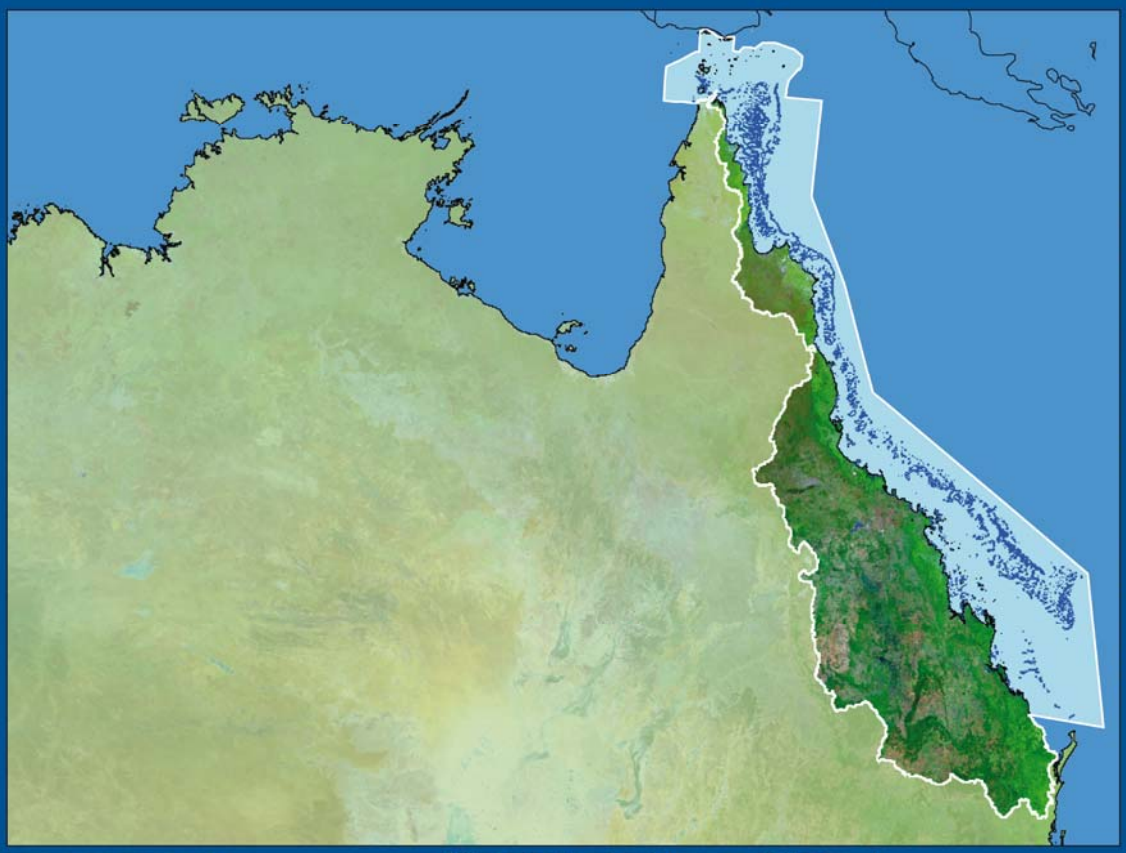
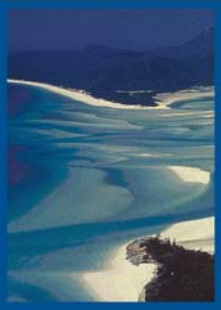
Australian Government

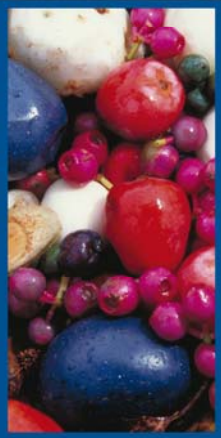
Department of the Environment and Water Resources

Annual Research Plan 2007-2008

Marine and Tropical Sciences Research Facility







July 2007

PREFACE

The Australian Government's Marine and Tropical Sciences Research Facility (MTSRF) has successfully completed its first year. I am delighted with the progress of this programme. Already it is helping to develop sound policies for sustainably managing the unique ecosystems of the Great Barrier Reef, the Wet Tropics Rainforests, and the Torres Strait.

The MTSRF programme covers a large region in northern Queensland, and includes two World Heritage Areas - the Wet Tropics of Queensland and the Great Barrier Reef. These areas are among Australia's most valuable natural assets.

Significant challenges face these ecosystems. Adverse hanges are already evident in some areas, such as the increasing frequency of mass bleaching of corals, and serious threats to rainforest biodiversity from population pressures as northern coastal areas grow. MTSRF will find solutions to some of these challenges and provide insights to help solve others.

This is a highly innovative research programme driven by pressing questions that must be answered for the Australian public, for the industries that operate in the region and, importantly, for the public policy makers and natural resource managers who are charged with protecting the rainforests and reefs for future generations.

The programme of research outlined in this Annual Research Plan represents a significant collaborative effort, bringing together some three hundred researchers from fourteen organisations. Researchers bring skills form a range of disciplines – marine, climate change, other environmental sciences and economics. This cross disciplinary, collaborative approach will provide Australia's environmental managers and decision makers with the information they need to help protect these important and diverse assets for the future.

The Australian Government has committed $40 million over five years to the MTSRF programme. In this second year of the research programme some of Australia's leading research organisations will match the $7.6 million of Australian Government funds with $10 million of their in-kind resources. We are also expecting over $1 million in additional cash contributions from sponsors and partners. This funding collaboration shows what Australian organisations can achieve through partnership and cooperation.

This work is important for the future of Australia and I look forward to the contribution it will make to our environment.

The Hon. Malcolm Turnbull MP
Minister for the Environment and Water Resources
Australian Government

CONTENTS

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 Defence 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 Facilities
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
DSS	Decision Support System
EC	Eddy Covariance
ELF	Effects of Line Fishing
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 (James Cook University and CSIRO)
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
WHA	World Heritage Area
WTMA	Wet Tropics Management Authority
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 second MTSRF Annual Research Plan (ARP2). It directs $7.6 million into priority research activities in 2007/2008 and builds on the $7.5 million research investment made through ARP1 in 2006-07.

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	$60,000	$2,686,674	**$4,784,674**
2. Risks and Threats to the Ecosystems	$1,350,000	$160,000	$2,466,491	**$3,976,491**
3. Halting and Reversing the Decline of Water Quality	$1,175,000	-	$1,587,446	**$2,762,446**
4. Sustainable Use and Management of Resources	$2,258,275	$427,900	$3,892,142	**$6,578,317**
5. Enhancing Delivery	$797,500	-	$29,000	**$826,500**
Total	**$7,618,775**	**$647,900**	**$10,661,753**	**$18,928,428**

* Predicted cash co-contribution from Great Barrier Reef Foundation, James Cook University, terrain NRM, Burdekin Dry Tropics NRM, Port Authorities. A total of $160,000 surplus from the CRC Reef is also included.

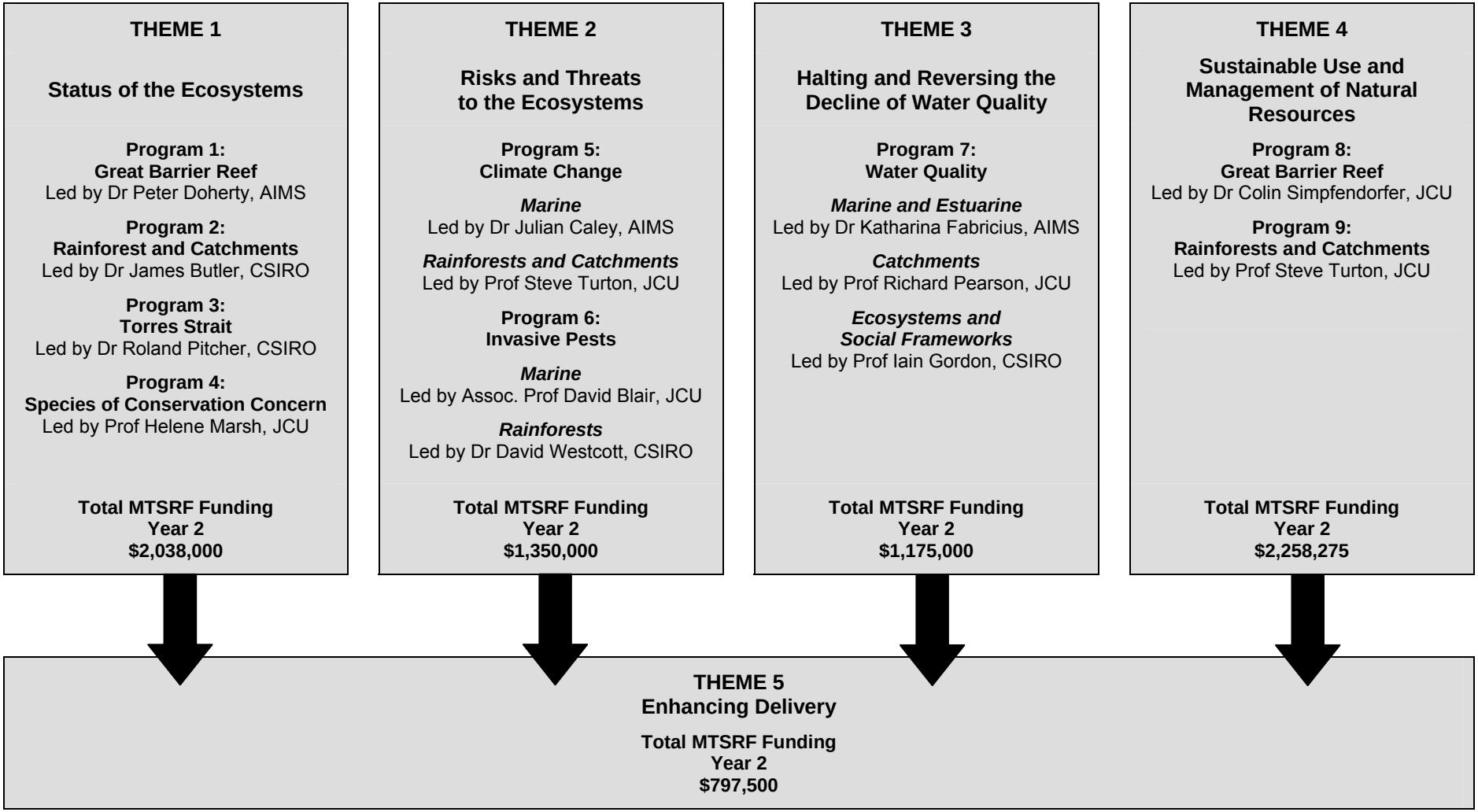


Figure 1: Outline of the MTSRF Research Programme structure for 2007/2008.

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.

Budget Summary

Program	Title	MTSRF	Other Cash	In-kind	Total
Program 1	GBR Status and Trends	$775,000	$10,000	$1,393,174†	**$2,178,174**
Program 2	Rainforest Status and Trends	$350,000	-	$397,250	**$747,250**
Program 3	Torres Strait – Status, Use and Trends	$393,000	$50,000	$335,000†	**$778,000**
Program 4	Species and Communities of Conservation Concern	$520,000	-	$561,250	**$1,081,250**
Total		**$2,038,000**	**$60,000***	**$2,686,674**	**$4,784,674**

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

† Final in-kind contributions to be confirmed.

The total value of Theme 1 is $4,784,674.

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

	Cash	In-kind	Total
MTSRF	$775,000	-	$775,000
Other	$10,000	$1,073,648	$1,083,648
Total	**$785,000**	**$1,073,648**	**$1,858,648**

* Projects 1.1.1 and 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 2005[1]). 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. The program will also develop an early warning system for crown-of-thorns starfish to allow the industry to prepare tactical responses. Support for community-based monitoring (Reef Check Australia) of tourism intensive sites will 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. This 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 feeds 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 a data integration and synthesis process, 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. This type of information will be used to assist the managing agencies in State of the Environment reporting, including international obligations for World Heritage Periodic reporting. 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.

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

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

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

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Dr Michelle Waycott	JCU	Project leader, indicators, reporting, communication	0.15
Dr Hugh Sweatman	AIMS	Reef ecology, monitoring	0.1
Dr Peter Doherty	AIMS	Reef ecology, R&D management	TBA
Dr Glenn De'ath	AIMS	Statistical assemblage analysis	TBA
Dr Katherina Fabricius	AIMS	Reef ecology	TBA
Dr Helene Marsh	JCU	Marine ecology, dugong	TBA
Dr Alana Grech	JCU	Marine ecology	TBA
Dr Len McKenzie	QDPI&F	Seagrass ecology	TBA
Mr Jon Brodie	JCU	Water quality	TBA
Dr Kerry Neil	RRRC	Marine ecology, exotic species	0.1

Summary Table of Research Users

Organisation	Organisational Contact
GBRMPA	Lawrence McCook / Andrew Chin
GBRMPA	David Wachenfeld
DEW	Stephen Oxley

Project Duration

Start Date: July 2007 End Date: 30 June 2008

Project / Task Objectives

(a) Identify indicators of condition and trend in biodiversity, ecosystem health and thresholds of concern or triggers for management action for reef and non-reefal systems (with reference to the GBR Bioregions, 2003) that are appropriate for reporting the condition and trend in the health of the GBR ecosystem.

(b) Develop a set of standard criteria for selection and use of indicators to guide the further development of indicators of condition and trend in the health of the GBR ecosystem as new information becomes available.

(c) Develop indicators for the links between reef water quality and the condition and trend in the health of the GBR

(d) Develop methods and estimates of thresholds of concern for reef health indicators.

Project Methods

The project will be led by JCU and AIMS (Waycott and TBA, respectively) and involve five stages:

1. Convene a workshop on indicators of condition and trend in health of the GBR ecosystem (seeking national, international and local expertise);
2. Review of existing data sets that are available for analysis to evaluate the indicators arising from the workshop listed above (link to MTSRF Project 1.1.5);
3. Test potential indicators (non-reefal and reefal) where necessary (link to MTSRF projects monitoring biodiversity and the health of the GBR ecosystem where opportunities for field testing may occur);
4. Convene a second workshop focused on the results of the first workshop and preliminary analysis of data sets to develop a set of threshold levels that represent threshold points (of 'concern' and/or for triggering management action); and
5. Synthesis of 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".

Project Targeted Activities

Objective	Targeted Activity	Completion Date
(a)	Workshop 1 on indicator development with national and international participation. [JCU, AIMS]	November 2007
(b)	Review of existing data sets and test potential indicators where appropriate.	February 2008
(c)	Workshop 2 on thresholds of concern and management triggers for reef health indicators.	March 2008
(d)	Report on "Indicators and thresholds of concern for the status and trends of the health of the Great Barrier Reef".	June 2008

Project 1.1.1 Milestones 2007/2008

For 2007/2008 Outputs Only	**Date**
Milestones	
Signing of contract	
Report 1 submission: Report of Workshop 1 on Indicators of Reef Health (Workshop in September 2007).	30 Nov 2007
Report 2 submission: Review of data sets; preliminary analysis and field testing where possible, to evaluate indicators identified in Report 1.	15 Feb 2008
Report 3 submission: Report on Workshop 2 on thresholds of concern and management triggers for reef health indicators.	30 Mar 2008
Final report submission	1 Jun 2008
Total MTSRF Funding	**$60,000***

* Total includes $1,000 Visual Documentation Allocation.

Project 1.1.1 Budget

Year 1 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$59,000	-	$59,000
MTSRF Visual Documentation*	$1,000	-	$1,000
JCU	-	TBA	TBA
AIMS	-	TBA	TBA
Total	**$60,000**	**TBA**	**TBA**

* 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 2007/2008

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	TBA	TBA	
Operating	TBA		
Travel	TBA		
Communication / Extension	TBA		
Capital	TBA		
Institutional overheads	TBA		
Total	**$29,500**		**$59,000**

AIMS Project 1.1.1 Budget 2007/2008

Item	MTSRF Funds	AIMS In-kind	Total Cost
Salaries	TBA	TBA	
Operating	TBA		
Travel	TBA		
Communication / Extension	TBA		
Capital	TBA		
Institutional overheads	TBA		
Total	**$29,500**		**$59,000**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	**$60,000**					**TBA**
2009/2010	**$60,000**					**TBA**
Total	**$120,000**		**TBA**		**TBA**	**TBA**

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 the 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 2007/2008

Title	Organisation	Role	FTE
Dr Hugh Sweatman	AIMS	Task Leader (AIMS)	0.3
AIMS Long Term Monitoring Team	AIMS	Reef ecologists	4.27
Ms Jos Hill	Reef Check	Task Leader (Reef Check)	0.2

Summary Table of Research Users 2007/2008

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 cycles of disturbance (due to. cyclones, crown-of-thorns starfish, coral disease and coral bleaching) and recovery that are related to resilience. 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 development of indicators and thresholds of concern for reef health and COTs Alert – early warning of a fourth wave of starfish outbreaks;

(b) Influence of the GBR Zoning Plan (2003) upon coral reef biodiversity;

(c) Crown-of-thorns starfish early warning surveys; and

(d) 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 board-scale surveys. The fine-scale surveys 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 provides a larger picture that can be linked with the fine scale surveys but 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.

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/ltm/ltm200601.html) Results from the fine-scale surveys are also posted to the website but with a substantial lag because of the need to extract the coral data 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.

While these links provide transparent timely results to the public, the project reports on a regular basis directly to DEW and to the GBRMPA to ensure that the situational awareness of the Authority by geographic region is updated shortly after the completion of each voyage.

The LTMT will be a major source of information for the evolving Data Integration and Synthesis for Reporting process being undertaken within the MTSRF for the GBR. 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 Data Integration and Synthesis team for the GBR within MTSRF 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 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 indicators in order to follow potential trophic cascades. The latter could include changes in the abundance of small species of fish, changes in the abundance of herbivorous fishes, and changes in the dynamics of coral assemblages. This will be a particular focus of the 2007/2008 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 and the last one was first detected in 1992, so history suggests 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 of 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, another set the COTS Alert surveys will be made 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 is part of an international marine conservation NGO that operates in 82 countries. This organisation trains and supports volunteers for community-based assessments of condition and trend of coral reefs and has a strong international outreach program. In the GBR, this NGO is growing links with marine parks tourism operators who offer logistic support for Reef Check volunteers to visit their operations in exchange for reports on the condition of reef resources. In the next four years, 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 patterns and more closely observe emerging phenomena such as outbreaks of pests and disease. A program of fine-scale surveys on tourism sites will be developed together with local operators to inform businesses with early warning about local outbreaks of crown-of-thorns starfish (COTs Alert). The Reef Check survey protocols are also appropriate for monitoring the abundance of rare biota such as clams and large fish as they are not restricted to fixed transects. Reef Check 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. All information and capacity will be shared as best practice with the international Reef Check network of 82 countries.

Project Targeted Activities 2007/2008

Objective	Targeted Activity	Completion Date
(a)	No field data collection for this task.	-
	Progress report on the integration of reef health indicators and thresholds into the GBR Reporting for the GBRMPA Outlook report needs.	Dec 2007
	Status report on survey reefs to 2007 – CD and on AIMS webpage.	Mar 2008
(b)	Forty percent of reef pairs surveyed (subject to weather). Preliminary summaries on AIMS web page within one month of the end of field trip.	Dec 2007
	Fieldwork completed; preliminary summaries online within one month of voyage completion (www.aims.gov.au).	Jun 2008
(c)	No COTS early warning surveys are planned until 2008-09.	-
(d)	Reef Check Surveys: a) Survey and report on findings of 25 dive sites identified in 2006/7 b) Train 16 new community volunteers to join current RCA survey teams. c) Data entry into the RCA GIS database.	Jun 2008
	Dive Industry Workshops: a) Coordination of International Year of the Reef dive community activities. b) Development of formal Reef Check / dive operator MoU to secure long term support.	Mar 2008
	c) Online reporting systems: further development of GIS database d) Review of RCA GIS database custom reporting for individual operators.	Jun 2008
	Extensive communication through quarterly newsletters, web updates.	Jun 2008
	Report on Reef Check training.	Mar 2008

Project 1.1.2 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones [agency responsible for report delivery identified in brackets]. All reports to be written reports unless otherwise specified.	Date
Signing of contract	
Report 1: [AIMS] • Progress update for objective (b) (above): preliminary findings, schedule of proposed fieldwork for areas still to be surveyed. Delivery of on-line regional assessments for voyages to date.	30 Nov 2007
Report 2: [Reef Check] Progress report for objective (d) • Reports on development of MoU	15 Dec 2007
Report 3: Progress report • Reports describing outputs from 3 workshops to introduce Tourism operators to potential reporting structures for GIS data system [obj (d), Reef Check] • Report on results of training of volunteers [objective (d), Reef Check] • Status Report on Long term Monitoring of the GBR describing findings up to 2006 – 2007 survey [objective (a), AIMS] • Report on inputs from AIMS' long term monitoring to RRRC workshop on conceptual models of reef health, including identification of agreed indicators of coral reef health and thresholds of concern [objective (a), AIMS] • Progress report on objective (a) field work: sites visited, schedules for sites still to survey [objective (b), AIMS].	31 Mar 2008
Report 4: Final report on areas surveyed for objective (b) including summary of results for surveys undertaken in 2007 / 2008 [AIMS] Progress report for objective (d) [Reef Check]: • Report describing results and sites visited for 25 surveys completed, data posted on the web.	15 Jun 2008
Total MTSRF Funding	**$320,000***

* Total includes $4,000 Visual Documentation Allocation.

Project 1.1.2 Budget

Year 2 – 2007/2008 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)	-	$711,526	$771,526
AMPTO (d)	-	$5,000	$5,000
Total	**$320,000**	**$716,526**	**$1,096,526**

* 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 2007/2008

Item	MTSRF Funds	In-kind	Total Cost
Salaries	-	$194,193	$194,193
Operating	$133,000		$133,000
Travel	$133,000	$278,250	$411,250
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$239,083	$239,083
Total	**$266,000**	**$711,526**	**$977,526**

Reef Check Project 1.1.2 Budget 2007/2008

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 third party co-investment.

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$350,000	-	$600,000	-	$5,000	$955,000
2009/2010	$350,000	-	$600,000	-	$5,000	$955,000
Total	**$700,000**		**$1,200,000**		**$10,000**	**$1,910,000**

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

Objective Leaders and Host Organisations
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 QDPI&F.

Research Team Commitment 2007/2008

Title	Organisation	Role	FTE*
A Prof Michelle Waycott	JCU	Task leader (b) 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 David Haynes	GBRMPA	Research partner (b)	0.05
Dr Rob Coles	QDPI&F	Task collaborator (a & c)	0.2
Mr Len McKenzie	QDPI&F	Task leader (a) Task collaborator (all tasks)	0.5
Dr Michael Rasheed	QDPI&F	Task collaborator (a & c)	0.4
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	QDPI&F[#]	Task collaborator (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

Organisation	Organisational Contact
QDPI&F	Malcolm Dunning
AMPTO	Col McKenzie
GBRMPA	David Haynes
Queensland Canegrowers	Tim Wrigley
DEW	Stephen Oxley

Project 1.1.3 Duration

Start Date: 1 July 2006 End Date: 30 June 2010

Description of Project / Task 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 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 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 28 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 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 and other impacts. Regulatory decisions to manage these activities require scientific information. 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. We will initially take a spatial risk assessment approach with seagrasses in the Great Barrier Reef.

Currently, there is limited information on risk to seagrasses from anthropogenic activities across various areas of the GBRWHA. We will address this and other data limitations using a Delphi technique (Veal 1992) at a workshop with government and research personnel with expertise in the region's seagrass ecology and management hosted by the Queensland Department of Primary Industries and Fisheries, Cairns. The experts will weight the relative impact on seagrass from anthropogenic activities to develop a composite index of the risk of each activity and its components. The ratings for each activity developed by the group of experts will be imported into a geographical information system to generate a composite impact coverage. We will evaluate the current management arrangements via a spatial risk assessment approach that quantifies and compares the distribution of anthropogenic activities with spatially explicit models of inshore and deepwater seagrass, and assess options that ameliorate that risk. This approach will allow us to identify key locations that require management attention and to compare the value of various management approaches.

Project 1.1.3 Targeted Activities

Objective	Targeted Activity	Completion Date
(a)	A1. Undertake Seagrass-Watch community monitoring for intertidal seagrass abundance, community structure, distribution, physical parameters at agreed regularly monitored sites throughout the GBRMP.	1 Dec 2007
(a)	A2. Undertake Seagrass-Watch community monitoring for intertidal seagrass abundance, community structure, distribution, physical parameters at agreed regularly monitored sites throughout the GBRMP.	28 May 2008
(a)	A3. Seagrass-Watch newsletter completed every 4-6 months from 1 July 2007 (min. two for year ending June 2008).	1 ea. at minimum of 30 Nov 07, 31 May 08
(b)	B1. Develop research plan and trial techniques for drivers of seagrass change experimental work.	1 Dec 2007
(b)	B2. Conduct mesocosm experiments on temperature and light effects on seagrass growth.	10 Jun 2008
(b)	B3. Record *in-situ* light measurements at selected seagrass monitoring sites in objective (a).	10 Jun 2008
(c)	C1. Development of inshore (< 15m) seagrass habitat model and validation for the GBRWHA	1 Dec 2007
(c)	C2. Spatial review of the risk to seagrasses in the GBR due to specific threats such as habitat use (case study).	28 May 2007
(c)	C3. Workshop applying Delphi technique to quantify the risk of anthropogenic activities to seagrass in the GBRWHA	1 May 2008

Project 1.1.3 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones –all JCU responsibilities	Date
Signing of contract	
Report 1 submission QDPI&F: • 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 1 and summary of any communication activities undertaken to date, including minutes of meetings/workshops as applicable (obj a) • Assist with assembling/provision of scientific equipment (light loggers & Diving PAM) (b) • Assist with deployment of light loggers at selected and additional field sites (b3) • Provision of inshore (< 15m) seagrass data to JCU for GIS-based habitat model for the GBRWHA (c1) *Report 1 submission JCU:* • Literature synthesis and research proposal for drivers of seagrass change and trial of techniques (b1) • Experimental design for initial mesocosm experiments (b2) • Deploy light loggers at selected field sites (b3) • GIS-based inshore (<15m) seagrass habitat model for the GBRWHA (c1) • Plan of any communication products/events for Year 1 and summary of any communication activities undertaken to date, including minutes of meetings/workshops as applicable (b) and (c)	1 Dec 2007
Report 2 submission QDPI&F: • Findings of Seagrass-Watch intertidal: locations, abundance, community structure and distribution at agreed sites (newsletter) (a) • Assist with maintenance of light loggers at selected and additional field sites (b3) • Host, attend and assist in the organization of workshop applying Delphi technique to quantify the risk of anthropogenic activities to seagrass in the GBRWHA (c3) Report 2 submission JCU: • Progress report on experimental work and the development of spatial risk assessments via workshop activities (b and c). • Review case study on the risk to seagrasses in GBR due to specific threats such as habitat use (c2).	28 May 2008
Report 3 submission QDPI&F: • 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) *Report 3 submission JCU:* • Description of results of temperature and light mesocosm experiments (b 2) • Summary of outputs from Cairns risk assessment workshop (c3) • Final summary describing communication and collaboration activities completed to date. (b & c) • Proposed work plan for 2008/9. (a-c)	11 June 2008
Total MTSRF Funding	**$200,000***

* Total includes $3,000 for Visual Documentation Allocation and $2,000 to support collaboration between JCU and QDPI&F.

Project 1.1.3 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Total Payment Summary	JCU	QDPI&F	GBRMPA	Total
MTSRF	$102,000	$95,000	-	$197,000*
In-kind Contributions	$179,490	$158,308	$5,850	$343,648
Total	**$281,490**	**$253,308**	**$5,850**	**$540,648**

* A total of $3,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project.

Project 1.1.3 Budget 2007/2008

Contributing Organisation	Cash	In-kind	Total
MTSRF specifically against research objective (a)	$50,000	-	$50,000
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
JCU support	-	$179,490	$179,490
QDPI&F support	-	$158,308	$158,308
GBRMPA	-	$5,850	$5,850
Total	**$200,000**	**$343,648**	**$543,648**

* A total of $3,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project.

JCU Project 1.1.3 Objective (a) Budget 2007/2008

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	**-**	**$10,041**	**$10,041**

JCU Project 1.1.3 Objective (b) Budget 2007/2008

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	-	$6,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$61,251	$61,251
Total	**$100,000**	**$134,099**	**$234,099**

JCU Project 1.1.3 Objective (c) Budget 2007/2008

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 Project 1.1.3 Objective (a) Budget 2007/2008

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	-	-	-
Capital	-	-	-
Institutional overheads	-	$49,711	$49,711
Total	**$50,000**	**$94,342**	**$144,342**

DPI&F collaboration with JCU for all objectives Project 1.1.3 Budget 2007/2008

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 2007/2008

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	-	-	-
Capital	-	-	-
Institutional overheads	-	$5,602	$5,602
Total	**$25,000**	**$10,632**	**$35,632**

DPI&F component of Objective (c) Project 1.1.3 Budget 2007/2008

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 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$200,000		$290,000			$490,000
2009/2010	$200,000		$300,000			$500,000
Total	**$400,000**		**$590,000**			**$990,000**

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 2007/2008

Title	Organisation	Role	FTE
Assoc. Professor Jian-Xin Zhao	UQ	Project Leader	0.2
Assoc. Professor John Pandolfi	UQ	Co-investigator	0.2
Dr Terry Done	AIMS	PI	0.1
Dr. Kefu Yu (ARC Research Fellow)[1]	UQ	Co-investigator	0.1
PhD student (sediment coring, palaeoecology and geochronology) – Mr George Roff*[2]	UQ	Co-investigator	1.0
Honours Student (death assemblage, geochronology and ecology) Miss Kylie McGrath[3]	UQ	Co-investigator	1.0

[1] Dr Kefu Yu is now employed by UQ as an Australian Research Fellow funded by the Australian Research Council. He is a mid-career researcher with an established track record in coral reef research and U-series geochronology with over 50 publications. He was listed as a co-investigator in the initial Expression of Interest for this MTSRF project, when he was an ARC linkage international fellow. His name was subsequently removed when this project was funded, mainly because he was no longer employed by UQ at that time. We now wish to include him in this year's research plan, and he will make significant contributions to this project.

[2] Mr Roff has already started his Ph.D project, focusing on comparing coral community structure between pre- and post-European settlement from a longer-time perspective.

[3] Miss McGrath has already started her Honour's project, focusing on death assemblage of the top 30 cm (i.e. since European settlement). Another strong candidate with a first-class honour's degree Miss Tara Clark is in the process of applying for Ph.D enrolment to continue on research in this topic as well as in massive coral mortality rates.

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
DEW	Stephen Oxley
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 three 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.

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 preliminary study of Swain Reefs in southern GBR shows that most branching coral rubbles dated between 1791 to 1919 AD with a sharp declining trend to modern time (Quaintance, 2006, Honour's thesis, UQ), implying abundant occurrence of branching corals prior to intensive farming in the Pioneer River catchment area. More dating work is to be carried out to confirm if this trend is statistically significant.

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. To address this question more appropriately and systematically, we also design to collect short cores (up to 5m, extending up to 4000 yr ago) from back-reef environment, establish their chronology by U-series dating, and compare and contrast coral community structure between pre- and post-

[†] Pandolfi, J.M. *et al*., 2003. Global trajectories of the long-term decline of coral reef ecosystems. Science, 301(5635): 955-958.

European settlement of coastal central-north Queensland. A large number of cores have already been collected from central GBR (e.g. Whitsunday and Townsville regions). This will form the main part of Mr George Roff's Ph.D project.

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* on Magnetic Island which shows the coral died in 1983±2 AD, probably in response to the 1982-1983 AD El Niño.

We plan 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 will also 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 study and contain vital information on life assemblage composition. Ideally, we will 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 run-off from agricultural and urban sources in the Wet Tropics catchments) and markedly different intensity of human use. 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 intend to piggyback on AIMS voyages for our sampling and census of the death assemblages.

Project Targeted Activities (indicative only for out years)

Objective	Output / Milestone	Completion Date
(a)-(c)	Dating results obtained from branching coral fragments in the UQ-CMS collection	Sept 2007
(a)-(c)	Fieldwork completed in central Great Barrier Reef	Dec 2007
(a)-(c)	Laboratory analysis completed on fifty percent of cores	Jun 2008
(a)-(c)	Fieldwork completed in northern Great Barrier Reef	Dec 2008
(a)-(c)	Laboratory analysis completed	Jun 2009
(a)-(c)	Thesis draft completed	Jan 2010

[‡] Yu K.-F., Zhao J.-X., Shi Q., Chen T.-G., Wang P.-X., Collerson K. D., and Liu T.-S. (2006) U-series dating of dead *Porites* corals in the South China Sea: evidence for episodic coral mortality over the past two centuries. Quaternary Geochronology 1:129-141.

Project 1.1.4 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones**	**Date**
Signing of contract	
Report 1 submission: • Results on dating for coral rubbles from Swain Reefs and other sites that are currently in CMM collection [UQ] • Report on sample collection in central GBR	28 Jan 2008
Information transfer between agencies • Evidence of provision of preliminary data if any on coral mortality ages and ecological implications to Data Intergration and Synthesis team. Responsible officers; Zhao and Pandolfi from UQ	19 May 2008
Report 2 submission: • Description and interpretation of results obtained for cores from central GBR [UQ] • Description and interpretation of results obtained for branching coral rubbles from Swain Reefs [UQ] • Proposed fieldwork schedule for other southern GBR work in out years [UQ] • Final summary of communication activities undertaken through the course of Year 2 of project [UQ] • Plan for completion of out year activities [UQ]	2 June 2008
Total MTSRF Funding	**$50,000**

Project 1.1.4 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$50,000	-	$50,000
UQ	-	$125,000	$125,000
Total	**$50,000**	**$125,000**	**$175,000**

UQ Project 1.1.4 Budget 2007/2008

Item	MTSRF Funds	In-kind	Total
Salaries	$20,000	$62,500	$82,500
Operating	$20,000	$60,000	$80,000
Travel	$8,500	$2,500	$11,000
Communication / Extension	$1,500	-	$1,500
Capital	-	-	-
Institutional overheads	-	-	-
Total	**$50,000**	**$125,000**	**$175,000**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$50,000	$3,500	$125,000	$15,000	-	$193,500
2009/2010	$20,000	$3,500	$80,000	$15,000	-	$118,500
Total	**$70,000**	**$7,000**	**$205,000**	**$30,000**	**-**	**$312,000**

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

Project 1.1.5: Reef Atlas: Risk, Resilience and Response

NB: This project is in draft form until all parties agree to the details of the schedule.

Project Leader and Host Organisation

Katharina Fabricius, AIMS

Project Team

Title	Organisation	Role	FTE
Dr Katharina Fabricius	AIMS	Project leader, reef ecologist, indicators, reporting, communication	0.4
Dr Glenn De'ath	AIMS	Statistics and spatial / risk modelling	0.5
Dr Bill Venables	AIMS	Statistics and spatial / risk modelling	0.4
Stuart Kininmonth	AIMS	Web-based delivery, Data Centre	0.3
Oceanographer (new position)	AIMS	Hydrodynamic model of GBR	0.1

Summary Table of Research Users

Organisation	Organisational Contact
DEW	Kevin Dale (Steering)
GBRMPA	David Wachenfeld
GBRMPA	Jon Day (Steering)
QDPI-F	TBA
AMPTO	Col McKenzie

Project Duration

Start Date: July 2007 End Date: 30 June 2010

Project / Task Objectives

Summary: Effective management and conservation of the Great Barrier Reef requires detailed knowledge of key components of its biodiversity (reef, seafloor, seagrass, threatened species), processes that determine biodiversity (such as genetic resilience), and the principal threats to them (climate change, water quality, fishing, tourism use, shipping through invasive species and incidents, and crown-of-thorns starfish) and their interactions. Failure to adequately understand and manage risks will result in the loss of environmental, economic and social values. In the last few years, the availability of large-scale data and modelling tools has increased substantially (Fig. 1). Available data are based on diverse sources such as large-scale and long-term surveys, real-time monitoring, satellite-based information, and these are complemented by experimental studies, theoretical models and expert opinion. Integration of this information requires modelling techniques and, given the spatial and temporal scales involved, effective expression and representation by mapping. This project will develop the conceptual and statistical framework to integrate existing data sets on biodiversity and risks, interpret the various risk factors and produce maps of

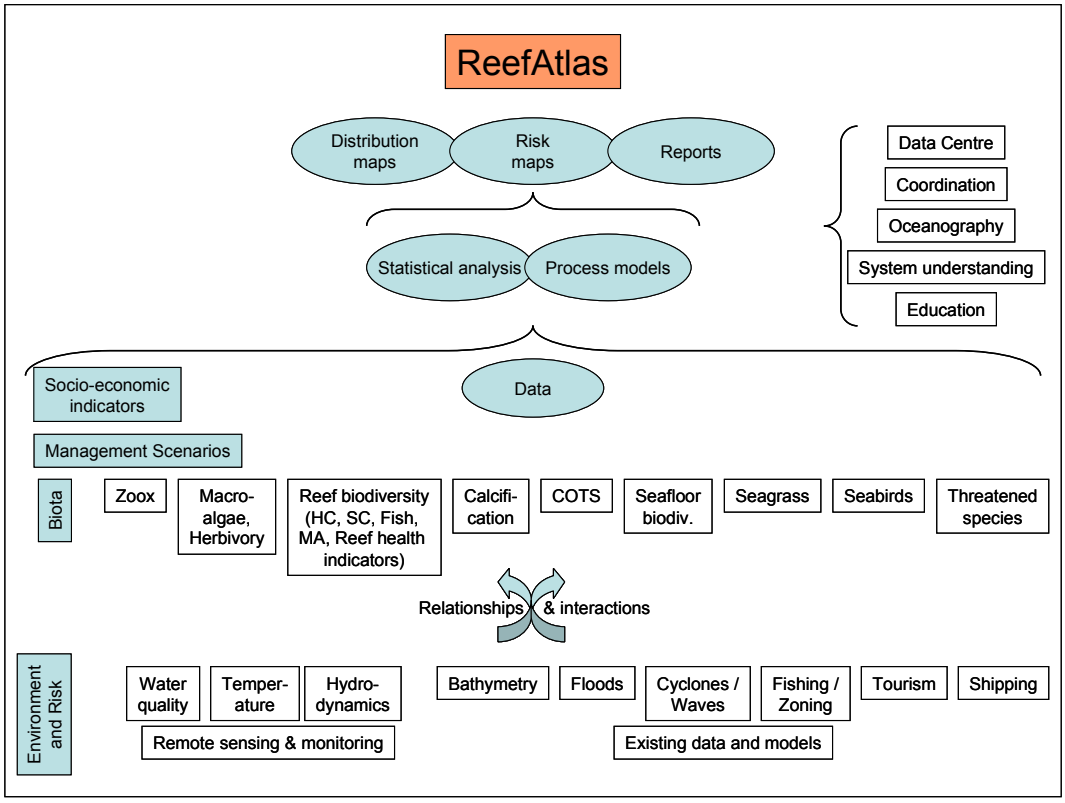
environmental conditions and distributions of taxa on the GBR, risk maps, and scientific reports detailing the risk analyses.

