

ANNUAL REPORT



*Cooperative
Research Centre
for Ecologically
Sustainable
Development of the
Great Barrier Reef*

1998/99



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

MISSION STATEMENT

*Science for the ecologically sustainable development
of the Great Barrier Reef World Heritage Area*

CENTRE OBJECTIVES

*To undertake an integrated program of applied research and development, training
and extension aimed at enhancing the viability of, and expanding sustainable
Reef-based industries and economic activity, with particular emphasis on tourism,
and providing an improved scientific basis for Reef management and
regulatory decision making*

An unincorporated joint venture between



AMPTO Association of Marine Park
Tourism Operators



(on behalf of the
Qld Government)

with the



Cooperative
Research
Centres
Program

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Centre Director: Mr Simon Woodley

Cover photo: Cover photograph by David Wachenfeld. The sea cucumber pictured is *Thelenota rubrolineata*, found on a Ribbon Reef in the northern Great Barrier Reef.

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1. CHAIRMAN'S REPORT

Several major reviews of the CRC have been undertaken this year, which have significantly influenced future directions of our research programs and management operations.

In September, as part of our agreement with the Federal Government, the CRC undertook a major Fifth Year Review. Accountability is an essential part of the national CRC Program and while individual Centres are given responsibility for their own management, they are accountable to the government, their participating organisations and the public for meeting national objectives.



Sir Sydney Williams,
Centre Chairman
of the Board

Photo: Cairns Post

Overall, the CRC rated extremely well in the quality and relevance of its research, and in converting knowledge into products and decision-making processes for industry and government partners. A number of recommendations were made for developing future research, postgraduate education, information transfer and management programs. These were incorporated into our renewal application for the next seven years. In April 1999, the CRC was advised of its successful application for continued funding by the Federal Government and the new Cooperative Research Centre for the Great Barrier Reef World Heritage Area will receive a Commonwealth grant of \$16.4 million over the next seven years.

Partners from the existing CRC will comprise core partners in the new CRC for the Great Barrier Reef World Heritage Area. We have developed new research programs, a fresh look and a commercial and international focus. We will be incorporated into a company and adopt private sector practices within our research operations and governance.

The Board of the CRC has been at the forefront of CRC activities, setting the example for the strategic direction for the new CRC; taking a leading role in the Fifth Year Review and in the renewal processes; and bringing user needs and perspectives to bear on CRC programs.

I congratulate the staff, students and associates of the CRC Reef Research Centre for their hard work, dedication and innovation in providing strategic knowledge for the sustainable use of the Great Barrier Reef World Heritage Area. In particular, I would like to thank Mr Simon Woodley as our new Director for his efforts during a busy and demanding year.

Sadly, for my own part, I will soon say farewell to the Centre after a very enjoyable six years association with a dedicated Board of Directors made up from all walks of life, and an outstanding executive team that has helped make this collaborative enterprise trouble free.

For many decades I have been involved with a large number of organisations and interests but none has been as exciting as this CRC in helping to preserve and sustainably develop the Great Barrier Reef World Heritage Area.

Sir Sydney Williams
Chairman

2. DIRECTOR'S REPORT

This year has been very demanding, stimulating and a time of significant growth for the Centre. After six years of research, education and extension, the coming year should see the finalisation of many tasks and the graduation of the final cohort of postgraduate students in the Centre.

Apart from maintaining a fully functioning Centre, significant effort was required for the major (Fifth Year) review of the Centre, the preparation of a renewal application for a new Centre and the negotiation of Agreements for a new CRC. The Fifth Year Review and renewal application processes demanded the allocation of significant resources over and above those for running the Centre. I would like to acknowledge with thanks the enormous effort of Centre staff and Program Leaders and the support of Board Members in meeting these extra demands.

The Fifth Year Review process was completed with excellent results. The review of the scientific program concluded the Centre:

- “Is performing extremely well in the quality and relevance of its research and that the proposed research activity to the end of the current contract is relevant to its mission, and achievable.
- Has made excellent progress in converting research outcomes into products, processes and assistance to decision-making needed by its industry partners and the community in general.
- Is adding value through cooperative research which would not have been attained by the partners acting individually.
- Has made significant progress towards achieving all milestones identified in the Commonwealth Agreement 1993 and the Centre's own Strategic Plan 1994-1998.
- Has achieved a good strategic and tactical balance in its research, and an appropriate breadth and depth to serve its stakeholders.
- Has produced work that is of international standard and which is not being performed elsewhere in the world.”

The second Panel strongly endorsed the work of the Centre and concluded that “the Centre had made very significant progress in achieving the fundamental objectives of the CRC Program”; it “has addressed virtually all of the major areas of research relevant to achieving ecologically sustainable development of the Great Barrier Reef” and “had to be classed as highly successful”. The Panel recommended a number of areas of improvement which have been incorporated into the new CRC for the Great Barrier Reef World Heritage Area.

Immediately following this review, a renewal application was prepared for a new Centre to continue and improve on the work of the current Centre. The proposal for the new Centre included new activities in research, external collaboration, and commercial and international activities. One of the significant changes has been to align the CRC specifically with the World Heritage Area, through its name and programs.

In April 1999, the Minister for Industry Science & Resources, the Hon. Nick Minchin, approved funding of \$16.4m for a new Centre, the Cooperative Research Centre for the Great Barrier Reef World Heritage Area, to commence on 1 July 1999.

During the year the Centre continued its excellent research and education record. The long-term temperature monitoring data were invaluable for understanding the effects of the 1998 severe coral bleaching event on the GBR. Fine-scale surveys for Crown-of-thorns starfish have discovered a large cohort of juveniles in the reefs from Lizard Island to Innisfail. This has given tourist operators early warning of a possible outbreak in the next 12-18 months. The COTS extension program provides assistance to operators in managing infestations at tourist sites. Research into the fates of terrestrially derived sediments has concluded that most of the coarse sediments remain entrained inshore and do not reach outer reefs. This information has allowed the CRC to move now to researching the fate and biological responses to nutrients derived from land based sources. The Centre undertook surveys on behalf of the Ports Corporation of Queensland for marine pests introduced by ballast water.



Simon Woodley,
Director

Photo: JCU

DIRECTOR'S REPORT

A major modelling analysis was completed for the transport of fish larvae to more than 300 reefs. This modelling will be continued in the new Centre and should contribute significantly to the development of the Representative Areas Program of the Great Barrier Reef Marine Park Authority.

Other highlights for the year included:

- Dr Terry Done (Leader Program 1) was elected President of the International Society for Reef Studies.
- A briefing of local state and federal politicians was held on 8 April 1999 to continue the process of transferring knowledge to key stakeholders.
- CRC scientists have been at the forefront of debate about the effects of global warming on coral reefs and the coral bleaching phenomenon.
- Tourism research continues to assist industry to forecast trends in tourism and to adjust marketing strategies accordingly.
- The world class research and extension program into the effects of line fishing received support to continue into the second phase of manipulative experiments.
- Agreement was reached between the Centre and CRCs for Tropical Rainforest Ecology & Management, Sustainable Tourism, the Cairns Port Authority and Cairns City Council to establish a node in Cairns to service the needs of the tourism industry in that region.

The Centre and its researchers continued to receive strong support from the tourism and fishing industries in the conduct of its research. During the year an estimated in-kind contribution of \$730,000 was provided by these industries.

Postgraduate students continue to receive excellent support from the Postgraduate Coordinator. The Coordinator assists students in the completion of their degrees and helps to provide essential training in skills necessary for employment. The CRC has published a book describing the postgraduate student support system developed and utilised by the Centre. It was launched at the CRC Association Conference in Melbourne on 23 April 1999.

Significant effort has gone into maintaining and improving the communication and extension services, including an upgraded web page.

Research staff and associates have worked hard over the past 12 months to complete their existing research tasks and design new programs for the future. There have been high expectations by many private and public interest groups. I'm pleased to report that these expectations are almost always met in full, and often surpassed, when reviewed by independent panels, by CRC participants, and by community groups.

There are currently 92 CRC research tasks that focus on better understanding of the GBRWHA and sustainable use of its rich resources. Each task collaborates with government agencies to improve public policies or with private companies to help improve industry sustainability. Usually, the project team is made up of people from various stakeholder groups. This close association has worked well in the past and will continue and expand into the new CRC.

The coming year will be one of considerable change and development. Agreements for the new Centre have been signed and the Centre has been incorporated as a company limited by guarantee to align it more with private sector management practices and to put the Centre on a more commercial footing. The recruitment of new staff, including a new CEO and the development of an independent funding base will be key milestones. Above all the generation of high quality information of value to reef-based industries, to reef management agencies and to the community will remain the core business of the CRC.

Simon Woodley
Director

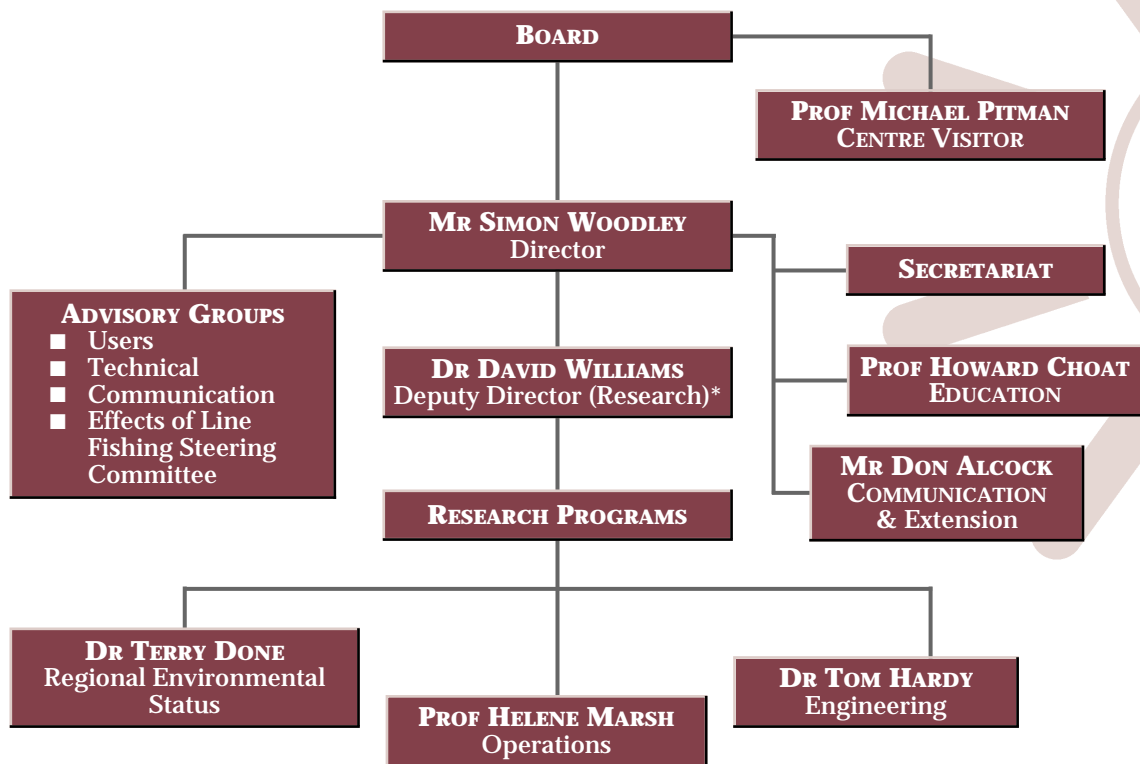
3. STRUCTURE AND MANAGEMENT

The Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef (CRC Reef Research Centre) is an unincorporated joint venture established in 1993 by an Agreement between the Centre Parties

- The Association of Marine Park Tourism Operators (AMPTO)
- The Australian Institute of Marine Science (AIMS)
- The Great Barrier Reef Marine Park Authority (GBRMPA)
- The James Cook University (JCU), and
- The State of Queensland through its Department of Primary Industries (DPI)

and an Agreement with the Commonwealth of Australia.

The organisational structure of the Centre is outlined below. The management structure consists of the Board and the Director. The Board and Director are advised by Advisory Groups and supported by a Secretariat dealing with administrative and financial activities. The Centre Agent is James Cook University. Operational activities of the Centre are carried out through the Centre Programs.



*from 1 April 1999

The Board comprises an independent Chair and members including the Chair of AMPTO; 2 persons nominated by AMPTO; the Executive Director of AMPTO; the Director of AIMS; the Chair of GBRMPA; the Pro-Vice Chancellor (Research & International), JCU; a nominee of the Director-General, QDPI; and nominees from the Queensland Commercial Fishermen’s Organisation (QCFO) and of SUNFISH invited to the Board by the Parties.

The Board regulates all operations of the Centre including monitoring and determining strategic development, reporting to the Parties and the Commonwealth, approving Centre Programs, the Annual Budget, financial arrangements and commercialisation of Centre intellectual property, and appointing the Director and Program Leaders. The Board met four times during the year.

STRUCTURE AND MANAGEMENT

The Board membership was:

Sir Sydney Williams	Chair
Mr Mike Burgess	AMPTO
Sir Sydney Schubert	AMPTO (Deputy Chair)
Mr Tony Briggs	AMPTO
Mr David Windsor	AMPTO
Dr Russell Reichelt	AIMS
Dr Ian McPhail	GBRMPA (to 12 April 1999)
Mr Richard Kenchington	GBRMPA (from 12 April 1999)
Professor Norman Palmer	JCU
Dr Barry Pollock	QDPI
Mr Ted Loveday	QCFO
Mr Alan Turnbull	SUNFISH

The Centre Visitor, Prof Michael Pitman, provides a strong link between the Centre and the CRC Program. Prof Pitman has continued to be actively involved in Centre governance, attending three meetings of the Board, providing advice on strategic direction and participating in review processes.



The Director attends all meetings of the Board and is responsible to the Board for the operational management of the Centre. He chairs, and is advised by, four Advisory Groups; the Users Advisory Group, the Technical Advisory Group, the Communication Advisory Group and the Effects of Line Fishing Steering Committee.

The Board appointed Dr David Williams as Deputy Director (Research) with effect from 1 April 1999. Dr Williams advises the Director on the development and direction of the scientific research programs and has a major role in external research advisory forums.

The CRC has "a dedicated Board of Directors made up from all walks of life", (Sir Sydney Williams). It met four times during the year at regional centres adjacent to the Great Barrier Reef.

Photo: Don Alcock

The Users Advisory Group considers issues and knowledge required by major user groups, reviews research tasks and outputs and assists in implementation towards effective use of research. The Group met on four occasions and membership in this period included:

Mr Simon Woodley	Chair, CRC
Dr David Williams	Deputy Director (Research), CRC (from 1 April 1999)
Mr David Windsor	AMPTO
Dr Terry Done	AIMS (from 15 October 1998)
Mr John Hicks	QPWS (to 15 October 1998)
Mr Malcolm Turner	GBRMPA (from 15 October 1998)
Dr Jamie Oliver	GBRMPA
Dr Zena Dinesen	GBRMPA (to 15 October 1998)
Mr David Lloyd	GBRMPA (to 15 October 1998)
Dr Robert Coles	QDPI (to 15 October 1998)
Mr Martin Breen	QCFO (from 15 October 1998 to 4 March 1999)

STRUCTURE AND MANAGEMENT

Mr Duncan Souter	QCFO (from 4 March 1999)
Mr Steve Hillman	PCQ (from 15 October 1998)
Ms Melita Samoilyls	QDPI (to 18 September 1998)

The Technical Advisory Group develops research, training and extension activities to meet the issues-related information needs identified by users. The Group comprises the Program Leaders, and has met on four occasions. Membership in this period was:

Mr Simon Woodley	Chair
Dr David Williams	Deputy Director (Research), CRC (from 1 April 1999)
Dr Terry Done	AIMS, Leader Program 1
Professor Helene Marsh	JCU, Leader Program 2
Dr Tom Hardy	JCU, Leader Program 3
Mr Don Alcock	CRC, Leader Program 4
Professor Howard Choat	JCU, Leader Program 5
Mr David Windsor	AMPTO
Ms Melita Samoilyls	QDPI (from 18 September 1998)
Dr Vicki Hall	CRC, Postgraduate Coordinator (from 21 January 1999)
Mr David Welch	JCU, Student Representative (to 21 January 1999)
Mr Darren Oemcke	JCU, Student Representative (to 21 January 1999)
Mr Paul Marshall	JCU, Student Representative (from 21 January 1999)
Ms Kirsten Michalek-Wagner	JCU, Student Representative (from 21 January 1999)

The Communication Advisory Group provides advice to the Communication Program Manager, Director and Board on policies and procedures for a range of media publicity, displays, science journalism competitions and research publications. The Group met on two occasions and membership in this period included:

Mr Simon Woodley	Chair, CRC
Mr Don Alcock	CRC
Ms Siriol Giffney	CRC
Ms Anna Cahill	QDPI
Mr Craig Sambell	GBRMPA (to December 1998)
Mr John Camplin	GBRMPA (from December 1998)
Ms Sandra Childs	AIMS
Ms Jill Shields	JCU

The Effects of Line Fishing Steering Committee provides advice to the Board on the conduct and progress of the Effects of Line Fishing project. The Group has met on three occasions and membership in this period included:

Mr Simon Woodley	Chair, CRC
Dr Bruce Mapstone	CRC
Mr Alan Turnbull	SUNFISH
Mr Eddie Hegerl	AMCS
Mr John Tanzer	GBRMPA
Mr Pat Appleton	QFMA
Mr Martin Breen	QCFO

4. COOPERATIVE LINKAGES

To secure the long term future of the Centre, it is necessary to maintain the support of the Centre's partner organisations and to gain additional support from Australian industries and international agencies. Since commencement, there has been an emphasis from senior management on building cooperative linkages among the participants.

A vital ingredient to enhancing research linkages has also been the extensive postgraduate students' participation in Centre programs, with most students being co-supervised and working with resource managers and scientists from more than one participating organisation.

The Centre maintained strong links with industry groups, coastal and marine management agencies, government departments, community groups and private companies – in Australia and overseas.

A series of strategic planning meetings, program reviews and project management systems have helped staff, researchers and associates improve internal and external linkages. For further information see Chapter 12 (Performance Indicators).

4.1 INTERNAL LINKS WITH PARTICIPATING ORGANISATIONS

The Centre maintained an associate program to help increase liaison between CRC researchers, resource managers and private operators. The role of associates, who are linked to each research task, is to improve the relevance and application of strategic research, facilitate information transfer and help develop public policy and better industry practices. A large number of staff from GBRMPA, QDPI, QPWS, QFMA and the tourism industry continued to help develop new CRC tasks, identify management needs, support projects and review results during the year.

In addition, more formal associate partnerships were forged to link the Centre with several companies and peak agencies. Agreements have been made with Ports Corporation of Queensland and Western Australia's Department of Fisheries, and Commerce and Trade for closer ties to the Centre.



A test of any CRC's effectiveness is continued support by its participating organisations. During the fifth year review of the Centre's performance and subsequent bid to form a new CRC, all partners again agreed to comprise the core partners with the Commonwealth Government. The Fifth Year Review Panel Report states "the panel has no doubt that the Centre is adding value through cooperative research which would not have been attained by the partners acting individually."

Internal links were facilitated by CRC Board Members and senior research staff being actively involved in a range of policy, industry and management committees (see examples at end of chapter).

Stakeholder linkages were also enhanced by:

- Extensive email information networks between staff, students and associates.
- Publishing scientific results in a range of newsletters, reports, brochures and in the media.
- Conducting informal discussion groups, meetings and workshops with stakeholders.
- Regular seminars and briefings to industry and regional resource management agency staff.
- Formal representation on various committees (such as the Effects of Line Fishing Steering Committee) to provide information for management plans, fisheries proposals, tourism policy and ports and shipping codes of practice.
- Regular meetings of Program Leaders and research project managers to discuss issues and improve collaboration.
- Regional industry functions prior to quarterly CRC Board Meetings.

CRC Reef Research Affiliate Award recipients, representing Pacific Marine Group, Pure Pleasure Cruises and Sinclair Knight Merz, were presented by AMPTO Chairman, Sir Sydney Schubert. The awards recognised significant support by private companies to the CRC.

Photo: Don Alcock

COOPERATIVE LINKAGES

The Users Advisory Group also helps facilitate links throughout the CRC. This group is made up of representatives from AMPTO, GBRMPA, QCFO, QDPI, QPWS and Ports Corporation of Queensland. Much of the committee's work involves reviewing research results and working with individual scientists to effectively use knowledge emerging from the CRC.

During the year, four Townsville companies were recognised for their support to marine research projects associated with the CRC. They were Pacific Marine Group, Sinclair Knight Merz, Pure Pleasure Cruises and Mike Ball Dive Expeditions. Each company received a *CRC Reef Affiliate Award* for their support in providing transport, technical expertise and use of facilities by researchers.

4.2 EXTERNAL LINKS

Briefings about the application of the Centre's research programs were again given to Federal and State Parliamentarians, senior policy-makers and industry leaders. In April, several North Queensland CRCs presented environmental issues to a large audience in Townsville on the theme "Science for Sustainable Use of Tropical North Queensland."



CRC Reef Board member and QCFO President Ted Loveday presented a Showcase Session on "Fishing for the Future" at the CRC Association Conference in Melbourne.

Photo: CRC Association

A briefing on sustainable management of Great Barrier Reef fisheries was also made in April by Board Member Mr Ted Loveday to delegates attending the National CRC Association Conference in Melbourne.

An agreement was made with the CRC for Tropical Rainforest Ecology and Management, the CRC for Sustainable Tourism, the Cairns Port Authority, Cairns City Council and Tourism Tropical North Queensland to establish a joint cooperative Research Unit in Cairns. The new unit will provide strategic research information and decision support to the regional tourism industry.

Strong links have continued with other CRCs particularly in the environment sector. The Director, Mr Simon Woodley, advised a new CRC for Coastal Zone Estuarine and Waterways Management on the development of their program proposal for funding. The Director initiated discussions with other selected CRCs to form an alliance. These CRCs are Sustainable Sugar Production, Sustainable Development of Tropical Savannas, Tropical Rainforest Ecology & Management and Sustainable Tourism. A number of staff training, education and public awareness activities have been conducted by CRCs in North Queensland.

