



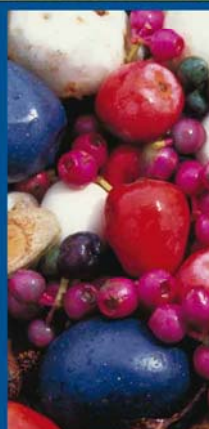
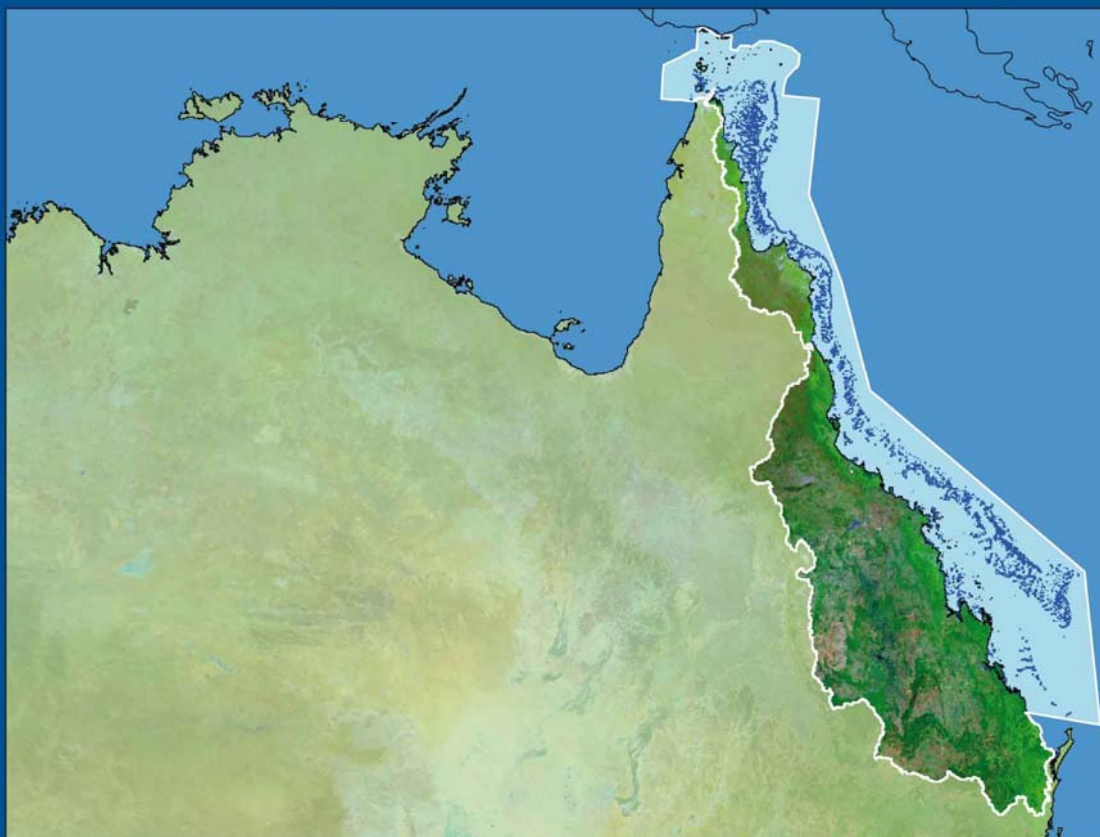
Australian Government

Department of the Environment and Water Resources



Annual Research Plan 2006-2007

Marine and Tropical Sciences Research Facility



**Revision
February 2007**

PREFACE

The Australian Government's Marine and Tropical Sciences Research Facility creates a unique hub of expertise generating knowledge needed for the conservation and sustainable use of the Great Barrier Reef and the tropical forests of North Queensland. The scope of the work extends into the catchments of the Great Barrier Reef to support initiatives in improving water quality, and into Torres Strait.

The Facility brings into close partnership the scientific researchers and the users of the scientific results. It will inform the Australian people on the condition and trends in these internationally important environmental assets. It will answer questions being posed by government, industry and the public, and will produce knowledge across a range of disciplines including biological and physical sciences, economics and social science. Rather than allow these results to sit on the shelf, the Facility will put a major effort into enhancing the adoption of the results and communicating these to the public.

It is very important to the Government that the research work done by the Facility passes a common sense test of 'so what does this mean?' The funds will be directed where the results are demonstrably practical and will target specific issues, however they will be reviewed rigorously to ensure the products meet the highest scientific standards. The Facility will encourage innovation and enhance the regional capacity of North Queensland in its stewardship of these very important environmental assets.

This Annual Research Plan is the first step in building a unique scientific capacity in North Queensland solving problems that all Australians will regard as critically important.

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

MARINE AND TROPICAL SCIENCES RESEARCH FACILITY ANNUAL RESEARCH PLAN 2006-2007

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ACRONYMS

AAC	Advanced Analytical Centre (James Cook University)
ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ACCSP	Australian Climate Change Science Program
ACTFR	Australian Centre for Tropical Freshwater Research
ADFA	Australian Defence Force Association
AFFFM	Australian Farm Forestry Financial Model
AGO	Australian Greenhouse Office
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
AIMS	Australian Institute of Marine Science
AIMSLTMT	Australian Institute of Marine Science Long Term Monitoring Team
AMC	Australian Maritime College
AMPTO	Association of Marine Park Tourism Operators
AMSA	Australian Marine Safety Authority
ANU	Australian National University
ARC	Australian Research Council
ARP	Annual Research Plan
ASS	Acid Sulfate Soils
BDTB	Burdekin Dry Tropics Board (now BDTNRM)
BDTNRM	Burdekin Dry Tropics Natural Resource Management
BMP	Best Management Practice
BMRGNRM	Burnett Mary Regional Natural Resource Management
BRS	Bureau of Rural Sciences
CAEPR/ANU	Centre for Aboriginal Economic Policy Research, Australian National University
CCI	Coastal Catchments Initiative
CEO	Chief Executive Officer
CERF	Commonwealth Environment Research Facility
CMAR	Centre for Marine and Atmospheric Sciences
COTS	Crown-of-Thorns Starfish
CPA	Cairns Port Authority

CPUE	Catch Per Unit Effort
CQPA	Central Queensland Ports Authority
CQU	Central Queensland University
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CV	Curriculum Vitae
DAFF	Commonwealth Department of Agriculture, Fisheries and Forestry
DBH	Diameter Breast Height
DEW	Commonwealth Department of the Environment and Water Resources
DEW ERIN	Commonwealth Department of the Environment and Water Resources Environment Resource Information Network
DFAT	Department of Foreign Affairs and Trade
DOTARS	Department of Transport and Regional Services
DPA	Dugong Protection Area
DPC	Department of the Premier and Cabinet
ELF	Effects of Line Fishing
EPA	Environmental Protection Agency
FBA	Fitzroy Basin Association
FNQ	Far North Queensland
FNQ NRM Ltd	Far North Queensland Natural Resource Management
FNQROC	Far North Queensland Regional Organisation of Councils
FRDC	Fisheries Research and Development Corporation
GA	Geosciences Australia
GBR	Great Barrier Reef
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GBRMPA FRAC	Great Barrier Reef Marine Park Authority Fisheries Reef Advisory Committee
GBRMPA RAC	Great Barrier Reef Marine Park Authority Reef Advisory Committee
GBRWHA	Great Barrier Reef World Heritage Area
GIS	Geographical Information System
GPS	Global Positioning System
GU	Griffith University
IPCC	Intergovernmental Panel on Climate Change

JCU	James Cook University
LTMP	Long Term Monitoring Program
MATS	Management Action Targets
MC	Moulter Cay
MI	Murray Island
MMP	Marine Monitoring Program
MOU	Memorandum of Understanding
MPA	Marine Protected Area
MPG	Marine Plant Group
MSQ	Maritime Safety Queensland
MTSRF	Marine and Tropical Sciences Research Facility
MWNRM	Mackay Whitsunday Natural Resource Management
NAILSMA	National Aboriginal and Islander Land and Sea Management Authority
NASA	National Aeronautics and Space Administration
NGO	Non Government Organisation
NHT	Natural Heritage Trust
NOAA	National Oceanic and Atmospheric Administration
NRM	Natural Resource Management
DNRMW	Queensland Department of Natural Resources, Mines and Water
NSW	New South Wales
OSRA	Oil Spill Response Atlas
PCQ	Ports Corporation of Queensland
PFNQ	Private Corporation Chain Reaction
PNG	Papua New Guinea
PZJA	Protected Zone Joint Authority
QCFO	Queensland Commercial Fisherman Organisation
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
QLD	Queensland
QLD EPA	Queensland Environmental Protection Agency
QPWS	Queensland Parks and Wildlife Services
QSCP	Queensland Shark Control Program

QSIA	Queensland Seafood Industry Association
Rainforest CRC	Cooperative Research Centre for Tropical Rainforest Ecology and Management (Rainforest CRC)
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
SAC	Scientific Advisory Committee
SCU	Southern Cross University
SES	State Emergency Service
SOE	State of the Environment
STCRC	Sustainable Tourism Cooperative Research Centre
TBA	To Be Advised
The Facility	Marine and Tropical Science Research Facility
The Plan	Annual Research Plan
TS	Torres Strait
TSCRC	Torres Strait Cooperative Research Centre
TSI	Torres Strait Island
TSRA	Torres Strait Regional Authority
UQ	The University of Queensland
UVC	Underwater Visual Census
UVR	Ultra Violet Radiation
WFHC-GBR	Water For a Healthy Country – Great Barrier Reef Theme
WHA	World Heritage Area
WQ	Water Quality
WQIP	Water Quality Improvement Plan
WTMA	Wet Tropics Management Authority
WTWHA	Wet Tropics World Heritage Area

INTRODUCTION

The aim of the Marine and Tropical Sciences Research Facility (MTSRF or 'the Facility') is to ensure the health of North Queensland's public environmental assets – particularly the Great Barrier Reef (GBR) and its catchments, tropical rainforests including the Wet Tropics World Heritage Area (WTWHA), and the Torres Strait – through the generation and transfer of world-class research and knowledge sharing.

Protection of the health of these environmental assets is a joint responsibility of governments, community and industry and needs the commitment of each if it is to be achieved. The MTSRF outcomes will support each of those parties in their endeavours to protect, conserve, sustainably use and manage North Queensland's public environmental assets.

In March 2006, the Australian Government Minister for the Environment and Heritage approved a Research Investment Strategy for the Facility, and this Annual Research Plan 2006-2007 ('the Plan') describes the work to be done in to achieve the goals of the Strategy during its first year of operation. The research conducted through the Facility must be for the public benefit and be targeted towards delivering useful products that support the health of these environmental assets.

The Annual Research Plan 2006-2007 outlines the specific tasks, products, budgets and staff for Research Programs developed for each Research Theme identified in the Research Investment Strategy:

1. **Status of the ecosystems:** understanding the condition, trend and interdependencies of environmental assets of the North Queensland region; developing methods to support ongoing regular assessment and reporting; and developing methods to identify priorities for action.
2. **Risks and threats to the ecosystems:** understanding the threats to, and their impacts on the environment and hence the North Queensland region, and developing options to mitigate them.
3. **Halting and reversing the decline of water quality:** understanding the causes and effects of changing water quality and water resource use in North Queensland's coastal catchments; developing options for improving practices, reducing risks and mitigating adverse impacts; and developing ways to measure the effectiveness of regulation, management and other actions to halt and reverse declines. This goal supports the objectives of the Australian and Queensland Government's Reef Water Quality Protection Plan (Reef Plan).
4. **Sustainable use and management of natural resources:** understanding the current and potential industry and community uses of biodiversity and natural resources with respect to ecological, social and economic sustainability; and providing information and options to assist North Queensland managers, industries and communities to optimise the use of biodiversity resources and minimise adverse impacts of use where they occur.
5. **Enhancing delivery:** increasing the relevance and adoption of research in policy development, management applications and use practices; supporting effective data exchange and adoption of data standards; funding the delivery of relevant reports in the public interest; providing system wide overviews through the integration of biophysical studies of the environmental assets of North Queensland and the integration of social

and economic research into these; and providing access to data and knowledge for organisations and the public.

The overall structure of the MTSRF Research Programme is shown in Figure 1.

Budget

Theme	
1. Status of the Ecosystems	\$2,023,000
2. Risks and Threats to the Ecosystems	\$1,325,000
3. Halting and Reversing the Decline of Water Quality	\$1,175,000
4. Sustainable Use and Management of Resources	\$2,233,275
5. Enhancing Delivery	\$797,500
Administration	To be negotiated
Emerging Priorities	-
Total	\$7,553,775

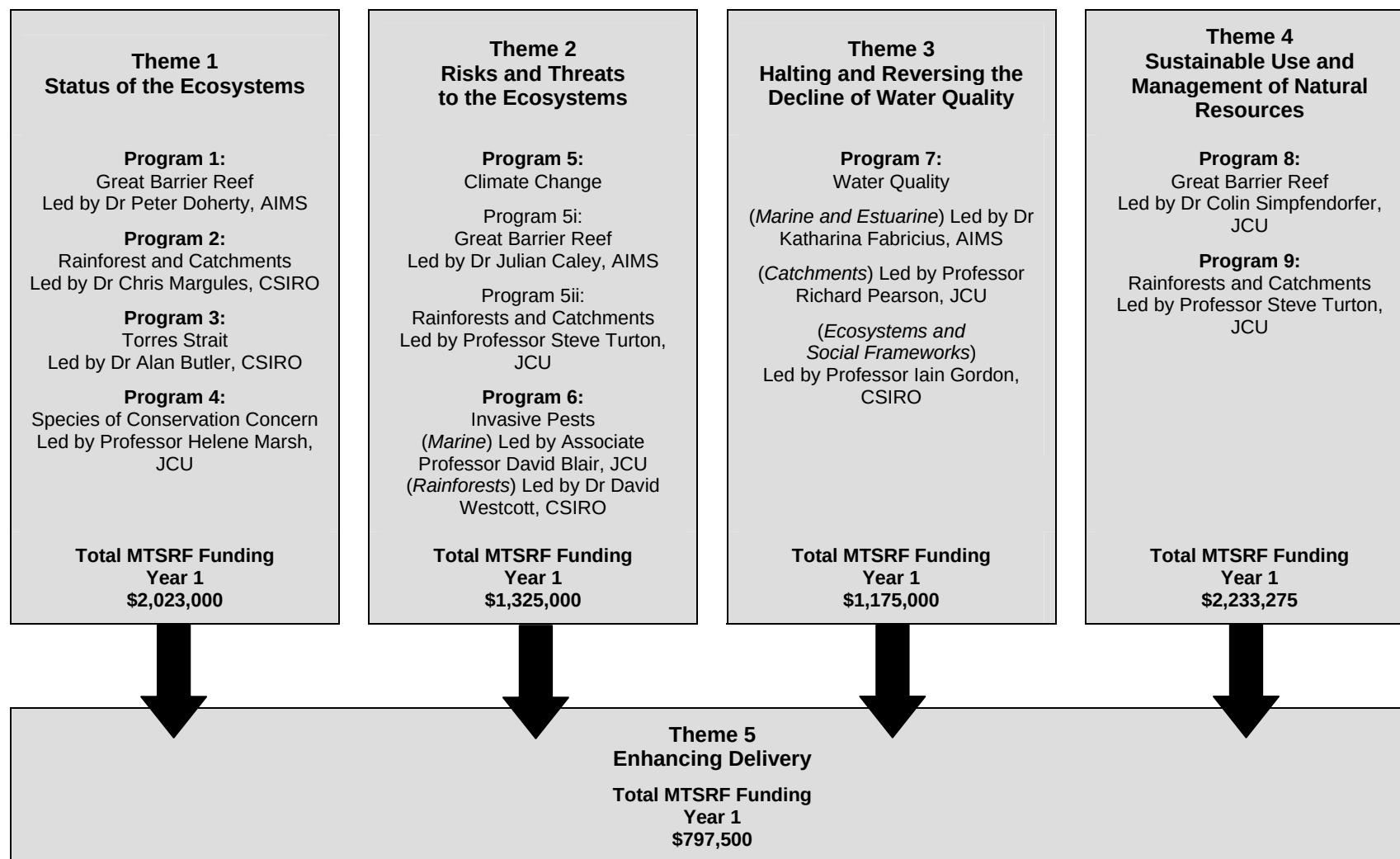


Figure 1: Outline of the MTSRF Research Programme structure.

Theme 1

Status of the Ecosystems: Understanding the Condition, Trend and Interdependencies of Environmental Assets of North Queensland

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

Budget Summary

Program	Title	MTSRF	Other Cash	In-kind
Program 1	GBR Status and Trends	760,000	345,200	1,349,986
Program 2	Rainforest Status and Trends	350,000	-	402,500
Program 3	Torres Strait – Status, Use and Trends	413,000	50,000	432,257
Program 4	Species and Communities of Conservation Concern	500,000	-	576,750
Total		2,023,000	395,200	2,761,493

The total value of Theme 1 is \$5,179,693.

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	760,000	-	760,000
Other	345,200	1,349,986	1,695,186
Total	1,105,200	1,349,986	2,455,186

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

Program 1 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) 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 Trend 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 develop an Integrated Report Card for the GBR which is 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. After the first year, when the integrated framework is agreed, it is expected that the data needs of the Integrated Report Card will have a strong influence on the evolving shape of the Status and Trends 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 Integrated Report Card.

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

Projects

1.1.1	Identification of non-reefal species and potential indicator species on a bioregional scale	\$60,000
1.1.2	Condition and trend of the GBR ecosystem: indicators, thresholds of potential concern and ecological influence of GBR Zoning Plan on mid and outer 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.....	\$35,000
1.1.5	GBR data synthesis and development of GBR component of the Integrated Report Card	\$145,000

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

Project 1.1.1: Identification of non-reefal species and potential indicator species on a bioregional scale

Project Leader and Host Organisation

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

Project Team

Title	Organisation	Role	FTE
Dr Roland Pitcher	CSIRO	Project leader, indicators, reporting, communication	0.15
Dr Bill Venables	CSIRO	Statistical analysis	0.05
Dr Glenn De'ath	AIMS	Statistical assemblage analysis	0.10
Dr Ian McLeod	CSIRO	Spatial analysis and mapping	0.15

Project Duration

Start Date: January 2007

End Date: 30 June 2007

Project / Task Objectives

- (a) Develop indicators of protection levels for seabed species, habitats and assemblages in non-reef areas with respect to the GBR Bioregions (2003).

For additional information and methodology relating to these objectives refer to the Scheduling Extract of the MTSRF Annual Research Plan.

In brief, the team will collaborate and use the Seabed Biodiversity dataset to develop indicators of biodiversity protection levels for seabed species, habitats and assemblages, and investigate Seabed habitat/species assemblage information and document representation of biological assemblages by GBR Zone and Bioregions. It is suggested that indicators of protection levels may be expressed, for example, in terms of: percent biomass by zone for species; percent area by zone for habitats; and percent area by zone for assemblages.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Report on indicators for seabed with respect to GBR Bioregions	June 2007

Project 1.1.1 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission: - Contribute to defining indicators, methods and communication activities – to CSIRO to enable reporting [AIMS] - Progress update for objective a (above): what indicators are being investigated, justification and methodology [CSIRO] - Plan of communication activities/products/events for Year 1 and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable [CSIRO]	30 April 2007
Report 2 submission: - Contribute to statistical assemblage analyses, protection indicators, communication activities and reporting – provide to CSIRO for final reporting [AIMS] - Final summary of communication activities undertaken through the course of Year 1 of project [CSIRO] - Final report on indicators of protection levels for seabed species, habitats and assemblages in non-reef areas with respect to the GBR Bioregions (2003) [CSIRO]	11 June 2007
Total MTSRF Funding	\$58,986

Project 1.1.1 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	58,986	-	58,986
MTSRF Visual Documentation*	1,014	-	1,014
CSIRO	-	47,265	47,265
AIMS	-	11,721	11,721
Total	60,000	58,986	118,986

* A total of \$1,014 is held by the Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

CSIRO Project 1.1.1 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	34,565	10,648	45,213
Operating	3,500	-	3,500
Travel	2,000	-	2,000
Communication / Extension	7,200	-	7,200
Capital	-	-	-
Institutional overheads	-	36,617	36,617
Total	47,265	47,265	94,530

AIMS Project 1.1.1 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	11,721	2,487	14,208
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	9,234	9,234
Total	11,721	11,721	23,442

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

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

Project Leader and Host Organisation

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

Project Team

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

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project will deliver regular reports on the broad-scale status and relative health of coral reefs in the GBR including information about regional and global resilience to natural disturbances (e.g. cyclones, crown-of-thorns starfish, coral disease and coral bleaching). These reports of condition and response will be linked with research in other MTSRF Programs, notably those for water quality and climate change, and will feed into the Integrated Report Card (refer Theme 5). 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) 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 14 years. Although this is a small sample of the thousands of reefs comprising the reef matrix, the survey reefs are widely distributed by latitude and longitude and cover all major sectors of the GBR Marine Park. The annual surveys follow standard operating procedures described on the AIMS website, <http://www.aims.gov.au/pages/publications.html#sop> and consist of a mixture of fine- and coarse-scale surveys. The fine-scale surveys achieved 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.

Given the special interest of marine park tourism operators in crown-of-thorns starfish outbreaks, the LTMT proposes to conduct special surveys of COT populations on reefs in the source area (north of Cairns to Cooktown) to provide early warning about a build up in adult densities towards the critical mass required to spawn the secondary outbreaks that then cascade to other reefs both north and south of this region. The purpose of this COTs Alert is to provide early warning of another decade long series of outbreaks and provide the opportunity for more focused control of these pest populations at their source. Given that the last primary outbreaks were generated from this area around 16 years ago (circa 1990) it is considered timely to institute an early warning system for a new wave of outbreaks as the last two were separated by a similar time interval.

Annual coverage of the entire GBR is accomplished by 5-6 voyages using AIMS vessels. Results from the broad-scale surveys are posted within a month of the end of each voyage (see example at <http://www.aims.gov.au/pages/research/reef-monitoring/lrm/lrm200601.html>). Results from the fine-scale surveys are also posted to the website 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; see the following links for examples at regional and global level:

<http://www.aims.gov.au/pages/research/reef-monitoring/survey-archive.html>

<http://www.aims.gov.au/pages/research/reef-monitoring/lrm/mon-statrep7/statrep7.html>

While these links provide transparent timely results to the public, the Team Leader reports verbally on a regular basis directly to its major client (GBRMPA) so that the situational awareness of the Authority by geographic region is updated shortly after the completion of each voyage.

In order to add even greater value to these information streams on current ecological status and trends (Key Area 1.1, GBR Theme, MTSRF RIS), the LTMT will contribute to the development of the Integrated Report Card for the GBR. The generic Integrated Report Card will be a structured framework for assimilating data from multiple sources with an emphasis

on quantitative indicators of condition and trend for the purpose of assessing the performance of systems against thresholds of critical concern. AIMS will lead the development of appropriate indicators and thresholds of concern for reef health. The directions for this development will be agreed at a workshop to be held in the first quarter between the LTMT and the teams working with the generic Integrated Report Card formulation (Theme 5). This meeting is key to ensuring that the work done by AIMS on indicators and thresholds for reefs will contribute seamlessly to the final Integrated Report Card product.

The time series of data on dynamics and resilience of coral communities collected by the LTMT at reef, regional and global scales is likely to be a major source of information for determining the appropriate settings for any performance thresholds based on quantitative indicators like coral cover. From experience, it is obvious that very low coral cover on a single reef is not a threshold of concern (wrong scale) because resilience at this scale is dependent upon connectivity among reefs at regional scales. Determination of an appropriate indicator (e.g. coral cover over a wider region) is likely to require substantial simulation modeling based on the best available knowledge of reef connectivity but committing further detail would pre-empt the purpose of the scoping workshop.

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

Following the rezoning of the GBR in July 2004, GBRMPA expressed a need for information to assess the performance of the new zoning plan upon biodiversity. This was accompanied by another need to spread these assessments along the coastal strip with the greatest concentrations of fishing effort (Cairns to Gladstone, 7° of latitude). In January 2005, CRC Reef (acting on request from GBRMPA) convened a Technical Working Group to design such a monitoring program. An early distinction was drawn between reefs on opposite sides of the GBR Lagoon based mainly on monitoring methodology. Inshore reefs and shoals in many locations near the coast have to be surveyed opportunistically during periods of calm weather that permit adequate underwater visibility, whereas access to oceanic reefs (100-200km offshore) requires live aboard vessels and substantial logistics. Recognising the need to act quickly to collect baseline data within 1-2 years of the rezoning, the AIMS LTMT was considered to be the most suitable vehicle for collecting data from the oceanic reefs but the design of the broad-scale monitoring program (Objective (a)) was not suitable for the purpose given that it was designed around geographical pattern and not zoning categories. The Working Group spent months designing and refining an alternative set of broad-scale surveys to answer this new question.

In the first year of MTSRF (2005/06), the AIMS LTMT is implementing the new sampling plan, which consists of comparisons between six pairs of matched reefs (similar size, complexity, cross-shelf position, exposure, etc.) in each of five regional clusters between Gladstone and Cairns. 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 is a matched control that remains open to fishing. These reefs are being surveyed with the standard protocols used by the LTMT for its broad-scale surveys and this task was 80% complete at March 2006.

From 2006/2007, the LTMT will alternate broad-scale assessments of reef health (Objective (a)) with the assessments of zoning performance (Objective (b)). Thus the new sampling design 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 ecological responses to spatial closures ('no-take' zones).

While Russ and others (JCU) have shown differences in the demography of target fish species given long protection from fishing (comparing blue and green reefs after more than 10 years of differential zoning), there has not been a similar opportunity to examine the response of reef biodiversity to spatial management since the original zoning of the GBR Marine Park, now almost 30 years ago. Unlike previous blue-green comparisons, which have concentrated on the populations of line-caught fishes, this task will 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 rates of herbivory, and changes in the dynamics of coral assemblages.

Objective (c): 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 (seasonal) patterns and more closely observe emerging phenomena such as outbreaks of pests and disease. A program of fine-scale surveys on tourism sites (based on protocols validated by CRC Reef) will be developed together with local operators to inform businesses with early warning about local outbreaks of crown-of-thorns starfish (COTs Alert). 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 Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Forty percent of annual surveys completed; regional assessments on-line within one month of voyage completion (www.aims.gov.au)	Dec 2006
	Workshop held on reef health indicators and thresholds of concern	Dec 2006
	Report on reef health indicators and thresholds of concern	Mar 2007
	Fieldwork completed; regional assessments on-line within one month of voyage completion (www.aims.gov.au)	Jun 2007
	Report on early-warning surveys of COTs in the Cairns region	Jun 2007
	Report on the integration of reef health indicators and thresholds into the GBR Report Card	Jun 2007
(b)	Task not active 06/07; no milestones	
(c)	1. Preliminary COT surveys completed using timed swims while mapping proposed Reef Check survey sites	Jun 2007

Objective	Targeted Activity	Completion Date
(c)	2. Secured partnerships with 10 tourism operators for this task 3. Tourism industry workshops (3) scheduled	Mar 2006
(c)	4. Marine tourism sites (25) identified for monitoring activities	Mar 2007
	5. New community volunteers (16) trained 6. Tourism industry workshops (3) completed 7. Twenty-five marine tourism sites selected and mapped for monitoring activities 8. Reef Check protocol and training program aligned to end user needs	Jun 2007

Project 1.1.2 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission: Progress update for objective (a) (above): preliminary findings, schedule of proposed field work for areas still to be surveyed. Delivery of on-line regional assessments for voyages to date. Report/proceedings of workshop held on reef health indicators and thresholds of concern [AIMS]	30 Nov 2006
Progress report for objective (c) including [Reef Check]: - Schedule for tourism industry workshops (3) and volunteer training sessions - Identification of marine tourism sites targeted for monitoring activities - Identification of at least 2 secured partnerships with tourism operators to support objective - Plan of communication activities/events for Year 1 and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	Dec 15 2006
Provide summaries of Reef Check data on any sites mapped/preliminary COT surveys and progress to AIMS to enable status and trend reporting and progress reporting. Responsible Officer Jos Hill from Reef Check.	15 Mar 2007
Report 2 submission: - Final Report describing appropriate reef health indicators and thresholds of concern (objective a). [AIMS] - Report defining status and trends and ecosystem health of key taxa/habitats as indicators of biodiversity of coral reef environs in the Great Barrier Reef World Heritage Area. [AIMS] - Progress report on objective a field work: sites visited, schedules for sites still to survey. [AIMS]	31 Mar 2007
Provision of workshop minutes for events held. Update on partnership and training activities and progress report on site mapping/COT surveys (obj c). [Reef Check]	30 Apr 2007

For 2006/2007 outputs only	Date
Milestones	
Report 3 submission: Final report including: • Field areas surveyed (objectives a).[AIMS] • Identification of draft reef health indicators and thresholds delivered for integration into the GBR Report Card [AIMS] • 3xReport/proceedings of tourism industry workshops (unless provided previously) [Reef Check] • Summary of community volunteer training conducted [Reef Check] • Description of 25 selected sites from mapping activities and preliminary COT surveys (objective c) [Reef Check] • Delivery of regional assessments from field work on-line within one month of voyage completion (www.aims.gov.au) [AIMS]	10 June 2007
Total MTSRF Funding	\$316,000

Project 1.1.2 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF (a) (c)	316,000	-	316,000
MTSRF Visual Documentation*	4,000	-	4,000
AIMS (a)	-	600,000	600,000
Reef Check (GBRMPA) (c)	100,000	-	100,000
AMPTO (c)	-	5,000	5,000
Total	420,000	605,000	1,025,000

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

AIMS Project 1.1.2 Budget 2006/2007

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

Reef Check Project 1.1.2 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Contract	Total Cost
Salaries	35,000	-	35,000
Operating	5,000	100,000	105,000
Travel	5,000	-	5,000
Communication / Extension	5,000	-	5,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	50,000	100,000	150,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	320,000	100,000	700,000	-	105,000	1,225,000
2008/2009	350,000	100,000	700,000	-	105,000	1,255,000
2009/2010	370,000	100,000	700,000	-	105,000	1,275,000
Total	1,040,000	300,000	2,100,000	-	315,000	3,755,000

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

Project Leader and Host Organisation

Dr Rob Coles, Queensland Department of Primary Industries and Fisheries (QDPI&F)

Project Team

Title	Organisation	Role	FTE*
Dr Rob Coles	QDPI&F	Project leader Task leader - a4, a5	0.4
Mr Len McKenzie	QDPI&F	Task leader - a1 Task collaborator - a2, a3, a4, a5	0.60
Dr Michael Rasheed	QDPI&F	Task leader - a3, b Task collaborator – a1, a3, a4, a5	0.7
Dr Jane Mellors	QDPI&F	Researcher – a1	0.3
Mr Rudi Yoshida	QDPI&F	Technician – a1, a3	0.2
Ms Helen Taylor	QDPI&F	Researcher – a3, a4, b	1.0

* FTE from all sources including associated third party projects, i.e. RWQPP and Ports.

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

The components below will deliver cost effective monitoring and assessment of the region's seagrasses including assessment of the threats from human impacts and improving knowledge of distribution of seagrass habitats. The project has strong links to the threatened species theme as these seagrass habitats provide a key food resource for the nationally threatened species of marine turtles and dugong. The project is based on a strategy of using community and industry resources and co-investment to enhance and broaden the scope of the program. Outputs of the project will have a strong spatial component including production of GIS layers for seagrass mapping areas.

The outputs will contribute to the development of the Integrated Report Card for the GBR. The time series of data on dynamics and resilience of seagrass meadows collected by the Marine Plant Group (MPG) at many coastal locations through North Queensland will be a major source of information for determining appropriate performance thresholds based on quantitative indicators like cover and leaf density. As with corals and reefs, it is obvious that very low seagrass cover at a single site will not always be a meaningful indicator of a problem of environmental quality although it must be acknowledged that there is more potential for local impacts in the coastal zone from point source pollution and other factors (e.g. sedimentation) associated with development.

The MPG will collaborate with the team developing the Integrated Report Card framework and Theme 5 to capture the spatial and temporal dynamics of seagrasses with simulation models that will then be applied to scenario evaluation and sensitivity analysis in order to find the limits for resilient seagrass systems.

Project 1.1.3 has two objectives, (a) and (b). Objective (a) will deliver results through five discrete sub-tasks (a1-5).

(a) Assessing the status and trend of GBR seagrasses:

1. Seagrass-Watch (community seagrass assessment and monitoring)
2. GBRWQPP monitoring of seagrass meadows
3. Fine scale monitoring and mapping in coastal areas at risk.
4. Improved spatial knowledge of key intertidal and shallow subtidal seagrasses
5. Long-term changes in deep seagrasses and algae

(b) Assessments of GBR habitats at high risk from direct impacts from human activity.
(To be conducted in years 2-4 of MTSRF.)

Project / Task Methodology

Objective (a): Assessing the status and trend of GBR seagrasses

This Project/Task builds on and integrates existing long term data sets collected as part of the CRC Reef, transitional and other external projects. It addresses gaps and areas where data is out of date or at inappropriate spatial resolution. The project continues long term data sets enabling historic comparisons including those relevant for observations of climate change. This approach will build a picture of the health of seagrass communities appropriate for an integrated report card. It has 5 components.

Objective (a) 1: Seagrass-Watch (community seagrass assessment and monitoring)

This task will build and continue support of the established technical/scientific core of the seagrass assessment and monitoring program (Seagrass-Watch), which has a significant community based component. This is a cost effective monitoring 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 monitoring sites in many other areas (e.g. north of Cooktown) to improve knowledge of the distribution of biota and their associated habitats within the region. This task complements the 22 sites of the GBR Reef Water Quality Plan by including a larger geographic spread of sites (currently 122) including those in Dugong Protected Areas and in other areas of community interest.

The task will ensure continued development of the present quarterly long-term seagrass monitoring program within the GBRWHA, to integrate with existing water/sediment/climate quality data collections and to produce integrated report cards at location, regional, state and national scales. Seagrass-Watch monitoring also occurs in 12 other countries in the Asia Pacific, providing an excellent opportunity to evaluate the state of Queensland's seagrasses within a global context.

The methodology for the program is well established (see downloadable PDF manuals www.seagrasswatch.org) and has been independently reviewed and considered suitable as the intertidal seagrass monitoring component of the Reef Water Quality Protection Plan biological monitoring.

The methodology has a strong scientific underpinning with an emphasis on consistent data collection, recording and reporting. Scientific, statistical, data management, data interpretation and logistic support underpins all monitoring efforts. Seagrass-Watch identifies areas important for seagrass species diversity and conservation and the information

collected is used to assist the management of coastal environments and to prevent significant areas and species being lost.

The project will combine with the spatial monitoring conducted in other sections to provide current ecological status and trend of intertidal seagrass meadows in the GBRWHA at a fine temporal and spatial scale.

Objective (a) 2: GBRWQPP monitoring of seagrass meadows

There are nearly 6,000 km² of seagrasses in waters shallower than 15 metres, relatively close to the coast, and in locations that can potentially be influenced by adjacent land use practices. Monitoring of the major marine ecosystem types most at risk from land based sources of pollutants is being conducted to ensure that any change in their status is identified. Monitoring sites are associated with the river mouth and inshore marine water quality monitoring programs to enable correlation and concurrently collected water quality information.

The key aim of this objective is to detect long-term trends in seagrass abundance, community structure, distribution, reproductive health and nutrient status from representative intertidal seagrass meadows (and their sediments) in agreed coastal and offshore locations.

Objective (a) 3: Fine scale mapping and monitoring in coastal areas at risk: seagrass status and trend

This task builds on an established program of annual long-term seagrass monitoring in high risk coastal areas, such as the vicinity of ports. At risk coastal sites have been selected on the basis of likely anthropogenic impacts e.g. ports and areas of high urbanisation. Risk assessments have already been formally completed for ports and shipping lanes. In the agreed at risk areas detailed fine-scale information on changes to seagrass biomass, area and species composition will be collected by the team and an analysis of potential anthropogenic drivers of change undertaken. (See attached outputs and milestones for process to develop agreed sites)

Methodology includes establishing a fine-scale baseline of seagrasses in the study areas (completed for already established sites), and monitoring biomass and species composition in a selected subset of meadows that represents the range of seagrass meadow types and areas most likely to be impacted by human activity. Detailed power analysis is conducted for each of the monitoring meadows to ensure appropriate levels of seagrass change can be detected. Standard methodology has been developed and refined by the team over the past decade and enables direct comparisons between locations and over time (Rasheed et al 1996; Lee Long et al 1996). Significant cash co-investment from industries that may pose risks to coastal seagrasses offsets the expense of conducting these fine scale monitoring programs. The relationships with industry have already been established with the co-investment secured already for 2006-07 and a strong commitment for continued support in out years.

Outputs include annual reports and spatial GIS for each location and an integrated assessment of the status of seagrasses in coastal high risk/impact areas to feed into the overall status and trend of GBRWHA seagrasses. The task collects fine-scale information on seagrass condition that is not possible within the community based program (Seagrass Watch) including collection of spatial information on seagrass distribution changes and biomass, assessment of sub-tidal seagrass areas and an assessment of any anthropogenic causes of seagrass change.

Objective (a) 4: Improved spatial knowledge of key intertidal and shallow subtidal seagrasses

Over the next four years, this sub-task will remap key inter-tidal and shallow seagrass meadows within the region from Cape York to Cairns; most of which has not been surveyed since 1989 (>15 years). This area has been selected because existing data for the region is out of date and of poor spatial resolution. Survey methods will follow those used by the MPG in surveying seagrasses along the northern Australian coast for the National Oceans Office. This involves low level helicopter surveys during a daytime spring low tide of meadow location, meadow type, seagrass species, percent cover, and other meadow attributes: animals, feeding trails, algae beds, etc. It is proposed in years 3 and 4 to focus more on subtidal seagrasses in key areas that have been poorly surveyed: an area north of Cairns including Port Douglas, suggested as a new Dugong Protected Area (DPA), and an area south of Townsville, Bowling Green Bay, which includes an existing DPA and a Fish habitat Area. In both cases methodology will follow techniques developed by the MPG (Roelofs et al 2005; Rasheed et al 2003).

The products will include meadow shapes and sizes, species composition (voucher specimen if necessary) and community type, seagrass meadows and algae beds categorised in landscape types, seagrass and algae cover estimates, evidence of dugong feeding trails and preferred dugong feeding sites, evidence of turtle populations and marine debris such as net discards with GPS location.

