



Established and supported under the Australian Government's Cooperative Research Centres Program

The status of monitoring in the Great Barrier Reef World Heritage Area

VJ Harriott^{1,2}, CL Goggin¹, B Barnett¹, S Edgar³, S Kininmonth³, T Harvey¹

¹CRC Reef Research Centre,

²James Cook University and

³Australian Institute of Marine Science

CRC REEF RESEARCH CENTRE WORKING PAPER (update)

CRC Reef Research Centre Ltd is a joint venture between: Association of Marine Park Tourism Operators, Australian Institute of Marine Science, Great Barrier Reef Marine Park Authority, Great Barrier Reef Research Foundation, James Cook University, Queensland Department of Primary Industries, Queensland Seafood Industry Association and Sunfish Queensland Inc.

CRC REEF RESEARCH CENTRE
WORKING PAPER (update)

THE STATUS OF MONITORING IN THE GREAT BARRIER REEF WORLD HERITAGE AREA

VJ Harriott^{1,2}, CL Goggin¹, B Barnett¹,
S Edgar^{1,3}, S Kininmonth^{1,3}, T Harvey¹

CRC Reef Research Centre¹, James Cook University²
and Australian Institute of Marine Science³.

CRC Reef Research Centre was established and is supported under the Australian Government's Cooperative Research Centres Program. Its mission is to provide research solutions to protect, conserve and restore the world's coral reefs. It is a knowledge-based partnership of coral reef managers, researchers and industry. Partner organisations are:

- Association of Marine Park Tourism Operators
- Australian Institute of Marine Science
- Great Barrier Reef Marine Park Authority
- Great Barrier Reef Research Foundation
- James Cook University
- Queensland Department of Primary Industries
- Queensland Seafood Industry Association
- SUNFISH Queensland Inc.

A report funded by CRC Reef Research Centre Ltd.

CRC Reef Research Centre Ltd
PO Box 772 Townsville
QLD 4810 Australia
Phone: 07 4729 8400
Fax: 07 4729 8499
Email: info@crcreef.com
Web: www.reef.crc.org.au

©CRC Reef Research Centre Ltd
November 2002

This work is copyright. The Copyright Act 1968 permits fair dealing for study, research, news reporting, criticism or review. Selected passages, tables or diagrams may be reproduced for such purposes provided the source is acknowledged. Major extracts of the entire document may not be reproduced by any process without written permission of the Chief Executive Officer, CRC Reef Research Centre.

While every effort has been made to ensure the accuracy and completeness of information presented in this report, CRC Reef Research Centre Ltd accepts no responsibility for losses, damage, costs and other consequences resulting directly or indirectly from its use.

The material is assembled in good faith but does not necessarily reflect the considered views of CRC Reef Research Centre Ltd or indicate a commitment to a particular course of action.

Published by CRC Reef Research Centre Ltd,
PO Box 772, Townsville, QLD 4810 Australia.

EXECUTIVE SUMMARY

Monitoring the physical, biological and socio-economic conditions of coral reef ecosystems is needed for scientific research, natural resource management and industry to ensure the sustainable use and conservation of these ecosystems.

The Great Barrier Reef World Heritage Area (GBRWHA) is monitored in many ways, ranging from large-scale monitoring by government and research organisations, to community monitoring in coastal environments with an education and awareness focus.

CRC Reef Research Centre and its partner organisations, particularly the Great Barrier Reef Marine Park Authority (GBRMPA) and the Australian Institute of Marine Science (AIMS), recognised that there is a need to identify existing monitoring programs, analyse information needs and data gaps, and better integrate monitoring to optimise the use of limited resources.

This report is an updated version of an original working paper (July 2002) that included about 60 monitoring programs and was the first stage in identifying current monitoring programs within the GBRWHA. This report lists more than 100 monitoring programs.

In a previous CRC Reef project, Yaman (unpublished) identified monitoring programs on the Great Barrier Reef (GBR) and incorporated them into a database. Yaman listed projects of more than three years duration from 1975 to 1995. Many of the programs identified in that study are no longer ongoing in 2002.

The current review was restricted to programs that were likely to receive support beyond 2002 or were ongoing for a significant period in the past. Programs were categorised into clusters related to: nearshore, physical, biological, birds, fisheries and socio-economic.

