

CROWN-OF-THORNS
MONITORING



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



ANNUAL REPORT 1997/98

MOORINGS



CORAL
BLEACHING



TOURISM

FISHING



*"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 sustainable
Reef-based industries and economic activity, with particular emphasis
on tourism and fishing, and providing an improved scientific basis
for Reef management and regulatory decision making*

AN UNINCORPORATED JOINT VENTURE BETWEEN



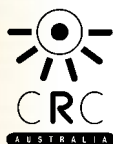
AMPTO Association of Marine Park
Tourism Operators



JAMES COOK UNIVERSITY



WITH THE



Cooperative
Research
Centres
Program

FOR FURTHER INFORMATION PLEASE CONTACT THE FOLLOWING:

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"I believe that the work of the Cooperative Research Centre can make a very substantial contribution towards the growth of environmental knowledge and capacity to achieve good environmental outcomes."

*Duncan Kerr
Federal Shadow Minister for the Environment
March 1998*

"Queensland has a particularly significant responsibility to the world community to care for the world's largest living organism. The scientific community along with government must shoulder this responsibility and the sharing of up to date information, as allowed through the CRC website, both facilitates and enhances this management."

*Peter Beattie
State Leader of the Opposition
December 1997*

"Benefits from the functioning CRCs such as yours are considerable and I appreciate being kept up to date on the role you are playing in our community."

*Senator David Brownhill
Deputy Leader of the National Party in the Senate
October 1997*

"I note with interest the applications towards which the CRC has made a contribution and look forward to future activities which will further enhance the understanding and application of ecologically sustainable management of this significant natural area."

*Brian Littleproud
Minister for Environment, Qld
October 1997*

"I would like to take this opportunity to congratulate you for the excellent role your CRC has carried out since its formation in 1993...I look forward to continuing our involvement in collaborative research."

*Trevor Perrett
Minister for Primary Industries, Qld
October 1997*

"The Great Barrier Reef is a national treasure, bringing beauty and tourism dollars to the country. Research organisations such as yours are indispensable to the continued use, and not abuse, of this natural wonder."

*Andrew Southcott
Member for Boothby, SA
September 1997*

"The CRC's work aimed at increasing opportunities for sustainable development of the Reef is commendable."

*Ian Sinclair
Member for New England, NSW
September 1997*

"The Reef forms an integral part of Queensland's tourism industry and the CRC Reef Research Centre will certainly play an important role in fostering environmental development and supporting high quality scientific and technological research."

*Bruce Davidson
Minister for Tourism, Small Business & Industry, Qld
September 1997*

1. CHAIRMAN'S REPORT

CRCs - PROFITABLE LINKS BETWEEN RESEARCH, PUBLIC POLICY AND INDUSTRY

A criticism often levelled at Australian scientific research is that our own ideas and inventions developed here are either lost to overseas interests or not picked up by industry or government sectors.

The national CRC Program is a unique system specifically designed to tackle these problems directly, and it has done so with tremendous success. CRCs are successfully bringing research and industry together in creative and cost-effective collaborations to develop new products and opportunities of immense value. Importantly, the CRC Program, by providing individual CRCs with the equity to enable them to retain ownership of intellectual property, ensures that the rewards for these developments are returned to Australia. Even in the short time that it has been in operation, the CRC Program is creating a major change in Australia's research culture. The Program has been acclaimed in both Australia and overseas, and is now being emulated by other countries.

The CRC Reef Research Centre, like Australia's other 67 CRCs, involves industry and management agencies directly in its research program. It allows industry demands, policy needs and research capabilities to be closely linked, so that research targets the problems and challenges relevant to those needs.



*Sir Sydney Williams,
Centre Chairman
of the Board*

Photo courtesy
Cairns Post

Employers and government have expressed the need for graduates experienced in industry. The unique educational environment created in our CRC is producing highly trained and experienced graduates, with many now obtaining employment in industry and in natural resource management agencies. Our Centre has exposed researchers, including postgraduate students, to interaction at all levels with Reef tourism, fishing and shipping industries, from product development through to the development of new public policy.

In the last two years the CRC Reef Research Centre has listed more than 40 significant achievements as a result of our research. It demonstrates an array of benefits to our industry partner organisations and to various government Reef and coastal management agencies. The list, being added to each month, has been sent to all Australian Members of Parliament and most Queensland MPs to make them aware of our progress. It has helped many Reef tourism operators better understand how a part of their environmental management charges is being used. It has also helped our staff appreciate scientific achievements in a range of disciplines outside their area of expertise.

The CRC Reef Research Centre is a producer of new knowledge through our research projects. We build this new knowledge into our existing knowledge base and then repackage it for our specific clients. We deliver our products to end users through publications, in various media, at conferences, through short courses, advisory committees and public relations that inform and sensitise people to the impacts of their activities in the Great Barrier Reef World Heritage Area.

Again, I would like to express a special thanks to our inaugural Director, Professor Chris Crossland, who recently resigned to take up a new position overseas.

**Sir Sydney Williams
Chairman**

2. DIRECTOR'S REPORT

After five years, the Centre has matured into a productive enterprise with a wide range of activities. Important scientific outcomes have been generated and users have been closely involved in the application of the science. The Centre has contributed to the development of significant policies nationally and internationally. An internal review of the strategic direction of the Centre has been done to lay the foundation for a new Centre beyond 2000. Preparations have been made for the external major review of the Centre in August/September 1998. There has been close collaboration with industry and management partners to meet their needs. Scientific information was delivered across a wide range of areas crucial to wise use and management of the Great Barrier Reef, through all of the Centre's activities - research, education and training, and communication. Importantly, the collaboration between industry, researchers and management across science disciplines underpins this success. More and more, the seeds of research knowledge are bearing fruit as input into policy, legislative and industry development. The Centre has established a strong reputation in assisting stakeholders identify and solve problems concerning sustainable use of the Great Barrier Reef World Heritage Area.



Simon Woodley,
Director

Photo courtesy JCU

Much of the success of the Centre can be attributed to the foresight, leadership and energy of the foundation Director, Prof Chris Crossland. Prof Crossland left the Centre in June to take up an appointment with the Land-Ocean Interactions in the Coastal Zone Project Core Office. The following report has been contributed by Prof Crossland:



Professor
Chris Crossland,
former Director

Photo by
Don Alcock

"This year, senior Centre staff contributed to the formation of strategic national science policy. Professor Helene Marsh and a number of our researchers made a major contribution to the development of ethical guidelines and principles for the conduct of research in protected and environmentally sensitive areas. The Fenner Conference on the Environment was held at the Australian Academy of Science to focus on assessing and approving research in sensitive environments, and ensuring research meets ethical standards. Professor Marsh's work in marine conservation was also recognised by her winning a prestigious Pew Fellowship from the United States. The US\$150,000 award was one of only three given outside the US. Darren Oemcke's PhD work on ballast water has provided information to national and international policy developments for the shipping and transport arena. Dr Terry Done was selected to represent the Centre in making a presentation to the Prime Minister's Science and Engineering Council on how marine science is supporting sustainable use of the Great Barrier Reef. The Prime Minister, Cabinet Ministers and Chief Scientist all heard updates on how marine science is responding to current issues. Other CRC Board members are actively involved in policy issues, including Dr Russell Reichelt who is taking a lead role in the development of the national Marine Science and Technology Plan.

A number of databases have been established to assist in monitoring the health of the Reef, provide decision support for resource managers and establish indicators to measure change for scientists, resource managers and community groups. There are now excellent integrated computer databases with our partner organisations. They include long term monitoring data of the Reef's physical and biological characteristics; sea surface temperature data linked to climatic and oceanographic changes; Crown-of-thorns surveys data tracking past and present outbreaks; social survey data that measure public perceptions to zoning; and visitor survey data to help the tourist industry better understand national and international markets. Much of our strategic information presented in the 1996 Great Barrier Reef: Science, Use and Management Conference, has provided the basis for GBRMPA's recent State of the Reef Report.

Communication and information transfer continues to be a major function of our programs. Each research task is allocated a management or industry associate to help oversee the task and ensure it meets its goals, particularly in the application of results. Communication training, media presentations, public displays, plain English summaries, informal meetings, electronic publishing and user workshops are encouraged with all researchers in addition to traditional scientific publications and conferences. Increasingly, scientists are becoming better public communicators and multi-skilled to negotiate outcomes of their work in policy and industry applications.

Equally significant are the close relationships built between science and industry, management and media in projecting information about GBR issues to all stakeholder interest levels. The effort in meeting this challenge is a particular mark of CRC Reef. All staff work hard to project our own science questions and outcomes to an array of interest groups and stakeholders, and maintain a key role in projection of the CRC philosophy and values. Our communication strategy and efforts are being effected through work with the CRC Association at national and international levels, and with industry and management at local and regional levels.

The Centre continued to receive high levels of cash and in-kind support from Reef industries. Part of the Environmental Management Charge, sourced by visitors to tourism operators in the Marine Park, is directed to Centre research, and accounted for \$945,000, or 24% of our annual budget. Generous support for researchers and students to use tourist vessels, island resort accommodation, commercial fishing boats and other industry facilities was valued at about \$539,000. A significant grant of \$304,488 from the FRDC was received this year for the Effects of Line Fishing Project. This culture of collaboration has always been a vital and underlying characteristic of our Centre and we greatly value the increasing and strong sectoral – and personal – linkages that it has forged.

A number of postgraduate students are now qualifying and taking up employment in Australia and overseas. Initiatives in the Centre's Education Program have seen the introduction of an industry placement program for PhD candidates, a larger number of Honours and Masters level students being supported by Centre resources and grants, and new student training courses for employment-related skills. 84 tertiary students were affiliated with the Centre's research and education programs. Our strong commitment to training has major spin-offs in terms of science and attitudinal approaches by graduates. This is reflected in their subsequent employment areas and involvement in practical issues contributing to national and international policy, reef management and industry interests.

The Centre has continuing challenges for the future. Past scientific priorities, shaped to meet medium-term issues perceived by management and industry, need a responsive approach in the design of our new Strategic Plan. This Plan will be a crucial part of the projection of the Centre into the future. The Fifth Year review of the Centre and an application to extend the Centre beyond 2000 as part of the CRC Program will be major milestones. Building wider collaborative links across research disciplines and with industry and management agencies are continuing endeavours for which the Centre has a good track-record and deserved reputation.

As I farewell the Centre to take up a new overseas position, I would like to express my gratitude to the hard work, dedication and innovation of so many Australian scientists working with business leaders and resource managers in the wise use of the Great Barrier Reef. The CRC Reef Research Centre has achieved a significant record to date and I'm certain it will continue to perform well in the future."

My thanks go to Prof Crossland and his dedicated and efficient staff for their efforts in creating a productive and innovative Centre. My task is to lead the Centre through the Fifth Year Review and renewal application; to ensure the continued production of high quality, relevant research results and outcomes and to support the effective transfer of results to industry, management and other stakeholders.