Objective (a) 5: Long-term changes in deep seagrasses and algae

Surveys in the mid to late 1990's and the recent CRC Reef seabed biodiversity project (2003-6) have both identified extensive meadows of seagrass and macroalgae in GBR waters deeper than 35 metres and as deep as 60 metres. At such depths, the survival of plants is likely to be limited by the amount of light reaching the bottom. We know very little of the role these presumably slow growing plant communities play in the GBR ecosystem and what changes are taking place. It is reasonable to assume that if water quality in reef waters has declined, reducing light penetration, then loss or reduction of these communities would be one of the first signs because they integrate light availability over long time scales. This task will be a desktop analysis of long-term changes in seagrasses obtained by comparing the results of the two historical broad-scale surveys. As such it will generate information about stability or change in these important ecosystems within the first year of MTSRF. It builds on existing research (Coles et al 2000).

Objective (b): Assessments of GBR habitats at high risk from direct impacts from human activity.

This task will provide fine scale mapping (GIS) of critical habitats (benthic habitat / coral/ algae seagrass) in areas of the GBR where there is an identified high risk of direct human impact. The project will focus on areas of the inner GBR shipping route and recently established cruise ship transit lanes through the GBR that have been identified as high risk for accidental groundings and oil spills in a risk assessment conducted by GBRMPA and Maritime Safety Queensland (QTand GBRMPA 2000). Information collected will be used to develop habitat risk maps for shipping accidents and oil spills that will be incorporated into the national Oil Spill Response Atlas (OSRA) to aid in protection of key habitats in the event of an accident/ oil spill. Methodology includes the use of helicopter aerial surveys, remote imagery and boat/diver based rapid visual assessment techniques as established and reviewed for shipping lane areas already assessed by the team in previous programs (Rasheed et al 2004). The end product of the surveys is a detailed GIS and atlas tailored for direct assimilation into national accident response systems such as the oil spill response atlas (OSRA).

While the team has already assessed some of the highest risk areas in the GBR as part of CRC Reef, there is an identified need for more detailed information on shoal and reef-top habitats along the inner GBR shipping route from the tip of Cape York to Cape Flattery. The task has been designed in consultation with GBRMPA, the Australian Maritime Safety Authority (AMSA) and MSQ to ensure that the key high risk (from shipping) areas with poor fine-scale habitat information have been targeted. While previous consultation and risk assessment has identified the broad areas of concern additional consultation with stakeholders will be required to prioritise high risk areas that can be reasonably be addressed with the resources provided.

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Queensland Transport and the Great Barrier Reef Marine Park Authority. (2000). Oil Spill Risk Assessment for the Coastal Waters of Queensland and the Great Barrier Reef Marine Park. Department of Transport (Queensland), 65 pp.

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Rasheed M A, Thomas R and Roelofs A J (2004). Critical Marine Habitats Adjacent to the High-risk Inner Shipping Route in the Shelburne, Margaret and Indian Bays Region – 2004 Atlas. *QDPI&F Information Series QI04048* (Queensland Fisheries Service, Northern Fisheries Centre, Cairns), 25pp.

Roelofs A, Coles R G and Smit N (2005). A survey of intertidal seagrass from Van Diemen Gulf to Castlereagh Bay, Northern Territory, and from Gove to Horn Island. Report to the National Oceans Office, Tasmania Australia. 18pp.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	1. Status and trend report for GBRWHA / NQ seagrasses	10 Jun 2007
(a)	2. Seagrass abundance, community structure, distribution, physical parameters at regularly monitored sites throughout the GBRMP including the RWQPP sites	1 Dec 2006
(a)	3. Seagrass abundance, community structure, distribution, physical parameters at regularly monitored sites throughout the GBRMP including the RWQPP	28 May 2007
(a)	4. Seagrass-Watch newsletter completed every 3-4 months from 1 July 2006 (min. 3 for yr ending June 07)	1 ea. at minimum of 31 Oct 06, 28 Feb 07, 10 June 07
(a)	5. Complete the annual monitoring of seagrasses in coastal high risk areas	10 Jan 2007
(a)	6. Produce coastal habitat monitoring report and GIS for each high risk location surveyed prior to Jan 2007	10 June 2007
(a)	7. Initial coastal seagrass survey – progressive in out years	10 June 2007
(a)	8. Report on long-term changes in deep water seagrasses	10 June 2007
(b)	No activity Year 1	June 2007 - June 2010

Project 1.1.3 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones – all QDPI&F responsibilities	
Signing of contract	
Report 1 submission (activities identified against project output and milestone table): • Report on GBRMP seagrass monitoring: locations, abundance, community structure and distribution (a2, a4) • Plan for conduct of initial coastal seagrass survey: sites to be visited, field schedule (a7) • 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 (a)	1 Dec 2006
Report 2 submission: • Report of review of design and location of GBR habitats at high risk from direct impacts from human activity to be targeted for monitoring. (a6) • Findings of GBRMP seagrass monitoring: locations, abundance, community structure and distribution (newsletter) (a3, a4) • Notification of sites visited during conduct of annual monitoring (a5) • Report on initial coastal seagrass survey (sites, findings) (a7) • Draft status and trend report for GBRWHA / NQ seagrasses (data collated, areas surveyed, preliminary findings) (a1)	28 May 2007
Report 3 submission: • Report on long-term changes in deep water seagrasses: distribution, species assemblage composition (a8) • GIS for each risk location surveyed prior to Jan 2007 and report on findings of annual coastal habitat monitoring of seagrass in high risk locations for objectives a5 and a6 • Findings of GBRMP seagrass monitoring: locations, abundance, community structure and distribution (newsletter) (a4) • Status and trend report for GBRWHA / NQ seagrasses based on survey and monitoring work undertaken through objective a: species assemblages and distributions, monitored changes in benthic groups associated with meadows, relationship of changes to influencing factors (e.g. climate change, ecosystem health) (a1, a2)	11 June 2007
Total MTSRF Funding	\$197,000

Project 1.1.3 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	197,000	-	197,000
MTSRF Visual Documentation*	3,000	-	3,000
QDPI&F	-	321,000	321,000
QDPI&F (from third party contract with Cairns Port Authority)	-	20,000 ^c	20,000
QDPI&F (from third party contract with Ports Corporation Queensland)	-	50,000 ^c	50,000
Volunteers (Seagrass Watch)	-	60,000 ^b	60,000
Ports Corporation Queensland	**37,050 ^{a3}	10,000	47,050
Central Queensland Ports Authority	**54,150 ^{a3}	-	54,150
GBRMPA (RWQPP) third party contract	**154,000 ^{a2}	-	154,000
Total	445,200	461,000	906,200

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

** Amount does not include 5% RRRC administration charge; figure shown + 5% to be paid to RRRC from third party under third party contract; amount shown to be paid to QDPI&F.

^{a2} Cash GBRMPA contract with RRRC. Delivered as separate contract, but directly supporting activities conducted here (task a2).

^{a3} Includes cash to be contracted for tasks tied to objective a3.

^b Estimated based on an average of thirty Seagrass Watch sites sampled at each of four times per year (four people for five hours per site).

^c Money already received by QDPI&F from Port Authorities prior to contract finalisation.

QDPI&F Project 1.1.3. Budget 2006/2007

Item	MTSRF Funds	In-kind and third party contracts	Total Cost
Salaries	115,000	222,000	337,000
Operating	57,000	200,200	257,200
Travel	25,000	90,000	115,000
Communication / Extension	-	part of institutional overheads	-
Capital	-	-	-
Institutional overheads	-	194,000	194,000
Total	197,000	706,200	903,200

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	200,000	-	302,000	335,000	125,000	962,000
2008/2009	200,000	-	302,000	235,000	130,000	867,000
2009/2010	200,000	-	302,000	195,000	120,000	817,000
Total	600,000	-	906,000	765,000	375,000	2,646,000

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

Title	Organisation	Role	FTE
Assoc. Professor Jian-Xin Zhao	UQ	Project Leader	0.2
Assoc. Professor John Pandolfi	UQ	Co-investigator	0.2
Dr Laurence McCook	GBRMPA	Manager (R&M)	0.1
Dr Terry Done	AIMS	PI	0.1
PhD student (geochronology)	UQ	Project Leader	0.2

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:

- Determine the decadal death rate of massive corals over the last 200 years (since European settlement).
- Determine the variation in coral community structure over the past 200 years.
- 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 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.

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*)², 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.

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 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)³. 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 runoff 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.

²Pandolfi, J.M. *et al.*, 2003. Global trajectories of the long-term decline of coral reef ecosystems. *Science*, 301(5635): 955-958.

³Yu 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* (accepted).

Project Outputs / Milestones

Objective	Output / Milestone	Completion Date
(a)-(c)	PhD student recruited	Jan 2007
(a)-(c)	Preliminary results obtained from corals in the AIMS collection	Jun 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

Note, the Great Barrier Reef Marine Park Authority will be the primary end-user of this research.

Project 1.1.4 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission: - Schedule of examining corals in AIMS collection, and possible field collection with AIMS ship trips [UQ] - Plan of communication outputs and products for Year 1 and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable [UQ]	30 Jan 2007
Information transfer between agencies: Provision of preliminary data if any on coral mortality ages and ecological implications to Integrated Report Card Team. Responsible officers: Zhao and Pandolfi from UQ.	11 June 2007
Report 3 submission: - Preliminary results obtained from corals in the AIMS collection [UQ] - Proposed fieldwork schedule for central GBR work [UQ] - Final literature review [UQ] - Final summary of communication activities undertaken through the course of Year 1 of project [UQ] - Plan for completion of out year activities [UQ]	11 June 2007
Total MTSRF Funding	\$35,000

Project 1.1.4 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	35,000	-	35,000
UQ	-	85,000	85,000
Total	35,000	85,000	120,000

UQ Project 1.1.4 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	20,000	52,500	72,500
Operating	15,000	30,000	45,000
Travel	-	2,500	2,500
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	35,000	85,000	120,000

Indicative Budget Summary – Years 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	50,000	3,500	95,000	15,000	-	163,500
2008/2009	50,000	3,500	95,000	15,000	-	163,500
2009/2010	20,000	3,500	70,000	15,000	-	108,500
Total	120,000	10,500	260,000	45,000		435,500

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

Project 1.1.5: GBR Data synthesis and development of GBR component of the Integrated Report Card

Project Leader and Host Organisation

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

Project Team

Title	Organisation	Role	FTE
Dr Alan Butler	CSIRO	Project leader, indicators, reporting, communication	0.09
Dr Bill Venables	CSIRO	Statistical analysis	0.08
Dr Glenn De'ath	AIMS	Statistical assemblage analysis	
Dr Scott Woolridge	AIMS	Spatial analysis and mapping	
CSIRO Integrated Report Card Team	CSIRO	Integrated Report Card MTSRF Project 3.7.7	

Project Duration

Start Date: January 2007

End Date: 30 June 2007

Project / Task Objectives

- (a) Conceptual and statistical framework for the GBR component of the Integrated Report Card.
- (b) Statistical analysis and synthesis of GBR monitoring data with particular emphasis on threats and risks and the biological implications of GBR zoning (2003).

For additional information and methodology relating to these objectives are outlined in the ARP and will be further developed in cooperation with primary end users.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Develop an Integrated Report Card frame work that will be evolved into a prototype for the Great Barrier Reef (\$60,000)	June 2007
(b)	Report on synthesis of GBR monitoring data for issues (risks, threats and biological implications of zoning) specified through agreement with major end-users and other MTSRF projects (\$80,000)	June 2007

Project 1.1.5 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission: - Progress of input into the Integrated Report Card Framework (links to Project 3.7.7) [CSIRO] - Progress update for objective b (above): what data sets are being investigated; justification and methodology [AIMS]	1 Feb 2007
Transfer of information for objective (b) from CSIRO to AIMS	30 April 2007
Report 2 submission: Draft report on synthesis of GBR monitoring data for specified risks and threats and the biological implications of GBR zoning. [AIMS]	16 May 2007
Report 3 submission: - Update report on input into the Integrated Report Card Framework (links to project 3.7.7) - Report on conceptual and statistical framework for the GBR component of the integrated report card [CSIRO] - Report on synthesis of GBR monitoring data for specified risks and threats and the biological implications of GBR zoning [AIMS]	11 June 2007
Total MTSRF Funding	\$143,000

Project 1.1.5 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	143,000	-	143,000
MTSRF Visual Documentation*	2,000	-	2,000
CSIRO	-	100,000	100,000
AIMS	-	40,000	40,000
Total	145,000	140,000	285,000

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

CSIRO Project 1.1.5 Budget 2006/2007

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	31,500	-	31,500
Operating	-	13,792	13,792
Travel	5,000	-	5,000
Communication / Extension	5,000	-	5,000
Capital	-	-	-
Institutional overheads	-	26,208	26,208
Total	41,500	40,000	81,500

CSIRO Integrated Report Card Project 3.7.7 Budget 2006/2007

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	50,000	-	50,000
Operating	-	18,400	18,400
Travel	10,000	-	10,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	41,600	41,600
Total	60,000	60,000	120,000

AIMS Project 1.1.5 Budget 2006/2007

Item	MTSRF Funds	AIMS In-kind	Total Cost
Salaries	31,500	40,000	71,500
Operating	-	-	-
Travel	10,000	-	10,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	41,500	40,000	81,500

Proposed Communication Products / Events

Objective	Proposed Communication Product / Event	Date
All	Presentations to GBRMPA Critical Issues Groups, Resource Advisory Groups, Industry Representative Groups, etc.	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
	Technical report	30 June 2007

Program 2

Status and Trends of Species and Ecosystems in the Wet Tropics Rainforests

Program Leader and Host Organisation

Dr Chris Margules, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Budget Summary

	Cash	In-kind	Total
MTSRF	350,000	-	350,000
Other	-	402,500	402,500
Total	350,000	402,500	752,500

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 then 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 develop an Integrated Report Card for the Wet Tropics World Heritage Area and North Queensland's coastal catchments, which is 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 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 WTMA and DEW; 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. After the first year, when the integrated framework is agreed, it is expected that the data needs of the Integrated Report Card will have a strong influence on the evolving shape of this Program.

Projects

1.2.1 Status and trends of biodiversity and ecosystem services \$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

Title	Organisation	Role	FTE
Dr James Butler	CSIRO	Sustainable resource use scientist, project design	0.46
Professor Chris Margules	CSIRO	Project design	0.05
Dr Dan Metcalfe	CSIRO	Tropical Plant Ecologist	0.17
Dr Kristen Williams	CSIRO	Ecological Geographer	0.15
Dr David Westcott	CSIRO	Ecologist, project design	0.05
Ms Petina Pert	CSIRO	Spatial Analyst	0.15
Mr Andrew Ford	CSIRO	Botanist and taxonomic support	0.15
Mr Matt Bradford	CSIRO	Plant ecology research support	0.15
Dr Caroline Bruce	CSIRO	GIS and Data Management	0.23
Dr Steve Williams	JCU	Biodiversity specialist	0.15
Professor Nigel Stork	JCU	Entomological biodiversity	0.10
Mr Steve Goosem	WTMA	Project design	0.125
Dr Mark O'Donahue	FNQ NRM Ltd	Project design	0.05

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project will develop the methods needed to acquire the necessary data for an integrated report card on the Wet Tropics WHA and north Queensland's coastal catchments. Scientists in the Program will work in close collaboration with WTMA and FNQ NRM Ltd to identify data requirements, develop monitoring methods and then implement a monitoring protocol that can be used to produce an integrated report card. In the process of doing this, it will develop tools for measuring, monitoring and reporting, and identify priorities for management action. It is intended that the Project will collaborate with the scoping project for the Integrated Report Cards being completed for GBR, Torres and Water Quality programs.

The overall objective is to provide the knowledge and methods needed for accurate and up-to-date state of the region reporting on the key ecosystem service and biodiversity 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 ecosystem processes, 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 FNQ NRM Ltd. It is not possible to separate science and end users roles clearly because knowledge, management, monitoring and reporting are all joint responsibilities. The methods are introduced below, under two headings, knowledge synthesis and gap filling, and the design of a monitoring program, 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 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.

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 would provide the foundation for comprehensive condition monitoring, allow the range of existing work to be assessed and promote integration or linkages between projects and Programs, and will highlight areas where gaps in existing data coverage remain.

The initial two month phase of the project will incorporate the establishment of an agreed metadata format between the project host organisations and the end-users, which will ensure that the final products will mesh with the existing metadata banks of organisations such as CSIRO and EPA. This will be developed from the largely plant-based metadata set compiled under the Rainforest CRC, with a particular emphasis on capturing datasets concerned with vertebrate animals. Once the formats and interchange issues are resolved, collation of additional metadata sets from the project host and end-user organisations will commence. 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, and ecosystem processes) will commence 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. Targeted gap filling in conjunction with Project 2 will commence early in Year 1 of this project.

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 rain forest in the world, and an invaluable tool for managers, scientists and decision makers.

WTMA and FNQ NRM Ltd 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 FNQ NRM Ltd planning region.

A vital component of the Wet Tropics 'Integrated Report Card' 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 major workshop will be conducted 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. This workshop will elicit both scientific and management experience and expertise, to identify these key trigger points, also called thresholds of concern. In particular, coordination with the Integrated

Report Card format being developed by Program 10 for monitoring environmental quality in other MTSRF projects will be achieved through this process.

Project Outputs / Milestones

Primary end-users include the Wet Tropics Management Authority (for State of Wet Tropics Reporting obligations) and DEW (for international World Heritage Periodic Reporting obligations), and FNQ NRM Ltd for tracking trends in indicators of environmental condition.

Objective	Targeted Activity	Completion Date
(a)	Manage metadata database	Jun 2007
(a)	Scrutinise existing data sets and identify knowledge gaps	May 2007
(b)	Collate information to complete Rainforest Plant Key	May 2007
(b)	Collate information to go towards filling knowledge gaps	May 2007
(b)	Identify key biodiversity features eg. species, regional ecosystems.	Nov 2006
(b)	Workshop metadata database and the gap analysis to identify clear monitoring objectives.	Nov 2006
(c)	Workshops to develop thresholds of concern and Wet Tropics Integrated Report Card	Feb 2007
(c)	Source documents from the region, evaluate monitoring tools and methods, literature review	Nov 2006
(c)	Identify suitable spatial reporting units	Nov 2006
(c)	Design and workshop monitoring program	May 2007
(c)	Contribute to the development of statistical analytical techniques for the Program 10 Integrated Report Card	May 2007

Project 1.2.1 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	1 Sep 2006
Progress Report 1: • Preliminary description of meta data sourced and managed [CSIRO, JCU]; • Summary of data and relevant documents sourced, including ongoing monitoring programs, knowledge gaps, and findings of previous monitoring programs (objectives a, b and c); [CSIRO, JCU] • Preliminary description of identified poorly-sampled environments, locations and species (data gaps); [CSIRO, JCU] • Preliminary list of key environmental assets and methods for designing monitoring program identified by science and stakeholder workshops, and projects 1.4.3 (Threatened Species) and 2.6.2 (Invasives); [CSIRO, JCU, WTMA, FNQ NRM Ltd.] • Preliminary identification of spatial units for monitoring; [CSIRO, JCU, WTMA, FNQ NRM Ltd.] • Plan of communication activities/products for Year 1 and summary of any communication activities undertaken to date, including minutes of meetings/workshops; [CSIRO]	30 Nov 2006
Progress Report 2: • Report on potential thresholds of concern workshop for monitoring program: outcomes; [CSIRO, JCU, WTMA, FNQ NRM Ltd.] • Outcomes (via report) of workshop to develop Wet Tropics Integrated Report Card. [CSIRO, JCU, WTMA, FNQ NRM Ltd.]	28 Feb 2007
Progress Report 3: • Design of prototype monitoring program including thresholds of concern; [CSIRO, JCU, WTMA, FNQ NRM Ltd.] • Summary of existing baseline data for monitoring program, and status and trends indicated; [CSIRO, JCU, WTMA, FNQ NRM Ltd.] • Summary of gap analyses and work required to fill critical gaps; [CSIRO, JCU, WTMA, FNQ NRM Ltd.] • Delivery of monitoring program indicators for Integrated Report Card needs in Program 10; [CSRIO] • Summary of any communication activities undertaken to date, including minutes of meetings/workshops; [CSIRO] • Description of progress with Rainforest Plant Key; [CSIRO] • Data transfer and awareness between CSIRO, JCU, WTMA and FNQ NRM plus other stakeholders through workshops. Responsible officer Dr. James Butler, CSIRO • Plan for completion of out year activities. [CSIRO, JCU, WTMA, FNQ NRM Ltd.]	31 May 2007
Total MTSRF Funding	\$346,500

Project 1.2.1 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	346,500	-	346,500
MTSRF Visual Documentation*	3,500	-	3,500
CSIRO Sustainable Ecosystems	-	198,005	198,005
CSIRO Plant Industry	-	49,510	49,510
JCU	-	98,985	98,985
WTMA	-	20,000	20,000
FNQ NRM Ltd	-	36,000	36,000
Total	350,000	402,500	752,500

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

CSIRO Sustainable Ecosystems Project 1.2.1 Budget 2006/2007

Item	MTSRF Funds	CSIRO-CSE In-kind	Total Cost
Salaries	142,569	-	142,569
Operating	30,300	79,388	109,688
Travel	25,136	-	25,136
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	118,617	118,617
Total	198,005	198,005	396,010

CSIRO Plant Industry Project 1.2.1 Budget 2006/2007

Item	MTSRF Funds	CSIRO-PI In-kind	Total Cost
Salaries	21,272	49,510	70,782
Operating	28,238	-	28,238
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	49,510	49,510	99,020

JCU Project 1.2.1 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	73,000	98,985	171,985
Operating	25,985	-	25,985
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	98,985	98,985	197,970

WTMA Project 1.2.1 Budget 2006/2007 (In-kind Only)

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	-	20,000	20,000
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	-	20,000	20,000

FNQ NRM Ltd Project 1.2.1 Budget 2006/07 (In-kind Only)

Item	MTSRF Funds	FNQ NRM Ltd 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 2, 3, 4

Year	MTSRF	CSIRO / JCU		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	350,000	80,000	310,000	-	56,000	796,000
2008/2009	350,000	80,000	313,000	-	56,000	799,000
2009/2010	300,000	-	220,000	-	56,000	576,000
Total	1,000,000	160,000	843,000	-	168,000	2,171,000

Program 3

Torres Strait – Status, Use and Trends

Project Leader and Host Organisation

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

Budget Summary

	Cash	In-kind	Total
MTSRF	413,000	-	413,000
Other	50,000	432,257	482,257
Total	463,000	432,257	895,257

Torres Strait starts behind the other nodes in terms of research previously completed; this program is therefore concentrating its limited resources on establishing the key background knowledge and models to enable predictive power and management strategy evaluation in the future.

The Torres Strait Node comprises two programs:

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

Program 2 is not addressed here, but is a separate program covering both the Great Barrier Reef and Torres Strait nodes of MTSRF and is led by Professor Helene Marsh. It is proposed that communications and an engagement system is 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-card on the environmental assets in Torres Strait (linked to MTSRF Project 3.7.7). 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;
- to identify conceptual models of the processes surrounding those key issues;
- to identify potential indicators and thresholds of status and trends in each issue;
- to identify 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); and

- to contribute to the development of an Integrated Report Card Framework to be used in out years for reporting the ecosystem health of Torres Strait.

In addition the program will, where possible filling data gaps in inter-reef sea bed mapping and Torres Strait reef characterisation from existing data. 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, invasives), and establish a ecologically sustainable strategy for seed stock harvest.

In the first year the project will also focus on developing a process for analysis of the economic value of environmental assets in the Torres Strait.

Projects

1.3.1	Improved knowledge of biota, habitats and risks.....	\$193,000
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, tradeoffs.....	In-kind Only
1.3.4	Communication, community engagement and enhanced delivery	\$40,000
1.3.5	Data Synthesis and development of Torres Strait component of the Integrated Report Card.....	\$120,000

PROGRAM 3: TORRES STRAIT – STATUS, USE AND TRENDS

Project 1.3.1: Improved knowledge of biota, habitats and risks

Project Leader and Host Organisation

Dr Michael Haywood, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team

Title	Organisation	Role	FTE
Mr M. D. E. Haywood	CSIRO	Project leader: co-ordination, characterisation analyses, reporting	0.20
Dr C. R. Pitcher	CSIRO	Benthic ecologist: science and project management direction	0.05
Dr M. Browne	CSIRO	Mathematical modeller: biophysical modeling of inter-reef data	0.20
Ms S. J. Cheers	CSIRO	Analysis of video data for inter-reef data gaps	0.20
Mr D. M. Dennis	CSIRO	Finfish biologist: integration of disparate reef associated finfish data	0.15
Mr J. R. Dunn	CSIRO	Oceanographic data analyst: water column database and mapping for bio-physical correlates	0.05
Mr I. M. McLeod	CSIRO	Spatial modeller: physical database, modelling and gridding physical data	0.33
Dr W. A. Rochester	CSIRO	Quantitative ecologist: characterisation analyses and biophysical modeling of shallow reef data	0.20
Ms J. A. Sheils	CSIRO	Analysis of video data for inter-reef data gaps	0.20
Mr T. D. Skewes	CSIRO	Reef biologist: integration of disparate shallow reef habitat and biological data, characterisation analyses, reporting	0.30
Dr W. Venables	CSIRO	Spatial statistician: biophysical characterisation and modelling	0.05
Mr T. D. Wassenberg	CSIRO	Seabed biologist: Integration and analysis of inter-reef biodiversity data	0.20

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Despite the work in support of fisheries over many years, and despite the recent work in the CRC Torres Strait, the Torres Strait Node starts behind the other nodes in terms of research previously completed. This program is therefore concentrating its limited resources on

establishing the key background knowledge and models to enable predictive and management strategy evaluation in the future. The Integrated Report Card Framework process in Year 1 is important in improving understanding of the usefulness and limitations of existing knowledge, and identifying key questions (in a management context) for future research. Project 1.3.1 envisages a range of activities to build on the work of the current CRC Torres Strait, identified by the Torres Strait Scientific Advisory Committee and favoured by stakeholders. Limited tasks can be identified for Year 1 noting that projects in CRC Torres Strait are not due for completion until June and, in some projects, December 2006.

Project / Task Objectives

- (a) Identify and, where possible, fill data gaps in Torres Strait inter-reef seabed mapping from existing data.
- (b) Characterisation of Torres Strait coral reefs.
- (c) Identification of areas for future work – recommendations for targeted investigation of biota, habitats and risks for Years 2-4.

Objective (a): Identify and, where possible, fill data gaps in Torres Strait inter-reef seabed mapping from existing data.

Undertake a desktop gap analysis of data collected to date for the Torres Strait region. Where information exists in raw format, analyse information to fill these gaps. For example, shoal areas too rough for biodiversity sampling may have poorly sampled sessile biota, information for these areas could be filled by detailed quantification of visible seabed species from existing Seabed video and stills; including mapping output products.

Objective (b): Characterisation of Torres Strait coral reefs.

Using available datasets of biological and physical data from internal and external sources, characterise the seabed associated with reefal areas of the Torres Strait. This process will align with work undertaken for the National Oceans Office Torres Strait (inter-reef) Seabed Characterisation project.

The available reef edge and reef top inventory data includes: habitat type, coral morphotypes, seagrass species, algal genera, reef fish species and invertebrate resource species. An earlier series of reports point-mapped the composition of each of the above categories and analysed some simple surrogates (e.g. distance from land/rivers on seagrass and reef-fish). A cluster analysis of reef-fish communities was conducted, but only point mapped.

These previous analyses will form a basis for further development of reef assemblage definitions for each of the above reef faunal categories, as well as a single reef assemblage classification across all faunal categories.

The surrogate relationships will be developed with more complex bio-physical modelling with the considerably more extensive suite of near-full-coverage physical variables that we have now, and spatial prediction of assemblages to reefs that were not sampled (with uncertainty mapped also) to deliver a full coverage of all Torres Strait reefs.

The earlier work also classified LANDSAT TM imagery for Central/Eastern Torres Strait shallow reef habitats, based on the reef survey "ground-truth" data. A suitable LANDSAT TM image is now available for Western Torres Strait and some ground-truth data are available, thus a similar high-resolution shallow reef habitat classification analysis and mapping can be conducted for Western Torres Strait Reefs, as is available for the Central/Eastern Reefs.

Objective (c): Identification of areas for future work – recommendations for targeted investigation of biota, habitats and risks for Years 2-4.

Objectives to be delivered in Years 2-4 are still under development and will, in some respects, be defined by the work to be undertaken in Year 1. It is anticipated that a collaborative project (likely involving CMAR, GA, AIMS, QDPI&F, JCU) will be conducted to follow-up the work of the CRC Torres Strait. The precise activities to be undertaken in Years 2-4 cannot be specified for the following reasons. Projects that have been proposed by researchers and desired by stakeholders, amount to much greater cost than the available funds. The activities in Year 1 will (a) infill gaps in existing knowledge of TS environmental assets from existing sources and (b) identify, through the user-engaged process of developing the Framework for the Integrated Report Card, priority issues and hence priority data gaps for this project for Years 2-4. It is, therefore, inappropriate to commit to particular activities or deliverables now.

Following completion of objectives (a) and (b) a workshop to discuss opportunities for future work will be held to assist in defining the pathway forwards for work to be conducted under this project.

It is anticipated that the project will:

1. Build on the basic outputs from CRC Torres Strait Seabed Mapping, Seagrass Mapping, Biophysical (hydrodynamic and sediment-movement) Modelling and Trawl Modelling Projects and the new high-resolution bathymetric map of Torres Strait developed by GA; capitalise information in those extensive datasets; and in other available under-utilised data sets; deploy a limited amount of targeted field work; also consider use of remote-sensing information; thus integrate information on: status and trend of key seabed habitats and assemblages; the range of threats and predicted impacts on sustainability/risk assessment; and environmental change prediction.
2. Identify indicators, and species / habitats at risk, and design appropriate monitoring for them.
3. Compare Torres Strait seabed condition and trend and benchmark against existing knowledge of similar regions.

Based on our understanding of potential future directions for work, we have provided an indicative budget for outyears below. This will be refined following completion of Year 1 and determination of activities for out years.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Quantification of visible seabed species from existing inter-reef video data to extract detailed species data	Feb 2007
(b)	Collate available existing biological data relating to the shallow reefs of Torres Strait.	Feb 2007
(c)	Analyse and integrate new inter-reefal data and mapping of output products. Progress report, detailing data gaps that have been filled and analysis to date.	June 2007
(d)	Characterise reefs in Torres Strait (those where data is available) based on clustering of available biological and physical data. Progress report, detailing analysis to date.	June 2007
(e)	Identification of areas for future work	June 2007*
(f)	Progress report on coral reef characterisation and inter-reef data gaps filled by further analysis of video data	June 2007*

Project 1.3.1 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones (all CSIRO responsibilities)	
Signing of contract	
Activity Plan for conduct of project including any engagement activities, communication activities, workshops and products planned for Year 1.	15 Dec 2007
Report 1 submission: - Report on video analysis progress. - Report on shallow reef data collation including transfer of data (LDAS, CARS, SST and current model) between agencies, historical data collated and new data added.	1 Mar 2007
Report 2 submission: - Progress report on coral reef characterisation: reef assemblage classifications and mapping.* - Progress report on data gaps identified for the region, gaps filled from data sourced during this project.* - Report identifying areas for future work in the region to fill remaining data gaps. - Summary of communication activities undertaken through the course of Year 1 of project.	11 June 2007
Total MTSRF Funding	\$193,000

Project 1.3.1 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	193,000	-	193,000
CSIRO	-	193,000	193,000
Total	193,000	193,000	386,000

CSIRO Project 1.3.1 Budget 2006/2007

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	174,000	27,500	201,500
Operating	10,000	-	10,000
Travel	-	-	-
Communication / Extension	9,000	-	9,000
Capital	-	-	-
Institutional overheads	-	165,500	165,500
Total	193,000	193,000	386,000

Indicative Budget Summary – Years 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	243,000	-	200,000	TBA	-	443,000
2008/2009	243,000	-	200,000	TBA	-	443,000
2009/2010	243,000	-	200,000	TBA	-	443,000
Total	729,000	-	600,000	TBA	-	1,329,000

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

Title	Organisation	Role	FTE
Dr Alan Duckworth	AIMS	Project leader	0.3
Dr Chris Battershill	AIMS	Statistical/survey design, benthic community population dynamics, ecology, indicator species relevance, environmental risk analysis: (sedimentation / harvest / farming / disease / invasions)	0.2
Ms Libby Evans-Illidge	AIMS	Uptake / transfer of project results for business planning and environmental effects assessment.	0.2
Mr Carsten Wolff	AIMS	Project coordinator (field visits)	0.3
Mr Don Mosby	Yorke Island Council	Masig Island project development – socio-economic, reef / sedimentation advice	0.1
Mr John Morris	Yorke Island Council	Project manager at Masig Island	0.1
Ms Robin Maxwell	TSRA	Business / marketing advice	0.05
Dr Nicole Webster	AIMS	Population genetics and connectedness, disease risk, micro-organism monitoring tools.	0.2

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 (CRC Torres Strait Task 1.6). 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 explore 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, currently undertaken with CRC Torres Strait and Torres Strait Regional Authority, will be based on other funds and in collaboration with the Yorke Island Council and the Authority.

A business model for a commercial venture at Masig Island, grounded on a sustainable environmental bottom line, will place this project in the context of the economic potential of the broader sponge resource in Torres Strait region, and facilitate the uptake of outputs for the development of a viable commercial sponge farming industry throughout the Torres Strait. Ecological and risk assessment information will be integrated into the relevant reports cards.

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, invasives), and establish a sustainable strategy for seed stock harvest.
- (b) Determine connections between sponge populations and risks in translocation.
- (c) Determine patterns of sponge recruitment/mortality and the environmental risk of seed stock harvest leading to development of a sustainable seed collection strateg.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Demography assessment and sustainable harvest report	11 June 2007
(b)	Population genetics and translocation report	11 June 2007
(c)	Sponge recruitment/mortality preliminary report	11 June 2007

Project 1.3.2 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission: Schedule of proposed field activities and community engagement/liaison activities plan for Year 1 (engagement of TSI in project). [AIMS]	15 Nov 2006
Report 2 submission [all AIMS responsibilities]: One report detailing in separate segments: - what data, documents/reports have been sourced to assist achieving objectives (a)-(c); - findings of field work conducted to date (surveys of populations, collection for genetic work, recruitment plate deployment, sponge pathogen characterisation) and schedule of remaining field work; and - summary of all liaison activities conducted to date (including employment of TSI for project).	1 Feb 2007

For 2006/2007 outputs only	Date
Milestones	
Report 3 submission: One report detailing in separate segments: • Final demography assessment and sustainable harvest findings. • Final population genetics and translocation findings. • 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 1 of project. • Plan for completion of out year activities.	11 June 2007
Total MTSRF Funding	\$60,000

Project 1.3.2 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	60,000	-	60,000
TSRA	50,000	-	50,000
AIMS	-	110,000	110,000
Total	110,000	110,000	220,000

AIMS Project 1.3.2 Budget 2006/2007

Item	MTSRF Funds	AIMS In-kind	Total Cost
Salaries	8,000	-	8,000
Operating	4,000	8,000	12,000
Travel	28,000	80,000*	108,000
Communication / Extension	5,000	-	5,000
Capital	-	-	-
Institutional overheads	-	22,000	22,000
Total	45,000	110,000	155,000

* Includes AIMS shiptime (in-kind).

TSRA Project 1.3.2 Budget 2006/2007

Item	MTSRF Funds	TSRA In-kind	Total Cost
Salaries	10,000	50,000	60,000
Operating	-	-	-
Travel	5,000	-	5,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads			
Total	15,000	50,000	65,000

Indicative Budget Summary – Years 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	60,000	-	110,000	50,000	-	220,000
2008/2009	60,000	-	110,000	50,000	-	220,000
2009/2010	60,000	-	110,000	50,000	-	220,000
Total	180,000	-	330,000	150,000	-	660,000

PROGRAM 3: TORRES STRAIT – STATUS, USE AND TRENDS

Project 1.3.3: Economic analysis of alternative uses, tradeoffs

Project Leader and Host Organisation

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

Project Team

Title	Organisation	Role	FTE
Dr Alan Butler	CSIRO	Project leader	0.46
Professor Sean Pascoe	CSIRO	Principal Researcher	0.10

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2007

This project will benefit from the capacity building component in Theme 5 Enhancing Delivery.

Project / Task Objectives

MTSRF gives high priority to an analysis of the economic value of the environmental assets of the Torres Strait region in terms of alternative economic uses of assets and tradeoffs. CSIRO's newly appointed natural resource economist, and other senior staff are being appointed in Australian institutions (e.g. AIMS) in the area of Resource Economics. There are other natural resource economists in their network of colleagues and associates (e.g. Dr Bill Arthur, ANU).

It is proposed that, during Year 1, Professor Pascoe will engage with other resource economists in Australian institutions including MTSRF researchers, Dr Bill Arthur (ANU) and end-users (taking advantage of the interactions occurring under the Integrated Report Card Framework process) and will identify the most appropriate economic projects for the Torres Strait region for conduct in Years 2-4.

MTSRF has not committed funds to this work in 2006-2007. Some of this work will be achieved through staff participation in the IRC process; some of this work may depend on and would likely attract co-investment. However, the time of the economists in engagement during Year 1 is recorded here as an in-kind contribution to MTSRF by their institutions to ensure recognition of the contribution to MTSRF's goals.

Project Outputs / Milestones

Informal review of the economic value of the environmental assets of the Torres Strait region in terms of alternative economic uses of assets and tradeoffs, data and knowledge gaps.

Project Output: Professor Pascoe and Dr Butler jointly responsible for delivery.

31 March 2007: Summary of preliminary review of key resource economic issues based on approximately one week's work in review and discussions with leading resource economists. The report should summarise "what are the key resource economics issues in the region?"

15 May 2007: Report outlining proposal/s in MTSRF format identifying appropriate resource economics project/s to be conducted in the Torres Strait region for consideration for conduct under a research plan for Years 2-4 of MTSRF. The report will include communication activities undertaken through the course of this project: staff and organisations consulted, workshop/meeting attendance, minutes of events.

