c). This has achieved the following:

1. An agreed conceptual framework identifying natural assets, ecosystem services and key ecological functions and processes supplying these services, based on expert workshops held in June-August 2007;
2. Potential indicators of the condition of ecological functions, and pressures/threats to these functions;
3. Prioritisation of headline indicators based on network analysis;
4. Exploration of options for synthesising and presenting headline indicators and ecosystem services;
5. Collation of data sets relevant to headline indicator development.

The project will now focus on delivering a trial 'report card' for the Biodiversity asset, based on the framework and indicators developed in Years 1 and 2. This will combine the requirements of WTMA for reporting WHA condition and pressures, and Terrain NRM's review of the Wet Tropics Natural Resource Management Plan, including Resource Condition Targets and Management Action Targets. This will form the blueprint for reporting of the other regional assets, Climate, Water/Wetlands and Soil/Landscape in Year 4. In Year 3 the work programme will achieve the following:

1. An agreed baseline for monitoring;
2. Collation of data sets from WTMA, Terrain NRM and other sources to populate agreed indicators;
3. Trends in condition and pressures against agreed targets and thresholds of concern;
4. Delivery of a reporting shell appropriate to the scale of issues under consideration.

The work program will also explore the feasibility of spatially evaluating and mapping the ecosystem service of carbon sequestration in the Wet Tropics, to support Terrain NRM's Degrees Celsius Joint Venture on voluntary carbon markets.

In addition, the monitoring program will include links between local communities and biodiversity health. For Indigenous communities this will be achieved through continued links with cultural mapping undertaken by Project 4.9.1 (Indigenous Landscapes of the Wet Tropics). A CSIRO-funded post-doctoral fellow, Dr. Leanne Cullen, will provide an in-kind contribution (0.25 EFT) to develop indicators for Indigenous and non-Indigenous communities linked to biodiversity health and condition. These sociological aspects of Status and Trends will deliver to Terrain's requirement to assess and monitor their 'People and Country' asset, and WTMA's requirement to ensure the Wet Tropic World Heritage Area's relevance to the local community. Links with Project 4.9.7 (Measuring social resilience in relation to water quality) will also continue to be developed.

Objective (d): Insect Abundance and Diversity

Invertebrates are a large component of tropical forest biodiversity, particularly insects. Our understanding of this insect biodiversity and its distribution is limited for the Wet tropics and this study aims to provide a broader baseline on the abundance and diversity of insects at different times of the year across five altitudinal transects which have been established by Dr Stephen Williams and his team. In this study we are focusing on the beetles since this group represents almost 45% of all insect species and a quarter of all described species on Earth. We are making use of a long-term baseline study of beetle diversity at the canopy crane site to compare our results of sampling across the five transects. For that reason we have used the same sampling methods across the two studies. The flight interception trapping methods we use catch many thousands of insects and we expect to be counting and sorting almost a million individuals over the course of the project. This work will tell us how insect abundance and diversity changes during the year and at different altitudes. This is important as insects are an important food resource for many species of vertebrates. We will also be able to model how the species ranges of some of these insects will change as temperatures increase, and how many species may be threatened with extinction.

Project Activities (indicative for out years only)

Objective	Targeted Activity	Completion Date
(a)	Meta-database created and established with recommendations for future management	Jun 2010
(b)	Existing data sets for natural assets identified, and knowledge gaps identified. Assessment of the usefulness and limitations of existing available data sets and coverage, and what can be used in the interim, medium or long- term. Recommendations developed for future research requirements to fill key knowledge gaps.	Jun 2010
(b)	Complete Rain Forest Plant Key	Jun 2009
(c)	Prototype report card for Biodiversity asset, including trends and thresholds of concern and incorporating JCU altitudinal biodiversity surveys and CSIRO lowland communities surveys.	Jun 2009
(c)	Report card for Climate, Water/wetlands and Soil/landscape assets, including trends and thresholds of concern.	Jun 2010
d)	Sorting insect samples collected from traps on five altitudinal transects being managed by Dr Stephen Williams	End 2009
d)	Data collation and modeling of insect diversity and abundance	Mid 2010
d)	Modelling of extinction proneness of insects	Mid 2010

Project 1.2.1 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones [agency responsible for report delivery identified in brackets]	
Signing of contract	3 Sep 2008
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
Progress Report 1: • Progress report on report card shell and data collation for Biodiversity asset [CSIRO] • Progress report on the feasibility of mapping and evaluating carbon sequestration ecosystem services, including literature review of current approaches [CSIRO] • Update on monitoring of altitudinal rainforest biodiversity including location and number of sites surveyed, results and contributions to Biodiversity asset report card [JCU] • Update on gap analysis and gap filling of poorly-documented species and communities, and contributions to Biodiversity asset report card [CSIRO] • Summary of any communication activities undertaken to date, including minutes of meetings/workshops [CSIRO] • Pathway to Impact Report [All] • Report against full collation of beetle abundance across the five altitudinal transects with comparisons with the long-term Cape Tribulation study site [UM]	3 Dec 2008
Verbal Progress Report Verbal progress report to the Operations Committee on: • Progress on monitoring of altitudinal rainforest biodiversity including location and number of sites surveyed, results and contributions to Biodiversity asset report card [JCU] • Progress on gap analysis and gap filling of poorly-documented species and communities, and contributions to Biodiversity asset report card [CSIRO] • Summary of any communication activities undertaken to date, including minutes of meetings/workshops [CSIRO]	1 Mar 2009
Progress Report 2: • Final report on Biodiversity asset report card shell, including status, trends and thresholds of concern with appropriate attribution of MTSRF Funding [CSIRO] • Final report on evaluating the feasibility of evaluating and mapping carbon sequestration in Terrain NRM region [CSIRO] • Update on monitoring of altitudinal rainforest biodiversity including location and number of sites surveyed, results and contributions to Biodiversity asset report card [JCU] • Update on gap analysis and gap filling of poorly-documented species and communities, and contributions to Biodiversity asset report card [CSIRO] • Summary of any communication activities undertaken to date, including minutes of meetings/workshops [CSIRO] • Report on completion of Rainforest Plant Key with appropriate attribution of MTSRF Funding [CSIRO] • Evidence of data transfer and awareness between CSIRO, JCU,UM, WTMA and FNQ NRM plus other stakeholders through workshops. [Responsible officer Dr. James Butler, CSIRO] • Plan for completion of out year activities [CSIRO]	1 Jun 2009

For 2008/2009 outputs only	Date
Milestones [agency responsible for report delivery identified in brackets]	
Report on first model of insect abundance across the Wet Tropics landscape including seasonal change [UM]	
Total MTSRF Funding*	\$350,000

* Totals include \$3,500 Visual Documentation Allocation for this project.

Project 1.2.1 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	346,500	-	346,500
MTSRF Visual Documentation*	3,500	-	3,500
CSIRO Sustainable Ecosystems	-	198,005	198,005
CSIRO Plant Industry	-	49,510	49,510
JCU	-	88,985	88,985
Uni Melb	-	19,199	19,199
WTMA	-	20,000	20,000
Terrain NRM Ltd	-	36,000	36,000
Total	350,000	411,699	761,699

* A total of \$3,500 is held by the Reef and Rainforest Research Centre for Visual Documentation of this project (see Theme 5).

CSIRO Sustainable Ecosystems Project 1.2.1 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	165,497	22,000	187,497
Operating	26,451	-	26,451
Travel	6,057	-	6,057
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	176,005	176,005
Total	198,005	198,005	396,010

CSIRO Plant Industry Project 1.2.1 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	11,002	26,559	37,561
Operating	38,508	-	38,508
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	17,701	17,701
Total	49,510	44,260	93,770

James Cook University Project 1.2.1 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	58,500	18,985	77,485
Operating	3,485	-	3,485
Travel	2,000	-	2,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	70,000	70,000
Total	63,985	88,985	152,970

University of Melbourne Project 1.2.1 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	35,000	19,199	54,199
Operating			
Travel			
Communication / Extension*			
Capital			
Total	35,000	19,199	54,199

Wet Tropics Management Authority Project 1.2.1 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	-	20,000	20,000
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	Nil	20,000	20,000

Terrain NRM Ltd Project 1.2.1 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	-	36,000	36,000
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	Nil	36,000	36,000

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	350,000	-	411,699	-	-	761,699
Total	350,000	-	411,699	-	-	761,699

Communication Products / Events 2008-2009

The following products and events have been agreed with the Reef and Rainforest Research Centre and are to be reported against milestones above.

Objective	Proposed communication product / event	Date
All	End user briefing sessions.	On request for specific policy needs
All	Provision of content for website updates and project visual documentation.	Ongoing
All	Provision of content for Fact Sheets, depending on MTSRF Communication Strategy and enduser requirements.	Several throughout Program in consultation with end users
All	Enduser/science workshops to develop Biodiversity asset report card shell.	July 2008 - June 2009
	Enduser collaboration in research project.	Throughout project

Table 1: Summary of existing and proposed linkages between MTSRF Project 1.2.1 and other MTSRF Rainforests and Catchments projects.

MTSRF Project	Linkage
1.4.3: Threatened Species and Communities	Geospatially referenced data from field surveys provided to compliment gap filling efforts on areas outside WHA
2.5ii.3: Understanding climate change threat to ecosystems and ecological processes	Data and expertise on climate change impacts in biodiversity within and outside WHA
2.6.2: Identification and impact of invasive pests in the Wet Tropics Rainforest	Data on distribution and ecology of invasive species with particular reference to fish and weeds
4.9.1: Indigenous Landscapes of the Wet Tropics	Collaboration on identification of Indigenous indicators of biodiversity and ecosystem health
4.9.3: Impacts of urbanisation on North Queensland environments: management and remediation	Data and expertise on impacts of roads, traffic and fragmentation on biodiversity and ecosystem services
4.9.4: Integrating ecology, economics and people in forest and landscapes	Data and expertise on biodiversity values of timber plantations outside WHA
4.9.5: Restoring tropical forest landscapes	Data and expertise on biodiversity values of forest restoration projects outside WHA
4.9.6: Strategic Natural Resource Management and land use planning	Data and expertise on local pressures and state of biodiversity and ecosystem services (e.g. Mission Beach)
4.9.7 Measuring social resilience in relation to water quality	Integration of social resilience data with biophysical monitoring data

PROGRAM 3

TORRES STRAIT – STATUS, USE AND TRENDS

Program Leader and Host Organisation

Mr Vic McGrath, Torres Strait Regional Authority (TSRA)

Budget Summary

	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
MTSRF	\$393,000		\$393,000
Other	-	\$448,440	\$448,440
Total	\$393,000**	\$448,440	\$841,440

** Investment into the knowledge repatriation project is considered within Theme 5.

The Torres Strait Node comprises two sub-programs:

- Status, Trends and Use; and
- Marine Species of Conservation Concern.

Sub-program 2 covers both the Great Barrier Reef and Torres Strait nodes of MTSRF, is led by Professor Helene Marsh and is addressed under Program 4. Communications and an engagement system are shared between the two programs.

Program 3 will focus on identifying key issues in Torres Strait that should lead to the development of indicators to be incorporated into a Data Integration and Synthesis process that will assist development of environmental reporting for the Torres Strait region and incorporation into the Reef Atlas. The indicators will align with the broad 'Land and Sea Program' issues to assist management decision making through the provision of precise information on environmental condition and trends of the region. The issues and indicators described above will be identified through a process of engaging with stakeholders in Torres Strait, including Torres Strait Regional Authority Executive Members, the Community Liaison Officer, and relevant management agencies. The engagement will include explanation of what has been learned from the work of CRC Torres Strait in relation to the 'health of the marine ecosystem', and facilitate dialogue about the linkages between research and management approaches in the Torres Strait region.

The intent is to then evaluate the identified key issues (and in discussion and interaction with the stakeholders of Torres Strait), with the following aims:

- to identify existing management objectives associated with them;
- to identify conceptual models of the processes surrounding those key issues;
- to identify potential indicators and thresholds of status and trends in each issue;
- to identify, prioritise and undertake the research needed to develop those indicators with thresholds of concern, limits and implied actions, and to develop systems to measure and report on them, and link them into the overall report card; and
- to contribute to the development of Data Integration and Synthesis process for reporting the ecosystem health of Torres Strait.

The primary objective of work undertaken in the first two years of the Program was to identify appropriate areas where future research is required in the Torres Strait region. Climate change, ecological assessment of wild commercial sponges, investigation of co-management for hand collectable fisheries and the repatriation of knowledge will be key areas for research in the third year of the Program.

Previous work under the Torres Strait CRC has identified the potential of bath sponge aquaculture in Torres Strait. Through this program an assessment of the distribution and abundance of wild commercial sponge species in Torres Strait, identification of elements of environmental risk (evidence of disease, sedimentation), and establishment of an ecologically sustainable strategy for seed stock harvest will be established. The outcomes from this research will provide fundamental information for the support of a sustainable bath sponge aquaculture industry.

Climate change issues in the Torres Strait region has been raised in response to the inundation events experienced on several of the islands over recent years. Climate change impacts likely to be experienced in the coming years include less predictable winds and currents that will affect traditional and commercial fishing practices, an increase in disease vectors (eg mosquitoes carrying dengue), cultural impacts from flooded heritage sites (e.g. grave yards) and reduced fresh water resources. The primary goal of this project is to establish ways to increase community resilience to environmental change in the Torres Strait Islands by integrating scientific and socio-economic assessments to develop recommendations for climate change resilience and adaptation and planning in Torres Strait.

Management agencies are interested in trialing adaptive co-management of fishery resources in the Torres Strait. The project will prototype methods of assessing the social, economic, cultural and ecological benefits resulting from co-management using the hand collectable fisheries (beche de mer and trochus) as a case study. It would also develop the role for communities to contribute to reporting initiatives being developed through program 3.

Community feedback has indicated that not all past and present research activities in the Torres Strait region have been appropriately disseminated to communities. As part of MTSRF Theme 5, a proposal has been submitted to develop appropriate format and delivery mechanisms of scientific research in the Torres Strait Islands, the information gained through this process will help the assessment of future research investment in the region.

Projects

1.3.1	Climate change impacts in the Torres Strait: Building resilience and planning adaptation strategies.....	\$ 80 000
1.3.2	Ecological role and potential value of sponges to the Torres Strait.....	\$ 80 000
1.3.3	Livelihood benefits of co-management of hand collectable fisheries in the Torres Strait	\$ 80 000
1.3.4	Communication, community engagement and enhanced delivery	\$ 50 000
1.3.5	Data integration and synthesis for development of reports on ecosystem health in the Torres Strait region	\$ 103 000

PROGRAM 3: TORRES STRAIT – STATUS, USE AND TRENDS***Project 1.3.1 Climate change impacts in the Torres Strait: Building resilience and planning adaptation strategies*****Project Leader and Host Organisation**

Dr Donna Green, Climate Change Research Centre, The University of New South Wales (UNSW)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Dr Donna Green	CCRC, UNSW	Integrated assessment/ socio-economic impacts	0.6
Prof Andy Pitman	CCRC, UNSW	Climate science/modelling	0.1
Saibai Islander (Name TBC)	Island council	TEK* researcher	0.33
Mer Islander (Name TBC)	Island council	TEK researcher	0.33
Masig Islander (Name TBC)	Island council	TEK researcher	0.33
Dr Benjamin Preston	CSIRO	Integrated climate assessment	0.1
L Minchin	consultant	Recording TEK, transcription	0.2
L Alexander	Monash University	Science research	0.1

* Traditional Environmental Knowledge

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
TSRA	Damian Miley, Vic McGrath, Miya Isherwood
Local Island Councils	Chairs of relevant councils
DEWHA	Sheryl Hedges

Project Duration

Start Date: 1 August 2007

End Date: 30 June 2010

Project Background

The activities and approaches of the project are informed by the outcomes of the Sharing Knowledge - Climate Impacts in Northern Australia workshop (held in Darwin in 2006). This initial workshop brought together thirty Traditional Owners and thirty researchers and scientists from across the North – including several Torres Strait Islanders and TSRA representatives. Through the workshop it was highlighted that a coordinated and strategic approach to climate change is required to establish needs a priorities for each region across northern Australia.

The concern about the Torres Strait region was raised in response to the inundation events experienced on several of the islands over recent years. These inundation events were caused by a combination of high tides and strong winds, and repeat incidents are likely to become more frequent with rising sea levels and increasing intensity of tropical cyclones in the region caused by climate change. Other climate change impacts likely to be experienced in the coming years include less predictable winds and currents that will affect traditional and commercial fishing practices, an increase in disease vectors (eg mosquitoes carrying dengue), cultural impacts from flooded heritage sites (e.g. grave yards) and reduced fresh water resources.

Although Islander communities have responded to past episodes of environmental change over hundreds of years, the speed of change in the last 200 years is much more rapid than any previously experienced. This makes adaptation planning to reduce the costs associated with existing and future infrastructure developments critical for the longer term sustainability of Island culture.

Recent environmental change is recorded in the oral histories of Indigenous communities, which form a critical part of their living culture. To date, few non-Indigenous scientists have attempted to engage and learn from the people who have lived through environmental change on the Islands, and who currently live with human-induced climate change. Addressing this gap may allow past Indigenous experience to serve as a resource from which culturally appropriate adaptation strategies may be formulated.

Project / Task Objectives

The primary goal of this work is to establish ways to increase community resilience to environmental change on the Islands by integrating scientific and socio-economic assessments. This project objective is to be realised through several steps. The first year of this project focused on the collation and assessment of existing scientific and traditional knowledge about climate change including weather, seasons and relevant environmental change information. This information is being integrated into feedback from climate workshops which were targeted to discuss with Islanders the likely impacts of climate change at a local level. The key focus of the second year of the project is to use the discussions and expressed concerns brought out at the workshops in order to prioritise areas of strategic adaptation planning for the Torres Strait region.

A secondary goal of this project is to establish mechanisms for ongoing Indigenous community engagement with non-Indigenous scientists, researchers and government representatives on environmental impacts. This would encourage greater appreciation of the importance of Islanders' environmental knowledge about their country among non-Indigenous scientists, policy makers and the general public. The implementation of the Traditional Environmental Knowledge (TEK) project itself (by training and working with local community members directly) is a deliberate strategy to foster ongoing community involvement in the project, and to facilitate direction from community leaders about their priorities and concerns. This Torres Strait project would fit within a larger programme that looks at climate impacts for Indigenous communities in Northern Australia. Similarly, it is hoped that the project would increase Indigenous community awareness about non-Indigenous understanding of environmental change.

This project aims to:

- a) Collate existing scientific information;
- b) Collect TEK;
- c) Produce initial climate impact assessments from (a);

- d) Communicate information to stakeholders;
- e) Integrate scientific impact assessment, stakeholder feedback and TEK from (b), (c) and (d); and
- f) Recommend resilience-building, planning and adaptation activities from (e).

Project / Task Methodology

Objective (a): collate existing scientific information

Key climate scientists from CSIRO, UNSW, Queensland NRM, BoM who have existing datasets and information relevant for understanding the likely impacts of climate change in the TSI region have been consulted to develop the science document.

Consistency with and ability to derive information from climate projects already participating in the MTSRF will be achieved by including relevant researchers from the Climate Change program of the MTSRF in the workshop.

Current information assembled at this meeting will be fed into a set of scientific summary sheets.

Knowledge gaps in regard to likely climate change impacts and sea level rise will be addressed, and existing modelling and predictive data, including geospatial data layers, will be presented.

Objective (b): collect TEK

Discuss process with TSRA and local Island councilors and individual TEK holders (as appropriate) to ensure full local support and agreement over process for TEK recording. Discuss how this information will be collected and managed in a culturally appropriate manner and how and to whom access will be allowed.

Employ (and train) as appropriate local community members on a part-time basis over the course of one year (to ensure a full seasonal cycle) to discuss with Island Elders, and others as appropriate, traditional environmental knowledge about weather, seasons and relevant environmental change.

Objective (c): produce initial climate impact assessments

Analyse information from objective (a) and (b) and produce information in two forms. The first product would report information in a format for local community use: summarised form, in local language (if requested) and in English, and geospatial data and maps indicating likely inundation prone areas. The second format would provide a more scientific detailed analysis with a view to publishing reported information in peer reviewed scientific journals.

Objective (d): communicate information to stakeholders

Perform four Island workshops (likely timing to coincide with high tides at the end of Jan and Feb 08). These workshops would use the scientific information from (c) and, if accessible, some of the initial TEK material directly from (b). Detailed discussions at workshops would serve to further understand key areas of concern for islanders to help with further stages of integrated assessment, planning and adaptation recommendations.

Objective (e): integrate scientific impact assessment, stakeholder feedback and TEK

Both the scientific data and the full year of TEK would be compiled and assessed to ascertain what are the key areas of concern about climate change to improve climate projections and identify likely planning and adaptive strategies. This activity will occur through close community collaboration and be presented in a format decided upon after consultation with the community leaders and collaborative organisations, to ensure integration with broader MTSRF and TSRA initiatives, including the development of sustainable land use plans for a pilot suite of islands.

Objective (f): Resilience building activities and adaptation recommendations

Recommend actions and priority assessments for adaptation and planning purposes. Some of these actions could be acted on immediately by communities with limited resources. Other recommendations and priorities that emerge from the project would be used either to strengthen proposals for future activities led by communities that would require additional funding or to inform policy and planning activities by relevant government and other agencies that could help to reduce specific vulnerabilities (Oct 08- June 09).

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	80,000	-	80,000
UNSW	-	100,000	100,000
Total	80,000	100,000	180,000

Targeted Activities

Objective	Targeted Activity	Completion Date
(a & b)	Analyse data from TEK projects in concert with scientific data, translate into local languages as appropriate, present material to stakeholders for feedback before finalisation of individual island reports	Feb 09
(b)	Arrange ongoing discussion with stakeholders to allow feedback into key recommendations to increase resilience and adaptation planning for islands and final TSI report.	June 09
(b)	Employ and train islanders from Saibai, Mer and Masig for the recording of TEK	Sept 08
(all)	Maintain regular contact with the TSRA (in particular the CLO) during all aspects of project development, planning, community consultation and progress	On going

Project 1.3.1 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones [All deliveries UNSW responsibility]	
Arrange for the employment of Torres Strait Islanders for the recording of TEK	31 st Sept 08
Analyse existing scientific data with respect to information obtained at workshops and translate reports and summaries into local languages as requested.(i.e. 2 pager summaries for islands) Provide posters templates for islands schools to collaborate on developing local seasonal weather calendars as discussed.	31 st Aug 08
Pathways to impact report for end user relevance	16 th Dec 08
Produce integrated assessments from existing desktop research combined with	28 th Feb 09

For 2008/2009 outputs only	Date
Milestones [All deliveries UNSW responsibility]	
'on Island' research including input from consultants. Reports to RRRC as each island report is produced. (Island reports to be worked on in sequence from Aug 08 to Feb 09) this work is to be informed by (and will also in turn inform) the data collected by the sustainable land use project, tide gauge project (GU) and possibly the JCU erosion project.	
Present project outcomes to the Torres Strait Operations/Steering Committee Meeting/TSRA Board	2008/09
Project leader to attend Torres Strait Committee Meetings (3 meetings/year)	2008/09
Report on the analysis of TEK projects in concert with scientific data with appropriate attribution to MTSRF.	30 th April 09
MTSRF Funding	\$80,000

2008/2009 Project funding and Partnerships

Contributing Organisations	Cash	In-kind	Total
MTSRF	80,000	-	80,000
UNSW	-	100,000	100,000
Total	\$80,000	\$100,000	\$180,000

UNSW Project 1.3.1 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	40,000	80,000	120,000
Operating	15,000	20,000	35,000
Travel	10,000	-	10,000
Communication / Extension	10,000	-	10,000
Capital	5,000	-	5,000
Total	\$80,000	\$100,000	\$180,000

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	80,000	-	100,000	-	-	180,000
Total	80,000	-	100,000	-	-	180,000

For 2009/2010 outputs only
Milestones [All deliveries UNSW responsibility]
Translate reports and summaries into local languages as requested, final round of on island discussions with relevant stakeholder groups, including presentation of final TEK product /TEK posters to: Island councilors, Island managers, school teachers and community.
Final report on project outcomes including actions and recommendations for climate change resilience and adaptation and planning in Torres Strait. This report would use extracted data from TEK as appropriate to inform climate impacts as appropriate and provide broad recommendations for communities across Northern Australia (with appropriate attribution to MTSRF funding.)

PROGRAM 3: TORRES STRAIT – STATUS, USE AND TRENDS***Project 1.3.2 Ecological role and potential economic value of sponges to the Torres Strait*****Project Leader and Host Organisation**

Dr Stephen Whalan, Australian Institute of Marine Science (AIMS)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Dr Stephen Whalan	AIMS	Project leader and field work coordinator	0.75
Ms Libby Evans-Illidge	AIMS	Uptake / transfer of project results for business planning and environmental effects assessment.	0.05
Mr John Morris	Kailag Enterprises, Yorke Island	Project manager at Masig Island	0.2

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
TSRA	Damian Miley
Kailag Enterprises, Yorke Island	Philippa Bauer

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

The project outlined builds on outputs and methodology of sponge aquaculture research previously conducted in the Torres Straits. Given awareness that the scale of the potential international market for commercial sponges may permit a venture larger than cottage industry size, it is now important to examine sustainability of the likely commercial development of a new industry in the Torres Strait. This will be achieved by laying ground work for an understanding the dynamics of shallow water sponge characterised communities and exploring risks and threats to sponge seed stock populations. Given sponges play an important ecological role in these environments, possibly acting as nursery or recruitment habitat for other species of economic or ecological importance (as reported in other tropical habitats); and as sponges themselves are useful indicator or sentinel species for environmental stress, then relevant information will be delivered that will inform assessment of general habitat risk (from pollution, disease, invasions or sedimentation). Exploring the wider economic potential of bath sponge aquaculture in Torres Strait, based on work undertaken with CRC Torres Strait and Torres Strait Regional Authority will be contingent upon other funds and future work in collaboration with the Yorke Island Council and the Authority.

Ecological and risk assessment information will be integrated into the relevant Data Integration and Synthesis Frameworks for Reporting on the health of the Torres Strait ecosystems.

Key Objectives:

- (a) Undertake an assessment of the distribution and abundance of wild commercial sponge species in Torres Strait, identifying elements of environmental risk (evidence of disease, sedimentation, etc.);
- (b) Determine connections between sponge populations and risks in translocation;
- (c) Determine patterns of sponge recruitment/mortality and the environmental risk of seed stock harvest leading to development of a sustainable seed collection strategy.
- (d) Develop optimal handling guidelines to improve sponge explants growth and survival

Project Targeted Activities 2008/09

Objective	Targeted Activity	Completion Date
(a)	Updated demography assessment.	11 June 2009
(b)	Transplantation experiment of sponge recruits between Masig and Marsden Islands to examine connectivity.	11 June 2009
(c)	Sponge recruitment/mortality report.	11 June 2009
(d)	Optimal sponge handling report	11 June 2009

Project 1.3.2 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones [all AIMS responsibilities]	
On Signing	
Pathway to Impact Report for end user relevance	31 Jan 2009
Deploy experiments to optimize handling methods to improve sponge explant growth and survival	28 Feb 2009
Project leader to attend Torres Strait Committee Meetings (3 meetings/year)	2008/09
Report 3 submission: One report detailing in separate segments: - findings of field work conducted to date (surveys of populations recruitment plate deployment,) and schedule of remaining field work; and - summary of all liaison activities conducted to date (including employment of TSI for project).	31 Mar 2009
Report 4 submission: One report detailing in separate segments: - Interim demography assessment including sponge abundance and occurrence of disease - Interim sponge recruitment/mortality findings. - Interim findings of status and trends of key sponge assets and their ecosystem health. - Interim findings of translocated sponge recruits survivorship. - Interim findings of experiments to optimize handling methods - Final findings of field work conducted: sites visited; liaison activities and	11 June 2009

For 2008/2009 outputs only	Date
Milestones [all AIMS responsibilities]	
appropriate attribution of MTSRF funding. - Final summary of communication activities undertaken through the course of Year 3 of project. - Plan for completion of out year activities.	
Total Funding to and from TSRA	

Project 1.3.2 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	80,000	-	80,000
AIMS	-	131,583	131,583
TSRA	30,000	15,000	45,000
Total	110,000	146,583	256,583

AIMS Project 1.3.2 Budget 2008/2009

Item	MTSRF funds	TSRA Funds	AIMS in-kind	Total Cost
Salaries	40,200	12,808	22,053	62,253
Operating	19,800	17,192	17,000	36,800
Capital	-		-	-
Institutional overheads	-		76,789	76,789
Total	60,000	30,000	115,842	175,842

TSRA Project 1.3.2 Budget 2008/2009

Item	MTSRF funds	TSRA in-kind	Total Cost
Salaries	15,000		15,000
Operating			
Travel	5,000		5,000
Capital	-		-
Institutional overheads	-	15,000	15,000
Total	20,000	15,000	35,000

Indicative Budget Summary – Years 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	60,000	-	115,000	-	-	175,000
Total	60,000	-	115,000	-	-	175,000

PROGRAM 3: TORRES STRAIT – STATUS, USE AND TRENDS***Project 1.3.3 Livelihood benefits of co-management of hand collectable fisheries in the Torres Strait*****Project Leaders and Host Organisation**

James Butler, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Dr. James Butler	CSIRO	Human ecologist: community-based management	0.15
Dr. Tim Skewes	CSIRO	Marine biologist	0.05
Erik Raudzens	AFMA	Senior Fisheries Management Officer	0.10*
Alifereti Tawake	JCU	Researcher	1.0
Steve Hall	TSRA	Fisheries Officer – Community engagement	0.1*
Toshi Nakata	TSRA	Fisheries Officer – Community engagement	0.1*
Prof. Helene Marsh	JCU	Ecologist	0.05*
Dr. Natalie Stoeckl	JCU	Environmental economist	0.05*

* In-kind FTE allocation

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
TSRA	Damian Miley, Vic McGrath
AFMA	Annabel Jones, Erik Raudzens
DEWHA	Sheryl Hedges
Torres Strait Islanders	

Project Duration

Start Date: 1 July 2008

End Date: 30 June 2010

Project Background

The Torres Strait consists of numerous islands dominated by an Indigenous population. Livelihoods are based on marine fisheries (e.g. beche de mer, trochus, tropical rock lobster, dugong, turtle) which are managed by the Australian Fisheries Management Authority (AFMA), Queensland Department of Primary Industries and Fisheries (DPI&F) and the Torres Strait Regional Authority (TSRA). Systems of permits and total allowable catches are imposed on fisheries with varying degrees of compliance and efficiency. Ecological information of stock assessments is provided by CSIRO.

Following a history of contested resource management, relations between management agencies and communities are frequently strained. Communities are frustrated by the limits placed on catches and access to resources, and hence income and livelihood options. Social, economic and cultural impacts are significant, and the sustainability of fisheries is regularly questioned, resulting in prevailing conflict around resource governance.

To break this cycle, agencies are interested in trialing adaptive co-management of fishery resources using the hand collectables fisheries (beche de mer and trochus). Under this system of control of effort, catches and reporting is undertaken in partnership with local communities, and learning is used to provide feedback and adjustment to the system. Indigenous aspirations for fisheries management and livelihoods can be integrated with western science methods of catch limits and stock assessments to derive collaborative and sustainable harvest strategies. Community-based approach could be integrated with other initiatives including the ranger programs and the development of turtle, dugong and other fishery management plans, which are due to be introduced from 2008. The project would prototype methods of assessing the social, economic, cultural and ecological benefits resulting from co-management. It would also develop the role for communities to contribute to reporting initiatives being developed through MTSRF Project 1.3.5 '*Data integration and synthesis for development of reports of ecosystem health in the Torres Strait Region*'. Due to the focus on community-based management of fisheries, the project will also be closely linked to Project 1.4.2 '*Sustainable use of marine species of conservation concern*' through the involvement of Prof Helene Marsh, Dr. Natalie Stoeckl and Dr. James Butler.

The project will be linked to a broader program being initiated by AFMA and CSIRO. This program includes research to assess the current size and status of trochus and beche de mer stocks using remotely sensed data, traditional fisher knowledge, biophysical models and ground-truthing.

Project / Task Objectives

This project aims to test an adaptive co-management framework approach to hand collectable fisheries in the Torres Strait. Working in a co-research framework with one or two island communities, the project will aim to follow a participatory planning approach with fisherman and management agencies to develop sustainable harvest and livelihood strategies. The project will test the success of co-management in terms of social, economic, cultural and ecological outcomes using the sustainable Livelihoods framework as part of a wider suite of CSIRO case studies in Australian and Melanesian indigenous communities. Lessons learned and indicators developed will be applied to future co-management initiatives in the Torres Strait, including those for dugong and turtles investigated through Project 1.4.2.

Key Objectives:

- (a) Identify the key processes and tools for developing adaptive co-management framework and harvest strategies for hand collectables in the Torres Strait
- (b) Identify indicators and assess the social, economic, cultural, ecological and livelihood benefits derived from adaptive co-management
- (c) Assess the adaptive co-management approach tested for future co-management initiatives in the Torres Strait.
- (d) Develop community-based harvest strategies which incorporate traditional knowledge within a co-management framework.

Project Targeted Activities 2008/09

Objective	Targeted Activity	Completion Date
(a)	Undertake a literature review of existing co-management strategies and frameworks	December 2008
(b)	Engagement of communities interested in being involved in a case study of adaptive co-management for the hand collectable fisheries (beche de mer and trochus)	October 2008
(a & b)	Undertake community engagement workshops for the design and development of community based management framework	December 2008
(a & b)	Undertake community engagement workshops to develop harvest strategies for incorporation in to the co-management framework	July 2009
(b)	Identify appropriate indicators for assessing stock status of beche de mer and trochus	December 2009
(d)	Community-based harvest strategies delivered to all stakeholders	December 2009
(b)	Identify appropriate indicators for assessing economic, social and cultural benefits of adaptive co-management of beche de mer and trochus fisheries	June 2010
(c)	Assessment of the adaptive co-management approach and its applicability for future co-management initiatives for fisheries in the Torres Strait.	June 2010
(d)	Develop and distribute communication material for communities and stakeholders	June 2010

Project 1.3.3 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones	
On Signing	
Project leader to attend Torres Strait Committee Meetings (3 meetings/year)	2008/09
Report 1 submission - Literature review of existing co-management strategies and frameworks outlining tools and processes that have resulted in successful co-management outcomes - Project plan, including identification of island communities to be involved in the co-management case study	30 Oct 2008
Pathway to Impact Report for end user relevance	30 Dec 2008
Report 2 Submission - Report on the outcomes of the community engagement workshops - Report on the outline for the adaptive co-management framework	10 Mar 2009

For 2008/2009 outputs only	Date
Milestones	
Report 3 Submission - Report on the development of potential harvest strategies for community based management of beche de mer and trochus - Potential indicators for assessing stock status of beche de mer and trochus	15 May 2009
Total MTSRF Funding	\$80,000

Project 1.3.3 Budget

2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	80,000		80,000
CSIRO		23,061	23,061
AFMA		28,000*	28,000
JCU		16,000**	16,000
TSRA		17,800***	17,800
Total	80,000	84,861	164,861

* AFMA salary, office space, accommodation, cost-sharing for travel

** In-kind salary for Prof Helene Marsh and Dr Natalie Stoeckl from linked Project 1.4.2

*** TSRA In-kind salary, accommodation and travel

CSIRO Project 1.3.3 Budget 2008/2009

Item	MTSRF funds	CSIRO in-kind	Total Cost
Salaries	24,528		24,528
Travel	5,417		5,417
Operating	3,075		3,075
Capital			
Institutional overheads		23,061	23,061
Total	33,020	23,061	56,081

JCU Project 1.3.3 Budget 2008/2009

Item	MTSRF funds	JCU in-kind	Total Cost
Salaries	30,000	16,000	46,000
Travel	8,000		8,000
Operating	8,980		8,980
Capital			
Institutional overheads			
Total	46,980	16,000	62,980

PROGRAM 3: TORRES STRAIT – STATUS, USE AND TRENDS***Project 1.3.4 Communication, community engagement and enhanced delivery*****Project Leader and Host Organisation**

Mr Vic McGrath, Torres Strait Regional Authority (TSRA)

Project Team 2008/2009

Title	Organisation	Role	FTE
Damian Miley	TSRA	Project leader: co-ordination,	0.05
Mr Vic McGrath	TSRA	Liaison Officer	0.5

Summary Table of Research Users

Organisation	Organisational Contact
TSRA Board	Yoshi Hirakawa

Project DurationStart Date: 1st July 2008End Date: 30th June 2010 (subject to continuation of funding for the position under the MTSRF Annual Research Plan for 2009/10).**Project / Task Objectives**

Undertaking research in the Torres Strait requires that researchers understand and respect the culture and communication protocols of the Torres Strait region. Throughout the life of the CRC Torres Strait program, a system for researcher engagement had been developed and used, and the resulting protocols formed the basis for the communication and engagement of the current MTSRF science projects conducted in Program 3 (Torres Strait) and in Program 4 (Species of Conservation Concern). It is anticipated that, due to recent Qld Government reforms affecting local governance, these protocols will need some adjustment throughout 2008 that reflect the new changes.

This project in part, involves the recruitment of a Community Liaison Officer which is co-funded by MTSRF and the TSRA, and based at the TSRA offices on Thursday Island. The CLO is required to work with the Manager of the Land and Sea Management Unit, TSRA in achieving contractual milestones and reporting requirements for MTSRF projects. Importantly the CLO's involvement and support for MTSRF research projects in the region will continue to ensure appropriate communication with Torres Strait Island communities and also to maintain partnerships and knowledge transfer with supporting agencies in the region.

Science delivery system: It is important that the results of research be made accessible to users. This is sometimes to be done in specialised, tailored ways as indicated above and covered by our budget for communications and engagement. However, it is increasingly desirable also to make information available using web-based delivery and similar tools. Such a system is also to be developed through Theme 5.

Project Activities 2008/2009

Objective	Targeted Activity	Date
(a)	Facilitate information dissemination program on research activities in Torres Strait through newsletter articles, visits to communities and meetings where appropriate	June 2009
(b)	Report to Reef and Rainforest Research Centre on communication activities	June 2009

Project 1.3.4 Outputs 2008/2009

For 2007/2008 outputs	Date
Milestones All TSRA Responsibilities	
Signing of contract	
Project leader to attend Torres Strait Committee Meetings (3 meetings/year)	2008/09
Progress Report 1. Plan of liaison and facilitation activities and communication events/products to assist MTSRF researcher activity in the Torres Strait (e.g. meetings, workshops, information flyers etc) for year to June 2009.	15 Jul 2008
Progress Report 2. - Report on liaison and facilitation activities and communication products completed during milestone period (15 Jul to 15 Dec 2008) with appropriate attribution of MTSRF funding. - Pathways to impact report for end user relevance	15 Dec 2008
Final Report. Final report on liaison activities and communication products during milestone period (15 Dec 2008 to 15 May 2009) and assessment of effectiveness and delivery against plan.	15 May 2009
Total MTSRF \$ 2008/2009*	\$50,000

* Total includes \$10,000 held by Reef and Rainforest Research Centre for Visual Documentation.

Project 1.3.4 Budget

Contributing Organisation	Cash	In-kind	Total
MTSRF	50,000	-	50,000
MTSRF Visual Documentation*	10,000	-	10,000
TSRA	-	50,000	50,000
Total	50,000	50,000	110,000

* A total of \$10,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

TSRA Project 1.3.4 Budget 2008/2009

Item	MTSRF Funds	TSRA In-kind	Total Cost
Salaries	30,000	50,000	80,000
Operating	5,000	-	5,000
Travel	5,000	-	5,000
Communication / Extension	0	-	0
Capital	0	-	-
Institutional overheads	0	-	-
Total	40,000	50,000	90,000

Indicative Budget Summary – Years 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash ¹	In-kind	
2009/2010	50,000	-	-	150,000	-	270,000
Total	50,000	-	-	150,000	-	270,000

¹ Indicative contribution

PROGRAM 3: TORRES STRAIT – STATUS, USE AND TRENDS**Project 1.3.5 Reporting Ecosystem Health in the Torres Strait****Project Leader and Host Organisation**

James Butler, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

1.3.5 Project Team 2008/2009

Title	Organisation	Role	FTE
James Butler	CSIRO Sustainable Ecosystems	Human ecologist: community-based management	0.06
Research assistant	CSIRO	Data analysis and synthesis	0.50
Leanne Cullen	CSIRO Sustainable Ecosystems	Human ecologist: postdoc on linked social and ecological indicators	0.06*
Roland Pitcher	CSIRO Marine and Atmospheric Research	Marine biologist	0.06
Tim Skewes	CSIRO Marine and Atmospheric Research	Marine biologist	0.06
Darren Dennis	CSIRO Marine and Atmospheric Research	Marine biologist	0.02
Damian Miley	TSRA	Local co-ordination	0.06
Vic McGrath	TSRA	Community Liaison Officer	0.10

* FTE Contribution in-kind

Summary Table of Research Users

Organisation	Organisational Contact
TSRA Board	Yoshi Hirakawa

Project Duration

Start Date: July 2008 End Date: 30 June 2010

Indicative Project / Task Objectives

- (a) To identify key indicators in the Torres Strait and thresholds of concern for the identified indicators to be incorporated into a Data Integration and Synthesis process that will assist development of environmental reporting for the Torres Strait. The indicators will align with the broad 'Land and Sea Program' issues and will be operationalised to assist management in decision making through the provision of precise information on environmental condition and trends of the region. The MTSRF Community Liaison

Officer, and relevant MTSRF researchers will assist in this process. The engagement will include building on the work to date on the 'health of the marine ecosystem', and facilitate dialogue about the linkages between research and management approaches in the Torres Strait region.

- (b) To evaluate the identified key indicators (and in discussion and interaction with the stakeholders of Torres Strait), with the following activities will occur:
 - the identification of existing management objectives associated with the indicators;
 - the identification of conceptual models for determining efficiency of indicators;
 - the identification of potential thresholds of status and trends in each issue;
- (c) To contribute to the development of a Framework to enable Data Integration and Synthesis (Risk Resilience and Response Atlas (1.1.5) for reporting. This framework will be used for reporting the ecosystem health of Torres Strait.

Over year 2 of this project relevant ecosystem health indicators have been identified. In year 3 data available data for indicators considered most relevant will be assessed and potential thresholds on concern will be identified. Community feedback has indicated that community level indicators are not appropriate at this stage of this project, as communities are currently focusing on issues of immediate concern (e.g. water supplies), and there is a concern of the communities acceptance of the current project objectives. Consequently, the next stage of this project will focus on regional level indicators of ecosystem health (considered important to Torres Strait Island communities and of direct relevance to the TSRA's Land and Sea Management Strategy asset framework. The process of engagement with the community on the development of these resource condition and indicators will be integrated with the ongoing TSRA Land Use Plan development process.

A number of communication products have been identified that will provide the opportunity to better target local communities. The development of these products will continue in the next year of the project and will be trialed within the communities as possible mechanisms for the dissemination of information on ecosystem health of the Torres Strait region.

Project Activities

Objective	Targeted Activity	Date
(a)	Prioritize indicators and attribute management objectives associated with indicators	September 2008
(a)	Identify potential thresholds of concern	March 2008
(a&b)	Operationalise indicators into Land and Sea Program reporting framework	March 2009
(b)	Develop communication products for reporting natural resource management issues in the Torres Strait Region	June 2009

Project 1.3.5 Outputs 2008/2009

For 2008/2009 outputs	Date
Milestones [Reporting Responsibilities identified by institution in brackets]	
Signing of contract	
Project leader to attend Torres Strait Committee Meetings (3 meetings/year)	2008/09
Progress Report 1. Report on prioritization of indicators and the associated management objectives [CSIRO] Report on the progress of engagement with the community on indicator development. [TSRA]	20 Sept 2008
Pathway to Impact Report for end user relevance	31 Dec 2008
Progress Report 2. Report on potential thresholds of concern' for the indicators [CSIRO, TSRA] Report on the conceptual models developed for the evaluation of the efficiency of indicators defined [CSIRO]	31 st March 2009
Progress Report 3 Report on operationalising indicators into Land and Sea Program reporting framework [CSIRO, TSRA] Report in the initial assessment of ecosystem health in the Torres Strait region [CSIRO] Report on communication products developed for communicating Torres Strait natural resource management issues [TSRA] Report on responses of the community to the communication products developed [TSRA]	05 th June 2009
Total MTSRF Funding*	

* Milestones described above will be met using funds carried over from 2007/08.

Project 1.3.5 Budget

Contributing Organisation	Cash	In-kind	Total
MTSRF	103,000		103,000
MTSRF Visual Documentation*			
CSIRO		72,737	72,737
TSRA		10,000*	10,000*
Total	103,000	82,737	185,737

* In-kind indicative

TSRA Project 1.3.5 Budget 2008/2009

Item	MTSRF Funds	TSRA In-kind	Total Cost
Salaries	5,000		5,000
Operating	5,000	2,000	7,000
Travel	5,000		6,000
Communication / Extension	5,000	8,000	13,000
Capital			
Institutional overheads			
Total	20,000	10,000*	30,000

* In-kind indicative

Indicative Budget Summary – Years 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	125,000	-	125,000	-	-	125,000
Total	125,000	-	125,000	-	Total	125,000

PROGRAM 4

SPECIES AND COMMUNITIES OF CONSERVATION CONCERN

Program 4 is divided into two components: Marine species and communities of conservation concern (Projects 1.4.1 and 1.4.2), and Rainforest species and communities of conservation concern (Project 1.4.3).

	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
MTSRF	\$520,000	-	\$520,000
Other	-	\$487,750	\$487,750
Total	\$520,000	\$487,750	\$1,007,750

MARINE SPECIES AND COMMUNITIES OF CONSERVATION CONCERN – PROJECTS 1.4.1 AND 1.4.2

Program Leader and Host Organisation

Professor Helene Marsh, James Cook University (JCU)

Budget Summary (Marine)

	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
MTSRF	\$320,000	-	\$320,000
Other	-	\$293,000	\$293,000
Total	\$320,000	\$293,000	\$613,000

The marine component of Program 4 will generate world-class biological, social and economic research to provide reports on the condition and trends of dugongs, marine turtles and coastal dolphins that occur in the Great Barrier Reef World Heritage Area and Torres Strait and evaluate management options to improve their status. The marine component involves two Projects.

Project 1.4.1 has three tasks (a) dugong distribution and abundance, (b) sea turtle nesting success and (c) communication of the research activities in partnership with TSRA. Objective (c) will include the conduct of a workshop as a training tool and be completed in conjunction with Program 8 under the dedicated communication processes for marine related MTSRF activities. The outcomes of Project 1.4.1(a) will include: an estimate of sustainable anthropogenic harvest of dugongs for the northern GBR and Torres Strait; information on the spatial distribution of dugongs and sea turtles to inform management options; improved understanding of environmental factors influencing dugong population dynamics and the sustainability of different levels of anthropogenic mortality.

Project 1.4.1 (b) will analyse the patterns, rates and causes of sand loss from green turtle rookeries of international significance in the northern Great Barrier Reef region; and provide an assessment of remote methods of recording human visitation at remote sites of high conservation significance. The effects of various climate change scenarios on sea turtle sex ratios and hatchling survivorship will also be assessed.

Project 1.4.2 has three main tasks (a) effects of acoustic alarms on behaviour of wildlife catch, (b) economics of Indigenous hunting and its management and (c) delivering information on marine species of conservation into data integration processes using a spatial risk assessment approach. The outcomes of Project 1.4.2 (a) will include as assessment of the capacity of acoustic alarms to minimise the bycatch of protected species in commercial gillnets without alienating these species from critical habitats, providing the data necessary for a spatial risk assessment of various management options.

Project 1.4.2 (b) will provide an assessment of the economic costs and benefits (ecological, social and health) of options for Indigenous hunting management. In addition this task will evaluate the direct contribution of customary harvesting to livelihoods and social welfare.

Project 1.4.2 (c) will use a spatial risk assessment approach and a GIS-based Decision Support System to integrate: spatial data obtained from the dugong aerial surveys; other relevant scientific data such as maps of the distribution of seagrasses; spatial information on current management arrangements; and spatial information on relevant use such as that in the logbooks of commercial fishers.

The outcomes of the this component will be of relevance to: (1) the Data Integration and Synthesis process for enabling ecosystem Report Cards to be developed, Condition and Trends, Risks and Threats to Critical Habitats Projects in the GBR Status and Trends Program; (2) Fisheries / Zoning, Fisheries, Socio Economic Indicators and Tourism Projects in the Sustainable-Use GBR Program; (3) Status and Trends, Economic Value, Integrated Reporting Project in the Torres Strait Program. The Marine Species of Conservation Concern Program will have a strong Indigenous focus and will also work closely with the Indigenous Landscapes Project in the Sustainable Use – Rainforest and Catchments Program. The Extension and Communication Project of the Marine Species of Conservation Concern Program will be developed jointly with the Sustainable-Use – GBR Program and the Torres Strait Program.

Projects

1.4.1	Condition, trends and projected futures of marine species of conservation concern	\$225,000
1.4.2	Sustainable use of marine species of conservation concern.....	\$95,000*

* Includes \$20,000 cash contribution from the Program 3 Torres Strait.

RAINFOREST THREATENED SPECIES AND COMMUNITIES AND ECOSYSTEMS OF CONSERVATION CONCERN – PROJECT 1.4.3

Program Leader and Host Organisation

Dr Daniel Metcalfe, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Budget Summary (Rainforest)

	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
MTSRF	\$200,000	-	\$200,000
Other	-	\$194,750	\$194,750
Total	\$200,000	\$194,750	\$394,750

This component of Program 4 will build on the reporting of the condition and trend of threatened species and communities in the rainforest and coastal catchments of North Queensland and will identify management options to mitigate risks, and reduce threats to key threatened species, including cassowaries and arboreal marsupials, and habitat of threatened ecosystems.

The project continues to clarify the community composition of threatened lowland ecosystems and their role in terms of maintaining rare and threatened species and harbouring exotic and pest species. Key indicators of ecosystem health have been identified and the threshold of concern for these threatened species and direction of community change will continue to be assessed.

The program now links with the Rainforest Climate program to assess the likelihood of community change to threatened regional ecosystems under the agreed climate change scenarios. This work will be extended to determine the impacts of climate change on rare and threatened species. The outcomes of the Program will be delivered into the Data Integration and Synthesis process for enabling ecosystem Report Cards to be developed, Condition and Trends for the Wet Tropics World Heritage and North Queensland coastal catchments and into the Impacts of Climate on the Rainforests of North Queensland.

Projects

1.4.3 Rainforest threatened species and communities and ecosystem processes	\$200,000
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PROGRAM 4: MARINE SPECIES AND COMMUNITIES OF CONSERVATION CONCERN***Project 1.4.1 Condition trends and projected futures of marine species of conservation concern*****Project Leader and Host Organisation**

Dr Mark Hamann, James Cook University

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Dr Mark Hamann	JCU	Sea Turtle ecologist: project leader Raine Is tasks manager.	0.95
Dr Col Limpus	QEPA	Sea turtle ecologist: co-investigator on the Raine Is task and manage QPWS projects that link to MTSRF.	0.05
Ian Bell	QEPA	Sea turtle ecologist: advice and expertise regarding North QLD marine turtles	0.03
Professor Helene Marsh	JCU	Project advisor	0.025
Dr Scott Smithers	JCU	Marine geomorphologist: co-investigator Raine Island task	0.1
QEPA engineers David Robinson John Mohaupt	QEPA	Coastal engineers: co-investigators Raine Island task	0.1
Dr Marc Burgman	Melb Uni	Expert in Risk Assessment for NRM projects	0.02
Dr Kirstin Dobbs	GBRMPA	Project guidance and advice	0.03
Ms Mariana Fuentes	JCU	PhD student investigating sea turtles and climate change in the northern GBR and Torres Strait	0.25
Ms Kristen Weis	JCU	PhD student investigating issues of management of marine turtles and dugongs	0.25
Mr John Dawson	JCU	PhD student investigating reef geomorphology – including Raine Island	0.25
Indigenous counterparts	TSRA participating Indigenous communities	Local experts: expert local advice and guidance to the community based aspects of the project and towards research participants understanding local ecology, sites and customs	0.2

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
DEWHA	Kevin Gale
AMPTO	Col McKenzie
QEPA	Col Limpus, Ian Bell, David Robinson, John Mohaupt
GBRMPA	Kirstin Dobbs
TSRA	Lachlan Sutherland, Marcus Finn, Toshi Nakata

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project harnesses the expertise of researchers from James Cook University and Queensland's Environmental Protection Agency together with Indigenous local experts to conduct world class multidisciplinary problem-focused research that will enhance the scientific information required to develop effective management strategies for the populations of marine species of conservation concern that occur in the Great Barrier Reef World Heritage Area and Torres Strait.

The priorities for MTSRF funding have been determined in consultation with the key end user groups. The research will be conducted across jurisdictions at spatial scales relevant to ecology of the focal species and to the end users of the research. Including co-investment funded tasks, the research will potentially provide reports on the condition and trends of dugongs, marine turtles and marine turtle habitats (nesting) that occur in the Great Barrier Reef World Heritage Area and Torres Strait and evaluate management options to improve the status of these species. Where links between this project and projects in other programs occur, we will ensure that collaboration with other research groups occurs to reduce duplication and maximise the research potential of both projects. Where applicable, information from this project/tasks will enable reporting and assessment of the ecosystem health of key environmental assets.

Key Objectives:

- (a) **Sea turtle nesting success:** To determine factors influencing nesting success of female turtles and egg survivorship of green sea turtles at Raine Island, Moulter Cay (GBR) and Murray Island (TS) and recruitment of juvenile turtles into the population; and
- (b) **Communication:** To communicate the results of these research activities and discuss/workshop relevant research and management issues in partnership with TSRA.

Project / Task Methodology

Objective (a) Sea turtle nesting success.

The specific aims of this project are:

1. To determine the patterns, rates and causes of sand loss from Raine Island, Moulter Cay (GBR), Bramble Cay and Murray Island (Torres Strait);
2. To calculate reproductive parameters for nesting green turtles at Raine Island, Moulter Cay, Bramble Cay and Murray Island (size range, recruitment rates, nesting success, mortality rates [of nesting turtles], egg production);
3. To determine factors influencing nesting success;
4. To determine recruitment rates of juvenile turtles into the population;
5. To explore whether the climate models developed under MTSRF Program 5 may relate to marine turtles in the GBR and Torres Strait;
6. To conduct a risk assessment of climate change (PhD – Fuentes); and
7. To investigate issues of scale in relation to marine turtle management (PhD – Weiss).

In 2007/8, the project involves conducting two concurrent trips to green turtle nesting sites and one trip per year to a green turtle foraging site. One nesting turtle trip will visit Raine Island and Moulter Cay (coordinated by QPWS) and the second trip will visit the Murray Islands in Torres Strait. The foraging turtle site will be the reefs of Torres Strait. While the foraging area trip can be held at various times of the year the trips to the nesting beaches will follow the routine established for green turtle nesting population monitoring by Queensland Parks and Wildlife Service (QPWS). At the nesting beaches; geomorphologic surveys will be conducted at Raine Island and Moulter Cay to determine patterns of sand movement. At Raine Island, Moulter Cay and Murray Island ecological data on the nesting turtles will be collected using the standard collection methods of QPWS (Limpus et al. 2003). Environmental factors influencing egg and hatchling survivorship at each rookery will be explored using a quantifiable approach (Miller 1985; 1999). At the foraging area sites in Torres Strait, turtles will be randomly caught on the reef flats and data will be collected on size, sex and age class structure, recruitment rates and breeding rates (Limpus and Reed 1985; Hamann et al. 2005). At Murray Island and Bramble Cay, local Indigenous people will be trained in all aspects of the field-work (see Hamann et al. 2005 for examples).

We aim to develop a working partnership with QPWS, TSRA and GBRMPA to improve the science and management of northern GBR green turtle rookeries.

Marine turtle life history is strongly tied to environmental variables, and consequently they are vulnerable at several life stages to the predicted effects of climate change. In Project 1.4.1 (PhD - Fuentes), we will explore how the predicted impacts of climate change may relate to marine turtles, develop a risk assessment for green turtles in the northern GBR and Torres Strait.

Management of marine turtles (& dugong) is complex and will involve several State and Commonwealth agencies and may include several management options. A PhD (Weiss) project will address issues of scale as they relate to marine turtle management.

Objective (b) Communication. We will hold a workshop in November 2008 to discuss with Torres Strait Islanders:

1. Research results and development of research partnerships with communities; and
2. The costs and benefits (Risk Assessment) of using spatial management techniques (such as area closures) to manage their dugongs and sea turtles.

TSRA's Land and Sea Management Unit's dugong and turtle project will be invited to participate in the workshop. During the workshops, practical exercises involving GIS and spatial information collected via this program and other MTSRF projects will allow participants to obtain hands-on experience on how they can develop spatial marine management plans. Dr Marc Burgman from Melbourne University who is an expert in Risk Assessment development for NRM projects, and Alana Grech a spatial data expert will be involved in this workshop.

Co-investment objectives

The following objectives were developed in ARP1 for co-investment opportunities, and their current status is outlined in the table.

Objective	Task	Status
E	Coastal dolphin distribution, abundance and genetics	A proposal by Guido Parra (UQ) for coastal dolphin research is currently being evaluated by GBRMPA for co-investment
F	Trends in snubfin dolphin CPUE in QSCP	
G	Minke abundance, movements demography and sustainability indicators	Separate project with Dr Alastair Birtles
H	Inshore shark genetics	To be incorporated into the Fish & Fisheries projects
I	Trends in easily identified sharks and sawfish CPUE in QSCP	To be incorporated into the Fish & Fisheries projects

Project Outputs / Milestones 2008/2009

Objective	Targeted Activity	Completion Date
(a)	Final report on work undertaken in 2008/2009 – including reports of fieldwork undertaken to identify aspects of nesting success and egg survivorship. The report will include an initial identification and revised evaluation of key threats – such as climate change threats related to geomorphological issues at Raine Island.	10 June 2009
(b)	Report on the workshop in which extension officers employed by relevant Indigenous communities will discuss spatial closures and other management options in a risk assessment framework	10 June 2009

Project 1.4.1 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones – All JCU responsibilities	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Report 1 submission: • Schedule of field activities (community feedback, site visits etc.) for objective (a). • Proposed schedule of training events for Indigenous Torres Strait Islander participants in project. • Plan of any communication activities in partnership with Indigenous organizations plus detail of products for 2008/2009 and summary of liaison activities.	30 Sept 2008
Pathway to Impact Report for end user relevance.	31 Dec 2008
Report 2 submission: • Report on communication workshop (Objective b) and field work conducted to date to meet objective (a): areas monitored, data collected, and preliminary findings (with appropriate attribution of MTSRF funding). • Summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable.	11 Jan 2009
Report 3 submission: • Draft report on field work undertaken in year three - to identify aspects of nesting success and egg survivorship (with appropriate attribution of MTSRF funding). The report will build upon results from year 2 and include a revised identification and evaluation of key threats (obj a).	15 May 2009
Report 4 submission • Final report on fieldwork undertaken in year three - to identify aspects of sea turtle nesting success and egg survivorship (with appropriate attribution of MTSRF funding). The report will build upon results from year 1 and include a revised identification and evaluation of key threats (obj a) (with appropriate attribution of MTSRF funding). • Final summary of communication activities undertaken through course of project and example of communication products (obj b).	10 June 2009
Total MTSRF Funding	\$225,000*

*includes \$3000 for MTSRF Visual Documentation Project

Project 1.4.1 Budget**Year 3 – 2008/2009 Project Funding and Partnerships**

Contributing Organisation	Cash	In-kind	Total
MTSRF	222,000	-	222,000
MTSRF Visual Documentation*	3,000	-	3,000
JCU	-	77,000	77,000
QEPA/QPWS	-	TBA	TBA
GBRMPA	-	60,000	60,000
TSRA	-	51,000**	51,000
Total	225,000	188,000	413,000

* A total of \$3,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

** JCU to report against TSRA in-kind activities for this Project.

JCU Project 1.4.1 Budget 2008/2009

Item	MTSRF	JCU In-kind	TSRA In-kind	GBRMPA in-kind	QPWS/QEP A in-kind	
Salaries	95,000	12,000	51,000	5,000		163,000
Operating	45,000	-	-	50,000		95,000
Travel	45,000	15,000	-	5,000		65,000
Communication / Extension	30,000	-	-			30,000
Capital	7,000	50,000	-			57,000
Total	222,000	77,000	51,000*	60,000	TBA	410,000

* JCU to report against TSRA in-kind activities for this Project.