Simon Woodley
Director

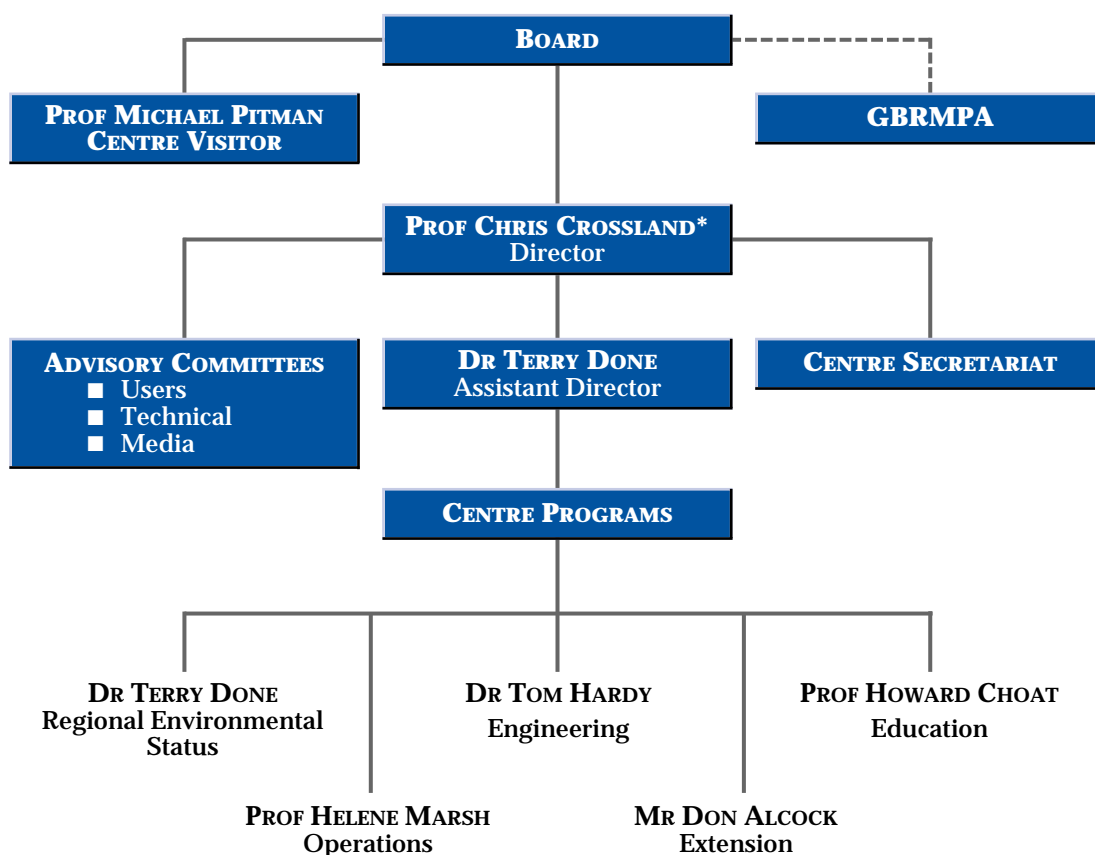
3. STRUCTURE AND MANAGEMENT

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 Committees 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.



*Prof Crossland resigned 24 June 1998

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

STRUCTURE AND MANAGEMENT CONT'D

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. Representative and working groups of the Board were convened on several occasions to plan strategic direction beyond 2000.

The Board membership was:

Sir Sydney Williams	Chair
Mr Mike Burgess	AMPTO, Deputy Chair (to 1 March 1998)
Sir Sydney Schubert	AMPTO, Deputy Chair (from 1 March 1998)
Mr Tony Briggs	AMPTO
Mr David Windsor	AMPTO
Dr Russell Reichelt	AIMS
Dr Ian McPhail	GBRMPA
Professor Peter Arlett	JCU (to 22 May 1998)
Professor Norman Palmer	JCU (from 22 May 1998)
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 in 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, three Advisory Groups; the Users Advisory Group, the Technical Advisory Group and the Media Advisory Group.

The inaugural Director, Professor Chris Crossland, resigned with effect from 24 June 1998 to take up a position as Executive Officer, Land Ocean Interaction in the Coastal Zone (LOICZ) based in Holland.

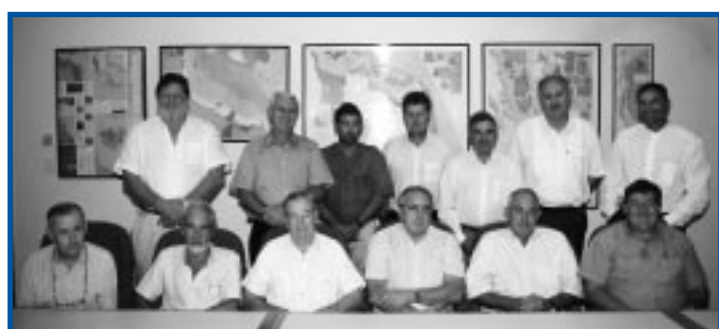
Dr Terry Done was appointed Acting Director until 30 June 1998. Mr Simon Woodley will take up the position as Director for one year as from 1 July 1998.

Recruitment of a long-term Director will commence in July 1998.

The **Assistant Director** advises the Director on the development and direction of the scientific research programs and has a major role in external advisory forums of research application.

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. The Group has met on six occasions and membership in this period was:

Professor Chris Crossland	Chair, CRC (to 24 June 1998)
Dr Terry Done	AIMS, Leader Program 1 (Chair from 22 April 1998)
Professor Helene Marsh	JCU, Leader Program 2
Dr Tom Hardy	JCU, Leader Program 3
Mr Don Alcock	CRC, Leader Program 4



Members of the Board meet quarterly to determine the Centre's strategic directions, financial arrangements and research progress.

Photo by
Don Alcock

STRUCTURE AND MANAGEMENT CONT'D

Professor Howard Choat	JCU, Leader Program 5
Mr David Windsor	AMPTO
Ms Michaela Dommissie	AIMS, Student Representative (to 27 May 1998)
Mr David Welch	JCU, Student Representative (from 27 May 1998)
Mr Darren Oemcke	JCU, Student Representative (from 27 May 1998)

The **Users Advisory Group** considers issues and knowledge required by major user groups, reviews research outputs and assists in implementation towards “effective use” of research. The role and structure of the Group was reviewed during 1997/8 to broaden involvement in the process of selection of tasks and the assessment of opportunity for research products and as a sounding board for issues. The Board agreed to a new Users Advisory Group structure based on a discussion paper written in September. The Group met on one occasion and membership in this period included:

Professor Chris Crossland	Chair, CRC (to 24 June 1998)
Mr David Windsor	AMPTO
Mr John Hicks	DoE
Dr Jamie Oliver	GBRMPA
Dr Zena Dinesen	GBRMPA
Mr David Lloyd	GBRMPA
Dr Robert Coles	QDPI
Ms Melita Samoilys	QDPI

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 one occasion and membership in this period included:

Professor Chris Crossland	Chair, CRC (to 24 June 1998)
Mr Alan Turnbull	SUNFISH
Mr Eddie Hegerl	AMCS
Mr John Tanzer	GBRMPA
Mr Pat Appleton	QFMA
Mr Martin Breen	QCFO

4. COOPERATIVE LINKAGES

The Centre continues to build cooperative links with industry, reef managers, policy makers, researchers and community groups in Australia and overseas. Processes to develop new research portfolios, bring in new scientists and associates and revise task operations during our half-yearly reviews have substantially improved internal links. We are also increasing our links in the area of science communication, through organisations such as the science communicators network. For further information see Chapter 12 (Performance Indicators).

4.1 INTERNAL LINKS

Effective links with different organisations and key individuals has resulted in strong internal cooperation within the Centre and has enhanced ownership of the Centre among all users. We have further harnessed expertise, information and experience in the delivery of research and contributed to strategic development, planning and industry practices (e.g. Cairns sector Reef Tourism - RT2005) and management agencies (e.g. management plans developed by GBRMPA and Queensland Department of Environment).



One advantage is that the Centre is geographically focussed in Townsville, making communication between most personnel simple. Research staff, Management Associates, administrators, and industry groups can meet easily for seminars, workshops, committee meetings and social events.

Fisheries links to QCFO, SUNFISH and QFMA have continued this year. Alliances were forged with other environmental CRCs, such as Sustainable Tourism, where there is a capacity to apply our collective specialist skills to Reef issues. Association partnership arrangements are being pursued to formally link the Centre into a number of key agencies and peak bodies

which have major or long-standing cooperative associations with the Centre. Negotiations are being made with several national and international agencies in the Centre's planning beyond the year 2000.

Internal links were facilitated by:

- weekly email news service to all research staff and students;
- bi-monthly newsletter *CRC Reef Research News*;
- regular updates on a website;
- half-yearly research reviews for all staff;
- regular social meetings;
- lunchtime seminar series;
- regular staff meetings and workshops between core partner staff;
- contributions to *Reef Research* – GBRMPA's Research & Monitoring newsletter;
- distributing 'Exploring Reef Science' fact sheets.

Peak industry groups and management agencies are a focus for much of our collaborative activities. Through these, the Centre has developed close working relationships with many individual operators - mostly small to medium business enterprises (SMEs). The personal efforts of staff – at Board, advisory group, management associate and researcher levels – is the glue that cements close working relationships between our core and associate partners. Without these developments our research effectiveness would be lessened and the value-adding of the Centre partnerships would be diminished.

4.2 EXTERNAL LINKS

Briefings on the application of Centre and CRC Program research were given to Federal and State parliamentarians, senior policy makers and industry leaders. In October, several Federal Members and senior portfolio administrators were briefed by the Director on Australia's marine

CRC Research
Affiliates presented
to Whitsunday
tourism operators.

From left:
Sir Sydney Williams,
Brampton Island
Resort, Club Med
Lindeman Resort,
Hayman Island
Resort, FantaSea
Cruises and
Chris Crossland.

Photo courtesy
Whitsunday Times

potential in a presentation entitled *Oceans of Wealth*. Plans are underway to increase parliamentary and industry briefings on key science issues in association with other CRCs.

A number of regional workshops have strengthened linkages with client groups during the year. For example, tourism industry workshops to present a visitor database on different domestic, international and special interest visitor groups to the Reef have linked more SMEs to the Centre. Briefings to marine engineering consultants and large operators were made in Cairns, Port Douglas, Townsville and Airlie Beach to develop design guidelines for offshore pontoons. Similarly, general science briefings were made to regional advisory groups and state management agencies in Cairns, Cooktown, Townsville, Airlie Beach, Rockhampton and Brisbane, cementing stronger professional working relationships.

The Centre provides information and products to more than 1000 SMEs in tourism, fishing and engineering, mostly through peak associations such as AMPTO and QCFO. Some 44 SMEs were directly involved in our research with wide support in field work given by operators: for example, tourist operators in COTSWATCH, consultant engineers and marine surveyors in engineering guideline development. Approximately 20 operators in the commercial line fishing fleet directly helped researchers in the Effects of Line Fishing experiment.

The Centre continued to receive strong operational support from industry in the form of logistics and personnel. In-kind contributions by SME tourism operators was valued at more than \$75,000. The commercial fishing industry also made a substantial contribution to the Centre through cash (QFMA) and in-kind support from the FRDC, and commercial fishing operators shiptime. Support was given to students and researchers to use tourism vessels, commercial fishing vessels, accommodation and equipment for their field work.

To recognise significant collaboration and support by private companies to the Centre research, *Research Affiliate* certificates were presented to one Port Douglas company and four Whitsunday companies.

Undersea Explorer received a *Research Affiliate* award during an industry function at Port Douglas in November; Brampton Island Resort, Club Med Lindeman, Hayman Island Resort and FantaSea Cruises received *Research Affiliate* awards during an industry function at Airlie Beach in August. All certificates were presented by the Chairman, Sir Sydney Williams.

One problem faced by the Centre was a relatively high turnover of CRC Management Associate staff, especially within GBRMPA and the Department of Environment. Organisational restructures, new committee memberships and staff resignations have affected some project teams. Centre staff briefed incoming management staff about many aspects of the Centre's research history but this effort will need to be expanded in 1998/9.

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

Australian Universities & TAFE Colleges

Australian National University
James Cook University
Newcastle University
Southern Cross University
University of Adelaide
University of New England
University of Melbourne
University of New South Wales
Griffith University

University of Queensland
University of Sydney
University of Tasmania
University of Western Australia
RMIT, Melbourne
Central Queensland University
Curtin University
Barrier Reef Institute of TAFE (6 colleges)
Far North Queensland TAFE (6 colleges)



Queensland
dive instructors
are using
Centre research
findings in
diver training
courses.