Project 1.3.3 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	-	-	-
CSIRO	-	20,000	20,000
ANU	-	5,000	5,000
Total	-	25,000	25,000

CSIRO Project 1.3.3 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	-	20,000	20,000
Operating	-	-	-
Travel	-	5,000	5,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	-	25,000	25,000

Indicative Budget Summary – Years 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	TBA	TBA	TBA	TBA	TBA	TBA
2008/2009	TBA	TBA	TBA	TBA	TBA	TBA
2009/2010	TBA	TBA	TBA	TBA	TBA	TBA
Total	TBA	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

Project Team

Title	Organisation	Role	FTE
Mr Damian Miley	TSRA		
Mr Vic McGrath	TSRA		

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

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 involves an Indigenous liaison officer (Mr Toshi Nakata) employed by the CRC Torres Strait and based at the TSRA offices on Thursday Island. Such a system is to be established through Theme 5 of MTSRF.

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 Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Facilitate researcher activity in Torres Strait through newsletter articles, visits to communities and meetings where appropriate.	June 2007
(b)	Report to Reef and Rainforest Research Centre on communication activities.	June 2007

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 \$40,000 allocated to communication in this Program, \$25,000 is allocated towards the salary of the Indigenous liaison officer, \$5,000 to general costs of communications and \$10,000 towards production of visuals. The Marine Species of Conservation Concern Program (Projects 1.4.1 and 1.4.2) will budget \$30,000 p.a to communication. It is estimated that a further \$100,000 p.a. will be needed, which might come from another coinvestor or from MTSRF's Enhanced Delivery

fund, or some combination of the two. This would provide the necessary salaries and operating expenses for an effective communication and engagement system across both Torres Strait Programs.

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 building on what was established by the CRC Torres Strait.

Project 1.3.4 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones All TSRA Responsibilities	
Signing of contract	
Report 1 submission: Update on position recruitment process.	15 Jan 2007
Report 2 submission: - 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 2007. - Report of any activities undertaken to dateReport on liaison and facilitation activities and communication products to date (15 Jan to 1 May 2007).	1 May 2007
Report 3 submission: Final report on liaison activities and communication products during milestone period (1 May 2007 to 30 June 2007) and assessment of effectiveness and delivery against plan.	11 June 2007
Total MTSRF Funding	\$30,000

Project 1.3.4 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	30,000	-	30,000
MTSRF Visual Documentation*	10,000	-	10,000
TSRA	-	50,000	50,000
Total	40,000	50,000	90,000

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

TSRA Project 1.3.4 Budget 2006/2007

Item	MTSRF Funds	TSRA In-kind	Total Cost
Salaries	25,000	50,000	75,000
Operating	-	-	-
Travel	-	-	-
Communication / Extension	5,000	-	5,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	30,000	50,000	80,000

Indicative Budget Summary – Years 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	120,000	-	-	150,000	-	270,000
2008/2009	120,000	-	-	150,000	-	270,000
2009/2010	120,000	-	-	150,000	-	270,000
Total	360,000	-	-	450,000	-	810,000

PROGRAM 3: TORRES STRAIT – STATUS, USE AND TRENDS

Project: 1.3.5: Data synthesis and development of Torres Strait component of the Integrated Report Card

Project Leader and Host Organisation

Mr Damian Miley, Torres Strait Regional Authority

Project Team

Title	Organisation	Role	FTE
Mr Damian Miley	TSRA	Project leader	TBA
Miya Isherwood	TSRA	Proposed Workshop participant*	TBA
TBA	TSRA	Community Liaison Officer – adviser and workshop participant	0.25
Dr Alan Butler	CSIRO	Project collaborator (and Program Leader)	0.05
Dr Sean Pascoe	CSIRO	Proposed Workshop participant*	0.05
Dr Roland Pitcher	CSIRO	Proposed Workshop participant*	0.05
Dr Rob Coles	QDPI&F	Proposed Workshop participant*	0.05
Dr Francis Pantus	CSIRO	Proposed Workshop participant*	0.05
Dr Peter Harris	GA	Proposed Workshop participant*	0.05
TBA		People of Torres Strait to engage in discussions as appropriate.(Project Leader to arrange).	
CSIRO Integrated Report Card Team: Professor Iain Gordon / Dr Andy Stevens	CSIRO	Integrated Report Card project (MTSRF Project 3.7.7)	

* Note: Scientific workshop participants are likely to be doing this as part of their final roles in CRC Torres Strait, explaining their activities and findings locally. It will be valuable to do this as a prelude to the IRC discussions.

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

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 report-card on the environmental assets in Torres Strait (linked to MTSRF Project 3.7.7). These issues will be identified through a process of engaging with stakeholders in Torres Strait including TSRA 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

- (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;
 - to identify conceptual models of the processes surrounding those key issues;
 - to identify potential indicators and thresholds of status and trends in each issue;
 - to identify 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 an Integrated Report Card Framework. To be used in out years for reporting the ecosystem health of Torres Strait.

Objective	Targeted Activity	Completion Date
(a)	Desktop review of existing reports, and investigation of the nature and status of biophysical, ecological, social and cultural indicators in other regions. Preliminary surveys and interviews to be carried out by the Community Liaison Officer.	January – February 2007
(b)	Workshop (Brisbane/Townsville/Cairns) to agree upon the key issues and framework for the development of indicators, attended by scientists, management agencies, and the Community Liaison Officer. Production of community education and awareness-raising materials about indicators for use in community consultations in the Torres Strait (TSRA Community Liaison Officer to develop with in-kind support from MTSRF for graphic design and production). Development of an agreed suite of pilot indicators: • Scientists to develop biophysical and ecological indicators; • TSRA to develop draft socio-economic and cultural indicators, based on endorsed regional policy documents (e.g. TSRA Development Plan) – verified and ground-truthed through appropriate community consultations carried out by the Community Liaison Officer Final workshop and report, detailing consultations conducted and workshops held, and explaining outcomes in terms of: • Key issues identified • Conceptual models related to those issues • Potential indicators required to report on those key issues • Outline of work needed in later years to develop those indicators, develop limits and thresholds of concern, and develop systems to measure and report on those indicators • Possible community-based monitoring approaches • Outline of any research needed in TS, identified during the workshops and consultations but not directly germane to a “report card” process.	March 2007 15 June 2007
(c)	Contribute to the development of an Integrated Report Card framework that will be evolved into a prototype for the Torres Strait in 2007-2008.	15 June 2007

Project 1.3.5 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission: - Progress report, summarising outcomes of desktop review, proposed facilitation activities by the Community Liaison Officer including engagement with Torres Strait communities and the TSRA Executive, a description of links to other relevant activities in Torres Strait (such as NHT funded work, TSRA Development Plan) and reference to local considerations regarding the development of draft potential indicators and thresholds for the Torres Strait. [TSRA] - Plan of communication activities/products for Year 1 [Jointly between TSRA and CSIRO] - Participation in workshop to provide advice on engagement with Torres Strait communities and suggestions regarding potential indicators and thresholds for the Torres Strait and report on the input into the Integrated Report Card Framework and feedback from Project 3.7.7 to this project (links to Project 3.7.7). [CSIRO]	27 April 2007
Report 2 submission: - A 'first draft final report', detailing initial outcomes of meetings and workshops, and engagement with Torres Strait leaders and communities with reference to local considerations on draft potential indicators and thresholds for the Torres Strait. [TSRA] - A 'first draft final report', detailing a short list of potential indicators for Torres Strait and summarising their strengths and weaknesses, including summary of progress with linking these potential indicators into the draft framework for the IRC (the exchange between Projects 1.3.5 and 3.7.7). [CSIRO]	15 May 2007
Report 3 submission: Final report, detailing consultations conducted and workshops held, and explaining outcomes in terms of: - Key issues identified. [TSRA] - Conceptual models related to those issues. [CSIRO] - Potential indicators and potential thresholds required to report on those key issues. [CSIRO] - Plan for activities needed in later years to develop those indicators, develop limits and thresholds of concern, and develop systems to measure and report on those indicators. [CSIRO] - Outline of any research needed in Torres Strait, identified during the workshops and consultations. [CSIRO] - Update report on input into the Integrated Report Card Framework (links to Project 3.7.7). [CSIRO]	15 June 2007
Total MTSRF Funding	\$120,000

Project 1.3.5 Budget

- Travel and accommodation costs for non-Torres Strait Islanders, and QDPI&F and GA involvement in meetings throughout 2006-2007 to be met by CSIRO Travel component.
- Schedule of meetings, locations and participants to be set by agreement between CSIRO and TSRA.

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	120,000	-	120,000
CSIRO	-	54,257	54,257
TSRA	-	-	-
Total	120,000	54,257	174,257

CSIRO Project 1.3.5 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	15,000	22,436	37,436
Operating	6,000	-	6,000
Travel	25,000	-	25,000
Communication / Extension	4,000	-	4,000
Capital	-	-	-
Institutional overheads	-	31,821	31,821
Total	50,000	54,257	104,257

CSIRO Integrated Report Card Project 3.7.7 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	50,000	-	50,000
Operating	-	18,400	18,400
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	41,600	41,600
Total	50,000	60,000	110,000

TSRA Project 1.3.5 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	10,000	-	10,000
Operating	-	-	-
Travel	5,000	-	5,000
Communication / Extension	5,000	-	5,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	20,000	-	20,000

Program 4

Species and Communities of Conservation Concern

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

Budget Summary

	Cash	In-kind	Total
MTSRF	500,000	-	500,000
Other	-	576,750	576,750
Total	500,000	576,750	1,076,750

MARINE SPECIES AND COMMUNITIES OF CONSERVATION CONCERN (PROJECTS 1.4.1 AND 1.4.2)

Project Leader and Host Organisation

Professor Helene Marsh, James Cook University

Budget Summary

	Cash	In-kind	Total
MTSRF	300,000	-	300,000
Other	-	382,000	382,000
Total	300,000	382,000	682,000

The marine component of Program 4 will generate world-class biological, social and economic research to provide reports on the condition and trends of dugongs, marine turtles, 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 two main tasks (a) dugong distribution and abundance and (b) sea turtle nesting success. 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 two main tasks (a) effects of acoustic alarms on behaviour of wildlife catch and (b) economics of Indigenous hunting and its management. 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.

The outcomes of the this component will be of relevance to: (1) the Integrated Report Card, 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 Report Card 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 \$235,000
- 1.4.2 Sustainable use of marine species of conservation concern..... \$65,000

RAINFOREST SPECIES AND COMMUNITIES OF CONSERVATION CONCERN (PROJECT 1.4.3)

Project Leader and Host Organisation

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

Budget Summary

	Cash	In-kind	Total
MTSRF	200,000	-	200,000
Other	-	194,750	194,750
Total	200,000	197,750	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 Integrated

Report Card, 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

Project Team

Title	Organisation	Role	FTE
Dr Mark Hamann	JCU	Sea Turtle ecologist: project leader Raine Is tasks manager.	0.95
Dr Emma Gyuris	JCU	Sea turtle ecologist: co-investigator Raine Is task	0.05
Dr Ivan Lawler	JCU	Dugong ecologist: co-coordinator of the dugong ecology task	0.05
Dr Col Limpus	QEPA	Sea turtle ecologist: advice on the Raine Is task and manage QPWS projects that link to MTSRF.	0.05
Professor Helene Marsh	JCU	Dugong ecologist: co-coordinator of the dugong ecology task	0.075
Dr Scott Smithers	JCU	Marine geomorphologist: co-investigator Raine Island task	0.1
QEPA engineers	QEPA	Coastal engineers: co-investigators Raine Island task	0.1
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

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, coastal dolphins, minke whales, sea birds and sharks 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 be delivered into the Integrated Report Card framework.

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 and sea turtles 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 of the research activities in partnership with TSRA

Project / Task Methodology

Objective (a) Dugong distribution and abundance

This project will be undertaken in Year 1 and will estimate the sustainable anthropogenic harvest of dugongs for northern Great Barrier Reef and Torres Strait, an essential component of the science required to implement the National Approach to Sustainable and Legal Indigenous Harvest of Dugongs in Australia, the development Traditional Use Marine Resource Agreements in the Great Barrier Reef region and management plans for Indigenous hunting in Torres Strait and the review of the Inshore Finfish Fishery and Dugong Protection Areas. This project will also obtain information on the spatial distribution of dugongs and sea turtles to inform a spatial assessment of risk management options in Project 1.4.2(e) by conducting aerial survey of dugongs and sea turtles in the northern Great Barrier Reef and Torres Strait and index blocks in Hervey Bay. These surveys will complete the aerial survey census that commenced in 2005 and has already surveyed from the Qld / NSW border to Cooktown. The aerial surveys will be followed by population and spatial modelling of resultant data in context of time series dating from early 1980s. The methods used to design and conduct the aerial surveys, and undertake the data analysis will follow Marsh et al. (2004) and Pollock et al. (in press).

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). Modeling 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) and Murray Island (Torres Strait).
- To calculate reproductive parameters for nesting green turtles at Raine Is, Moulter Cay and Murray Island (size range, recruitment rates, nesting success, mortality rates [of nesting turtles], egg production).
- To determine factors influencing nesting success and hatchling survivorship of sea turtles.
- To determine recruitment rates of juvenile turtles into the population.

- To trial remote methods of recording human visitation at remote sites of high conservation significance.

The project involves conducting two concurrent trips per year 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 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; in Yr 1, geomorphologic surveys will be conducted at Raine Island and Moulter Cay to determine patterns of sand movements, in Yrs 2-4 the geomorphologic surveys will continue and aim to develop potential mitigation measures. 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 experimental approach (Miller 1985; 1999). Ecological data will be collected on nesting seabirds at Raine Island. 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 local Indigenous people will be trained in all aspects of the field work (see Hamann et al. 2005 for examples). Surveillance cameras will be deployed to record human visitation at selected sites in collaboration with Australian Fisheries Management Authority (AFMA) and Traditional Owners.

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)

Communication and extension for this project will be incorporated into Program 8 (Sustainable use and management of marine resources of the GBR).

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)i	Draft report on the condition, trends and projected futures of the dugong; including identification and evaluation of the key threats and evaluation of available management options to improve its status	May 2007
(a)ii	Report on the condition, trends and projected futures of the dugong; including identification and evaluation of the key threats and evaluation of available management options to improve its status.	June 2007
(b)	Report on work undertaken in 2006/2007 – including reports of field work undertaken to identify aspects of nesting success and egg survivorship. The report will include an initial identification and baseline evaluation of key threats.	June 2007
(c)	Report on the communication of research activities in partnership with the TSRA	

A dedicated engagement (communication and extension) strategy will be an integral component of the proposed project and our budget assumes that \$30,000 of the MTSRF budget plus additional funds included in the extension strategy developed by the Torres Strait Program will be used for community engagement in partnership with the Sustainable Use-GBR and Torres Strait Programs.

Project 1.4.1 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones – All JCU responsibilities	
Signing of contract	
Report 1 submission: - Schedule of field activities (aerial surveys, site visits etc.) for objectives (a) and (b) (above). - Proposed schedule of training events for Murray Island indigenous participants in project. - Plan of any communication activities in partnership with TSRA / detail products for Year one and summary of liaison activities.	31 Aug 2006
Report 2 submission: - Progress report on field work conducted to date to meet objectives (a) and (b) (above): areas monitored, data collected, and preliminary findings. - Summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable.	20 Jan 2007
Report 3 submission: - Draft report on the condition, status and trends and projected futures of the dugong; including identification and evaluation of the key threats and evaluation of available management options to improve its status (obj a)*. - Draft report on field work undertaken in year one to identify aspects of nesting success and egg survivorship. The report will include an initial identification and baseline evaluation of key threats (obj b).	15 May 2007

For 2006/2007 outputs only	Date
Milestones – All JCU responsibilities	
Report 4 submission - Final report on field work undertaken in year one to identify aspects of sea turtle nesting success and egg survivorship. The report will include an initial identification and baseline evaluation of key threats (obj b). - Final summary of communication activities undertaken through course of project and example of communication products. - The final report for (a) will be submitted in Year 2 (August 2007)*	11 June 2007
Total MTSRF Funding	\$132,000

* The final report on the condition, trends and projected futures of the dugong; including identification and evaluation of the key threats and evaluation of available management options to improve its status (obj a) will be submitted in August 2007. This is necessary because the final activity to complete the project (site visits to Traditional Owners) is scheduled for July 2007 after ARP report for 2006/2007 is finalised.

Project 1.4.1 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Note: \$30,000 from this project has been allocated under Project 4.8.8 to enable communication, extension, liaison and product development for the marine components (Projects 1.4.1 and 1.4.2) of Program 4 prior to development of budget below.

Contributing Organisation	Cash	In-kind	Total
MTSRF	232,000	-	232,000
MTSRF Visual Documentation*	3,000	-	3,000
JCU	-	271,000	271,000
TSRA	-	51,000**	51,000
Total	235,000	322,000	557,000

* 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 2006/2007

Item	MTSRF	JCU In-kind	TSRA In-kind	Total Cost
Salaries	80,000	151,000	51,000	282,000
Operating	10,000	-	-	10,000
Travel	112,000	70,000	-	182,000
Communication / Extension	12,000	-	-	12,000
Communication products	18,000	-	-	18,000
Capital	-	50,000	-	50,000
Total	232,000	271,000*	51,000	554,000

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

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF*	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	245,000	-	27,000	-	43,000	315,000
2008/2009	225,000	-	47,000	-	22,000	294,000
2009/2010	235,000	-	31,000	-	21,000	287,000
Total	705,000	-	105,000	-	86,000	896,000

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

Project Team

Title	Organisation	Role	FTE
Professor Jon Altman	ANU	Economist: co-supervise the economic task of the project. Plus co-supervision of PhD student (economic task)	0.05
Dr Bill Arthur	ANU	Economist: co-supervise the economic task of the project. Plus co-supervision of PhD student (economic task)	0.05
Dr Mark Hamann	JCU	Sea turtle ecology expert: advice on sea turtle ecology and will co-supervise PhD student (dolphin acoustics)	0.05
Professor Helene Marsh	JCU	Dugong ecologist: co-coordinator of the acoustic and economic tasks and co-supervisor of PhD students.	0.075
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
PhD students*	1 x JCU 1 x TBA	Two PhD projects have been identified (1) acoustics of cetacean and sea turtles and (2) socio-economics of turtle and dugong issues	1.0 FTE each (note TBA student starts early 2007)
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	0.1 each

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project harnesses the expertise of researchers from three research providers and two 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. In total the MTSRF and co-investment funded projects 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 it is applicable, information from this project will be delivered into the Integrated Report Card framework.

Key Objectives:

- (a) To evaluate the effects of acoustic alarms on behaviour of wildlife bycatch.
- (b) To evaluate the economics factors related to Indigenous hunting and its management.

Project / Task Methodology

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

This project 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 three species of coastal dolphins and at least one species of sea turtles to acoustic alarms. A spatial risk assessment of various management options will be completed. Note: The project needs to start in mid 2006 to take advantage of JCU research student Alvaro Berg who commenced in 2006

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

This project 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 project 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 will be achieved by literature search, participant observation (fieldwork) with Torres Strait organisations and with a small sample of 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 NAILSMA Marine Turtle and Dugong Management project and proposed by Objective (a) in Project 1.4.2. Note: Needs to start in Jan 2007 to include PhD student. Communication and extension for this project will be incorporated into Program 8 (Sustainable use and management of marine resources of the GBR).

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	JCU PhD student confirmation of candidature completed (student started March 2006). Literature review undertaken for acoustic alarms on behaviour of wildlife bycatch.	Sept 2006
(a)	Progress report on evaluating the capacity of acoustic alarms to minimise the bycatch of protected species in commercial gill nets without alienating the bycatch species from critical habitats.	June 2007
(b)	Report on progress of evaluation of economic factors related to Indigenous hunting and its management.	June 2007

Project 1.4.2 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones – All JCU responsibilities	
Signing of contract	
Report 1 submission: • Literature report (obj a) • Schedule of activities (field and desktop) for objectives (a) and (b) Year 1 (above). • Plan of communication activities for Year 1 and summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable in collaboration with ANU.	30 Sep 2006
Report 2 submission: • Progress report on field and desktop work conducted to date to meet objective a (above): areas monitored, data collected, literature reviewed, preliminary findings. • Summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable in collaboration with ANU.	20 Jan 2007
Report 3 submission: • Baseline report on status of protected species and trend of these species being caught as bycatch in commercial fishing nets from QPWS data. • Draft report on findings of Year 1 activities to evaluate the capacity of acoustic alarms to minimise the bycatch of protected species in commercial gill nets without alienating the bycatch species from critical habitats. Field and desktop work undertaken, consultation undertaken, plan for completion in out years. (obj a). • Draft report on findings of Year 1 activities to evaluate economic factors related to indigenous hunting and its management: field and/or desktop work undertaken, doctoral student appointment and activities (eg draft literature review or school progress report), consultation undertaken, plan for completion in out years (obj b).	15 May 2007
Report 4 submission: • Final report on findings of Year 1 activities to evaluate the capacity of acoustic alarms to minimise the bycatch of protected species in commercial gill nets without alienating the bycatch species from critical habitats. Field and desktop work undertaken, consultation undertaken, plan for completion in out years. (obj a). • Final report on findings of Year 1 activities to evaluate of economic factors related to indigenous hunting and its management: field and desktop work undertaken, consultation undertaken (obj b). • Plan for completion of out year activities. • Final summary of liaison activities undertaken through course of Year 1 of project in collaboration with ANU.	10 June 2007
Total MTSRF Funding	\$64,000

Project 1.4.2 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	64,000	-	64,000
MTSRF Visual Documentation*	1,000	-	1,000
Research Provider Co-investment	-	60,000	60,000
Total	65,000	60,000	125,000

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

JCU Project 1.4.2 Objective (a) Budget 2006/2007

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	20,000	12,000	32,000
Operating	10,000	-	10,000
Travel	5,000	-	5,000
Communication / Extension	-	-	-
Capital	4,500	48,000	52,500
Total	39,000	60,000	99,500

JCU Project 1.4.2 Objective (b) Budget 2006/2007

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	10,000	-	10,000
Operating	7,250	-	7,250
Travel	7,250	-	7,250
Communication / Extension	-	-	-
Capital	-	-	-
Total	24,500	-	24,500

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	75,000	-	83,000	20,000	12,000	190,000
2008/2009	75,000	-	83,000	-	12,000	170,000
2009/2010	45,000	-	82,000	-	12,000	139,000
Total	195,000	-	248,000	20,000	36,000	499,000

PROGRAM 4: RAINFOREST SPECIES AND COMMUNITIES OF CONSERVATION CONCERN

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

Title	Organisation	Role	FTE
Daniel Metcalfe	CSIRO	Tropical Plant Ecologist	0.2
David Westcott	CSIRO	Vertebrate Ecologist	0.1
Andrew Krockenberger	JCU	Vertebrate physiologist	0.25

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 *Melaleuca* 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. Data on Regional Ecosystem composition and condition will support the QEPA re-assessment program; identified threats and condition will feed into FNQ NRM Ltd and WTMA statutory reporting, and inform policy development, and collation of information on the impact of fire and of weeds and feral animals will inform QPWS management policy and QDNRM&W weed eradication programs. 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 FNQ NRM Ltd and links into the work being undertaken through the Coastal Catchment Initiatives program in the Tully catchment and potentially, in subsequent years, in the Barron catchment.

Key Objectives:

- 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.
- Completion of baseline data for the Tully-Murray-Hull catchments using revised protocol, and collection of baseline for other priority catchments.
- 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) 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).
- (f) 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)-(d): 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 will be merged and supplemented with specific tasks to generate data on identified species and on management issues. Two proformas will be produced, a detailed one for use by survey teams working primarily on the MTSRF project, and a more general one to supplement survey work carried out by end users but with a specific focus on another aspect, such as weed distribution. Selection of survey sites in Tully-Murray-Hull catchments will involve agreement with stakeholders on survey site selection and prioritization, both for targeted surveys and non-targeted surveys which yield additional data from other management work. Collection of additional data for pre-surveyed sites, and completion of additional sites to generate baseline data for the Tully – Murray – Hull catchments, will follow. Statistical and spatial analysis of data will include (i) comparison of plant inventories with published RE classifications (in collaboration with QEPA), (ii) assessment of weed and feral invasion and load in fragments of different sizes and after various damage levels due to cyclone Larry (with QDNRM&W and FNQ 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. 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.

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

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

Objective	Targeted Activity	Completion Date
(a)	Agreement with end-users on revised survey format	October 2006
(a), (b)	Selection of survey sites in Tully-Murray-Hull catchments	October 2006
(b)	Completion of baseline surveys in Tully-Murray-Hull	April 2007
(c), (d), (e)	Analysis of baseline data, workshops and reporting	June 2007
(f)	Select study sites for microhylid frogs and arboreal marsupials	March 2007

Project 1.4.3 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission – all CSIRO tasks: • Progress on revision of survey format for objective (a) (above) including methods, sites, activity schedule, data to be collected. • Schedule of activities (field and desktop) for objectives (a) and (b) Year 1 (above). • Progress report on field and desktop work conducted to date to meet objectives (a)-(e) (above): areas monitored, data collected, literature reviewed, preliminary findings (baseline surveys, community composition of threatened lowland REs, identification and evidence of threatening processes). • Report/minutes of end-user meetings to revise survey format and sites, and agenda for stakeholder workshop scheduled Nov 2006 with Projects 1.2.1 and 2.6.2. • Plan of communication outputs and products for year one and summary of any communication activities undertaken to date not covered above.	30 Oct 2006
Report 2 submission: • Draft report on findings of Year 1 activities to meet objectives a-e (above) including: results of baseline survey data analysis, community composition of threatened lowland REs, identification and evidence of threatening processes and pest species, identification of indicators of key ecosystem health, examination of RE community change scenarios. Report identifies status and trend of lowland communities and ecosystem health, threats to biodiversity and ecosystem health. [CSIRO] • Location of study sites selected for microhylid frogs and arboreal marsupials (objective f). [JCU] • Progress report on activities to meet objective (f). [JCU]	16 Mar 2007

For 2006/2007 outputs only	Date
Milestones	
Progress update of any liaison activities undertaken including minutes of meetings/workshops to address objectives (a)-(e) (above). [CSIRO]	
Report 3 submission - Final report on findings of year 1 activities to meet objectives a-e (above) including: results of baseline survey data analysis, community composition of threatened lowland REs, identification and evidence of threatening processes and pest species, identification of indicators of key ecosystem health, examination of RE community change scenarios. [CSIRO] - Progress report on activities to meet objective (f). [JCU] - Final report of any liaison activities undertaken including minutes of meetings/workshops to address objectives (a)-(e) (above). [CSIRO] - Plan for completion in out years. [JCU and CSIRO]	11 June 2007
Total MTSRF Funding	\$197,000

Project 1.4.3 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

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

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

CSIRO Project 1.4.3 Budget 2006/2007

Item	MTSRF	JCU In-kind	Total Cost
Salaries	102,751	147,750	250,501
Operating	28,375	-	28,375
Travel	12,273	-	12,273
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	4,351	-	4,351
Total	147,750	147,750	295,500

JCU Project 1.4.3 Budget 2006/2007

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

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	200,000	-	197,000	-	3,000	400,000
2008/2009	200,000	-	197,000	-	3,000	400,000
2009/2010	200,000	-	197,000	-	3,000	400,000
Total	600,000	-	591,000	-	9,000	1,200,000

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
Program 5i	Climate Change – Marine	580,000	25,000	1,515,200
Program 5ii	Climate Change – Rainforests	520,000	-	1,128,000
Program 6	Invasive Species	225,000	-	316,980
Total		1,325,000	25,000	2,960,180

The total value of Theme 2 is \$4,310,180.

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

	Cash	In-kind	Total
MTSRF	1,100,000	-	1,100,000
Other	25,000	2,643,200	2,668,200
Total	1,125,000	2,643,200	3,768,200

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

Project Leader and Host Organisation

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

Budget Summary

	Cash	In-kind	Total
MTSRF	580,000	-	580,000
Other	25,000	1,515,200	1,540,200
Total	605,000	1,515,200	2,120,200

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 prioritizing management responses. To ensure the relevance of this research program to end user, end user representatives were consulted extensively throughout the development of this program. To ensure ongoing relevance, end user representatives are included within the program team. 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

	Cash	In-kind	Total
MTSRF	520,000	-	520,000
Other	-	1,128,000	1,128,000
Total	520,000	1,128,000	1,648,000

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 CO₂ 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 year 2050) 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

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

Project Leader and Host Organisation

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

Project Team

Title	Organisation	Role	FTE
Dr Andreas Schiller	CSIRO	Hydrodynamic modeller	0.2
Dr 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

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, Project 1 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 model

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 1 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 2 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 Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Review of oceanographic processes relevant to this modelling exercise and assembly of regional data relevant to the models. Assembly of pilot suite of nested models completed.	Jun 2007
(b)	Forward plan to completing reef-scale simulations in years 2 and 3 (3 max.)	Jun 2007

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 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Evidence of provision of information (agreed with CSIRO) to CSIRO to enable progress Report 1 submission [AIMS]	21 April 2007
Report 1 submission: - Progress report on activities conducted against objective (a) (above): data assembled for model; oceanographic processes reviewed and assembly of pilot suite of nested models completed [CSIRO] - Minutes of meeting/s held with Project 2.5ii.1 team member/s to derive common starting point of global climate models: include description of common starting point/s[CSIRO] - Plan of any communication activities, products or events for year one 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]	30 April 2007
Evidence of provision of information (agreed with CSIRO) to CSIRO to enable progress Report 2 submission (including pilot suite of nested models and AIMS contribution to plan for out year activities) [AIMS]	28 May 2007
Report 2 submission: - Draft report describing pilot suite of nested models to be used in Years 2 and 3. [CSIRO] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [CSIRO] - Plan for out year activities [CSIRO]	11 June 2007
Total MTSRF Funding	\$122,500

Project 2.5i.1 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	122,500	-	122,500
MTSRF Visual Documentation*	2,500	-	2,500
AIMS	15,000	235,000	250,000
CSIRO	-	125,000	125,000
BLUElink II (CSIRO)	-	150,000	150,000
Total	140,000	510,000	650,000

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

CSIRO Project 2.5i.1 Budget 2006/2007

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	27,376	-	27,376
Operating	5,000	150,000	155,000
Travel	3,104	-	3,104
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	23,270	125,000	148,270
Total	58,750	275,000	333,750

AIMS Project 2.5i.1 Budget 2006/2007

Item	MTSRF Funds	AIMS Cash	AIMS In-kind	Total Cost
Salaries	50,000	15,000	10,000	75,000
Operating	7,750	-	100,000	107,750
Travel	6,000	-	-	6,000
Communication / Extension	-	-	-	-
Capital	-	-	-	-
Institutional overheads	-	-	125,000	125,000
Total	63,750	15,000	235,000	313,750

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources*		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	125,000	15,000	250,000	125,000	-	515,000
2008/2009	-	-	-	-	-	-
2009/2010	-	-	-	-	-	-
Total	125,000	15,000	250,000	125,000	-	515,000

* Co-investment not yet secured.

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

Title	Organisation	Role	FTE
Dr Ken Anthony	JCU	Coral Physiology	0.1
Dr Ray Berkelmans	AIMS	Coral Ecology	0.5
Dr Sophie Dove	UQ	Coral Physiology	0.1
Dr Julian Caley	AIMS	Evolutionary Ecology	0.1
Dr Brad Congdon	JCU	Bird Ecology	0.1
Professor Ove Hoegh-Guldberg	UQ	Coral Physiology	0.2
Dr Andrew Krockenberger	JCU	Vertebrate Physiology	0.1
Dr Janice Lough	AIMS	Climate Records	0.05
Mr Craig Steinberg	AIMS	Hydrodynamic Modeller	0.5
Dr Madeleine van Oppen	AIMS	Coral and Algal Genetics	0.1
Dr Bette Willis	JCU	Coral Biology	0.05
Dr Scarla Weeks	UQ	Physical Oceanography	0.3

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

The components outlined below will provide threshold values for input into early warning system and projections, define the genetic bases of current bleaching thresholds, improve our understanding of how water quality affects outcomes from bleaching (e.g. risk of dying, recovery potential) and better predictive capability with respect to bleaching and related climate disturbances. In addition, the project will address determination of short-term, seasonal and inter-annual variability in GBR waters, and regional physical and biological responses to climatic perturbations, improved understanding of mesoscale oceanographic influences on patterns of bleaching, identification of productivity hotspots of relevance to higher trophic levels and improved understanding of how these fronts may vary with projected climate change. The provision of new tools for remotely sensed oceanographic monitoring of the upper layer dynamics of the GBR regional waters will be investigated.

Key Objectives:

- (a) Refine threshold values for coral bleaching.
- (b) Determine the role of mesoscale oceanographic variability in mass coral bleaching patterns, and on higher trophic levels.

Objective (a) Refine threshold values for coral bleaching.

Currently, our understanding of the relationship between sea temperatures and bleaching risks of coral assemblages hinges on the assumption that thermal thresholds for bleaching are stable within geographical regions and taxa. Also, current models do not formally account for interactions between temperature and other environmental factors in determining bleaching risks. To improve our detection and projection capabilities of bleaching risks in the future, the potential acclimatization and the role of historical adaptation and interactions between key environmental variables new models will be developed. These 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, water quality and UVR will be determined. These laboratory experiments will be complimented with detailed analyses of historical data of thermal histories, bleaching severity and success of recovery to better understand the associated risks of mortality.

This new information will be incorporated in the further development of integrated, multivariate stress algorithms (based on the degree–heating day principle), and risk-based approaches to modelling (e.g. Anthony, Connolly and Hoegh-Guldberg 2006, in press). 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).

In addition to work done on refining thresholds, it will be explored how different genetic varieties (i.e., species and “ecotypes”) of *Symbiodinium* affect the thermal tolerance in corals and 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. The work associated with this objective will lead to improved accuracy among detection methods and a greater understanding of the challenges that lie ahead as oceans warm.

Objective (b) Determine the role of mesoscale oceanographic variability in mass coral bleaching patterns and on higher trophic levels.

Climate change is expected to lead to changes in ocean currents, and to the physical dynamics and biological processes that impact the GBR continental shelf. An improved understanding of the key processes that drive the GBR ecosystem and of the regional physical and biological responses to climatic perturbations requires the routine acquisition of high quality spatial and temporal observations. Moderate resolution (1 km) data from satellites that provide daily synoptic coverage of the ocean have been available over the past number of years. This objective will generate an historic archive of selected geophysical parameters (sea surface temperature, chlorophyll concentration, attenuation coefficient) from 1km resolution SeaWiFS and Modis data for the GBR regional waters, in close collaboration with NASA. NASA will both provide satellite data extending back to 1997, and contribute expertise and processing capacity in the generation of the long-term time-series. An analysis of the time series will be undertaken for the selected geophysical parameters. Seasonal and inter-annual climatologies and anomalies will be generated to derive physical and biological oceanographic patterns, and the relationship of mesoscale variability to mass coral bleaching will be explored.

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 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.

Finally, selected geophysical satellite products will be determined for routine generation on an ongoing basis. A modus operandi will be developed in collaboration with NASA and GBRMPA, whereby these products may provide input into the early warning and assessment system, thus providing remotely sensed oceanographic monitoring of the upper layer dynamics of the GBR regional waters.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Progress Report produced which covers: How bleaching thresholds vary between and within coral species, with respect to genetics and with variables such as water quality and how threshold values link to mortality risk of corals. This will represent a combination of literature review and experimental data.	Jun 2007
(b)	Summarised physical data (in situ and satellite) and biological data (coral bleaching and associated benthic change data). Links to GBRMPA bleach watch web page/Annual report.	Jun 2007

Project 2.5i.2 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission: - Progress report on activities conducted against objectives (above) - data sets examined to underpin development of new acclimation (physiological) models (UQ) - schedule and scope of laboratory experiments to test models (UQ) - target coral species to be examined to test models (UQ) - Collection permit obtained for heritability studies and samples collected from 1 population for experimentation.(Madeleine van Oppen AIMS) - data sets examined to review bleaching thresholds and construct mortality thresholds (Ray Berkelmans AIMS) - oceanographic processes / data sets targeted for review to explain mass coral bleaching. (Craig Steinberg AIMS) - Plan for communication activities / products for year one and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable, schedule of future communication activities. (UQ)	15 Jan 2007
Information transfer between agencies: - Provision of UQ data on differential susceptibility of reef-building corals and zooxanthellae to thermal stress, provided to GBRMPA (Paul Marshall). Responsible officer Ove Hoegh-Guldberg, UQ. - Provision of physical in situ data from AIMS to UQ. Responsible officer: Craig Steinberg, AIMS. - Provision of MODIS satellite data from NASA to UQ: Responsible officer: Scarla Weeks, UQ.	1 Mar 2007
Report 2 submission: - Progress update on activities conducted against objectives (a) and (b) (above). [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] - Report on threshold bleaching values and links to mortality risk of reefs subjected to bleaching in 98, 02 and 06 (Ray Berkelmans AIMS); reports will include preliminary findings of laboratory experiments; physiological and biological data examined/reviewed to explain bleaching events. - Provision of summary of data provided to GBRMPA on temperature trends against bleaching thresholds. Responsible: Ray Berkelmans, AIMS - coral species being investigated for thermal tolerance heritability – preliminary findings of experiments. Responsible: Madeleine van Oppen, AIMS - Plan to complete year 1 activities. [UQ] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [UQ]	1 May 2007

For 2006/2007 outputs only	Date
Milestones	
Report 3 submission: • Report which covers: How bleaching thresholds vary between and within coral species, with respect to genetics and with variables such as water quality and how threshold values link to mortality risk of corals (UQ and AIMS). • Review and refining of time-integrated bleaching thresholds based on new temperature and bleaching data since 98 and develop empirical mortality thresholds for reefs which suffered high mortality Responsible: Ray Berkelmans, AIMS • Copy of workshop minutes/documents provided to other MTSRF projects describing threshold findings: note which projects information provided to and any collaboration. • 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 2007
Total MTSRF Funding	\$196,500

Project 2.5i.2 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	196,500	-	196,500
MTSRF Visual Documentation*	3,500	-	3,500
UQ	-	95,000	95,000
AIMS	-	242,000	242,000
ARC Centre of Excellence	-	55,000	55,000
NASA	-	50,000	50,000
Total	200,000	442,000	642,000

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

UQ Project 2.5i.2 Budget 2006/2007

Item	MTSRF Funds	UQ In-kind	Total Cost
Salaries	90,000	74,000	164,000
Operating	30,000	30,000	60,000
Travel	7,000	7,000	14,000
Communication / Extension	20,500	20,000	40,500
Satellite data	-	50,000	50,000
Capital	-	-	-
Institutional overheads	-	19,000	19,000
Total	147,500	200,000	347,500

AIMS Project 2.5i.2 Budget 2006/2007

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

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant*		Other sources*		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	200,000	235,000	460,000	277,000	100,000	1,272,000
2008/2009	200,000	235,000	400,000	277,000	100,000	1,212,000
2009/2010	200,000	235,000	400,000	277,000	100,000	1,212,000
Total	600,000	705,000	1,260,000	831,000	300,000	3,696,000

* Applicant and other sources are presented for Project 2.5i.2.