Indicative Budget Summary – Year 4

Year	MTSRF*	Applicant		Other sources		Total
2009/2010	250,000	-	31,000	-	21,000	302,000
Total	250,000	-	31,000	-	21,000	302,000

Note: Queensland Environmental Protection Agency classified as end-user.

* Communication / Extension included here.

PROGRAM 4: MARINE SPECIES AND COMMUNITIES OF CONSERVATION CONCERN***Project 1.4.2 Sustainable use of marine species of conservation concern*****Project Leader and Host Organisation**

Professor Helene Marsh, James Cook University (JCU)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Professor Jon Altman	ANU	Economist: member of supervisory team for PhD student (economic task)	0.025
Professor Helene Marsh	JCU	Dugong ecologist: co-coordinator of the acoustic and economic tasks and co-supervisor of PhD students.	0.10
Dr Mike Noad	UQ	Marine mammologist: Co-supervisor of the PhD student (dolphin acoustics)	0.05
Dr Guido Parra	JCU	Dolphin expert: Co-supervisor of the PhD student (dolphin acoustics)	0.05
Dr Natalie Stoeckl	JCU	Economist: chair of supervisory team for PhD student (economic task)	0.05
Dr James Butler	CSIRO	Economist: member of supervisory team for PhD student (economic task)	0.05
PhD students*	2 x JCU	Two PhD projects have started (1) acoustics of cetacean and sea turtles and (2) socio-economics of turtle and dugong issues	1.5 FTE (note economic student now starts early 2008)
Indigenous counterparts	TSRA, GBRMPA participating Indigenous communities	Local experts: expert local advice and guidance to the community based aspects of the project and towards research participants understanding local ecology, sites and customs	1FTE +(made up from several people)

+ this amount will be increased if third party funding is obtained

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GBRMPA	Kristen Dobbs
TSRA	Vic McGrath
QDPI&F	Malcolm Dunning
AMPTO	Col McKenzie
ARC and TO communities	Russell Butler

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project harnesses the expertise of researchers from four research providers and three end user institutions together with Indigenous local experts to conduct world class multidisciplinary problem-focused research that will enhance the natural and social science information required to develop effective management strategies for the populations of marine species of conservation concern that occur in the Great Barrier Reef World Heritage Area and Torres Strait. The priorities for MTSRF funding have been determined in consultation with the key end user groups. The research will be conducted across jurisdictions at spatial scales relevant to ecology of the focal species and to the end users of the research. The project will provide information relevant to the sustainable use and management of marine species of conservation concern in the Great Barrier Reef World Heritage Area and Torres Strait. Where applicable, information from this project will be delivered into the Data Integration and Synthesis framework for reporting, using a spatial risk assessment approach.

Key Objectives:

- a) To evaluate the effects of acoustic alarms on behaviour of marine wildlife, with emphasis on coastal dolphins.
- b) To evaluate the economic factors related to Indigenous hunting and its management.

Project / Task Methodology

Objective (a): To evaluate the effects of acoustic alarms on behaviour of wildlife bycatch.

This task will assess the capacity of acoustic alarms to minimise the bycatch of protected species in commercial gill nets without alienating the bycatch species from critical habitats. It will involve experimental evaluation of the behavioural and acoustic response of two species of coastal dolphins to acoustic alarms. Different species of dolphins react differently to acoustic alarms and the coastal dolphins of Queensland have not been studied. A spatial risk assessment of various management options will be completed. Note: This task is the PhD of research student Alvaro Berg who commenced in mid 2006.

Objective (b): Evaluate the economic factors related to Indigenous hunting and its management.

This task will apply the hybrid economy framework (customary [non-market] state and market sectors) to an investigation of the economics of the Indigenous harvest of turtles and dugongs in the Torres Strait and northern Great Barrier Reef. The task will also investigate the economic costs and benefits (including social and health benefits) of management options available within this framework including the possible role of payment for environmental services (PES). This task will be achieved by literature search, participant observation (fieldwork) with relevant Indigenous organisations managing agencies and with a small sample of Torres Strait and Northern GBR communities actively engaged in marine turtle and dugong harvesting. It will include evaluation of the direct contribution of customary harvesting to livelihoods and to social life; and examination of indirect and induced benefits from PES, and examination of costs and benefits of strategies developed by relevant communities, Indigenous organisations and managing agencies together or separately. Note: The commencement of this task was deferred until Jan 2008 because delays in recruiting the PhD student.

Project Targeted Activities 2008/2009

Objective	Targeted Activity	Completion Date
(a)	Progress report on evaluation of the capacity of acoustic alarms to minimise the bycatch of coastal dolphins in commercial gill nets without alienating the bycatch species from critical habitats.	June 2009
(b)	Report on the evaluation of economic factors related to Indigenous hunting and its management.	June 2009

Project 1.4.2 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones – All JCU responsibilities. All reports to be written reports unless otherwise specified.	
Signing of contract	
Report 1 submission: - Schedule of activities (field and desktop) for objectives (a), (b), (c) Year 2 (above). - Plan of communication activities for Year 2 and summary of any liaison activities undertaken to date, including minutes of meetings/workshops	30 Sep 2008
Pathway to Impact Report for end user relevance.	31 Dec 2008
Report 2 submission: - Verbal progress report to operations committee on field and desktop work conducted to date to meet objectives a and c (above): data collected, findings. - Update to operations committee of any liaison activities undertaken to date, including minutes of meetings/workshops	20 Jan 2009
Report 3 submission (with appropriate attribution of MTSRF funding): Draft report on findings of Year 2 activities in relation to objectives (a) and (b) including summary of field and desktop work undertaken, consultation undertaken, plan for completion in out years.	15 May 2009
Report 4 submission (with appropriate attribution of MTSRF funding): Final report on findings of Year 2 activities in relation to objectives (a) and (b) including summary of field and desktop work undertaken, consultation undertaken, plan for completion in out years.	10 June 2009
Total MTSRF Funding	\$95,000

* A total of \$1,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project. Includes \$20,000 from Program 3 Torres Strait.

Project 1.4.2 Budget**Year 3 – 2008/2009 Project Funding and Partnerships**

Contributing Organisation	Cash	In-kind	Total
MTSRF	95,000		95,000
CSIRO		5,000	5,000
JCU		97,500	96,000

GBRMPA		11,000	11,000
TSRA		2,000	2,000
UQ		8,500	8,500
Total	95,000	124,000	219,000

* A total of \$1,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project.

JCU Project 1.4.2 Objective (a) Budget 2008/2009

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	20,000	6,500	26,500
Operating	3,000	21,000	24,000
Travel	-	-	-
Communication / Extension*	-	-	-
Capital	-	50,000	50,000
Total	23,000	77,500	100,500

JCU Project 1.4.2 Objective (b) Budget 2008/2009

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	20,000	9,000	29,000
Operating	20,000	1,000	21,000
Travel	-	-	-
Communication / Extension*	-	-	-
Capital	-	2,000	2,000
Total	40,000	12,000	52,000

JCU Project 1.4.2 Objective (c) Budget 2008/2009

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	6,000	5,000	11,000
Operating	5,500	-	5,500
Travel	19,500	2,000	21,500
Communication / Extension	-	1,000	1,000
Capital	-	-	-
Total	31,000	8,000	39,000

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total**
		Cash	In-kind	Cash	In-kind	
2009/2010	50,000	-	45,000	-		95,000
Total	50,000	-	45,000	-	-	95,000

RAINFOREST THREATENED SPECIES AND COMMUNITIES AND ECOSYSTEMS OF CONSERVATION CONCERN – PROJECT 1.4.3

Project 1.4.3 Rainforest threatened species and communities and ecosystem processes

Project Leader and Host Organisation

Dr Daniel Metcalfe, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Daniel Metcalfe	CSIRO	Tropical Plant Ecologist	0.19
David Westcott	CSIRO	Vertebrate Ecologist	0.06
Andrew Krockenberger	JCU	Vertebrate physiologist	0.25
Tina Lawson	CSIRO	Research Officer	0.12
Matt Bradford	CSIRO	Research Officer	0.17
Caroline Bruce	CSIRO	Research Officer	0.05
Andrew Ford	CSIRO	Research Officer	0.25
David Hilbert	CSIRO	Research Group Leader	0.06
Dean Jones	CSIRO	Research Officer	0.08
Adam McKweon	CSIRO	Research Officer	0.10

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
WTMA	Steve Goosem
Alliance for Sustainable Tourism	Melinda Connolly
Terrain NRM	Rowena Grace
QEPA	Peter Latch

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project will identify the condition and trend of, and likely future for, cassowaries and arboreal mammals and the rare and threatened species and ecosystems of the coastal lowlands, with an initial focus on the Tully-Murray-Hull catchments which include some of the best remnant *Melaleucas* in the bioregion, and the important Mission Beach area. It will also develop management options for mitigating threats to these environmental assets. Surveys to report condition and trend will be agreed through discussion with end users and in a workshop to ensure that the maximum utility may be achieved from the survey effort, and to ensure that data collection meets individual requirements for statutory reporting and to support other projects (see Tables 1 & 2). Data on Regional Ecosystem composition and condition will support the QEPA re-assessment program; identified threats and condition will feed into Terrain NRM Ltd and WTMA statutory reporting, and inform policy development,

and collation of information on the impact of fire and of weeds and feral animals will inform QPWS management policy and QDNRM&W weed eradication programs. One consequence of the range of Research Users with an interest in the outputs of the project is that the data needs to be collected and analysed in a manner suitable to providing outputs at a range of scales and to a range of different types of research user. Outputs from climate change related objectives will assist managers to critically assess realistic and mechanistic-based climate change threats to two groups of Wet Tropics endemic vertebrates, the microhylid frogs and rainforest possums, allowing identification of likely refugia and possible mitigation measures.

The project involves substantial collaboration with Terrain NRM Ltd and links into the work being undertaken through the Coastal Catchment Initiatives program in the Tully catchment and potentially, in subsequent years, in the Barron catchment.

Key Objectives:

- (a) Refinement of existing survey protocols for birds and vascular plants to incorporate flying foxes, signs of fire history, presence and abundance of weeds and ferals, and expand data collection on cassowaries and on ecosystem health.
- (b) Completion of baseline data for the Tully-Murray-Hull catchments using revised protocol, and collection of baseline for other priority catchments.
- (c) Clarification of the community composition of threatened lowland Regional Ecosystems (REs) and their role in terms of maintaining rare and threatened species, and harbouring exotic and pest species. Identification of key indicators of ecosystem health.
- (d) Assessment of key threatening processes and of effectiveness of current management practices in maintaining lowland ecosystem health.
- (e) Focus on the impact of fragmentation as a key threatening process toward which targeted management approaches may have significant outcomes; contextualisation of fragments in terms of their size, location and age, and the biological trajectories that different combinations of these may confer.
- (f) Assessment of likelihood and direction of community change of REs under climate change scenarios, or as a result of changed ecological functioning (linked to 2.5ii.3).
- (g) Determine physiological mechanisms of impacts of climate change on highland rare and threatened species concentrating on arboreal marsupials and microhylid frogs (linked to 2.5ii.4).

Project / Task Methodology

Objectives (a)-(e): Refinement of existing survey protocols for birds and vascular plants to incorporate flying foxes, signs of fire history, presence and abundance of weeds and ferals, and expand data collection on cassowaries and on ecosystem health; and completion of baseline surveys.

Existing CSIRO and QPWS CORVEG survey methodologies and datasets will be merged and supplemented with specific tasks to generate data on identified species and on management issues. Two proformas will be produced, a detailed one for use by survey teams working primarily on the MTSRF project, and a more general one to supplement survey work carried out by end users but with a specific focus on another aspect, such as weed distribution. Selection of survey sites in Tully-Murray-Hull catchments will involve agreement with stakeholders on survey site selection and prioritization, both for targeted

surveys and non-targeted surveys which yield additional data from other management work. Collection of additional data for pre-surveyed sites, and completion of additional sites to generate baseline data for the Tully – Murray – Hull catchments, will follow. Statistical and spatial analysis of data will include (i) comparison of plant inventories with published RE classifications (in collaboration with QEPA), (ii) assessment of weed and feral invasion and load in fragments of different sizes and after various damage levels due to cyclone Larry (with QDNRM&W and Terrain NRM and FNQ ROC), (iii) impacts of past and current management practices on maintaining biodiversity and ecosystem integrity (with QPWS and WTMA).

Biodiversity analysis and prediction of habitat use by key species, notably cassowaries and mahogany gliders, will be carried out using process modelling where data allows. Threatened species and communities will be identified using current statutory listings, expert opinion and consultation with local Indigenous groups. A review of a range of existing models with respect to highlighting potential indicators of habitat condition will be carried out. Regular reporting to stakeholders and workshops with end users will ensure that the research direction remains close to the end users' requirements. Engagement with local indigenous groups, where possible, will ensure that cross-cultural concepts of threat are also considered.

The first year of this project focussed on defining the approach to achieving the desired outcomes, in particular agreeing on a focal area on which to concentrate all resources in order to achieve better resolution of the questions at hand. To this end the coastal lowlands of the Tully/Hull, Murray and South Johnstone catchments were selected, and baseline data for the rainforest communities assembled. Whilst all appropriate threatening processes will be considered, the focus in years 2-4 will be primarily on the impacts and consequences of fragmentation of lowland communities, with the fate of threatened and iconic species, the impacts of weeds and ferals, and on other human-mediated impacts considered within that context. These impacts may include the effects of tourism in highly visited areas around Mission Beach and some parts of Edmund Kennedy National Park. Fragments will be studied in the context of their size, their isolation and their age, and will range from tiny blocks in the corner of cane paddocks to extensive natural areas such as the Mt Mackay and Mission Beach communities. Surveys will continue to document plant species and avian diversity, measures of ecosystem health, and the presence or signs of threatened or feral animals. Established collaborative links with the QPWS Threatened Species Unit will see the incorporation of specific work targeted at the assessment of habitat quality and fragmentation of cassowary and mahogany glider habitat, and on determining the lessons to be learned from cyclone Larry in terms of its impact on the cassowary habitat around Mission Beach, and the need to prioritise restoration and corridor plantings in areas where they will have most impact.

Objectives (f)-(g): Mechanisms of climate change impact on threatened species

Two groups of Wet Tropics endemic vertebrates have been selected as highly likely to be threatened by the effects of climate change- microhylid frogs and marsupial folivores. Objective (f) is designed to determine the role of physiological tolerances in limiting the range of these groups and to use those tolerances to improve/redefine distributional models that can be used to predict impacts of climate change. The approach is twofold, first to extend a model of thermal limitation developed for the green ringtail possum. The model of distributional limitation by thermal extremes will be extended from that developed for the green ringtail possum to include the Lemuroid ringtail possum and the Herbert River ringtail possum. This will require parameterisation of the model for the new species, including the role of the den as a thermal refuge. Secondly, to develop models of physiological limitation of microhylid frogs based on oviposition/incubation, as well as adult overwintering requirements. Physical/microclimate parameters of microhylid frog distribution and

oviposition sites will be determined and relevant aspects of the physiological tolerances of eggs/adult microhylid frogs will be determined across that range of environments. In both cases, selected study sites will be designed to maximise divergence within the range of restricted and widespread microhylid frog species, Lemuroid and Herbert river ringtail possums, so that models are based on the range of physiological characteristics displayed within the species.

The distributional models for highland arboreal marsupials and microhylid frogs will be altered/redefined using physiological tolerances determined during the project and used to model the effects of varied climate change scenarios on distributions and identify refugia.

Project Targeted Activities (indicative only for out years)

Objective	Targeted Activity	Completion Date
(b), (e)	Selection of supplementary fragment survey sites in Tully-Murray-South Johnstone catchments	October 2008
(c)	Survey fieldwork and ground-truthing of models*	May 2009
(b), (c), (d), (e)	Decision with Research Users (see Table 2) about broad location of final years' work (either continuation in Tully-Murray-South Johnstone, or extension into additional catchments)	April 2009
(d), (e), (f)	Analysis of threats and trajectories*, workshops and reporting	June 2009
(c), (d), (e), (f)	Provide geo-referenced data to MTSRF 1.2.1 and 2.6.2, to FNQ NRM, WTMA, QEPA & QPWS Threatened Species Unit	June 2009
(e)	Report on effects of fragmentation and associated threats to native wildlife in a spatial and temporal context*	June 2009
(d), (f)	Development of guidelines, with Research Users, for prioritisation and site selection criteria for restoration and corridor planting for the express purposes of maintaining population viability of key threatened assets	June 2010
(g)	Completion of measurement of the effect of den-use on the thermal environment of possums- full annual cycle	October 2008
(g)	Continued measurements of metabolic responses to temperature in Lemuroid and Herbert River ringtail possums	July - December 2008
(g)	Continued measures of thermal tolerance and microclimatic measures of habitat in microhylid frogs	December 2008-March 2009
(g)	Initial development of conceptual model of physiological limitation of microhylid frogs and ringtail possums	June 2009
(g)	Final measurements of metabolic responses to temperature in Lemuroid and Herbert River ringtail possums	July- December 2009
(g)	Final measures of thermal tolerance, water loss and microclimatic measures of habitat in microhylid frogs	December 2009-March 2010
(g)	Extension of conceptual model into spatial model of physiological limitation of microhylid frogs and ringtail possums	2010
(g)	Model effects of varied climate change scenarios on distribution of microhylid frogs and rainforest ringtail possums	2010

* These outputs will be continued and refined in subsequent years.

Project 1.4.3 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
Report 1 submission: - Interim report on activities to meet objectives (a) – (f), specifically identification of supplementary fieldwork sites, photo-interpretation of fragment age and context, and initial fieldwork [CSIRO] - Summary of communication activities to date, and communication plan for 2008-09 [CSIRO] - Report on activities and progress toward measuring effect of den-use on thermal environment of possums. Update on activities and progress toward preliminary measures of metabolic responses to temperature in Lemuroid and Herbert River ringtails [JCU]	1 st October 2008
Pathway to Impact Report for end user relevance.	5 th December 2008
Verbal Report to Operations Committee: - Progress on activities to meet objectives (a) – (f), specifically further contextualisation of fragments in time and space, fieldwork to date and trajectory model development[CSIRO] - Summary of communication activities to date [CSIRO] - Progress on activities and measures of metabolic responses to temperature in Herbert River and Lemuroid ringtail possums [JCU]	24 th February 2009
Report 2 submission - Final report on findings (with appropriate attribution of MTSRF Funding) of year 2 activities to meet objectives (a)-(f) – year 2 of fragment assessment including continued model development to relate fragment size, shape, age and landscape context with current condition and inferred trajectory; possible implications for restoration prioritization and identification of thresholds of concern[CSIRO] - Final report on measurement of effect of den-use on thermal environment of possums. Progress report on measures of metabolic responses to temperature in Herbert River and Lemuroid ringtail possums. Update on activity and progress toward; initial measures of thermal tolerance, microclimatic measures of habitat and identification of oviposition sites, in microhylid frogs [JCU] Appropriate attribution of MTSRF Funding required. - Final report of any liaison activities undertaken including minutes of meetings/workshops to address objectives (a)-(f) (above). Appropriate attribution of MTSRF Funding required. [CSIRO] - Plan for completion in out years. [CSIRO] - Contribution to plan for completion developed by CSIRO for out years [JCU]	1 st June 2009
Total MTSRF Funding*	\$200,000

* Totals include \$3,000 Visual Documentation Allocation.

Project 1.4.3 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	197,000	-	197,000
MTSRF Visual Documentation*	3,000	-	3,000
CSIRO	-	147,750	147,750
JCU	-	47,000	47,000
Total	200,000	194,750	394,750

* A total of \$3,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

CSIRO Project 1.4.3 Budget 2008/2009

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	109,570	-	109,570
Operating	23,280	-	23,280
Travel	14,900	-	14,900
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	147,750	147,750
Total	147,750	147,750	295,500

JCU Project 1.4.3 Budget 2007/2008

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	31,850 (0.65 FTE RA)	47,000 (In-kind 0.25 FTE)	78,850
Operating	6,700	-	6,700
Travel	10,700	-	10,700
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	49,250	47,000	96,250

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	200,000	-	197,000	-	3,000	400,000
Total	200,000	-	197,000	-	3,000	400,000

Table 1: Summary of existing and proposed linkages between MTSRF Project 1.4.3 and other MTSRF projects.

MTSRF Project	Data Delivery or Other Linkage
1.2.1: Status and trends of biodiversity	Geospatially referenced data from field surveys provided to compliment gap filling efforts; equivalent sharing of 1.2.1 refugial area surveys where appropriate
2.5ii.3: Understanding climate change threat to ecosystems and ecological processes	Two lowland climate change plots at in the South Johnstone catchment provided to 1.4.3 as species and abundance data
2.6.2: Identification and impact of invasive pests in the Wet Tropics Rainforest	All non-native plant species, and signs or sightings of feral animals, geospatially referenced and passed to project 2.6.2
4.9.3: Impacts of urbanisation on North Queensland environments: management and remediation	Six-monthly meetings with project team to ensure fragment survey methods are compatible, and to align conservation prioritization approaches
4.9.4: Integrating ecology, economics & people in forest and landscapes	Maintain regular contact to ensure that biodiversity values of timber plantations in lowland contexts are communicated, and ensure that the values of native hardwood plantations are appropriately recognized in determining landscape connectivity
4.9.5: Restoring tropical forest landscapes	Six-monthly meetings with project team to ensure fragment survey methods are compatible, and to align conservation prioritization approaches. Input data from surveys of revegetation projects into 4.9.5 to inform success of restoration plantings, and receive information back regarding best management practice for restoration plantings
4.9.6: Strategic Natural Resource Management and land use planning	Six-monthly meetings with project team to ensure fragment classification and corridor planning approaches are aligned. Exchange of reports detailing recommendations to ensure that the Mission Beach focus area matches with the larger Tully/Murray/South Johnstone area.

Table 2: Summary of existing and proposed linkages between MTSRF Project 1.4.3 and external Research Users.

Research Users external to MTSRF	Data, interpretation and other products
WTMA	Identification of status of key rainforest communities and a number of legislatively defined threatened species outside the WTWHA, together with an assessment of their long term viability. Listing of key threatening processes, their relative impact on fragmented native vegetation, and potential thresholds of concern
QPWS Threatened Species Unit	Proposed cassowary-habitat mapping project in relation to corridor placement, and similar approach for mahogany gliders in fragments and corridors, especially in the light of post-cyclone Larry damage.
Queensland EPA	Complimentary rain forest surveys using a broadly similar methodology to compliment CORVEG surveys to be carried out in the lowland woodlands in 2008-09. Exchange of data and measures of habitat condition.
Terrain NRM	Identification of habitat quality, condition and trend in the light of identified threatening processes. Assessment of prioritization approaches for habitat remediation. Documentation of distributions of all non-native plant species, and signs or sightings of feral animals.
Private landholders	Identification of condition, trend and value of specific fragments. Spatial location and infestation information for all non-native plant species encountered for which landholders have statutory responsibility for control.
Local councils	Identification of condition, trend and value of specific fragments. Spatial location and infestation information for all non-native plant species encountered for which local government has statutory responsibility for control.
Biosecurity Queensland	Distribution and location of all class 1 non-native plant species, and signs or sightings of listed feral animals for which the State organisations have statutory control requirements

THEME 2

**RISKS AND THREATS TO THE ECOSYSTEMS:
UNDERSTANDING CAUSES, IMPACTS AND MITIGATION OPTIONS
FOR SPECIFIC THREATS, AND UNDERSTANDING AND MEASURING
THE UNDERPINNING FACTORS SUPPORTING RESILIENCE**

Early identification of risks and threats to North Queensland's key environment assets and early advice on options to mitigate and better manage threats, are critical to the future environmental, economic and social underpinning of North Queensland. In particular, options for promoting adaptation to climate change, increased climate variability and mitigation of the impacts of invasive species have been identified as key priorities for North Queensland. It is anticipated that research results will be dealing with prediction of impacts, sources of resilience and importantly, practical responses to threats and their mitigation.

Budget Summary

Program	Title	MTSRF	Other Cash	In-kind	Total
Program 5i	Climate Change – Marine	\$580,000	\$10,000	\$1,311,585	\$1,901,585
Program 5ii	Climate Change – Rainforests	\$520,000	\$5,000	\$1,132,649	\$1,657,649
Program 6	Invasive Species	\$250,000	-	\$196,500	\$446,500
Total		\$1,350,000	\$15,000	\$2,640,734	\$4,005,734

* Predicted cash co-investment. C

The total value of Theme 2 is **\$4,005,734**

PROGRAM 5

CLIMATE CHANGE – UNDERSTANDING THE THREAT, ECOSYSTEM IMPACTS AND MITIGATION

Program 5 consists of two main components: Climate change impacts in the Great Barrier Reef (Program 5i) and Climate change impacts in Wet Tropics rainforests and adjoining catchments (Program 5ii).

Budget summary Program 5

	Cash	In-kind	Total
MTSRF	\$1,100,000	-	\$1,100,000
Other	\$15,000	\$2,444,234	\$2,459,234
Total	\$1,265,000	\$2,444,234	\$3,559,234

* Predicted cash co-investment.

PROGRAM 5i: CLIMATE CHANGE – UNDERSTANDING THE THREAT, ECOSYSTEM IMPACTS AND MITIGATION OF THE GREAT BARRIER REEF

Program Leader and Host Organisation

Dr Julian Caley, Australian Institute of Marine Science (AIMS)

Budget Summary (Great Barrier Reef)

	Cash	In-kind	Total
MTSRF	\$580,000	-	\$580,000
Other	\$10,000*	\$1,311,585	\$1,321,585
Total	\$590,000	\$1,311,585	\$1,901,585

* Predicted cash co-investment.

Climate change is one of the most significant threats to the sustainable use of coral reefs in Australia and worldwide (IPCC 2001). The Climate Change – Marine Program addresses specific information gaps of direct relevance and importance to users of the Great Barrier Reef and those charged with its sustainable management. This program addresses high priority issues for climate change impacts on the Great Barrier Reef:

- Regional climate change scenarios – evaluating possible futures for the GBR ecosystem on the basis of our present knowledge and forecast climate changes;
- Early Warning and Assessment System for thermal stress on the Great Barrier Reef;
- Resilience of coral reef ecosystems to climate change;
- Tools to support resilience-based management in the face of climate change.

Understanding the potential impacts of climate change on the Great Barrier Reef and management options for promoting adaptation and minimising, and remediating its impacts is critical to the long-term sustainable use of this valuable natural asset. This program describes a large-scale, integrated approach for understanding how environmental conditions will change in the near future, how these changes will impact the species that

make up the reef, how resilient these species are likely to be to such impacts, and what are the best management options for minimising the risks of climate change to these reef communities.

Expected outcomes from this program will include greatly improved understanding of the links between atmospheric and oceanic conditions on the hydrodynamics around reefs at small spatial scales. These models will facilitate better understanding of how climate change will change water circulation patterns and how such changes will affect the environmental conditions faced by the organisms living on these reefs. Linked to these models will be the development of an early warning system for coral bleaching. To deliver this objective, further research will be done to better define the tolerances of corals to increasing water temperatures, how these might vary, and how the impact of changing hydrodynamics might affect other species such as seabirds. This information will then be fed into research about how well these reef systems might be able to cope with the impacts of climate change.

How best to use this information in a management context will be the focus of the fourth project which will concentrate on developing an atlas of climate change risk including socio-economic risks and building tools for prioritising management responses. To ensure the relevance of this research program to end users, end user representatives were consulted extensively throughout the development of this program. To ensure ongoing relevance, end user representatives are included within the program teams. Further value and synergies will be derived from the close integration of this program with the Climate Change: Rainforest, Sustainable Use, Status and Trends and Synthesis and Integration programs.

Projects

2.5i.1	Regional climate scenarios.....	\$125,000
2.5i.2	Early warning and assessment system for thermal stress on the Great Barrier Reef	\$200,000
2.5i.3	Resilience to climate change.....	\$150,000
2.5i.4	Tools to support resilience-based management in the face of climate change	\$105,000

PROGRAM 5ii: CLIMATE CHANGE – UNDERSTANDING THE THREAT, ECOSYSTEM IMPACTS AND MITIGATION OF RAINFORESTS AND CATCHMENTS
Project Leader and Host Organisation

Professor Steve Turton, James Cook University (JCU)

Budget Summary (Rainforest & catchments)

	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
MTSRF	\$520,000	-	\$520,000
Other	\$5,000	1,132,649	1,137,649
Total	\$525,000	1,132,649	1,657,649

Climate change is one of the most significant threats to global biodiversity and human well-being. Global biodiversity is concentrated in the tropics, with high levels of endemism in regions such as the Wet Tropics World Heritage Area of Queensland. However, what is very unclear is how climate change will impact at the regional level.

This program continues to focus on delivering strategic knowledge on the impact that climate change is having and will have on North Queensland's tropical forests, and management options for how to mitigate against the negative impacts. It will provide early identification of the risks and threats posed by climate change to North Queensland's key terrestrial environmental assets and early advice on options to mitigate and better manage these threats and reduce the risks. It will also provide advice on the resilience or lack of resilience of different terrestrial ecosystems and biodiversity.

The Program continues to develop improved regional scenarios and understanding of future climate change relevant to North Queensland's tropical forests, such as increased temperature in mountainous areas, changes in patterns of rainfall, clouds, extreme weather events and CO₂ dynamics and develop landscape-level indicators for ecosystem response to climate change. Assessment of the potential of Wet Tropics vertebrates to adapt to predicted future climatic changes and predict the risk of extinction through climate change continues to identify how, at the local level, plant communities and the biodiversity associated with them respond to current climate variability in terms of water stress, flowering and fruiting, carbon use and storage; and scaling-up from these data to provide regional scenarios. Finally the program will produce regional maps (projected to temporal scales of relevance to management) outlining likely changes to North Queensland ecosystems given a variety of scenarios for future warming, responses of biota and management interventions. These data sets will be integrated into the Risk and Resilience Atlas which will enable managers and industry to access spatially explicit information on the status and trends of the Wet Tropics through a single data repository.

Projects

2.5ii.1	Regional climate projections for tropical rainforests.....	\$100,000
2.5ii.2	Climate change: scaling from trees to ecosystems.....	\$120,000
2.5ii.3	Understanding climate change threat to ecosystems and ecological processes.....	\$150,000
2.5ii.4	Impacts of climate change on biodiversity	\$150,000

PROGRAM 5i: CLIMATE CHANGE – UNDERSTANDING THE THREAT, ECOSYSTEM IMPACTS AND MITIGATION OF THE GREAT BARRIER REEF
Project 2.5i.1: Regional climate scenarios

Note: Project linked to Project 2.5ii.1 Regional climate projections for tropical rainforests.

Project Leader and Host Organisation

Dr Andreas Schiller, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Programmer/system design (new position, level AOF 5.1)	AIMS	System development, Data Centre	1.0

Summary Table of Research Users 2008/2009

Organisation	Contact
DEWHA	Kevin Gale
GBRMPA	David Wachenfeld
AMPTO	Col McKenzie

Project Duration

Start Date: July 2007

End Date: 30 June 2010

Project / Task Objectives

The incorporation of climate scenarios and models into the Reef Risk, Resilience and Response Atlas depends on a sound, functional, practical and fully integrated combination of hardware and software for its success. A full-time systems developer and programmer dedicated to the Reef Atlas is required to design, develop and implement such architecture. This systems designer will work in close collaboration with the AIMS Data Centre to maximize the transfer of experience on data standards, metadata formats, data storage and data sharing agreements, and with the data providers and users who will contribute to the growth of the Atlas and its population with data and text pages.

The design of the Atlas is still under development. After consideration of alternative competing solutions, it is now planned that the Reef Atlas should develop an architecture that would allow institutions to maintain and host their own data if they wished, or to host their data with a Reef Atlas repository if they did not. The system will be based on international standards described by the Open Geospatial Consortium (OGC) for geospatial services. These standards allow servers to present spatial data as a visual map (Web Map Service (WMS) standard, Keyhole Markup Language (KML)), and access to the underlying data (Web Feature Service (WFS) and Web Coverage Service (WCS) standards). In this architecture each of the participating data providers, including the Reef Atlas repository, delivers access to their data using OGC standards. These services are then tied together using a web based client that can consume these services.

Figure 1 shows a plan of the basic structure of such distributed system. Each of the participating data providers would host a server that is compatible with the OGC standards,

these include the ESRI ArcGIS Server, GeoServer and MapServer. Each of the layers provided will be registered (not shown in the figure) with the Reef Atlas website. When a user views the interactive maps of the Reef Atlas the web map client displays all the registered layers.

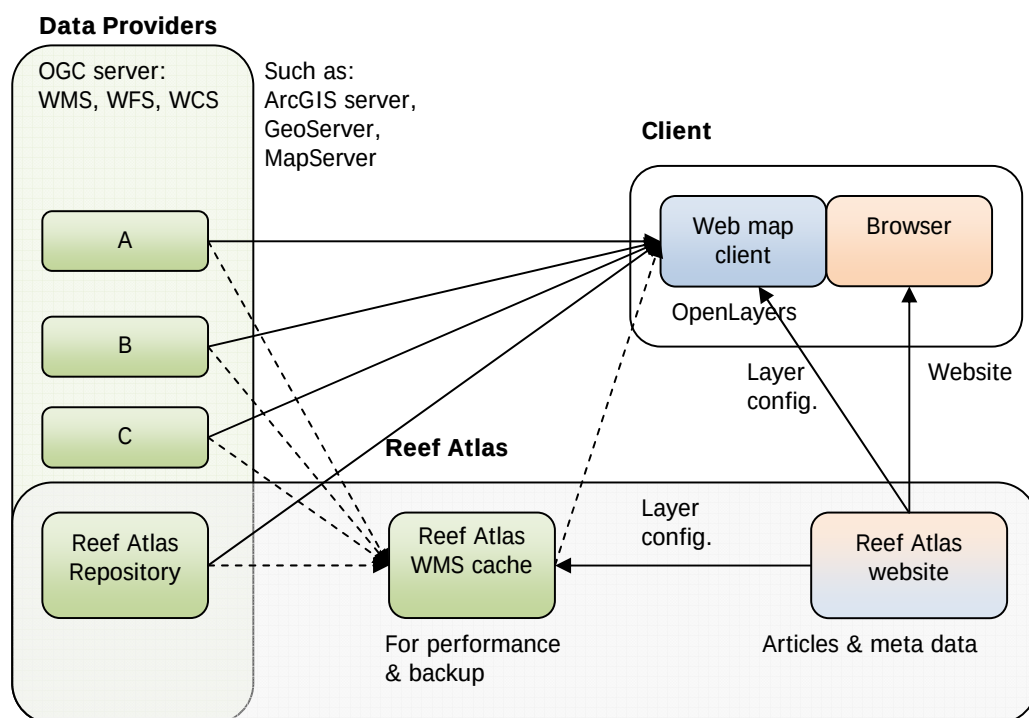


Figure 1: Structure of the distributed system

A decision was also made to create the Reef Atlas website using an off-the-shelf Content Management System (CMS) so that users of the system could easily maintain and add content to the site, and that the amount of custom software could be minimized (Figure 2). After a review of existing CMS products, Drupal is presently considered as preferred program, as it allows custom websites to be created without any custom programming and has a good separation between content, look-and-feel, and custom program extensions.

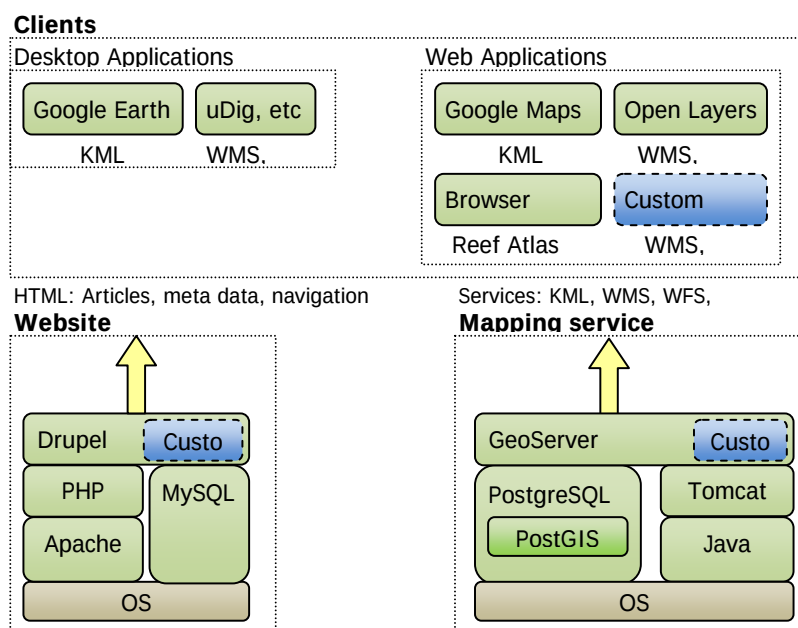


Figure 2: Software layers for some aspects of the Reef Atlas

Application Glossary

Software	OSS	Description
Google Earth	✗	3D virtual globe mapping desktop application that allow KML overlays
Google Maps	✗	Javascript 2D mapping library and web application that allows KML overlays
uDig	✓	Desktop Internet GIS.
Open Layers	✓	Javascript 2D mapping library similar to Google Maps that can allow WMS, and WFS overlays.
Drupal	✓	Web based Content Management System written in PHP, designed for easy creation of custom websites and wiki style article editing.
GeoServer	✓	Java based GIS mapping server. Can serve WMS, WFS, WCS services.
GeoWebCache	✓	Tile caching extension for GeoServer.
Tomcat	✓	Java servlet application server
Java	✓	Programming language
PHP	✓	Programming language for web applications that runs on Apache
Apache	✓	Web server
PostgreSQL	✓	Database
PostGIS	✓	Spatial database extension for PostgreSQL

OSS: Open Source Software

Protocol Glossary

Protocol	Description
KML	Keyhole Markup Language. XML based presentation language for geographic data. Used by Google Maps and Google Earth
KMZ	Zipped form of KML
WMS	Web Map Service. Service that will render a map as an image for a specified bounding box and layer.
WFS	Web Feature Service: Service that allows a remote client to access the data underlying a vector map.
WCS	Web Coverage Service: Service that allows a remote client to access the data from a gridded data set.

In Year 2008/09, we will continue to design and develop the Atlas architecture. We will implement and/or further refine the draft architecture outlined in Figs 1 and 2. The system will be based on existing off-the shelf software where possible, but will also require modification, adaptation and creation of additional tools (e.g., java extensions). We will also start developing tools integrated into the GIS system for simple interactive analyses of GBR data.

We will closely collaborate with sister initiatives such as the WetlandInfo – the EPA/QPWS Queensland Wetlands Information System and ERIN to ensure seamless compatibility and complementarity. We will also establish a system to involve and send updates to data contributors and users, to ensure maximum uptake.

Project Targeted Activities 2008/2009

Objective	Targeted Activity	Completion Date
(a)	Design, develop and implement the Reef Atlas system.	June 2009
(b)	Establish and maintain contact with complementary parties and users to maximise compatibility and uptake.	June 2009

In Years 2 and 3 we will use output from OFAM simulations of climate change (10 km resolution) to produce fine-resolution ocean climate change scenarios for the GBR. Output from the OFAM model will be provided by WAMSI (Node 2).

Project 2.5i.1 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones	
Signing of contract	
Progress Report submission: • Progress update for objective (a) (above) [AIMS]	20 Dec 2008
Pathway to Impact Report for end user relevance	20 Dec 2008
Report submission [AIMS]: • Summary of the newly developed Reef Atlas architecture	11 June 2009
Total MTSRF Funding	125,000

* Includes \$2,500 Visual Documentation Allocation.

Project 2.5i.1 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	122,500	-	122,500
MTSRF Visual Documentation*	2,500	-	2,500
AIMS	-	181,998	181,998
Total	125,000	181,998	306,998

* A total of \$2,500 is held by Reef and Rainforest Research Centre for Visual Documentation (see Theme 5).

CSIRO Project 2.5i.1 Budget 2008/2009

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	27,376	21,667	49,043
Operating	28,270		28,270

Travel	3,104	-	3,104
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	48,708	48,708
Total	58,750	70,375	129,125

AIMS Project 2.5i.1 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	52,000	52,508	104,508
Operating (including contracts)	8,750	0	8,750
Travel	3,000	0	3,000
Communication / Extension	0	0	0
Capital	0	0	0
Institutional overheads	0	127,490	129,490
Total	63,750	181,998	245,748

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	125,000	-	125,000	-	-	125,000
Total	125,000	-	125,000	-	Total	125,000

PROGRAM 5i: CLIMATE CHANGE – UNDERSTANDING THE THREAT, ECOSYSTEM IMPACTS AND MITIGATION OF THE GREAT BARRIER REEF
Project 2.5i.2: Early warning and assessment system for thermal stress on the Great Barrier Reef
Project Leader and Host Organisation

Professor Ove Hoegh-Guldberg, The University of Queensland (UQ)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Dr Ken Anthony	University of Queensland	Coral Physiology and Ecology	0.1
Dr Ray Berkelmans	AIMS	Coral Ecology	0.25
Dr Sophie Dove	University of Queensland	Coral Physiology	0.15
Dr Julian Caley	AIMS	Evolutionary Ecology	0.1
Prof. Ove Hoegh-Guldberg	University of Queensland	Coral Physiology	0.2
Dr Brad Congdon	JCU	Seabird Ecology	0.1
Mr Craig Steinberg	AIMS	Hydrodynamic Modeller	0.25
Dr Madeleine van Oppen	AIMS	Coral and Algal Genetics	0.15
Dr Scarla Weeks	University of Queensland	Satellite Oceanography	0.25
Ms Severine Choukroun	JCU/AIMS	Physical Oceanography	student
Mr Nikolaus Csaszar	UTS/AIMS	Coral and Algal Genetics	student
Ms Ana Redondo Rodriguez	University of Queensland/AIMS	Oceanography	student

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GRBMPA	Paul Marshall
AMPTO	Col McKenzie

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

(a) Thresholds and coral response

To improve our ability to detect coral stress and predict coral mortality risks in the future, we will develop new predictors and models that incorporate knowledge about how key environmental factors interact in the coral stress response, and to what extent potential acclimatization and historical adaptation may affect such risk. The models will be calibrated using controlled laboratory and raceway experiments in which the responses of a range of coral species to combinations of temperature, light and water quality will be determined. These laboratory experiments will be complimented with detailed analyses of how thermal history, bleaching severity, carbon acquisition/translocation and recovery interact in order to better understand the associated risks of mortality. These thresholds will be incorporated into projection models of how reefs might change as seas warm (Project 2.5i.1: Regional climate scenarios, and Project 2.5i.4: Tools to support resilience-based management in the face of climate change). An important outcome is to the development of an expanded framework for how climate-change stressors impact on coral communities at levels ranging from cell biology to community ecology.

(b) Heritability and genetics

How corals are likely to respond to selection for increased thermal tolerance will be investigated by exploring the heritability of key genetic traits within corals and their symbionts. This information will be fed back into this objective to provide more accurate estimates of the trajectory of GBR coral communities under rapid climate change.

c) Oceanography, bleaching and higher trophic effects

The role of mesoscale oceanographic patterns and variability will be investigated to better understand their link to, and influence on, mass coral bleaching and higher trophic animals, especially sea birds. Modis SST and chlorophyll remote sensing data will be used to explore the GBR oceanography and its influence on biological systems. SST and chlorophyll climatologies have been generated (ARP2) as a 1km resolution baseline essential for future studies, showing distinct “bio-geographic provinces” across the GBR region. The higher resolution time series have provided unique insights into coral bleaching patterns in the southern GBR, particularly for the inshore Keppels Islands reefs. Further to this, we will investigate how broad-scale climate change phenomena translate into changes within the GBR ecosystem and impact reefs on the meso- and smaller-scale. Key environmental variables will be mapped in space and time to improve our understanding of climate change impacts across the scale of the GBR ecosystem. The spatial-temporal variability of the physical dynamics will be investigated to determine the biological response, and also whether particular reef systems may be heated or cooled (flushed) and hence likely to experience coral bleaching and mortality or not.

Seabird foraging and reproductive success is explicitly linked to both local and large-scale oceanographic variation. We will investigate the relationships between prey availability/accessibility and specific physiochemical oceanographic parameters at different scales. These data will be combined with satellite and hydrodynamic information on meso-scale oceanographic variability to better predict how seabirds will respond to projected increases in both SST and other ENSO associated phenomena. Further, we will aim to assess both behavioral and developmental plasticity in multiple seabird species under fluctuating resource availability. These project components will allow determination of the likely range of oceanographic and climatic conditions within which seabird reproduction on the GBR will remain viable.

Project Activities for 2008/2009

Objective	Targeted Activity	Date
(a)	Progress Report covering: - Investigations of the links between thermal stress, carbon acquisition, translocation and utilization, and coral mortality - The development of new projection models for coral communities associated with climate-change stressors. The study will use an approach that integrates physiological response models with model of demographic changes and community dynamics in a novel mathematical framework. Calibrations will be based on data from a series of experimental studies in the CMS group and by collaborators overseas.	June 2009
(b)	Investigate the broad sense heritability of heat tolerance in <i>A. millepora</i> from two populations with different zooxanthella types under optimal, sub-optimal and stressful thermal conditions.	June 2009
(c)	- Investigate the link between oceanographic process and patterns with events of known biological importance, including upwelling, thermocline dynamics, productivity and coral bleaching. - Investigate the relationships between seabird prey availability/accessibility and specific physiochemical oceanographic parameters at different scales.	June 2009

Project 2.5i.2 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Pathway to Impact Report for end user relevance.	31 Dec 2008
Report 1 submission (with appropriate attribution of MTSRF funding): <i>Thresholds and coral response milestones:</i> Evidence of provision of AWS data and interpretation to GBRMPA on temperature trends against bleaching thresholds during summer. Responsible: Berkelmans [AIMS]. Calibrate stress response models for interactions between temperature, light and time in multifactorial experiments and meta-data analysis. Model analyses of coral population and community changes for under projected climate-change scenarios. Anthony [UQ] Complete experiment and analysis of ¹⁴C carbon acquisition and translocation by clade D and clade C <i>Acropora millepora</i> exposed to thermal stress. Analyse composition of labelled secondary metabolites and host cellular response. Dove [UQ] <i>Heritability milestones:</i> Complete laboratory analysis of samples from the second heritability heat tolerance experiment. Responsible: van Oppen/ Csaszar [AIMS].	1 April 2009

For 2008/2009 outputs only	Date
Milestones	
<i>Oceanography, bleaching and higher tropic effects milestones:</i> Evidence of provision of MODIS SST and Ocean Colour data and interpretation on bleaching conditions during summer to GBRMPA and to the Risk, Resilience and Response Atlas (Project 1.1.5). Responsible: Weeks [UQ]. Evidence of ongoing provision of MODIS satellite data from NASA to UQ: Responsible: Weeks [UQ]. Investigate and identify relevant data sets to use characterizing SEC and EAC dynamics during bleaching and their influence on upwelling on the GBR. Responsible: Steinberg/Berkelmans [AIMS], Weeks [UQ]. Progress report covering Analysis of levels of adult behavioural and chick developmental plasticity within one off-shore foraging species. Responsible: Congdon [JCU] Preliminary analysis of the relationship between among-season variation in SST/thermocline depth/productivity and foraging success / reproductive output. Responsible: Congdon [JCU]	
Report 2 submission (with appropriate attribution of MTSRF funding): <i>Thresholds and coral response milestones:</i> Complete web-delivery and delivery to the Risk, Resilience and Response Atlas (Project 1.1.5) of AWS data, including summary graphs on bleaching thresholds and current trends against long-term means. Responsible: Berkelmans [AIMS]. Finalise manuscripts (with appropriate attribution of MTSRF funding) and delivery of outcomes to the Risk, Resilience and Response Atlas (Project 1.1.5) on thresholds for stress in coral populations and projected community changes under complex climate scenarios. Anthony [UQ] Complete manuscript describing differences in carbon acquisition and utilization under thermal stress by <i>Acropora millipora</i> hosting hardy vs sensitive symbionts (with appropriate attribution of MTSRF funding): Dove [UQ] <i>Heritability milestones:</i> Report on broad sense heritability of heat tolerance in <i>A. millepora</i> population from Orpheus Island. Responsible: van Oppen/ Csaszar [AIMS]. Preparation of scientific manuscript (with appropriate attribution of MTSRF funding) on broad sense heritability of heat tolerance and potential to respond to selection in <i>A. millepora</i>. Responsible: van Oppen/ Csaszar [AIMS]. <i>Oceanography, bleaching and higher tropic effects milestones:</i> Report on the dynamics of SEC and EAC and its influence on upwelling on the GBR. Outcomes of analyses delivered to the Risk, Resilience and Response Atlas (Project 1.1.5). Steinberg/Berkelmans [AIMS], Weeks [UQ]. Progress report covering Overlays of satellite telemetry foraging data on meso-scale oceanographic information to further identify and confirm critical 'at-distance' foraging locations & associated oceanographic features. Outcomes of analyses delivered to the Risk, Resilience and Response Atlas (Project 1.1.5). Congdon [JCU] / Weeks [UQ].	10 June 2009

For 2008/2009 outputs only	Date
Milestones	
Preliminary analysis of oceanographic phenomena used by local foraging shearwaters in the southern GBR during chick rearing based on one seasons data. Responsible: Congdon [JCU]	
Total MTSRF Funding	196,500

* Totals exclude \$3,500 MTSRF funding for Visual Documentation Allocation.

Project Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	196,500	-	196,500
MTSRF Visual Documentation*	3,500	-	3,500
The University of Queensland	-	200,000	200,000
Australian Institute of Marine Science	-	242,000	242,000
ARC Centre of Excellence	-	55,000	55,000
NASA	-	50,000	50,000
Total	200,000	547,000	747,000

* A total of \$3,500 held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

UQ Project 2.5i.2 Budget 2008/2009

Item	MTSRF Funds	UQ In-kind	Total Cost
Salaries	87,500	74,000	161,500
Operating	27,500	30,000	57,500
Travel	4,500	7,000	11,500
Communication / Extension	18,000	20,000	38,000
Satellite data	-	50,000	50,000
Capital	-		0
Institutional overheads	-	19,000	19,000
Total	137,500	200,000	337,500

AIMS Project 2.5i.2 Budget 2008/2009

Item	MTSRF Funds	AIMS In-kind	Total Cost
Salaries	49,000	25,000	74,000
Operating		120,000	120,000
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	97,000	97,000
Total	49,000	242,000	291,000

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	200,000	TBC	TBC	TBC	TBC	TBC
Total	200,000	TBC	TBC	TBC	TBC	TBC

PROGRAM 5i: CLIMATE CHANGE – UNDERSTANDING THE THREAT, ECOSYSTEM IMPACTS AND MITIGATION OF THE GREAT BARRIER REEF

Project 2.5i.3: Resilience to climate change
Project Leader and Host Organisation

Professor Terry Hughes, James Cook University (JCU)

Dr Julian Caley, Australian Institute of Marine Science

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Professor Bette Willis	JCU	Coral Biology	0.1
Dr Madeleine van Oppen	AIMS	Coral and Algal Genetics	0.15
Dr Julian Caley	AIMS	Evolutionary Biology	0.15
Dr Line Bay	JCU	Coral Genetics	0.2
Professor Terry Hughes	JCU	Coral Ecology	0.1
Professor David Bellwood	JCU	Fish Biology and Ecology	0.1
Dr Morgan Pratchett	JCU	Fish Biology and Ecology	0.1
Dr Shaun Wilson	JCU	Fish Biology and Ecology	0.1

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GBRMPA	Laurence McCook
AMPTO	Col McKenzie / Alan Wallish
ARC	Russell Butler

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

The project will examine the resilience of coral and reef fish assemblages to climate change and investigate how impacts of climate change will interact with other human induced stresses to influence the resilience of coral reef ecosystems. The project will utilise existing strengths in the population genetics of corals and their algal endosymbionts, in the population, community and ecosystem ecology of corals and reef fishes, and in mechanistic modelling. A key outcome will be an integrated, multi-level, assessment of climate change effects on GBR corals and fishes. Key components of the life history, community ecology and functional capacity of corals and reef fishes will be targeted to determine how individuals, populations and communities will respond to climate change, and to assess the feedback that these impacts will have on the resilience of coral reef ecosystems within the GBRMP.

Key Objectives:

Resilience of coral assemblages to climate change:

- (a) Estimate genetic connectivity among GBR populations of coral and their algal endosymbionts to determine their potential for replenishment following disturbances associated with climate change.
- (b) Identify mechanisms of adaptation available to local coral populations to understand their potential for adaptation to climate change.
- (c) Identify links between thermal anomalies and coral disease dynamics to predict the response of coral assemblages to ocean warming associated with climate change.

Resilience of fish assemblages to climate change:

- (d) Quantify current levels of herbivory by reef fishes on the GBR and evaluate the extent to which reefs across the GBR shelf are vulnerable to ecosystem phase-shifts and domination by macroalgae as a result of climate change.
- (e) Identify critical thresholds in macro-algal phase shifts and evaluate alternate management strategies in order to limit the impacts of climate change on the ability of fish assemblages to prevent ecosystem phase-shifts on coral reefs.
- (f) Evaluate the long term recovery and resilience of reef fish communities to climate change induced habitat degradation.

Project / Task Methodology**Objective (a): Estimate genetic connectivity among GBR populations of coral and their algal endosymbionts to determine their potential for replenishment following disturbances associated with climate change.**

Connectivity within and between coral populations is an important component of coral reef resilience. Exchange of larvae creates and maintains high levels of genetic diversity and buffers populations against disturbance. Migrants may carry new alleles that may be integrated into populations through reproduction, creating new gene combinations on which selection can potentially act. The spread of selectively advantageous alleles at DNA loci involved in physiological responses such as bleaching resistance is a potentially important consequence of migration. Furthermore, gene flow increases local effective population sizes, thereby enhancing the ability of populations to resist rapid random changes in allele frequencies from one generation to the next through drift. Larval-exporting or source reefs with diverse populations of healthy adult corals are essential to maintain the genetic diversity and resilience of larval-importing or sink reefs. Therefore, an assessment of larval transport in and out of reefs, i.e. the extent to which reefs are self-seeding or accumulate recruits from surrounding areas, as well as the direction of larval dispersal will improve our ability to forecast how reef corals are likely to respond to environmental change. Successful migrants leave a genetic signature of their movements and allow inference of connectivity using population genetic methods. We will estimate genetic connectivity among GBR populations of coral and their algal endosymbionts using analysis of DNA microsatellite loci, and link this information to hydrodynamic models to provide improved estimates of reef connectivity.

Objective (b): Identify mechanisms of adaptation available to local coral populations to understand their potential for adaptation to climate change.

Observed differences in bleaching sensitivity between geographically distinct, conspecific coral populations may be caused by differential expression of genes involved in the bleaching response (as a consequence of either local adaptation or acclimatisation), and/or by the presence of distinct alleles at these loci (due to selection and local adaptation). We will identify fast diverging genes (that are therefore likely to be under selection) in a GBR coral species that is known to show a latitudinal gradient in thermal tolerance using DNA microarray technologies. Common garden experiments and microarray/quantitative real time PCR analyses will subsequently be used to examine whether or not genetically determined (i.e. a consequence of selection and hence reflecting adaptation) differences in gene expression levels exist between these latitudinal populations.

DNA sequence analysis of a subset of the genes identified as fast evolving will reveal whether selection on the DNA sequences themselves has occurred in these populations. Theoretical models of the potential for corals to evolve greater bleaching resistance in response to climate change will be developed as part of this objective. Results from the empirical studies described above will be used to parameterise these models and model outputs will be used in turn to guide the design of further experiments.

Objective (c): Identify links between thermal anomalies and coral disease dynamics to predict the response of coral assemblages to ocean warming associated with climate change.

Increases in the severity and frequency of wildlife disease epidemics over the past three decades are thought to be linked, in part, to increasing thermal stress associated with climate change. Understanding the implications of increasing ocean temperatures for the spread of coral pathogens and for disease resistance of corals will significantly enhance current understanding of the resilience of GBR coral assemblages in relation to climate change. We will determine the linkages between seasonal thermal anomalies and the prevalence of coral disease. A modelling approach will be used to evaluate metrics of thermal anomalies based on NOAA satellite data that best explain spatial and temporal patterns in the prevalence of coral disease on the GBR. The relationship between peaks in disease prevalence and thermal anomalies will be analysed to determine thermal thresholds associated with outbreaks of coral disease. We will also identify interactions between bleaching and disease. We aim to produce algorithms to (a) relate temperature to past disease outbreaks, and (b) develop a product that provides predictive outlooks for outbreaks of key coral diseases, similar to the NOAA hotspot algorithm that predicts bleaching events.

Objective (d) Quantify current levels of herbivory by reef fishes on the GBR and evaluate the extent to which reefs across the GBR shelf are vulnerable to ecosystem phase-shifts and domination by macroalgae as a result of climate change.

Objective (e) Identify critical thresholds in macro-algal phase shifts and evaluate alternate management strategies in order to limit the impacts of climate change on the ability of fish assemblages to prevent ecosystem phase-shifts on coral reefs

Climate change will influence the community structure of reef fish assemblages, however, it is unknown if these changes will affect ecosystem processes, and subsequently lead to a phase shift from coral to algal dominated reefs. Here, we will utilise and build on existing databases of the distribution and abundance of herbivorous fishes across the GBR to quantify current rates of herbivory. These data will be combined with direct experimental analyses of fish-algal interactions that will enable us to estimate the current capacity of GBR reef fish populations to maintain low macroalgal cover on mid and outer reefs. The second

part of this objective will use a modeling approach to permit direct estimation of critical thresholds in the coral – macroalgal phase shift and to evaluate alternative management strategies to respond to changes in macro-algal distributions. We will combine the results from part one with existing algal distribution data and algal growth trajectories to model fish-algal interactions and outcomes under a range of climate change scenarios. Furthermore, it will provide us with an indication of the relative resilience of different components of the GBR ecosystem. In particular, it will indicate to what extent the current stands macroalgae on inshore reefs reflect a state of heightened vulnerability to climate change.

Objective (f) Evaluate the long term recovery and resilience of reef fish communities to climate change induced habitat degradation.

The most immediate and substantial effects of climate change on coral reefs are severe episodes of climate-induced coral bleaching, which cause widespread mortality of reef corals. Extensive mortality of reef corals results in the loss of essential habitat for coral reef fishes, leading to reduced abundance and localised extinction of coral reef fishes. While many studies have documented sudden declines in the abundance of fishes immediately following extensive coral depletion, the degree to which fish communities are resilient and may eventually recover is currently unknown.