Photo courtesy
Mike Ball Dive
Expeditions

COOPERATIVE LINKAGES CONT'D

CRCs and Australian Research Organisations

Australian Geological Survey Organisation	AIMS
CRC for the Antarctic and Southern Ocean Environment	CSIRO Land & Water
CRC for Aquaculture	CSIRO Marine Research, Hobart
CRC for Sustainable Sugar Production	CSIRO Tropical Agriculture
CRC for Sustainable Tourism	CSIRO Wildlife & Ecology
CRC for Tropical Rainforest Ecology & Management	Lizard Island Research Station
CRC for the Sustainable Development of Tropical Savannas	One Tree Island Research Station
	Australian Nuclear Science & Technology Organisation

State Government Departments & Corporations

Bureau of Sugar Experimental Stations	Queensland Fishing & Boating Patrol
Ports Corporation of Queensland	Queensland Tourism and Travel Corporation
Queensland Sugar Corporation	Queensland Department of Economic Development and Trade
Queensland Department of Primary Industries	Department of Main Roads
Queensland Department of Environment	South Australian Research & Development Institute
Queensland Department of Natural Resources	Western Australian Department of Conservation and Land Management
Queensland Department of Tourism, Industry & Small Business	NSW Fisheries Institute
Queensland Fisheries Management Authority	

Commonwealth Departments and corporations

Australian Bureau of Agricultural and Resource Economics	Department of Industry Science & Tourism
Australian Centre for International Agricultural Research	Energy Research & Development Corporation
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 Environment Sport & Territories	Commonwealth Department of Tourism

Local Government & Consultative Organisations

Cairns City Council	Townsville Enterprise
Gladstone Port Authority	Townsville Port Authority
Cairns Port Authority	Trinity Inlet Management Program
Herbert River Catchment Management Ctre	Rockhampton City Council

Community Organisations

Alliance for Sustainable Tourism	Zonal Advisory Committees
Australian Coral Reef Society	Cleveland Bay Consortium
Australian Marine Science Association	Surf Life Saving, Queensland
Ecotourism Association	Low Isles Preservation Society
Federation of Australian Science and Technology Societies	North Queensland Conservation Council
	Australian Marine Conservation Society

COOPERATIVE LINKAGES CONT'D

Regional Marine Resource Advisory
Committees (Cooktown, Port Douglas,
Townsville, Cairns, Airlie Beach,
Rockhampton)
Palm Island Community

Private Companies

Captain Cook Cruises
FantaSea Cruises
Frankland Island Tours
Great Adventures
Hamilton Island
Hayman Island Resort
Rumrunner
Ocean Free
P & O Cruises
Pure Pleasure Cruises
Sun Metals
Qantas Australian Resorts
Pacific Marine Group
Prominent & Fluid Controls Pty Ltd

QEST Consultants
Robe River Iron, WA
SEA Consultants
Watertech Engineering Pty Ltd
Woodside Petroleum WA
Sinclair Knight Merz
Telecasters North Queensland (Channel 10)
Powerlink Pty Ltd
Prosail
Whitsunday All Over Cruises
Whitsunday Diver
Brampton Island Resort

Industry Associations

Queensland Canegrowers
APPEA
Association of Environmental Engineers
Queensland Charter Vessels Association
AMPTO

Queensland Wilderness Society
Marine Science Teachers Association
SUNFISH
OUCH, Whitsunday

Quicksilver Connections
Quicksilver Diving Services
Club Med Lindeman Island Resort
Sunlover Cruises
Undersea Explorer
Bob Littler Agencies
BP Australia
Cape Flattery Silica Mines
Mount Isa Mines
Dames & Moore Consultants
GME Electronics
Kinhill Engineers Pty Ltd
Kinhill Riedel & Byrne
Memtec
Digital Dimensions
BHP
Sea Research
McLeans Roylen Cruises
G.A. Glanville & Co
Stewart Marine Design
UVS Ultraviolet Pty Ltd
Seatrek Cruises
Renbrent Charters Pty Ltd
Illusions
M.V. Jillian Fishing Charters
Reef Biosearch



*Large tourist
operators
assisted
researchers and
students
undertake field
work aboard
their vessels and
pontoons.*

Photo courtesy
FantaSea Cruises

4.3 INTERNATIONAL LINKS

The Centre continued to develop international links with an emphasis on South East Asia. Staff have been involved with presenting marine habitat monitoring training advice and courses (Indonesia, Thailand) and attracting full-fee paying students to our member universities (Korea, USA). The CRC Reef model was promoted to several environmental research and management agencies (Korea, United Kingdom, USA, Indonesia) and follow-up action is planned to continue providing advice and support.

Several overseas collaborative links were strengthened. One researcher, Dr Graeme Inglis, visited the Department of Recreation, Parks and Tourism Sciences at Texas A & M University to investigate social science in park planning and environmental impacts. He also visited the Marine Park Unit at the Malaysian Department of Fisheries to initiate collaborative projects on tourism impact in Malaysian marine parks. A visitor survey was initiated to compare tourist expectations and satisfaction levels with similar GBR research. Dr Inglis worked with a former CRC Chief Investigator and postgraduate student on these projects.

CRC researchers, Prof Philip Pearce and Dr Gianna Moscardo worked with USA tourism research centres at Purdue University and the Department of Forestry and Natural Resource Management to obtain major data sets of overseas visitors to the GBR region. Market numbers were obtained for UK, German, Japanese and USA visitors.

CRC Extension Manager, Don Alcock, visited the United Kingdom to establish collaborative links with English Nature and the Natural Resource Environment Council. Both UK agencies are considering establishing a cooperative research structure similar to the Australian CRC model. He also advised the BBC Natural History Unit about filming in the GBR for a major international documentary called 'The Blue Planet'.

CRC tourism researcher, Dr Edward Kim, continued to build links with Honan University in South Korea, encouraging Korean students to study in north Queensland. He has been invited to join an APEC Youth Science Festival in Seoul to promote GBR study opportunities next year.

Centre staff provided lectures and facilitated of case studies in coastal management training courses undertaken at JCU on behalf of the Government of Indonesia. The Director, Prof Chris Crossland, provided technical advice to the government of Indonesia on the design of a major coral reef rehabilitation and management program (COREMAP).

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 9 and 10. Internationally, the Centre was associated with:

Organisations and Programs

Food and Agriculture Organization
IBM International Foundation, USA
International Panel on Climate Change
International Union of Biological Sciences
Pacific Asia Travel Association Foundation
US Geological Survey (Sirenia Project), USA
Land-Ocean Interactions in the Coastal Zone,
The Netherlands
ROPAC
TOPEX/Poseidon, NASA
TROPICS
World Conservation Monitoring Centre

English Nature – Marine Branch, UK
Natural Environment Research Cncl, UK
BBC Natural History Unit, UK
USGS (coral program)
ORSTOM, Noumea
IGBP-SARC, SE Asia
KEPCO Carbon Budget Study, Japan
The Cnidaria Research Programme,
Natural History Museum, London
International Centre for Social and
Policy Research
International Maritime Organisation

Universities and research institutions

CROBE, French Polynesia
International Centre for Computational
Hydraulics, Denmark
Honan University, Korea
Hasanuddin University, Ujung Pandang,
Sulawesi, Indonesia
Instituto de Investigaciones Marinas y
Costeras, Santa Marta, Colombia
Universtitaet Oldenburg, Germany
Institute of Nuclear & Geological Science,
New Zealand
Jemboa University, Indonesia
North Carolina State University, USA
Purdue University, USA
Centre for Marine Tropical Ecology (ZMT),
Germany
University of the Philippines

Scottish Universities Research & Reactor Centre, UK
Kasetsart University, Bangkok
Texas A & M University, USA
University of East Anglia, UK
University of Genova, Italy
University of Hawaii
University of Perpignan, France
University of South Carolina, USA
University of Waikato, New Zealand
Virginia Polytechnic, USA
Vrije University, Netherlands
Xi'an Foreign Language University, China
University of Maryland, USA
Lulea University of Technology, Sweden
Department of Fisheries, Malaysia
University of Michigan
University of New York, Buffalo

4.4 EXAMPLES OF CRC BOARD & STAFF COMMITTEE MEMBERSHIP OF KEY POLICY, INDUSTRY AND TRAINING GROUPS

Prof Chris Crossland

- CRC Association Committee
- Socio-Cultural and Economic Research Advisory Committee
- State of the Great Barrier Reef World Heritage Area Steering Committee
- Effects of Line Fishing Steering Committee
- Crown-of-thorns Starfish Research Committee
- Coastal Marine Tourism International

Mr Alan Turnbull

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

Mr Tony Briggs

- Queensland Transport Marine Board

Mr Ted Loveday

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

Dr Russell Reichelt

- Fisheries Research and Development Corporation (Chair)
- Great Barrier Reef Consultative Committee
- Board of CRC Aquaculture
- Heads Of Marine Agencies
- AIMS-JCU-GBRMPA Liaison Committee
- CSIRO Marine Sector Advisory Committee
- INTROMARC

Dr Terry Done

- SCOR Working Group 104
- International Union of Biological Sciences
- Crown-of-thorns Starfish Research Committee
- Atmosphere & Ocean Science Committee, Australian Academy of Science

Prof Peter Arlett

- Boards of CRCs (Tropical Rainforest Ecology & Management, Aquaculture, Sustainable Tourism, Sustainable Sugar Production, Sustainable Development of Tropical Savannas)
- TAFE Council (Deputy Chair)
- NORQEB (Deputy Chair)

Mr Mike Burgess

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

Dr Barry Pollock

- Fisheries Management Committee, Standing Committee on Fisheries
- Crab Management Advisory Committee

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
- Queensland Fisheries Management Authority
- Australian Science, Technology and Engineering Council
- Dugong Advisory Group
- Dugong Scientific Advisory Group

Prof Philip Pearce

- World Tourism Organisation
- Asia Pacific Tourism Association (Vice-President to September 1997)
- Coastal Marine Tourism International

Dr Robert Coles

- Trinity Inlet Management Program Technical Committee (Chair)
- Zonal Advisory Environmental Committee (Chair)
- Trinity Inlet Management Program Review Committee (Chair)
- Ports Corporation of Queensland Dredging Advisory Committee
- DPA Committee
- FIRDC Seagrass Review Committee

Dr Bruce Mapstone

- ReefMAC
- Regional Marine Resource Advisory Committee, Townsville
- IUCN Working Group on Design & Selection of Protected Areas
- QFMA Mackerel Stock Assessment Group

Dr Miles Furnas

- Technical Sub-Committee on Downstream Effects of Agricultural Practice

Dr Gregg Brunskill

- Technical Advisory Panel for DNR Water Infrastructure Planning
- Technical Advisory Group for the Cardwell-Hinchinbrook Regional Management Plan

Dr Janice Lough

- AAS CLIVAR Sub-Committee (climate variability)

Dr Garry Russ

- QFMA Mackerel Stock Assessment Group
- GBRMPA Representative Protected Areas Committee

Mr John Robertson

- REEFMAC
- Queensland Fishing Industry Research Advisory Committee
- Recreational Fishing Information Coordination 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.

This year was one of the most significant for the Great Barrier Reef in recent decades, and a momentous one for this Program. Not unexpectedly (based on our previous work) Crown-of-thorns starfish continued their upward trend in large sections of the Reef. However, contrary to what is predicted for an El Niño year in Australia, this was also the year of the worst climate-related coral deaths on record, as anomalous floods, calm conditions and high sea temperatures bleached corals over a significant section of the Great Barrier Reef. Similar summer-time bleaching was reported at

coral reefs throughout the Indian and Pacific Oceans. The Program provided GBRMPA with most of the documentation and analysis of the early months of this event, providing a strong information base for media coverage and advice to government. Without the contributions of people and resources from this Program, the capacity of researchers to respond to this remarkable phenomenon would have been extremely limited.

This year also saw important research milestones passed, and advances to better integrate projects to address key issues: quantifying the risk of deleterious flood plumes reaching coral reefs at different distances from rivers and from land; evaluating the utility for fisheries management and representative area planning of connectivity and source-sink concepts for stock replenishments; and providing a regional typology for the Great Barrier Reef as a unifying basis for research and management.



Centre researchers monitored extensive areas of coral 'bleaching' that occurred on many inner and mid-shelf reefs.