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

Project 2.5i.3: Resilience to climate change

Project Leader and Host Organisation

Professor Terry Hughes, James Cook University (JCU)

Project Team

Title	Organisation	Role	FTE
Associate 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
Dr Laurence McCook	GBRMPA / PEW Fellowship Program	Algal Biology and Ecology	0.05

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 modeling. 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:

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

Resilience of fish assemblages to climate change:

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

Project / Task Methodology

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

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

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

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

DNA sequence analysis of a subset of the genes identified as fast evolving will reveal whether selection on the DNA sequences themselves has occurred in these populations. Theoretical models of the potential for corals to evolve greater bleaching resistance in response to climate change will be developed as part of this objective. Results from the

empirical studies described above will be used to parameterise these models and model outputs will be used in turn to guide the design of further experiments.

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

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

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

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

Climate change will influence the community structure of reef fish assemblages, however, it is unknown if these changes will affect ecosystem processes, and subsequently lead to a phase shift from coral to algal dominated reefs. Here, we will utilise and build on existing databases of the distribution and abundance of herbivorous fishes across the GBR to quantify current rates of herbivory. These data will be combined with direct experimental analyses of fish-algal interactions that will enable us to estimate the current capacity of GBR reef fish populations to maintain low macroalgal cover on mid and outer reefs. The second part of this objective will use a modeling approach to permit direct estimation of critical thresholds in the coral – macroalgal phase shift and to evaluate alternative management strategies to respond to changes in macro-algal distributions. We will combine the results from part one with existing algal distribution data and algal growth trajectories to model fish-algal interactions and outcomes under a range of climate change scenarios. Furthermore, it will provide us with an indication of the relative resilience of different components of the GBR ecosystem. In particular, it will indicate to what extent the current stands 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 Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Assessment of genetic connectivity among <i>Symbiodinium</i> populations on the GBR	June 2007
(b)	Modelling framework for rates of adaptation for bleaching resistance	June 2007
(c)	No activity Year 1	2008-2009
(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
(f)	No activity Year 1	2008-2010

Project 2.5i.3 Milestone Payments 2006/2007

For 2006/2007 outputs only	
Milestones	Date
Signing of contract	
Report 1 submission: - Progress report on activities conducted against objectives (above) - Preliminary findings of genetic connectivity among <i>Symbiodinium</i> hosted by the soft coral, <i>Sinularia flexibilis</i>, populations on the GBR: methodology, taxa and populations examined. [AIMS/JCU] - Development of preliminary model for the evolution of heat stress resistance. [AIMS] - Preliminary findings of status of herbivory patterns by fishes on the GBR. [JCU] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [JCU/AIMS]	1 Mar 2007
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	
Report 2 submission: - Progress report on activities conducted against objectives (above) - Report of genetic connectivity among <i>Symbiodinium</i> populations hosted by the soft coral, <i>Sinularia flexibilis</i>, on the GBR. Analyses of genetic diversity of <i>Symbiodinium</i> in this species before and after mass bleaching events. [AIMS/JCU] - Development of microsatellite markers for study of genetic connectivity among populations for a range of <i>Symbiodinium</i> strains	11 Jun 2007

For 2006/2007 outputs only	
Milestones	Date
- o hosted by hard corals. [JCU] - o Report of theoretical models of the potential for corals in the GBR to evolve greater bleaching resistance in response to climate change. [AIMS] - o Collection of colonies from different thermal environments to establish baseline expression levels of genes involved in bleaching response. [JCU] - o Preliminary status and trend report of herbivory patterns by fishes on the GBR, relationship to reef closures, ecosystem health and climate change on reefs on the GBR. [JCU] • Summary of any communication activities undertaken, including minutes of meetings/workshops if applicable. [JCU/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

Project 2.5i.3 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	150,000	-	150,000
AIMS	-	200,000	200,000
PEW Foundation	-	4,000	4,000
JCU	-	250,000	250,000
Total	150,000	454,000	604,000

JCU Project 2.5i.3 Budget 2006/2007

Item	MTSRF Funds	JCU In-kind + PEW Foundation In-kind	Total Cost
Salaries	35,000	250,000	285,000
Operating	30,000	-	30,000
Travel	25,000	-	25,000
Communication / Extension	10,000	4,000	14,000
Capital	-	-	-
Total	100,000	254,000	354,000

AIMS Project 2.5i.3 Budget 2006/2007

Item	MTSRF Funds	AIMS In-kind	Total Cost
Salaries	45,000	100,000	145,000
Operating	-	100,000	100,000
Travel	-	-	-
Communication / Extension	5,000	-	5,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	50,000	200,000	250,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	150,000	-	110,000	-	217,000	477,000
2008/2009	150,000	-	110,000	-	217,000	477,000
2009/2010	150,000	-	110,000	-	217,000	477,000
Total	450,000	-	330,000	-	651,000	1,431,000

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

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

Project Leader and Host Organisation

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

Project Team

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

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 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-modeling approach to explicitly represent linkages between the catchments and the reef.

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

- Road testing the model outputs for sustainable resource use and water quality based on end user driven targets and objectives and assess the systems' principal agro-ecological and socio-economic attributes, processes and dynamics.
- Identifying landscape management (i.e. way in which land is used and managed) and arrangement (i.e. spatial distribution of land use and management) options that comply with the above determined targets.
- Assessing instruments, regulations and institutional changes, to identify those that are most cost-effective in providing incentives to land users to change their landscape management and arrangements accordingly.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	- Development of a spatial database (GIS) for the inshore reefs of the GBR, which synthesizes AIMS datasets for water quality (chl a), thermal history, and species richness (corals) [AIMS] - Development of a modelling framework for the GBR that aids identification of regional areas which display differential sensitivities to thermal stress (per unit increase in SST) [AIMS] - Development of a modelling framework for inshore GBR reefs that provides preliminary threat rankings based on existing water quality and thermal stress regimes [AIMS] - Review of existing literature regarding climate change predictions and projected impacts upon the GBR [CQU] - Development of a set of scenarios of reef degradation (resulting from coral bleaching) [CQU] - Desktop research of socio-economic data for the target areas [CQU]	July 1 2006 – June 30 2007

Project 2.5i.4 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Submission of Progress Report (1), which outlines: - Development of a spatial database (GIS) for the inshore reefs of the GBR, which synthesizes AIMS datasets for water quality (chl a), thermal history, and species richness (corals) [AIMS] - Desktop research of socio-economic data for the target areas [CQU] - Recruitment of postdoctoral scientist with expertise in implementation of Bayesian Belief Network [CSIRO] - Plan of communication activities/products for year one and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable, schedule of future communication activities.[AIMS, CSIRO, CQU]	15 Jan 2007
Submission of Progress Report (2), which outlines: - Development of a modelling framework for the GBR that aids identification of regional areas which display differential sensitivities to thermal stress (per unit increase in SST) [AIMS] - Review of existing literature regarding climate change predictions and projected impacts upon the GBR [CQU] - Conduct workshop with key terrestrial and marine stakeholders [CSIRO] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable [AIMS, CSIRO, CQU]	1 April 2007

Submission of Report (3), which outlines: • Development of a modelling framework for inshore GBR reefs that provides preliminary threat rankings based on existing water quality and thermal stress regimes [AIMS] • Development of a set of scenarios of reef degradation (resulting from coral bleaching) [CQU] • Draft discussion document on the possibilities of implementing BBN for assisting in the management of the GBR Catchments [CSIRO] • Final summary of communication activities undertaken through the course of year 1 of project. [AIMS, CSIRO, CQU]	10 June 2007
Total MTSRF Funding	\$103,000

Project 2.5i.4 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

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

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

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

AIMS Project 2.5i.4 Budget 2006/2007

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

CSIRO Project 2.5i.4 Budget 2006/2007

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

CQU Project 2.5i.4 Budget 2006/2007

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, 2, 3, 4

Year	MTSRF	Applicant		Other sources*		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	105,000	10,000	295,000	140,000	-	550,000
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	315,000	50,000	885,000	560,000	-	1,810,000

* Co-investment not yet secured.

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

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

Project Leader and Host Organisation

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

Project Team

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

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

Project 1 will develop new high-resolution *OzClim* climate models 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. 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.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Analysis of existing global climate models and higher resolution regional model simulations (horizontal resolution of 200 kilometres down to 60 kilometres).	June 2007*
(b)	Run CSIRO CCAM model under current greenhouse conditions nested in simulations with the CSIRO Mk 3 GCM, in preparation for enhanced simulations.	June 2007*
(c)	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.	June 2007*

* Involves associated activities that carry into Out Years.

Project 2.5ii.1 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones – all CSIRO responsibilities	
Signing of contract	
Report 1 submission: - Progress update of activities associated with objectives a-c: model analysis – consisting of new regionally focused analysis of existing model runs, data assembled for climate change simulations, end users approached and climate change scenario needs identified. - Plan of communication outputs and products for year one and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Dec 2006
Report 2 submission: Minutes of meeting/s held with Project 2.5i.1 team member/s to derive common starting point of global climate models: include description of common starting point/s.	28 February 2007
Report 3 submission: - Draft report on analysis of existing models (obj a). - Draft report on current climate high-resolution simulation (obj b). - Progress update of activities associated with objective c: outcomes of workshops or meetings held with end-users. - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	31 April 2007
Provision of agreed interim climate change scenario information for use in program impact assessment studies.	31 April 2007
Report 4 submission: - Final report on initial results of the analysis of existing models (obj a). - Report on outcomes of the new current climate simulation models for the Region - Report on consultation undertaken with users and identification of the full climate change information requirements of the program and the form in which it needs to be delivered. Include requirements for OzClim developments. - Final summary of communication activities undertaken through the course of year 1 of project. - Plan for completion of out year activities.	8 June 2007
Total MTSRF Funding	\$98,000

Project 2.5ii.1 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

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

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

CSIRO Project 2.5ii.1 Budget 2006/2007

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

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash*	In-kind	Cash	In-kind	
2007/2008	115,000	115,000	-	-	-	230,000
2008/2009	95,000	95,000	-	-	-	190,000
2009/2010	50,000	50,000	-	-	-	100,000
Total	260,000	260,000	-	-	-	520,000

* Cash = Combined CSIRO In-kind contribution.

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 Michael Liddell, James Cook University (JCU)

Project Team

Title	Organisation	Task Involvement	Role/Expertise	FTE
Dr Michael Liddell	JCU	Project Leader; P202; P204; P205	Atmospheric Chemist	0.25
Professor Nigel Stork	JCU	P201	Entomologist	0.1
Dr Peter Franks	JCU	P203; P205	Plant Physiologist	0.25
Dr Paul Nelson	JCU	P204; P205	Soil Scientist	0.01

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 modeling 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 to climate change by scaling-up for the region. 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 understand the biology underlying 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 belowground, and on the factors controlling these fluxes.
- (d) To understand the partitioning of whole-canopy net primary productivity and water use efficiency into major floristic components, to integrate with flux and hydrology measurements at the footprint scale to develop forest-level models net primary productivity in tropical lowland rainforests which can then be used as predictive tools in investigating the climate sensitivity of these forests.
- (e) To understand how invertebrate populations fluctuate in relation to local climatic variables and ecological processes, e.g. plant pollination, herbivory, decomposition.

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). Transpiration rates will be measured using sap flow probes (installed) on selected dominant canopy trees and vines. A full suite of microclimate instrumentation is present on site (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 understand the biology underlying 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 and litter trap 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 (capacitance and TDR probes); and saturated zone (piezometers); zone of water uptake using isotopic composition of water in the soil/groundwater and the transpiration stream (^{18}O). Transpiration rates will be measured using sap flow probes (Granier method). Measurement of the biophysical controls on carbon mineralisation in soil and leaching losses using incubations and ^{13}C NMR.

Objective (d): To understand the partitioning of whole-canopy net primary productivity and water use efficiency into major floristic components, to integrate with flux and hydrology measurements at the footprint scale to develop forest-level models of the carbon and water balance at the Australian Canopy Crane research facility site.

Development and implementation of models that predict net primary productivity, using physiological and hydrological data for mechanistic basis and calibrated against measurements of forest carbon and water fluxes. Use will be made of the dendrometer and dbh studies at a landscape level to truth the wider application of the models.

Objective (e) To understand how invertebrate populations fluctuate in relation to local climatic variables and ecological processes, e.g. plant pollination, herbivory, decomposition.

Develop an understanding of the magnitude and causes of inter-and intra-annual variation in insect populations and how they relate to ecosystem productivity and climate variability.

Project Outputs / Milestones

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. Provision of first 5 years of data on the WEB for OZFLUX network end-users.	June 2007
(b)	Tree Physiology: Improved knowledge of physiological controls on rainforest productivity and water use. Report on the risks and threats to lowland rainforest canopy trees under changing rainfall and temperature scenarios.	June 2007
(c)	Soil: Report on basic soil structure, soil chemistry and exploratory hydrology at the canopy crane site.	June 2007
(d)	No activity in Year 1	
(e)	Fauna: Report on the magnitude and causes of inter-and intra-annual variation in insect populations and how they relate to ecosystem productivity and climate variability.	June 2007

Project 2.5ii.2 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones – All JCU responsibilities	
Signing of contract	
Report 1 submission - Update on activities associated with objectives a-c and e (above) including status of field sampling programs and baseline report of knowledge current at the start of the research program. - Plan of communication products and events for year one and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Nov 2006
Report 2 submission - Progress report on the physiological controls on rainforest tree productivity and water use efficiency (obj b). - Progress report on characterisation of the soil structure and soil chemistry at the canopy crane site (obj c). - Progress report on the magnitude and causes of inter-and intra-annual variation in insect populations and how they relate to ecosystem productivity and climate variability (obj e). - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. - Plan for completion for all out year activities.	16 March 2007
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). - Evidence of the provision of first 5 years of data on the WEB for OZFLUX network end-users (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	8 June 2007

For 2006/2007 outputs only	Date
Milestones – All JCU responsibilities	
(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 the magnitude and causes of inter-and intra-annual variation in insect populations and how they relate to ecosystem productivity and climate variability (obj e). • Summary of communication activities undertaken through the course of year 1 of project, including any examples of application of the results by WTMA, DEW, EPA and FNQ NRM Ltd. • Plan of activities for out years.	
Total MTSRF Funding	\$118,000

Project 2.5ii.2 Budget

Year 1 – 2006/2007 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 (see Theme 5).

JCU Project 2.5ii.2 Budget 2006/2007

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, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash*	In-kind	Cash	In-kind	
2007/2008	120,000	200,000 ¹	76,000	109,000	-	505,000
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	360,000	600,000	228,000	327,000	-	1,515,000

* Matching funding is not clear in subsequent years.

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

² Funding requested from Australian Greenhouse Office.

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

Title	Organisation	Role	FTE
Dr David Hilbert	CSIRO	Ecological Modeller	
Dr Dan Metcalfe	CSIRO	Plant Ecologist	
Dr David Westcott	CSIRO	Vertebrate Ecologist	
Mr Matt Bradford	CSIRO		
Mr David Grice	CSIRO		
Ms Patina Pert	CSIRO		

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

Projects 2.5ii.3 and 2.5ii.4 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. 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 modeling work. Project 2.5ii.3 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.

Key Objectives:

- (a) Assessment of current and ongoing climate change impacts (Major priority identified at the workshop).
- (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 – claring, 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 year 2050) outlining likely changes to North Queensland ecosystems given a variety of scenarios for future warming, responses of biota and management interventions.

Project / Task Methodology

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

- Assessment of forest structure, biomass and species composition. Twenty-five 0.1 ha forest plots surveyed at regular elevation intervals and coinciding as much as possible with Stephen Williams' existing altitudinal surveys of vertebrates. All trees ≥ 10 cm 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 Project 2.5ii.3 and repeated surveys of the 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 sentinel chicken 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.
- 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 modeling of vector and disease distributions under many climate change scenarios using outputs from Project 2.5ii.3.

- Spatial identification of weed threats. Identification of weeds by altitude in plots established in Objective (a).
- Application of models and data developed in the Project 2.5ii4.
- 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.

Objective (e): Produce regional maps (project to year 2050) outlining key changes to North Queensland ecosystems given a variety of scenarios for future warming, responses of biota and management interventions.

- 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.
- 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.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Assessment of how forest structure, biomass and species composition change along altitudinal climate gradients.	June 2007*
(a)	Assessment of how forest dynamics change along altitudinal climate gradients.	January 2007
(a)	Assessment of how seed dispersal processes change along altitudinal climate gradients.	June 2007*
(a)	Assessment of the distribution of vectors of animal diseases and the diseases themselves along altitudinal climate gradients.	January 2007*
(a)	Assessment of the distribution of vectors of animal diseases (chickens) and the diseases themselves along altitudinal climate gradients.	June 2007*
(b), (c), (d)	An updated model of forest distributions based on climate, soils and topography: – Evaluate the capacity to upgrade an existing model of forest distributions to current hardware and operating environments and evaluate the availability of input data throughout the Wet Tropics Bioregion. – Modify the neural network model to meet the needs of the project.	September 2006 June 2007*
(e)	No activity in Year 1	

* Involves activities that carry into Out Years.

Project 2.5ii.3 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones – all CSIRO responsibilities	
Signing of contract	
Report 1 submission - Report of the evaluation of the capacity to upgrade an existing model of forest distributions to current hardware and operating environments and evaluate the availability of input data throughout the Wet Tropics Bioregion (obj b,c,d). - Progress update on activities associated with objective a. - Plan of communication activities/products for year one and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Nov 2006
Report 2 submission - Progress update on activities associated with objectives (a)-(d): preparation and implementation of field work, data collation for model inputs. - Preliminary results for changes in forest dynamics with climate change using existing 0.5ha long-term plots (obj a). - Design methodology for studies of diseases and vectors (obj a).	16 March 2007
Report 3 submission - Detail of the twelve forest plots established along altitudinal gradients with enumeration and measurement of trees ≥ 10cm diameter (obj a). - Preliminary identification of seed disperser functional types in forest plots (obj a). - Location of installed mosquito traps and progress of sentinel chicken surveys along altitudinal gradients (obj a). - Modification of the neural network model to meet the needs of the project (obj b,c,d) - Final summary of communication activities undertaken through the course of year 1 of project. - Plan for completion of out year activities.	8 June 2007
Total MTSRF Funding	\$147,000

Project 2.5ii.3 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	147,000	-	147,000
MTSRF Visual Documentation*	3,000	-	3,000
CSIRO	-	147,000	147,000
Total	150,000	147,000	297,000

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

CSIRO Project 2.5ii.3 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	115,700	18,500	134,200
Operating	20,000	16,846	36,846
Travel	10,000	-	10,000
Communication / Extension	1,300	-	1,300
Capital	-	-	-
Institutional overheads	-	111,654	111,654
Total	147,000	147,000	294,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	150,000	-	150,000	-	-	300,000
2008/2009	150,000	-	150,000	-	-	300,000
2009/2010	150,000	-	150,000	-	-	300,000
Total	450,000	-	450,000	-	-	900,000

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

Title	Organisation	Role	FTE
Associate Professor Stephen Williams	JCU	Project Leader, macroecology, biodiversity and climate change impacts	0.25
Professor Nigel Stork	JCU	Invertebrate biodiversity; extinction proneness;	0.1
Professor Chris Johnson	JCU	Macroecology; phylogenetic analysis; extinction proneness analysis	0.1
Spatial Analyst	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
Post-doctoral Researcher	JCU	Refugial ecology; thermal microhabitats; extinction proneness;	1.0
PhD Student	JCU	Net primary productivity and relationships across altitude with biodiversity	1.0
Research Assistant	JCU	Field work, data management, management of insect sampling across region, datalogger downloads and maintenance	1.0

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.

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 modeling 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 modeling 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 RAP 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. Links to monitoring design projects in Theme 1. Linking with Theme 1 project Status and Trends, Threatened Species and Communities, and Invasives, 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.

Objective (d)

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

Objective (e)

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

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 Outputs / Milestones

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).	June 2007*
(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. 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 RAP funded Spatial Analyst).	June 2007*
	Field work: – <i>Collection of faunal data using standardised survey techniques across altitudinal and latitudinal gradients in the region.</i>	June 2007*
	– <i>Identify and collect microclimate data in potential refugia (as above) to empirically measure buffering effect; using multi-channel data loggers to measure temperature, soil moisture and humidity.</i>	June 2007*
	– <i>Establish data loggers across altitudinal and latitudinal gradients in the region. These dataloggers will be downloaded at approximately monthly intervals. Additional temperature dataloggers will be placed at the same sites in a variety of microhabitats including under logs, under leaf litter, in tree hollows, in sunspots/clearings.</i> – <i>Employ leaf litter traps, dendrometer bands and vegetation structure proforma (including hemispherical photography) to estimate net primary productivity.</i>	
(g)	Field and lab determination of actual and potential temperature ranges of Wet Tropics microhylid frogs and arboreal mammals.	June 2007*

* Carries into Out Years.

Project 2.5ii.4 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones – All JCU responsibilities	
Signing of contract	
Report 1 submission • Progress update on activities associated with objectives a-f (above): details of survey sites established, field equipment installed and dataloggers. • Details of how database reconfigured and integrated with GIS • spatial layers of productivity for region produced and reported • Plan of communication activities/products for year one and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Nov 2006
Report 2 submission • Draft report of desk top analysis on the links between the ecological characteristics of species and their relative extinction proneness using collation of existing data and literature (obj a). • Progress and status report associated with objectives b-e (above) • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	16 March 2007
Information transfer between agencies • Evidence of the provision of Net Primary Productivity layers to Status and Trends Program 2 • Evidence of the provision of revised DEM coverage to Program 2	31 March 2007
Report 3 submission • Progress report and preliminary analysis on the links between extinction proneness and ecological characteristics of each species using collation of existing data and literature. • Progress update on spatial modeling of species distributions and biodiversity patterns (obj a). • Progress and status report on data collected as part of objectives b-e (above). • Summary of communication activities undertaken through the course of year 1 of project. • Plan for completion of out year activities.	8 June 2007
Total MTSRF Funding	\$14,700

Project 2.5ii.4 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	147,000	-	147,000
MTSRF Visual Documentation*	3,000	-	3,000
JCU – Centre for Tropical Biodiversity and Climate Change	-	445,000	445,000
JCU – Earthwatch	-	40,000	40,000
JCU – Queensland Government Smart State Funds	-	100,000	100,000
WTMA	-	20,000	20,000
Total	150,000	605,000	755,000

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

JCU Project 2.5ii.4 Budget 2006/2007

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	97,000	480,000	577,000
Operating	50 000	70,000	120,000
Travel	-	10,000	10,000
Communication / Extension	-	10,000	10,000
Capital	-	15,000	15,000
Institutional overheads	-	-	-
Total	147,000	585,000	732,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	150,000	285,000	140,000	140,000	20,000	735,000
2008/2009	150,000	285,000	140,000	140,000	20,000	735,000
2009/2010	150,000	285,000	140,000	140,000	20,000	735,000
Total	450,000	855,000	420,000	420,000	60,000	2,205,000

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	225,000	-	225,000
Other	-	316,980	316,980
Total	225,000	316,980	541,980

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. The Program will report on the condition and trend of the GBR and assess risks and threats associated invasive species.

This Program will report on the current and potential risks and mitigation of invasive marine species in the GBR. This will be a desk-top study based on published and grey literature. The program will also develop a set of protocols for translocation of genetic material within the GBR to minimise the risks of genetic contamination based on current understanding of the spatial structure of GBR populations.

Projects

2.6.1 Understanding threats and impacts of invasive pests
in the Great Barrier Reef \$25,000

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. (Year 1).

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 |
|-------|---|-----------|

PROGRAM 6: UNDERSTANDING THREATS AND IMPACTS OF INVASIVE PESTS ON ECOSYSTEMS

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

Project Leader and Host Organisation

Dr David Blair, James Cook University (JCU)

Project Team

Title	Organisation	Role	FTE
Dr David Blair	JCU	All tasks	0.2
Dr Michelle Waycott	JCU	All tasks	0.1
Dr Kirsten Heimann	JCU	All tasks	0.15
Dr Phil Schneider	JCU	Objective b	0.05
2 x PhD students*	JCU	Objectives b and d	2.0

* One PhD dependent on co-investment.

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

Under this project the first task (Objective a) will support detection, eradication, monitoring and management of key pests in at-risk habitats for the GBR region and adjacent coastal habitats. The first step in dealing with risks posed by invasive species is to understand what species are actually (and potentially) present. Once alerted to the presence of these species, end users can institute measures for surveillance and control. The second component (Objective b) will assess the presence of toxic microalgae in the GBR, the potential threats posed by these and management responses.

Key Objectives:

- (a) Prepare status reports on marine invasive species in the GBR.
- (b) Monitoring techniques and risk assessment for invasive toxic microalgae (PhD Project).

Project / Task Methodology

Objective (a): Invasives – Status reports

This project is proposed to commence in Year 2. It includes two desk-top studies. The first, based on both primary and “grey” literature, will be on risks posed by potential invasive species and delivered in Year 3. This report will also consider risk-mitigation measures available and ways in which these can be trialed and integrated into management regimes.

The second report (delivered in Year 4) will assess what is known about “genetic provinces” in the GBR and more generally along the eastern Australian seaboard and use this information in development of protocols for moving plants and animals between genetic provinces.

Objective (b): Toxic microalgae (PhD Project)

This project is proposed to commence in January 2007. 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 nothing has been done beyond basic identification. The proposed project will build on this baseline knowledge of species present and link with the expertise of the Queensland-based Consortium of Expertise in Tropical Marine Pest Assessment and Management. Given the timing constraints of a PhD project, this objective will need to proceed partly independently from objective a, Project 2.6.1. Consequently, the first phase of this project will involve a risk-assessment of toxic species of concern to the GBR and incorporate the previous pest survey work. Thereafter, target species will be cultured and subjected to biological (including toxicological) characterisation.

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 Outputs / Milestones

Objective	Targeted Activity ¹	Completion Date
(a)	No activity Year 1	
(b)	Annual report on progress of PhD project	June 2007 – June 2010
(b)	National and International conference presentations on aspects of each task	Timing and frequency will depend on what conferences occur during the life of the project

¹ The only MTSRF supported work in Year 1 will be that done under a PhD studentship commencing in January 2007.

Project 2.6.1 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones – all JCU responsibilities	
Signing of contract	
Report 1 submission - Development of research schedule: Schedule of activities for completion of study including proposed experiment schedule. - Draft literature review - Plan of communication outputs and products for year one and summary of any communication activities undertaken to date	1 May 2007
Report 2 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. - Updated research plan - Final summary of communication activities (e.g. any presentations/seminars given to School) undertaken through the course of Year 1 of project. - Plan for completion of out year activities.	10 Jun 2007
Total MTSRF Funding	\$25,000

Project 2.6.1 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	25,000	-	25,000
JCU	-	106,000	106,000
Total	25,000	106,000	131,000

JCU Project 2.6.1 Budget 2006/2007

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries / Stipends	12,500	56,000	68,500
Operating	12,500	-	12,500
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	50,000	50,000
Total	25,000	106,000	131,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF*	Applicant		Other sources		Total
		Cash	In-kind	Cash*	In-kind	
2007/2008	120,000	2,000	105,000	45,000	-	272,000
2008/2009	120,000	2,000	109,000	45,000	-	276,000
2009/2010	100,000	-	113,000	20,000	-	233,000
Total	340,000	4,000	327,000	110,000	-	781,000

* Co-investment not yet secured.

PROGRAM 6: UNDERSTANDING THREATS AND IMPACTS OF INVASIVE PESTS ON ECOSYSTEMS**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

Title	Organisation	Role	FTE
David Westcott	CSIRO	Tropical Vertebrate Ecologist	0.21
Dan Metcalfe	CSIRO	Tropical Plant Ecologist	0.10
Denise Hardesty	CSIRO	Plant and Invasion Geneticist	1.00
Iain Gordon	CSIRO	Vertebrate Ecologist	0.02
Cameron Fletcher	CSIRO	Ecological Modeller	0.20
Helen Murphy	Weeds CRC / CSIRO	Invasion Biologist	0.25
Tony Grice	Weeds CRC / CSIRO	Weeds Scientist	0.05
Paul de Barro	CSIRO / Biosecurity CRC	Invasion Biologist	0.05
Michelle Waycott	JCU	Population Geneticist	0.10
Damien Burrows	ACTFR	Fish Ecologist	0.20
Allen Webb	ACTFR	Fish Ecologist	0.25
John Russell	QDPI&F	Fish Ecologist	0.10
Kylie Galloway	QDNR&M	Weed Eradication Manager	0.10
Simon Brooks	QDNR&M	Weeds Scientist	0.10
Rowena Grace	FNQ NRM Ltd	Terrestrial Biodiversity Program Manager	0.05
Frederieke Kroon	FNQ NRM Ltd	Aquatic Biodiversity Program Manager	0.10
Kirby Doak‡	FNQ ROC	Liason with Local Govt	0.02
Steve Goosem‡	WTMA	Biodiversity Planning and Policy	0.02

‡ To be confirmed.

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 as species moved beyond their natural range and may include exotic, translocated, and pest species. The term “rainforest landscapes” is used to include terrestrial and aquatic systems and human-dominated parts of the landscape (agricultural and urban areas) as well as rainforest ecosystems.

Key Objectives:

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

Project / Task Methodology

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

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

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

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

All biological invasions, irrespective of whether they are invasions by exotic plants, animals, diseases or translocated native species, are the expression of a single process – the movement of individuals through the landscape. Understanding how invasives move through landscapes enables prediction of patterns and rates of invasion and the opportunity to target management investment at times or in places where it will be most effective. This sub-project will i) develop a process-based framework for predicting the pattern and rate of invasive spread and will use this model to ii) produce and test modelling tools that will enable prediction of invasions in real landscapes and the assessment of alternative management

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

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

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

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

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

New or imminent incursions require immediate management action without the luxury of data collection in the field. First responses to incursions are crucial yet are most effective if based on some knowledge of the invading species, in particular knowing how fast and how far an invasive can spread is fundamental to first response as it can set search areas and locations of risk. We will use existing data on ecological (e.g. introduction history, distribution, abundance, taxonomy, population parameters, reproduction, environmental tolerances, habitat preferences, movement, feeding habits), dispersal traits and a statement of current or potential impact of native and exotic species to develop a risk assessment of current and potential invasives. Functional classifications of traits that influence the invasive spread potential of pre-emergent or new invasives and allow for data-based predictions of likely dispersal characteristics to be developed will be done for vertebrate-dispersed plants and fish. The resulting classifications will allow managers to assign pre-emergent or new species to risk categories based on the spread characteristics of similar species already in Australia and to develop management response strategies based on these classifications. This analysis will also identify gaps in knowledge of invasives, and will be used to guide research in Years 2-4 (Year 1).

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, FNQ NRM Ltd, 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 Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Workshop leading to the formation of a collaborative team of end users and researchers to review invasives issues in the region	Nov 2006
(a)	Report on outcomes and recommendations of a Workshop and review consisting of: identification of priority invasives issues that builds on previous priority lists, current experience and forecasts; the extent to which systems are in place to meet invasive threats; a review of current weeds research and action in the region; and a set of recommendations for further MTSRF investment.	April 2007
(b)	Establishment of modelling team, identification of modelling framework	Aug 2006

Objective	Targeted Activity	Completion Date
(b)	Develop prototype model, parameterization for isotropic weed dispersal for application with end-users to species of concern.	Jun 2007
(b)	Description of data needs for modelling of landscape structure effects on the pattern and rate of spread, summary of existing data, identification of movement data gaps and/or of invasives of concern for which appropriate movement data doesn't exist	Jun 2007
(b)	Data summary and gap identification for development of frameworks for predicting invasive risk of vertebrate dispersed weeds and of exotic fish	Dec 2006
(b)	Literature surveys completed and field work to fill data gaps in progress to fill data gaps for frameworks.	Mar 2007
(b)	Framework finalization, completion of web-based material to allow use by end-users	Jun 2007
(c)	Fieldwork on distributions and impacts commenced	Jun 2007
(d)	Identification of impact, distribution and control methods for invasive fish	Jun 2007

Project 2.6.2 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones [responsible agency listed in square brackets]	
Signing of contract	
Report 1 submission - Minutes of invasive fish workshop to develop collaboration between end users and researchers including outcomes for scoping study (obj a). Attendees to include end users (e.g. WTMA). [JCU] - Provision of established modelling team contacts (obj b). [CSIRO] - Modelling framework (obj b). [CSIRO] - Schedule of activities for completion of study against all objectives (listed above) including proposed field and desktop review work. [CSIRO] - Plan of communication products/outputs/events for year one and summary of any activity undertaken to date [CSIRO, JCU, QDPIF] - Information transfer between agencies: - Tilapia presence/absence data to ACTFR [FNQ NRM Ltd]	20 Oct 2006
Report 2 submission - Minutes of combined Invasives, TS&C, and Status and Trends workshop. Attendees to include end users (e.g. WTMA) [CSIRO] - Progress report on tools for predicting invasive risk of exotic fish and vertebrate dispersed weeds in far north Queensland including summary of data collated and gaps in knowledge (obj b). - vertebrate dispersed weeds – [CSIRO]; - exotic fish [JCU and QDPI&F] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [CSIRO, JCU, DPIF]	10 Dec 2006
Report 3 submission Report on outcomes of workshops (obj a). [CSIRO, JCU, DPIF]	10 April 2007

For 2006/2007 outputs only	Date
Milestones [responsible agency listed in square brackets]	
Report 4 submission • Provision of prototype model: parameterization for isotropic weed dispersal for application with end-users to species of concern (obj b). [CSIRO] • Description of effects of landscape structure on the pattern and rate of spread of invasive spread summarised and identification of data gaps and/or of invasives of concern for which appropriate movement data doesn't exist in preparation for further model development (obj b). [CSIRO] • Final report: tools to predicting invasive risk of exotic fish [JCU] and vertebrate dispersed weeds [CSIRO] in far north Queensland. • Delivery of web-based material to allow use by end-users (obj b) of tools to predict invasion risk. [JCU and CSIRO] • Report identifying impact, distribution and control methods for invasive fish in far north Queensland (obj d). [JCU] • Plan for completion of out year activities. [CSIRO and JCU] • Final summary of communication activities undertaken through the course of Year 1 of project. [CSIRO, JCU, DPIF]	8 Jun 2007
Total MTSRF Funding	\$196,500

Project 2.6.2 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	196,500	-	196,500
MTSRF Visual Documentation*	3,500	-	3,500
CSIRO	-	141,980	141,980
JCU	-	55,000	55,000
QDPI&F	-	3,000	3,000
FNQ NRM Ltd	-	11,000	11,000
Total	200,000	210,980	410,980

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

CSIRO Project 2.6.2 Budget 2006/2007

Item	MTSRF Funds	CSIRO In-kind	Total Cost
Salaries	71,568	-	71,568
Operating	47,248	82,435	129,683
Travel	6,664	-	6,664
Communication / Extension	16,500*	-	16,500
Capital	-	-	-
Institutional overheads	-	59,545	59,545
Total	141,980	141,980	283,960

* Shown here as a separate value but includes amounts that, because of the structure of the project and the direct involvement of stakeholders, are in reality incorporated into salary, travel and operating expenses associated with workshops.

JCU Project 2.6.2 Budget 2006/2007

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	39,000	45,000	84,000
Operating	2,500	8,000	10,500
Travel	8,020	-	8,020
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	2,000	2,000
Total	49,520	55,000	104,520

QDPI&F Project 2.6.2 Budget 2006/2007

Item	MTSRF Funds	QDPI&F In-kind	Total Cost
Salaries	-	-	-
Operating	1,000	-	1,000
Travel	1,500	-	1,500
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	3,000	3,000
Total	2,500	3,000	5,500

FNQ NRM Ltd Project 2.6.2 Budget 2006/2007

Item	MTSRF Funds	QDPI&F In-kind	Total Cost
Salaries	-	8,000	8,000
Operating	1,000	-	1,000
Travel	1,500	-	1,500
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	3,000	3,000
Total	2,500	11,000	13,500

Indicative Budget Summary – Years 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	200,000	90,000	93,000	37,000	127,000	547,000
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	600,000	182,000	300,000	111,000	361,000	1,554,000

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.

Budget Summary

Program	Title	MTSRF	Other Cash	In-kind
Program 7	Water Quality	1,175,000	-	2,114,000
Total		1,175,000	-	2,114,000

The total value of Theme 3 is \$3,289,000.

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	-	2,114,000	2,144,000
Total	1,175,000	2,114,000	3,289,000

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 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 simplified Report Card 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 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.

The outcomes of the Program will be of relevance to: (1) the Report Card, Condition and Trends , Risks and Threats to Critical Habitats Projects in the GBR Status and Trends Program; (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 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	\$75,000
3.7.6	Delivery of social and economic indicators of water quality	\$75,000
3.7.7	Conceptual and statistical framework for the water quality component of the Integrated Report Card	\$100,000

PROGRAM 7: HALTING AND REVERSING THE DELINE OF WATER QUALITY

Project 3.7.1: Marine and estuarine indicators and thresholds of concern

Project Leader and Host Organisation

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

Project Team

Title	Organisation	Role	FTE
Katharina Fabricius	AIMS	Program leader, Researcher, reef ecology	0.2
Sven Uthicke	AIMS	Researcher, biofilms	1.0
Craig Humphrey	AIMS	Researcher, biomarkers and ecology, support	0.8
Andrew Negri	AIMS	Researcher, biomarkers, ecotoxicology	0.1
Tim Cooper	AIMS, JCU	Researcher, coral ecology	0.25
PhD student	AIMS	Biofilms	1.0
Marcus Sheaves	JCU	Researcher, estuaries	0.1
Rod Connolly	GU	Researcher, estuaries	0.1
Len McKenzie	QDPI&F	Researcher, seagrasses	0.1
Andrew Moss	EPA	Advisor, researcher	0.1

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project will capitalise on, and take to completion, previous research efforts on the identification of indicators suitable as monitoring tools, conducted under the "Catchment-to-Reef CRC". After review and prioritisation of the hundreds of potential indicators tested during the 'Catchment-to-Reef CRC', we will determine dose-response relationships and thresholds of potential concern for pollutant exposure of selected bioindicators. We will also provide a better understanding of the significance of such thresholds for GBR water quality and ecosystem condition, as well as contribute to the scientific underpinning of a Report Card system. Advanced statistical data synthesis will integrate previously collected large-scale data sets, towards developing a composite indicator system, to interpret water quality monitoring data and their link to ecosystem condition, and to improve estimates of river pollutant loads from discharge concentrations. This synthesis and integration activity will be managed through Theme 5. Additional work complementary to this project could be conducted if co-investment was sourced.