Overview of objectives and work plan:

Conservation of biodiversity is a fundamental objective of risk management. In the last few years, a number of large-scale data on biodiversity and on environmental conditions have become available for the GBR, and new spatial modelling tools have been developed. In particular, AIMS has gathered extensive data sets on hard and soft corals, algae, fish, coral calcification through long-term monitoring and extensive spatial one-off surveys, providing key information on temporal trends, distribution and turn-over of individual taxa and communities. Other available data include seagrass distribution, seafloor biodiversity, water quality and seawater temperature fishing effort and bathymetry maps. Additional data such as genetic patterns in coral resilience and socio-economic responses to environmental change are currently being compiled. A Data Centre now exists at AIMS that can provide long-term data storage and provision of metadata.

By relating spatial distributions to environmental drivers and thresholds, we can estimate risk and forecast biotic communities under various risk scenarios (especially temperature and water quality regimes). Such analyses that shed light on the properties of the World Heritage Area of the GBR, its environmental values, and understaning of the various factors contributing to risks and resilience, as well as potential management response scenarios, will provide essential information to reef managers, and should be compiled in one single repository. We propose to compile such repository, in the form of a 'ReefAtlas'.

Fig. 1: Proposed structure and components of the Reef Atlas: data that are or may become available, the processing through analysis and models, and proposed outputs of risk and distribution maps and reports.



Initially, the main outputs of the ReefAtlas will be Distribution maps, Risk maps and reports. ReefAtlas will be web-based and will initially comprise a core set of reference maps (e.g. biodiversity and bleaching risk etc), but over time will also include modeling tools to run scenarios.

Where data exist at adequate resolution, the Atlas will be nested at three spatial scales (local, regional and whole GBR). Analyses and outputs will be related to the GBR rezoning, the NRM regions, and the RWQPP, and will feed into the GBRMPA Outlook Report.

Estimation of risk is complex and requires both knowledge of the systems involved and high-level mathematical and statistical skills. For complex ecosystems, the estimation of risk is highly uncertain and this uncertainty needs to be expressed to the users of risk maps. The study of interactive risks will likely leads to the formulation of new research questions as data might be insufficient to answer certain priority questions.

The development and implementation of the Mapping Project needs to include a broad cross-section of scientists and end users. 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 included into the Atlas.

Work Plan:

Year 1: We will provide a framework for the web delivery (probably using a combination of Google Map systems for the maps, web sites and downloadable pdf for reports), and establish long-term data storage and access through the Data Centre. We will also provide a proof of concept for the risk mapping: initially we will focus on biodiversity maps, risk mapping based on water quality and temperature distributions, and we will start testing proposed thresholds and indices (in particular for WQ). We will also address Implications for the GBR zoning and where applicable provide information at scales relevant for the NRM regions.

Consecutive years:

In the years 2 and 3, we will refine the delivery framework, and will add new topics to the mapping of risk, identification of resilience factors, and management options, and start addressing their interactions (e.g., threatened species, shipping, fishing, tourism, water quality – climate – hydrodynamics interactions, etc; see Fig. 1). However, for the risk analyses and the ReefAtlas to become comprehensive and fully functional, the support base of researchers will have to be widened. In particular, the success of the project will depend on the development of process and scenario models, and the refinement of hydrodynamics model. AIMS is committed to further involve scientists and postdocs, the data centre and science communications to contribute to expanding the Atlas project, and involve other research providers to address priority components. The main priorities are:

(1) Hydrodynamics and connectivity: Knowledge of the physical processes that control the spatial and temporal patterns of sea temperature, the genetic connectivity of populations between regions, and the flushing and dispersal of waterborne pollutants is essential for the development of ecological process-based models, and to the estimation of water quality and temperature risks risk. Improved hydrodynamic models are therefore an essential component of process-based risk modelling. AIMS will be employing a new oceanographer in late 2007, and is committed to substantial co-investment into this area to conduct and complete such study from late in year 1 onwards.

(2) Process-based models are also essential for the Atlas, to analyse and interpret the extensive data sets, and to test hypotheses that contribute to improved ecosystem

understanding. For example, the linkages between crown-of-thorns outbreaks and water quality have been established through process models and related to long-term survey data, while other models have been used to investigate the linkages between river nutrient discharges and lagoonal chlorophyll concentrations, or water quality and bleaching propensity. AIMS is currently expanding ecological modelling capacity to address some of the main gaps in reef risk, resilience and response understanding, and is committed to coninvestment to conduct such study from year 2 onwards.

Project Outputs / Milestones 2007/2008

Objective	Targeted Activity	Completion Date
(a)	Review, compile and prioritise data sets, establish long-term data storage and meta data through the Data Centre	December 2007
(b)	Develop a framework for integrated web-based mapping of spatial and process-based data from GBR related research	June 2008
(c)	Statistical analysis and synthesis of selected GBR biodiversity and environmental data, with particular emphasis on threats and risks (water quality, temperature), and the biological implications for the GBR zoning system (Proof of concept for the ReefAtlas).	June 2008

Project 1.1.5 Milestone Payments 2007/2008

For 2007/2008 Outputs Only Milestones	Date
Signing of contract	
Progress Report submission: • Progress update for objective a (above): what data sets are being investigated; justification and choice of methodology [AIMS]	1 Feb 2007
Report submission: • Completion of the development of a conceptual and statistical framework for the GBR Atlas [AIMS] • Completion of the web site framework [AIMS] • Completion of exemplary web pages and scientific report based on synthesis of GBR biodiversity data for specified risks and risk maps [AIMS]	11 June 2007
Total MTSRF Funding	**$243,000**

Project 1.1.5 Budget

Year 1 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$143,000	-	$143,000
MTSRF Visual Documentation*	$2,000	-	$2,000
Reef Foundation	$100,000		$100,000
AIMS	-	$208,000	$208,000
Total	**$245,000**	**$208,000**	**$451,000**

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

Note: Additional costs of $120,000 will arise in Years 2 and 3 to deliver on the Hydrodynamics and Modelling components as specified above; these would be matched by an equivalent research provider co-investment of salaries and in-kind contributions.

AIMS Project 1.1.5 Budget 2007/2008

Item	MTSRF Funds	AIMS In-kind	Total Cost
Salaries	$208,000	$208,000	$416,000
Operating	$30,000	-	$30,000
Travel	$5,000	-	$5,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	**$243,000**	**$208,000**	**$451,000**

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 incorporated or referenced 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 over its three year duration. The Research Provider retains ownership of the all datasets referenced in project reports submitted to the RRRC including, but not limited to, datasets 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

	Cash	In-kind	Total
MTSRF	$350,000	-	$350,000
Other	-	$397,250	$397,250
Total	**$350,000**	**$397,250**	**$747,250**

Program 2 will 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 a baseline for comprehensive condition monitoring and reporting of the North Queensland rainforest environmental assets.

The Program will 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 will be 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) and Theme 5 (Program 10: Enhancing Delivery). The Program will develop rainforest monitoring methods and implement the refined monitoring protocol on existing and newly focused monitoring sites. In the process of doing this, it will develop tools for measuring, monitoring and reporting, 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. This integration will be a distinguishing feature from work done previously in the Rainforest CRC. The data needs of the data integration and synthesis process will have a strong influence on the evolving shape of this Program.

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 Commitment 2007/2008

Title	Organisation	Role	FTE
Dr James Butler	CSIRO	Social ecologist, project design	0.20
TBA	CSIRO	Project design	0.01
Dr Dan Metcalfe	CSIRO	Tropical Plant Ecologist	0.20
Dr David Westcott	CSIRO	Ecologist, project design	0.07
Mr Andrew Ford	CSIRO	Botanist and taxonomic support	0.23
Mr Matt Bradford	CSIRO	Plant ecology research support	0.23
Caroline Bruce	CSIRO	Project and data coordination	0.51
Tina Lawson	CSIRO	GIS and Data Management	0.25
GIS officer	CSIRO	GIS and Data Management	0.42
Prof. Steve Williams	JCU	Biodiversity specialist	0.15
Frank Zich	CSIRO	Rainforest key, Australian Tropical Herbarium Curator.	0.20
Dr Jeremy VanDerWal	JCU	Spatial ecologist	0.10

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
WTMA	Steve Goosem
Terrain NRM	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

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*, and Project 2.6.2 *Identification and impact of invasive pests in the Wet Tropics Rainforest*.
(c) Design and test a monitoring program to track status and trends of key environmental assets.

Project / Task Methodology

This project will proceed as a direct partnership between CSIRO, JCU, MTSRF, WTMA and Terrain NRM. 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, for ease of exposition. 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) a synthesis of current knowledge and databases on key biological and environmental assets in the Wet Tropics World Heritage Area; (b) the design and trial of a potentially suitable and cost-effective monitoring program to track the status and trends of key indicators of ecological health. The project will link with eight other relevant MTSRF projects in the Rainforest & Catchments theme (Table 1), and monitoring and evaluation projects in other MTSRF themes, with particular reference to Water Quality. In addition, parallel projects not funded by MTSRF will also 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. 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 Programs, and will highlight areas where gaps in existing data coverage remain.

Year two of this project builds upon the work conducted in year one, which included the establishment of an agreed metadata format between the project host organisations and the end-users to ensure that the final products will mesh with the existing metadata banks of organisations such as CSIRO and QEPA. Following resolution of the formats and

interchange issues, collation of additional metadata sets from the project host and end-user organisations commenced. From this collated metadata a gap-analysis will be carried out considering geographical coverage, scale, target taxa, accuracy and accessibility. After consultation with end-users, targeted gap-filling will enable a good quality baseline to be completed which will provide a foundation for the monitoring project. This is likely to include a considerable amount of effort in coastal lowland communities which lie outside the WHA boundary, and so have received little attention under the CRC umbrella. Targeted gap filling in conjunction with Project 1.4.3 (Threatened species and communities) 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 gaps 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 will also 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. These layers may already be available in the data base, for example as digital elevation models, climate surfaces or geology maps, but they may also have to be compiled by overlaying various layers to produce composite maps or derived products such as soil and terrain indices. Additionally, the extent of these datasets may need to be expanded to cater for additional areas of interest beyond the Wet Tropics bioregion or Terrain NRM planning region.

A vital component of the Wet Tropics 'Data Integration and Synthesis for Reporting' will be an assessment of how well management to date has succeeded in maintaining environmental condition, and countering any perceived trends in degradation. Subsequent to the continued development of the metadata bank and gap filling will be collation of management and condition reports from the last 15 years where possible, to assess the evolution of management actions, the development of understanding of threats to the World Heritage Area, and the success or impact of those management actions. Assessment will focus provisionally on responses to weeds and feral animals (Project 2.6.2) and to vegetation clearance associated with urbanisation (Project 4.9.3).

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

This will proceed in a series of steps (tasks), beginning with desk-top studies of previous (mostly failed) monitoring protocols and finishing up in a design/implementation, re-design/re-implementation phase, with science and management skills reinforcing one another iteratively, to strengthen World Heritage Area management and Wet Tropics NRM planning. The monitoring program will also test and challenge current models of how ecosystems work and how biodiversity is maintained in rainforests and north Queensland coastal catchments, delivering positive feedback to the people who influence and use these ecosystems and their biodiversity.

A series of workshops were held in year one and these will be built upon in year two to determine exactly what variables should be monitored. Monitoring Programs have failed in the past because they have been too ambitious in scope. It will be critical to limit the variable

or indicators to monitor to the smallest set consistent with delivering useful information on trends. Another reason monitoring programs have not been successful in the past is because it has not been clear at what point, along a trend continuum, should trigger a management action. The workshops provide opportunity to elicit both scientific and management experience and expertise, to identify these key trigger points, also called thresholds of concern. In particular, coordination with the Data Integration and Synthesis format being developed by Program 10 for monitoring environmental quality in other MTSRF projects will be achieved through this process.

The monitoring program will deliver to both Terrain NRM monitoring and evaluation framework based on condition of ecosystem assets, and WTMA's existing monitoring strategy using pre-established indicators. Delivery for WTMA will take cognisance of recent moves to standardise reporting for World Heritage Areas by UNESCO.

In addition, the monitoring program will include links between local communities and biodiversity health, and potentially integrate community-based monitoring schemes. For Indigenous communities this will be achieved through 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 develop indicators for Indigenous and non-Indigenous communities linked to biodiversity health and condition. Another parallel project potentially funded by Earthwatch will trial the utility of community-based monitoring of key indicators (Table 2). These sociological aspects of Status and Trends will deliver to Terrain NRM 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.

Project Activities (indicative for out years only)

Objective	Targeted Activity	Completion Date
(a)	Manage and collate metadata database	Jun 2010
(a)	Scrutinise existing geospatial data sets, identify and fill knowledge gaps	Jun 2010
(b)	Identify and monitor key biodiversity features relevant to program i.e. species and communities of concern, altitudinal rainforest biodiversity	Jun 2010
(c)	Workshop and identify indicators for assessing ecosystem services and biodiversity condition and thresholds of concern.	Dec 2007
(b)	Complete orchid module of RFK : Key to all northern orchid species published on CD and on the web	Feb 2008
(b)	Transfer existing RFK modules to Lucid software: Existing modules of RFK – trees, shrubs, vines, palms & pandans – running in Lucid V3	Jun 2008
(b)	Complete rainforest plant key	Jun 2009
(c)	Workshop and identify indicators for assessing pressures and thresholds of concern	Jun 2008
(c)	Literature review of monitoring tools and methods	Aug 2008
(c)	Produce design of monitoring program	Aug 2008
(c)	Populate monitoring program with data to deliver State of Region for biodiversity and ecosystem services	Aug 2009
(c)	Deliver data and assist with design of Rainforest and Catchments Integrated Reporting process	Dec 2009

Project 1.2.1 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones [agency responsible for report delivery identified in brackets]	Date
Signing of contract	
Progress Report 1: • List of indicators for assessing resource condition and thresholds of concern workshopped and identified [CSIRO] • Update on monitoring of altitudinal rainforest biodiversity including location and number of sites surveyed and findings from surveys to date [JCU] • Update on gap analysis and gap filling of lowland threatened species and communities [CSIRO] • Update on gap analysis and gap filling of geospatial data [CSIRO • Summary of any communication activities undertaken to date, including minutes of meetings/workshops [CSIRO]	3 Dec 2007
Progress Report 2: • List of indicators for assessing pressures and thresholds of concern [CSIRO] • Update on monitoring of altitudinal rainforest biodiversity including location and number of sites surveyed and findings from surveys to date [JCU] • Update on gap analysis and gap filling of lowland threatened species and communities [CSIRO] • Update on gap analysis and gap filling of geospatial data [CSIRO] • Summary of any communication activities undertaken to date, including minutes of meetings/workshops [CSIRO] • Description of progress with Rainforest Plant Key [CSIRO] • Evidence of data transfer and awareness between CSIRO, JCU, WTMA and Terrain NRM plus other stakeholders through workshops. [Responsible officer Dr. James Butler, CSIRO] • Plan for completion of out year activities [CSIRO] • Contribution to plan for delivery of out years activities [JCU]	1 Jun 2008
Total MTSRF Funding	**$350,000***

* Total includes $3,500 Visual Documentation Allocation.

Project 1.2.1 Budget

Year 2 – 2007/2008 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	-	$44,260	$44,260
JCU	-	$98,985	$98,985
WTMA	-	$20,000	$20,000
Terrain NRM	-	$36,000	$36,000
Total	**$350,000**	**$397,250**	**$747,250**

* 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 2007/2008

Item	MTSRF Funds	In-kind	Total Cost
Salaries	$155,435	-	$155,435
Operating	$36,570	-	$36,570
Travel	$6,000	-	$6,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$198,005	$198,005
Total	**$198,005**	**$198,005**	**$396,010**

CSIRO Plant Industry Project 1.2.1 Budget 2007/2008

Item	MTSRF Funds	In-kind	Total Cost
Salaries	$21,272	-	$21,272
Operating	$28,238	-	$28,238
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$44,260	$44,260
Total	**$49,510**	**$44,260**	**$93,770**

James Cook University Project 1.2.1 Budget 2007/2008

Item	MTSRF Funds	In-kind	Total Cost
Salaries	$73,000	$18,985	$91,985
Operating	$22,985	-	$22,985
Travel	$3,000	-	$3,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$80,000	$80,000
Total	**$98,985**	**$98,985**	**$197,970**

Wet Tropics Management Authority Project 1.2.1 Budget 2007/2008

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

terrain NRM Project 1.2.1 Budget 2007/2008

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

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$350,000	-	$402,500	-	-	$752,500
2009/2010	$350,000	-	$402,500	-	-	$752,500
Total	**$700,000**	**-**	**$805,000**	**-**	**-**	**$1,505,000**

Communication Products / Events 2007/2008

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 end user requirements.	Several throughout Program in consultation with end users
	End user/science workshops to identify indicators for assessing resource condition and thresholds of concern.	July-Dec 2007
	End user/science workshops to identify indicators for assessing pressures and thresholds of concern.	Jan-May 2008
	End user 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)

Table 2: Proposed parallel projects not funded by MTSRF, but contributing to monitoring program design and reporting for Project 1.2.1 in 2007-2010.

Project	Linkage
CSIRO Post-doctoral Fellow (Dr. Leanne Cullen): Developing linked socio-cultural indicators of biodiversity and ecosystem health	Developing socio-cultural indicators of biodiversity health linked to human well-being among Indigenous and non-Indigenous Wet Tropics communities. Indicators will be populated with data to provide assessment of biodiversity and human condition
Earthwatch: Community-based monitoring schemes for assessing biodiversity condition	Design and trial of community-based monitoring of key indicators identified by Project 1.2.1. Also, social benefits of involvement in monitoring for communities will be investigated

PROGRAM 3
TORRES STRAIT – STATUS, USE AND TRENDS

Program Leader and Host Organisation

Dr Roland Pitcher, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Budget Summary

	Cash	In-kind	Total
MTSRF	$393,000	-	$393,000
Other	$50,000	$335,000*	$385,000
Total	**$443,000**	**$335,000***	**$778,000**

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 and thresholds of concern to be incorporated into a report on the environmental assets in Torres Strait. These issues 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;
- Identify conceptual models of the processes surrounding those key issues;
- Identify potential indicators and thresholds of status and trends in each issue;
- 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
- Contribute to the development of a Data Integrated and Synthesis Framework to be used for reporting the ecosystem health of Torres Strait.

In addition the program will, where possible fill data gaps and 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), and establish a ecologically sustainable strategy for seed stock harvest.

In the first year this program focussed on developing a process for analysis of the economic value of environmental assets in the Torres Strait. Findings from that process will be used to develop and implement appropriate economic research objectives to be undertaken in the Torres Strait region to support reporting on the health of the ecosystems within that region.

A primary objective of Projects 1.3.1, 1.3.3 and 1.3.5 in Year 1 was to identify appropriate areas for future research required in the Torres Strait region. Findings from these projects were used to structure out year activities of relevance to 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 economic value of sponges to the Torres Strait $60,000

1.3.3 Economic analysis of alternative uses, trade-offs $100,000

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 Commitment 2007/2008

Title	Organisation	Role	FTE
Dr Donna Green	CCRC, UNSW	Integrated assessment/ socio-economic impacts	0.5
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
Dr Janet Bishop	CSIRO	Scientific data collection	0.1

* Traditional Environmental Knowledge

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
TSRA	Damien Miley
Local Island Councils	Chairs of relevant councils

Project Duration

Start Date: 1 August 2007 End Date: 30 June 2009

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.

One of the aims of the workshop was to establish the needs and priorities of each region, and provide direction for a coordinated, strategic approach to climate change responses. One resounding message from the workshop's participants was to begin traditional knowledge collection activities and scientific modeling activities in the Torres Strait as soon as possible due to their pressing need to identify and implement adaptation strategies.

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. Significantly, the severity of these inundation events had only once been of similar magnitude in the Islanders' living memory.

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 (e.g. 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 is a collation and assessment of existing scientific and traditional knowledge, which will be integrated into climate workshops to discuss with Islanders the likely impacts of climate change at a local level. The discussions and expressed concerns brought out at the workshops will be used to prioritise areas of strategic adaptation planning.

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) Resilience-building activities and adaptation recommendations 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 will be brought together for a full day meeting where a gap analysis will be performed (Sept 07). 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 (Oct to Dec 07). 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 councils 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 (Aug 07).

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 (Sept 07 – Sept 08).

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 and in English. The second format would provide a more scientific detailed analysis with a view to publishing reported information in peer reviewed scientific journals (Jan 08).

Objective (d): communicate information to stakeholders

Presentation of project to TSRA board at initiation of project (likely executive board meeting date 28 August 07).

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 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 the key areas of concern about climate change are 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 (April 08 – Oct 08), 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).

Project Targeted Activities

Objective	Targeted Activity	Completion Date
(a)	Prepare background data collection, scope out key scientific individuals/institutions for meeting, arrange meeting, record activities and summarise gaps as well as existing information.	Oct 07
(b)	Discuss appropriate protocols for TEK collection, identify local stakeholders, engage and train local researchers	Dec 07
(c)	Analyse existing scientific data obtained at workshop, produce integrated assessments inc geospatial datasets (timed to coincide with TSRA land use project).	Feb 08
(d)	Negotiate with Island councils about when best to perform workshops, prepare necessary logistical activities to ensure maximum attendance and participation by community. Prepare adequate recording facilities and follow up/feed back channels.	Mar 08
(e)	Analyse data from TEK projects in concert with scientific data, translate into local languages, present material to stakeholders for feedback before finalisation of reports.	Feb 09
(f)	Arrange ongoing discussion with stakeholders to allow feedback into key recommendations to increase resilience and adaptation planning for islands.	June 09

Project 1.3.1 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones (responsible organisation should be identified in [brackets] after each milestone)	Date
Signing of contract	
Report 1 submission • Report on scientific workshop: examine data sets and identify gaps in knowledge, develop collaborative links to produce necessary geospatial datasets [UNSW] • Report on protocol discussions and methodological agreements between stakeholders for TEK documentation, training of Islanders completed and recording projects begun [UNSW]	Nov 07
Report 2 submission • Report (including maps at an appropriate local scale) describing climate impact assessments for use in community workshops [UNSW] • Report on outcomes from community based workshops [UNSW]	April 08
Report 3 submission • Interim TEK summary analysis: data recorded, process for synthesising with climate impact assessments (preliminary findings) [UNSW]	June 08
Total MTSRF Funding	**$80,000**

Project 1.3.1 Budget – 2007/2008

Year 2 – 2007/2008 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**

UNSW Project 1.3.1 Budget 2007/2008

Item	MTSRF Funds	In-kind Contribution	Total
Salaries	$45,500	$78,000	$123,500
Operation	$8,000	$10,000	$18,000
Travel	$9,000	$5,000	$14,000
Communications/Extension	$10,000	$2,000	$12,000
Capital	$7,500	$5,000	$12,500
Total	**$80,000**	**$100,000**	**$180,000**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$120,000	-	$150,000	-	-	$270,000
2009/2010	$80,000	-	$100,000	-	-	$180,000
Total	**$200,000**	**-**	**$250,000**	**-**	**-**	**$450,000**

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 Alan Duckworth, Australian Institute of Marine Science (AIMS)

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Dr Alan Duckworth	AIMS	Project leader	0.3
Mr Carsten Wolff	AIMS	Project coordinator (field visits)	0.3
Mr John Morris	Yorke Island Council	Project manager at Masig Island	0.1

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
TSRA	Vic McGrath
TSRA	Damian Miley

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. The potential for bath sponge aquaculture in the context of broader economic development opportunities will also be explored in Project 1.3.3 (Economic analysis of alternative uses, trade-offs).

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.);

(c) Determine patterns of sponge recruitment/mortality and the environmental risk of seed stock harvest leading to development of a sustainable seed collection strategy.

Project Targeted Activities 2007/08

Objective	Targeted Activity	Completion Date
(a)	Demography assessment.	11 June 2008
(b)	No activity in Year 2.	
(c)	Sponge recruitment/mortality report.	11 June 2008

Project 1.3.2 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones	Date
Signing of contract	
Verbal briefing to Operations Committee on project progress	Before Dec 2007
Report 1 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).	1 Feb 2008
Report 2 submission: One report detailing in separate segments: • Preliminary demography assessment including sponge abundance and occurrence of disease • Preliminary sponge recruitment/mortality findings. • Preliminary findings of status and trends of key sponge assets and their ecosystem health. • Final findings of field work conducted: sites visited; liaison activities. • Final summary of communication activities undertaken through the course of Year 2 of project. • Plan for completion of out year activities.	9 June 2008
Total MTSRF Funding	**$60,000**

Project 1.3.2 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$60,000	-	$60,000
TSRA	$50,000*	$15,000	$65,000
AIMS	-	$70,812	$70,812
Total	**$110,000**	**$85,812**	**$195,812**

* TSRA cash against AIMS component of project and delivery through AIMS contract.

AIMS Project 1.3.2 Budget 2007/2008

Item	MTSRF + TSRA Funds	AIMS In-kind	Total Cost
Salaries	$50,000	$4,053	$54,053
Operating	$12,000	-	$12,000
Travel	$28,000	-	$28,000
Communication / Extension	$5,000	-	$5,000
Capital	-	-	-
Institutional overheads	-	$66,759	$66,759
Total	**$95,000**	**$70,812**	**$165,812**

TSRA Project 1.3.2 Budget 2007/2008

Item	MTSRF Funds	TSRA In-kind	Total Cost
Salaries	$10,000	-	$10,000
Operating	-	-	-
Travel	$5,000	-	$5,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads		$15,000	$15,000
Total	**$15,000**	**$15,000**	**$30,000**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$60,000	-	$70,000	-	-	$130,000
2009/2010	$60,000	-	$70,000	-	-	$130,000
Total	**$120,000**	**-**	**$140,000**	**-**	**-**	**$260,000**

PROGRAM 3: TORRES STRAIT – STATUS, USE AND TRENDS

Project 1.3.3 Economic analysis of alternative uses, trade-offs

NB: This project is in draft form until all parties agree to the details of the schedule.

Project Leader and Host Organisation

Dr Sean Pascoe, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team

Title	Organisation	Role	FTE
Dr Sean Pascoe	CSIRO CMAR	Economist	0.24
Dr Wendy Proctor	CSIRO CLW	Economist	0.21
Dr Nadine Marshall	CSIRO CSE	Social scientist	0.22
Vic McGrath	TSRA	Community liaison officer	0.08
Miya Isherwood	TSRA	Strategic regional facilitator	0.05
Dr Bill Arthur	ANU	Economist	0.09
Jim Prescott	AFMA	Fisheries manager	0.03
Other team members to be advised – to include a PhD student			

Summary Table of Research Users

Organisation	Organisational Contact
TSRA	Vic McGrath, Miya Isherwood, Marcus Finn
AFMA	TBA

Project Duration

Year 2: Start Date: 1 July 2007 End Date: 30 June 2010

Project / Task Objectives

The project activities for Year 2-4 are based on the results of the review of natural resource economic issues in the Torres Straits undertaken in Year 1. The review identified several issues, the highest priority being given to those involving community based management of commercial and traditional fisheries in the region.

An objective of the TSRA is to increase the involvement of islanders in the commercial fishing industry as part of the regional development (TSRA 2006). However, the current management system provides incentives that do not capture the full benefits of increasing islander involvement in the fisheries. Licences for the Indigenous sector are unlimited to encourage new entrants. The competitive TACs being proposed for the Indigenous sector provide incentives for existing fishers to increase their fishing activity, and as there is no restriction on the number of Indigenous fishers who can fish for the TAC the potential of dissipating the economic benefits that a well managed fishery could achieve are high.[4] As a result, the benefits of increased allocation of catch to the islander communities is likely to be less than under alternative management plans that provide a different set of incentives.

[4] The dissipation of economic profits through increasing effort arising from a competitive quota is well documented.

However, cultural drivers may encourage the Indigenous sector to adopt a management scheme that sacrifices economic benefits to encourage a culturally appropriate quota-sharing regime.

The objective of the project in Years 2-4 is to assess potential community based management schemes for the management of both traditional and commercial fishing activities undertaken by islanders. The assessment will consider the economic benefits (employment and incomes) as well as the cultural benefits associated with various governance structures. The project will focus on three aspects:

- Resource sharing mechanisms between commercial, community and traditional fisheries;
- How to maximise future returns to Islanders from the major fisheries given the new sustainable management constraints they will be operating under; and
- Triple bottom line costs and benefits of targeted capacity building with the aim of paying Torres Strait Islanders for environmental service provision, including in a monitoring, management and enforcement capacity.

Project Targeted Activities

The project will be broken into sub-activities each year, some to be undertaken primarily by a doctoral research student, others to be undertaken by the research team as a whole (in varying degrees).

Year 2 (2007- 08)

Student

2.1 Structure of fisheries and management in TS (background)

- Performance, inter-dependencies
- Include ABARE results and results from a TSRA-funded report

2.2 Previous attempts at community management in TS

- What happened? What were the perceived problems?
- Link to the TSRA dugong and turtle management project?

Project team (incl. student)

2.3 Objectives of fisheries management in TS

- Do they differ between commercial and islander components?
- Objectives of management of traditional fisheries
- Interactions with other areas (e.g. tourism)

2.4 Capability and capacity to manage fisheries

- Who should be involved in management?
- Traditional knowledge
- Potential for environmental service provision
- Identify training needs

Year 3 (2008-09)

Student

3.1 Models of community based management

- Review in other countries, applicability to TS.

3.2 Resource allocation mechanisms

- Review of various alternative mechanisms
- Implications of different approaches to TS

Project team (incl. student)

3.3 Potential benefits from community based management

- Bioeconomic models; multi-objective models
- Impact on other sectors (e.g. tourism)

3.4 Potential benefits of management and environmental services provision

- Monitoring, compliance, enforcement
- Compensatory mitigation

Year 4 (2009-10)

Project team (incl. student)

4.1 Synthesis

- Focus on
    1. how to maximise future returns to Islanders from the major fisheries given the new sustainable management constraints they will be operating under
    2. triple bottom line costs and benefits of targeted capacity building with the aim of paying Torres Strait Islanders for environmental service provision

Student

4.2. Write up thesis

Methods

2.1, 2.2, 3.1 and 3.2 will be review based and form part of the student's literature review. 3.1 and 3.2 will also include a qualitative assessment of the applicability to fisheries management in Torres Strait.

2.3 and 2.4 will be undertaken through workshops/meetings with community groups in Torres Strait. Preference elicitation methods are to be used to develop management objective hierarchy and priority. Workshops to be conducted in TSI during January or February 2008. To be led by Wendy Proctor (CLW).

3.3. A relatively simple bioeconomic model of the fisheries will be developed which will also include the management objectives hierarchy and preference structure. The model will be used to estimate what level of fishing activity in each area may best satisfy the multiple objectives of the different stakeholders. The model will identify potential areas of conflict between different stakeholders. The model will be developed based on known biological relationships in the fisheries, expert knowledge of key participants in the fisheries, and

economic information collected in the recent ABARE and TSRA-funded surveys of the fisheries. To be led by Sean Pascoe (CMAR).

3.4 The potential for environmental service provision, particularly in terms of monitoring, compliance and enforcement, will be analysed using a triple bottom line accounting approach. To be led by Wendy Proctor (CLW) and Nadine Marshall (CSE).

3.3 and 3.4 will flow over partly into Year 4.

4.1 The results from all the previous sections will be synthesised into a final report and series of journal articles. To be co-ordinated by Sean Pascoe (CMAR).

4.2 The student will write up their thesis for submission by the end of 2010.

Project 1.3.3 Budget (still not finalised)

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$100,000	-	$100,000
CSIRO	-	TBA	TBA
TSRA	-	$15,000	$15,000
Total	**$100,000**	**$100,000**	**$215,000**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$100,000	TBA	TBA	TBA	TBA	TBA
2009/2010	$100,000	TBA	TBA	TBA	TBA	TBA
Total	**$200,000**	**TBA**	**TBA**	**TBA**	**TBA**	**TBA**

PROGRAM 3: TORRES STRAIT – STATUS, USE AND TRENDS

Project 1.3.4 Communication, community engagement and enhanced delivery

Project Leader and Host Organisation

Mr Damian Miley, Torres Strait Regional Authority (TSRA)

Project Team Commitment 2007/2008

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 2007/2008

Organisation	Organisational Contact
TSRA Board	Yoshi Hirakawa

Project Duration

Start Date: On signing of contract
End Date: 30 June 2008 (subject to continuation of funding for the position under the MTSRF Annual Research Plan for 2007/08).

Project / Task Objectives

All of the above science proposals need to be conducted in the context of an engagement system like that developed for the CRC Torres Strait:
(http://www.crctorres.com/forcrctorres/index.htm and
http://www.crctorres.com/forcrctorres/complan.htm).

This system involved an Indigenous liaison officer employed by the CRC Torres Strait and based at the TSRA offices on Thursday Island. Such a system has been established for facilitation of the MTSRF research activities for the Torres Strait 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

Objective	Targeted Activity	Date
(a)	Facilitate researcher activity in Torres Strait through newsletter articles, visits to communities and meetings where appropriate	June 2008
(b)	Report to Reef and Rainforest Research Centre on communication activities	June 2008

Project 1.3.4 Milestones 2007/2008

For 2007/2008 outputs Milestones All TSRA Responsibilities	Date
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 2008.	15 Jul 2007
Progress Report 2. • Report on liaison and facilitation activities and communication products completed during milestone period (15 Jul to 15 Dec 2007).	15 Dec 2007
Final Report. • Final report on liaison activities and communication products during milestone period (15 Dec 2007 to 15 May 2008) and assessment of effectiveness and delivery against plan.	15 May 2008
Total MTSRF Funding	**$50,000***

* Includes $10,000 Visual Documentation Allocation.

Project 1.3.4 Budget

Contributing Organisation	Cash	In-kind	Total
MTSRF	$40,000	-	$40,000
MTSRF Visual Documention*	$10,000	-	$10,000
TSRA	-	$50,000	$50,000
Total	**$50,000**	**$50,000**	**$100,000**

* A total of $10,000 is held by the Reef and Rainforest Research Centre for Visual Documentation for this project

TSRA Project 1.3.4 Budget 2007/2008

Item	MTSRF Funds	TSRA In-kind	Total Cost
Salaries	$30,000	$50,000	$80,000
Operating	-	-	-
Travel	-	-	-
Communication / Extension	$10,000	-	$10,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	**$40,000**	**$50,000**	**$90,000**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$120,000	-	-	$150,000	-	$270,000
2009/2010	$120,000	-	-	$150,000	-	$270,000
Total	**$240,000**	**-**	**-**	**$300,000**	**-**	**$540,000**

Budget Information

TSRA has offered co-investment of $50,000 per annum towards the salary of the Indigenous liaison officer to continue this engagement system. From the $50,000 allocated to communication in this Program, $30,000 is allocated towards the salary of the Indigenous liaison officer, $10,000 to general costs of communications and $10,000 towards production of visuals for the Torres Strait program. The Marine Species of Conservation Concern Program (Projects 1.4.1 and 1.4.2) will budget $30,000 p.a. to communication.

Although each project will develop specific engagement activities, these are not currently detailed in the task proposals. All project PIs understand that they will work through the established communications system, run through Theme 5 and build on what was established by the CRC Torres Strait.

PROGRAM 3: TORRES STRAIT – STATUS, USE AND TRENDS

Project 1.3.5 Data integration and synthesis for development of reports on ecosystem health in the Torres Strait region

NB: This project is in draft form until all parties agree to the details of the schedule.

RRRC Note: This project requires the support of analysis and synthesis skills for input into the integration and reporting framework. Discussions about sourcing these skills for the project are in progress between TSRA, CSIRO and JCU.

Project Leader and Host Organisation

Mr Damian Miley, Torres Strait Regional Authority (TSRA)

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Damian Miley	TSRA	Project Leader	TBC
Other team members to be advised			

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
TSRA Board	TBA
Land and Sea Management Unit	TBA

Project Duration

Start Date: 1 September 2007 End Date: 30 June 2010

Indicative Project / Task Objectives

(a) To identify key issues in Torres Strait that should lead to the development of indicators and thresholds of concern to be incorporated into a Data Integration and Synthesis process that will assist development of a report-card on the environmental assets in Torres Strait. These issues will be identified through a process of engaging with stakeholders in Torres Strait including TSRA Executive Members, the MTSRF 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.

(b) To 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;
- Identify conceptual models of the processes surrounding those key issues;
- Identify potential indicators and thresholds of status and trends in each issue;
- Identify and prioritise the research needed in future years 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 for North Queensland (Project 3.7.7).

(c) To contribute to the development of a Framework to enable Data Integration and Synthesis for reporting. This framework will be used for reporting the ecosystem health of Torres Strait will be based on the BRS Integrated Report Card Framework.

Project Activities

Objective	Targeted Activity	Completion Date
(a)	Identify draft indicators of ecosystem health and thresholds of concern for input into a report card on the environmental assets of the Torres Strait	Jul 2007
(b)	Test indicators with key stakeholders and develop conceptual models of the processes surrounding those key indicators and thresholds. Link indicators with the TSRA Land and Sea Strategy.	Mar 2008
(c)	Test the BRS Report Card Framework and undertake synthesis of existing and new data for incorporation in the reporting framework	Jun 2008

Project 1.3.5 Milestones 2007/2008

Detail on the delivery from this project for 2007/2008 is being finalised in conjunction with discussions about what analysis and integration support can be provided to the project. Specific milestones for payment will be provided against this project following completion of that activity and be included through a contract variation.

For 2007/2008 Outputs Only	**Date**
Milestones	
Signing of contract variation	
TBC	
Total MTSRF Funding	

Project 1.3.5 Budget TBA

Year 1 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$103,000	TBA	TBA
CSIRO	TBA	TBA	TBA
TSRA	TBA	TBA	TBA
JCU	TBA	TBA	TBA
Total	**$103,000**	**TBA**	**TBC**

CSIRO Project 1.3.5 Budget 2007/2008

Item	MTSRF Funds	In-kind	Total Cost
Salaries	TBA	TBA	TBA
Operating	TBA	TBA	TBA
Travel	TBA	TBA	TBA
Communication / Extension	TBA	TBA	TBA
Capital	TBA	TBA	TBA
Institutional overheads	TBA	TBA	TBA
Total	**$83,000**	TBA	TBA

TSRA Project 1.3.5 Budget 2007/2008

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

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$103,000	TBC	TBC	TBC	TBC	TBC
2009/2010	$103,000	TBC	TBC	TBC	TBC	TBC
Total	**$206,000**	**TBC**	**TBC**	**TBC**	**TBC**	**TBC**

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).

	Cash	In-kind	Total
MTSRF	$520,000	-	$520,000
Other	-	$561,250	$561,250
Total	**$520,000**	**$561,250***	**$1,081,250**

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)

	Cash	In-kind	Total
MTSRF	$320,000	-	$320,000
Other	-	$366,500	$366,500
Total	**$320,000**	**$366,500***	**$686,500**

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)

	Cash	In-kind	Total
MTSRF	$200,000	-	$200,000
Other	-	$194,750	$194,750
Total	**$200,000**	**$194,750**	**$394,750**

This component of Program 4 will report on 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 will 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. The program will identify key indicators of ecosystem health and the threshold of concern for these threatened species and direction of community change.