We will conduct a detailed analysis of the recovery and resilience of fish assemblages at Trunk Reef, central GBR, which were severely impacted by climate induced coral bleaching in 2001-02. Recovery of reef fish assemblages is likely to be contingent upon increases in coral cover and a return to pre-disturbance structure of benthic communities. Changes in the structure and dynamics of fish communities will be monitored annually and directly compared to temporal changes in the physical and biological structure of benthic habitats.

Project Targeted Activities (indicative only for out years)

Objective	Targeted Activity	Completion Date
(a)	Assessment of genetic connectivity among populations of corals and their algal endosymbionts on the GBR.	June 2009
(b)	Review of rates of trait evolution and mutualism to refine modelling framework to predict rates of adaptation for bleaching resistance.	June 2009
(b)	Assessment of expression levels of genes involved in the bleaching response in coral populations from different thermal environments.	June 2009
(b)	Present report on the role of selection on expression levels of genes involved in the bleaching response.	June 2010
(c)	Complete surveys of coral disease prevalence at key sites missing from JCU / AIMS LTMP coral disease surveys.	June 2009
(c)	Develop a model to predict the likelihood of coral disease outbreaks in response to ocean warming.	June 2009
(c)	Present report on the vulnerability of GBR corals to disease in relation to ocean warming.	June 2010
(d), (e)	Complete regional scale evaluation of inshore reef susceptibility to coral-algal phase-shifts and ecosystem collapse. Initiate compilation of herbivore abundance data and preliminary evaluation of ecosystem thresholds.	June 2009
(d), (e)	Complete field and experimental evaluation of algal ecosystem thresholds, modeling of coral algal phase shifts under different climate change scenarios.	June 2010

Objective	Targeted Activity	Completion Date
(d), (e)	Present report on vulnerability of GBR to climate change induced shifts in macroalgae distribution and abundance in relation to fish herbivory and present options for alternate management options.	June 2010
(f)	2008-09 surveys of fish and coral assemblages, with sampling design extended to include Trunk Reef, Rib Reef and Bramble Reef.	Mar 2009
(f)	Develop appropriate genetic tools to quantify patterns of connectivity among fish populations within the central GBR	Mar 2009
(f)	Analyse data to reveal key limitations (e.g. connectivity) in recovery and resilience of fish and coral assemblages	Jun 2009
all	Final end-user briefings, seminars or workshops to communicate results and contribute to management strategies. Publish and disseminate peer-reviewed scientific publications	June 2010

Project 2.5i.3 Milestones 2008/2009

For 2008/2009 outputs only	
Milestones [agency responsible for reporting identified in brackets]	Date
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Pathway to Impact for end user relevance	31 Dec 2008
Report 1 submission: - Progress report on activities conducted against objectives (above) - Preliminary findings of microsatellite genotyping of larval and adult populations of the brooding coral <i>Seriatopora hystrix</i> from the Palm Islands. [(a) AIMS/JCU] - Report (with appropriate attribution of MTSRF funding) on development of an oligonucleotide microarray for coral gene expression studies [(b) AIMS/JCU] - Report (with appropriate attribution of MTSRF funding) on development of a higher throughput gene expression method [(b) AIMS/JCU] - Report (with appropriate attribution of MTSRF funding) on surveys of coral disease prevalence at key sites missing from JCU / AIMS LTMP surveys and delivery of outcomes to the Risk, Resilience and Response Atlas (Project 1.1.5) [(c) JCU] - Progress report (with appropriate attribution of MTSRF funding) on developing a modeling framework for investigating the relationship between coral disease abundance and ocean warming. [(c) JCU] - Report preliminary findings of regional scale variation in capacity of reefs to respond to increased macroalgae on the GBR, and delivery of outcomes to the Risk, Resilience and Response Atlas (Project 1.1.5). [(d/e) JCU] subject to external funding - Preliminary findings of microsatellite development for key butterflyfishes as a potential tool for measuring population connectivity as key factor in population resilience [(f) JCU] subject to external funding - Summary of any communication activities undertaken to date, including	1 Mar 2009

For 2008/2009 outputs only	
Milestones [agency responsible for reporting identified in brackets]	Date
minutes of meetings/workshops if applicable. [JCU]	
Evidence of information transfer between agencies: • Provision of JCU data (coral samples, experimental results) to AIMS. [Responsible officer: B Willis from JCU.] • Provision of AIMS data (theoretical model, experimental results) to JCU. [Responsible officer: J Caley and M van Oppen from AIMS]	As required
Report 2 submission: • Progress report on activities conducted against objectives (above) - o Submit manuscript (with appropriate attribution of MTSRF funding) on newly developed microsatellites for <i>Symbiodinium</i> species. [(a) AIMS/JCU] - o Submit manuscript (with appropriate attribution of MTSRF funding) on complete common garden experiment of <i>Acropora millepora</i> from Davies Reef and Orpheus Island to assess extent of fixed population differences in gene expression. [(b) AIMS/JCU] - o Report (with appropriate attribution of MTSRF funding) on a framework for modeling the relationship between coral disease abundance and sea temperature to predict the impacts of ocean warming. [(c) JCU] - o Report (with appropriate attribution of MTSRF funding) on progress of regional scale evaluation of the potential of herbivores on inshore reefs to respond to increases in macroalgae. [(d/e) JCU] - o Provide initial report on the capacity to identify thresholds in algal-herbivore interactions. [(d/e) JCU] - o Report (with appropriate attribution of MTSRF funding) on status and trends in recovery of fish communities following ongoing recovery in coral habitats, including preliminary assessment of key factors promoting or limiting recovery of fish communities [(f) JCU] • Summary of any communication activities undertaken, including minutes of meetings/workshops if applicable. [AIMS/JCU]	10 Jun 2009
Total MTSRF Funding	150,000

Requires \$50,000 external funding

*No visual documentation from this project

Project 2.5i.3 Budget**Year 3 – 2008/2009 Project Funding and Partnerships**

Contributing Organisation	Cash	In-kind	Total
MTSRF	100,000	-	100,000
RRRC	50,000	-	50,000
AIMS	-	200,000	200,000
PEW Foundation	-	4,000	4,000
JCU	-	146,000	146,000
Total	150,000	350,000	500,000

JCU Project 2.5i.3 Budget 2008/2009

Item	MTSRF	JCU & PEW Foundation In-kind	Total Cost
Salaries	50,000	150,000	200,000
Operating	13,300		13,300
Travel	36,700		36,700
Communication / Extension	-		
Capital	-		
Total	100,000	150,000	250,000

AIMS Project 2.5i.3 Budget 2008/2009

Item	MTSRF	In-kind	Total Cost
Salaries	15,000	115,000	130,000
Operating	30,000		30,000
Travel	-	85,000	85,000
Communication / Extension	5,000		5,000
Capital	-		
Institutional overheads	-		
Total	50,000	200,000	250,000

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind*	Cash	In-kind	
2009/2010	150,000	-	110,000	-	217,000	477,000
Total	150,000	-	110,000	-	217,000	477,000

* Indicative only.

PROGRAM 5i: CLIMATE CHANGE: UNDERSTANDING THE THREAT, ECOSYSTEM IMPACTS AND MITIGATION OF THE GREAT BARRIER REEF

Project 2.5i.4: Tools to support resilience-based management in the face of climate change

Project Leader and Host Organisation

Dr Scott Wooldridge, Australian Institute of Marine Science (AIMS)

Project Team

Title	Organisation	Role	FTE
Dr Scott Wooldridge	AIMS	Bayesian modeler	0.35
Professor Iain Gordon	CSIRO	Ecologist	0.1
Professor Bob Miles	CQU	Social economist	0.1
Dr Colette Thomas	CSIRO	Bayesian modeler	0.45

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

In order to effectively manage the resources of the Great Barrier Reef under climate change, information from many sources must be integrated in such a way that the risks faced and how they vary through time and space can be made explicit. A critical step in meeting this challenge is the development of spatially explicit, sub-regional scale information about the risks posed by climate change and variability in resilience. Once these risks are understood, it is then necessary to build management tools that facilitate the optimum use of management resources under conditions of considerable uncertainty. This project has two objectives that will enable it to make considerable advances beyond our current understanding of the risks of climate change and how best to manage these resources in the face of climate change. These objectives include: a) an investigation of the risks to and resilience of the GBR social-ecological system (SES) to climate change and b) the development of integrative knowledge for prioritising management responses to climate change. The research in this project has been developed in close collaboration with managers who need this information and tools. These managers will be part of this project throughout to ensure the outputs produced maximise potential outcomes for more effective management of the Great Barrier Reef.

Key Objectives:

- (a) Investigate the risks to and resilience of the GBR social-ecological system (SES) to climate change.
- (b) Develop integrative knowledge for prioritising management responses to climate change.

Project / Task Methodology

Objective (a): Investigate the risks to and resilience of the GBR social-ecological system (SES) to climate change

Climate change is acknowledged as one of the most serious threats to the future of coral reef ecosystems and their management, and there is an urgent need to identify and implement meaningful management responses. While the causes of climate change are beyond the direct influence of management agencies and individual stakeholders, a range of options are emerging for minimising its impacts on the ecosystem and the industries and regional communities that depend on it. A critical step for progress in meeting this challenge is the development of spatially explicit, sub-regional scale information about the risks posed by climate change and variability in resilience. This project will provide this information by investigating the risks to and resilience of key elements of the GBR social-ecological system (SES) to climate change. This will enable managers to incorporate climate-related threats into future management policies and activities, most of which are spatially explicit. It will also enable managers and stakeholders to identify areas where ecological or socio-economic values are most at risk. For example, the outcomes of this research might guide the distribution of RWQPP resources toward catchments where adjacent reefs are more susceptible to damage from coral bleaching. A priority list of target components of the GBR SES will be developed in consultation with end-users and data providers, and risk maps developed for each. This will provide an essential resource for end-users to develop feasible and defensible strategies in response to the threat of climate change.

Outcomes of this investigation will be presented as maps of risk and resilience of priority elements of the GBR SES and will be incorporated into the Risk, Resilience and Response Atlas for the GBR (Project 1.1.5). Spatial analysis and modelling of key system variables (and causative interactions) will generate GIS map layers describing:

- Physico-chemical drivers affected by climate change (hazard);
- Synergistic (non-climate) stressors, e.g. water quality (interactions);
- Distributions of key elements of the GBR social-ecological system (exposure); and
- Susceptibility of elements to climate change (sensitivity)

Temporal projections of identified spatial patterns (hazard, interactions, exposure, sensitivity) will be generated on the basis of plausible climate change scenarios, adaptation measures and management activities.

Objective (b): Integrative knowledge for prioritising management responses to climate change.

The outcomes of objective (a) will provide critical new insights into spatial variability of climate change risk. However, the need remains for a basis for prioritising the allocation of limited management resources among the range of issues presented by climate change. An integrative modelling approach, based on Bayesian belief networks, will be used to represent the dynamic linkages and inter-dependencies of the many components of the GBR SES, and examine their vulnerability to climate change and their responsiveness to different management interventions. This approach will involve active participation from end-users and stakeholders through a series of workshops to define the scope of the model, its conceptual elements and links, and the format of scenarios or outputs. The model will enable end-users to test alternative scenarios for future climate, management actions and adaptation measures.

This will add fundamental capacity to the ability of managers to test the cost-benefit ratio of alternative management responses as a basis for identifying strategies that deliver the best outcomes at the lowest cost. For example, reef managers might use the model to decide whether to prioritise investment toward restoring water quality or excluding human activities from key refugia for important reef species.

CSIRO's component of the project will be to provide a model that allows for the exploration and evaluation of the biophysical (water quality), social and economic outcomes of terrestrial landscape management and arrangement options and sustainable development pathways, taking principal agro-ecological and socio-economic attributes, processes and dynamics into account.

The Bayesian Belief Network (BBN) model of climate change impacts on GBR social-ecological system will be developed through participatory workshops with scientists, end users and stakeholders. The model will build on work previously published by the task leader (Wooldridge), with expansion to integrate knowledge on exposure, sensitivity and adaptation potential. A user-friendly interface will be built to allow exploration of relative costs and benefits of management interventions. It will integrate information on the hazard (climate change), potential impacts (sensitivity of different elements) and the impacts of other stresses (water quality, fishing etc). Existing models (eg. ReefClim, Sednet) will be incorporated using a meta-modeling approach to explicitly represent linkages between the catchments and the reef.

CSIRO will provide the project with a model (building on various Water for a Healthy Country projects) that allows for the assessment of the impacts of climate change on catchment biophysical processes and the outcomes for conservation, economic and social values. This will include:

- Road testing the model outputs for sustainable resource use and water quality based on end user driven targets and objectives and assess the systems' principal agro-ecological and socio-economic attributes, processes and dynamics.
- Identifying 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.
- Scoping the feasibility of developing a model framework to assess the impacts of future climate change effects on the water quality outcomes for BMP implementation in land-based management systems.

Project Targeted Activities 2008/2009

Objective	Targeted Activity	Completion Date
(a,b)	For the inshore coral reefs that are under the influence of the Tully flood-plume, model the envelope of future bleaching risks based on a range of optimised land management actions. Attempt to link with CSIRO economic 'costings' for the land management actions [AIMS]	July 1 2008 – June 30 2009
(a,b)	For the inshore coral reefs that are under the influence of the Burdekin flood-plume, model the envelope of future bleaching risks based on a range of optimised land management actions. Attempt to link with CSIRO economic 'costings' for the land management actions [AIMS]	
(a, b)	For the inshore coral reefs between Townsville and Cooktown, model the envelope of future bleaching risks based on a range of end-of-catchment scenarios for DIN reduction [AIMS]	
(b)	Preparation of draft socio-economic report, which includes the synthesis of climate change literature review, socio-economic characterization and business survey [CQU]	
(b)	Project linkage of biophysical analysis, land use change and the socio economic implications [CQU]	
(b)	Submission of final socio-economic report [CQU]	
(b)	Assess ecological costs/benefits of implementation of land management practice changes in the Tully catchment for reef health outcomes [CSIRO]	
(b)	Assess economic costs/benefits of implementation of land management practice changes in the Tully for reef health outcomes [CSIRO]	
(b)	Scope the feasibility of developing a model framework to assess the impacts of climate change effects and land practice changes on the delivery of nutrients from the Tully into the GBRWHA [CSIRO]	

Project 2.5i.4 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Submission of Progress Report (1), which outlines: - For the inshore coral reefs that are under the influence of the Tully flood-plume, models of the envelope of future bleaching risks based on a range of optimised land management actions (with appropriate attribution of MTSRF funding). Attempt to link with CSIRO economic 'costings' for the land management actions [AIMS] - Delivery of model outputs of future bleaching risks based on a range of optimised land management actions in the Tully catchment to the Risk, Resilience and Response Atlas (Project 1.1.5)	1 Nov 2008

For 2008/2009 outputs only	Date
Milestones	
- Preparation of draft socio-economic report , which includes the synthesis of climate change literature review, socio economic characterization and business survey (with appropriate attribution of MTSRF funding) [CQU] - Assess ecological costs/benefits of implementation of land management practice changes in the Tully catchment for reef health outcomes [CSIRO] - Plan of communication activities/products for year two and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable, schedule of future communication activities.[AIMS, CSIRO, CQU]	
Pathway to Impact Report for end user relevance.	31 Dec 2008
Submission of Progress Report (2), which outlines: - For the inshore coral reefs that are under the influence of the Burdekin flood-plume, models of the envelope of future bleaching risks based on a range of optimised land management actions (with appropriate attribution of MTSRF funding). Attempt to link with CSIRO economic 'costings' for the land management actions [AIMS] Assess economic costs/benefits of implementation of land management practice changes in the <i>Burdekin</i> for reef health outcomes [AIMS/CSIRO] - Delivery of model outputs of future bleaching risks based on a range of optimised land management actions in the Burdekin catchment to the Risk, Resilience and Response Atlas (Project 1.1.5) - In a participatory workshop, create a conceptual model identifying key relationships between reef condition and tourism income under future coral bleaching scenarios [CSIRO] - Project linkage of biophysical analysis, land use change and the socio economic implications [CQU] - Delivery of outputs of biophysical analysis, land use change and the socio economic implications to the Risk, Resilience and Response Atlas (Project 1.1.5) - Assess economic costs/benefits of implementation of land management practice changes in the <i>Burdekin</i> for reef health outcomes [CSIRO] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable [AIMS, CSIRO, CQU]	30th January 2009
Submission of Report (3), which outlines: - For the inshore coral reefs between Townsville and Cooktown, models of the envelope of future bleaching risks based on a range of end-of-catchment scenarios for DIN reduction (with appropriate attribution of MTSRF funding) [AIMS] - Delivery of model outputs of future bleaching risks based on a range of end-of-catchment scenarios for DIN reduction between Townsville and Cooktown to the Risk, Resilience and Response Atlas (Project 1.1.5) - Submission of final socio-economic report (with appropriate attribution of MTSRF funding) [CQU] - Convert the conceptual model developed in ARP2 into a prototype Bayesian belief network [CSIRO] - Scope the feasibility of developing a model framework to asses the influence of climate change on the efficacy of land practice changes in reducing the delivery of nutrients from the Tully into the GBRWHA [CSIRO] - Scope the feasibility of developing a model framework to asses the impacts of climate change effects and land practice changes on the	10 June 2009

For 2008/2009 outputs only	Date
Milestones	
delivery of nutrients from the Tully into the GBRWHA [CSIRO] • Final summary of communication activities undertaken through the course of year 3 of project. (with appropriate attribution of MTSRF funding) [AIMS, CSIRO, CQU]	
Total MTSRF Funding	\$105,000

Project 2.5i.4 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	103,000**	-	103,000
MTSRF Visual Documentation*	2,000	-	2,000
AIMS	-	45,500	45,500
CSIRO	-	26,000	26,000
CQU	10,000	37,700	47,700
Total	115,000	109,200	224,200

* A total of \$2,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

** Includes co-investment of \$35,000 in Program 5ii, Project 2.5ii.2.

AIMS Project 2.5i.4 Budget 2008/2009

Item	MTSRF Funds	AIMS In-kind	Total Cost
Salaries	35,000	-	35,000
Operating	10,000	-	10,000
Travel	10,000	-	10,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	45,500	45,500
Total	55,000	45,500	100,500

CSIRO Project 2.5i.4 Budget 2008/2009

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	29,000	-	29,000
Operating	-	1,872	1,872
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	24,128	24,128
Total	29,000	26,000	55,000

CQU Project 2.5i.4 Budget 2008/2009

Item	MTSRF Funds	CQU Cash	CQU In-kind	Total Cost
Salaries	19,000	10,000	-	29,000
Operating	-	-	-	-
Travel	-	-	-	-
Communication / Extension	-	-	-	-
Capital	-	-	-	-
Institutional overheads	-	-	37,700	37,700
Total	19,000	10,000	37,700	66,700

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources*		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	105,000	20,000	295,000	210,000	-	630,000
Total	105,000	20,000	295,000	210,000	-	630,000

* Co-investment not yet secured.

PROGRAM 5ii: CLIMATE CHANGE – UNDERSTANDING THE THREAT, ECOSYSTEM IMPACTS AND MITIGATION OF RAINFORESTS AND CATCHMENTS
Project 2.5ii.1: Regional climate projections for tropical rainforests
Project Leader and Host Organisation

Dr Suppiah Ramasamy, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team

Title	Organisation	Role	FTE
Dr Suppiah Ramasamy	CSIRO	Climatologist	0.57
Dr Penny Whetton	CSIRO	Climatologist	0.9
Dr Deborah Abbs	CSIRO	Extreme events climatologist	0.34
Dr John McGregor	CSIRO	Climate modeller	0.37
Dr David W. Hilbert	CSIRO	Ecological modeller	0.1

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
WTMA	Andrew Maclean
Alliance of Sustainable Tourism	Annie Riddet
QEPA	TBA

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

Project 2.5ii.1 will develop a new high-resolution software tool, *OzClim*, for the North Queensland region to a spatial resolution of fifteen kilometers with multiple scenarios so that uncertainty in future climate change projections can be represented. It is closely linked to the equivalent project of the marine impacts program, and both projects could be considered as two parts of a single package. The climate change projections in both projects will start from the common starting point of the global climate models but different techniques are required to provide regional detail in the two realms. There is also linkage at the level of data delivery to impact researchers.

Key Objectives:

- (a) Utilise the output of global climate models to prepare an assessment of the range of likely changes in climate means relevant to tropical rainforests, e.g. mean, minimum and maximum temperature, humidity, rainfall, seasonality of rainfall, cloud base height, lapse rate and solar radiation. Consider also extreme precipitation and winds associated with tropical cyclone occurrence.

- (b) Provide fine resolution detail in projected climate change for the region. Enable an assessment to be made of how local topographical variations impact on the patterns of projected future climate change.
- (c) Provide climate change data tailored for use in impact assessment and for more general MTSRF communication.

Project / Task Methodology

Objective (a): Utilise the output of global climate models to prepare an assessment of the range of likely changes in climate means relevant to tropical rainforests.

- Will be based initially on the analysis of existing global climate models and higher resolution regional model simulations (horizontal resolution of 200 kilometres down to 60 kilometres).
- Analysis would then be undertaken of a climate simulation focused on the tropical rainforest region at a horizontal resolution of fifteen kilometres. This resolution is required to obtain a reasonable representation of regional topographical effects on climate.
- Existing high-resolution simulations of tropical cyclone events will be analysed for the north Queensland region.
- By using both multiple models and high-resolution simulation, issues of uncertainty due to model-to-model differences and how large-scale changes are expressed at fine spatial scale will be addressed.

Objective (b): Provide fine resolution detail in projected climate change for the region. Enable an assessment to be made of how local topographical variations impact on the patterns of projected future climate change.

The CSIRO CCAM model will be run under current and enhanced greenhouse conditions (in simulations of at least thirty years' duration) nested in simulations with the CSIRO Mk 3 GCM. The current climate simulations will be used for validating the model against regional observed climate.

Objective (c): Provide climate change data tailored for use in impact assessment and for more general MTSRF communication.

- Interact with users of climate change products to determine the climate change information that is required and the form in which the information is required.
- Provide data in tailored form. This is likely to involve the development of a regional and project specific version of CSIRO's OzClim software for the region and the needs of the impact assessment users. OzClim provides climate scenarios for user-selected time slices and emission scenarios and combines these with a high-resolution observed database. Output of OzClim is in the form of regional maps and data files.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a.1)	Further analysis of AR4 global climate models to produce probability based climate change projections for the MTSRF region.	June 2009*
(a.2)	Further analysis on minimum and maximum temperatures, humidity, rainfall, seasonality of rainfall, cloud base height, lapse rate and solar radiation.	June 2009*

(b.1)	Analysis of the existing higher resolution regional model simulations at 15 kilometres for present and enhanced greenhouse conditions for A2 emission scenario.	June 2009*
(b.2)	Run CSIRO CCAM model under greenhouse conditions nested in simulations with the CSIRO Mk 3.5 GCM for B1 and A2 or A1B emission scenario.	June 2009
(b.3)	(1) Analyse downscaled TC simulations, based on RAMS downscaling of CCAM simulations, to quantify changes in TC intensity (pressure and winds) and changes in rainfall intensity. (2) Use outputs from existing CCAM simulations of 21st century climate change over Australia (A2 scenario initially) and detect TCLVs. Investigate if the changes that have been identified in the previously examined model are robust. (3) Use outputs from the 15km CCAM MTSRF simulation to quantify changes in extreme rainfall and winds. These model outputs will also be used in the TCLV detection of (2).	June 2009
(c.1)	Interim version of Project-specific OzClim produced and provided to impact researchers. Provide other climate change information as required.	July 2008
(c.2)	Final version of project-specific version of OzClim. Provide other climate change information as required.	June 2009

*An assessment of 23 AR4 climate models was completed and the in year one and mean temperature and rainfall projections for 2030 and 2070 have been prepared for the rainforest region. These tasks will continue for coming years with the analysis of high resolution climate model simulations.

Project 2.5ii.1 Milestone Payments 2008/2009

For 2008/2009 outputs only	Date
Milestones – all CSIRO responsibilities	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
Report 1 submission: • Participation in MTSRF wide meeting regarding climate change modeling, scenario development and mapping of deliverables across the MTSRF. Report on findings of relevance to this project. • Progress update of activities associated with objectives a-c including: findings from model analysis – consisting of new regionally focused analysis of existing model runs, data assembled for climate change simulations, end users approached and climate change scenario needs identified. • Plan of communication outputs and products for year two and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	October 2008
Pathway to Impact Report for End User Relevance	December 2008
Verbal Progress Report to Operations Committee: • Report progress on analysis of existing models (obj a): Based on IPCC AR4 climate models simulations, temperature and rainfall projections for four seasons and wet and dry half years for the tropical rainforest region were completed and the report is available in the RRRC website. Results were also presented in April and October, 2007 Meetings. Annual temperature and rainfall changes based on probability density functions were presented at the October, 2007 and February 2008 meetings. Further analysis will be done to produce seasonal changes in temperature and rainfall in the MTSRF region. • Report progress on current climate high-resolution simulation (obj b). We have conducted control and climate change experiments using the CSIRO high resolution, Conformal Cubic Atmospheric model (CCAM). The horizontal resolution of this model is 15 km and control and climate change experiments were done for the periods, 1971-2000 and 2055-2085. The CCAM simulations are nested in CSIRO Mk3.5 global climate model (A2 emission scenario). A report on the performance of the CCAM simulating the control climate has been completed and it is available on the RRRC website. Some preliminary results from the climate change experiments were presented in the Rainforest & Catchments Operations Committee Meeting held on the 19th of February 2008 in Cairns. A report will be written about the model performance and its predicted changes in temperature and rainfall. • Report progress activities associated with objective c: outcomes of workshops or meetings held with end-users: Suppiah attended Rainforest & Catchments Operations Committee Meetings held on the 25th of October, 2007 and Suppiah and Jim Ricketts attended the meeting on the 19th of February 2008 in Cairns. Suppiah gave a presentation that included some preliminary results of probability based climate change projections, progress on high resolution modeling, changes in relative humidity at various levels over tropical rainforest region and some results about tropical cyclones under climate change conditions. Jim Ricketts gave a presentation about OzClim climate change scenario generator tool kit. . • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable: Jim Ricketts and Suppiah had discussion with Caroline Bruce about the use of OzClim in their impact	March 2009

For 2008/2009 outputs only	Date
Milestones – all CSIRO responsibilities	
research.	
Report 4 submission: - Provision of agreed interim climate change scenario information for use in program impact assessment studies - Final report on year two results of the analysis of existing models with attribution of MTSRF funding(obj a). - Report on outcomes of the current climate simulation models for the Region developed/progressed in year two with attribution of MTSRF funding. - Report on consultation undertaken with users and final summary of communication activities undertaken through the course of year 2 of project. - Plan for completion of out year activities.	1 st June 2009
Total MTSRF Funding	\$100,000

Project 2.5ii.1 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	98,000	-	98,000
MTSRF Visual Documentation*	2,000	-	2,000
CSIRO	-	100,000	100,000
Total	100,000	100,000	200,000

* A total of \$2,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

CSIRO Project 2.5ii.1 Budget 2008/2009

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	64,000	6,000	70,000
Operating	8,000	12,000	20,000
Travel	8,000	12,000	20,000
Communication / Extension	18,000	-	18,000
Capital	-	-	-
Institutional overheads	-	70,000	70,000
Total	98,000	100,000	198,000

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	50,000		50,000	-	-	100,000
Total	50,000		50,000	-	-	100,000

PROGRAM 5ii: CLIMATE CHANGE – UNDERSTANDING THE THREAT, ECOSYSTEM IMPACTS AND MITIGATION OF RAINFORESTS AND CATCHMENTS
Project 2.5ii.2 Climate change: Scaling from trees to ecosystems
Project Leaders and Host Organisation

Dr Michael Liddell James Cook University (JCU)

Project Team commitments 2008/2009

Title	Organisation	Task Involvement	Role/Expertise	FTE
Dr Michael Liddell	JCU	Project Co-Leader; (a)	Atmospheric Chemist	0.25
Dr Peter Franks	JCU	Project Co-Leader; (b)	Plant Physiologist	0.25
Dr Paul Nelson	JCU	(c)	Soil Scientist	0.05
Assoc. Prof. Caroline Gross	UNE	(d)	Plant Reproductive Ecologist	0.1
Professor Nigel Stork	Uni Melbourne	(e)	Entomologist	0.1

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
MTSRF Project 1.2.1	James Butler
MTSRF Project 2.5ii.4	Steve Williams
SkyRail	Max Shepherd
Discovery Centre	Ron Burkett

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

Most of the research discussed in this Program is at the landscape level with a range of sites being used to provide the data for the modelling work. Project 2.5ii.2 will look in much more detail at two sites (tropical lowland rainforest) and determine how plants and invertebrates respond physiologically and phenologically, (e.g. fruiting, flowering) to natural climate variability and how trees and forests as a whole respond in terms of carbon and water use. This information will be used to indicate the sensitivity of ecosystems of this type to climate change. This research will be carried out at the Australian Canopy Crane research facility and the SkyRail rainforest cableway and takes advantage of over \$50 million in infrastructure and ten years of existing data sets.

Key Objectives:

- To improve our understanding of the factors influencing the variability in carbon and water fluxes from the rainforest through a long-term study in parallel with microclimate measurements.
- To monitor the differential effect of climate change on productivity of different floristic elements of a taxonomically diverse rainforest canopy – essential baseline data for predictive and scaling models of ecosystem productivity.

- (c) To determine the fluxes of carbon and water belowground, and the factors controlling these fluxes, including the influence of climate.
- (d) To describe flowering / fruiting phenology in lowland rainforest and determine correlations with fluctuations in climatology.
- (e) To understand how invertebrate resource use fluctuates in relation to seasonal local climatic variables and link this to ecosystem productivity and plant phenology.

Project / Task Methodology

Objective (a): To improve our understanding of the factors influencing the variability in carbon and water fluxes from the rainforest through a long-term study in parallel with microclimate measurements.

Eddy covariance (EC) methods are used to continuously measure carbon and water fluxes from the footprint surrounding the crane tower. The EC methods use equipment installed in March 2001. Soil fluxes will be measured using an automatic chamber system (JCU in 2nd stage of development). A full suite of microclimate instrumentation is present on site (Automatic Weather Station; AWS) and on the crane tower (radiometry). A second eddy covariance system was installed in early 2008 near Cow Bay in the Daintree rainforest; the Discovery tower system will be similarly equipped to the Canopy Crane tower system.

Objective (b): To monitor the differential effect of climate change on productivity of different floristic elements of a taxonomically diverse rainforest canopy – essential baseline data for predictive and scaling models of ecosystem productivity.

Gas exchange measurements and stable isotope analyses of the dominant canopy trees and vines at the study site over several wet-dry season cycles. Dendrometer measurements of stem incremental growth, litter trap and Leaf Area Index (LAI) measurements to monitor and compare carbon storage and turnover across species. Elemental analysis of canopy vegetation to correlate with litter turnover and soil mineralisation.

Objective (c): To determine the fluxes of carbon and water belowground, and the factors controlling these fluxes, including the influence of climate.

Measurements of the soil water regime in the unsaturated zone (TDR probes and gypsum blocks); and saturated zone (piezometers); zone of water uptake using isotopic composition of water in the soil/groundwater and the transpiration stream (¹⁸O). Measurement of the biophysical controls on carbon mineralisation in soil and leaching losses using incubations and ¹³C NMR.

Objective (d): To describe flowering / fruiting phenology in lowland rainforest and determine correlations with fluctuations in climatology.

Qualitative data on flowering and fruiting episodes (tree and species level) will be scored from digital images at set times throughout the census period using the SkyRail aerial transect. This data set will then be evaluated against climatic information for the same period. The work will provide the first long term assessment of community flowering resources and the strategies used by species at the community level in response to climatic variation.

Objective (e) To understand how invertebrate resource use fluctuates in relation to seasonal and local climatic variables and link this to ecosystem productivity and plant phenology.

Develop an understanding of the resource related causes of inter-and intra-annual variation in insect populations and how they relate to trends in plant phenology, ecosystem productivity and climate variability.

Project Targeted Activities 2008/2009

Objective	Targeted Activity	Completion Date
(a)	Atmosphere: Collection of the basic biophysical data (fluxes of carbon, water linked to microclimate variables) required in understanding forest level response to climatic drivers. Comparisons will be made between the two flux sites. Carry out preliminary soil carbon dioxide flux measurements.	June 2009
(b)	Plant Physiology: Collate 2008-2009 dendrometer and litter trap data. Analyse leaf* carbon isotopes. Analyse leaf N*. Analyse 2008 leaf conductance* Analyse 2008 canopy LAI data. Collate 2008 canopy leaf conductance data*. (* note this is contingent on crane access in 2008-9)	June 2009
(c)	Soil: Monitor soil water content and groundwater levels and calculate water uptake throughout the season. Quantify C fluxes Determine nature of organic C in litter and soil and the effect on turnover	June 2009
(d)	Phenology: Identify core sampling trees along the SkyRail transect. Commence digital data collection and develop skills to recognize flowering / fruiting events using the digital images. Establish a database for the transect to identify species level flowering / fruiting episodes. Provide 1 year of analysis on reproductive phenology patterns.	June 2009
(e)	Fauna: Continued collection of beetles inhabiting leaf litter, fruits and logs on the ground on a monthly basis. Explore the temporal variation in these beetle assemblages and report on how they relate to the temporal variation in the quality of organic input (e.g. leaf litter, woody debris, fruit, flower etc).	June 2009

Project 2.5ii.2 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones – All JCU responsibilities	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
Report 1 submission: progress report describing: • The seasonal fluxes of carbon and water from the Daintree rainforest in relation to climatic drivers (obj a). • The physiological controls on rainforest tree productivity and water use efficiency (obj b). • Characterization of water uptake and C turnover at the canopy crane site (obj c). • Characterization of flowering / fruiting events in phenological monitoring program. (obj d) • Resource related fluctuations in insect populations inhabiting leaf litter on the ground and how they relate to ecosystem productivity, and resource quantity (obj e). • Plan of communication products and events for year two and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Nov 2008
Pathway to Impact Report for end user Relevance	1 Dec 2008
Verbal Progress Report to Operations Committee describing: • On-going work on seasonal fluxes of carbon and water from the Daintree rainforest in relation to climatic drivers (obj a). • Preliminary findings of work on the physiological controls on rainforest tree productivity and water use efficiency (obj b). • Preliminary findings of water uptake and C turnover at the canopy crane site (obj c). • Characterisation of flowering / fruiting events in phenological monitoring program. (obj d) • Further findings from work on the resource related fluctuations in leaf litter insect populations on the ground and how they relate to the quality of organic input ecosystem status / productivity and climate variability (obj e). • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	16 March 2009
Report 2 submission • End of year report on the seasonal variation in fluxes (fluxes of carbon, water) linked to microclimate variables in the Daintree including the first year of data from the Discovery Tower. Early results on soil carbon fluxes will also be reported (obj a). • End of year report on tree physiology and the risks and threats to lowland rainforest canopy tree productivity under changing rainfall and temperature scenarios (obj b) . • End of year report on the results of water uptake and C turnover measurements at the canopy crane site (obj c). • End of year report of the results on the annual variations in phenology over the SkyRail transect and correlations will be made with species also present at the Crane site. (obj d). • End of year report on ground organic resource fluctuations and variations in insect populations. How insect population changes relate to: variations in the quality and quantity of resources, ecosystem status,/ productivity and climate variability will be examined (obj e). • Summary of communication activities undertaken through the course of year 3 of project, including any examples of application of the results by MTSRF projects, SkyRail, Discovery Centre or ARC. Each report requires attribution of MTSRF funding.	8 June 2009
Total MTSRF Funding*	\$120,000

*Total includes \$2,000 Visual Documentation Allocation.

Project 2.5ii.2 Budget
Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	118,000	-	118,000
MTSRF Visual Documentation*	2,000	-	2,000
SkyRail Foundation / SkyRail	5,000	1,000	6,000
JCU	-	276,000	276,000
Total	125,000	277,000	402,000

* A total of \$2,000 is held by RRRC for Visual Documentation for this project.

JCU Project 2.5ii.2 Budget 2008/2009

Item	MTSRF Funds	JCU In-kind, Canopy Crane + SkyRail Funds	Total Cost
Salaries	58,000	77,000	135,000
Operating	55,000	205,000	255,000
Travel	5,000	-	10,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	118,000	282,000	400,000

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash*	In-kind	Cash	In-kind	
2009/2010	120,000	200,000 ¹	76,000	5,000 ²	1,000 ³	402,000
Total	120,000	200,000	76,000	5,000	1,000	402,000

¹ Funding of \$200,000 per year for the following 2 years has been put forward by JCU.

² Funding of \$5,000 per year for the following year has been applied for from the SkyRail Foundation.

³ In kind contribution from SkyRail of technical support.

PROGRAM 5ii: CLIMATE CHANGE: UNDERSTANDING THE THREAT, ECOSYSTEM IMPACTS AND MITIGATION OF RAINFORESTS AND CATCHMENTS

Project 2.5ii.3: Understanding climate change threat to ecosystems and ecological processes

Project Leader and Host Organisation

Dr David W. Hilbert, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team

Title	Organisation	Role	FTE
Dr David Hilbert	CSIRO	Ecological Modeler	.31
Dr David Westcott	CSIRO	Vertebrate Ecologist	.12
Dr Dan Metcalfe	CSIRO	Plant Ecologist	.12
Ms. Lawson	CSIRO	Spatial analyst	.23
Mr Ford	CSIRO	Botanist	.12
Mr Jones	CSIRO	Animal ecology technician	.23
Mr McKeown	CSIRO	Animal ecology technician	.23
Dr Steve Goosem	WTMA	User input and advice	NA

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
WTMA	Steve Goosem
Alliance for Sustainable Tourism	Melinda Connolly
Terrain NRM	Allan Dale, Rowena Grace
QEPA	Wolf Sievers

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

Project 2.5ii.3 uses a series of sites on an altitudinal transect and regional, existing forest plots to examine responses at the ecosystem and species level to climate change. This project takes advantage of existing data from twenty-five to thirty-five years of measurements in plots maintained by CSIRO. Most of the research in this project is at the landscape level with a range of sites being used to provide the data for modeling. This project will assess current and ongoing climate change impacts on ecosystems, identify how they might adapt under predicted climate change, identify key refugia and important landscape links, identify how climate change might interact with other threats, assess ecosystem resilience, and produce regional maps (projected to year 2050) outlining likely changes to North Queensland ecosystems given a variety of scenarios for future warming, responses of biota and management interventions.

This project has many links with several other MTSRF programs and projects.

Key Objectives:

- (a) Assessment of current and ongoing climate change impacts
- (b) Identify how ecosystems might adapt under predicted climate change, including identification of key refugia and important landscape links, and guidelines for design of refugia to allow for movement of organisms and persistence of gene pools.
- (c) Identify how climate change and its primary impacts might interact with other threats – clearing, fragmentation, fire, urbanisation, weeds, zoonoses, storms and land uses – to impact on ecosystems, including identification of those which have the greatest potential for substantial impact.
- (d) Identify how resilient North Queensland regional ecosystems are and how resilience can be enhanced within scenarios of increased climate variability.
- (e) Produce regional maps (projected to appropriate temporal scales of relevance to MTSRF end users) outlining likely changes to North Queensland ecosystems given a variety of scenarios for future warming, responses of biota and management interventions. The specific climate change scenarios will be consistent with those used by all other projects in this program. Note that Hilbert is a participant in project 2.5ii.1 where scenarios are being developed. The maps will be provided to all end-users to facilitate their management planning and actions.

Project / Task Methodology

Objective (a): Assessment of current and ongoing climate change impacts.

- Assessment of forest structure, biomass and species composition. twelve 0.1 ha forest plots surveyed at regular (100 m) elevation intervals and coinciding as much as possible with MTSRF Project 2.5ii.4's existing altitudinal surveys of vertebrates. All trees ≥ 10 cm diameter at 1.3m height (dbh) enumerated, measured and identified to species. Full vascular plant surveys in each plot.
- Assessment of forest dynamics. Direct analysis of size-frequency distributions from CSIRO's long-term plots as well as this project's survey plots.
- Assessment of seed dispersal processes. On plots from above, undertake studies of seed dispersers and Identification of plant seed dispersal functional groups by elevation.
- The distribution of vectors of animal diseases and the diseases themselves. Standard mosquito traps and molecular biology methods (to detect avian diseases transmitted by arthropod vectors) coinciding with the altitudinal gradients used in above.
- Present changes and greatest threats to ecosystems. Analyses of results from and synthesis of previous research outputs.

Objective (b): Identify how ecosystems might adapt under predicted climate change, including identification of key refugia and important landscape links, and guidelines for design of refugia to allow for movement of organisms and persistence of gene pools.

- Maps of refugia for forest types. Application of the forest distribution model to all of the Wet Tropics Bioregion at a fine scale of resolution using outputs from the climate scenarios project. Uncertainty analyses conducted by using results from the range of likely climate scenarios and GIS, landscape analysis techniques.

- Landscape links among refugia. GIS, landscape analysis techniques and network theory assessments of connectivity taking species movement and dispersal properties into account.
- Capacity of forest ecosystems to shift spatially. Methods similar to those above but applied more broadly to the entire bioregion.
- Suggestions for management interventions to conserve refugia and improve their connectivity. Synthesis of results.

Objective (c): Identify how climate change and its primary impacts might interact with other threats to impact on ecosystems, including identification of those which have the greatest potential for substantial impact.

Objective (d): Identify how resilient North Queensland regional ecosystems are and how resilience can be enhanced within scenarios of increased climate variability.

- Potential ecosystem impacts of altered distributions and prevalence of animal diseases. Spatial modelling of vector and disease distributions under many climate change scenarios using outputs from Project 2.5ii.1.
- Spatial identification of weed threats. Identification of weeds by altitude in plots established in Objective (a).
- Application of models and data developed in Project 2.5ii3.
- Model of forest distributions. The current model needs to be modified and updated to run on the newer, existing hardware and the different spatial extent of application in this project. As much as possible, the existing model, which is well tested, will be retained. Temporal projections will be of relevance to end users and agreed across the MTSRF.

Objective (e): Produce regional maps (projected to appropriate temporal scales of relevance to MTSRF end users) outlining key changes to North Queensland ecosystems given a variety of scenarios for future warming and responses of the biota.

- Maps of projected forest environments. Application of the forest distribution model to all of the Wet Tropics Bioregion at a fine scale of resolution and using climate change scenarios from Project 2.5ii.1 as agreed upon by the end-users.
- Uncertainty analyses conducted by using results from the range of likely climate scenarios. Application of the forest distribution model to all of the Wet Tropics Bioregion at a fine scale of resolution and using outputs from the climate scenarios project.
- Maps of projected forest basal area and biomass. Uncertainty analyses conducted by using results from the range of likely climate scenarios.
- These maps will provide information to end-users that they can use to develop management procedures based upon climate refugia and landscape connectivity in future climates.

Project Outputs July 08 – June 09

Objective	Targeted Activity	Completion Date
(a)	Report on forest structure and biomass along altitudinal climate gradients (12 MTSRF monitoring plots).	December 2008
(a)	Preliminary report on the distribution of vectors of animal diseases and the diseases themselves along altitudinal climate gradients.	June 2009
(b)	Report on how seed dispersal processes change along altitudinal, climatic gradients (based on 12 MTSRF monitoring plots).	June 2009
(b), (c), (d)	Maps of refugia for forest types in 2025, 2050, and 2100 under several realistic climate change scenarios.	June 2009*

*Involves activities that carry into Out Years.

Anticipated objectives / deliverables for year 4 (09/10)

Objectives	Deliverables	Approximate Date
Advice to managers concerning the present changes and greatest threats to ecosystems due to climate change	Report to managers (WTMA and Queensland EPA) on the present changes and greatest threats to ecosystems due to climate change	June 2010
Identification of landscape links among refugia in 2025, 2050, and 2100	Maps of landscape links among refugia in 2025, 2050, and 2100	December 2009
Maps identify the capacity of forest ecosystems to shift spatially in response to realistic climate scenarios in 2025, 2050 and 2100.	Maps and GIS layers	December 2009
Recommendations for management interventions to conserve refugia and improve their connectivity.	Report on management interventions to conserve refugia and improve their connectivity	June 2010
Identification potential ecosystem impacts of altered distributions and prevalence of animal diseases due to climate change	Report on potential ecosystem impacts of altered distributions and prevalence of animal diseases due to climate change	December 2009
Maps of projected forest basal area and biomass in 2025 and 2050 based on a realistic range of climate scenarios	Maps and GIS layers	June 2010

Project 2.5ii.3 Milestone Payments 2008/2009

For 2008/2009 outputs only	Date
Milestones – all CSIRO responsibilities	
Renewal of contract variation	1 August 2008
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
Report 1 submission: • Full vascular plant list for the twelve MTSRF, altitudinal climate-change monitoring plots • Plan of communication activities/products for year three Each report requires attribution of MTSRF funding.	8 Oct 2008
Report 2 submission • Report of preliminary results from a model of forest distributions (obj b,c,d). • Report on forest structure and biomass along the altitudinal gradient (12 MTSRF plots) • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. • Pathway to Impact Report for end user relevance. Each report requires attribution of MTSRF funding.	1 Dec 2008
Report 3 oral update to MTSRF operational committee • Progress update on activities associated with objectives (a)-(d): implementation of field work, data collation and modeling results.	16 March 2009
Report 4 submission • Maps, for several climate change scenarios using the neural network model applied to the entire Wet Tropics Bioregion (obj b,c,d) • Report on how seed dispersal processes may or may not change along altitudinal climate gradients. • Report on the distribution of vectors of animal diseases and the diseases themselves along altitudinal climate gradients. • Maps of refugia for forest types in 2025, 2050, and 2100 under several realistic climate change scenarios. • Final summary of communication activities undertaken through the course of year 3 of project. • Plan for completion of out year activities. Each report requires attribution of MTSRF funding.	30 May 2009
Total MTSRF Funding	\$150,000

Project 2.5ii.3 Budget**Year 3 – 2008/2009 Project Funding and Partnerships**

Contributing Organisation	Cash	In-kind	Total
MTSRF	147,000	-	147,000
MTSRF Visual Documentation*	3,000	-	3,000
CSIRO	-	170,649	170,649
Total	150,000	170,649	320,649

* A total of \$3,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

CSIRO Project 2.5ii.3 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	119,781	31,129	150,910
Operating	13,511		13,511
Travel	13,708	-	13,708
Communication / Extension	-	-	
Capital	-	-	-
Institutional overheads		139,520	139,520
Total	147,000	170,649	317,649

Indicative Budget Summary – year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	150,000	-	150,000	-	-	300,000

PROGRAM 5ii: CLIMATE CHANGE – UNDERSTANDING THE THREAT, ECOSYSTEM IMPACTS AND MITIGATION OF RAINFORESTS AND CATCHMENTS
Project 2.5ii.4: Impacts of climate change on biodiversity
Project Leader and Host Organisation

Associate Professor Steven Williams, James Cook University, Townsville (JCU).

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Associate Professor Stephen Williams	JCU	Project Leader, macroecology, biodiversity and climate change impacts	0.25
Professor Chris Johnson	JCU	Macroecology; phylogenetic analysis; extinction proneness analysis	0.1
Dr Jeremy Vanderwal	JCU (RAP funded)	Spatial analysis; GIS	0.1
Dr Andrew Krockenberger	JCU	Ecophysiology (thermal and desiccation tolerances etc)	0.2
Professor Steve Turton	JCU	Climatology; microclimates	0.1
Dr Lucas Shoo	JCU	Refugial ecology; thermal microhabitats; extinction proneness;	1.0
Dr Joanne Isaac	JCU	Extinction proneness, Life history traits	0.1
Vanessa Valdez Rameriz	JCU	Net primary productivity and relationships across altitude with biodiversity	1.0
Alex Anderson	JCU	Effect of climate variation on bird abundance and distribution	0.5
Andres Merino Viteri	JCU	Physiological tolerances in microhylid frogs	0.5
Collin Storlie	JCU	Field work, data management, management of insect sampling across region, datalogger downloads and maintenance	1.0

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
DEWHA	TBA
WTMA	Ellen Weber, Steve Goosem
EPA	Paul Williams
Terrain NRM	Kirby Doak, Rowena Grace, Allan Dale
Alliance for Sustainable Tourism	Melinda Connolly

NQCA	John Rainbird
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Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

In conjunction with Project 2.5ii.3, this project will utilise a series of well-established sites on altitudinal and regional transects and existing forest plots to examine responses at the ecosystem and species level to climate change. Both projects will take advantage of existing data from ten to twenty-five years of collections at these sites / plots by CSIRO, JCU and through the Rainforest CRC. The aim of Project 2.5ii.4 is to assess the potential of wet tropics species to adapt to climatic change through ecological and evolutionary mechanisms, and establish the potential for refuges to mitigate impacts on vulnerable species. Using an extensive existing database and combined expertise, results will allow us to better predict the consequences of climate change on tropical biodiversity. This project will assist in modifying species-specific management / conservation plans for biodiversity in the Wet Tropics and developing options to mitigate threats to species at high risk of extinction, and to avoid costly management actions on species that have the necessary natural adaptive capacity.

It will also provide information to modify management practices by assessing the current ecological status and trends in biodiversity in North Queensland; the condition and trends of threatened species and communities and ultimately develop options to mitigate the threat of climate change to the Wet Tropics as a whole. In particular, the conservation of existing or addition of artificial thermally buffered habitats.

This project has many links with other MTSRF programs and projects that will be mapped explicitly in the next year. While the tourism industry's and aboriginal groups' needs were not specifically identified in the original development of this project within MTSRF, the project will now engage these stakeholders as much as possible through operational committee's and through discussion with the Tropical Tourism Alliance and Aboriginal Rainforest Council.

Key Objectives:

Extinction vulnerability

- (a) To assess the relative extinction proneness and vulnerability of all rainforest vertebrate species to predicted climate changes including physiological tolerances and potential ecological responses that buffer the species from impacts.

Resilience, ecological responses, plasticity, refugia (topographic, micro-habitat)

- (b) To quantify patterns of distribution and abundance of selected faunal groups, and existing levels of niche breadth and ecological plasticity with respect to climatic variables, habitat type, topography, life history traits and ecology.
- (c) To identify geographic areas that potentially provide thermally-buffered habitats and measure the actual degree of microclimatic buffering across the main environmental gradients within identified refugia, replicated both temporally and spatially.
- (d) To produce regional GIS coverages of microclimate based on regional climatic layers calibrated by empirical microclimate data, and to use these higher-resolution, targeted data to improve predictive spatial models of species distributions and impact predictions.
- (e) To obtain empirical measurements of net primary productivity across altitudinal / latitudinal gradients within the Wet Tropics region to test hypotheses that increasing primary productivity may alleviate impacts on biodiversity.

- (f) To assess the relative vulnerability of biodiversity to climate change and thereby provide management and policy recommendations on adaptation to climate change impacts and provide the knowledge to maximise the efficient utilisation of management resources across species and geographic areas.

Physiological tolerances of threatened species (arboreal mammals, microhylid frogs)

- (g) To determine the physiological range and tolerances, and potential for adaptation, of those species predicted to be most at risk under climatic changes.

Project / Task Methodology

Extinction vulnerability

Objective (a)

Desktop analysis of ecological characteristics of vertebrates using existing data, and spatial modelling of species distributions and biodiversity patterns that includes habitat, climate, ecological characteristics, physiology, microclimate / microhabitat relationships (Links with CSIRO 'Status and Trends' theme and 'Climate Change Project 3 Impacts on Ecosystem Processes and other Objectives in this project). Spatial modelling of fauna distributions and abundance, refugial potential and vulnerable geographic areas, employing empirically derived data (linking to Theme 1 project Status and Trends, Threatened Species and Communities, and Invasives) and in collaboration with spatial analyst (JCU CTBCC-funded).

Resilience, ecological responses, plasticity, refugia (topographic, micro-habitat)

Objective (b)

Collection of faunal data using standardised survey techniques across altitudinal and latitudinal gradients in the region (mostly at existing sites). Species distribution modelling both regionally and across gradients associated with potential refugia. Use ecological characteristics and spatial analyses to measure environmental niche breadth and ecological adaptability (post-doctoral fellow funded by this projects MTSRF funds). Links to monitoring design projects in Theme 1. Linking with Theme 1 project Status and Trends, Threatened Species and Communities, and Invasives, in-kind contributions from Earthwatch and CTBCC and within this project to Objective (c).

Objective (c)

Identify and collect microclimate data in potential refugia (as above) to empirically measure buffering effect; using multi-channel data loggers to measure temperature, soil moisture and humidity. Linking with Theme 1 project Status and Trends, Threatened Species and Communities and Project 2.5ii.3.

Objective (d)

By calibrating regional climate layers with field based microclimate data obtained from dataloggers we can produce regional microclimate layers that will vastly improve our understanding of spatial refugia and predictive modelling of impacts. The data collection requires establishing data loggers across altitudinal and latitudinal gradients in the region. These dataloggers will be downloaded at approximately 3 monthly intervals. Additional temperature dataloggers will be placed at the same sites in a variety of microhabitats including under logs, under leaf litter, in tree hollows, in sunspots/clearings. The field assistant will be vital to managing and collecting this data as it is very time consuming and includes a lot of travel across the whole region.

Objective (e)

Employ leaf litter traps, dendrometer bands and vegetation structure proforma (including hemispherical photography) at all the standard sites mentioned above. Plant inventory (to be conducted by CSIRO via links within Theme 1 Status and Trends and Project 3 Understanding the Climate Change Threat to Threat to Ecosystems and Ecosystem Processes. This subproject requires significant collaboration with the CSIRO-based Status and Trends program and Project 2.5ii.3 in this program as no funding from this project is allocated for this subproject. Student support is already being funded via the Centre for Tropical Biodiversity and Climate Change and Earthwatch in-kind.

Objective (f)

Based on findings of research provide management and policy recommendations on adaptation to climate change impacts and provide the knowledge to maximise the efficient utilisation of management resources across species and geographic areas.

Physiological tolerances of threatened species (arboreal mammals, microhylid frogs)**Objective (g)**

Field and lab determination of actual and potential temperature ranges of Wet Tropics microhylid frogs and arboreal mammals.

Project Targeted Activities 2008/2009

Objective	Targeted Activity	Completion Date
(a)	Production of detailed assessment of extinction risk due to predicted climate change scenarios in Wet Tropics vertebrates based on ecological characteristics (linking to Theme 1 project Status and Trends, Threatened Species and Communities, and Invasives). (CTBCC in-kind)	June 2009*
(b)-(f)	Determination of ecological plasticity in Wet Tropics vertebrates with regard to potential for adaptation to climatic changes Identification of the potential for refugia such as boulder fields, logs and gorges to provide areas of thermal buffering to protect species at risk from extreme temperatures. Identification of the use of these refugia by vertebrate taxa. Production of regional maps of refugial potential. (MTSRF funded Post-doc, this project) Production of GIS maps of Wet Tropics including microclimate data and spatial models of species distributions to predict impact of climate change (in conjunction with CTBCC-funded Spatial Analyst). Field work: – <i>Collection of faunal data using standardised survey techniques across altitudinal and latitudinal gradients in the region.</i> – <i>Identify and collect microclimate data in potential refugia (as above) to empirically measure buffering effect; using multi-channel data loggers to measure temperature, soil moisture and humidity.</i> – <i>Establish data loggers across altitudinal and latitudinal gradients in the region. These dataloggers will be downloaded at approximately monthly intervals. Additional temperature dataloggers will be placed at the same sites in a variety of</i>	June 2009*

Objective	Targeted Activity	Completion Date
	<i>microhabitats including under logs, under leaf litter, in tree hollows, in sunspots/clearings.</i> – <i>Employ leaf litter traps, dendrometer bands and vegetation structure proforma (including hemispherical photography) to estimate net primary productivity.</i>	
(g)	Field and lab determination of actual and potential temperature ranges of Wet Tropics microhylid frogs and arboreal mammals. (34% this MTSRF project; 66% Threatened species program)	June 2009*

* Carries into Out Years.

Project 2.5ii.4 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones – All JCU responsibilities	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
Report 1 submission: - Establish a framework to integrate all of the various factors that contribute to vulnerability under climate change including sensitivity, exposure and adaptation to a changing climate (Obj. f) - Report on progress in developing collaboration between Bob Pressey (JCU), WTMA, EPA and NSW DECC (Department of Environment and Climate Change) that specifically focuses on the application of the above framework to vulnerability assessment and systematic regional conservation planning (Obj. f) - Quantify niche-breadth (climatic specialisation and marginality) of all rainforest vertebrates using climatic niche analysis (ENFA) and macroclimate data (Obj. b) - Progress report and status update on objectives a,c-g (above) - Progress report on measurement of physiological tolerances of common Microhylid species. - Pathway to Impact Report for End User relevance.	8 Nov 2008
Written Progress Report to Operations Committee on: - Analysis of relationship between historical climate conditions, habitat and current patterns of biodiversity. Use past climate change to make better predictions of future biodiversity, i.e. what can the past tell us about extinction dynamics to allow better predictions about the future? (Obj. a and b) - Regional maps describing thermal buffering due to complex topography (eg. gorges and steep slopes) (Obj. c) - Compilation of metadata on empirical net primary productivity (NPP) from published studies within tropical forests and review data gaps and shortcomings of existing algorithms used to predict NPP (Obj. e) - Determine variability in spatial predictions of NPP derived from existing algorithms and remote methods applied to the region. (Obj. e) - Exploration of possible map generation of cloud frequency for the region using MODIS satellite data in order to quantify the buffering of temperature due to the cloud layer (Obj. d) - Analyse available microclimate data from high elevation boulder fields on Thornton Peak. Quantify buffering effect of boulder microhabitats (containing high species endemism) by relating to ambient temperature traces and macroclimate inferred from Esoclim interpolations (Obj. c). - Further findings and summary data from field surveys conducted on fauna and plants and from microclimate data collected and spatial refugia identified. Report to update progress towards assessment of extinction risk and ecological plasticity	8 Mar 2009

For 2008/2009 outputs only	Date
Milestones – All JCU responsibilities	
of vertebrate species and general progress associated with objectives a-g (above) Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	
Report 2 submission - Status report of field measurements physiological tolerances on restricted Microhylid species (Obj. g). - Produce regional GIS coverages of microclimate (temperature under canopy, in surface soil and under logs) based on regional climatic layers calibrated by empirical microclimate data (Obj. d). - Take hemispherical photographs of canopy for all permanent monitoring sites (Obj. e) - Compare spatial predictions of NPP derived from existing algorithms with empirical data collected from permanent monitoring sites (Obj. e) - Analyse available microclimate data (eg. under logs) at permanent monitoring stations. Quantify buffering effect by relating to ambient temperature traces from established Hobo weather stations and macroclimate inferred from Esoclim interpolations (Obj. c). - Progress and status report, preliminary data and findings for work conducted as part of objectives a-g (above). - Summary of communication activities undertaken through the course of year 2 of project. - Plan for completion of out year activities. All final report requires attribution of MTSRF funding.	6 Jun 2009
Total MTSRF Funding*^	\$170,000*

* Total includes \$3,000 Visual Documentation Allocation.