Photo by
Andreas Wagner

Highlights included publication of peer reviewed papers on key issues such as:

- conservation values for coral reefs (Task 1.4.1)
- ecological performance indices for multiple use marine ecosystems
- the limited ecological impact of sediments carried by rivers into coastal seas (Tasks 1.3.1 and 1.5.1)
- support for representative area planning through predictive models of benthic composition
- recent history of coral bleaching
- representation on local scientific advisory committees and a number of Australian, international and global working groups for marine conservation and management (all Chief Investigators)
- recognition of the Program as a resource for local and global communities
- commissioning of biological surveys for GBRMPA in support of planning (Task 1.4.2)
- establishment of reef monitoring sites for the aboriginal community on Palm Island
- collaboration with community conservation groups in monitoring coral bleaching
- working with tourism industry on a marine stinger project (Task 1.7.1)

5.1 INPUTS AND IMPACTS

(Dr Miles Furnas, AIMS)

The health, productivity and amenity value of coral reefs and other ecosystem types in the Great Barrier Reef World Heritage Area (GBRWA) is affected in a variety of ways by the quality of the water in which they exist and the occurrence of extreme events (cyclones, floods, high or low



CRC researcher
Dr Miles Furnas
is using river
loggers to monitor
sediment and
nutrient inputs
from rivers to
the Reef region.

Photo courtesy
AIMS

temperatures), pests or disease (e.g. Crown-of thorns-starfish, coral eating snails; microbial infections). The Long Term Monitoring task published a report covering 1992 to 1997 and showed a general improvement in reef condition in all GBR sectors except some recently affected by Crown-of-thorns starfish and no declines attributable to water quality or disease. There was no evidence of systemic decline in water quality, but improved documentation and understanding of regional variability and the relative importance of land runoff versus autogenous sources of nitrogen and internal cycling of nitrogen and phosphorous (Progress in this task was aided by advances by two post-graduate students nearing the end of their studies, but seriously compromised by the prolonged illness of key senior scientist Alan Mitchell). The Cyclone Hindcasting task was completed with the publication of an atlas of cyclone paths and statistics. A network of continually recording thermometers along and across the Reef provided critical records of distribution and duration of temperatures $>30^{\circ}\text{C}$ that correlated with the distribution of coral bleaching on the Reef.

5.2 HYDRODYNAMICS AND DISPERSAL

(Dr Lance Bode, JCU)

A new task 'Connectivity and replenishment' was established to determine the extent to which fisheries and protected area management decisions in the GBR context can realistically be based on a dominant paradigm that views habitats such as coral reefs as interconnected 'sources' and 'sinks'. It uses hydrodynamic models, risk theory and decision theory to evaluate how good fish refuges (green zones) need to be to affect replenishment and fish recruitment to other reefs. The models, developed and refined in the first four years of the Centre, are driven by meteorological and tidal records for the last 30 breeding seasons (i.e. summers). They will use a statistical analysis of a >10 year continuous CRC-supported AIMS data set for the East Australian Current to investigate the influence of this major oceanographic force. They also build in some 'biology' about the location and timing of spawning for their 'virtual fish'.

5.3 SEDIMENT HISTORY AND ACCUMULATION

(Dr Ken Woolfe, JCU)

A key issue for this Project is the possible deterioration of inshore habitats of the GBR as a result of agriculture and urban development on the mainland. Runoff from land carries increased sediments, increased nutrients and, possibly, toxic substances. This project has shown that nearly all of the river mud from the last 6,000 years is trapped in the inner shelf, protected embayments and mangrove regions of the Great Barrier Reef Lagoon. It found, in different parts of single embayments, evidence for both declining and increasing river mud accumulation over the last century, indicating that sediment accumulation is focused in very small areas. It found that little or no recent river mud is deposited in the mid and outer reef areas. In some places where mud does accumulate on the surface of the mangrove mudbanks, some trace elements (Cd, Hg, As, U) are enhanced, and this is related to agricultural usage of phosphatic fertilizer and mercury-containing fungicides in the sugar cane industry. These elements have increased 2-5 times background since 1900. No trace was found of organic pesticides in any marine mud sample.

Many 'turbid coastal reefs' exist in shallow water within ten meters from open sandy beaches, their short term survival due to a combination of shade-adapted corals and energy subsidies (i.e. sediments removed regularly by waves and currents). It is well known, however that hyposaline flood plumes, regardless of sediments, nutrients and toxins, can cause major coral kills on these and 'true' reefs further offshore. A new integrative task is using 'flood markers' (luminescent lines in coral skeletons) to reconstruct when and how far flood plumes penetrated into the GBR over the last 30 years. These maps of river influence will be matched against those predicted in the flood plume simulation task and the results used to define exceedance maps for key salinity/duration thresholds.

5.4 LIVING SYSTEM RESPONSE

(Dr Rob Coles, DPI)

Researchers played key roles as providers of information and analyses to users while progressing long-term strategic research. Coral reef assessments were conducted for GBRMPA at Whitsunday Islands and Shoalwater Bay to assist development of management plans. The studies influenced the plan and also led to innovations in the use of data from inventory and rapid ecological assessments to assign indices of 'coral reef conservation value' based on uniqueness, diversity, age and condition of the coral communities. Inventories of soft coral and algal communities on coral reefs distinguished several distinctive 'nearshore' and 'offshore' community types. The soft coral data set was used as a case study to develop powerful statistical approaches to predict community types by gross habitat characteristics, a useful skill for researchers to aid managers by predicting potential representative areas and boundaries of homogeneous bioregions.

The coral reef group performed a vital response role in relation to the major bleaching event of 1998. In collaboration with GBRMPA aerial surveys, they did ground truth validations over large areas and, at one key site, at monthly intervals. Their data indicate major coral mortality has followed. They also indicated the likelihood of increased frequency of mass bleaching events under global warming scenarios.



The Seagrass Group completed important work in support of dugong management plans and resource mapping of the Great Barrier Reef. Their research revealed dugongs in southern habitats with high tidal range can be seriously affected because their seagrass food resource is limited by the tides to a narrow depth range. Major deepwater surveys in the southern section of the GBR discovered very limited seagrass development over large areas due to strong bottom current stresses and absence of suitable sediments. A PhD study nearing completion is showing differences in recovery potential among seagrass species related to reproduction, seed banks and nutrient requirements.

Mapping
techniques

developed by the

CRC Seagrass

Ecology Group

in Cairns are

being adopted by

Hervey Bay

community groups

participating in a

'Seagrass-Watch'

training course.

Photo courtesy DPI

5.5 SYSTEM MODELS

(Dr Terry Done, AIMS)

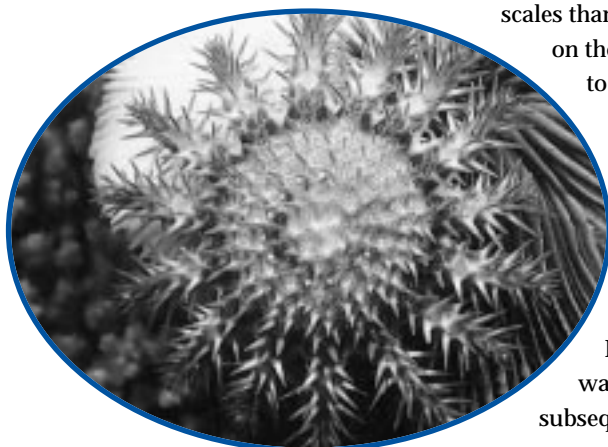
This project acquired new highly skilled staff to progress integration and transmission of Program research that informs representative area planning, risk analysis, the identification of biophysical regions, and fisheries management. It also aims to produce interactive products that will be a vital aid to researchers in translating predictive environment/biota relationships into maps of 'derived data' for parts of the Reef where costs, time and distance ensure real data will be sparse or absent at the time decisions need to be made. The new task's first achievement since commencing in February 1998 is step one in a long-term project to capture the Reef's biophysical variability in a 'regional typology' of the Great Barrier Reef in a Geographic Information System. Using all available data sources, the team has produced digital maps that combine a digital terrain model for the land with a bathymetric model for the Great Barrier Reef.

In a second current task, the ongoing heavy and routine three dimensional simulations of the largest Burdekin River flood plumes over the last 30 years were completed. All the simulations were used to conduct a major risk assessment for flood plumes reaching habitats at different distances from the river mouth. Such statistics now exist for the Burdekin River for the first time, and they are being validated against flood plume records in corals collected at different distances from the Burdekin River. Information of this type allows managers and researchers to assess the significance of particular destructive runoff events such as the one that destroyed seagrass beds in Hervey bay in 1990 in the context of normal return intervals between extreme flood events. Analysis of extreme flows for all major rivers is planned as a contribution to the regional typology.

5.6 CROWN-OF-THORNS STARFISH

(Mr Udo Engelhardt, GBRMPA)

Large crown-of-thorns starfish population outbreaks occurred on the Great Barrier Reef in the mid 1960s and 1980s. A new outbreak has now been observed on reefs covering four degrees of latitude from Cooktown to Innisfail. Those reefs having large adult populations for the first time in 1997/8 had been correctly predicted by the team in 1996/7, based on detailed data on starfish sizes at each reef. This predictive capacity is a vital tool in providing tourism operators with early warning of imminent outbreaks and hence opportunity for implementing control measures to protect valuable tourist sites. The research also casts some doubt on the widely held 'southward wave' hypothesis and suggests instead that starfish larvae recruit simultaneously and repeatedly to reefs throughout that large area. If the latter is true, it would imply the cause(s) of outbreak operate at larger scales than are implied by the southward wave hypothesis. A training workshop on the safe and efficient local-scale control measures was presented, taking to over a dozen the number of tourism operators that are actively involved.



The Project increased its international profile in 1997-8. The Great Barrier Reef community observation project '*COTSWATCH*' spawned '*COTSWATCH - International*', which, like its parent, has a website for data access for all wired participants. In addition, AUSAid supported the team in establishing a training program for Marine Park and tourism staff in the Seychelles to improve the early warning capacity for possible future outbreaks and the effectiveness of subsequent local-scale control measures.

An industry-based reporting scheme for Crown-of-thorns starfish expanded internationally on the internet to transfer current information about overseas outbreaks to any interested group.

Photo courtesy GBRMPA

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
1.1.3	Dr T Done (AIMS)	Cyclone Hindcasting
1.1.4	Mr R Berkelmans (GBRMPA)	Long-Term Monitoring of Sea Temperature on the Great Barrier Reef
1.2.1	Dr L Bode (JCU) & Dr D Burrage (AIMS)	Regional Circulation Models
1.3.1	Dr K Woolfe (AIMS)	Sediment Accumulation/Dynamics
1.3.2	Dr G Brunskill (AIMS)	History of Sediment Accumulation
1.3.3	Dr D Barnes (AIMS)	Biomarkers - Corals and Clams
1.3.5	Dr G Brunskill (AIMS)	Accumulation Rates and Depositional History of Organochlorine Pesticide Residues in Mangrove and Coastal, Sediments
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
1.4.4	Ms J Mellors (JCU)	Effects of Experimentally Enhanced Nutrients on Inshore Seagrass Beds in the Great Barrier Reef Region
1.4.5	Dr N Duke (AIMS)	Mangrove Forests - Oil Effects
1.4.6	Dr R Coles (QDPI)	Baseline Survey of Seagrass Resources, Dunk Island to Cape Cleveland (Spring 1996)

RESEARCH CONT'D

- 1.4.7 Dr D Klumpp & Dr B Schaffelke (AIMS)
- 1.5.1 Dr T Done (AIMS)
- 1.5.1/2 Dr B King (AIMS)
- 1.5.2 Dr A Lewis (JCU)
- 1.5.3 Dr T Done (AIMS)
- 1.6.1 Mr U Engelhardt (GBRMPA)
- 1.6.4 Mr U Engelhardt (GBRMPA)
- 1.6.7 Mr D Fisk (GBRMPA)
- 1.7.1 Mr R Hore (Reef Biosearch)

Growth Responses of Macroalgae to Different Forms of Nutrients from Natural or Anthropogenic Sources
 Science Modelling
 Impact of River Plume on the Central Great Barrier Reef
 Spatial Systems to Support Planning for Ecologically Sustainable Use of the GBR at Regional Scales
 Book on Science for Management of the Great Barrier Reef Beyond 2000
 Fine-scale Surveys of Crown-of-thorns starfish in the Cairns Section of the GBR Marine Park
 Crown-of-thorns starfish: Public Information & Extension Program
 Development of Cost-Effective Local Crown-of-thorns starfish Control Strategies
 Irukandji Research



CRC researchers Adam Lewis (left) and Rick Smith are building special maps and databases to help integration and data sharing across Centre projects.