For each monitoring program, the principal researcher or data custodian was approached in person, by telephone or by email, with a questionnaire or spreadsheet outlining the type and location of data collected. The responses were incorporated into an Access database, and geographic information about the location of sampling was included in a Geographic

Information System (GIS) linked to the database. This report presents summary information for each project, printed directly from the database. The GIS is being prepared for presentation on the CRC Reef website.

WATER QUALITY

There are few programs that monitor the sediment and nutrient discharge in rivers out of a catchment and therefore, the impact of river flow on the nearshore environment.

Queensland Environment Protection Agency (EPA) maintained a water quality and nutrient monitoring project in rivers and estuaries for several years, but the north Queensland component of the project finished in 1999-2000. The data was collected infrequently and has limited use for estimating exports to the reef.

Queensland Department of Natural Resources and Mines (NRM) continues to monitor water quality in 29 rivers along the Queensland coast. This sampling is infrequent and is not designed to estimate export of material to the reef.

Work by AIMS to monitor turbidity in north Queensland rivers was largely completed in 2000. AIMS maintains some data on sediment fluxes in up to seven rivers (Normanby, Barron, Johnston, Tully, Burdekin, Fitzroy) and have also monitored water quality offshore from Cairns since 1989.

The only broad-scale ongoing project on water quality in the GBR region is the AIMS/ CRC Reef chlorophyll *a* project, which was established in 1992. Most stations in this project are well offshore with only a few stations close to the coast.

Other water quality projects include analysis by City Councils, Port Authorities and local industries (e.g. Queensland Nickel) of local water quality issues. Volunteer organisations are also monitoring water quality in Queensland rivers e.g. NRM Waterwatch program, Woongarra Marine Park water quality monitoring.

Given the high level of concern about inshore water quality in the GBR region in recent years, it is particularly notable that there are few ongoing long-term studies to provide data that could be analysed to determine whether water quality deteriorates or improves in the GBR lagoon in the future. The lack of co-ordination between programs is also noteworthy.

PHYSICAL

Physical data sets relate to weather, oceanography, coastal processes and water temperature. The Bureau of Meteorology holds extensive data sets on rainfall, wind speed and direction, light, air pressure and air temperature for coastal Queensland. These are supplemented by records from remote weather stations provided by AIMS. A network of water temperature monitoring stations is maintained by AIMS and GBRMPA, and wave and storm tide information is collected by Queensland's EPA. AIMS also supports remote sensing projects which have been focused on water temperature, but have recently begun investigating the feasibility of ocean colour monitoring, in conjunction with a project on chlorophyll *a* monitoring.

BIOLOGICAL

NEARSHORE

There are few projects which monitor nearshore communities. QDPI monitor habitats which are critical to fisheries as well as conduct baseline surveys of ports for introduced marine species. The GBRMPA monitors benthic communities in Nelly Bay, Magnetic Island. AIMS have begun monitoring some nearshore reefs (Palm Islands) as part of the Long-Term Monitoring Program. The nearshore community at Woongarra Marine Park is monitored by a community group.

Community groups play a major role in monitoring seagrass through Seagrass-Watch, which is managed by the Queensland Department of Primary Industries (QDPI), with some other monitoring of seagrass by Queensland Parks and Wildlife Service (QPWS).

The status of marine turtles has been monitored by QPWS under the stewardship of Dr Col Limpus. Community groups are also involved in turtle monitoring e.g. Indo-Pacific Sea Turtle Monitoring

James Cook University (through Prof Helene Marsh) undertakes most of the monitoring of inshore mammals, including dugongs and dolphins. Queensland government agencies monitor the strandings of marine turtles and mammals (QPWS) and the numbers and type of sharks and accidental by-catch caught in shark nets (QPPI).

OFFSHORE

The largest biological monitoring program on the GBR is the AIMS Long-Term Monitoring Program, which has assessed reef-wide benthic and fish communities since 1993. The data has been extensively used in evaluating crown-of-thorns starfish outbreaks and coral bleaching impacts. Other studies of crown of-thorns starfish observations and juvenile densities are currently unfunded, hence inactive. There are several community monitoring programs that primarily rely on volunteers, including the Eye on the Reef and Reef Check. Other studies of reef benthic communities are part of either long-term ecological research projects, such as the 40-year dataset collected by Prof Joe Connell at Heron Island reef flat, or have been collected as a part of a number of environmental impact assessment programs.