^ JCU Cash contribution of \$20,000 is to be directed towards the PhD Student Stipends

Project 2.5ii.4 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF (Obj. a,b,c,f,g)	147,000	-	147,000
MTSRF Visual Documentation*	3,000	-	3,000
JCU	20,000		20,000
JCU – Centre for Tropical Biodiversity and Climate Change (Obj. a,b,c,d,e,f,g)	-	425,000	425,000
JCU – Earthwatch (Obj. b,e)	-	40,000	40,000
JCU – Queensland Government Smart State Funds (Obj. a,b,c,d,e,f,g via Williams salary)	-	100,000	100,000
WTMA (Obj. a, f)	-	20,000	20,000
Total	170,000	585,000	755,000

* A total of \$3,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

JCU Project 2.5ii.4 Budget 2008/2009

Item	MTSRF Funds	JCU Cash	JCU In-kind*	JCU In-kind**	JCU In-kind***	WTMA In-kind	Total
Salaries	97,000	20,000	360,000	-	100,000	20,000	597,000
Operating	45 000		30,000	40,000	-	-	120,000
Travel	5 000		10,000	-	-	-	10,000
Communication / Extension	-		10,000	-	-	-	10,000
Capital	-		15,000	-	-	-	15,000
Institutional overheads	-		-	-	-	-	-
Total	147,000	\$20,000	425,000	40,000	100,000	20,000	732,000

* In-kind contribution from JCU Centre for Tropical Biodiversity and Climate Change.

** In-kind contribution from Earthwatch via JCU.

*** In-kind contribution from Smart State Fund via JCU.

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	150,000	305,000	160,000	140,000	20,000	735,000
Total	150,000	305,000	160,000	140,000	20,000	735,000

PROGRAM 6

UNDERSTANDING THREATS AND IMPACTS OF INVASIVE PESTS ON ECOSYSTEMS

Program 6 is divided into two components: Invasive pests in the Great Barrier Reef (Project 2.6.1), and Invasive pests in Wet Tropics rainforests and adjoining catchments (Project 2.6.2).

Budget Summary

	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
MTSRF	\$250,000	-	\$250,000
Other	-	\$196,500	\$196,500
Total	\$250,000	\$196,500	\$446,500

UNDERSTANDING THREATS AND IMPACTS OF INVASIVE PESTS IN THE GREAT BARRIER REEF (PROJECT 2.6.1)

Project Leader and Host Organisation

Dr David Blair, James Cook University (JCU)

The Great Barrier Reef (GBR) is a multiple use marine park where shipping, coastal development and an expanding aquaculture industry present potential risks to local biodiversity through the import of invasive species (e.g. Asian Green Mussel) and/or aquatic pollution.

This Program will report on the current and potential risks of invasive marine toxic dinoflagellate species in the GBR. This project will also contribute to the development of capacity in this important area of research through the conduct of a doctoral project at James Cook University.

Projects

2.6.1	Understanding threats and impacts of invasive pests in the Great Barrier Reef	\$50,000
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IDENTIFICATION AND IMPACT OF INVASIVE PESTS IN THE WET TROPICS RAINFORESTS (PROJECT 2.6.2)

Project Leader and Host Organisation

Dr David Westcott, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

New or imminent incursions of invasive terrestrial pests require immediate management action without the luxury of data collection in the field. First responses to incursions are crucial yet are most effective if based on some knowledge of the invading species, in particular knowing how fast and how far an invasive can spread is fundamental to first response as it can set search areas and locations of risk.

This program will build on and refine a rapid response strategy to incursion by detailing ecological dispersal traits (e.g. introduction history, distribution, abundance, taxonomy, population parameters, reproduction, environmental tolerances, habitat preferences, movement, feeding habits), and a statement of current or potential impact of native and exotic species. These functional classifications of traits that influence the invasive spread potential of pre-emergent or new invasives will allow for data-based predictions of likely dispersal characteristics to be developed. This will be done for vertebrate-dispersed plants and fish. Gaps in knowledge of invasives have been identified in previous years which will now be used to guide research in the current and future years. The resulting classifications of invasives will allow managers to assign pre-emergent or new species to risk categories based on the spread characteristics of similar species already in Australia and to develop management response strategies based on these classifications.

To enable the program to build on current invasive research the Program will:

1. Continue to focus on species identified of key concern in workshops and stakeholder assessment. Detailed surveys appropriate to the taxa will be broadened in a regional context and will be used to build on data detailing distribution. At a species level, functional classification of invasive plants that includes dispersal, recruitment niche and life history will be completed at both a species level and at a community and landscape level. This will assist in identification of invasive 'hotspots' and of critical landscape features for invasive spread within landscapes.
2. Test and refine isotropic models of population spread through rainforest landscapes to allow assessment of the potential outcomes of management effort. Understanding how invasives move through landscapes enables prediction of patterns and rates of invasion and the opportunity to target management investment at times or in places where it will be most effective. This sub-project will i) test the process-based framework for predicting the pattern and rate of invasive spread and will use this model to ii) produce and test modelling tools that will enable prediction of invasions in real landscapes and the assessment of alternative management options.

This program is closely linked to Program 2 Status and Trends of Biodiversity and Ecosystem Services, Threatened Species and Communities projects and the Climate Change Impacts Program with the terrestrial invasives data coming from the biodiversity surveys being conducted as part of these projects. To document the landscape features that influence biological invasions of rainforest landscapes, the Program will continue to utilise GIS modelling to overlay distribution of invasives in, and landscape features of rainforest landscapes, e.g. roadsides, fragments etc. These data sets will be integrated into the Risk and Resilience Atlas which will enable managers and industry to access spatially explicit information on the status and trends of the Wet Tropics through a single data repository.

Projects

2.6.2 Identification and impact of invasive pests in the Wet Tropics rainforests \$200,000

UNDERSTANDING THREATS AND IMPACTS OF INVASIVE PESTS IN THE GREAT BARRIER REEF (PROJECT 2.6.1)

Project 2.6.1: Understanding threats and impacts of invasive pests on the Great Barrier Reef

Project Leader and Host Organisation

Dr David Blair, James Cook University (JCU)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Dr David Blair	JCU	Objective a	0.15
Dr Kirsten Heimann	JCU	Objective a	0.2
1 x PhD student	JCU	Objective a	1.0

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GBRMPA	James Monkavitch
GBRMPA	Andrew Chin
Ports Corporation of Queensland	Simona Trimarchi
Biosecurity Queensland	Tony Pople

Project Duration

Start Date: 1 July 2007

End Date: 30 June 2010

Project / Task Objectives

There is a need to determine what key pests pose a risk to, or are already present in, habitats in the GBR region and adjacent coastal habitats and to determine appropriate detection, eradication, monitoring and management strategies for Research Users including the Great Barrier Reef Marine Park Authority and Biosecurity Queensland. This is a student-based research project addressing one potential group of marine pests for concern in the GBR, toxic microalgae. The primary objective of this project is to assess the presence of toxic microalgae in the GBR, the potential threats posed by these and relevant management responses to mitigate impacts.

Key Objective:

- (a) Monitoring techniques and risk assessment for invasive toxic microalgae (PhD Project).

Project / Task Methodology

Objective (a): Toxic microalgae (PhD Project)

As background, it should be noted that CRC Reef / QDPI&F have undertaken marine pest baseline surveys in ports and elsewhere in recent years. This has resulted in identification of a number of dinoflagellate species in GBR waters, but this information was from coastal habitats only, representing a snapshot in time which is inadequate in order to obtain an overview of seasonal variations of distribution and abundance patterns. In addition, information from those surveys is restricted to basic identification of species present at the time of sampling. Much remains unknown, such as the nature of the native biota of toxic dinoflagellates supported by the GBR region, the potential for pest species to be translocated into the region and the risks these species may or may not pose. The proposed project will build on the baseline knowledge collected under the CRC Reef by reviewing methods of risk-assessment of toxic species of concern to the GBR. Thereafter, target species will be cultured and subjected to biological (including toxicological) characterisation, which will assist identification of appropriate management responses to species of concern.

Further components of the study will:

- Assess the impact of disturbances to marine sediments on the potential distribution of toxic algae and their cysts by developing a fast detection strategy to identify genotypes of particular toxic microalgae.
- Compile an atlas of relevant marine microalgae.
- Develop molecular probes for species known to have potential for toxin production to enable risk assessment for particular regions and to develop effective preventative measures.

Project Targeted Activities (indicative only for out years)

Objective	Targeted Activity	Completion Date
(a)	Development of webpage	Oct 2009
(a)	Annual reports on progress of PhD project, including updates on findings from field, laboratory and desktop studies	June 2009 – June 2010
(a)	National and, where appropriate, International conference presentations on aspects of each task	Timing and frequency will depend on what conferences occur during the life of the project

Project 2.6.1 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones – all JCU responsibilities	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
Report 1 submission • Report arising from student confirmation of candidature seminar.	15 Aug 2008
Report 2 submission • Detailed technical review of genetic probe development for invasive species, with a focus on choice of target gene and on DNA amplification technology	12 Jan 2009
Report 3 submission • Report on laboratory culture of marine microalgae of the GRB.	10 Mar 2009
Report 4 submission • Interim report on the development of genetic probes for marine microalgae. • Final summary of communication activities (e.g. any presentations/seminars given to School) undertaken through the course of Year 2 of project (objectives a and b). • Plan for completion of out year activities.	14 Jun 2009
Total MTSRF Funding	\$50,000

Project 2.6.1 Budget**Year2 – 2008/2009 Project Funding and Partnerships**

Contributing Organisation	Cash	In-kind	Total
MTSRF	50,000	-	50,000
JCU	-	TBA	
Total	50,000		

JCU Project 2.6.1 Budget 2008/2009

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries / Stipends	25,000	TBA	25,000
Operating	20,000	2,000	22,000
Travel	3,000	-	3,000
Communication / Extension	2,000	-	2,000
Capital	-	-	
Institutional overheads	-		
Total	50,000	2,000	52,000

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	50,000		TBA		-	117,000
Total	50,000		TBA		-	117,000

IDENTIFICATION AND IMPACT OF INVASIVE PESTS IN THE WET TROPICS RAINFORESTS (PROJECT 2.6.2)

Project 2.6.2: Identification and impact of invasive pests in the Wet Tropics rainforests

Project Leader and Host Organisation

Dr. David Westcott, CSIRO

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
David Westcott	CSIRO	Tropical Vertebrate Ecologist	0.20
Dan Metcalfe	CSIRO	Tropical Plant Ecologist	0.05
Denise Hardesty	CSIRO	Plant and Invasion Geneticist	0.30
Cameron Fletcher	CSIRO	Ecological Modeller	0.50
Helen Murphy	Weeds CRC / CSIRO	Invasion Biologist	0.10
Damien Burrows	ACTFR	Fish Ecologist	0.20
Allen Webb	ACTFR	Fish Ecologist	0.25
John Russell	QDPI&F	Fish Ecologist	0.10
Kylie Galloway	QDNR&M	Weed Eradication Manager	0.10
Simon Brooks	QDNR&M	Weeds Scientist	0.10
Rowena Grace	FNQ NRM Ltd	Terrestrial Biodiversity Program Manager	0.05
Frederieke Kroon	FNQ NRM Ltd	Aquatic Biodiversity Program Manager	0.10
Kirby Doak‡	FNQ ROC	Liaison with Local Govt	0.02
Steve Goosem‡	WTMA	Biodiversity Planning and Policy	0.02

‡ To be confirmed.

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
WTMA	Steve Goosem
Terrain NRM Ltd	Kirby Doak, Rowena Grace, Allan Dale
EPA	TBA
Alliance for Sustainable Tourism	Melinda Connolly

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project will focus on invasive species (including translocated native species) and will develop tools for predicting the spread of invasive species in rainforests and modified coastal landscapes, map the distribution and document the impacts of invasive species, identify priority species for detailed study, and carry out those detailed studies. This will include an analysis of end user needs and priorities as well as research currently being undertaken in the Weeds CRC, the Australasian Invasive Animals CRC and the Plant BioSecurity CRC, to identify exactly where MTSRF can get the best return on its investment in invasive species.

For the purposes of this project invasives are defined (from a European perspective) as species moved beyond their natural range and may include exotic, translocated, and pest species. The term “rainforest landscapes” is used to include terrestrial and aquatic systems and human-dominated parts of the landscape (agricultural and urban areas) as well as rainforest ecosystems.

Key Objectives:

- (a) Assessment of research needs for management of invasives.
- (b) Frameworks and tools for predicting invasive species' spread through rainforest landscapes.
- (c) Distribution and impacts of invasives.
- (d) Research into priorities species and those identified in Objective (a).

Project / Task Methodology

Objective (a): Assessment of research needs for management of invasives

This objective will establish involvement between end-users and researchers to develop and plan the research collaboration. Priority lists previously developed on behalf of stakeholders will be reviewed to ensure currency and used as the basis for the development of the research program. Current research and management activities outside MTSRF will be mapped to allow the identification of i) connections and collaborations in invasive species research and any appropriate opportunities to expand these, and, ii) critical gaps and opportunities in invasive species research for the region will be identified. These outcomes will be used to assess invasive impact, the extent to which systems are in place to prevent or control incursions and additional research objectives.

The final year will include a reassessment of future research needs, current threats and preparedness to meet these. These activities will be conducted via a scoping workshop, literature review and interviews to ascertain threat and impact. A Reporting Workshop will contribute to finalization of the scoping study, research goal setting and identification of priority species for on-going research focus.

Objective (b): Frameworks and tools for predicting invasive species' spread through rainforest landscapes

All biological invasions, irrespective of whether they are invasions by exotic plants, animals, diseases or translocated native species, are the expression of a single process – the movement of individuals through the landscape. Understanding how invasives move through landscapes enables prediction of patterns and rates of invasion and the opportunity to target management investment at times or in places where it will be most effective.

This sub-project will i) develop a process-based framework for predicting the pattern and rate of invasive spread and will use this model to ii) produce and test modelling tools that will

enable prediction of invasions in real landscapes and the assessment of alternative management options. Being process, rather than species based, the modelling framework will be generalizable to a wide-range of invasive species. Currently adequate movement data exists to allow development and application with fleshy-fruited invasive plants, e.g. *Miconia calvenscens* and *Annona glabra*, but the approach will be extended to other taxa, e.g. fish or deer, as appropriate and possible. Additional movement data will need to be collected for other invasive taxa, however, the modelling framework itself will not have to be re-developed and will prescribe the data to be collected.

In the first instance, a proof of concept modelling framework will be developed, parameterised and tested in the context of fleshy fruited invasive plants, e.g. *Miconia calvenscens*, *Annona glabra*. These have been chosen because: 1) they are high on the list of priorities identified by WTMA and Terrain NRM as high risk invasive plants; 2) they are the focus of significant current on-ground management efforts by QDNRMW and Local Government; and 3) high quality data on the movement of fleshy fruited plants within the landscape is available from the Rainforest CRC. The modelling framework will employ spatially-explicit percolation modelling, based initially on isotropic dispersal curves (symmetric dispersal in all directions).

The framework will be refined to improve predictive ability by incorporating models of disperser movement responses to landscape structure.

The majority of this data has already been produced as part of the Rainforest CRC though some additional data may need to be collected. This will be done using continuous radio-telemetry as appropriate.

Models will be tested and validated in collaboration with QDNR&M's Tropical Weeds Eradication Team and where appropriate or possible with Local Government. Dispersal predictions will be developed for real infestations and these will then be tested against the plants found in the field by the eradication teams. In addition, QDNRMW will provide spatial data on historical *M. calvenscens* infestations and these will be used to post-predict the actual pattern of these invasions. *M. calvenscens* incursions in FNQ are still in the very earliest phases of invasion; the initial incursion and establishment phases. These phases are virtually undescribed as invasions are usually not described until after the establishment phase. Consequently, it represents an opportunity to document demographic and genetic processes that influence the early success of invasions. This will be done as a comparative study of *M. calvenscens* and *Melastoma affine* (a native species in the same family as *M. calvenscens*, the Melastomataceae). This work will use micro-satellite markers to perform genetic parentage analysis, progeny dispersal distances, and spatial genetic structure.

New or imminent incursions require immediate management action without the luxury of data collection in the field. First responses to incursions are crucial yet are most effective if based on some knowledge of the invading species, in particular knowing how fast and how far an invasive can spread is fundamental to first response as it can set search areas and locations of risk. We will use existing data on ecological (e.g. introduction history, distribution, abundance, taxonomy, population parameters, reproduction, environmental tolerances, habitat preferences, movement, feeding habits), dispersal traits and a statement of current or potential impact of native and exotic species to develop a risk assessment of current and potential invasives. Functional classifications of traits that influence the invasive spread potential of pre-emergent or new invasives and allow for data-based predictions of likely dispersal characteristics to be developed will be done for vertebrate-dispersed plants and fish.

The resulting classifications will allow managers to assign pre-emergent or new species to risk categories based on the spread characteristics of similar species already in Australia and to develop management response strategies based on these classifications. This analysis will also identify gaps in knowledge of invasives, and will be used to guide research in Years 2-4.

Objective (c): Distribution and impacts of invasives

Description of the distribution of invasives within landscapes will be derived from existing data and other work. For terrestrial invasives, data will come from the biodiversity surveys being conducted as part of Program 2, Status and Trends of Biodiversity and Ecosystem Services, Threatened Species and Communities and Program 5ii, Rainforest Climate Change. These surveys document the presence and abundance of incidence of plant and avian biodiversity against landscape structure and vegetation types. Aquatic invasives data will come from the Wet Tropics Fish Atlas (Rainforest CRC), NHT Pest Fish project (ACTFR), long-term monitoring (QDPI&F), and additional field surveys as required. To document the landscape features that influence biological invasions of rainforest landscapes, we will use GIS modelling to overlay distribution of invasives in, and landscape features of rainforest landscapes, e.g. roadsides, fragments etc. We will compare this distribution data with landscape condition data, collected as part of the existing projects and / or GIS information from ACTFR, QDPI&F and CSIRO. Based on overlay of distribution and landscape condition data, critical landscape conditions and landscape hotspots that may influence distribution of invasives will be identified (Years 2-3).

Focus will be on species identified as of key concern in previous assessments conducted by stakeholders, e.g. WTMA, Terrain NRM Ltd, local government etc. Detailed surveys appropriate to the taxa will be used to document distribution for selected taxa and otherwise will rely on reporting through managers. Where feasible, impact studies will be designed appropriately for the identified taxa but may include comparative studies of community structure and functioning in infested and uninfested areas, studies of direct competition between species, comparative studies of economic and other costs.

Objective (d): Research into priority species and those identified in Objective (a)

This will involve research into the population and community ecology of invasives, including their impacts and control research as identified in the scoping study. Methods will vary according to the taxa and question. In the case of aquatic invasives, to evaluate the effectiveness of control and / or removal methods, we will implement several methods based on the outcomes of (1) the identification of critical invasion processes, and (2) critical landscape condition and landscape hotspots. Exact methods will depend on the outcomes of (1) and (2), but may include riparian rehabilitation, removal of fish barriers, and removal of aquatic weeds. These methods will complement methods already being considered by existing projects (NHT Pest Fish project (ACTFR) and Tilapia population modelling (QDPI&F)). Based on the outcomes of these studies, recommendations on the most efficient and effective control and/or removal methods for invasive fish will be made. (Year 2-4).

Project Targeted Activities (indicative only for out years)

Objective	Targeted Activity	Completion Date
CSIRO Modelling		
(b)	Refinement of isotropic model of population spread to allow assessment of the potential outcomes of management effort. Incorporates realistic, mechanistic, isotropic models of dispersal and the impact of control on patterns of spread given these. Model parameterised with dispersal data for <i>Miconia spp.</i>	Dec 2008
(b)	Prototype anisotropic model of invasive spread that incorporates landscape effects on recruitment and survival	Dec 2008
(c)	Completion of an anisotropic model for invasive spread, i.e. that incorporates landscape effects on the direction frequency of spread	Jun 2009
(b)	Trialling of isotropic model with management agency staff finalised	Mar 2009
(b)	Final isotropic model for use by management agencies	Jun 2009
(c)	Model refinement and finalization, application with end-users	Dec 2010
(b)	Incorporation of anisotropic model of population spread into management model to allow assessment of the potential outcomes of management effort. Incorporates realistic, mechanistic, anisotropic models of dispersal and the impact of control on patterns of spread given these	Sept 2009
(b)	Trialling with managers complete and model ready for application	Jun 2010
CSIRO Ecological		
(c)	Description of the distribution of invasives in complex rainforest landscapes	Dec 2008
(c)	Identification of invasive “hotspots” and of critical landscape features for invasive spread within landscapes.	Dec 2008
(c)	Functional classification of invasive plants that includes dispersal, recruitment niche and life history characteristics completed	Dec 2008
(c)	Identification of functional attributes of communities and landscape that influence susceptibility to invasion	Jun 2009
CSIRO Genetics		
(b)	DNA Extractions for natives and invasives continuing	Jun 2008
(b)	Supplementary collections continuing	Sep 2008
(b)	Descriptions of spatial patterns of invasive spread at landscape and regional scales to enable identification of source populations completed	Dec 2008
	Comparison of population genetic structure in native, non-Australian and Australian invasive range of <i>Miconia calvescens</i>	Dec 2008
(b)	Genetic descriptions of realised dispersal kernels completed and relationships with landscape and environmental features defined	Jun 2009
(c)	Testing of model predictions and description of genetic factors influencing incursion and establishment phases of incursions	Dec 2009
(b)	Description of the role of novel processes in invasive spread through a comparison of native and invasive dispersal population parameters finalised	June 2010

Objective	Targeted Activity	Completion Date
ACTFR		
(d)	Identification of distribution and control methods for invasive fish (continuing)	Jun 2008
(c)	Interim description of the distribution of invasive fish in rainforest landscapes, refinement of risk assessment model to allow confident discrimination between high and low risk fish species	Jun 2008
	Distributional data and associated environmental data to identify the environmental variables that may (i) limit or prevent spread, and (ii) contribute to or promote the spread of invasive fish	Jun 2009
(d)	Completion of assessment of control/removal methods for key invasives (Tilapia) leading to recommendations for the most efficient and effective control methods (JCU).	2010
QDPIF/ Terrain		
(c)	Conduct appropriately designed surveys for invasive fish and environmental variables in a focus catchment in the Wet Tropics to input into ANN	Dec 2008
	Broaden ANN to include these survey data, as well as spatial data layers on additional environmental variables that may affect invasive fish spread at catchment scale	Mar 2009
(c)	Broaden surveys to regional scale across Wet Tropics region to input into ANN	
	Broaden ANN to include these survey data, as well as spatial data layers on additional environmental variables that may affect invasive fish spread at regional scale	
	Prediction of presence, abundance and locations for control for invasive fish	
(c)	Final classification of landscape features influencing invasion in rainforest landscapes	Jun 2010

Project 2.6.2 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones [responsible agency listed in square brackets]	
Signing of contract	
Attendance y Project Leader at Operational Committee meetings (3 per year)	2008/2009
Verbal Progress Update to Operations Committee: - Review of progress in each sub-project and research plan for year two activities [CSIRO] - Contribution to CSIRO review of progress in each sub-project and research plan for year two activities [JCU] - Contribution to CSIRO review of progress in each sub-project and research plan for year two activities [FNQNRM] - Contribution to CSIRO review of progress in each sub-project and research plan for year two activities [DPIF] - Communication plan for year two activities and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [CSIRO with contributions from all] Written reports on: - Interim description of the distribution of invasive fish in rainforest landscapes with appropriate attribution of MTSRF funding [JCU]	Oct 2008

Refinement of risk assessment model to allow confident discrimination between high and low risk fish species [JCU]	
Pathway to Impact Report for end user relevance	Dec 2008
Report 2 submission - Distribution of invasive plants and critical landscape features for invasion [CSIRO] - Report on population genetic structure in native, and non-Australian and Australian invasive ranges with appropriate attribution of MTSRF funding [CSIRO] - Report on ANN prediction of distribution and abundance of invasive fish with appropriate attribution of MTSRF funding [QDPIF/Terrain] - Review of progress towards each objective – this will include - progress in invasive spread and management modeling - functional classification of weeds, - the impact of 'Weed Week' (run with QDNRM) on data collection and modification of the model, - summary of progress on invasion genetics - a progress report on data compilation from other projects (1.2.1 and 1.4.3) and on targeted work on aquatic pests [CSIRO] - Contribution to review being done by CSIRO of progress towards each objective [JCU] - Contribute to review being done by CSIRO of progress towards each objective [FNQNRM] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [CSIRO with contributions from all]	Feb 2009
Report 3 submission - Descriptions of realized dispersal kernels for Melastomes [CSIRO] - Review of progress towards each objective – this will include a summary of continued work on assessment of research needs, the current state of development of the predictive spread model, a progress report on data compilation from other projects (1.2.1 & 1.4.3) and on targeted work on aquatic pests [CSIRO] - Contribution to CSIRO review of progress towards each objective [JCU] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [CSIRO] - Plan for out year activities	May 2009
Total MTSRF Funding*	\$200,000

* Totals include \$3,500 Visual Documentation Allocation.

Project 2.6.2 Budget

Year 1 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	196,500	-	196,500
MTSRF Visual Documentation*	3,500	-	3,500
CSIRO	-	131,500	131,500
JCU	-	30,000	30,000
QDPI&F	-	15,000	15,000
Terrain NRM Ltd	-	20,000	20,000
Total	200,000	196,500	396,500

* A total of \$3,500 is held by the Reef and Rainforest Research Centre for Visual Documentation of this project (see Theme 5).

CSIRO Project 2.6.2 Budget 2008/2009

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	97,500		97,500
Operating	21,000	-	21,000
Travel	10,000	-	10,000
Communication / Extension		-	0
Capital	-	-	0
Institutional overheads	3,000	138,400	141,400
Total	131,500	138,400	269,900

JCU Project 2.6.2 Budget 2008/2009

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	26,000	27,000	53,000
Operating	3,000	1,000	4,000
Travel	1,000	-	1,000
Communication / Extension	-	-	0
Capital	-	-	0
Institutional overheads	-	2,000	2,000
Total	30,000	30,000	60,000

QDPI&F Project 2.6.2 Budget 2008/2009

Item	MTSRF Funds	QDPI&F In-kind	Total Cost
Salaries	12,000	15,000	27,000
Operating	1,500	-	1,500
Travel	1,500	-	1,500
Communication / Extension	-	-	0
Capital	-	-	0
Institutional overheads	-		0
Total	15,000	15,000	30,000

Terrain NRM Ltd Project 2.6.2 Budget 2008/2009

Item	MTSRF Funds	Terrain NRM Ltd In-kind	Total Cost
Salaries	7,500	13,600	21,100
Operating	7,500	-	7,500
Travel	5,000	-	5,000
Communication / Extension	-	-	0
Capital	-	-	0
Institutional overheads	-	3,000	3,000
Total	20,000	16,600	36,600

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	200,000		140,000		60,000	400,000

THEME 3

HALTING AND REVERSING THE DECLINE OF WATER QUALITY

Water quality is a key issue for North Queensland's environmental assets. Water quality is vital to the ongoing health of the Great Barrier Reef and the rainforest, and for the communities, industries and ecosystems that rely on good water quality in North Queensland's catchments. Research conducted will provide information for halting the decline of water quality entering the Great Barrier Reef lagoon by considering influences across catchments. The research conducted as part of this program will provide valuable information to assist the evaluation of the Reef Rescue Plan.

Budget Summary

Program	Title	MTSRF	Other Cash	In-kind	Total
Program 7	Water Quality	\$1,175,000	\$20,000*	\$1,601,912	\$2,796,912
Total		\$1,175,000	\$20,000*	\$1,601,912**	\$2,796,912

* Predicted cash co-investment.

** In-kind contributions still to be confirmed.

The total value of Theme 3 is \$2,796,912

PROGRAM 7

HALTING AND REVERSING THE DECLINE OF WATER QUALITY

Program Leaders and Host Organisations

Dr Katharina Fabricius, Australian Institute of Marine Science (AIMS)

Professor Richard Pearson, James Cook University (JCU)

Professor Iain Gordon, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Budget Summary

	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
MTSRF	\$1,175,000	-	\$1,175,000
Other	\$20,000*	\$1,601,912**	\$1,621,912
Total	\$1,195,000	\$1,601,912	\$2,796,912

* Predicted cash co-investment.

** In-kind contributions still to be confirmed.

The quality of water entering the Great Barrier Reef (GBR) lagoon has been declining and is negatively affecting the condition of GBR ecosystems. There is urgent need to increase certainty about the effectiveness of actions taken under the Reef Water Quality Protection Plan (Reef Plan) and those to be taken under the Reef Rescue Plan, as well as for improved scientific understanding of how the condition of freshwater, estuarine and marine ecosystems are linked to terrestrial processes. The Water Quality Program consists of three main areas:

- Marine and estuarine water quality;
- Freshwater water quality; and
- Economic and social frameworks for water quality.

The main outcome of this Program is to further identify robust indicators for water quality in freshwater, estuarine and marine ecosystems which will enable the development of tools to improve water quality specific monitoring and determine pollutant thresholds of potential concern for exposure of key ecosystems to sedimentation, light, nutrients and herbicides. The program will also develop improved approaches for the estimation of end of river loads and guidance on the appropriate mechanism by which the load of pollutants entering the Reef can be estimated. The approach will be tested for use in identifying priorities for the Reef Rescue Plan.

The program will also develop catchment-specific tracers for improved understanding of the links between terrestrial and marine water quality, and for identification of GBR lagoon areas at greatest risk of exposure to land-based pollutants. The tracer project will characterise and obtain a distinct isotopic, elemental, physical and mineralogical “fingerprint” of the fine sediments (mud fraction) delivered to GBR within selected Wet Tropics and Dry Tropics catchments.

In addition the program will further develop predictive tools to enable the impacts of changes in land use, management and climate on the flow and water quality regimes and ecological dynamics in the wetlands and floodplains of catchments adjacent to the GBR. There is a considerable gap in our current understanding of ecological connectivity between coastal wetlands and Reef and the impact declining water quality has on this important linkage.

Two projects conducted as independent processes in year one was brought together in year two to strengthen the delivery and outcomes for end user needs regarding social and economic considerations for improving water quality in the GBR. The amalgamation of these critical research components has resulted in greater benefit from work conducted by enabling stronger linkages between catchment based activities, water quality and climate to be established. The third year of the program will explore sustainable environmental targets and associated land use and land management patterns in linked terrestrial and marine ecosystems in the Dry Tropics. This will include the assessment of instruments promoting the adoption of land use and land management patterns.

The risk, resilience and response atlas will provide a mechanism by which data collated through this program can be assimilated with other data sources and interpreted for relevant management and reporting needs for water quality in the Great Barrier Reef.

Projects

3.7.1	Marine and estuarine indicators and thresholds of concern	\$300,000
3.7.2	Connectivity and risk: tracing materials from the upper catchment to the reef	\$275,000
3.7.3	Freshwater indicators and thresholds of concern	\$175,000
3.7.4	Wetlands and floodplains: connectivity and hydro-ecological function	\$175,000
3.7.5	Socio-economic constraints to and incentives for the adoption of land use and management options for water quality improvement	\$150,000
3.7.6	(This project has been amalgamated with Project 3.7.5 and activities and funding for this project now sit under that project heading).	Nil
3.7.7	Analysis and synthesis of information for reporting credible estimates of loads for compliance against targets and tracking trends in loads.	\$100,000

PROGRAM 7: HALTING AND REVERSING THE DELINE OF WATER QUALITY**Project 3.7.1: Marine and estuarine indicators and thresholds of concern****Project Leader and Host Organisation**

Dr Katharina Fabricius, Australian Institute of Marine Science (AIMS)

Project Team 2008/2009

Title	Organisation	Role	FTE
Katharina Fabricius	AIMS	Program leader, Researcher, coral reef ecology	0.3
Sven Uthicke	AIMS	Researcher, biofilms	1.0
Craig Humphrey	AIMS	Researcher, biomarkers and ecology, support	0.6
Andrew Negri	AIMS	Researcher, biomarkers, ecotoxicology	0.1
PhD student	AIMS	Biofilms	1.0
Marcus Sheaves	JCU	Researcher, estuaries	0.1
Rod Connolly	GU	Researcher, estuaries	0.1
Len McKenzie	QDPI&F	Researcher, seagrasses	0.1
Andrew Moss	EPA	Advisor, researcher	0.1

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GBRMPA	Laurence McCook
DEWHA	Kevin Gale, Olga Braga
Reef Water Quality Partnership	Rachel Eberhard
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
Queensland Canegrowers	Tim Wrigley
WWF	Nick Heath
FBA	Nathan Johnson
MWNRM	Carl Mitchell

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project is developing a system of indicators to monitor changing water quality in the estuarine and marine environment.

Years 1 and 2 were used to complete a series of field studies and reviews prioritising potential marine and estuarine indicators, and to determine dose-response relationships and thresholds of potential concern in selected bioindicators to pollutant exposure. In Year 3 we will continue working on dose-response relationships and validating proposed thresholds, and will test the validity of the proposed indicators on a large number of inshore reefs including those of the Reef Plan Monitoring Program. The biofilm component will focus on finetuning benthic foraminifera as WQ indicators by experimental work, hindcasting and validation with the RMP data. In addition, more detailed studies on microbial bioindicators will commence. We will also continue our field trials of estuarine indicators.

Our Key Objectives are to:

- (a) Develop a composite bioindicator system based on biofilms for improved monitoring of water quality and for hindcasting past water quality conditions.
- (b) Identify dose-response relationships and tolerance thresholds in key coral reef measures to specific changes in rates of sedimentation, light, nutrients and herbicides.
- (c) Identify and operationalise indicators for seagrass condition in response to changing water quality.
- (d) Identify and operationalise estuarine indicators for ecosystem condition.

Project / Task Methodology

Objective (a): Develop an indicator system based on benthic biofilms for improved water quality monitoring in the GBR.

Progress: The first year of this project was used to identify and review organism groups in biofilm that consistently change along water quality gradients (bacterial biofilms on sediments, microphytobenthos layers on sediments, and foraminifera on sediment and other reef substrata).

In Year 2, we have focussed on further developing benthic foraminifera as indicators. We have investigated foraminifera measures indicating specific changes along water quality gradients. Specifically, the effects of light and nutrients on growth, mortality and photosynthesis were tested for several foraminiferan species in the laboratory. We have also completed the analyses of the foraminifera samples collected by the Reef Plan Monitoring Program to investigate spatial patterns across 30 nearshore reefs. These data are now available for three years of monitoring and the usefulness of this indicator can be tested by comparison with water quality, sediment and coral community data.

A method to transplant and measure individual foraminifera in the field has been developed and is now used in ongoing field experiments, measuring the same response parameters as in the laboratory. This work is complemented by testing changes in foraminiferan communities in sediment cores to test if these reflect changes in land use in the GBR catchment. Experiments designed to identify thresholds of potential concern for pollutant exposure for individual organism groups and biofilm communities are ongoing. We have also conducted further field studies to identify bacterial communities specific to high nutrient/low light conditions. This work in conjunction with our previous studies has now provided further leads for the development of microbial indicators.

In Year 3 we will conduct further experimental work in the laboratory and in situ to establish which stressors influence foraminiferan distribution. This will result in improved knowledge on the thresholds of potential concern for pollutant exposure for individual organism groups and biofilm communities.

We will continue our trial to hindcast changes in water quality over up to 200 years, by analysing changes in foraminiferan communities in dated sediment cores. We will also continue to work on interactions between water quality parameters and global warming by manipulating both temperature and water quality parameters in aquarium experiments. In addition, supported by a MTSRF funded PhD student, we will investigate the interactive effects of pesticides and global change on benthic foraminifera.

In the Years 3 we will also continue to test bacteria in biofilms as indicators for water quality. Our initial results have shown distinct differences in microbial communities in inshore and offshore waters, both in sediments and artificial substrates. In year 3 and 4, supported by a PhD student, we will focus on microbial work on previously identified target groups and will conduct monitoring and experimental work of these target groups.

Year 4 will be used to summarise results from the foraminifera work to result in final recommendations about this group as WQ indicator. These recommendations will take into consideration results from experiments, field monitoring, cross validation with the RMP data and results of the hindcasting. Experimental and field work will focus on the microbial indicators.

The project closely collaborates with the Reef Plan Marine Monitoring Program to maximise the use of the inshore monitoring data. We will develop protocols to optimize inshore monitoring programs, identify thresholds and develop and field test monitoring protocols. We will also cross-link to the Tracers Project to assess present-day and past water quality conditions based on *Porites* skeleton cores.

Objective (b): Coral indicators for ecosystem condition

Progress: Years 1 and 2 have been used to identify and review suitable indicator measures in corals and reef communities that consistently change along water quality gradients in the field at response times of days (gene expression and physiology), to weeks or months (populations responses), and years (community responses). We have determined concentration-response relationships of key species in the AIMS controlled environment aquarium facility using environmentally relevant exposures and ecotoxicological protocols. We have reviewed the literature on water quality indicators, and tested a long list of priority indicators along the Whitsundays water quality gradient. This resulted in eight priority indicators being recommended for further testing in other NRM regions and laboratory validation experiments.

In Year 3, we will investigate the consistency of the eight priority indicators across the six regions along the GBR, and will relate indicator values and other ecosystem measures to the water quality data and risk maps that are currently under development through 1.1.5. We will measure the priority indicators and water quality on most of the 30 Marine Monitoring Program reefs plus selected additional reefs to investigate longer water quality gradients. This will allow us to identify the most ecologically relevant water quality variables and the most useful biotic responses, and validate the water quality risk maps developed in the Reef Atlas. We will also compile, review and analyse quantitative data on the main life history stages of coral recruitment as the potentially most sensitive life history stage for reef models. A 2-weeks field trip will be conducted jointly with the inshore Reef Plan Marine Monitoring Program team, to combine benthic and indicator data and to maximise the use of the inshore benthic and water quality monitoring data. We will also develop and test the practicality of monitoring protocols for future use by monitoring programs.

In Year 4, we will complete the research determining thresholds of potential concern and concentration-dependent responses in key species in controlled experiments, rank and combine the indicators and feed the results into the Reef Atlas.

We will report on concentration-response relations in coral reef organisms (corals, macroalgae) to various types of changes in water quality, incl. identification of response times and limiting factors for each of the potential indicator groups. We will complete the identification of critical levels of major water pollutants (“thresholds of potential concern”) for major ecosystem components (biofilms, reef organisms, seagrasses, estuarine organisms), and disseminate optimised monitoring methods based on novel and improved indicators for water quality and ecosystem conditions.

Objective (c): Indicators for seagrass condition in response to changing water quality

Proposed work for Year 3: We will use the funds to integrate our research in MTSRF Task 1.1.3 with Task 3.7.1 and Task 1.1.5, by contributing to analyses and interpretation of mapping, monitoring and experimental data, with a focus on identifying physiological, morphological, community measures and indicators of meadow resilience in response to changing water quality. This proposed research directly addresses the GBRMPA ‘critical’ research issue “What are the critical levels of major water pollutants (nutrients, sediments, agricultural and other chemicals) on seagrass beds i.e. pollutant load-impact relationships?” and “What are the trends in the condition of major habitat types in the GBRMP and what human and natural factors influence those trends?”.

Objective (d): Estuarine indicators for ecosystem condition

Progress: After a detailed literature review to identify the current knowledge and determine potentially useful indicators of estuarine health (conducted in Year 1), we used Year 2 to develop research strategy and started sampling in 11 estuarine areas with contrasting biophysical characteristics, in line with characterisation in the OzEstuaries data base as near pristine, modified and highly modified. Sampling is designed to evaluate and develop process-level indicators of ecosystem condition, in particular 1) success of nursery ground provision, 2) health of juveniles at the end of nursery ground residence, 3) spawning success, 4) food web integrity and functioning, 5) the integrity of crucial functional guilds: detritivores, benthivores, scavengers. Although sampling in January and February 2008 was disrupted by floods we collected substantial data sets in November 2007, December 2007 and March 2008 and limited data in February 2008. Data analysis is well underway with a large amount of laboratory time dedicated to sorting with 29,284 animals sorted to date. Additional research students (1 honours, 2 MAppSci (leading in to MSc)) have been included in the project to ensure the pace of field and laboratory work is maintained.

In Year 3 we will complete an annual cycle of sampling (to March 2009) and complete laboratory sorting, stable isotope analysis, statistical analysis and model building (data rich Bayesian Belief Networks). Running the cycle to March 2009 should ensure a full year of data for recruitment and trophic studies. Due to the large volume of data substantial time will be devoted to laboratory analysis. This requires the largest allocation of time of any aspect of the project so although samples will be collected on a monthly periodicity initially laboratory analysis will be confined to a 2 monthly periodicity and additional sample stored for targeted analysis at the end of the project. This is necessary because of the extensive time required for this component relative to the resources available.

In Year 4, we will evaluate the success of the models, by application of the methods and models to a series of estuaries not included in the initial investigation. This group will include degraded sites where the reasons for degradation are unknown, because these will allow the models to be tested for their abilities to suggest reasons for the degradation.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Field testing and analysis of marine biofilms (bacteria, diatoms, foraminifera) for their suitability to indicate changes in water quality. [AIMS]	June 2009
(b)	Field testing and analysis of coral reef organisms and physiological change tested for their suitability to indicate changes in water quality and ecosystem condition. [AIMS]	June 2009
(c)	Contribution to research on seagrass communities and their responses to changing environmental conditions along the Queensland coast. [QDPI]	June 2009
(d)	Conduct research towards identifying potentially useful ecological indicators of the condition of North Queensland's estuaries [JCU, GU]	June 2009

Project 3.7.1 Milestone Payments 2008/2009

	Date
Milestones	
Project leader to attend Water Quality Operation Committee Meetings (3 meetings/year)	2008/09
Report 1 submission - Progress update for activities listed against objective (a) and (b) [AIMS] - Complete field and laboratory work for objective (d) (above) [JCU, GU] - Progress update for objective (d) (above) [JCU, GU] - Summary of any liaison activities undertaken to date. [AIMS]	1 November 2008
Pathway to Impact Report for end user relevance	30 December 2008
Report 2 submission - Progress update for activities listed against objectives (a) and (b) (above). [AIMS] - Complete field work for the activity listed against objective (b). [AIMS] - Progress update for objective (c) (above). [QDPI] - Complete statistical analysis and model construction for objective (d) (above) [JCU, GU] - Commence work on evaluation studies for objective (d) [JCU, GU]. - Progress update for activities listed against objective (d) [JCU, GU]. - Summary of any liaison activities undertaken to date. [AIMS]	1 Mar 2009
Report 3 submission - Complete Final Report on progress in the development of foraminifera and bacteria in biofilms as indicators for reef health (objective a) with appropriate attribution of MTSRF funding. [AIMS] - Complete laboratory analyses and data processing for the activity listed against objective (b). [AIMS] - Final report on the use of coral physiology and reef ecosystem properties as indicators of changing water quality (objective b), with appropriate attribution of MTSRF funding. [AIMS] - Complete report on development of indicators (eg sediments, epiphytes and reproductive success) for seagrass health (objective c) with appropriate attribution of MTSRF funding. [QDPI]. - Complete final report / publication on for objective (d) with appropriate attribution of MTSRF funding. [JCU, GU]. - Final summary of liaison activities undertaken through course of year 1 of project. [AIMS]	15 June 2009
Total MTSRF Funding	\$300,000

* Total includes \$2,000 held for Visual Documentation.

Project 3.7.1 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	298,000	-	298,000
MTSRF Visual Documentation*	2,000	-	2,000
AIMS	-	537,490	537,490
JCU	-	30,000	30,000
GU	-	30,000	30,000
Total	300,000	597,490	897,490

* A total of \$2,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

AIMS Project 3.7.1 Budget 2008/2009

Item	MTSRF	AIMS In-kind	Total Cost
Salaries	173,000	101,500	274,500
Operating*	75,000		75,000
Travel (32 days of RV Cape Ferguson)	-	171,600	171,600
Communication / Extension	-	30,000	30,000
Capital	-	-	0
Institutional overheads	-	234,390	234,390
Total	248,000	537,490	785,490

* This includes \$26,700 for a student stipend, \$10,000 operationals for the student project, \$10,380 for field and diving allowances, as well as ongoing operational costs for the group including costs for isotope, genetic and nutrient analyses).

QDPI&F Project 3.7.1 Budget 2008/2009

Item	MTSRF	QDPI&F In-kind	Total Cost
Salaries	-	-	-
Operating	10,000	-	10,000
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	10,000	-	10,000

JCU Project 3.7.1 Budget 2008/2009

Item	MTSRF	JCU In-kind	Total Cost
Salaries	10,000	10,000	20,000
Operating	10,000	10,000	20,000
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	10,000	10,000
Total	20,000	30,000	50,000

GU Project 3.7.1 Budget 2008/2009

Item	MTSRF	GU In-kind	Total Cost
Salaries	10,000	10,000	20,000
Operating	10,000	10,000	20,000
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	10,000	10,000
Total	20,000	30,000	50,000

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	300,000	122,000	555,500	440,000 ^{#2}	623,000 ^{#3}	2,040,500
Total	300,000	122,000	555,500	440,000 ^{#2}	623,000 ^{#3}	2,040,500

#1 Twenty days' ship time.

#2 Other end-user co-investment.

#3 Additional research provider in-kind and cash should co-investment be available.

PROGRAM 7: HALTING AND REVERSING THE DELINE OF WATER QUALITY***CURRENTLY BEING BROKERED*****Project 3.7.2: Connectivity and risk: tracing materials from the upper catchment to the reef****Project Leader and Host Organisation**

Mr Jon Brodie, James Cook University (JCU)

Project Team 2008/2009

Title	Organisation	Role	FTE
Katharina Fabricius	AIMS	Researcher, reef ecology	0.1
Craig Humphrey	AIMS	Researcher, field and lab support	0.4
Oceanographic technician	AIMS	Field support	0.18**
Eric Wolanski	AIMS	Researcher, oceanography	(through service contract)**
Jon Brodie	JCU	Project leader, researcher	0.1
Stephen Lewis	JCU	Researcher, biogeochemistry	0.55
Zoë Bainbridge	JCU	Researcher, geomorphology	0.1
Malcolm McCulloch	ANU	Researcher, coral geochemistry	0.2

** Funded through GBRMPA co-contribution (E. Wolanski & 0.08 FTE of the oceanographic technician)

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GBRMPA	Laurence McCook
DEWHA	Kevin Gale
CAS	Olga Braga
Reef Water Quality Partnership	Rachel Eberhard
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
Queensland Canegrowers	Tim Wrigley
WWF	Nick Heath

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

The principal objectives of this project are to assess the risk to GBR ecosystems from the various land-sourced pollutants entering the GBR. Risk will be assessed by establishing explicit links between the sources of pollutants within catchments (land uses, land management practices), delivery of these materials to the river mouths (including trapping and transformation processes) and transport of the materials in the GBR lagoon (including trapping, transformation and storage regimes). Thus exposure of GBR ecosystems (particularly coral reefs, seagrass meadows, mangrove forests and the water column ecosystem) to land-sourced pollutants can be determined and, in combination with the known toxicities/effect concentrations of the pollutants, risk can be assessed.

The project will characterise and obtain a distinct “fingerprint” of the fine sediments (mud fraction) entering the marine environment, using their isotopic and elemental properties, and link these to the sediment sources of the major terrestrial catchments. It will also examine historical changes in the delivery of terrestrial materials from the major river systems in the Rockhampton-Cairns region to the marine environment using coral and sediment cores. This will involve determining transport mechanism, residence time and fate of terrigenous materials in the floodplains, estuaries, inshore reefal areas and mid-shelf regions of the Great Barrier Reef, and develop and apply new technologies to specifically trace pathways of the key nutrient elements phosphorus and nitrogen from the terrestrial catchments, through estuaries, inshore coastal zones to the mid-shelf of the Great Barrier Reef.

Key Objectives:

- (a) Tracing of materials in the terrestrial environment – generation, transport, transformation, trapping.
- (b) Tracing of materials in the marine environment – transport, transformation, trapping, fate.
- (c) Inshore-offshore sediment transport in the Wet Tropics – relationships between sediment input and transport and regional turbidity regimes.

Project / Task Methodology

Objective (a): Tracing of materials in the terrestrial environment

The key tasks for this objective are:

- Characterise and obtain a distinct “fingerprint” of the fine sediments (mud fraction) delivered to the inshore regions of the Great Barrier Reef within the Burdekin and selected wet tropics catchments (Herbert, Tully, Johnstone and Russell-Mulgrave).
- Trace the transport and extent of the each sediment type and nitrate through the main tributaries of the Burdekin and selected wet tropic catchments in the Townsville Cairns region
- Determine the sediment trapping capacity of estuaries and coastal zones as well the effects of the Burdekin Falls Dam during major flow events.

Sediments will be collected from different soil and rock types as well as from the major stream channels within the Burdekin River catchment and from selected wet tropics rivers between Townsville and Cairns. Suspended sediments will also be recovered from the tributaries of the Burdekin River catchment. The composition of Sr–Nd and other isotopes of tracing potential in the Burdekin River sediments will be measured at Centre for Microscopy and Microanalysis (CMM: University of Queensland) and Research School of Earth Sciences (RSES: Australian National University) laboratories. The $^{87}\text{Sr}/^{86}\text{Sr}$ isotopic ratio of sediments

is mainly controlled by age while the $^{143}\text{Nd}/^{144}\text{Nd}$ and other isotopic ratios are influenced by both the composition of the source rock (e.g. basalt rocks contain a different isotope signature to granites) as well as the age. These isotope tools coupled with the trace element composition and clay mineralogy provide a powerful tool to fingerprint different sediment types and to trace and quantify sediment transport through river catchments. This technique (Nd-Sr) has been applied successfully in the Johnstone River and offshore reefs (McCulloch et al., 2003b) and the Murray-Darling fluvial system (Gingele and De Deckker, 2005). The trace element composition of the sediments will also be determined using XRF and ICP-MS at the Advanced Analytical Centre AAC (JCU), CMM and at the RSES. Particular elements (e.g. Ti, Zr, Ca, K) and elemental ratios (Rb/Sr, Zr/Hf, Y/Ho, Th/Tl, Th/W) provide a useful complementary tool to trace sediment through a large river system.

The sediments will be collected and sieved to recover the mud fraction ($< 63\ \mu\text{m}$) which will be used exclusively to trace the transport of fine sediments throughout the Burdekin. The particle size of this mud fraction (proportion of silt, clay and colloidal particles) will be determined on a Melvin Mastersizer® in the School of Earth Sciences, James Cook University (JCU). X-ray diffraction in conjunction with the Siroquant® program will be employed to determine and quantify the mineralogy of the sediments and, in particular the relative proportion of the major clay minerals (chlorite, smectite, kaolinite and illite) in the sediments. This analysis will be performed at the AAC, JCU.

Personnel: *Stephen Lewis, Jon Brodie, Zoë Bainbridge, Malcolm McCulloch*

Objective (b): Tracing of materials in the marine environment.

The key tasks for this objective are:

- Examine historical changes in the delivery of terrestrial materials from the major river systems in the Townsville-Cairns region to the marine environment using coral and sediment cores
- Characterise and obtain a distinct “fingerprint” of the fine sediments (mud fraction) in the marine environment using their isotopic and elemental properties and to link these to the sediment sources of the major terrestrial catchments
- Determine the transport mechanism, residence time and fate of terrigenous sediments in the inshore as well as mid-reef regions of the Great Barrier Reef.

It is planned to undertake a comprehensive sampling of Porites corals in the Townsville-Cairns region in 2006-2008 and again in 2010 to provide quantitative constraints on the effectiveness of the Reef Water Quality Protection Plan. These will complement the AIMS collection made in the mid – 1980's with the new cores covering the last 20 -50 years of river discharge. Coral cores will be analysed using the state-of-the-art laser ablation analyses only possible at ANU, in conjunction with the study at AIMS of the distinctive luminescent lines that are a result of low salinities from flood plumes. In addition to the already well described Ba method (McCulloch et al., 2003a) measurements of ^{15}N isotopes in coral cores and luminescent lines will be undertaken at ANU to provide a novel technique to examine changes in sediment and nutrient sources from the major rivers. The isotopic composition (Sr-Nd) of suspended sediment actually reaching coral reefs will also be determined and compared the compositions of material from the various river sources. This approach will then be applied and other wet tropics catchments in the Townsville-Cairns region

Burdekin, Fitzroy, Herbert, Tully, Johnstone and Russell-Mulgrave river flood plumes will be sampled on an opportunistic basis and suspended sediments and dissolved materials will be recovered along a salinity transects. The isotopic, elemental and mineralogical properties of these materials will be measured according to the methods outlined in Task 1 and linked to a sediment source within the river catchments. In addition, routine collection (weekly) of water samples will be undertaken from both the AIMS and Orpheus Island Research station in order to obtain a long-term 'baseline' record of water quality and trace element composition of the inner Great Barrier Reef waters covering both wet as well as dry seasons. Water samples will be also taken within the flood plume to measure the isotopic, trace element and nutrient compositions of the dissolved components of the flood plume along a salinity transect. This analysis will investigate sediment desorption within the estuarine and flood plume mixing zone.

Personnel: Malcolm McCulloch, Stephen Lewis, Jon Brodie, Zoe Bainbridge, Katharina Fabricius

Objective (c): Inshore-offshore sediment transport in the Wet Tropics

This task aims at determining transport mechanisms for fine particulate matter from river mouth to inshore and offshore reefs in the Wet Tropics section of the GBR lagoon. It aims at answering the question "Does increased SS load due to increased erosion from agricultural and urban development in major rivers lead to increased regional turbidity generated by resuspension in inshore areas of the GBR lagoon (with depths generally less than 10m)?" This old question argued over by geologists/physicists (Larcombe, Ridd and colleagues) and biologists/oceanographers/geochemists (Wolanski, Fabricius, McCulloch and colleagues) is critically in need of a definitive answer if we are to justify our strategies to reduce erosion on GBR catchments as a major RWQPP action. In Year 1 we quantified transport dynamics within the January flood plume off Tully River. We collected data on the transport of riverine mud to coastal reefs, the formation of a nepheloid layer as suspended sediment settled out from the river plume, the loss of light during that flood plume around reefs, and the resuspension of that 'fresh' mud by storms and its subsequent cross-shelf and longshore transport and sedimentation on reefs. In Year 2, we started determining the longevity of this 'fresh' riverine mud and its progressive flushing in the wet tropics. We have set up arrays of nephelometers, wave gauges and current meters off the Tully and Murray Rivers focusing on Dunk and Bedarra Islands, and off the Burdekin and Houghton Rivers focusing on Cape Bowling Green and Cape Cleveland.

In Year 3, we will continue maintaining the instrument arrays throughout the coming dry and wet seasons and serviced 6-weekly. We will quantify temporal and spatial patterns in resuspension and deposition dynamics in response to wind and riverine inputs, and quantify the resulting water clarity and sedimentation regimes. We will also start developing a model that integrates the wet and dry season data from this study to quantify the spatial extent and duration of increased water turbidity over corals in the wet tropics coral reefs from river runoff during the year.

Personnel: Craig Humphrey, Oceanography technician, Eric Wolanski, Katharina Fabricius

Objective (d): Hazard mapping and information gathering for the Reef Rescue Plan.

This project will gather information to identify assets in the GBR region and also to identify the water quality risks to these assets. This process will enable the characterisation and mapping of the source areas (within catchments) for these threats. This information will be used to help support the Reef Rescue Investment Plan.

Personnel: Jon Brodie

Objective (e): *Yet to be established*

CSIRO did not receive the internal funding to support this area of research in 2008/09. The quantum of work to be undertaken as part of this project is currently unbrokered. Discussions with the Steering Committee will help decide the allocation of these funds in 2008/09.

Personnel: To be identified

Project Outputs / Milestones 2008/2009

Objective	Targeted Activity	Completion Date
(a&b)	Technical report on pesticide tracing in the Great Barrier Reef Catchment Area and lagoon	November 2008
(a)	Report on 2008 wet season event flow sampling in the Burdekin catchment including particle size analysis.	November 2008
(a)	Final report on Burdekin Falls Dam trapping.	November 2008
(a)	Preliminary results from suspend sediment tracing in the Burdekin River catchment.	April 2009
(a)	Report on the collection of suspended sediment, nutrient and pesticide samples from selected tributaries of the Burdekin River in wet season flow including above and below Burdekin Falls Dam	April 2009
(b)	Report on collection and analysis of coral core samples of Porites corals in the Townsville -Cairns region in 2008.	November 2008
(b)	Report on the results from coral coring in the Townsville-Cairns region.	April 2009
(c)	Maintain two transects with arrays of oceanographic instruments off Tully and of Townsville	June 2009
(c)	Progress report on temporal dynamics in resuspension and fine sediment transport of river-derived materials	June 2009
all	Plan of communication outputs and products for year one and summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable.	November 2008

Project 3.7.2 Milestone Payments 2008/2009

For 2008/2009 outputs only	Date
Milestones	
Signing of contract	
Project leader to attend Water Quality Operation Committee Meetings (3 meetings/year)	2008/09
Report 1 submission - Technical report on pesticide tracing in the Great Barrier Reef Catchment Area and lagoon with appropriate attribution for MTSRF funding (JCU) - Report on 2008 wet season event flow sampling in the Burdekin catchment including particle size analysis with appropriate attribution for MTSRF funding (JCU) - Plan for information gathering and synthesis for water quality hazard mapping for Reef Rescue Plan - Final report on Burdekin Falls Dam trapping (JCU) - Report on collection and analysis of coral core samples of Porites corals in the Townsville -Cairns region in 2008 with appropriate attribution for MTSRF funding (ANU, JCU). - Plan of communication outputs and products for year three and summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable (JCU) - Progress report on the maintenance of 2 instrument arrays in the Wet Tropics and off Townsville (AIMS)	1 Nov 2008
Pathway to Impact report for end user relevance completed	30 Dec 2008
Report 2 submission Report on water quality hazard mapping and information for Reef Rescue Plan [JCU]	15 Jan 2009
Report 3 submission - Preliminary results from suspended sediment tracing in the Burdekin River catchment (JCU) - Preliminary results from coral coring in the Townsville-Cairns region in 2008 (ANU, JCU) - Report on the collection of suspended sediment, nutrient and pesticide samples from selected tributaries of the Burdekin River in wet season flow including above and below Burdekin Falls Dam (JCU) with appropriate attribution for MTSRF funding (JCU).	2 April 2009
Report 4 submission - Progress report on temporal dynamics in resuspension and fine sediment transport of river-derived materials (AIMS) - Final report on water quality hazard mapping and information for Reef Rescue Plan [JCU]	10 June 2009
Total MTSRF Funding**	\$170,500

* Total excludes \$1,500 held by Reef and Rainforest Research Centre for Visual Documentation.

^ These milestone payments totalling \$10,000 are ARP2 funds reallocated as approved by DEWHA.

Project 3.7.2 Budget Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	273,500**	-	273,500
MTSRF Visual Documentation*	1,500	-	1,500
MTSRF (ARP2 reallocation) ^	10,000	-	10,000
JCU	-	200,000	200,000
AIMS	-	105,217	105,217
ANU	-	80,000	80,000
UNSW@ADFA	-	60,000	60,000
Total**	285,000	445,217	730,217

* A total of \$1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5)

^ The \$10,000 for report 2 are ARP2 funds reallocated as approved by DEWHA.