Photo by Don Alcock



A joint project funded by the Australian offshore petroleum industry investigated the impact of large oil spills on mangrove habitats adjacent to the Great Barrier Reef. Crude oil, spread over small plots of mangroves, was studied to measure changes on natural ecological processes.

Photo by Dr Norm Duke

Program 2. Operations

(Program Leader: Prof Helene Marsh, JCU)

Objective

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

Unlike many other World Heritage Areas which are managed as national parks, the Great Barrier Reef World Heritage Area is zoned for multiple use. The challenge is to make this use ecologically sustainable. This Program aims to provide the scientific information to enable management agencies and user groups to maximise opportunities for the sustainable use of the Region, with particular emphasis on its two most commercially important industries, tourism and fishing. For further information see Chapter 12 (Performance Indicators).

The Program is organised into five projects:

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



CRC Program
Leader Professor
Helene Marsh
received a \$150,000
Pew Charitable
Trusts Fellowship
for research
in marine
conservation.

Photo courtesy JCU

These projects address integrated themes, all of which are central to the Program's mission of 'Science for sustainable tourism and fishing in the GBR'.

5.7 UNDERSTANDING REEF USERS AND THEIR PATTERNS OF USE

There are three challenges in visitor research in relation to the sustainable multiple use of the Great Barrier Reef. First, it is necessary to overcome the widespread belief that managers and operators know all they need to know about visitors. Second, there is the challenge to collect valid, reliable useable knowledge about visitors. A related difficulty in using visitor data for informed decision making is that even amongst the most motivated users, regionally relevant data has been difficult to access and interpret. The third major challenge is the task of transferring this knowledge for productive outcomes.

This Program confronted these three challenges and produced increasingly tangible outcomes. Convincing people that there is much more to be known about visitors than knowledge gained from personal experience or in one location was addressed through database workshops where managers and operators asked the researchers questions about the new visitor information. Having users trust the information and the methods by which this information is collected is being achieved by continued success in having the work published internationally and developing personal researcher-user rapport in face-to-face meetings.

5.8 UNDERSTANDING REEF TOURISM

A strong focus was to generate information relevant to specific regions of the Reef. Such material, which has not been available before, has been one of the strongest links in a chain of argument that managers and operators have new and useable material with which to work. A topical application is the capacity to predict the likely changes to reef tourism resulting from the Asian economic crisis. The data predicted an increased popularity of trips conducted by small operators.



Researchers work closely with commercial line fishers to measure the effects of different fishing pressures at key locations on the Great Barrier Reef.

Photo courtesy JCU

The large growth in tourism and associated infrastructure development within the GBR has prompted calls for research into the carrying capacity of the Region for recreation and tourism. Past research has shown that attempts to determine a single numerical limit to the use of natural environments are misguided and that limiting use alone does not adequately protect the natural and aesthetic qualities of the resource. Contemporary planning frameworks rely on the basis of the natural and aesthetic conditions desired by stakeholders and managers. This approach requires an understanding of the range of opportunities sought by visitors and the conditions that influence perceptions of environmental quality.

A self-administered questionnaire survey of almost 2,000 day-trip visitors to the Cairns Section of the GBR identified four main classes of benefits from their reef trip: (1) experiencing nature; (2) relaxing and escaping from normal routines; (3) excitement with family and friends; (4) being physically active. Five general types of reef visitor were identified on the basis of these benefit classes. These groupings were characterised by important demographic differences. The factors which most influenced a visitor's enjoyment were natural features of the environment (aspects of the corals and fish) and the services offered by staff. The influence of biophysical conditions on enjoyment was generally consistent across operations, the most important differences being between the experiences offered by 'small' and 'large' operators. Participation in snorkelling and diving was generally greater on the small boats. The results of this research taken together with the likely changes to reef tourism predicted by the study of patterns of visitor use reported above, suggest that a greater proportion of visitors to the reef will be undertaking activities with the potential to damage coral. This highlights an increased need for the research to understand and quantify the impacts of use.

5.9 UNDERSTANDING THE EFFECTS OF FISHING

Line fishing is the largest extractive activity permitted in the GBRMP and line fishing is an activity that is likely to impact directly on coral reefs fish communities. Line fishing is also a major recreational pursuit for both members of local communities and visitors. Previous evaluations of fisheries management strategies have focussed on their effectiveness for achieving biological objectives. This has often been at the expense of considering their efficacy in relation to the dynamics of the fishers. Ultimately, sustainable use is achieved through changing actions of the fishers, not the fish. A better understanding of the operational dynamics of the fishers (what influences when, where and how much they fish, and what they fish for) will provide the basis for developing more effective, and possibly more efficient, management strategies. This Program is identifying, quantifying and comparing factors that affect the operational dynamics of fishers in the Reef Line Fishery.



Centre PhD student Seiji Nakaya is completing a study of motivations, use characteristics and perceptions of spearfishers along the Reef.

Photo courtesy JCU

The Effects of Line Fishing (ELF) Project has strong links with the all sectors of the reef line fishing communities. This regular contact has provided the researchers with an understanding of the complexity of the reef line fishing fleet. A strong and consistent observation has been the large variation in various characteristics of the fleet among regions of the GBR. For example, the operational behaviour of a commercial fisher from Gladstone is likely to be substantially different from one operating out of Cairns, which will be different again to one operating out of Cooktown. Quantifying these differences, identifying the factors that determine them and incorporating them into the fleet dynamics model will substantially increase the robustness of the management strategy evaluations.

5.10 SOCIAL RESEARCH FOR RESOURCE MANAGERS

To date, no research has looked at the potential social ramifications of management strategies based on ecological criteria. As many coastal communities are directly dependent on the resources of the GBR, any change in resource management regimes will directly affect the well-being and welfare of these communities. The most significant management challenge to coastal communities is the representative areas program (see report for Program 1) which involves the designation of closure areas based on biophysical criteria. Commercial fishing will be the industry most directly and seriously affected by this program.

Program 2 is spatially modelling the dependency of particular fishing-related communities (towns or groups of interdependent towns) on the fishing resources in various areas of the GBR. The resultant model will enable resource managers to identify the social impacts of changes in natural resource management regimes on the communities that are dependent on those natural resources before the changes happen. This will allow managers to predict and quantify the likely effects of any proposed changes in the zoning of areas of the GBR on specific communities and hence choose alternatives which meet the ecological requirements and which have least detrimental social impact on the fishing industry.

5.11 UNDERSTANDING AND QUANTIFYING THE IMPACTS OF USE

The GBR Marine Park is renowned both for its environmental values and for the recreational opportunities it provides. One challenge facing marine park managers is management of those human activities which can directly damage reefs. Activities such as boat anchoring, SCUBA diving and reef walking can all result in physical disturbance to corals and reef structure, and can be a significant concern in popular, rare or fragile reef areas. Reef managers require information about the susceptibility of different coral communities to physical disturbance so that management efforts can be prioritised to sites most sensitive to human impacts. Corals vary in their ability to withstand the stresses associated with many human activities, and research in Program 2 is elucidating the factors which determine the response of corals to physical disturbance. This understanding will form the basis of a model to predict the fragility, or sensitivity, of reef sites (coral assemblages) to physical disturbances. The research is also addressing the question of coral recovery following damage including questions such as: Will corals survive being damaged? How much damage is too much before corals cannot recover? How fast will corals recover from damage? Is damage likely to influence the dynamics of reef communities? Is recovery predictable, and can we rely on recovery as a management strategy? A major outcome of this research will be a publication targeted at reef managers which explains the implications for reef management.



Studies into the impacts of scuba divers and snorkelers on coral reefs have found current management controls and industry practices adequately protect popular sites.

Photo courtesy Quicksilver Connections

5.12 VISITOR EFFECTS ON SEABIRDS

The needs of seabirds for foraging grounds and nesting sites are increasingly perceived as in conflict with the commercial interests of various fisheries and the tourism industry. Some seabird populations have suffered significant declines over the last decade. However, the cause of such declines remains unknown. Program 2 has collected empirical data to facilitate the sustainable management of several island nesting sites in the GBR. The research demonstrates firstly, that bridled terns are able to accommodate intense, short bursts of simulated tourist disturbance without suffering a reduction in breeding success; and secondly, islands which have a complex, three dimensional terrain are more likely to be able to receive tourist visitation without adverse impacts on nesting birds than

islands with a relatively simple, low profile. The data collected on the size of the breeding populations of dominant seabirds nesting at Rocky Islets north of Cooktown also provides a sound base for future monitoring. These results allow managers to allocate visitation by tourists to those islands that are able to withstand such pressure.

5.13 EFFECTS OF LINE FISHING EXPERIMENT

The Effects of Line Fishing (ELF) Experiment is designed to test the sustainability of line fishing in the GBR. The experiment is measuring the effects of different levels of fishing pressure and reef closure using 24 reefs arranged in four clusters of six reefs as experimental units. Each cluster includes four reefs which were closed to fishing for 12 years as a result of marine park zoning and two reefs which have been open to fishing during that period. The zoning status of reefs has needed to be changed for the experiment which hinges on exact measures of fishing pressure on 16 reefs over periods of 12 months. After this, all the experimental reefs will be closed to fishing for five years while the status of the stocks is monitored.

The results of the first year of the experiment provide information about the variation in catch rates, species composition and size structure of reef fish populations among reefs, regions and management zones of the GBR, and their response to changes in fishing pressure. There are large regional differences in the relative abundance of target species, such as the common coral trout. Catch rates for *P. leopardus* are higher in the southern two clusters involved in the ELF Experiment than in the northern two clusters. The size of this difference is substantially greater than the difference in catch rates between “blue” (open to fishing) and “green” (closed to fishing) reefs. These regional patterns in catch rates, and other population parameters, have also been demonstrated for other exploited species, such as the red throat emperor. This large-scale variation suggests that the population dynamics, the response of the populations to fishing, and consequently the sustainable level of harvest, may differ considerably between regions of the GBR.

Preliminary outcomes from the ELF Experiment demonstrate the utility of research catch rates for monitoring changes in fish populations. There were significant declines in catch rates on control and manipulation reefs in the three southern clusters involved in the ELF Experiment. This decline may be the result of a large-scale environmental effect associated with Cyclone Justin in early 1997. Importantly, the declines were significantly greater on the reefs opened to fishing as part of the experiment. This indicates that the experiment manipulation imposed an effect over and above that due to the environment, and that this difference could be detected in the catch rate data.

This information is being used in the development of population dynamics management strategy evaluation (MSE) models to evaluate the relative merits of alternative management strategies for line fishing on the GBR. The MSE models will provide the tools to compare the effectiveness of management strategies that take regional variation in stock characteristics and their responses to fishing into account with strategies that do not.



Commercial line
fishers assisted
researchers in the
ELF Experiment.
Catch rate
information is being
used to develop
population dynamics
management
strategy evaluation
(MSE) models.

Photo courtesy JCU

5.14 DECISION INFORMATION SUPPORT FOR MANAGEMENT AND PUBLIC POLICY

Comprehensive and specific management objectives are essential to thorough evaluation of policy or program options and to explain decisions to stakeholders and ministers. While marine park objectives have been defined to varying degrees in existing documents, no one framework combines all the cultural, economic, ecological, social and other objectives that underpin the management of the GBR.



Doctoral student
Barbara Breen
worked with the
Great Barrier Reef
Marine Park
Authority to
help integrate
bio-physical and
social data needed
for the Cairns
Area Plan of
Management.

Photo by
Don Alcock

To broaden the support, understanding and acceptability of management decisions, a framework of well-defined management objectives is required to facilitate transparent and appropriate decision-making and development of management performance indicators. Program 2 is developing a structured, transparent and integrated framework which decision-makers can use to assess, and then justify, complex decisions. This framework represents the input of over 220 stakeholders (including GBRMPA staff) and multiple documents and includes over 200 cultural, ecological, social and other management objectives. The framework resembles a family tree with objectives listed on its branches and leaves to represent relationships among, and trade-offs between, different objectives, so that the attractiveness of management options to different people can be explicitly explored by placing different people's preferences upon different objectives. The final outputs of this research will be made available to government agencies, non-government groups (e.g. conservation groups, Aboriginal & Torres Strait Islander groups) and users (e.g. tourism, commercial and recreational fishers). In this way, all stakeholders enter consultative processes with a knowledge of the overall picture and an understanding of their role.