BIRDS

Queensland parks and Wildlife Service (QPWS) is the lead agency monitoring coastal and island birds. There are also several community-based bird watching projects e.g. Townsville Region Bird Observers Club.

FISH AND FISHERIES

Three major fisheries projects are managed by QDPI. The CFISH program collects industry data from commercial fishers, the RFISH project has several components which evaluate the value of recreational fisheries. The Fisheries Long-Term Monitoring Program is a large

program of fisheries independent monitoring of key target species such as mackerel, crabs and reef line fish.

The Effects of Line Fishing experiment (JCU, CRC Reef) also has a significant amount of information about coral reef fishes.

SOCIO-ECONOMIC

There is a paucity of socio-economic monitoring, relative to the other categories listed, however, there are some socio-economic data held with the Australian Bureau of Statistics which are not captured in this database (e.g. population, employment statistics, etc).

The Environmental Management Charge (EMC) database provides information about reef visitation with commercial marine tourism operators. Three JCU research projects funded by CRC Reef monitor tourist and community perceptions and media presentation of the GBR region. A JCU / CRC Reef project is conducting a social assessment of commercial fishers. Registration of recreational vessels collected by the Queensland Department of Transport provides a surrogate for recreational fishing activity.

REPORTING

Reporting from the monitoring projects is extremely variable. The AIMS Long-Term Monitoring Program publishes near-annual summaries, as well as web updates within a few weeks of the return of each research cruise. Other projects, such as those supported by CRC Reef and GBRMPA, produce annual unpublished reports and occasional publications, e.g. technical reports and publications in scientific journals.

SCOPE AND FUTURE OF MONITORING PROGRAMS

Relatively few monitoring programs in the GBR region provide extensive geographic coverage of major parameters. Even fewer have guaranteed funding beyond a 2-3 year framework.

Table 1. Monitoring programs (June 2003).

Program	Parameters	Organisation (contact)	Ref. No.
Cairns coastal transect	Standard water quality parameters	AIMS (Furnas)	9
Cairns Port water quality and sediment	Water quality and sediments	Cairns Port Authority (Fletcher)	98
Cairns Water	Water quality at point source discharge points	Cairns City Council (Clayton)	42
EPA ambient water quality monitoring	Dissolved oxygen, pH, conductivity, turbidity, chlorophyll a, suspended solids, nutrients	EPA (Moss)	16
Flood plume monitoring	Extent, and nutrient and sediment concentration in flood plumes	GBRMPA (Haynes)	93
Herbert River water quality	Water quality	CSIRO (Bramley)	100
Land use impacts on water quality in the Johnstone River catchment	Water quality	DNRM (Hunter)	118
Long-term chlorophyll monitoring	Chlorophyll a; wind speed & direction, wave height & direction, cloud cover, rainfall, depth, salinity, temperature, clarity, <i>Trichodesmium</i>	AIMS/ CRC Reef (Furnas)	7
Mackay mangrove monitoring	Mangroves, water quality	QDPI (Coles/ Wake)	51
Mackay Port water quality and sediment	Water quality, sediment	Mackay Port Authority (Keane)	112
Mackay-Whitsunday Waterwatch *	Water quality - rivers in Mackay area	Mackay Waterwatch DNR (Mitchell)	48
NRM water quality and quantity monitoring (WaterShed)	Water quality	NRM (Rayment)	87
Pioneer Bay effluent monitoring	Water quality	Whitsunday Shire Council (Seymour)	59
Queensland Nickel water quality monitoring (Yabulu site)	Water quality, marine plants	QNI (Treddinick)	92
Ross Creek water quality monitoring	Water quality	GBRMPA (Michalek-Wagner)	90
Ross River estuary – birds and water quality *	Physical, water quality, mangroves, birds, bats	Conservation Volunteers Australia (RIVER Group)	46
Sediment and nutrient dynamics – Fitzroy estuary	Water quality	NRM/CSIRO (Noble)	105
Sediment distribution and transport mechanisms, Burdekin region, Central GBR	Grain size distribution	JCU/ CRC Reef (Ridd)	113
Stream monitoring in the Burdekin catchment	Water quality, seasonal flow	CSIRO (Post)	114
Suspended sediment and nutrient export monitoring	Turbidity, flood dynamics	AIMS (Furnas)	8
Suspended sediment sampling in streams	Suspended sediment and bedload	NRM (Joo)	94
Townsville Citiwater	Water quality - receiving water at sewage outfalls	Citiwater Townsville (TCC)	40