The program will link 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

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 (JCU)

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Dr Mark Hamann	JCU	Sea Turtle ecologist: project leader Raine Is tasks manager.	0.95
Dr Ivan Lawler	JCU	Dugong ecologist: co-coordinator of the dugong ecology task	0.01
Professor Helene Marsh	JCU	Dugong ecologist: co-coordinator of the dugong ecology task	0.025
Dr Scott Smithers	JCU	Marine geomorphologist: co-investigator Raine Island task	0.1
Ms Mariana Fuentes	JCU	PhD student investigating sea turtles and climate change in the northern GBR and Torres Strait	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

* QEPA and TSRA FTEs will be confirmed by mid June 2007.

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
Reef Water Quality Partnership	Rachel Eberhard
AMPTO	Col McKenzie
QEPA*	Col Limpus
QEPA	Ian Bell
GBRMPA	Kirstin Dobbs
QEPA	QEPA Engineers, David Robinson, John Mohoupt
ARC	Russell Butler
TSRA Land and Sea Management Unit and Fisheries	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 it is applicable, information from this project/tasks will enable reporting and assessment of the ecosystem health of key environmental assets.

Key Objectives:

(a) **Dugong distribution and abundance.** To estimate the sustainable anthropogenic harvest of dugongs for northern Great Barrier Reef (GBR) and Torres Strait (TS) and to obtain information on the spatial distribution of dugongs to inform spatial assessment of risk management options.

(b) **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 Is (TS) and recruitment of juvenile turtles into the population

(c) **Communication.** To communicate the results of the research activities in partnership with TSRA and the Cape York Land Council (for both the dugong research and the turtle work at Raine Island and Moulter Cay work).

Project / Task Methodology

Objective (a) Dugong distribution and abundance

The dugong aerial surveys were conducted in year 1 of the project. In year 2 we will (1) conduct spatial modelling of resultant data in context of time series dating from early 1980s in Project 1.4.2 Objective (c); and (2) inform relevant Indigenous communities of the survey results see Project 1.4.1 Objective (c) Communication below. The methods used to design and conduct the aerial surveys, and undertake the data analysis have followed Marsh *et al*. (2004) Pollock *et al*. (2006) and Grech and Marsh (2007).

Grech, A. and Marsh, H. 2007. Prioritising areas for dugong conservation in a marine protected area using a spatially explicit population model, *Applied GIS*, 3(2): 1-14.

Marsh H, Lawler IR, Kwan D, Delean S, Pollock K, and Alldredge M. (2004). Aerial surveys and the potential biological removal technique indicate that the Torres Strait dugong fishery is unsustainable. Animal Conservation 7: 435-443.

Pollock K, Marsh H, Lawler I, and Alldredge M. (2006). Modelling availability and perception processes for strip and line transects: an application to dugong aerial surveys. Journal of Wildlife Management.

Objective (b) Sea turtle nesting success

The specific aims of this project are to:

- Determine the patterns, rates and causes of sand loss from Raine Island, Moulter Cay (GBR), Bramble Cay and Murray Island (Torres Strait).
- Calculate reproductive parameters for nesting green turtles at Raine Is, Moulter Cay, Bramble Cay and Murray Island (size range, recruitment rates, nesting success, mortality rates [of nesting turtles], egg production).
- Determine factors influencing nesting success
- Determine recruitment rates of juvenile turtles into the population.
- Explore whether the climate models developed under MTSRF Program 5 may relate to marine turtles in the GBR and Torres Strait.

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 movements. The potential to use recently emerged uranium dating (see Program 1) to assess whether coral age profiles can depict whether there have been human induced alterations to the Raine Island reef crest will be explored. 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. Our end user contacts at GBRMPA and TSRA are Dr Kirstin Dobbs and Lachlan Southerland respectively and the end user contact at QPWS is yet to be decided.

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(b) we will explore how the predicted impacts of climate change developed using MODIS models (Program 5) may relate to marine turtles, and how the models may be included into a risk assessment for green turtles in the northern GBR and Torres Strait.

Hamann M, Grayson J, Marsh H (2005) Raising Indigenous community awareness and promoting on-ground recovery activities for marine turtle and dugongs in Torres Strait. Report to Australian Department of the Environment and Heritage.

Limpus C, Miller J, Parmenter C, Limpus D (2003) The green turtle, *Chelonia mydas*, population of Raine island and the northern Great Barrier Reef 1843-2001. Memoirs of the Queensland Museum 49, 349-440.

Miller JD (1985) Embryology of marine turtles. In 'Biology of The Reptilia'. (Eds C Gans, F Billett and PFA Maderson) pp. 269-328. (John Wiley & Sons: New York)

Miller J (1999) Determining clutch size and hatching success. In 'Research and management techniques for the conservation of sea turtles'. (Eds K Eckert, KA Bjondal, FA Abreu Grobois and M Donnelly). (IUCN/SSC Marine turtle specialist group publication No. 4)

Limpus CJ, Reed P (1985) The green turtle, *Chelonia mydas*, in Queensland: a preliminary description of the population structure in a coral reef feeding ground In 'Biology of Australasian Frogs and Reptiles'. (Eds G Grigg, R Shine and H Ehmann) pp. 47-52. (Royal Zoological Society of New South Wales)

Objective (c) Communication

We will: (1) hold a workshop at JCU in Townsville in which extension officers employed by relevant Indigenous communities will be assisted to develop their own extension products based on the results of our dugong and turtle research and (2) continue extension activities at Murray Island in collaboration with TSRA.

Note: Additional activities are being conducted under this project through co-investment from the GBRMPA. These activities are already included in the MTSRF contract to JCU under contract variation addressed to Norman Palmer from Sheriden Morris dated 17 June 2007 and reference should be made to that document when considering the objectives of this project for completeness.

Project Targeted Activities 2007/2008

Objective	Targeted Activity	Completion Date
(a) and (c)	Report on the workshop in which extension officers employed by relevant Indigenous communities will be assisted to develop their own extension products via workshop at JCU in Townsville	20 January 2008
(b)	Final report on work undertaken in 2007/2008 – including reports of fieldwork undertaken to identify aspects of nesting success and egg survivorship. The report will include an initial identification and baseline evaluation of key threats.	20 June 2008
(c)	Report on the communication of results of the research activities in partnership with TSRA and Cape York Land Council (for both the dugong research and the turtle work at Raine Island and Moulder Cay)	11June 2008

Project 1.4.1 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones – All JCU responsibilities. All reports to be written reports unless otherwise specified.**	Date
Signing of contract	
Report 1 submission: • Schedule of field activities (community feedback, site visits etc.) for objectives (a) and (b) (above). • Proposed schedule of training events for Indigenous Torres Strait Islander participants in project. • Plan of any communication activities in partnership with Indigenous organizations (including for obj c) plus detail of products for 2007/2008 and summary of liaison activities.	30 Sept 2007
Report 2 submission: • Report on communication workshop and field work conducted to date to meet objectives (b & c) (above): workshop minutes/outcomes, areas monitored, data collected, and preliminary findings. • Summary of any other liaison activities undertaken to date, including minutes of	11 Jan 2008

For 2007/2008 Outputs Only **Milestones – All JCU responsibilities. All reports to be written reports unless otherwise specified.**	**Date**
meetings/workshops if applicable.	
Report 3 submission: • Draft report on field work undertaken to date - to identify aspects of nesting success and egg survivorship. The report will build upon results from year 1 and include a revised identification and evaluation of key threats (obj b).	15 May 2008
Report 4 submission • Final report on fieldwork undertaken in year two - to identify aspects of sea turtle nesting success and egg survivorship. The report will build upon results from year 1 and include a revised identification and evaluation of key threats (obj b). • Final summary of communication activities undertaken through course of project and example of communication products.	11 June 2008
Total MTSRF Funding	**$225,000***

* Includes $3000 Visual Documentation Allocation.

Project 1.4.1 Budget

Year 2 – 2007/2008 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	$12,000
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 2007/2008

Item	MTSRF	JCU In-kind	TSRA In-kind*	GBRMPA In-kind	Total
Salaries	$93,000	$12,000	$51,000	$5,000	$161,000
Operating	$50,000	-	-	$50,000	$100,000
Travel	$56,000	$15,000	-	$5,000	$76,000
Communication/Extension	$23,000	-	-	-	$23,000
Capital	-	$50,000	-	-	$50,000
Total	**$222,000**	**$77,000**	**$51,000**	**$60,000**	**$410,000**

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

JCU Project 1.4.1 Objective a Budget 2007/2008

Item	MTSRF	JCU In-kind	Total
Salaries	-	$5,000	$5,000
Operating	$5,000	-	$5,000
Travel	$5,000	-	$5,000
Communication/Extension	-	-	-
Capital	-	-	-
Total	**$10,000**	**$5,000**	**$15,000**

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

JCU Project 1.4.1 Objective b Budget 2007/2008

Item	MTSRF	JCU In-kind	TSRA In-kind*	GBRMPA In-kind	Total
Salaries	$93,000	$2,000	$41,000	$5,000	$141,000
Operating	$45,000	-	-	$50,000	$95,000
Travel	$41,000	$5,000	-	$5,000	$51,000
Communication/Extension	$13,000	-	-	-	$13,000
Capital	-	$50,000	-	-	$50,000
Total	**$192,000**	**$57,000**	**$41,000**	**$60,000**	**$350,000**

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

JCU Project 1.4.1 Objective c Budget 2007/2008

Item	MTSRF	JCU In-kind	TSRA In-kind*	Total
Salaries	-	$5,000	$10,000	$15,000
Operating	-	-	-	-
Travel	$10,000	$10,000	-	$20,000
Communication/Extension	$10,000	-	-	$10,000
Capital	-	-	-	-
Total	**$20,000**	**$15,000**	**$10,000**	**$45,000**

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

Indicative Budget Summary – Years 3, 4

Year	MTSRF*	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$237,000	-	$47,000	-	$22,000	$306,000
2009/2010	$250,000	-	$31,000	-	$21,000	$302,000
Total	**$487,000**	**-**	**$78,000**	**-**	**$43,000**	**$608,000**

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 Commitment 2007/2008

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
Alana Grech	JCU	Expert in spatial risk assessment	1.0
PhD students*	2 x JCU	Two PhD projects have been identified (1) acoustics of cetacean and sea turtles and (2) socio-economics of turtle and dugong issues	1.5 FTE (note economics 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 2007/2008

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.
c) To deliver information on marine species of conservation concern into the Data Integration and Synthesis framework for reporting, of the MTSRF using a spatial risk assessment approach in the GBR and Torres Strait.

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 has been deferred until Jan 2008 because of the

unexpected necessity of transferring the task from ANU to JCU in April 2007 and the resultant delays in recruiting the PhD student.

Objective (c) Deliver information on marine species of conservation concern into the Data Integration and Synthesis framework of the MTSRF using a spatial risk assessment approach.

This task will use a spatial risk assessment approach and a GIS-based Decision Support System to integrate: spatial data obtained from the dugong aerial surveys (see Project 1.4.1); 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. In collaboration with the Torres Strait Program, the task will also train Torres Strait Islanders in community GIS and with co-funding from the Torres Strait Program undertake a community mapping program in most of the 19 Torres Strait communities. This program will be managed by Indigenous counterparts, with assistance from Research Associate Alana Grech.

Project Targeted Activities 2007/2008

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 2008
(b)	Report on the evaluation of economic factors related to Indigenous hunting and its management.	June 2008
(c)	(1) A spatial model of dugong distribution and relative density in Torres Strait from data integrated across six aerial surveys from 1987-2006 including the dugong survey conducted as part of Project 1.4.1 (with co-funding already obtained from ACAMMS via JCU). (2) An upgraded spatially explicit dugong distribution and density model or the northern GBR using data from the dugong survey conducted as part of Project 1.4.1 (with co-funding from JCU and GBRMPA already obtained through the JCU Collaborative Grant Scheme). (3) A spatial risk assessment of the ecological consequences of various mutual obligation scenarios to manage hunting and commercial gill netting in the northern GBR to inform discussions between GBRMPA and the communities, and GBRMPA and the Queensland Fisheries Service (with co-funding from JCU and GBRMPA already obtained through the JCU collaborative grant scheme). (4) A report on a workshop to train Torres Strait Islanders in community GIS. (5) A report on progress with the Torres Strait GIS-based Decision Support System to be used in developing adaptive solutions to natural resource management problems (6) Input to the regional Data Integration and Synthesis for developing Integrated Reports for Northern GBR and Torres Strait.	June 2008

Project 1.4.2 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones – All JCU responsibilities. All reports to be written reports unless otherwise specified.**	**Date**
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 2007
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 2008
Report 3 submission: • Draft report on findings of Year 2 activities in relation to objectives (a), (b) and (c) including summary of field and desktop work undertaken, consultation undertaken, plan for completion in out years.	15 May 2008
Report 4 submission: • Final report on findings of Year 2 activities in relation to objectives (a), (b) and (c) including summary of field and desktop work undertaken, consultation undertaken, plan for completion in out years.	10 June 2008
Total MTSRF Funding	**$95,000***

* Includes $20,000 from Torres Strait Program; $10,000 from Project 1.4.1 (compared with ARP1); and $1,000 of this project is allocated to Visual Documentation

Project 1.4.2 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$94,000	-	$94,000
MTSRF Visual Documentation*	$1,000	-	$1,000
Co-investment	-	$178,500	$178,500
Total	**$95,000**	**$178,500**	**$273,500**

* A total of $1,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5). Includes $20,000 from Program 3 Torres Strait.

JCU Project 1.4.2 Objective (a) Budget 2007/2008

Item	MTSRF Funds	JCU/UQ In-kind	Total Cost
Salaries	$20,000	$15,000	$35,000
Operating	-	$21,000	$21,000
Travel	-	-	-
Communication / Extension*	-	-	-
Capital	-	$50,000	$50,000
Total	**$20,000**	**$86,000**	**$106,000**

JCU Project 1.4.2 Objective (b) Budget 2007/2008

Item	MTSRF Funds	JCU / ANU / CSIRO In-kind	Total Cost
Salaries	$10,000	$16,000	$26,000
Operating	$1,000	$1,000	$2,000
Travel	$4,000	-	$4,000
Communication / Extension*	-	-	-
Capital	-	$2,000	$2,000
Total	**$15,000**	**$19,000**	**$34,000**

JCU Project 1.4.2 Objective (c) Budget 2007/2008

Item	MTSRF Funds	In-kind / Co-funding	Total Cost
Salaries	$26,000	$43,000+	$69,000
Operating	$13,000	$10,500+	$23,500
Travel	$20,000*	-	$20,000
Communication / Extension)*	-	-	-
Capital	-	$20,000	$20,000
Total	**$59,000**	**$73,500**	**$132,500**

*Communication and extension for this project will be conducted in association with Project 1.4.1 and funded from that project

+ co-funding already obtained from ACAMMS ($24,035; Grech salary $15,000); JCU collaborative grant ($9,500; Grech salary $9000); JCU Dugong Research Fund ($10,000 all Grech salary)

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total++
		Cash	In-kind	Cash	In-kind	
2008/2009	$63,000	-	$95,000	[$75,000+]	[$168,000+]	$158,000++
2009/2010	$50,000	-	$45,000	-		$95,000++
Total	**$113,000**	**-**	**$140,000**	**[$75,000+]**	**[$168,000+]**	**$253,000++**

+ assumes external co-funding obtained for community GIS in Torres Strait.

++ Potential co-funding not included, if obtained will be included as a contract variation.

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 Commitment 2007/2008

Title	Organisation	Role	FTE
Daniel Metcalfe	CSIRO	Tropical Plant Ecologist	0.2
David Westcott	CSIRO	Vertebrate Ecologist	0.1
Andrew Krockenberger	JCU	Vertebrate physiologist	0.2

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
WTMA	Steve Goosem
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
QEPA	Peter Latch
ARC	Russell Butler

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 and WTMA statutory reporting. This will 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 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)-(f): 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 QEPA 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 with involve agreement with stakeholders on survey site selection and prioritisation, 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.

The first year of this project has focussed on better 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 have been 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 diversity, the presence of signs of threatened or feral animals. Newly 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 (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 (g) 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. Second, 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 fragment survey sites in Tully-Murray-South Johnstone catchments	October 2007
(c)	Survey fieldwork and ground-truthing of models*	May 2008
(b), (c), (d), (e)	Decision with Research Users (see Table 2) about broad location of subsequent years' work (either continuation in Tully-Murray-South Johnstone, or extension into additional catchments)	May 2008
(d), (e), (f)	Analysis of threats and trajectories*, workshops and reporting	June 2008
(c), (d), (e), (f)	Provide geo-referenced data to MTSRF 1.2.1 and 2.6.2, to Terrain NRM, WTMA, QEPA & QPWS*	June 2008
(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)	Initiation of measurement of the effect of den-use on thermal environment of possums	October 2007
(g)	Preliminary measurements of metabolic responses to temperature in Herbert River ringtail possums	December 2007
(g)	Preliminary measurements of metabolic responses to temperature in Lemuroid ringtail possums	March 2008
(g)	Initial measures of thermal tolerance and microclimatic measures of habitat in adult microhylid frogs Identification of oviposition sites	June 2008
(g)	Completion of measurement of the effect of den-use on the thermal environment of possums	October 2008
(g)	Completion of measurements of metabolic responses to temperature in Lemuroid and Herbert River ringtail possums	December 2008
(g)	Completed measures of thermal tolerance and microclimatic measures of habitat in microhylid frogs	March 2009
(g)	Initial development of conceptual model of physiological limitation of microhylid frogs and ringtail possums	2009
(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 2007/2008

For 2007/2008 Outputs Only **Milestones [agency responsible for report identified in brackets]. All reports are written reports unless otherwise specified.**	**Date**
Signing of contract	
Report 1 submission: • Interim report on activities to meet objectives (a) – (f), specifically identification of target Regional Ecosystems for fragment survey work, identification of key fragments, development of photo-interpretation for fragment aging and initial fieldwork [CSIRO] • Summary of communication activities to date, and communication plan for 2007/2008 [CSIRO] • Update 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 Herbert River ringtails [JCU]	22 October 2007
Report 2 submission: • Interim report on activities to meet objectives (a) – (f), specifically a report on the initial fragment-group meeting (with project staff from 4.9.3 & 4.9.5), further contextualisation of fragments in time and space, fieldwork to date and preliminary findings[CSIRO] • Summary of communication activities to date [CSIRO] • Progress report on measurement of effect of den-use on thermal environment of possums. Update on activities and progress of measures of metabolic responses to temperature in Herbert River ringtails and activities and progress toward preliminary measures of metabolic responses to temperature in Lemuroid ringtail possums [JCU]	18 February 2008
Report 3 submission • Final report on findings of year 2 activities to meet objectives (a)-(f) – year 1 of fragment assessment including initial 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] • Progress 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] • Final report of any liaison activities undertaken including minutes of meetings/workshops to address objectives (a)-(f) (above). [CSIRO] • Plan for completion in out years. [JCU and CSIRO] • Contribution to plan for completion development by CSIRO for out years [JCU]	5 June 2008
Total MTSRF Funding	**$200,000***

* Includes $3,000 Visual Documentation Allocation.

Project 1.4.3 Budget

Year 2 – 2007/2008 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

CSIRO Project 1.4.3 Budget 2007/2008

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	$47,000	$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 – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$200,000	-	$197,000	-	$3,000	$400,000
2009/2010	$200,000	-	$197,000	-	$3,000	$400,000
Total	**$400,000**	**-**	**$394,000**	**-**	**$6,000**	**$800,000**

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 and 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.
QEPA	Complimentary rain forest surveys using a broadly similar methodology to compliment CORVEG surveys to be carried out in the lowland woodlands in 2007/2008. 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 prioritisation 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 organizations 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 mitigating and adapting to climate change, increased climate variability and 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	$160,000	$1,104,824	$1,844,824
Program 5ii	Climate Change – Rainforests	$520,000	-	$1,101,417	$1,621,417
Program 6	Invasive Species	$250,000	-	$206,250	$456,250
Total		**$1,350,000**	**$160,000***	**$2,466,491**	**$3,976,491**

* Predicted cash co-investment.

The total value of Theme 2 is $3,976,491

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	$160,000*	$2,206,241	$2,366,241
Total	**$1,260,000**	**$2,206,241**	**$3,466,241**

* 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	$160,000*	$1,104,824	$1,264,824
Total	**$740,000**	**$1,104,824**	**$1,844,824**

* 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 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 (Rainforests and Catchments)

	Cash	In-kind	Total
MTSRF	$520,000	-	$520,000
Other	-	$1,101,417	$1,101,417
Total	**$520,000**	**$1,101,417**	**$1,621,417**

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 will 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 will 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 CO_2 dynamics and develop landscape-level indicators for ecosystem response to climate change. It will also assess the potential of Wet Tropics vertebrates to adapt to predicted future climatic changes and predict the risk of extinction through climate change 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.

This Program will integrate closely with the Program on Climate Change and the Great Barrier Reef although it is clear that the impacts will be very different because of the vastly different ecosystems. It will also have a close relationship with the Programs on Rainforests and Sustainable Landscapes both under the Rainforests and Catchments Theme.

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

NB: 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 Commitment 2007/2008

Title	Organisation	Role	FTE
Dr Andreas Schiller	CSIRO	Hydrodynamic modeller	0.2
Mr Craig Steinberg	AIMS	Hydrodynamic modeller	0.5
Dr Mike Herzfeld	CSIRO	Hydrodynamic modeller	0.5
Mr Mike Mahoney	AIMS	Technical support: data specialist	0.5
Ocean modeller (subject to CSIRO approval)	CSIRO	Hydrodynamic modeller	0.3
Dr Tony Hirst	CSIRO	Climate Change Modeller	0.2
Dr David Griffin	CSIRO	Bio-physical modeller	0.2
Dr Russell Fiedler	CSIRO	Technical support: programming	0.3

Summary Table of Research Users 2007/20087

Organisation	Organisational Contact
AMPTO	Col McKenzie / Alan Wallish
GBRMPA	Paul Marshall
ARC	Russell Butler

Project Duration

Start Date: 1 July 2006 End Date: 30 June 2009

Project / Task Objectives

This project will focus on downscaling of physical climate change scenarios in the marine environment from global-scale down to reef-scale. The physical downscaling capability will be based on tools developed by CSIRO and AIMS and maintained in projects outside MTSRF. Products will be made available to all MTSRF projects, including global climate change scenarios (ocean and atmosphere), eddy-resolving regional ocean simulations of climate change, and sub-km/reef-scale ocean simulations of climate change. This project will underpin research on coral bleaching due to climate change by providing key physical

parameters to other research projects in MTSRF. As such, this project forms a cornerstone for informing ecosystem assessment and supporting management decisions in response to coral bleaching.

Key Objectives:

(a) Through multiple nesting of local models and forcing from an eddy-resolving/10-km scale hydrodynamic model (OFAM), we will downscale climate change signals to reef-scale (sub-km scale). To meet this objective, work will start using existing climate model output, using the existing OFAM 'nowcast' (1993-2005), or a present-day climate scenario. This approach will allow us to assess hierarchical model behaviour under downscaling conditions and will help to resolve technical issues.

Note 1: This project is closely linked to Program 5ii, Project 2.5ii.1; an equivalent project for rainforests and catchments. The climate change projections in both projects will start from the common starting point of global climate models. Different techniques, however, are required to provide regional detail in the two realms. There is also linkage at the level of data delivery. In the rainforests program, a regionally specific version of the climate scenario generator, OzClim is to be developed for data delivery. Although located in the rainforests proposal at this stage, OzClim will also provide predicted sea surface temperatures (based on the outcomes of the marine modelling).

Note 2: In case of no co-investment and in order to meet the objectives, the project has to draw on similar work done under the West Australian Marine Science Initiative (WAMSI) Node 2. In particular, the downscaling of climate change scenarios from climate change models to the 10km-eddy-resolving scale for the whole of the Australian EEZ will be done as part of WAMSI. Further downscaling in the GBR region with resolutions higher than 10km will be achieved as part of this project. Scheduling of work under MTSRF has been synchronized with WAMSI Node 2. Furthermore, as the same CSIRO and AIMS teams are involved in downscaling work in WAMSI and MTSRF the decision of climate change scenarios will also be made jointly (and in agreement with the tropical rainforest team). This approach will generate considerable added value to MTSRF at no extra cost.

Note 3: The shelf-to-reef down-scaling system might be enhanced at a later stage by a hydro-dynamic “ribbon model” around Australia (to be developed outside MTSRF Program).

Project / Task Methodology

Objective (a) Multiple shelf-scale downscaling with local models

We will use output from OFAM simulation of climate change scenarios to produce fine-resolution ocean climate change scenarios. Assess output and provide data to decision-support tools in other project of MTSRF. The data sets will be made available in netcdf format.

The number of downscaling simulations in year 2 will be limited to a maximum of one complete scenario based on today’s climate and covering all spatial scales described by objective (a); year 3 will provide a maximum of 3 downscaling scenarios. We intend to use output from more than one climate model subject to being able to get access to appropriate forcing data sets. The choice of climate scenarios will be discussed with other projects and end users interested in outputs from this project. In particular, we will also take into account similar downscaling approaches adopted by the tropical rainforest project and coordinate our efforts with this team. Finally, we will draw on the experience of an ACCSP/CSIRO project which explores large-scale marine (physical) climate change impacts as simulated by coarse resolution climate models.

Project Targeted Activities 2007/2008

Objective	Targeted Activity	Completion Date
(a)	First reef-scale simulation completed	Jan 2008
(b)	Analysis and communication of first complete marine climate scenario	Jun 2008

Project Targeted Activities 2008/2009

Objective	Targeted Activity	Completion Date
(a)	Three (max.) reef-scale scenarios completed	Mar 2009
(b)	Rudimentary analysis and interpretation of three scenarios (max.) from eddy-resolving down to reef-scale completed	Jun 2009

In Years 2 and 3 we will use output from OFAM simulations of climate change (10km 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 2007/2008

For 2007/2008 Outputs Only **Milestones [agency responsible for report delivery identified in brackets] All reports to be written unless otherwise specified.**	**Date**
Signing of contract	
Report 1 submission: • Participation in MTSRF wide meeting regarding climate change modelling, scenario development and mapping of deliverables across the MTSRF. Report on findings of relevance to this project [CSIRO]. • Plan of any communication activities, products or events for year one two activities and summary of any communication activities undertaken to date (e.g. WAMSI), including minutes of meetings/workshops if applicable, schedule of future communication activities.[CSIRO]	Before December 2007
Evidence of provision of information on first downscaling experiment (agreed with CSIRO) to CSIRO to enable progress Report 2 submission [AIMS]	10 Dec 2007
Report 2 submission: • Progress report on activities conducted against objective (a) (above): Model details and outputs described [CSIRO] • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [CSIRO]	30 Jan 2008
Evidence of provision of information on first downscaling experiment (agreed with CSIRO) to CSIRO to enable progress Report 2 submission (including analysis of nested models and AIMS contribution to plan for out year activities) [AIMS]	28 May 2008
Report 3 submission: • Draft report describing analysis and outputs of first downscaling experiment of nested models. [CSIRO] • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [CSIRO] • Plan for out year activities [CSIRO]	9 Jun 2008
Total MTSRF Funding	**$125,000***

* Includes $2,500 Visual Documentation Allocation.

Project 2.5i.1 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$122,500	-	$122,500
MTSRF Visual Documentation*	$2,500	-	$2,500
AIMS	-	$117,287	$117,287
CSIRO	-	$58,750	$58,750
Total	**$125,000**	**$176,037**	**$301,037**

* A total of $2,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project

CSIRO Project 2.5i.1 Budget 2007/2008

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	$27,376	$19,176	$46,552
Operating	$28,270	-	$28,270
Travel	$3,104	-	$3,104
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$39,574	$39,574
Total	**$58,750**	**$58,750**	**$117,500**

AIMS Project 2.5i.1 Budget 2007/2008

Item	MTSRF Funds	AIMS In-kind	Total Cost
Salaries	$50,000	$24,641	$74,641
Operating	$7,750	-	$7,750
Travel	$6,000	-	$6,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$92,646	$92,646
Total	**$63,750**	**$117,287**	**$181,037**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$125,000	TBC	TBC	TBC	TBC	TBC
2009/2010	$125,000	TBC	TBC	TBC	TBC	TBC
Total	**$250,000**	**TBC**	**TBC**	**TBC**	**TBC**	**TBC**

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

Project 2.5i.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 Commitment 2007/2008

Title	Organisation	Role	FTE
Dr Ken Anthony	UQ	Coral Physiology and Ecology	0.1
Dr Ray Berkelmans	AIMS	Coral Ecology	0.25
Dr Sophie Dove	UQ	Coral Physiology	0.1
Dr Julian Caley	AIMS	Evolutionary Ecology	0.1
Prof. Ove Hoegh-Guldberg	UQ	Coral Physiology	0.2
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	UQ	Satellite Oceanography	0.25
Ms Severine Choukroun	JCU/AIMS	Physical Oceanography	0.5
Mr. Nicholas Csaszar	JCU/AIMS	Coral and Algal Genetics	Student (AIMS)

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
DEW	Stephen Oxley
GBRMPA	Paul Marshall
AMPTO	Col McKenzie / Alan Wallish
ARC	Russell Butler

Project Duration

Start Date: 1 July 2006 End Date: 30 June 2010

Project / Task Objectives

(a) Refine threshold values for coral bleaching.

To improve our ability to detect coral stress and predict coral mortality risks in the future, we will develop new models that incorporate knowledge about how key environmental factors interact in the coral stress response, and to what extent potential acclimatisation and historical adaptation may affects 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 and recovery interact in order to better understand the associated risks of mortality.

This new information will be incorporated in the further development of new, process based multivariate stress algorithms (based on the degree–heating day principle), and risk-based approaches to the modelling of coral mortality (e.g. Anthony, Connolly and Hoegh-Guldberg 2007, L&O, 52:716-726). 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).

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.

(b) To determine the role of mesoscale oceanographic variability in mass coral bleaching patterns. Specific questions will be addressed in the analysis:

(a) Does the GBR regional circulation display short-term, seasonal and inter-annual variability, as deduced from Modis satellite data?

(b) Are the dynamics reflected in remotely-sensed patterns of phytoplankton biomass (chlorophyll *a* concentration)?

(c) To what extent can physical oceanographic processes explain spatial thermal stress variability?

(d) Can hotspots be identified in GBR regional waters from Modis satellite data? Specific events will be examined in detail (e.g. 2002 vs. 2006 coral bleaching periods) to identify the evolution of processes involved.

(c) Vulnerability of high trophic levels on the GBR (e.g. sea birds) to climate change.

Seabird foraging and reproductive success is explicitly linked to oceanographic variation. This makes seabirds sensitive indicators of potential climate change impacts at upper trophic levels in the GBR. Project (c) aims to use state-of-the-art data logging equipment attached to foraging seabirds to investigate the relationship between prey availability/accessibility and specific physiochemical oceanographic parameters. This will allow us to better predict how seabirds will respond to projected increases in sea-surface temperature, and so ultimately determine the likely range of oceanographic conditions within which seabird reproduction remains viable.

Specific Objectives

Determine how meso-scale oceanographic variability impacts foraging and reproductive success in wedge-tailed shearwaters. This includes:

i) Identifying specific foraging locations and/or oceanographic features targeted/used by foraging shearwaters;
ii) Establishing the relationship between within-season variation in SST and foraging success/reproductive output; and
iii) Establishing the relationship between among-season variation in SST and foraging success/reproductive output.

Project Activities for 2007/2008

Objective	Targeted Activity	Date
(a)	Progress Report which covers: • How do bleaching thresholds vary among and within coral species? • How does bleaching relate to reduced productivity amongst and within coral species? • How do the key environmental factors, such as temperature, light, and water quality interact to define thresholds for coral bleaching and/or mortality? • What is the influence of symbiont and host genetics in those thresholds? These questions will be addressed based on a combination of meta-data syntheses (i.e. review paper) and analyses of new experimental data. Investigate the heritability of thermal tolerance in *Acropora millepora* with C2-type zooxanthellae. Commence development of novel molecular markers for the identification of *Symbiodinium* and its physiological performance. Provide first map based reference for ITS2 identity of *Symbiodinium* in reef-building corals.	Jun 2008
(b)	Summarised physical data (*in situ* and satellite) and biological/ecological data (coral bleaching and associated benthic change data). Links to GBRMPA bleach watch web page/Annual report. Investigate the link between upwelling and coral bleaching and the utility of using strong upwelling events as a seasonal forecasting tool for upcoming bleaching summers.	Jun 2008
(c)	Progress report covering • Preliminary analysis of relationship between within-season variation in SST and foraging/reproductive success based on one seasons data. • Initial deployment of satellite telemetry data logging equipment and preliminary identification of critical foraging locations/oceanographic features based on one seasons data	Jun 2008

Project 2.5i.2 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones [agency responsible for report delivery identified in brackets]. All reports to be written report unless otherwise specified.**	**Date**
Signing of contract	
Participation in MTSRF wide meeting regarding climate change modelling, scenario development and mapping of deliverables across the MTSRF. [project team to nominate representative].	Before Dec 2007

Report 1 submission
• If possible report on findings of relevance to this project from participation in MTSRF wide climate meeting conducted in late 2007 [UQ].
• Progress report on activities conducted against objectives (above)
  • Description of the new physiological / ecological models being developed, including the role of acclimation / adaptation. Responsible: Anthony Dove [UQ].
  • Target coral species to be examined to calibrate and test models and justification for selection of such species. Responsible: Anthony Dove [UQ]
  • Data sets examined and key findings from that process that enable refinement of link between bleaching severity and reduced productivity. Responsible: Dove [UQ]
  • Oceanographic processes targeted for review to explain mass coral bleaching. Responsible: Steinberg, [AIMS],
  • Satellite data sets targeted for review to explain mass coral bleaching. Responsible: Weeks, [UQ]
  • Investigate and identify relevant data sets to use in linking upwelling to coral bleaching and provide justification for data sets selected. Responsible: Berkelmans, [AIMS]
  • Complete laboratory analysis of tissue samples from first heritability experiment – description of preliminary findings. Responsible: van Oppen/Csaszar [AIMS]
• Plan for 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 [UQ].
• Establish a database of *Symbiodinium* types in collaboration with Todd LaJeunesse's global study. Establish strategy for interfacing with Scott Wooldridge team at AIMS (UQ/Hoegh-Guldberg)
• Progress report on activities conducted against objectives (c) above
  • Collation of data obtained from SST data loggers. Responsible: Congdon [managed by UQ]
• Relational linking of data on foraging success, provisioning rates, chick developmental rates, and reproductive success to SST data for individual adults. Responsible: Congdon [JCU]
	1 Nov 2007

Report 2 submission Information transfer between agencies • Evidence of provision of UQ data on differential susceptibility of coral-dinoflagellate symbioses to thermal stress to GBRMPA (Paul Marshall). Responsible: Hoegh-Guldberg [UQ]. • Evidence of provision of physical *in situ* summary data from AIMS to UQ. Responsible: Steinberg [AIMS]. • Evidence of ongoing provision of MODIS satellite data from NASA to UQ: Responsible: Weeks [UQ].	10 Apr 2008

For 2007/2008 Outputs Only **Milestones [agency responsible for report delivery identified in brackets]. All reports to be written report unless otherwise specified.**	**Date**

• Evidence of provision of summary data to GBRMPA on temperature trends against bleaching thresholds. Responsible: Berkelmans [AIMS]
• Progress update on activities conducted against objectives (a) - (b) (above): progress on experimental work, preliminary findings [UQ]
• Report on status and trends of bleaching of coral species within the GBR and variability of bleaching susceptibility in response to genetic and environmental variables. [UQ]
• Description of findings from trend analysis of GBR biogeographic provinces/key locations from Modis data. Responsible: Weeks [UQ]
• Analyse, characterize and describe the relationship between upwelling and coral bleaching Responsible: Berkelmans [AIMS]
• Preliminary findings from second heritability experiment with *A. millepora* from Davies Reef. Responsible: van Oppen/ Csaszar [AIMS]
• Plan to complete year 2 activities. [UQ]
• Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [UQ]
• Report on the analysis of the ITS2 identity of Symbiodinium within 800 corals. [UQ/Hoegh-Guldberg]
• Identify candidates for potential markers for improving precision of population studies of *Symbiodinium*. (van Oppen/AIMS)
• Progress report on activities conducted against objectives (c) above
  • Preliminary analysis of SST preferences of foraging adults. Responsible: Congdon [managed by UQ]
  • Preliminary analysis of relationships between SST and foraging success. Responsible: Congdon [managed by UQ]
• Preliminary overlay of satellite telemetry foraging tracks on associated physiochemical and satellite oceanographic data layers to establish possible links. Responsible: Congdon [managed by UQ] / Weeks [UQ]	

Report 3 submission • Report which covers: How bleaching thresholds vary between and within coral species, with respect to genetics and with variables such as light and water quality and how threshold values link to mortality risk of corals Responsible: Anthony / Dove [UQ]. • Contribute to description of findings (developed by UQ) from correlation of *in situ* current meter data and satellite imagery with changes in chlorophyll and temperature. Responsible: Steinberg [AIMS] • Description of findings from correlation of *in situ* current meter data and satellite imagery with changes in chlorophyll and temperature. Responsible: Weeks [UQ]. • Report on the assessment of the utility of upwelling as a seasonal forecasting tool of coral bleaching events. Responsible: Berkelmans [AIMS] • Findings from the preliminary assessment of the broadsense heritability of thermal tolerance in *Acropora millepora.* Responsible: van Oppen/ Csaszar [AIMS] • Evidence that copy of workshop minutes/documents provided to other MTSRF projects describing threshold findings: note which projects information provided to and any collaboration. [UQ] • Copy of summarized physiological and biological data provided to GBRMPA bleach watch report/web page. [Responsible: UQ] • Completion plan for remaining activities in out years. [UQ]	10 Jun 2008

For 2007/2008 Outputs Only	Date
Milestones [agency responsible for report delivery identified in brackets]. All reports to be written report unless otherwise specified.	
• Map produced in collaboration with Wooldridge at AIMS of *Symbiodinium* types on the GBR. Perspective developed on ARP-3 mission. (Hoegh-Guldberg/ UQ) • Report on new marker development (AIMS/Van Oppen) • Progress report as per objectives (c) above [UQ]	
Total MTSRF	**$217,500***

* Includes $3,500 Visual Documentation Allocation.

Project Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$196,500	-	$196,500
MTSRF Visual Documentation*	$3,500	-	$3,500
Great Barrier Reef Foundation (GBRF)	$100,000	-	$100,000
The University of Queensland	-	$95,000	$95,000
Australian Institute of Marine Science	-	$190,164	$190,164
ARC Centre of Excellence	-	$55,000	$55,000
NASA	-	$50,000	$50,000
Total	**$300,000**	**$390,164**	**$690,164**

* A total of $3,500 held by Reef and Rainforest Research Centre for Visual Documentation for this project

UQ Project 2.5i.2 Budget 2007/2008

Item	MTSRF + GBRF Funds	UQ In-kind	Total Cost
Salaries	$110,000	$74,000	$184,000
Operating (corals and birds)	$70,000	$30,000	$100,000
Travel	$17,000	$7,000	$24,000
Communication / Extension	$20,500	$20,000	$40,500
Satellite data	-	$50,000	$50,000
Capital	-	-	-
Institutional overheads	-	$19,000	$19,000
Total	**$217,500**	**$200,000**	**$417,500**

* $100,000 cash co-investment yet to be allocated.