Program 2 Summary - Current Tasks

Task	Chief Investigator	Title
2.1.2	Mr P Valentine (JCU)	Review of Visitor Use Patterns
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	Dr G Inglis (JCU)	Socially and Ecologically Acceptable Levels of Use
2.1.11	Dr G Inglis & Mr J White (JCU)	The Feasibility of Constructing Coral Viewing Platforms on Underwater Observatories by Transplanting Coral Fragments
2.1.12	Ms D Benzaken/ Mr J Innes (GBRMPA)	Socio-economic Implications of the Bramble Reef Reopening
2.1.14	Dr G Inglis (JCU)	"Reef Watch" - Monitoring
2.1.16	Dr L Fernandes (JCU)	Towards Integrating Social, Cultural and Economic Concerns into Management of the Great Barrier Reef
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
2.3.2	Mr R Pratt (JCU)	Restoration Ecology
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

RESEARCH CONT'D

- | | |
|--|--|
| 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 Line Fishing on Reef Fish Stocks on the GBR Visual Surveys of Experimental Reef Clusters |
| 2.4.12/3 Dr D Williams (AIMS) & Dr T Ayling | |
| 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 |
| 2.4.13 Dr B Mapstone, Dr G Inglis & Mr S Nakaya (JCU) | Spearfishing on the GBR |
| 2.4.14 Dr B Mapstone & Mr J Higgs (JCU) | Recreational Boating - Townsville Model |
| 2.4.15 Dr B Mapstone (CRC) | Bramble Reef Re-opening: Fisheries Dynamics |
| 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 |
| 2.5.2 Dr E Gyuris (JCU) | The Ecological Impacts of Visitors on Seabird Populations |
| 2.5.3 Prof H Marsh (JCU) & Ms J Robins (QDPI) | The Survivorship of Sea Turtles after Capture in Trawls |



Tourism researchers conducted surveys of visitor motivations and expectations in the Whitsundays region.

Photo by Ned Kelly

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 continued. 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. For further information on engineer's research applications, see Section 7.3.



5.15 DESIGN WAVES AND WATER LEVELS IN THE GREAT BARRIER REEF

(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.

A state-of-the-art wave modelling system, *WAMGBR*, for the prediction of wave energy in the Great Barrier Reef region has been developed, tested, validated, and presented at an international conference on ocean wave modelling. The model predicts the evolution in time and space of wave energy by calculating wave generation by wind and wave transformations caused by interactions with shallow water. In particular, features to account for the geographic complexity of the reef have been incorporated.

The wave conditions during 147 historical tropical cyclones in the Coral Sea (the whole of the database since 1969) have been simulated by the model, and statistics of wave energy have been calculated at thousands of points throughout the GBR. These results confirm that a larger synthetic ensemble of cyclones must be modelled in order to represent accurately the cyclone population. This process is now in progress. The output will be compiled in the *Atlas of Waves in the Great Barrier Reef*. This information will provide engineers, managers and scientists with much more accurate information on the GBR's wave climate. This should result in better-designed and more economical development.

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

(Prof Ray Volker, UQ)

The policy of GBRMPA in relation to wastewater discharge on islands is that all island resorts with wastewater must be treated to an acceptable standard (tertiary) before release into the reef environment. An alternative is to allow wastewater treated to secondary standard to be disposed of on land. The assumption is that the nutrients from the wastewater will not affect coral reefs. The use of

A shipping risk analysis for the Great Barrier Reef and Torres Strait continues to be used as a basis for introducing new policies for shipping transportation.

Photo courtesy
Queensland Ports
Corporation

effluent from the secondary treatment of wastewater for irrigation is a practice that has gained acceptance at mainland sites. Several island locations have golf courses and all have landscaping that need water and fertiliser; therefore, the use of effluent for these purposes 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 environmentally and economically sound practices for the use of wastewater as irrigation on islands in the Great Barrier Reef?

In order to evaluate the upper limits for potential nutrient discharges from resort islands, numerical modelling of the fate of nitrate in the unsaturated zone has been undertaken for two different island types. A draft CRC report, *Numerical studies of nitrogen flows under effluent irrigated lawns on islands in the Great Barrier Reef* has been prepared. In addition to subsurface flow, surface runoff is being investigated from a typical island resort catchment on Dunk Island.

Research sites are now well established on four islands in the Great Barrier Reef Lagoon and field data of nitrogen concentrations have been collected and evaluated. These data give necessary information on the temporal and spatial variability of nitrogen concentration for the several island geologies.

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.

5.17 ENGINEERING GUIDELINES: DESIGN, CONSTRUCTION AND OPERATION

(Dr Stan Massel, AIMS/Dr Tom Hardy, 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. Current standards require design to deal with a Category 4 cyclone.

Work has concentrated on preparation of *Part 2PN - Pontoon Guidelines*. A working document for the pontoon guidelines will be available for industry use during 1998. Consultations with tourism operators, consultants, GBRMPA and other government agencies have continued. Meetings were held with industry representatives in Port Douglas, Cairns, Townsville and Airlie Beach to discuss the guidelines. 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.



Consultations
with marine
engineers, tourism
operators and
GBRMPA staff
have helped
develop guidelines
for installing
pontoons.

Photo courtesy
Pure Pleasure Cruises

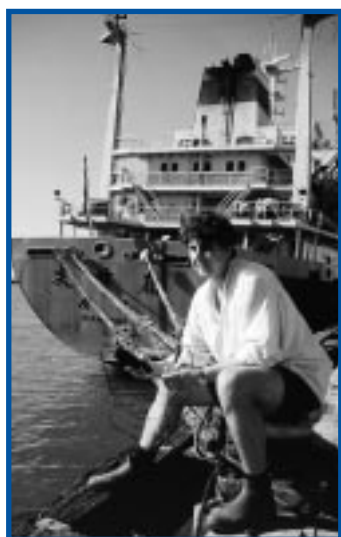
5.18 TREATMENT OF BALLAST WATER DISCHARGES TO PORTS

(Mr Darren Oemcke, JCU)

Concern about potential impacts of introduced marine organisms via ships' ballast led to an interagency project to test different treatment systems. A major finding has been obtained: that ozone will not be appropriate for shipboard treatment of ballast water. In contrast, UV radiation in combination with filtration has considerable potential and should be developed to the pilot testing stage. Project results have received international attention from the Marine Environmental Protection Committee of the International Maritime Organization (UK), the Battelle Memorial Institute (US), Cawthorn Institute (NZ) as well as the Centre for Research on Introduced Marine Pests (Aust).

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
3.3	Dr S Massel (AIMS)	Engineering Guidelines: Design, Construction and Operation
3.4	Dr T Hardy (JCU)	Engineering Design for the Great Barrier Reef
3.4.2/1	Mr M Britton (JCU)	Dynamic Response of a Tourist Pontoon in a Coral Reef Lagoon
3.4.2/2	Mr D Oemcke (JCU)	Ballast Water Discharge
3.4.2/4	Mr S McCorkell (JCU)	The Hydrodynamics of a Coral Reef Flat



CRC PhD student Darren Oemcke published findings from a ballast water treatment study that recommended ozone is

not a suitable treatment system, and that ultra-violet light combined with filtration has more potential.

Photo by Don Alcock

6. EDUCATION

Program 5. Education

(Program Leader: Prof Howard Choat, JCU)

Objective

To provide scholarships and research support for outstanding tertiary students.

This year has proven to be one of the most demanding and rewarding times in the development of postgraduate education in Australia. The issue of postgraduate education in Marine Science, the core discipline of this CRC, has been given special emphasis by four events:

- a shift in government funding policies to make research links between the public and private sectors more explicit through the CRC Program
- a review of financing and policy in tertiary education; the West Report
- the dissemination of the draft Marine Sciences and Technology plan
- new compliance requirements in workplace health and safety governing access to marine environments.

The CRC Reef Education Program used these events as opportunities to develop the education and training required for the next generation of scientists in coral reef management; today's graduate students.

6.1 TRAINING STUDENTS FOR INDUSTRY



CRC postgraduate students are encouraged to undertake industry placements. Michaela Beringer, researching the influence of detritus on water quality, worked with Sinclair Knight Merz.

Photo by
Don Alcock

A recent survey of 154 employer organisations commissioned through the Marine Science and Technology Working Group identified two themes concerning the education and training of marine scientists. Marine science industries and organisations included in the survey argued for increased emphasis on practical and workplace experience as a value-adding element to the tertiary education of potential employees. In addition the responses noted the need for improved communication skills and the particular need for graduates to have better report writing skills. These findings complement previous surveys, on marine science in particular (McKinnon 1990) *Oceans of Wealth*, and on research training within the entire tertiary sector (West 1998) *Review of Higher Education Financing and Policy*. During this period, the process of postgraduate training was undergoing scrutiny and re-organisation within the tertiary sector. Consequently the process of postgraduate education is in a state of change. There are tensions between externally driven demands for more generic skills and work place experience and internal demands for more explicit milestones for progression through, and completion of research degrees.

The requirement for workplace experience and industry linkages in postgraduate education was anticipated by the CRC Program. For this reason CRC education programs have played a critical role in preparing the ground for new developments in postgraduate training. Most importantly CRCs have provided the opportunity to explore ways in which directed and industry-sponsored research can be successfully integrated with more traditional models of postgraduate education. Research is a creative process and the benefits of directed and strategic research must be balanced against the need to preserve creative and innovative elements. The purpose after all is to produce the next generation of marine scientists. Students and their supervisors will be confronted by the need to manage both intellectual freedom and intellectual property and strike an appropriate balance between creativity and accountability.

Finally, a CRC is more than the sum of its joint partner activities. An important role of the CRC is to broker collaborative arrangements which improve outcomes and to provide a setting in which links between education and industry and management can be developed. These diverse requirements have been the driving forces that have shaped the Education Program.

6.2 CRC SCHOLARSHIPS AND SUPPORT

The Education Program fulfilled its major task in providing scholarships and research support for outstanding students. While the primary objective was to provide training and education for postgraduate students in areas relevant to the CRC objectives, increasing attention was also directed towards honours students. This included an augmentative grant scheme for honours study. In terms of student numbers, the Education Program fulfilled its mandate since 1994 in supporting 49 PhD, 16 MSc and 66 Honours students either by direct provision of scholarships or through research support. The numerical pattern of student enrolments by year and courses is shown (Table A). A comprehensive summary of honours and postgraduate students is grouped by the level of support (Scholarship holders vs Postgraduate Associates) and shows details of task affiliations, thesis topics supervision and sources of funding and research support (Table B).

The need for closer links between postgraduate training programs and industry was anticipated by the Education Program. An *Industry Sponsored Placement Program* was developed with the following objectives:

- to improve linkages between research and industry
- to benefit our industry and management partners by producing graduates with experience in reef-based industries
- to provide students with skills that will enhance their employment opportunities and encourage innovative industry-based approaches to the sustainable development of the Reef resources.

A consequence of this program is an increase in the duration of the candidature of postgraduate students. The philosophy of the Education Program is that such extensions of candidature represent an additional training component consistent with the aims of the CRC Program and the Australian Marine Sciences and Technology draft plan.

6.3 INTERDISCIPLINARY STUDIES

A major challenge was the sheer diversity of tasks to be undertaken for sustainable development and sound management of coral reef ecosystems. For example, the Education Program supports students from 11 different disciplines. These disciplines involve not only very different areas of knowledge but span a spectrum of training requirements. Engineering for example requires relatively short training periods and places great store on early involvement of students in the private sector. For students of the natural sciences a doctoral qualification is usually essential and students often have limited experience in the private sector at the time of graduation. More importantly the effective management of coral reefs requires that the social and economic implications of scientifically based management practices be evaluated. To operate in such an environment, students require excellent research skills, a capacity to communicate their results in written and oral forms, and to be able to describe the management or user implications of their work. In addition, working with external partners involves a range of issues concerning intellectual property and research ethics.