Staff visited Murdoch University and CALM in Western Australia to open negotiations to develop a CRC node for research and education collaboration. It is planned to establish the node in 1999/00.

The Centre provides information and products to more than 1000 SME's in tourism, fishing, ports, shipping and engineering industries, mostly through peak associations such as AMPTO and QCFO. Many operators are directly involved with research, and support staff conducting field work. For example, 11 reef tourist operators have joined with GBRMPA and the CRC to fund "Eye on the Reef" in Cairns. This industry monitoring program collects information about the health of reef sites, water temperatures and unusual changes in marine life.

In addition, an extension program continued in the Cairns region by CRC researcher Udo Engelhardt to brief tourism operators about the status of Crown-of-thorns starfish. Training was provided to 15 operators about monitoring and control programs.

During the year a considerable effort was put into reviewing existing research programs and participating in stakeholder planning workshops for the new CRC.

COOPERATIVE LINKAGES

Nationally, the Centre was associated with more than 154 organisations, including:

Australian Universities & TAFE Colleges

Australian National University	University of Queensland
James Cook University	University of Sydney
Southern Cross University	University of Tasmania
University of New South Wales	University of Western Australia
Griffith University	Central Queensland University
Flinders University	Barrier Reef Institute of TAFE (4 campuses)
Monash University	Far North Queensland TAFE (4 campuses)

CRCs and Australian Research Organisations

CRC for the Antarctic and Southern Ocean Environment	GK Williams CRC for Extractive Metallurgy
CRC for Aquaculture	AJ Parker CRC for Hydrometallurgy
CRC for Sustainable Sugar Production	CRC for Freshwater Ecology
CRC for Sustainable Tourism	AIMS
CRC for Tropical Rainforest Ecology & Management	CSIRO Land and Water
CRC for the Sustainable Development of Tropical Savannas	CSIRO Marine Research, Hobart
CRC for Vaccine Technology	CSIRO Tropical Agriculture
CRC for Diagnostic Technologies	CSIRO Wildlife and Ecology
CRC for Waste Management & Pollution Control Ltd	Lizard Island Research Station
	One Tree Island Research Station
	The Australian Museum

State Government Departments & Corporations

Bureau of Sugar Experimental Stations	Tourism Queensland
Ports Corporation of Queensland	Queensland Department of State Development
Queensland Sugar Corporation	Department of Main Roads
Queensland Department of Primary Industries	South Australian Research & Development Institute
Queensland Department of Natural Resources	Western Australian Department of Conservation and Land Management
Queensland Fisheries Management Authority	WA Department of Commerce & Trade
NSW Fisheries Institute	
WA Department of Fisheries	
Queensland Fishing & Boating Patrol	

Commonwealth Departments and Corporations

Australian Bureau of Agricultural and Resource Economics	Environment Australia
Australian Centre for International Agricultural Research	Department of Industry, Science and Resources
Australian Marine Science & Technology Ltd	Fisheries Research & Development Corporation
Australian Bureau of Statistics	Great Barrier Reef Marine Park Authority
Australian Quarantine Inspection Service	Bureau of Tourism Research
Australian Tourist Commission	Coastwatch
	Department of Defence
	Australian National Audit Office

Local Government & Consultative Organisations

Cairns City Council	Townsville City Council
Gladstone Port Authority	Townsville Port Authority
Mackay Port Authority	Trinity Inlet Management Program

COOPERATIVE LINKAGES

Cairns Port Authority
Herbert River Catchment Management Centre
Townsville Enterprise
Mackay Tourism and Development Bureau
Strand Scientific Advisory Group
Johnstone River Catchment Management Group
Bundaberg City Council
Hervey Bay City Council

Community Organisations

Alliance for Sustainable Tourism
Australian Coral Reef Society
Australian Marine Science Association
Ecotourism Association
Federation of Australian Science
and Technology Societies
Zonal Advisory Committees
Low Isles Preservation Society
Australian Marine Conservation Society
OUCH, Whitsunday
Regional Marine Resource Advisory Committees
(Cooktown, Port Douglas, Townsville, Cairns,
Airlie Beach, Rockhampton)
North Queensland Conservation Council
Queensland Wilderness Society
Cairns and Far North Environment Centre
Marine Science Teachers Association
SUNFISH

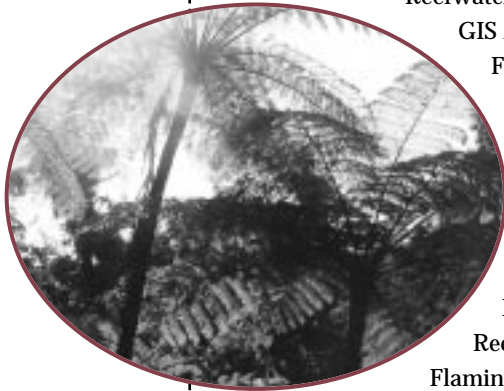
Private Companies

Reefwatch Australia
GIS Australia
Friendship Cruises
Haba Dive
Ocean Spirit Cruises
Passions of Paradise
Sea Research
Quickcat Cruises
Freedom Flyer
Keppel Tourist Services
Reef Lady Charters
Flamingo Bay Research
Sinclair Knight Merz
Dames & Moore Consultants
Kinhill Engineers Pty Ltd
Digital Dimensions
Poseidon Outer Reef Cruises
G A Glanville & Co
Stewart Marine Design
Hooker 1 Charters
Elizabeth E II Charters
Lady Musgrave Barrier Reef Cruises
Blue Whaler Charters
Southern Pacific Petroleum
Central Pacific Minerals
Whitsunday Diver
Freedom Flyer Transport

Captain Cook Cruises
FantaSea Cruises
Frankland Island Cruises
Great Adventures
Hamilton Island
P & O Australian Resorts
Pure Pleasure Cruises
Pacific Marine Group
SEA Consultants
Woodside Petroleum WA
Powerlink Pty Ltd
Brampton Island Resort
Quicksilver Connections
Quicksilver Diving Services
Sunlover Cruises
Undersea Explorer
Yamaha
Reef Biosearch
Gutteridge Haskins Davey Pty Ltd
Econnect Pty Ltd
Aquacat Charters
Norseman Charters
Prosail
Whitsunday All Over
Sea Trek Cruises
Reef Express
Illusions

Industry Associations

Queensland Canegrowers
APPEA
Association of Environmental Engineers
Queensland Charter Vessel Association
AMPTO
QCFO
Reef Tourism 2005
PADI
Tourism Tropical North Queensland
Great Barrier Reef Charter Association
Cairns Profession Game Fishing Association
Dive Queensland



CRCs for Reef,
Rainforest and
Tourism have joined
with the Cairns
City Council, Port
Authority, and
Tourism Tropical
North Queensland
to establish a joint
Cooperative Research
Unit for the tourism
industry in Cairns.

Photo: WWd

COOPERATIVE LINKAGES

4.3 INTERNATIONAL LINKS

Mr Richard Kenchington made several trips throughout the year to the United States in conjunction with his role as Coordinator for the International Coral Reef Initiative, and in preparation for the International Tropical Marine Ecosystems Management Conference in Townsville. In particular he developed closer links with the US National Oceanographic and Atmospheric Administration.

In November, Dr Russell Reichelt briefed the executive council of the UN-funded Inter-governmental Oceanographic Commission in Paris about the CRC-AIMS Long-Term Monitoring Program for the Great Barrier Reef. The briefing helped present an important Australian initiative that will soon be used within the IOC's Global Ocean Observing System. Dr. Reichelt also developed international links for the Long-Term Monitoring Program with the UN's Land-Ocean Interactions in the Coastal Zone Program.

Dr Terry Done was a member of an expert workshop on Global Climate Change and Marine Biodiversity in Washington DC during February, sponsored by the World Wide Fund for Nature. Systems biologists for the Arctic and Antarctic, the North Pacific salmon fisheries, and for the California current and coastal systems also attended, concluding that signals in all of these systems, including coral reefs, are giving evidence of climate impacts. In March he attended a Paris meeting of the Coordinating and Planning Committee for the ICRI Initiative, as President of the International Society for Reef Studies, to advance international coral reef initiatives including global coral reef monitoring, action plans for improving management of coral reefs around the world, and assessing the bleaching event in the Indian Ocean.

Dr Done was also the plenary speaker at the National Coral Reef Institute conference in Florida during April, where he presented an address "*Useful Science for Coral Reef Management: the CRC Model*". He also visited Jakarta to discuss the organisation of the 9th International Reef Symposium, planned for Bali in October 2000, and Hawaii for a NOAA/ICLARM workshop on monitoring and mapping coral reefs using remote sensing.

Professor Helene Marsh visited several overseas countries in relation with her work for Program 2. She attended an international function at Virgin Gorda to receive her \$150,000 Pew Charitable Trusts Fellowship for research in marine conservation. She also was a guest speaker at the United Nations University in Japan on marine conservation issues.

Professor Marsh, an international expert in dugong research and conservation, also accepted an invitation to assist the Johore State Government in Malaysia develop strategies to manage and research dugong populations in offshore coastal waters. As a result, a team of Malaysian marine scientists and resource managers will visit the CRC next year to study these issues in the Great Barrier Reef Marine Park more closely.

Gianna Moscardo and Edward Kim attended the Asia Pacific Tourist Association Annual Conference in Tanyang, South Korea in August 1998 to present papers. During October 1998 Barbara Woods and Gianna Moscardo ran a workshop on maps as an interpretive tool in marine settings at the Annual National Association of Interpretation Conference in Anchorage, Alaska. Edward Kim attended PACON 1999 in Moscow in June and chaired sessions on coastal and marine tourism.

In May, Mr Don Alcock attended the World Congress on Marine and Coastal Tourism. Australia's CRC Program was promoted using CRC Reef as a model for collaboration and provider of strategic knowledge to participating organisations. A number of countries, particularly Canada, have since investigated the CRC Program with a view to possibly adapting the model for their environmental research efforts.

A large number of papers have been published in the international scientific literature, especially in top-rating journals in our field. Full details of international papers and presentations are in Chapters 8 and 9. Internationally, the Centre was associated with:



CRC Program Leader
Professor Helene Marsh
began a marine
conservation project
with funding from
the Pew Charitable
Trust Fellowship.

Photo: JCU

COOPERATIVE LINKAGES

Organisations and Programs

International Panel on Climate Change	Natural Environment Research Centre, UK
International Union of Biological Sciences	BBC Natural History Unit, UK
Pacific Asia Travel Association Foundation	USGS (coral program)
Land-Ocean Interactions in the Coastal Zone, The Netherlands	ORGSTROM, Noumea
TOPEX/Poseidon, NASA	IGBP-SARC, SE Asia
World Conservation Monitoring Centre	International Centre for Social and Policy Research
International Maritime Organisation	

Universities and research institutions

International Centre for Computational Hydraulics, Denmark	University of New Hampshire, USA
Honan University, Korea	Florida Institute of Oceanography
Purdue University, USA	National Centre for Ecological Analysis & Synthesis, Santa Barbara, USA
University of the Philippines	McGill University, Canada
Kasetsart University, Bangkok	National Coral Reef Institute, Fort Lauderdale, USA
Texas A & M University, USA	Clemson University, USA
University of Hawaii	Vrije University, The Netherlands
University of Waikato, New Zealand	Department of Fisheries, Malaysia
National Oceanic and Atmospheric Administration, USA	University of Auckland

4.4 VISITORS TO THE CENTRE

Japanese Universities Delegation

Dr Isao Koike	Professor of Marine Biochemistry, Ocean Research Institute, University of Tokyo
Prof Eiji Matsumoto	Institute for Hydrospheric-Atmospheric Studies, Nagoya University
Prof Tetsuo Yanagi	Coastal Oceanography Research Institute for Applied Mechanics, Kyushu University
A/Prof Teruhisa Komatsu	Division of Fisheries Ecology, Ocean Research Institute, University of Tokyo

Palau Study Tour

Obak Isao Singeo	High Chief and Legislator of Peleliu State, Palau
Noah Idechong	Executive Director, Palau Conservation Society
Dr Andrew J. Smith	Coastal/Marine Management Specialist, Asia Pacific, The Nature Conservancy
Lolita K. Gibbons	Legislator, Koror State Government
Charlene T. Mersai	Rock Islands Coordinator, Palau Conservation Society

Indonesian delegation

Ian Dutton	Project Leader, University of Rhode Island
Dr Dietrich Bengen	Bogor Agricultural University
Chris Rotinsulu	North Sulawesi CRMP
Ramli Malik	CRMP
Sapta Putra Ginting	Ministry of Home Affairs
Karla Boreri	Consultant, Jakarta

COOPERATIVE LINKAGES

Other

Meriwether Wilson	USA
Dr Robert J. Clements	Director, Australian Centre for International Agricultural Research
Junichi Harada	Researcher of Energy Research Department, Nomura Research Institute Ltd, Japan
Prof Thomas A. Heberlein	University of Wisconsin, Madison, USA
Mr M. Jagannadha Rado	M.S. Swaminathan Research Foundation of India
Mr Roderick Hurst	European Union
Prof Rolf Schmid	Head of Institute for Technical Biochemistry, University of Stuttgart, Centre for Bioprocess Engineering, Germany
Dr Kumthorn Thirakhupt	Assistant Professor, Department of Biology, Chulalongkorn University, Bangkok, Thailand
Bill Taylor	Project Development Manager, Scottish Natural Heritage

4.5 EXAMPLES OF CRC BOARD & PROGRAM LEADER MEMBERSHIP OF KEY POLICY, INDUSTRY AND TRAINING COMMITTEES

Sir Sydney Williams

- CRC for Sustainable Tourism

Mr Simon Woodley

- Effects of Line Fishing Steering Committee

Dr David Williams

- Reef Fish Management Advisory Committee
- CRC Aquaculture Board
- North West Shelf Marine Environment Management Study Steering Committee

Mr Alan Turnbull

- Effects of Line Fishing Steering Committee
- Great Barrier Reef Consultative Committee

Sir Sydney Schubert

- Great Barrier Reef Consultative Committee

Mr Tony Briggs

- Queensland Transport Marine Board

Prof Norman Palmer

- CRC for Tropical Rainforest Ecology & Management, CRC for Sustainable Tourism, CRC for Sustainable Sugar Production and CRC for Aquaculture

Mr Ted Loveday

- Fisheries Research and Development Corporation
- Great Barrier Reef Consultative Committee
- CSIRO Marine Sector Advisory Committee
- Torres Strait Fisheries Management Committee
- Queensland Fishing Industry Training Council
- Landcare and Catchment Management Council
- Seafood Export Consultative Committee
- Australian Seafood Industry Council
- Qld Fishing Industry Development Council

COOPERATIVE LINKAGES

Dr Russell Reichelt

- Fisheries Research and Development Corporation (Chair)
- National Ocean Advisory Group (Chair)
- Great Barrier Reef Consultative Committee
- Heads of Marine Agencies
- State of Environment Committee (Australia)
- Scientific Steering Committee, Institutional Dimensions of Global Environmental Change
- James Cook University and University of Queensland (Adjunct Professor)

Mr Mike Burgess

- Regional Tourism Ministerial Advisory Committee
- Tourism Council Australia
- Australian Marine Industries and Sciences Council

Dr Barry Pollock

- Fisheries Resource Management Sub-Program, Department of Primary Industries (Chair)
- Maryborough/Hervey Bay Fishing Development Focus Group (Chair)
- Bundaberg Fishing Development Focus Group (Chair)
- Fisheries Management Committee, Standing Committee on Fisheries

Dr Ian McPhail

- Portfolio Marine Group, Environment Australia
- Environment Executive, Environment Australia
- Heads of Marine Agencies
- Great Barrier Reef Consultative Committee (*ex officio*)
- Australian Committee for IUCN

Mr Richard Kenchington

- Australian Committee for IUCN
- Great Barrier Reef Marine Park Authority Ethics Committee
- International Coral Reef Initiative Committees

Dr Terry Done

- International Society for Reef Studies (President)
- GBRMPA Representative Areas Steering Committee
- Scientific Committee for a National System of Marine Protected Areas
- International Union of Biological Sciences
- Atmosphere & Ocean Science Committee, Australian Academy of Science

Prof Helene Marsh

- IUCN Sirenia Specialist Group (Chair)
- Great Barrier Reef Consultative Committee (Chair)
- Queensland Department of Environment Scientific Advisory Committee (Chair)
- Ocean Park Conservation Foundation
- Marine Science & Technology Plan Working Group (DIST)
- Australian Science, Technology and Engineering Council

Prof Howard Choat

- Museum of Tropical Queensland Management Committee
- Centre for Research on Ecological Impacts on Coastal Cities Advisory Committee
- Lizard Island Research Station Management Committee
- FRDC Quantitative Training Unit for Fisheries Advisory Committee

5. RESEARCH

Program 1. Regional Environmental Status

(Program Leader: Dr Terry Done, AIMS)

Objective

To develop the understanding of regional environmental status, events and processes necessary to minimise and solve problems associated with increasing use and impacts on the Great Barrier Reef Marine Park.



1998 proved to be the Barrier Reef's most severe coral bleaching event on record.

CRC scientists and students monitored the extent of bleaching and researched the ability of corals to recover.

Photo: Paul Marshall

This was a year in which the globally widespread coral bleaching and coral death was linked in the public arena to global climate change, widening concerns of a major deterioration in coral reef services to humans over coming decades. It was also a year when sustainability of dugong populations and their seagrass food resources developed into a major cause for public concern. This Program contributed to increased public awareness, through its reporting of these events on the Great Barrier Reef, and through its involvement in international collaborations and initiatives. At the same time as promoting the global focus, it was critical that the Program continue its contribution to the relatively more localised, yet still huge, spatial domain of the Great Barrier Reef region. Accordingly, the prime focus of our research continued to be resource and habitat mapping, and the documentation and understanding of 'how the ecosystem works', spatial risk assessments for stresses, inputs and impacts, both human and natural, and how living systems respond. As the sixth year of the current Centre, much of the work was consolidation and publication of advanced projects, and there was little in the way of new tasks. Further information see Chapter 7: Utilisation and Application of the Research

5.1 INPUTS AND IMPACTS

(Dr Miles Furnas, AIMS)

Inputs of nutrients and sediments from rivers, impacts of elevated water temperatures and marine pests were the focus of attention over the year. Relationships between wet season river flow rates, nutrient levels and suspended sediment loads continued to be monitored by instrumental and manual methods in four representative river catchments (Fitzroy, Burdekin, Herbert and Normanby). Intensive water sampling was carried out in the Herbert River during the flood associated with tropical cyclone "Rona" and an intercalibration of suspended sediment sampling methods was conducted with personnel from the Queensland Department of Natural Resources (QDNR). A second year's record of water levels and suspended sediment concentrations was obtained from the relatively undeveloped Normanby River (Cape York). Broad-scale sampling of water quality was conducted throughout the northern and far-northern GBR following widespread monsoonal rainfall. Further analysis of data from long-term monitoring of coral reefs and fishes on 52 reefs over 10 degrees of latitude, mostly offshore, shows that water-quality impacts are restricted to nearshore reefs. Outbreaks of Crown-of-thorns starfish were observed on a number of reefs. Most of the sampled reefs were characterised by improved coral cover or remained the same. High coral mortality following coral bleaching was observed on two of the reefs and low mortality on several others. The Long-Term Monitoring Project (LTMP) results are reported to the Great Barrier Reef Marine Park Authority and posted on the LTMP web site (<http://www.aims.gov.au/monmap>). The LTMP completed the third reef status report and several peer reviewed methodology and results papers. Water temperatures throughout the GBR were monitored on an ongoing basis by automated weather stations, networks of digital underwater temperature loggers on selected reefs and oceanographic moorings to develop the basis for a real-time coral bleaching warning system. A small project to monitor regional ports for introduced marine pests was initiated.

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5.2 HYDRODYNAMICS AND DISPERSAL

(Dr Lance Bode, JCU)

This project completed a major modelling analysis of the transport of fish larvae of more than three hundred reefs in the Cairns - Townsville section of the Great Barrier Reef - thus providing important insights into how highly protected areas might be best located to ensure reliable replenishment by fish and coral larvae. Using a simple fish population model and a state of the art hydrodynamic model driven by real winds and tides during the spawning seasons of the last 20 years, a vast set of fish dispersals were simulated. Based on recent observations of aggregated spawning of some reef fishes, 'virtual' fish eggs were released from either entire or partial reef perimeters to drift passively with the currents for a few weeks. Building on other recent findings, late stage virtual fish larvae were caused to 'home' onto reefs. The entire simulated data sets are being analysed as part of an assessment of the effectiveness of protected areas on regional fish replenishment. The protocols are now well developed and the preliminary results so far are very encouraging. The next simulations leading to an assessment of current protected areas will feature incorporation of the spawning season currents from 10 years of monitoring the East Australian Current.

5.3 SEDIMENT HISTORY AND ACCUMULATION

(Dr Ken Woolfe, JCU)

There is a background of concern regarding fate of land-derived sediments entering Great Barrier Reef waters, and the extent to which they threaten coastal ecosystems. Understanding the distribution of all sediments and the processes that control their transport is thus of fundamental importance in assessing the degree of threat. Focusing on Cape York, the project found that shoreline orientation and the directions of prevailing winds and currents trap most sand and mud against the shore - be they newly derived from rivers, marine sediments, or soils from a lower sea level of just a few thousand years ago. The conclusion was that those heavier land-derived sediments that fall to the sea floor pose no threat to offshore ecosystems, especially the high value coral reefs. There was no mechanism to transport such sediments very far into the Great Barrier Reef lagoon and the reefs of the middle and outer shelf. On the west coast of Cape York, by contrast, land-derived sediments are deposited across a sediment wedge some tens of kilometres wide.