AIMS Project 2.5i.2 Budget 2007/2008

Item	MTSRF + GBRF Funds	In-kind	Total Cost
Salaries	$49,000	$40,588	$89,588
Operating	$30,000	-	$30,000
Travel	-	$37,500	$37,500
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$112,076	$112,076
Total	**$79,000**	**$190,164**	**$269,164**

* $100,000 cash co-investment yet to be allocated.

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$200,000	TBC	TBC	TBC	TBC	TBC
2009/2010	$200,000	TBC	TBC	TBC	TBC	TBC
Total	**$400,000**	**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 Leaders and Host Organisations

Professor Terry Hughes, James Cook University (JCU)
Dr Julian Caley, Australian Institute of Marine Science (AIMS)

Project Team Commitment 2007/2008

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
Dr Philip Munday	JCU	Fish Biology and Ecology	0.05
Dr Morgan Pratchett	JCU	Fish Biology and Ecology	0.1
Professor David Bellwood	JCU	Fish Biology and Ecology	0.1

Summary Table of Research Users 2007/2008

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 modelling 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 of 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 *Symbiodinium* populations on the GBR	June 2007
(a)	Assessment of small scale population structure and genetic connectivity among populations in the *Acropora aspera* group	June 2008
(b)	Modelling framework for rates of adaptation for bleaching resistance	June 2007
(b)	Assessment of expression levels of genes involved in the bleaching response in coral populations from different thermal environments	June 2009
(b)	Understanding of 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.	Mar 2008
(c)	Analyse patterns in coral disease prevalence on the GBR in relation to seawater temperature patterns.	June 2008
(c)	Develop a model to predict the likelihood of coral disease outbreaks in response to ocean warming.	Dec 2008
(c)	Present report on the vulnerability of GBR corals to disease in relation to ocean warming.	June 2009
(d), (e)	Collate available data on herbivory patterns on GBR	Dec 2006
(d), (e)	Status and trend report on herbivory patterns on GBR based on current knowledge.	May 2007
(d), (e)	Develop a protocol for quantifying the capacity of inshore reef fish communities to respond to local macroalgal growth; directly identifying the critical functional groups responsible for macroalgal browsing.	Dec 2007
(d), (e)	Complete experimental evaluation of relative susceptibility of dominant inshore macroalgal species to browsing by mobile reef	June 2008

Objective	Targeted Activity	Completion Date
	herbivores.	
(d), (e)	Evaluate Island-scale variation in herbivory on macroalgae using a hierarchical design to explore site and local variation in browsing rates.	June 2008
(d), (e)	Report on Island-scale variation in herbivory and estimated capacity of inshore reefs to respond to increased macroalgae.	June 2008
(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, modelling of coral algal phase shifts under different climate change scenarios.	June 2010
(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.	Dec 2010
(f)	2007/2008 surveys of fish assemblages on Trunk Reef. Report on trajectories for coral cover and fish populations 5-yr post-disturbance.	Mar 2008
(f)	2008 surveys of fish assemblages on Trunk Reef. Compare fish and coral communities at Trunk Reef to pre-disturbance structure, as well as against other reefs with contrasting disturbance histories	June 2009
(f)	2009 surveys of fish assemblages on Trunk Reef. Establish key factors and limitations to recovery in highly disturbed fish communities. Briefing to end-users GBRMPA, DEH, DPI&F.	Dec 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 2007/2008

For 2007/2008 Outputs Only	
Milestones [Agency responsible for report delivery identified in brackets]. All reports to be written reports unless otherwise specified.	**Date**
Signing of contract	
Participation in MTSRF wide meeting regarding climate change modelling scenario development and mapping of deliverables across the MTSRF.	Before Dec 2007

Report 1 submission:
• Progress report on activities conducted against objectives (above)
  • Preliminary findings of microsatellite genotyping of populations of the corals *Acropora millepora, A.spathulata, A. pulchra, A. aspera, A. papillare* from the Palm Islands. (a) [JCU]
  • Preliminary findings of optimization of microsatellite loci for *Symbiodinium* species (a) [JCU]
  • Contribute to JCU report on preliminary findings of microsatellite genotyping of populations of the corals *Acropora millepora, A.spathulata, A. pulchra, A. aspera, A. papillare* from the Palm Islands.(a) [AIMS]
  • Contribute to JCU report on preliminary findings of optimization of microsatellite loci for *Symbiodinium* species [(a) AIMS]
  • Report on results from modelling of bleaching resistance evolution
	1 Mar 2008

For 2007/2008 Outputs Only	
Milestones [Agency responsible for report delivery identified in brackets]. All reports to be written reports unless otherwise specified.	**Date**
[(b) AIMS] • Progress report on developing a modelling framework for investigating the relationship between coral disease abundance and ocean warming. [(c) JCU] • Preliminary findings of quantification protocol for identifying critical functional groups and measuring the capacity of reef fishes to respond to increased macroalgae on the GBR. [(d/e) JCU] • Summary of any communication activities undertaken to date, including 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) • Report on population structure and genetic connectivity of populations of the corals *Acropora millepora, A.spathulata, A. pulchra, A. aspera, A. papillare* from the Palm Islands. [(a) JCU] • Preliminary findings from analysis of genetic diversity in populations of the coral, *Acropora pulchra,* before and after a mass bleaching event. [(a) AIMS] • Findings from complete common garden experiment of *Acropora millepora* from Davies Reef and Orpheus Island to assess extent of fixed population differences in gene expression. [(b) JCU] • Contribute to JCU report on population structure and genetic connectivity of populations of the corals *Acropora millepora, A.spathulata, A. pulchra, A. aspera, A. papillare* from the Palm Islands. [(a) AIMS] • Contribute to AIMS report on preliminary findings from analysis of genetic diversity in populations of the coral, *Acropora pulchra,* before and after a mass bleaching event. [(a) JCU] • Contribute to JCU report on findings from complete common garden experiment of *Acropora millepora* from Davies Reef and Orpheus Island to assess extent of fixed population differences in gene expression. [(b) AIMS] • Preliminary findings from modelling framework for rates of adaptation for bleaching resistance, description of refinement [(b) AIMS] • Preliminary report on findings of relationship between seawater temperature and prevalence of coral disease for one disease type [(c) JCU] • Report on progress of development of protocol for identifying critical functional groups and measuring capacity of reefs to respond to increasing macroalgae.[(d/e) JCU] • Findings from complete experimental evaluation of relative susceptibility of macroalgal species to browsing by reef fishes.[(d/e) JCU] • Description of findings from evaluation of Island-scale variation in herbivory on macroalgae: site and local variation in browsing rates. [(d/e) JCU] • Report on findings of estimated capacity of GBR reefs to respond to	11 Jun 2008

For 2007/2008 Outputs Only	
Milestones [Agency responsible for report delivery identified in brackets]. All reports to be written reports unless otherwise specified.	**Date**
climate change induced increases in macroalgae..[(d/e) JCU] • Report on findings: trajectories for coral cover and fish populations 5 years post-disturbance [(f) JCU] • Summary of any communication activities undertaken, including minutes of meetings/workshops if applicable. [JCU] • Contribute to JCU report on summary of any communication activities undertaken, including minutes of meetings/workshops if applicable. [AIMS] • Contribution of AIMS activities to completion plan for out year activities [AIMS] • Completion plan for remaining activities in out years. [JCU]	
Total MTSRF Funding	**$150,000**

* There is no visual Documentation from this project

Project 2.5i.3 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$150,000	-	$150,000
Great Barrier Reef Foundation (GBRF)	$50,000		
AIMS	-	$172,630	$172,630
PEW Foundation	-	$4,000	$4,000
JCU	-	$250,000	$250,000
Total	**$200,000**	**$426,632**	**$626,632**

JCU Project 2.5i.3 Budget 2007/2008

Item	MTSRF + GBRF Funds	JCU In-kind + PEW Foundation In-kind	Total Cost
Salaries	$75,000	$150,000	$225,000
Operating	$20,000	-	$20,000
Travel	$55,000	-	$55,000
Communication / Extension	-	-	-
Capital	-	-	-
Total	**$150,000**	**$150,000**	**$300,000**

AIMS Project 2.5i.3 Budget 2007/2008

Item	MTSRF + GBRF Funds	AIMS In-kind	Total Cost
Salaries	$15,000	$26,298	$41,298
Operating	$30,000	-	$30,000
Travel	-	$94,400	$94,400
Communication / Extension	$5,000	-	$5,000
Capital	-	-	-
Institutional overheads	-	$51,932	$51,932
Total	**$50,000**	**$172,630**	**$222,630**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind*	Cash	In-kind	
2008/2009	$150,000	-	$110,000	-	$217,000	$477,000
2009/2010	$150,000	-	$110,000	-	$217,000	$477,000
Total	**$300,000**	**-**	**$220,000**	**-**	**$434,000**	**$954,000**

* 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 Commitments 2007/2008

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

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
GBRMPA	Gillian Goby / Lawrence McCook
Reef Foundation	Judy Stewart
AMPTO	Col McKenzie
ARC	Russell Butler

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, therefore, 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 which 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 atlas of climate change risk and resilience for the GBR social-ecological system and b) 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) Develop an atlas of climate change risk and resilience for the GBR social-ecological system (SES).

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

Project / Task Methodology

Objective (a): An atlas of climate change risk and resilience for the GBR social-ecological system.

Climate change is acknowledged as one of the most serious challenges 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 developing an atlas of climate change risk for key elements of the GBR social-ecological system (SES). 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, such an atlas 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.

The atlas will comprise maps of risk and resilience of priority elements of the GBR SES. 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 at scales of relevance to management 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 atlas of climate change risk and resilience produced in Project 2.5i.4, 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-modelling 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.
- Develop the framework for a spatial model that assesses the impacts of climate change on the water quality outcomes for BMP implementation in land based management systems.

Project Targeted Activities 2007/2008

Objective	Targeted Activity	Completion Date
(a,b)	• Facilitate a spatial linkage between end-of-catchment water quality scenarios (CSIRO), and the follow-on flood plume dilution across the GBR lagoon [AIMS]	July 1 2007 – June 30 2008
(a,b)	• Develop a downscaling methodology that enables GCM-scale scenarios of future SST to be interpreted as a regional-scale coral bleaching threat [AIMS]	
(b)	• Develop a decision support framework for the inshore reef areas of the GBR lagoon, which enables the envelope of future bleaching risks to be mapped as a function of land management imperative and global warming scenarios [AIMS]	
(b)	• Undertake a high level socio-economic and demographic characterisation of the region using ABS, OESR and other	

	statistical sources [CQU]	
(b)	• Undertake a detailed socio economic analysis of three key industries in the region including input-output analysis for three hubs [CQU]	
(b)	• Assess the risk and resilience of GBR industries and regional communities, by adopting a staged process based on the risk management process set out in AS/NZS4360 [CQU]	
(b)	• Workshop the spatial linkage model and its outputs with end users and define targets based on reef outcomes (e.g. Reef Partnership and GBRMPA) [CSIRO]	
(b)	• Scenario test land management options to achieve land management that achieves targets based on reef outcomes [CSIRO]	
(b)	• Develop the framework for a spatial model that assesses the impacts of climate change on the water quality outcomes for BMP implementation in land based management systems [CSIRO]	

Project 2.5i.4 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones [agency responsible for delivery identified in brackets]. All reports are to be written reports unless otherwise specified.**	**Date**
Signing of contract	
Report 1 submission: • Participation in MTSRF wide meeting regarding climate change modelling, scenario development and mapping of deliverables across the MTSRF. Report on findings of relevance to this project [CSIRO].	Before Dec 2007
Submission of Progress Report (2), which; • Describe the methodology developed to facilitate the spatial linkage between end-of-catchment water quality scenarios (CSIRO), and the follow-on flood plume dilution across the GBR lagoon [AIMS] • Describe the findings from a high level socio-economic and demographic characterisation of the region using ABS, OESR and other statistical sources [CQU] • Present summary from workshop on the spatial linkage model and its outputs with end users and define targets based on reef outcomes (e.g. Reef Partnership and GBRMPA) [CSIRO] • Summary of any communication activities undertaken to date by the project team, including minutes of meetings/workshops if applicable, schedule of future communication activities.[AIMS]	1 Nov 2007
Submission of Progress Report (3), which; • Describe the downscaling methodology developed to enable GCM-scale scenarios of future SST to be interpreted as a regional-scale coral bleaching threat [AIMS] • Report findings from a detailed socio economic analysis of three key industries in the region including input-output analysis for three hubs [CQU] • Describes findings from scenario tests of land management options to achieve land management that achieves targets based on reef outcomes [CSIRO] • Summarise any communication activities undertaken to date by the project team, including minutes of meetings/workshops if applicable	30 Jan 2008

For 2007/2008 Outputs Only Milestones [agency responsible for delivery identified in brackets]. All reports are to be written reports unless otherwise specified.	Date
[AIMS]	
Submission of Report (4), which; • Describe a decision support framework developed for the inshore reef areas of the GBR lagoon, which enables the envelope of future bleaching risks to be mapped as a function of land management imperative and global warming scenarios [AIMS] • Describe findings from an assessment of the risk and resilience of GBR industries and regional communities, conducted by adopting a staged process based on the risk management process set out in AS/NZS4360 [CQU] • Describe the framework developed for a spatial model that assesses the impacts of climate change on the water quality outcomes for BMP implementation in land based management systems [CSIRO] • Provide a final summary of communication activities undertaken by the project team through the course of year 2 of project. [AIMS]	10 Jun 2008
Total MTSRF Funding	**$105,000***

* Includes $2,000 Visual Documentation Allocation.

Project 2.5i.4 Budget

Year 2 – 2007/2008 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	-	29,000	29,000
CQU	10,000**	37,700	47,700
Total	**115,000**	**112,200**	**227,200**

* A total of $2,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project

Co-investment in this project from the Great Barrier Reef Foundation is being negotiated. It is expected to be to the level of $100,000.

** CQU is contributing this funding towards salary costs of project personnel.

AIMS Project 2.5i.4 Budget 2007/2008

Item	MTSRF Funds	AIMS In-kind	Total Cost
Salaries	$35,000	$3,324	$38,324
Operating	$10,000	-	$10,000
Travel	$10,000	-	$10,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$42,176	$42,176
Total	**$55,000**	**$45,500**	**$100,500**

CSIRO Project 2.5i.4 Budget 2007/2008

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	$29,000	-	$29,000
Operating	-	$1,872	$1,872
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$27,128	$27,128
Total	**$29,000**	**$29,000**	**$58,000**

CQU Project 2.5i.4 Budget 2007/2008

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 – Years 3, 4

Year	MTSRF	Applicant		Other sources*		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$105,000	$20,000	$295,000	$210,000	-	$630,000
2009/2010	$105,000	$20,000	$295,000	$210,000	-	$630,000
Total	**$210,000**	**$40,000**	**$590,000**	**$420,000**	**-**	**$1,260,000**

* Co-investment not yet secured.

Proposed Outputs / Deliverables (Years 3 and 4)

Objective	Targeted Activity	Completion Date
(a)	• Develop a modelling methodology that accepts remotely-sensed data (e.g. MODIS) to help identify regional areas within the GBRWHA that experience regular upwelling events of cool, nutrient and CO_2 rich water [AIMS]	July 1 2008 – June 30 2009
(a)	• Investigate the potential for various skeletal variables (e.g. luminescence, ^{15}N) to act as proxy indicators of resilient coral reef locations [AIMS]	
(a)	• Investigate the potential for community-level indices of species richness and morphological complexity to act as proxy indicators of resilient coral reef locations [AIMS]	
(b)	• Preparation of draft socio-economic report [CQU]	
(b)	• Submission of draft socio-economic report [CQU]	
(b)	• Submission of final socio-economic report [CQU]	
(b)	• Assess costs/benefits of implementation of land management practice changes for reef health outcomes [CSIRO]	

Objective	Targeted Activity	Completion Date
(b) (b)	• Develop a spatial model of the impacts of climate change on the delivery of nutrients into the GBRWHA from land management practices [CSIRO] • Road test the spatial model of the impacts of climate change on the delivery of nutrients into the GBRWHA from land management practices with end users [CSIRO]	
(a) (a) (b) (b)	• Prepare draft report on bio-physical measures of coral reef resilience within the GBR [AIMS] • Submit final report on bio-physical measures of coral reef resilience within the GBR [AIMS] • Link spatial terrestrial climate change impacts model to flood plume dilution and reef impacts model [CSIRO] • Assess cost/benefits of implementation of land management practice changes for reef health outcomes [CSIRO]	July 1 2009 – June 30 2010

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 Penny Whetton, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Dr Penny Whetton	CSIRO	Climatologist	0.9
Dr Ramasamy Suppiah	CSIRO	Climatologist	0.57
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 2007/2008

Organisation	Organisational Contact
WTMA	Andrew McLean
Alliance of Sustainable Tourism	Annie Riddet
QEPA	TBA
ARC	Russell Butler

Project Duration

Start Date: 1 July 2006 End Date: 30 June 2010

Project / Task Objectives

Project 2.5ii.1 will develop 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 Targeted Activities 2007/2008

Objective	Targeted Activity	Completion Date
(a.1)	Analysis of existing AR4 global climate models	June 2007*
(a.2)	Analysis of higher resolution regional model simulations (horizontal resolution of 200 kilometres down to 60 kilometres).	September 2007*
(a.3)	Further analysis on minimum and maximum temperatures, humidity, rainfall, seasonality of rainfall, cloud base height, lapse rate and solar radiation,	June 2008*
(b.1)	Run CSIRO CCAM model under current greenhouse conditions nested in simulations with the CSIRO Mk 3 GCM	September 2007*
(b.2)	Run CSIRO CCAM model under enhanced greenhouse conditions	June 2008*
(c)	Interact with users of climate change products, eg. OzClim outputs and climate change projections, to determine the climate change information that is required and the form in which the information is required. We will develop a version of OzClim specifically relevant to MTSRF region at 0.05 deg horizontal resolution for monthly minimum, maximum and mean temperatures, and sea surface temperature, rainfall and humidity.	June 2008*

* An assessment of 23 AR4 climate models was completed 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 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones – all CSIRO responsibilities	Date
Signing of contract	
Report 1 submission: • Participation in MTSRF wide meeting regarding climate change modelling, scenario development and mapping of deliverables across the MTSRF. Report on findings of relevance to this project • Verbal progress update to operations committee 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. • One page (or less) summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	Before December 2007
Report 2 submission: Written Progress report on the following: • analysis of existing models (obj a): • current climate high-resolution simulation (obj b): • activities associated with objective c: outcomes of workshops or meetings held with end-users: • any communication activities undertaken to date, including minutes of meetings/workshops if applicable: .	28 February 2008

For 2007/2008 Outputs Only Milestones – all CSIRO responsibilities	Date
Report 3 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 (obj a). • Report on outcomes of the current climate simulation models for the Region developed/progressed in year two • Report on consultation undertaken with users and final summary of communication activities undertaken through the course of year 1 of project. • Plan for completion of out year activities.	8 June 2008
Total MTSRF Funding	**$100,000***

* Includes $2,000 Visual Documentation Allocation.

Project 2.5ii.1 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$98,000	-	$98,000
MTSRF Visual Documentation*	$2,000	-	$2,000
CSIRO	-	$95,520	$95,250
Total	**$100,000**	**$95,520**	**$195,520**

* A total of $2,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project

CSIRO Project 2.5ii.1 Budget 2007/2008

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	-	$65,520	$65,520
Total	**$98,000**	**$95,520**	**$193,520**

Indicative Budget Summary – Years, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$95,000		$95,000	-	-	$190,000
2009/2010	$50,000		$50,000	-	-	$100,000
Total	**$145,000**		**$145,000**	**-**	**-**	**$290,000**

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 Leader and Host Organisation
Dr. Peter Franks, James Cook University (JCU)

Project Team Commitment 2007/2008

Title	Organisation	Task Involvement	Role/Expertise	FTE
Dr Peter Franks	JCU	Project Leader (b);(d)	Plant Physiologist	0.25
Dr Michael Liddell	JCU	(a); (c); (d)	Atmospheric Chemist	0.25
Professor Nigel Stork	Uni Melbourne	(e)	Entomologist	0.1
Dr Paul Nelson	JCU	(c)	Soil Scientist	0.01
Ellen Weber	WTMA	(e)	Plant Ecologist	0.01

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
WTMA	Andrew McLean
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
QEPA	TBA
ARC	Russell Butler

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 a single site (tropical lowland rainforest) and determine how plants and invertebrates respond physiologically and phenologically, e.g. fruiting, flowering, etc.) 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 takes advantage of over $2 million in infrastructure and five years of data sets.

Key Objectives:

(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.

(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.

(c) To determine the likely effects of changing climate on the fluxes of carbon and water below ground, and on the factors controlling these fluxes.

(d) To correlate local, high resolution ecosystem information with regional, low resolution information from forest plots across the wet tropics- essential for ground-truthing and calibrating regional vegetation models.

(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). Biometry mass balance studies to calculate above-ground biomass will be expanded, these calculations make use of 1Ha dbh surveys (2001, 2005) and measurements made from the crane.

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.

Photosynthetic 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 likely effects of changing climate on the fluxes of carbon and water belowground, and on the factors controlling these fluxes.

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 (^{18}O). Measurement of the biophysical controls on carbon mineralisation in soil and leaching losses using incubations and ^{13}C NMR.

Objective (d): To correlate local, high resolution ecosystem information with regional, low resolution information from forest plots across the Wet Tropics – essential for ground-truthing and calibrating regional vegetation models.

Estimate qualitative changes in forest productivity (changes in above ground biomass) by integration of data from dendrometer, litter trap and LAI measurements. Correlate and compare seasonal trends with low resolution data from other catchments and elevations across the Wet Tropics.

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 2007/2008

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. Carry out preliminary Volatile Organic Carbon (VOC) measurements at the Crane site	June 2008
(b)	Tree Physiology: Collate 2007/2008 dendrometer and litter trap data. Analyse 2007/2008 leaf litter and fresh leaf* carbon isotopes. Analyse 2007/2008 leaf litter and fresh leaf N*. Collate 2008 canopy LAI data. Collate 2008 canopy leaf conductance data*. (*note this is contingent on crane access in 2008)	June 2008
(c)	Soil: Install monitoring bore(s) with depth loggers Complete installation of soil water monitoring sensors Monitor soil water and calculate water uptake from soil Monitor watertable Analyse soil and soil solution for C (amount and characteristics)	June 2008
(d)	Correlate the results from dendrometer and leaf litter trapping studies at the ACC site with results from the Wet Tropics for 2007	June 2008
(e)	Fauna and Phenology: Collect observational data of insect resource use in the canopy and on the ground. This will include making direct observations (from the canopy crane gondola) of insects feeding on and residing in particular resources. Other insect collecting techniques (leaf beating, bark sprays etc) will also be employed to make further insect-habitat associations. Phenological dataset collection will continue. Analyse Ordinal insect data (2000-2004) and relate it to phenological and beetle species data collected over the same time period. Correlations will be examined between variations in insect abundance and climatic variability.	June 2008

Project 2.5ii.2 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones – All JCU responsibilities. All reports are to be written reports unless otherwise specified.s	Date
Signing of contract	
Report 1 submission: progress report describing: • the fluxes of carbon and water from the rainforest in relation to climatic drivers (obj a). • the physiological controls on rainforest tree productivity and water use efficiency (obj b). • characterisation of the soil, soil fluxes and site hydrology at the canopy crane site (obj c). • resource related fluctuations in insect populations and how they relate to ecosystem productivity and climate variability. Current status of phenological monitoring program. (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 2007
Report 2 submission: progress report describing • Preliminary findings of work on the fluxes of carbon and water from the 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 characterising of the soil, soil fluxes and site hydrology at the canopy crane site (obj c). • Preliminary findings from work on the resource related fluctuations in insect populations and how they relate to 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 2008
Report 3 submission • End of year report on the results of the basic biophysical data (fluxes of carbon, water linked to microclimate variables) required in understanding forest level response to climatic drivers (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) provided in conjunction with data from OzClim (Objective (c) from 5.2.ii.1. • End of year report of the results on characterisation of the soil structure, soil chemistry and exploratory hydrology at the canopy crane site (obj c). • End of year report on plant resource fluctuations and variations in insect populations. How insect population changes relate to ecosystem status / productivity and climate variability will be examined (obj e). • Summary of communication activities undertaken through the course of year 2 of project, including any examples of application of the results by WTMA, DEW, QEPA and Terrain NRM.	8 June 2008
Total MTSRF Funding	**$120,000***

* Includes $2,000 Visual Documentation Allocation.

Project 2.5ii.2 Budget

Year 1 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$118,000	-	$118,000
MTSRF Visual Documentation*	$2,000	-	$2,000
JCU	-	$276,000	$276,000
Total	**$120,000**	**$276,000**	**$396,000**

* A total of $2,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project.

JCU Project 2.5ii.2 Budget 2007/2008

Item	MTSRF Funds	JCU In-kind + Canopy Crane Funds	Total Cost
Salaries	$58,000	$76,000	$134,000
Operating	$55,000	$200,000	$255,000
Travel	$5,000	-	$5,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	**$118,000**	**$276,000**	**$394,000**

Indicative Budget Summary – Years, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash*	In-kind	Cash	In-kind	
2008/2009	$120,000	$200,000[1]	$76,000	$109,000	-	$505,000
2009/2010	$120,000	$200,000[1]	$76,000	$109,000	-	$505,000
Total	**$240,000**	**$400,000**	**$152,000**	**$218,000**	**-**	**$1,010,000**

[1] Funding of $200,000 per year for one year has been secured from the following charitable organisations and is provided through James Cook University: John T. Reid Charitable Trusts, Vincent Fairfax Family Foundation.

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 Hilbert, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
David Hilbert	CSIRO	Ecological Modeler	0.32
David Westcott	CSIRO	Plant Ecologist	0.12
Dan Metcalfe	CSIRO	Vertebrate Ecologist	0.12
Petina Pert	CSIRO	Spatial analyst	0.24
Andrew Ford	CSIRO	Botanist and biogeographer	0.12
Dean Jones	CSIRO	Animal ecology technician	0.24
Adam McKeown	CSIRO	Animal ecology technician	0.24

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
QEPA	TBA
WTMA	Steve Goosem
ARC	Russell Butler

Project Duration

Start Date: 1 July 2006 End Date: 30 June 2010

Project / Task Objectives

Project 2.5ii.3 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. This project will take advantage of existing data from ten to twenty-five years of collections at these sites, plots maintained by CSIRO, and through the Rainforest CRC. 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. 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 other MTSRF programmes and projects that will be mapped explicitly in the next year. While tourism industry and aboriginal group needs where not identified in the original development of MTSRF, with respect to this project, the project will now engage these stakeholders as much as possible. However, additional new research or activities aimed at these groups would require further funding.

Key Objectives:

(a) Assessment of current and ongoing climate change impact.
(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 will be 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 elevation intervals and coinciding as much as possible with MTSRF Project 2.5ii.4's existing altitudinal surveys of vertebrates. All trees ≥10cm dbh enumerated and measured (dbh and height) 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 focal tree studies of disperser feeding, fruiting phenology and Identification of dispersal functional groups by elevation.
- The distribution of vectors of animal diseases and the diseases themselves. Standard mosquito traps and standard 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 2.5ii.4.
- 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 Targeted Activities 2007/2008

Objective	Targeted Activity	Completion Date
(a)	Initial assessment of how forest structure, biomass and species composition change along altitudinal climate gradients.	June 2008*
(a)	Initial assessment of how forest dynamics change along altitudinal climate gradients.	January 2008*
(a)	Initial assessment of how seed dispersal processes change along altitudinal climate gradients.	June 2008*
(a)	Initial assessment of the distribution of vectors of animal diseases and the diseases themselves along altitudinal climate gradients.	January 2008*
(a)	Initial assessment of the distribution of vectors of animal diseases (chickens) and the diseases themselves along altitudinal climate gradients. Assess the use of molecular methods in place of sentinel chickens	June 2008* December 2007
(b), (c), (d)	An updated model of forest distributions based on climate, soils and topography: Further modify the neural network model to meet the needs of the project. Develop several climate change scenarios 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 outputs from the climate scenarios project.	June 2008*
(e)	Initial mapping of forest environments under several climate change scenarios	June 2008*

* Involves activities that carry into Out Years.

Anticipated Objectives / Deliverables for Years 3 and 4

Objectives	Deliverables	Approximate Date
Initial assessment of how forest structure, biomass and species composition changes along altitudinal climate gradients	Report on forest structure and biomass along an altitudinal gradient	December 2008
Initial assessment of how seed dispersal processes change along altitudinal climate gradients	Report on how seed dispersal processes change along altitudinal climate gradients	June 2009
Initial assessment of the distribution of vectors of animal diseases and the diseases themselves along altitudinal climate gradients	Preliminary report on the distribution of vectors of animal diseases and the diseases themselves along altitudinal climate gradients	June 2009
Advice to managers concerning the present changes and greatest threats to ecosystems due to climate change	Report to managers on the present changes and greatest threats to ecosystems due to climate change	June 2010

Objectives	Deliverables	Approximate Date
Maps of refugia for forest types in 2025, 2050, and 2100 under several realistic climate change scenarios	Maps and GIS data layers	June 2009
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
Spatial identification of weed threats to ecosystems in relation to climate change.	Report on weed threats to ecosystems in relation to climate change	June 2010
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 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones – all CSIRO responsibilities	Date
Renewal of contract	
Report 1 submission: • Participation in a MTSRF wide meeting regarding climate change modelling, scenario development and mapping of deliverables across the MTSR and report on findings of relevance to this project. • Plan of communication activities/products for year two	8 Oct 2007
Report 2 submission • Report of preliminary results from a model of forest distributions (obj b,c,d). • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Dec 2007
Verbal progress update to Operations committee on: • Progress on activities associated with objectives (a)-(d): implementation of field work, data collation for model inputs. • Progress in studies of diseases and vectors (objs. a and c).	16 Mar 2008
Report 3 submission • Final results for changes in forest dynamics with climate change using existing 0.5ha long-term plots (obj a) and draft manuscript. • Report the tree species identified in the altitudinal transect of twelve forest plots (obj a). • Report the preliminary identification of seed disperser functional types in the altitudinal transect of twelve forest plots (obj a). • Progress update and summary of data (preliminary findings) from mosquito traps and progress of sentinel chicken surveys (or molecular techniques) along altitudinal gradients (obj a). • Maps for several climate change scenarios using the neural network model and applied to the entire Wet Tropics bioregion (obj b,c,d) • Progress update on engaging the tourism industry and aboriginal groups. • Final summary of communication activities undertaken through the course of year 2 of project. • Plan for completion of out year activities.	30 May 2008
Total MTSRF Funding	**$150,000***

* Includes $3,000 Visual Documentation Allocation.

Project 2.5ii.3 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$147,000	-	$147,000
MTSRF Visual Documentation*	$3,000	-	$3,000
CSIRO	-	$144,897	$144,897
Total	**$150,000**	**$144,897**	**$294,897**

A total of $3,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project

CSIRO Project 2.5ii.3 Budget 2007/2008

Item	MTSRF Funds	In-kind	Total Cost
Salaries	$119,555	$20,889	$140,444
Operating	$16,052	-	$16,052
Travel	$10,093	-	$10,093
Communication / Extension	$1,300	-	$1,300
Capital	-	-	-
Institutional overheads	-	$124,008	$124,008
Total	**$147,000**	**$144,897**	**$291,897**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$150,000	-	$150,000	-	-	$300,000
2009/2010	$150,000	-	$150,000	-	-	$300,000
Total	**$300,000**	**-**	**$300,000**	**-**	**-**	**$600,000**

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 Stephen E. Williams, James Cook University (JCU)

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Associate Professor Stephen Williams	JCU	Project Leader, macroecology, biodiversity and climate change impacts	0.25
Dr. Peter Grimbacher	JCU	Invertebrate biodiversity	0.5
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
PhD Student	JCU	Net primary productivity and relationships across altitude with biodiversity	1.0
Collin Storlie	JCU	Field work, data management, management of insect sampling across region, datalogger downloads and maintenance	1.0

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
DEW	Amanda Brigdale
WTMA	Steve Goosem
QEPA	TBA
Terrain NRM	Allan Dale
Alliance for Sustainable Tourism	Annie Riddet
NQCA	John Rainbird

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. At a recent MTSRF meeting in Townsville, we started discussions with Chantal Roder (ARC-Project co-ordinator on cultural heritage mapping) regarding their data compilation on traditional knowledge about ecological changes over time. We discussed possible future collaborative work on analysing this data in the context of possible changes already induced by climate change.

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 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 leaflitter, 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 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

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 2008*
(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: – *Collection of faunal data using standardised survey techniques across altitudinal and latitudinal gradients in the region.* – *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.* – *Establish data loggers across altitudinal and latitudinal gradients in the region. These dataloggers will be downloaded at approximately monthly intervals. Additional temperature*	June 2008*

Objective	Targeted Activity	Completion Date
	dataloggers will be placed at the same sites in a variety of microhabitats including under logs, under leaflitter, in tree hollows, in sunspots/clearings. – *Employ leaf litter traps, dendrometer bands and vegetation structure proforma (including hemispherical photography) to estimate net primary productivity.*	
(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 2008*

* Carries into Out Years.

Project 2.5ii.4 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones – All JCU responsibilities. All reports to be written reports unless otherwise specified.**	Date
Signing of contract	
Report 1 submission: Participation in a MTSRF wide meeting regarding climate change modelling, scenario development and mapping of deliverables across the MTSRF. • Plan of communication activities/products for year two and comments regarding how outputs from MTSRF wide meeting influence this project • Report on meeting between Steve Williams, Luke Shoo (MTSRF funded post-doc), Andrew Krockenburger – to discuss integration of physiology and field studies of refugial dynamics and ecological plasticity. • Preliminary data from field surveys conducted on fauna and plants associated with objectives a-f (above) - progress update on the assessment of extinction risk and ecological plasticity of vertebrate species, identification of spatial refugia, compilation of microclimate data from dataloggers at all sites Draft report of species distribution models using MAXENT including all relevant maps	8 Nov 2007
Verbal Progress Update to Operations Committee on: • Progress on projection of climate change impacts on species distribution using IPCC predictions. • Progress and status update on the assessment of extinction risk of vertebrate species, identification of regional-scale refugia, field surveys and status report associated with objectives a-g (above) Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	By Feb 2008
Report 3 submission • Preliminary report on ecological plasticity of selected Wet Tropics vertebrates and potential thermally buffered habitats. • 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 of vertebrate species and general progress associated with objectives a-g (above)	8 Mar 2008

For 2007/2008 Outputs Only **Milestones – All JCU responsibilities. All reports to be written reports unless otherwise specified.**	**Date**
Report 4 submission • Report on Extinction proneness / population viability analysis, including a variety of climate scenarios, for Wet Tropics vertebrates. • Draft report on initial projection of species distributions with respect to IPCC 2007 predictions using ensemble modelling. • Progress and status report on data collected 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.	6 Jun 2008
Total MTSRF Funding	**$150,000***

* Includes $3,000 Visual Documentation Allocation.

Project 2.5ii.4 Budget

Year 2 – 2007/2008 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 – 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	**$150,000**	**$585,000**	**$735,000**

* A total of $3,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project

JCU Project 2.5ii.4 Budget 2007/2008

Item	MTSRF Funds	JCU In-kind*	JCU In-kind**	JCU In-kind***	WTMA In-kind	Total
Salaries	$97,000	$360,000	-	$100,000	$20,000	$577,000
Operating	$45,000	$30,000	$40,000	-	-	$115,000
Travel	$5,000	$10,000	-	-	-	$15,000
Communication / Extension	-	$10,000	-	-	-	$10,000
Capital	-	$15,000	-	-	-	$15,000
Institutional overheads	-	-	-	-	-	-
Total	**$147,000**	**$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 – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$147,000	$285,000	$140,000	$140,000	$20,000	$732,000
2009/2010	$147,000	$285,000	$140,000	$140,000	$20,000	$732,000
Total	**$294,000**	**$570,000**	**$280,000**	**$280,000**	**$40,000**	**$1,464,000**

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

	Cash	In-kind	Total
MTSRF	$250,000	-	$250,000
Other	-	$206,250	$206,250
Total	**$250,000**	**$206,250**	**$456,850**

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

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 develop 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 will be developed. This 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.

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

1. Conduct a workshop with end-users and researchers aimed at i) developing a unified perspective on project approach and framework, and ii) reviewing currently identified priorities, mapping current research and management activities and research gaps and opportunities. Review of research activities, prioritization of research needs based on (a) agreed priority derived from workshop and (b) lack of current program.
2. Develop frameworks and tools for predicting invasive spread through rainforest landscapes. 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.

This program will be 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 use GIS modelling to overlay distribution of invasives in, and landscape features of rainforest landscapes, e.g. roadsides, fragments etc. 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).

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

NB: This project is in draft form until all parties agree to the details of the schedule.