Key Objectives:

- (a) Develop biofilm indicators for improved monitoring of water quality.
- (b) Develop indicators for reef ecosystem condition.
- (c) Develop indicators for seagrass condition in response to changing water quality.
- (d) Develop estuarine indicators for ecosystem condition.
- (e)* Establish a synthesis and integration program for the water quality of North Queensland tropical marine systems.

Project / Task Methodology

Objective (a): Develop biofilm indicators for improved monitoring of water quality

The first year will be used to complete research commenced under the Catchment-to-Reef CRC, determining organism groups in biofilms that consistently change along water quality gradients (bacterial biofilms on sediments, microphytobenthos layers on sediments, and foraminifera on reef substrata). Responses tested to date included responses in genetics, photophysiology and species composition, and multivariate techniques will be used to determine the best indicators. A synthesis of the responses of the hundreds of species in each of the 3 groups investigated, and of selected priority indicators will be published. The following two years will be used for in-depth investigations of priority organism groups and measures that best indicate changes along water quality gradients. This will include determining dose-response relationships of the most promising biofilm properties to the varying pollutants under controlled conditions in the AIMS controlled environment aquarium facility and under field conditions. This will ultimately lead to the identification of thresholds of potential concern for pollutant exposure for individual organism groups and biofilm communities. The data on foraminifera are of priority, 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. The data on benthic diatoms are also of 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. Indeed, our latest data have shown clear changes in diatom communities along nutrient/light gradients, and have identified potential indicator taxa for changing water quality. In the fourth year we will develop protocols for the integration of biofilms into monitoring programs, and field test these protocols. We will also use Year 4 to test foram-based indicators in sediment cores aiming at hindcasting historic changes in water quality, as foraminifera are assumed to be well-preserved in sediment cores.

Objective (b): Coral indicators for ecosystem condition

The first year will be used to complete the Catchment-to-Reef Task, identifying those measures in corals and reef communities that consistently change along 2 independent water quality gradients (Whitsundays and Wet Tropics). We tested changes in the expression of 13,000 genes in one coral, 6 physiological and visible measures in each of 3 coral species, 5 life history and population measures in one coral species, and changes in abundances of hundreds of reef dwelling species including corals. Response times ranged from rapid (gene expression and physiology), to slower (populations responses expressed after weeks to months of exposure), and to slow (community responses expressed after years of exposure). From these, the most reliable indicators will be identified, and a synthesis of the responses of all measures tested will be published. In Year 2-4, we will determine concentration-response relationships of key species (e.g., the corals *Acropora millepora*,

* This component will be funded and managed under Theme 5 Enhancing Delivery.

Pocillopora damicornis, and massive Porites), using the AIMS controlled environment aquarium facility that was built for the Catchment-to-Reef CRC. We will further test responses of these corals and their larvae to trace concentrations of agrochemicals and Trichodesmium. We will derive thresholds of potential concern for exposure to major pollutants (sediments, nutrients, turbidity and pesticides/herbicides) for these species. In years 2 – 4 we will also investigate the responses of key macroalgal species (macroalgae were not included in the Catchment-to-Reef study but also deserve high priority due to their immense importance in inshore coral reefs, especially encrusting coralline algae and bloom-forming species). The project will closely collaborate with the Reef Plan Marine Monitoring Program to maximise the use of the inshore monitoring data. We will develop protocols for optimizing inshore monitoring programs, identify thresholds, and develop and field test monitoring protocols. We will 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 (c): Indicators for seagrass condition in response to changing water quality

The first year will be used to conduct an analysis of existing Seagrass-Watch and Reef Plan MMP data, to test which seagrass community properties (eg, species composition, epiphyte loads) will change in response to changing sediment and water quality. In years 2 – 4, experiments will be conducted in the AIMS controlled environment aquarium facility to follow up on the field observations; seagrasses will be grown in different types of sediments (e.g. carbonate vs terrigenous), with contrasting levels of dissolved inorganic porewater nutrients, temperature and suspended sediments, to assess physiological changes in seagrasses to changing sediment and water quality. These data will support the development of thresholds of exposure, potentially further improved protocols for the community-based Seagrass Watch program, and the scientific underpinning for a report card system. 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 water quality related estuarine health specific to 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.

The first year will be used to complete the assessment of stress markers in barramundi: We will complete the quantification of 10 major stress markers in barramundi in four rivers with contrasting levels of pollutant loads (the Herbert and Johnstone Rivers, which drain agricultural catchments and the remote and presumably pristine Lockhard and Pascoe Rivers). We will also investigate the suitability of those stress markers that are consistently expressed at contrasting pollutant levels as indicators for physiologically relevant water quality impacts. In parallel, a four-year study will be commenced to develop a bioindicator system for estuarine water quality condition. Initially, a detailed literature review will be used to identify the current state of knowledge and determine specific potentially useful indicators of estuarine health, including topics such as the utility of community attributes (eg. food chain integrity), and invertebrate indicators. The latter have a poor track record in estuaries elsewhere in Australia but we will include measures currently under development in local tropical estuaries, such as relative changes in nematode versus polychaete assemblages. A suite of potentially useful indicators will then be trialled by comparing estuaries identified in the OzEstuaries data base as "near pristine" (e.g. Zoe Bay, Saltwater Ck.), "modified" (e.g.

Ross and Herbert Rivers) and “extensively modified” (Auckland Inlet is the only estuary in this classification close to the tropics). Final selection will depend on logistics, and can be modified to some extent to suit stakeholders.

Objective (e): Synthesis, integration and enhanced delivery

This component will be managed and funded from Theme 5 to provide a combination of high-level numerical and ecological synthesis of large-scale data using statistical experts and ecologists to maximise the value derived from existing and newly collected data. Depending on the amount of co-investment available we would deliver on the issues listed here, and to other topics as priorities emerge.

- High-level statistical support would be given to link the Seagrass Watch data to sediment quality and water quality data from the sampling sites, to determine how intertidal seagrasses change along water quality gradients.
- Assessment of changes in reef biodiversity in response to water quality conditions at GBR-wide scale, by linking large-scale reef benthic survey data and water quality data; this would be done with special consideration of the new zoning plan.
- High-level statistical support to develop composite coral and biofilm indicator measures, by identification and prioritization from the hundreds of indicators tested during the Catchment-to-Reef CRC, for inclusion into future monitoring programs and the Report Card.
- Expansion and completion of models on how crown-of-thorns starfish are linked to lagoonal water quality and to the long-term chlorophyll monitoring data.
- Synthesis activities that span across the Water Quality Programs, and
- Numerical models and syntheses that link water quality research to research conducted in the other Themes.

Members of all Marine Water Quality Tasks will further contribute to this ‘Synthesis, integration and enhanced delivery’ task. Regular information updates are planned for community groups such as those conducting Seagrass Watch, Reef Plan Marine Monitoring Program, and Reef Check.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Field testing and analysis of marine biofilms (bacteria, diatoms, foraminifera) for their suitability to indicate changes in water quality. [AIMS]	June 2007
(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 2007
(c)	Report on relationships between seagrass communities and sediment properties along the Queensland coast. [QDPI]	June 2007
(d)	Analysis of stress markers in estuarine barramundi in response to contrasting water quality in four estuaries. [AIMS]	Dec 2006
(b)	Contribute to GBR workshop held on reef health indicators and thresholds of concern with program 1.1.2 [AIMS]	Dec 2006
(b)	Contribute to integration workshop to define end-user needs for reporting on issues related to freshwater water quality and ecosystem health. [AIMS]	

Objective	Targeted Activity	Completion Date
(d)	Literature review on potentially useful ecological indicators of the condition of North Queensland's estuaries [JCU, GU]	June 2007
(b)	Conceptual framework for reef ecosystem condition in relation to changing river discharges. [AIMS]	June 2007

Project 3.7.1 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission • Progress update for objectives (a), (b), (d) (above). [AIMS] • Progress update for objective (c) (above). [QDPI] • Progress update on the literature review on potentially useful ecological indicators of the condition of North Queensland's estuaries. [JCU, GU] • Progress update on development of the conceptual framework. [AIMS] • Collation of Catchment to Reef products related to the activities listed in objectives a-d available for uploading to website. [AIMS] • Plan of communication outputs and products for year one and summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable. [AIMS]	15 Jan 2007
Report 2 submission • Progress update for activities listed against objectives (a), (b), (d) (above). [AIMS] • Progress update for activities listed against objective (c) (above). [QDPI] • Final report on use of stress markers in barramundi as indicators of water quality (obj d). [AIMS] • Progress update on literature review on potentially useful ecological indicators of the condition of North Queensland's estuaries [JCU, GU]. • Summary of any liaison activities undertaken to date. [AIMS]	16 Mar 2007
Report 3 submission • Final report on use of marine biofilms as indicators for changes in water quality. [AIMS] • Final report on the use of physiological measures in coral reef organisms as indicators of water quality and ecosystem condition (objective b). [AIMS] • Final report on relationships between seagrass communities and sediment properties along the Queensland coast. [QDPI] • Final report detailing the conceptual framework for reef ecosystem condition in relation to changing river discharges. [AIMS] • Final report on literature review on potentially useful ecological indicators of the condition of North Queensland's estuaries [JCU, GU]. • Final summary of liaison activities undertaken through course of year 1 of project. [AIMS]	8 June 2007
Develop data exchange agreements between organisations as basis for integrated report card development. [AIMS, JCU, QDPI and GU]	Mar 2007
Total MTSRF Funding	\$298,000

Project 3.7.1 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	298,000	-	298,000
MTSRF Visual Documentation*	2,000	-	2,000
AIMS	-	627,500	627,500
JCU	-	30,000	30,000
GU	-	30,000	30,000
Total	300,000	687,500	987,500

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

AIMS Project 3.7.1 Budget 2006/2007

Item	MTSRF	AIMS In-kind	Total Cost
Salaries	173,000	287,000	460,000
Operating*	75,000	23,000	98,000
Travel (Research Vessel)	-	122,000	122,000
Communication / Extension	-	30,000	30,000
Capital	-	-	-
Institutional overheads	-	165,500	165,500
Total	248,000	627,500	875,500

* Includes \$20,000 for PhD student.

QDPI&F Project 3.7.1 Budget 2006/2007

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

JCU Project 3.7.1 Budget 2006/2007

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 2006/2007

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, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	400,000	122,000 ^{#1}	555,500	440,000 ^{#2}	623,000 ^{#3}	2,140,500
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	1,160,000	366,000	1,666,500	1,320,000	1,869,000	6,381,500

#1 Twenty days' ship time.

#2 Other end-user co-investment.

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

PROGRAM 7: HALTING AND REVERSING THE DELINE OF WATER QUALITY

Project 3.7.2: Connectivity and risk: tracing materials from the upper catchment to the reef

Project Leader and Host Organisation

Dr Jon Brodie, James Cook University (JCU)

Project Team

Title	Organisation	Role	FTE
Katharina Fabricius	AIMS	Researcher, reef ecology	0.05
Eric Wolanski	AIMS	Researcher, biofilms	0.15
Tim Cooper	AIMS	Researcher, support	0.25
Jon Brodie	JCU	Project leader, researcher	0.15
Stephen Lewis	JCU	Researcher, biogeochemistry	0.6
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

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This 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 Townsville-Cairns region to the marine environment using coral and sediment cores. This will involve determining transport mechanism, residence time and fate of terrigenous sediments in the inshore as well as mid-reef regions of the Great Barrier Reef, and develop and apply new technologies to specifically trace pathways of the key nutrient elements P & N from the terrestrial catchments, through estuaries, inshore coastal zones to the mid-reef of the Great Barrier Reef.

Key Objectives:

- (a) Sediment tracing in the terrestrial environment.
- (b) Sediment tracing in the marine environment.
- (c) Inshore-offshore sediment transport in the Wet Tropics.
- (d) Floodplain sedimentation dynamics in Dry Tropics catchments.

Project / Task Methodology

Objective (a): Sediment tracing 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 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 Sr–Nd and Pb isotopic composition of the sediments will be measured at the RSES laboratories. The $^{87}\text{Sr}/^{86}\text{Sr}$ isotopic ratio of sediments is mainly controlled by age while the $^{143}\text{Nd}/^{144}\text{Nd}$ and $^{207}\text{Pb}/^{206}\text{Pb}$ and $^{208}\text{Pb}/^{206}\text{Pb}$ 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 isotopes 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, and at the Research School of Earth Sciences (RSES), ANU. Particular elements (e.g. Ti, Zr, Ca, K) and elemental ratios (Rb/Sr, Zr/Hf, Y/Ho, Th/Tl, Th/W) provide a useful complementary tool to trace sediment through a large river system.

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

Objective (b): Sediment tracing 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.

- Develop and apply new cutting-edge technologies to specifically trace the pathways of the key nutrient elements P & N from the terrestrial catchments, through estuaries, inshore coastal zones to the mid-reef of the Great Barrier Reef.

It is planned to undertake a comprehensive sampling of Porites corals in the Townsville-Cairns region in 2006 and again in 2010 to provide quantitative constraints on the effectiveness of the Reef Water Quality Protection Plan. These will complement the AIMS collection made in the mid – 1980's with the new cores covering the last 20 -50 years of river discharge. Coral cores will be analysed using the state-of the-art laser ablation analyses only possible at ANU, in conjunction with the study at AIMS of the distinctive luminescent lines that are a result of low salinities from flood plumes. In addition to the already well described Ba method (McCulloch et al., 2003) measurements of $^{143}\text{Nd}/^{144}\text{Nd}$ and ^{15}N isotopes in coral cores and luminescent lines will be undertaken at ANU to provide a novel technique to examine changes in sediment and nutrient sources from the major rivers. 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 ^{210}Pb ages, but more refined ages may be obtained using OSL dating and distinctive time transgressive terrestrial markers (eg 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. 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 Task 1 and linked to a sediment source within the river catchments. In addition, routine collection (weekly) of water samples will be undertaken from both the AIMS and Orpheus Island Research station in order to obtain a long-term ‘baseline’ record of water quality and trace element composition of the inner Great Barrier Reef waters covering both wet as well as dry seasons. Water samples will be also taken within the flood plume to measure the isotopic, trace element and nutrient compositions of the dissolved components of the flood plume along a salinity transect. This analysis will investigate sediment desorption within the estuarine and flood plume mixing zone.

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

This task will determine the existence of a nepheloid layer able to transport fine particulate matter (containing nutrients) from inshore to offshore in the Wet Tropics section of the GBR lagoon. Sediment transport mechanisms within the reef will be studied using arrays of nephelometers, sediment traps and current meters off the Tully and Johnstone rivers including Dunk and High Islands, and extending arrays out longshore and into the midshelf. These will be deployed for one month each in the wet and dry season over two years. The existence of a nepheloid layer to assist offshore transport of nutrients associated with the fine particles, longshore transport in relation to wind-waves and currents, facilitation resuspension and deposition events etc will be assessed. This work will be integrated with work on coral cores from the same region as well as the isotope tracing of the sediment sources.

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

The key tasks for this objective are:

- Identify catchment choke points in the FRC 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.

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 adjacent 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 three components: (a) Field data collection (b) Model conceptualisation and parameterisation and (c) Model validation. 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 landuse practices in areas immediately adjacent to the choke points in order to investigate if these activities have contributed to increased delivery 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 off-shore delivery rates will be evaluated using current monitoring and evaluation strategies.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Collection of sediments 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 for analysis of the Sr–Nd and Pb isotopic composition of the sediments.	February 2007
(a)	Collection of suspended sediments from the tributaries of the Burdekin River catchment.	April 2007*
(b)	Collection of coral core samples of Porites corals in the Townsville-Cairns region in 2006.	April 2007*

Objective	Targeted Activity	Completion Date
(b)	Collection of water samples for sediment/nutrient analysis in river flood plumes from Burdekin, Fitzroy and Tully Rivers as a first priority and the Johnstone and Russell-Mulgrave Rivers as a second priority if the river produces a significant plume.	May 2007*
(b)	Collection of weekly water samples from AIMS and Orpheus Island Research Station for baseline water quality and trace element composition.	August 2006 to June 2007*
(c)	Study sediment transport mechanisms within the Wet Tropics inshore area using arrays of nephelometers, sediment traps and current meters off the Tully and Johnstone rivers including Dunk and High Islands.	January to February 2006*
(d)	Refine existing GIS framework for identifying catchment choke points and apply this to the Fitzroy River catchment.	December 2006
(d)	Commence a structured drilling program of selected choke points in the Fitzroy River catchment by obtaining 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.	June 2007*
	Contribute to integration workshop to define end-user needs for reporting on issues related to freshwater water quality and ecosystem health.	Dec 2006

* Includes activities that will carry into Out Years.

Project 3.7.2 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission - Progress update and submission of a work schedule for activities listed against objectives (a)-(d) (above), including progress of field work (site preparation and deployment and installation of field equipment). [JCU] - Report of outcome of integration workshop to define end user needs for sediment indicators and thresholds of concern. [JCU] - 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 one and summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable [JCU]	1 December 2006
Report 2 submission - Report on the collection of coral core samples of Porites corals in the Townsville-Cairns region in 2006 (obj b). [ANU] - Status of wet season sampling for water quality and sediment analysis (obj b) [JCU]	30 April 2007

For 2006/2007 outputs only	Date
Milestones	
Report 3 submission • Progress report for all activities listed against objectives a-d (above), including: • Presentation of available results of 2006/2007 wet season water quality and sediment sampling (obj b). [JCU] • Results from the collection of coral core samples of Porites corals in the Townsville-Cairns region in 2006. [ANU] • Results from the structured drilling program in the Fitzroy River to identify catchment choke points (obj d). [ADFA] • Progress update on the characterisation of sediments within the Burdekin River, Tully and the Fitzroy (obj a). [JCU] • Report on the deployment of oceanographic instruments in inshore locations off the Tully and Johnstone Rivers for one month in the wet seasons. [AIMS] • Final summary of liaison activities undertaken through course of year 1 of project. [JCU]	8 June 2007
Total MTSRF Funding	\$273,500

Project 3.7.2 Budget

Year 1 – 2006/2007 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	-	176,500	176,500
ANU	-	80,000	80,000
CSIRO	-	70,000	70,000
UNSW@ADFA	-	60,000	60,000
Total	275,000	586,500	861,500

* A total of \$1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

AIMS Project 3.7.2 Budget 2006/2007

Item	MTSRF	AIMS In-kind	Total Cost
Salaries	45,000	74,000	119,000
Operating	10,000	18,000	28,000
Travel	6,000	15,500	21,500
Communication / Extension		6,000	6,000
Capital			
Institutional overheads		63,000	63,000
Total	61,000	176,500	237,500

JCU Project 3.7.2 Budget 2006/2007

Item	MTSRF	JCU In-kind	Total Cost
Salaries	70,000	83,500	153,500
Operating	48,500	20,500	69,000
Travel	2,000	17,500	19,500
Communication / Extension	-	7,000	7,000
Capital	-	-	-
Institutional overheads	-	71,500	71,500
Total	120,500	200,000	320,500

ANU Project 3.7.2 Budget 2006/2007

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

UNSW@ADFA Project 3.7.2 Budget 2006/2007

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

CSIRO Project 3.7.2 Budget 2006/2007

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	25,000	30,000	55,000
Operating	-	7,000	7,000
Travel	-	6,000	6,000
Communication / Extension	-	2,000	2,000
Capital	-	-	-
Institutional overheads	-	25,000	25,000
Total	25,000	70,000	95,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	285,000	31,500	555,000	-	800,000*	1,671,500
2008/2009	270,000	-	555,000	-	600,000*	1,425,000
2009/2010	270,000	-	555,000	-	400,000*	1,225,000
Total	825,000	31,500	1,665,000		1,800,000	4,321,500

* Regional catchment event monitoring.

PROGRAM 7: HALTING AND REVERSING THE DELINE 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

Title	Organisation	Role	FTE
Richard Pearson	JCU	Joint project leader; aquatic ecologist	0.35
Niall Connolly	JCU	Invertebrate ecologist and link to Report Card Framework	0.75
Jon Brodie	JCU	Water quality input and link to Project 3.7.2	0.10
Barry Butler	JCU	Water quality input and link to other JCU projects	0.10
Damien Burrows	JCU	Link to wetlands research program and other JCU projects	0.05
Angela Arthington	GU	Joint project leader; aquatic ecologist	0.30
Stuart Bunn	GU	Aquatic ecologist; link to other related research programs	0.05
Brad Pusey	GU	Fish ecologist	0.10
Mark Kennard	GU	Fish ecologist	0.20
Steve Mackay	GU	Aquatic plant ecologist	0.60
Jim Wallace	CSIRO	Hydrologist, link to Project 3.7.4	0.10
Lachlan Stewart	CSIRO	Hydrological modeler, link to Project 3.7.4	0.05
Frederieke Kroon	CSIRO	Aquatic ecologist, link to other CSIRO projects	0.10

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

This project will develop conceptual biophysical models based on our previous work to identify (i) appropriate indicators of waterway health and (ii) probable thresholds of concern, in terms of contaminant concentrations, ecological processes and biodiversity. We will test those indicators in waterways in the wet and the dry tropics, so that they can be implemented in fully functional monitoring systems as part of the Integrated Report Card (Project 3.7.7). We will build on the Catchment to Reef program, which has concentrated on sampling protocols and design, 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 government agencies,

industry, community groups and land owners), and will feed the essential scientific methodology into the Integrated Report Card (Project 3.7.7).

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.

Key Objectives:

- (a) Conduct field, laboratory and desk-top research to develop physical, chemical and ecological indicators of freshwater ecosystem health in the Wet and Dry Tropics as part of an Integrated Water Quality Report Card that meets end-user needs and objectives.
- (b) Identify thresholds of potential concern relating to land use, water quality, riparian condition, habitat 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 PhD 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 outlined below on mature and new biophysical indicators will progress in stages that will link to the steps of the Integrated Water Quality Report Card framework.

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 an Integrated Water Quality Report Card that meets end-user needs and objectives.

We will work with Project 3.7.7 (Integrated Report Card) to define end-user needs for water quality and freshwater ecosystem health monitoring using biophysical indicators and protocols. We will undertake a review of knowledge of spatial/temporal scales of indicator response to disturbance along the whole river continuum, and identify possible spatial and temporal thresholds of potential concern in Wet Tropics rivers (e.g. Russell-Mulgrave, Tully), using published results and results from our CRC Catchment to Reef program, in relation to disturbances of land use, water quality, channel, habitat and food web structure and riparian condition. From this we will develop summary conceptual models and identify knowledge gaps concerning the sensitivity of existing indicators and potential new indicators for subsequent testing. We will workshop these 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, and riparian vegetation condition.

In new field and/or laboratory studies, a range of promising 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 and food web structure along gradients of disturbance. Potential indicators will include:

- Community analysis of fish and invertebrates, including analysis at functional group level, number of species that are alien (e.g. tilapia, poeciliids), accounting for different habitats;
- Condition, growth and breeding metrics on key species;
- Community analysis of aquatic plants and measures of biomass and cover including metrics to represent plant alien species; and
- Food web structure and sources of energy driving aquatic food webs.

We will test both spatial and temporal variability of Catchment to Reef freshwater indicators in Wet Tropics rivers (e.g. Russell-Mulgrave, Tully) to refine our spatial/temporal understanding and conceptual /predictive models of responses to gradients of disturbances. This will provide early information on thresholds of potential concern.

We plan to develop new PhD projects to test freshwater indicators and thresholds of concern in Wet Tropics (Russell-Mulgrave, Tully) and Dry Tropics (Burdekin). PhD research will run over years 2 to 4, alongside team research 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 Report Card framework.

Objective (b): Identify thresholds of potential concern relating to land use, water quality, riparian condition, habitat 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 (b), we will review historical and 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). We may invite external experts to give advice on threshold methodologies, linking this task to Project 3.7.7. A collaborative end-user Workshop will allow us to present the review of the most useful and robust approaches to threshold identification, reporting and visualisation, also linked to Project 3.7.7

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.

By the end of the Catchment to Reef program in 2006 we will 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): To train new young researchers via PhD programs

Part of our research strategy is to engage with existing and new PhDs and link their work into this Project. We will share the supervision between JCU and GU, as we do now with two Catchment to Reef PhDs, to great effect. Both will be able to contribute to improving the

scientific basis for selection of indicators beyond those already well established from previous Catchment to Reef and other monitoring programs. We expect that at least three new PhDs will be recruited, and supervised collaboratively across universities. 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 channelling different products to different end-users. This part of the project will link to the Integrated Report Card framework which will be developing a report card system for GBR catchments.

The Catchment to Reef Communication Strategy revised in April 2006 offers a range of communication products and activities. By June 2006 we will produce a Technical Report on the catchment and freshwater indicators trailed in the Russel-Mulgrave system in 2005. MTSRF research will allow 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 Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Contribute to the integration workshop to define end-user needs for reporting on issues related to freshwater water quality and ecosystem health.	December 2006
(a), (b)	Synthesise knowledge of biophysical models of the ecological consequences of changes in landscape stressors in the tropics, and propose a suite of biophysical indicators of freshwater ecosystem health, building on Catchment to Reef research, ANZECC Water Quality Monitoring Guidelines, EPA Water Quality Guidelines and SEQ Healthy Waterways Program.	March 2007
(a), (c)	Workshop biophysical models and indicators for Wet Tropics waterways with end users. Develop summary conceptual models and identify knowledge gaps. Define final scope of project research and where to house Web-based atlases.	May 2007
(a)	Test spatial and temporal variability of Catchment to Reef freshwater indicators in selected Wet Tropics rivers, refine summary conceptual models and identify key research issues to support development of new or refined indicators.	June 2007

Objective	Targeted Activity	Completion Date
(b)	Synthesise knowledge of spatial/temporal scales of indicator response to disturbance along the river continuum, and identify possible spatial and temporal thresholds of potential concern in Wet Tropics rivers in relation to disturbances of land use, riparian condition and instream biophysical parameters and/or processes.	June 2007
(d)	Develop postgraduate projects	
(e)	Develop end-users agreed products from the program	

Project 3.7.3 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission: • Input into progress update for activities listed against objectives a-e (above) [GU] • Input into progress update for activities listed against objectives a-e (above) [CSIRO]. • Progress update for activities listed against objectives a-e (above). [JCU] • Input into collation of Catchment to Reef products related to the activities listed in objectives a-e available for uploading to website [GU] • Collation of Catchment to Reef products related to the activities listed in objectives a-e available for uploading to website. [JCU] • Plan of communication outputs and products for Year 1 and summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable. [JCU]	8 Dec 2006
Report 2 submission: • Input into report defining status and trends of freshwater water quality and ecosystem health of freshwater environments in the Wet Tropics World Heritage Area [GU] • Input into report defining status and trends of freshwater water quality and ecosystem health of freshwater environments in the Wet Tropics World Heritage Area [CSIRO] • Report defining status and trends of freshwater water quality and ecosystem health of freshwater environments in the Wet Tropics World Heritage Area. [JCU] • Input into report on the review of biophysical models of the ecological consequences of changes in landscape stressors and proposed suite of biophysical indicators of freshwater ecosystem health [GU] • Input into report on the review of biophysical models of the ecological consequences of changes in landscape stressors and proposed suite of biophysical indicators of freshwater ecosystem health [CSIRO] • Report on the review of biophysical models of the ecological consequences of changes in landscape stressors and proposed suite of biophysical indicators of freshwater ecosystem health. [JCU] • Summary of any liaison activities undertaken to date in collaboration with GU. [JCU]	18 Mar 2007

For 2006/2007 outputs only	Date
Milestones	
Report 3 submission: • Report on the review of spatial/temporal scales of indicator response to disturbance along the whole river continuum, and identification of possible spatial and temporal thresholds of potential concern in Wet Tropics rivers [JCU] • Report on the review of spatial/temporal scales of indicator response to disturbance along the whole river continuum, and identification of possible spatial and temporal thresholds of potential concern in Wet Tropics rivers. [GU] • Report on end-user workshop on biophysical models, indicators and thresholds, including provisional list of indicators – Wet Tropics. [JCU] • Progress report on field testing of indicators, model refinement and threshold determination – Wet Tropics in collaboration with CSIRO and GU. [JCU] • Input into progress report on development of web-based atlases [GU] • Progress report on development of web-based atlases [JCU] • Summary of liaison activities undertaken through course of Year 1 of project in collaboration with GU. [JCU]	8 June 2007
Information transfer between agencies: • Mutual transfer of information between JCU, GU and CSIRO to progress development of Integrated Report Card required.	8 June 2007
Total MTSRF Funding	\$173,000*

Project 3.7.3 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	173,000	-	173,000
MTSRF Visual Documentation*	2,000	-	2,000
JCU	-	125,000	125,000
GU	-	125,000	125,000
CSIRO	-	25,000	25,000
Total	175,000	275,000	450,000

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

JCU Project 3.7.3 Budget 2006/2007

Item	MTSRF Funds	JCU In-kind	Total Cost
Salaries	65,000	125,000	190,000
Operating	10,000	-	10,000
Travel	9,000	-	9,000
Communication / Extension	5,000	-	5,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	89,000	125,000	214,000

GU Project 3.7.3 Budget 2006/2007

Item	MTSRF Funds	GU In-kind	Total Cost
Salaries	55,000	125,000	180,000
Operating	10,000	-	10,000
Travel	9,000	-	9,000
Communication / Extension	5,000	-	5000
Capital	-	-	-
Institutional overheads	-	-	-
Total	79,000	125,000	204,000

CSIRO Project 3.7.3 Budget 2006/2007

Item	MTSRF Funds	GU In-kind	Total Cost
Salaries	-	13,000	13,000
Operating	-	-	-
Travel	3,000	-	3,000
Communication / Extension	2,000	1,184	3,184
Capital	-	-	-
Institutional overheads	-	10,816	10,816
Total	5,000	25,000	30,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources ¹		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	175,000	5,000	180,000	150,000	25,000	535,000
2008/2009	175,000	5,000	180,000	150,000	25,000	535,000
2009/2010	175,000	5,000	180,000	150,000	25,000	535,000
Total	525,000	15,000	540,000	450,000	75,000	1,605,000

¹ Prediction – not yet confirmed.

PROGRAM 7: HALTING AND REVERSING THE DELINE OF WATER QUALITY

Project 3.7.4: Wetlands and floodplains: connectivity and hydro-ecological function

Project Leader and Host Organisation

Professor Jim Wallace, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team

Title	Organisation	Role	FTE
Jim Wallace	CSIRO	Project leader; hydrology expertise	0.35
Lachlan Stewart	CSIRO	Hydrological modeling	0.95
Frederieke Kroon	CSIRO	Catchment management; links other CSIRO/NRM program	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 programme	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

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

Floodplains and wetlands are important physical and biological links in the aquatic continuum, providing unique and essential habitat and connectivity for specialist and wide-ranging fauna. Yet very little is known about the hydrological dynamics of these systems, and about the dynamics of the physical and biological connectivity through them. These systems provide access and vital habitat for iconic species such as Barramundi, but they are typically badly managed, highly impacted and, in the case of freshwater wetlands, severely depleted (~75% of such wetlands in GBR catchments having been lost to agricultural and other development). Proper management will depend on understanding the biophysical relationships and 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 Report Card framework will be delivered via our wetland connectivity index Decision Support System. This DSS will then be used to clarify how the current Queensland Wetlands program assessment could be improved. Subject to co-investment to support additional components, this project will develop its ecological scope in close collaboration with Project 3.7.3.

Project / Task Methodology

Objective (a): Quantify how the flood regime affects the main sinks and sources of sediment and nutrient and their transport across floodplains.

We will use a novel approach that combines state-of-the-art remote sensing and ground based data with the development of a hydrodynamic model of floodplain inundation. It will build on hydrodynamic modelling work already carried out by Main Roads in the Tully-Murray catchments in support of the redesign of the road south of Tully. The Main roads model only deals with water quantity and so this project will focus on developing and testing the sediment and nutrient transport routines that will quantify the sinks, sources and movement of materials across the floodplain during flood events. These important processes are not dealt with in existing sediment and nutrient transport models (e.g. SedNet), yet the floodplain is the area where much of the pollutants arise and it is also the area where most management interventions can take place.

The high resolution topography needed for accurate hydraulic modelling on low relief floodplains will be acquired from remote sensing (e.g. airborne laser altimetry, stereoscopic aerial photography, etc.). These types of data will also give important information on the hydraulic roughness of the vegetation on the floodplain, an essential parameter in the hydrodynamic model of the floodplain. Historical and current flood extents can be obtained using SAR (Synthetic Aperture Radar) data. Ground based data on drainage channel networks and cross sections are also required.

The hydrodynamic model predictions of flood depth, flow velocity and direction and sediment and nutrient concentrations will be tested using a combination of manual and automatic sampling of these variables during flood events.

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 a map of the current wetlands (permanent and ephemeral) with dynamic simulations of the evolution of flood waters it will be possible to quantify the timing and duration of hydrological connections between wetlands. The model will also be able to quantify the degree of connectivity of different wetlands (e.g. how many other water bodies are they connected to, how far away are they and how long do they stay connected?).

Using historical flood frequency data it will also be possible to characterise the frequency with which different wetland bodies are flooded and how these frequencies change with climate, land use and management changes. For example, it should be possible to quantify how a range of wetland connectivity indices have changed since the introduction of flood levees and cane drains. The impacts of future options for the introduction and/or removal of drains, levees and artificial wetlands on the wetland connectivity of the entire floodplain should also be predictable. We will make explicit links to the socio-economic aspect of floodplain development and change through Project 3.7.5.

Objective (c): Develop models that link ecological structure (e.g. biodiversity, community patterns) and processes to the core floodplain hydrology model to quantify the consequences of changes in water body connectivity between freshwater and saline waterways for biodiversity, biological connectivity and proper ecological function.

The core hydrodynamic model developed above will provide a range of new opportunities to explore the interactions between flood regimes, water quality and aquatic productivity and biodiversity. In particular the model will allow fish passage during and after flood events to be studied. This will require links with biological processes that affect the migration of tropical fish between the floodplain wetlands, freshwater streams, estuaries and the ocean.

The mechanism adopted to identify the types of freshwater ecological model that are required will be via a Workshop involving the key aquatic scientists and natural resource managers in the region. The workshop will focus on developing a plan for implementing the aquatic ecology work identified. Some initial pump-priming of the core work identified will be funded through a small number of PhD student 'top up' grants. These PhD studies and other externally funded projects will be targeted at field sampling to test flow-habitat-ecology relationships and models for test locations in the wet and dry tropics.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Obtain hydrodynamic software and high resolution data for test location/s.	February 2007
(a)	Acquire hydraulic characteristics and water quality data for test location in the Wet Tropics; preliminary analysis of model predictive ability for sediment and nutrient transport.	June 2007*
(b)	Workshop to define scope and scale of inundation and connectivity model, explore links between the hydrodynamic model and aquatic ecology model/s, and methods to link flow-ecology models. Participants to include researchers and relevant stakeholders, including representatives of the Qld Wetlands program, to ensure appropriate linkages.	February 2007
(c)	Review of flood data, inundation models and existing wetland connectivity models.	June 2007
	Start initial linked hydrological and ecological PhD studies using top-up funds.	June 2007*

Project 3.7.4 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission: • Input into progress update for activities listed against objectives (a)-(c) (above). [JCU] • Input into progress update for activities listed against objectives (a)-(c) (above). [GU] • Progress update for activities listed against objectives (a)-(c) (above). [CSIRO] • Evidence that hydrodynamic software and high resolution data for test location/s has been secured. [CSIRO] • Plan of communication outputs and products for Year 1 and summary of any liaison activities undertaken to date including minutes of meetings/workshops if applicable. [CSIRO]	28 Feb 2007
Report 2 submission: • Input into proceedings of the workshop on the development of the hydrological and ecological models and the links between them (objective b), including an implementation plan. [GU] • Input into proceedings of the workshop on the development of the hydrological and ecological models and the links between them (objective b), including an implementation plan. [JCU] • Proceedings of the workshop on the development of the hydrological and ecological models and the links between them (objective b), including an implementation plan. [CSIRO] • Draft synthesis report on the review of existing hydrological data, inundation models for use in floodplain sediment and nutrient transport and wetland connectivity models. [CSIRO]	30 Apr 2007

For 2006/2007 outputs only	Date
Milestones	
Report 3 submission: • Report on hydraulic characteristics and water quality data for test locations in the Wet Tropics and the preliminary analysis of model predictive ability for sediment and nutrient transport. [CSIRO] • Final synthesis report on the review of existing hydrological data, inundation models for use in floodplain sediment and nutrient transport and wetland connectivity models. [CSIRO] • Progress update on student activities associated with objectives (a)-(c) (above). [JCU] • Progress update on student activities associated with objectives (a)-(c) (above). [GU] • Final summary of liaison activities undertaken through course of Year 1 of project. [CSIRO]	8 Jun 2007
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	\$173,500

Project 3.7.4 Budget

Year 1 – 2006/2007 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
JCU	-	20,000	20,000
Griffith University	-	20,000	20,000
Total	175,000	240,000	415,000

* A total of \$1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

CSIRO Project 3.7.4 Budget 2006/2007

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	127,500	56,671	184,171
Operating	22,000	-	22,000
Travel	4,000	-	4,000
Communication / Extension	10,000	-	10,000
Capital	-	-	-
Institutional overheads	-	143,329	143,329
Total	163,500	200,000	363,500

JCU Project 3.7.4 Budget 2006/2007

Item	MTSRF	JCU In-kind	Total Cost
Salaries	3,000	20,000	23,000
Operating	1,000	-	1,000
Travel	1,000	-	1,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	5,000	20,000	25,000

GU Project 3.7.4 Budget 2006/2007

Item	MTSRF	GU In-kind	Total Cost
Salaries	2,000	20,000	22,000
Operating	1,000	-	1,000
Travel	2,000	-	2,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	5,000	20,000	\$25,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources¹		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	175,000	5,000	200,000	150,000	25,000	555,000
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	525,000	15,000	600,000	450,000	75,000	1,665,000

¹ Prediction – not yet confirmed.