Note: Shaded programs have no current or projected funding.

* community monitoring program

Program	Parameters	Organisation (contact)	Ref. No.
Townsville Port Authority monitoring	Water quality, sediment and heavy metals, stormwater in Port	Townsville Port Authority (Wilson)	54
Water management in the Johnstone River basin	Water quality	DNRM (Hunter)	119
Waterwatch: Burdekin	Water quality	Waterwatch (Reid)	101
Waterwatch: Fitzroy Basin	Water quality	Waterwatch (Bock)	102
Waterwatch: Port Curtis	Water quality	Waterwatch (Sigley)	103
Wet Tropics Waterwatch *	Water quality	Waterwatch (Wright)	66
Woongarra Marine Park - water quality *	Water quality and physical	WMP Monitoring and Education Project (Sargent)	49

Note: Shaded programs have no current or projected funding.

* community monitoring program

Program	Parameters	Organisation (contact)	Ref. No.
Physical			
Aerial photography	Coastal processes and erosion	EPA/ Beach Protection Authority	19
Antifoulant compounds in the GBRWHA	Antifoulant (TBT) content of marine sediments	GBRMPA (Haynes)	115
Australian baseline sea level monitoring	Sea level monitoring	National Tidal Facility Australia (Davill)	65
Cairns Port water quality and sediment	Water quality and sediments (filed under Water Quality)	Cairns Port Authority (Fletcher)	98
Coastal weather stations	Air pressure, air temperature, cloud, sunshine, wind speed and direction	Bureau of Meteorology	29
Coral cores	Past climate record	AIMS /ANU (Lough)	95
East Trinity Acid Sulfate Soils remediation	Sediment and water quality	State Devpt/NRM/EA (Linnan)	108
Fossil corals	Past climate record	Gagan (ANU)	96
Hadley seawater temperature	Water temperatures	AIMS (Lough)	63
Hydrographic surveys	Beach erosion processes	EPA (Waldron)	60
Long-term monitoring of sea temperatures	Water temperature	AIMS/ GBRMPA (Berkelmans)	6
Ocean monitoring network	Sea level, current speed and direction, water temperature	AIMS (Steinberg, Brinkman)	4
Rainfall stations	Rainfall	Bureau of Meteorology	30
Remote sensing of the marine environment	Ocean colour, water temperature, turbidity	AIMS (Steinberg)	5
Remote weather stations	Air pressure, air temperature, light, water temperature, wind speed and direction,	AIMS (Lough)	23
Southern GBR water temperature	Water temperature	AIMS (Furnas)	10
Storm tide network	Storm surge	EPA	17
Subtidal sediment pollutant concentrations	Sediment pollutants	GBRMPA (Haynes)	64
Townsville Port Authority monitoring	Water quality, sediment and heavy metals, stormwater in Port (filed under Water Quality)	Townsville Port Authority (Wilson)	54
Waverider buoys	Wave heights, wave direction	EPA	18

Note: Shaded programs have no current or projected funding.