** The financial components for objective d and e (\$55,000) remains unbrokered at this stage

AIMS Project 3.7.2 Budget 2008/2009

Item	MTSRF	GBRMPA	AIMS In-kind	Total Cost
Salaries	56,000	20,000	25,826	101,826
Operating	4,000			4,000
Travel (Research Vessel)	6,000		27,000	33,000
Communication / Extension				0
Capital				0
Institutional overheads			52,391	52,391
Total **	66,000	20,000	105,217	191,217

JCU Project 3.7.2 Budget 2008/2009

Item	MTSRF	JCU In-kind	Total Cost
Salaries	132,790	83,500	216,290
Operating	35,590	20,500	56,090
Travel	2,120	17,500	19,620
Communication / Extension	-	7,000	7,000
Capital	-	-	-
Institutional overheads	-	71,500	71,500
Total	170,500	200,000	370,500

ANU Project 3.7.2 Budget 2008/2009

Item	MTSRF	ANU In-kind	Total Cost
Salaries	30,000	33,500	63,500
Operating	15,000	8,200	23,200
Travel	2,000	7,000	9,000
Communication / Extension	-	2,700	2,700
Capital	-	-	-
Institutional overheads	-	28,600	28,600

Total	47,000	80,000	127,000
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Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	275,000	-	555,000	-	400,000*	1,230,000

Future Deliverables

The future major deliverables from Project 3.7.2 will consist of answers to major questions facing water quality management on the GBR Catchment. A number of the most important of these follows:

1. Only a small proportion (perhaps 5%) of the suspended sediment (SS) load of major rivers is transported large distances in the marine environment during major discharge events (evident from satellite images and flood plume monitoring). What is the specific origin in catchments of this small, but high risk, component and how do geology, soil type and land management practices interact to produce this presumably fine grained, non-settling suspended sediment? Areas of catchments producing this component of the SS load will be of high management priority.
2. Does increased SS load due to increased erosion from agricultural and urban development in major rivers lead to increased regional turbidity generated by resuspension in inshore areas of the GBR lagoon (with depths generally less than 10m)? This old question argued over by geologists/physicists (Larcombe, Ridd and colleagues) and biologists/oceanographers/geochemists (Wolanski, Fabricius, McCulloch and colleagues) is critically in need of a definitive answer if we are to justify our strategies to reduce erosion on GBR catchments as a major RWQPP action.
3. Is the Burdekin Fall Dam a highly efficient SS trap as predicted by the SedNet model with predicted trapping of 75% of inflow SS on a long-term basis? If this is the case then there is no priority to manage soil erosion above the Dam to protect the GBR from SS delivery as little of this SS will ever reach the river mouth. If however the Dam is only a low efficiency trap (as suggested from some limited monitoring data) then management of these areas above the Dam (the majority of the area of the Burdekin catchment) may still be a priority for GBR water quality management.

PROGRAM 7: HALTING AND REVERSING THE DECLINE OF WATER QUALITY***Project 3.7.3: Freshwater indicators and thresholds of concern*****Project Leaders and Host Organisations**

Professor Richard Pearson, James Cook University (JCU)

Professor Angela Arthington, Griffith University (GU)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Richard Pearson	JCU	Joint project leader; aquatic ecologist	0.40
Regina Camacho	JCU	Invertebrate ecology	1.00
Angela Arthington	GU	Joint project leader; aquatic ecologist	0.30
Brad Pusey	GU	Fish ecologist	0.05
Paul Godfrey	GU	Fish and general aquatic ecologist	0.75
Jim Wallace	CSIRO	Hydrologist, link to Project 3.7.4	0.05

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GBRMPA	Laurence McCook
DEWHA	Kevin Gale
Reef Water Quality Partnership	Rachel Eberhard
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
Queensland Canegrowers	Tim Wrigley
WWF	Nick Heath

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

In Year 1 we developed conceptual biophysical models to identify (i) appropriate indicators of waterway health and (ii) probable thresholds of concern, in terms of contaminant concentrations, ecological processes and biodiversity. In Year 2 we have extended our testing of those indicators in waterways in the Wet Tropics, so that they can be implemented in fully functional monitoring systems as part of Integrated Reporting. In Year 3 we will continue to develop monitoring protocols for Wet Tropics wetlands. Subject to supplementary funding, we will also progress development of our program in the Dry Tropics.

We will build on the Catchment to Reef program, which has concentrated on sampling design, methodology and data analysis, and has produced understanding of the

requirements of an indicator system. We now aim to fully develop that indicator system. We will provide methods and protocols for monitoring and will feed the essential scientific methodology into the Integrated Reporting processes.

The generality of the results of this project will depend on the level of co-investment attracted, which will govern the number of systems in which model and indicator testing can be undertaken, and will determine the scope of laboratory testing of indicators. In Year 3 we will continue to focus on field work in the Wet Tropics, but will commence work in the Dry tropics if appropriate funding is forthcoming. We expect to have student involvement in the ecology of Dry Tropics systems, essentially kick-starting our program there.

Key Objectives:

- (a) Conduct field and laboratory research to develop physical, chemical and ecological indicators of freshwater ecosystem health in the Wet and Dry Tropics as part of Integrated Water Quality Reporting that meets end-user needs and objectives.
- (b) Identify thresholds of potential concern relating to land use, water quality, riparian condition, habitat, biodiversity and food web structure in freshwater ecosystems of the Wet and Dry Tropics.
- (c) Train new researchers via postgraduate programs that will be integral to the identification and testing of efficient and effective freshwater condition indicators in the Wet and Dry tropics.
- (e) Provide monitoring methods, manuals and guidelines of relevance to a range of skills and end users.

Project / Task Methodology

The research will link to the steps of the Integrated Water Quality Reporting process.

Objective (a): Conduct field and laboratory research to develop physical, chemical and ecological indicators of freshwater ecosystem health in the Wet and Dry Tropics as part of Integrated Water Quality Reporting that meets end-user needs and objectives.

We will continue work with to define end-user needs for water quality and freshwater ecosystem health monitoring using biophysical indicators and protocols. We will review knowledge of spatial/temporal scales of indicator response to disturbance in rivers and wetlands, and identify possible spatial and temporal thresholds of potential concern in Wet Tropics systems (e.g. Russell/Mulgrave, Tully/Murray), using results from the literature, from our CRC Catchment to Reef program and from Years 1 and 2 of MTSRF, in relation to disturbances of land use, water quality, flow regime, channel and habitat structure, biodiversity, food web structure and riparian condition. From our conceptual models based on our Russell/Mulgrave and Tully/Murray work we will identify and test indicators of ecosystem health and thresholds of concern. We will identify knowledge gaps concerning the sensitivity of existing indicators and potential new indicators for subsequent testing. We will workshop our conceptual models and freshwater indicators with end users to ensure that they can provide the means for various user groups to monitor and interpret pressures of particular relevance to their interests and concerns in tropical waterways. These pressures are likely to include patterns and types of land use, general water quality, and contaminants, hydrological regime, channel and habitat structure, alien species of plants and fish, and riparian vegetation condition.

In new field and/or laboratory studies, potential indicators will be quantified and correlated with physico-chemical indicators of water quality, riparian influences on light and shade,

stream channel condition, hydraulic habitat structure, sources of energy and food web structure along gradients of disturbance. Indicators identified include:

- Flow regime of the waterway;
- Physical condition of sites (including current velocity, bank stability, channel form, width, depth, sediment characteristics, particle size and amount of large woody materials and detritus);
- Major water quality characteristics, including maximum and minimum values of temperature, conductivity, pH, dissolved oxygen, clarity, suspended solids, hardness, ammonia, nitrate and phosphate;
- Riparian condition (vegetation structure, canopy cover, weediness);
- Aquatic macrophyte cover and species richness,
- Proportion of aquatic macrophyte species that are alien;
- Species and/or family richness of invertebrates;
- Species richness and assemblage composition of fishes;
- Number and proportion of alien fish species;
- Proportion of fish abundance due to alien species;
- Food web structure and sources of energy driving aquatic food webs.

We will test both spatial and temporal variability of these indicators in Wet Tropics waterways in the Tully-Murray catchment to refine our spatial/temporal understanding and conceptual /predictive models of responses to gradients of disturbances and attempt to identify thresholds of concern. Subject to supplementary funding/co-investment, we will also progress our program in the Dry Tropics, following a similar process to that in the Wet Tropics.

We will continue to develop postgraduate projects to test freshwater indicators and thresholds of concern. Proposed projects aim to test organism-level indicators of fish, invertebrate and plant health, as well as ecological processes, by testing response levels, rates and times, and to examine the efficacy of measurement using surveys and laboratory and field experiments. Research on refined indicators will be linked to the broad-scale field trials of indicators to be conducted under the Integrated Reporting processes.

Objective (b): Identify thresholds of potential concern relating to land use, water quality, riparian condition, habitat, biodiversity and food web structure in freshwater ecosystems of the Wet and Dry Tropics.

To provide theoretical and practical support to the research on thresholds outlined under objective (a), we will continue to assess existing approaches to determining and representing thresholds of potential concern, such as water quality guidelines (e.g. ANZECC Guidelines), benchmarking methods such as those applied in Queensland Water Resource Plans, and other approaches used globally (e.g. in South Africa).

Objective (c): Train new researchers via postgraduate programs that will be integral to the identification and testing of efficient and effective freshwater condition indicators in the Wet and Dry tropics.

We will engage with existing and new postgraduate students and link their work into this project. Supervision will be shared between JCU and GU, as currently occurs. Postgraduate projects will contribute to improving the scientific basis for selection of indicators. We propose these projects for co-investment, but we will also seek candidates with

Commonwealth or University Scholarships and top them up using MTSRF funds as a cost-effective approach. Currently the following projects are in progress:

- Recruitment dynamics of fish in wet tropics Floodplain Rivers – P. Godfrey, PhD, Griffith University, due to complete in 2008.
- Testing of indicators of ecosystem health and climate change – K. Leonard, PhD, JCU, completion 2011.
- Ecosystem dynamics in dry tropics waterways – M. Blanchette, PhD, JCU, completion 2011.
- Conservation planning for wet tropics waterways – S. Januchowski, PhD, JCU, completion 2011.
- Scoping indicators of ecosystem health in floodplain lagoons – M. Eklison, Grad. Dip., JCU, completion 2008.

K. Leonard has been funded by a MTSRF Ph D scholarship. The second MTSRF Ph D scholarship on fish ecology in floodplain lagoons will be supervised from GU subject to recruitment of an appropriate student. All of these projects require operational funds, which should be a valuable investment for MTSRF.

Objective (d): To provide monitoring methods, manuals and guidelines of relevance to a range of end users.

Our biophysical models, indicator development and threshold identification will provide the underpinning science for the development of monitoring manuals and guidelines that will be useable by a variety of parties, including government agencies, industry bodies, community groups and landholders. We will build on the Catchment to Reef protocols by including the models and specified indicators, and by channelling different products to different end-users. This part of the project will link to the Integrated Reporting processes of MTSRF which will be synthesis information across the MTSRF to assist the Reef Water Quality Partnership with their development of a report card system for the Water Quality of GBR catchments.

In 2007 we produced a Catchment to Reef Technical Report on the catchment and freshwater indicators trialed in the Russell-Mulgrave system. MTSRF research allowed us to test the spatial and temporal variability of this suite of physical, water quality and ecological indicators, and new indicators of ecological processes, in wet and dry tropical rivers. A final manual and guidelines will be produced from this Project. This will provide scientific background to river health monitoring, conceptual models of stressor-response relationships along the river continuum, a process for indicator selection, field techniques and monitoring methods, data analysis and modeling requirements, and guidelines on the establishment of monitoring programs of relevance to a range of people, skills and end users.

Project Targeted Activities 2008/2009

Objective	Targeted Activity	Completion Date
(a), (b)	Update biophysical models of the ecological consequences of changes in landscape stressors in the tropics, and proposed biophysical indicators of freshwater ecosystem health	June 2009
(a)	Test spatial and temporal variability of freshwater indicators in the Tully-Murray catchment – field work	June 2009
(a)	Subject to supplementary funding, report on preliminary field work and desk-top review of Burdekin system	Dec 2008
(a)	Complete laboratory work on 2008 samples for the Tully/Murray, refine summary conceptual models and	Feb 2009

Objective	Targeted Activity	Completion Date
	identify key research issues to support development of new or refined indicators.	
(a)	Subject to supplementary funding, report on draft indicators for the Burdekin system	Dec 2008
(c)	Develop and support postgraduate projects	ongoing
(d)	Develop end-user-agreed products from the program	ongoing

Project 3.7.3 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission: - Progress update for activities listed against objectives a-d (above) describing work achieved to date, any preliminary research findings. [JCU and GU] - Plan of communication outputs and products for Year 2 and summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable. [JCU and GU]	7 Dec 2008
Project leader to attend Water Quality Operation Committee Meetings (3 meetings/year)	2008/09
Pathway to Impact Report	31 st Dec 2008
Report 2 submission: Progress update for activities listed against objectives a-d (above) including review of Burdekin catchment ecology and potential indicators of ecosystem health. [JCU and GU]	17 Mar 2009
Report 3 submission: - Report on indicators in the Tully/Murray system and identification of possible spatial and temporal thresholds of potential concern in Wet Tropics waterways with appropriate attribution for MTSRF funding [JCU and GU] - Report on ecological work in the Burdekin system (subject to supplementary funding) [JCU and GU] - Summary of liaison activities undertaken through course of Year 3 of project. [JCU and GU]	7 Jun 2009
Information transfer between agencies: Evidence (e.g. e-mail record) of mutual transfer of information between project agencies and project 3.7.4 to progress integration [JCU and GU]	7 Jun 2009
Total MTSRF Funding*	\$175,000

* Totals include \$2,000 Visual Documentation Allocation.

Project 3.7.3 Budget

Year 2 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	\$173,000	-	173,000
MTSRF Visual Documentation*	2,000	-	2,000
JCU	-	137,000	137,000
GU	-	105,000	105,000
Total	175,000	242,000	417,000

* A total of \$2,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

JCU Project 3.7.3 Budget 2008/2009

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	64,000	137,000	201,000
Operating	18,000	-	18,000
Travel	3,500	-	3,500
Communication / Extension	1,000	-	1,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	86,500	137,000	223,500

GU Project 3.7.3 Budget 2008/2009

Item	MTSRF Funds	GU In-kind	Total Cost
Salaries	64,000	105,000	169,000
Operating	18,000	-	18,000
Travel	3,500	-	3,500
Communication / Extension	1,000	-	1,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	86,500	105,000	191,500

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant ¹		Other sources ¹		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	175,000	5,000	212,000	50,000	25,000	467,000

¹ Prediction – not yet confirmed.

PROGRAM 7: HALTING AND REVERSING THE DELINE OF WATER QUALITY**Project 3.7.4: Wetlands and floodplains: connectivity and hydro-ecological function****Project Leader and Host Organisation**

Professor Jim Wallace, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Jim Wallace	CSIRO	Project leader; hydrology expertise	0.2
Mohammed Karim	CSIRO	Hydro-dynamic modeler	0.80
Lachlan Stewart	CSIRO	Hydrological modeling	0.2
Frederieke Kroon	CSIRO	Catchment management; links other CSIRO/NRM program	0.1
Anne Henderson	CSIRO	GIS support	0.1
Aaron Hawdon	CSIRO	Flood water quality sampling	0.1
Richard Pearson	JCU	Aquatic ecology; links to Project 3.7.3 and to other relevant research	0.05
Niall Connolly	JCU	Aquatic ecology; links to project 3.7.3	0.05
Jon Brodie	JCU	Water quality; link to Project 3.7.2	0.1
Damien Burrows	JCU	Wetland rehabilitation; link to wetlands research program	0.05
Marcus Sheaves	JCU	Estuarine ecology	0.05
Angela Arthington	GU	Aquatic ecology; links to project 3.7.3 and to other relevant research	0.05
Brad Pusey	GU	Freshwater fish ecology	0.05
Steve Mackay	GU	Freshwater plant ecology	0.05
Rod Connolly	GU	Estuarine ecology	0.05

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GBRMPA	Donna Audas
DEWHA	Kevin Gale
Reef Water Quality Partnership	Rachel Eberhard
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
Queensland Canegrowers	Tim Wrigley
WWF	Nick Heath

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

Floodplains and wetlands are important physical and biological links in the aquatic continuum, providing unique and essential habitat and connectivity for specialist and wide-ranging fauna. Yet very little is known about the hydrological dynamics of these systems, and about the dynamics of the physical and biological connectivity through them. These systems provide access and vital habitat for iconic species such as Barramundi, but they are typically badly managed, highly impacted and, in the case of freshwater wetlands, severely depleted (~75% of such wetlands in GBR catchments having been lost to agricultural and other development). Proper management will depend on understanding the biophysical relationships and connectivity's in these systems. This project will develop a core floodplain hydrological model to quantify two important aspects of hydro-ecological functioning: (i) sources, sinks and transport of sediments and nutrients across floodplains and (ii) connectivity of wetland systems within floodplains. In parallel, we will develop conceptual models of the ecological dynamics of these systems and how these interact with the hydrological processes. Ecological work to test the models of ecological processes and dynamics and links to estuarine systems will depend on the level of co-investment in the project.

The overall objective of this project is to develop the capability to predict the impacts of changes in land use, management and climate on the flow and water quality regimes and ecological dynamics in the wetlands and floodplains of catchments adjacent to the GBR. This will be achieved via the following key objectives:

- (a) Quantify how the flood regime affects the main sinks and sources of sediment and nutrient and their transport across floodplains.
- (b) Develop a model to predict how the hydrological response and connectivity of tropical floodplains are affected by land use, land and water management and climate.
- (c) Develop models that link ecological structure (e.g. biodiversity, community patterns) and processes to the core floodplain hydrology model to quantify the consequences of changes in water body connectivity between freshwater and saline waterways for biodiversity, biological connectivity and proper ecological function.

This project will make links with several other MTSRF and non-MTSRF Projects, particularly Project 3.7.2, and CSIRO and other wetland-orientated research. Our hydrological Workshop will involve representatives from all of the MTSRF water quality projects and there will be particularly strong links with Projects 3.7.1 and 3.7.2 as they will be working in the marine environment adjacent to the Tully-Murray catchments. The biophysical information generated by this project will be linked with appropriate socio-economic aspects of land use change via the economic case studies that Project 3.7.5 will carry out in the Wet tropics. Socio-economic links will also be strengthened via the geographical co-location of Project 3.7.4 and social and economic studies funded by CSIRO WFHC in the Tully-Murray catchments. Our main contribution to the Integrated Report Card framework will be delivered via our wetland connectivity index Decision Support System. This DSS will then be used to clarify how the current Queensland Wetlands program assessment could be improved. Subject to co-investment to support additional components, this project will develop its ecological scope in close collaboration with Project 3.7.3.

Project / Task Methodology

Objective (a): Quantify how the flood regime affects the main sinks and sources of sediment and nutrient and their transport across floodplains.

We will use a novel approach that combines state-of-the-art remote sensing and ground based data with the development of a hydrodynamic model of floodplain inundation. It will build on hydrodynamic modelling work already carried out by Main Roads in the Tully-Murray catchments in support of the redesign of the road south of Tully. The Main roads model only deals with water quantity and so this project will focus on developing and testing the sediment and nutrient transport routines that will quantify the sinks, sources and movement of materials across the floodplain during flood events. These important processes are not dealt with in existing sediment and nutrient transport models (e.g. SedNet), yet the floodplain is the area where much of the pollutants arise and it is also the area where most management interventions can take place.

The high resolution topography needed for accurate hydraulic modelling on low relief floodplains will be acquired from remote sensing (e.g. airborne laser altimetry, stereoscopic aerial photography, etc.). These types of data will also give important information on the hydraulic roughness of the vegetation on the floodplain, an essential parameter in the hydrodynamic model of the floodplain. Historical and current flood extents can be obtained using SAR (Synthetic Aperture Radar) data. Ground based data on drainage channel networks and cross sections are also required.

The hydrodynamic model predictions of flood depth, flow velocity and direction and sediment and nutrient concentrations will be tested using a combination of manual and automatic sampling of these variables during flood events. As it would be prohibitively expensive to apply the fully hydro-dynamic model to all of the floodplains in the GBR catchments, transferability of the main model could be explored by comparing the detailed information with non-dynamic inundation models (e.g. Overton 2005⁵). Additional funds would be needed to commission Ian Overton's group to carry out this work.

The MTSRF Steering Committee has recommended that we include pesticides in the project. This would be possible with additional funding to cover (i) the costs of chemical analysis at the ACTFR laboratory and (ii) data analysis and the calculation of pesticide loads in over bank flood events. This would complement data recorded previously by ACTFR on pesticide concentrations in (chanellised) river waters in the Tully catchment.

Objective (b): Develop a model to predict how the hydrological response and connectivity of tropical floodplains are affected by land use, land and water management and climate.

The hydrodynamic model developed above will also be used to calculate wetland connectivity and how this would vary under land use and climate change. By overlaying the new Queensland Wetland Program map of the current wetlands (permanent and ephemeral) with dynamic simulations of the evolution of flood waters it will be possible to quantify the timing and duration of hydrological connections between wetlands. The model will also be able to quantify the degree of connectivity of different wetlands (e.g. how many other water bodies are they connected to, how far away are they and how long do they stay connected?).

Using historical flood frequency data it will also be possible to characterise the frequency with which different wetland bodies are flooded and how these frequencies change with climate, land use and management changes.

For example, it should be possible to quantify how a range of wetland connectivity indices have changed since the introduction of flood levees and cane drains. The impacts of future options for the introduction and/or removal of drains, levees and artificial wetlands on the wetland connectivity of the entire floodplain should also be predictable. We will make explicit links to the socio-economic aspect of floodplain development and change through Project 3.7.5.

Objective (c): Develop models that link ecological structure (e.g. biodiversity, community patterns) and processes to the core floodplain hydrology model to quantify the consequences of changes in water body connectivity between freshwater and saline waterways for biodiversity, biological connectivity and proper ecological function.

The core hydrodynamic model developed above will provide a range of new opportunities to explore the interactions between flood regimes, water quality and aquatic productivity and biodiversity. In particular the model will allow fish passage during and after flood events to be studied. This will require links with biological processes that affect the migration of tropical fish between the floodplain wetlands, freshwater streams, estuaries and the ocean.

The mechanism adopted to identify the types of freshwater ecological model that are required will be via a Workshop involving the key aquatic scientists and natural resource managers in the region. The workshop will focus on developing a plan for implementing the aquatic ecology work identified. Some initial pump-priming of the core work identified will be funded through a small number of PhD student 'top up' grants. These PhD studies and other externally funded projects will be targeted at field sampling to test flow-habitat-ecology relationships and models for test locations in the wet and dry tropics.

Project Targeted Activities

Objective	Targeted Activity	Completion Date
a.	Refine hydro-dynamic model for Tully – Murray catchments, including further testing of the sediment and nutrient sub-routines.	December 2008
b.	Develop and refine hydro-dynamic model estimates of wetland connectivity and compare with other flood models used elsewhere in Australia (e.g. Murray-Darling).	December 2008
c.	Record flood depths, suspended sediment and nutrient concentrations in flood waters during over bank events in the Tully-Murray catchments during the 2008/2009 wet season	April 2009
d.	Develop linked hydrological and ecological PhD studies	ongoing
e.	Draft report/s on year 3 progress	June 2009
f.	Finalize development of hydro-dynamic model and make final estimates of flood borne loads of sediment and nutrients to the ocean adjacent to the Tully-Murray catchments	December 2009
g.	Finalize estimates of wetland connectivity made using the hydro-dynamic model and link to appropriate aquatic ecological impact models.	April 2010
h.	Complete linked hydrological and ecological PhD studies	June 2010
i.	Write up and publish results in report, Journal paper and Thesis forms	June 2010

Project 3.7.4 Milestone Payments 2008/2009

For 2008/2009 outputs only	
Milestones	Date
Project leader to attend Water Quality Operation Committee Meetings (3 meetings/year)	2008/09
Report 1 submission: • Input into progress update for activities listed against objectives (a)-(e) (above). [JCU] • Input into progress update for activities listed against objectives (a)-(e) (above). [GU] • Progress update for activities listed against objectives (a)-(e) (above). [CSIRO] • Evidence that hydrodynamic model development for material transport and wetland connectivity is progressing. [CSIRO] • Plan of communication outputs and products for Year 3 and summary of any liaison activities undertaken to date including minutes of meetings/workshops if applicable. [CSIRO]	30 December 2008
• Pathways to Impact Report for End User Relevance	31 December 2008
Report 2 submission: • Input into draft hydro-dynamic modeling progress report, including a summary of linked ecological modeling work. [GU] • Input into draft hydro-dynamic modeling progress report, including a summary of linked ecological modeling work. [JCU] • Draft progress report on the development and testing of hydro-dynamic modeling for use in floodplain sediment and nutrient transport and wetland connectivity. [CSIRO]	30 June 2009
Information transfer between agencies: • Data collected in this project by CSIRO, JCU and GU will be made freely available amongst these parties on request. Responsible officers: J Wallace (CSIRO), R Pearson (JCU) and A Arthington (GU)	2008/09
Total MTSRF Funding	\$173,500

*Total includes \$1,500 is held by Reef and Rainforest Research Centre for Visual Documentation

Project 3.7.4 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	173,500	-	173,500
MTSRF Visual Documentation*	1,500	-	1,500
CSIRO Water for a Healthy Country Program	-	150,000	150,000
CSIRO Division of Land and Water	-	50,000	50,000
Total	175,000	200,000	375,000

*A total of \$1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5)

CSIRO Project 3.7.4 Budget 2008/2009

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	132,500	56,671	189,171
Operating	29,000	-	29,000
Travel	7,000	-	7,000
Communication / Extension	5,000	-	5,000
Capital	-	-	-
Institutional overheads	-	143,329	143,329
Total	173,500	200,000	373,500

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources ¹		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	175,000	5,000	200,000	150,000	25,000	555,000
Total	175,000	5,000	200,000	150,000	25,000	555,000

1 Prediction – not yet confirmed

PROGRAM 7: HALTING AND REVERSING THE DECLINE OF WATER QUALITY***Project 3.7.5 (includes Project 3.7.6): Socio-economic constraints to and incentives for the adoption of land use and management options for water quality improvement*****Project Leader and Host Organisations**

Dr Martijn van Grieken, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Martijn van Grieken	CSIRO	Program leader and environmental economist	0.65
Iris Bohnet	CSIRO	Social ecologist	0.12
Peter Thorburn	CSIRO	Cropping systems scientist	0.05
Tony Webster	CSIRO	Agronomist	0.15
Adam Fakes	CSIRO	Software Developer	0.30
Scott Wooldridge	AIMS	Marine impact and link to 'Climate change' Project 2.5i.4.	0.05
Richard Pearson	JCU	Water quality indicators and link to 'Freshwater WQ' Project 3.7.3.	0.05

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GBRMPA	Ingrid Van Putten
DEWHA	Kevin Gale
DEWHA	
Reef Water Quality Partnership	Rachel Eberhard
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
Queensland Canegrowers	Tim Wrigley
WWF	Nick Heath

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

Halting and reversing the decline in water quality from rural and urban areas in North Queensland's catchments requires the adoption of land use and management options that are less water polluting.

In cases where these 'best' land use and management options provide a *private* benefit to the agent⁶, adoption generally occurs naturally over time provided there is access to good information and extension networks. In cases where these 'best' land use and management options do not provide a private benefit to the agent but a *social* benefit to the community, we need to focus on those options that are most cost-effective in reducing water pollution and identify instruments⁷ that are most effective in promoting the adoption of these 'best' land use and management options. Focusing on the adoption of most cost-effective land use and management options allows for the maximum water quality outcomes at the lowest possible costs.

This project evaluates the socio-economic constraints to and risks associated with the adoption of land use and management options for water quality improvement at the private and social level, to identify and assess instruments that are most cost-effective in promoting the adoption of these 'best' land use and management options by community embedded agents in rural and urban areas in North Queensland's catchments.

Key Objectives:

- (a) Assess the cost-effectiveness of land use and management options for water quality improvement, including agricultural as well as non-agricultural diffuse and point sources.
- (b) Identify agent profiles, aspirations and attitudes, characterising (private) agent specific constraints to and risks associated with the adoption of land use and management options for water quality improvement.
- (c) Identify community (including institutional) structures and networks, characterising (social) community specific constraints to and risks associated with the adoption of land use and management options for water quality improvement.
- (d) Identify and assess instruments that are most effective in promoting the adoption of 'best' land use and management options by community embedded agents.
- (e) Explore sustainable resource use and water quality targets as well as associated land use and land management patterns in a linked terrestrial and marine ecosystem.

Project / Task Methodology

The project will deliver an approach that allows for the rapid identification of constraints to and assessment of instruments for the adoption of land use and management options for water quality improvement in North Queensland's catchments, thus aiding in removing the gap between current water quality levels and future water quality targets.

This project uses inputs from and provides key inputs to several projects in the Water Quality Program (Projects 3.7.3 and 3.7.7) as well as Climate Change Program (project 2.5i.4) and the Sustainable Use Program (project 4.9.6):

In addition, the project builds on work developed within CSIRO's Water for a Healthy Country – Great Barrier Reef flagship as well as associated projects within the Coastal Catchments Initiative (CCI).

⁶ Agents include agricultural land users (e.g. sugarcane, grazing, horticulture and forestry industry), non-agricultural land users (rural, peri-urban and urban residents) and water resource managers (e.g. aquaculture industry and water treatment plants).

⁷ Drivers include information dissemination, extension services, price incentives, taxes, market-based instruments, regulations and institutional arrangements.

Case studies will be developed in the Wet Tropics and Dry Tropics of North Queensland, in alignment with the above mentioned projects, to ensure that the developed approach can be applied throughout the North Queensland's catchments. Case study areas include the Tully-Murray catchment and the Burdekin catchment.

Project Activities 2008/2009

Objective	Targeted Activity	Date
b	Agent profile, characterisation and stratification for the Wet Tropics case study, in close collaboration with industries, extension services, DPI&F and regional NRM bodies	Wet Tropics: October 2008
c	Community/institutional profile, characterisation and stratification for the Wet Tropics case study, in close collaboration with local governments, industries, extension services, DPI&F and regional NRM bodies	Wet Tropics: December 2008
e	Explore sustainable environmental targets and associated land use and land management patterns in linked terrestrial and marine ecosystems for Wet Tropics case study, in collaboration with marine-based industries, NRM bodies and GBRMPA	Wet Tropics: April 2009
d	Assessment of instruments promoting the adoption of land use and land management patterns that comply with these sustainable environmental targets for the Wet Tropics case study, in close collaboration with state governments, local governments, industries, extension services and regional NRM bodies	Dry Tropics: June 2009

* Involves activities that carry into out-years

Project 3.7.5 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones – all CSIRO Responsibilities	
Signing of contract	
Project leader to attend Water Quality Operation Committee Meetings (3 meetings/year)	2008/09
Report 1 submission, which outlines: - Report on agent, community and institutional profile, characterization and stratification for the Dry Tropics case study, including: i) outcomes of the agent survey; ii) summary of communication activities including summaries of key informant interviews, stakeholder meetings and focus group discussions with appropriate attribution for MTSRF funding (obj b and c). - Report on review of predictive bio-economic approaches used to assess the effectiveness of instruments promoting the adoption of alternative land use and technology options (obj. d). - Progress report on application of modeling approach, for exploration of sustainable environmental targets in linked terrestrial and marine ecosystems for the Dry Tropics case study – with Project 2.5i.4 (obj. e). - Plan of communication outputs and products for year three.	15 Dec 2008
Pathway to Impact report for end user relevance	31 st December 2008

For 2008/2009 outputs only	Date
Milestones – all CSIRO Responsibilities	
Report 2 submission: - Report on sustainable environmental targets in linked terrestrial and marine ecosystems for the Dry Tropics case study, including assessment of associated spatial land use and management patterns – with Project 2.5i.4 with appropriate attribution for MTSRF funding (obj. e). - Progress report on the development and application of bio-economic single-agent modeling approach, for ex-ante effectiveness assessment of instruments promoting adoption of land use and management options by non-community embedded representative agents (obj. d). - Summary of communication activities.	01 Apr 2008
Report 3 submission, which outlines: Assessment of instruments promoting adoption of land use and land management patterns by (non-community embedded) agents that comply with sustainable environmental targets for the Dry Tropics case study, including: i) cost-effectiveness, efficiency and gap analysis, ii) progress report on development of bio-economic multi-agent modeling approach for adoption assessment by community embedded agents, iii) final summary of communication activities undertaken through the course of year 1 of project, and iv) plan for completion of out year activities, including objectives b-e.	15 Jun 2009
Total MTSRF Funding*	\$150,000

Project Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisations	Cash	In-kind	Total
MTSRF	150,000	-	150,000
CSIRO: Sustainable Ecosystems	-	112,383	112,383
Total	150,000	112,383	262,383

CSIRO Project 3.7.5 Budget 2008/2009

Item	Funds from MTSRF	CSE In-kind	Total Cost
Salaries	128,000	-	128,000
Operating	7,500	-	7,500
Travel	6,000	-	6,000
Communication / Extension	8,500	-	8,500
Capital	-	-	-
Institutional overheads	-	112,383	112,383
Total	150,000	112,383	262,383

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	150,000	0	111,578	-	-	261,578
Total	150,000	0	111,578	-	-	261,578

PROGRAM 7: HALTING AND REVERSING THE DECLINE OF WATER QUALITY

Project 3.7.7: Analysis and synthesis of information for reporting credible estimates of loads for compliance against targets and tracking trends in loads.

Project Leaders and Host Organisations

Dr Petra Kuhnert, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team

Title	Organisation	Role	FTE
Petra Kuhnert	CSIRO	Lead statistician	0.15
Brent Henderson	CSIRO	Statistician	0.10
Erin Peterson	CSIRO	Geospatial analysis and statistics	0.10
Paul Rustomji	CSIRO	Water quality modeller	0.10
You-Gan Wang	CSIRO	Project and statistical oversight	0.10

Organisation	Organisational Contact
QNRW	David Roberts
QNRW	Simon Catzikiris
DEWHA	Kevin Gale
ReefWQ Partnerships	Rachel Eberhard
Tourism alliance	Annie Riddet
FNQ NRM	Allan Dale
Canegrowers	Tim Wrigley
GBRMPA	Hugh Yorkston

Project Duration

Start Date: 1 July 2008

End Date: 30 June 2010

Project/Task Objectives

The export of pollutants from coastal catchments has important implications for the health of the Great Barrier Reef (GBR). Regional Natural Resource Management Plans and Water Quality Improvement Plans seek to improve coastal water quality and are underpinned by a set of load-based targets for these pollutants (e.g. sediments, nutrients, pesticides).

There is a strong need to identify appropriate statistical methods for reliably estimating annual pollutants loads (with some measure of uncertainty) based on monitoring data, and assessing progress towards defined loads targets. When pollutant load data is collected over a number of years there is also a need for methods for assessing trends in those loads.

This project will synthesise existing knowledge and information, and where necessary develop methods, for evaluating and reporting pollutant loads from the GBR catchments. This synthesis is essential to the development of common agreed approaches across all regions for measuring loads and assessing them relative to targets. Pilot subcatchment areas will be identified in the wet and dry tropic regions and used to demonstrate the approaches. The approach will be tested for use for identifying priorities for the Reef Rescue Plan.

The **key project objectives** over the 2007-2010 period are to:

- Identify robust and scientifically defensible statistical methods for the estimation of annual pollutant loads, with quantified measures of uncertainty, from monitoring data for the GBR catchments. These methods need to build on existing work, consider the data availability and characteristics, and address the nature of the local environment.
- Develop approaches for reliably assessing the progress towards defined loads targets and estimating trends in pollutant loads.
- Conduct case studies in the wet and dry tropics to demonstrate the performance of these methods.
- Test approaches for use by the Reef Rescue Plan
- Develop a communication strategy for reporting pollutants loads and the progress towards defined targets over both time and space. This will identify those aspects that need to be reported as a part of giving a credible load assessment.
- Inform the current monitoring so that it may be adapted, where necessary, so as to provide more accurate and precise load estimates.

Project tasks for 2008 / 2009

The proposed tasks for 2008 / 2009 (Year 2) are as follows:

1. Finalise a **case study** of the pilot region identified:
 - Demonstrate the application of the developed methodology. Recommend methods for calculating pollutant loads, with associated measurement of uncertainty.
2. **Report and communicate** the outcomes of the case study to stakeholders (e.g. DEWHA under the Reef Rescue Plan) with particular emphasis on exploring suitable visualisation techniques for assessing progress towards meeting the loads target, assessment of spatial and temporal trends (where applicable) and examining the uncertainty in loads calculations. This objective will also consider the information that should be communicated as part of integrated loads reporting framework.
3. Develop a second case study from the wet or dry tropics (whatever region that did not feature in the first case study) and
 - Demonstrate the application of the developed methodology. Recommend methods for calculating pollutant loads, with associated measurement of uncertainty.
4. Examine the adequacy of the current monitoring in the GBR so that it may be adapted, where necessary, so as to provide more accurate and precise load estimates. This will include reporting for the reef rescue Plan and developing scenarios that illustrate the monitoring required to detect specific changes (power analyses). It will also consider the adequacy of the current monitoring to attribute any observed changes to key

management interventions in the GBR catchments. It may be necessary to consider the sampling regime against requirements for model calibration and a range of different water quality variates given they may respond to discharge in different ways. Deliver final report.

We engage with QNRW to ensure that methods developed are fit for purpose in an operational sense. We are committed to “knowledge transfer” as part of this project, particularly given QNRW will ultimately be required to carry the estimation and reporting of GBR pollutant loads in an on-going way.

Project tasks for 2009 / 2010

The proposed tasks for 2009/2010 (Year 3) are conditional on the findings during Year 2 of this project and will be determined before the start of the 2009/2010 financial year.

The anticipated activities are as follows:

5. Extend methodology identified in years 2 and 3 from sediments and nutrients to pesticides and other pollutants of interest to the NRM plans and WQIPs.
6. Provide input into the Reef Rescue Plan reporting process which relates to loads. Methods for standardising loads so they can be interpreted in a reporting framework will be a focus. There will also be some emphasis on how to use temporal and spatial changes in concentrations in a reporting framework for assessing change.

Project Outputs / Milestones for 2008-2009.

Objective	Targeted Activity	Completion Date
1	Finalise a case study on the Burdekin pilot region to demonstrate the application of the developed methodology for estimating pollutant loads with associated measures of uncertainty. Methods for visualisation will also be discussed as outlined in Objective 2.	12 December 2008
2	Develop suitable methods for visualisation and reporting that is applicable to the case study.	12 December 2008
3	Progress report on the adequacy of the current monitoring regime for the Burdekin case study for incorporating uncertainty into loads calculations.	13 February 2008
4	Finalise the Wet Tropics case study and apply appropriate methods for estimating pollutant loads with associated measures of uncertainty. A focus on nutrients and in particular DIN will be of interest.	15 June 2009
5	Provide input into the current monitoring regime for both case studies for incorporating uncertainty into loads calculations.	15 June 2009

Project 3.7.7 Milestone Payments 2008/2009

For 2007/2008 Outputs Only	
Milestones	Date
Project leader, where possible, to attend Water Quality Operation Committee Meetings (3 meetings/year)	2008/09
Report: Interim report on the methods applied to the Burdekin	12 Dec 08

For 2007/2008 Outputs Only	
Milestones	Date
catchment case study, outlining sampling issues applicable sampling regimes for the Burdekin Region (Obj 1-2)	
Pathway to Impact Report for end user relevance completed	31 Jan 08
Report: Progress report on the methods applied to the Wet Tropics case study, outlining sampling issues applicable sampling regimes for the Wet Tropics Region (Obj 1-2)	13 Mar 08
Final Report on (i) incorporating uncertainty into loads calculations, (ii) reporting loads and (iii) applicable sampling regimes for the GBR based on case studies in the Burdekin and Wet Tropics regions with appropriate attribution to MTSRF funding (Obj 4).	15 June 09
Total MTSRF Funding	\$100,000

Project 3.7.7 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	\$100,000	\$64,822	\$164,822
Total	\$100,000	\$64,822	\$164,822

Institutional Project 3.7.7 Budget 2008/2009

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	\$74,453	\$23,105	\$97,558
Operating			
Travel	\$5,000		\$5,000
Communication / Extension			
Capital			
Institutional overheads	\$20,547	\$41,717	\$62,264
Total	\$100,000	\$64,822	\$164,822

Indicative Budget Summary – Year 3,

Year	MTSRF	Applicant ¹		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	100,000	TBA	143,105	TBA	TBA	243,105
Total	100,000	TBA	143,105	TBA	TBA	243,105

THEME 4 SUSTAINABLE USE AND MANAGEMENT

Sustainable use of North Queensland's natural assets, the Great Barrier Reef and the Wet Tropics rainforests, is critical to maintaining the environmental, social and economic values of the region. The research to be undertaken will provide knowledge and options for promoting sustainable use and minimising adverse impact on these natural assets.

Budget Summary

Program	Title	MTSRF	Other Cash	In-kind	Total
Program 8	Sustainable Use – Great Barrier Reef	\$1,055,000	\$150,000	\$1,987,690	\$3,192,690
Program 9	Sustainable Use – Rainforests	\$1,203,275	\$202,900	\$1,603,887	\$3,010,062
Total		\$2,258,275	\$352,900	\$3,591,577	\$6,202,752

The total value of Theme 4 is \$6,202,752.

PROGRAM 8

SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES OF THE GREAT BARRIER REEF

Program Leader and Host Organisation

Dr Colin Simpfendorfer, James Cook University (JCU)

Budget Summary

	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
MTSRF	\$1,055,000	-	\$1,055,000
Other	\$150,000	\$1,987,690	\$2,137,690
Total	\$1,205,000	\$2,010,690	\$3,192,690

This research program will provide strategic research directions for the sustainable use and management of the biodiversity and natural resources of the Great Barrier Reef (GBR) with respect to ecological, social and economic sustainability. The Program is highly integrative, both within and across Programs, and has an over-arching theme related to the effects of the GBR Zoning Plan, with an emphasis on biodiversity resource use in inshore habitats. The Program addresses specific critical issues of end user relevance that align directly with the MTSRF Priority Research Areas and key questions and products. The Program captures the major gaps in knowledge for sustainable use and management of marine resources in the GBR, and provides a basis for additional targeted projects to be undertaken, which will have direct relevance to end users. The research will occur throughout the GBR and involve large-scale, integrated projects of a multi-disciplinary and collaborative nature involving the key end users. Expected outcomes from the Program include:

- 1) A state-of-the-art biophysical larval dispersal model and direct measures of connectivity and dispersal for coral trout that will ground-truth the model and provide information on whether green zones augment larval supply to exploited fish populations. The principal outcome of this Project is an understanding of the spatial scale of connectivity via dispersal of fish larvae, and the provision of more realistic measures of dispersal and connectivity than are available at present. Knowledge of this is essential for intermediate goals such as modelling fishing impacts on biodiversity and testing the effectiveness of the Zoning Plan.
- 2) An ecological assessment of the influence of the GBR Zoning Plan on inshore and inter-reefal (i.e., shoals) habitats and biodiversity of the GBR. The inshore areas of the GBR are strongly influenced by recreational and community use. Social and economic dimensions of the impacts and use on the inshore biodiversity will be linked through Project 4.
- 3) An analysis of the biological parameters and current and historical patterns of use of key inter-reef fish species.
- 4) An evaluation of the impact from industry and community uses on inshore biodiversity. Very little is known about the impacts on biodiversity from industry and community activities in this area. Historically, research has focused on the main targeted species of the line and net fisheries without considering broader biodiversity impacts.
- 5) An investigation of the effects (costs/benefits) of the GBR Zoning on use (tourism, recreation and fishing) of the GBRWHA. The economic analysis component of this

Project will be deferred until adequate capability has been developed in North Queensland through a CSIRO/JCU cooperative arrangement.

- 6) Determination of the social and economic values of key marine species, particularly large fish around tourist facilities. In addition, the Project will identify annual visitor usage patterns of the GBR to enable the identification of key trends and drivers of visitor patterns and economic impacts of visitation. Impacts of tourist and visitation to critical reef sites and sustainable levels of visitation to these sites will be assessed. This Project will provide a link with the Inshore Biodiversity Project on irukandii movement and habits and the risk of human encounters to irukandji and other marine stingers that may influence tourist visitation.

Program Communication (Project 4.8.8)

A dedicated communication and extension strategy will be an integral component of the proposed Sustainable Use and Management Program with linkages to the Threatened Species Program and other MTSRF Programs such as Status and Trends for the GBR. This strategy will build upon existing CRC Reef, Fish & Fisheries, CapReef and AMPTO experiences, and will operate in line with the overarching strategy for Enhancing Delivery of MTSRF as a whole. A total of \$85,000 has been allocated specifically against Communication, which includes \$75,000 for communication strategies to be utilised across all GBR related projects conducted under the MTSRF and \$10,000 specifically for visual documentation of the Program 8 projects.

Projects

4.8.1	Resilience and connectivity	\$123,000
4.8.2	Influence of GBR Zoning Plan on inshore habitats and biodiversity, of which fish and corals are indicators.....	\$228,000
4.8.3	Evaluation of the resiliency of key inter-reefal fish species	\$50,000
4.8.4	Evaluation of the impacts from industry and community uses on..... inshore biodiversity	\$248,000
4.8.5	Incorporating stakeholders and their values, knowledge and aspirations in the care and development of the Great Barrier Reef Marine Park	\$123,000
4.8.6	Analysis of recreational and tourism use and impact on the GBR for managing sustainable tourism.....	\$148,000
4.8.7	Forecasting risk of exposure to irukandji	\$50,000
4.8.8	Communication, community engagement and enhanced delivery for GBR projects	\$85,000

PROGRAM 8: SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES OF THE GREAT BARRIER REEF

Project 4.8.1: Resilience and connectivity

Project Leader and Host Organisation

Professor Terry Hughes, James Cook University (JCU)

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Terry Hughes	JCU	Project Leader	0.05
Jeff Leis	Australian Museum	Chief investigator, Part 1a,a. Larval-fish biologist	0.20
Geoffrey Jones	JCU	Co-chief investigator, Part 1a,b. Reef-fish ecologist	0.10
Garry Russ	JCU	Co-chief investigator, Part 1a,b. Reef-fish ecologist	0.10
Luciano Mason	AMC	Modeller/oceanographer	0.33
Lynne van Herwerden	JCU	Geneticist	0.10

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GBRMPA	Martin Russell
DEW	David Osborne
DEW	Stephen Oxley
Tourism alliance	Melinda Connolly
Terrain NRM	Allan Dale
ARC	Russell Butler

Project Duration

Start Date: November 2006

End Date: 30 June 2010

Project / Task Objectives

Understanding the scale of larval dispersal is a major challenge in marine ecology and it is clear that management of marine fishes, including by marine protected areas (MPAs), must incorporate the scales over which their populations are connected by larval dispersal. MPAs (green zones) in the GBR promote the abundance, size and reproductive potential of exploited fishes within their boundaries, but an important question remains unanswered - Do green zones provide a recruitment subsidy to exploited fish populations such as coral trout beyond their boundaries (blue zones), thereby promoting the resilience and sustainable exploitation of fish resources?

This project will provide answers to the following questions critical to the assessment of the effectiveness of the GBR Zoning model:

- (1) What is the spatial scale of connectivity by larval fish dispersal within the GBR?
- (2) How much do green zones contribute to the recruitment of coral trout and other fish species in blue zones (via larval connectivity)?
- (3) To what extent are populations in green zones sustained by their own reproduction (via larval retention)?
- (4) Are particular areas especially important sources of larvae for blue zones?
- (5) Are particular areas sustained by retention or by dispersal?

Key Objectives:

- (a) Develop and test realistic larval-fish dispersal models for the GBR.
- (b) Develop and test methods to ground-truth larval-fish dispersal models for the GBR.

Project / Task Methodology

The two parts (Objectives (a) and (b)) of this Project run in parallel. Leis and oceanographic modeller Mason will develop realistic dispersal models for the GBR that can be used both for forecasting and hindcasting (Objective (a)). Likewise, Jones leads a team including experts on marine reserves (Russ), otolith microchemistry (Thorrold) and genetics (van Herwerden) to provide empirical estimates of dispersal and ground-truth the models, with a emphasis on coral trout (Objective (b)). The proposal is structured under two alternative assumptions of funding: *MTSRF funds only* (\$123,000 pa), and *Additional Co-investment funding* by ARC Centre of Excellence and other sources (\$100,000 pa each). It is planned to involve the following postgraduate students: 1 MSc, 2 PhD.

Objective (a): Develop realistic larval-fish dispersal models for the GBR.

Collaboration between biologists and oceanographers will produce true biophysical dispersal models for larval fishes on the GBR by integrating new biological data on larval-fish behaviour into an upgraded, existing physical dispersal model. This will give the first realistic predictions of larval fish dispersal and hence population connectivity for reef fishes. These estimates of scale (dispersal kernels, or the spatial probability of dispersal) are essential for understanding how GBR fish populations are structured and for their efficient management. Outcomes are biophysical models to predict and hindcast dispersal and connectivity, and better understanding and management of GBR fish populations.

Objective (b) Test realistic larval-fish dispersal models for the GBR.

This part will empirically test the models using two new techniques that will revolutionise the direct assessment of larval dispersal. The otoliths (ear bones) of larval fish can now be safely marked by maternal transmission of stable isotopes. Also, the paternity of recruits can be established by sampling their DNA and matching it to putative parents. These two techniques will be applied to coral trout in a series of capture, mark and release programs at spawning sites within selected green zones. Larvae retained within or moving beyond green zones will be identified and the direction and extent of dispersal compared with model predictions. This approach will provide the first empirical test of larval dispersal models, and will establish whether green zones augment larval supply to exploited fish populations.

As mass-marking in the field is costly, we outline two levels at which direct larval marking can be applied. MTSRF funding will be based on an experimental design (experiment 1) in which a substantial proportion of adult coral trout in a single green zone each year will be fin-clipped for DNA fingerprinting and injected with an isotopic marker. Juveniles (~6 months old) will subsequently be collected and analysed for isotope marks and parentage to establish how many are retained within the green zone and how many disperse out into adjacent blue zones. The empirical estimates can be compared with the fine-scale biophysical model (Objective (a)), which will either be supported or modified to more accurately predict dispersal. However, the biophysical model will be based on existing larval behaviour data from a serranid species other than coral trout if co-investment to study behaviour of coral trout larvae is not forthcoming.

The program will be integrated into the existing mark-release-recapture program being coordinated by Suntag and the CapReef community monitoring program.

Project Targeted Activities (indicative only for out years)

Note, targeted activities listed in italics below depend on adequate co-investment

Objective	Targeted Activity	Date
(a)	Biophysical model 50% complete; Include data on larval behaviour of coral trout in model with additional co-investment.	31 Dec 2008
(b)	Complete otolith preparation and ICPMS analysis for detection of Barium marks for 3 fish species (<i>P. maculatus</i>, <i>L. carponotatus</i> and <i>E. quoyanus</i>). Analyse contribution of 3 Keppel Is. green zones to recruitment in blue zones (if tagged recruits discovered)	
(b)	Complete genetic parentage analyses for 1 fish species (<i>P. maculatus</i>). Analyse direction and distance of dispersal.	
(a)(b)	Initial comparison of direction and distance of tagged recruits to predictions of physical model.	
(b)	Begin genetic parentage analyses for <i>L. carponotatus</i> from Keppel islands. <i>Begin genetic parentage analysis for E. quoyanus</i> with additional co-investment.	
(a)(b) (a)(b)	- Presentation to GBRMPA on Keppel Is. experiment. - Briefing to DEH, GBRMPA and other co-contributors.	
(a)	Biophysical model complete; Testing model outputs 50% complete; Initial ground-truthing model with results part B.	30 Jun 2009
(b)	Complete genetic parentage analysis for <i>L. carponotatus</i>. Analyse direction and distance of dispersal.	
(a),(b)	End user presentation to demonstrate model and results.	
(a),(b)	Briefing to GBRMPA, CapReef and other end users.	
(a),(b)	MTSRF newsletter article.	

(a) (b)	• Sensitivity analysis of 3D model complete. • Complete publication of larval dispersal findings for Keppel Is. for <i>P. maculatus</i> and <i>L. carponotatus</i>. Complete genetic analysis of <i>E. quoyanus</i> dispersal with additional co-investment.	31 Dec 2009
(b)	• Begin 1-population coral trout larval marking experiment at Lizard Region. Expand to three populations with additional co-investment.	
(a), (b) (a), (b)	• Dedicated program newsletter article. • Briefing to DEH, GBRMPA and other co-contributors.	
(a) (b)	• Final biophysical model; Testing model outputs complete; Final ground-truthing model. • Complete field work for 1-population coral trout larval marking experiment at Lizard Is (3-populations with additional co-investment).	30 Jun 2010
(a), (b)	• Final end user workshop to demonstrate results and evaluate strategies.	
(a), (b)	• Final technical report, brochure on how coral trout populations respond to green and blue zones and relevant scientific peer-reviewed publications.	

Project 4.8.1 Milestones 2008/2009

For 2008/2009 Outputs Only	Date
Milestones – All JCU responsibilities	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Pathway to Impact Report for end user relevance.	31 Dec 2008
Report 1 submission: • Detailed progress report (with appropriate attribution of MTSRF funding) on activities conducted under objectives for (a) and (b), including: (i) Biophysical model 50% complete (obj. a); (ii) Completed otolith analysis for Barium marks for 3 fish species (<i>P. maculatus</i>, <i>L. carponotatus</i> and <i>E. quoyanus</i>). Analysis of contribution of 3 Keppel Is. green zones to recruitment in blue zones. Completed genetic parentage analyses for 1 fish species (<i>P. maculatus</i>). Analysis of direction and distance of dispersal (obj. b). (iii) Initial comparison of direction and distance of tagged recruits to physical model (obj. a, b). (iv) Copies of briefing reports (with appropriate attribution of MTSRF funding) to DEWHA and GBRMPA on research findings to date (obj. a, b). (v) Plan of communication outputs and products for Year 3 and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable (obj. a, b).	31 Jan 2009
Verbal progress report by Project Leader to Operations Committee on progress of all objectives.	By Mar 2009

For 2008/2009 Outputs Only	Date
Milestones – All JCU responsibilities	
Report 2 submission: - Detailed progress report (with appropriate attribution of MTSRF funding) on activities conducted under objectives for (a) and (b), including: (i) Biophysical model complete; Testing model outputs 50% complete; Initial ground-truthing model with results part B (obj. a). (ii) Complete genetic parentage analysis for <i>L. carponotatus</i>. Analysis of direction and distance of dispersal (obj. b). (iii) End user presentation to demonstrate model and results (obj. a). (iv) Copies of briefing reports (with appropriate attribution of MTSRF funding) to Industry (GBRMPA and CapReef) and MTSRF newsletter article (obj. b).	10 Jun 2009
Total MTSRF Funding*	\$123,000

Project 4.8.1 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	123,000	-	123,000
JCU	-	224,700*	224,700
Total	123,000	224,700	347,700

- Includes \$52,100 in-kind contribution from the Australian Museum.

JCU Project 4.8.1 Budget 2008/2009

Item	MTSRF	JCU In-kind	Total Cost
Salaries	60,800	119,800	180,600
Operating	50,200	-	50,200
Travel	12,000	-	12,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	104,900	104,900
Total	123,000	224,700[#]	347,700

[#] Includes in-kind contributions from the Australian Museum that are to be reported by JCU.

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	123,000	-	224,700	200,000 ¹	-	547,700
Total	123,000	-	224,700	200,000¹	-	547,700

¹ Dependent on co-investment.

PROGRAM 8: SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES OF THE GREAT BARRIER REEF

Project 4.8.2: Influence of the Great Barrier Reef Zoning Plan on inshore habitats and biodiversity, of which fish and corals are indicators

Project Leader and Host Organisation

Peter Doherty, Australian Institute of Marine Science (AIMS)

Garry Russ, James Cook University (JCU)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Mike Cappel	AIMS	Shoals Task Leader	0.75
Peter Doherty	AIMS	Project Leader	0.05
Gavin Ericson	AIMS	Database/Programmer	0.05
Richard Evans	JCU	Fish biologist	0.2
Charlotte Johansson	AIMS	Tape Reader	0.35
Aaron MacNeil	AIMS	Biostatistician	0.10
Garry Russ	JCU	Reef Task Leader	0.2
Marcus Stowar	AIMS	Fish biologist	0.5
David Williamson	JCU	Fish biologist	0.2

* Inclusion of this FTE is dependent on the final work program

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
GBRMPA	Martin Russell
AMPTO	Col McKenzie / Alan Wallish
WWF	Richard Leck
QDPI&F	Malcolm Dunning

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This Project is part of a wider performance assessment of the new GBR Zoning Plan. Project 1.1.2 of Program 1 Status and Trends of the GBR, includes biannual assessments of the impacts on biodiversity of stopping fishing on regional clusters of coral reefs in the offshore (mid and outer-shelf) domain. This Project investigates the same basic questions for coastal habitats, where the major pressure is from recreational fishing. While the emphasis in both Projects is about the impact of the zoning upon biodiversity, especially the response of fish populations when released from fishing pressure, the wider study is also about the impacts of the new Zoning Plan upon fishers and the Tourism industry. Social and economic dimensions of this problem will be studied through Projects 4.8.4 and Project 4.8.5 of this Program.

Key Objectives:

- (a) Measure the response of biological communities (fish and benthos) to differential zoning of human use on inshore coral reefs.
- (b) Measure the response of biological communities (fish and benthos) to differential zoning of human use on inshore shoals.

Project / Task Methodology

Objective (a): Measure the response of biological communities (fish and benthos) to differential zoning of human use on inshore coral reefs – JCU

The intent is to monitor the abundance of a wide range of fish and benthic invertebrates at a large number of sites on coastal reefs in four groups of islands: Palm Is., Magnetic Is., Whitsunday Is. and Keppel Is. The main data set would consist of 20 sites that changed from blue to green in 2004 matched with 20 control sites that remained open to fishing. In addition, the team has long-term data from another 60 sites in the Palm, Magnetic, Whitsunday & Keppel Island groups, half of which were closed to fishing in the first Zoning Plan (old green, closed 1987). The group have identified the potential to expand the coverage of new green and fished sites to other island groups along the coast (e.g., Family, Sir James Smith, Cumberland, Northumberland and Duke Island groups), representing a further 18 paired contrasts (36 sites). Co-investment funding (CRC Reef residual) was granted in 2007/08 to survey these sites for the first time. If more funding can be secured, these sites will be resurveyed in ARP4.

The team will monitor approximately half of the 100 core sites in 2008/09 with the intention that each location will be monitored twice during the lifetime of MTSRF. All counts of fish and benthos will be done following the same protocol of underwater visual census (UVC) that has been used since this work began more than 10 years ago. The counts will include both large and small fish species. Local stocks of the former can be expected to benefit from protection but this may be accompanied by trophic cascades where more predators mean fewer prey with possible consequences flowing on to invertebrate biodiversity (not explicitly measured here). The final output due in 2010 is expected to be a report on the impact of no-take zones upon biological communities, including potential trophic cascades within fish food webs.

Objective (b): Measure the response of biological communities (fish and benthos) to differential zoning of human use on inshore shoals – AIMS

During the extensive community consultation that accompanied the rezoning of the Marine Park, anecdotal information emerged about the importance of submerged “shoals” and low-relief seabed features as intensified targets for commercial and recreational fishing. In the offshore domain, there was evidence of effort shift in the commercial fishery for live coral

trout from shallow reef flanks to deeper inter-reefal shoals because of the more valuable red colour of coral trout living at depth. In the coastal zone, there was evidence of effort shift in the recreational fishery from shallow reefs to deeper waters away from the immediate vicinity of emergent and island fringing reefs. While part of this shift in effort may have been in response to the high fishing pressure placed upon accessible and popular reefs, technology creep (e.g., affordable colour echo sounders and GPS units) that have allowed recreational fishers to find and return to small habitat features supporting alternative species, especially the high value red snappers (red emperor, small- and large-mouth nannygais), appear to be driving factors. Fisheries managers are not well equipped to deal with this shift in fishing effort in either domain because there is almost no information about the distribution and nature of these submerged seabed habitats and their biology.