Unlike the heavier river sediments, river water carrying fine suspended sediments and nutrients does find its way out to offshore reefs (see 5.5 System Models) and leaves its mark as luminescent lines in the skeletons of massive corals. A preliminary study of the date and intensity of lines in corals at different distances from rivers was completed and will be further refined and used in conjunction with flood-plume modelling to map the frequency and extent of flood plume intrusions into Great Barrier Reef waters.

5.4 LIVING SYSTEM RESPONSE

(Dr Rob Coles, DPI)

The Project made significant advances in understanding the distribution, roles and significance of hard corals, soft corals, algae and seagrasses. The project's octocoral and seagrass teams continued the largest and most even spatial spread of GBR biotic surveys ever undertaken, important inputs to the design of the GBR Marine Park's system of 'Representative Protected Areas' (RPAs).

Within the Coral Reef sub-project, it was discovered that octocoral communities on reefs close to 'dirty' rivers differed from those close to 'clean' rivers. Soft corals were affected by the 1998 mass bleaching event to an extent similar to hard corals. The project also produced a synthesis of available scientific



Community volunteers participated in Seagrass Watch, contributing to DPI's data analysis and base mapping of these important marine plant fisheries habitat.

Photo: DPI, Cairns

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information on GBR macroalgal distributions, important information for evaluating effects of nutrient runoff on marine ecosystems. Reflecting the importance of ecological factors in controlling algal-coral outcomes, ten separate experiments were undertaken on processes such as competition and recruitment. Long-term photographic (20 year) records used in a post-graduate pilot study established useful and cost-effective protocols for comparing and contrasting local scale changes of disturbed and undisturbed reef communities.

In the Seagrass sub-project, a further 300 deepwater sites over a 400 km section of the northern GBR were sampled for sediments and associated sea-floor communities, providing a major collection for detailed analysis, and a preliminary assessment for use by GBRMPA in its RPA program. In collaboration with QPWS staff, EPA staff and volunteer groups, coastal seagrass areas were sampled and mapped in the vicinity of Fraser Island, Hervey Bay, and the Whitsunday Islands. Preliminary analysis of surveys of the important dugong feeding areas of Hervey Bay before and after the 1998-9 wet-season flooding of the Mary River showed both a decline in seagrasses, and some post-disturbance recovery. The implications for the dugong food resource are as yet unclear. Other experimental studies on recovery in disturbed sea-grass areas showed that prolonged periods of shading or elevated turbidity can inhibit recovery, so that artificial restoration programs without rectifying turbidity problems are likely to be futile.

5.5 SYSTEM MODELS

(Dr Terry Done, AIMS)

The project completed important milestones of system description, spatial analysis, risk assessment and ecosystem response. A digital, three dimensional, depth and elevation model from the deepest outer reaches of the Great Barrier Reef to the top of the Great Dividing Range was completed in hard copy and CD forms that will be published in 1999 - 2000. These products represent the terrain that accommodates all of the Great Barrier Reef's use, protection, and land-sea interactions. It is a representation of the land-and sea-scape for all sedimentary, biological and oceanographic patterns and processes. It is an important framework for much of the information generated in other Projects, and was used in assisting the design of GBRMPA's system of RPAs.

Risk assessment concepts proved invaluable in quantifying a major aspect of the natural environment of the Great Barrier Reef. The underlying question is that of distinguishing human impacts from natural variability in the system. Based on published field data for model validation, and on simulation of the twenty-one largest floods over the last 30 years, the project produced two invaluable products now in preparation for publication: 1) the estimated return periods (ranging from annual to > 30 years) for the influence of Burdekin River flood plumes at any point in the Great Barrier Reef; 2) the characteristics of the 'typical' one, ten and fifteen year flood in terms of salinity of surface waters (called 'design floods' in engineering parlance). Used in conjunction with river flow rating curves that may become modified as a result of climate change or changed water allocation practices within catchments, the outputs, tools and expertise are important resources for exploring scenarios for catchment use and climate change in the 21st Century.

From the viewpoint of a coral reef, seagrass bed or other marine ecosystem, such scenarios can usefully be expressed as the projected frequency and/or intensity of extreme events, like floods, cyclones or Crown-of-thorns starfish, or as changes in mean conditions, such as average nutrient delivery rates and concentrations. Accordingly the project produced a classification of potential adaptive outcomes or other responses for coral reefs under scenarios for environmental change: a) tolerance; b) faster turnover; c) strategy shift, d) phase shift. While responses a), b) and c) all equate to coral reef states that are coral dominated, aesthetically appealing, and ideal fish habitat, some plausible projections of



The prime focus of the Regional Environmental Status Program remains the documentation and understanding of "how the ecosystem works".

Photo: GBRMPA

impacts of global climate change are pointing to 'phase shift', or widespread replacement of appealing and structurally critical corals by non-structural forms such as seaweeds.

5.6 CROWN-OF-THORNS STARFISH

(Mr Udo Engelhardt, JCU)

This project has applied intensive fine scale searches of coral reef sites systematically distributed around 21 standard reefs in the Cairns and Central Sections of the Great Barrier Reef. Although there are no comparative data from either of the previous two documented outbreaks on the Great Barrier Reef, indications are that the time interval between serious coral destruction may be shortening. The presence of juvenile starfish on key tourism reefs off Port Douglas and Cairns poses a short-term threat to the appearance of these reefs, and the study has performed a vital role in alerting, advising and training operators about the needs for and methods of control of the starfish. The tourist industry, researchers and QPWS staff are collaborating very effectively in extension and public awareness and involvement. A key initiative is the COTSWATCH Reef User Reporting Scheme, featuring an electronic reporting form on the Internet.

Program 1 Summary - Current Tasks

Task	Chief Investigator	Title
1.1.1	Dr M Furnas (AIMS)	Biological Oceanography
1.1.2	Dr H Sweatman (AIMS)	Long Term Monitoring of the GBR
1.1.4	Mr R Berkelmans (GBRMPA)	Long-Term Monitoring of Sea Temperature on the Great Barrier Reef
1.1.5	Prof H Choat (JCU)	Mourilyan Harbour & Abbot Point Surveys
1.2.1	Dr L Bode (JCU) & Dr D Burrage (AIMS)	Regional Circulation Models
1.3.1	Dr K Woolfe (AIMS)	Sediment Accumulation/Dynamics
1.3.3	Dr D Barnes (AIMS)	Biomarkers - Corals and Clams
1.3.7	Dr D Barnes (AIMS)	Assessment of the Spatial and Temporal Variability of Terrestrial Impacts on the Great Barrier Reef using Coral Fluorescent Banding
1.4.1	Dr T Done (AIMS)	Coral Reefs
1.4.2	Dr R Coles (QDPI)	Seagrass Beds
1.4.5	Dr N Duke (AIMS)	Mangrove Forests - Oil Effects
1.4.8	Mr D Haynes (GBRMPA)	Pollutant Concentration in the GBRMP
1.5.1	Dr T Done (AIMS)	Science Modelling
1.5.1/2	Dr B King (AIMS)	Impact of River Plume on the Central Great Barrier Reef
1.5.2	Dr A Lewis (JCU)	Spatial Systems to Support Planning for Ecologically Sustainable Use of the GBR at Regional Scales
1.5.3	Dr T Done (AIMS)	Book on Science for Management of the Great Barrier Reef Beyond 2000
1.6.1	Mr U Engelhardt (JCU)	Fine-scale Surveys of Crown-of-thorns starfish in the Cairns Section of the GBR Marine Park
1.6.4	Mr U Engelhardt (JCU)	Crown-of-thorns starfish: Public Information & Extension Program
1.6.9/1	Mr M Hartcher (JCU)	COTS Base Version 1.0
1.6.9/2	Mr R Berkelmans (GBRMPA)	Review Workshop on COTS Outbreaks
1.7.1	Mr R Hore (Reef Biosearch)	Irukandji Research

Program 2. Operations

(Program Leader: Prof Helene Marsh, JCU)

Objective

To find solutions to problems associated with the increasing use of the Great Barrier Reef Marine Park relevant to tourist operators, natural resource managers and recreational and commercial fishers.

With an area of some 350,000 km², the Great Barrier Reef World Heritage Area is much larger than the Australian State of Victoria. Globally it is by far the largest World Heritage site, with an area equivalent to one third of the combined total of all natural World Heritage areas. This huge size, and the diversity of social and economic values associated with the area, means that it is inappropriate to manage the Great Barrier Reef region as a national park, the approach adopted to manage most of the World Heritage sites which have been listed because of their outstanding natural values. To do this would effectively 'lock up' the entire eastern coast of Queensland north of Bundaberg. Accordingly, the Great Barrier Reef Region is zoned for multiple use. The challenge is to ensure that this use is ecologically sustainable. This Program aims to provide scientific information to assist stakeholders to use the Region sustainably, particularly the two major industries, tourism and fishing.



Major Reef industries, especially tourism and fishing, contributed an estimated \$730,000 worth of in-kind support during the year, and assisted CRC staff and students to conduct their field research.

Photo: WWd

The Program is organised in five projects:

- Visitor-Environment Interactions (Professor Helene Marsh, JCU)
- Tourist Destination Image and Interpretation (Professor Philip Pearce, JCU)
- Habitat Restoration (Professor Howard Choat, JCU)
- Effects of Line Fishing (Dr Bruce Mapstone, JCU)
- Endangered Species Interactions (Professor Helene Marsh, JCU)

Highlights of progress in 1998/99 are outlined below. Further information see Chapter 7: Utilisation and Application of the Research.

5.7 VISITOR-ENVIRONMENT INTERACTIONS

In terrestrial parks and remote environments, the distribution of recreational impacts reflects the predominant patterns of use, with the most severe impacts usually found where recreationists congregate; at campsites, scenic vantage points or along access trails. In marine environments, however, the relationship between use and damage is less obvious, as the movement of snorkellers and SCUBA divers are not necessarily constrained by trails or features of the surrounding landscape. CRC Reef researchers have conducted several studies of diver behaviour with the aim of making the recreational use of the Reef more sustainable.

Drs Graeme Inglis and Scott Shafer examined the relationship between the patterns of use by snorkellers at two intensively visited coral reef sites and the distribution of physical coral damage. Video monitoring was used to produce composite maps of the distribution of snorkellers at each site under varying conditions of use, tide, weather and managerial settings. Timed underwater observations and surveys of coral damage determined rates of damage in areas of the sites that received comparatively high and low usage. Patterns of site use were remarkably consistent, despite major differences in reef topography. At each site, the distribution of snorkellers was positively associated with reef-edge habitats and negatively associated with distance from safety features such as fixed rest stations, the tourist pontoon and the shallow reef flat. At any time more than 50% of snorkellers were less than 50 m from the pontoon. The rate at which damage occurred generally

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reflected this pattern of use, but was also influenced by the distribution of branching corals and the state of the tide. These results are consistent with the 'prospect-refuge' theory of recreational site use, which suggests that recreationists prefer ecotones because they provide the opportunity to view 'threatening areas', such as the edge of the reef, while offering the security of a nearby refuge such as a tourist pontoon. This research shows that the placement of safety infrastructure such as ropes and buoys is an important determinant of the pattern of use of snorkelling sites and may be an effective and unobtrusive means of distributing use to areas where impact is minimal.

Underwater trails are intended as interpretative tools in marine parks. However, by concentrating divers and snorkellers in defined areas they may focus impacts in the marine environment in the same manner as the infrastructure around pontoons. Sakanan Plathong, a Masters student associated with the CRC, examined the spatial and temporal patterns of diver impact caused by the use of underwater trails on coral reef flats in the Great Barrier Reef Marine Park. Despite comparatively low levels of use (approximately 15 snorkellers per trail per week), snorkellers caused significant damage along trails, especially to branching corals. More damage occurred near the interpretative signs than elsewhere on the trails. The number of broken branches and damaged coral colonies increased rapidly after the trails were established, but stabilised within two months of the commencement of use. There was no significant change in the overall benthic assemblage after six months' use by snorkellers. Sakanan's research showed that although concentrating snorkellers within defined trails can increase damage to corals, the impacts can be mitigated by appropriate design and placement of trails and by managing the behaviour of snorkellers.

5.8 CONNECTING WITH THE COMMUNITY: PERCEPTIONS OF THE STATUS OF THE GREAT BARRIER REEF WORLD HERITAGE AREA

The Great Barrier Reef Marine Park Authority is committed to encouraging community support for protection of the Area and developing community understanding of management practices. In accordance with these aims, the Authority has developed a variety of measures for community consultation and input. While any member of the public can use these mechanisms, interest groups and a small number of individuals with specific concerns usually dominate the use of these options.

With the help of Authority staff, CRC Researchers Gianna Moscardo, Tanya Greenwood and David Green, developed and conducted a series of telephone surveys designed to gather information from Australian residents, especially those living in close proximity to the World Heritage Area, about their views on the status of the reef and its management. In 1997, more than 1000 respondents in Melbourne, Sydney, Canberra, Brisbane and the Great Barrier Reef coast were surveyed by telephone. In 1998, more than 1500 residents from coastal areas adjacent to the Region were surveyed. Both surveys had an almost 60% response rate. More than 90% of those surveyed knew that the Great Barrier Reef region was managed as a World Heritage Area and a Marine Park, however, 29% of

these thought that World Heritage Areas are managed by the United Nations. Fifty-eight percent of respondents believed that World Heritage Listing meant greater control on activities than a national park. Pollution was considered to be the most serious threat to the Reef Region, followed in descending order by human impacts, tourism/tourists, Crown-of-thorns starfish, oil-spills and shipping, over-fishing, over-development, agricultural runoff, mining and sewage. Two thirds of respondents considered the present condition of the Great Barrier Reef to be good or very good, 35% thought it would be in similar or better condition in ten years time, 51% thought its condition would be worse, the remainder were unsure. Respondents involved in activities which gave them direct contact with the Reef were more likely to be pessimistic about its future than those without direct contact. An encouraging 79% of local respondents want to learn more about what they can do to help prevent negative impacts.



Crown-of-thorns starfish are correctly perceived to be a significant threat to the Reef, according to a large national survey conducted by JCU Tourism Department researchers.

Photo: Stella M. Cove

5.9 EFFECTS OF LINE FISHING

The Effects of Line Fishing Experiment is a large-scale experiment designed to evaluate the effects of line fishing on major target species. The experiment, which enjoys strong industry support, is measuring the effects of different levels of fishing pressure and/or reef closures using 24 reefs between Cape Flattery and the Swains arranged in four clusters each of six reefs. An international panel very favourably reviewed the results of the first round of manipulations in 1998. The second and final

round of manipulations were effected in March 1999. Preliminary results for the second round of manipulations reinforce the results of the first round which suggested great regional variation in the effects of the manipulations and in the response of fishers to the opening and closing of reefs. The experiment demonstrates a clear need to evaluate regional variation in fishery and stock dynamics when assessing management strategies. The modelling work associated with the experiment is progressing well and a draft allocation model of stock dynamics, effort allocation and harvest strategies is scheduled for completion in November 1999. The project team were successful in obtaining funding from the Fisheries Research & Development Corporation to enable the scope of the project to be extended to include research on the stock structure of the Red Throat Emperor. Sally Troy has been appointed to the team to extend their work to the Reef charter fishery. Bruce Mapstone, the leader of the project, has been appointed to the Queensland Fisheries Management Authority's Reef Management Committee to facilitate the transfer of the results of the experiment to the policy arena, a process facilitated by the considerable emphasis placed by the team on its extension and communication efforts.



Stephanie Slade discussed fisheries research at the Port Douglas Seafood Festival in May, organised by QCFO, which attracted more than 12,000 visitors.

Photo: Annabel Jones

5.10 ENDANGERED SPECIES INTERACTIONS

A temporal series of aerial surveys indicated that numbers of dugongs have declined significantly since the mid 1980s, over more than one thousand kilometres of coastline in the Great Barrier Reef World Heritage Area, from Innisfail to the southern border of the Area near Bundaberg. Anecdotal evidence suggests that this decline, which threatens the World Heritage values of the Region, has been going on for decades. The Australian and Queensland governments agreed to several measures aimed at arresting this decline in 1997. The most controversial measure was to establish a two-tiered system of Dugong Protection Areas. Gill netting is greatly restricted or banned in seven Zone A Dugong Protection Areas totalling 2,407 km², and subject to lesser modifications designed to increase the chance of a dugong which entangles in a net being released alive in eight Zone B Dugong Protection Areas totalling 2,243 km².

The long-term effectiveness of the Zone A Hinchinbrook Dugong Protection Area, which supports about 15% of dugongs in the Great Barrier Reef Region south of Cooktown, depends on the successful management of boat traffic, the level of which is expected to increase as a result of resort and marina developments. Vessel strikes are a major cause of mortality for the dugong's close relative, the Florida manatees. Although there are few records of dugong deaths due to vessel strikes in Australian waters, increasing vessel traffic increases the likelihood of strikes. Areas such as this where there are extensive shallow areas used by regionally important populations of dugongs close to recreational boating facilities are particularly at risk.

CRC researcher, Tony Preen conducted 25 aerial surveys of the Townsville-Hinchinbrook region, and attached satellite tracking devices to 13 dugongs over 19 months to document the pattern of their fine-scale habitat use of the Hinchinbrook area. The results of his study are being used in the development of boating regulations for the Hinchinbrook Dugong Protection Area with a view to protecting the area as prime dugong habitat while allowing for reasonable boating activity.

Program 2 Summary - Current Tasks

Task	Chief Investigator	Title
2.1.5/2	Dr G Inglis & Mr P Marshall (JCU)	The Effects of Physical Disturbance and Partial Mortality on Corals
2.1.6/2	Prof H Marsh & Mrs B Breen (JCU)	Decision Support System for Reef Visitors
2.1.8/2	Dr G Inglis (JCU)	Socially and Ecologically Acceptable Levels of Use (Phase 2)
2.1.14	Dr G Inglis (JCU)	"Reefwatch" - Monitoring
2.1.16	Dr L Fernandes (JCU)	Towards Integrating Social, Cultural and Economic Concerns into Management of the Great Barrier Reef
2.1.17	Dr M Fenton (JCU)	Socioeconomic Impacts
2.1.19	Dr G Inglis & Dr V Hall (JCU)	Impacts of Coastal Development on Inshore Seagrass Meadows in the GBRWHA
2.1.20	Dr Z Dinesen (JCU)	Performance Indicators for Management of the GBR
2.2.1	Prof P Pearce (JCU)	Analysis of Great Barrier Reef Visitors: Their Attitudes, Motivations, Socio-demographic Profiles & Activity Preferences
2.2.2	Dr A Birtles (JCU)	Towards Ecotourism: Developing Quality Tourism in the Special Interest Tourism Sector
2.2.3	Prof P Pearce (JCU)	Evaluation and Design of Great Barrier Reef Interpretation
2.4.2	Ms M Samoilys (DPI)	Reproductive Strategies of the Common Coral Trout on the Northern GBR
2.4.12/1	Dr C Davies & Dr B Mapstone (JCU)	Fleet Dynamics and Determinants of Fishing Effort and Catch in the Reef Line Fishery of the Great Barrier Reef Region
2.4.12/2	Dr B Mapstone & Dr C Davies (JCU)	The Use of Experimental Stock Manipulations to Compare Stock Assessment Techniques and Examine the Effects of Fishing on Reef Fish Stocks on the GBR
2.4.12/3	Dr D Williams (AIMS) & Dr T Ayling	Visual Surveys of Experimental Reef Clusters
2.4.12/4 A	Prof G Russ (JCU) & Dr I Brown (QDPI)	Use of Age-Structure Data to Measure Effects of Fishing, Growth, Mortality and Recruitment of Target and Some Non-Target Species of Reef Fish
2.4.12/5	Dr C Davies, Dr B Mapstone & Mr D Welch (JCU)	Assessment of Size Selectivity in Samples of the Common Coral Trout <i>Plectropomus leopardus</i> , taken by Line Fishing for Age Structure Analysis
2.4.12/6	Dr T Smith (CSIRO DMR)	Modelling and Evaluation of Management Strategies
2.4.16	Mr J Robertson (GBRMPA)	Fisheries Management Models: Options and Development
2.4.17	Dr B Mapstone & Mr J McKinlay (JCU)	Fisheries Databases - QFMA
2.4.18	Dr A Miles & Dr B Mapstone (JCU)	Interview/Liaison with Industry: Effects of Fishing
2.4.20	Dr B Mapstone & Mr J Kung (JCU)	The Economic Management of Multispecies Fisheries and the Commercial Collection of Aquarium Fisheries on the Great Barrier Reef
2.5.1	Prof H Marsh (JCU)	Strategies to Reduce the Impact Of Gill-Netting on Dugongs in the Great Barrier Reef Region
2.5.4	Dr E Gyuris (JCU)	Impacts of humans on seabirds

Program 3. Engineering

(Program Leader: Dr Tom Hardy, JCU)

Objective

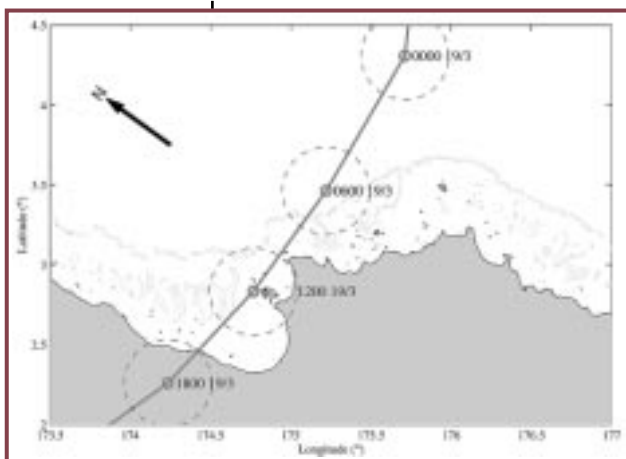
The improvement of engineering practices for the design, construction and operation of reef facilities and coastal development infrastructure.

To meet this objective, a range of engineering tasks has been established. These will provide developers, engineering consultants, and management agencies with tools, information, and guidelines that will improve safety and minimise impacts of developments in the Great Barrier Reef. Further information see Chapter 7: Utilisation and Application of the Research.