Project Leader and Host Organisation

Dr David Blair, James Cook University (JCU)

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Dr David Blair	JCU	Objective a	0.05
Dr Michelle Waycott	JCU	Objective a	0.05
Dr Kirsten Heimann	JCU	Objective a	0.15
1 x PhD student	JCU	Objective a	1.0

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
GBRMPA	James Monkavitch
GBRMPA	Malcolm Turner
AMPTO	Col McKenzie
Ports Corporation of Queensland	Simona Trimarchi
Biosecurity Queensland	Tony Pople
DAFF	Andrew Johnson

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)	Interim report: status of invasive toxic microalgae within the GBR region	June 2008
(a)	Annual reports on progress of PhD project, including updates on findings from field, laboratory and desktop studies	June 2008 – 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 2007/2008

For 2007/2008 Outputs Only **Milestones – all JCU responsibilities. All reports to be written unless otherwise specified.**	**Date**
Signing of contract	
Report 1 submission • Progress report on recruitment of appropriate student to undertake task and report on tasks completed to date to establish project.	15 Aug 2007
Report 2 submission • Research plan for duration of project, including field and laboratory study schedules	15 Oct 2007
Report 3 submission • Complete literature review and assessment of toxic microalgae species of concern to the GBR and status and threat of such species in GBR World Heritage Area	10 Dec 2007
Report 4 submission • Interim report on toxic dinoflagellate species identified within the GBR region and maps of their distribution • Final summary of communication activities (e.g. any presentations/seminars given to School) undertaken through the course of Year 2of project (objectives a and b). • Plan for completion of out year activities.	9 Jun 2008
Total MTSRF Funding	**$50,000**

Project 2.6.1 Budget

Year2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$50,000	-	$50,000
JCU	-	$63,750	$63,750
Total	**$50,000**	**$63,750**	**$113,750**

JCU Project 2.6.1 Budget 2007/2008

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries / Stipends	$25,000	$61,750	$86,750
Operating	$20,000	$2,000	$22,000
Travel	$3,000	-	$3,000
Communication / Extension	$2,000	-	$2,000
Capital	-	-	
Institutional overheads	-		
Total	**$50,000**	**$63,750**	**$113,750**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$50,000		$65,000		-	$115,000
2009/2010	$50,000		$67,000		-	$117,000
Total	**$100,000**		**$132,000**		**-**	**$232,000**

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, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team Commitment 2007/2008

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	Terrain NRM	Terrestrial Biodiversity Program Manager	0.05
Frederieke Kroon	Terrain NRM	Aquatic Biodiversity Program Manager	0.10
Kirby Doak	FNQ ROC	Liason with Local Govt	0.02
Steve Goosem	WTMA	Biodiversity Planning and Policy	0.02

Summary Table of research Users 2007/2008

Organisation	Organizational contact
WTMA	Steve Goosem
Terrain NRM	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 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. Indigenous perspectives and the impact of tourism operators in spreading weeds will be considered within this review. 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 generalisable 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 calvescens* 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 calvescens, 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 QDNRM&W 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, QDNRM&W will provide spatial data on historical *M. calvescens* infestations and these will be used to post-predict the actual pattern of these invasions. *M. calvescens* 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. calvescens* and *Melastoma affine* (a native species in the same family as *M. calvescens*, 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, local government etc. Detailed surveys appropriate to the taxa will be used to document distribution. 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 control methods for aquatic invasives, especially Tilapia and other control research as identified in the scoping study. Methods will vary. 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
(c)	Completion of field work to fill invasive movement data gaps for inclusion in model	Sept 2008
(c)	Completion of an anisotropic model for invasive spread, i.e. that incorporates landscape effects on the direction frequency of spread	Dec 2008
(c)	Testing of model predictions and description of genetic factors influencing incursion and establishment phases of incursions	Dec 2009
(c)	Model refinement and finalization, application with end-users	Dec 2010
(c)	Description of the distribution of invasives in complex rainforest landscapes	Jun 2008
(c)	Identification of invasive “hotspots” and of critical landscape features for invasive spread within landscapes.	Jun 2008
(c)	Identification of functional attributes of communities and landscape that influence susceptibility to invasion	Jun 2008
(d)	Identification of impact, distribution and control methods for invasive fish (continuing)	Jun 2008
(d)	Completion of assessment of control/removal methods for key invasives leading to recommendations for the most efficient and effective control methods.	2010
(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 paramaterised with dispersal data for *Miconia spp.*	Jun 2008
(b)	Trialling of isotropic model with management agency staff finalised	Sep 2008
(b)	Final isotropic model for use by management agencies	Jun 2009
(b)	Description of movement geometry of dispersers, field data gaps reassessed	Dec 2007
(b)	Description of movement rules and their relationship to environmental features completed	Jun 2008
(b)	Previously identified field data gaps for movement data filled, data incorporated into model	Dec 2008
(b)	Prototype anisotropic model of invasive spread that incorporates movement rules and landscape context	Dec 2008
(b)	Refinement of anisotropic model of population spread 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	Jun 2009
(b)	Trialling with managers complete and model ready for application	Jun 2010
(b)	Progress with field tissue sampling and infestation mapping reviewed with agency partners, additional requirements identified	Sep 2007
(b)	Library development finalised and protocols implemented for invasive/native comparisons	Mar 2008
(b)	DNA Extractions for natives and invasives completed	Jun 2008
(b)	Supplementary collections completed	Sep 2008

Objective	Targeted Activity	Completion Date
(b)	Descriptions of spatial patterns of invasive spread at landscape and regional scales to enable identification of source populations completed	Dec 2008
(b)	Genetic descriptions of realised dispersal kernels completed and relationships with landscape and environmental features defined	Jun 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
	Exploration of the potential for the inclusion of pest fish into a spread model, adapted from the seed dispersal model	Dec 2007
(c)	Functional classification of invasive plants that includes dispersal, recruitment niche and life history characteristics completed	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
(c)	Annual surveys and monitoring of distribution and environmental context of invasions completed	Jun 2008
(c)	Development of an interim classification of locations in landscapes that are at risk of invasion or should be a focus of control effort	Dec 2008
(c)	Annual surveys and monitoring of distribution and environmental context of invasions completed	Jun 2009
(c)	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
(c)	Final classification of landscape features	Jun 2010
(d)	Identification of impact, distribution and control methods for invasive fish (continuing)	Jun 2008
(d)	Completion of assessment of control/removal methods for key invasives leading to recommendations for the most efficient and effective control methods.	2010

Project 2.6.2 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones [responsible agency listed in square brackets]	Date
Signing of contract	
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 [Terrain NRM] • 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]	20 Oct 2006
Report 2 submission • Report on disperser movement geometry [CSIRO] • Results of review of movement data gaps [CSIRO] • Review of progress towards each objective – this will include a summary of continued work on assessment of research needs including details of discussions with ARC about indigenous perspectives on invasive species and with the Invasive Animals CRC, the impact of 'Weed Week' (run with QDNRM&W) on data collection and modification of the model, 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 [Terrain NRM] • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [CSIRO]	10 Feb 2006
Report 3 submission • Report on description of movement rules for weed dispersers and their relation to environmental features [CSIRO] • Report on classification of invasive plants including Indigenous perspectives [CSIRO] • Review of progress towards each objective – this will include a summary of continued work on assessment of research needs including consideration of the impact of the tourist industry (in conjunction with 1.4.3), 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	30 May 2007
Total MTSRF Funding	**$200,000***

* Includes $3,500 Visual Documentation Allocation.

Project 2.6.2 Budget

Year 1 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$196,500	-	$196,500
MTSRF Visual Documentation*	$3,500	-	$3,500
CSIRO	-	$131,900	$131.900
JCU	-	$45,000	$45,000
QDPI&F	-	$3,000	$3,000
Terrain NRM	-	$16,600	$16,600
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

CSIRO Project 2.6.2 Budget 2007/2008

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	$94,500	-	$94,500
Operating	$24,000	-	$24,000
Travel	$10,000	-	$10,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$128,500	$128,500
Total	**$128,500**	**$128,500**	**$257,000**

JCU Project 2.6.2 Budget 2007/2008

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	$39,000	$40,000	$79,000
Operating	$4,000	$3,000	$7,000
Travel	$2,000	-	$2,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$2,000	$2,000
Total	**$45,000**	**$45,000**	**$90,000**

QDPI&F Project 2.6.2 Budget 2007/2008

Item	MTSRF Funds	QDPI&F In-kind	Total Cost
Salaries	-	$3,000	$3,000
Operating	$1,500	-	$1,500
Travel	$1,500	-	$1,500
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	
Total	**$3,000**	**$3,000**	**$6,000**

Terrain NRM Project 2.6.2 Budget 2007/2008

Item	MTSRF Funds	Terrain NRM In-kind	Total Cost
Salaries	-	$13,600	$13,600
Operating	$15,000	-	$15,000
Travel	$5,000	-	$5,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$3,000	$3,000
Total	**$20,000**	**$16,600**	**$36,600**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$200,000	$92,000	$99,000	$37,000	$127,000	$555,000
2009/2010	$200,000	-	$108,000	$37,000	$107,000	$452,000
Total	**$400,000**	**$92,000**	**$207,000**	**$74,000**	**$234,000**	**$1,007,000**

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.

Budget Summary

Program	Title	MTSRF	Other Cash	In-kind	TotaL
Program 7	Water Quality	$1,175,000	-	$1,587,446	$2,762,446
Total		**$1,175,000**	**-**	**$1,587,446***	**$2,762,446**

* Predicted cash co-investment.

** In-kind contributions still to be confirmed.

The total value of Theme 3 is $2,762,446.

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

	Cash	In-kind	Total
MTSRF	$1,175,000	-	$1,175,000
Other	-	$1,523,789	$1,523,789
Total	**$1,175,000**	**$1,523,789**	**$2,698,789**

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 for improved scientific understanding of how the condition of freshwater, estuarine and marine ecosystems are linked to terrestrial processes. The proposed Water Quality Program will consist of three main areas:

- Marine and estuarine water quality;
- Freshwater water quality; and
- Ecosystem 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 selected bio-indicators. This information will be integrated with economic and social drivers of land-use management that influence water quality to produce a 'Report Card' framework for water quality. The Program will collaborate with the relevant managing agencies of the Reef Water Quality Protection Plan and user groups to assimilate data from multiple sources into a synthesised report for GBR catchments. This information will form a significant part of the water quality reporting under the Reef 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 have been 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 will result in greater benefit from work conducted by enabling stronger linkages between catchment based activities, water quality and climate to be established and for the work to be expanded into Dry Tropics regions.

The outcomes of the Program will be of relevance to: (1) Data Integration and Synthesis for reporting and Projects in the GBR Status and Trends Program focusing on Condition and Trends, Risks and Threats to Critical Habitats; (2) Sustainable use, Planning and Management of Tropical Rainforest, (3) Reef Resilience projects within Marine Climate Program and (4) the indigenous project in the Indigenous Landscapes of the Wet Tropics World Heritage Area Project in the Sustainable Use – Rainforest and Catchments Program.

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 $150,000

3.7.6 Delivery of social and economic indicators of water quality (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 on the health of the catchment and GBR water quality $100,000

PROGRAM 7: HALTING AND REVERSING THE DECLINE 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 Commitments 2007/2008

Title	Organisation	Role	FTE
Katharina Fabricius	AIMS	Program leader, Researcher, reef ecology	0.3
Sven Uthicke	AIMS	Researcher, biofilms	1.0
Craig Humphrey	AIMS	Researcher, biomarkers and ecology, support	0.55
Glenn De'ath	AIMS	Researcher, statistical modelling	0.25
Andrew Negri	AIMS	Researcher, biomarkers, ecotoxicology	0.1
Steve Clarke	AIMS	Researcher	0.12
PhD student	AIMS	Biofilms / Coral	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	QEPA	Advisor, researcher	0.1

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
GBRMPA	David Haynes
Reef Water Quality Partnership	Rachel Eberhard
DEW	David Osborne
DEW	Stephen Oxley
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
ARC	Russell Butler
Queensland Canegrowers	Tim Wrigley
WWF	Nick Heath

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. Year 1 was used to complete a series of field studies and reviews prioritising potential marine and estuarine indicators. Years 2 and 3 will be used to determine dose-response relationships and thresholds of potential concern in selected bioindicators to pollutant exposure. We will work towards developing risk maps of specific

ecosystem changes in response to altered loads in fine particulate matter, light, nutrients or light. This should help prioritising management actions on the ground aiming at reducing the loss of soils vs nutrients vs agrochemicals. The work will result in maps of reefs at highest risk of degradation from altered water quality. We will also start field trials of estuarine indicators. We will provide a better understanding of the significance of such thresholds for GBR water quality and ecosystem condition, and continue to contribute to the scientific underpinning of a Report Card system. Work towards developing indicators for the condition of estuarine systems will also continue. Once completed, this indicator system will be directly used in the Reef Plan monitoring and reported through a Report Card on water quality specific monitoring. Additional work complementary to this project could be conducted if co-investment was sourced.

Key Objectives:

(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) Develop indicators for seagrass condition in response to changing water quality.
(d) Develop 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 biofilms that consistently change along water quality gradients (bacterial biofilms on sediments, microphytobenthos layers on sediments, and foraminifera on sediment and other reef substrata).

Proposed work in Year 2: We will investigate priority biofilm measures indicating specific changes along water quality gradients. The main focus will be to identify the major environmental drivers (nutrients, light, sedimentation), and seasonal changes for the respective organism groups. We will determine dose-response relationships of the most promising biofilm properties to the varying pollutants in the AIMS controlled environment aquarium facility. We will also complete the analyses of the biofilms samples collected by the Reef Plan Monitoring Program to investigate spatial patterns across 30 reefs. Experiments will be designed to identify thresholds of potential concern for pollutant exposure for individual organism groups and biofilm communities. The responses tested will include changes in photophysiology, growth and calcification, genetics and species composition in foraminifera and bacteria; the possibility to use cultured indicator diatoms will also be tested. Multivariate statistical techniques will be used to determine the best indicators for different stressors. The studies on foraminifera are of priority in year 2, as a low-tech 'FORAM' index has been successfully developed and is now being applied to monitor water quality in the Caribbean, our work on this group to date suggests that this will also be feasible in the GBR. However, further experimental work is needed to establish which stressors influence foraminiferan distribution and then to establish dose response relationships. We will also trial the option of hindcasting changes in water quality over up to 200 years, by analysing changes in foraminiferan communities in dated sediment cores. Obtaining further data on benthic diatoms will also be a priority, as they may represent the most important group of primary producers in shallow waters of the GBR, and may also be major producers of marine snow.

Year 3 and 4 will be used to fine tune findings on thresholds of potential concern for pollutant exposure by additional targeted experimental work and statistical analysis. In addition, studies on hindcasting and seasonal changes that commence in year 2 will be completed. It is expected that studies on foraminifera will result in an indicator to be used in routine monitoring by the end of year 3. Throughout years 3 and 4 further studies will be conducted focussing on a second biofilm group. Based on experiments and data analysis in year 2, it will be decided if these are benthic diatoms or bacteria. This will results in further potential indicators to be used in monitoring at the end of year 4.

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, and integrate all indicators into the report card framework developed in Program 3.

Objective (b): Coral indicators for ecosystem condition

Progress: The first year has been used to identify and review 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).

Proposed work in Year 2: We will focus on differentiating between responses to sedimentation vs nutrients vs turbidity/light and to trace concentrations of pesticides/herbicides, to aid prioritising management actions on land. We will determine concentration-response relationships of key species in the AIMS controlled environment aquarium facility using environmentally relevant exposures and ecotoxicological protocols. We will also investigate the consistency of responses across regions, and relate ecosystem properties to the water quality risk maps that are currently under development. This may allow us to identify the most ecologically relevant water quality variables and validate the water quality risk maps of reefs at the greatest risk of degradation through changing water quality. The project closely collaborates with the Reef Plan Marine Monitoring Program and the AIMS Long-term Reef Monitoring Program, maximising the use of the inshore benthic and water quality monitoring data, and trialling proposed indicators.

OPTIONAL: We are investigating opportunities to significantly expand the proposed pesticide work. This would be done through a 3-years PhD study investigating the interactive effects between herbicides, salinity and temperatures in tropical symbiotic organisms (corals and biofilms). The costs would be $40,000 for 3 years, which will cover a student stipend ($25,000 pa), operationals and lab analyses ($15,000 pa). We investigate the option of having this student based at UQ, under the supervision of Jochen Mueller, Andrew Negri and Sven Uthicke.

In Years 3 and 4, we will complete the research that will allow us to specifically track responses to sediments vs light vs nutrients and agrochemicals. This will result in clear recommendations of the contrasting ecological benefits if land management actions should prioritise to focus either on loss of soils or loss of fertilisers. We will complete determining thresholds and concentration-dependent responses in key species in controlled experiments, and will numerically combine the various responses into one composite indicator system for potential integration into the WQ report card framework. Using these, we will complete the GBR-wide risk mapping of coral reefs that are at various levels of risk of degradation by changing sedimentation, turbidity, nutrients or herbicides. We will develop and field test sampling and monitoring protocols to be utilised by the inshore monitoring program. We will

closely collaborate with the MTSRF Tracers Project to assess present-day and past water quality conditions based on fine sediment transport models.

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

Progress: The first year focused on a review of recorded sediment properties in the seagrass watch data, to assess links to species composition and epiphyte loads.

In Year 2, we will continue to closely align our research with MTSRF Task 1.1.3, by contributing scientific input to analyses and interpretation of mapping, monitoring and experimental data, with a focus on identifying physiological, morphological, community measures and indicators of seagrass meadow resilience that respond to changing water quality conditions along the GBR. 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

There is currently little understanding of estuarine health specific to water quality related issues in tropical systems. Climatic conditions and high faunal diversity of tropical systems render much of the understanding from temperate estuaries non-transferable. Because the health of estuarine organisms depends on the healthy functioning of the whole ecosystem, it is important to consider indicators at both the individual and community levels.

Progress: In the first year, we completed a detailed literature review to identify the current knowledge and determine potentially useful indicators of estuarine health, such as the utility of community attributes (eg. food chain integrity), and invertebrate indicators. Its main conclusions are: (1) That there are limitations to most techniques currently in use, and few situations where a single approach has yielded comprehensive results that can be interpreted beyond a narrow context. Consequently, comprehensive detection of ecosystem condition needs a multi-variable approach integrating a spectrum of indicators. (2) The most promising approaches for comprehensive detection of ecosystem condition are those that focus on functional attributes such as the integrity of trophic function, nursery ground provision and recruitment success. (3) Approaches are needed that can detect ecosystem-level effects, with specific indicators targeted at detecting particular stressors at specified scales. (4) There is a need to step beyond simply measuring water quality and move towards approaches that integrate and link specific indicators to ecological outcomes. (5) Fish appear to be the most useful indicator group, because they are best understood and have high public recognition. We have also completed the assessment of 10 major stress markers in barramundi in five rivers with contrasting levels of pollutant loads.

Proposed work in Year 2: The first year's detailed literature review identified the need for a multi-variable approach, focussed on the integrity of ecosystem processes, for the identification of estuarine ecosystem condition, and the utility of fish faunas as appropriate indicator organisms.

In Year 2 we will begin field testing a spectrum of variables for their abilities to detect ecological impacts of changes in water quality due to pollutants (nutrients and agrochemicals) and altered environmental flows. This will be done in close alignment with the estuarine indicator trials by QEPA. Because of recent developments in our detailed understanding of tropical estuarine fish faunas, we will concentrate on fish as the main focal indicator group. The principal focus will be on community attributes that are direct indicators of integrity of ecosystem function (eg. trophic function, nursery ground provision, recruitment success). These attributes will be compared across estuaries representing a range of

ecological conditions, using examples of estuaries identified in the OzEstuaries database as near pristine, modified and highly modified. In particular the modified sites selected will comprise estuaries where impaired condition can be clearly related to particular environmental stressors. Other faunal groups, such as benthic macro- and meio-fauna, with known indicator potential will be used as comparative indicators, and also assessed for their ability to contribute additional information. Our objective by the end of year 2 is to have identified an initial subset of useful measures and developed a preliminary model of the way the information they provide can be integrated into a useful multi-variable system.

In Year 3 we will focus on further refining measures to a final set suitable for particular applications, testing and refining the multi-variable analytical models, and integrating model outputs into a report card format. The success of the models will be evaluated in Year 4 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 Targeted Activities 2007/2008

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 2008
(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 2008
(c)	Contribution to research on seagrass communities and their responses to changing environmental conditions along the Queensland coast. [QDPI]	June 2008
(d)	Conduct research towards identifying potentially useful ecological indicators of the condition of North Queensland's estuaries [JCU, GU]	June 2008

Project 3.7.1 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones [Agency responsible for report delivery identified in brackets]. All reports are written reports unless otherwise specified.**	**Date**
Signing of contract	
Report 1 submission • Complete development of culture methods for benthic foraminifera at AIMS, and complete first laboratory experiment on dose-response relationships to nutrients and light in foraminifera (objective (a) (above). [AIMS] • Progress update for objective (b) (above) identifying the key species used in the controlled environment study. [AIMS] • Progress update for objective (c) (above). [QDPI&F] • Completed experimental design for year 2 studies for objective (d) [JCU,] • Contribute to completed experimental design for year 2 studies for objective (d) [GU] • Summary of any liaison activities undertaken to date. [AIMS]	1 Nov 2007
Report 2 submission • Progress update for activities listed against objectives (a) and (b) (above). [AIMS] • Progress update for activities listed against objective (d) [GU]. • Contribute to progress update for activities listed against objective (d) [JCU]. • Summary of any liaison activities undertaken to date. [AIMS]	1 Mar 2008
Report 3 submission • Complete Final Report on progress in the development of biofilms as indicators for reef health. [AIMS] • Complete laboratory based experiment on interactive effects between herbicides and elevated temperature/reduced salinity on adult corals (objective b). [AIMS]. • Final report on specific changes in coral physiology and reef ecosystem properties as indicators of changing water quality (objective b). [AIMS] • Complete final report on year 2 field testing and model development [JCU]. • Contribute to completion of final report on year 2 field testing and model development [GU]. • Final summary of liaison activities undertaken through course of year 1 of project. [AIMS]	15 Jun 2008
Total MTSRF Funding	**$300,000***

* Includes $2,000 Visual Documentation Allocation.

Project 3.7.1 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$298,000	-	$298,000
MTSRF Visual Documentation*	$2,000	-	$2,000
AIMS	-	$535,946	$535,946
JCU	-	$30,000	$30,000
GU	-	$30,000	$30,000
Total	**$300,000**	**$595,946**	**$895,946**

* A total of $2,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project

AIMS Project 3.7.1 Budget 2007/2008

Item	MTSRF	AIMS In-kind	Total Cost
Salaries	$173,000	$89,295	$262,295
Operating	$75,000	-	$75,000
Travel (Research Vessel)	-	$160,000	$160,000
Communication / Extension	-	$30,000	$30,000
Capital	-	-	-
Institutional overheads	-	$256,651	$256,651
Total	**$248,000**	**$535,946**	**$783,946**

QDPI&F Project 3.7.1 Budget 2007/2008

Item	MTSRF	QDPI&F In-kind	Total Cost
Salaries	$8,500	-	$8,500
Operating	-	-	-
Travel	$1,500	-	$1,500
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	**$10,000**	**-**	**$10,000**

JCU Project 3.7.1 Budget 2007/2008

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 2007/2008

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 – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$370,000	$122,000	$555,500	$440,000 #2	$623,000 #3	$2,110,500
2009/2010	$390,000	$122,000	$555,500	$440,000 #2	$623,000 #3	$2,130,500
Total	**$760,000**	**$244,000**	**$1,111,000**	**$880,000**	**$1,246,000**	**$4,241,000**

#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 DECLINE OF WATER QUALITY

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 Commitments 2007/2008

Title	Organisation	Role	FTE
Katharina Fabricius	AIMS	Researcher, reef ecology	0.1
Craig Humphrey	AIMS	Researcher, field and lab support	0.25
Barry Bennett	AIMS	Field support	0.1
Cary McLean	AIMS	Field support	0.1
Jon Brodie	JCU	Project leader, researcher	0.1
Stephen Lewis	JCU	Researcher, biogeochemistry	0.55
Zoe Bainbridge	JCU	Researcher, geomorphology	0.1
Leo Lymburner	JCU	Researcher, sedimentology	0.15
Malcolm McCulloch	ANU	Researcher, coral geochemistry	0.2
Jacky Croke	ADFA	Researcher, sedimentology	0.15
Perran Cook	CSIRO	Researcher, estuaries and biogeochemistry	0.15

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
GBRMPA	David Haynes
DEW	David Osborne
DEW	Stephen Oxley
Reef Water Quality Partnership	Rachel Eberhard
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
ARC	Russell Butler
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 into the marine environment using coral and sediment cores. This will involve determining transport mechanisms, residences 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.
(d) Floodplain sedimentation dynamics in Dry Tropics catchments – the role of riparian and floodplain vegetation.
(e) Determining the bioavailability of dissolved organic matter (and particularly dissolved organic nitrogen) in Wet Tropics rivers and hence ecological significance to both the rivers and the GBR.

Potential additional work on pesticides is being examined for inclusion in this project and detailed discussions with Research Users regarding their needs for information to support their management activities will occur in coming weeks regarding the inclusion of pesticide work in this project.

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 $^{7}Sr/^{86}Sr$ isotopic ratio of sediments is mainly controlled by age while the $^{143}Nd/^{144}Nd$ 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*., 2001) 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 AAC, 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.

We also plan to conduct preliminary research into tracing the source of nitrate in the Burdekin River catchment. The Burdekin River exports high loads of nitrate and currently the source is unknown. We plan to use nitrogen isotopes to uncover the source of this nitrate.

The sediments will be collected and sieved to recover the mud fraction (< 63 µm) 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 Advanced Analytical Centre (AAC), JCU. Nitrogen isotope analyses of water samples will be conducted at ANU.

Personnel: Stephen Lewis, Jon Brodie, Zoe 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.

The comprehensive sampling of Porites corals in the Townsville-Cairns region undertaken in 2006/2007 will again be conducted 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*., 2003), measurements of 143Nd/144Nd and 15N 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. This will be complemented by sediment cores from Bowling Green Bay, a major sink for sediments from the Burdekin River, as well as other cores taken from the inner and mid-shelf between Townsville and Cairns. The sediment geochemistry of these cores has already been partially characterised by the Australian Institute of Marine Science (G. Brunskill pers comm.) and additional isotopic and where necessary physical and mineralogical properties will complete this dataset. A chronology of these cores is also available from 210Pb ages, but more refined ages may be obtained using OSL dating and distinctive time transgressive terrestrial markers (e.g. onset of Hg from gold mining). The terrigenous sediment "fingerprints" from these cores will be compared to the terrestrial dataset to examine and quantify the contribution of sediment from each Burdekin sub-catchment. The isotopic composition (Sr-Nd) of suspended actually reaching coral reefs will also be determined and compared with the compositions of material from the various river sources as well as sediment cores. This approach will then be applied and other wet tropics catchments in the Townsville-Cairns region. The possibility of using the oxygen isotopic composition of phosphate to distinguish how the marine versus terrestrial sources of P may have changed over time in the inner and mid-shelf regions of the GBR will also be investigated.

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 objective (a) 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. 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 nepehloid 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 will determine the longevity of this 'fresh' riverine mud and its progressive flushing in the Wet Tropics. We will quantify temporal and spatial patterns in resuspension and deposition dynamics in response to wind and riverine inputs, resulting in altered water clarity and sedimentation regimes. We will also assess longshore transport in relation to wind-waves and currents, and offshore transport of nutrients associated with nepheloid layers. We will use arrays of nephelometers, sediment traps, 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. These arrays will remain deployed throughout the coming dry and wet seasons and be serviced 6-weekly for up to 24 months. This work will be integrated with other MTSRF Tasks, in particular the work on coral indicators and coral cores from the same regions as well as the isotopic tracing of sediment sources. This deployment will continue throughout year 3.

In Years 3 and 4, we will develop 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 run-off during the year.

Personnel: Craig Humphrey, Katharina Fabricius, Barry Bennett, Cary McLean, Eric Wolanski

Objective (d): Floodplain sedimentation dynamics in Dry Tropics catchments

The key tasks for this objective are:

- Identify catchment choke points in the Fitzroy River Catchment and quantify the rate and temporal patterns of sediment and contaminant storage in these zones using field data and GIS modelling.
- Determine the relationship between sediment storage in these sinks with recent changes in landuse history or management practices.
- Compare field measurements of floodplain sedimentation and storage with those predicted by catchment scale sediment transport models such as SedNet.
- Characterise the change in floodplain sediment trapping potential, based on changes in floodplain vegetation observed by satellite imagery.

In this task we will develop a methodology that inherently recognises catchment connectivity in large-scale sediment transport modelling. This will be supported by the collection of field data for the Fitzroy River Catchment (FRC), where terrestrial pollutants have been identified in the off-shore record by McCulloch *et al.*, (2003).

The methodology will consist of four components: (a) Field data collection (b) Model conceptualisation and parameterisation, (c) Model validation, and (d) Characterisation of changes in floodplain vegetation. We propose to refine our existing GIS framework for identifying catchment choke points and apply this to the FRC. Once identified, we propose to commence a structured drilling program of selected choke points in the FRC. We will obtain deep cores from these sites and reaches immediately downstream that will be used to produce a chronology of sedimentation rates using OSL. Cores will also be analysed for geochemical and radionuclide tracers to determine the characteristics of stored sediment. Comparisons between rates of sedimentation and the characteristics of sediment in the choke reaches and areas downstream will be used to quantify sediment transfer or leakage through the system and will provide important parameters for model parameterisation. Specifically we will use detailed particle size analysis of the cores to differentiate any differences in transfer related to sediment size. Using high-resolution remote sensing imagery we will obtain a detailed account of current and past land use practices within the

floodplain/riparian zone to investigate if these activities have contributed to increased delivery and changed dynamics of fine sediment to these zones. In consultation with local agencies and government, we will negotiate access to current water quality monitoring data from gauging sites in the vicinity of these zones and compare contemporary fluxes of sediment transfer with that observed over millennia. Using field parameters we aim to develop a catchment connectivity model that accurately predicts sediment transfer through the basin. Model output and predictions of end-of-catchment delivery rates will be evaluated using current monitoring and evaluation strategies.

Personnel: Jacky Croke, Leo Lymburner

Objective (e): Determining the bioavailability of dissolved organic matter (and particularly dissolved organic nitrogen) in Wet Tropics rivers and hence ecological significance to both the rivers and the GBR.

The key components for this objective are:

1. To determine the origin (rainforest vs cane and grazing) and bioavailability of organic nutrients (dissolved and particulate) in the Tully River system during low and high flow periods.
2. Determine the origin (marine, rainforest, agriculture (cane and grazing)) of organic matter deposited and metabolised under the Tully River flood plume.

Future work will follow on from these results and may extend to the impact of solar irradiance on the bioavailability of organic nutrients. ^{15}N and ^{18}O isotopes will be used to investigate the cycling of N and loss through denitrification as N transits the river and estuary to the sea. This may possibly also extend to some direct measurements of denitrification in the river and estuary.

The work on the bioavailability of organic nutrients has not been measured to date, and has direct relevance to understanding how these forms of nutrients may impact on the reef. Their relative sources and bioavailability also have implications for how agriculture has changed the bioavailability of these nutrient forms, which are the dominant form of nutrients exported in intact catchments.

Personnel: Perran Cook, Jim Wallace

Project Targeted Activities 2007/2008

Objective	Targeted Activity	Completion Date
(a)	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 2008
(a)	Report on 2006/2007 wet season Burdekin high flow sampling with first estimates of the trapping efficiency of the Burdekin Falls Dam.	September 2007
(b)	Report on the collection of coral core samples of Porites corals in the Townsville-Cairns region during 2006 - 2007.	November 2007*
(b)	Collection of water samples for sediment/nutrient/pesticide analysis in river flood plumes from Burdekin, Fitzroy, Tully, Pioneer, O'Connell and Proserpine Rivers as a first priority and the Barron, Johnstone and Russell-Mulgrave Rivers as a second priority if the river produces a significant plume.	April 2008*
(b)	Report on results of 2007 wet season flood plume sampling from FNQ, Burdekin and Mackay Whitsunday Regions	December 2007
(c)	Complete and report on the setup of 2 instrument arrays in Wet Tropics Region	September 2007
(c)	Progress report on temporal dynamics in resuspension and fine sediment transport of river-derived materials	June 2008
(d)	Progress report detailing outcomes of the drilling program	December 2007
(d)	Progress report on the changes in riparian and floodplain vegetation in the Fitzroy catchment	April 2008
(e)	Report on the collection and analysis of water samples for bioavailability studies from high and low flow conditions in Tully River and Tully flood plume in 2008 wet season.	April 2008
(e)	Progress report on organic matter bioavailability studies in Tully River system from 2007 wet season	September 2007

* Includes activities that will carry into Out Years.

Project 3.7.2 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones [agency responsible for report delivery identified in brackets]. All reports to be written reports unless otherwise specified.	Date
Signing of contract	
Report 1 submission • Report on 2006/2007 wet season Burdekin high flow sampling with first estimates of the trapping efficiency of the Burdekin Falls Dam (JCU) • Progress report on collection and analysis of coral core samples of Porites corals in the Rockhampton -Cairns region in 2006 (ANU) • Contribute to ANU progress report on collection and analysis of coral core samples of Porites corals in the Rockhampton – Cairns region in 2006 [JCU] • Report on setup of 2 instrument arrays in Wet Tropics Region (AIMS) • Progress report on organic matter bioavailability studies in Tully River system from 2007 wet season (CSIRO) • Report on the refinement of the existing GIS framework for identifying catchment choke points and application of this work to the Fitzroy River catchment (obj d). [ADFA] • Plan of communication outputs and products for year two and summary of any liaison activities undertaken, including minutes of meetings/workshops if applicable [JCU]	1 Sept 2007
Report 2 submission • Report on results of 2007 wet season flood plume sampling from FNQ, Burdekin and Mackay Whitsunday Regions (JCU) • Report on the collection of coral core samples of Porites corals in the Rockhampton - Cairns region in 2007 (obj b). [ANU] • Contribute to ANU report on the collection of coral core samples of Porites corals in the Rockhampton – Cairns region in 2007 (obj b) [JCU] • Progress report detailing outcomes of the drilling program on the Fitzroy floodplains [ADFA] • Contribute to ADFA progress report detailing outcomes of the drilling program of the Fitzroy floodplains [JCU]	1 Dec 2007
Report 3 submission • Report on collection of suspended sediment, nutrient and pesticide samples from selected tributaries of the Burdekin River in 2007/2008 wet season flow including above and below Burdekin Falls Dam. [JCU] • Report on collection of water samples for sediment/nutrient/pesticide analysis in river flood plumes from Burdekin, Fitzroy, Tully, Pioneer, O'Connell and Proserpine Rivers as a first priority and the Barron, Johnstone and Russell-Mulgrave Rivers as a second priority if the river produces a significant plume during 2007/2008 wet season. [JCU] • Report on collection and analysis of water samples for bioavailability studies from high and low flow conditions in Tully River and Tully flood plume in 2008 wet season. [CSIRO] • Progress report on the collection and analysis of coral core samples of Porites corals in the Rockhampton-Cairns region in 2006 - 2007. [ANU] • Contribute to ANU progress report on the collection and analysis of coral core samples of Porites coral in the Rockhampton – Cairns region in the 2006 - 2007 [JCU] • Progress report on the changes in riparian and floodplain vegetation in the Fitzroy catchment [JCU] • Final summary of liaison activities undertaken throughout the course of year 2	15 May 2008

For 2007/2008 Outputs Only Milestones [agency responsible for report delivery identified in brackets]. All reports to be written reports unless otherwise specified.	Date
of project [JCU] • Progress report on temporal dynamics in resuspension and fine sediment transport of river-derived materials [AIMS])	
Total MTSRF Funding	**$275,000***

* Includes $1,500 Visual Documentation Allocation.

Project 3.7.2 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$273,500	-	$273,500
MTSRF Visual Documentation*	$1,500	-	$1,500
JCU	-	$200,000	$200,000
AIMS	-	$103,932	$103,932
ANU	-	$80,000	$80,000
CSIRO	-	$21,528	$21,528
UNSW@ADFA	-	$60,000	$60,000
Total	**$275,000**	**$465,460**	**$740,460**

* A total of $1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project

JCU Project 3.7.2 Budget 2007/2008

Item	MTSRF	JCU In-kind	Total Cost
Salaries	$67,000	$83,500	$150,500
Operating	$46,500	$20,500	$67,000
Travel	$2,000	$17,500	$19,500
Communication / Extension	-	$7,000	$7,000
Capital	-	-	**-**
Institutional overheads	-	$71,500	$71,500
Total	**$115,500**	**$200,000**	**$315,500**

AIMS Project 3.7.2 Budget 2007/2008

Item	MTSRF	AIMS In-kind	Total Cost
Salaries	$40,000	$22,191	$62,191
Operating	$20,000	-	$20,000
Travel (Research Vessel)	$6,000	$27,000	$33,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$54,741	$54,741
Total	**$66,000**	**$103,932**	**$169,932**

ANU Project 3.7.2 Budget 2007/2008

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**

CSIRO Project 3.7.2 Budget 2007/2008

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	$23,000	-	$23,000
Operating	-	-	-
Travel	$2,000	-	$2,000
Communication / Extension	-	-	-
Capital	-	-	**-**
Institutional overheads	-	$21,528	$21,528
Total	**$25,000**	**$21,528**	**$46,528**

UNSW@ADFA Project 3.7.2 Budget 2007/2008

Item	MTSRF	UNSW@ADFA In-kind	Total Cost
Salaries	$20,000	$25,000	$45,000
Operating	-	$6,200	$6,200
Travel	-	$5,300	$5,300
Communication / Extension	-	$2,000	$2,000
Capital	-	-	**-**
Institutional overheads	-	$21,500	$21,500
Total	**$20,000**	**$60,000**	**$80,000**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$275,000	-	$555,000	-	$600,000*	$1,430,000
2009/2010	$275,000	-	$555,000	-	$400,000*	$1,230,000
Total	**$550,000**	**-**	**$1,110,000**	**-**	**$1,000,000**	**$2,660,000**

* Regional catchment event monitoring.

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 Commitment 2007/2008

Title	Organisation	Role	FTE
Richard Pearson	JCU	Joint project leader; aquatic ecologist	0.40
Niall Connolly	JCU	Invertebrate ecologist and link to Report Card Framework	1.00
Jon Brodie	JCU	Water quality input and link to Project 3.7.2	0.10
Angela Arthington	GU	Joint project leader; aquatic ecologist	0.30
Brad Pusey	GU	Fish ecologist	0.10
Clayton Sharpe	GU	Fish and general aquatic ecologist	0.90
Jim Wallace	CSIRO	Hydrologist, link to Project 3.7.4	0.05
Frederieke Kroon	CSIRO	Aquatic ecologist, link to other CSIRO projects	0.05

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
GBRMPA	David Haynes
DEW	David Osborne
DEW	Stephen Oxley
Reef Water Quality Partnership	Rachel Eberhard
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
ARC	Russell Butler
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 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 will extend 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 the Integrated Reporting. Subject to supplementary funding, we will also progress development of our program in the Dry Tropics. We will finalise and continue to 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. In this project we will fully develop that indicator system. We will provide methods for monitoring for a range of people and organisations (including scientists, government agencies, industry, community groups and land owners), 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 2 we will continue to focus on field work in the Wet Tropics. We will also workshop indicators and thresholds for the Dry Tropics, with a view to commencing fieldwork there in 2008, or earlier if appropriate funding/co-investment is available.

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) Develop an interactive Web database documenting the distribution and ecological requirements of freshwater biota in the Wet and Dry Tropics, to assist river health assessments and inform a range of end users.
(d) 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 to work with the Integrated Reporting project (3.7.7) to define end-user needs for water quality and freshwater ecosystem health monitoring using biophysical indicators and protocols. We will continue to 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 Year 1 of MTSRF, in relation to disturbances of land use, water quality, channel, habitat, biodiversity, food web structure and riparian condition. From our conceptual models based on our Russell/Mulgrave work we will identify indicators of ecosystem health and thresholds of concern, and test them in the Tully-Murray system. 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 (linking to Project 4.9.4), 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 minium 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. Projects will 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 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): Provide an interactive Web database documenting the distribution and ecological requirements of freshwater biota in the Wet and Dry Tropics to assist river health assessments.

We have developed a prototype interactive platform that will provide a Web database of the distributions and ecological requirements of freshwater invertebrates, plants and fish in streams, rivers and wetlands. New data collected during MTSRF research will be entered into this database during the program. Where to house this Web database and how to support its ongoing development and delivery of useful information is an issue for discussion with a range of end-user agencies and MTSRF.

Objective (d): 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.

Objective (e): 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 channeling 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 June 2007 we produced a Technical Report on the catchment and freshwater indicators trialled 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 modelling requirements, and guidelines on the establishment of monitoring programs of relevance to a range of people, skills and end users.