PROGRAM 7: HALTING AND REVERSING THE DELINE OF WATER QUALITY

Project 3.7.5: Socio-economic constraints to and incentives for the adoption of land use and management options for water quality

Project Leader and Host Organisation

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

Project Team

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
Geoff McDonald	CSIRO	Institutional analysis and link to 'Strategic NRM' Project 4.9.6.	0.05
Ryan McAllistar	CSIRO	Systems modeler	0.15
Tilak Mallawaarachchi	ABARE	Survey design and link to 'Cost-Effective Delivery' Project 3.7.6.	0.05
Richard Pearson	JCU	Water quality indicators and link to 'Freshwater WQ' Project 3.7.3.	0.05
Mark O'Donohue	FNQ NRM Ltd	End-user input	0.05

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 agent⁴, 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 instruments⁵ that are most effective in promoting the adoption of these 'best' land use and management options. Focusing on the adoption of

⁴ 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).

⁵ Drivers include information dissemination, extension services, price incentives, taxes, market-based instruments, regulations and institutional arrangements.

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.

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, 3.7.6 and 3.7.7) as well as the Sustainable Use Program (project 4.9.6):

- i) Relationships between land use, channel, habitat and riparian condition on the one hand and water quality and freshwater indicators on the other hand will be obtained from Project 3.7.3
- ii) Geographically referenced farm survey information will be obtained from Project 3.7.6
- iii) Plot level bio-physical as well as farm and community level socio-economic information and relationships will feed into Project 3.7.6, Project 3.7.7 and Project 4.9.6
- iv) Regional and national level institutional arrangements impacting farm and community level decisionmaking will be obtained from 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-Witsunday area is currently under consideration.

Objective (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.

- Review current and future land use and management options for water quality improvement, in close collaboration with industries, extension services, QDPI&F and regional NRM bodies.
- 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.
- 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.
- 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.

Objective (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.

- Geographically referenced agent survey for collection of agent profile, using stratified random sampling techniques (in conjunction with Project 3.7.6).
- In-depth agent interviews to obtain insight into agents' attitudes, aspirations and risks regarding the adoption of land use and management options for water quality improvement, using stratified and random sampling techniques.

Objective (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.

- Institutional analysis and stakeholder mapping at the industry, community and government level (in conjunction with Project 4.9.6), using desktop study and interview-based network analysis.
- Key informant interviews, stakeholder group meetings and focus group discussions regarding the community/institutional constraints to and risks associated with the adoption of land use and management options for water quality improvement.

Objective (d): Identify and assess instruments that are most effective in promoting the adoption of 'best' land use and management options by community embedded agents.

- Review of predictive bio-economic approaches used to assess the effectiveness of instruments promoting the adoption of alternative land use and technology options.
- Identify socio-economic trends and fluctuations that may impact on the rate of adoption (or dis-adoption) of 'best' land use and management options by agents in rural and urban areas in North Queensland's catchments.
- Develop predictive single-agent models for representative types of agents, which allow for the ex-ante effectiveness assessment of instruments promoting the adoption of 'best' land use and management options by non-community embedded agents in rural and urban areas in North Queensland's catchments. Bio-economic single-agent models

(based on Singh et al., 1986; Sadoulet et al., 1995)⁶ are developed for different types of agents (based on Objective b), which explicitly relate resource use and management decisions (as well as resulting externalities) to technology, knowledge and attitude, resource availability and access, and natural resource conditions (for applications see Barbier et al., 1999; Roebeling et al., 2001; Roebeling et al., 2005)⁷.

- Develop predictive multi-agent decision support tool, which allows for the ex-ante effectiveness assessment of instruments promoting the adoption of 'best' land use and management options by community embedded agents in rural and urban areas in North Queensland's catchments. Based on proper agent characterization (based on Objective b), corresponding single-agent based bio-economic modelling (see above) and community and institutional analysis (based on Objective c), inter-agent relationships are taken into account through the inclusion of product and factor markets, community relationships and institutional arrangements (see for example Roebeling et al., 2000; Huigen., 2004; Smith et al., 2005)⁸.

⁶ Singh, I., L. Squire and J. Strauss [1986]. *Agricultural household models: extensions, applications and policy*. Johns Hopkins Press for the World Bank, Baltimore, USA.

Sadoulet, S., and A. De Janvry, 1995. *Quantitative development policy analysis*. The Johns Hopkins University Press, Baltimore, USA. 397 pp.

⁷ Barbier, B. and G. Bergeron [1999]. *Natural resource management in the hillsides of Honduras: bioeconomic modeling at the micro-watershed level*. EPTD Discussion Paper No.32. International Food Policy Research Institute, Washington.

Roebeling, P.C. and R. Ruben [2001]. *Technological progress versus economic policies as tools to control deforestation: the Atlantic Zone of Costa Rica*. Pages 135-152 in: Angelsen, A. and D. Kaimowitz (Eds) *Agricultural technologies and tropical deforestation*. CABI Publishing, New York, U.S.A., 422 pp.

Roebeling, P.C., D.M. Smith, J. Biggs, A.J. Webster, and P. Thorburn [2004]. *Private-economic analysis of drivers promoting the adoption of best management practices for water quality improvement in the Douglas Shire: Report on the cost-effectiveness of BMP implementation for water quality improvement*. Report prepared for the Douglas Shire Water Quality Improvement Program, CSIRO-Sustainable Ecosystems, Townsville, Australia. 95 pp.

⁸ P.C. Roebeling, H.G.P. Jansen, R.A. Schipper, F. Sáenz, E. Castro, R. Ruben, H. Hengsdijk and B.A.M. Bouman [2000], *Farm Modelling for Policy Analysis on the Farm and Regional Level*. Pages 171-198 in: B.A.M. Bouman, H.G.P. Jansen, R.A. Schipper, H. Hengsdijk and A. Nieuwenhuyse (Eds) *Tools For Land Use Analysis on Different Scales: With Case Studies for Costa Rica*. Kluwer Academic Publishers, Dordrecht, The Netherlands. 274 pp.

D.M. Smith, P.C. Roebeling, A.J. Webster, M. Kragt, I. Bohnet and A. Zull [2005], *Assessment of the Socio-Economic Impacts of Management Options for Improving Water Quality in the Douglas Shire*. CSIRO-Sustainable Ecosystems, Townsville, Australia. 42 pp.

Huigen, M.G.A. [2004]. *First principles of the MameLuke multi-actor modelling framework for land use change, illustrated with a Phillipine case study*. *Journal of Environmental Management* 72: 5-21.

Project Outputs / Milestones

Output / Milestone	Completion Date
Cost-effectiveness assessment of land use and management options for the Wet Tropics case study	06/2008
Cost-effectiveness assessment of land use and management options for the Dry Tropics case study	06/2009
Agent profile, characterisation and stratification for the Wet Tropics case study	09/2008
Agent profile, characterisation and stratification for the Dry Tropics case study	09/2009
Community/institutional profile, characterisation and stratification for the Wet Tropics case study	12/2008
Community/institutional profile, characterisation and stratification for the Dry Tropics case study	12/2009
Assessment of instruments promoting the adoption of 'best' land use and management options for the Wet Tropics case study	06/2009
Assessment of instruments promoting the adoption of 'best' land use and management options for the Dry Tropics case study	06/2010

Project 3.7.5 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	Date
Milestones – all CSIRO Responsibilities	
Signing of contract	
Report 1 submission: - Progress update on the review of Best Management Practice for the most important production systems in the Wet 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 Wet Tropics; and (ii) summary of any communication activities undertaken to date, including minutes of meetings and workshops if applicable (e.g. for review of land use management options). - Plan of communication outputs and products for Year 1.	1 Dec 2006
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 wet 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 Wet Tropics for water quality improvement using climate dependent hydrological and production systems simulation models (obj a).	16 Mar 2007

For 2006/2007 Outputs Only	Date
Milestones – all CSIRO Responsibilities	
Report 3 submission: - Final report on the assessment of the long term effectiveness of BMPs for water quality for the most important production systems in the Wet 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 Wet 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)-(d) and activities associated with objective a for the Dry Tropics region.	15 May 2007
Total MTSRF Funding	\$75,000

Project 3.7.5 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	75,000	-	75,000
CSIRO	-	75,000	75,000
ABARE	-	25,000	25,000
Total	75,000	100,000	175,000

Note that other related projects (through the CSIRO Water for a Healthy Country Great Barrier Reef Theme Flagship and various Regional Natural Resource Management bodies), of an estimated value of \$690,000 per year.

CSIRO Project 3.7.5 Budget 2006/2007

Item	MTSRF Funds	Funds from CSIRO	Funds from ABARE	Total Cost
Salaries	60,000	75,000	25,000	160,000
Operating	5,000	-	-	5,000
Travel	4,000	-	-	4,000
Communication / Extension	6,000	-	-	6,000
Capital	-	-	-	-
Institutional overheads	-	-	-	-
Total	75,000	75,000	25,000	175,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources*		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	78,750	-	105,000	-	-	183,750
2008/2009	81,600	-	110,250	-	-	191,850
2009/2010	84,600	-	115,750	-	-	200,350
Total	244,950	-	331,000	-	-	575,950

* Subject to approval from NRM Bodies.

Again note that other related projects (through the CSIRO Water for a Healthy Country Great Barrier Reef Theme Flagship and various Regional Natural Resource Management bodies), of an estimated value of \$690,000 per year, may contribute to this project.

PROGRAM 7: HALTING AND REVERSING THE DELINE OF WATER QUALITY

Project 3.7.6: Delivery of social and economic indicators of water quality

Project Leader and Host Organisation

Dr Allan Dale, FNQ NRM Ltd

Project Team

Title	Organisation	Role	FTE
Dr Allan Dale	FNQ NRM Ltd	Lead role in participatory research	0.05
Professor Helen Ross	UQ	Researcher in co-managed research process, project management, case studies	0.05
Dr Tim Lynam	CSIRO	Principle contributor to resilience indicators and resilience analysis tools	0.15
Dr Margaret Gooch	JCU	Researcher in science communication	0.05
Dr Karen Vella	FNQ NRM Ltd	Social science researcher	0.3
Professor Richard Pearson	JCU	Researcher in integration of ecological system drivers for water quality	0.15
Professor Angela Arthington	GU	Researcher in integration of ecological system drivers for water quality	0.15

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

- 1) Delivery of indicators of social resilience (and drivers) that are applicable to linked social and ecological systems for water quality at a catchment scale.
- 2) Tools for the analysis of resilience in social – ecological systems for water quality.
- 3) Integration of ecological systems drivers across the social/ ecological construct for inclusion in the Integrated Report Card.

Note: This project is linked to Projects 4.9.7 and 3.7.7 (Integrated Report Card).

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Establish working linkages with key partners and other MTSRF projects for the development of social indicators.	December 2006
(b)	Development of draft conceptual framework assessment of potential indicators.	June 2007
(c)	Development of draft ecological components for conceptual model to contribute into the Integrated Report Card.	June 2007

Project 3.7.6 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	
Milestones	Date
Signing of contract	
Report 1 submission: - Input into report on the establishment of working linkages with key partners and other MTSRF projects for social indicator development. [CSIRO] - Input into plan of communication products and activities for Year 1. [CSIRO] - Delivery of plan of communication products and activities/events for Year 1. [FNQ NRM Ltd]	6 Dec 2006
Report 2 submission: - Progress report for objective (b). [CSIRO] - Input into summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable, interactions between program teams and end-users. [FNQ NRM Ltd]	15 Mar 2006
Report 3 submission - Draft assessment framework (obj b). [CSIRO] - Draft conceptual models of interaction of selected ecosystem processes with the social resilience conceptual framework (obj c). [GU and JCU]	16 May 2007
Report 4 submission - Report on draft conceptual framework assessment of potential social resilience indicators. [CSIRO] - Development of draft ecological components for conceptual model to contribute into the Integrated Report Card. [JCU] - Development of draft ecological components for conceptual model to contribute into the Integrated Report Card. [GU] - Input into summary of communication activities undertaken through the course of Year 1 of project. [CSIRO]	11 Jun 2007
Total MTSRF Funding	\$75,000

Project 3.7.6 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	75,000	-	75,000
JCU	-	21,250	21,250
CSIRO	-	15,000	15,000
GU	-	16,000	16,000
UQ	-	5,250	5,250
FNQ NRM Ltd	-	17,500	17,500
Total	75,000	75,000	150,000

Note that other related projects (through the CSIRO Water for a Healthy Country Great Barrier Reef Theme Flagship and various Regional Natural Resource Management bodies), of an estimated value of \$690,000 per year.

CSIRO Project 3.7.6 Budget 2006/2007

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	15,000	-	15,000
Operating	-	2,520	2,520
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	12,480	12,480
Total	15,000	15,000	30,000

JCU Project 3.7.6 Budget 2006/2007

Item	MTSRF	JCU In-kind	Total Cost
Salaries (Pearson)	16,000	16,000	32,000
Salaries (Gooch)	5,250	5,250	10,500
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	21,250	21,250	42,500

FNQ NRM Ltd Project 3.7.6 Budget 2006/2007

Item	MTSRF	FNQ NRM Ltd In-kind	Total Cost
Salaries	17,500	17,500	35,000
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	17,500	17,500	35,000

GU Project 3.7.6 Budget 2006/2007

Item	MTSRF	GU In-kind	Total Cost
Salaries	16,000	16,000	32,000
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	16,000	16,000	32,000

UQ Project 3.7.6 Budget 2006/2007

Item	MTSRF	UQ In-kind	Total Cost
Salaries	5,250	5,250	10,500
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	5,250	5,250	10,500

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	150,000	75,000	-	150,000	-	375,000
2008/2009	150,000	75,000	-	150,000	-	375,000
2009/2010	150,000	75,000	-	150,000	-	375,000
Total	450,000	225,000	-	450,000	-	1,125,000

PROGRAM 7: HALTING AND REVERSING THE DELINE OF WATER QUALITY

Project 3.7.7: Conceptual and statistical framework for the water quality component of the Integrated Report Card

Project Leaders and Host Organisations

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

Dr Andy Steven, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team

Title	Organisation	Role	FTE
Andy Steven	CSIRO	Project Leader, estuarine and nearshore coastal indicators	0.15
Rebecca Bartley	CSIRO	Project Manager, catchment model outputs	0.25
Mick Hartcher	CSIRO	Data management and GIS	0.3
David McJannet	CSIRO	Temporal analysis, wetland indicators	0.1
Vittorio Brando	CSIRO	Remote Sensing indicators	0.1
Bronwyn Harch	CSIRO	Statistical issue oversight	0.1
Petra Kuhnert	CSIRO	Regionalisation and indicator statistics, CMIS Project Management	0.4
Matthew Browne	CSIRO	Statistics	0.25
Erin Peterson	CSIRO	Geospatial analysis and statistics	0.25

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

- Summarise current approaches to condition reporting and implications for the integrated report card framework.
- Outline appropriate regionalisation approaches and implementation for a trial catchment.
- Test inclusion of mature indicators of ecosystem health and thresholds of concern and recommend a process for trialling developmental indicators.
- Synthesis report summarising a recommended framework for Integrated Report Card development.
- In 2007-2010, develop techniques required for data fusion and ontologies in the context of an integrated report card with diverse data types and scales.
- In 2007-2010 develop prototype report cards notionally on *Water Quality*, *GBR health*, *Rainforest*, and *Torres Strait*. The number and timing of prototypes is to be determined following delivery of 2006-2007 milestones.

Note: The review, definition and trialling of appropriate biophysical and socio-economic indicators for the IRC is funded within the individual MTSRF Programs and reported in individual contract schedules.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Summarise current approaches to condition reporting and implications for the Integrated Report Card Framework: Review approaches to environmental condition reporting relevant to tropical ecosystems and identify potential indicators and datasets for assessment.	28 February 2007
(b)	Report on a recommended approach to developing a statistically robust regionalisation for the GBR and present results from a pilot implementation for a trial catchment: - Identify pilot region; - Source relevant data and present in GIS layers; - Test pilot data and develop and appropriate methodology; - Report preparation.	27 April 2007
(c)	Report outlining initial indicators for inclusion and a process for trialling other candidate indicators: - Identify mature indicators; - Develop an approach for the trialling of recommended indicators; - Trial suitability of mature indicators with available data considering their conceptual relevance, spatial and temporal characteristics, logistics of data collection and responsiveness to environmental drivers; - Examine statistical issues of indicators combination; - Using pilot data recommend an approach to defining thresholds of potential concern (TPC) for selected water quality parameters.	31 May 2007
(d)	Final Synthesis Report of a recommended framework for Report Card Development, summarising: - Initial report card framework and issues related to data integration (activity 1); - Recommended regionalisation and trial implementation in pilot area; - Recommended mature and development al indicators and process for trialling; - Scope of work required for Years 2 to 4 to develop and implement Report Card.	11 June 2007
(e)	Develop methods for data integration and the science to support the development of prototype report cards notionally on Water Quality, GBR health, Rainforest and Torres Strait. - Further develop spatial regionalisation; - Methods for incorporation socio-economic indicators; - Data-model fusion methods; - Trial developmental indicators; - Prototype Report Card development.	July 2007 to June 2010*

* Will include activities that carry into out years.

Project 3.7.7 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	
Milestones – all CSIRO Responsibilities	Date
Signing of contract	
Report 1 submission: • Draft Report on existing approaches to an environmental condition reporting. • Revised plan for conduct of activities to be reported on under this project including an outline of issues with respect to regionalisation, selection of indicators, data integration and visualisation, and communication activities plan for Year 1.	28 Feb 2007
Report 2 submission: Progress report on: • Regionalisation methods, outlining issues with respect to collation and extraction of data, identification of important variables, clustering methods and progress with pilot area regionalisation. • Trialing of candidate water quality indicators considering: conceptual models, spatial and temporal characteristics, logistics of data collection with a focus on representativeness, redundancy, responsiveness to drivers.	27 Apr 2007
Report 3 submission: • Draft report recommending indicators of common relevance to end-users and researchers, boundaries of thresholds of concern for indicators, management pathways of relevance to indicators/thresholds, availability of datasets, to be potentially used in the prototype report card. • Identification of indicators requiring development. • Outline statistical issues to be addressed for pilot indicators.	31 May 2007
Transfer information to Projects 1.1.5 and 1.3.5	
Report 4 submission: • Outline of initial framework and report card shell. • Present the recommended regionalization. • Recommend options for visualisation of the reported condition and trend. • List of mature indicators and developmental indicators. • Outline spatial and temporal monitoring strategies for indicators. • Issues relating to data integration. • Recommended framework for development and implementation in Years 2 to 4.	11 Jun 2007
Total MTSRF Funding	\$100,000

Project 3.7.7 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	100,000	150,000	250,000
Total	100,000	150,000	250,000

CSIRO Project 3.7.7 Budget 2006/2007

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	87,000	33,000	120,000
Operating	3,000	17,160	20,160
Travel	10,000	-	10,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	99,840	99,840
Total	100,000	150,000	250,000

2006/2007 Project Funding and Partnerships for the Integrated Report Card Projects 3.7.7, 1.1.5 and 1.3.5

Item	MTSRF	In-kind*	Total Cost
MTSRF Project 3.7.7	100,000	-	100,000
MTSRF Project 1.1.5 Contribution	60,000	-	60,000
MTSRF Project 1.3.5 Contribution	50,000	-	50,000
CSIRO	-	150,000	150,000
Total	210,000	150,000	360,000

* Other related projects through the CSIRO Water for a Healthy Country Great Barrier Reef Theme Flagship and various regional Natural Resource Management bodies of an estimated value of \$690,000 per year.

Theme 4

Sustainable Use and Management

Sustainable use of North Queensland's natural assets is critical to maintaining the environmental, social and economic values of the region. The research results will provide knowledge and options for promoting sustainable use and minimising adverse impact on the natural assets.

Budget Summary

Program	Title	MTSRF	Other Cash	In-kind
Program 8	Sustainable Use – Great Barrier Reef	1,030,000	170,000	1,147,168
Program 9	Sustainable Use – Rainforests	1,203,275	372,422	1,634,915
Total		2,233,275	542,422	2,782,083

The total value of Theme 4 is \$5,557,780.

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	1,030,000	-	1,030,000
Other	170,000	1,147,168	1,317,168
Total	1,200,000	1,147,168	2,347,168

The proposed 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 influence 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:

- 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.
- 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.
- An analysis of the biological parameters and current and historical patterns of use of key inter-reef fish species.
- 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.
- 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.

- Determination of the social and economic values of key marine species, particularly large fish around tourist facilities. Undertake an economic analysis of 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. 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 irukandji movement and habits and the risk of human encounters to irukandji and other marine stingers that may influence tourist visitation.

Program Communication

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 where possible other MTSRF Programs such as Status and Trends for the GBR. This strategy will build upon existing CRC Reef, F&F, CapReef and AMPTO experiences and will value add to existing communication systems and networks where possible. A total of \$85,000 has been allocated to Program Communication.

Projects

4.8.1	Resilience and connectivity	\$123,000
4.8.2	Influence of the Great Barrier Reef Zoning Plan on inshore habitats and biodiversity, of which fish and corals are indicators: reefs and shoals	\$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 Great Barrier Reef for managing sustainable tourism	\$148,000
4.8.7	Forecasting risk of exposure to irukandji	\$25,000
4.8.8	Communication, community engagement and enhanced delivery of Program 8	\$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

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

Project Duration

Start Date: 1 July 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 leads a team of oceanographic modellers (Bode, Mason) to 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 Hons, 1 MSc, 1 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. A pilot experiment 1 is planned for the bar-cheek coral trout (*P. maculatus*) at the Keppel Island group in the Mackay / Capricorn section of the GBRMP in the first 6 months of this study.

The program 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 Outputs / Milestones

Objective	Targeted Activity	Date
(a) (b) (b) (a), (b)	• Begin: development of 3-D hydrodynamic model, assembly of bathymetric data, development of theoretical framework for biophysical model, assembly of data from literature, and analysis of Leis' existing behavioural data. • Complete first stage of validation of otolith marking technique and development of primers for DNA analysis. • Dedicated program newsletter article. • Briefing to DEW and other co-contributors.	16 Feb 2007
(a) (b) (a), (b) (a), (b)	• Physical model components 50% complete; Complete theoretical framework, assembly of data from literature and analysis of existing behavioural data. Behavioural data for 2 species prepared for model incorporation. • Complete validation of larval marking and genetic techniques. Analyse data from larval marking validation experiments and prepare publications. • Presentation to end users and annual report. • Industry, Sunfish, CapReef and other end user newsletter article.	30 Jun 2007

Project 4.8.1 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	Date
Milestones – All JCU responsibilities	
Signing of contract	
Report 1 submission: • Progress update on activities conducted against objectives (above): coral trout marking validation, progress on 3-D hydrodynamic model development including bathymetric data • Program newsletter article. • Copies of briefing reports to DEW, GBRMPA and other co-contributors on research findings to date • Plan of communication outputs and products for Year 1 and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	2 Mar 2007
Report 2 submission: • Progress report: 3-D hydrodynamic model (50% complete). • Report on completed (50%) components of physical model; report describing complete theoretical framework: assembly of data from literature and analysis of existing behavioural data. Identification of two species and behavioural data prepared for model incorporation. • Final report on validation of otolith marking and genetic techniques from laboratory studies. • Copies of presentations/workshop minutes to end users. • Newsletter article. • Plan for completing next year's activities.	10 Jun 2007
Total MTSRF Funding	\$123,000

Project 4.8.1 Budget

Year 1 – 2006/2007 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 2006/2007

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, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	125,000	-	299,200	200,000 ¹	-	624,200
2008/2009	125,000	-	299,200	200,000 ¹	-	624,200
2009/2010	125,000	-	299,200	200,000 ¹	-	624,200
Total	375,000	-	897,600	600,000¹	-	1,872,600

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

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

Project Team

Title	Organisation	Role	FTE
Mike Cappo*	AIMS	Fish biologist	0.75
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	0.75
Marcus Stowar**	AIMS	Fish biologist	0.75
David Williamson	JCU	Fish biologist	0.2

* Years 2-4 only (beyond June 2007).

** Year 1 only (2006/2007).

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 1.1.1 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:

- Measure the response of biological communities (fish and benthos) to differential zoning of human use on inshore coral reefs.
- 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 the three main groups of islands: Palms Is., Whitsunday Is. And Keppel Is. The main data set would consist of 50 sites that changed from blue to green in 2004 matched with 50 control sites that remained open to fishing. In addition, the team has long-term data from another 50 locations, half of which were closed to fishing in the first Zoning Plan (old green), and have identified the potential to expand the coverage of new green to other island groups along the coast (e.g., Frankland and Barnard Is.), representing a further 50 paired contrasts.

The team will monitor half of these 200 locations 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 15 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. The final output due in 2010 is expected to be a definitive report on the impact of no-take zones upon biological communities, including trophic cascades.

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.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a) (b)	Submit detailed work plans for both Objectives	31 Oct 2006
(a)	Report on the influences of zoning that are detectable on inshore reefs (synthesis of existing knowledge).	1 Mar 2007
(b)	Baseline 1 (Magnetic shoals) established.	
(a)	Half sampling design for coral reefs completed.	30 Jun 2007
(b)	Baseline 2 (Brook shoals) established.	
	Magnetic shoals resampled.	
	Annual report (including temporal variability at Magnetic shoals).	

Project 4.8.2 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	Date
Milestones	
Signing of contract	
Report 1 submission: - Schedule of field activities including proposed methodology and contingency planning to complete objectives a [JCU] and b [AIMS] (above). - Plan of communication events/activities/products for Year 1 and summary of any activities undertaken to date. [AIMS]	15 Nov 2006
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: - Status baseline report: synthesis of existing knowledge of impacts of zoning on inshore reef fish and corals. [JCU] - Preliminary findings from completed first baseline survey of Magnetic shoals. [AIMS] - Input into progress report of proposed field activities. [JCU] - Progress report of proposed field activities. [AIMS] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. [AIMS]	1 Mar 2007
Report 3 submission: - Preliminary findings from completed second baseline survey of Brook shoals. [AIMS] - Comparison of fish and coral data from open and closed coral reefs (half of total targeted). [JCU] - Report (including temporal variability at Magnetic shoals based on resampling event) comparing fish abundance collected from open and closed inter-reefal areas in Cleveland and Rockingham Bays. [AIMS] - Final summary of communication activities undertaken through the course	10 Jun 2007

For 2006/2007 Outputs Only	Date
Milestones	
of Year 1 of project. [AIMS] - Input into plan for completion of activities in out years. [JCU] - Plan for completion of activities in out years in collaboration with JCU. [AIMS]	
Total MTSRF Funding	\$228,000

Project 4.8.2 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	228,000	-	228,000
AIMS	20,000	375,780	395,780
JCU	-	111,688	111,688
Total	248,000	487,468	735,468

AIMS Project 4.8.2 Budget 2006/2007

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	-	20,000*	20,000
Institutional overheads	-	201,094	201,094
Total	149,000	395,780	544,780

* AIMS cash contribution.

JCU Project 4.8.2 Budget 2006/2007

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	-	20,000	20,000
Institutional overheads	-	60,288	60,288
Total	79,000	111,688	190,688

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	248,000	0	400,000	20,000	-	668,000
2008/2009	248,000	0	400,000	20,000	-	668,000
2009/2010	248,000	0	400,000	20,000	-	668,000
Total	744,000	-	1,200,000	60,000	-	2,004,000

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

Title	Organisation	Role	FTE
Dr Colin Simpfendorfer	JCU	Acting: Responsible for overseeing and managing all aspects of the Project.	1.0
Research Assistant	JCU	Biological sample processing, data analysis, write-up and database management.	1.0

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 and build on the existing modelling simulation framework developed by the CRC Reef/JCU Fishing and Fisheries team and CSIRO to evaluate effects of fishing on the reef and inter-reef (i.e., shoals) fish resources of the GBR. The extensions to this framework will aim to develop a cross-shelf, inter-reef habitat model to capture the population dynamics and resource use of key inter-reef fish species that comprise the “other reef fish” species group in the GBR line fishery. 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 and alternate management arrangements.

The Project will be comprised of four components: 1) Description of historic and current patterns of resource use of key inter-reef fish species; 2) Estimation of biological parameters of key inter-reef fish species; 3) Development and implementation of cross-shelf, inter-reef habitat model; and 4) Evaluation of current and alternate management strategies, particularly with respect to the Zoning Plan. It is proposed that only the first and second components will be MTSRF funded.

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. Dependent on co-investment, this information will also be used as critical inputs to an inter-reef habitat model. Data derived from the Seabed Biodiversity Project and proposed Projects 4.8.2 and 4.8.4 will also provide critical inputs to parameterising the distribution and available habitat of key inter-reef fish species in the GBR. The proposed inter-reef and current reef fish population model will be significantly enhanced by inclusion of the dispersal matrix to be developed in proposed Project 4.8.1 (Resilience and Connectivity). The inter-reef habitat model and associated data will be used to evaluate current and alternate management strategies, particularly the ecological and bioeconomic effects of the Zoning Plan, for key inter-reef fish species, as well as coral trout and red throat emperor.

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 Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Collation of available data sources to characterise inter-reef fish resources of the GBR. Dedicated program newsletter article. Briefing to DEW, QDPI&F ReefMAC and GBRMPA FRAC.	31 Dec 2006
(a)	Analysis of resource use from available data sources to characterise inter-reef fish resources of the GBR. Industry, Sunfish, CapReef and other end user newsletter article.	30 Jun 2007
(b)	No activity in Year 1	

Project 4.8.3 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	Date
Milestones – all JCU responsibilities	
Signing of contract	
Report 1 submission: - Program newsletter article. - Briefing report to DEW, QDPI&F ReefMAC and GBRMPA FRAC on project progress and activity: preliminary findings of data collated to characterise inter-reef fish resources of the GBR. - Plan of communication outputs and products for Year 1 and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Jan 2007
Report 2 submission: - Status and trend baseline report of historic and current patterns in resource use of identified key inter-reef fish species of the GBR. - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Mar 2007
Report 3 submission: - Program newsletter article. - Plan for completion of out year activities including identification of key inter-reef species targeted for biological parameter estimation, parameters to be estimated and schedule of laboratory work.	10 Jun 2007
Total MTSRF Funding	\$76,000

Project 4.8.3 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	50,000	-	50,000
JCU	26,000	120,000	146,000
Total	76,000	120,000	196,000

JCU Project 4.8.3 Budget 2006/2007

Item	MTSRF	JCU In-kind	Total Cost
Salaries	45,000	26,000	71,000
Operating	5,000	-	5,000
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	50,000	26,000	76,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	50,000	-	272,500	-	120,000	442,500
2008/2009	50,000	-	305,000	-	120,000	475,000
2009/2010	50,000	-	305,000	-	120,000	475,000
Total	150,000	-	882,500	-	360,000	1,392,500

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

Title	Organisation	Role	FTE
Ashley Williams	JCU	Project Leader responsible for overseeing and managing all aspects of the project.	1.0
David Welch	QDPI&F	Responsible for coordinating the collection of field data and historical data, interpretation and analysis, and write-up	0.5
TBA PhD Student	JCU	Responsible for completing a project related to the biology of key inshore species	1.0
TBA Research Assistant	JCU	Responsible for field work, biological sample processing data entry and analyses	
John Salini	CSIRO	Responsible for assisting with risk assessment development	0.05
Malcolm Dunning	QDPI&F	Responsible for coordinating linkages with QDPI&F Long Term Monitoring Program	0.05
Rod Garrett	QDPI&F	Responsible for providing advice on the inshore fishery and assisting with data interpretation	0.05
Neil Gribble	QDPI&F	Responsible for providing advice on the inshore fishery and assisting with risk assessment development	0.05

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 (QDPI&F, CRC Reef, CapReef, UQ and CSIRO) will be collated to assess the extent of species-specific information available for inshore species. Where gaps are identified, additional data will be collected from observer surveys on commercial and charter vessels and boat ramp surveys for recreational fishers. Personal interviews with fishers from all sectors of the inshore fishery will be conducted as part of proposed Project 4.8.5. Species-specific data collected from these interviews will be made available to this Project. The collection of detailed information for the indigenous sector is beyond the scope of this Project.

An observer survey program will be designed to capture the spatial and seasonal trends in use of inshore biodiversity within the GBRWHA. The observer program will strongly complement existing observer surveys conducted by QDPI&F by collecting similar information from locations and at times not covered by the QDPI&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 QDPI&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 (QDPI&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 with relevant experience in fisheries research will be sought to contribute to the completion of this objective. The student will be located at JCU and jointly supervised by JCU and QDPI&F 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 QDPI&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 Outputs / Milestones

Objective	Output / Milestone	Date / Timing
a,b,c a,b	Identify commercial operations to participate in observer surveys. Collate available data sources to characterise the inshore fishery. Dedicated program newsletter article.	December 2006
a c a,b,c a,b c	Complete review of existing species-specific data and identify knowledge gaps. Complete review of existing biological information for inshore species and identify species for which additional information is required. Commence observer surveys on commercial vessels. Commence boat ramp surveys for recreational fishers. Commence sample collection from commercial fishers and seafood processors. Industry or other end user newsletter article.	June 2007
c	Commence processing of biological samples. Briefing to DEW, QDPI&F, Inshore finfish MAC, CapReef SC and GBRMPA FRAC.	December 2007
d	Develop risk assessment framework for inshore species. Industry or other end user newsletter article.	June 2008
a,b	Collate data from QDPI&F observer surveys. Briefing to DEW, QDPI&F, Inshore finfish MAC, CapReef SC and GBRMPA FRAC.	December 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 June 2009

Objective	Output / Milestone	Date / Timing
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, QDPI&F, Inshore finfish MAC, CapReef SC and GBRMPA FRAC.	December 2009
c	Completion of student thesis. Final workshop with end users to discuss project results. Technical report and relevant peer-reviewed publications.	June 2010

Project 4.8.4 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	Date
Milestones	
Signing of contract	
Report 1 submission [all JCU activities]: - Proposed schedule of engagement activities with commercial operators, recreational fishers, end users and other parties. - Proposed data (e.g. annual catch, species) and sources to be collated to meet objective (a) activities (above).	30 Nov 2006
Report 2 submission: - Report on observer surveys: engagement activities, operators included in project, proposed schedule of field activities and data (type and schedule) to be collected. [JCU] - Input into report on data collated to characterise the inshore fishery – preliminary findings.[CSIRO] - Report on data collated to characterise the inshore fishery – preliminary findings.[JCU] - Dedicated program newsletter article. [JCU] - Plan of Year 1 communication products and events and summary of any other communication activities undertaken to date including minutes of meetings/workshops if applicable, schedule of future communication activities. [JCU]	1 Jan 2007
Report 3 submission: - Status report on knowledge (and gaps in) of industry and community use of inshore GBR biodiversity, of which fish are indicators: opportunities to fill knowledge gaps, review of existing inshore species-specific data. [JCU] - Status report on knowledge (and gaps in) of existing biological information for inshore species used by industry and community and identification of mechanisms to fill data gaps for species that require additional information. [JCU] - Newsletter article. [JCU] - Report on: schedule of observer surveys on commercial vessels and data to be collected, schedule of boat ramp surveys of recreational fishers and data to be collected, data to be collected from commercial fishers and seafood processors to meet objective c. [JCU] - Plan to complete out year activities. [JCU] - Summary of any communication activities undertaken including minutes of	10 Jun 2007

For 2006/2007 Outputs Only	Date
Milestones	
meetings/workshops if applicable, schedule of future communication activities. [JCU]	
Total MTSRF Funding	\$242,500

Project 4.8.4 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	248,000	-	248,000
QDPI&F	-	70,000	70,000
QSIA	-	20,000	20,000
JCU	94,000	25,000	119,000
Total	342,000	115,000	457,000

JCU Project 4.8.4 Budget 2006/2007

Item	MTSRF Funds	JCU Cash	Third Party (QDPI&F)	JCU In-kind	Total Cost
Salaries	194,500	72,000	50,000	7,000	323,500
Operating	33,000	22,000	-	3,000	58,000
Travel	15,000	-	-	15,000	30,000
Communication / Extension	-	-	-	-	-
Capital	-	-	-	-	-
Institutional overheads	-	-	-	-	-
Total	242,500	94,000	50,000	25,000	411,500

CSIRO Project 4.8.4 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	5,500	-	5,500
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	5,500	-	5,500

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	248,000	-	-	50,000	57,000	355,000
2008/2009	248,000	-	-	50,000	57,000	355,000
2009/2010	248,000	-	-	50,000	57,000	355,000
Total	744,000	-	-	150,000	171,000	1,065,000

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

Title	Organisation	Role	FTE
Dr Stephen Sutton	JCU	Project Leader responsible for overseeing and managing all aspects of the project. Dr. Sutton has 12 years experience conducting applied social science research in support of sustainable natural resource management.	0.7
TBA PhD Student	JCU	If end-user co-investment is sufficient, the project will include one PhD student (See Project 4.8.11)	
TBA Post doctoral research fellow	JCU	If end-user co-investment is sufficient, a post-doctoral fellow with appropriate socio-economic research experience will be hired to conduct data collection and analysis and report writing.	1.0

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:

- Understand and document the influence of the 2003 GBR Zoning Plan on use (tourism, recreation, and fishing) of the GBRWhA and users.
- 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.
- 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.

Note: End user co-investment funding of approximately \$40,000 per year will be necessary to undertake Element 2. If sufficient co-investment is available, Element 1 will be de-emphasised in favour of Element 2. Without sufficient co-investment funds, Element 2 will be limited to interviews with a small number (approximately 10-15) of key informants.

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 Outputs / Milestones

The primary end-users who will benefit from the outputs of this project are the Great Barrier Reef Marine Park Authority, the recreational, commercial, and charter fishing industries, and the GBR marine tourism industry.