5.11 DESIGN WAVES AND WATER LEVELS

(Dr Tom Hardy, JCU)

Wave information in the GBR is needed for engineering design and marine park management, as well as for the understanding of the link between physical and biological processes. Unfortunately wave measurements in the GBR are almost nonexistent and the cost of purchase, deployment, and maintenance of wave measuring equipment is prohibitive. Furthermore, measurements tell us what has happened, whereas we often need to know what could happen. In other words, a modelling capability is needed to predict the wave climate in the geometric complexity of the GBR for tropical cyclone conditions.



Track of cyclone Ivor. Modelling historical cyclones is important in the verification process.

Figure: Jason McConochie

A model capable of simulating the time histories of tracks and central pressures for tropical cyclones in the Coral Sea has been developed and tested. This model has been used to generate an ensemble of 6000 tropical cyclones, which is representative of the population of cyclones that threaten the GBR region. This ensemble of synthetic tropical cyclones is in the process of being simulated by the numerical wind (*WINDGBR*) and wave (*WAMGBR*) models that have been developed in this project. The end result will be an enormous amount of high quality wave information at a resolution of 1500 m throughout the GBR. Innovative interactive information retrieval and display techniques are being investigated for use in the *Atlas of Waves in the Great Barrier Reef*, planned for completion in 2000.

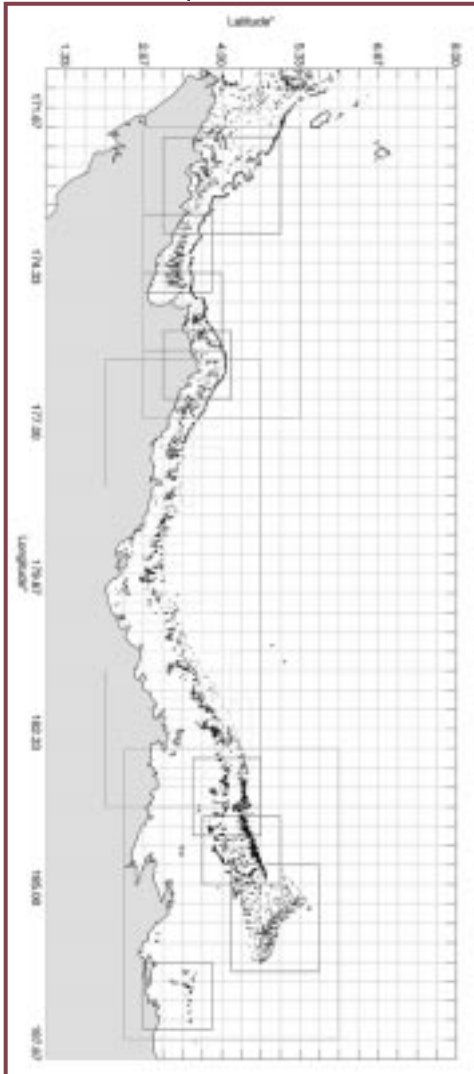
5.12 THE INFLUENCE OF GROUNDWATER AND SURFACE WATER DISCHARGES ON WATER QUALITY

(Prof Ray Volker, UQ)

The Great Barrier Reef Marine Park Authority has established policies for the discharge of sewage waste into the Great Barrier Reef Marine Park. One option available to island tourist resort operators is to recycle wastewater effluent onto land areas such as golf courses and gardens. Such use of wastewater effluent for irrigation on island resorts could offer a benefit to both the economic operation of the resort and the quality of reef waters. The important questions are: What is the ultimate fate of the nutrients? Is the water quality of the groundwater and eventually the surrounding reef water adversely affected? What are the environmentally and economically sound practices for the use of wastewater as irrigation on islands in the Great Barrier Reef?

RESEARCH

The major focus of work this year has been on the output of nitrogen to the sea for irrigation of treated effluent compared with piping effluent direct to the sea. This has been accomplished by numerical modelling of water and nitrogen movement from the surface through to the bottom of the root zone of vegetation. Three different island resorts that have climatically and geologically differing characteristics have been used to demonstrate the power of the approach and to show how management of the effluent irrigation can be used to minimise output of nitrogen to the sea.



Although effluent irrigation shows a reduction of the outflow of nitrogen, several critical factors have been noted. The rapid transport of nitrogen via surface runoff and short circuit subsurface pathways is possible if the resort is subjected to intense tropical rainfalls. Also, for sites that have a high degree of hydraulic conductivity (sandy substrates) moderate to high rates of effluent irrigation could result in a more pronounced level of sub-surface nitrogen transport. For two of the study islands, effluent irrigation was deemed very effective and, even for an island of greater hydraulic conductivity because of its sandy composition, acceptable reductions may be achieved by increasing the area of application.

Anticipated outputs for the coming year include the prediction of nitrogen discharges to the sea for a range of effluent management scenarios on a number of types of islands. General guidelines for effluent irrigation on island resorts are to be prepared. Advice will be given for maximum effluent application levels and allowable limits of effluent nitrogen concentration as a function of island geology and seasonal variations.

5.13 ENGINEERING GUIDELINES: DESIGN, CONSTRUCTION AND OPERATION

(Mr Ross Kapitzke, JCU)

The design, installation, and maintenance of structures in the Great Barrier Reef offer challenges due to the remote, harsh environment and the environmental sensitivity of the region. The goal is safe, economical, and environmentally friendly structures that will enhance visitor appreciation of the World Heritage Area. The guidelines provide the framework and procedures for planning, design and installation of a pontoon project from the concept phase, through to monitoring, maintenance and review. Guiding principles, design approaches and best practice guides are provided for use by the operator, designer and regulatory agency.

Numerical wave models are being used to estimate the cyclone wave climate over the entire GBR.

Figure: Jason McConachie

Work has concentrated on preparation of guidelines for tourist pontoons. A major focus of the past year's effort was the study of mooring systems. The *Australian Marine and Offshore Group*, an affiliate of the *Maritime Engineering CRC*, were engaged to study mooring forces and configurations using sophisticated computer models developed and tested in applications for the offshore oil and gas industry. This study will allow the determination of the relative importance of wind, wave and current forces and will lead to more reliable mooring designs. The guidelines will be completed in 2000.

RESEARCH

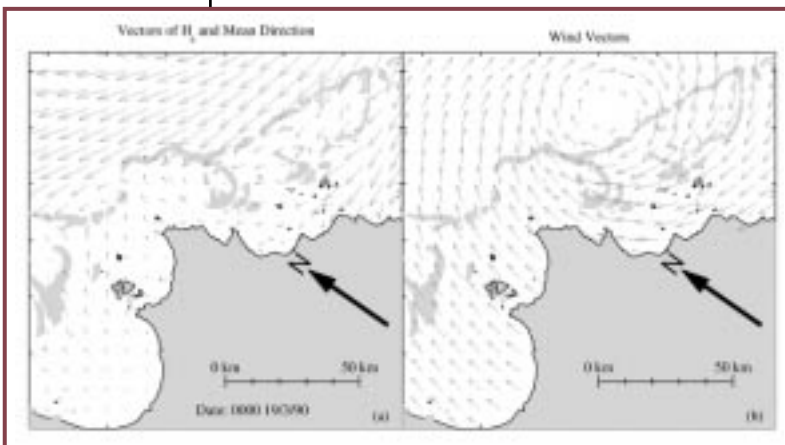
5.14 TREATMENT OF BALLAST WATER DISCHARGES TO PORTS

(Mr Darren Oemcke, JCU)

This PhD study has been concluded very successfully. The task results have received international attention from the Marine Environmental Protection Committee of the International Maritime Organisation (UK), the Battelle Memorial Institute (US), Cawthorn Institute (NZ) as well as the Centre for Research on Introduced Marine Pests (Australia). Several journal articles are currently under review. The study recommendation, that a pilot plant be built, has received strong support from industry and may lead to a future CRC task.

Program 3 Summary - Current Tasks

Task	Chief Investigator	Title
3.1	Dr T Hardy (JCU)	Design Waves and Water Levels in the Great Barrier Reef
3.2	Prof R Volker (UQ)	The Influence of Groundwater and Surface Water Discharges on the Water Quality of the Great Barrier Reef Lagoon
3.4	Dr T Hardy (JCU)	Engineering Design for the Great Barrier Reef
3.4.2/2	Mr D Oemcke (JCU)	Ballast Water Discharge



Wave model results, significant wave height (left) and wind vectors (right) for cyclone Ivor.

The wave climate is being determined at a resolution five times finer than shown.

Figure: Jason McConochie

6. EDUCATION

Program 5. Education

(Program Leader: Prof Howard Choat, JCU)

Objective

To provide scholarships and research support for outstanding tertiary students.

The renewal bid for CRC Reef has seen the successful completion of the first six years of the Centre and its Education Program and has provided the foundation for the next phase of this enterprise. The new bid will incorporate Education and Communication and will have as its primary responsibility the provision of 25 PhD and 10 MSc degree scholarships and research funding within the overall program of the CRC. As with the first six years of the Centre, the new CRC will operate so as to allocate scholarships to task areas (identified in the renewal bid) with the provision for a minority of floating awards that can be nominated within any area consistent with the CRC.

The second major influence on the Education Program is one that affects all postgraduate education within Australia. The publication of the new research policy paper “*New Knowledge New Opportunities*” has substantial implications for all postgraduate training and education activities. The central element of the new policy is a restriction on the amount of time that postgraduate students will be funded for higher degree studies and an increased emphasis on completion rates. At the same time the publication of Australia’s Marine Science and Technology Plan has highlighted the need for postgraduate training to be more responsive to employers’ needs and an emphasis on skills development and experience.



PhD student Paul Marshall won the 1998 CRC Reef marine science journalism cash prize for a feature about his research on coral bleaching.

Photo: Don Alcock

The CRC Education Program has anticipated many of these changes of policy and emphases, especially through the development of work placement programs and opportunities for students to gain additional skills and experience during their candidature. However, the impact of the Green Paper is to emphasise rapid completion times. This is one of the major challenges facing the future development of the CRC Education and Communication Program and will require careful planning to ensure that work opportunities do not extend completion times of research degrees.

A major outcome of the Education Program has been the publication of a Best Practice Case Study outlining the development of CRC Education Programs. This will provide a blueprint for the future operations of the Education and Communication Program and vindicates the decision to employ a postgraduate student coordinator.

6.1 TRAINING STUDENTS FOR INDUSTRY

Two postgraduate students completed training with relevant industry and management agencies during the period July 1998 – June 1999. These were Rohan Pratt, who was sponsored by Flamingo Bay Research Pty Ltd to conduct a study on “Coral restoration and mariculture” and Tim Smith, who was sponsored by the Environmental Protection Agency to investigate the compliance of licences under the Environmental Protection Act.

The process for establishing workplace experience has been formalised and time spent under conditions of suspension has been shortened on account of the need to ensure timely completion of degrees. However, the primary aim for planning future work placements will be to investigate the opportunity to make these a post-degree experience.

More importantly, there was an opportunity to secure future opportunities for work placement, including overseas training. The results of these will be reported in the next financial year.

EDUCATION

As anticipated in the Centre's renewal bid, the international reputation of the research programs is providing a means for facilitating overseas placements. This is consistent with the goal of developing an international network of coral reef scientists and managers. A strategic element in the international network development is the association of overseas students with the Education Program. Upon graduation these students return to influential positions in their home countries and will be a valuable resource for international networking.

6.2 SCHOLARSHIPS AND SUPPORT

The emphasis of the CRC's Education Program is on research training through the provision of stipends and support for postgraduates. The Centre currently supports 69 postgraduates (43 PhD, 5 MSc and 21 Honours students). Nineteen of the 69 students have stipend support such as a CRC Reef full-time scholarship or a top-up to an Australian Postgraduate Research Award. The rest of the Centre's students have research funding or some other form of research support such as a supervisor paid from CRC funds, a supervisor who is a CRC task leader, or they may be a task leader in their own right.

Of the 69 students presently in the program, 5 have recently submitted theses (all PhD students) and there are 15 recent completions of Honours, MSc and PhD students. Over the period of this annual report, 12 new students were incorporated into the program - 2 PhD, 2 MSc and 8 Honours students. Of the current Honours students 6 have benefited from CRC Augmentative grants, which is consistent with the Centre's policy of value adding to the research training experience.

It is worth noting, in terms of total investment in the Education Program over the first cycle of CRC activity, that the Centre provided \$900,000 in stipends, \$440,000 in direct research support and \$250,000 in laboratory infrastructure. More importantly, the private sector partners and associates of the Centre made available resources in the form of vessel and reef access. This input of funds provided much of the infrastructure support required to allow hands-on approaches to coral reef research programs. The Education Program takes this opportunity to acknowledge this generous level of support.

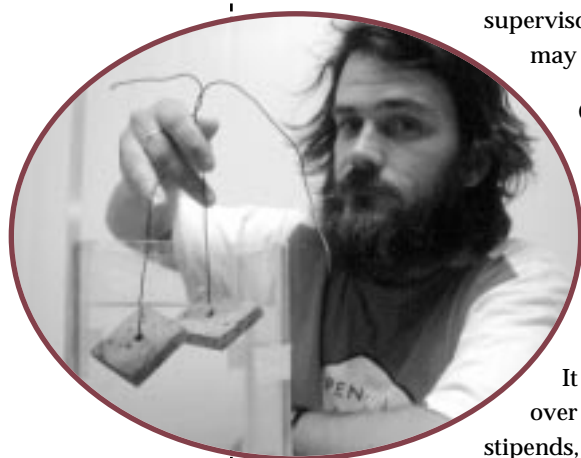
The first cycle of the Education Program also acknowledges the significant input of Centre Postdoctoral Fellows to the supervision process. Six Centre Postdoctoral Fellows provided supervision for 25 students over this period and were of crucial importance in the development of the new research activities. The completion of the final year of the CRC Program re-affirmed the Centre's commitment to inter-disciplinary studies, with 12 major disciplines represented in the research programs.

6.3 TRAINING INITIATIVES

Training initiatives follow the recommendations of the Marine Science and Technology Plan that emphasises the acquisition of skills and experience as a complement to knowledge. These include sponsorship of students to scientific writing courses and a multivariate statistics course designed to provide students from a wide range of disciplines with the knowledge of new techniques in this field.

■ Student Research Day

This accommodated 12 seminars and 4 poster presentations by Centre postgraduates, including 15 PhD studies and 1 MSc study. The postgraduate studies stemmed from a diverse range of disciplines including Economics, Environmental Studies, Fisheries Biology, Reef Management, Coral Reef Ecology, Chemical Ecology and Coral Reef Restoration.



PhD student Andrew Baird has received support from the CRC, GBRMPA, the Australian Coral Reef Society and Professional Association of Dive Instructors for his postgraduate studies into the behaviour and ecology of coral larvae.

Photo: Don Alcock

EDUCATION

■ Postgraduate Discussion Group

Several meetings dealt with topics to help students develop other professional skills. Sessions included:

1. Time management
2. How to present a scientific seminar
3. Speed reading
4. Life after the CRC

■ Research Leadership

Two postdoctoral fellows, Campbell Davies and Leanne Fernandes, and one postgraduate student, Darren Oemcke, were sponsored to attend a Business and Higher Education Round Table Leadership and Career Development Course held at the University of Melbourne's Business School.

■ Multivariate Statistics

In June, a multivariate statistics training course was held at James Cook University for CRC/JCU students. The course, conducted by Dr Brian McArdle, a Biostatistician from Auckland University, New Zealand, helped young researchers with statistical problems and analyse their data.

■ Information and Databases

The postgraduate student database set up to monitor the progress of postgraduates within the Centre has been extended and maintained. This database, in association with the CRC Postgraduate Information Booklet and the publication of the Best Practice Case Study provides a framework of information on policy, student responsibilities with respect to the Centre and to the degree program, and offers a capacity to identify student difficulties in completing research programs.

■ External Supervision

The Centre has maintained its commitment to external supervision partners in the Education Program. Currently twelve staff from a range of public sector institutions, including AIMS, GBRMPA, DPI and CSIRO are involved in the student supervision process. This anticipates many of the changes incorporated in the Marine Science and Technology Plan and the green paper on research policy. During the year 2000 supervisor training courses, designed to increase the number of external supervisors, will be implemented.

6.4 STUDENT AWARDS

The reporting period saw the implementation of a prestigious award, the CRC Reef Research Centre Prize, sponsored by AMPTO through the generous assistance of P & O Australia. This prize was awarded to Rebecca Fisher for her overall ability in Honours level studies whose research was relevant to the sustainable use of the GBR. Four travel awards to allow CRC students to attend national conferences were also made. These covered a range of research activities, including Geoscience, Resource Management and Ecological Economics and are indicative of the Centre's commitment to inter-disciplinary studies. In addition, six students were awarded CRC Reef Honours Augmentative grants.

The last six years have been significant in terms of policy changes in the field of postgraduate training. The Centre has kept abreast of these and indeed anticipated many of the more significant changes. At the time of writing we can report that completion times for Centre students are within the national envelope.

EDUCATION

Centre 1998/9 students are grouped as follows:

PhD students	43
Masters level students	5
Honours level students (inc. 6 Augmentative Grant students)	21
TOTAL	69

Employment of Students

CRC Postgraduates	Thesis Title	Place of Employment
Ken Anthony	The role of suspended sediment in coral energy budgets	Great Barrier Reef Marine Park Authority
Ray Berkelmans	Upper thermal tolerance limits for acclimatisation of reef corals	Australian Institute of Marine Science
Glenn De'ath	Modelling spatial and temporal change in benthic reef communities	CRC Reef Research Centre
Vicki Hall	Injury and regeneration in reef-crest corals	CRC Reef Research Centre
Jim Higgs	Distribution of recreational boating activities in the Townsville region	Queensland Fisheries Management Authority
John McKinlay	A spatial and temporal analysis of the Queensland multi-species commercial line fishery from fishers logbook data	Western Australian Fisheries
Sue Muloin	The psychological benefits experienced from human/animal interactions	University of Newcastle
Seiji Nakaya	Spearfishing on the Great Barrier Reef: Understanding motivations, use characteristics and perceptions of spearfishers	Japanese Research Institute for Subtropics
Darren Oemcke	The treatment of ballast water discharges to ports in the Great Barrier Reef region	Gutteridge, Haskins & Davey Pty Ltd
Rohan Pratt	Coral reef restoration, ecology and techniques	Flamingo Bay Research Pty Ltd
Marji Puotinen	Tropical cyclone impacts on coral reefs: Modelling the disturbance regime in the GBR lagoon	James Cook University
Michael Rasheed	Investigations of recovery and succession in North Queensland tropical seagrass communities	Queensland Department of Primary Industries
Julie Robins	The impact of trawling on sea turtles	Queensland Department of Primary Industries
Melita Samoilyis	Reproductive strategies of the common coral trout on the northern Great Barrier Reef	Queensland Department of Primary Industries
Jamie White	The feasibility of constructing coral viewing platforms on underwater observatories	Misima Mines, Papua New Guinea

EDUCATION

TABLE A: POSTGRADUATE STUDIES

The following students have CRC Scholarships or a combination of CRC Scholarship & an Australian Postgraduate Research Award (APRA):

Name	Degree	Institution Enrolled/ Task Affiliation	Thesis Title	Commencement Date	Supervisor	Status of Study	Source of Funding
S Adams	PhD	JCU/Task 5.5.7	Effects of fishing and regional variation on the sexual structure of <i>Plectropomus leopardus</i> and <i>P. laevis</i> populations on the GBR	01.03.97	Prof H Choat & Dr B Molony (JCU) Dr B Mapstone (CRC)	Current	CRC/ APRA
K Anthony	PhD	JCU/Task 5.5.1	The role of suspended sediment in coral energy budgets	30.03.95	Dr B Willis (JCU)	Submitted	CRC
B Breen	PhD	JCU/Task 2.1.6/2	Decision Support System for the Cairns Section of the GBRMP	28.02.94	Prof H Marsh (JCU)	Current	CRC
N Crosbie	PhD	JCU/Task 1.1.1	Environmental and ecological controls on <i>in situ</i> population growth rates of Great Barrier Reef phytoplankton	01.09.94	Prof D Griffiths (JCU) Dr M Furnas (AIMS)	Submitted	CRC
G De'ath	PhD	JCU/Task 5.5.5	Modelling spatial and temporal change in benthic reef communities	15.08.96	A/Prof D Coomans & Prof H Marsh (JCU) Dr T Done (AIMS)	Submitted	CRC
M Dommissie	PhD	JCU/Task 1.1.1	Detritus and its influences on water quality in the Great Barrier Reef: quality and quantity	01.09.95	A/Prof C Alexander (JCU) Dr M Furnas (AIMS)	Current	CRC
A Heap	PhD	JCU/Task 1.3.1	Sedimentology of the Whitsundays	17.02.97	Dr K Woolfe & Dr P Larcombe (JCU)	Current	CRC
J Higgs	PhD	JCU/Task 2.4.14	Distribution of recreational boating activities in the Townsville region	01.02.95	Dr B Mapstone (CRC) A/Prof G Russ (JCU)	Susp.*	CRC
J Kritzer	PhD	JCU/Task 5.5.6	Spatial and temporal variation in the population dynamics and life history traits of the tropical snapper, <i>Lutjanis carponotatus</i> , on the GBR	31.03.98	Prof H Choat (JCU) Dr C Davies (CRC)	Current	CRC
J McKinlay	PhD	JCU/Task 2.4.17	A spatial and temporal analysis of the Queensland multi-species commercial line fishery from fishers' logbook data	01.01.97	Dr B Mapstone & Mr C Davies (CRC) Mr G De'ath (JCU)	Current (part-time)	CRC/ APRA
P Marshall	PhD	JCU/Task 2.1.5/2	Physical impacts to corals: implications for community structure and management	30.03.95	Dr G Inglis (JCU) Dr J Oliver (GBRMPA)	Current	CRC