In ARP 1, AIMS searched the seafloor in the vicinity of Cairns, Cardwell, Townsville, Whitsundays, Rockhampton, and Gladstone using a multibeam acoustic swathe mapper, ground-truthed by towed video, to develop baselines in comparable “pairs” of fished (“blue”) and unfished (“green”) submerged shoals. The fish populations on these shoals were then sampled with baited remote underwater video stations [BRUVS] because the habitats of interest were below diving depth (i.e. >20 m).

In ARP2, the core sites (Cardwell, Townsville) were resampled with only partial success due to the exceptional wet season of 2007/08 and a very strong La Nina. On the advice of GBRMPA, Cairns shoals were abandoned because of uncertainty about the level of fishing effort. Southern shoals (Barcoo and Karama Banks; East and West Warregoes) were sampled intensely in order to recommend an optimal strategy for sampling large, discrete, submerged shoals. Although there were some mixed results, these large shoals showed differences in the abundance of a dozen key “target” species consistent with an effect of fishing detectable since the rezoning (blue to green) of one shoal from each pair in July 2004.

In contrast, the low relief shoals in the vicinity of Townsville known as the Magnetic Shoals did not show any impact from the rezoning despite the likelihood of good enforcement resulting in substantial differential fishing effort on blue and green shoals. We believe that this is because the low-relief habitat is only a transient habitat for the large “target” species and that the mobility of these species soon exposes them to fishing.

During ARP 1 & 2, we searched a lot of ground for suitable targets in inshore shoal country without finding strong candidates for additional baselines and do not recommend extending this search further. We believe that we have useful baselines on the Brook Shoal (Cardwell) and the two pairs of southern banks (Rockhampton, Gladstone) but believe that it is too soon after the last sampling to revisit them.

As forecast towards the end of ARP2, we recommend that our key question and approach (detection of effects arising from rezoning of deep water habitats) be shifted offshore to support and expand the MTSRF study (1.1.2) which, in alternate years, is about testing the effect of the rezoning upon the shallow water biodiversity of mid-shelf coral reefs.

In the last year of CRC Reef (05/06), the Centre received advance funds from the MTSRF Program and implemented a new set of fish and coral surveys on 28 matched reef pairs, representing similar reefs with shared histories in which one reef became a ‘no take’ zone in the GBRMPA Zoning Plan (2003) while the neighbouring reef remained open to fishing. The reef pairs were clustered in five regional groups and the first set of surveys in 2006 (18-24 months after rezoning) showed patterns consistent with an “effect of line fishing” using coral trout abundance as a logical proxy. Apart from the consistent difference between blue/green reefs across all regions, the three regions south of Townsville showed higher abundance of trout on both zoning classes. This is a known pattern in the abundance of this predatory fish

that is most likely related to the higher natural productivity of these southern ecosystems, which also attracts higher fishing pressure.

This new sampling program is being implemented by AIMS Long-term Monitoring Team on a biannual tempo alternating with their broad-scale surveys of general reef health. Consequently, the “rezoning” surveys were repeated in ARP 2 with even greater divergence between blue and green reefs in the three southern regions most exposed to commercial fishing.

Commercial line fishing for coral trout is concentrated on live captures, which means fishing in relatively shallow water (<20 m). Industry spokespersons have used this fact recently to argue that their impact is less because there is a large biomass of trout in depth water on the same reefs that is protected from fishing (because of barotrauma). This assertion is untested because coral trout abundance is typically determined by shallow water SCUBA surveys, where small fish prey (and hence their predators?) are also most abundant.

We propose to use our ability to assess fish abundance in deep water to establish the abundance of fish species vulnerable to line fishing around the bases of reefs where there is evidence of strong fishing effects. For this reason, we propose to focus on the three southern regions where there is evidence of a sustained and growing impact of fishing upon the trout populations in shallow water.

In ARP3, we propose to apply proven approaches to assess fish species richness, abundance, and size distributions on the leeward bases of 32 southern reefs (blue/ green pairs) with a focus on deep water coral trout, emperors, snappers, cods and tuskfish.

We will use BRUVS to sample fish abundance (and sizes) in deep (~45-60 m) water around blue/green pairs where diver surveys have shown either weak or strong contrasts in coral trout abundance in shallow water. The 32 target reefs lie offshore in the Mackay, Swains and Capricorn-Bunker regions.

The sampling will be done in 40 days of fieldwork in late summer (Jan/Feb 2009) as a single charter out of Townsville using the JCU vessel (RV James Kirby), which is well suited to the tight manoeuvring required near reefs. Each reef will be sampled on its leeward side, where more fishing is expected, with four drops of four baited cameras.

We will analyse this as a hierarchical analysis in order to detect regional effects (Attachment 2) but our focus will be on the main effect (zoning). The analyses will also include depth and micro-habitat type (recorded in the immediate field of view of the BRUVS) as explanatory variables, using regression trees.

The design will reveal whether the “effect of fishing” signals detected by shallow-water surveys are reflective of relative abundance also for deepwater sweetlips (*Lethrinus miniatus*), snappers (*Lutjanus sebae*), cods (*Plectropomus leopardus*, *Epinephelus undulatostratus*) and tusk fish (*Choerodon venustus*). The starry triggerfish (*Abalistes stellatus*) and iodine bream (*Gymnocranius audleyi*) will be considered as unfished “controls” to ensure comparability in habitats.

Project Targeted Activities 2008/2009

Objective	Targeted Activity	Completion Date
(a) (b)	Submit detailed work plan for reef sampling in 07/08 Submit detailed work plan for shoal sampling in 07/08	30 Sep 2008
(a) (b)	Report progress and results from diver surveys of fished and unfished inshore fringing reefs. Report progress and results from camera surveys of fished and unfished submerged shoals.	31 Mar 2009
(a) (b)	Report full results of annual schedule of fish surveys from inshore reefs. Report full results of annual schedule of fish surveys from submerged shoals.	10 Jun 2009

Project 4.8.2 Milestones 2008/2009

For 2008/2009 Outputs Only	Date
Milestones [responsible agency identified in brackets]	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Report 1 submission - Schedule of field activities including proposed methodology and contingency planning to complete objectives a [JCU] - Schedule of field activities including proposed methodology and contingency planning to complete objectives b [AIMS]	By 30 Sep 08
Provide summaries of JCU data to AIMS within one month of collection. [Responsible Officer: Professor Garry Russ, JCU].	As required
Pathway to Impact Report for end user relevance.	15 Dec 2008
Report 2 submission (with appropriate attribution of MTSRF funding): - Report progress and results from diver surveys of fished and unfished inshore fringing reefs. [JCU] - Report progress and results from camera surveys of fished and unfished submerged shoals. [AIMS] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [AIMS]	31 Mar 2009
Report 3 submission (with appropriate attribution of MTSRF funding): - Report describing findings from agreed Schedule of field activities comparing fish and coral data from open and closed coral reefs. [JCU] - Report describing findings from agreed Schedule of field activities comparing fish and coral data from open and closed shoal habitats. [AIMS] - Final summary of communication activities undertaken through the course of Year 1 of project. [AIMS] - Input into plan for completion of activities in out years. [JCU] - Plan for completion of activities in out years in collaboration with JCU. [AIMS]	12 Jun 2009
Total MTSRF Funding	\$228,000

* Visual documentation for this project addressed through Project 4.8.8.

Project 4.8.2 Budget

Year 1 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	228,000		228,000
RRRC (CRC Residual)	100,000		100,000
AIMS		425,865	425,865
JCU		95,356	95,356
Total	328,000	521,221	849,221

AIMS Project 4.8.2 Budget 2008/2009

Item	MTSRF	AIMS In-kind	Total Cost
Salaries		131,932	131,932
Operating	38,000	-	38,000
Travel (charter vessel costs)	100,000	-	100,000
Communication / Extension	-	-	-
Capital	-		
Institutional overheads	-	171,512	171,512
Total	138,000	303,444	441,444

JCU Project 4.8.2 Budget 2008/2009

Item	MTSRF	JCU In-kind	Total Cost
Salaries	50,000	32,656	82,656
Operating	30,000	-	30,000
Travel	10,000	-	10,000
Communication / Extension	-	-	-
Capital	-		
Institutional overheads	-	62,700	62,700
Total	90,000	95,356	185,356

Indicative Budget Summary – Years 4

Year	MTSF Cash	MTSRF Cash	Applicant		Other sources		Total
	AIMS	JCU	Cash	In-kind	Cash	In-kind	
2009/2010	147,000	81,000	-	400,000	-	-	628,000
Total	147,000	81,000	-	400,000	-	-	628,000

PROGRAM 8: SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES OF THE GREAT BARRIER REEF
Project 4.8.3: Evaluation of the resiliency of key inter-reefal fish species
Project Leader and Host Organisation

Dr Colin Simpfendorfer, James Cook University (JCU)

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Dr Colin Simpfendorfer	JCU	Responsible for overseeing and managing all aspects of the Project.	0.22
Dr Andrew Tobin	JCU	Assists with coordination of project, data analysis and reporting	0.1
Ms Leanne Currey	JCU	Biological sample processing, data analysis, write-up and database management.	1.0
Mr Aaron Ballagh	JCU	Database management	0.1

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
GBRMPA	Mr Martin Russell
AMPTO	Col McKenzie
QDPI&F	TBA

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

The Project will significantly build on to the previous data collections of the Effects of Line Fishing (ELF) research. Recent changes to management of the fishery have resulted in the implementation of an Individual Transferable catch Quota (ITQ) system for the management of all harvested reef fish, where the “other reef fish” comprise one third of the total quota; highlighting the importance of this ecological resource. However, very little is known about patterns and motivation in resource use or biology of species in this group as historically most attention has focused on the main target species in the fishery (i.e., coral trout and red throat emperor). Consequently, there is a need to document historic and present resource use of “other reef fish” to monitor shifts in targeting behaviour of fishers with the introduction of the GBR Zoning Plan and ITQ system, and an urgent need to obtain basic biological parameters for at least the key species within the “other reef fish” group to assess their vulnerability to increased resource use.

The Project will be comprised of two components: 1) Description of historic and current patterns of resource use of key inter-reef fish species; and 2) Estimation of biological parameters of key “other reef fish” species.

Key Objectives:

- (a) Document the resource use of “other reef fish” species in the GBR, and identify key ecologically and economically important inter-reef fish species.
- (b) Estimate biological parameters for key “other reef fish” species.

Project / Task Methodology

The Project will use archived biological samples collected as part of the CRC Reef ELF Project that will provide information on the ecological resilience and vulnerability of key inter-reef fish species.

Objective (a): Document the resource use of “other reef fish” species in the GBR, and identify key ecologically and economically important inter-reef fish species.

The first component of the Project will provide a description of historic and current patterns in resource use of key inter-reef fish species obtained from all available data sources. An analysis of current and past market values and catch levels will identify key species in the “other reef fish” group that may be subject to increased resource use in the future in response to the introduction of the GBR Zoning Plan and ITQ system.

Objective (b): Estimate biological parameters for key inter-reef fish species.

The second component of the Project will involve the processing of archived otolith and gonad samples collected during the ELF catch surveys for many species of “other reef fish”. Samples will be processed and analysed to estimate a range of critical population parameters that indicate potential ecological resilience and vulnerability to resource use, as well as being required for key inputs into the inter-reef habitat model, including longevity, sexual pathway (i.e., gonochorism, protogyny) and size at maturity. Additional samples for species with low sample numbers will be supplemented from QDPI&F observer surveys, fishery-independent surveys and fleet sampling. CapReef and other community groups and fishing clubs will also be engaged to provide additional samples as required.

To determine the priority species for the project, an analysis of available data from commercial, recreational and charter fishing was undertaken in the first year of the project (Harvest patterns of the “Other Species” quota group in the Coral Reef Fin Fish Fishery). This report identified 21 key species based on landings data that were used to help identify species for which data would be most beneficial (Table 1). Not all of these species were collected as part of the ELF project, mostly because they occur either deeper (e.g. *Pristipomoides* spp.) or more inshore (e.g. *Lutjanus russelli*, *Epinephelus coiodes*) than the sampling effort. Of the 21 species identified, 12 have samples available from the ELF project.

In addition to the species identified through the key species analysis, the ELF project also collected a range of other species for which samples are available (Table 2). Species with 30 or less otoliths will not be reported on due to a lack of samples. Species for which previous studies have been conducted using ELF samples and data will not be included so as not to replicate data analysis. Species for which previous analysis has occurred include *Lutjanus bohar* (Ross Marriott), *Cephalopholis cyanostigma* (Bob Mosse) and *Epinephelus fuscoguttatus* (Rachel Pears) and *E. polyphekadion* (Rachel Pears).

The proposed schedule for reporting on the results of the processing and analysis of data is given in Table 3. The barramundi cod (*Cromileptes altivelis*) was selected as the first species to be examined for several reasons. Firstly, this species is listed as Vulnerable on the IUCN

Red List (www.redlist.org) and there is little information available on its life history throughout its range in the Indo-West Pacific. Therefore, this study would provide valuable information for conservation and management of this species not only in Australia but also other parts of its range where information is needed to help with conservation efforts. Secondly, preliminary work on this species occurred in the lead up to the start of the MTSRF project and so was more advanced than for other species, enabling research to be completed for an early milestone. This preliminary work had also focused on the development of analytical methods for the data set and so would provide the model for the other species, making later analysis more straightforward. Thirdly, data were available for two regions of interest to MTSRF – GBR and Torres Strait (the former in which the species is protected and the later in which it is fished) – while data for other species was only available from the GBR. This made discussion of the results easier (e.g. regional differences in life history) if it was treated separately.

Table 1. Key components of the “other species” group in the Coral Reef Fin Fish Fishery as determined by analysis of harvest patterns in the major sectors. Names in square brackets are codes from the QDPI database that do not match accepted common names. Shaded species indicate those for which samples are available from the Effects of Line Fishing Project.

Common name	Species name
Yellow-Tailed Emperor	<i>Lethrinus atkinsoni</i>
Spangled Emperor	<i>Lethrinus nebulosus</i>
Hussar (pink)	<i>Lutjanus adetii</i>
Stripey bass	<i>Lutjanus carponotatus</i>
Small-mouth nannygai	<i>Lutjanus erythropterus</i>
Black-spot snapper [Black-Spot Emperor]	<i>Lutjanus fluviflamma</i>
Large-mouth nannygai	<i>Lutjanus malabaricus</i>
Moses perch	<i>Lutjanus russelli</i>
Red emperor	<i>Lutjanus sebae</i>
Rosy jobfish	<i>Pristipomoides filamentosus</i>
Goldband jobfish	<i>Pristipomoides multidens</i>
Blue-spotted rockcod [Bommie cod]	<i>Cephalopholis cyanostigma</i>
Gold-spot cod	<i>Epinephelus coioides</i>
Black-tipped cod	<i>Epinephelus fasciatus</i>
Flowery cod	<i>Epinephelus fuscoguttatus</i>
Speckle-finned cod	<i>Epinephelus ongus</i>
Longfin rockcod [Wire-netting cod]	<i>Epinephelus quoyanus</i>
Maori cod [Cod – maori unspecified]	<i>Epinephelus undulatostratus</i>
Bream coral	<i>Gymnocranius audleyi</i>
Venus tusk fish	<i>Choerodon venustus</i>
Tusk fish [Parrotfish ¹]	Family Labridae

¹ fish identified as parrotfish in the QDPI database are almost all tusk fish caught in the Capricorn Bunker Group

The order of milestones following the barramundi cod were grouped by family to provide for comparisons within taxonomic groups, and the order of the families was based on the number of species for which data were to be analysed. Families with the least were placed first to provide more time for data from larger families to be analysed. Two species of coral trouts (*Variola* spp) were not included in the Family Serranidae milestone species list because they fall within the coral trout quota group. However, these species will be analysed in a final milestone that encompasses a few miscellaneous species so that the data are available. Also included in this final group is the humphead wrasse (*Cheilinus undulatus*). This species is listed on the IUCN Redlist (Endangered), but unlike barramundi cod published life history data are available for this species (e.g. Choat et al. 2006 Marine Ecology-Progress Series 318:237-246).

Table 2. Species with biological samples available from the Effects of Line Fishing Project. Shaded species are those identified from the results of the key species analysis given in Table 1.

Family	Genus	Species	Otolith samples	Gonad samples
Labridae	<i>Cheilinus</i>	<i>undulatus</i>	71	80
Labridae	<i>Choerodon</i>	<i>venustus</i>	20	20
Lethrinidae	<i>Lethrinus</i>	<i>atkinsoni</i>	1850	727
Lethrinidae	<i>Lethrinus</i>	<i>lentjan</i>	73	74
Lethrinidae	<i>Lethrinus</i>	<i>nebulosus</i>	494	328
Lethrinidae	<i>Lethrinus</i>	<i>olivaceus</i>	70	32
Lutjanidae	<i>Aprion</i>	<i>virescens</i>	108	80
Lutjanidae	<i>Lutjanus</i>	<i>adetii</i>	150	55
Lutjanidae	<i>Lutjanus</i>	<i>bohar</i>	976	279
Lutjanidae	<i>Lutjanus</i>	<i>carponotatus</i>	4183	
Lutjanidae	<i>Lutjanus</i>	<i>fulviflamma</i>	80	51
Lutjanidae	<i>Lutjanus</i>	<i>gibbus</i>	100	67
Lutjanidae	<i>Symphorus</i>	<i>nematophorus</i>	175	63
Serranidae	<i>Aethaloperca</i>	<i>roga</i>	4	3
Serranidae	<i>Anyperodon</i>	<i>leucogrammicus</i>	75	35
Serranidae	<i>Cephalopholis</i>	<i>argus</i>	139	85
Serranidae	<i>Cephalopholis</i>	<i>cyanostigma</i>	2656	727
Serranidae	<i>Cephalopholis</i>	<i>miniata</i>	34	13
Serranidae	<i>Cromileptes</i>	<i>altivelis</i>	128	150
Serranidae	<i>Epinephelus</i>	<i>cyanopodus</i>	81	73
Serranidae	<i>Epinephelus</i>	<i>fasciatus</i>	848	452
Serranidae	<i>Epinephelus</i>	<i>fuscoguttatus</i>	187	213
Serranidae	<i>Epinephelus</i>	<i>maculatus</i>	82	69
Serranidae	<i>Epinephelus</i>	<i>merra</i>	23	250
Serranidae	<i>Epinephelus</i>	<i>ongus</i>	805	434
Serranidae	<i>Epinephelus</i>	<i>polyphekadion</i>	130	101
Serranidae	<i>Epinephelus</i>	<i>quoyanus</i>	183	69
Serranidae	<i>Variola</i>	<i>albimarginata</i>	39	39
Serranidae	<i>Variola</i>	<i>louti</i>	134	99

Project Targeted Activities (indicative only for out years)

Objective	Targeted Activity	Completion Date
(a)	Completed analysis and report on historic and current trends in harvest patterns of “other reef fish” species	1 Jun 2010
(b)	Completion of sample processing and analysis for species from, the family Lutjanidae	1 Dec 2008
(b)	Completion of sample processing and analysis for species from, the family Serranidae	1 Jun 2009
(b)	Completion of sample processing and analysis for remaining species.	1 Dec 2009
(b)	Completion of a comparative analysis of the life history and resilience of the “other species” group on the Great Barrier Reef.	1 Mar 2010
(b)	Final reporting and publication of biological information on key “other reef fish” species	30 Jun 2010

Project 4.8.3 Milestones 2008/2009

For 2008/2009 Outputs Only	Date
Milestones – all JCU responsibilities	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Report 1 submission: Report on the biology of “other reef species” from the family Lutjanidae with appropriate attribution for MTSRF Funding	1 Dec 2008
Pathway to Impact report for end user relevance	15 Dec 2008
Report 2 submission: - Fishing and Fisheries Newsletter article with appropriate MTSRF co-badging and attribution of MTSRF funding. - Completion of processing of biological samples for the family Serranidae.	1 Mar 2009
Report 3 submission: - Report on the biology of “other reef species” from the family Serranidae with appropriate attribution for MTSRF Funding. - Plan for completion of out year activities including identification of key inter-reefal species targeted for biological parameter estimation, parameters to be estimated and schedule of laboratory work. - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	10 Jun 2009
Total MTSRF Funding	\$50,000*

*Visual documentation for this project addressed through Project 4.8.8.

Project 4.8.3 Budget**Year 3 – 2008/2009 Project Funding and Partnerships**

Contributing Organisation	Cash	In-kind	Total
MTSRF	50,000	-	50,000
JCU	26,000	191,295	217,295
Total	76,000	191,295	267,295

JCU Project 4.8.3 Budget 2008/2009

Item	MTSRF	JCU Cash	JCU In-kind	Total Cost
Salaries	45,000	26,000	11,295	82,295
Operating	5,000	-		5,000
Travel	-	-		-
Communication / Extension	-	-		-
Capital	-	-		-
Institutional overheads	-	-	180,000	180,000
Total	50,000	26,000	191,295	267,295

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	50,000	26,000	191,295	-	-	267,295
Total	50,000	26,000	191,295	-	-	267,295

PROGRAM 8: SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES OF THE GBR

Project 4.8.4 Evaluation of the impacts from industry and community uses on inshore biodiversity

Project Leader and Host Organisation

Dr Ashley Williams, James Cook University (JCU)

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Dr Ashley Williams	JCU	Project Leader responsible for overseeing and managing all aspects of the project.	0.85
Dr Colin Simpfendorfer	JCU	Responsible for assisting with coordination of all aspects of the project	0.68
Mr David Welch	DPI&F	Responsible for coordinating the collection of field data and historical data, interpretation and analysis, and write-up	0.75
Mr Aaron Ballagh	JCU	Responsible for database management and some field work	0.1
Mr Alistair Harry	JCU	Responsible for completing a PhD related to the biology of key inshore sharks	1.0
Mr Olivier Bittar	JCU	Responsible for field work, biological sample processing, data entry and analyses	1.0
Dr Richard Pillans	CSIRO	Responsible for assisting with risk assessment development	0.05
Dr Malcolm Dunning	DPI&F	Responsible for coordinating linkages with QDPI&F Assessment and Monitoring	0.05
Dr Rick Officer	DPI&F	Responsible for providing advice on shark biology and assisting with risk assessment development	0.025
Dr Neil Gribble	DPI&F	Responsible for providing advice on the inshore fishery and assisting with risk assessment development	0.05

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GBRMPA	Randall Owens
DPI&F	Claire Andersen
AMPTO	Col McKenzie
ARC	Russell Butler
WWF	Richard Leck

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This Project will evaluate the impacts on inshore biodiversity arising from industry and community uses. Fishing is the primary extractive use of inshore marine species by industry and the wider community, but currently the ecological, social and economic sustainability of this use and associated impacts on the inshore biodiversity is unknown. This Project will directly address the key MTSRF goal of sustainable use and management of natural resources by providing an understanding of the current and potential industry and community uses of inshore biodiversity and natural resources with respect to ecological sustainability and provide information and options to assist managers, industry and communities to optimise the use of biodiversity resources and minimise adverse impacts where they occur.

Specifically, this Project will provide a report on the ecological effects of the 2003 Zoning Plan on inshore biodiversity resources and a report on strategies to better mitigate the environmental impacts of the inshore finfish fishery, particularly impacts on sharks and other vulnerable species. This Project also directly supports the MTSRF Mission to facilitate capacity-building for sustainable environmental management and environmental management research by incorporating and fostering postgraduate research within the Project.

Key objectives:

- (a) Characterise the industry and community use of inshore biodiversity.
- (b) Evaluate the effects of current management arrangements, in particular the GBR 2003 Zoning Plan, on industry and community use of inshore biodiversity resources.
- (c) Derive biological parameters, determine stock structure and identify critical habitats for key inshore species, in particular sharks, used by industry and the community.
- (d) Evaluate the impacts of industry and community use on key inshore marine species, such as sharks, within the GBRWHA by identifying vulnerable species or species groups and assessing potential risks.
- (e) Assess potential strategies to mitigate the impacts of industry and community use on inshore resources within the GBRWHA.

Project / Task Methodology

Objective (a): Characterise the industry and community use of inshore biodiversity.

The use of inshore biodiversity by industry and the community will be characterised by analysing existing fisheries data for the inshore fishery. This will provide estimates of relative importance of species groups to the various users of the inshore biodiversity resources. Where possible, these data will be analysed within years and among regions to explore overall seasonal and regional patterns in use. Species-specific data and information on discarded bycatch species are generally not available from existing fisheries data sources. Therefore, data from previous and current research projects (DPI&F, CRC Reef, CapReef, UQ and CSIRO) will be collated to assess the extent of species-specific information available for inshore species.

Where gaps are identified, additional data will be collected from observer surveys on commercial and charter vessels and boat ramp surveys for recreational fishers. Personal interviews with fishers from all sectors of the inshore fishery will be conducted as part of proposed Project 4.8.5. Species-specific data collected from these interviews will be made available to this Project. The collection of detailed information for the indigenous sector is beyond the scope of this Project.

An observer survey program will be designed to capture the spatial and seasonal trends in use of inshore biodiversity within the GBRWHA. The observer program will strongly complement existing observer surveys conducted by DPI&F by collecting similar information from locations and at times not covered by the DPI&F surveys. Specific data collected from observer surveys will include time spent fishing, location, depth, habitat, species composition of the harvest and bycatch, lengths of all species caught and condition of discards. Biological samples from key species will also be collected during observer surveys (see Objective (c)). Data from the DPI&F observer surveys will be made available to this Project as an in-kind contribution.

Objective (b): Evaluate the effects of current management arrangements, in particular the GBR 2003 Zoning Plan, on industry and community use of inshore biodiversity resources.

The patterns in use of inshore biodiversity resources by industry and the community prior to and since the implementation of the Zoning Plan will be compared to assess shifts in use of key harvested species or species groups. Personal interviews with commercial and recreational fishers will be conducted and will be designed to elicit information about species-specific shifts in use since the implementation of the Zoning Plan. Geographical Information Systems (GIS) will be used to map shifts in the distribution of use and to highlight areas of concentrated use and areas of significant overlap among sectors.

Objective (c): Derive biological parameters, determine stock structure and identify critical habitats for key inshore species, in particular sharks, used by industry and the community.

Data from previous research projects (DPI&F, CRC Reef, UQ and CSIRO) will be collated to review existing biological knowledge of key inshore species at risk. This process will identify species for which biological information is lacking or insufficient. Biological samples of these species will be collected during the observer surveys for Objective (a) and from targeted sampling from the commercial fleet and seafood processors. Otoliths (fin fish), vertebrae (sharks) and gonads will be extracted and processed to provide estimates of age, sex and stage of sexual development. Additional features will be measured for sharks including clasper length and rigidity and presence of sperm in sperm ducts for males, and uterus width and presence of eggs or pups for females. These data will be used to estimate longevity, growth rates, mortality rates, size and age at first maturity and fecundity for key species or species groups. Fin clips from samples will be used for genetic analysis using mitochondrial and microsatellite markers to examine the stock structure and potential movements of key species, in particular sharks. Additional information on dietary preferences will be obtained where possible from stomach contents. Critical habitats for key species will be identified by linking the catch and effort data from observer surveys to life stages identified through biological examination.

A PhD student (A. Harry) with relevant experience in fisheries research will contribute to the completion of this objective. Harry will be located at JCU and supervised by JCU Project staff.

Objective (d): Evaluate the impacts of industry and community use on key inshore marine species, such as sharks, within the GBRWHA by identifying vulnerable species or species groups and assessing potential risks.

A risk assessment framework specifically tailored for the assessment of tropical sharks has been developed by an expert panel of shark researchers from DPI&F and CSIRO. This framework will be used as a basis to assess the potential vulnerability of species to current patterns in use of inshore biodiversity resources by industry and the community. The established risk assessment model will be refined to incorporate data collected from the first three objectives of this Project, including relative harvest rates, biological characteristics, discard practices, stock structure and estimates of the survival rates of released species.

The presence in other fisheries within the GBRWHA of species identified during this process as being at risk to over-exploitation will be identified. Information on the use of these species from other fisheries will be incorporated into a refined risk assessment to provide a more comprehensive assessment of overall risks to these species within the GBRWHA.

Objective (e): Assess potential strategies to mitigate the impacts of industry and community use on inshore resources within the GBRWHA.

Based on results from the risk assessment (Objective (d)) and biological information (Objective (c)), the performance of a range of potential mitigation strategies including education, seasonal and area closures to fishing, reduction or redistribution of fishing effort and fishing gear modifications will be assessed for their ability to reduce the interaction of potentially vulnerable species with various fishing gears used in the inshore fishery. This objective relies heavily on the results from Objective (d) and, therefore, specific methods for assessing potential mitigation strategies will not be developed until results are known. Engagement of management and fishers in the assessment of potential mitigation strategies will be essential to ensure such strategies are effective, practical and are accepted and adopted by industry. Workshops with end users will be organised in the third and fourth years of the Project to facilitate the assessment, development and potential implementation of mitigation strategies identified as being effective.

Project motivation and relationship to other projects

The main focus of this project is the collection of information to enable an Ecological Risk Assessment (ERA) to be implemented for the inshore species taken by the major sectors. The results of the ERA will identify species that are most at risk, help identify possible solutions and provide resource managers with information on which to improve management of inshore resources of the GBRWHA. It should be stressed that this project is implementing this risk assessment for all species taken in the inshore commercial and recreational fisheries, including sharks, rays and teleost fish.

Ecological risk assessment requires a range of information that falls within two broad categories:

1. *Life history.* These data provide the basis for the biological sustainability and risks of a particular species. A large part of the current project is devoted to the collection of life history data that will be used in the ERA. Two approaches to collecting life history data were available in designing this project. Firstly, fishery independent sampling. This approach requires dedicating sampling by researchers, and was considered too expensive and time consuming to collect the large amount of material and data required (species and regional representation). The second approach is fishery dependent sampling where data and samples are collected by observers working either with commercial or recreational fishers. This approach was chosen for this project because it provided a cost effective method of collecting material for the project. The material collected was also from the species that are most commonly

caught and thus most needed; a problem for fishery independent approaches if sampling strategies are poorly designed. The fishery dependent approach therefore provided a representative and cost effective means of collecting life history data. The material collected is being processed to provide the required life history information. There are at least three student projects involved in this process (life history of commercially important inshore shark species [Alastair Harry, PhD]; life history of blue threadfin [Aaron Ballagh, PhD]; stock structure and life history of king threadfin [Bradley Moore, PhD]), and probably a fourth, dependent on funding. The other advantage of a fishery dependent approach was that data on the species composition of the catch could be investigated. There is limited data available on the species composition of catches in the inshore fishery, and by recording species composition while on vessels this project could also contribute to the understanding of the diversity of species encountered. These data would also help inform the ERA approach in terms of the species that needed to be included and how they interact with the fishing gear, whether they are retained or released, etc for use in the next section (susceptibility). In addition to the species composition data collected in this study, data from QDPI&F observer programs are also being used to help frame the risk assessment.

2. *Susceptibility.* These data provide an understanding of how various processes affect a given species. The most common approach is to consider a species susceptibility to a fishery (e.g. efficiency of the gear, the range of the fishery relative to the species range, release practices, etc.). This is the approach specified in the current project. However, the susceptibility aspect of ERA is quite open, in that it allows the inclusion of a variety of other factors that may affect a species' risk level (e.g. ecological effects such as changes in water quality, competition for resources or spatial dynamics that change susceptibility given the mosaic of management zones within the GBRWHA). Given this, a number of related projects, mostly undertaken by graduate students, have been developed that are aiming to provide additional information on this aspect of the ERA. These projects are briefly outlined below (section on Internal student projects).

In addition to the core research being carried out as part of this project, there are a number of other projects that are linked to this study that are providing additional information that will expand the scope of the ERA. These fall into two areas:

1. *Externally funded projects.* Three projects on the stock structure of groups of inshore species (grey mackerel, threadfin and sharks) are currently funded by FRDC. Two of these projects are investigating stock structure across northern Australia (grey mackerel and threadfin), while the third is investigating the stock structure of four species of sharks (top commercially caught species) on Queensland's east coast. These projects on stock structure are designed to provide information on the appropriate spatial scales for management of these widely-distributed stocks, but also provide ancillary information (e.g. life history data) that will be useful in the ERA. A fourth funded project will start to develop tools for investigating the post-release survival of sharks (funding from Save Our Seas Foundation). This topic is especially important given that recreational fishers release > 95% of their shark and ray catch in the GBRWHA, and with increasing regulation commercial fishers are also required to release more individuals.

2. *Internal student projects.* A number of student projects are currently underway (or will be in the near future) that will provide additional data to the ERA. This includes a study on the competition for food resources by inshore predators (sharks and fish) and its implications for nursery areas (Mike Kinney, MSc); attitudes and practises of recreational fishers to sharks and rays (Ann-Maree Lynch, Hons); spatial dynamics of inshore predators in relation to a marine protected area (Danielle Knip, MSc); methods for evaluating post-release stress and survival in sharks and rays (Cynthia Awruch, postdoc).

All of these projects have some level of linkage to the core MTSRF-funded project. Some utilise samples collected during fishery dependent sampling (e.g. shark stock structure), while others feed samples in to the MTSRF project (e.g. grey mackerel and threadfin stock structure). This synergy between projects provides for outputs that are greater than could be achieved by projects individually.

Project Targeted Activities (indicative only for out years)

Objective	Output / Milestone	Date
(a, b, c) (c) (d) (a, b)	Work with QDPI&F on the observer surveys on commercial vessels (co-funding). Continue boat ramp surveys for recreational fishers. Continue sample collection from commercial fishers and seafood processors. Continue processing of biological samples. Develop Ecological Risk Assessment framework for inshore species. Collate data from DPI&F observer surveys. Briefing to DEH, DPI&F, Inshore finfish MAC, CapReef SC & GBRMPA FRAC, QSIA (including regional offices), Sunfish (including regional offices),	December 2008
(a, b, c) (a, b) (c)	Complete boat ramp surveys for recreational fishers. Complete sample collection. Preliminary description of life history parameters of key inshore fish and shark species Industry or other end user newsletter article.	30 June 2009
(c) (d) (b) (d, e)	Description of life history parameters for key inshore fish and shark species. Complete preliminary Ecological Risk Assessment for inshore species and identify potentially vulnerable species. Complete assessment of the impacts of the 2003 Zoning Plan on the use of inshore biodiversity resources. Workshop with end users to discuss results from risk assessment and assess potential mitigation strategies. Briefing to DEH, DPI&F, Inshore finfish MAC, CapReef SC & GBRMPA FRAC.	December 2009
(c)	Completion of student thesis. Final workshop with end users to discuss project results. Technical report and relevant peer-reviewed publications.	June 2010

Project 4.8.4 Milestones 2008/2009

For 2008/2009 Outputs Only	Date
Milestones – all JCU responsibility. All reports to be written reports unless otherwise specified.	
Signing	
Report 1 submission: - Develop Ecological Risk Assessment framework for inshore species. - Plan of communication outputs and products for Year 2 and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Dec 2008
Pathway to Impact Report for end user relevance	31 st Dec 2008
Report 2 submission: - Preliminary report on estimates of life history parameters for key inshore fish and shark species. - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Mar 2009
Report 3 submission: - Summary report of two years of fishery-dependent sampling – frequency and distribution of surveys completed and samples collected with appropriate attribution of MTSRF funding - Plan for completion of out year activities including schedule for completing final report on observer surveys and boat ramp surveys, completing description of life history parameters of key inshore fish and shark species and completing an Ecological Risk Assessment.	30 Jun 2009
Total MTSRF Funding*	\$248,000

* Visual documentation for this project addressed through Project 4.8.8

Project 4.8.4 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	248,000	-	248,000
DPI&F	-	29,250 ¹	29,250
JCU	94,000	708,645	802,645
Total	342,000	737,895	1,079,895

¹ Secured co-investment from QDPI&F for portion of D. Welch salary, remaining portion of salary from MTSRF funds.

Budget 2008/2009

Item	MTSRF Funds	JCU Cash	In-kind	Total Cost
Salaries	194,500*	94,000	29,250 ^{DPI}	317,750
Operating	33,000		-	33,000
Travel	15,000		-	15,000
Communication / Extension	-		-	-
Capital	-		-	-
Institutional overheads	-		708,645 ^{JCU}	708,645
Total	242,500	94,000	737,895	1,074,395

* Visual documentation for this project addressed through Project 4.8.8

Indicative Budget Summary - Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	248,000	94,000	708,645		29,250	1,079,895
Total	248,000	94,000	708,645		29,250	1,079,895

PROGRAM 8: SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES OF THE GREAT BARRIER REEF

Project 4.8.5: Incorporating stakeholders and their values, knowledge and aspirations in the care and development of the Great Barrier Reef Marine Park

Project Leader and Host Organisation

Dr Stephen Sutton, James Cook University (JCU)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Dr. Stephen Sutton	JCU	Project Leader responsible for overseeing and managing all aspects of the project.	0.6
Dr. Renae Tobin	JCU	Post-doctoral fellow with socio-economic research experience employed to conduct data collection and analysis and report writing.	0.4
Mr. John Diacopalous	JCU	Research Assistant	0.5
Ms. Debora DeFreitas	JCU	PhD Student	0.25

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
AMPTO	Allan Wallish
DEW	Andrew McNee
CapReef	Bill Sawynok
JCU (PI of MTSRF Project 4.8.6)	Bruce Prideaux
Commercial Fisherman	Carl D'aguiar
GBRMPA	Chris Briggs
Sunfish	David Bateman
GBRMPA	James Innes
QDPI&F	John Kung
GBRMPA	Karen Lawrence
GBRMPA	Lisha Mulqueeny
Fish Collector	Lyle Squire Jnr
GBRMPA	Margie Atkinson
QSIA	Neil Green
GBRMPA	Randall Owens
Charter Fisher	Ray Joyce
WWF	Richard Leck
DEWR	Siobhan Davies

End-user reference group

Parts of this project (in particular as related to Objective (b)) are being undertaken in collaboration with end-users. A one-day workshop with end-users was held in Townsville during the first year of the project. One outcome of that workshop was the establishment of a reference group consisting of representatives of the identified end-users of the project outcomes. The reference group is kept informed of the project's progress through e-mail updates on a regular basis, and participates in relevant project activities (e.g., selection, review, and testing of socio-economic indicators).

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

The overarching goal of this Project is to provide information that will enhance our capacity to incorporate social considerations in decision making, predict, evaluate and mitigate negative social impacts of changes in policy or resource condition, and facilitate the development of community partnerships and community engagement in research and management of the Great Barrier Reef World Heritage Area (GBRWhA).

Specific objectives of the project are:

- (a) Understand and document the influence of the 2003 GBR Zoning Plan on use (tourism, recreation, and fishing) of the GBRWhA and users.
- (b) Develop, test, and parameterise a set of indicators that can be used to assess change in the socio-economic environment of GBRWhA use in response to policy or environmental changes, utilizing the framework currently being developed through the MTSRF Interim Funding program.
- (c) Explore and document the social values, attitudes, perceptions, knowledge, concerns and aspirations related to the GBRMP and its use, management, and conservation held by Marine Park users and the wider community

Project / Task Methodology

Element 1: Analysis of existing data

Objectives (a) and (b)

Existing sources of information will be sourced, collated, and analysed to predict and assess potential influence of the 2003 GBR Zoning Plan on GBR users. Available data sources include (but are not limited to): CRC Reef tourism surveys and surveys of recreational, commercial, and charter fishers; media articles about the influence of the Zoning Plan; historical catch and effort data from commercial, recreational, and charter fishers; and catch and effort data collected through the QDPI&F RFISH and CFISH programs.

Element 2: GBR user interviews**Objectives (a) and (b)**

Face-to-face interviews will be conducted with a random sample of approximately 200 GBR users including tourism operators, recreational fishers, and commercial fishers to assess and understand the socio-economic influence of the 2003 Zoning Plan. Changes in reef-use patterns will be recorded on maps and entered into GIS for archiving and analysis. Additional questions will focus on attitudes and knowledge concerning the Zoning Plan, user characteristics, and involvement in the rezoning public consultation program. The survey will also collect information necessary to parameterise the social indicators identified in the framework currently being created by GBRMPA/JCU through a MTSRF bridging-fund project (see Element 3 below). The survey will build on research undertaken by the Project Leader under CRC Reef Task 1.2.3b “Understanding the effects of management changes in the GBR on the recreational fishing community” by expanding the data collected to include geographic areas outside the CapReef study area (i.e., the Rockhampton/Gladstone region), and by including the tourism and commercial fishing sectors.

Element 3: Development of a socio-economic indicators monitoring system.**Objective (b)**

Through a project funded through MTSRF bridging funds, researchers at GBRMPA and JCU are currently developing a framework to monitor socio-economic variables related to use of the GBR and incorporate this information into management. The surveys to be undertaken in Element 2 above will build on the GBRMPA/JCU project by collecting data to parameterise the indicators identified through that project, and by providing industry-specific indicators that can be used in other evaluative frameworks (e.g., fishery indicators to be used in fisheries Management Strategy Evaluations (see Project 4.8.2(a)). To provide a link between this Project and the GBRMPA/JCU project, a one-day workshop will be conducted in Townsville to discuss and refine further information needs and issues related to the use of socio-economic indicator information.

The workshop will include a selected group of representatives of major reef user groups (tourism, recreational fishing, commercial fishing), and relevant fisheries and marine park managers, and scientists. The major outcome of the workshop will be a list of social and economic indicators to be parameterised through Elements 1 and 2 above.

Element 4: Community survey of reef use and value**Objective (c)**

A telephone survey will be conducted to explore and document community social values, attitudes, etc. towards the GBRMP. The geographic area to be covered by the survey (e.g., North Queensland, state-wide, or nation-wide) will be determined at a later date in consultation with Marine Park managers. The telephone survey methodology used will be based on the methods developed and used successfully in CRC Reef Task 1.2.3b to survey recreational fishers in Queensland. The sample size will be sufficient to segment the population according to their primary relationship with the Marine Park (e.g., tourism, recreational fishing, non-fishing recreational use, non-users, etc) and explore differences in attitudes and social values between the groups.

Project Outputs / Milestones

The primary end-users who will benefit from the outputs of this project are the Great Barrier Reef Marine Park Authority, the recreational, commercial, and charter fishing industries, and the GBR marine tourism industry.

Objective	Output / Milestone	Completion Date
(a) (b)	Collate existing information relevant to assessing influence of the Zoning Plan. Conduct the socio-economic indicators workshop. Industry and other end user magazine article. Article for communication purposes	December 2006
(a)	GBR user survey and sampling plan developed. Commence analysis of existing data and GBR user survey. Briefing to DEW, GBRMPA RACs, CapReef, and industry. Article for communication purposes.	June 2007
(c)	Industry and other end user magazine article.	December 2007
(a) (b) (c)	Develop telephone survey instrument. Article for communication purposes Briefing to DEW, GBRMPA, CapReef, and industry.	June 2008
(a) (c)	Complete user interviews and telephone survey. Article for communication purposes Industry and other end user magazine article. Briefing to GBR Operations Committee	December 2008
(a) (c)	Complete data entry into GIS and statistical databases. Analysis of interview and survey data commenced. Briefing to DEW, GBRMPA, CapReef, GBR Operations Committee and industry.	June 2009
(a) (c)	Complete data analysis. Article for communication purposes Industry and other end user magazine article.	December 2009
(a) (b) (c)	Technical reports and relevant scientific peer-reviewed publications. Briefing to DEW, GBRMPA, CapReef, and industry.	June 2010

Project 4.8.5 Milestones 2008/2009

For 2008/2009 Outputs Only	Date
Milestones – all JCU Responsibilities	
Signing of contract	
Report 1 submission: - Report summarizing number and location of stakeholder interviews and community telephone surveys completed. with appropriate attribution for MTSRF funding. - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. - Article for communication purposes - Industry and other end user magazine article.	15 Dec 2008
Pathway to Impact for enduser relevance	31 st Dec 2008
Report 2:	15 June 2009

For 2008/2009 Outputs Only	Date
Milestones – all JCU Responsibilities	
- Report outlining preliminary findings of the analysis of user interview and community survey data with appropriate attribution for MTSRF funding. - Summary of any communication activities undertaken including minutes of meetings/workshops if applicable. - Progress briefing to Reef stakeholder workshop.	
Total MTSRF Funding	\$123,000

Project 4.8.5 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	123,000	-	123,000
JCU	30,000*	240,000	270,000
Total	153,000	240,000	393,000

* Co-investment by JCU to cover thirty percent of PI salary.

JCU Project 4.8.5 Budget 2008/2009

Item	MTSRF	JCU Cash	Total Cost
Salaries	115,000	30,000*	145,000
Operating	5,000	-	5,000
Travel	3,000	-	3,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	123,000	30,000	153,000

* Co-investment by JCU to cover thirty percent of PI salary.

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	123,000	30,000 ¹	240,000		2009/2010	123,000
Total	123,000	30,000	240,000		Total	123,000

¹ Co-investment requested from JCU to cover thirty percent of PI salary.

PROGRAM 8: SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES OF THE GREAT BARRIER REEF

Project 4.8.6: Analysis of recreational and tourism use and impact on the Great Barrier Reef for managing sustainable tourism

Project Leader and Host Organisation

Professor Bruce Prideaux, James Cook University (JCU)

Project Team commitments 4.8.6

Title	Organisation	Role	FTE
Prof Bruce Prideaux	JCU	Principle Investigator 1 Task Objectives b and d	0.3
Prof Glenn Ross	JCU	Principle Investigator 2 Task Objectives d	0.1
Dr Alexandra Coghlan	JCU	Post Doctoral Research Fellow Task Objective d	1.0
Dr Alastair Birtles	JCU	Principle Investigator 1 Task Objectives a and c	0.2
Assoc Prof Peter Valentine	JCU	Principle Investigator Task Objective a and c	0.1
Dr Natalie Stoeckl	JCU	Principle Investigator 3 Task Objectives a and c	0.1
PhD students Marina Farr (Research assistant); Arnold Mangott and Matthew Curnock (PhD students)	JCU	Task Objective a	0.2
TBA Post Doctoral Researcher	JCU	Post Doctoral Research Fellow Task Objective (not currently funded)b	1.0
TBA Researcher for Task Objective b	JCU/CSIRO	Post Doctoral Research Fellow Task Objective b (not currently funded)	TBA

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
GBRMPA	Lisha Mulqueeny
AMPTO	Col McKenzie / Alan Wallish

This Project links to Project 4.8.5 and will benefit from the capacity building component of Theme 5 Enhancing Delivery.

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project includes determination of the social values of key marine species, particularly large fish around tourist facilities, and identification of key trends and drivers of visitor patterns in the GBR and an economic analysis of the value of no-take zones to tourism in the GBR. The economic analysis will be deferred until adequate capability has been developed in North Queensland through a CSIRO/JCU cooperative arrangement. In addition, the program will identify annual visitor usage patterns of the GBR to enable the identification of key trends and drivers of visitor patterns. Impacts of tourism and visitation to critical reef sites and sustainable levels of visitation to these sites will be assessed. This Project will provide link with the inshore biodiversity project (Project 4.8.7) on Irukandji movement and habits, and the risk of human encounters to irukandji and other marine stingers that may influence tourist visitation.

The project is linked to Project 4.8.5, Objective (a) and (b): Understand and document the influence of the 2003 GBR Zoning Plan on use (tourism, recreation, and fishing) of the GBRWHA and users and Project 4.9.2 Sustainable Nature Based Tourism: Planning and Management. There is potential for the project to be linked to other projects within the MTSRF program

Key Objectives:

- (a) Identify relative social and economic values of key marine species, particularly large fish around tourist facilities.
- (b) Undertake a bio-economic analysis of the 2003 GBR Zoning Plan to determine the value of no-take zones to tourism in the GBR. This component will be deferred until adequate capability has been developed in North Queensland through a CSIRO/JCU cooperative arrangement.
- (c) Identify impacts of tourist and visitation to key reef sites and sustainable levels of visitation to these sites.
- (d) Identification of key trends and drivers of visitor patterns, including a comparison of the GBR with international reef tourist attractions.

Project / Task Methodology

Objective (a): Identify relative social and economic values of key marine species, particularly large fish around tourist facilities.

Surveys of tourists visiting the GBR and interacting with iconic marine wildlife species (e.g. minke whales, sharks and rays, turtles and large fishes such as Maori wrasse, potato cod and Queensland grouper), combined with a business expenditure survey of GBR tourism operators providing these experiences, will provide the first in-depth assessment of some of the relative social and economic values of these iconic marine species and their impact on the local and regional economy. Field assessments of the quality of key wildlife attractions, impacts and their management will be conducted and will require the continued in-kind support of industry. Assessment of social values requires an understanding of visitor expectations, satisfaction and perceptions of iconic wildlife species. An understanding of these social and economic values of these key species is required for a Triple Bottom Line (or Quadruple Bottom Line) evaluation of the sustainability of tourism utilising these important resources.

Objective (b): Undertake a bio-economic analysis of the 2003 GBR Zoning Plan to determine the value of no-take zones to tourism in the GBR. This component will be deferred until adequate capability has been developed in North Queensland through a CSIRO/JCU cooperative arrangement.

This objective, which links with Project 4.8.5, will require specific expertise in resource economics. The scope and details of this project will be further developed pending commencement of a CSIRO/JCU cooperative arrangement to build this capacity in the MTSRF program. The project will be budgeted separately and will combine the outcomes of Project 4.8.5: Incorporating stakeholders and their values, knowledge, and aspirations in the care and development of the Great Barrier Reef Marine Park; in particular, Objective 4.8.5(a): Understand and document the influence of the 2003 GBR Zoning Plan on use (tourism, recreation, and fishing) of the GBRWHA and users.

Objective (c): Identify impacts of tourist and visitation to key reef sites and sustainable levels of visitation to these sites. This component is deferred until funding becomes available.

Data collected through the visitor survey, focus groups and operator survey will establish the importance of specific attractors in the reef experience, the importance of specific sites as triggers to attract visitors and key elements of the experience that determine satisfaction levels. Combining this knowledge with environmental sustainability levels will assist in determining the level of visitor sustainability if there are restrictions placed on visitor numbers or visitor usage of specific sites. A number of management tools will be identified and a sustainable level of visitation framework developed as a new assessment and management tool to assist GBR managers mitigate impacts of loss of sustainability through overuse.

Objective (d): Identification of key trends and drivers of visitor patterns, including a comparison of the GBR with international reef tourist attractions.

Visitor patterns will be identified and published as a barometer on a quarterly and annual basis. The annual publication will link GBR visitor patterns to state, national and global trends to develop performance benchmarks with these trends. This objective will allow examination of trends and drivers that effect visitor flows to the reef. Monthly visitor surveys will be conducted with approximately 350 respondents. Marine operators will assist by distribution and collection of the surveys in 5 GBR regions (Port Douglas, Cairns, Townsville, Whitsunday's and the Capricorn Coast). This methodology will also enable the research team to respond rapidly to emerging issues that impact on the GBR. Specific issues that will be investigated during the project will include motivations, seasonality, segmentation and other issues including responses to global warming, the importance of photography, coral bleaching as well as an indication of the size of the dive market in the GBR. Surveys will be conducted in English and where appropriate in Japanese and Chinese. A triangulation method using participant observation and informal dialogues with tourists will increase the robustness and depth of the survey data, and ensure its representativeness. This project will, together with project 4.9.2 provide a comprehensive picture of the pattern of tourism in the study region and allow reef tourism to be placed within the overall context of motivations to visit the study region and the range of activities engaged in once in the region. Co-investment would substantially enhance this objective.

Project Targeted Activities 2007/08 (indicative only for out years)

Objectives	Output / Milestone	Completion Date
(d)	Technical report on seasonality effects on reef tourism	Nov 2008
(d)	Preliminary report on comparison of visitor trends and drivers between GBR regions Annual Visitor's Report	Feb 2009
(a)	Report on social and economic value of Minke Whales	Jun 2009
(d)	Report on changes in market segmentations of reef visitors	Oct 2009
(d)	Report on trends and changes in reef experiences and activities undertaken on the reef Annual visitor's report	Feb 2010
(a)	Report on social and economic values of marine turtles	Mar 2010
(a)	Final Report on the social and economic values of key marine species (all species)	Jun 2010
(d) (a), (d)	Final report on visitor patterns, trends and drivers. Final report on economic trends.	Jun 2010

Project 4.8.6 Milestones 2007/2008

For 2007/2008 outputs only	Date
Milestones – all JCU responsibilities	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Report 1 submission - Technical report on seasonality effects on reef tourism - Plan of communication outputs and products for year three and summary of any communication activities undertaken to date including minutes of meetings/workshops if applicable.	30 Nov 2008
Pathway to Impact Report for end user relevance.	15 Dec 2008
Report 2 submission - Preliminary report on comparison of visitor trends and drivers between GBR regions. - Plan for completion of activities for objective (d) including completion of remaining surveys, data collated on visitor usage of other Australian and international reef tourist attractions for comparison to data from GBR. - Visitor Survey Annual Report for the year ended December 2008 - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	28 Feb 2009
Report 3 submission - Preliminary report on social and economic values of minke whales with appropriate attribution of MTSRF funding - Summary of communication activities undertaken, including minutes of meetings/workshops if applicable. - Preliminary findings of first stage of research on relative social and economic values of key marine species (obj a above).	13 Jun 2009
Total MTSRF Funding*	

* Visual documentation for this project addressed through Project 4.8.8.

Project 4.8.6 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	148,000*	-	148,000
JCU	-	70,000	70,000
AMPTO	-	80,000	80,000
Total	148,000	150,000	298,000

* Visual documentation of this project is covered under Project 4.8.8.

JCU Project 4.8.6 Budget 2008/2009

Item	MTSRF	In Kind	Total Cost
Salaries	95,000	70,000	165,000
Operating	23,000	80,000	103,000
Travel	15,000	-	15,000
Communication / Extension	15,000	-	15,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	148,000	150,000	298,000

* The in-kind contribution to the operating budget is provided by AMPTO

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	148,000	-	90,000	145,000	10,000	393,000
Total	296,000		180,000	290,000	20,000	786,000

Co-investment would substantially enhance Objective (d and c).

PROGRAM 8: SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES OF THE GREAT BARRIER REEF

Project 4.8.7: Forecasting risk of exposure to irukandji
Project Leader and Host Organisation

Professor Michael Kingsford, James Cook University (JCU)

Proposed Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Prof Michael Kingsford	JCU	Chief investigator	0.05
Dr Eric Wolanski	JCU	Associate investigator	0.05
Post Doc/Project funds	JCU	TBA (contingent on funding)	TBA
Dr Jamie Seymour	JCU	Principal investigator	0.05
Dr Madeleine van Oppen	AIMS	Principal investigator	0.05

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
AMPTO	Col McKenzie
GBRMPA	Chris Briggs
Surf Lifesaving Australia	TBA
Queensland Health	TBA

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

- Collect samples for the project during the stinger season from November to May.
- Use a microsatellite DNA marker library, that has been developed as part of the project, to assess spatial structure in *C. barnesi*
- Use elemental chemistry and microsatellites to test for differences in the population structure of *C. barnesi* and *C. fleckeri* among locations.
- Expand risk maps for stingers including time of year, geographic variation, species distribution etc. from existing data sets and expert opinion (contingent on funding).
- Develop set of response guidelines to reduce risk to human health (contingent on funding).

Project Activities 2008/2009

Objective	Targeted Activity	Date
A	Collect additional samples – from research vessels and jellyfishes of opportunity from the Quicksilver stinger sampling program and other marine tourism operators.	November 2008 to March 2009
B & C	Use microsatellites and statolith microchemistry to elucidate stocks and movements of cubozoans	December 2008 to March 2009
D & E	Expand risk maps for stingers (with uncertainty identified) Produce guidelines for marine operators and the public to reduce the risk of exposure to marine stingers (contingent on funding)	June 2009

Project 4.8.7 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones – all JCU responsibilities	
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/09
Report 1 submission Schedule of field activity and communication activities for 08/09 including collaborative project meetings to assist in development of risk maps and guidelines to reduce risk of exposure to marine stingers.	10 Sept 2008
Pathway to Impact Report for end user relevance.	31 Dec 2008
Report 2 draft submission - Final guidelines for marine operators and public that identify techniques to minimize risk of exposure to marine stingers and actions to take if contact with stingers is made. Inclusion of a range of species (with appropriate attribution of MTSRF funding). - Progress update on development of risk maps: data being integrated, process for development of maps etc. - Report and publications describing the microsatellite library and where possible the population genetic structure of <i>C. barnesi</i> and <i>C. fleckeri</i> derived from microsatellite DNA markers and statolith microchemistry and morphology. - Article for MTSRF Program newsletter	30 May 09
Total MTSRF Funding*	\$50,000

Project Budget

Year 3– 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash*	In-kind	Total
MTSRF	50,000	-	50,000
JCU		30,000	30,000
AIMS	-	15,000	15,000
Total	50,000	45,000	95,000

JCU Project 4.8.7 Budget 2008/2009

Item	MTSRF Funds	In-kind	Total Cost
Salaries	-	45,000	45,000
Operating	45,000	-	45,000
Travel	5,000	-	5,000
Communication / Extension ¹	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	50,000	45,000	95,000

¹ Funds have been allocated to the generic communication/extension activities for the Sustainable Use and Management Program. This is to be managed under Project 4.8.8.

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	50,000	TBA	TBA	TBA	TBA	TBA
Total	50,000	TBA	TBA	TBA	TBA	TBA

Project 4.8.8: Communication, community engagement and enhanced delivery for GBR projects

Project Leader and Host Organisation

Dr Suzanne Long, RRRC (Host organisation JCU)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Dr Suzanne Long	RRRC	Principal Investigator: Strategic oversight and project management	0.2
Hayley Gorsuch	RRRC	Assistant Investigator: Strategic oversight and project management	0.2
Ann Penny	JCU	Communications officer: project activities and liaison with researchers and end users	0.5

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
GBRMPA	Karen Vohland
AMPTO	Col McKenzie

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

In the context of MTSRF's overarching strategic plan for enhancing delivery (Theme 5), this project aims to facilitate increasingly sustainable management and use of the Great Barrier Reef through strategic communication, community engagement and enhanced delivery of MTSRF Program 8 projects.

The key objectives of this project are:

- To facilitate increasingly sustainable use and management of the Great Barrier Reef region, in which decision-making is informed by sound science, by enhancing delivery of scientific information generated within MTSRF Program 8 to end users and the community at large.
- To facilitate cooperation and collaboration both within MTSRF and between MTSRF, other research providers, end users, and the community at large, such that the capacity for sustainable, informed management of the Great Barrier Reef region is enhanced.
- During this process, to raise awareness of and demonstrate the value of MTSRF Program 8 to the community that has funded it.