Project Targeted Activities 2007/2008

Objective	Targeted Activity	Completion Date
(a)	Workshop biophysical models and indicators for Dry Tropics waterways with end users. Develop summary conceptual models and identify knowledge gaps.	Dec 2007
(a)	Contribute expertise and data as required to the Integrated Reporting processes.	June 2008
(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 2008
(a)	Test spatial and temporal variability of freshwater indicators in the Tully-Murray catchment – field work	Dec 2007
(a)	Subject to supplementary funding, report on preliminary field work and desk-top review of Burdekin system	Dec 2007
(a)	Complete laboratory work on Tully-Murray samples, refine summary conceptual models and identify key research issues to support development of new or refined indicators.	June 2008
(a)	Subject to supplementary funding, report on draft indicators for the Burdekin system	June 2008
(c)	Develop concept of Web-based atlases and seek appropriate support to implement them.	June 2008
(d)	Develop postgraduate projects	ongoing
(e)	Develop end-user-agreed products from the program	ongoing

Project 3.7.3 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones [agency responsible for report delivery identified in brackets]. All reports to be written unless otherwise specified.**	**Date**
Signing of contract	
Report 1 submission: • Progress update for activities listed against objectives a-e (above) describing work achieved to date, any preliminary research findings. [JCU] • Input into progress update for activities listed against objectives a-e (above) [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]	7 Dec 2007
Report 2 submission: • Report on workshop on biophysical models of the ecological consequences of changes in landscape stressors and proposed suite of biophysical indicators of freshwater ecosystem health in the Dry Tropics: describe models discussed, proposed suite of indicators [JCU] • Input into report on workshop on biophysical models of the ecological consequences of changes in landscape stressors and proposed suite of biophysical indicators of freshwater ecosystem health in the Dry Tropics [GU]	17 Mar 2008

For 2007/2008 Outputs Only **Milestones [agency responsible for report delivery identified in brackets]. All reports to be written unless otherwise specified.**	**Date**
Report 3 submission: • Report on testing of indicators in the Tully systems and identification of possible spatial and temporal thresholds of potential concern in Wet Tropics rivers: description and interpretation of preliminary findings [JCU] • Input to report on testing of indicators in the Tully systems and identification of possible spatial and temporal thresholds of potential concern in Wet Tropics rivers [GU] • Summary of liaison activities undertaken through course of Year 2 of project in collaboration with GU. [JCU]	7 Jun 2008
Information transfer between agencies: • Evidence (e.g. e-mail record) of mutual transfer of information between agencies and project 3.7.4 to progress integration [JCU]	7 Jun 2008
Total MTSRF Funding	**$175,000***

* Includes $2,000 Visual Documentation Allocation.

Project 3.7.3 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$173,000	-	$173,000
MTSRF Visual Documentation*	$2,000	-	$2,000
JCU	-	$75,000	$75,000
GU	-	$75,000	$75,000
Total	**$175,000**	**$150,000**	**$325,000**

* A total of $2,000 is held by Reef and Rainforest Research Centre for Visual Documentation for this project

JCU Project 3.7.3 Budget 2007/2008

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	$74,000	$75,000	$149,000
Operating	$8,000	-	$8,000
Travel	$3,500	-	$3,500
Communication / Extension	$1,000	-	$1,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	**$86,500**	**$75,000**	**$161,500**

GU Project 3.7.3 Budget 2007/2008

Item	MTSRF Funds	GU In-kind	Total Cost
Salaries	$74,000	$75,000	$149,000
Operating	$8,000	-	$8,000
Travel	$3,500	-	$3,500
Communication / Extension	$1,000	-	$1,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	**$86,500**	**$75,000**	**$161,500**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant[1]		Other sources[1]		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$200,000	$5,000	$180,000	$50,000	$25,000	$460,000
2009/2010	$200,000	$5,000	$180,000	$50,000	$25,000	$460,000
Total	**$400,000**	**$10,000**	**$360,000**	**$100,000**	**$50,000**	**$920,000**

[1] Prediction – not yet confirmed.

PROGRAM 7: HALTING AND REVERSING THE DECLINE 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 2007/2008

Title	Organisation	Role	FTE
Jim Wallace	CSIRO	Project leader; hydrology expertise	0.2
Mohammed Karim	CSIRO	Hydro-dynamic modeler	0.8
Lachlan Stewart	CSIRO	Hydrological modelling	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 2007/2008

Organisation	Organisational Contact
GBRMPA	Donna Audas
DEW	David Osborne
DEW	Stephen Oxley
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 to 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 connectivities 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 Reporting 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 2005[5]). 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 (chanelised) 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

[5] Overton, I.C. 2005. Modelling floodplain inundation on a regulated river: integrating GIS, remote sensing and hydrological models. River Research and Applications 21, 991-101.

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)	Develop hydro-dynamic model for Tully – Murray catchments, including preliminary tests of the sediment and nutrient sub-routines that quantify the transport of materials across the floodplain during flood events.	December 2007
(b)	Combine hydro-dynamic model dynamic simulation of flood events with wetland locations to make first estimates connectivity indices.	December 2007
(c)	Record flood depths, suspended sediment and nutrient concentrations in flood waters during over bank events in the Tully-Murray catchments during the 2007/2008 wet season	April 2008
(d)	Compare preliminary hydro-dynamic model simulations of flood depth and water quality with field based measurements	April 2008
(e)	Develop linked hydrological and ecological PhD studies	ongoing
(f)	Refine hydro-dynamic model for Tully – Murray catchments, including further testing of the sediment and nutrient sub-routines.	December 2008
(g)	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
(h)	Develop linked hydrological and ecological PhD studies	ongoing
(i)	Draft report/s on year 3 progress	June 2009
(j)	Finalise development of hydro-dynamic model and make final	December 2009

Objective	Targeted Activity	Completion Date
	estimates of flood borne loads of sediment and nutrients to the ocean adjacent to the Tully-Murray catchments	
(k)	Finalise estimates of wetland connectivity made using the hydro-dynamic model and link to appropriate aquatic ecological impact models.	April 2010
(l)	Complete linked hydrological and ecological PhD studies	June 2010
(m)	Write up and publish results in report, Journal paper and Thesis forms	June 2010

Project 3.7.4 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones – All CSIRO delivery responsibilities. All reports to be written unless otherwise specified.**	**Date**
Signing of Contract	
Report 1 submission: • Progress update describing work to date and any preliminary findings for activities listed against objectives (a)-(e) (above). [CSIRO] • Evidence that hydrodynamic model development for material transport and wetland connectivity is underway. [CSIRO] • 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. [CSIRO]	30 Dec 2007
Verbal update on progress of project to Operations Committee	Before March 2008
Report 2 submission: • Draft progress report on the development and testing of hydro-dynamic modelling for use in floodplain sediment and nutrient transport and wetland connectivity. [CSIRO]	30 Jun 2008
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)	
Total MTSRF Funding (from ARP)	**$175,000***

* Includes $1,500 Visual Documentation Allocation.

Project 3.7.4 Budget

Year 2 – 2007/2008 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

CSIRO Project 3.7.4 Budget 2007/2008

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 – Years 3, 4

Year	MTSRF	Applicant[1]		Other sources[1]		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$175,000	$5,000	$200,000	$150,000	$25,000	$555,000
2009/2010	$175,000	$5,000	$200,000	$150,000	$25,000	$555,000
Total	**$350,000**	**$10,000**	**$400,000**	**$300,000**	**$50,000**	**$1,110,000**

[1] Prediction – not yet confirmed.

PROGRAM 7: HALTING AND REVERSING THE DECLINE OF WATER QUALITY

Project 3.7.5 and 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 Organisation

Dr Peter Roebeling, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Peter Roebeling	CSIRO	Project leader and Environmental Economist	0.12
Iris Bohnet	CSIRO	Social ecologist	0.12
Peter Thorburn	CSIRO	Cropping systems scientist	0.05
Tony Webster	CSIRO	Agronomist	0.15
Mark O'Donohue	CSIRO	Institutional analysis and link to 'Strategic NRM' Project 4.9.6	0.05
Ryan McAllistar	CSIRO	Systems modeler	0.15
Martijn van Grieken	CSIRO	Spatial economist	0.45
Scott Wooldridge	AIMS	Marine impact and link to 'Climate change' Project 2.5i.4.	0.25
Richard Pearson	JCU	Water quality indicators and link to 'Freshwater WQ' Project 3.7.3.	0.05

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
GBRMPA	James Innes
DEW	David Osborne
DEW	Stephen Oxley
Reef Water Quality Partnership	Rachel Eberhard
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale, Mark O'Donohue
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 agent[6], 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 instruments[7] 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 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). 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 Johnstone catchment, the Tully-Murray catchment and the Burdekin catchment, while a second Dry Tropics case study in the Mackay-Whitsunday area is currently under consideration.

[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.

Project Activities

Objective	Targeted Activity	Date
a	Review current and future land use and management options for water quality improvement, in close collaboration with industries (Canegrowers, GrowCom, etc.), extension services, DPI&F and regional NRM bodies in the Dry Tropics.	Dry Tropics: December 2007
a	Identify bio-physical trends and fluctuations that may impact the long-term cost-effectiveness of land use and management options for water quality improvement using climate dependent hydrological and production systems simulation models in the Dry Tropics.	Dry Tropics: February 2008
a	Assess the effectiveness of current and future land use and management options in reducing water pollution, based on literature review and production systems simulation models in combination with hydrological models in the Dry Topics.	Dry Tropics: March 2008
a	Assess the implementation costs of current and future land use and management options for water quality improvement, based on literature review and cost-benefit analysis.	Both wet and dry tropics components in out years
e	Develop framework for a spatially explicit model that allows for the assessment of sustainable land use and land management patterns in GBR catchments.	June 2008

* Involves activities that carry into out-years

Project 3.7.5 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones – all CSIRO Responsibilities. All reports are to be written reports unless otherwise specified.	Date
Signing of contract	
Report 1 submission, which outlines: • Progress update on the review of Best Management Practice for the most important production systems in the Dry Tropics of the GBR region, including: i) outcomes of the review of current and future land use and management options for water quality improvement in the Dry Tropics; ii) summary of any communication activities undertaken to date, including minutes of meetings and workshops if applicable (eg for review of land use management options). • Report on Workshopping of the spatial linkage model and its outputs with end users and define targets based on reef outcomes (e.g. Reef Partnership, GBRMPA) – with Project 2.5i.4. • Plan of communication outputs and products for year two.	1 Dec 2007
Report 2 submission: • Draft report on the assessment of the effectiveness of current and future land use and management options in reducing water pollution in the Dry Tropics (obj a), including a progress update on identification of the bio-physical trends and fluctuations that may impact the long-term cost-effectiveness of land use and management options in the Dry Tropics for water quality improvement using climate dependent hydrological and production systems simulation models (obj a). • Progress report on framework development for spatially explicit model that allows for the assessment of sustainable land use and land management	16 March 2008

For 2007/2008 Outputs Only **Milestones – all CSIRO Responsibilities. All reports are to be written reports unless otherwise specified.**	**Date**
patterns in GBR catchments – with Project 2.5i.4.	
Report 3 submission, which outlines: • Assessment of the long term effectiveness of BMPs for water quality for the most important production systems in the Dry Tropics, taking into account the impact of biophysical trends and fluctuations, and including: i) progress update on the assessment of the implementation costs of current and future land use and management options for water quality improvement, based on literature review and cost-benefit analysis in the Dry Tropics, ii) final summary of communication activities undertaken through the course of year 1 of project, and iii) plan for completion of out year activities, including objectives b-e. • Framework for a spatially explicit model that allows for the assessment of sustainable land use and land management patterns in GBR catchments – with Project 2.5i.4.	10 June 2008
Total MTSRF Funding	**$150,000**

Project Budget

Year 2 – 2007/2008 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 2007/2008

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 – Years 3 and 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$150,000	-	$112,183	-	-	$262,183
2009/2010	$150,000	-	$111,578	-	-	$261,578
Total	**$300,000**	**-**	**$223,761**	**-**	**-**	**$523,716**

PROGRAM 7: HALTING AND REVERSING THE DECLINE OF WATER QUALITY

Project 3.7.6 Now amalgamated with Project 3.7.5

This project has been amalgamated with Project 3.7.5 and activities and funding for this project now sit under that project. Please refer to Project 3.7.5 for project details.

The bringing together of these two projects in Year 2 of the MTSRF will strengthen the delivery and outcomes for end-user needs regarding social and economic considerations for improving water quality in the Great Barrier Reef. The amalgamation of these (Projects 3.7.5 and 3.7.6) critical research components will result in greater benefit from the work conducted by enabling stronger linkages between catchment based activities, water quality and climate to be established and for the work to be expanded into Dry Tropics regions.

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 Bronwyn Harch, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team

Title	Organisation	Role	FTE
Bronwyn Harch	CSIRO	Project and statistical oversight	0.05
Petra Kuhnert	CSIRO	Lead statistician	0.25
Brent Henderson	CSIRO	Statistician	0.15
Erin Peterson	CSIRO	Geospatial analysis and statistics	0.10
Paul Rustomji	CSIRO	Water quality modeller	0.15

Organisation	Organisational Contact
DEWR	David Osborne
DEWR	Stephen Oxley
Reef WQ Partnerships	Rachel Eberhard
Tourism alliance	Annie Riddet
Terrain NRM	Allan Dale
QNRW	David Roberts
Canegrowers	Tim Wrigley
GBRMPA	Hugh Yorkston

Project Duration

Start Date: 1 July 2007 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 area will be identified in the wet or dry tropic regions and used to demonstrate the approaches.

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.
- 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 2007/2008

The proposed tasks for 2007/2008 (Year 1) are as follows:

1. Liaise with appropriate data custodians in relation to **acquiring appropriate data** (in both wet and dry tropic regions) for applying existing load based methods to determine progress towards meeting the prescribed target and reporting trends. In particular, identify:

    a. The format that the data is in, and whether it can be easily input into a statistical or hydrological package for analysis and (if required) a geostatistical system such as Arc GIS
    b. The meta-data and in particular, the spatial resolution of all datasets identified
    c. (if required) An appropriate stream network that has rivers and streams positioned in the direction of flow. Where this has not been achieved, identify a GIS expert to correct the stream network appropriately.

2. Desktop analysis and synthesis of existing information on the '**reporting of pollutant loads'** with particular emphasis on how annual loads have been reported across the whole of GBR and surrounding catchments. This report will have a **management focus,** concentrating on:

    a. What methods have been used to assess annual loads in the GBR, nationally and internationally? This will necessarily build on existing work in this area, and will consider a variety of averaging, interpolation, ratio and regression or rating curve methods.
    b. What information should be reported as part of a credible loads assessment
    c. How has progress towards, or compliance with, a defined loads target been determined
    d. How have trends in pollutant loads been assessed, by whom, and for what purpose
    e. The sources of uncertainty in load estimation and methods that have been used to quantify it.
    f. How have loads assessments been communicated to stakeholders and community groups

There will be a key focus on identifying approaches that have been successful and those which have failed, and where gaps exist in the current methodologies. Only sediment and a limited set of nutrient species will be considered in Year 1. From this process identify an appropriate methodology for assessing trends and progress towards a defined load target which is spatially and temporally explicit.

3. **Assess the adequacy of data** collected in the wet and dry tropic regions in terms of the spatial (in particular, the scale) and temporal coverage collected and decide on an appropriate **pilot region** (a priority subcatchment in the wet or dry tropics regions) to showcase methods developed for reporting and assessing progress towards the loads target.

4. Commence a **case study** of the pilot region identified:

    a. Assessing trends in loads both spatially and temporally;
    b. Assessing progress towards the loads target to determine if we are "on track" to meeting the prescribed target
    c. Incorporating uncertainty into loads calculations, possibly using Monte Carlo, resampling or other methods yet to be determined, to demonstrate the application of the developed methodology.

Project tasks for 2008 to 2010

The proposed tasks for 2008/2009 (Year 2) and 2009/2010 (Year 3) are conditional on the findings during Year 1 of this project and will be determined before the start of the 2008/2009 financial year.

The anticipated activities are as follows:

- Finalise a **case study** of the pilot region identified:
    - Assessing trends in loads both spatially and temporally;
    - Assessing progress towards the loads target to determine if we are "on track" to meeting the prescribed target
    - Incorporating uncertainty into loads calculations
- To demonstrate the application of the developed methodology.
- **Report** and **communicate** the outcomes of the case study to stakeholders (e.g. the Reef Water Qualtiy Partnership) with particular emphasis on exploring suitable visualisation techniques for assessing progress towards meeting the loads target, assessment of spatial and temporal trends 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.
- Develop second case from the wet or dry tropics (whatever region that did not feature in the first case study) and
    - Assessing trends in loads both spatially and temporally;
    - Assessing progress towards the loads target to determine if we are "on track" to meeting the prescribed target
    - Incorporating uncertainty into loads calculations
- Report on 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 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.

- Extend methodology from sediments and nutrients to pesticides and other pollutants of interest to the NRM plans and WQIPs

Project Outputs / Milestones for 2007/2008.

Objective	Targeted Activity	Completion Date
1	Liaise with appropriate data custodians in relation to acquiring appropriate data and summarise available data and catchment area identified.	March 2008
2	Synthesis of existing methods for evaluating and reporting pollutant loads and identification of appropriate methodology.	March 2008
3	Assess data adequacy for wet and dry tropics and select pilot region for demonstration.	May 2008
4	Develop and propose appropriate methods for assessing progress towards a defined target taking into account space and time aspects and uncertainty.	May 2008
5	Commence a **case study** on the pilot region identified to demonstrate the application of the developed methodology for: (i) assessing trends in loads (ii) assessing progress towards the loads targets, and (iii) incorporating uncertainty into loads calculations.	June 2008

Project 3.7.7 Milestone Payments 2007/2008 – TO BE AGREED WITH PROEJCT TEAM

For 2007/2008 Outputs Only	
Milestones	**Date**
Signing of contract (25%)	Signing
Report: Desk top analysis and synthesis of existing methods for evaluating and reporting pollutant loads. Identification of gaps. (Obj 1)	20 Mar 08
Progress report on (i) pilot region, (ii) data adequacy and (iii) identification of methodologies for trend and compliance assessment in the GBR region. (Obj 1-4)	28 Mar 08
Interim report on case study in pilot area on trends and progress towards the defined target for loads flowing to the GBR (Obj 1-5).	30 May 08
Total MTSRF Funding	

Project 3.7.7 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$100,000	$63,657	$163,657
Total	**$100,000**	**$63,657**	**$163,657**

Institutional Project 3.7.7 Budget 2007/2008

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	$95,000	$26,859	$121,859
Operating	-	-	-
Travel	$5,000	-	$5,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$36,798	$36,798
Total	**$100,000**	**$63,657**	**$163,657**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant[1]		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$100,000	TBA	$63,657	TBA	TBA	$163,657
2009/2010	$100,000	TBA	$63,657	TBA	TBA	$163,657
Total	$200,000	TBA	$127,314	TBA	TBA	$327,314

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	$2,224,256	$3,429,256
Program 9	Sustainable Use – Rainforests	$1,203,275	$277,900	$1,667,886	$3,149,061
Total		**$2,258,275**	**$427,900**	**$3,892,142**	**$6,578,317**

The total value of Theme 4 is $6,578,317.

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

	Cash	In-kind	Total
MTSRF	$1,055,000	-	$1,055,000
Other	$150,000	$2,224,256	$2,374,256
Total	**$1,205,000**	**$2,224,256**	**$3,429,256**

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, Fishing and Fisheries, CapReef and AMPTO experiences and will value add to existing communication systems and networks where possible. 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 2007/2008

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 2007/2008

Organisation	Organisational Contact
GBRMPA	Martin Russell
DEW	David Osborne
DEW	Stephen Oxley
Alliance for Sustainable Tourism	Annie Riddet
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 will be integrated into the existing mark-release-recapture program being coordinated by Suntag and the CapReef community monitoring program. The experiments will be repeated over 3 subsequent spawning seasons at 3 different locations on the GBR to provide a broad-scale description of the strength of local exchange between green and blue zones (subject to the level of funding).

Project Targeted Activities (indicative for out years only)

NB: Targeted activities listed in italics below depend on adequate co-investment.

Objective	Targeted Activity	Date
(a)	• Theoretical framework complete; Behavioural data for 2 species prepared for model incorporation; *Identify coral trout larva rearing location to obtain behavioural data.*	31 Dec 2007
(b)	• Complete baseline surveys and begin a 1 population coral trout (*P. maculatus*) larval marking field experiment at the Keppel Islands.	
(a), (b)	• Dedicated program newsletter article.	
(a), (b)	• Briefing to DEH, GBRMPA and other co-contributors.	
(a)	• Physical model components complete; Behavioural data for 4 species prepared for model incorporation. *Field work with coral trout larvae; Physical model tailored for part B experiment other locations.*	30 Jun 2008
(b)	• Complete field work a 1 population coral trout (*P. maculatus*) larval marking field experiment at the Keppel Islands. *Expand sampling design to 3 populations with additional co-investment.* Begin otolith and genetic analyses to estimate recapture positions.	
(a), (b)	• Begin comparing capture patterns of marked larvae to completed 3-D model. Modify model as necessary.	
(a), (b)	• Presentation to end users and annual report.	
(a)	• Biophysical model 50% complete ; *Include coral trout data in model*	31 Dec 2008
(b)	• Complete all analysis and prepare manuscript on Keppel Is. marking experiment.	
(b)	• Begin 1-population coral trout (*P. leopardus*) larval marking experiment at northern GBR (Lizard Island region). *Expand sampling design to 3 populations with additional co-investment.*	
(a), (b)	• Presentation to GBRMPA on Keppel Is. experiment.	
(a), (b)	• Briefing to DEH, GBRMPA and other co-contributors.	

Objective	Targeted Activity	Date
(a)	• Biophysical model complete; Testing model outputs 50% complete; Initial ground-truthing model with results part B.	30 Jun 2009
(b)	• Compare distribution of marked larvae from Keppel Is experiment to completed 3-D model. Modify model as necessary.	
(b)	• Complete field-work on 1-population coral trout larval marking experiment at northern GBR (Lizard Island region).	
(a), (b)	• Initial end user workshop to demonstrate results and specify objectives, and performance indicators, and annual report.	
(a), (b)	• Industry, Sunfish, CapReef and other end user newsletter article.	
(a)	• Sensitivity analysis complete;	31 Dec 2009
(b)	• Complete analysis and manuscript preparation on Lizard Is. marking experiment.	
(b)	• Begin 1-population coral trout larval marking experiment at central GBR. *Expand sampling design to three populations with additional co-investment.*	
(a), (b)	• Dedicated program newsletter article.	
(a), (b)	• Briefing to DEH, GBRMPA and other co-contributors.	
(a)	• Final biophysical model; Testing model outputs complete. Final ground-truthing model.	30 Jun 2010
(b)	• Complete field work for 1-population coral trout larval marking experiment at central GBR.	
(a), (b)	• Compare distribution of marked larvae to completed 3-D model for northern GBR. Modify model as necessary.	
(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 2007/2008

For 2007/2008 Outputs Only **Milestones – All JCU responsibilities. All reports are to be written reports unless otherwise specified.**	**Date**
Signing of contract	
Report 1 submission: • Detailed progress report on activities conducted against objectives (above) including preliminary outputs from biophysical model to demonstrate 50% completion; findings, completed analysis and report on Keppel Is marking experiment outputs and data • Program newsletter article. • Copies of briefing reports to DEW and GBRMPA on research findings to date • 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.	14 Jan 2008
• Verbal progress report by Project Leader to Operations Committee on progress of all objectives, of experiments (including data summaries to date) and of model development (% completion, preliminary findings)	By Mar 2008
Report 2 submission: • Report describing the components of the completed physical model. Describe which four species and what behavioural data has been prepared for model incorporation. • Report on findings (including data analysis outputs and interpretations) from field work on population coral trout (*P. maculatus*) larval marking field experiment at the Keppel Islands. Report on when otolith and genetic analyses, to estimate recapture positions, data will be presented. • Report on preliminary findings of comparison of capture patterns of marked larvae to complete 3-D model and likely modifications to model. • Copies of presentations/workshop minutes to end users. • Plan for completing next year's activities.	28 May 2008
Total MTSRF funding	**$123,000**

* Visual documentation for this project addressed through Project 4.8.8.

Project 4.8.1 Budget

Year 2 – 2007/2008 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 2007/2008

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 – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$123,000	-	$224,700	$200,000[1]	-	$547,700
2009/2010	$123,000	-	$224,700	$200,000[1]	-	$547,700
Total	**$246,000**	**-**	**$449,400**	**$400,000**[1]	**-**	**$1,095,400**

[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 2007/2008

Title	Organisation	Role	FTE
Mike Cappo	AIMS	Fish biologist	0.6
Peter Doherty	AIMS	Project Leader	0.1
Richard Evans	JCU	Fish biologist	0.2
Garry Russ	JCU	Reef Task Leader	0.2
Peter Speare	AIMS	Shoals Task Leader	0.7
Marcus Stowar*	AIMS	Fish biologist	0.7
David Williamson	JCU	Fish biologist	0.2

* Inclusion of this FTE is dependent on the number of regions to be surveyed (see below)

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 – to be led by Garry Russ

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). Funding has been secured (CRC Reef Remaining Funds) to survey these sites once in 2008. These sites will be resurveyed (perhaps in 2010) if funding can be secured for this purpose.

The team will monitor approximately half of the 100 sites (136 sites if the new island groups are included) each year, so 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 9 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 of fish.

Objective (b): Measure the response of biological communities (fish and benthos) to differential zoning of human use on inshore shoals – to be led by Peter Doherty

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.

The AIMS team proposes to find, map, characterise and monitor a set of seabed shoals off Townsville (Magnetic Shoals) that were popular targets for recreational fishing prior to July 2004 and compare them with adjacent controls that remain open to fishing in the new Zoning Plan. The site selection will be extremely important for the reasons given above. In addition, treatments and controls must be sufficiently isolated that they do not exchange fish with each other on a regular basis, nor with other habitats belonging to the opposite zoning category (i.e., suspect possible edge effects across zoning boundaries). The sampling strategy will follow the prescription for a robust design established by the pilot studies; i.e. assemble knowledge base from interviews of local fishers, swathe map a range of likely targets, characterise the habitat of a subset sharing the most similar physical aspects, and finally sample the most similar pairs (blue/green) with baited videos replicated in space and time.

The first site, which will be established near Townsville for cost-effective access, will be sampled at regular intervals over the four years of MTSRF to provide original knowledge about the temporal variability in the fish fauna. In each year, an additional region will be added along the coast adjacent to communities that have a strong history of recreational fishing upon local shoal habitats. The plan in these four regions is to complete a baseline study with the help of the local community and then provide training and support to embed and continue community-based monitoring.

Progress towards Objective (b) in 2006/07 leading to modified objectives for 2007/08

Consultations with GBRMPA directed the AIMS team to collect baseline data from the Brook Shoals in Rockingham Bay and a baseline plus seasonal repeat from the Magnetic Shoals. Both have been done. The original proposal was to continue sampling on the Magnetic Shoals over multiple years and shift the effort invested in Rockingham Bay in 06/07 to add a new area in each of the following years.

GBRMPA expressed some concern that the proposal to add a new area each year meant that the last baseline would be created almost six years after the rezoning of the Park and therefore reveal little about the dynamic response of biodiversity to the change in human use. In late additional funds from the wind-up of CRC Reef were directed to an expansion of the sampling of zoning impacts on both reefs and shoals. In the latter case, an additional $200K was provided to collect baselines from four new areas (Cairns, Bowen, Rockhampton, and Gladstone). This work is underway and will extend into 07/08 (Year 2 of MTSRF).

The scope of sampling on shoals in 07/08 will depend upon resources allocated to the task. If they remain the same as the original proposal ($150K), then it will be possible to resurvey one area additional to the ongoing study of the Magnetic Shoals. Based on progress to date, the best choice would be Cairns where the team has collected baseline data from three green and three blue contrasts during 06/07 whereas the original choice (Rockingham Bay, Brooke Shoal) provides limited scope (single green/blue comparison, restricted visibility) for reliable and replicated observation. The shoals team has committed to review the whole program of shoal monitoring with relevant end users (GBRMPA, DEW, RRRC etc.) once the extended work described in the final letter of variation has been completed. The MTSRF GBR Steering Committee places a high value on further monitoring of Brooke Shoal, subsequently AIMS will make best endeavours to include this area within the proposed annual cruise to the Cairns reefs, subject to weather and visibility constraints. Individual excursions to the Brook shoals in addition to the scheduled Cairns annual surveys are not proposed.

If additional surveying is required from shoals south of Townsville, a supplementary budget and letter of variation will be developed to cover the expanded work as in 06/07. On that possibility, the staff budget allows for a possible increase from 1.3 to 2 FTE.

Project Targeted Activities 2007/2008

Objective	Targeted Activity	Completion Date
(a)	Submit detailed work plan for reef sampling in 07/08	31 Aug 2007
(b)	Complete additional sampling of shoals south of Townsville as per final letter of variation Submit detailed work plan for shoal sampling in 07/08	31 Oct 2007
(a) (b)	Report progress and results from diver surveys of inshore reefs. Report results from fished and unfished shoal habitats in the Cairns region	31 Mar 2008
(a) (b) (b)	Report full results of annual schedule of fish surveys from inshore reefs Report results from two seasonal samplings of Magnetic Shoals Report results from resurvey of shoals south of Townsville (dependent upon resources and letter of variation)	10 Jun 2008

Project 4.8.2 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones. [Agency responsible for report delivery identified in brackets]. All reports are to be written reports unless otherwise specified.**	**Date**
Signing of contract	
Verbal briefing by Project Leader/s to Operations Committee on the following [AIMS]: • Completion of additional field work contracted in 06/07 • Progress towards completion of year two activities	By Nov 07
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]. • Plan of communication events/activities/products for Year 1 and summary of any activities undertaken to date. [AIMS]	31 Oct 2007
• Provide summaries of JCU data to AIMS within one month of collection. [Responsible Officer: Professor Garry Russ, JCU].	Within 1 month of data collection.
Report 2 submission: • Report on results of effects of fishing on inshore reef fish and corals – field and desktop work. [JCU] • Report on results of effects of fishing on offshore shoals near Cairns – field and desktop work. [AIMS] • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [AIMS]	31 Mar 2008
Report 3 submission: • Report describing findings from comparison of fish and coral data from open and closed coral reefs (half of total targeted). [JCU] • Report on analysis of temporal variability data from Magnetic shoals based on two re-sampling evens comparing fish abundance on inter-reefal areas open and closed to fishing. [AIMS] • Final summary of communication activities undertaken through the course of Year 1 of project. [AIMS]	10 Jun 2008

For 2007/2008 Outputs Only **Milestones. [Agency responsible for report delivery identified in brackets]. All reports are to be written reports unless otherwise specified.**	**Date**
• Input into plan for completion of activities in out years. [JCU] • Plan for completion of activities in out years in collaboration with JCU. [AIMS]	
Total MTSRF Funding*	**$228,000***

* Visual documentation for this project addressed through Project 4.8.8.

Project 4.8.2 Budget

Year 1 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$228,000	-	$228,000
AIMS	-	$375,780	$375,780
JCU	-	$91,688	$91,688
Total	**$228,000**	**$467,468**	**$695,468**

AIMS Project 4.8.2 Budget 2007/2008

Item	MTSRF	AIMS Cash and In-kind	Total Cost
Salaries	$100,000	$54,686	$154,686
Operating	$49,000	-	$49,000
Travel	-	$120,000	$120,000
Communication / Extension	-	-	-
Capital	-		
Institutional overheads	-	$201,094	$201,094
Total	**$149,000**	**$375,780**	**$524,780**

JCU Project 4.8.2 Budget 2007/2008

Item	MTSRF	JCU In-kind	Total Cost
Salaries	$50,560	$31,400	$81,960
Operating	$23,700	-	$23,700
Travel	$4,740	-	$4,740
Communication / Extension	-	-	-
Capital	-		
Institutional overheads	-	$60,288	$60,288
Total	**$79,000**	**$91,688**	**$170,688**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$248,000	-	$500,000	-	-	$748,000
2009/2010	$248,000	-	$500,000	-	-	$748,000
Total	**$496,000**	**-**	**$1,000,000**	**-**	**-**	**$1,496,000**

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 2007/2008

Title	Organisation	Role	FTE
Dr Colin Simpfendorfer	JCU	Responsible for overseeing and managing all aspects of the Project.	0.22
Dr Ashley Williams	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	Malcolm Dunning

Project Duration

Start Date: 1 July 2006 End Date: 30 June 2010

Project / Task Objectives

The Project will significantly value-add to the data collections of the CRC Reef 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 inter-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 inter-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 may 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.

Project Targeted Activities (indicative only for out years)

Objective	Targeted Activity	Completion Date
(a)	Updated analysis of resource use from available data sources to characterise inter-reef fish resources of the GBR, with particular reference to the period after the introduction of quota management.	1 Jun 2008
(a)	Finalised analysis and report on historic and current trends in harvest patterns of inter-reefal species	1 Jun 2010
(b)	Completion of sample processing and analysis for barramundi cod.	1 Dec 2007
(b)	Completion of sample processing and analysis for key species from, the family Lethrinidae.	1 Jun 2008
(b)	Completion of sample processing and analysis for key species from, the family Lutjanidae	1 Dec 2008
(b)	Completion of sample processing and analysis for key species from, the family Serranidae	1 Jun 2009
(b)	Completion of sample processing and analysis for remaining key species.	1 Dec 2009
(b)	Final reporting and publication of biological information on key inter-reef species	30 Jun 2010

Project 4.8.3 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones – all JCU responsibilities	Date
Signing of contract	
Report 1 submission: • Program newsletter article. • Report on the biology of the barramundi cod.	1 Dec 2007
Report 2 submission: • Fishing and Fisheries Newsletter article. • Report on the biology of the key species of the family Lethrinidae	1 Mar 2008
Report 3 submission: • Program newsletter article. • Updated status and trend report of historic and current patterns in resource use of identified key inter-reef fish species of the GBR. • 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 2008
Total MTSRF Funding	**$50,000***

*Visual documentation for this project addressed through Project 4.8.8.

Project 4.8.3 Budget

Year 2 – 2007/2008 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 2007/2008

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 – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$50,000	$26,000	$191.295	-	-	$267,295
2009/2010	$50,000	$26,000	$191,295	-	-	$267,295
Total	**$100,000**	**$52,000**	**$382,590**	**-**	**-**	**$534,590**

PROGRAM 8: SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES OF THE GREAT BARRIER REEF

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 2007/2008

Title	Organisation	Role	FTE
Dr Ashley Williams	JCU	Project Leader responsible for overseeing and managing all aspects of the project.	0.9
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	1.0
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 2007/2008

Organisation	Organisational Contact
GBRMPA	Randall Owens
DPI&F	Claire Anderson
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 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 Targeted Activities (indicative only for out years)

Objective	Output / Milestone	Date
(c)	Continue observer surveys on commercial vessels. Continue boat ramp surveys for recreational fishers. Commence sample collection from commercial fishers and seafood processors. Commence processing of biological samples. Briefing to DEW, DPI&F, Inshore finfish MAC, CapReef SC & GBRMPA FRAC.	Dec 2007
(d)	Develop risk assessment framework for inshore species. Industry or other end user newsletter article.	Jun 2008
(a, b)	Collate data from DPI&F observer surveys. Briefing to DEW, DPI&F, Inshore finfish MAC, CapReef SC & GBRMPA FRAC, QSIA (including regional offices), Sunfish (including regional offices),	Dec 2008
(a, b, c) (a, b) (c)	Complete observer surveys on commercial vessels. Complete boat ramp surveys for recreational fishers. Complete sample collection. Industry or other end user newsletter article.	30 Jun 2009
(c) (d) (b) (d, e)	Estimate biological parameters for key inshore species. Complete preliminary 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 DEW, DPI&F, Inshore finfish MAC, CapReef SC & GBRMPA FRAC.	Dec 2009
(c)	Completion of student thesis. Final workshop with end users to discuss project results. Technical report and relevant peer-reviewed publications.	Jun 2010

Project 4.8.4 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones – all JCU responsibility. All reports to be written unless otherwise specified.**	**Date**
Signing of contract	
Report 1 submission: • MTSRF GBR newsletter article – update on project progress. • Report describing preliminary findings from initial observer surveys. Summary of species composition and biological samples collected from observer trips. • 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 2007
Report 2 submission: • MTSRF GBR newsletter article – update on project progress • Report on preliminary findings from initial boat ramp surveys of recreational fishers. Summary of species composition and size frequency data collected from boat ramp surveys. • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Mar 2008
Report 3 submission: • MTSRF GBR newsletter article – update on project progress. • Report on first year of observer surveys on commercial vessels. Update of species composition and biological samples collected. • Plan for completion of out year activities including schedule for remaining observer surveys and boat ramp surveys and key species for collection of biological samples	10 Jun 2008
Total MTSRF Funding	**$248,000***

* Visual documentation for this project addressed through Project 4.8.8.

Project 4.8.4 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$248,000	-	$248,000
CSIRO	-	$5,148	$5,148
DPI&F	-	$50,000[1]	$50,000
JCU	$94,000	$708,645	$802,645
Total	**$342,000**	**$763,793**	**$1,105,793**

[1] Secured co-investment from QDPI&F for portion of D. Welch salary, remaining portion of salary from MTSRF funds.

JCU Project 4.8.4 Budget 2007/2008

Item	MTSRF Funds	JCU Cash	In-kind	Total Cost
Salaries	$194,500	$94,000	$50,000[DPI]	$338,500
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**	**$758,645**	**$1,095,145**

CSIRO Project 4.8.4 Budget 2007/2008

Item	MTSRF Funds	In-kind	Total Cost
Salaries	$5,500	-	$5,500
Operating	-	-	-
Travel	-	-	-
Communication / Extension[1]	-	-	-
Capital	-	-	-
Institutional overheads	-	$5,148	$5,148
Total	**$5,500**	**$5,148**	**$10,648**

[1] A total budget of $75,000 per year has been allocated to the generic communication/extension activities for the Sustainable Use and Management Program. This is managed through Project 4.8.8 and includes Visual Documentation for this project.

Indicative Budget Summary - Year 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$248,000	$94,000	$734,177	-	$50,000	$1,126,177
2009/2010	$248,000	$94,000	$759,318	-	$50,000	$1,151,318
Total	**$496,000**	**$188,000**	**$1,493,495**	**-**	**$100,000**	**$2,277,495**

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 2007/2008

Title	Organisation	Role	FTE
Dr Stephen Sutton	JCU	Project Leader responsible for overseeing and managing all aspects of the project.	0.7
Dr Renae Tobin	JCU	Post-doctoral fellow with socio-economic research experience employed to conduct data collection and analysis and report writing.	0.5

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
AMPTO	Allan Wallish
DEW	Andrew McNee
RecFishing Services	Bill Sawynok
JCU (PI of MTSRF Project 4.8.6)	Bruce Prideaux
Commercial Fisherman	Carl D'aguiar
GBRMPA	Chris Briggs
Sunfish	David Bateman
GBRMPA	Gillian Goby
GBRMPA	James Innes
QDPI&F	John Kung
GBRMPA	Karen Lawrence
RRRC	Kerry Neil
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). Membership of the reference group is as follows:

This Project links to Project 4.8.6 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

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 of approximately 3,000 people 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 Targeted Activities (indicative only for out years)

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. Dedicated program newsletter article.	Dec 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.	Jun 2007
(c)	Develop telephone survey instrument. Dedicated program newsletter article. Industry and other end user magazine article.	Dec 2007
(a) (b) (c)	Complete user interviews and telephone survey. Briefing to DEW, GBRMPA, CapReef, and industry.	Jun 2008
(a) (c)	Complete data entry into GIS and statistical databases. Dedicated program newsletter article. Industry and other end user magazine article.	Dec 2008
(a) (c)	Analysis of interview and survey data commenced. Briefing to DEW, GBRMPA, CapReef, and industry.	Jun 2009
(a) (c)	Complete data analysis. Dedicated program newsletter article. Industry and other end user magazine article.	Dec 2009
(a) (b) (c)	Technical reports and relevant scientific peer-reviewed publications. Briefing to DEW, GBRMPA, CapReef, and industry.	Jun 2010

Project 4.8.5 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones – all JCU Responsibilities. All reports to be written reports unless otherwise specified.,**	**Date**
Signing of contract	
Report 1 submission: • Report summarizing number and location of GBR user surveys completed to date • Plan of communication outputs and products for Year 2 and summary of any other communication activities undertaken to date including minutes of meetings/workshops if applicable, schedule of future communication activities. • Report summarizing activities undertaken to strengthen and maintain links with other social science programs (e.g., Project 4.8.6) and the social science framework of MTSRF	15 Oct 2007
Report 2 submission: • Report detailing the community telephone survey instrument and sampling plan to collect information on community values of the GBR • Program newsletter article and end user magazine article • Report on findings of assessment of existing data of influences of Zoning Plan on use of GBRWHA and users including identification of gaps in knowledge. • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	15 Feb 2008
Report 3 submission: • Report summarizing number and location of community telephone surveys completed • Progress briefing for DEW, GBRMPA RACs, CapReef, and industry. • Summary of any communication activities undertaken including minutes of meetings/workshops if applicable. • Report summarizing activities undertaken to strengthen and maintain links with other social science programs (e.g., Project 4.8.6) and the social science framework of MTSRF	15 Jun 2008
Total MTSRF Funding	**$123,000***

* Visual documentation for this project addressed through Project 4.8.8.