Objective	Output / Milestone	Completion Date
(a) (b)	Collate existing information relevant to assessing influence of the Zoning Plan. Conduct the socio-economic indicators workshop. Industry and other end user magazine article. Dedicated program newsletter article.	December 2006
(a)	GBR user survey and sampling plan developed. Commence analysis of existing data and GBR user survey. Briefing to DEW, GBRMPA RACs, CapReef, and industry.	June 2007
(c)	Develop telephone survey instrument. Dedicated program newsletter article. Industry and other end user magazine article.	December 2007
(a) (b) (c)	Complete user interviews and telephone survey. Briefing to DEW, GBRMPA, CapReef, and industry.	June 2008
(a) (c)	Complete data entry into GIS and statistical databases. Dedicated program newsletter article. Industry and other end user magazine article.	December 2008
(a) (c)	Analysis of interview and survey data commenced. Briefing to DEW, GBRMPA, CapReef, and industry.	June 2009
(a) (c)	Complete data analysis. Dedicated program newsletter article. Industry and other end user magazine article.	December 2009
(a) (b) (c)	Technical reports and relevant scientific peer-reviewed publications. Briefing to DEW, GBRMPA, CapReef, and industry.	June 2010

Project 4.8.5 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	Date
Milestones – all JCU Responsibilities	
Signing of contract	
Report 1 submission: - Report describing the data to be collected to assess change in the socio-economic environment of GBRWHA use in response to the Zoning Plan. - Report summarizing the current state of knowledge regarding socio-economic indicators for GBRWHA use and outlining the types of indicators (and derivation of such) to be investigated in this study. - Plan of communication outputs and products for Year 1 and summary of any other communication activities undertaken to date including minutes of meetings/workshops if applicable, schedule of future communication activities.	15 Nov 2006
Report 2 submission: - Report of data collated and end user engagement conducted to enable assessment of influences of Zoning Plan on use of GBRWHA and users. - Minutes and findings/outcomes of socio-economic indicator workshop. - Program magazine article. - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	10 Feb 2007
Report 3 submission: - Preliminary findings of assessment of existing data of influences of Zoning Plan on use of GBRWHA and users including identification of gaps in knowledge. - Progress briefing for DEH, GBRMPA RACs, CapReef, and industry. - Report detailing GBR user survey and sampling plan to fill data gaps to meet objective (a). - Summary of any communication activities undertaken including minutes of meetings/workshops if applicable. - Plan for completion of out year activities including completion of obj. (a) activities, testing of indicators (obj b) and documenting the social values and concerns etc related to the GBRMP and its use, management, and conservation (obj c).	10 Jun 2007
Total MTSRF Funding	\$123,000

Project 4.8.5 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	123,000	-	123,000
JCU	30,000*	-	30,000
Total	153,000	-	153,000

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

JCU Project 4.8.5 Budget 2006/2007

Item	MTSRF	JCU Cash	Total Cost
Salaries	98,000	30,000*	128,000
Operating	15,000	-	15,000
Travel	10,000	-	10,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	123,000	30,000	153,000

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

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	123,000	60,000 ¹	-	25,000 ²	-	208,000
2008/2009	123,000	60,000 ¹	-	25,000 ²	-	208,000
2009/2010	123,000	60,000 ¹	-	20,000 ²	-	203,000
Total	369,000	180,000	-	70,000	-	619,000

¹ Co-investment requested from JCU to cover sixty percent of PI salary.

² Co-investment requested from end-users to cover fieldwork and data collection.

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

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 b and 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	0.3
Assoc Prof Peter Valentine	JCU	Post Doctoral Research Fellow Task Objective a and c	0.1
Dr Natalie Stoeckl	JCU	Principle Investigator 3 Task Objectives a and c	0.2
TBA PhD students	JCU	Task Objectives a and c	
TBA Post Doctoral Research Fellow	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

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 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 link with the inshore biodiversity project (Project 7) on irukandji movement and habits, and the risk of human encounters to irukandji and other marine stingers that may influence tourist visitation.

The project is linked to Project 4.8.5, Objective (a) and (b): Understand and document the influence of the 2003 GBR Zoning Plan on use (tourism, recreation, and fishing) of the GBRWHA and users.

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.

This task will collect data on iconic reef marine species and assess their social and economic value. A triple bottom line approach will be adopted. Data will be collected by questionnaires to assess human-wildlife encounters and to assess the economic value of species such as minke whales, turtles and large fish.

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.

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.

Project Outputs / Milestones

Objectives	Output / Milestone	Completion Date
(d)	Technical report on establishment of visitor monitoring structure.	February 2007
(d)	Annual report on visitor patterns.	August 2007
(a) (b)	First Technical report on social values of key marine species. Preliminary report on key drivers and benchmarks and economic value.	February 2008
(a) (d) (d)	Second Technical report on social values of key marine species. Annual report on visitor patterns Annual report on economic value	July 2008
(a) (d)	Third Technical report on the social and economic values of key marine species. <i>Preliminary report on key trends, and benchmarks.</i>	February 2009
(d) (d)	Annual report on visitor patterns. Annual report on economic value.	July 2009
(c) (a) (a)	Report on evaluative frameworks and management tools. Report on triple bottom Line and Sustainable Management Final report on the social and economic values of key marine species.	February 2010

Project 4.8.6 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission • Design and schedule of visitor monitoring surveys to meet objective (d) (above): identify end users engaged in project. • Plan of communication outputs and products for year one and summary of any communication activities undertaken to date including minutes of meetings/workshops if applicable.	1 Nov 2006
Report 2 submission • Preliminary findings of visitor monitoring surveys conducted to date: status of visitor usage, key trends in patterns of use, drivers of visitor use of the GBR. • 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.	1 Feb 2007
Report 3 submission • Status and trends of visitor usage of key environmental assets of the GBR: Identification of key trends, attractive assets, drivers of visitor patterns to the GBR, comparison with visitation of other Australian and international reef tourist attractions (final report due August 2007). • 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.	11 Jun 2007
Total MTSRF Funding	\$148,000

Project 4.8.6 Budget

Year 1 – 2006/2007 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

JCU Project 4.8.6 Budget 2006/2007

Item	MTSRF	Funds from Other Sources	Total Cost
Salaries	95,000	70,000	165,000
Operating	23,000	80,000	103,000
Travel	15,000	-	15,000
Communication / Extension	15,000	-	15,000
Capital	-	-	-
Institutional overheads	-	-	-
Total	148,000	150,000	298,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	148,000	-	90,000	145,000	10,000	393,000
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	444,000	-	270,000	435,000	30,000	1,179,000

* Co-investment would substantially enhance Objective (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

Project Leader and Host Organisation

Professor Mike Kingsford, James Cook University (JCU)

Project Team

Title	Organisation	Role	FTE
Prof Michael Kingsford	JCU	TBA	TBA
Dr Jamie Seymour	JCU	TBA	TBA
Dr Madeleine van Oppen	AIMS	TBA	TBA

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

The purpose of this Project is to minimise risk to swimmers through knowledge of the sources of jellyfishes and changes in their abundance. Although anecdotally there is no link between abundance of *C. barnesi* and proximity to estuaries this has never been tested critically. The inshore zone is the area of highest use by the public and forecasting the risk of envenomation is critical. Our approach involves sampling near-shore waters near to and away from estuaries in an area of north Queensland that has high usage by tourists and locals. The coastal zone between the Daintree River and Mackay has the highest frequency of envenomation and is our area of focus. Samples of *C. barnesi* and *C. flecker* will be used for genetics and elemental fingerprints to determine population structure.

Key Objectives:

- (a) Develop a microsatellite DNA marker library to assess spatial structure in *C. barnesi*.
- (b) Use elemental chemistry and microsatellites to test for differences in the population structure of *C. barnesi* and *C. flecker* among locations.

Project / Task Methodology

Objective (a): Develop a microsatellite DNA marker library to assess spatial structure in *C. barnesi*.

Microsatellite DNA markers have been developed for *C. fleckeri* and we will develop a microsatellite library that will also allow us to assess spatial structure in *C. barnesi*.

Objective (b): Use elemental chemistry and microsatellites to test for differences in the population structure of *C. barnesi* and *C. flecker* among locations.

We will use elemental chemistry and microsatellites to test for differences in the population structure of *C. barnesi* and *C. flecker* among locations. The use of elemental chemistry to distinguish population of fishes is well established. A pilot study will be done to determine the detectable elements that will be best to discriminate populations of jellyfishes. The number of

locations that are sampled will depend on funding levels. Sampling will be done at two sites near Palm Cove to obtain samples for preliminary work on elemental chemistry and genetics. Variation in elemental chemistry and genetics within a site will be used to make final decisions on numbers of replicates. These samples will also be critical for the development of a DNA marker library.

Project Outputs / Milestones

Note: end users of this research will include the tourist Industry, Surf Life Saving, local Councils and other managers of coastal waters, the medical fraternity.

Objective	Output / Milestone	Completion Date
a	Development of microsatellites for field studies.	June 2007
b	Use of elemental chemistry and microsatellites – results	June 2008

Project 4.8.7 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission - Provision of field schedule plan - Plan of communication outputs and products for year one	15 Jan 2007
Report 2 draft submission - Collect samples of <i>C. fleckeri</i> and <i>C. barnesi</i> - Report on microsatellite DNA markers in existence for <i>C. fleckeri</i>, applicability for use with <i>C. barnesi</i>, including any laboratory testing, and approach to developing microsatellite library of <i>C. barnesi</i>. - 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 stinger newsletter.	10 June 2007
Acceptance of draft submission	30 June 2007
Information transfer between agencies. Provision of Agency – Surf Lifesaving data on risk of exposure to be disseminated. Officer Responsible for provision of information to Surf Lifesaving – Michael Kingsford	
Total MTSRF Funding	\$25,000

Project 4.8.7 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	25,000	-	25,000
JCU	-	35,000	35,000
AIMS	-	15,000	15,000
Total	25,000	50,000	75,000

JCU Project 4.8.7 Budget 2006/2007

Item	MTSRF	JCU / AIMS In-kind	Total Cost
Salaries	-	50,000	50,000
Operating	20,000	-	20,000
Travel	5,000	-	5,000
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	25,000	50,000	75,000

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	25,000	5,000	45,000	40,000	-	115,000
2008/2009	25,000	5,000	45,000	40,000	-	115,000
2009/2010	25,000	5,000	45,000	40,000	-	115,000
Total	75,000	15,000	135,000	120,000	-	345,000

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 Program 8**Project Leader and Host Organisation**

Dr Colin Simpfendorfer, James Cook University (JCU)

Project Team

Title	Organisation	Role	FTE
Norman Palmer	JCU	JCU co-ordination.	0.05
Ann Penny	JCU	Principal Investigator, Communications officer: project activities and liaison with researchers and stakeholders	0.7

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

The science projects conducted in Program 8 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 Program 8 related activities based on the previous communication model described above. It is anticipated that the communication activities identified in the schedule (4.8.8) link to other communication activities within the MTSRF program, in particular Program 4 (Threatened Species).

Key Objectives:

- (a) Coordinate communication activities and products to enhance the delivery of research activities and findings of Program 8 in 2006/2007.
- (b) Develop linkages with other communication activities within the MTSRF Program.

Project Outputs / Milestones

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 (Program 8) 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 Programs 8 and other 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 Program 8 and GBR related projects into products (including newsletters and media releases) to deliver research information to stakeholders.	June 2007 (carries into out years)
(a)	Facilitate Program 8 and GBR related project researchers to provide research information in newsletter articles, visits to communities and meetings where appropriate	June 2007 (carries into out 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 Program 8 and other MTSRF program communication activities.	June 2007, 2008, 2009 and 2010

Project 4.8.8 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	Date
Milestones	
Signing of contract	
Progress Report 1. - Plan of communication activities and actions to enable communication template/product development for research activities under Program 8. - Drafts of newsletter, pamphlets, media brief and any other product templates developed for delivery of Program 8 activities - Plan for researcher engagement activities for Program 8 for Year 1 - Report of any communication activities undertaken to date and synthesis of any preliminary Program 8 findings communicated to date	15 Jan 2007
Progress Report 2. - Final templates for Program 8 media briefs, reports to RRRC and newsletters - Provision of any newsletters, pamphlet, media briefs or other products produced to date synthesising research conducted under Program 8 - Report on meetings conducted with Program 8 researchers and links with other communications/liaison activities in the MTSRF program.	1 May 2007
Final Report - 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 2007
Total MTSRF Funding	\$75,000

Project 4.8.8 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

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

* A total of \$20,000 is held by Reef and Rainforest Research Centre for Visual Documentation for Program 8 collectively (see Theme 5).

JCU Project 4.8.8 Budget 2006/2007

Item	MTSRF	Funds from Other Sources	Total Cost
Salaries	65,000	-	65,000
Operating	20,000	-	20,000
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	85,000	-	85,000

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	372,422	1,526,915	1,899,337
Total	1,575,697	1,526,915	3,102,612

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, FNQ NRM Ltd, Indigenous groups, industry and other key stakeholders based in the Wet Tropics bioregion and NRM region:

- Indigenous landscapes of the Wet Tropics World Heritage Area: use, planning and management.
- Sustainable nature based tourism: use, planning and management.
- Impacts of urbanisation on north Queensland environments: management and remediation.
- Integrating ecology, economics and people in forest landscapes.
- Restoring tropical forest landscapes.
- Strategic natural resource management and landuse planning.
- Tools and processes for social engagement

Project 7 is shared with Program 2 (Theme 1). This fulfils an integrative function across both programs, and will articulate with Theme 5 – Enhancing Delivery. Within our 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 Project 3.7.7 Integrated Report Card Framework for the MTSRF Program.

The research outputs 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 in forest and 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 and enhancing social resilience: science and management integration project	\$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

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
Mr 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	FNQ NRM Ltd	Research user, all objectives	0.1
Bruce White	JCU	Researcher, all objectives	1.0

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

Contemporary Indigenous natural resource use across the Wet Tropics is poorly understood and often ignored in regional planning and management processes. This gap in existing knowledge is flagged as a critical issue in 'Caring for Country and Culture', Australia's first dedicated Indigenous NRM plan for a multi-tenured region. This project will improve understanding of past, current and potential Indigenous natural resource use of the Wet Tropics leading to the incorporation of Indigenous ecological values and practices in regional environmental planning and management schemes. In identifying the nature, limits and impacts of Indigenous resource use this project will assist both Traditional Owners and regional resource agencies in the development of culturally-appropriate country-based management strategies. The project will dovetail with country-based planning and cultural mapping exercises initiated by the Aboriginal Rainforest Council (ARC) and FNQ NRM. The project will build upon existing research, capacity-building and Indigenous engagement strategies, notably the *Aboriginal Plan*, initiated by the Rainforest CRC and regional Traditional Owners.

Key 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.

Project / Task Methodology

The formulation of culturally-appropriate and sustainable planning approaches and management strategies, which fully acknowledge Aboriginal resource use of the Wet Tropics and the range of Indigenous values ascribed to the regional landscape, hinges upon the meaningful participation of Traditional Owners at all phases and levels of the process. Critical to the success of these strategies is the development of methods for the recording, assessment and monitoring of Indigenous resource use in collaboration with Traditional Owner groups. All too often in the past, the use of inappropriate methodologies has resulted in the non-involvement of Aboriginal people in planning and management, the reduction of their role in research to that of subjects, subordinates, or clients, or has brought about the complete failure of a research project.

One of the key initial project tasks is the development of relevant methods, indicators and criteria for recording, monitoring and evaluating Indigenous resource use. The project will evaluate current models, methods and techniques for recording Indigenous natural resource use. In collaboration with Traditional Owners, the project will develop culturally-appropriate research methods based upon this assessment of existing research models and methods. The research methods adopted in this project may include the use of Traditional Owner logbooks, various mapping techniques, community questionnaires and surveys, individual interviews, and participant observation fieldwork. In conjunction with the development of this research techniques, the project will also establish local research and intellectual property protocols prior to the commencement of research.

Objective (a). To understand Indigenous natural resource use within the Wet Tropics WHA through the completion of reviews and comparative assessments.

- Based on a desk-top survey, identify knowledge gaps and establish baseline data on past and present Indigenous nature resource use within the Wet Tropics World Heritage Area.
- Assess Indigenous natural resource use in comparable World Heritage-listed natural sites in Australia and in the Wet Tropics 'sister' World Heritage site in West Papua.
- Identify appropriate and effective management strategies, conservation frameworks and capacity-building programs in comparable World Heritage natural sites for use in the Wet Tropics WHA.
- Evaluate models, methods and techniques for recording Indigenous resource use and develop culturally-appropriate research and IP protocols (linked to IRC).

Objective (b). To optimise Traditional Owner engagement and knowledge in natural resource management.

- Identify Indigenous notions of ecological cause and effect, ecosystem risks and threats, and the interdependencies within and between Indigenous-defined landscapes in order to

develop possible points for the interface and integration of Indigenous knowledge and scientific knowledge in NRM (linked to IRC).

- Identify the social and economic benefit to Indigenous people of ecological goods and services derived from their traditional estates. Benefit assessment will be undertaken by Project Leader in conjunction with Traditional Owners using culturally-appropriate assessment criteria and based upon an assessment of current EIA and SIA criteria.
- Assess Indigenous past, current and potential uses of introduced species, identify Indigenous prevention or control practices regarding these species, and develop best practice management solutions for key species.
- Identify Indigenous values for water resources, perceptions regarding water quality and changes to it, and those Indigenous practices which maintain water quality and minimise pollution (linked to IRC).
- Identify Indigenous values for other identified natural resources, including perceptions regarding resource integrity and changes to it, and those Indigenous practices which maintain resource integrity and minimise environmental degradation and pollution (linked to IRC).
- In contrast to and in comparison with broader community natural resource access and use, determine what are the key social, cultural, economic, legal and institutional impediments to Indigenous use of natural resources, and the maintenance of sustainable natural resource environments.

Objective (c). To enhance opportunities for building capacity in Traditional Owner groups for engagement in research and management of the Wet Tropics WHA.

- Identify Indigenous best practice resource use and management practices that will contribute to improved catchment management and ecosystem restoration practices (linked to IRC).
- Working with Traditional Owners and Project partners, develop practical solutions and best practice pathways to facilitate the incorporation and use of Indigenous environmental values and knowledge of ecological conditions, risk and change in mainstream planning and management policies and practices.
- Provide further documentation of Aboriginal environmental values and natural resource use in support of the re-nomination of the Wet Tropics WHA for its Indigenous values.
- Contribute to the practical development of culturally-appropriate and best practice management and planning strategies based upon Indigenous values and concepts.
- Identify existing Traditional Owner research capacity and contribute to the practical enhancement of Aboriginal research recording and monitoring through skills-transfer.
- Conduct workshops with Traditional Owners and Project partners to report and discuss research findings.
- Conduct workshops with Traditional Owners and Project partners to discuss a regional strategy for Indigenous involvement in biodiversity conservation.
- In collaboration with Traditional Owners and Project partners, identify culturally-appropriate and best practice research adoption, integration and communication formats and strategies.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
a	Complete desktop reviews and comparative assessments of indigenous resource use, past and contemporary, in the Wet Tropics, and Indigenous natural resource management strategies.	May 2007
b	Initiate program of engagement with Traditional Owner groups and Aboriginal organisations in the Wet Tropics.	June 2007
b	In collaboration with Traditional Owners, identify strategies for addressing research-related issues and problems for indigenous engagement.	June 2007
b	Identify the research recording capacity of those Traditional Owner groups involved in the project and where necessary facilitate skills-enhancement workshops to enable Traditional Owners to participate in the recording of Indigenous resource use and maintain technologically and culturally-appropriate data management systems.	June 2007

Project 4.9.1 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	Date
Milestones – all JCU responsibilities	
Signing of contract	
Report 1 submission - Report based upon a desk-top survey of documented Aboriginal resource use, values and knowledge, which identifies integration gaps in current management and research practices, and recommends pathways to facilitate the inclusion of Traditional Owner values and knowledge as part of best practice engagement strategies. - Plan of communication activities and outputs for Year 1, summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	14 Jan 2007
Information transfer between agencies - Provision of Project 4.9.1 data from desktop survey to Rainforest Aboriginal Council for approval and endorsement, thence to DEW (integrated report card), WTMA, QEPA and FNQ NRM - Provision of workshop proceedings, reports and other documents to the above agencies and organisations	As available, no later than 11 June 2007
Report 2 submission - Final report on Indigenous resource use and management strategies in comparable World Heritage natural sites in Australia and elsewhere, which identifies best practice models and practical solutions which could be applied in the Wet Tropics. - Final report which evaluates previous and current methods and models for researching Indigenous resource use and purposes, and recommends best practice research solutions. - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	31 Mar 2007
Report 3 submission Progress update of activities identified for Objective b.	18 May 2007

For 2006/2007 Outputs Only	Date
Milestones – all JCU responsibilities	
Report 4 submission - Final report including sections on the following outputs: - Identified Traditional Owner researchers in the Wet Tropics region. - Establish best practice local research and intellectual property protocols based upon an assessment of current protocols. - Development of culturally-appropriate, best practice research methods based upon a review of previous RCRC projects, recommendations and outcomes. - Research Charter (extending upon existing protocols, MoUs and regional agreements). - Identification of Traditional Owner recording capacities. - Identified existing skills enhancement courses and develop Traditional Owner best practice research toolkit which link into current provisions. - Evidence of the development of Traditional Owner researcher/capacity data base for use by ARC, FNQ NRM Ltd, and other research institutions and management agencies. - Final summary of communication activities undertaken through the course of Year 1 of project. - Plan for completion of out year activities.	11 June 2007
Total MTSRF Funding	

Project 4.9.1 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	73,500	-	73,500
MTSRF Visual Documentation*	1,500	-	1,500
JCU	70,000	80,000	150,000
FNQ NRM Ltd	-	324,000	324,000
ARC	-	10,000	10,000
Girringun	-	5,000	5,000
UQ	-	5,000	5,000
AIATSIS	-	10,000	10,000
CSIRO	-	20,000	20,000
Total	145,000	454,000	599,000

* A total of \$1,500 is held by the Reef and Rainforest Research Centre for Visual Documentation of this project (see Theme 5).

JCU Project 4.9.1 Budget 2006/2007

Item	MTSRF Funds	JCU Cash	JCU In-kind	Total Cost
Salaries	47,000	70,000*	80,000	197,000
Operating	11,000	-	-	11,000
Travel	8,000	-	-	8,000
Communication / Extension	7,500	-	-	7,500
Capital	-	-	-	-
Institutional overheads	-	-	-	-
Total	73,500	70,000	80,000	223,500

* Cash contribution from JCU towards Senior Indigenous Research Officer's salary.

Indicative Budget Summary – Years 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	75,000	70,000	20,000	-	407,000	572,000
2008/2009	75,000	70,000	20,000	-	75,000	240,000
2009/2010	75,000	70,000	20,000	-	75,000	240,000
Total	225,000	210,000	60,000	-	557,000	1,052,000

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

Project 4.9.2: Sustainable nature based tourism: planning and management

Project Leader and Host Organisation

Professor Bruce Prideaux, James Cook University (JCU)

Project Team

Title	Organisation	Role	FTE
Professor Bruce Prideaux	JCU	Project Leader, researcher in objectives (a) (b)	0.2
Adj. Prof. Glenn Ross	JCU	Researcher, objective (a)	0.1
Dr Heather Zeppel	JCU	Researcher, objectives (a)	0.1
Prof. Steve Turton	JCU/CSIRO	Researcher, objective (b)	0.1
Fay Falco-Mammone	JCU	Post Doc Research Fellow, objectives (a)	1.0
Dr Noel Scott	UQ	Researcher, objectives (a)	0.5
Max Chappell	WTMA	Liasion,user, objectives (a) (b)	0.1
Post Doc Fellow (TBA)	JCU	Research, objective (b)	1.0
PhD Student	JCU	Research, objective (a or b)	1.0

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 improved understanding of the perceptions and motivations of the tourists and local community who use the Wet Tropics rainforests, allow identification of major drivers and trends in visitation, report on tour operator accreditation, development of a visitor barometer, report on benchmarking of tourism patterns and development of tools to determine visitor sustainability. Understanding trends and drivers will enable WTMA and the tourism industry to develop internationally competitive visitor experiences and enable WTMA to develop more effective visitor management policies. The 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 meta tourist data set that will facilitate long term analysis of tourist patterns as well as collect a range of economic data. The data output will enable detailed knowledge of tourist segment characteristics; use patterns over time, expenditure patterns, motivations, satisfaction etc to be developed. For end users this data will provide regular updates on tourist patterns and behaviors. 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, 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 CRC⁹) 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. 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. Results will be benchmarked against national and

⁹ 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

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 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 CRC Rainforest¹ and is designed to identify changes that have occurred in visitor usage and perceptions in the period since the last survey. The survey will be conducted in two stages, a dry season component and a wet season component. A detailed site specific report will be compiled with changes and major emerging trends identified. The second survey proposed is a mail out survey to capture community reactions to the use and management of the Wet Tropics. Other components of this task will include focus groups involving key tourism industry users and identified community leaders. Combining this knowledge with data collected in Objective (a) will develop specific knowledge of environmental sustainability levels and will assist in determining the level of tourist sustainability if there are restrictions placed on visitor numbers or tourist usage of specific sites. A number of management tools will be identified and a sustainable level of visitation framework developed as a new assessment and management tool to assist WTMA and EPA managers mitigate impacts of loss of sustainability through overuse. These tools will incorporate previous work by the Rainforest CRC 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 a tour operator guide(s) that will assist towards future production of a WTWHA tour operator accreditation system.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
a	Establish a visitor monitoring program for the Wet Tropics WHA. <i>Objective a(i) and (iii)</i>	March 2007
a	Identify key drivers of Wet Tropics visitor patterns including economic contribution. <i>Objective a(ii)</i>	August 2007*

Objective	Targeted Activity	Completion Date
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. <i>Objective b(ii)</i>	April 2007
b	Identify community attitudes, knowledge and perceptions of use and management of the Wet Tropics. <i>Objective b(i)</i>	August 2007*

* Involves ongoing activities in Out Years.

Project 4.9.2 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	
Milestones	Date
Signing of contract	
Report 1 submission [all JCU tasks] - Progress update of activities associated with objective a: design and implementation of visitor surveys, visitor barometer, tourist operator manual. - Plan of communication activities for Year 1 and summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Dec 2006
Report 2 submission - Technical report on the establishment and methods used for a visitor monitoring program in the Wet Tropics WHA. [JCU] - Contribution to the technical report on the establishment and methods used for a visitor monitoring program in the Wet Tropics WHA [UQ] - Submission of the first quarterly visitor barometer. [JCU] - Tour operator user guide / manual for best practice for ecotourism in Wet Tropics.[JCU] - Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.[JCU]	30 April 2007
Report 3 submission - Report on progress of the first Annual report of Wet Tropics visitor patterns including evaluation of indicators used to identify key drivers and trends. [JCU] - Report on progress of the survey of visitor usage and perceptions at site level objective b(1). [JCU] - Report on progress to identify community attitudes, knowledge and perceptions of use and management of the Wet Tropics [JCU] - Contribution to report on progress of the survey of visitor usage and perceptions at site level. [UQ] - Report on the stakeholder workshop to explain visitor monitoring program. [JCU] - Final summary of communication activities undertaken through the course of Year 1 of project. [JCU] - Plan for completion of out year activities. [JCU]	30 June 2007
Total MTSRF Funding	\$198,500

Project 4.9.2 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	198,500	-	198,500
MTSRF Visual Documentation*	1,500	-	1,500
JCU	-	35,000	35,000
WTMA	-	10,000	10,000
UQ	-	10,000	10,000
Sustainable Tourism CRC (0.5 PhD Scholarship) [#]	-	10,000	10,000
Total	200,000	65,000	265,000

* A total of \$1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

[#] Linked with Objective (a).

UQ Project 4.9.2 Budget 2006/2007

Item	MTSRF	Funds from Other Sources	Total Cost
Salaries	3,000	-	3,000
Operating	-	-	-
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	3,000	-	3,000

JCU Project 4.9.2 Budget 2006/2007

Item	MTSRF	JCU In-kind	Total Cost
Salaries	147,000	65,000	212,000
Operating	15,000	-	15,000
Travel	15,000	-	15,000
Communication / Extension	18,500	-	18,500
Capital	-	-	-
Institutional overheads	-	-	-
Total	195,500	65,000	260,500

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

Project 4.9.3: Impacts of urbanization on North Queensland environments: management and remediation

Project Leader and Host Organisation

Professor Steve Turton, James Cook University (JCU)

Project Team

Title	Organisation	Role	FTE
Prof Steve Turton	JCU/CSIRO	Program and Project Leader, researcher, objectives (a) (b)	0.50
Prof David Gillieson	JCU	Researcher, GIS, remote sensing, objectives (a) (b)	0.10
Dr Miriam Goosem	JCU	Researcher, ecology, objectives (a) (b)	1.00
Dr Joan Bentrupperbäumer	JCU	Researcher, social-sciences, objectives (a) (b)	0.10
Ms Catherine Pohlman	JCU (PDF) (50% salary from Powerlink)	Researcher (PDF), ecology, objective (a)	1.00
Dr Iris Bohnet	CSIRO	Researcher, social-sciences, objectives (a) (b)	0.05
Mr Max Chappell	WTMA	User, PA manager, objectives (a) (b)	0.05
Dr Steve Goosem	WTMA	User, PA manager, objectives (a) (b)	0.05
Environmental Officer	Powerlink	User, utilities, objective (a)	0.10
Environmental officer	QDMR	User, planner, objective (a)	0.10
Project support/logistics officer	QDMR	Technical, engineer, objective (a)	0.10

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 Invasives) and 7 (Water Quality). These links will feed into the Integrated Report Card process.

Key Objectives:

- (a) Linear community infrastructure: impacts and mitigation.
- (b) Riparian vegetation: Modeling of quality and habitat connectivity in urban and rural areas.

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 and adjoining habitats 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).
- 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 runoff waters (linked to IRC).
- Examine the effectiveness of mitigation strategies in reducing impacts of infrastructure on threatened, rare and endemic species.

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. Previous research in Rainforest CRC Project 4.2 on impacts of linear infrastructure on microclimate, vegetation and fauna will be used to inform this work, together with new research concerning interactions between natural and anthropogenic disturbances and application of remote sensing as a potential indicator of habitat condition.

Mitigatory strategies that have been or will be assessed and/or trialed and monitored for effectiveness include road underpasses and canopy bridges, barriers to disturbance from noise and headlights, in-drainage pollutant scrubbers, bridges high above the canopy to allow habitat connectivity under highways, canopy connectivity over narrow roads and experimental revegetation across powerline clearings.

Objective b: Riparian vegetation: Modeling of quality and habitat connectivity in urban and rural areas.

This objective has several key tasks:

- Test and apply riparian vegetation quality indicators that are quickly and easily assessed using remote sensing and GIS modeling that were successfully established in recent research in the Douglas Shire to other urban and rural areas in the Wet Tropics bioregion and test these using indicators of faunal habitat connectivity (linked to IRC).
- Create GIS models and a priority classification of riparian vegetation in these areas for conservation or restoration in terms of maintaining or creating faunal habitat connectivity (linked to Project 4.9.5).
- Undertake psychosocial analysis of landholder attitudes to riparian forests.

Remote sensing via aerial and/or satellite photographic analysis forms the basis of this project to determine canopy cover and width of riparian 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. Visitor, resident and manager/expert interviews and surveys with qualitative and quantitative response formats are analysed using psychometric scaling and criteria checklists to examine landholder attitudes to riparian vegetation.

Project Outputs / Milestones

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).	December 2006
a	Preliminary identification of informative and cost-effective ecological indicators of linear infrastructure impacts in rainforests and adjoining habitats in the Wet Tropics bioregion.	June 2007 ^{*#}
a	Preliminary 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).	June 2007
a	Initial examination of the use of high-resolution remotely sensed data to assess habitat condition adjacent to linear community infrastructure.	June 2007 [#]
a	Ongoing monitoring of the effectiveness of mitigation strategies in reducing impacts of linear infrastructure on threatened, rare and endemic species.	June 2007 [*]
b	Commencement of testing and application of riparian vegetation quality indicators that are quickly and easily assessed using remote sensing and GIS modelling.	June 2007 [*]

* Involves ongoing activities in Out Years.

Co-funded by Powerlink.

Project 4.9.3 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	Date
Milestones – All JCU responsibilities	
Signing of contract	
Report 1 submission • Submission of final research proposal for collaborative work to be undertaken with funding from Powerlink (identified above in activities associated with obj a), specifically: - o Powerline clearing edge impacts in Dry Sclerophyll Woodlands; - o Impacts of Cyclone Larry on rainforest adjacent to powerline clearings; and - o Pre- and Post Cyclone comparisons of disturbance along edges of the Palmerston Powerline clearing. • Plan of communication activities, products and events for Year 1 activities.	25 August 2006
Report 1 submission • Report of outcomes of workshop with research users (obj a). • Copy of 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: Impacts of Cyclone Larry on rainforest adjacent to powerline clearings. • Progress report on the remaining Powerlink projects (obj a, Tasks noted as #). • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable. • Reports regarding effectiveness of overpasses and underpasses.	1 December 2006
Report 2 submission • Progress update on activities associated with objective a: field surveys, impact indicator development, remote sensing applications. • Progress update on activities associated with objective b: site selection, review of riparian vegetation quality indicators. • Progress report on the remaining Powerlink projects (obj a, Tasks noted as #). • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable.	16 March 2007
Report 3 submission • Final report on selection of riparian vegetation assessment area(s) and findings of the desktop analysis on remote sensing imagery and GIS interpretation (obj b, dependent on a student). • 3 Wet Tropics book chapters: - o Rethinking Road Ecology (obj a) - o Fragmentation effects in rainforests (obj a) - o Application of remote sensing in rainforest conservation and management (obj b) • Final summary of communication activities undertaken through the course of Year 1 of project. • Plan for completion of out year activities. • Final report on the Powerlink projects (obj a, Tasks noted as #: indicators of infrastructure impacts; use of remote sensing data to assess habitat condition adjacent to infrastructure).	8 June 2007

For 2006/2007 Outputs Only	Date
Milestones – All JCU responsibilities	
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).	
Total MTSRF Funding	\$213,500

Project 4.9.3 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	*213,500	-	213,500
James Cook University	60,000	100,810	160,810
Queensland Department of Main Roads	55,120	52,300	107,420
Powerlink	114,402	6,000	120,402
WTMA	-	14,400	14,400
Total	443,022	173,510	616,532

* A total of \$1,500 is held by the Reef and Rainforest Research Centre for Visual Documentation of this project (see Theme 5).

JCU Project 4.9.3 Budget 2006/2007

Item	MTSRF Funds	JCU Cash	Third Party Contracts Cash**	In-kind	Total Cost
Salaries	*170,500	60,000	100,000	100,000	430,500
Operating	23,000	-	69,522	73,510	166,032
Travel	-	-	-	-	-
Communication / Extension	20,000	-	-	-	20,000
Capital	-	-	-	-	-
Institutional overheads	-	-	-	-	-
Total	213,500	60,000	169,522	173,510	616,532

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

** Includes third party contracts with Queensland Department of Main Roads and Powerlink Queensland.

Indicative Budget Summary – Years 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	*215,000	-	105,000	120,000	40,000	480,000
2008/2009	*215,000	-	108,000	120,000	42,000	485,000
2009/2010	*215,000	-	111,000	160,000	42,500	528,500
Total	*645,000	-	324,000	400,000	124,500	1,493,500

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

PROGRAM 9: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES**Project 4.9.4: Integrating ecology, economics and people in forest and landscapes****Project Leader and Host Organisation**

Dr John Herbohn, The University of Queensland

Project Team

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

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) 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.
- (b) 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.
- (c) Investigate financial performance, risk profiles, plus the broader social, environmental and economic impacts of revegetation plantings suitable for use in the Wet Tropics.

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 FNQ-NRM and PFNQ involved at all stages – design, implementation, interpretation and application. We will hold regular workshops and meetings with key stakeholders.

Objective (a): 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 (AFFFFM), 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. We will gather data for other tree species commonly grown for timber in the region and those that could become widely grown in the near future. 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 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 (Catterall) will be incorporated. In addition, we will investigate the potential to develop a more complex physiologically-based model (e.g. Plantgro, 3PG and APSIM). The revised model will be distributed at a training workshop in June 2007. Further versions of the model will be released as modules are updated. Each major new release will be accompanied by a workshop for users.

Objective (b): 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 and planted vegetation. 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., 2001¹⁰, Herbohn et al., 2005¹¹ Emtage et al.,¹² in press) and that developed by the National Land and Water Resources Audit and the

¹⁰ 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.

¹¹ Herbohn, J.L., Emtage, N.F., Harrison, S.R. and Smorff, D.B. (2005), 'Attributes of landholders to farm forestry in tropical eastern Australia', *Australian Forestry*, 68(1): 50-58.

¹² 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*.

Bureau of Rural Sciences (Nelson et al. 2005¹³) 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 FNQ-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 and information. As such the research will be directly relevant to meeting the objectives described for Program 10 of the MTSRF (enhancing delivery).

Objective (c): Investigate financial performance, risk profiles, plus the broader social, environmental and economic impacts of revegetation plantings suitable for use in the Wet Tropics.

This objective deals with developing cost-effective farm-based small-scale revegetation systems using mainly 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 private investment in tree planting to protect ecological goods and services such as through biodiversity (Catterall) and landscape connectivity (Turton). To do this, we will develop an integrated bio-economic model based on a modified AFFFM, which will be used to investigate the tradeoffs between management for ecological objectives and economics and 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 the financial analyses for the landholder types 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.

¹³ 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.

In addition, we will draw upon the substantial work undertaken by the project team over the past ten years in the Wet Tropics region. Information about the financial impacts of forest management and revegetation by individual landholders will be drawn from research undertaken for meeting Objectives (a) and (c). For individual landholder types we will undertake a comprehensive risk analysis (including the impacts of cyclones) and apply the principles of portfolio theory to identify which revegetation systems are best suited to integrating into various farming systems (using the modified AFFFM and landholder types as described for objectives (a) and (b)). Understanding about the social impacts of revegetation programs and forest management will be developed using results from research to meet objective (b). In addition, we will use the understanding of landholder types obtained in objective (b) 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 Geoff McDonald and Steve Turton within this Program.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
a	Completion of Delphi survey of forestry experts to update the growth module for forestry species.	June 2007*
b	Development of a sampling framework and questionnaire for a survey of landholder practices, values, needs, attitudes, capacity and knowledge in regards to NRM in the Wet Tropics.	June 2007*

* Involves ongoing activities in Out Years.