Project Targeted Activities (indicative only for out years)

Objective	Targeted Activity	Completion Date
(a,b,c)	Strategic plan to guide enhanced delivery of Program 8, in the context of the overarching plan for enhanced delivery of MTSRF (RRRC)	31 Aug 08
(a,b,c)	In line with the strategic plan, identify at least three high priority messages emanating from Program 8 and the most effective means of their communication (RRRC), and prepare and disseminate at least three communication products (JCU).	quarterly
(c)	Establish and maintain archive of all tangible products from this project (JCU)	ongoing
(a)	Establish and maintain a database of opportunities for disseminating communication products (for example existing newsletters of relevant organizations) (JCU)	ongoing
(a)	Establish and maintain a database of contact details of end users identified in the strategic plan, to facilitate regular communication via email and post (JCU)	ongoing
(c)	Establish and maintain database and archive of all media coverage and other indicators of delivery success deriving from this project's products or activities (JCU), such that quantitative analyses of the delivery success of each product/activity can be made on an annual basis (RRRC)	ongoing

Project 4.8.8 Milestones 2008/2009

For 2008/2009 Outputs Only	Date
Milestones – agency responsible identified in brackets	
Signing of contract (JCU)	15 Jul 08
Strategic Plan for Enhanced Delivery of Program 8 agreed by Program Leader, researchers, and research users, and provided to Reef and Rainforest Research Centre (RRRC)	31 Aug 08
Written report provided to RRRC, containing, in addition to standard milestone report information: • Description of all project activities during this quarter, along with an indication of the proportion of time invested in each activity (eg 10% on product B) • Copies of strategic guidelines for at least three messages, and copies of all tangible products produced during this quarter (at least three). • Indicators of delivery success (eg media monitoring or other indicator) for each product • Electronic copies of all databases (JCU)	31 Aug 08
Written report provided to RRRC, containing, in addition to standard milestone report information: • Description of all project activities during this quarter, along with an indication of the proportion of time invested in each activity (eg 10% on product B) • Copies of strategic guidelines for at least three messages, and copies of all tangible products produced during this quarter (at least three). • Indicators of delivery success (eg media monitoring or other indicator) for each product • Electronic copies of all databases (JCU)	30 Nov 08
Written report provided to RRRC, containing, in addition to standard milestone report information: • Description of all project activities during this quarter, along with an indication of the proportion of time invested in each activity (eg 10% on product B)	28 Feb 09

For 2008/2009 Outputs Only	Date
Milestones – agency responsible identified in brackets	
- Copies of strategic guidelines for at least three messages, and copies of all tangible products produced during this quarter (at least three). - Indicators of delivery success (eg media monitoring or other indicator) for each product - Electronic copies of all databases (JCU)	
Written report provided to RRRC, containing, in addition to standard milestone report information: - Description of all project activities during this quarter, along with an indication of the proportion of time invested in each activity (eg 10% on product B) - Copies of strategic guidelines for at least three messages, and copies of all tangible products produced during this quarter (at least three). - Indicators of delivery success (eg media monitoring, number of newsletters distributed, or other indicator) for each product - Electronic copies of all databases (JCU)	15 May 09
Written report provided to RRRC evaluating delivery success against investment for the past year, with recommendations for improvement in outyears (RRRC)	1 Jun 09
Total	\$85,000*

* Includes \$10,000 for Visual Documentation of all Program 8 projects.

Project 4.8.8 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	75,000	(TBC)	75,000
MTSRF Visual Documentation*	10,000	-	10,000
Total	85,000	(TBC)	85,000

* A total of \$10,000 is held by the Reef and Rainforest Research Centre for Visual Documentation of Program 8 (see Theme 5).

JCU Project 4.8.8 Budget 2008/2009

Item	MTSRF	Funds from Other Sources	Total Cost
Salaries	27,500	(TBC)	36,539
Operating	10,000	-	10,000
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-		66,480
Total	37,500	(TBC)	113,019

RRRC Project 4.8.8 Budget 2008/2009

Item	MTSRF	Funds from Other Sources	Total Cost
Salaries	37,500	-	37,500
Operating		-	
Travel		-	
Communication / Extension		-	
Capital	-	-	-
Institutional overheads	-	-	-
Total	37,500	-	37,500

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	85,000	-	(TBC)	-	-	(TBC)

PROGRAM 9

SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES

Program Leader and Host Organisation

Professor Steve Turton, James Cook University (JCU)

Budget Summary

	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
MTSRF	\$1,203,275	-	\$1,203,275
Other	\$202,900	\$1,603,887	\$1,806,787
Total	\$1,406,175	\$1,603,887	\$3,010,062

The program is focused on sustainable use, planning and management of environmental assets of North Queensland's tropical rainforests and adjacent Wet Tropics production and urban landscapes that constitute significant catchment areas for the Great Barrier Reef. The approach is to consider these landscapes as linked social, ecological and economic systems. The main objective is to provide the knowledge base that supports the management of the Wet Tropics World Heritage Area, as well as supporting sustainable economic activities (notably agriculture, agroforestry, tourism and Indigenous enterprises), while enhancing biodiversity and maintaining essential ecosystem services across the entire Wet Tropics landscape.

This is a large program that hosts seven project areas that align directly with research needs for DEW, WTMA, Terrain NRM, Indigenous groups, industry and other key stakeholders based in the Wet Tropics bioregion and NRM region:

Project 4.9.7, focussing on strategic natural resource management, is shared with Program 2 (Theme 1). This fulfils an integrative function across both programs, and will articulate with Theme 5 – Enhancing Delivery. Within the program the conduct of participatory case studies will continue with end users and communities, for their benefit, complementing each of the other project areas (e.g. land use planning, Indigenous, forests, restoration). Within Program 2 it will build on the development of a framework and tools for status and trend reporting, to match directions established in collaboration with end users through Theme 5. Baseline data and data management services continue to be provided by the Status and Trends, Threatened Species, Invasive Species programs to avoid duplication. Program 9 also provides strong links with the MTSRF Terrestrial Climate Change and Water Quality Programs and Data Integration and Synthesis processes across the MTSRF.

The research outputs will include:

- Development of mechanisms to enhance institutional and planning arrangements to underpin biodiversity, water quality and wider ecosystem services in the GBR Region whilst maintaining viable regional communities.
- Valuation of residential contribution to biodiversity and ecosystem services in regional and local planning areas e.g. Daintree as the first site.
- Identification of biodiversity values and metrics for incorporation into regional and local planning mechanisms.

- Analysis of incentive mechanisms available for the management of ecosystem services in urbanising environments in north Queensland.
- Assessment of the impacts of community infrastructure on the Wet Tropics WHA and surrounding ecosystems and develop methodologies to mitigate the impacts.
- Mapping of riparian vegetation quality and habitat connectivity in urban and rural areas of north Queensland.
- Identification of major issues relating to tourist motives and behaviours for visiting the Wet Tropics.
- Determination of key trends and economic contribution of Wet tropics tourism to North Queensland.
- Determination of impacts of tourism in the Wet Tropics WHA and mitigation strategies for adverse impacts.
- Identification of community perceptions and knowledge of use and management of the Wet Tropics.
- Development of toolkit and indicators for monitoring and evaluating reforestation success.
- Development of methods to optimise reforestation success.
- Development of an optimisation model for regional investment in reforestation and management.
- Assess indigenous nature resource use within the Wet Tropics World Heritage Area.
- Optimise traditional owner knowledge and engagement in natural resource management particularly water resources and changes to water quality and resulting ecological impacts.
- Development of tools and mechanisms to integrate the learnings across the program to enhance the information delivered to major natural resource management agencies and the community.

Projects

4.9.1	Indigenous landscapes of the Wet Tropics World Heritage Area	\$75,000
4.9.2	Sustainable nature based tourism: planning and management.....	\$200,000
4.9.3	Impacts of urbanisation on North Queensland environments: management and remediation	\$215,000
4.9.4	Integrating ecology, economics and people into forest landscapes	\$125,000
4.9.5	Restoring tropical forest landscapes	\$125,000
4.9.6	Strategic Natural Resource Management and land use planning	\$243,275
4.9.7	Understanding social resilience and identification of social resilience indicators for management.....	\$220,000

PROGRAM 4.9.1: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL FOREST LANDSCAPES***CURRENTLY BEING BROKERED******Project 4.9.1 Indigenous Landscapes of the World Heritage Area*****Project Leader and Host Organisation****Dr. Mike Wood, James Cook University (JCU)****Project Team Commitment 2008/2009**

Title	Organisation	Role	FTE
Henrietta Fourmile	JCU	Researcher, all objectives	0.20
Prof Steve Turton	JCU	Researcher, all objectives	0.10
Linda Leftwich (TBA)	JCU	Researcher, all objectives	1.0
Traditional Owners of the WTWHA (TBA)	Various	Researchers and users, all objectives	0.3
Rainforest Aboriginal Advisory Committee	WTMA	Researchers and users, all objectives	0.1
Mr Phillip Rist	Girringun Aboriginal Corporation	Researcher and user, all objectives	0.1
Dr Allan Dale	Terrain	Research user, all objectives	0.1
Dr Rosemary Hill	CSIRO	Researcher, all objectives	0.02
Dr. Leanne Cullen	CSIRO	Researcher, all objective	0.2

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
WTMA	Andrew Maclean
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
QEPA	TBA

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

- (a) To understand Indigenous natural resource use within the Wet Tropics WHA through the completion of reviews and comparative assessments.
- (b) To optimise Traditional Owner engagement and knowledge in natural resource management.
- (c) To enhance opportunities for building capacity in Traditional Owner groups for engagement in research and management of the Wet Tropics WHA.

2008-2009 Outcomes and Links to Forward Planning

Governance and institutional linkages

Governance arrangements established for the project have ensured that the research remains responsive to Traditional Owner's directions despite the closing of the Aboriginal Rainforest Council (ARC). Processes to consider an independent representative Rainforest Aboriginal organisation or organisations to replace the role of ARC are underway, facilitated by the WTMA.

However in the interim, the Rainforest Aboriginal Advisory Committee to the WTMA (the same elected people who previously sat on the ARC Board) is able to play an ongoing role in ensuring Traditional Owner Involvement in providing advice and a decision making body for the MTSRF and CHMP projects. The ARC's Intellectual Property Sub-Committee (IPSC) played a considerable role in contributing to the activities of the Indigenous Landscapes project by vetting reports prior to them being released to RRRC and the wider public and by debating a future role for the Intellectual Property Sub-Committee in setting strategic goals and research agendas for MTSRF 4.9.1. Members of the IPSC continue to advise the CHMP project on intellectual property issues.

Meetings are continuing between members of the Coordination Group including JCU, CSIRO, WTMA, Terrain, and Girringun. The Cultural Heritage Mapping Project Coordinator for now will be based in Terrain, and hosted with CSIRO at JCU under funding from WTMA, JCU and Terrain.

Staff Developments

The appointment of Henrietta Marrie as Project Leader of 4.9.1 from 30 June 2008 should result in the project developing new and appropriate governance arrangements. Henrietta's initiatives in the area of indigenous intellectual property rights particularly concerning knowledge and cultural values will enhance already established areas of Indigenous priority in the Wet Tropics World Heritage Area. Partly due to her efforts, intellectual property protocols have been developed for application in the WTWHA. All this work clearly adds value to MTSRF Project 4.9.1 objectives.

Leanne Cullen, a post-doctoral student with CSIRO Sustainable Eco-Systems, joined MTSRF 4.9.1 in 2007. She has finished a preliminary overview on the periodic reporting requirements of the WTWHA. An analysis of these requirements was a key activity of this project in 2007-8. In 2008-9 she will further develop her research interest in reporting requirements and measuring cultural values through case studies in partnership with several Traditional Owner groups. The resulting outcomes will clearly assist Traditional Owners engage in the management of the Wet Tropics WHA.

In 2007 Linda Leftwich was appointed as Indigenous Research Officer for Project 4.9.1. She has spent much of her time developing a booklet that will be published in May. It provides basic instructions for first time users of recording equipment that will be used by Rainforest Aborigines in their cultural recording activities supported by the CHMP team.

Implications for forward planning for 2008-2009.

After discussion with the Intellectual Property Sub-Committee it has been agreed MTSRF objectives will be realised in 2008-9 primarily through detailed case studies on various topics (outlined below). Findings will be reported to national and international stakeholders through conference participation and publication of reports and papers.

Regional workshops will be used to deliver information to Indigenous end users and the proposed case studies will provide detailed accounts of how Rainforest Aborigines have interpreted information and events relevant to the selected topics and whether they have found it useful (or otherwise) to their engagement with management.

One of the workshops will be on the emerging markets for ecological services related to global warming. The aim here is to kick-start debate among Rainforest Aborigines about these new markets and how they can most effectively participate in them.

The case studies with Traditional Owners will concern:

1 The trial application of the recently developed Intellectual Property protocols. Findings from this trial will be presented to the World Intellectual Property Organisation (WIPO). WIPO has a strong commitment to addressing indigenous intellectual property issues. WIPO and the associated World Trade Organisation, have considerable influence on Australia's position as a fair trader in international markets. Because of this influence WIPO's views may carry considerable weight with the National government. Findings of the trial will also be presented to local WTWHA management agencies with the view to establishing an agreement to adopting them fully or partially in their policy and procedures. This case study would deliver results relevant to project objectives (b) and (c).

2 Indigenous engagement with management in the WTWHA, particularly building on the findings of the best practice global assessment undertaken in ARP 1 and 2. The proposed case studies will focus on the role of Indigenous non-government organisations, identified as key to best-practice management in the global assessment. We will record and analyse Rainforest Aboriginal peoples' satisfaction with engagement and participation (decision making and on-ground management) compared to their aspirations and negotiated agreement outcomes (as expressed in the Wet Tropics Regional Agreement of 2005). The case study will also make any recommendations for improvement.

3 Discussions with Traditional Owners and a regional case study, concerning the development of protocols and metrics associated with 'cultural indicators' that will help fulfil reporting required by the World Heritage Convention and secondly by the Regional NRM Plan. Discussions on this topic with traditional owners will be presented at an international workshop on Indigenous Culture and Conservation at the World Conservation Congress in Barcelona in 2008.(see separate submission and supporting documents attached to this document). Findings will also be presented to management agencies involved in the WTWHA.

The emphasis on case studies has emerged as the most effective means of directly engaging Traditional Owners in research, a key aim of the research project. In addition, consultations with the IP Sub-Committee and other Rainforest Aborigines has identified that the repatriation of past writing about Indigenous cultural values in the WTWHA was not seen as a priority (in the manner indicated in Project 4.9.1's ARP 2 for 2007-8). A view has emerged that those groups, families and individuals wanting access to such material should effectively undertake their own searches. However some collection of documents may still be useful to a full realisation of the CHMP goals.

2008- 2010 Project Activities

The following table outlines the proposed targeted activities for the next two years. The proposed activities largely emerge from the findings of the project's activities in the year 2006-2008.

End users

One of our main end users, the ARC has closed down, and is going through a re-structuring to provide the best independent Aboriginal governance for Wet Tropics World Heritage Area Management. A new independent body (or bodies) will emerge over the next few months. In the meantime, the Rainforest Aboriginal Advisory Committee (RAAC), including the same *elected* representatives as the ARC, continues to play an important role in providing advice and as a decision making body for matters concerning land and cultural heritage management in the Wet Tropics World Heritage Area. In the interim our end users will continue to be Girringun, RAAC, the Rainforest Aboriginal people of the WTWHA, Aboriginal Councils, NTRBs, WTMA, Terrain, DEWHA and other government funded bodies involved in the management of the WTWHA. We will continue to use the Co-ordination Committee as a key mechanism for allowing these end users a capacity to drive the research activities and outcomes of Project 4.9.1.

Table 1 Targeted Activities for 2008-2010

Objective	Targeted Activity	Completion Date
a ¹	Evaluation of Leanne Cullen's Report on Indicators (completed March 2008). Establish procedures for further co-operative research and determination of case studies.	31 Oct 2008
b ¹ .	Commencement of case studies into the way WTWHA managers engage with traditional owner groups and regional representative bodies	31 Oct 2008
c ¹ .	Commence evaluation of intellectual property protocols through trials and report to the WIPO.	31 Oct 2008
a ² .	On-going data collection of cultural values associated with the Wet Tropics World Heritage Area useful to parties implementing the Wet Tropics Regional Agreement and the Aboriginal Natural and Cultural Resource Management Plan	27 Feb 2009
b ²	Workshop on emerging markets for indigenous environmental services and carbon trading using rainforest. Develop recommendations for management	27 Feb 2009
c ²	Provide research support to facilitate ongoing Aboriginal research and recording for Wet Tropics Cultural Heritage Information System (CHIMS) through on –going evaluation of the impact of intellectual property protocols on cultural transmission and exchange.	27 Feb 2009
a ³	Finalise and report on international best practice standard two-way research process to establish cultural values of the WTWHA	31 May 2009
b ³	Report on the outcomes and lessons learned from additional set of Aboriginal engagement case studies.	31 May 2009
c ³	Produce report for WIPO on the costs and benefits of intellectual property protocols in the WTWHA. Including recommendations for WIPO and other multilateral bodies (WTO,UN)	31 May 2009
	2009-2010	
a ¹	Workshop to discuss and fine tune cultural indicators and other reporting requirements	June 2010

1

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3

Objective	Targeted Activity	Completion Date
b ¹ .	Final set of case studies into the way WTWHA managers engage with traditional owners	June 2010
c ¹ .	Undertake further analysis of the impact of intellectual property protocols on Rainforest Aborigines and their participation in the Wet Tropics Cultural Heritage Mapping Project	June 2010
a ² .	Identify and arrange to collect final, mutually agreed set of data most useful to parties implementing the Wet Tropics Regional Agreement and the Aboriginal Natural and Cultural Resource Management Plan	June 2010
b ²	Implement study of indigenous ecosystems services markets in WTWHA.	June 2010
c ²	Provide additional specialist research to assist systematise , sustain and evaluate intellectual property protocols in ongoing recording and use of Cultural Heritage Information Management System (CHIMS) and in other forms of cultural exchange and transmission occurring throughout the WTWHA.	June 2010
a ³	Finalise a world class multi media document effectively describing the natural and cultural heritage values of WTWHA	June 2010
b3	Report on the outcomes and lessons learned from final set of Aboriginal engagement case studies.	June 2010
c3	Produce final year report and recommendations assessing effectiveness of intellectual property protocols and CHIMPS	

Table 2: 2008-9 Milestones

Milestones All JCU Responsibilities	Date
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
Report 1 submission - Progress Report on: (activity a¹): case studies developing cultural indicators (activity b¹): Aboriginal engagement in management and ecological services markets -case studies. (activity c¹): Aboriginal research, recording and intellectual property protocols in CHIMS and other contexts; - Copies of papers, reports, and publications produced up to this date, in relation to the above identified project activities (with attribution of MTSRF funding to all documentation) - Plan of Project Activities, Communications and Outputs for year to June 2009, plus summary of Project Activities, Communications and Outputs undertaken to date (including notes on meetings/ workshops etc)	31 Oct 2008
Pathway to Impact Report for End User Relevance	1 Dec 2008
Report 2 oral submission to Operations Committee - Progress Report on: (activity a²): Cultural indicators case studies, update on presentations at WCC in 2008 (activity b²): Aboriginal. engagement in management and ecological services markets -case studies. (activity c²) Aboriginal research, recording and intellectual property protocols in CHIMS and other contexts	29 Feb. 2009

- Copies of papers, reports, and publications produced up to this date, in relation to the above identified project activities - Summary of all further Project Activities, Communications and Outputs undertaken to date (including notes on meetings/ workshops etc)	
Report 3 submission - Progress Report on: (activity a³): natural & cultural values documented with attribution of MTSRF funding (activity b³): Outcomes of engagement case studies and recommendations from ecological services workshop . (activity c³): Aboriginal research, recording and intellectual property protocols. Report to WIPO. - Copies of papers, reports, and publications produced up to this date, in relation to the above identified project activities - Final Summary of all Project Activities, Communications and Outputs undertaken in the course of year to 16 June 2008 - Plan for completion of out year activities	31st May 2009
Total \$ 2008/2009	\$75,000

* Includes \$1500 Visual Documentation Allocation

Project Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	MTSRF	Cash	In-kind	Total
MTSRF	\$73,500		-	\$73,500
Visual Documentation	\$1,500			\$1,500
JCU		\$70,000	\$80,000	\$150,000
Terrain NRM Ltd		-	\$324,000	\$324,000
ARC		-	\$10,000	\$10,000
Girringun		-	\$5,000	\$5,000
UQ		-	\$5,000	\$5,000
AIATSIS		-	\$10,000	\$10,000
CSIRO		-	\$20,000	\$20,000
Total	75,000	\$70,000	\$454,000	\$599,000

JCU Project 4.9.1 Budget 2008/2009

Item	MTSRF Funds	JCU Cash	In-kind	Total Cost
Salaries	\$47,000	*\$70,000	\$300,000	\$417,000
Operating	\$11,000	-	-	\$11,000
Travel	\$8,000	-	-	\$8,000
Communication / Extension	\$7,500	-	\$20,000	\$27,500
Capital	-	-	-	-
Institutional overheads	-	-	\$134,000	\$134,000
Total	\$73,500	\$70,000	\$454,000	\$597,500

- Cash contribution from JCU towards Snr Indigenous Research Officer's salary.

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	75,000		454,000			529,000

PROGRAM 9: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES
Project 4.9.2: Sustainable nature based tourism: planning and management
Project Leader and Host Organisation

Professor Bruce Prideaux, James Cook University (JCU)

Project Team

Title	Organisation	Role	FTE
Professor Bruce Prideaux	JCU	Project Leader, researcher in objectives (a) (b)	0.2
Adj. Prof. Glenn Ross	JCU	Researcher, objective (a)	0.1
Dr Heather Zeppel	JCU	Researcher, objectives (a)	0.1
Prof. Steve Turton	JCU/CSIRO	Researcher, objective (b)	0.1
Dr Karen McNamara	JCU	Post Doc Researcher objectives (a)	1.0
Dr Julie Carmody	JCU	Post Doc Researcher	1.0
Dr Noel Scott	UQ	Researcher, objectives (a)	0.05
Max Chappell	WTMA	Liasion, user, objectives (a) (b)	0.1
Lisa King (PhD student)	JCU	Research, objective (a)	1.0

This Project will benefit from the capacity building component of Theme 5 Enhancing Delivery.

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
WTMA	Steve Goosem
Terrain NRM Ltd	Allan Dale
QEPA	TBA
Alliance for Sustainable Tourism	Annie Riddet

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project will develop an improved understanding of the perceptions and motivations of the tourists and local community who use the Wet Tropics rainforests, allow identification of major drivers and trends in visitation, report on tour operator accreditation, development of a visitor barometer, report on benchmarking of tourism patterns and development of tools to determine visitor sustainability. Understanding trends and drivers will enable WTMA and the tourism industry to develop internationally competitive visitor experiences and enable WTMA to develop more effective visitor management policies. A Rapid Assessment Capability built into the visitor survey will allow stakeholders to understand the implications of unexpected events and assist in allowing them to respond to such events in an informed and effective manner.

The major outputs of the second component will enable WMTA to: understand visitor behaviour at site level, identify changes in community perceptions towards the wet tropics and understand commercial tour operators concerns and perceptions. This information will enable more effective management at site level, provide information that will assist in selection of alternative sites and better understand changes in community perceptions. The task will provide commercial tour operators with data on the sustainability of various attractions.

Key Objectives:

- (a) Report on the sustainable use of rainforest resources by the tourism industry.
- (b) Monitoring of visitors at site level and determining community perceptions.

Project / Task Methodology

Objective (a): To report on the sustainable use of rainforest resources by the tourism industry

To establish a Wet Tropics wide system for tourist monitoring, a range of whole of industry tourism data will be collected. This data will be used as the input to a report on a range of tourist related issues identified by end users. Tourists display a wide range of behaviours and characteristics including; significant variations in their motivations for visiting the Wet Tropics, their expectations of their visit, their expenditure patterns and usage patterns of facilities. To identify these characteristics this project will develop a Wet Tropics wide tourist meta data set that will facilitate long term analysis of tourist patterns as well as collect a range of economic data. The data output will enable detailed knowledge of tourist segment characteristics; use patterns over time, expenditure patterns, motivations, satisfaction etc to be developed. For research users this data will provide regular updates on tourist patterns and behaviours. The data will also be essential for identification of the key patterns of tourist use, to identify changes in tourist use and the reason for those changes; to identify the economic contribution of the Wet Tropics to the regional economy and identify issues related to sustainability at the micro and macro levels. The data is also critical for the development of management tools and frameworks as well as the identification of tourism impact parameters (building on work undertaken by the Rainforest CRC⁸) that will ensure long-term sustainability of key Wet Tropics sites and measurement against state, national and international benchmarks.

To gather the data a long term monitoring system based on up to six survey sites (including sites in the forest as well as outside) will be developed and data collected monthly. The survey instrument will be flexible enough to gather long-term tourist data as well as introduce new items to explore issues and trends identified during the course of ongoing data collection. Data will also be collected from commercial users. The Task will include a part PhD scholarship co-funded with Sustainable Tourism CRC.

- (i) **Identify major issues relating to tourist motivations and behaviours for visiting the Wet Tropics.** Tourist patterns and motivations will be identified and published as a barometer on a quarterly and annual basis. Data collected through the tourist survey, focus groups and operator survey will establish the importance of specific attractors in the rainforest experience, the importance of specific sites as triggers to attract tourists, and identify key elements of the experience that determine satisfaction levels. Findings will support Project 4.9.2b.

⁸ Wilson, R. F., Turton, S. M., Bentrupperbaumer, J. M. and Reser, J. P. (2004) *Visitor Monitoring System for the Wet Tropics World Heritage Area, Volume 1 Procedural Manual, Rainforest CRC, Cairns*

- (ii) **Identify key trends and drivers of Wet Tropics visitor patterns including economic contribution.** Trends will be identified on a year-to-year basis using a number of indicators including gross tourist numbers as well as by specific industry indicators. These will be compared to state and national trends for comparison and benchmarking. Drivers are sometimes difficult to determine and this part of the research will commence with a literature survey followed with a series of targeted items within the ongoing survey. The economic contribution of tourism will also be assessed building on work undertaken for the CRC Rainforest. Results will be benchmarked against national and international trends and drivers. A whole of industry approach will be taken and include the tourist distribution channel.
- (iii) **Develop a rapid assessment capability.** This capability will allow a rapid assessment to be made of major issues and threats that may emerge in the future. For example, such a capacity if available now would allow assessment of visitor reaction to events such as Cyclone Larry. This capability will be built into the monitoring system in Objective a(i).
- (iv) **Develop Management tools.** Management tools and frameworks including environmental impact parameters will be developed to assist maintain long term sustainability of key Wet Tropics sites.

Objective (b): Monitoring of visitors at site level and community perceptions

Tools developed for monitoring visitor attitudes and perceptions at site level under the CRC Rainforest program will be revised where necessary and a follow-on survey conducted to reassess visitor and community attitudes.

- (i) **Identify community attitudes, knowledge and perceptions of use and management of the Wet Tropics.** This objective will require two major surveys. The first is a follow-on of the previous site survey funded by the CRC Rainforest¹ and is designed to identify changes that have occurred in visitor usage and perceptions in the period since the last survey. The survey will include a dry season component and a wet season component. A detailed site specific report will be compiled with changes and major emerging trends identified. The second survey proposed is a mail out survey to capture community reactions to the use and management of the Wet Tropics. Other components of this task will include focus groups involving key tourism industry users and identified community leaders. Combining this knowledge with data collected in Objective (a) will develop specific knowledge of environmental sustainability levels and will assist in determining the level of tourist sustainability if there are restrictions placed on visitor numbers or tourist usage of specific sites. A number of management tools will be identified and a sustainable level of visitation framework developed as a new assessment and management tool to assist WTMA and EPA managers mitigate impacts of loss of sustainability through overuse. These tools will incorporate previous work by the CRC Rainforest on the impacts of visitation.
- (ii) **Develop a best practice strategy for creating a Wet Tropics wide integrated rainforest experience theme for visitors.** This component of the project will build on existing data as well as new data to develop whole of Wet Tropics visitor strategy to develop and test coherent themes to attract visitors to the park and to differentiate the park from other ecotourism areas. The project will build on survey data from Objective a(i) and Task b(i) to develop a best practice strategy. Specific outputs will include: a best practice presentation package for the WHA using theme based approaches; and tour operator guides that will assist towards future production of a WTWHA tour operator accreditation system.

Project Outputs / Milestones – July 2008 – June 2010

Objective	Targeted Activity	Completion Date
a	Continue visitor monitoring program for the Wet Tropics WHA. <i>Objectives a(i), (iii) and (iv)</i>	Ongoing till June 2010
a	Identify key drivers of Wet Tropics visitor patterns including economic contribution. <i>Objective a(ii)</i>	* Ongoing till June 2010
b	Produce tour guide handbook as part of the establishment of a best practice strategy for ecotourism in the Wet Tropics WHA. <i>Objective b(ii)</i>	April 2009
b	Identify community attitudes, knowledge and perceptions of use and management of the Wet Tropics. <i>Objective b(i)</i>	* April 2008
b	Understand & identify levels of visitor use and perceptions of WT sites during Wet & dry seasons <i>Objective b (i)</i>	June 2010

* Involves ongoing activities in Out Years.

Project 4.9.2 Milestone Payments 2008 - 2010

For July 2008 – June 2009 Outputs Only	
Milestones	Date
Signing of Contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
Report 1 submission - Submission of quarterly visitor barometer (#2, 08) with attribution of MTSRF funding (A) [JCU] Verbal Progress Report to operation Committee on - Public presentation & release of results from Community Attitude Survey (Bi) [JCU] - Progress report on Tour Guide Handbook (Bii) [JCU] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable [JCU]	1 Oct 2008
Pathway to Impact Report for End User Relevance	Dec 2008
Report 2 submission - Submission of quarterly visitor barometers (#3,08; #4,08) (A) with attribution of MTSF funding[JCU] - Annual visitor report of Wet Tropics visitor patterns including motivations and behaviours, evaluation of indicators used to identify key drivers and trend, seasonality issues, key visitor segments and economic contributions (A) [JCU] - Final Tour Guide Handbook publication (Bii) [JCU] with attribution of MTSRF Funding. - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable [JCU]	01 April 2009
Report 3 submission - Submission of quarterly visitor barometer (#1,09) (A) [JCU] - Preliminary Progress Report on Wet/Dry Season site surveys (Bi) [JCU] - Final summary of communication activities undertaken throughout the course of Year 3 of project [JCU] - Plan for completion of out year activities [JCU]	1 June 2009
Total MTSRF Funding	\$200,000

Includes \$1500 visual documentation each financial yr.

Project 4.9.2 Budget

Year 1 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	198,500	-	198,500
MTSRF Visual Documentation*	1,500	-	1,500
JCU	-	35,000	35,000
WTMA	-	10,000	10,000
UQ	-	10,000	10,000
Sustainable Tourism CRC (0.5 PhD Scholarship) [#]	-	10,000	10,000
Total	200,000	65,000	265,000

* A total of \$1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

[#] Linked with Objective (a).

UQ Project 4.9.2 Budget 2008/2009

Item	MTSRF	Funds from Other Sources	Total Cost
Salaries	3,000	-	3,000
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	3,000	-	3,000

JCU Project 4.9.2 Budget 2008/2009

Item	MTSRF	JCU In-kind	Total Cost
Salaries	147,000	65,000	212,000
Operating	15,000	-	15,000
Travel	15,000	-	15,000
Communication / Extension	18,500	-	18,500
Capital	-	-	-
Institutional overheads	-	-	-
Total	195,500	65,000	260,500

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	200,000					
Total	200,000	TBA	TBA	TBA	TBA	200,000

PROGRAM 9: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES
Project 4.9.3: Impacts of urbanisation on North Queensland environments: management and remediation
Project Leader and Host Organisation

Professor Steve Turton, James Cook University (JCU)

Project Team

Title	Organisation	Role	FTE
Prof Steve Turton	JCU/CSIRO	Program and Project Leader, researcher, objectives (a) (b) (c)	0.50
Prof David Gillieson	JCU	Researcher, GIS, remote sensing, objectives (a) (b) (c)	0.05
Dr Miriam Goosem	JCU	Researcher, ecology, objectives (a) (b) (c)	1.00
Ms Catherine Pohlman	JCU (PDF) (20% salary from Powerlink)	Researcher (PDF), ecology, objective (a) (b) (Until December 31, 2008)	1.00
Dr Iris Bohnet	CSIRO	Researcher, landscape planning, social-sciences, objectives (b) (c)	0.20
Pam Schultz (PhD student)	CSIRO/JCU	Researcher, social sciences, NRM, objective (c)	1.00
Mr Max Chappell	WTMA	User, PA manager, objectives (a) (b) (c)	0.05
Dr Steve Goosem	WTMA	User, PA manager, objectives (a) (b) (c)	0.05
Environmental Officers	Powerlink	User, utilities, objective (a)	0.05
Environmental officer	QDMR	User, planner, objective (a) (c)	0.05
Project support/logistics officer	QDMR	Technical, engineer, objective (a)	0.05
Dr Allan Dale	Terrain NRM Ltd	User, objectives (b) (c)	0.05
Ms Pam Schultz	JCU	Researcher, social sciences, NRM, objective (c)	1.00
Ms Ally Lankester	JCU	MTSRF Program 7	1.00
Ms Michelle Esparon	JCU	MSTRF project 4.9.2	1.00

This Project will benefit from the capacity building component of Theme 5 Enhancing Delivery.

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
WTMA	Steve Goosem
Terrain NRM Ltd	Rowena Grace
EPA	TBA
Alliance for Sustainable Tourism	Annie Riddett
QDMR	Project Support/Logistics Officer
QDMR	Environmental Officer
Powerlink	Stephen Martin
Queensland Canegrowers	Tim Wrigley

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project will develop increased understanding of impacts of rapid urban, peri-urban and rural development on wet tropics ecosystems and linked socio-economic systems, together with mitigation strategies for minimising or reversing adverse trends. Our projects are linked with terrestrial components of Programs 6 (Threatening Processes and Invasive Species) and 7 (Water Quality), and with Projects 4.9.5 (Restoring Tropical Forest Landscapes) and 4.9.6 (Strategic Natural Resource Management and Land Use Planning) within Program 9. These links will feed into the Integrated Report Card process.

Key Objectives:

- (a) Linear community infrastructure: impacts and mitigation.
- (b) Riparian and remnant vegetation: Modelling of quality and habitat connectivity in urban and rural areas.
- (c) Landscape values: defining landscape character, impact of urbanisation, and management and remediation through case studies.

Project / Task Methodology

Objective a: Linear community infrastructure: impacts and mitigation

This objective has several key tasks:

- In collaboration with stakeholders, establish feasible best-practice designs to maximise ecological connectivity and minimise impacts of linear community infrastructure in rainforests, adjoining habitats and urbanising landscapes of the Wet Tropics bioregion.
- Identify informative and cost-effective ecological indicators of linear infrastructure impacts in rainforests and adjoining habitats in the Wet Tropics bioregion.
- Consider effectiveness of mitigation strategies in restoring ecological processes and function in the vicinity of linear community infrastructure (linked to Project 4.9.5) and in reducing impacts of infrastructure on threatened, rare and endemic species.

- Examine the use of high-resolution remotely sensed data to assess habitat condition adjacent to linear community infrastructure.
- Test remediation strategies and management practices for treatment of urban and road run-off waters (linked to IRC).

Methods to be used for this task involve assessment of impacts by field survey of biophysical attributes using replicated sites on linear clearings situated in the same habitat type, satellite and aerial photographic remote sensing and establishment of easily assessed cost-effective indicators of these impacts.

Mitigatory strategies that will continue to be assessed and/or trialled and monitored for effectiveness include fencing, road underpasses and canopy bridges, in-drainage pollutant scrubbers, traffic calming strategies and experimental revegetation across powerline clearings.

Objective b: Riparian and remnant vegetation: Modelling of quality and habitat connectivity in urban and rural areas.

This objective has the following key tasks:

- Test and apply riparian vegetation quality indicators that are quickly and easily assessed using remote sensing and GIS modelling that were successfully established in recent research in the Douglas Shire to riparian and remnant vegetation in major urbanising landscapes in sea- and tree-change areas of the Wet Tropics bioregion (linked to IRC). Sites are to be selected in collaboration with stakeholders, together with allied MTSRF projects.
- Test vegetation quality as a surrogate for faunal habitat quality using indicators of faunal habitat connectivity.
- Create GIS models and a priority classification of riparian and remnant vegetation in these areas for conservation or restoration in terms of maintaining or creating faunal habitat connectivity (linked with Projects 4.9.6 and 1.4.3).

Remote sensing via aerial and/or satellite photographic analysis forms the basis of this project to determine canopy cover and width/area of riparian and remnant vegetation and from this determine a quality ranking. This quality is tested at randomly-chosen but stratified field sampling sites and further examined in terms of faunal habitat quality using targeted faunal indicators such as guilds of birds or small mammals and/or particular species of conservation concern. GIS models constructed from this data are used to examine gaps in connectivity or low quality areas which can then be prioritised in terms of importance of gap in provision of connectivity in the landscape and by feasibility of restoration. Field investigation and photographic records can be incorporated into free software GIS models or more complex GIS system models of priorities on aerial photograph or topographic backgrounds to allow easy identification of site and priority by stakeholders.

Objective c: Sea- and tree-change landscapes: impacts of urbanisation

This new objective has several key tasks:

- Identify sea- and tree-change phenomena among the Australian community including a historical analysis of landscape change in field/case studies in North Queensland using social science and landscape planning methods.

- Identify environmental, recreational, scenic and other values in selected sea- and tree-change landscapes in the wet tropics bioregion.
- Identify landholder attitudes to riparian and remnant vegetation for selected sea- and tree-change areas in the wet tropics bioregion.
- Develop practical recommendations for local government and NRM authorities on how to manage and remediate the impacts of urbanisation.

This sub-project aims to gain a better understanding of who the people are, and how or why they choose particular areas of North Queensland to live or invest in and what the potential landscape and environmental impacts of urbanisation, peri-urban and rural development are and how to best manage and remediate these impacts.

Methods to be used involve a literature review of the phenomena of sea- and tree-change in Australia. In collaboration with the MTSRF project team 4.9.6 and Terrain NRM Ltd sea- and tree-change case study landscapes will be selected. Case studies include historical analyses of land use change and urbanisation patterns and qualitative interviews with residents and 'newcomers' to these landscapes, which inform the analysis of environmental, recreational, scenic and other landscape values. Stakeholder workshops are also used to inform the development of practical recommendations for local government and NRM authorities on how to manage and remediate the impacts of urbanisation. The project works in close collaboration with MTSRF project 4.9.6.

Project Outputs / Milestones (08/09)

Objective	Targeted Activity	Completion Date
a	Continue refinement of best practice designs to maximise ecological connectivity and minimise impacts of linear community infrastructure in rainforests and adjoining habitats of Wet Tropics WHA	June 2009
a	Continuing identification of informative and cost-effective ecological indicators of linear infrastructure impacts in rainforests and adjoining habitats in the Wet Tropics bioregion	December 2008 [#]
a	Continuing consideration of effectiveness of mitigation strategies in restoring ecological processes and function in the vicinity of linear community infrastructure (linked to Project 4.9.5), and reducing impacts on threatened, rare and endemic species, subject to further funding from QDMR	June 2009 ^{*@}
b	Ongoing testing and application of riparian and remnant vegetation quality indicators. Field-truthing for Mission Beach case study area.	June 2009 [*]
b	Identification of priority areas for conservation, including maintenance of landscape connectivity for Mission Beach area. Field-truthing of priority areas.	June 2009 [*]
b	Commencement of remote sensing and GIS modelling for Myola/Speewah case study area.	June 2009 [*]
c	Confirmation seminar presented (by PhD student) to project collaborators and MTSRF project team 4.9.6 to inform them about project progress and to discuss research details (i.e. goals, objectives, methods, case study locations for PhD project).	August 2008
c	Initial qualitative interviews with residents and 'newcomers' in selected tree- and sea-change landscapes carried out that inform the analysis of environmental, recreational, scenic and other landscape values and thresholds (through PhD project)	Dec 2008 [*]

Objective	Targeted Activity	Completion Date
c	Updated/completed literature review of the phenomena of sea- and tree-change in Australia.	Jun 2009
c	Updated and more detailed analysis of urbanisation patterns in selected areas within the wet tropics bioregion.	Jun 2009*

* Involves ongoing activities in Out Years.

Co-funded by Powerlink.

@ Co-funded by QDMR

Project 4.9.3 Milestone Payments 2008/2009

For 2008/2009 Outputs Only	Date
Milestones – All JCU/CSIRO responsibilities	
• Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
Report 1 submission • Final report with attribution of MTSRF funding where appropriate on the remaining Powerlink project (dry sclerophyll woodland) (obj a, Task noted as #). • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. • Progress report regarding effectiveness of overpasses, subject to continued and renewed QDMR funding of underpass and overpass monitoring (obj a). • Progress report for Mission Beach area on activities associated with objective b: Remote sensing and GIS analyses of riparian and remnant vegetation quality indicators (obj b). • Progress update on activities associated with objective c. Responsible: Dr Iris Bohnet [CSIRO]: Summary of confirmation seminar, communication activities, number of interviews carried out in case study areas that inform analysis of landscape values (obj c).	14 Nov 2008
Pathway to Impact Report on End User Relevance	14 Dec 2008
Report 2 submission • Final report with attribution of MTSRF funding on testing and application of riparian and remnant vegetation quality indicators for Mission Beach study area using remote sensing, GIS modeling (obj b) • Progress report on testing and application of riparian and remnant vegetation quality indicators for Myola/Speewah study area using remote sensing, GIS modelling (obj b). • Report associated with objective c. Responsible: Dr Iris Bohnet [CSIRO]: Literature review of sea-and tree-change phenomena in Australia and historical analysis of urbanisation patterns in selected case study areas in the wet tropics bioregion (obj c). • Final summary of communication activities undertaken through the course of Year 3 of project. • Plan for completion of out year activities.	30 June 2009
Verbal progress report to Operations Committee and Information transfer between agencies on: • Provision of Project 4.9.3 data to Powerlink on savanna microclimate and vegetation edge effects and impacts. Responsible Officer: Dr Miriam Goosem (JCU). • Provision of Project 4.9.3 data to QDMR on linear infrastructure mitigation in the wet tropics region. Responsible Officer: Dr Miriam Goosem (JCU).	30 June 2009
Total MTSRF Funding	\$215,000*

* Includes \$1,500 for visual documentation.

^ JCU cash contribution is to be directed towards 3 PhD students on this project.

Project 4.9.3 Budget

Year 3– 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	213,500	-	213,500
Visual Documentation	***1,500		1,500
James Cook University	60,000	89,230	149,230
Qld Dept Main Roads		7,200	7,200
Powerlink		7,200	7,200
CSIRO		19,034	19,034
WTMA	-	14,700	14,700
FNQNRMLtd	-	7,200	7,200
Total	275,000	144,564	419,564

*** A total of \$1,500 is held by the Reef and Rainforest Research Centre for Visual Documentation of this project (see Theme 5).

JCU Project 4.9.3 Budget 2008/2009

Item	MTSRF Funds	JCU Cash	In-kind	Total Cost
Salaries	150,830	60,000	125,530	336,360
Operating	27,670	-		27,670
Travel	-	-	-	-
Communication / Extension	10,000	-	-	10,000
Capital	-	-	-	-
Institutional overheads	-	-	-	-
Total	188,500	60,000	125,530	374,030

* Includes third party contracts with Queensland Department of Main Roads and Powerlink Queensland, still under negotiation.

CSIRO Project 4.9.3 Budget 2008/2009

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	18,535	-	18,535
Operating	5,321	-	5,321
Travel	1,144	-	1,144
Communication / Extension ¹	-	-	-
Capital	-	-	-
Institutional overheads	-	19,034	19,034
Total	25,000	19,034	44,034

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	215,000	-	115,000			330,000
Total	215,000	-	115,000			330,000

Objectives/deliverables 2009-10 (Year 4)

Task	Objective / Deliverable	Date / Timing
(a)	Finalisation of informative and cost-effective ecological indicators of linear infrastructure impacts in rainforests and adjoining Wet Tropics habitats, dependent on funding from Powerlink and/or QDMR	June 2010
	Finalisation of analysis of effectiveness of mitigation strategies for linear infrastructure impacts for restoring ecological processes and reducing impacts on rare or threatened species, dependent on funding from Powerlink and/or QDMR	June 2010
(b)	Completion of analysis of habitat quality using easily assessed indicators from remote sensing and GIS for Myola Speewah	June 2010
	Completion of analysis of habitat quality using easily assessed indicators from remote sensing and GIS for all sites agreed by stakeholders	June 2010
	Identification of priority areas for restoration for enhancement of landscape connectivity for the chosen regions	June 2010
(c)	Assessment of landscape values in sea- and tree- change landscapes	June 2010
	Assessment of the impacts of urbanisation on sea- and tree-change landscapes	June 2010
	Practical recommendations for local government and NRM authorities on managing and remediating impacts of urbanisation	June 2010

PROGRAM 9: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES
Project 4.9.4: Integrating ecology, economics and people into forest landscapes
Project Leaders and Host Organisation

Dr Nick Emtage, Assoc. Prof. John Herbohn, The University of Queensland

Project Team

Title	Organisation	Role	FTE
Dr Nick Emtage	UQ	Project leader, social science and natural resource management, programming and modeling; Objectives a, b	1.00
Assoc Prof John Herbohn	UQ	Project Leader, project researcher - integrative systems, economics, ecology Objectives a,b	0.20
Dr Krishna Shrestha	Sydney University	Project Researcher – social science, Objectives b	0.20
Prof Jerry Vanclay	Southern Cross University	Project Researcher- forest ecology and ecological modeling. Objectives b	0.10
Dr David Pullar	UQ	Project Researcher – GIS and resource management, Objectives a, b	0.05
Assoc. Prof Steve Harrison	UQ	Project Researcher, Economist, Objective a, b	0.05

This Project will benefit from the capacity building component of Theme 5 Enhancing Delivery.

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
WTMA	Steve Goosem
Terrain NRM Ltd	Allan Dale
EPA	TBA
Alliance for Sustainable Tourism	Annie Riddett
GBRMPA	Ingrid vanPutten
Queensland Canegrowers	Tim Wrigley

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project will develop an understanding and application of how to integrate complex social, economic and environmental considerations in maintaining and developing sustainable forest landscapes in the Wet Tropics.

Key Objectives:

(a) Produce a comprehensive set of profiles (typology) of landholders in relation to NRM practices on private land in the Wet Tropics region that will facilitate effective design and delivery of NRM and rural development programs by public agencies.

(b) Develop tools to assist landholders, managers and researchers in decision making about investments in forest restoration and to help identify the resulting economic, social and environmental benefits.

Project / Task Methodology

The project applies systems thinking as an integrating framework and uses a mixed methods approach. The research will be co-managed, with stakeholders such as Terrain NRM involved at all stages – design, implementation, interpretation and application. Project team members will hold regular workshops and meetings with key stakeholders.

Objective (a): Produce a comprehensive set of profiles (typology) of landholders in relation to NRM practices on private land in the Wet Tropics region that will facilitate effective design and delivery of NRM and rural development programs by public agencies.

The research will investigate the attitudes, capacity and knowledge of landholders in relation to their management of their natural resources. Information will be gathered about rural landholders in the Wet Tropics region in a multi-stage and mixed methods process using both qualitative and quantitative survey techniques. The information gathered about landholders has been developed into a landholder typology i.e. a set of profiles of various types of landholders in the region as part of activities in ARP 1 and ARP2.

Following the development of this understanding about rural landholders and their activities in the first two years of the project, researchers are now set to work with personnel from local, regional, state and national agencies involved in NRM and rural development in subsequent years. This is to refine landholder profiles to aid them to effectively tailor and target their communication strategies, policies and programs to landholders' circumstances and values. The research will contribute directly to the development and use of a framework for the integration and synthesis of information from the MTSRF research programmes across a range of research disciplines and geographic regions; including systems for data management, co-ordination of data and access to data. This work is being piloted in collaboration with Terrain to develop best practice manuals for herbicide applications in the potato, peanut and maize cropping systems. Further discussions are planned with representatives from the cane growing, beef, dairy, banana and papaya industries.

The landholder survey data is spatially explicit. During the second half of 2008 the project team will investigate relationships between catchment attributes (such as vegetation cover and health, water quality, land values, topography etc) and landholders socioeconomic characteristics, management values, practices and objectives using a GIS under the lead of Dr Pullar.

The results of these analyses will be used to develop GIS based assessment tools to assist the planning and implementation of revegetation programs in the Wet Tropics region as discussed further below. Where possible, aggregated data from the survey will be processed for inclusion into the ReefAtlas.

Data collected from the survey of landholders in NQ, along with interviews with landholders and discussions with NRM stakeholders will be used to construct a Bayesian Belief Network (BBN). Bayesian Belief Networks have proven to be an effective tool in formulating decision support systems for resource management across various applications. The BBN allows the use of a multitude of data types from a variety of sources. Further, the graphical interface of BBN makes it a simple tool for participatory modelling particularly for stakeholders with limited experience in model development and interpretation. For instance Cain *et al.* (1999) used a belief network to examine the impact of management options implemented as part of a watershed development project. A BBN has also been used to model habitat and population viability of selected at-risk fish and wildlife species (Marcot *et al.* 2001). The BBN represented the ecological causal web of key environmental correlates that most influence habitat capability, potential population response for each species and influence of habitat planning alternatives. Bacon *et al.* (2001) used BBN in land-use modelling, determining whether the dissatisfaction of land managers brought on by the shift in the present land use (farming) to another one (forestry) would be out-weighed by the anticipated benefits. As a part of Project 4.9.4 we will construct a series of BBN's to explore the effective design and uptake of NRM programs by landholders in the region. Integrated into the BBN will be landholder types identified from the survey, along with a spatial component (i.e. how these landholder types are distributed across the wet tropics landscape).

Initially this BBN will be constructed and applied to one key NRM issue and used to identify the intervention (or policy leverage) points. Once the methodology has been proved, it will then be applied to other key NRM issues. At this stage we envisage the first application will be to explore issues associated with improving water quality entering the Great Barrier Reef lagoon.

Objective (b): Develop tools to assist landholders, managers and researchers in decision making about investments in forest restoration and to help identify the resulting economic, social and environmental benefits.

The project will commence development on a module specific to restoration plantings (building on the Australian Farm Forestry Financial Model (AFFFM), which was developed under Project 5.3 in the Rainforest CRC) that will supplement the existing modules dealing with farm forestry plantations and native forest management. The focus is exclusively on native species.

Building on the previous research to incorporate information about the ecological attributes of species used in revegetation programs from expert surveys, we will commence development of improved growth models for native species used in reforestation situations based on previous growth models developed for North Queensland rainforests by Jerry Vanclay. A PhD candidate, Mr Nang, has recently begun his research program through the University of Queensland to further this work. This research will allow the identification of combinations of native species best suited to specific soil types in the region based on extensive native forest datasets used in the initial analysis of Vanclay. Additional data will be collected from CRRP plots and other native species plantings in the Wet Tropics in order to adapt growth equations of Vanclay to mixed species restoration plantings. While some information on site species matching and combinations are already available for commonly planted species (usually those with a high timber value), there is a scarcity of information about less common species. This research will help address this information deficit about less commonly planted species.

In addition, we will draw upon the substantial work undertaken by the project team over the past ten years in the Wet Tropics region. Information about the financial impacts of forest management and revegetation for individual landholders will be drawn from research undertaken for meeting Objective (a). For individual landholder types we will identify which revegetation systems are best suited to integrating into various farming systems (using the modified AFFFM and landholder types as described for objective a). Understanding about the social impacts of revegetation programs and forest management will be developed using results from research to meet objective (a). In addition, we will use the understanding of landholder types obtained in objective (a) to assist in the development of effective revegetation schemes matched to the characteristics of the landholders in the target areas.

During the first half of 2009 the research team will develop GIS tools that integrate biophysical information (e.g. location of existing remnant vegetation, soils, topography, aspect and climate), with information about the legal constraints to revegetation (i.e. local and state government regulations) and landholders preferences to produce assessments of where revegetation programs are best sited in the landscape. When the above mentioned growth equations become available in future years, they will be incorporated into a GIS platform to produce maps illustrating the suitability of various species for different locations in the Wet Tropics region.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
a	Participate in workshops describing a comprehensive set of landholder profiles (typology) for key stakeholders involved in NRM and rural development in the Wet Tropics	From Dec 2008
	Draft of peer reviewed papers assessing the landholder profiles (typology) and their potential use for NRM and rural development	Mar 2009
	Work with NRM and Primary Industries agencies to develop best management practices in relation to NRM for specific industries – hold focus groups in conjunction with Terrain	2008-2010
b	Assessment of the potential of adapting growth models of Vanclay to identifying species combinations for different soil types in the Wet Tropics.	June 2008 – June 2009
	A series of reports, papers and workshops examining the potential economic, social and environmental impacts of various forest management and revegetation development systems in the Wet Tropics -	June 2008 – June 2010

* Involves ongoing activities in Out Years.

Objective	Output / Milestone	Date / Timing
(a)	Participate in workshops and focus groups with industry associations, landholders and Terrain to develop best practice manuals for various rural industries	May - Oct 2008
	Prepare report from best practice development workshops	Dec 2008
	Submit papers to peer reviewed journals assessing the landholder profiles (typology) and their potential use for NRM and rural development programs	Mar 2009
	Report examining key NRM policy issue using Bayesian Belief Networks	Mar 2009
	GIS analyses of landholder survey results and report	Dec 2008
	Incorporate aggregated data from landholder survey into ReefAtlas (if the ReefAtlas is operational by this time)	June 2009
(b)	Assessment of revegetation programs and options for various landholders types defined using the landholder survey??	Dec 2008
	Development of GIS tools to assess the positioning of revegetation plantings in the landscape	June 2009
	Suitability maps for key native species groups used in restoration plantings in the Wet Tropics	June 2010

Project 4.9.4 Milestone Payments 2008/2009

For 2008/2009 outputs only	Date
Milestones – all UQ responsibilities	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
Publish report with attribution of MTSRF funding from best practice development workshops and focus groups. Verbal presentation to the Operations Committee on best practice development workshops and focus groups.	31 Oct 2008
Submit Pathway to Impact Report for EndUser relevance	TBA
Publish reports with attribution of MTSRF funding on the development of GIS based tool to evaluate positioning of revegetation plantings in the landscape and the spatial analysis of responses to the landholder survey.	28 Feb 2009
Publish report with attribution of MTSRF funding on the outcomes of interviews with landholders regarding reef rescue packages	31 Mar 2009
Publish report with attribution of MTSRF funding on the use of Bayesian Belief Networks to improve policies and programs for water quality improvement in the Wet Tropics region	28 Feb 2009
Submit journal articles with attribution of MTSRF funding based on analyses of landholder survey	30 Mar 2009
Report with attribution of MTSRF funding. on assessment of potential of adapting growth models of Vanclay to identifying species combinations for different soil types in the Wet Tropics	31 May 2009
Total MTSRF Funding	\$123,500

#Total includes \$1500 visual documentation

Project 4.9.4 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	123,500	-	123,500
MTSRF Visual Documentation*	1,500	-	1,500
GBRMPA	10,000		10,000
UQ	-	198,800	198,800
WTMA	-	25,500	25,500
Total	125,000	224,300	359,300

* A total of \$1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	125,000	-	256,000		TBA	381,000
Total	125,000	-	256,000			381,000

PROGRAM 9: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES
Project 4.9.5: Restoring tropical forest landscapes
Project Leader & Host Organisation

Dr Carla Catterall, Griffith University (GU)

Project Team commitments 2008/2009

Title	Organisation	Role	FTE
Dr Carla Catterall	Griffith University	Project leader and researcher. Senior ecologist.	0.25
Dr John Kanowski	Griffith University	Research fellow and key scientific researcher across objectives. Wildlife ecologist.	1.00
Kylie Freebody	Griffith University	Research assistant. Plant ecologist and revegetation practitioner.	0.50
Debra Harrison	TERRAIN NRM Ltd / Griffith University	Research assistant and facilitator in objective (c). Ecologist and information manager.	0.70
Rowena Grace	TERRAIN NRM Ltd	End-user collaborator in objective (a). Biodiversity manager.	0.10
Catchment coordinators	TERRAIN NRM Ltd	End-user collaborators in objective (c). Vegetation managers.	0.20
Allan Dale	TERRAIN NRM Ltd	End-user collaborators in objective (c). Senior environmental planner.	0.05
PhD Students*	Griffith University	Researchers on sub-projects of objective (b). Wildlife and vegetation ecologists.	1.00
Dr Grant Wardell-Johnson	Curtin University	Research collaborator in objectives (b) and (c). Wildlife ecologist.	0.05
Dr Heather Proctor	University of Alberta	Research collaborator in objective (b). Insect ecologist.	0.05
Robert Kooyman	Private researcher	Research collaborator in objective (b). Vegetation ecologist.	0.05
Nigel Tucker	Biotropica Pty Ltd	Research collaborator in objective (c). Revegetation practitioners.	0.05

* One current PhD and 1-3 future Honours or postgraduate students at Griffith University.

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
Alliance for Sustainable Tourism	Melinda Connolly
TERRAIN NRM Ltd	Debra Harrison, Rowena Grace, Allan Dale
EPA	TBA
WTMA	Steve Goosem
ARC	Russell Butler

Project Duration

Start Date: 1 July 2006 End Date: 30 June 2010

Project / Task Objectives

This project will advance knowledge and practice in understanding and managing forest restoration and degradation for biodiversity outcomes in Wet Tropics landscapes. It will help build a functional understanding of the ecological processes involved, and will develop and apply tools for monitoring and evaluation of forest disturbance, recovery and restoration, for end-users and researchers. Project activities will also facilitate a coordinated approach to reforestation and restoration, involving interaction between scientists, land managers and the wider community.

Key objectives:

- (a) Develop and apply toolkits and indicators for monitoring and evaluation of degradation and restoration.
- (b) Develop and communicate a functional understanding of reforestation and restoration processes.
- (c) Improved facilitation and future optimisation of regional investments and management actions.

Project / Task Methodology

Objective (a): Toolkits and indicators: monitoring and evaluation of reforestation success

In collaboration with stakeholders, this project will develop user-friendly but ecologically meaningful toolkits for monitoring progress of vegetation condition and biodiversity at sites whose vegetation is changing because of either impacts (including land clearing and cyclones) or recovery processes (including regrowth, restoration and reforestation). This work is supported in part by TERRAIN NRM.

The series of monitoring toolkits will provide guidance in design, data collection, analysis and interpretation, and will include written materials and computer-based data management and summary tools. They will be applied to assess both improvements in vegetation condition and biodiversity in reforested sites, and impacts of cyclone Larry, in relation to measurements at relatively-intact forest reference sites.

The toolkits will draw on relevant research (including Rainforest CRC Project 5.2 and this Project 4.9.5(b)), and will be tested by end-users, with the assistance of TERRAIN NRM staff and revegetation groups, and revised based on their feedback. Toolkit development includes the establishment of baseline and reference states and measurements, against which progress at impacted or reforested sites can be judged, and which allow for background spatio-temporal variation in environment and biota.

The monitoring toolkits will be applied to revegetated sites, including NHT1 and NHT2 sites, with the involvement of TERRAIN NRM staff. The results will both provide data on the progress of reforestation at these sites and help refine the toolkits. The monitoring protocols will also be applied to assess impact and recovery at both forest and replanted sites affected by cyclone Larry. Information from this project, and from the monitoring of revegetated sites by end-users, will be used to identify ecologically-meaningful and cost-effective indicators of restoration and degradation.

Objective (b): Reforestation processes: functional understanding of reforestation processes

This task will advance knowledge of the ecological processes involved in forest (vegetation and biodiversity) degradation and recovery within rainforest landscapes. Initially, a scoping study will identify priorities for new data collection, based on a synthesis of current knowledge of reforestation and degradation processes. Once priorities are defined, data collection will involve field measurements of aspects of biodiversity and vegetation condition, including (a) by professional ecologists and (b) by application of the monitoring toolkits. Data will be collected at sites which have been selected to provide replication within experimental designs that are focused on factors such as area, establishment style (ecological restoration, forestry or regrowth), type of disturbance (cyclone, clearing, or fragmentation), isolation, context and age. Some data collection will involve re-surveys to determine vegetation and biodiversity change at sites previously assessed in Rainforest CRC Project 5.2. Additional data will be obtained from manipulative trials of key agents and processes affecting the development of reforested and regrowth areas.