Project 4.8.5 Budget

Year 2 – 2007/2008 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 2007/2008

Item	MTSRF	JCU Cash	In-kind	Total Cost
Salaries	$98,000	$30,000*	-	$128,000
Operating	$15,000	-	-	$15,000
Travel	$10,000	-	-	$10,000
Communication / Extension	-	-	-	-
Capital	-	-	-	-
Institutional overheads	-	-	$240,000	$240,000
Total	**$123,000**	**$30,000**	**$240,000**	**$393,000**

* Co-investment by JCU to cover thirty percent of PI salary.

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$123,000	$30,000[1]	$240,000	-	-	$393,000
2009/2010	$123,000	$30,000[1]	$240,000	-	-	$393,000
Total	**$246,000**	**$60,000**	**$480,000**	**-**	**-**	**$786,000**

[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 Commitment 2007/2008

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
TBA PhD students	JCU	Task Objectives a and c	0.2
TBA Post Doctoral Researcher	JCU	Post Doctoral Research Fellow Task Objective b	1.0
TBA Researcher for Task Objective b	JCU/CSIRO	Post Doctoral Research Fellow Task Objective b	TBA

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
GBRMPA	Lisha Mulqueeny
AMPTO	Col McKenzie / Alan Wallish
Alliance for Sustainable Tourism	Annie Riddet

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 and economic impacts of visitation. Impacts of tourism 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 (Project 7) on Irukandii 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 assessment of the economic impacts of visitation and 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.

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. To scope out this project, which is currently not funded, a workshop will be conducted in October 2007. The outcomes of the Workshop will be to agree on the task objectives, scope an agreed series of methodologies, identify the logistical requirements of the study (including the in-kind contributions e.g. of access), establish explicit milestones, and detail the necessary funding.

Objective (d): Identification of key trends and drivers of visitor patterns, including assessment of the economic impacts of visitation and 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 as well as estimates to be made of the economic value of reef tourism. 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 Yeppoon). 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. Surveys will be conducted in English and where appropriate in Japanese and Chinese. 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
(a)	Technical report on pilot study of social and economic values of key marine species and ongoing tourism business expenditure survey interviews	30 Jul 2007
(d)	Report on visitor patterns including motivations.	30 Aug 2007
(d)	Technical report on GBR's competing destinations, including analysis of media coverage of reef tourism destinations and tourists' appraisals of destinations.	30 Sept 2007
(c)	Report on outcomes of a workshop to develop key objectives and costs of a examining the impacts of tourism visitation on key reef sites	Dec 2007
(d)	Preliminary report on key drivers and benchmarks and economic value.	26 Feb 2008
(a) (d)	Preliminary report on social and economic values of sharks, rays and large fish. Annual report on visitor patterns	30 Jun 2008 30 Dec 2008
(d)	Technical report on seasonality effects on reef tourism	30 Nov 2008
(d)	Preliminary report on comparison of visitor trends and drivers between GBR regions	Feb 2009
(a)	Report on social and economic value of Minkie Whales	Jul 2009
(d) (d)	Annual report on visitor patterns. Report on economic value.	Aug 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	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 **Milestones – All JCU responsibilities. All reports to be written reports unless otherwise specified.**	**Date**
Signing of contract	
Report 1 submission • Technical report on GBR's competing destinations, including analysis of media coverage of reef tourism destinations and tourists' appraisals of destinations. • 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.	30 Sep 2007
Report 2 submission • Preliminary report on key drivers and benchmarks and economic values • 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. • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	26 Feb 2008
Report 3 submission • Preliminary report on social and economic values of sharks, rays and large fish • 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) • Plan for completion of out years activities including those to complete bio-economic analysis of the 2003 GBR Zoning Plan, assessment of impacts and sustainability of tourist visitation to key reef sites, socio-economic analysis of value of key marine species around tourist facilities.	13 Jun 2008
Total MTSRF Funding	**$148,000***

* Visual documentation for this project addressed through Project 4.8.8.

Project 4.8.6 Budget

Year 2 – 2007/2008 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 2007/2008

Item	MTSRF	Funds from Other Sources	Total Cost
Salaries	$105,000	$70,000	$175,000
Operating	$23,000	$80,000	$103,000
Travel	$15,000	-	$15,000
Communication / Extension	$5,000	-	$5,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	**$148,000**	**$150,000**	**$298,000**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$148,000	-	$90,000	$145,000	$10,000	$393,000
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 Objectives (c) and (d).

PROGRAM 8: SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES OF THE GREAT BARRIER REEF

Project 4.8.7: Forecasting risk of exposure to irukandji

NB: This project is in draft form until all parties agree to the details of the schedule.

Project Leader and Host Organisation

Professor Michael Kingsford, James Cook University (JCU)

Proposed Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Prof Michael Kingsford	JCU	Chief investigator	0.05*
Dr Alana Gretch	JCU	Principal investigator	0.05*
Dr Madeleine van Oppen	AIMS	Principal investigator	0.05*

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
AMPTO	Alan Wallish
GBRMPA	Chris Briggs
Surf Lifesaving Australia	TBA
ARC	Russell Butler
Queensland Health	TBA

Project Duration

Start Date: 1 July 2006 End Date: 30 June 2010

Project / Task Objectives

(a) Collect samples for the project during the stinger season from November to May.
(b) Commence a microsatellite DNA marker library 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.
(c) Develop a risk maps for stingers including time of year, geographic variation, species distribution etc. from existing data sets and expert opinion.
(d) Develop set of response guidelines to reduce risk to human health.

Project Activities 2007/2008

Objective	Targeted Activity	Date
a	Collect samples - link with Quicksilver stinger sampling program and other marine tourism operators.	June 2008
b	Continue development of microsatellites for field studies.	June 2008
c	Risk map for stingers (with uncertainty identified) Guidelines for marine operators and the public to reduce the risk of exposure to marine stingers	June 2008

Project 4.8.7 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones – all JCU responsibilities. All reports to be written reports unless otherwise specified.**	**Date**
Signing of contract	
Report 1 submission • Schedule of field activity and communication activities for 07/08 including collaborative project meetings to assist in development of risk maps and guidelines to reduce risk of exposure to marine stingers.	10 Sept 2007
Report 2 draft submission • Draft guidelines for marine operators and public that identify techniques to minimise risk of exposure to marine stingers and actions to take if contact with stingers is made. Inclusion of a range of species. • Progress update on development of risk maps: data being integrated, process for development of maps etc. • Article for MTSRF Program newsletter	11 Feb 2008
Report 2 draft submission • Final guidelines (based on any feedback) for marine operators and public that identify techniques to minimise risk of exposure to marine stingers and actions to take if contact with stingers is made. Inclusion of a range of species • Risk maps integrating data of where samples of *C. fleckeri* and *C. barnesi* were collected from with knowledge of currents and human activities (to provide level of risk to human health) • Report on microsatellite DNA markers in existence for *C. fleckeri*, applicability for use with *C. barnesi*, including any laboratory testing, and approach to developing microsatellite library of *C. barnesi*. • Summary/provision of any communication activities/articles undertaken to date, including minutes of meetings by investigators and half day workshop if applicable. Information to be disseminated through the MTSRF Program newsletter.	9 Jun 2008
Total MTSRF Funding	**$50,000**

Project Budget

Year 2 – 2007/2008 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 2007/2008

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 – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$50,000	TBA	TBA	TBA	TBA	TBA
2009/2010	$50,000	TBA	TBA	TBA	TBA	TBA
Total	**$100,000**	TBA	TBA	TBA	TBA	TBA

PROGRAM 8: SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES OF THE GREAT BARRIER REEF

Project 4.8.8: Communication, community engagement and enhanced delivery for GBR projects

Project Leader and Host Organisation

Dr Colin Simpfendorfer, James Cook University (JCU)

Project Team Commitments 2007/2008

Title	Organisation	Role	FTE
Dr. Colin Simpfendorfer	JCU	Responsible for overall coordination of project.	0.1
Ann Penny	JCU	Principal Investigator, Communications officer: project activities and liaison with researchers and stakeholders	1.0

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
GBRMPA	Karen Vohland
AMPTO	Col McKenzie

Project Duration

Start Date: 1 July 2006 End Date: 30 June 2010

Project / Task Objectives

The science projects conducted in the Great Barrier Reef for the MTSRF have a strong interplay with community engagement to ensure the successful conduct and delivery of the research. In addition, they have a need to be conducted in the context of an engagement system like that developed for the CRC Reef's Fishing and Fisheries Team. The previous system involved a communications officer to facilitate researcher engagement with industry, public and indigenous sectors, and coordinating communications between researchers and stakeholders.

This schedule describes the principal communication activities and products for Great Barrier Reef related MTSRF activities based on the previous communication model described above.

Key Objectives:

(a) Coordinate communication activities and products to enhance the delivery of research activities and findings of GBR related MTSRF research.
(b) Develop linkages with other communication activities within the MTSRF Program.

Project Targeted Activities (indicative only for out years)

Objective	Targeted Activity	Completion Date
(a)	Development, delivery and implementation of communication protocols for research activities conducted for the Sustainable Use of the Great Barrier Reef (Theme 4) and other GBR related projects including extension products and outputs.	March 2007
(a)	Development, delivery and implementation of report, newsletter media brief and other product templates that enable effective communication and product delivery for research activities conducted for GBR related projects	March 2007
(a)	Facilitation of researcher use of templates and protocols and the development of products to enhance delivery of research findings.	June 2007 (carries into out years)
(a)	Synthesis of research information from Great Barrier Reef related projects into products (including newsletters and media releases) to deliver research information to stakeholders.	June 2007, 2008, 2009 and 2010
(a)	Facilitate GBR related project researchers to provide research information in newsletter articles (three GBR Newsletters produced annually), visits to communities and meetings where appropriate	Continuous, all years
(a)	Report to Reef and Rainforest Research Centre on communication activities and examples of communication products from GBR related projects.	June 2007, 2008, 2009 and 2010
(b)	Report to Reef and Rainforest Research Centre on links between this and other MTSRF program communication activities.	June 2007, 2008, 2009 and 2010

Project 4.8.8 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones – all JCU responsibilities. All projects to be written reports unless otherwise specified.**	**Date**
Signing of contract	
Report 1. • Report of any communication activities undertaken to date and synthesis of any preliminary GBR related research findings communicated to date	1 Nov 2007
Report 2. • Provision of any newsletters, pamphlet, media briefs or other products produced to date synthesising research conducted within the GBR for the MTSRF • Report on meetings conducted with GBR MTSRF researchers and links with other communications/liaison activities in the MTSRF program.	1 Mar 2008
Report 3 • Report to Reef and Rainforest Research Centre on communication activities and examples of communication products. • Report on links with other MTSRF program communication activities.	11 June 2008
Total MTSRF Funding	**$85,000***

* Includes $10,000 for Visual Documentation of all Program 8 projects.

Project 4.8.8 Budget

Year 1 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$75,000	$142,000	$217,000
MTSRF Visual Documentation*	$10,000	-	$10,000
Total	**$85,000**	**$142,000**	**$227,000**

* A total of $10,000 is held by the Reef and Rainforest Research Centre for Visual Documentation of Program 8

JCU Project 4.8.8 Budget 2007/2008

Item	MTSRF	Funds from Other Sources	Total Cost
Salaries	$55,000	$18,078	$73,078
Operating	$20,000	-	$20,000
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$123,922	$123,922
Total	**$75,000***	**$142,000**	**$217,000**

* A total of $10,000 is held by the Reef and Rainforest Research Centre for Visual Documentation of Program 8

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$85,000	-	$142,000	-	-	$227,000
2009/2010	$85,000	-	$142,000	-	-	$227,000
Total	**$170,000**	**-**	**$284,000**	**-**	**-**	**$454,000**

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

	Cash	In-kind	Total
MTSRF	$1,203,275	-	$1,203,275
Other	$277,900	$1,667,886	$1,945,786
Total	**$1,481,175**	**$1,667,886**	**$3,149,061**

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 it will conduct participatory case studies 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 assist in 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 will 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 9: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES

Project 4.9.1: Indigenous landscapes of the Wet Tropics World Heritage Area

Project Leader and Host Organisation

Dr Mike Wood, James Cook University (JCU)

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Dr Mike Wood	JCU	Researcher, all objectives	0.20
Prof Steve Turton	JCU	Researcher, all objectives	0.10
Snr Research Officer (TBA)	JCU	Researcher, all objectives	1.0
Traditional Owners of the WTWHA (TBA)	Various	Researchers and users, all objectives	0.3
Mr Russell Butler	Aboriginal Rainforest Council	Researcher and user, all objectives	0.1
Mrs Allison Halliday	Aboriginal Rainforest Council	Researcher and user, all objectives	0.1
Mr Phillip Rist	Girringun Aboriginal Corporation	Researcher and user, all objectives	0.1
Dr Allan Dale	Terrain NRM	Research user, all objectives	0.1
PhD Student (TBA)	JCU	Researcher, all objectives	1.0
Dr Rosemary Hill	CSIRO	Researcher, all objectives	0.2

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
WTMA	Andrew McLean
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.

Collaboration with Other MTSRF Projects

In addition we will enhance our co-operation with other MTSRF projects. Part of the Project 4.9.1 work plan for 2007/2008 will involve assisting the Aboriginal Rainforest Council in developing a capacity to report on indigenous issues for periodic reporting requirements derived from the Wet Tropics Regional Agreement and statutory obligations to facilitate this process we will develop co-operative links with MTSRF Project 1.2.1 which is developing integrated reporting protocols. In addition, we have initiated discussions with Project 4.9.2 Sustainable Nature based Tourism about using their survey instruments to elicit data on visitor perceptions of Indigenous destinations and tours. In conjunction with the ARC we will seek to develop opportunities for tourist industry and Indigenous community collaboration within the project

Project / Task Objectives

Note: An outcome of the 2006-2007 Indigenous Landscapes project is that intellectual property arrangements, culturally appropriate databasing, and an overarching Wet Tropics Aboriginal Research Charter are to be developed in collaboration with and mandated by the Aboriginal peoples of the Wet Tropics World Heritage Area. All project activities for 2007-2010 are intended to be carried out in accordance with this mutually agreed Research Charter, and project activities outlined below may be subject to that Research Charter, due to be finalised by 16 June 2007.

Project Targeted Activities 2007/2008

Objective	Targeted Activity	Date
a[1]	Digitise and repatriate first instalment of Aboriginal data and records, including grey (unpublished) literature, into Wet Tropics Regional Cultural Heritage Information Management System	31 Oct 2007
b[1]	Research initial set of case studies into the way WTWHA managers engage with traditional owner groups and integrate Aboriginal ecological resource use, practices, knowledge and beliefs into effective National and World Heritage co-management requirements.	31 Oct 2007
c[1]	Provide research support to assist early phase of Aboriginal research and recording, in collaboration with ARC cultural mapping project	31 Oct 2007
a[2]	Arrange for data to be collected on indigenous ecological resource use, practices, knowledge and beliefs and compiled in a form suitable for ongoing World Heritage Convention periodic reporting	29 Feb 2008
b[2]	Identify and arrange to collect initial set of data as most useful to parties implementing the Wet Tropics Regional Agreement and the Aboriginal Natural and Cultural Resource Management Plan	29 Feb 2008
c[2]	Provide specialist research to assist ARC develop best practice research methods for date recording in the establishment phase of Cultural Heritage Information Management System (CHIMS)	29 Feb 2008
a[3]	Engage in a national best practice standard two-way research process using modern multi-media technologies to describe the natural and cultural values of WTWHA	30 Jun 2008
b[3]	Report on the outcomes and lessons learned from initial set of Aboriginal engagement case studies	30 Jun 2008
c[3]	Produce first year report and recommendations assessing effectiveness of mutually agreed, and mandated Wet Tropics Aboriginal Research Charter 2007-2010	30 Jun 2008

Project 4.9.1 Milestone Payments

For 2007/2008 Outputs Only **Milestones - All JCU Responsibilities All reports to be written reports unless otherwise specified.**	**Date**
Signing of contract	
Report 1 submission: • Progress Report on: (activity a[1]): Aboriginal records repatriated to CHIMS; (activity b[1]): Aboriginal engagement in management - case studies. (activity c[1]) Aboriginal research and recording • Copies of papers, reports and publications produced up to this date, in relation to the above identified project activities, • Report 1 to be submitted to ARC's Intellectual Property Sub-Committee for review two weeks prior to due date • Plan of Project Activities, Communications and Outputs for year to June 2008, plus summary of Project Activities, Communications and Outputs undertaken to date (including notes on meetings / workshops etc.)	31 Oct 2007
Evidence of Information transfer between agencies: • All Project 4.9.1 data, records, documents and reports: - Are all produced in accordance with mutually agreed Wet Tropics Aboriginal Research Charter 2007 - Are provided to Aboriginal Rainforest Council Incs sub-committee to obtain Aboriginal intellectual property approvals and licenses, thence to DEW, WTMA, QEPA, Terrain NRM and any Others.	As avail. no later than 11 June 2008
Report 2 submission: • Progress Report on: (activity a[2]): periodic reporting for World Heritage Convention; (activity b[2]): implementing co-management case studies. (activity c[2]) CHIMS recording methods and research • Copies of papers, reports and publications produced up to this date, in relation to the above identified project activities. • Report 2 to be submitted to ARC's Intellectual Property Sub-Committee for review two weeks prior to due date • Summary of all further Project Activities, Communications and Outputs undertaken to date (including notes on meetings/ workshops etc)	29 Feb 2008
Report 3 submission: • Progress Report on: (activity a[3]): natural and cultural values documented (activity b[3]): outcomes of engagement case studies. (activity c[3]) implementing Aboriginal Research Charter • Copies of papers, reports and publications produced up to this date, in relation to the above identified project activities. • Report 3 to be submitted to ARC's Intellectual Property Sub-Committee for review two weeks prior to due date. • 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.	8 Jun 2008
Total MTSRF Funding	**$75,000***

* Includes $1,500 Visual Documentation Allocation.

Project Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$73,500	-	$73,500
Visual Documentation*	$1,500	-	$1,500
JCU	$70,000	$80,000	$150,000
Terrain NRM	-	$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	**$145,000**	**$454,000**	**$599,000**

* A total of $1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project

JCU Project 4.9.1 Budget 2007/2008

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.

Terrain NRM Project 4.9.1 Budget 2007/2008

Item	MTSRF Funds	In-kind	Total Cost
Salaries	-	$300,000	$300,000
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	$20,000	$20,00
Capital	-	-	-
Institutional overheads	-	$4,000	$4,000
Total	**-**	**$324,000**	**$324,000**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$150,000	-	$454,000	-	-	$604,000
2009/2010	$150,000	-	$454,000	-	-	$604,000
Total	**$300,000**	**-**	**$908,000**	**-**	**-**	**$1,208,000**

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 Commitments 2007/2008

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
Fay Falco-Mammone	JCU	Post Doc Researcher objectives (a)	1.0
Dr Noel Scott	UQ	Researcher, objectives (a)	0.05
Julie Carmody	JCU	Researcher, objectives (b)	1.0
PhD Student Lisa King	JCU	Research, objective (a or b)	1.0

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
WTMA	Andrew McLean
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
QEPA	TBA
ARC	Russell Butler

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, reports on benchmarking of tourism patterns, seasonality and visitor segments 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 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 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 metadata 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 environmental impact parameters (building on work undertaken by the Rainforest CRC[8]) with 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. The survey will include Japanese and Chinese versions to develop a more detailed understanding of these markets. The survey will allow the examination of motivations for visiting the rainforest, seasonality patterns, segments and dispersal of visitors between the various

[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

elements of the Wet Tropics. Findings will be communicated to industry and WTMA via technical reports on specific issues such as the Japanese market, seasonality and motivations. This survey is a companion to the visitor survey funded via project 4.8.6. Findings will support Project 4.9.2b.

(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 Rainforest[1] 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 QEPA 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 Targeted Activities 2007/2008

Objective	Targeted Activity	Completion Date
a	Continue visitor monitoring program for the Wet Tropics WHA. *Objective a(i) and (iii)*	Ongoing
a	Identify key drivers of Wet Tropics visitor patterns including economic contribution. *Objective a(ii)*	*Ongoing
b	Produce tour operator user guide(s)/manual as part of the establishment of a best practice strategy for ecotourism in the Wet Tropics WHA. *Objective b(ii)*	Aug 2008
b	Identify community attitudes, knowledge and perceptions of use and management of the Wet Tropics. *Objective b(i)*	Mar 2008*

* Involves ongoing activities in Out Years.

Project 4.9.2 Milestones 2007/2008

For July 2007 – June 2008 Outputs Only	
Milestones	**Date**
Quarterly Visitor Barometer	30 Jul 07
Report 1 submission [all JCU tasks] • Progress update of activities associated with objectives a & b: design and implementation of visitor surveys, visitor barometer, tourist operator manual (bii), report on community survey (bi). • Plan of communication activities for Year 2 and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Dec 2007
Report 2 submission • Submission of quarterly visitor barometer.[JCU] • Progress report on tour operator user guide.[JCU] • Submission of Stage 3 Technical Report (Final) of community survey (bi) • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.[JCU]	30 Apr 2008
Report 3 submission • Preliminary second Annual report of Wet Tropics visitor patterns including evaluation of indicators used to identify key drivers and trends, seasonality issues, key visitor segments and economic contribution. [JCU] • Progress report on Tour Operator Manual – draft version of manual (bii). [JCU] • Report on the stakeholder workshop to explain visitor monitoring program. [JCU] • Final summary of communication activities undertaken through the course of Year 2 of project. [JCU] • Plan for completion of out year activities. [JCU]	30 Jun 2008
Total MTSRF Funding	**$200,000***

* Includes $1,500 Visual Documentation Allocation.

Project 4.9.2 Budget

Year 2 – 2007/2008 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

Linked with Objective (a).

UQ Project 4.9.2 Budget 2007/2008

Item	MTSRF	UQ In kind	Total Cost
Salaries	$1,000	$10,000	$11,000
Operating	-	-	-
Travel	$2,000-	-	$2,000-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	**$3,000**	**$10,000**	**$13,000**

JCU Project 4.9.2 Budget 2007/2008

Item	MTSRF	JCU In-kind	Total Cost
Salaries	$170,000	$65,000	$235,000
Operating	$10,000	-	$10,000
Travel	$10,000	-	$10,000
Communication / Extension	$5,500	-	$5,500
Capital	-	-	-
Institutional overheads	-	-	-
Total	**$195,500**	**$65,000**	**$260,500**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$200,000					
2009/2010	$200,000					
Total	**$400,000**	**TBA**	**TBA**	**TBA**	**TBA**	**400,000**

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 Commitment 2007/2008

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)	0.10
Dr Miriam Goosem	JCU	Researcher, ecology, objectives (a) (b) (c)	1.00
Ms Catherine Pohlman	JCU (PDF) (50% salary from Powerlink)	Researcher (PDF), ecology, objective (a) (b)	1.00
Dr Iris Bohnet	CSIRO	Researcher, landscape planning, social-sciences, objectives (b) (c)	0.20
Ms Pam Schultz	JCU / CSIRO	PhD Student social sciences, NRM planning, contribution to, objective (c)	1.00

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
WTMA	Andrew McLean
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
QEPA	TBA
QDMR	Environmental Officer
QDMR	Project Support / Logistics Officer
Powerlink	Stephen Martin
Queensland Canegrowers	Tim Wrigley

This Project 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 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 Reporting 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 Integrated Reporting processes).

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 Integrated Reporting). 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.
- 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 mange 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 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 Targeted Activities 2007 / 2008

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 (QDMR Best-Practice Manual).	Dec 2007
a	Continuing identification of informative and cost-effective ecological indicators of linear infrastructure impacts in rainforests and adjoining habitats in the Wet Tropics bioregion.	Jun 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 and/or Powerlink.	Jun 2008*[#@]
b	Collaborative meeting between stakeholders and allied MTSRF project personnel to identify sites for riparian and remnant vegetation quality assessment and discuss activities to be undertaken at those sites	Aug 2007
b	Ongoing testing and application of riparian and remnant vegetation quality indicators using remote sensing and GIS modelling and field-truthing at one of the sites agreed by stakeholders	Jun 2008*
b	Identification of priority areas for conservation, including maintenance of landscape connectivity for one of the sites agreed by stakeholders	Jun 2008*
c	Meeting with MTSRF project team 4.9.6 and Terrain NRM to select sea- and tree-change case study landscapes for PhD project	Sept 2007
c	Identification of sea- and tree-change phenomena among the Australian community.	June 2008*
c	Identification of urbanisation patterns in the Wet Tropics bioregion	June 2008*
c	Initial qualitative interviews with residents and 'newcomers' in select 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*

* Involves ongoing activities in Out Years.

[#] Co-funded by Powerlink.

[@] Co-funded by QDMR

Project 4.9.3 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones – [agency responsible for report delivery identified in brackets]. All reports to be written reports unless otherwise specified].**	**Date**
Signing of contract	
• Summary of meetings with MTSRF project team 4.9.6 and Terrain NRM to select sea- and tree-change case study landscapes for this project and ensure collaboration in the potential case studies. Responsible: Prof Steve Turton [JCU] (obj b, c) • Contribute to summary of meetings with MTSRF project team 4.9.6 being developed by JCU [Dr iris Bohnet, CSIRO]	Oct 2007
Report 1 submission [All JCU responsibilities] • Copy of revised best practice guidelines on linear community infrastructure in rainforest habitats prepared for the Department of Main Roads (obj a). • Final report on one component of Powerlink supported work: Cyclonic Disturbance along Palmerston Powerline Clearing edges (obj a) • Progress report 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. • Reports regarding effectiveness of overpasses and underpasses, subject to continued and renewed QDMR funding of underpass and overpass monitoring. • Progress update on activities associated with objective b: site selection, review of riparian and remnant vegetation quality indicators.	10 Dec 2007
• Final report on Powerlink-supported project: Powerline Clearing Impacts in Dry Sclerophyll Woodland of the Wet Tropics Bioregion (obj a, Tasks noted as #), subject to extension to Powerlink funding.[JCU]	31 Mar 2008
Report 2 submission • Progress report on testing and application of riparian and remnant vegetation quality indicators (for the sites selected by stakeholders workshop) using remote sensing, GIS modelling and field-truthing including completed analysis of one of the chosen areas (obj b) [JCU]. • Progress summary based on literature review of the phenomena of sea- and tree-change in Australia. Responsible: Dr Iris Bohnet (obj c) [CSIRO] • Final summary of communication activities undertaken through the course of Year 2 of project.[JCU] • Plan for completion of out year activities.[JCU] • Contribution to plan for completion of out year activities [CSIRO]	8 Jun 2007
Evidence of information transfer between agencies • Provision of Project 4.9.3 data to Powerlink on Cyclone Larry impacts research and 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].	Provided before 15 June 08
Total MTSRF Funding	**$215,000***

* Includes $1,500 for visual documentation of this project.

Project 4.9.3 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Co-investment is secured for 2007/2008, other than where noted (**).

Contributing Organisation	Cash	In-kind	Total
MTSRF	*$213,500	-	$213,500
MTSRF Visual Documentation	**$1,500	-	$1,500
James Cook University	$20,000	$93,700	$113,700
QDMR (3rd Party)	$45,200	$30,000	$75,200
Powerlink (3rd Party)	$44,000	$12,000	$56,000
CSIRO	-	$17,349	$17,349
WTMA (3rd Party)	-	$14,400	$14,400
Terrain NRM (3rd Party)	-	$7,000	$7,000
Total	**$324,200**	**$174,449**	**$498,649**

* Includes $15,000 towards Program Management, Program 9, for Professor Steve Turton.

** A total of $1,500 is held by the Reef and Rainforest Research Centre for Visual Documentation of this project

JCU Project 4.9.3 Budget 2007/2008

Item	MTSRF Funds	JCU Cash	Third Party Contracts Cash**	In kind	Total Cost
Salaries	*$162,500	$20,000	$50,000	$149,100	$381,600
Operating	$16,000	-	$39,200	$8,000	$63,200
Travel	-	-	-		-
Communication / Extension	$10,000	-	-		$10,000
Capital	-	-	-		-
Institutional overheads	-	-	-		-
Total	**$188,500**	**$20,000**	**$89,200**	**$157,000**	**$454,800**

* Includes $15,000 towards Program Management, Program 9, for Steve Turton.

** Includes third party contracts with Queensland Department of Main Roads and Powerlink Queensland, still under negotiation.

CSIRO Project 4.9.3 Budget 2007/2008

Item	MTSRF Funds	In-kind	Total Cost
Salaries	$25,000	-	$25,000
Operating	-	-	-
Travel	-	-	-
Communication / Extension[1]	-	-	-
Capital	-	-	-
Institutional overheads	-	$17,349	$17,349
Total	**$25,000**	**$17,349**	**$42,349**

Indicative Budget Summary – Years 3 and 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	*$215,000	-	$111,000	$106,000	$44,000	$476,000
2009/2010	*$215,000	-	$115,000	$108,000	$46,500	$484,500
Total	***$430,000**	**-**	**$226,000**	**$214,000**	**$90,500**	**$960,500**

* Includes $15,000 towards Program Management, Program 9, for Steve Turton.

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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 John Herbohn and Dr Nick Emtage, The University of Queensland

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Dr John Herbohn	UQ	Joint project leader, project researcher - integrative resource management, economics, ecology Objectives a and b	0.25
Dr Nick Emtage	UQ	Joint project leader, project researcher - social science and natural resource management, programming and modelling; Objectives a and b	1.00
Dr Krishna Shrestha	UQ	Project Researcher – social science, Objective a	0.25
Prof Jerry Vanclay	SCU	Project Researcher- forest ecology and ecological modelling. Objective b	0.10
Dr David Pullar	UQ	Project Researcher – GIS and resource management, Objectives a and b	0.05
Assoc. Prof Steve Harrison	UQ	Project Researcher, Economist, Objective b	0.05

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
Queensland Canegrowers	Tim Wrigley
QEPA	TBA
WTMA	Andrew McLean

This Project 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 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 will be developed into a landholder typology i.e. a set of profiles of various types of landholders in the region based on the livelihoods framework.

The methodology applied will draw on the landholder survey methodology developed by the research team in previous studies (Emtage *et al.*, 2001[9], Herbohn *et al.*, 2005[10] Emtage *et al*.,[11] in press) and that developed by the National Land and Water Resources Audit and the Bureau of Rural Sciences (Nelson *et al.* 2005[12]) which has been applied in other regions of Australia. Indicators of variations in landholder types will be developed to enable the use of GIS to map the prevalence of various landholders across the region. Representatives of key stakeholder groups (e.g. Allan Dale from Terrain NRM, Steve Goosem from WTMA and others) will be involved in all stages of the research as well as other research teams involved in socio-economic research using MTSRF funding (i.e. those for Projects 1.3.2, 1.3.4, 3.7.5, 4.8.5, 4.8.11, 4.9.6 and 4.9.7 and projects under program 5). Following the development of this understanding about rural landholders and their activities in the first two years of the project researchers will work with personnel from local, regional, state and national agencies involved in NRM and rural development in subsequent years 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

[9] Emtage, N.F., Harrison S.R. and J.L. Herbohn (2001). Landholder attributes to and participation in Farm Forestry Activities in Sub-Tropical and Tropical Eastern Australia. Pages 195 – 210 in S.R. Harrison and J.L. Herbohn (eds.) *Sustainable Farm Forestry in the Tropics*. Cheltenham, Edward Elgar.

[10] Herbohn, J.L.., Emtage, N.F., Harrison, S.R. and Smorftt, D.B. (2005), 'Attributes of landholders to farm forestry in tropical eastern Australia', *Australian Forestry*, 68(1): 50-58.

[11] Emtage, N.F., S.R. Harrison and J.L. Herbohn, (in press) Landholder Typologies used in the development of natural resource management programs in Australia – a review. *Australian Journal of Environmental Management*.

[12] Nelson, R., T. Webb, and I. Byron I. (2005). *Integrating conceptual frameworks to coordinate information for natural resource management decision makers*. A report to the National Land and Water Resources Audit, NLWRA socioeconomic workplan project B0, Canberra.

and information. As such, the research will be directly relevant to meeting the objectives described for Program 10 of the MTSRF (Enhancing Delivery).

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. The revised module will then be used to assess the performance of timber using a variety of species including approximately 30 endemic rainforest species. Included in this report will be discussion of the ecological benefits of each of these species. This new module will support landholders and their advisors when making decisions about vegetation management on their properties, and to the extent possible, the broad ecological impacts of these decisions. This will assist in the modelling of the economic impacts of vegetation management in the Wet Tropics region and will include insights into the economic consequences of modifying the management regimes to enhance biodiversity and other ecological benefits. Where possible, information from past research under Rainforest CRC Program 5 and 4.9.5 (Catteral) will be incorporated. We will also investigate the potential to develop an improved growth module for native species used in reforestation situations based on previous growth models developed for North Queensland rainforests by Jerry Vanclay.

We will also investigate cost-effective farm-based small-scale revegetation systems using native species that can be used for broad-scale revegetation in the Wet Tropics. The focus is on developing integrated ecological/economic/social small-scale systems that will facilitate an increase in tree planting to protect ecological goods and services such as biodiversity (Catterall) and landscape connectivity (Turton). To do this, we will develop an integrated bio-economic model based on a modified AFFFM. This model will be used to investigate the trade-offs between management for ecological objectives and economics and used to identify cost effective public and private investment strategies to restore/maintain ecological goods and services at a regional scale. By integrating biodiversity outcomes with economic considerations, the model can be used to identify appropriate support measures for different types of planting systems and management strategies.

Information will be drawn from a number of the projects within the sustainable land use program the MTSRF research. Information about the environmental impacts of forest land and plantation management will be drawn from research by Dr Catterall within this theme. Combining the results of the environmental conservation research of the Catterall team with our research will provide information about the trade-off between production and biodiversity conservation in forest systems. This will provide a possible basis on which payments to landholders for providing ecological services. The broader economic impacts of revegetation options will be determined using econometric input/output models and on the social research outlined above. The research will assist in the identification of the social and economic value of environmental assets, including those related to nature-based tourism, in the Wet Tropics World Heritage Area and their flow-on benefits to the community.

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 and broader economic impacts of forest management and revegetation by 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 cost effective revegetation schemes matched to the characteristics of the landholders in the target areas. Information about land parcels and land use regulations will be drawn from the findings of the research teams led by Catherine Robinson and Steve Turton within this Program.

Project Targeted Activities

Objective	Targeted Activity	Completion Date
a	Completion of survey of landholder practices, values, needs, attitudes, capacity and knowledge in regards to NRM in the Wet Tropics.	June 2008*
b	Completion of module for restoration plantings for AFFFM	June 2008*

* Involves ongoing activities in Out Years.

Project Targeted Activities

Objective	Output / Milestone	Date / Timing
(a)	Survey of landholders in the Wet Tropics	July 2007 – Sept 2007
(a)	Submit Interim report from survey of landholders	Dec 2007
(a)	Conduct workshops describing a comprehensive set of landholder profiles (typology) for key stakeholders involved in NRM and rural development in the Wet Tropics	From Dec 2007
(a)	Final report describing the set of landholder profiles (typology) for NRM agencies	Jun 2008
(a)	Draft of peer reviewed papers assessing the landholder profiles (typology) and their potential use for NRM and rural development	Aug 2008
(a)	Work with NRM and Primary Industries agencies to develop best management practices in relation to NRM for specific industries	2008-2010
(b)	Development of new module on restoration plantings using native species for AFFFM	Jun 2008
(b)	Refinement of growth modules and the development of new modules on native vegetation management, various reports (e.g. cost effective revegetation options for NRM)	Jul 2007 – Jun 2010
(b)	A series of reports, papers and workshops detailing the potential economic, social and environmental impacts of various forest management and revegetation development systems in the Wet Tropics	Jan 2008 – Jun 2010

Project 4.9.4 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones – all UQ responsibilities	Date
Signing of contract	
Report 1 submission • Completion of landholder interviews • Interim report on results of landholder survey released	1 Dec 2007
Report 2 submission • Progress update on activities associated with objectives (a) and (b) (above): surveys undertaken, activities undertaken to develop landholder profiles, progress toward new module development.	31 Mar 2008
Report 3 submission • Report outlining typology of landholders (obj a) • Report detailing development of the AFFFM module on restoration plantings using native species	10 Jun 2008
Total MTSRF Funding	**$125,000***

* Includes $1,500 Visual Documentation Allocation.

Project 4.9.4 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$123,500	-	$123,500
MTSRF Visual Documentation*	$1,500	-	$1,500
UQ	-	$198,800	$198,800
SCU	-	$25,500	$25,500
Total	**$125,000**	**$224,300**	**$349,300**

* A total of $1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project

UQ Project 4.9.4 Budget 2007/2008

Item	MTSRF	In-kind	Total Cost
Salaries**	$91,000	$64,300	$155,300
Operating	$11,600	$10,000	$21,600
Travel	$12,400	-	$12,400
Communication / Extension#	$8,500	-	$8,500
Capital	-	-	-
Institutional overheads	-	$150,000	$150,000
Total	**$123,500**	**$224,300**	**$347,800**

* SCU are providing in-kind to UQ on this project. UQ are to report against that in-kind contribution.

** Includes Research Fellow ($82,200) and casual research assistance ($8,800).

Production of distribution reports, workshop expenses, reproduction and distribution of AFFFM.

Indicative Budget Summary – Years 3 and 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$125,000	-	$243,900		TBA	$368,900
2009/2010	$125,000	-	$256,000		TBA	$381,000
Total	**$250,000**	**-**	**$499,900**		**TBA**	**$749,900**

PROGRAM 9: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES

Project 4.9.5: Restoring tropical forest landscapes

Project Leader and Host Organisation

Dr Carla Catterall, Griffith University (GU)

Project Team Commitment 2007/2008

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
Debra Harrison	Terrain NRM / Griffith University	Research assistant and facilitator in objective (c). Ecologist and information manager.	0.70
Rowena Grace	Terrain NRM	End-user collaborator in objective (a). Biodiversity manager.	0.10
Catchment coordinators	Terrain NRM	End-user collaborators in objective (c). Vegetation managers.	0.20
Allan Dale	Terrain NRM	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	University of Queensland	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

* Two current PhD and 1-3 future Honours or postgraduate students at Griffith University.