* community monitoring program

Program	Parameters	Organisation (contact)	Ref. No.
Biological			
Aerial surveys of coral bleaching	Extent of coral bleaching in GBR	GBRMPA/ CRC Reef (Berkelmans)	70
AIMS Long-Term Monitoring Program	Benthic communities, fish, COTS	AIMS (Sweetman)	41
Cairns fringing reefs	Benthic communities	GBRMPA (Sea Research)	15
Central Queensland flat back turtle research	Flatback turtles	CQU (Parmenter)	120
Coastal dolphins in Australia	Coastal dolphins	JCU/ CRC Reef (Parra Vergara)	81
Community dynamics at the Palm Group	Coral and algal communities	JCU (Willis)	26
Community dynamics at Lizard Island	Coral and algal communities	JCU (Hughes)	25
COTSWATCH/COTSBASE *	Public reports and anecdotal records on COTS abundance	GBRMPA (Wachenfeld)	34
Dugong aerial surveys	Dugong, turtle, dolphin	JCU/ GBRMPA (Marsh)	47
Dwarf minke whales	Dwarf minke whales	NHT/ JCU/ MTQ (Birtles)	80
Effects of terrestrial run-off on coastal communities	Coral communities	AIMS / CRC Reef (Fabricius)	107
Extent and severity of coral bleaching on the GBR	Coral communities	GBRMPA (Marshall)	77
Eye on the Reef *	Benthic communities, selected fish species, physical, <i>Trichodesmium</i> , megafauna	GBRMPA/CRC Reef	12
Fine-scale COTS surveys	Juvenile COTS	Reefwatch (Englehardt)	35
Heron Island reef monitoring	Coral communities	GBRMPA (Berkelmans)	11
Indo Pacific Sea Turtle Monitoring*	Turtle sightings	IPSTM (Harvey)	58
Introduced marine pests – Cairns Port	Benthic communities	Cairns Port Authority (Fletcher)	99
Introduced marine species survey – Hay Point	Introduced marine species	PCQ (Brunner)	111
Introduced marine species surveys in ports	Baselines surveys of ports	QDPI/ CRC Reef (Neil)	67
Macroinvertebrate, water quality and habitat sampling	Macroinvertebrates in fresh water, a range of water quality and habitat parameters	NRM (Choy)	109
Marine turtle breeding	Turtles	QPWS (Limpus)	1
Marine turtle capture in trawl nets	Marine turtles	ODPI (Robins)	88
Marine turtle foraging	Turtles, dugong	QPWS (Limpus)	2
Marine wildlife stranding and mortality	Turtles, dugong, cetaceans	QPWS (Haines)	3
Nelly Bay monitoring	Benthic communities	GBRMPA (Various)	28
Piper Reef impact site monitoring	Coral reef benthos	QPWS (Short)	74

Note: Shaded programs have no current or projected funding.

* community monitoring program

Program	Parameters	Organisation (contact)	Ref. No.
Biological			
Ports fisheries habitat monitoring	Seagrass and benthic communities in Old ports	QDPI (Rasheed)	45
Reef Check *	Benthic communities, fish	Undersea Explorer (Dunstan)	43
Reef crest community dynamics- Heron Island	Coral and algal communities	UCLA, USA (Connell)	24
Retrieval and necropsy of dead marine wildlife	Marine mammals, sea turtles	QPWS (Turner)	85
Scale insect populations on the <i>Pisonia</i> forests of the Capricornia Cays National Park	Plants on coral islands	QPWS /QDPI (Kay)	72
Seagrass monitoring at Green Island	Seagrass	QDPI (Mackenzie)	116
Seagrass monitoring in Shoalwater Bay	Seagrass	QPWS (Kay)	76
Seagrass monitoring – Port of Mourilyan	Seagrass	PCQ (Brunner)	110
SeagrassNet	Seagrass health	QDPI (Coles)	61
Seagrass-Watch *	Seagrass health	QDPI, community (Campbell)	44
Shark netting	Sharks and by-catch	QDPI (Lane)	84
Soft sediment epibenthos (central Queensland shelf)		JCU / MTQ (Birtles/ Arnold)	86
Spatial variability in coral community dynamics	Coral communities	AIMS (Done)	27
Sudbury Reef coral benthos (after ship grounding)	Coral reef benthos	GBRMPA (Marshall)	73
Woongarra Marine Park - benthic *	Benthic communities	WMP Monitoring and Education Project (Sargent)	50

Note: Shaded programs have no current or projected funding.