Kirsten Michalek-Wagner at Orpheus Island during a field trip to study survival mechanisms and reproduction systems of soft corals affected by raised water temperatures and increased ultraviolet light.

Photo by
Tanya Ashworth

6.4 TRAINING INITIATIVES

In order to achieve research excellence in a diversity of fields and to improve outcomes relevant to management the Centre has implemented the following:

■ Student Research Days

Seventeen speakers presented talks on their research in a format designed by a committee comprising five students and two CRC staff. Presentations were made by Honours, MSc and PhD students from six different disciplines, including Economics, Earth Sciences, Botany, Marine Biology, Engineering and Environmental Studies.

■ Writing Courses

This included sponsoring students to attend Effective Scientific Writing courses run by the School of Languages and Communication, and locally developed workshops, "Getting into Print" and "CV & Interview Techniques".



CRC PhD student Melita Samoilys completed research into reproductive strategies of coral trout. Her findings are being considered by the Queensland Fisheries Management Authority and community groups to protect spawning aggregations on reefs.

Photo courtesy DPI

■ Media Skills Workshop

This included sponsoring students to attend a Media Skills Workshop to help work with journalists and gain interview skills.

■ A Needs Analysis Survey

A survey was distributed to 26 current students designed to identify areas of greatest student need. Issues raised confirmed the importance of providing better communication systems for students (student email communication network), participation in decisions (postgraduate student representative on the Technical Advisory Group and the Travel Awards Selection Committee), and interactions with industry (*Industry Sponsored Placement Program* and appointment of a Postgraduate Coordinator).

■ Development of a Postgraduate Student Database

Promotes a more efficient approach to dealing with individual student problems, queries and monitoring of progress. The database will also help track students who leave the Centre.

■ External Supervision

There are 22 external supervisors officially associated with Centre postgraduate students; eight from AIMS, three from GBRMPA, one from DPI, one from CSIRO, eight from other national universities and one from an overseas university.

■ A CRC Postgraduate Information Booklet

Covering information concerning intellectual property, authorship, thesis production, industry placement program and the benefits and responsibilities of being a CRC student.

Anticipating increasing challenges of the Education Program, especially the need to develop industry placements, the Centre employs a part-time Postgraduate Coordinator. The objectives of this appointment are to facilitate information flow amongst the students, develop training courses, raise student awareness of opportunities and obligations of the CRC Program, and encourage participation in the Centre research culture. The Centre was fortunate in securing the services of Ms Gilianne Brodie as CRC Postgraduate Coordinator who was instrumental in setting up the programs and opportunities listed above.

6.5 FIELD STUDY SUPPORT

Access to appropriate study sites is a continuing issue facing Centre Postgraduate students. As most research projects require field work ensuring that they have access to field sites and operate under conditions mandated by the appropriate Workplace Health and Safety directives has proven to be a challenge. This is especially true in circumstances in which students are working within the private sector in recreational activities which are subject to different codes of practice than those concerning research activities. Moreover consistent access to reef field sites is an increasingly expensive undertaking for graduate students. The tourism industry has been very pro-active in the provision of transport to and support at field sites and in ensuring that research workers can operate under the appropriate Workplace Health and Safety directives. It is clear that without this private sector input it would not be possible to run the comprehensive programs of student based research.

6.6 STUDENT AWARDS

Centre students performed well in terms of competitive awards and funding. These have included an Australian Marine Science International Travel Award, SETAC/Taylor & Francis Advance Training Fellowship, Society for Environmental Toxicology and Chemistry Award (Ms J Cavanagh); CSIRO Division of Marine Research supplementary PhD Award (Mr K Anthony), John Lake Award, Australian Fish Society Conference (Mr D Welch); Gilbert Whitely Award Australian Fish Society Conference (Mr A Williams). Centre students have also gained competitive funding through the GBRMPA Augmentative awards scheme with seven students being successful in the 1998 round. In addition Mr P Marshall was invited to make a presentation at the Fenner Conference on "Ethics and Manipulative Research" and to subsequently submit a paper. These results indicate that Centre students are performing well in terms of competitive academic research.

The high level of enthusiasm shown by students coupled with the strongly supportive joint partners provides a sound basis for continuing postgraduate education and training. One area of future studies is tropical fisheries science and management. This represents an area of increasing public participation in the management process, a significant source of local and regional economic activity and a recognised area of international strength in Australia's research activities. Our first five years have provided benchmarks in the development of integrated research activities especially through the multidisciplinary Effects of Line Fishing Project led by Dr B Mapstone. This provided a unique opportunity to carry out fisheries research at geographically meaningful scales and to examine the economic and social aspects of reef fisheries.

6.7 FUTURE DIRECTIONS

A major challenge for future developments in the Education Program will be matching Centre expectations of the development of work skills and experience with the increasing pressures on postgraduate students to perform in terms of academic milestones, including reducing time of candidature. It is the belief of the Education Program that developing practical knowledge and communication skills can be integrated into an academically competitive postgraduate program attracting high calibre students. However this requires acknowledgement that additional training and skills acquisition will add to the period of candidature. This is a primary reason for the extended candidatures of the Centre's present student cohort. For further information see Chapter 12 (Performance Indicators).

Future postgraduate student initiatives will be to:

- establish a program for development of communication skills relevant to their topic to be completed early in the candidature
- identify opportunities for work experience at an early period in the project to enable better planning for research milestones

- establish a comprehensive system of formal pre-enrolment agreements between candidates, supervisors and Centre management to ensure that issues of intellectual property, reporting requirements and ownership of data are understood by all participants. This process will be aided by the newly developed academic monitoring programs of the JCU Postgraduate Student Office.

Centre 1997/8 students are grouped as follows:

PhD students	44
Masters level students	10
Honours level students (inc. 8 Augmentative Grant students)	30
TOTAL	84

TABLE A: Numbers of students enrolling in degree programs by year

	PhD	MSc	MAppSc	Hons
1993/4	7 (4)	3	-	1
1994/5	15 (6)	5	-	16
1995/6	7 (5)	2	-	13
1996/7	10 (5)	5	1	18
1997/8	10 (1)	1	1	18
	49	16	2	66

() = scholarship support

TABLE B: 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)	Current	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
J Bruncher	PhD	JCU/Task 3.1	Nonlinear wave modelling: Reef flat	01.01.96	Dr L Bode & Dr T Hardy (JCU)	Susp.*	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	01.01.95	Prof D Griffiths (JCU) Dr M Furnas (AIMS)	Current	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)	Current	CRC
M Dommisie	PhD	JCU/Task 1.1.1	Detritus and its influences on water quality in the Great Barrier Reef: quality and quantity	11.07.95	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)	Current	CRC
J Kritzer	MSc/ 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	24.02.98	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	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 CONT'D

Name	Degree	Institution Enrolled/ Task Affiliation	Thesis Title	Commencement Date	Supervisor	Status of Study	Source of Funding
S McCorkell	PhD	JCU/Task 3.4.2/4	Hydrodynamics of a coral reef flat	07.04.97	Dr T Hardy (JCU)	With-drawn	CRC
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	21.08.97	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)	Submitted	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)	Current	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)	Current	CRC
T Roupheal	PhD	JCU/Task 2.1.5/1	The effects of recreational SCUBA divers on coral reef benthos within the GBRWHA	01.07.94	Dr G Inglis (JCU) Dr J Oliver (GBRMPA)	Completed	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
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

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
T Abbott	MSc	JCU/Task 2.1.9	Evaluation of time-lapse video techniques to monitor site use in the GBRMP	01.01.95	Dr G Inglis (JCU)	Completed	CRC
N Aragones	PhD	JCU/Task 2.1.8	Techniques for the restoration of tropical seagrass beds	27.02.95	Dr G Inglis (JCU)	Current	CRC
B Ataie-Ashtiani	PhD	UQ/Task 3.2.0	Contaminant transport in coastal aquifers	01.07.94	Prof R Volker (UQ)	Completed	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	01.02.98	Dr T Hardy & Mr J McConochie (JCU)	Current	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)	Current	CRC Hons.*
C Bentley	Hons	JCU/Task 3.1.0	Investigation of the performance of a wave staff	01.01.97	Dr T Hardy & Mr J McConochie (JCU)	Completed	CRC
R Berkelmans	PhD	JCU/Task 1.1.4	Upper thermal tolerance limits for acclimation of reef corals	15.08.95	Dr B Willis (JCU) Dr J Oliver (GBRMPA)	Current (part-time)	CRC
E Bolitho	MSc	JCU/Task 2.5.2	Behavioural changes in breeding bridled terns in response to the presence of recreational visitors	01.01.97	Dr E Gyuris & A/Prof R Pearson (JCU)	With-drawn	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
M Britton	PhD	JCU/Task 3.4.2/1	Pontoon dynamics in a coral reef lagoon: field measurement and numerical modelling studies	01.07.94	Prof A Johnston (JCU)	With-drawn	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
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 CONT'D

Name	Degree	Institution Enrolled/ Task Affiliation	Thesis Title	Commencement Date	Supervisor	Status of Study	Source of Funding
J Davidson	MSc	JCU/Task 1.4.1	Video as a survey and monitoring tool for coral reef benthos	01.01.95	Dr T Done (AIMS) Prof H Marsh (JCU)	Completed	CRC
G Diaz	PhD	JCU/Task 1.4.1	Impacts of algal recruitment on bleached corals, and roles in reef recovery or decline	01.01.98	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)	Current	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)	Current	CRC Hons.*
A Frisch	Hons	JCU/Task 5.1.3	Characterisation of the stress responses of coral trout <i>Plectropomus leopardus</i> and <i>Plectropomus maculatus</i>	01.01.96	Dr T Anderson (JCU)	Completed	CRC Hons.*
E Fulton	Hons	JCU/Task 5.1.3	Investigation of catch rate determinants via computer simulation – with regard to the targeting of spawning aggregations	02.03.96	Drs D Kault & M Sheaves (JCU) & Dr B Mapstone (CRC)	Completed	CRC Hons.*
M Gallagher	MSc	UQ/Task 3.2.0	Significance of groundwater and surface water discharges from the Great Barrier Reef Lagoon	01.01.96	Prof R Volker (UQ)	Susp.*	CRC
P Gleeson	Hons	JCU/Task 3.4.0	Planning and design of tourist pontoons on the GBR	01.01.96	Prof A Johnston & Mr R Kapitzke (JCU)	Completed	CRC
V Hall	PhD	JCU/Task 5.5.4	Injury and regeneration in reef-crest corals	01.07.93	Dr T Hughes (JCU)	Submitted	CRC
D Heubush	Hons	JCU/Task 3.1.0	Application of Reef sheltering to numerical wave modelling	01.03.97	Drs T Hardy & L Mason & Mr J McConochie (JCU)	Completed	CRC
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)	Current	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)	Current	CRC
L Johnson	Hons	JCU/Task 2.2.1	Aussie – host quality	01.01.96	Dr G Ross (JCU)	Completed	CRC

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

EDUCATION CONT'D

Name	Degree	Institution Enrolled/ Task Affiliation	Thesis Title	Commencement Date	Supervisor	Status of Study	Source of Funding
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)	Current	CRC Hons.*
J Jompa	PhD	JCU/Task 1.4.1	Coral algal interactions and their roles in reef degradation	01.07.98	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
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
A Manzon	MappSc	JCU/Task 2.5.2	Estimating populations sizes of breeding bridled terns and wedge-tailed shearwaters at Rocky Island National Park	01.01.96	Dr E Gyuris (JCU)	With-drawn	CRC
B Massel	Hons	JCU/Task 5.1.3	Impact of tropical cyclone on beach morphology and sediment transport in the GBR Area. TC 'Charlie' (1988) Hindcast Study	01.02.96	Dr C Skelly & Mr S Smithers (JCU)	Completed	CRC Hons.*
S Mauger	Hons	JCU/Task 5.1.3	Standing stock concentrations of heavy metals in three species of tropical seagrass	01.02.97	Dr G Inglis (JCU)	Completed	CRC Hons.*
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)	Susp.*	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)	Current	CRC Hons.*
R Monfils	MSc	JCU/Task 1.4.5	The toxicity of Bunker C fuel oil and BP-AB dispersant on estuarine perchlets	01.03.97	Drs B Molony & N Moltchaniwsky (JCU)	Completed	CRC
K Mortimer	Hons	JCU/Task 5.1.3	Management of the archaeological record in the Great Barrier Reef Province	01.02.96	Dr P Veth (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