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
QEPA	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 involves 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 (MAT). 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 2007/2008

Objective	Targeted Activity	Date
(a)	End user workshop on monitoring biodiversity of revegetation*	September 2007*#
(a)	Data collection (vegetation condition and extent) at NHT sites*	July 2007-June 2008*
(a)	Trialing and development of plant and bird survey methods*	July-October 2007*#
(a)	Condition report NHT1 sites*	June 2008*
(a)	Monitoring toolkit version 2*	June 2008*#
(b)	Data collection for study of reforestation processes**	July 2007-June 2008**#
(b)	Scientific paper on conceptual model of reforestation processes submitted**	September 2007**#
(b)	Scientific paper on cyclone impacts*	November 2007*
(b)	Fact sheet on reforestation processes**	March 2008**
(b)	Developed design for study of factors affecting restoration outcomes**	March 2008**#
(c)	Reporting system for restoration works and regional investments under development with Terrain NRM	July 2007-June 2008*#
(c)	Stakeholder workshop on strategic experimental priorities in reforestation**	June 2008**#

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 or other partners.

Project Targeted Activities (All 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 Terrain NRM 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
	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#

Task	Output / Milestone	Date / Timing
	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
	Scientific paper on restoration costs and benefits**	2008-2009
	Workshop on integrating reforestation costs and benefits into Terrain NRM RIS*	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 suppprted by MTSRF (including in-kind from GU), but also require funds and in-kind contributions from Terrain NRM.

Outputs/milestones without asterisks are not dependent on MTSRF funds, although they will benefit from the relationship with MTSRF.

Project 4.9.5 Milestones 2007/2008

For 2007/2008 Outputs Only	
Milestones – all GU responsibilities. All reports to be written reports unless otherwise specified.	**Date**
Signing of contract	
Report 1 submission: • Report on outcomes of stakeholder workshop on monitoring biodiversity in revegetation (objective a). • Progress update on data collection at NHT sites, and trialing of survey methods (objectives a and b) • Update on scientific paper on conceptual model of reforestation processes submitted for publication (objective b) • Scientific paper on cyclone impacts prepared for publication pr5ovided to the RRRC (objective b) • Plan of communication activities, products and events for Year 2 and summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Nov 2007
Report 2 submission: • Provision of fact sheet on reforestation processes (objective b) • Report on developed design for study of factors affecting restoration outcomes (objective b) • Summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable.	31 Mar 2008
Report 3 submission: • Progress update on data collection for study of reforestation processes (objectives a and b). • Final report on monitoring toolkit version 2 (objective a).	8 Jun 2008

For 2007/2008 Outputs Only	
Milestones – all GU responsibilities. All reports to be written reports unless otherwise specified.	**Date**
• Final report on condition of NHT1 sites (objective b). • Progress update on reporting system for restoration works and regional investments under development with Terrain NRM (objective c). • Report of outcomes of stakeholder workshop on strategic experimental priorities in reforestation (objective c). • Final summary of liaison activities undertaken through course of Year 2 of project.	
Total MTSRF Funding	**$125,000***

* Includes $1,500 Visual Documentation Allocation.

Project 4.9.5 Budget

Year 2 Project Funding and Partnerships 2007/2008

Contributing Organisation	Cash	In-kind	Total
MTSRF	$123,500	-	$123,500
MTSRF Visual Documentation	$1,500	-	$1,500
Terrain NRM	$72,900	$60,000	$132,900
Griffith University	$20,000	$76,000	$96,000
Powerlink / 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

Griffith University Project 4.9.5 Budget 2007/2008

Item	MTSRF Funds	Terrain NRM Cash	GU Cash	In-kind	Total Cost
Salaries	$80,500	$53,400	$20,000	$84,674**	$238,574
Operating	$18,700	$6,200	-	-	$24,900
Travel	$8,600	$6,000	-	$2,500	$17,100
Communication / Extension	$15,700	$7,300	-	-	$23,000
Capital	-	-	-	-	-
Institutional overheads*	-	-	-	$93,826	$93,826
Total	**$123,500**	**$72,900**	**$20,000**	**$181,000**	**$397,400**

*GU responsible for managing and reporting in-kind of all agencies
** Includes $20,000 Internal Griffith university cash contribution

Indicative Budget Summary - Year 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$125,000	$20,000	$76,200	$72,900	$60,400	$354,500
2009/2010	$125,000	$20,000	$76,200	$72,900	$60,400	$354,500
Total	**$250,000**	**$40,000**	**$152,400**	**$145,800**	**$120,800**	**$709,000**

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 Commitment 2007/2008

Title	Organisation	Role	FTE
Dr Cathy Robinson	CSIRO	Overall project leader. Principal investigator of Project 4.9.6a (catchment and regional planning)	0.35
Bruce Taylor	CSIRO	Researcher 4.9.6a (social and institutional appraisal in resource planning and policy)	0.45
Dr Leonie Pearson	CSIRO	Researcher 4.9.6c (resource economics and environmental decision-making)	0.14
Ben Harman	CSIRO	Researcher 4.9.6a (local government roles in water management)	0.10
Dr Kristen Williams	CSIRO	Co-principal investigator of 4.9.6b (biography and conservation planning)	0.12
Dr Petina Pert	CSIRO	Researcher 4.9.6b (ecology)	0.16
Dr Rosemary Hill	CSIRO	Co-principal investigator 4.9.6b (conservation planning)	0.25
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)	0.12
Dr Stuart Whitten	CSIRO	Researcher 4.9.6c (environmental economics and decision making)	0.07

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
WTMA	Andrew McLean
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
QEPA	TBA
Reef Water Quality Partnership	Rachel Eberhard
Queensland Canegrowers	Tim Wrigley
ARC	Russell Butler

This 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, QEPA, WTMA and Terrain NRM 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 Targeted Activities (indicative only for out years)

Objective	Targeted Activity	Completion Date
(a.1)	Identify and synthesise the potential management actions and partnerships within and between key sectors and industries (in conjunction with other projects). The scope of the initial pilot study is the major farming and grazing sectors of the Tully Catchment in Far North Queensland region	December 2007
(a.2)	Develop to test a catchment scale monitoring and reporting framework to provide rigorous and consistent information on water quality management responses (including partner measures of successful outcomes and successful delivery efforts) (in conjunction with other projects) for the catchment area of the GBR. Initial pilot will be the Tully catchment.	March 2008
(a.3)	Select key management actions and partnership issues identified in the Tully catchment to compare with water quality responses (in conjunction with other projects) in a second case-study catchment. The comparative analysis will enable generic and catchment-specific pollutant, institutional and resource user capacity drivers that affect cost-effective target design to be identified.	December 2008
(a.4)	Review and report on water quality 'action' and 'partnerships' monitoring data from a.2 and synthesise key trends, indicators and thresholds of acceptable change for broader application in the GBR. Consider use in cross-jurisdictional or cross-regional partnerships needs to ensure greater investment efficiencies and maximisation of outcomes.	July 2009
a, b and c	Integrate biodiversity metric, market-based instrument and local and regional planning methods and approaches developed by Project 4.9.6 task a), b) and c) into a collaborative adaptive ecosystem service management and decision-making framework for Reef catchments	March 2010
(a.5)	Refine and implement Project and Task communication research synthesis and communication strategy targeted at industry, government and community groups to provide planning and decision-making approaches and information on water quality and biodiversity issues of concern	March 2010
(b.1)	Generate and test local area planning frameworks and key tools including scenarios through the Mission Beach Habitat Network Action plan, participatory decision support with Landscapes Toolkit in the Tully-Murray Floodplain, and active landholder conservation in the Daintree	December 2007
(b.2)	Finalise in partnership with Action Committee, the Mission Beach scenarios and optimal habitat network action plan and strategies including both unique areas and complementary rainforest bioregion land areas based on biodiversity persistence that can be incorporated into the local area and regional NRM plans; ensure review of optimisation strategy through Action Committee incorporating QPWS, QEPA and other stakeholders.	March 2008
(b.2)	Scope local area planning needs in key biodiversity/impact hotspots within the Wet Tropics bioregion with Terrain NRM, MTSRF Project 4.9.3 and other relevant researchers, and identify any additional sites for testing approaches	June 2008
(b.3)	Generate adaptive collaborative local area planning frameworks and key tools in for testing in second-tier case study sites	March 2009

Objective	Targeted Activity	Completion Date
(b.5)	Identify and apply biodiversity metrics that capture species turn-over and phylogeny into the first and second tier local area planning case studies	July 2009
(b.6)	Review, in collaboration with project partners, outcomes from local area planning scenarios, decision support tool and biodiversity metric applications and implement research synthesis aimed at community, industry and government to provide guidelines on best-practice approaches	March 2010
(c.1)	Identify the failures of the current market that are contributing to development's potentially continuing adverse impact on ecosystem services. Consolidate market failure analysis and the first year's research to assess and provide comment on an instrument or instrument mix for the management of development, which effects ecosystem services. This instrument or mix will be the focus of the design and testing for the remainder of this research.	December 2008
(c.2)	Identify and describe the critical parameters that are essential to the successful implementation and operation of the proposed instrument or instrument mix	March 2008
(c.3)	Review necessary factors for construction of an appropriate metric, an important parameter for any market based instrument. Including identifying existing measures that could be adapted and specifying any new knowledge needs.	June 2008
(c.4)	In collaboration with Terrain NRM and other relevant regional actors, build offset scenarios for the Mission Beach development context	June 2008
(c.5)	Finalise suitable ecosystem service metric, scenarios and testing frameworks	June 2009
(c.6)	Test ecosystem service management instrument design to analyse the nature of trades (including who would participate), landscape outcomes, distribution of impacts etc of incorporating different parameters in offset arrangements.	March 2010

Project 4.9.6 Milestones 2007/2008

For 2007/2008 Outputs Only	
Milestones – all CSIRO Responsibilities. All reports to be written reports unless otherwise specified.	**Date**
Signing of contract	
Report 1 submission: • (a) Report describing project outputs that have application to Tully WQIP Implementation plan and delivery arrangements – this will focus on preliminary management actions, partnerships and opportunities that enhance investment in that catchment • (b) Report on the application of alternative landscape vision scenarios and biodiversity underpinning the Mission Beach Habitat Network Action plan. • (c) Progress report on market failure analysis for cassowary conservation and market-based instrument recommendation.	13 Dec 2007
Report 2 submission: • (a) Report on progress of development and application of monitoring and reporting framework for management responses to water quality – include preliminary indicators and protocols. • (b) Report on contribution to the Mission Beach Habitat Network Action Plan • (c) Report recommending the ecosystem service management instrument mix for cassowary conservation and justification for use. (c) Report on the instrument parameters critical to instrument implementation success and uptake by management.	24 Mar 2008
Report 3 submission: • (a) Report on overall contribution of research outputs a.1 and a.2 in Tully catchment and progress on identifying and negotiating a second case-study catchment for comparative testing of approach • (b) Report on scoping of priorities for local area planning frameworks for second tier case-studies in the identified priority biodiversity hotspot/impact areas in the wet tropics • (c) Report on development of participatory decision support with Landscapes Toolkit in the Tully-Murray Floodplain • (d) Structure of a suitable ecosystem services metric, and suitable measures to support the metric, that can be used in an in-house workshop of offset operations and scenarios. • (e) Report describing design issues for offsets addressing the cumulative ecosystem services impacts of development. • (f) Report on activities to develop offset scenarios for future testing	11 Jun 2008
Total MTSRF Funding	**$243,275***

* Includes $1,500 Visual Documentation Allocation.

Project 4.9.6 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$241,775	-	$241,775
MTSRF Visual Documentation*	$1,500	-	$1,500
CSIRO	-	$192,614	$192,614
Total	**$243,275**	**$192,614**	**$435,889**

* A total of $1,500 is held by the Reef and Rainforest Research Centre for Visual Documentation of this project

CSIRO Project 4.9.6 Budget 2007/2008

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	$201,924	-	$201,924
Operating	$26,632	-	$26,632
Travel	$13,219	-	$13,219
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	$192,614	$192,614
Total	**$241,775**	**$192,614**	**$434,389**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$252,673	-	$195,393	-	-	$448,066
2009/2010	$255,233	-	$197,059	--	-	$452,292
Total	**$507,906**	**-**	**$392,452**	**-**	**-**	**$900,358**

PROGRAM 9: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES

Project 4.9.7: Understanding social resilience and identification of social resilience indicators for management

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 Commitment 2007/2008

Title	Org.	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	0.30
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	0.05
Dr Bradd Witt	UQ	Lead role in participatory case studies, contributor to indicators of resilience	0.10
Research Assistant	CSIRO	Lead role in resilience indicators at GBR scale	0.08
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 resilience indicators; community level research methodology	0.15
Dr Jo Balatti	JCU	Contributor to community level resilience indicators; community level research methodology	0.20
Dr. Kristen MacLean Postdoctoral Fellow	UQ	Substantive fieldwork and data collection for case studies. Contributor to indicators of resilience.	1.00
PhD students: Ms Moni Carlisle	JCU	Community level resilience indicators – WQIP focus	1.00
Ms Snowy Evans	JCU	Community level resilience indicators – educational policy focus	1.00
Casual Research Assistant (Dr Donna Rigano, others as requested))	JCU	Community level resilience indicators	0.50

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
WTMA	Andrew McLean
Alliance for Sustainable Tourism	Annie Riddet
Terrain NRM	Allan Dale
QEPA	TBA
Queensland Canegrowers	Tim Wrigley
ARC	Russell Butler
RWQP	Rachel Eberhard

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 the following four sub-objectives:

(a) Development of indicators of social resilience to water quality change at whole of GBR scale; (coordinated by CSIRO)
(b) Development of indicators of social resilience to water quality change at large catchment (regional body administration) scale; (coordinated by UQ)
(c) Development of indicators of social resilience to water quality change at community scale; (coordinated by JCU)
(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. The process will occur in close collaboration with end-users and related MTSRF projects.

Three questions guide the project activities designed 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 indicators of social resilience are needed to inform management decisions made in relation to water quality at different scales of interest?
3. What investments are most likely to enhance, or detract from, social resilience in relation to water quality change?

Methodology

The project methodology is derived from the conceptual framework developed for the project (see Figure 1). This framework is a 'living document' as well as a 'summary' document. Literature reviews, initial consideration of case studies, dialogue with end-user organisations, and the team's considerable background intellectual property are already suggesting key components of social resilience that could elaborate each set of words within the centre of the figure below. For instance, essential elements of social resilience, and suggestions towards potential indicators, are already emerging and can progressively be elaborated into sub-frameworks.

The conceptual framework combines well tested social science methodologies (qualitative and quantitative) through a collaborative process with decision-makers (end-user organisations, and communities) to understand social resilience. The framework highlights the major processes and linkages contributing to the development of robust and relevant indicators of social resilience that support decision-making and managerial learning. The framework incorporates three nested scales of research focus:

- Whole of GBR catchment area (by CSIRO);
- Large catchment (by UQ); and
- Community scale (by JCU).

The conceptual framework assumes that to be of value, the indicators of social resilience developed through this project must directly inform the decisions that end-user agencies and communities need to make. The indicators will inform decision-makers about the key social attributes of the systems in which they seek to intervene (the social resilience characteristics of societies at their scale of interest), and assist decision-makers in their processes of monitoring and evaluation, to identify the impacts on social resilience of water quality changes or policy interventions designed to achieve water quality targets.

The conceptual framework thus underpins a project approach that uses rigorous and theoretically grounded social science to develop indicators that have the greatest likelihood of 'ownership' and thus use by decision-makers, because decision-makers have been closely involved in their generation and have integrated their use into their decision-making processes. The conceptual framework follows principles of 'engaged scholarship': being applied, transdisciplinary, collaborative and directed towards achieving mutually beneficial outcomes.

The entire approach is based on close collaboration with decision-makers, whether end-user agencies or participating communities of place (locations, reached for instance through a school community or local water quality monitoring group) or interest (for example a water quality improvement planning group, a primary industry).

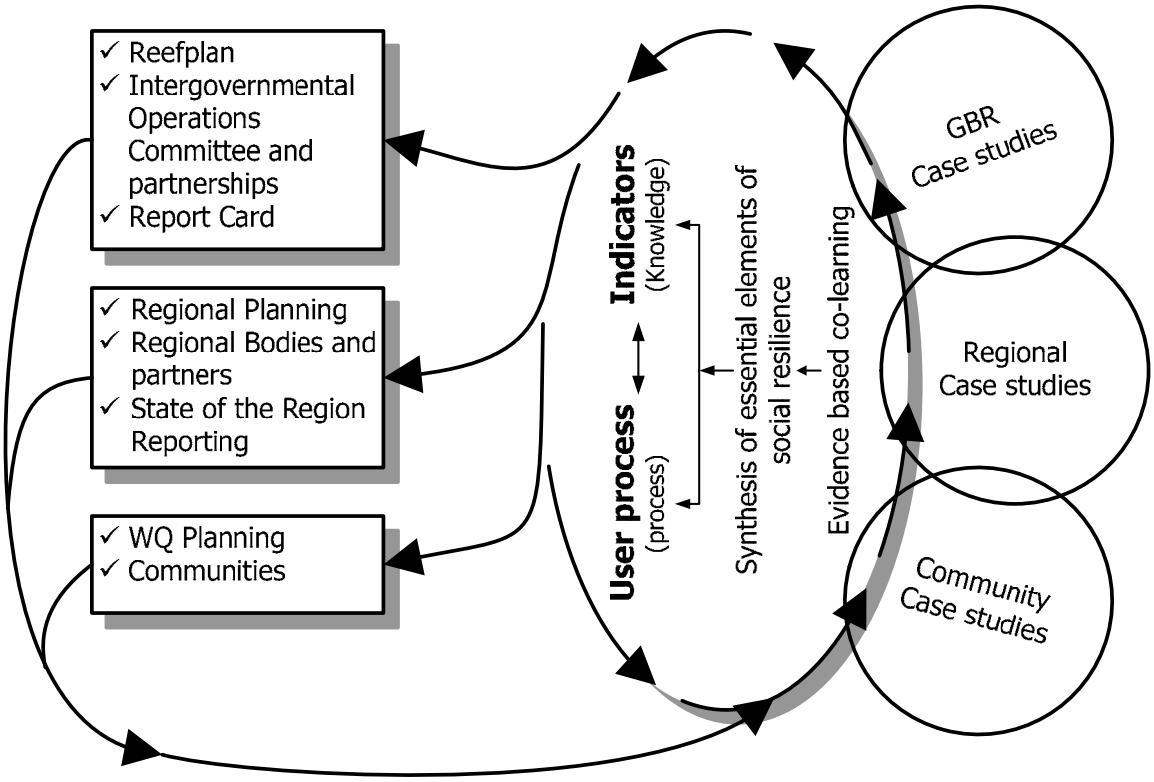

Figure 1: Conceptual framework for the development of indicators of social resilience through a collaborative process with decision-makers.

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 (see Figure 1):

- 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;
- **Regional bodies' scale of interest,** where regional planning is achieved through regional bodies and their environmental management and regional development partners - linked to proposed State of the Region reporting; and
- **Communities' scale of interest,** where Water Quality Improvement Planning and broader community capacity building are focal.

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 viability or social structures and processes. 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, 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 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 will provide the combined team of researchers and end-users with a provisional view of what needs to be indicated (e.g. 'capacity'), and they will proceed to consider how it can best be indicated (one or more indicators of capacity). At the same time the process for using those indicators is clarified. The method will be 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 will necessarily differ at each scale, since the most relevant end-users at each scale will have different preferences for modes of involvement, such as regular workshops versus periodic one-to-one consultations. We recognise that key agencies are interacting with a number of MTSRF projects, have limits to staff capacity, and that the processes need to be efficient and rewarding for them. Where workshops are held (e.g. at regional body scale of interest), we will be using social learning methods focused on workshops, enhanced with participatory processes for indicator development that focus on eliciting managers' goals, then ways of indicating progress towards achievement of those 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 update to the regional NRM plan, the regional growth management plan, FNQ2025 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). The methods for each of these will differ, and be negotiated as part of the collaborative process with end-users.

- At the community scale, participatory case studies will be 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 of community-based end-users living in the urban areas of Townsville and Thuringowa will be conducted to elicit knowledge and beliefs about community level resilience to water quality change. The case studies and interviews, together with a desk top study will provide the basis for the development of community-scale proto-indicators.
- Regional-scale case studies will be defined at or subsequent to the first workshop with end-users and the regional report card MTSRF project on 31st May. These will be aligned with shared long-term change goals of the main end-users. They may be catchment-based, or focus on particular social-ecological systems (e.g. aligned to land uses, ecosystems services or Aboriginal interests) across catchments.
- 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.

Project Targeted Activities

Objective	Targeted Activity	Completion Date
b, c	• PhD students to: o Identify literature areas; o Identify and contact relevant research participants and end-users; and o Prepare research proposal (JCU)	Sept 2007
a, b, c	• Short report on design and commencement of first case study (UQ). • Report on end-user workshops or equivalent collaborative process: nature of agreed collaborative process; shared management goals suggestive of needs for indicators; 'first cut' or least regrets listing of potential indicators for provisional development (UQ). • Preliminary analysis of case study data complete (CSIRO). • PhD students to: o Submit ethics application; o Complete PhD confirmation of candidature seminar and paper; o Further explore concepts/theory in literature; and o Finalise formulation of methodology (JCU). • Workshop with Townsville/Thuringowa case study participants (JCU) o Final report on Phase One of Townsville/ Thuringowa case study (JCU)	Nov 2007
a, b	• Report on second (UQ) end-user workshop: progress towards refinement of design of a set of 'least regrets' indicators to assist end-users and other MTSRF teams with design of the State of Region report card (due June 2008) (UQ). • GBR scale user definitions of social resilience are tested against perceptions of social resilience generated at different user scales (e.g. NRM bodies, local government) and where appropriate revised (CSIRO) • Workshop with Townsville/Thuringowa case study participants (JCU) • Interim Report on Phase Two of Townsville/ Thuringowa case study (JCU).	Mar 2008
a, b, c	• Interim Report on Phase Two of Townsville/ Thuringowa case study (JCU) • Workshop with Townsville/Thuringowa case study participants (JCU) • Conference papers (JCU) • PhD students to undertake: o Data collection; and o Coding and content analysis (JCU). • Case study database extended with more refined data sets and where feasible field data collection to update secondary data sources (CSIRO). • Analysis of GBR end-user perceptions of social resilience and case study data analysis used to refine conceptual model of social resilience to GBR (CSIRO).	Jun 2008

Objective	Targeted Activity	Completion Date
	• Partnership developed with an end-user able to test the application of prototype social resilience indicators and indicator use process for the GBR region (CSIRO). • Report on contribution of least-regrets indicators to State of Region report card (role shared with other organisations) (UQ). • Paper on social resilience submitted for publication in peer reviewed journal (CSIRO). Conference papers (UQ; JCU)	August 2007, November 2007 and April 2008 (proposed)

Project 4.9.7 Milestones 2007/2008

For 2007/2008 Outputs Only	
Milestones [agency responsible for report delivery identified in brackets]. All reports to be written reports unless otherwise specified.	**Date**
Signing of Contract	
Report 1 submission [CSIRO to coordinate report submission] • Results of the GBR scale case study data analysis presented for initial review (obj a) [CSIRO] • Progress update on end-user workshop, design of case study (obj b) [UQ] • Progress of JCU PhD students (obj c) [JCU] • Final report on Phase One of Townsville/Thuringowa case study (obj c) [JCU]	15 Nov 2007
Report 2 submission [JCU to Coordinate report submission] • Report on discussion of how inclusion of different scaled perceptual information would alter the concept of social resilience used at the GBR scale (obj a) [CSIRO] • Report on end-user workshops and indicators stage – outcomes and indicators (obj b) [UQ] • Progress of JCU PhD students (obj c) [JCU] • Interim report on Phase Two of Townsville/Thuringowa case study (obj c) [JCU]	28 March 2008
Report 3 submission [UQ to coordinate report submission] • Description of case study data set for GBR scale (obj a) [CSIRO] • Discussion of modification of GBR scale conceptual framework based on inputs from case studies and end-user perceptual analyses (obj a) [CSIRO] • Partnership for testing social resilience indicators described (obj a) [CSIRO] • Paper submitted for publication attached (obj a) [CSIRO] • Report indicators and how contributing to SoR report (obj b) [UQ] • Progress of JCU PhD students (obj c) [JCU] • Interim report on Phase Two on Townsville/Thuringowa case study (obj c) [JCU]	8 June 2008
Total MTSRF Funding (2007/2008)	**$220,000***

* Includes $1,000 Visual Documentation Allocation.

Project 4.9.7 Budget

Year 2 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	$219,000	-	$219,000
MTSRF Visual Documentation*	$1,000	-	$1,000
JCU	-	$72,600	$72,600
CSIRO	-	$47,848	$47,848
UQ		$210,875	$210,875
Total	**$220,000**	**$331,323**	**$551,323**

* UQ cash contribution is dedicated to balance of salary for a Post Doctoral Fellow.

JCU Project 4.9.7 Budget 2007/2008

Item	MTSRF	JCU In-kind	Total Cost
Salaries	$50,470	$72,600	$123,070
Operating	$11,980	-	$11,980
Travel*	$6,250	-	$6,250
Communication / Extension	$4,300	-	$4,300
Capital	-	-	-
Institutional overheads	-	Included in figure above	-
Total	**$73,000**	**$72,600**	**$145,600**

CSIRO Project 4.9.7 Budget 2007/2008

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	$53,040	-	$53,040
Operating	$5,751	-	$5,751
Travel*	$9,909	-	$9,909
Communication / Extension	$4,300	-	$4,300
Capital	-	-	-
Institutional overheads	-	$47,848	$47,848
Total	**$73,000**	**$47,848**	**$120,848**

UQ Project 4.9.7 Budget 2007/2008

Item	MTSRF	UQ Cash	UQ In-kind	Total Cost
Salaries	$45,000	$30,000	$58,750	$133,750
Operating	$9,000	-	$122,125	$131,125
Travel*	$11,250		-	$11,250
Communication / Extension	$7,250	-	-	$7,250
Capital	-	-	-	-
Institutional overheads	-	-	-	-
Total	**$73,000**	**$30,000**	**$180,875**	**$283,375**

Indicative Budget Summary – Years 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2008/2009	$220,000	UQ $30,000	UQ $190,000	-		$440,000
2009/2010	$220,000	UQ $30,000	UQ $200,000	-		$450,000
Total	**$440,000**	**$60,000**	**$390,000**	**-**		**$890,000**

THEME 5 (PROGRAM 10)
ENHANCING DELIVERY

Underpinning the capacity to ensure MTSRF goals are met is the ability to communicate effectively with:

- End users and stakeholders – to identify critical research needs and to deliver synthesised information that provides more effective delivery to relevant end users of the research;
- Researchers – to assist in the development and delivery of the research; and
- The public – to identify strategies for, and undertake delivery of research findings in a manner that will enable uptake and use of the research.

To this end the Reef and Rainforest Research Centre undertakes a number of activities under Theme 5 to provide a communication framework that provides a co-learning operating environment for the agencies involved in the MTSRF. The strategies that sit within the communication framework under Theme 5 define communication approaches and a standard set of procedures and styles that operate at a range of scales and that have been agreed with research providers, end users and stakeholders (critically DEW).

The communication framework addresses the development, conduct and delivery of:

- Communication products (e.g. scientific papers, research reports [technical and others]);
- Media activities;
- Popular news articles;
- Conference and workshop events; and
- Data management and reporting structures.

Theme 5 will facilitate the development of knowledge products that will be useful to the major end-users of the MTSRF program such as government agencies, industry and community sectors. This will be achieved through the coordination and integration of the research programs across the MTSRF facility, by enhancing linkage between research teams, creating multi-media web products and producing reports that synthesise knowledge in forms that are relevant to the target audiences. It is a significant task to bring together the necessary biophysical, economic and social data in a robust and scientifically valid process.

This information for the knowledge products will be based on the results generated across MTSRF projects as well as that sourced from other current and historical projects and end-user knowledge networks.

This information will grow over time; in the first year, we are synthesising research findings into four benchmark reports for the Great Barrier Reef, Wet Tropics Rainforest, Torres Strait areas and water quality in the GBR Catchment. These are essential in establishing the baseline of our current understanding of these areas. In Years 2-4 of the MTSRF program these 'benchmark' reports will be built on to deliver updated information on the health and use of these areas.

In addition to the synthesis reports, Theme 5 provides for the conduct of a series of large annual workshops through a conference structure to harness the existing knowledge and newly generated information for the identified areas. The conference structure for the

conduct of these workshops affords the researchers an opportunity to communicate directly with many of the end users and highlight the synergies derived from research integration.

Specialist workshops are also coordinated through Theme 5 activities to develop agreed social and resource economic research within the MTSRF program. The MTSRF program will also work with other CERF hubs through Theme 5 activities to coordinate research across the social and economic disciplines of relevant CERF funded programs. Specialist synthesis reports on topical issues of concern such as climate impacts on the environment and ecotourism industries and the influence of zoning on the biodiversity and use of the Great Barrier Reef are also undertaken through Theme 5.

Theme 5 activities use the synthesis reports and associated data sets as the basis for synthesising and integrating data from the Great Barrier Reef, Wet Tropics Rainforest, Torres Strait areas and water quality in the GBR Catchment. The development of the Data and Integration Synthesis processes are partly undertaken within the MTSRF Themes 1-4 and coordinated and delivered through Theme 5. The particular biological and social indicators and critical thresholds utililised within the Integrated Reporting are also developed within MTSRF Themes 1-4. The Integrated reports are developed and customised to the individual requirements of the particular end users of the geographical area, they will need to be delivered to the appropriate management arrangement to enable on going reporting. Agreement from end user organisations regarding the structure and process for delivery of the Integration reports is essential if they are to be a valuable reporting tool in the future.

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. Specific focus areas for targeted partnership to facilitate the delivery of Theme 5 activities include the following Theme 5 sub-projects:

5.10.1 Visual documentation of 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

The first project is developed in consultation and agreement with researchers participating in the MTSRF and part funded (video collection) through Theme's 1-4. Ouptuts include high quality digital video footage of science activities being conducted under the MTSRF with appropriate scripts for use in describing and documenting research being conducted under the MTSRF. Footage will be web-enabled and available for use by all research organizations within the MTSRF for communicating their research findings.

The latter two projects are assisting communication between MTSRF researchers and key groups, critically tourism groups and Indigenous rainforest people, within the Wet Tropics Rainforests 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 three projects are provided.

Budget Summary

Title	MTSRF	Other Cash	In-kind	Total
RRRC Enhancing Delivery Activities	$737,500	-	-	$737,500
Partnership opportunities to Enhancing Delivery	$60,000	-	$29,000	$89,000
Total	**$797,500**	**-**	**$29,000**	**$826,500**

The total value of Theme 5 (Program 10) is $826,500.

PROGRAM 10: ENHANCING DELIVERY

Project 5.10.1: Visual Documentation of MTSRF Projects

Project Leader and Host Organisation
Reef and Rainforest Research Centre Ltd

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
DEW	Elizabeth Oliver
Researchers	MTSRF Research Providers
Canegrowers Queensland	Tim Wrigley
Stakeholders	End users of MTSRF Research

Project Duration

Start Date: 1 July 2006 End Date: 30 June 2010

Project / Task Objectives

To create a visual record of the MTSRF program for use in multimedia and public presentations that includes the scientific research work and the environmental assets of North Queensland, with the aim of disseminating the results to the public and all those who may benefit from using the results of the MTSRF products.

This project has been formed through contributions amounting to $79,000 from projects within Themes 1-4. Its purpose is to deliver multimedia video that documents the work undertaken with MTSRF funding. This multimedia product will be designed to enable subsequent findings from MTSRF projects to be added as they become available, creating a visual record of the MTSRF work, the research projects and the environmental assets of North Queensland, that will be accessible to the public, the Australian Government and all major stakeholders in MTSRF.

Project Targeted Activities

Objective	Targeted Activity	Date
(a)	Produce visual documentation through collection and, where agreed, 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 be provided in a range of formats in order for it to be used on websites, in public presentations and in the media as appropriate.	Ongoing to 2010
(b)	Provide periodic reports of results and material generated for website presentation	Quarterly

Project 5.10.1 Milestones 2007/2008

For 2007/2008 Outputs Only **Milestones**	**Date**
Report 1 submission: • Delivery of Phase 1 of visual media products (ten products agreed)	18 Sept 2007
Report 2 submission: • Delivery of Phase 2 of visual media products (products to be agreed)	15 Jan 2008
Final Report • Delivery of visual media products for all agreed MTSRF projects.	28 May 2008
Total MTSRF Funding	**$79,000**

Project 5.10.1 Budget

Year 1 – 2007/2008 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF*	$79,000	-	$79,000
Total	**$79,000**	**-**	**$79,000**

* The total Visual Documentation allocation from projects within Themes 1 to 4, held by Reef and Rainforest Research Centre allocated against this activity.

Project 5.10.1 Budget 2007/2008

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	-	-	-
Products	$79,000	-	$79,000
Travel	-	-	-
Communication / Extension	-	-	-
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

Reef and Rainforest Research Centre Ltd in conjunction with the Tourism Alliance through Tourism Tropical North Queensland (TTNQ)

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Annie Riddet	TTNQ	Project leader, Business Manager	0.05
Rob Giason	TTNQ	Chief Executive Officer	0.025
David Rose	TTNQ	Director, Strategy and New Markets	0.025

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
DEW (MTSRF)	Kerry Neil (RRRC)
MTSRF Research providers	Associated with tourism research projects

Project Duration

Start Date: 1 July 2007 End Date: 30 June 2008

Project / Task Objectives

The science projects conducted in the Wet Tropics under the MTSRF have a strong interplay with industries that rely on the health of the Wet Tropics ecosystem. To ensure the research is meeting the needs of the Tropical Ecotourism sector (land based), it is important to have a clear and concise understanding of the research priorities for this group. In addition, mechanisms to facilitate the engagement between researchers and the Tropical Ecotourism industry, within the context of the engagement system and framework of the MTSRF, are required.

This schedule describes the principal activities to be undertaken by a Tropical Tourism North Queensland (TTNQ) representative working across the Cairns and Townsville nodes of the Industry. The representative would be expected to interact with the RRRC and MTSRF research providers and have a comprehensive knowledge of the tropical ecotourism industry.

Project / Task Objectives for 2007/2008

(a) To report on the research priorities for land based ecotourism in the Cairns and Townsville regions that align with the MTSRF research priorities.

(b) To recommend mechanisms to enhance the delivery of research findings and uptake by the Tropical Ecotourism sector in these regions.

Project Activities 2007/2008

Objective	Targeted Activity	Date
a	Initiate a program of engagement with Tropical Ecotourism sector in the Cairns and Townville region.	Jun 2006 Completed ARP1
a	In collaboration with the Industry, identify research priorities that align with the research focus of the MTSRF.	Oct 2006
b	Recommend mechanism to facilitate delivery of research findings to the Industry.	Dec 2006
b	Collaborate in the delivery of research findings to the Industry.	Jun 2008
all	Attend meetings of relevance to MTSRF program to inform researchers and management of the Industries research needs.	ongoing
all	Report to Reef and Rainforest Research Centre on liaison activities.	ongoing

Project 5.10.2 Milestones 2007/2008

For 2007/2008 Outputs Only	**Date**
Milestones – All TTNQ Responsibilities	
Signing of contract	
• Report on Tourism Industry's research priorities that align with the MTSRF program.	31 Oct 2007
• Report on mechanisms to facilitate delivery of research findings to the Tourism Industry's	15 Dec 2007
• Report on the activities to deliver of research findings from the MTSRF to the Tourism Industry	10 Jun 2008
Total MTSRF Funding	**$30,000**

Project 5.10.2 Budget 2007/2008

Tourism Tropical North Queensland Project 5.10.2 Budget 2007/2008

Item	MTSRF Funds	Funds from TTNQ In-kind	Total Cost
Salaries	$5,000	$5,000	$10,000
Operating	$2,000	-	$2,000
Travel	$1,000	$3,000	$4,000
Contractors – Industry Consultation	$10,000	-	$10,000
Contractors – Communication and PR	$12,000	-	$12,000
Capital	-	-	-
Service provider overheads	-	$2,000	$2,000
Total	**$30,000**	**$10,000**	**$40,000**

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 Aboriginal Rainforest Council (ARC)

Project Team Commitment 2007/2008

Title	Organisation	Role	FTE
Allison Halliday	Aboriginal Rainforest Council	Project leader, co-ordination	0.05
Russell Butler Jr	Aboriginal Rainforest Council	Liaison Officer	0.5

Summary Table of Research Users 2007/2008

Organisation	Organisational Contact
DEW	TBA
Board of Aboriginal Rainforest Council	Through project team
Terrain NRM	Allan Dale
Alliance for Sustainable Tourism	Annie Riddet
WTMA	Andrew McLean

Project Duration

Start Date: On signing of contract
End Date: 30 June 2008 (subject to performance and continuation of funding for the position under the MTSRF Annual Research Plan for 2007/08).

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 northeast Australia. 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 Wet Tropics Rainforest related activities. The schedule provides support for a liaison officer to relate research and management gaps, issues, concerns and ideas identified by Rainforest 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 organisations (particularly the ARC) 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 WTWHA 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 ARC Intellectual Property Sub-Committee 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 ARC Intellectual Property Sub-Committee, and where possible, assist to negotiate Intellectual Property agreements or licenses for research projects.	throughout
all	Ensure that progress reports are approved by the ARC Intellectual Property Sub-Committee and licenses procured prior to being submitted to RRRC	throughout

Project 5.10.3 Milestones 2007/2008

For 2007/2008 Outputs Only Milestones All ARC Responsibilities	Date
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 2008.	15 Jul 2007
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 2007).	15 Dec 2007
Progress Report 3. • Final report on liaison activities and communication products during milestone period (15 Dec 2007 to 30 June 2008) and assessment of effectiveness of delivery against plan and liaison position suitability for Traditional Owner engagement.	11 Jun 2008
Total MTSRF Funding *Funding for 2007/2008 is contingent upon ongoing funding for the position under the MTSRF Annual Research Plan for 2007/08.*	**$30,000**

Project 5.10.3 Budget 2007/2008

*Aboriginal Rainforest Council Project 5.10.3 Budget 2007/2008**

Item	MTSRF Funds	ARC In-kind	Total Cost
Salaries	$24,000	-	$24,000
On-costs (super, leave)	$5,000	-	$5,000
Operating	-	$2,000	$2,000
Travel	-	$7,000	$7,000
Communication / Extension	-	$7,000	$7,000
Capital	$1,000	-	$1,000
Institutional overheads	**-**	$3,000	$3,000
Total	**$30,000**	**$19,000**	**$49,000**

* Funding for 2007/2008 is subject to performance and ongoing support for this position under the 2007/2008 Annual Research Plan.

Further information

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Credits: **Southern cassowary** Wet Tropics Management Authority; **Hill Inlet in the Whitsundays** Department of Foreign Affairs and Trade - Overseas Information Branch; **Butterfly fish** Robert Thorn; **Rainforest fruits** Wet Tropics Management Authority; **Rainforest** C. Totterdell and the Australian Heritage Photo Library; **Satellite image** compiled by Environmental Resources Information Network (Department of the Environment and Water Resources); **Other images within this report** MTSRF research community.