Project 4.9.4 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones – all UQ responsibilities	
Signing of contract	
Report 1 submission - Results of Delphi survey (obj a). - Outline of sampling framework and questionnaire for a survey of landholder practices, values, needs, attitudes, capacity and knowledge in regards to NRM in the Wet Tropics (obj b). - Plan of communication activities for year one and summary of any communication/liaison activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Dec 2006
Report 2 submission Progress update on activities associated with objectives a-b (above).	31 March 2007
Report 3 submission - Implementation plan for objective c. - Final summary of liaison activities undertaken through course of year 1 of project.	10 June 2007
Total MTSRF Funding	\$123,500

Project 4.9.4 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	123,500	-	123,500
MTSRF Visual Documentation*	1,500	-	1,500
JCU	-	198,800	198,800
WTMA	-	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 (see Theme 5).

UQ Project 4.9.4 Budget 2006/2007

Item	MTSRF	Funds from Other Sources	Total Cost
Salaries**	91,000	Split to be advised	
Operating	11,600	-	11,600
Travel	12,400	-	12,400
Communication / Extension [#]	8,500	-	8,500
Capital	-	-	-
Institutional overheads	-	-	-
Total	123,500		

* 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 AFFFFM.

Indicative Budget Summary – Years 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	125,000	-	232,200	25,000	TBA	382,200
2008/2009	125,000	-	243,900	25,000	TBA	393,900
2009/2010	125,000	-	256,000	25,000	TBA	406,000
Total	375,000	-	732,100	75,000	-	1,182,100

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

Project 4.9.5: Restoring tropical forest landscapes

Project Leader and Host Organisation

Associate Professor Carla Catterall, Griffith University (GU)

Project Team

Title	Organisation	Role	FTE
Dr Carla Catterall	GU	Project leader and researcher. Senior ecologist.	0.25
Dr John Kanowski	GU	Research fellow and key scientific researcher across objectives. Wildlife ecologist.	1.00
Debra Harrison	FNQ NRM Ltd / GU	Research assistant and facilitator in objective (c). Ecologist and information manager.	0.70
Rowena Grace	FNQ NRM Ltd	End-user collaborator in objective (a). Biodiversity manager.	0.10
Catchment coordinators	FNQ NRM Ltd	End-user collaborators in objective (c). Vegetation managers.	0.20
Dr Allan Dale	FNQ NRM Ltd	End-user collaborator in objective (c). Senior environmental planner.	0.05
PhD Students	GU	Researchers on sub-projects of objective (b). Wildlife and vegetation ecologists.	1.00
Dr Grant Wardell-Johnson	UQ	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 / Tania Simmons	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.

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. In this way the project will be strongly linked to the Integrated Report Card Framework (Project 3.7.7). 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 (linked to IRC).
- (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 FNQ NRM Ltd.

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, including FNQ NRM Ltd catchment coordinators 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 (linked to IRC).

The monitoring toolkits will be applied to revegetated sites, including NHT1 and NHT2 sites, with the assistance of FNQ NRM Ltd 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 (linked to IRC).

Objective (b): Reforestation processes: functional understanding of reforestation processes

This task will advance knowledge of the ecological processes involved in forest (vegetation and biodiversity) degradation and recovery within rainforest landscapes. Initially, a scoping study will identify priorities for new data collection, based on a synthesis of current knowledge of reforestation and degradation processes. Once priorities are defined, data collection will involve field measurements of aspects of biodiversity and vegetation condition, including (a) by professional ecologists and (b) by application of the monitoring toolkits. Data will be collected at sites which have been selected to provide replication within experimental designs that are focused on factors such as area, establishment style (ecological restoration, forestry or regrowth), type of disturbance (cyclone, clearing, or fragmentation), isolation, context and age. Some data collection will involve re-surveys to determine vegetation and biodiversity change at sites previously assessed in Rainforest CRC Project

5.2. Additional data will be obtained from manipulative trials of key agents and processes affecting the development of reforested and regrowth areas.

The data obtained from this work, together with information from Rainforest CRC Project 5.2 and other relevant studies, will be analysed to examine relationships between controlling and response variables, and the performance and surrogacy value of a range of potential indicator attributes (including vegetation structure, floristics, and selected faunal taxa). The results of the analyses will be used to: (a) refine a conceptual model of reforestation processes, applicable to assessing reforestation trajectories and guiding management interventions in reforested sites; (b) identify cost-effective rehabilitation practices, especially where these have potential over large land areas, including different forms of plantation design, and management of regrowth; and (c) identify factors associated with the impact of cyclone Larry on vegetation and biodiversity, and the rate of recovery of vegetation and biodiversity. The cyclone work is supported in part by the TLJV.

Objective (c): Facilitation and futures: facilitating and optimising regional investments and management.

This component aims to improve regional-scale coordination of investments in reforestation, and to develop and implement reporting protocols for improvements in resource condition, within the Wet Tropics NRM framework. This will require participation in, and contribution to, the reporting and management systems developed for the Wet Tropics NRM Regional Investment Strategy (RIS) and Management Action Targets (MATs). This work is supported in part by FNQ NRM Ltd.

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 and water quality outcomes, will be developed and communicated (linked to IRC). Project Workshops will be held with stakeholders to integrate and disseminate information on restoration strategies; this will include liaison with MTSRF Project 4.9.3, concerning development of rehabilitation strategies for retired linear infrastructure. Workshops will also aim to encourage the development of experimental management approaches to reforestation through collaboration between scientists, funding bodies and stakeholders.

Project Outputs / Milestones

The end users from this research project are organisations and individuals concerned with forest degradation and recovery; in the Wet Tropics these are primarily FNQ NRM Ltd 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.

Objective	Targeted Activity	Completion Date
(a)	End user workshop on monitoring and evaluation of reforestation success	September 2006 [#]
(a)	Book chapter on monitoring revegetation ^{**}	June 2007 ^{**}
(a)	Establishment of toolkits for monitoring progress of vegetation condition and biodiversity.	June 2007 [#]
(b)	Research workshop on reforestation processes and trajectories ^{**}	December 2006 ^{**#}

Objective	Targeted Activity	Completion Date
(b)	Scoping study to identify priorities for new data collection, based on synthesis of current knowledge of reforestation and degradation processes.	March 2007 [#]
(b)	Paper on invertebrates and reforestation ^{**}	March 2007 ^{**}
(b)	Book chapter on reforestation and biodiversity ^{**}	June 2007 ^{**}
(c)	Presentation on strategic reforestation to user workshop [*]	September 2006 ^{*#}
(c)	Book chapter on production-biodiversity value trade-offs ^{**}	June 2007 ^{**}

[#] 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 FNQ NRM Ltd.

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

Project 4.9.5 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	
Milestones – all GU responsibilities	Date
Signing of contract	
Report 1 submission: - Report on outcomes of stakeholder workshop on monitoring revegetation (objective a). - Plan of communication activities, products and events for Year 1 and summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable.	1 Nov 2006
Report 2 submission: - Progress update on activities associated with objectives (a) and (c) (above). - Report of outcomes of science workshop on reforestation processes and trajectories (objective b). - Overview of the findings of the scoping study to identify priorities for new data collection, based on synthesis of current knowledge of reforestation and degradation processes (objective b). - Paper on invertebrates and reforestation accepted by journal (objective b). - Outline of presentation on strategic reforestation to user workshop (objective c). - Summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable.	31 March 2007
Report 3 submission: - Progress update on establishment of baseline and reference states and measurements to assess progress of reforested and cyclone-impacted sites (objective a). - Final report on monitoring revegetation in the Wet Tropics including progress update on testing monitoring toolkit with end users (objective a). - Final report on reforestation and biodiversity (objective b). - Final report on production-biodiversity value trade-offs (objective c). - Final summary of liaison activities undertaken through course of Year 1 of project. - Plan for completion of out year activities.	8 June 2007
Total MTSRF Funding	\$123,500

Project 4.9.5 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

All co-investment is secured for 2006/2007.

Contributing Organisation	Cash	In-kind	Total
MTSRF	123,500	-	123,500
MTSRF Visual Documentation*	1,500	-	1,500
FNQ NRM Ltd Third Party contract	72,900	60,000	132,900
Griffith University	-	96,000	96,000
TLJV	-	18,000	18,000
University of Queensland	-	10,000	10,000
University of Alberta	-	10,000	10,000
Private (Kooyman)	-	10,000	10,000
Total	197,900	204,000	401,900

* A total of \$1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

GU Project 4.9.5 Budget 2006/2007

Item	MTSRF Funds	Third Party Contract	In-kind	Total Cost
Salaries	82,000	67,900	81,214	231,114
Operating	17,200	-	12,800	30,000
Travel	8,600	5,000	3,360	16,960
Communication / Extension	15,700	-	12,800	28,500
Capital	-	-	-	-
Institutional overheads	-	-	93,826	93,826
Total	123,500	72,900	204,000	400,400

Indicative Budget Summary – Years 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	125,000	20,000	76,200	72,900	60,400	354,500
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	375,000	60,000	228,600	218,700	181,200	1,063,500

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

Project 4.9.6: Strategic Natural Resource Management and land use planning

Project Leader and Host Organisation

Dr Catherine Robinson, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Project Team

Title	Organisation	Role	FTE
Dr Cathy Robinson	CSIRO	Overall project leader. Principal investigator of Project 4.9.6a (catchment and regional planning)	0.26
Bruce Taylor	CSIRO	Researcher 4.9.6a (participatory processes and evaluation in NRM)	0.50
Sonja Heyenga	CSIRO	Researcher 4.9.6a (participatory processes and evaluation in NRM)	0.17
Dr Peter Roebeling	CSIRO	Researcher 4.9.6a (resource economics)	0.03
Dr Mark O'Donohue	FNQ NRM Ltd	Researcher 4.9.6a (water quality management)	0.40
Dr Kristen Williams	CSIRO	Principal investigator of 4.9.6b (biography and conservation planning)	0.12
Dr Petina Pert	CSIRO	Researcher 4.9.6b (ecology)	0.63
Dr Rosemary Hill	CSIRO	Researcher 4.9.6b (conservation planning)	0.25
Anthea Coggan	CSIRO	Principal investigator of 4.9.6c (environmental economics and market based instruments)	0.31
Dr Stefan Hajkowicz	CSIRO	Researcher 4.9.6c (environmental economics and decision making)	0.7
Dr Stuart Whitten	CSIRO	Researcher 4.9.6c (environmental economics and decision making)	0.7

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 a regional/catchment water quality management model that produces cost-effective programs of action suited to the socio-economic context and implemented to meet environmental and water quality targets. Biodiversity values in regional and local area planning incorporating new biodiversity metrics for capturing and valuing different elements of biodiversity will be established, for the protection or enhancement of biodiversity values applied through case studies in local area planning. The Douglas Shire will be one of the key case study areas. The key longer term outcomes being targeted include 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 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 implement a rigorous cost-effective catchment water quality management model to meet targets for environmental and water quality improvement.
- (b) To define biodiversity values and ecosystem services, based on regional ecosystems, threatened species, threatening process and beneficial processes provided by landholders will be applied through case studies in local area planning.
- (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

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 and attitudes 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 and values 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.

- Generate and test the effectiveness of 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.
- Incorporate habitat suitability, connectivity and fragmentation effects in the design of biodiversity persistence metrics.
- Identify and value unique and complementary areas for the protection or enhancement of biodiversity values in the landscape through case studies in local area planning. Case studies 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. Biodiversity valuation based on regional ecosystems, threatened species, threatening process and beneficial processes provided by landholders within existing planning frameworks will be undertaken. To achieve this, we will work with identified project teams in this MTSRF RIS Theme 4 and Theme 1 who are collaborating with EPA, WTMA and FNQ NRM Ltd on predefined case studies. These include, but are not limited to: a) Daintree, , b) Mission Beach and surrounding areas, c) Barron Catchment, and d). Tully-Murray Flood Plain.
- 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, goods that are undersupplied through the market 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, 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 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 FNQ. 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 problem and constraints (including institutional); and Monitoring, evaluation and feedback. The evaluation of incentives in the policy design framework 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.
- An analysis of the key market failures resulting in undersupply of ecosystem services (this is essential to the design of an incentive based policy particularly a market based instrument (MBI)).
- An analysis of the current institutions and frameworks to manage ecosystem services with urbanisation (landholder motivations, incentive schemes, regulation and planning during development etc).
- A recommendation of a mixture of potential incentives as well as design parameters with an indication of implications of the mix.
- If possible and time and budget permits a field or laboratory test of a specific incentive scheme or mix could be conducted.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
(a)	Develop a regional/catchment water quality management model suited to GBR catchments that produces cost-effective programs of action (MATs) that are suited to socio-economic context and can be implemented to meet environmental targets (RCTs).	June 2007
(a)	Identify and synthesise the potential management actions in key sectors and industries (in conjunction with other projects). The scope is the major farming and grazing sectors of the Far North Queensland region (cane, grazing, and horticulture), the forests and urban sectors. Through cross-regional cooperation there will be extension to all GBR catchments. The initial pilot study will be the Tully Murray catchments.	January 2007 (to July 2008)*
(a)	Develop and test a water quality management action monitoring and reporting framework that would provide rigorous and consistent information on water quality management responses (in conjunction with other projects) for the catchment area of the GBR. Initial pilot will be the Tully catchment.	January 2007 (to July 2008)*
(b)	Generate and test the effectiveness of biodiversity metrics in capturing and valuing different elements of biodiversity in rainforest bioregions, including species turnover and phylogeny.	July 2006 (to March 2010)*
(b)	Incorporate habitat suitability, connectivity and fragmentation effects in the design of biodiversity persistence metrics.	July 2006 (to Sept 2010)*
(b)	Identify and value unique and complementary rainforest bioregion land areas for the protection or enhancement of biodiversity values based on regional ecosystems, threatened species, threatening process and beneficial processes provided by landholders.	July 2006 (to July 2010)*

Objective	Targeted Activity	Completion Date
(c)	An analysis of the development pressures and trends as well as the biophysical impact of urbanisation on ecosystem services building on and re-interpreting existing biophysical and socio-economic research.	June 2007
(c)	An analysis of the ecosystem services of importance to the terrestrial ecosystems of the Wet Tropics bioregion. The initial case study area will be the Mission Beach and lower Tully district in conjunction with tasks (a) and (b). An analysis of the current institutions and frameworks to manage ecosystem services with urbanisation (landholder motivations, incentive schemes, regulation and planning during development etc.).	June 2007

Project 4.9.6 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	
Milestones – all CSIRO Responsibilities	Date
Signing of contract	
Report 1 submission: - Progress update on activities associated with objectives (a)-(c) (above). - Communication activities and outputs plan for Year 1 and summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable.	15 Nov 2006
Report 2 submission: - Progress update on activities associated with objectives (a)-(c) (above): water quality management actions identified, progress towards synthesis, monitoring and reporting framework; biodiversity metrics identified. - Report on review and analysis of biodiversity configurations and work plan for characterising fragmented habitat configurations (obj b) (Daintree). - Summary of any liaison activities undertaken to date, including minutes of meetings/workshops if applicable.	31 March 2007
Report 3 submission: - Report presenting the regional/catchment water quality management model. Outline of preparations to implement the model in at least one north Queensland region or catchment (Tully) (obj a). - Conceptual framework and work plan for incorporating biodiversity information into the Landscape Toolkit applicable to the Tully-Murray Floodplain (obj b). - Progress update on ongoing activities within objective (a) and (b). - A report on ecosystem services impacts of urbanisation (obj c) - A report on current institutions, frameworks and methods to manage ecosystem service impacts (obj c). - Final summary of liaison activities undertaken through course of Year 1 of project. - Plan for completion of out year activities.	11 June 2007
Total MTSRF Funding	\$241,775

Project 4.9.6 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	241,775	-	241,775
MTSRF Visual Documentation*	1,500	-	1,500
UQ	-	188,305	188,305
Total	243,275	188,305	431,580

* A total of \$1,500 is held by the Reef and Rainforest Research Centre for Visual Documentation of this project (see Theme 5).

CSIRO Project 4.9.6 Budget 2006/2007

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	208,084	-	208,084
Operating	24,625	15,179	39,804
Travel	9,066	-	9,066
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	173,126	173,126
Total	241,775	188,305	430,080

Indicative Budget Summary – Years 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	248,819	-	192,614	-	-	441,433
2008/2009	252,673	-	195,393	-	-	448,066
2009/2010	255,233	-	197,059	--	-	452,292
Total	756,725	-	585,066	-	-	1,341,791

PROGRAM 9: SUSTAINABLE USE, PLANNING AND MANAGEMENT OF TROPICAL RAINFOREST LANDSCAPES**Project 4.9.7: Strategic Natural Resource Management and land use planning****Project Leaders and Host Organisations**

Professor Helen Ross, The University of Queensland (UQ)

Dr Tim Lynam, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Dr Margaret Gooch, James Cook University (JCU)

Project Team

Title	Organisation	Role	FTE
Prof. Helen Ross	UQ	Project co-leader, principal contributor to case studies and theory development, resilience indicators at catchment/NRM region scales, implications for co-management and community engagement.	0.20
Dr Tim Lynam	CSIRO	Project co-leader, principal contributor to theory development, resilience indicators at GBR region scale.	0.14
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
Dr Kostas Alexandridis	CSIRO	Lead role in resilience indicators at GBR regional scale	0.20
Anne Leitch	CSIRO	PhD project (enrolled at JCU), research on resilience indicators	1.00
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	0.15
Postdoctoral Fellow (TBA)	UQ (or shared)	Substantive fieldwork and data collection for case studies	1.00
PhD student (TBA)	JCU	community level resilience indicators	1.00
Casual research assistant	JCU	community level resilience indicators	0.30

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

To contribute a set of indicators of social resilience to water quality change for use by scientists, communities, natural resource management agencies (government, NRM agencies and industry agencies) and a more generally applicable approach to developing these indicators.

More specifically this objective will be achieved through achievement of the following four sub-objectives:

- (a) Development of indicators of social resilience to water quality change at whole of GBR scale;
- (b) Development of indicators of social resilience to water quality change at catchment scale;
- (c) Development of indicators of social resilience to water quality change at community scale;
- (d) Approach and methods for multi-scale indicator development and conceptual model for social resilience thresholds (No activity Year 1)

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 the general social resilience of communities in north Queensland recognised in the context of their relationships with ecological systems. The indicators will also contribute to the synthesis of information in the Integration framework, and make important communication contributions.

The tools for the analysis of resilience in social – ecological systems of north Queensland will be an important component of the Integration Framework. They will provide both a process and tool set for integration of social, economic and bio-physical understanding in the analysis of resilience. Through the participatory research process of developing the resilience analysis tools this component will also contribute to the End User Framework through co-learning, a fundamental output of any participatory process. Finally the resilience analysis tools will provide a means of exploring the impacts of some interventions on the attributes of social resilience in particular sites which will be an important contribution to End User endorsed solutions; again a major output of the MTSRF process.

Each of these core research processes will identify key social attitudes in relation to engagement and resilience as well as the potential links between social groups, these attitudes and behavioural intentions. These links will provide unique opportunities to develop targeted communications that seek to address specific attitudes of key social groups. The case study process will enhance MTSRF scientists' and end users' experience in science communication. The project outputs therefore will make key contributions to the development and implementation of the MTSRF communication strategy.

Project / Task Methodology

The project will use a Co-managed research approach¹⁴ whereby researchers and managers or key stakeholders collaborate fully in each step of the project, from defining the objectives and tasks, through participation in data collection if desired, to interpretation and use of the results. This will be achieved through a team based process comprising key management

¹⁴ George et al. 2004, Innes and Ross 2001

agency and key scientists representation. Representation on the team from other projects in the two contributing programmes will be strongly encouraged.

The development of best practice guidelines will make use of between three and five case studies (comprising cases of social-ecological systems relevant to other projects in the two programs and related management (end user) and community needs). These will be selected and developed by the co-managed research team, and where possible conducted collaboratively with the other project teams. Each case study will be conducted in a participatory way with local communities and other stakeholders, including the MTSRF science teams whose projects provide link points. The approach to be used will include gathering of baseline data of current interests, positions and knowledge bases, collected through a. focus group discussions within each case study area – a ValueMetrics approach and b. baseline attitudinal survey of residents in each of the case study areas (important for indicator and communications development). This will be followed by qualitative data collection, using methods most appropriate to the communities and issues concerned. End-users, participating communities and researchers will work together throughout the life of the case studies to refine the outputs sought by end-users and communities: tools and products; resources, and delivery mechanisms. This working relationship will follow an action research cycle of evaluation and change throughout the duration of the project. A formal evaluation of these engagement processes will be carried out continuously through the project.

Where feasible the same case studies will be used for the development of resilience indicators. Close collaboration between researchers, managers and select community groups will be used to ensure development of useful social indicators that complement ecological indicators to be developed within Program 2. Where feasible natural experiments such as cyclone Larry will be used to test the efficacy of the indicators. Other change events will also be used where these can be clearly identified and baseline data are available. The research on resilience indicators will build on existing research being carried out by Gail Kelly and Tim Lynam of CSIRO on measuring social resilience to climate change, and by Helen Ross and Christine King on community resilience (both non-MTSRF projects).

These projects differ and complement each other. This MTSRF project will develop our understanding of general indicators of resilience – baseline resilience whereas the CSIRO work will identify resilience measures for specific change or perturbation events related to climate change, and the UQ work (with University of Southern Queensland) integrates understanding of individual, community and environmental dimensions of resilience (as well as providing a comparable case study). The synergies across these MTSRF and external projects will add value to the broader development of the theory and practice of resilience management.

An important aspect of the research process design will be to ensure cross-comparisons of cases and the maximal uptake of learning by end user managers and management agencies.

Social network theory will be used to develop a model or set of models that link social indicators of resilience to the attributes of and relationships among people and ecosystem services for at least some of the resilience indicator case studies. To more effectively test the model, data from alternative sites that have useful historical data sets is likely to be necessary however, complete validation of this type of model may not be possible within the time and resources available.

The project leadership team will develop targeted communication strategies and materials to ensure the understanding developed through this participative research process is made widely available to likely users throughout the MTSRF program as well as in the broader academic and management communities.

Project Outputs / Milestones

Objective	Targeted Activity	Completion Date
a, b, c	Establish working relationships and work plans with key partners and linked MTSRF projects.	November 2006
a, b, c	Develop conceptual framework and linkages in proposed case studies.	February 2007
a, b, c	End-user workshops towards design of indicators and identification of their management purposes.	March 2007
a, b, c	Selection of case studies with key end users and relevant other MTSRF research teams Ethics approval granted for case studies.	June 2007*
a, b, c	Draft of potential resilience indicators for each scale.	June 2007 (a, b, c)*

* Involves ongoing activities in Out Years.

Project 4.9.7 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	
Milestones	Date
Signing of contract	
Report 1 submission - Minutes of first meeting agreed/held to establish protocols for projects: obj a [CSIRO], obj b [UQ], obj c [JCU]. - Report on plain English summary of project activities for Year 1: obj a [CSIRO], obj b [UQ], obj c [JCU]. - Plan of communication activities for Year 1 and summary of any liaison activities undertaken to date, including discussions with integrated report card team for: obj a [CSIRO], obj b [UQ], obj c [JCU].	1 Nov 2006
Report 2 submission - Draft conceptual framework and linkages in case studies for cross comparative purposes for: obj a [CSIRO], obj b [UQ], obj c [JCU]. - Report on end-user workshops for: obj a [CSIRO], obj b [UQ], obj c [JCU].	31 March 2007
Report 3 submission - Report detailing selected case studies and progress report on case study analyses for: obj a [CSIRO], obj b [UQ], obj c [JCU]. - Ethics approval granted for case study data gathering and participatory processes [UQ, CSIRO and JCU]. - Report on perceptions of key stakeholders of potential social resilience indicators: obj a [CSIRO], obj b [UQ], obj c [JCU]. - Final summary of communication activities undertaken through the course of Year 1 of project including linkages to the Integrated Report Card Team: obj a [CSIRO], obj b [UQ], obj c [JCU]. - Plan for completion of out year activities [UQ, CSIRO and JCU].	10 June 2007
Total MTSRF Funding	\$218,500

Project 4.9.7 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF	218,500	-	218,500
MTSRF Visual Documentation*	1,500	-	1,500
UQ	-	72,600	72,600
CSIRO	-	72,600	72,600
JCU	-	72,600	72,600
Total	220,000	217,800	437,800

* A total of \$1,500 is held by Reef and Rainforest Research Centre for Visual Documentation for this project (see Theme 5).

JCU Project 4.9.7 Budget 2006/2007

Item	MTSRF	JCU In-kind	Total Cost
Salaries	47,150	72,600	119,750
Operating	3,300	-	3,300
Travel	18,250	-	18,250
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 2006/2007

Item	MTSRF	CSIRO In-kind	Total Cost
Salaries	46,750		46,750
Operating	3,300	33,704	37,004
Travel	18,250	-	18,250
Communication / Extension	4,300	-	4,300
Capital	-	-	-
Institutional overheads	-	38,896	-
Total	72,600	72,600	145,200

UQ Project 4.9.7 Budget 2006/2007

Item	MTSRF	UQ In-kind	Total Cost
Salaries	47,150	72,600	119,750
Operating	3,300	-	3,300
Travel	18,250	-	18,250
Communication / Extension	4,300	-	4,300
Capital	-	-	-
Institutional overheads	-	Included in figure above	-
Total	73,000	72,600	145,600

Indicative Budget Summary – Years, 2, 3, 4

Year	MTSRF	Applicant		Other sources		Total
		Cash	In-kind	Cash	In-kind	
2007/2008	220,000	-	216,103	TBA	74,970	511,073
2008/2009	220,000	-	226,908	-	78,720	525,628
2009/2010	220,000	-	238,255	-	82,655	540,910
Total	660,000	-	681,266	-	236,345	1,577,611

Theme 5 Enhanced Delivery

PROGRAM 10: ENHANCING DELIVERY

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.

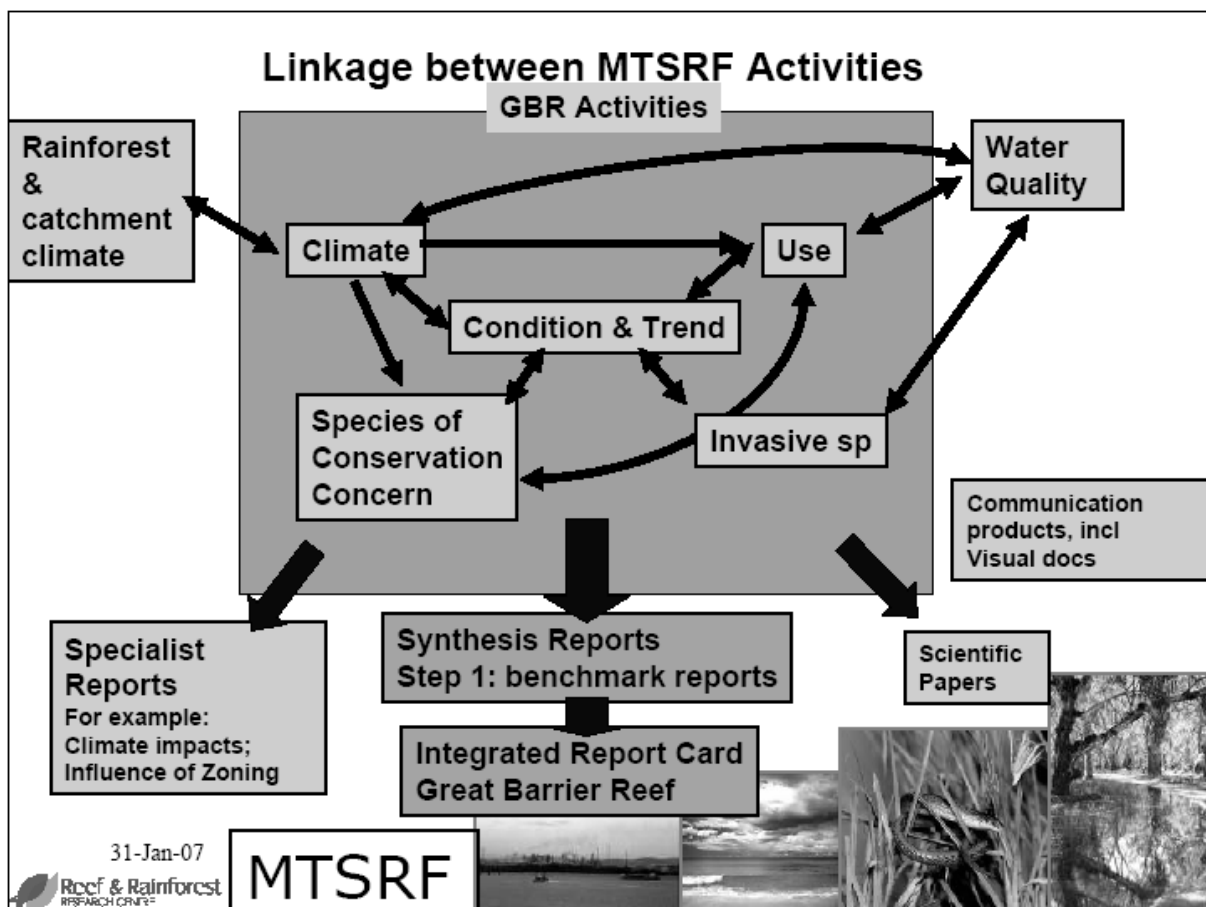


Figure 2: Example of the integration process for the Great Barrier Reef area.

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, however in the first year, the information will be synthesized into 4 benchmark reports for the Great Barrier Reef, Wet Tropical 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 the subsequent

years 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, the Theme 5 will conduct a series of large workshops to harness the existing knowledge and newly generated information for the identified areas. These meetings will afford 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 planned to develop an agreed approach to social and resource economic research within the MTSRF program. The MTSRF program will also work with other CERF hubs to develop a framework for research across the social and economic disciplines. 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 will also be undertaken through Theme 5.

The Theme 5 will use the synthesis reports and associated data sets as the basis for populating an Integrated Report Card on the Great Barrier Reef, Wet Tropical Rainforest, Torres Strait areas and water quality in the GBR Catchment. The development of the Integrated Report Card framework is partly undertaken within the MTSRF Themes 1 to 4 and coordinated and delivered through Theme 5. The particular biological and social indicators and critical thresholds utilised within the Integrated Report Card framework are also developed within MTSRF Themes 1-4. The Integrated report cards are based in part on the Morton Bay Water Quality model. Once the framework has been developed and customized to the individual requirements of the particular end users of the geographical area, it will need to be delivered to the appropriate management arrangement to enable on going reporting. Agreement from end user organisations regarding the structure and population of the Integrated Report card framework is essential if it is to be a valuable reporting tool in the future.

The Theme 5 delivery mechanisms are the specific responsibilities of the research management Centre representing MTSRF in North Queensland. The Centre will utilise contractual arrangements to capture required expertise.

Project Team

Title	Organisation	Role	FTE
Core Integration and Communication Team			
Dr Andy Stevens	CSIRO	Co-ordination of Integrated Report Card	0.15
Dr Tim Lynam	CSIRO	Principle contributor to integration and synthesis framework	0.15
Dr Glenn De'ath	AIMS	Statistics and data synthesis	0.2
Dr Scott Wooldridge	AIMS	Statistics and Bayesian modelling	0.10
Dr Bill Venables	CSIRO	Statistics and data synthesis	0.10
Dr Helen Ross	UQ	Social science, lead role in co-managed research process, case studies	0.15
Dr Margaret Gooch	JCU	Science communication	0.15
Dr Bruce Prideaux	JCU	Social science	0.10
Dr Bob Miles	CQU	Social economist	0.10
Russell Kelley	Communication consultant	Science communication	0.15
DEW officers	DEW	To be determined	
MTSRF Program	MTSRF	Coordination of Theme outputs into this	0.5

Managers		project	
Annabel Jones	JCU	Science communication	1.0
Allan Dale	FNQ NRM Ltd	Social science/community	
PhD student	JCU / AIMS / UQ	To be recruited	1.0
MTSRF Program Leaders			
Dr Peter Doherty	AIMS	GBR Status and trends	0.05
Dr Alan Butler	CSIRO	Torres Strait and IRC	0.05
Dr Chris Margules	CSIRO	Rainforest Status and trends, invasives pests, and species and communities of conservation concern	0.05
Dr Helene Marsh	JCU	Marine species and communities of conservation concern (GBR and Torres Strait)	0.05
Dr Julian Caley	AIMS	Marine Climate Change	0.05
Dr Nigel Stork	JCU	Rainforest Climate Change	0.05
Dr Katharina Fabricius	AIMS	Marine Water Quality	0.1
Prof. Angela Arthington	GU	Catchment Water Quality and Indicators	0.5
Dr Richard Pearson	JCU	Catchment Water Quality	0.05
Dr Iain Gordon	CSIRO	Water Quality socio-economic	0.05
Dr Gavin Begg	JCU	GBR Sustainable use and management	0.05
Dr Steve Turton	JCU	Rainforest Sustainable use and management and land use planning	0.05

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2010

Project / Task Objectives

1. Synthesis and Integration:
 - (a) Develop an Integrated Report Card on the status (condition and trend) of the environmental assets of North Queensland – the reefs, rainforests, Torres Strait and water quality.
 - (b) Develop synthesised reports for the environmental assets of North Queensland – the reefs, rainforests, Torres Strait and water quality (baseline report in year 1)
 - (c) Develop a frame work for MTSRF social and resource economic research.
2. Standards, data management and operating procedures:
 - (e) Establish a research quality and evaluation framework for MTSRF performance reporting
 - (f) Develop a data management system to enable public access to research findings and establish data management protocols and standards
 - (g) Establish Standard Operating Procedures for MTSRF services.
3. Capacity Building and Science Delivery:
 - (h) Enhancing end-user engagement
 - (i) Capacity building for science in North Queensland (not targeted for 06/07)
 - (j) Establishing and maintaining end-user partnerships

- (k) Develop and establish protocols for media and communications and develop a range of communication products for the MTSRF Program at a range of scales throughout the Program

Project Outputs / Milestones

Objective	Targeted Activity	Funding
a (b,c)	Development of an Integrated Report Card prototype that offers a 'user friendly' metric for reporting the status and trend of North Queensland's environmental assets (based on robust indicators and agreed thresholds of concern). This will integrate the best available understanding of system behaviour in a fundamental adaptive management tool. - Development of a MTSRF reporting structure that enables information to be readily utilised for major external reporting requirements e.g. World Heritage reporting, State of the Environment reporting, NRM reporting. (Contract desk top study) - Synthesis of Baseline (or Benchmark) Reports that feed into the Integrated Report Card. Including status and trends (and potential indicators) of environmental health, sustainable use and impacts on the GBR, Torres Strait, Wet Tropics Rainforest, GBR Catchment Water Quality. An additional report on an agreed approach to social and economic research for the MTSRF research program.	\$448,500
d	<i>No action</i>	
e	Establishment of a research quality framework and funding QAQC Committee and peer review costs for ARP programs 1 to 10 to ensure science quality.	\$20,000
f	Delivery of a publicly assessable knowledge and data management system that utilises existing data housing structures and data management protocols i.e. ERIN (co-ordination, start up and resolution of technical difficulties). NOTE: The approach proposed by ERIN for MTSRF and the CERF is currently at development stage).	\$19,000
g	Implementation of standard operating procedures to enable a consistent approach to ARP operations- start up costs (\$34,000). No funding allocated. Would seek collaboration with DEW to implement 2(g)	
h	Support funding to assist end-user engagement in MTSRF activities. Will include Tourism, indigenous and other stakeholders. Milestones to be reviewed to incorporate these end-users.	\$60,000
i	<i>Not undertaken</i>	
j,k	End-user communication and liaison. - Communication framework (with media protocols) - Web site development and management - End user engagement - Workshops/conference - Communication publications and products	\$250,000
	Total Funding	\$797,500

Program 10 Milestone Payments 2006/2007

For 2006/2007 outputs only	Date
Milestones	
Signing of contract	
Report 1 submission detailing: • Report detailing Integration Steering Committee (comprised of heads of agencies) meeting outcomes including the framework for synthesis and integration of information and the Integrated Report Card structure. • Research Quality Framework meeting outcomes. • Agreed data management and reporting structure arrangements. • Agreed media protocols.	Oct 2006
Report 2 submission • Report on communication framework and communication activity. • Report on end-user engagement structure and activity. • Progress update of Benchmark Report synthesis for GBR, Torres Strait, Rainforest, GBR Catchment Water Quality. • Draft report detailing agreed approach to social and economic research in the MTSRF program. • Draft Web enable communication productions • Report detailing progress of Integrated Report Card.	Jan 2007
Report 3 submission • Final report detailing agreed approach to social and economic research in the MTSRF program and activities.	April 2007
Final Report submission • Final Benchmark Report synthesis for GBR, Torres Strait, Rainforest, GBR Catchment Water Quality. • Delivery of Integrated Report Card prototype. • Report on communication products for Integrated Report Card. • Report on 2006/07 media activity. • Final report on MTSRF end-user engagement. • Report of MTSRF Research Quality (QAQC) activity • Delivery of web enabled communication products. • Report on Integration Steering Committee recommendations for synthesis/ integration and Integration Report Card	30 June 2007
Total MTSRF Funding	\$797,500

PROGRAM 10: ENHANCING DELIVERY

Project 5.10.1: Visual Documentation of MTSRF Projects

Project Leader and Host Organisation

Reef and Rainforest Research Centre Ltd

Project Duration

Start Date: 1 July 2006

End Date: 30 June 2007

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 \$79,514 from 29 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 Outputs / Milestones

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.	June 2007
(b)	Provide periodic reports of results and material generated for website presentation	Quarterly

Project 5.10.1 Milestone Payments 2006/2007

For 2006/2007 Outputs Only	Date
Milestones	
Signing of contract	Early Dec 2006
Report 1 submission: - Forward plan of proposed video collection and reporting. - Summary of activities to date and delivery of preliminary media products.	1 Feb 2007
Report 2 submission: - Summary of activities since Progress Report 1. - Report on media products delivered during the reporting period.	1 May 2007
Final Report - Summary of activities since Progress Report 2. - Report on media products delivered in the reporting period.	15 June 2007
Total MTSRF Funding	\$79,514

Project 5.10.1 Budget

Year 1 – 2006/2007 Project Funding and Partnerships

Contributing Organisation	Cash	In-kind	Total
MTSRF*	79,514	-	79,514
Total	79,514	-	79,514

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

Project 5.10.1 Budget 2006/2007

Item	MTSRF Funds	Funds from Other Sources	Total Cost
Salaries	-	-	-
Products	79,514	-	79,514
Travel	-	-	-
Communication / Extension	-	-	-
Capital	-	-	-
Institutional overheads	-	-	-
Total	79,514	-	79,514