*Susp. = Suspended

EDUCATION

Name	Degree	Institution Enrolled/ Task Affiliation	Thesis Title	Commencement Date	Supervisor	Status of Study	Source of Funding
K Michalek-Wagner	PhD	JCU/Task 5.5.3	The chemical ecology of the soft coral <i>zooxanthellae</i> interaction	01.01.96	Dr B Willis & Dr B Bowden (JCU)	Current	CRC
G Muldoon	PhD	JCU/Task 2.1.16	An ecological economic approach to determining optimal capacity where latent effort exists	01.07.97	Dr L Fernandes & A/Prof O Stanley (JCU) Dr C Davies (CRC)	Current	CRC
S Nakaya	PhD	JCU/Task 2.4.13	Spearfishing on the Great Barrier Reef: Understanding motivations, use characteristics and perceptions of spearfishers	31.12.94	Drs M Fenton & G Inglis (JCU) & Dr B Mapstone (CRC)	Completed	CRC
D Oemcke	PhD	JCU/Task 3.4.2/2	The treatment of Ballast Water discharges to ports in the Great Barrier Reef region	01.07.95	Prof J Patterson (JCU) & Prof H van Leeuwen (UNE)	Submitted	CRC
M Rasheed	PhD	JCU/Task 1.4.2	Investigations of recovery and succession in North Queensland tropical seagrass communities	30.06.95	Dr R Coles (QDPI) & Dr G Inglis (JCU)	Submitted	CRC
A Orpin	PhD	JCU/Task 1.3.1	Fate of riverine sediment entering the GBR lagoon from the Burdekin Delta	28.02.94	Dr K Woolfe & Dr R Carter (JCU)	Current	CRC
D Welch	MSc	JCU/Task 2.412/5	Development of techniques which minimise size selectivity for sampling populations of the common coral trout, <i>Plectropomus leopardus</i> , for age structure analysis.	01.01.95	A/Prof G Russ (JCU) Drs B Mapstone & C Davies (CRC)	Current	CRC
A Williams	PhD	JCU/Task 2.4.12/2	Population structure of the <i>Lethrinus miniatus</i> on the GBR	31.03.98	Dr C Davies (CRC) A/Prof G Russ (JCU)	Current	CRC/ APRA

EDUCATION

POSTGRADUATE ASSOCIATES

The following students have links to the CRC through research support:

Name	Degree	Institution Enrolled/ Task Affiliation	Thesis Title	Commencement Date	Supervisor	Status of Study	Source of Funding
J Ahn	MSc	JCU/Task 2.2.3	Chinese and Japanese reef tourists' understanding of safety and environmental messages	01.02.99	Drs E Kim & G Moscardo (JCU)	Current	CRC
B Akukubar	PhD	JCU/Task 2.2.1	Assessing environment settings and design	01.02.99	Prof P Pearce	Current	CRC
N Aragonés	PhD	JCU/Task 2.1.8	Techniques for the restoration of tropical seagrass beds	27.02.95	Dr G Inglis (JCU)	Current	CRC
P Armsworth	PhD	JCU/Task 1.2.1	The mathematical ecology of reef fishes	01.02.98	Dr L Bode & A/Prof D Bellwood (JCU)	Current (part-time)	CRC
A Baird	PhD	JCU/Task 5.5.2	Coral settlement patterns and the behaviour and ecology of coral larvae	01.07.95	Dr T Hughes (JCU)	Current	CRC
A Bartels	Hons	JCU/Task 3.1.0	Verification of a wave model for tropical cyclones in the GBR – T.C. Justin	01.03.98	Dr T Hardy & Mr J McConochie (JCU)	Completed	CRC
K Baxter	Hons	JCU/Task 5.1.13	Large scale monitoring of reef flats at a high resolution: application of aerial photogrammetry and image processing techniques	02.03.98	Dr A Lewis & Mr S Smithers (JCU)	Completed	CRC Hons.*
R Berkelmans	PhD	JCU/Task 1.1.4	Upper thermal tolerance limits for acclimation of reef corals	01.08.96	Dr B Willis (JCU) Dr J Oliver (GBRMPA)	Current (part-time)	CRC
S Bryce	PhD	JCU/Task 1.3.1	Sediment transport in mangrove creek systems of North Queensland	01.01.95	Dr P Larcombe & Dr R Carter (JCU)	Current (part-time)	CRC
J Bunt	PhD	JCU/Task 1.3.1	Sediment transport in mangrove systems and causes of turbidity	20.02.97	Drs P Larcombe & P Ridd (JCU)	Current	CRC
C Bastidas	PhD	JCU/Task 1.4.1	The importance of life history for determining patterns in the distribution and abundance of soft corals	01.07.98	Dr K Fabricius (AIMS) Dr B Willis (JCU)	Current	CRC
B Carroll	Hons	JCU/Task 5.1.3	Effects of Herbivory on the Distribution and Abundance of Macroalgae	01.09.98	A/Prof T Hughes (JCU)	Current	CRC Hons.*
J Cavanagh	PhD	JCU/Task 1.3.5	Organochlorine pesticide residues in near-shore marine sediment cores of the Herbert and Burdekin regions and their relationship to historical agricultural activities	01.07.96	Drs K Burns & G Brunskill (AIMS) A/Prof R Coventry (JCU)	Current	CRC

*CRC Hons. = CRC Honours Augmentative Research Grant

EDUCATION

Name	Degree	Institution Enrolled/ Task Affiliation	Thesis Title	Commencement Date	Supervisor	Status of Study	Source of Funding
G Diaz-Pulido	PhD	JCU/Task 1.4.1	Roles of reproduction and recruitment in determining macroalgal abundance and interactions with corals	01.02.98	Dr L McCook (AIMS) & Dr J Holtum (JCU)	Current	CRC
G Doherty	PhD	JCU/Task 1.3.5	Trace element geochemistry of the intertidal zone of Cleveland Bay, Queensland	01.10.97	Dr G Brunskill (AIMS)	Current	CRC
C Dudgeon	Hons	JCU/Task 5.1.3	An estimation of cross-shelf gene flow using mitochondrial DNA for two parrotfish species in the northern GBR	01.02.98	Dr D Blair (JCU)	Completed	CRC Hons.*
R Fisher	Hons	JCU/Task 5.1.3	An investigation of how the sustained swimming ability of larval reef fish changes during ontogeny	01.02.98	Dr D Bellwood (JCU)	Completed	CRC Hons.*
V Hall	PhD	JCU/Task 5.5.4	Injury and regeneration in reef-crest corals	01.07.93	Dr T Hughes (JCU)	Completed	CRC
A Hoey	Hons	JCU/Task 5.1.3	Early Post Settlement Mortality in Two Coral Reef Fishes (<i>Pomacentridae</i> : <i>Pomacentrus amboiensis</i> and <i>P. nagasakiensis</i>).	01.09.98	Dr M McCormick (JCU)	Current	CRC Hons.*
S Howe	Hons	JCU/Task 2.2.1	Bareboating in the Whitsundays-an evaluation of interpretation and its role in preserving the GBR	01.02.98	Dr G Moscardo & Ms B Woods (JCU)	Completed	CRC Hons.*
S Ironside	Hons	JCU/Task 3.1.0	Wave modelling in Cleveland Bay	01.02.98	Drs T Hardy & L Mason & Mr J McConochie (JCU)	Completed	CRC
R Johnston	Hons	JCU/Task 5.1.3	The effects of turbidity on the abundance and distribution of mobile fauna in tropical mangrove ecosystems	01.02.98	Drs M Sheaves & B Molony (JCU)	Completed	CRC Hons.*
J Jompa	PhD	JCU/Task 1.4.1	Coral algal interactions and their roles in reef degradation	01.07.97	Dr L McCook (AIMS) & Prof H Choat (JCU)	Current	CRC
J Kung	PhD	JCU/Task 2.4.20	Economic management of multispecies fisheries and the commercial collection of aquarium fishes on the Great Barrier Reef	01.03.95	Dr B Mapstone (CRC) A/Prof O Stanley (JCU)	Current	CRC
L Lambeck	MSc	JCU/Task 1.3.1	Sphere of influence of northern rivers	01.01.98	Drs K Woolfe & P Larcombe (JCU)	Current	CRC
B Lukoschek	Hons	JCU/Task 5.1.3	Foraging dynamics of benthic carnivorous fishes on tropical soft bottom sediments around Lizard Island	01.09.98	Dr M McCormick (JCU)	Current	CRC Hons.*

*CRC Hons. = CRC Honours Augmentative Research Grant

EDUCATION

Name	Degree	Institution Enrolled/ Task Affiliation	Thesis Title	Commencement Date	Supervisor	Status of Study	Source of Funding
J Madin	Hons	JCU/Task 5.1.3	Biomechanics and susceptibility to breakage of branching corals	01.09.98	A/Prof T Hughes (JCU)	Current	CRC Hons.*
S Mandagi	MAppSc	JCU/Task 2.1.8	The relationship between shoot age and heavy metal accumulation in seagrasses	02.03.98	Dr G Inglis (JCU)	Current	CRC
J Mellors	PhD	JCU/Task 1.4.4	Nutrient effects on inshore seagrasses of the GBRMPWHA	03.07.92	Dr R Coles (QDPI) & Prof H Marsh (JCU)	Current (part-time)	CRC
B Millar	Hons	JCU/Task 5.1.3	Stream rehabilitation for improved water quality: benefits for the Great Barrier Reef World Heritage Area	01.02.98	Mr R Kapitzke (JCU)	Completed	CRC Hons.*
J Mosse	PhD	JCU/Task 2.4.12	Regional variation age, growth and reproductive biology of the Blue spot rockcod, <i>Cephalopholis cyanostigma</i> (Serranidae) on the Great Barrier Reef	03.03.97	Prof H Choat (JCU) & Dr C Davies (CRC)	Current	CRC
S Muloin	PhD	JCU/Task 2.2.1	The psychological benefits experienced from human/animal interactions	29.03.94	Prof P Pearce (JCU)	Current (part-time)	CRC
C Page	Hons	JCU/Task 5.1.3	Patterns of reproduction and recruitment: Split spawning and bleaching	01.09.98	Dr B Willis (JCU)	Current	CRC Hons.*
R Pratt	PhD	JCU/Task 2.3.2	Coral reef restoration, ecology and techniques	01.01.95	Dr U Kaly (JCU) A/Prof T Hughes (JCU)	Current (part-time)	CRC
T Prior	Hons	JCU/Task 2.5.2	Behavioural responses of bridled terns to visitor disturbance	01.09.97	Dr E Gyuris (JCU)	Completed	CRC
M Puotinen	PhD	JCU/Task 1.1.3	Tropical cyclone impacts on coral reefs: Modelling the disturbance regime in the GBR Region	10.04.95	Dr C Skelly (JCU) & Dr T Done (AIMS)	Susp.*	CRC
B Radford	Hons	JCU/Task 5.1.3	Ecological perspectives on species boundaries in the coral genus <i>Acropora</i>	01.02.98	Dr B Willis (JCU)	Completed	CRC Hons.*
A Reed	Hons	JCU/Task 3.1.0	Verification of a wave model for tropical cyclones in the GBR – T.C. Justin	01.03.98	Dr T Hardy & Mr J McConochie (JCU)	Completed	CRC
J Robertson	PhD	UQ/Task 2.4.16	Ecological and economic implications of conservation management strategies intended to minimise the impacts of fishing on the GBR	01.01.94	Dr H Campbell (UQ) & Dr B Mapstone (CRC)	Current	CRC
J Robins	PhD	JCU/Task 2.5.3	The impact of trawling on sea turtles.	01.03.98	Prof H Marsh (JCU) & Dr D Die (CSIRO)	Current (part-time)	CRC

*CRC Hons. = CRC Honours Augmentative Research Grant
Susp. = Suspended

EDUCATION

Name	Degree	Institution Enrolled/ Task Affiliation	Thesis Title	Commencement Date	Supervisor	Status of Study	Source of Funding
B Russell	Hons	JCU/Task 5.1.3	The distribution and chemical nature of <i>Haliclona sp.</i>	01.07.98	Drs G Skilleter, M Garson & B Degnan (UQ)	Completed	CRC Hons.*
M Samoilyls	PhD	JCU/Task 2.4.2	Reproductive strategies of the common coral trout on the northern Great Barrier Reef	01.06.92	Prof JH Choat (JCU) & Dr P Doherty (AIMS)	Completed (part-time)	CRC
C Schoenberg	PhD	Uni. Oldenberg/ Task 1.4.1	Ecology of bioeroding sponges on the Great Barrier Reef	01.01.96	Drs C Wilkinson, L McCook & K Fabricius (AIMS)	Current	CRC
T Smith	Hons	JCU/Task 5.1.3	Attitudes of recreational fishermen in Townsville regarding fishery management regulations for a suite of estuarine species	01.02.98	Dr L Fernandes (JCU)	Completed	CRC Hons.*
A Straton	Hons	UQ/Task 5.1.3	Assessing the applicability of choice modelling to the management of the GBRMP	01.03.99	Drs R Brown & J Asafu-Adjaye (UQ)	Current	CRC Hons.*
J True	PhD	JCU/Task 1.3.7	Massive scleractinian corals as indicators of environmental change	31.03.97	Dr B Willis (JCU) Dr D Barnes (AIMS)	Current	CRC
J Vaughan	Hons	JCU/Task 1.5.2	Interpreting satellite sea surface maps of the GBR	01.03.99	Dr A Lewis (JCU)	Current	CRC Hons.*
M Wakeford	MSc Qual	JCU/Task 1.4.1	Crown of thorns starfish and reef-building communities	01.03.99	Dr J Collins (JCU) Dr T Done (AIMS)	Current	CRC
B Woods	PhD	JCU/Task 2.2.3	The interpretive and educational dimensions of wildlife tourism	01.05.98	Dr G Moscardo & Prof P Pearce (JCU)	Current	CRC

*CRC Hons. = CRC Honours Augmentative Research Grant

7. UTILISATION AND APPLICATION OF THE RESEARCH, COMMERCIALISATION, LINKS WITH USERS

The Board, Users Advisory Group, staff and associates continued to apply research results to a range of public policy issues and industry practices. Further information see Chapter 12: Performance Indicators. Highlights in the application of scientific knowledge included:

BALLAST WATER TREATMENT

A ballast water treatment analysis, funded by the Ports Corporation of Queensland, that measured the chemical and physical characteristics of ballast water as a baseline, is helping in the design of treatment systems to determine the efficiency of ballast exchange practices.

Engineering researchers from James Cook University and the University of New England found that preliminary filtration may be necessary to reduce suspended solids, prior to ozone or UV treatment to remove organisms. The researchers suggest that larger-sized screen filters could remove zooplankton from ballast water and smaller screen filters could remove dinoflagellate cysts. They suggest that UV irradiation will be effective as a treatment during ballasting, before iron from inside the tanks contaminates the water. Iron and organic material in sediments in ballast water may cause difficulty for oxidising biocides (eg. ozone). The findings and recommendations have been used by Queensland Ports Corporation to help shipping and ports industries proceed towards more efficient treatment of ballast water.

MARINE PARK DECISION SUPPORT SYSTEM

A review of GBRMPA's management objectives, using prioritised opinions and advice from stakeholder groups, has helped develop a decision support system for coastal resource planning and management staff. The system has increased awareness and understanding of the decision making process. Local Queensland residents, fishers and tourist operators have provided opinions about the biological, cultural, economic and social objectives they think GBRMPA should be aiming for. GBRMPA's Information Support Group plan to trial the system to help staff and other interest groups follow a framework of issues and objectives in the decision making process.



The CRC-AIMS Long-Term Monitoring Program is an important Australian initiative that will soon be used within the UN-funded Inter-governmental Oceanographic Commission's Global Ocean Observing System.

Photo: AIMS

ANALYSIS OF REEF VISITORS

Tourism researchers at James Cook University now have a complete set of integrated data about characteristics of visitors to the Great Barrier Reef World Heritage Area, with particular detail on attitudes, motivations and activity patterns. The CRC database can describe domestic and international visitors for tourism marketing and government planning purposes. Regional models to help predict the flow of different types of visitors are now being developed for Tourism Queensland, GBRMPA and several regional centres to support industry products and services. For example, a range of travel profiles, and experiences sought by visitors to the Whitsunday region have been identified to help local tour operators improve their products.

REEF MONITORING REPORT

The third status report of long term monitoring (LTMP) of the Great Barrier Reef between 1992-1998 was launched by the Australian Institute of Marine Science. The report gives data on the status and trends in corals, reef fish and Crown-of-thorns starfish throughout the marine park region and is used by management agencies and science organisations. Most regions show no consistent trends in coral cover or abundance of coral reef fish – for example reefs on the outer shelf off Cooktown and Gladstone had very low coral cover when the program began six years ago. The coral has now increased dramatically and the numbers of many fish species have also increased.

The Long-Term Monitoring Program for the Great Barrier Reef is the most ambitious monitoring program run by any single institution in the world. The program began in 1984 with surveys of

UTILISATION AND APPLICATION OF THE RESEARCH, COMMERCIALISATION, LINKS WITH USERS

Crown-of-thorns starfish, and now covers more than 50 different reefs throughout the Great Barrier Reef Marine Park. The program measures changes to populations of corals, reef fish and Crown-of-thorns starfish in an integrated fashion.

STARFISH CONTROL GUIDELINES

A Crown-of-thorns research project measuring the effectiveness of control programs using divers to eradicate starfish from infested reefs found that constant effort over a long period is better than sporadic, high intensity efforts. Using trained divers who injected solutions of sodium bisulphate into each starfish, the researchers trialled three different injection regimes at each reef to monitor changes in COTS densities and subsequent impact on coral cover.

Regular injections by divers over longer periods was found to be more effective in reducing coral impacts than irregular busts of efforts. The researchers recommended several points for tourism operators to bear in mind when undertaking any permitted starfish control program around their site. The guidelines have helped several tourism operators in the Cairns area to reduce Crown-of-thorns numbers around their dive sites.

SUPPORT FOR FISHING REGULATIONS

A recreational fishing survey in the Townsville region revealed positive support by fishers for current bag limits, size restrictions and seasonal closures. The James Cook University survey investigated attitudes of 297 Townsville recreational fishers towards Queensland fisheries regulations. Using bream, barramundi and mud crabs as examples, the study found that 90% of respondents believe the regulations are useful in protecting fish stocks.

Between 62-82% of fishers said they know the current bag and size limits for either bream, barramundi and crabs, or carried a copy of the regulations when fishing. Approximately half said they know size limits for all species and the bag limit for both crabs and barramundi. The survey supports current community education programs offered by the Queensland Fisheries Management Authority, Sunfish and Department of Primary Industries, such as 'FishCare' and fishing camps for children.



JCU Honours student, Tim Smith, surveyed almost 300 recreational anglers in Townsville about their attitudes to fishing regulations which revealed positive support by fishers for current bag limits, size restrictions and seasonal closures.

Photo: Tim Smith

PROTECTION FOR CORAL TROUT

A study into the reproductive behaviour of coral trout that identified specific times of the year and reef locations where spawning occurs has been used by government agencies to develop new fisheries policies. Common coral trout gather in groups at particular sites to mate. The gatherings, called spawning aggregations, occur repeatedly for several days over a period of months. While the predictable times and locations may increase chances of reproduction, they may also leave the fish vulnerable to overfishing. The Queensland Fisheries Management Authority has proposed new seasonal spawning closures for the reef line fishery based on a report to the Reef Management Advisory Committee. In addition, the GBRMPA issued an interim policy for fish spawning aggregation sites and tourism management measures for the Cairns section of the Marine Park. This policy may form the basis for managing fish spawning aggregation sites for the entire Marine Park.

EXPANSION OF SEAGRASS WATCH

CRC Reef researchers at the Queensland Department of Primary Industries' Northern Fisheries Centre in Cairns, supported by the CRC, harnessed local knowledge to assist in mapping and monitoring seagrass habitats that are vital for fish, prawns, turtles and dugongs. In a collaborative effort with government agencies and regional communities, they have recently been helped with a federal

UTILISATION AND APPLICATION OF THE RESEARCH, COMMERCIALISATION, LINKS WITH USERS

government Natural Heritage Trust grant of \$350,668 through the Coasts and Clean Seas program. The funding supported community-based *Seagrass Watch* projects in the Whitsunday and Hervey Bay regions with assistance from regional staff at the Queensland Departments of Environment and Heritage, and Primary Industries.

The aim of *Seagrass Watch* is for community groups and volunteers to collect quality information on changes in seagrass meadow characteristics, such as the extent of coverage, position and depth of habitat, species composition, estimates of biomass, presence of dugong feeding trails and possible human impacts.

CORAL BLEACHING EARLY WARNING SYSTEM



Ray Berkelmans
deployed sea
temperature data
loggers which may
provide a predictive
capacity for future
bleaching events.

Photo: Don Alcock

The sea temperature monitoring program captured comprehensive data during the 1998 coral bleaching event which may enable an early warning system to be developed for future bleaching events. CRC researchers currently working at AIMS are also helping to establish two new automatic Reef-based weather stations and software in collaboration with the US-based National Oceanographic and Atmospheric Administration to help provide early warning of temperature anomalies.

The monitoring program, which commenced in 1996, aims to build a picture of sea temperature trends at various locations throughout the Reef region. Initially, 80 data loggers were deployed at 40 representative sites, including northern and southern regions, and inner, mid-shelf and outer reefs. Additional sites at several Queensland ports were also added as the program expanded. The data loggers are downloaded every six to twelve months and summaries are made on GBRMPA's internet site. The website had 1500 visits over the last year and many research organisations, including the NOAA, can download data for global climate research.

GROUNDWATER NUTRIENT MODEL DEVELOPED

A numerical model was developed to simulate nitrate movement beneath turfgrass at three 'high' islands resorts which either currently employ or intend to adopt effluent irrigation for lawn and garden areas. The model, using information obtained at Brampton, Great Keppel and Dunk, demonstrates how wastewater irrigation systems can reduce nitrogen lost to the sea when compared with existing ocean outfalls. Various effluent management strategies and field data were used to broadly validate model simulations. The researchers are now confident in applying the model to determine optimal irrigation procedures for other resorts.