* community monitoring program

Program	Parameters	Organisation (contact)	Ref. No.
Birds			
Brook Islands Torresian Imperial Pigeon (TIP) and seabird surveys	Torresian Imperial pigeons and seabirds on Brook Islands	QPWS (Green)	62
Brown and masked boobie population monitoring	Brown and masked boobies on the southern GBR	QPWS (O'Neill)	37
Michaelmas Cay seabird monitoring	Breeding seabirds	QPWS (Short)	75
Queensland coastal bird monitoring strategy	Seabirds and island birds	QPWS (O'Neill)	36
Queensland waders study *	Wading birds	Queensland Wader Study Group (Cross)	52
Roseate and black-naped tern population monitoring	Roseate and black-naped tern	QPWS (O'Neill)	38
Ross River estuary - birds and water quality * (filed under nearshore)	Physical, water quality, mangroves, birds, bats	Conservation Volunteers Australia (RIVER Group)	46
Silvereye population monitoring	Silvereyes at Heron Island	Imperial College, London (Owens)	39
Site and nest fidelity of red-tailed tropic birds on Raine Island	Seabirds	QPWS (Cornelius)	78
Townsville region bird observers*	Birds	Townsville Region Bird Observers Club (Payet)	53

Note: Shaded programs have no current or projected funding.

* community monitoring program

Program	Parameters	Organisation (contact)	Ref. No.
Fish and fisheries			
Adult reef fish surveys	Abundance of reef fish and coral cover	AIMS (Williams)	82
Annual cross-shelf fish recruitment surveys	Fish recruitment	AIMS (Williams)	83
Australian Underwater Federation – spearfishing *	Fisheries target species, reefs off Cairns, Townsville, Mackay	Australian Underwater Federation (Smith)	32
CFISH	Commercial fishing logbook statistics	QDPI (Higgs)	20
Effects of line fishing experiment	Reef line fishing	CRC Reef / JCU (Mapstone)	71
Fisheries long-term monitoring program	Fisheries independent monitoring: mackerel, barramundi, reef fish, scallops, spanner crabs, tiger prawns	QDPI (Dunning)	22
Fitzroy - fisheries	Fisheries target species	QDPI (Robins)	106
RFISH	Surveys of recreational fishers	QDPI (Higgs)	21
Shark movements at Raine Island, Osprey Reef and Batt Reef	Tiger, hammerhead and white tip reef sharks	Digital Dimensions (Fitzpatrick)	117
Suntag	Tag recaptures of recreational fishing catch	Suntag (Sawynok)	68
Tuna and billfish data collection program	Tuna and billfish	AFMA (Alden)	79

Program	Parameters	Organisation (contact)	Ref. No.
Socio-economic			
Environmental Management Charge database	Tourism visitation (EMC)	GBRMPA (Lee)	31
GBR: destination image and competitiveness	Survey of GBR as portrayed in the media	JCU/ CRC Reef (Pearce)	56
Recreational vessels in Queensland	Surrogate for recreational fishing activity	Old Dept Transport (Nielson)	69
Social assessment of commercial fishers in Queensland		CRC Reef (Fenton/ Marshall)	89
Understanding public perceptions of the GBR and its management	Community perceptions on GBR management issues	JCU/ CRC Reef (Moscardo)	57
Understanding tourist use of the GBRWHA	Reef visitor perceptions	JCU/ CRC Reef (Moscardo)	55

Note: Shaded programs have no current or projected funding.

* community monitoring program

THE MONITORING DATABASE

Metadata collected about each monitoring project was entered into an Access database to provide a resource in support of a comprehensive review of monitoring in the GBRWHA. This stores information in a format that can be readily updated, and can be linked to a GIS with information about the location and distribution of study sites, for display and interrogation purposes. The GIS product will be available on the CRC Reef website as part of this project.

The contents of the database are summarised in Table 2. This report is a print-out of the summary report from the Access database. Each entry in the report has a unique reference number that identifies the study. These are printed at the bottom of each page and can be used to locate the record in the database.

Table 2: List of data categories in monitoring database.

Comments: Overview of project, comments on sampling regime and timing

Objectives of the monitoring program
Objective keywords

Monitoring target group/s
Monitoring methodology

Start date
End date
Number of samples completed
Sampling frequency
Seasonality

Location of geographic data
Data format description
Comments on data format, suitability, etc

Documentation: published papers, reports, manuals, other

Intellectual property status
Funding sources
Organisation coordinating monitoring
Organisation contact person, phone, email.