The data obtained from this work, together with information from Rainforest CRC Project 5.2 and other relevant studies, will be analysed to examine relationships between controlling and response variables, and the performance and surrogacy value of a range of potential indicator attributes (including vegetation structure, floristics, and selected faunal taxa). The results of the analyses will be used to: (a) refine a conceptual model of reforestation processes, applicable to assessing reforestation trajectories and guiding management interventions in reforested sites; (b) identify cost-effective rehabilitation practices, especially where these have potential over large land areas, including different forms of plantation design, and management of regrowth; and (c) identify factors associated with the impact of cyclone Larry on vegetation and biodiversity, and the rate of recovery of vegetation and biodiversity. The cyclone work has been supported in part by TLJV.

Objective (c): Facilitation and futures: facilitating and optimising regional investments and management.

This component aims to improve regional-scale coordination of investments in reforestation, and to develop and implement reporting protocols for improvements in resource condition, within the Wet Tropics NRM framework. This will require participation in, and contribution to, the reporting and management systems developed for the Wet Tropics NRM Regional Investment Strategy (RIS) and Management Action Targets (MATs). This work is supported in part by TERRAIN NRM.

Information on the costs of revegetation projects (e.g., obtained from NHT reporting) will be integrated with the results of on-ground assessment of biodiversity and vegetation condition, from the application of the monitoring toolkits. This and related information (e.g., from Rainforest CRC Project 5.2, and collaboration with MTSRF Project 4.9.4) will be used to quantify production-biodiversity trade-offs and synergies. Evidence-based criteria for decision-making about the quality, quantity and spatial context of reforestation actions, especially in relation to long-term biodiversity outcomes, will be developed and communicated. Project Workshops will be held with stakeholders to integrate and disseminate information on restoration strategies, and to encourage the development of experimental management approaches to reforestation through collaboration between scientists, funding bodies and stakeholders. Activities will also include liaison with MTSRF Projects 1.2.1 (rainforest and catchment status and trends), 4.9.3 (development of rehabilitation strategies for retired linear infrastructure), 1.4.3 (threats to forest remnants), and regional initiatives which are looking at the role of revegetation in catchment management and carbon sequestration.

Project Activities 2008/2009

Objective	Targeted Activity	Date
(a)	Trialing and development of bird survey methods**	July-December 2008* [#]
(a)	Monitoring toolkit version 3*	June 2009* [#]
(a)	Scientific paper on biodiversity indicators in reforestation submitted to journal**	November 2008*
(b)	Data collection for study of reforestation processes**	July 2008-June 2009** [#]
(b)	Scientific paper on conceptual model of reforestation processes published**	March 2009** [#]
(b)	Scientific paper on monitoring carbon sequestration during reforestation submitted to journal**	November 2008*
(c)	User-focused article on reforestation costs and benefits**	November 2008**
(c)	Reporting system for restoration works and regional investments under development with TERRAIN NRM*	July 2008-June 2009* [#]
(c)	Workshop on integrating reforestation processes and outcomes into TERRAIN NRM RIS*	March 2009** [#]

[#] Involves ongoing activities in out years.

** These outputs/milestones are primarily supported by MTSRF (including in-kind from GU).

* These outputs/milestones are partially supported by MTSRF (including in-kind from GU), but also require funds and in-kind contributions from TERRAIN NRM Ltd or other partners.

Project Targeted Activities (All Years, indicative only for out years)

The end users from this research project are organisations and individuals concerned with forest degradation and recovery; in the Wet Tropics these are primarily TERRAINNRM and WTMA, although the findings will also be highly relevant to the information needs of a very wide range of community groups, government and non-government agencies.

Task	Output / Milestone	Date / Timing
(a)	End user workshop on monitoring revegetation	2006-2007 [#]
	Book chapter on monitoring revegetation**	2006-2007 [#]
	Monitoring toolkit version 2*	2007-2008
	Condition report NHT1 sites*	2007-2008

Task	Output / Milestone	Date / Timing
	User workshop on monitoring biodiversity of revegetation*	2007-2008
	Monitoring toolkit version 3*	2008-2009
	User workshop on monitoring revegetation*	2008-2009
	Scientific paper on biodiversity indicators in reforestation**	2008-2009
	Scientific paper on community-based monitoring**	2009-2010
	Revised monitoring toolkit*	2009-2010
(b)	Research workshop on reforestation processes and trajectories**	2006-2007 [#]
	Paper on invertebrates and reforestation**	2006-2007 [#]
	Book chapter on reforestation and biodiversity**	2006-2007 [#]
	Scientific paper on conceptual model of reforestation processes**	2007-2008
	Fact sheet on reforestation processes**	2007-2008
	One or two scientific papers on an aspect of degradation or reforestation process**	2008-2009
	Fact sheet on restoration and reforestation in practice**	2009-2010
(c)	Presentation on strategic reforestation to user workshop*	2006-2007 [#]
	Book chapter on production-biodiversity value trade-offs**	2006-2007 [#]
	Regular liaison with State, Commonwealth regarding RIS and MAT reporting	2007-2010
	Reporting system for restoration works developed by TERRAIN NRM	2007-2009
	Stakeholder workshop on strategic approaches to reforestation*	2007-2008
	Article on restoration costs and benefits**	2008-2009
	Workshop on integrating reforestation processes and outcomes into TERRAIN NRM RIS*	2008-2009
(d)	Attendance at Operations Committee Meetings (3 per year)	2008/2009

[#] These achieved in year one of the MTSRF.

** These outputs/milestones are primarily supported by MTSRF (including in-kind from GU).

* These outputs/milestones are partially supported by MTSRF (including in-kind from GU), but also require funds and in-kind contributions from TERRAINRM.

Outputs/milestones without asterisks are not dependent on MTSRF funds, although they will benefit from the relationship with MTSRF.

Project 4.9.5 Milestones 2008/2009

For 2008/2009 Outputs Only	
Milestones – all GU responsibilities	Date
Signing of contract	
Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	08/09
Report 1 submission: - Progress update on data collection for study of reforestation processes (objectives a and b) - Update on scientific paper on monitoring carbon sequestration during reforestation submitted for publication (objective b) - User-focused article on reforestation costs and benefits provided to RRRC (objective c) - Plan of communication activities, products and events for Year 3 and summary of any liaison activities undertaken to date, including minutes of	1 Nov 2008

For 2008/2009 Outputs Only	
Milestones – all GU responsibilities	Date
meetings/workshops if applicable.	
Pathway to Impact Report for Enduser Relevance	14 Dec 2008
Verbal Report to Operations Committee on: : - Progress of outcomes of trialing and development of bird survey methods (objectives a and b) - Scientific paper with attribution of MTSRF funding on conceptual model of reforestation processes provided to RRRC (objective b) - Progress of outcomes of workshop on integrating reforestation processes and outcomes into TERRAIN NRM RIS (objective c). - Summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable.	31 Mar 2009
Report 3 submission: - Final report with attribution of MTSRF funding on monitoring toolkit version 3 (objective a) - Progress update on data collection for study of reforestation processes (objectives a and b). - Progress update on reporting system for restoration works and regional investments under development with TERRAIN NRM (objective c). - Final summary of liaison activities undertaken through course of Year 2 of project.	1 Jun 2009
Total Funding*	\$123,500

* Includes \$1,500 Visual Documentation Allocation

Project 4.9.5 Budget

Year 3 Project Funding and Partnerships 2008/2009

Contributing Organisation	Cash	In-kind	Total
MTSRF	123,500	-	123,500
MTSRF Visual Documentation	1,500	-	1,500
TERRAIN NRM Ltd (3 rd party contract)	72,900	60,000	132,900
Griffith University	20,000	76,000	96,000
Biotropica	-	15,000	15,000
University of Queensland	-	10,000	10,000
University of Alberta	-	10,000	10,000
Private (Kooyman)	-	10,000	10,000
Total	217,900	181,000	398,900

* A total of \$1,500 is held by Reef and Rainforest Research Centre for Visual Documentation of this project (see Theme 5).

Griffith University Project 4.9.5 Budget 2008/2009

Item	MTSRF Funds	TERRAIN NRM Cash	GU Cash	In-kind	Total Cost
Salaries	80,500	63,570	20,000	84,674	238,574
Operating	17,200	5,140	-	-	23,400
Travel	8,600	4,190	-	2,500	14,600
Communication / Extension	15,700	-	-	-	23,000
Capital	-	-	-	-	-
Institutional overheads*	-	-	-	93,826	93,826
Total	123,500	72,900	20,000	181,000	397,400

Indicative Budget Summary - Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	125,000	20,000	76,200	72,900	60,400	354,500
Total	125,000	20,000	76,200	72,900	60,400	354,500

PROGRAM 9: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES
Project 4.9.6: Strategic Natural Resource Management and land use planning
Project Leader and Host Organisation

Dr Cathy Robinson, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team

Title	Organisation	Role	FTE
Dr Cathy Robinson	CSIRO	Overall project leader. Principal investigator of Project 4.9.6a (catchment and regional planning)	0.40
Bruce Taylor	CSIRO	Researcher 4.9.6a (social and institutional appraisal in resource planning and policy)	0.40
Dr Marcus Lane	CSIRO	Researcher 4.9.6c (environmental planning)	0.08
Ben Harman	CSIRO	Researcher 4.9.6a (local government roles in water management)	0.10
Dr Rosemary Hill	CSIRO	Principal investigator 4.9.6b (conservation planning)	0.24
Dr Kristen Williams	CSIRO	Researcher 4.9.6b (biogeography and conservation planning)	0.12
Dr Petina Pert	CSIRO	Researcher 4.9.6b (ecology)	0.16
Anthea Coggan	CSIRO	Principal investigator of 4.9.6c (environmental economics and market based instruments)	0.25
Dr Andrew Reeson	CSIRO	Researcher 4.9.6c (experimental economics)	0.10
Dr Stuart Whitten	CSIRO	Researcher 4.9.6c (environmental economics and decision making)	0.07

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
Alliance for Sustainable Tourism	Annie Riddet
TERRAIN NRM L:td	Rowena Grace, Allan Dale
EPA	TBA
WTMA	Andrew Maclean
Reef Water Quality Partnership	Rachel Eberhard
Queensland Canegrowers	Tim Wrigley

The project contributes to Theme 4 – *Sustainable use and management* and Theme 5- *Enhancing Delivery* by integrating approaches from planning, resource economics and conservation biology to inform the design and assessment of cost-effective local and catchment-based delivery arrangements for sustainable NRM in Reef catchments

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project will design and test implementation approaches for improved natural resource management and conservation. This research is based on an adaptive management planning framework with a focus on effective implementation that seeks to integrate social, economic and ecological systems. The key longer term outcome being targeted in this research is the improvement in the management of natural resources and supply of ecosystem services on private land. Our research focuses on achieving this through:

- Improved planning and institutional arrangements underpinning biodiversity, water quality and wider ecosystem services in the GBR region whilst maintaining viable regional industries and communities; and
- Building effective partnerships between researchers, research institutions, resource managers, policy makers, government and non-government agencies that increase the relevance and impact of science in natural resource and regional decision making and governance.

Key Objectives:

- (a) To develop and test rigorous cost-effective catchment water quality management model to inform targets and enhance implementation approaches for water quality improvement
- (b) To develop a rigorous local area planning framework for biodiversity, incorporating values and ecosystem services, based on regional ecosystems, threatened species, threatening process and beneficial processes provided by landholders and applied through case studies.
- (c) To refine, tailor and apply the concept of market based instruments for implementing ecosystem goods and services specifically for the purpose of using offset schemes for environmental conservation in developing areas.

Project/Task Methodology

The methods and goals to meet the above objectives are tightly coupled to NRM end-user interests and needs. Care is taken however to ensure the research approach remains strategic and science-focused and not a substitute for the operational planning responsibilities of our partners. Building upon these active partnerships with regional NRM groups, we will develop concepts and methods of much wider strategic relevance to the disciplines of environmental planning and management across the GBR region.

Developing beneficial shorter-term outputs from the project relies on i) an ongoing dialogue with end-users to influence specific research questions and their priority; and ii) incorporating outputs from other projects to support the use of best available science in a focused and accountable policy environment. The main sets of outputs from the research are:

1. **Models and conceptual frameworks** to inform the construct of more rigorous and effective NRM planning at various scales
2. **Decision support tools** stemming from management requirements that enable the science outputs to be applied effectively in GBR management, biodiversity conservation planning, policy development and reporting processes,

3. **Demonstrations, through case study application, of innovative planning solutions and instruments** that incorporate best available science within the constraints and opportunities provided by regional socio-economic systems and governance, and
4. **Discussion papers, workshops, guidelines and collaborative projects** that communicate and build regional capacity to implement the science including the capacities of science providers to operate in this (environmental planning) setting.

In the longer term, key outcomes from the project will enable;

- improved planning and institutional arrangements underpinning biodiversity, water quality and wider ecosystem services in the GBR region whilst maintaining viable regional industries and communities with high levels of adaptability, and
- effective partnerships between researchers, research institutions, resource managers, policy makers, government and non-government agencies that increase the relevance and impact of science in natural resource and regional decision making and governance.

Objective (a): Strategic NRM planning for Water Quality Improvement

This project will construct a rigorous framework to evaluate alternative environmental management strategies for water quality improvement in North Queensland including their environmental, social and economic performance. The focus is on catchment and regional scale programs. The task is closely integrated with the work in the Water Quality Program (Program 7) of MTSRF. Specific tasks are outlined below.

- Develop a regional/catchment water quality management model that produces cost-effective programs of action (MATs) that are suited to socio-economic context and can be implemented to meet environmental targets (RCTs).
- Identify and synthesise the potential management actions in key sectors and industries that might be implemented to achieve those targets and the costs and efficacies of those management actions (in conjunction with other projects).
- Develop and test a management action monitoring and reporting framework that would provide rigorous and consistent information on management responses (in conjunction with other projects).
- Assess the capacity of resource users and management institutions to adopt management actions.
- Conduct an institutional analysis of the potential industry, government and community actors, roles, rules and arenas through which actions can be implemented.
- Implement the framework for at least one north Queensland region or catchment.

Objective (b): Biodiversity values in regional and local area planning

This project develops a rigorous local area planning framework based on principles of adaptive and collaborative management. The framework utilises biodiversity metrics that explicitly incorporate the effects of landscape function in addition to biological pattern and addresses the interacting effects of habitat quality, condition and connectivity. Contextually, biodiversity metrics, also commonly termed 'surrogates' will be designed to support a range of strategic NRM and land use planning requirements, integrating data and knowledge generated through this and other programs. Specific tasks are outlined below.

- Develop a rigorous, adaptive, collaborative local area planning framework for biodiversity and through this framework apply and test the effectiveness of relevant tools and

engagement processes at each stage of the planning process. Identified stages and tools currently under investigation include: exploratory stage—historical trends analysis, natural and cultural values significance assessment, biodiversity metric development, stakeholder analysis; platform building stage—local governance establishment (Mission Beach Habitat Network Action Committee), scenario generation, participatory decision support tool design; negotiation stage—Landscape Toolkit decision support system, biodiversity analysis under alternative land use configurations, scenario evaluation; implementation stage—offset policy and market design, devolved grant/tender development; evaluation stage—participatory workshop-based review.

- Incorporate habitat suitability, connectivity and fragmentation effects in the design and development of biodiversity persistence metrics.
- Test the effectiveness of generated biodiversity metrics in capturing and valuing different elements of biodiversity, including species turnover and phylogeny. In particular contrast taxon groups and new metrics with the Regional Ecosystem classification and with the predominantly structural vegetation types of the Stanton and Stanton mapping.
- Identify and value both unique areas and complementary areas for the protection or enhancement of biodiversity values based on regional ecosystems, threatened species, threatening process and beneficial processes provided by landholders through case studies in local area planning.
- Conduct case studies that ensure the science developed is applicable to the requirements of local area and NRM planning. Notwithstanding capacity, the case studies enable the project team to respond or react to the short-term needs and priorities of management agencies where datasets and planning timeframes also allow. To achieve this, we will work with identified project teams in MTSRF RIS Theme 4 (4.9.3) and Theme 1 (1.4.3) and collaborate with QPWS, EPA, WTMA and FNQ NRM Ltd on predefined case studies. These include, but are not limited to: a) Daintree, b) Mission Beach and surrounding areas, c) Myola. d) Tully-Murray Flood Plain. e) Southern Atherton Tablelands. f) Cairns Northern Beaches. h) FNQ Regional NRM Plan review and revision
- As knowledge accumulates in the development of biodiversity metrics, we will incorporate new metrics for species turnover and issues of fragmentation, habitat quality, threatening processes and biodiversity persistence into the valuation and prioritisation protocols.
- Assess priority biodiversity areas under alternative scenarios for land use identified in regional NRM plans and evaluate the potential effectiveness of investment schedules for biodiversity outcomes.

Objective (c): Implementing ecosystem goods and services

Ecosystems provide many goods and services from which humans benefit. These services include maintaining the water table, purifying water and air, decomposing waste, renewing soil fertility, controlling pests and pollinating plants. Urbanisation could have a positive or negative effect on environmental assets and the ecosystem services that they provide. In most urbanisation experiences the impact has been a negative one.

Normal market signals experienced by landholders primarily focus on goods for which they gain a private benefit, for example, the price of a block of land according to its housing development potential. Landholders are generally not rewarded for the environmental goods that the land also produces. This means that the value of these environmental goods is not signalled in tangible ways, and that land management decisions often fail to take account of their full natural resource management impact.

In theory, the undersupply of public goods such as ecosystem services can be remedied through some level of government intervention. Policy interventions by government can generally be divided into those that use regulation or coercion, or those that change the

incentives faced by private landholders through the provision of information and facilitation of management agreements and/or payments.

Urban development already occurs subject to regulation, such as planning requirements. Despite this, negative impacts to ecosystem services continue to occur. This is because planning requirements can not cost effectively capture all the impacts of development (for example the residual impacts on water quality of a cumulative increase in paved surfaces). An alternative to increased regulation is the use of incentives to motivate landholders in an urbanising setting to supply the land management required for the maintenance and enhancement of ecosystem services.

This research component will construct and apply a rigorous framework to analyse the incentive mechanisms available for the management of ecosystem services in urbanising environments in far north Queensland. This framework will be based on the policy design process of: understanding the problem; understanding the constraints and opportunities for improved policy; designing and implementing policy based on the problem and constraints (including institutional), and monitoring, evaluation and feedback. The evaluation of incentives in the policy design framework will be conducted in consultation with other MTSRF research projects as well as local actors and will specifically include:

- An analysis of the development pressures and trends, as well as the biophysical impact, of urbanisation on ecosystem services.
- An analysis of the ecosystem services of importance to the area under study.
- An analysis of the key market failures that result in undersupply of ecosystem services. This is essential to the design of an incentive based policy particularly a market based instrument (MBI).
- An assessment of the current formal and informal institutions and frameworks utilised to manage ecosystem services with urbanisation (landholder motivations, incentive schemes, regulation and planning for land management with and without development - this includes plans at the local, regional, state and federal level).
- A recommendation of a mixture of potential incentives as well as design parameters, with an indication of implications of the mix that could be utilised to improve ecosystem service management.
- If possible and time and budget permits a field or laboratory test of a specific incentive scheme or mix could be conducted.

Project Outputs / Milestones

For 2008/2009 Outputs Only		
Milestones – all CSIRO Responsibilities	Date	CSIRO
Report 1 submission • (a) Progress report on key regional and Reef-wide water quality partnership and knowledge integration issues. Focus will be on priority wetland restoration and sustainable agricultural activities • (b) Report with attribution of MTSRF funding on the spatial and other prioritisation processes for targets of the Mission Beach Habitat Network Action Plan • (c) Progress report on instrument development. • (c) Progress report on integration activities with working groups	December 2008	\$81,091

For 2008/2009 Outputs Only		
Milestones – all CSIRO Responsibilities	Date	CSIRO
Pathway to Impact Report for Enduser relevance		
Verbal Progress Report to Operations Committee on: • (a) Progress report on the development and application of cross-regional framework to evaluate progress of selected priority water quality management responses in the GBR • (b) Progress of biodiversity planning framework and approach to the second tier case study • (c) Summary of outcomes from instrument development – what we did and what we found, recommendations for design of instrument mix (which includes offsets) for the study area and next steps.	24 March 2009	\$81,091
Report 2 submission: • (a) Report with attribution of MTSRF funding on overall contribution of research outputs a.1 and a.2 in Tully catchment and broader GBR region. • (b) Report with attribution of MTSRF funding on overall contribution to biodiversity planning science from the Mission Beach Habitat Network Action Plan. • (c) Progress report on activities to further refine market parameter testing	June 2009	\$81,091
Total MTSRF Funding		\$243,275

Project 4.9.6 Milestone Payments 2008/2009

For 2008/2009 Outputs Only	
Milestones – all CSIRO Responsibilities	Date
Report 1 submission • (a) Progress report on key rural industry water quality action and partnership issues identified from comparative GBR analysis • (b) Report with attribution of MTSRF funding on the spatial and other prioritisation processes for targets of the Mission Beach Habitat Network Action Plan • (c) Progress report on instrument testing • (c) Progress report on integration activities with working groups	December 2008
Verbal Progress Report to Operations Committee on: • (a) . Progress of application of cross-regional monitoring and reporting framework for management responses to water quality • (b) Progress of biodiversity planning framework and approach to the second tier case study • (c) Summary of outcomes from instrument testing – what we did and what we found, recommendations for design of instrument mix (which includes offsets) for the study area and next steps.	24 March 2009
Report 2 submission: • (a) Progress report with attribution of MTSRF funding on overall contribution of research outputs a.1 and a.2 and progress on identifying and negotiating a second case-study for comparative testing of approach • (b) Report with attribution of MTSRF funding on overall contribution to biodiversity planning science from the Mission Beach Habitat Network Action Plan. • (c) Progress report on activities to further refine market parameter testing • Short summary on pathway to Impact for Enduser relevance	1 June 2009
Total MTSRF Funding	243,275

Project 4.9.6 Budget**Year 3 – 2008/2009 Project Funding and Partnerships**

Contributing Organisation	Cash	In-kind	Total
MTSRF	243,275		243,275
CSIRO		206,917	206,197
Total	243,275	206,917	450192

CSIRO Project 4.9.6 Budget 2008/2009

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	210,290	-	210,290
Operating	9,130		9130
Travel	23,855	-	23,855
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	206,917	206,917
Total	243,275	206,917	450,192

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	243,275	-	197,059	--	-	440,334
Total	243,275	-	197,059	--	-	440,334

PROGRAM 9: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES

CURRENTLY BEING BROKERED

Project 4.9.7: Understanding and enhancing social resilience: science and management integration project

Project Leaders and Host Organisations

Professor Helen Ross, The University of Queensland (UQ)

Dr Tim Lynam, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Dr Margaret Gooch, James Cook University (JCU)

Project Team

Title	Organisation	Role	FTE
Prof. Helen Ross	UQ	Project co-leader, principal contributor to case studies and theory development, resilience indicators at catchment/NRM region scales, implications for co-management and community engagement.	0.20
Dr Tim Lynam	CSIRO	Project co-leader, principal contributor to theory development, resilience indicators at GBR scale.	0.05
Dr Margaret Gooch	JCU	Project co-leader; principal contributor to theory development, community level resilience indicators; community level research	0.35
Dr Christine King	UQ	Lead role in participatory case studies, contributor to indicators of resilience	0.10
Dr Michael Cuthill	UQ	Lead role in community engagement and contributor to development of indicators of resilience	0.10
Dr Bradd Witt	UQ	Lead role in participatory case studies, contributor to indicators of resilience	0.10
Dr Kirsten Maclean	UQ	Substantive fieldwork and data collection for case studies	1.00
Research Assistant	CSIRO	Lead role in resilience indicators at GBR scale	0.12
Dr Samantha Stone-Jovicich	CSIRO	Lead role in resilience indicators at GBR scale	0.20
Dr Erin Bohensky	CSIRO	Lead role in resilience indicators at GBR scale	0.20
Dr Hilary Whitehouse	JCU	Contributor to community level indicators; community level research methodology	0.20
PhD student Ms Moni Carlisle	JCU	Community level resilience indicators	1.00
PhD student Ms Snowy Evans	JCU	Community level resilience indicators – educational policy focus	1.00
Research Assistant (Dr Donna Rigano, others as requested)	JCU	Community level resilience indicators	0.50

Summary Table of Research Users 2008/2009

Organisation	Organizational Contact
WTMA	Campbell Clarke
Terrain NRM	Allan Dale, Rachel Wicks, Fiona Barron, David Hinchley
Townsville City Council	Chris Manning
Cairns Regional Council	Peter Bradley
Great Barrier Reef Marine Park Authority	David Briggs, Doon McColl, Fred Nucifora
Earthwatch	Sue Jenkins
NRW	Andrew Drisdale, (Bris WQIP)
Conservation Volunteers Australia	Mick Brady, Adam King
Education Queensland	Ailsa Payne, Cam McKenzie

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

To contribute a set of indicators of social resilience to water quality change for use by scientists, communities, natural resource management agencies (government, NRM agencies and industry agencies) and a more generally applicable approach to developing these indicators. More specifically this objective will be achieved through achievement of the following four sub-objectives:

- (a) Development of indicators of social resilience to water quality change at whole of GBR scale;
- (b) Development of indicators of social resilience to water quality change at large catchment (regional body administration) scale;
- (c) Development of indicators of social resilience to water quality change at community scale;
- (d) Approach and methods for multi-scale indicator development and conceptual model for social resilience thresholds (Year 2 onwards)

The indicators of social resilience will make important contributions to the knowledge framework and the design of status and trend report cards, through providing an integrated set of indicators for use in monitoring and reporting social resilience to water quality change. The indicators will also contribute to the synthesis of information in the Integration framework, and make important communication contributions.

Project / Task Methodology

Aims

The project goal is to develop a theoretically defensible and project-appropriate understanding of social resilience that contributes to decision making in relation to water quality change as well as the management interventions to achieve water quality targets at several scales in the GBR catchment area. This understanding will be used to focus the development of indicators of social resilience designed to meet the needs of specific decision makers in specific decision making contexts.

Two questions guide the project activities to achieve this goal:

1. What do decision makers need to know or understand about social resilience at different scales of interest (e.g. GBR, catchment, community)?
2. What investments are most likely to enhance, or detract from, social resilience in relation to water quality change?

Methodology

This project is designed to support planning and decision-making initiatives, the parties responsible for that planning, and their reporting or planning tools, at three nested scales:

- the **whole-of-Great Barrier Reef catchment area** where the ReefPlan is implemented by the Intergovernmental Operations Committee and ReefPlan Partnerships, and their member agencies – linked to a MTSRF-built report card for that scale (by CSIRO);
- **regional bodies' scale of interest**, where regional planning is achieved through regional bodies and their partners - linked to proposed State of the Region reporting (by UQ); and
- **communities' scale of interest**, where Water Quality Improvement Planning, and broader community capacity building are focal (by JCU).

The project methodology is inductive and uses the conceptual framework developed for the project which was described in detail in the ARP 2 document (see Figure 1).

These scales are not discrete; they are mutually influencing. Some of the same indicators may apply at all scales, in other cases slightly different indicators may be required to indicate one dimension of resilience, such as economic dimensions. In decision-making, managers at the 'higher' scales often design programs to influence change at the lower scales, for instance incentives to encourage improvement of agricultural practices or the planting of riparian vegetation to improve water quality.

The methodology for each scale focuses on a strong and adaptive cycle of collaborative activity, involving evidence-based co-learning by end-users and research team, ultimately leading to synthesis of the key elements of social resilience and thence development of indicators, and identification of processes for using the indicators. Evidence from case study research and other primary data gathering at or relevant to the three scales (shown at right in Figure 1) provides data, draft indicators and important elements of process for the refinement and use of the indicators. The first cycle of collaboration is providing the teams of researchers and their respective end-users with a provisional view of what needs to be indicated (e.g. 'capacity'), and they are in the process of considering how it can best be indicated (one or more indicators of capacity). At the same time the process for using those indicators is clarified progressively, through monitoring and reporting frameworks appropriate to each scale. The method is iterative, both within the life of the project (provisional identification of dimensions needing indicators, and improvement to indicators as they

are proposed and data sought for them) and beyond the life of the project, since adaptive managers treat their underlying assumptions and their activities as available for continual improvement.

The process of collaboration necessarily differs at each scale, since the most relevant end-users at each scale have different preferences for modes of involvement, and some interact with a number of MTSRF projects or have limits to staff capacity. The collaboration processes need to be efficient and rewarding for them. Where possible we use social learning methods involving participatory processes for indicator development that focus on shared social resilience knowledge needs, managers' shared goals, then ways of indicating progress towards regional resilience-building interventions and achievement of management goals. At the regional scale, for example, the process will be directed towards indicators for the social indicators required for the State of the Region Report, which will inform at least three planning processes: the regional NRM plan, Wet Tropics Management planning, and Aboriginal planning.

As well as conducting a collaborative process to generate knowledge-needs then indicators with end-users, at each scale the research teams will be collecting data from secondary sources and through primary data collection activities (represented as 'case studies' in Figure 1) in order to inform indicator development. The methods for each of these differ, and have been negotiated as part of the collaborative process with end-users.

- At the community scale, participatory case studies are being conducted by PhD students, concentrating on water quality improvement plans, and school communities (as cores of place-based communities) in the Barron and Douglas catchments. In addition, personal interviews and a baseline survey of community-based end-users living in the urban areas of Townsville will form part of the Townsville case study collection to elicit knowledge and beliefs about community level resilience to water quality change. The baseline survey will guide the development and implementation of a community-based social marketing strategy which aims to foster desirable behaviour among residents in relation to water quality issues. The different approaches utilized by each of the case studies will provide the basis for the development of commonly-found community-scale proto-indicators.
- The regional-scale case studies focus on two catchments, the Johnstone and Barron, and eight areas within these – upper, middle catchment and coastal areas, and adjacent marine areas. (These align with the State of the Region report development approach). They consider particular social-ecological systems associated with water and contemporary change issues likely to reflect resilience factors.
- At the GBR region scale three sources of information will be used to develop proto-indicators that will thereafter be tested against additional case study material and expert knowledge. These sources are a) existing theory; b) end-user knowledge and beliefs; and c) analyses of case studies.

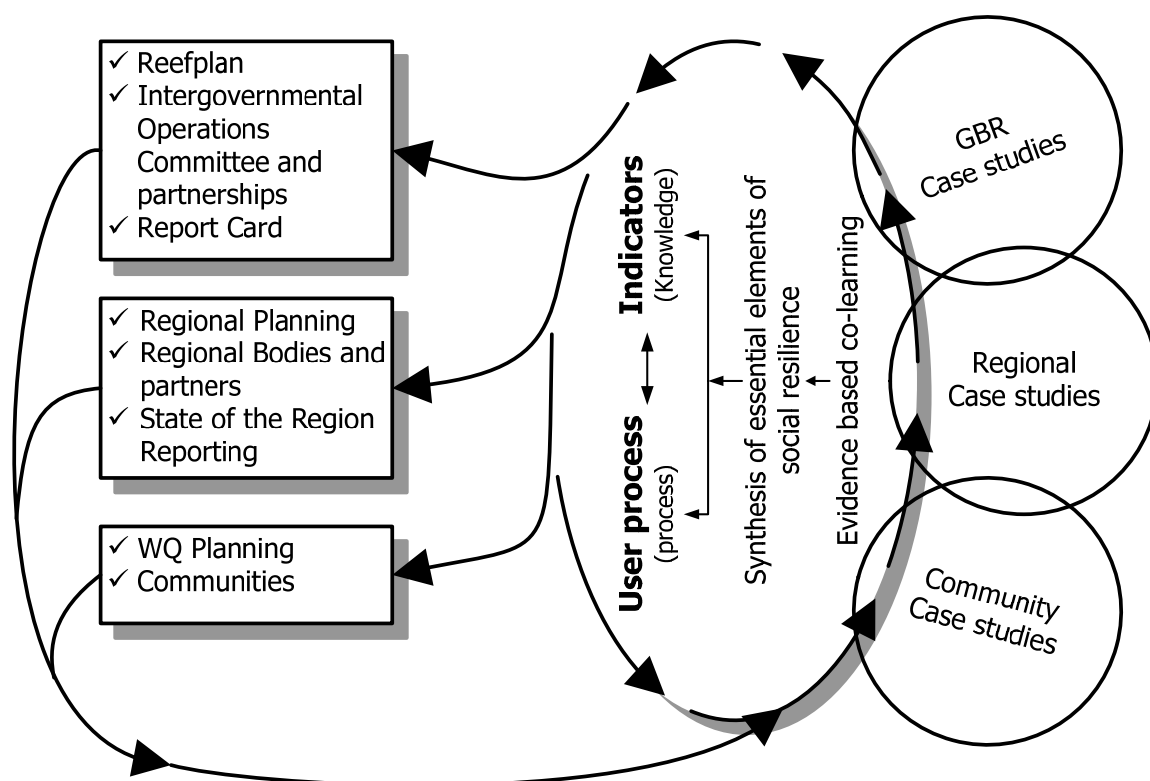


Figure 1: Conceptual framework for the development of indicators of social resilience through a collaborative process with decision-makers

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
	Attendance by Project Leader at Operations Committee meetings (3 meetings/year)	2008/2009
a b c	- Draft of integrated GBR scale indicators of social resilience available for end user evaluation – (CSIRO) - Progress report on case study data collection - (UQ) - Develop and present case study reporting 'template' including format for area profiles, analyses, and how indicators will be embedded - (UQ) - Draft report of completed first area profile - (UQ) - Test data availability for first set of proposed indicators (see June 08 milestone) – short report (UQ) - Short report of progress to date about each of the 3 community-scale projects (JCU) - Team meeting held and progress report provided on approach for multi-scale indicator development	November 2008
a,b,c	Pathway to Impact Report for end user relevance	December 2008
a b c	- Protocols and processes for analysing the contribution of social networks to social resilience defined (CSIRO) - Pre-publication case study reports for end users (UQ). - Hold and report on regional partner workshop (UQ) - Short report of progress to date about each of the 3 community-scale projects (JCU)	March 2009

a,b,c	Prepare a verbal short summary of progress to date about each of the 3 sub-projects (all)	
a	Preliminary investigations on the contributions of social networks to social resilience completed (CSIRO)	June 2009
b	Hold and report on regional partner workshop (UQ)	
c	- Case study analysis report: matched to the project's monitoring and reporting framework (UQ) - Report on types of data sources available and how they correspond with our draft 'monitoring criteria' (UQ) - Short report of progress to date about each of the 3 community-scale projects (JCU)	

Project 4.9.7 Milestone Payments 2008/2009

For 2008/2009 Outputs Only	
Milestones	Date
Report 1 submission - Paper on commonalities and differences between the case study based and user defined indicators based approaches with attribution to MTSRF funding submitted to international peer-reviewed journal (CSIRO) - Progress report on case study data collection; case study reporting 'template', draft report of completed first area profile, and short report on data availability for first set of proposed indicators (UQ) - Short report of progress to date about each of the 3 community-scale projects (JCU)	1 st Nov 2008 (Report compiled by CSIRO)
Report 2 submission Pathway to Impact Report for end user relevance	1 st Dec 2008 (Report compiled by UQ)
Report 3 – verbal report? - Report on the development of a first draft measurement protocol for collecting data in the GBR on social networks and their contribution to social resilience to water quality change. Report describing the development of a model to explore how social networks contribute to social resilience for one case study (CSIRO) - Short report on data availability for first set of proposed indicators (UQ) - Short report of progress to date about each of the 3 community-scale projects (JCU) - Prepare a verbal short summary of progress to date about each of the 3 sub-projects (all)	March 2009 (Verbal report – all contribute)
Report 4 submission - Two papers submitted to international peer reviewed journals with attribution to MTSRF funding; one on the analysis of contributions of social network to social resilience and the second on methods for measuring social networks in the GBR (CSIRO) - Report on regional partner workshop, Pre-publication case study reports for end users (UQ). - Short report of progress to date about each of the 3 community-scale projects (JCU)	1 st June 2009 (Report compiled by UQ)
Total MTSRF Funding (2008-09)	\$220,000

*Includes \$1,719 for MTSRF visual documentation

Project 4.9.7 Budget

Year 3 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	218,281		218,281
MTSRF Visual Documentation*	1719		1719
UQ	30,000	180,875	210,875
CSIRO		54,631	54,631
JCU		72,600	72,600
Total	250,000	\$308,106	558,106

NB: UQ cash contribution is dedicated to balance of salary for a PostDoctoral Fellow.

JCU Project 4.9.7 Budget 2008/2009

Item	MTSRF	JCU In-kind	Total Cost
Salaries	47,160	72,600	119,760
Operating	12,900	-	12,900
Travel	9,000	-	9,000
Communication / Extension	3,700	-	3,700
Capital	-	-	-
Institutional overheads	-		
Total	72,760	72,600	145,360

CSIRO Project 4.9.7 Budget 2008/2009

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	57,965		57,965
Operating	1,398		1,398
Travel	9,018	-	9,018
Communication / Extension	4,300	-	4,300
Capital	-	-	-
Institutional overheads	-	54,631	54,631
Total	72,681	54,631	127,312

UQ Project 4.9.7 Budget 2008/2009

Item	MTSRF	UQ In-kind	Total Cost
Salaries	45,000	210,875	255,875
Operating			
Travel	22,019	-	22,019
Communication / Extension	5,581	-	5,581
Capital	-	-	-
Institutional overheads	-		
Total	72,600	210,875	283,475

Indicative Budget Summary – Year 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2009/2010	220,000	UQ:30,000	210.875	-		
			CSIRO 54,631			
			JCU 72,600			
Total	220,000	UQ:30,000	338,106	-		588,106

THEME 5 (PROGRAM 10) ENHANCING DELIVERY

If the economic, social, cultural and environmental values of this region are to be maintained despite rapidly increasing pressures, then management needs to be sustainable and informed by sound science.

MTSRF is producing scientific information with the specific purpose of enabling management, policy and practice to become more sustainable. However, experience worldwide has shown that simply producing relevant information from good science is not sufficient to change management, policy or practice for the better. Specific investment in strategic, creative, effective ways of transmitting synthesised scientific information to targeted end users is essential if delivery from large multidisciplinary research programs is to become more successful. Now that substantial quantities of relevant scientific information have started to flow from the entire range of MTSRF research projects, the scene is set for a considerable expansion of strategic delivery-enhancing activities under Theme 5.

The Theme 5 delivery mechanisms are the specific responsibilities of the Reef and Rainforest Research Centre, representing MTSRF in North Queensland. Where appropriate the Centre utilises contractual arrangements to partner with required expertise. Theme 5 is comprised of the following specific projects:

5.10	Enhancing delivery for the MTSRF.....	\$737,500
5.10.1	Communication tools for MTSRF Projects.....	funded from Themes 1-4
5.10.2	Communication, engagement and enhanced delivery for tourism operators in the Wet Tropics rainforests.....	\$30,000
5.10.3	Communication, community engagement and enhanced delivery for Indigenous knowledge of the Wet Tropics rainforests.....	\$30,000

Project 5.10.1 has been developed in consultation and agreement with researchers participating in the MTSRF, and is funded through Themes 1-4. Outputs in previous years have included high quality digital video footage of science activities being conducted under the MTSRF. Although during ARP3 the focus of this project will shift to producing other strategic communication tools, the relevance to and use across the full scope of MTSRF research will be maintained.

Projects 5.10.2 and 5.10.3 are assisting communication between MTSRF researchers and two key groups, the tourism industry and Indigenous rainforest people, within the Wet Tropics Rainforests. The intent is to ensure that research being conducted is of relevance, is inclusive, considers all potential issues and that delivery mechanisms are appropriate to ensure findings are communicated for effect.

The schedules for these projects are provided below.

Budget Summary

Title	MTSRF	Other Cash	In-kind	Total
Project 5.10 (Enhancing Delivery for MTSRF)	\$737,500	-	-	\$737,500
Project 5.10.1 MTSRF communication tools (aka Visual Doc)	\$79,000*			
Project 5.10.2 (Tourism)	\$30,000	-	TBC	
Project 5.10.3 (Indigenous)	\$30,000			
Total	\$797,500	-	-	\$797,500

* This project is funded from the total allocation against Visual Documentation from projects within Themes 1-4, and is not included in the total funding for Theme 5.

The total value of Theme 5 (Program 10) is \$797,500.

PROGRAM 10: ENHANCING DELIVERY**Project 5.10 Enhancing delivery of the MTSRF****Project Leader and Host Organisation**

Reef and Rainforest Research Centre Ltd

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Dr Suzanne Long	RRRC	Project leader	0.7
Sheriden Morris	RRRC		0.5
Isobelle Lavers	RRRC		0.7
Dr David Souter	RRRC		0.2
Dr Joelle Prange	RRRC		0.1
Melissa Jess	RRRC		0.1
Hayley Gorsuch	RRRC		0.3
Toni Fulton	RRRC		0.1

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
Stakeholders	All end users of MTSRF research

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

The broad objectives of activities and projects in Theme 5 are:

- To facilitate increasingly sustainable management of the region, in which decision-making is informed by sound science, by enhancing delivery of that scientific information to end users.
- To facilitate cooperation and collaboration both within MTSRF and between MTSRF, other research providers, and end users, such that the capacity for sustainable, informed management of the region is enhanced.
- During this process, to raise awareness of and demonstrate the value of the MTSRF to the community that has funded it.

Communication is the major tool that RRRC will use to achieve these strategic objectives on MTSRF's behalf.

To fulfil these objectives efficiently, RRRC must be able to identify high-priority information and convey it effectively to targeted audiences/end users. In this context, the following questions should guide the preparation of every communication product emanating from RRRC:

1. How will communication of this research information help achieve our objectives?
2. To whom do we need to deliver this information if it is to help achieve our objectives? (end users and/or audience)

3. What form of communication will best facilitate the uptake of this information by the target audience/end user(s)? How can this be achieved most efficiently, given RRRC's limited resources?
4. How will we determine whether delivery of the information has been successful?

Identifying the message

While all the information produced through MTSRF will be publicly available in the form of reports via RRRC's website, some research results are more relevant to the strategic objectives of this plan than others. RRRC will institute policies and processes designed to identify high-priority messages into which RRRC's communication effort should be invested.

Identifying the audience

RRRC will need to communicate its diverse messages to a very wide range of audiences, from federal government ministers through to members of the general public. Clear perception of the intended audience for each message will be important, as understanding of the differing receptivities of audiences and end users will be needed to enable communication products to be tailored to maximise the likelihood of uptake (ie to maximise delivery success).

Effective communication of the message

Delivery failure frequently prevents relevant research results from being incorporated into management responses. Careful consideration of how results are going to be most effectively communicated to end users is therefore a critical component of delivery success. RRRC will communicate messages using a range of mechanisms, including (but not limited to) conferences, workshops, RRRC's website, fact sheets, newsletters, media releases, and synthesis reports. Templates and/or style sheets will be used for all of these mechanisms to help ensure both coherence of message and appropriate badging.

Evaluating delivery success

The need to demonstrate value for money for public investment in research, along with a growing culture of accountability within research organisations, is increasing the emphasis on evaluation of delivery success. Most cases in which some evaluation has been attempted have involved the use of proxies for delivery success, such as number of reports distributed, frequency of positive media coverage, or the use of market research-type interviews, surveys or questionnaires. None of these methods used in isolation really quantifies delivery success as defined by RRRC. RRRC will use a multidisciplinary, comparative approach involving the identification and monitoring of appropriate indicators of delivery success, benchmarking surveys to establish baselines for the indicators, case studies of the effectiveness of particular delivery mechanisms, as well as monitoring of conventional statistical proxies of delivery success. Periodic reporting on delivery success will help RRRC to refine its delivery mechanisms and communication products accordingly.

Project Targeted Activities

Objective	Targeted activity	Funding
	Delivery of synthesised, packaged research information to targeted end users in accordance with the Strategic Plan for Enhancing Delivery. This will include: - ongoing development and management of the RRRC/MTSRF website such that it can act both as an archive and as a portal for disseminating MTSRF's latest research results and activities - strengthening of mechanisms for transfer of MTSRF research results into RRRC, such that strategically important messages can be identified - preparation, packaging and delivery of research results such that their uptake by end users is facilitated (external expertise in writing, publications and delivery will be contracted where necessary) - identification and/or creation of opportunities for MTSRF research results to contribute directly to changes in management, policy or practice; use of innovative means to exploit these opportunities (eg synthesis reports addressing specific current policy issues)	\$400,000
	Maintenance and refinement of MTSRF's engagement framework such that its functionality is increased. Activities will include: - facilitating the critical functions of the Steering and Operations committees in engagement and peer review - developing and strengthening two-way knowledge transfer relationships with the full range of MTSRF end users (Pathway to Impact reporting) - developing and maintaining partnerships with other professional science communicators working for north Queensland research organisations, such that opportunities for delivery of MTSRF research are enhanced	\$97,500
	Evaluation of delivery success and adaptive management loop: - initial benchmarking survey of selected end user groups, such that progress against this benchmark can be measured (external expertise will be contracted where necessary) - evaluation of the delivery success of each communication product, and incorporation of lessons learned into preparation of future communications products - regular reporting to DEWHA regarding MTSRF's delivery success	\$300,000
Total MTSRF Funding		\$797,500

Project 5.10 Milestones 2008/2009

For 2008/2009 Outputs Only	Date
Milestones	
Strategic Plan for Enhanced Delivery for MTSRF prepared by the Project Leader, and workshopped and agreed to by key MTSRF researchers and end users	30 Sep 08
Written report provided to DEWHA, containing, in addition to standard milestone report information: • Description of all communication activities during this quarter, along with an indication of the proportion of time invested in each activity (eg 10% on product B) • Copies of strategic guidelines for at least three messages, and copies of all tangible products produced during this quarter (at least three). • Evaluations of delivery success (eg media monitoring, number of newsletters distributed, or other indicator) for each product	30 Sep 08
Written report provided to DEWHA, containing, in addition to standard milestone report information: • Description of all communication activities during this quarter, along with an indication of the proportion of time invested in each activity (eg 10% on product B) • Copies of strategic guidelines for at least three messages, and copies of all tangible products produced during this quarter (at least three). • Evaluations of delivery success (eg media monitoring, number of newsletters distributed, or other indicator) for each product	30 Nov 08
Written report provided to DEWHA, containing, in addition to standard milestone report information: • Description of all communication activities during this quarter, along with an indication of the proportion of time invested in each activity (eg 10% on product B) • Copies of strategic guidelines for at least three messages, and copies of all tangible products produced during this quarter (at least three). • Evaluations of delivery success (eg media monitoring, number of newsletters distributed, or other indicator) for each product	28 Feb 09
Written report provided to DEWHA, containing, in addition to standard milestone report information: • Description of all communication activities during this quarter, along with an indication of the proportion of time invested in each activity (eg 10% on product B) • Copies of strategic guidelines for at least three messages, and copies of all tangible products produced during this quarter (at least three). • Evaluations of delivery success (eg media monitoring, number of newsletters distributed, or other indicator) for each product	15 May 09
Written report evaluating delivery success against investment for the past year, with recommendations for improvement in outyears	1 Jun 09

Project 5.10 Budget

Year 1 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF*	797,500	-	797,500
Total	797,500	-	797,500

* This includes the \$79,000 Communication Products allocation from projects within Themes 1 to 4, held by Reef and Rainforest Research Centre allocated against this activity.

Project 5.10 Budget 2008/2009

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	250,000	-	
External contracts	250,000	-	
Products	100,000	-	
Travel	100,000	-	
Communication / Extension	97,500	-	
Capital		-	
Institutional overheads		-	
Total	797,500	-	797,500

PROGRAM 10: ENHANCING DELIVERY**Project 5.10.1: Communication tools for MTSRF Projects****Project Leader and Host Organisation**

Reef and Rainforest Research Centre Ltd

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Dr Suzanne Long	RRRC	Project leader	0.2
Isobelle Lavers	RRRC	Project officer	0.3

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
DEWHA	Doug Wright
Researchers	MTSRF Research Providers
Stakeholders	End users of MTSRF Research

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

In previous years this project has focused on creating a high-quality visual record of the MTSRF program for use in multimedia and public presentations, with the aim of disseminating the results to the public and end users. Most of the necessary films have now been produced and will shortly be available for public dissemination. Consequently, while filming of future MTSRF findings and activities will continue through ARP3 and beyond, the scope of this project will expand to include a range of other communication tools designed to enhance delivery of results deriving from all four research themes of MTSRF. The immediate priority for this project during ARP3 will be the compilation of a high quality still image library containing images that can be used freely for all RRRC/MTSRF applications.

This project has been formed through contributions amounting to \$79,000 from projects within Themes 1-4. Its purpose is to deliver strategic communication tools that will assist in the delivery of MTSRF science to targeted end users, as well as the community that has funded MTSRF.

Project Targeted Activities

Objective	Targeted Activity	Date
	Generation of strategic communication tools in line with RRRC's Strategic Plan to Enhance Delivery, facilitating end user uptake of results from Themes 1-4	Ongoing
	Continued visual documentation through generation, acquisition, and contribution of high quality digital imagery of MTSRF projects, their operations, the natural environmental assets of North Queensland and their uses. The material is to cover the full range of MTSRF activities and is to be available for use for all RRRC and MTSRF applications, including in the media as appropriate.	Ongoing to 2010
	Provide periodic reports of all communication tools (including visual documentation) developed/acquired during that quarter, and information about their use to date	Biannually
	Annual report analysing investment against return for these general communication tools, such that future efforts to enhance delivery can be informed by previous experience	Annually

Project 5.10.1 Milestones 2008/2009

For 2008/2009 Outputs Only	Date
Milestones	
Written report provided to DEWHA, containing, in addition to standard milestone report information: - Description of all project activities during this period, along with an indication of the proportion of time invested in each activity - Examples of use of this project's communication tools during this period for RRRC/MTSRF applications	30 Nov 08
Written report provided to DEWHA, containing, in addition to standard milestone report information: - Description of all project activities during this period, along with an indication of the proportion of time invested in each activity - Examples of use of this project's communication tools during this period for RRRC/MTSRF applications	15 May 09
Written report evaluating delivery success against investment for the past year, with recommendations for improvement in outyears	1 Jun 09
Total MTSRF Funding	79,000

Project 5.10.1 Budget

Year 1 – 2008/2009 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF*	79,000	-	79,000
Total	79,000	-	79,000

* The total Communication Products allocation from projects within Themes 1 to 4, held by Reef and Rainforest Research Centre, is allocated against this activity.

Project 5.10.1 Budget 2008/2009

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	29,000	-	
Generation/acquisition of material	10,000	-	
Travel	30,000	-	-
Communication / Extension	10,000	-	
Capital	-	-	-
Institutional overheads	-	-	-
Total	79,000	-	79,000

PROGRAM 10: ENHANCING DELIVERY**Project 5.10.2: Communication, engagement and enhanced delivery for tourism operators in the Wet Tropics Rainforests****Project Leader and Host Organisation**

Tourism Tropical North Queensland (TTNQ) in association with the Reef and Rainforest Research Centre Ltd

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
Annie Riddet	TTNQ	Project leader	0.05
Rob Giason	TTNQ		0.025
John McIntyre	TTNQ		0.025
Dr Suzanne Long	RRRC	Strategic direction	0.01

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
Wet Tropics tourism operators	various

Project Duration

Start Date: 1 July 2008 End Date: 30 June 2009

Project / Task Objectives

In recognition of the fact that the north Queensland tourism industry is a major end user of MTSRF research conducted in the Wet Tropics rainforest ecosystems, there is a need for enhanced delivery of MTSRF results into this sector. This should occur in line with MTSRF's overarching plan to enhance delivery. In addition, dedicated facilitation of engagement between researchers and this industry is required, also within the context of the engagement system and framework of the MTSRF.

This schedule describes the major activities to be undertaken by a Tropical Tourism North Queensland (TTNQ) representative working across the Cairns and Townsville nodes of the Industry. The representative is expected to use their comprehensive knowledge of the north Queensland ecotourism industry to enhance delivery of MTSRF information such that it benefits operators by improving the environmental sustainability of their management, policy or practice.

Project / Task Objectives for 2008/2009

- (a) To develop and use mechanisms to enhance the delivery of research findings and uptake by the Tropical Ecotourism sector in north Queensland.
- (b) To report on the success of these mechanisms in enhancing delivery.

Project Activities 2008/2009

Objective	Targeted Activity	Date
all	Develop and assess the usefulness of various methods of identifying MTSRF messages and delivering these messages to ecotourism operators in the region	ongoing
(a)	Deliver relevant research findings to the region's ecotourism industry, in the context of the report produced by this project in 2007/08 that identified industry research needs	ongoing
(b)	Monitor and evaluate delivery success of communication products, using a combination of indicators/proxies	ongoing
all	Liaise with and report to Reef and Rainforest Research Centre on activities and outcomes, particularly with regard to the identification of relevant MTSRF research.	ongoing

Project 5.10.2 Milestones 2008/2009

For 2008/2009 outputs only	Date
Milestones – All TTNQ Responsibilities	
Written report to RRRC describing at least three communication products developed from MTSRF research and delivered in this reporting period. The report will include an evaluation of the delivery success of each communication product, as well as notes describing any evidence of uptake of MTSRF research by the industry.	30 Sep 08
Written report to RRRC describing at least three communication products developed and delivered in this reporting period. The report will include an evaluation of the delivery success of each communication product, as well as notes describing any evidence of uptake of MTSRF research by the industry.	31 Jan 09
Written report to RRRC describing at least three communication products developed and delivered in this reporting period. The report will include an evaluation of the delivery success of each communication product, as well as notes describing any evidence of uptake of MTSRF research by the industry.	31 May 09
Total MTSRF Funding	\$30,000

Project 5.10.2 Budget 2008/2009**Tourism Tropical North Queensland Project 5.10.2 Budget 2008/2009**

Item	MTSRF Funds	Funds from TTNQ In-kind	Total Cost
Salaries	5,000	TBA	TBA
Operating	2,000	TBA	TBA
Travel	1,000	TBA	TBA
Contractors – Industry Consultation	10,000	TBA	TBA
Contractors – Communication and PR	12,000	TBA	TBA
Capital	-	TBA	TBA
Service provider overheads	-	TBA	TBA
Total	30,000	TBA	TBA

PROGRAM 10: ENHANCING DELIVERY**Project 5.10.3: Communication, community engagement and enhanced delivery for Indigenous knowledge of the Wet Tropics Rainforests****Project Leader and Host Organisation**

Reef and Rainforest Research Centre Ltd in conjunction with an appropriate indigenous organisation (to be brokered)

Project Team commitment 2008/2009

Title	Organisation	Role	FTE
	(indigenous organisation)	Project leader, co-ordination	0.05
	(indigenous organisation)	Liaison Officer	0.5
Dr Suzanne Long	RRRC	Strategic direction	0.01

Summary Table of Research Users 2008/2009

Organisation	Organisational Contact
DEWHA	TBA
Board of Indigenous organisation	TBA
Terrain NRM	Allan Dale
WTMA	Andrew McLean

Project Duration

Start Date: on signing of contract

End Date: 30 June 2009

Project / Task Objectives

The research projects conducted under the MTSRF have a strong interplay with community engagement to ensure the successful conduct and delivery of the research outputs and outcomes. In addition, they have a need to be conducted in the context of the engagement system and framework that has been developed by the RRRC for successful delivery of the MTSRF program in north Queensland. Part of this process includes an Indigenous liaison officer to facilitate Indigenous engagement with researchers, industry and public sectors, and facilitating the communication of research and research needs between researchers and Indigenous and non-Indigenous stakeholders.

This schedule describes the principal liaison activities to be undertaken by an Indigenous liaison officer working across MTSRF-supported research activities. The schedule provides support for a liaison officer to relate research and management gaps, issues, concerns and ideas identified by regional Aboriginal groups at relevant MTSRF meetings and to facilitate delivery of research information back to community groups. The officer would be expected to interact with other liaison officers supported by the MTSRF operating in areas such as the Torres Strait and Great Barrier Reef.

Project / Task Objectives

- (a) To understand and communicate Rainforest Aboriginal Peoples' management issues and preferred research topics within the Wet Tropics WHA and surrounding landscapes through liaison with Traditional Owner groups, management agencies, industry and research groups.
- (b) To optimise Traditional Owner participation in and knowledge of research for the sustainable use of Wet Tropics natural resources by engaging Traditional Owner groups and articulating with the MTSRF engagement framework.
- (c) To enhance delivery of research findings and opportunities for building capacity in Traditional Owner groups for engagement in research and management of the Wet Tropics WHA and Terrain NRM region.

Project Activities

Objective	Targeted Activity	Date
a	Develop a program of engagement with Traditional Owner groups, Aboriginal organizations and MTSRF researchers (e.g. Project 4.9.1) and stakeholders of relevance to the Wet Tropics WHA, in collaboration with other consultation and engagement underway across the WTQWHA and Terrain NRM region.	ongoing
b	In collaboration with Traditional Owners and research groups, identify strategies for addressing research-related issues and problems for Indigenous engagement and deliver these through the engagement with the MTSRF management and delivery framework.	ongoing
all	Attend meetings of relevance to MTSRF program management.	throughout
all	Facilitate research activity in the Wet Tropics WHA and Terrain NRM region through interaction with, and liaison between, Traditional Owners and researchers (particularly Project 4.9.1).	throughout
all	Report to Reef and Rainforest Research Centre on liaison activities.	throughout
all	Where appropriate, refer to the Intellectual Property Sub-Committee (or similar) to facilitate and assist procuring an appropriate license to access and use existing Aboriginal Intellectual Property.	throughout
all	Where required, refer Aboriginal knowledge, heritage or intellectual property related inquiries from MTSRF funded researchers to the Intellectual Property Sub-Committee (or similar), and where possible, assist to negotiate Intellectual Property agreements or licenses for research projects.	throughout
all	Ensure that progress reports are approved by the Intellectual Property Sub-Committee (or similar) and licenses procured prior to being submitted to RRRC	throughout

Project 5.10.3 Milestones 2007/2008

For 2007/2008 outputs only	Date
Milestones All ARC Responsibilities	
Signing of contract	
Progress Report 1. Plan of liaison and facilitation activities and communication events/products to assist MTSRF researcher activity in the Wet Tropics WHA and Terrain NRM region (e.g. meetings, workshops, information flyers etc) for year to June 2009.	To be agreed
Progress Report 2. Report on liaison and facilitation activities and communication products to assist engagement of Traditional Owner groups in the definition and implementation of MTSRF research activity in the Wet Tropics World Heritage Area and Terrain NRM region during milestone period (15 Jul to 15 Dec 2008).	To be agreed
Progress Report 3. Final report on liaison activities and communication products during milestone period (15 Dec 2008 to 30 June 2009) and assessment of effectiveness of delivery against plan and liaison position suitability for Traditional Owner engagement.	To be agreed
Total MTSRF Funding	\$30,000

Project 5.10.3 Budget 2007/2008***Indigenous organisation Project 5.10.3 Budget 2008/2009****

Item	MTSRF Funds	In-kind	Total Cost
Salaries	24,000	TBA	TBA
On-costs (super, leave)	5,000	TBA	TBA
Operating	-	TBA	TBA
Travel	-	TBA	TBA
Communication / Extension	-	TBA	TBA
Capital	1,000	TBA	TBA
Institutional overheads	-	TBA	TBA
Total	30,000	TBA	TBA

* Funding for 2009/2010 is subject to performance and ongoing support for this position under the 2008/2009 Annual Research Plan.