Potential reductions in the mass of nitrogen flowing to the sea compared with ocean outfalls were predicted at up to 90% if both Brampton and Dunk Island resorts spread wastewater over an area of turfgrass equivalent to the size of a small golf course. On Great Keppel Island however, a comparative reduction in the output of nitrogen to sea of no greater than 44% was predicted primarily due to its sandy soil composition. The project is also helping meet GBRMPA's policy of eliminating ocean outfalls for primary and secondary treated sewage.

COOPERATIVE TOURISM RESEARCH UNIT IN CAIRNS

A new unit providing strategic research information and decision support to the regional tourism industry in Cairns was established. The Tropical North Queensland Cooperative Research Unit is an initiative of the Reef, Rainforest and Tourism Cooperative Research Centres and Tourism Tropical North Queensland. Its role is to enhance the provision of information to the tourism industry in the region, and is supported by the Cairns City Council and the Cairns Port Authority.

UTILISATION AND APPLICATION OF THE RESEARCH, COMMERCIALISATION, LINKS WITH USERS

The unit, based in the office of Tourism Tropical North Queensland, will act as a 'knowledge broker' and also help identify future information needs of the industry. A management committee made up of representatives from participating organisations is overseeing the project. A coordinator was appointed to help develop and implement a research communication program for the tourism industry.

MARINE SCIENCE AND TECHNOLOGY PLAN

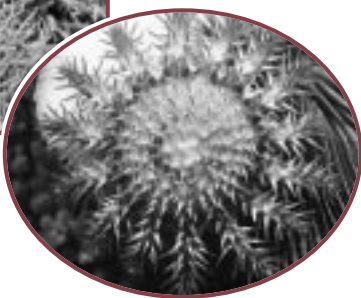
The CRC and AIMS contributed to the development of Australia's Marine Science and Technology Plan. CRC Board member Dr Russell Reichelt and Program Leader Prof. Helene Marsh both served on the Marine Science and Technology Plan Working Group. The Centre's Regional Environmental Status Program and the Sustaining Coral Reef Project at AIMS were used as a case study for sustaining coral reef ecosystems and developing a capacity for design and evaluation of representative protected area networks in the Great Barrier Reef Marine Park.

VISITOR PERCEPTIONS MEASURED

Results of a national telephone survey about Australian residents' perceptions of the Great Barrier Reef World Heritage Area and health of the reef have been provided to marine park management agencies and local tourism organisations in north Queensland. While most people know the Great Barrier Reef is managed as a World Heritage Area and marine park, a relatively large number feel the Reef is under significant threats from various impacts, and will get worse in the future. This information is a valuable benchmark for future public surveys and government/industry information programs.

EYE ON THE REEF

The CRC contributed to the development of 'Eye on the Reef', a tourism industry initiative to monitor the health of coral reefs in the Cairns region. The CRC, in partnership with GBRMPA and the Queensland Parks & Wildlife Service, is expanding this volunteer program to help report on indicators such as coral cover, bleaching, Crown-of-thorns starfish and site damage. Eleven tourist operators have been trained by marine biologists to undertake regular reporting of monitoring sites, collect observation data of marine plants and animals, and evaluate water temperature and visibility. The 'Eye on the Reef' program will provide an early warning system to management systems about unusual events.



The involvement of community volunteers in CRC Reef research continued to increase, with several tourist operators monitoring changes at their Reef sites.

*Photo:
Udo Engelhardt (top)
Stella M. Covre (right)*

8. STAFFING AND ADMINISTRATION

In 1998/99, approximately 230 people were involved in Centre activities including 44 CRC-funded positions and 69 postgraduate students and associates.

The CRC Board extended Mr Simon Woodley's position as Director to 30 June 2000 following an attempt to recruit a new long-term CEO in October 1998. Dr David Williams (AIMS) was appointed Deputy Director (Research) (50% time) also until 30 June 2000. The extended timeframe allowed the Board to complete the successful CRC refunding process with a stable Centre management team. A further attempt to recruit a new CEO will commence in September 1999.

Ms Alison Crump left the Centre Secretariat in November 1998 and was replaced by Ms Julie Trumper until recruitment for a permanent position was commenced in July 1999. The Postgraduate Coordinator, Ms Gilianne Brodie, resigned her position in November 1998 to concentrate on completing her PhD thesis. Dr Vicki Hall was appointed as the Postgraduate Coordinator (60% time) in January 1999.

Staff Training

Mr Simon Woodley and Dr David Williams completed the *Company Directors Course* conducted by the Australian Institute of Company Directors.

No purchases of major equipment items were made by Centre Parties over the past year.

There were approved changes to the Specified Personnel during 1998/99.

Specified Personnel

Name and Title	Contributing Organisation	Centre Role	% Time Commitment
Mr Simon Woodley	CRC	Director	100
Dr David Williams	CRC	Deputy Director (Research)	50
Dr Terry Done	AIMS	Leader, Program 1	55
Dr Miles Furnas	AIMS	Leader, Project 1.1	50
Dr Lance Bode	JCU	Leader, Project 1.2	30
Dr Ken Woolfe	JCU	Leader, Project 1.3	20
Dr Rob Coles	DPI	Leader, Project 1.4	50
Mr Udo Engelhardt	JCU	Leader, Project 1.6	60
Prof Helene Marsh	JCU	Leader, Program 2	30
Prof Philip Pearce	JCU	Leader, Project 2.2	30
Dr Bruce Mapstone	CRC/GBRMPA	Leader, Project 2.4	100
Dr Tom Hardy	JCU	Leader, Program 3	30
Mr Don Alcock	CRC	Leader, Program 4	100
Prof Howard Choat	JCU	Leader, Program 5	25

STAFFING AND ADMINISTRATION

Professional Staff Contributions in 1998/9

Australian Institute of Marine Science

Name	Role	Total % of time	% Spent on Research Program				% Spent on Education	% Spent on Comm*	% Spent on Admin*
			1	2	3	Total			
Dr T Done	R	72	60			60		12	
Dr M Furnas	R	63	63			63			
Dr G Brunskill	R	3	3			3			
Dr H Sweatman	R	43	43			43			
Dr A Mitchell	R	24	24			24			
Mr C Steinberg	R	10	10			10			
Dr D Burrage	R	15	15			15			
Dr D Williams	R	5		5		5			
Dr K Burns	R	17	17			17			
Dr J Lough	R	12	12			12			
Dr D Barnes	R	14	14			14			
Mr S Spagnol	R	2	2			2			
Dr P Doherty	R	23	10			10		13	
Dr R Reichelt	A	13				0		13	
Total (Person Years)		316	273	5	0	278	0	0	38

R Research

A Administration

* *Comm - Communication*

* *Admin - Administration*

STAFFING AND ADMINISTRATION

Association of Marine Park Tourism Operators and Other Contributing Agencies

Name	Role	Total % of time	% Spent on Research Program				% Spent on Education	% Spent on Comm*	% Spent on Admin*
			1	2	3	Total			
AMPTO									
Mr M Burgess	A	10				0			10
Mr T Briggs	A	10				0			10
Mr D Windsor	A	10				0			10
Sir S Schubert	A	10				0			10
CSIRO									
Dr B McDonald	R	10		10		10			
Dr A Punt	R	10		10		10			
Dr A D Smith	R	10		10		10			
Mr F Pantus	R	10		10		10			
QCFO									
Mr E Loveday	A	10				0			10
FRDC									
Mr A Davidson	R	75		75		75			
Dr S Troy	R	100		100		100			
Dr D Lou	R	100		100		100			
Dr A Jones	E	100				0	80		20
Total (Person years)		465	0	315	0	315	0	80	70

R Research

A Administration

E Education

* **Comm - Communication**

* **Admin - Administration**

STAFFING AND ADMINISTRATION

Department of Primary Industries

Name	Role	Total % of time	% Spent on Research Program				% Spent on Education	% Spent on Comm*	% Spent on Admin*
			1	2	3	Total			
Mr W Lee Long	R	88	88			88			
Dr R Coles	R	34	34			34			
Ms M Samoily	R	65		65		65			
Mr P Daniel	R	26	26			26			
Ms C Roder	R	11	11			11			
Mr A Roelofs	R	38	38			38			
Ms K Vidley	R	66	66			66			
Ms A Cahill	C	5					5		
Dr B Pollock	A	10						10	
Total (Person years)		343	263	65	0	328	0	5	10

R Research

A Administration

C Communication

* **Comm - Communication**

* **Admin - Administration**

Great Barrier Reef Marine Park Authority

Name	Role	Total % of time	% Spent on Research Program				% Spent on Education	% Spent on Comm*	% Spent on Admin*
			1	2	3	Total			
Dr B Mapstone	R	50		50		50			
Mr D Haynes	R	10	10			10			
Mr R Berkelmans	R	21	21			21			
Dr J Oliver	R	20	10			10		10	
Mr J Robertson	R	12		12		12			
Mr J Brodie	R	2		2		2			
Mr J Innes	R	10		10		10			
Dr D Wachenfeld	R	3	3			3			
Dr Z Dinesen	R	12		12		12			
Mr J Tanzer	A	1				0		1	
Dr R Kenchington	A	10				0		10	
Dr I McPhail	A	4				0		4	
Total (Person years)		155	44	86	0	130	0	0	25

R Research

A Administration

* **Comm - Communication**

* **Admin - Administration**

STAFFING AND ADMINISTRATION

James Cook University

Name	Role	Total % of time	% Spent on Research Program				% Spent on Education	% Spent on Comm*	% Spent on Admin*
			1	2	3	Total			
Dr G Inglis	R	5		5		5			
Dr T Hardy	R	45			45	45			
Prof H Marsh	R	23		15		15	5	3	
Dr L Bode	R	30	30			30			
Prof P Pearce	R	30		25		25	5		
Dr K Woolfe	R	25	25			25			
Mr L Mason	R	4			4	4			
Dr P Larcombe	R	8	3			3	5		
Dr A Lewis	R	20	20			20			
Dr L Murphy	R	20		20		20			
Dr G Russ	R	21		21		21			
Dr E Gyuris	R	15		15		15			
Prof R Volker (UQ)	R	15			15	15			
Dr G Ross	R	15		15		15			
Mr J Ackerman	R	8	8			8			
Dr M Fenton	R	7		7		7			
A/Prof C Alexander	R	5	5			5			
Dr P Ridd	R	5	5			5			
Dr E Kim	R	8		8		8			
Dr R Carter	R	10	5			5	5		
Prof J H Choat	E	37		7		7	30		
Prof J Patterson	E	5			5	5			
Dr R Coventry	E	5				0	5		
Dr D Bowden	E	5				0	5		
Dr J Holtum	E	5				0	5		
Dr J Collins	E	5				0	5		
A/Prof D Coomans	E	5				0	5		
Dr T Hughes	E	3				0	3		
Dr B Molony	E	5				0	5		
Dr M McCormick	E	5				0	5		
Dr B Willis	E	13				0	13		
A/Prof O Stanley	E	5				0	5		
Prof H van Leeuwen	E	1				0	1		
Dr D Bellwood	E	5				0	5		
Ms K Graydon	C	3				0	3		
Ms J Shields	C	3				0	3		
Prof N Palmer	A	10				0		10	
Total (Person years)		439	101	138	69	308	112	6	13

*R Research
A Administration

E Education
C Communication

* Comm - Communication

* Admin - Administration

STAFFING AND ADMINISTRATION

CRC Funded Staff

Name	Employer Org.	Role	Total % of time	% Spent on Research Program				% Spent on Education	% Spent on Comm*	% Spent on Admin*
				1	2	3	Total			
Dr C Davies	JCU	R	100		100		100			
Dr L Fernandes	JCU	R	100		100		100			
Mr M Gallagher	JCU	R	100			100	100			
Dr G Moscardo	JCU	R	60		60		60			
Mr R Kapitzke	JCU	R	80			80	80			
Dr M Young	JCU	R	100		100		100			
Dr L Mason	JCU	R	85	50		35	85			
Dr G Inglis	JCU	R	50		50		50			
Dr B Mapstone	JCU	R	50		50		50			
Mr M Matheson	JCU	R	50			50	50			
Dr T Preen	JCU	R	30		30		30			
Mr U Englehardt	JCU	R	80	80			80			
Mr M Hartcher	JCU	R	25	25			25			
Mr M James	JCU	R	28	28			28			
Ms S Giffney	JCU	C	100				0	100		
Ms G Brodie	JCU	E	12				0	12		
Dr V Hall	JCU	E	20				0	20		
Ms A Crump	JCU	A	35				0		35	
Ms J Trumper	JCU	A	65				0		65	
Ms A Tucker	JCU	A	100				0		100	
Dr K Fabricius	AIMS	R	100	100			100			
Dr L McCook	AIMS	R	100	100			100			
Dr D Ryan	AIMS	R	100	100			100			
Mr L Devantier	AIMS	R	25	25			25			
Mr E Turak	AIMS	R	25	25			25			
Dr N Duke	AIMS	R	25	25			25			
Ms M Skuza	AIMS	R	100	100			100			
Ms F McAllister	AIMS	R	30	30			30			
Dr D Williams	AIMS	A	12				0		12	
Mrs L Arnell	AIMS	A	100				0		100	
Mr D Alcock	GBRMPA	C	100				0		100	
Mr S Woodley	GBRMPA	A	100				0		100	
Mr L McKenzie	DPI	R	100	100			100			
Total (Person years)			2187	788	490	265	1543	32	100	512

R Research

A Administration

E Education

C Communication

* **Comm - Communication**

* **Admin - Administration**

STAFFING AND ADMINISTRATION

Summary of Contributions in Person Years (100%=1 Person Year)

Professional Staff	Total Equiv. Person Years	% Spent on Research Program				% Spent on Education	% Spent on Comm*	% Spent on Admin*
		1	2	3	Total			
Total Contributed	17.18	6.81	6.09	0.69	13.59	1.12	0.91	1.56
Total Funded by CRC	21.87	7.88	4.90	2.65	15.43	0.32	1.00	5.12
Grand Total	39.05	14.69	10.99	3.34	29.02	1.44	1.91	6.68
Proportion of total professional staff resources in each activity	100	38	28	9	74	4	5	17

* *Comm* - Communication

* *Admin* - Administration

Support Staff

(1) Contributed	
Organisation	No. staff (person years)
AIMS	0.52
AMPTO & Others	4.00
DPI	0.88
GBRMPA	5.89
JCU	0.29
Total	11.58

(2) CRC Funded (by employing organisation)	
Organisation	No. staff (person years)
AIMS	1.85
DPI	0.25
GBRMPA	0.50
JCU	3.50
Total	6.10

9. SCIENTIFIC PUBLICATIONS

* **publications cited as (in press) in previous Annual Reports.**
For further information see Chapter 12 (Performance Indicators).

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10. PUBLIC PRESENTATIONS, PUBLIC RELATIONS & COMMUNICATION

Objective

To facilitate effective communication of research results, enhance collaboration between participating organisations and increase the application of strategic knowledge by users.

Extension and communication activities are vital to support the research programs and the Centre's overall mission. Results include input into public policy; technological and industry development; assisting people to identify problems; increased skills and knowledge "uses"; greater community awareness and involvement, and information and technology transfer.

A range of communication and extension activities were used to reach stakeholders and industry groups. All CRC staff, students and associates were involved with communication activities, either directly or indirectly, which resulted in high levels of awareness about the Centre's programs. A review of information products and services was undertaken to help revise the Centre's Communication and Extension Strategy. For further information see Chapter 12: Performance Indicators.

10.1 PUBLICATIONS

Exploring Reef Science Fact Sheets

Eight new brochures featuring research projects were produced and distributed to resource managers, scientists, educators and industry groups. The brochures are rated very highly as an effective information product by readers.

CRC Reef Research News

Six issues of the bimonthly newsletter were produced, each edition reaching approximately 3000 people, including research summaries, updates and staff news. The CRC negotiated with GBRMPA to merge lists and will be distributing two *Reef Research* newsletters together in future, providing an added service to more readers.

CRC Technical Reports

At the conclusion of most research tasks, a final report is published for key stakeholders and public libraries. The technical reports often expand other scientific publishing and include results, implications for reef management or industry practices, and public policy options. The following Technical Reports were produced during the year:

- On the Nature of Luminescence in Coral Skeletons
- Development of Cost-effective Control Strategies for Crown-of-thorns starfish
- Fishes of the Yongala Historic Shipwreck
- Developing Reliable Coral Reef Monitoring Programs for Marine Tourism Operators and Community Volunteers
- Chemical and Physical Characteristics of Ballast Water: Implications for Treatment Processes and Sampling Methods

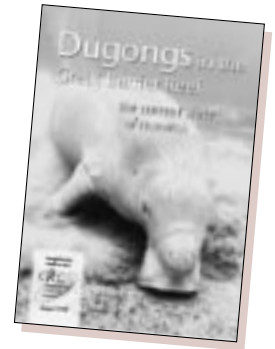
Effects of Line Fishing Newsletter

The Effects of Line Fishing Project produced a quarterly newsletter to update commercial and recreational fishers, reef managers and community groups on progress with this project. It is circulated to 2000 people and the media.

PUBLIC PRESENTATIONS, PUBLIC RELATIONS & COMMUNICATION

Dugong Brochure

To help inform the public about scientific facts relating to Dugong populations, surveys and biology, the Centre produced a colour brochure that was extensively distributed to resource managers, commercial fishers and conservation groups. The popular brochure was also reproduced in a Japanese environmental magazine and *Geo Australasia*.



Centre Website

The site, *CRC Reef Research Centre Online*, was regularly updated. It includes summaries of technical reports, newsletters, research tasks and links to other sites. Visitors to the site increased four fold during the year, now averaging 11 000 a week, and it has become a respected and popular information tool for students, scientists, industry staff and resource managers around the world. It was recognised in November by ABC's *The Lab* as the 'kool' site of the week. A free e-mail news service was also provided on the site and reaches approximately 300 people with a special interest in the CRC.

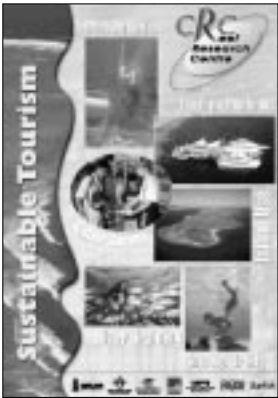
Tropical Topics

The CRC sponsored four editions of *Tropical Topics*, an environmental interpretation newsletter for Queensland tourism industry staff. A range of marine conservation management and research stories were published. The newsletter reaches 2000 readers and is rated highly as an effective source of information to stakeholder groups.

10.2 PUBLIC DISPLAYS

A number of regional and interstate displays were organised to promote CRC research and staff presentations. They included:

- National Science Week. A joint CRC, GBRMPA and AIMS display for the Australian Science Festival in Canberra. Approximately 50,000 young people visited the display with many entering a tourism industry sponsored Reef holiday competition.
- Cairns and Townsville Fishing Show. Reef fisheries and seagrass displays were set up for these regional expos, each attracting large crowds interested in learning about research projects and how to participate in local monitoring activities.
- Conferences and events. Various CRC research displays were set up including the Great Barrier Reef Aquarium in Townsville, at major national and international conferences, and during workshops such as the CRC Postgraduate Research Day. A major display was also set up for the International Tropical Marine Ecosystems Management conference held at Townsville in December.



10.3 MEDIA

Media publicity was at similar levels to previous years. A media monitoring service helped track all published news reports of the CRC research activities and is broken down in the table below. Further information see Chapter 12: Performance Indicators:

	Local	State/National	International
Print	64 (74)	43 (75)	3 (8)
Radio	73 (55)	25 (14)	2 (1)
Television	21 (7)	5 (135)	0+ (2)

+ two features have been filmed but not yet transmitted

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A number of issues were extensively covered. They included predictions of further Crown-of-thorns starfish outbreaks in parts of the northern reef, continuing fishing manipulations for the effects of line fishing project, the recovery of corals from the 1998 summer bleaching event, establishment of community based Seagrass Watch monitoring programs, visitor attitude studies in the Whitsunday's and socio-economic studies for management planning.

The CRC Communication Program continues to support, train and encourage staff, students and associates to publish results extensively and accurately in the media in association with GBRMPA, AMPPTO, QCFO, QDPI, AIMS and JCU.

A Communication Advisory Group, with representatives from participating organisations, helped plan media projects and news releases. The group met twice during the year and regularly exchanged stories for publications. Further information see Chapter 3: Structure and Management.

Communication Training

Communication skills training is an important service provided by the CRC's Extension Program. Staff arranged training for researchers and students in presenting to large audiences, report writing and dealing with journalists. The CRC also sponsors a Marine Science Journalism competition at James Cook University and Central Queensland University to encourage professional writing on contemporary Reef issues. One \$1000 prize was awarded to Paul Marshall a PhD student within the CRC, and several other commendations were made.

The Centre also helped organise a national CRC communication staff workshop in Brisbane in October. More than 30 representatives from other CRCs attended to plan joint media, publicity and regional briefings for the National CRC Program.

CRC Science Briefings

Two major science briefings for politicians, senior government officials and industry leaders were made by senior CRC staff and board members. Mr Simon Woodley joined a group of six north Queensland CRCs to present achievements in sustainable use and the development of public policy for the Great Barrier Reef World Heritage Area at Townsville in April. The briefing was hosted by CRC Association Chairman, the Hon Tony Staley, and was attended by several Queensland members of parliament. They included the Hon Ken Turner Queensland MP; Dr Lesley Clarke Queensland MP; the Hon Peter Slipper Federal MP; and Lieutenant General John Grey AC (Retd.), Chancellor of JCU.

Mr Ted Loveday, President of QCFO, also made a presentation on the CRC's contribution to sustainable management of Queensland fisheries at the National CRC Association Conference in Melbourne.

Communication Survey

The Centre undertook an internal review of its communication products and services. Overall, the results were positive with high levels of satisfaction for the range of information products, extension activities and communication support. Research leaders and knowledge 'users' were involved in the review and have suggested additional initiatives that will be incorporated into the Communication and Extension Program in the future. The Centre rated very highly in its capacity to disseminate research results to various stakeholder and interest groups.



The CRC won the prestigious Banksia Environmental Award for outstanding achievement in helping to understand, enhance and sustain Australia's coastal and marine areas. Sir Sydney Schubert is pictured with Diane James, Chair of the Victorian Coastal Council (left) and the Hon Marie Tehan, Victorian Minister for the Environment.

Photo: Banksia Environmental Foundation

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PUBLICATIONS

- Cavanagh, J.E. (1998) Organochlorine insecticides - the good, the bad, the ugly... *Australian Canegrower*, July 1998.
- Engelhardt, U. & Tighe, T. (1999) Crown-of-thorns starfish outbreaks - options for reef management. Appendix 2 in: *Renewed Call for Action*, ICRI 1999.
- Fernandes, L. (1998) What do recreational fishers want from marine park managers? *Sunfish Magazine*.
- Fernandes, L. (1998) Fishing in the marine park! What do fishermen want from marine park managers? *Queensland Fisherman*, December 1998.
- Jompa, J. & McCook, L.J. (1998) Seaweeds save the reef?!: *Sargassum* canopy decreases coral bleaching on inshore reefs. *Reef Research - Newsletter of the Research & Monitoring Section*, GBRMPA, Vol. 8(2), p. 5.
- Lough, J.M. (in press) Sea surface temperatures on the Great Barrier Reef: a contribution to the study of coral bleaching. *GBRMPA Technical Note*, 31 pp.

CONFERENCE PRESENTATIONS

International

- Alcock, D. (1999) Australia's CRC model: collaborative science for sustainable marine tourism. *1999 World Congress Coastal and Marine Tourism*, Vancouver, British Columbia, Canada, 26 April 1999.
- Bode, L. & Mason, L.B. (1998) A review of ocean tide models in the region. *Discussion Meeting on 'Sea Level Networks in the West Pacific Region including Development of GLOSS in the Region' and on 'Sea Level for the Asia-Pacific Space Geodynamics Project'*, Academia Sinica, Taipei, Taiwan, 20 July 1998.
- Bode, L., Harijanto, A., & Mason, L.B. (1998) Tidal Modelling in the Indonesian Seas: A Parameterised Approach. *Western Pacific Geophysics Meeting*, American Geophysical Union, Taipei, Taiwan, 21-24 July 1998.
- Codi, S. (1998) Weathering of hydrocarbons in mangrove sediments: testing the effects of using dispersants to treat oil spills. *International Meeting of the Society of Toxicology and Environmental Chemistry (SETAC)*, Orlando, Florida, November 1998.
- Coles, R.G., Lee Long, W.J., McKenzie, L.J. Roder, C.A., Roelofs, A.J., & Daniel, P. (1998) Seagrasses in deepwater on the Queensland continental shelf (poster). *Society for Conservation Biology International Meeting 1998*, Macquarie University, Sydney, Australia, 13-16 July 1998.
- Davies, C.R. & Mapstone, B.D. (1998) Performance of marine protected areas: regional variation in CPUE and size structure of the common coral trout (*Plectropomus leopardus*) among reefs and management zones on the Great Barrier Reef. *ICES Symposium: Confronting uncertainty in the evaluation and implementation of Fisheries-Management Systems*, Capetown, South Africa, 16-19 November 1998.
- Davies, C.R. & Mapstone, B.D. (1998) *CRC Reef Effects of Line Fishing Project: Large-scale research for conservation and fisheries management on the Great Barrier Reef*. Department of Marine Science, University of Newcastle, Newcastle upon Tyne, UK, 26 November 1998.
- Done, T.J. (1998) Performance indices for management of coral reef ecosystems. *IX Pacific Science Association Inter-Congress - International Symposium on Ecology and Conservation of Coral Reefs in the Pacific*, Academia Sinica, Taipei, 15-19 November 1998.
- Done, T.J. (1999) Useful science for coral reef management: the Cooperative Research Centre model. *International Conference on Scientific Aspects of Coral Reef Assessment, Monitoring and Restoration*, Ft Lauderdale, Florida, USA, 14-16 April, 1999.
- Done, T.J., Oliver, J.K., Berkelmans, R., Skirving, W., & Lough, J.E. (1999) Can satellites help to identify local scale variability in coral bleaching and coral death? Goals and

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- Duke, N.C. (1998) Mangrove biodiversity patterns in Central America affected by current climatic and ecological factors. *Recent Advances and Future Trends in Mangrove Research: Biodiversity, Genetics, Evolutionary Biology & Restoration Conference*, Toulouse, France, 8-10 July 1998.
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- Duke, N.C. (1998) Fate and effects of oil and dispersed oils on mangrove forests. *Oil Spill Response Group Meeting*, AEA Technology, Oxford, UK, 13 July 1998.
- Engelhardt, U. (1998) Crown-of-thorns starfish - current methods for early detection and handling of new outbreaks of *A. planci*. *International Tropical Marine Ecosystems Management Symposium (ITMEMS)*, Townsville, 25 November 1998.
- Fabricius, K.E., Brodie, J., & Turak, E. (1998) Mass bleaching of corals on the Great Barrier Reef. *International Society of Reef Studies Conference*, Perpignan, 1-5 September 1998.
- Fabricius, K.E. (1998) Reef invasion by soft corals: which taxa and which habitats? *International Society of Reef Studies Conference*, Perpignan, 1-5 September 1998.
- Fernandes, L. (1998) Linking facts and values in decision support for the biggest marine park in the world. *Dept. of Geography Seminar Series*, University of Hawaii, 12 November 1998.
- Fernandes, L. (1998) Linking facts and values in decision support for the biggest marine park in the world. *Fifth Biennial Meeting International Society for Ecological Economics*, 15-19 November 1998.
- Hendee, J., Berkelmans, R., Sweatman, H., Coleman, G., & Gill, E. (1999) A data driven expert system for producing coral bleaching alerts for Myrmidon Reef, GBR. (poster) *National Coral Reef Institute Conference on Scientific Aspects of Coral Reef Assessment, Monitoring and Restoration*, Ft Lauderdale, Florida, 14-16 April 1999.
- Inglis, G.J. & Shafer, C.S. (1999) Spatial patterns of impact at high-density snorkeling sites on the Great Barrier Reef. *International Symposium on Society & Resource Management*, Brisbane, 7-10 July 1999.
- Kritzer, J. (1998) Reef-Specific Life History Traits of Stripey Bass at the Palm Islands. *2nd International Congress on the Biology of Fish*, Baltimore, Maryland, USA, 25-29 July 1998.
- Kritzer, J. (1998) The Effects of Sample Size on the Precision of Fish Population Parameter Estimation. *128th American Fisheries Society Annual Meeting*, Hartford, Connecticut, USA, 23-28 August 1998.
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- Lough, J.M. (1999) Northeast Australian climate and the changing role of El Niño-Southern Oscillation. *79th American Meteorological Society Annual Meeting*, Dallas, TX, January 1999.
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- Müller, J.F., Haynes, D., & McLachlan, M.S. (1998) Polychlorinated dibenzodioxins and dibenzofurans and polychlorinated biphenyls in dugong, sediment and seagrass samples collected from the Great Barrier Reef environment of Australia. *Fifth International Meeting of the International Society for the Study of Xenobiotics*, Cairns, Australia, October 1998.
- Oemcke, D.J. (1999) Ballast water treatment: potential ship-board options and identifying strategic research needs. *First National Conference on Marine Bioinvasions*, Massachusetts Institute of Technology, Cambridge, Massachusetts, 24-27 January 1999.

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- Oxley, W. (1998) AIMS Long Term Monitoring Program. *International Tropical Marine Ecosystems Management Symposium (ITMEMS)*, Townsville, 25 November 1998.
- Pratt, R. (1999) Coral Reef Restoration (poster). *International Conference on Scientific Aspects of Coral Reef Assessment, Monitoring, and Restoration*, Ft. Lauderdale, FL USA, 14-16 April 1999.
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- Young, M. & Fenton, D.M. (1999) TRC-Analysis and evaluating the social impacts of commercial fisheries in Queensland, Australia. *Scottish Fisheries Research Service*, Aberdeen, Scotland, February 1999.

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- Barnes, D.J. (1998) Coral growth, calcification and skeletal records (invited plenary presentation). *Annual Scientific Meeting of the Australian Coral Reef Society*, Port Douglas, 16-18 October 1998.
- Breen, B. (1999) Perception of reef quality in the Cairns Section of the Great Barrier Reef Marine Park. *CRC Reef Research Centre Postgraduate Researcher Day*, Townsville, 28 May 1999.
- Breen, B. (1999) Perception of reef quality in the Cairns Section of the Great Barrier Reef Marine Park. *TESAG Postgraduate Conference*, Townsville, 7 June 1999.
- Burns, K.A. (1998) Weathering of hydrocarbons in mangrove sediments: testing the effects of using dispersants to treat oil spills. *Australian Organic Geochemistry Conference (AOGC)*, Canberra, August 1998.
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- Diaz-Pulido, G. & McCook, L.J. (1998) Algal distributions, recruitment and coral bleaching: from Colombian oceanic atolls to fringing reefs of the GBR. *Annual Scientific Meeting of the Australian Coral Reef Society*, Port Douglas, 16-18 October 1998.
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- Done, T.J. & Dinesen, Z. (1999) Performance indicators for management of the Great Barrier Reef: research directions. *GBRMPA/CRC Joint Scoping Workshop on Performance Indicators for the GBRWHA*, Townsville, 3-4 June 1999.
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- Haynes, D., Müller, J.F., McLachlan, M., & Dennison, B. (1998) Dugong pollutant concentrations: mermaids in distress? *Annual Scientific Meeting of the Australian Coral Reef Society*, Port Douglas, 16-18 October 1998.
- Inglis, G.J. (1999) Evidence for systemic changes in the benthic fauna or a tropical urban estuary. *Sources, Fates and Consequences of Pollutants in the Great Barrier Reef and Torres Strait*, Townsville, 29-30 June 1999.
- Kritzer, J. (1999) Spatial variation in demographic traits of stripey bass, and implications for population dynamics. *CRC Reef Research Centre Postgraduate Researcher Day*, Townsville, 28 May 1999.
- Kung, J. (1999) Dynamics of vessel movement: choice of fishing location. *CRC Reef Research Centre Postgraduate Researcher Day*, Townsville, 28 May 1999.
- Kung, J. (1999) Vessel movement dynamics: theoretical model of fishing location choice (poster). *TESAG Postgraduate Conference*, Townsville, 7 June 1999.
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- Marshall, P. (1998) Shades of pale - variability in taxa susceptibilities and assemblage response during the mass bleaching episode on the central Great Barrier Reef. *Annual Scientific Meeting of the Australian Coral Reef Society*, Port Douglas, 16-18 October 1998.
- Marshall, P. (1998) Predicting the resistance of reef corals to mechanical disturbance. *Annual Scientific Meeting of the Australian Coral Reef Society*, Port Douglas, 16-18 October 1998.
- Marshall, P. (1999) How corals are able to weather the storm: modularity, morphology and management implications. *CRC Reef Research Centre Postgraduate Researcher Day*, Townsville, 28 May 1999.
- Marshall, P. (1999) Are corals able to weather the storm: resistance and recovery in reef corals. *TESAG Postgraduate Conference*, Townsville, 7 June 1999.
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- Michalek-Wagner, K. (1998) The effects of bleaching on the reproductive output of the soft coral *Lobophytum compactum*. *Annual Scientific Meeting of the Australian Coral Reef Society*, Port Douglas, 16-18 October 1998.
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- Coles, R.G. (1998) *Dugong management in the GBR*. Northern Fisheries Centre Seminar Series, NFC, Cairns, July 1998.
- Coles, R.G. (1998) *Fisheries and Coastal Management in Queensland*. Tropical Ecosystems MB2090, 3rd year TESAG subject, JCU, Cairns Campus, 9 October 1998.
- Davies, C. (1999) *Effects of line fishing experiment - an update*. Meetings with commercial fishers and open public meetings for 2nd round of manipulations for ELF Experiment, Gladstone, Mackay, Bowen, Townsville, Innisfail, Port Douglas & Cooktown, 9-22 February 1999.
- De'ath, G. (1999) *New methods for modelling species - environment relationships*. PhD Exit Seminar, TESAG, James Cook University, 1 March 1999.
- De'ath, G. (1999) *New ecological methods for the analysis of complex ecological data*. Dept. of Zoology, UWA, 9 March 1999.
- De'ath, G. (1999) *New methods for the analysis of species-environment relationships*. TESAG, JCU, 4 May 1999.
- De'ath, G. (1999) *New methods for the analysis of species-environment relationships*. Biological Sciences, JCU, 25 May 1999.
- Dommissie, M. (1999) *Detritus: junk food of the Great Barrier Reef?* PhD Exit Seminar, Dept. of Marine Biology, James Cook University, Townsville, 5 February 1999.
- Done, T.J. (1999) *Coral community adaptability to environmental changes at the scales of regions, reefs and reef zones*. Open seminar in workshop for scientific diving among Japan, France, US and Australia. Ishgaki Island, Okinawa, Japan, 11 February 1999.
- Engelhardt, U. (1998) *Crown-of-thorns starfish on the Great Barrier Reef - just when you thought it was safe again*. Great Barrier Reef Marine Park Authority, Townsville, 2 December 1998.
- Engelhardt, U. (1999) *The status of COTS populations in the central GBR region - update 1998-99*. CRC Reef Research Centre Board Meeting, Townsville, 12 February 1999.
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- Engelhardt, U. (1999) *The status of COTS populations in the central GBR region - update 1998-99*. Association of Marine Park Tourism Operators (AMPTO) Northern Branch Meeting, Cairns, 18 February 1999.

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- Engelhardt, U. (1999) *The status of COTS populations in the central GBR region - update 1998-99*. Presentation to the Great Barrier Reef Aquarium Volunteers' Association of Townsville (GBRAVAT) at the GBR Aquarium, Townsville, 22 June 1999.
- Fenton, D.M. (1999) *TRC-Analysis and its application to harvest fisheries*. Harvest MAC, January 1999.
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- Fernandes, L. (1998) *Towards combining cultural, economic, environmental and social concerns in management of the GBRMP*. QFMA Reef Management Advisory Committee Meeting, October 1998.
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- Fernandes, L. (1998) *Towards combining cultural, economic, environmental and social concerns in management of the GBRMP*. Townsville RMRAC Meeting, 10 December 1998.
- Fernandes, L. (1999) *Towards combining cultural, economic, environmental and social concerns in management of the Great Barrier Reef Marine Park*. HarvestMAC Meeting, 21-22 January 1999.
- Fernandes, L. (1999) *Towards combining cultural, economic, environmental and social concerns in management of the Great Barrier Reef Marine Park*. TrawlMac Meeting, 24-25 February 1999.
- Gallagher, M.R. (1999) *Numerical predictions of the nitrogen balance for effluent irrigated lawns on islands in the Great Barrier Reef*. Department of Civil Engineering Seminar Series, University of Queensland, Brisbane, 2 June 1999.
- Greenwood, T. & Pearce, P. (1998) *CRC Reef tourism research*. Townsville Enterprise Tourism Advisory Committee, October 1998.
- Kritzer, J. (1998) *A review of past, current and future research on the biology of stripey bass*. Townsville Fisheries Zonal Advisory Meeting, QDPI, Townsville, 25 November 1998.
- Kritzer, J. (1999) *Spatial variation in demographic traits of stripey bass, and implications for population dynamics*. PhD Confirmation of Candidature Seminar, Dept. of Marine Biology, James Cook University, Townsville, 29 March 1999.
- Lee Long, W.J. (1998) *Seagrasses: their importance and management*. Seagrass-watch seminar, Port Douglas Community and QDoE. Outer Edge Conference Room, Port Douglas, 24 September 1998.
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- Lough, J.M. (1998) *20th Century Climate Variation in North east Australia*. Research School of Earth Science, ANU, Canberra, July 1998.
- Lough, J.M. (1998) *Comparisons of coastal climate of northwest Australia and an update of Queensland rainfall and temperature variations*. Australian Institute of Marine Science, August 1998.
- McCook, L.J. (1999) *The ecology of coral reef algae*. Marine Biology, James Cook University, May 1999.
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- Michalek-Wagner, K. (1999) *The chemical ecology of the soft coral - zooxanthellae interaction and its significance to bleaching*. PhD Exit Seminar, Marine Biology, James Cook University, 8 June 1999.
- Moscardo, G. (1998) *Graphics and maps at JCU*. JCU research staff and postgraduate students, 13 October 1998.
- Moscardo, G. (1999) *Signs and interpretive text*. Qld Chapter of the Interpretation Australia Association, Brisbane, 9 March 1999.
- Moscardo, G. (1999) *Evaluating interpretation and signs design*. EPA State Interpretation Workshop, Binna Burra, 10/11 March 1999.
- Moscardo, G., Greenwood, T., & Green, D. (1998) *Presentation of Whitsundays survey results to managers and operators*, Airlie Beach, 9 December 1998.
- Moscardo, G. & Greenwood, T. (1999) *Whitsundays survey results*. GBRMPA, Townsville, 30 March 1999.
- Moscardo, G. (1999) *Results of the World Heritage Brochure Evaluation*. GBRMPA, 30 April 1999.
- Roder, C.A. (1998) *Seagrasses*. Holloways Beach Environment Education Centre, 21 August 1998.
- Roder, C.A. (1998) *Seagrass-Watch*. Northern Fisheries Centre Seminar Series, NFC, Cairns, 4 September 1998.
- Slade, S. (1999) *Fishing practices and catch rates - the shift to live fishing*. Meetings with commercial fishers and open public meetings for 2nd round of manipulations for ELF Experiment, Gladstone, Mackay, Bowen, Townsville, Innisfail, Port Douglas & Cooktown, 9-22 February 1999.
- Smith, T. (1998) *Attitudes of recreational fishermen in Townsville regarding fishery management regulations*. Honours Thesis, September 1998.
- Welch, D. (1998) *Development of a technique that minimises size selectivity for sampling populations of the common coral trout, Plectropomus leopardus*. Department of Marine Biology, Townsville, 11 September 1998.
- Welch, D. (1999) *Possible effects of different fish ageing methodologies*. ELF Discussion Group, Townsville, 23 March 1999.

CONFERENCE ATTENDANCE

International

- Moscardo, G. (1998) *National Interpretation Conference*, Anchorage, Alaska, October 1998 (presented a workshop on designing and using graphics and maps).
- Pearce, P., Moscardo, G., & Kim, E. (1998) *Asia Pacific Tourism Association*. Korea, August 1998.

National

- Davies, C.R. (1999) *Perspectives on ecological sustainability - a workshop*, AIMS, Townsville, 15 June 1999.
- Gallagher, M. (1999) *Institution of Engineers Australia, Water Panel Workshop. Water Quality Modelling and Management*, 5 May 1999.
- Gallagher, M. (1999) Centre for Integrated Resource Management (CIRM). Interactive Workshop Session for the Establishment of a Water Reclamation Demonstration Program, 19 November 1998.
- McKenzie, L.J. (1998) *Monitoring Fisheries habitats - an indicator development workshop*. QDPI Fisheries, Brisbane, 6-7 August 1998.
- Pearce, P., Moscardo, G., & Greenwood, T. (1999) *Council of Australian Universities in Hospitality and Tourism Education*. Annual Research Conference, Adelaide, February 1999.

11. GRANTS & AWARDS

GRANTS

Researcher & Organisation	Title of Grant	Source	Period of Grant	\$
Dr Davies, JCU	Stock structure and regional variation in population dynamics of the Red Throat Emperor and other target species of the Queensland Tropical Reef Line Fishery	FRDC	2.5 years	388,447
A/Prof Garry Russ, JCU	Fish movements and marine reserves	Australian Research Council	1 year	15,500
A/Prof Garry Russ, JCU	Management zoning in Palm Island	Merit Research Grant, James Cook University	1 year	4,953
Burrage, Heron, Tomczak et al., Flinders Univ, AIMS, JCU, GBRMPA, UNSW, Univ Sydney	Airborne Salinity Mapping Facility	Australian Research Council RIEF Grant	1 year	300,000
Ms Barbara Woods, JCU	Faculty of Arts, Law & Business PhD Research Grant	James Cook University	6 months	978
Ms Barbara Woods, JCU	Sustainable Tourism Assistance Grant	CRC Sustainable Tourism	1 year	2000
Ms Rebecca Logan, JCU	Destination Images of the Whitsundays	QTTC	8 months	1000
Dr Gianna Moscardo, JCU	A Status Assessment of Research into Wildlife Tourists	CRC Sustainable Tourism	1 year	7000
Dr Katharina Fabricius	Field Guide to the Soft corals and sea fans of the Indopacific	Australian Biological Resource Foundation		20,000
Prof R Carter & Drs K Woolfe and P Larcombe, JCU	Shelf Seismic	Australian Research Council RIEF Grant	NA	402,000
Dr K Woolfe & Mr A Heap, JCU	Hi Res Stratigraphy	Australian Institute of Nuclear & Scientific Engineering	NA	5,360

AWARDS

Researcher & Organisation	Title of Award	For
CRC Reef Research Centre	1999 Banksia Environmental Award	Developing positive solutions to coastal and marine issues

12. PERFORMANCE INDICATORS

The Strategic Plan 1994-1998 for the Centre includes a set of performance indicators developed as foreshadowed in the Centre Agreements.

Criteria	Performance	Performance					
		1993/4	1994/95	1995/96	1996/97	1997/98	1998/99
A. COOPERATIVE ARRANGEMENTS (see Chapter 4)							
■ Industry partners involved in program logistics	Operators	6	21	35	35	33	50
■ Development of collaboration with other research groups	Universities	5	6	7	14	16	22
	TAFE Colleges			4	5	12	9
	CSIRO Divisions	3	4	5	4	5	4
	Government/industry	3	15	31	60	74	83
	Marine Research Agencies	2	3	4	12	8	7
■ Core institutional partners involved in each program	Yes.						
■ Industry partners involved in program content and execution	Yes; through Users Advisory Group, Management and Industry Associates and direct research (see sections 4.1 and 4.2)						
■ Development of involvement by fishing industry	Yes; a high level of liaison and involvement in the Effects of Fishing project and socioeconomic research (see sections 5.9 and 7)						
■ National and international recognition of the success of CRC approach	Liaison/advice on CRC Program model and CRC Reef to representatives from Malaysia, Indonesia, USA, Canada, Japan, European Union, Vietnam and Palau. Centre model proposed as a core structure in Indonesia and United Kingdom (see sections 4.2 and 4.3)						
B. RESEARCH AND RESEARCHERS (see Chapter 5)							
		1993/4	1994/95	1995/96	1996/97	1997/98	1998/99
■ Refereed papers accepted (see Chapter 9)		29	31	50	92	105	102
■ Invitations to present keynote/plenary papers in the name of the CRC		9	10	11	15	10	9
■ Research papers presented (see Chapter 9)		49	59	115	115	89	99
■ Presented/published papers on the practical application of CRC findings (see Chapters 9 and 10)		56	59	78	153	120	126
■ Recognition by the communications media (see Section 9.3)	TV	23	33	34	51	144	26
	radio	11	20	50	131	75	100
	print	10	91	175	273	163	110
	Frequent requests for comments on Great Barrier Reef issues						
■ Industry product design produced (see Chapter 7)	PADI Research Diver course, Heritage and Interpretive Tourism Training Course, COTS Control Program, Integrated Coastal Zone Planning & Management Training Course, Seagrass Watch Community Monitoring Program, Eye on the Reef, Ballast Water Treatment Pilot Plant						
■ Management tools produced (see Chapter 7)	Tourism Segmentation and Database for North Queensland, Information Support System for Reef Planning, Live Fish Trade Handling Guidelines, Seagrass Mapping for Representative Areas Program, Minke Whale Watching Guidelines, Reef Fish Spawning Closures, Third Reef Monitoring Status Report						

PERFORMANCE INDICATORS

C. EDUCATION AND TRAINING (see Chapter 6)		1993/4	1994/95	1995/96	1996/97	1997/98	1998/99
■ Graduate students aligned with CRC		12	46	61	77	84	69
■ Higher degrees awarded		N/A	2	3	2	6	13
■ Short courses conducted		5	6	7	11	20	18
■ Industry briefing workshops conducted		17	20	36	>70	>70	>60
■ Industry employment of CRC-aligned graduates		N/A	N/A	2	4	6	15

D. APPLICATION OF RESEARCH (see Chapter 7)	
■ Transfer of CRC products to INTROMARC	Close working association on developing opportunity for use of Centre skills in overseas training courses and strategic alliance with AMSAT and CRC participating organisations. AMSAT is not currently operational.
■ Application by industry of CRC products	Implementing Research Diver course; Regional tour operators employ HIT course graduates; Live fish holding tanks redesign; Improved permanent screw anchors; Eye on the Reef Program; Improved marine interpretative products used by operators.
■ Implementation by partners of environmental management products	Tools include COTS control and diver protocols. Use of educational and informational products by tourism and fishery industries. Contributions to develop Australia's Marine Science and Technology Ocean Policy and Plan. Integrated database used for Cairns Area Plan of Management. Aerial surveillance of dugongs contributed to eight new Dugong Protection Areas.
■ Implementation by other national and international agencies of all CRC products	Consultancies, expert advice on policy and strategic matters: Involvement in UN & NGO forums and provision of materials and training; International use of website; Wide distribution of Technical Reports; Extensive reporting of results at International Tropical Marine Ecosystems Management Conference and International Coral Reef Society networks; Contribution to IOC.

E. MANAGEMENT AND BUDGET		1993/4	1994/95	1995/96	1996/97	1997/98	1998/99
■ Increase in % commitment by Centre staff		N/A	15.68	6.62	3.34	-4.00	+ 0.44
■ Satisfactory increase in collaboration with researchers outside the CRC	non-CRC researchers	19	32	48	112	114	106
	- national	14	23	40	84	85	88
	- International	5	9	8	28	29	18
■ Board endorsement of Centre management and operation	Developed strategic plans and approved operational programs, tasks and research direction. Approved renewal application for new research, commercial and international activities. Approved budget.						
■ Great Barrier Reef Consultative Committee endorsement of Centre management and operation	The GBRCC met formally in March. Arrangements to advise CRC on research programs re-established.						
■ Operation within, but up to the full extent of the budget	97% cash committed						
■ Generation of further industry financial support	Grants, consultancies, contracts and increased in-kind contributions (see Chapter 11)						

13. BUDGET

TABLE 1: IN-KIND CONTRIBUTIONS
(*\$'000s*)

								Cumulative Total To Date				Grand Total		
	Actual 1993/94	Actual 1994/95	Actual 1995/96	Actual 1996/97	Actual 1997/98	Actual 1998/99	Agreement 1998/89 (\$1992/93)	Actual	Agreement	Estimate 1999/00	Agreement 1999/00 (\$1992/93)	Total* 7 Yrs	Agreement 7 Yrs	Variance 7 Yrs
AIMS														
Salaries	357	410	402	524	350	371	371	2,414	2,212	375	372	2,789	2,584	205
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	823	1,218	1,385	1,684	1,149	1,233	753	7,493	4,365	1,100	753	8,593	5,118	3,475
Total	1,180	1,628	1,787	2,208	1,499	1,605	1,124	9,907	6,577	1,475	1,125	11,382	7,702	3,680
TOURISM INDUSTRY (Represented by AMPTO & Others)														
Salaries	7	24	24	43	326	440	9	864	54	45	9	909	63	846
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	31	91	153	172	213	270	44	930	289	55	44	985	333	652
Total	38	115	177	215	539	710	53	1,794	343	100	53	1,894	396	1,498
GBRMPA														
Salaries	93	138	167	166	200	127	129	892	774	130	129	1,022	903	119
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	88	126	157	162	188	120	121	841	726	125	121	966	847	119
Total	181	264	324	328	389	247	250	1,733	1,500	255	250	1,988	1,750	238
JCU														
Salaries	289	374	458	475	476	404	454	2,476	2,724	476	454	2,952	3,178	(226)
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	633	710	932	887	828	778	717	4,768	4,360	800	717	5,568	5,077	491
Total	922	1,084	1,390	1,362	1,305	1,181	1,171	7,244	7,084	1,276	1,171	8,520	8,255	265
QDPI														
Salaries	100	157	685	119	227	207	151	1,495	906	160	151	1,655	1,057	598
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	136	228	237	158	306	286	223	1,351	1,338	250	223	1,601	1,561	40
Total	236	385	922	277	534	493	374	2,847	2,244	410	374	3,257	2,618	639
TOTAL IN-KIND CONTRIBUTIONS														
Salaries	846	1,103	1,736	1,327	1,580	1,550	1,114	8,142	6,670	1,186	1,115	9,328	7,785	1,543
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	1,711	2,373	2,864	3,063	2,685	2,687	1,858	15,383	11,078	2,330	1,858	17,713	12,936	4,777
Grand Total In-Kind	2,557	3,476	4,600	4,390	4,265	4,237	2,972	23,525	17,748	3,516	2,973	27,041	20,721	6,320

* Total = Cumulative Actual + Outyear 'Estimate'

BUDGET

TABLE 2: CASH CONTRIBUTIONS
(*\$'000s*)

	Actual 1993/94	Actual 1994/95	Actual 1995/96	Actual 1996/97	Actual 1997/98	Actual 1998/99	Agreement 1998/89 (\$1992/93)	Cumulative Total To Date		Estimate 1999/00	Agreement 1999/00 (\$1992/93)	Grand Total		
								Actual	Agreement			Total* 7 Yrs	Agreement 7 Yrs	Variance 7 Yrs
PARTNERS														
AIMS	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tourism Industry (rep by AMPTO)	500	750	810	875	945	1,020	1,020	4,900	3,880	1,102	1,102	6,002	4,982	1,020
GBRMPA	665	671	672	669	665	665	665	4,007	3,325	665	665	4,672	3,990	682
JCU	100	0	40	0	0	0	0	140	100	0	0	140	100	40
QDPI	100	0	0	0	0	70	0	170	100	0	0	170	100	70
Total Cash from Participants	1,365	1,421	1,522	1,544	1,610	1,755	1,685	9,217	7,405	1,767	1,767	10,984	9,172	1,812
OTHER														
Interest	13	21	53	21	17	21	0	146	0	20	0	166	0	166
Industry	0	0	129	168	75	130	0	502	0	0	0	502	0	502
Research Grants	82	25	0	160	94	96	0	457	0	6	0	463	0	463
CRC GRANT														
	1,134	1,520	2,656	2,151	2,200	2,164	2,000	11,825	8,955	2,095	2,000	13,920	10,955	2,965
TOTAL CRC CASH CONTRIBUTION														
	2,594	2,987	4,360	4,044	3,996	4,166	3,685	22,147	16,360	3,888	3,767	26,035	20,127	5,908
Cash carried over from previous year														
		1,016	1,092	934	627	728		4,397		1,256		5,653		
Less Unspent Balance														
	1,016	1,092	934	627	728	960		5,357		0		5,357		
TOTAL CASH EXPENDITURE														
	1,578	2,911	4,518	4,351	3,895	3,934	3,685	21,187	16,360	5,144	3,767	26,331	20,127	6,204
ALLOCATION OF CASH EXPENDITURE BETWEEN HEADS OF EXPENDITURE														
Salaries	894	1,222	1,914	1,952	1,765	1,873	1,921	9,620	8,119	2,315	1,994	11,935	10,113	1,822
Capital	50	93	80	59	0	0	0	282	225	0	0	282	225	57
Other	634	1,596	2,524	2,340	2,130	2,061	1,764	11,285	8,016	2,829	1,773	14,114	9,789	4,325
Grand Total	1,578	2,911	4,518	4,351	3,895	3,934	3,685	21,187	16,360	5,144	3,767	26,331	20,127	6,204

* Total = Cumulative Actual + Outyear 'Estimate'

BUDGET

TABLE 3: SUMMARY OF RESOURCES APPLIED TO ACTIVITIES OF THE CENTRE
(S'000s)

						Cumulative Total To Date				Grand Total				
	Actual 1993/94	Actual 1994/95	Actual 1995/96	Actual 1996/97	Actual 1997/98	Actual 1998/99	Agreement 1998/89 (\$1992/93)	Actual	Agreement	Estimate 1999/00	Agreement 1999/00 (\$1992/93)	Total* 7 Yrs	Agreement 7 Yrs	Variance 7 Yrs
GRAND TOTAL														
In-Kind Expenditure	2,557	3,476	4,600	4,390	4,265	4,237	2,972	23,525	17,748	3,516	2,973	31,277	20,721	10,556
Cash Expenditure	1,578	2,911	4,518	4,351	3,895	3,934	3,685	21,187	16,360	5,144	3,767	30,265	20,127	10,138
Total Resources Applied to Activities of Centre	4,135	6,387	9,118	8,741	8,159	8,171	6,657	44,711	34,108	8,660	6,740	61,542	40,848	20,694
ALLOCATION OF TOTAL RESOURCES														
Total Salaries (Cash & In-Kind)	1,741	2,325	3,650	3,279	3,345	3,423	3,035	17,761	14,789	3,501	3,109	21,262	17,898	3,364
Total Capital (Cash & In-Kind)	50	93	80	59	0	0	0	282	225	0	0	282	225	57
Total Other (Cash & In-Kind)	2,345	3,969	5,388	5,403	4,815	4,748	3,622	26,668	19,094	5,159	3,631	31,827	22,725	9,102

* Total = Cumulative Actual + Outyear 'Estimate'

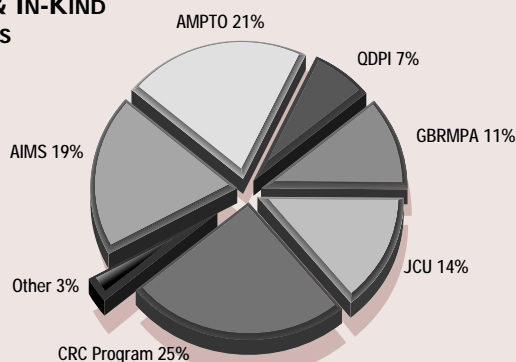
TABLE 4 : ALLOCATION OF RESOURCES BETWEEN CATEGORIES OF ACTIVITIES

PROGRAM	Resource Usage			
	\$ CASH ⁽¹⁾ ('000s)	\$ IN-KIND ('000s)	STAFF CONTRIBUTED ⁽²⁾	STAFF FUNDED BY CRC ⁽²⁾
RESEARCH	2,755	3,814	13.59	15.43
EDUCATION	296	247	1.12	0.32
EXTENSION/COMMUNICATION	364	27	0.91	1.00
ADMINISTRATION	520	149	1.56	5.12
Total	3,934	4,237	17.18	21.87

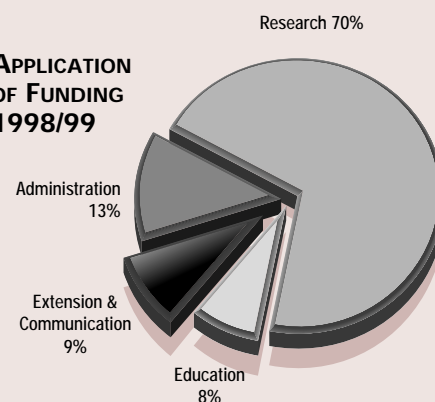
(1) Cash from all sources, including CRC Program

(2) Person years, Professional staff

TOTAL CASH & IN-KIND CONTRIBUTIONS 1998/99



APPLICATION OF FUNDING 1998/99



Notes to and forming part of the Financial Statement

Basis of accounting

The Financial Statement (Tables 1-3) was prepared on the accrual basis of accounting.

Capital Purchases

In 1998/99, there were no capital equipment purchases.

Receipts - Partners

\$1,020,000 sourced from the Environmental Management Charge has been recorded as a cash contribution by the Tourism Industry (represented by AMPTO).

Variation in Accounting Periods

With the exception of James Cook University, all members of the Cooperative Research Centre have reported for the period 1 July 1998 to 30 June 1999. James Cook University adopts a four-weekly financial reporting cycle and has reported from the 13 June 1998 to the 11 June 1999, being the end of the four-weekly cycle immediately prior to 30 June 1999.

Budget Estimates

The Agreement Budgets recorded in Tables 1, 2 and 3 are the budget estimates contained in the Commonwealth Agreement, including the Commonwealth-approved Amendments for the years 1996-2000. In the reported years 1993/94 to 1995/96, the Salaries Head of Expenditure in the Commonwealth Agreement Budget was estimated using a Salary multiplier of 1.7 to cover Base Salaries, Direct Salary On Costs and Indirect Infrastructure Costs. This resulted in an overstatement of estimated Salaries expenditure of approximately .45 of Base Salaries, along with a corresponding understatement of estimated Other expenditure as the Indirect Infrastructure Cost component is reported back as Other. In 1997, the CRC Program Secretariat approved the amendment of the Commonwealth Agreement Budget Schedules for the years 1996/97 to 1999/2000 to obviate the miscalculation. In all years, Postgraduate Stipends and Consultants Fees are reported back as Other.

The Estimates for 1999/00 are not Board-approved estimates and are based on current income and expenditure determinations. A revised 1999/00 Budget will be submitted to the Commonwealth following allocations made at a Board meeting to be held in August 1999. Major in-kind resource allocations will also occur in association with the disbursement of these funds to the Parties.

Unexpended Balance

The amount of \$960,213 on hand consists of (i) \$640,283 Unexpended Research Advances to Parties and (ii) Funds at Bank \$319,930 which includes advance payments to the Centre and planned cash reserves for projects in 1999/00. The Unexpended Research Advances to Parties include an operational buffer but generally reflect delays in processing purchase orders and invoices.

Costing of In-Kind Contributions

The basis of institutional multipliers is as set out in Schedule 4 of the Commonwealth Agreement.

14. AUDIT

AUDITORS REPORT TO THE COOPERATIVE RESEARCH CENTRES SECRETARIAT, DEPARTMENT OF INDUSTRY, SCIENCE AND RESOURCES REPRESENTING THE COMMONWEALTH IN RESPECT OF

COOPERATIVE RESEARCH CENTRE FOR ECOLOGICALLY SUSTAINABLE DEVELOPMENT OF THE GREAT BARRIER REEF

FINANCIAL INFORMATION FOR THE YEAR ENDED 30 JUNE 1999

SCOPE

We have audited the financial information of the Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef as set out in Tables 1 to 3 of the Annual Report (being the tables showing in-kind and cash contributions for each party to the CRC, and cash expenditure) for the year ended 30 June 1999 as required by clause 14(1)(f) of the Commonwealth Agreement. The parties to the Cooperative Research Centre are responsible for the preparation and presentation of the financial information. We have conducted an independent audit of the financial information in order to express an opinion on it to the Commonwealth.

Our audit has been conducted in accordance with Australian Auditing Standards to provide reasonable assurance as to whether the financial information is free of material misstatement. Our procedures include examination, on a test basis, of evidence supporting the amounts and other disclosures in the financial information, and the evaluation of accounting policies and significant accounting estimates. These procedures have been undertaken to form an opinion as to whether in all material respects, the financial information is presented fairly in accordance with Australian accounting concepts and standards and requirements of the Commonwealth Agreement so as to present a view of the sources of funding and the application of funding of the Cooperative Research Centre For Ecologically Sustainable Development of the Great Barrier Reef and the application of which is consistent with our understanding of its financial activities during the year and its financial position.

While we have not performed any audit procedures upon the estimates for the next period and do not express any opinion thereon, we ascertained that they have been formally approved by the Board of Management as required under the Joint Venture Agreement.

AUDIT OPINION

In our opinion, the financial information presented in Tables 1 to 3 presents fairly the sources of funding, the application of funding and the financial position of the Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef for the year ended 30 June 1999 in accordance with Australian accounting concepts and applicable Accounting Standards, the CRC Secretariat's Guidelines for Auditors, and the requirements of the Commonwealth Agreement in terms of Clauses 4 (Contributions), 5(1), 5(2), 5(3) (Application of Grant and Contributions), 9(1), 9(5) (Intellectual Property) and 12(2) (Financial Provisions).

1. The multipliers adopted by the Centre to value in-kind contributions other than salary costs have a sound and reasonable basis and each partner's component of the Researcher's Contributions for the year under report has been provided at least to the value for that year committed in the Budget as specified in the Agreement, and the total value of all Contributions for the year under report equalled or exceeded the amount of grant paid during the year (not including advances) (Clause 4).

AUDIT

- The Researcher has used the Grant and the Researcher's Contributions for the Activities of the Centre and in my professional opinion there appears to be no material reporting of irregularities (Clause 5(1)).
- The Researcher's allocations of the budgetary resources between Heads of Expenditure has been higher than the allocation in the budget by \$100,000 or 20% (whichever is the greater amount) without prior approval by the Commonwealth in the following circumstances:

	Actual	Budget	Variance	Variance % of Budget
Total Other	\$4,748,000	\$3,622,000	\$1,126,000	31.09%

- Capital Items acquired from the Grant and Researcher's Contributions are vested as provided in the Joint Venture Agreement (Clause 5(3)).
- Intellectual Property in all Contract Material is vested as provided in the Joint Venture Agreement and no Intellectual Property has been assigned or licensed without the prior approval of the Commonwealth (Clause 9(1), 9(5)).
- Proper accounting standards and controls have been exercised in respect of the Grant and Researcher's Contributions and income and expenditure in relation to the Activities of the Centre have been recorded separately from other transactions of the Researcher (Clause 12(2)).

Pickard Associates

PICKARD ASSOCIATES



John Zabala

Dated: 8 September 1999

ABBREVIATIONS

List of Organisational Abbreviations

- AIMS** – Australian Institute of Marine Science
- AMCS** – Australian Marine Conservation Society
- AMPTO** – Association of Marine Park Tourism Operators
- AMSAT** – Australian Marine Science & Technology Ltd
- APPEA** – Australian Petroleum Production & Exploration Association
- B/HERT** – Business and Higher Education Round Table
- CALM** – Department of Conservation & Land Management
- COTS** – Crown-of-thorns starfish
- ERDC** – Energy Research & Development Corporation
- FRDC** – Fisheries Research & Development Corporation
- GBRMPA** – Great Barrier Reef Marine Park Authority
- ICRI** – International Coral Reef Initiative
- IGBP** – International Geosphere-Biosphere Programme
- IGBP-SARC** – Southeast Asia Regional Committee
- IUCN** – World Conservation Union
- JCU** – James Cook University
- LOICZ** – Land-Ocean Interactions in the Coastal Zone
- LTMP** – Long-Term Monitoring Program
- OUCH** – Order of Underwater Coral Heroes
- NOAA** – National Oceanic and Atmospheric Administration
- PADI** – Professional Association of Dive Instructors
- PCQ** – Ports Corporation of Queensland
- QCFO** – Queensland Commercial Fishermen’s Organisation
- QDNR** – Queensland Department of Natural Resources
- QDPI** – Queensland Department of Primary Industries
- QFMA** – Queensland Fisheries Management Authority
- QPWS** – Queensland Parks & Wildlife Service
- QTTT** – Queensland Tourist & Travel Corporation (now Tourism Queensland)
- ReefMAC** – Reef Line Fishing Management Advisory Committee
- RMRAAC** – Regional Marine Resource Advisory Committee
- SME’s** – Small to Medium Enterprises
- USGS** – United States Geological Survey

CONTACT DETAILS

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Engineering Program:

Prof Tom Hardy

Program Leader

Phone: 07 4781 4984

Email: thomas.hardy@jcu.edu.au

Education Program:

Prof Howard Choat

Program Leader

Phone: 07 4781 4345

Email: john.choat@jcu.edu.au

Extension and Communication Program:

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