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

EDUCATION CONT'D

Name	Degree	Institution Enrolled/ Task Affiliation	Thesis Title	Commencement Date	Supervisor	Status of Study	Source of Funding
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
P Nangle	Hons	JCU/Task 5.1.3	Rarity and commonness in chaetodontid communities	01.02.96	Dr G Jones & Dr J Caley (JCU)	Completed	CRC Hons.*
S Northey	Hons	JCU/Task 3.1.0	Effect of southern ocean high pressure systems during cyclones	01.02.97	Drs T Hardy & L Mason & Mr J McConochie (JCU)	Completed	CRC
P O'Neill	PhD	GU/Task 2.1.10	Geographical isolation and genetic differentiation within two sympatric sulid species in Australia and implications for management	01.01.95	Drs J Hughes & K Hulsman (Griffith University)	Completed	CRC
C Pratt	Hons	JCU/Task 1.4.5	Weathering of hydrocarbons and the effectiveness of dispersants to treat oil spills in mangroves at the Gladstone experimental treatment sites	01.02.97	A/Prof G Meehan (JCU) Dr K Burns (AIMS)	Completed	CRC
R Pratt	PhD	JCU/Task 2.3.2	Coral reef restoration, ecology and techniques	01.01.95	Dr U Kaly (JCU)	Current	CRC
T Prior	Hons	JCU/Task 2.5.2	Behavioural responses of bridled terns to visitor disturbance	01.09.97	Dr E Gyuris (JCU)	Current	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)	Suspended	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)	Current	CRC Hons.*
A Reed	Hons	JCU/Task 3.1.0	Verification of a wave model for tropical cyclones in the GBR – T.C. Justin	01.02.98	Dr T Hardy & Mr J McConochie (JCU)	Current	CRC
F Richards	Hons	JCU/Task 2.2.1	Beach visitor awareness of health and safety issues	01.01.97	Prof P Pearce (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 (part-time)	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
R Rupp	Hons	CQU/Task 1.4.5	The effects of simulated oil spill on the crustacean fauna of a sub-tropical mangrove forest	01.08.96	Drs M Walker & S McKillop (CQU)	Completed	CRC

*CRC Hons. = CRC Honours Augmentative Research Grant

EDUCATION CONT'D

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</i> sp.	01.07.98	Drs G Skilleter, M Garson & B Degnan (UQ)	Current	CRC Hons.*
M Samoilys	PhD	JCU/Task 2.4.2	Reproductive strategies of the common coral trout on the northern Great Barrier Reef	01.01.94	Prof JH Choat (JCU) & Dr P Doherty (AIMS)	Current (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)	Current	CRC
C Steinberg	PhD	JCU/Task 1.2.1	An investigation of the pathways of biota in the Capricornia and Southern GBR: A bio-physical modelling approach	01.03.97	Dr L Bode (JCU) Dr D Burrage (AIMS)	Current	CRC
C Weigt	Hons	JCU/Task 1.3.1	Cross-shelf channels	02.03.98	Drs K Woolfe & P Larcombe (JCU)	Current	CRC
D Welch	MSc	JCU/Task 2.4.12/5	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	Dr B Mapstone & Dr C Davies (CRC) & A/Prof G Russ (JCU)	Current (part-time)	CRC
J White	MSc	JCU/Task 2.1.1	The feasibility of constructing coral viewing platforms on underwater observatories	26.07.93	Dr G Inglis (JCU)	Current (part-time)	CRC
A Williams	Hons	JCU/Task 5.1.3	Variation in population structure of the red throat emperor, <i>Lethrinus miniatus</i> , among regions and management zones on the GBR	01.02.96	A/Prof G Russ (JCU) Dr C Davies (CRC)	Completed	CRC Hons.*
L Wilson	Hons	JCU/Task 5.1.3	Reef composition and zonation, physical conditions, and reef walker routes and damage, Geoffrey Bay, Magnetic Island	01.02.96	Mr S Smithers (JCU)	Completed	CRC Hons.*
R Wright	Hons	JCU/Task 3.4.2/1	Pontoon motion measurement	01.02.97	Mr R Kapitzke (JCU)	Completed	CRC

*CRC Hons. = CRC Honours Augmentative Research Grant

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

The Centre continues to make research useful for input into industry development and public policy. It has an obligation to ensure the strategic knowledge generated by its research is transferred to industry groups and other end users. This obligation is recognised in the Centre's Corporate Strategy that identifies communication and extension as key performance indicators.

In addition to existing links that each research task has with user groups, extra effort was made to increase external communication, enhance collaboration with partner organisations (including new associate organisations), promote research outcomes to user and community interest groups, and increase applied research awareness through the media.

The Centre maintains active 'management and industry associates' with each research task. These representatives help focus the quality of research output. They act as partners with researchers: helping to achieve goals, publish information to stakeholders and implement change from research results. Their time is recognised as in-kind support to the Centre.

A Users Advisory Group helps review applications of research tasks and maintain links with stakeholders. Group members help disseminate research information to Reef management agencies, shipping, fishing and tourism industries. They help organise peer reviews for each final project and write up introductions to Technical Reports. The Group's structure and role is currently being reviewed.

The Centre's contribution to the understanding and sustainable use of the Great Barrier Reef World Heritage Area is mostly of a public good nature. Scientific results and knowledge are openly made available to any interested organisation or individual. While commercialisation is not a major issue, we have a number of opportunities to commercialise products and services that will be planned for the future.

7.1 KEY ACHIEVEMENTS: REGIONAL ENVIRONMENTAL STATUS



*CRC researcher
Udo Engelhardt
continued to train
tourism operators in
controlling starfish
populations at
their sites.*

Photo by
Don Alcock

CROWN-OF-THORNS STARFISH

Crown-of-thorns research data has led to improved predictions of starfish outbreaks, the development of new 'eco-friendly' eradication control techniques, and industry training programs for north Queensland tourism operators. Fine-scale starfish surveys ensured early predictions of outbreaks near Lizard Island and initiated early local control measures. Staff training, collecting permits and regular monitoring updates helped tourist operators between Cairns and Townsville with control mechanisms to maintain the visual appeal of their key sites. 12 operators were actively involved with these programs. COTSWATCH, the reef-user reporting scheme for starfish sightings, continued to be well supported with more than 1,300 individual site reports.

The scheme has also been launched internationally with an electronic data sheet and website facilitating information transfer to countries also affected by outbreaks. CRC monitoring research expertise is now being exported overseas through an AUSAid-funded project to initiate a training program for marine park and tourism staff in the Republic of the Seychelles. CRC researchers have also contributed to coral reef monitoring and marine protected area training programs in Vietnam.

SEAGRASS MAPPING

Vast areas of shallow and deep water seagrasses, found between 10 degrees of latitude, have been mapped for the first time, providing Marine Park and coastal managers with better information about sensitive dugong and fish nursery habits. The study has contributed to the designation of a Special

UTILISATION AND APPLICATION OF THE RESEARCH,

COMMERCIALISATION, LINKS WITH USERS CONT'D

Management Area near Lizard Island and the declaration of eight new Dugong Protection Areas in Queensland. Coral reef assessments, commissioned by GBRMPA, have been conducted at Whitsunday Islands and Shoalwater Bay to assist development of management plans. New seagrass mapping has

been used by the QFMA to help manage the gill net fishery, plan Representative Areas in the Marine Park and assist the Queensland Ports Corporation better understand the environmental impact of a new port development at Mourilyan Harbour.



Mangrove forests along Queensland's coastline play a vital role in the biological diversity of Barrier Reef waters.

Photo courtesy
Norm Duke

EFFECT OF OIL ON MANGROVES

Work funded by the Australian Petroleum Production and Exploration Association will help reduce any future impacts of large oil spills in the GBR World Heritage Area. The manipulative study into the impacts of oil on coastal mangrove areas has helped the Australian petroleum industry determine the usefulness of chemical dispersants and the

interdependence of plants and animals in mangrove habitats. Published results and recommendations are helping Queensland port authorities be better prepared in response to possible crude oil spills near the coast and understand when circumstances warrant the use of chemical dispersants.

SEDIMENT ACCUMULATION

Studies of sediment accumulation on the coastal shelf from river mud have found deterioration of inshore reefs are a potential result of mainland agriculture and urban development. Runoff from land may carry increased nutrients and toxic substances but nearly all of the river mud from the last 6,000 years is trapped along the inner shelf, protected bays and mangrove areas. Little or no recent river mud reaches mid-shelf and outer reefs. In some mangrove mudbanks, traces of phosphatic fertilizers and mercury-containing fungicides are up to five times higher than pre-1900. Depositional history studies on levels of mercury in Missionary Bay near Hinchinbrook Island have led the sugar industry to find substitutes for organomercurial fungicides and the Department of Primary Industries AgroChemical group to reinvestigate the accumulation of mercury in caneland soils. A study on the problem of increased sediments in inshore reefs has found that certain species of coral actually benefit from muddy waters. They feed on suspended sediments for energy and growth, adapting their nutritional needs to local conditions. Marine park planners who need to assess the resilience of inshore coral communities under higher sediment pressures can now identify these sediment-feeding corals.

SEDIMENT DATA FOR MANAGEMENT

Coastal sediment data was used during environmental impact assessments by both Federal and State Environmental Departments for the Port Hinchinbrook Resort development. Detailed records of sediment loads in north Queensland rivers during floods are also giving more accurate estimations of soil loss from major catchment areas. The results of the river input data on Barrier Reef water quality are a key source of information for GBRMPA and an interagency Technical Committee on Downstream Effects of Agricultural Practices.

CORALS AS CLIMATE INDICATORS

CRC researchers have facilitated establishment of AUSCORE – a network of Australian marine scientists working to recover climatic and environmental information from coral growth rings to help interpret sea-surface temperatures, river flows, rainfall, salinity, and El Niño effects.

IMPACTS OF CYCLONES

An atlas of tropical cyclones in Queensland was produced for scientists, resource managers and meteorologists. It is being used for geomorphological studies into coastal beach profiles, assessing the risk of future cyclones to the Cairns region, and assessing impacts of cyclones on coral reef growth.

BASELINE FOR MEASURING CHANGE

There is now a solid basis for measuring 'big picture' changes to populations of corals, reef fishes and crown-of-thorns starfish on the Great Barrier Reef from a multi-million dollar database at the Australian Institute of Marine Science. The Centre supported the Long Term Monitoring Program, now the largest coral reef monitoring program in the world based on an integrated biological history of 50 different reefs throughout the marine park. The LTMP has generated a computer database of several million entries providing enormous capacity to measure medium-term changes to reefs. The database provides environmental managers with a context for addressing impacts of human activities within the Barrier Reef. A recent application helped draw to the attention of GBRMPA managers that bleached corals at Middle Reef would be subjected to additional stress from sediments due to dredging in the Townsville port area.

MONITORING DATA ON THE WEB

The AIMS website is helping users answer questions about reef animals and regions that interest them. Using a combination of underwater visual counts, video records, manta tow surveys and water quality samples, interactive summaries are being made available on the internet. As many surveyed reefs are popular tourist destinations it is likely that tourist operators and community groups could use the data to complement their own environmental monitoring activities.

MONITORING CORAL BLEACHING

Sea temperature and coral reef monitoring programs have provided the first direct scientific link between sea temperature and coral bleaching. The long-term temperature monitoring project has helped unravel the causes of recent coral bleaching on the GBR, which affected 88% of inshore reefs and 28% of offshore reefs in the central section. The program, with inter-agency support from GBRMPA, AIMS, JCU, Queensland Ports Corporation and tourism operators is being used to define vulnerable periods, which help managers plan times for additional impacts such as dredging.

Knowledge of the vulnerability of coral reefs to climate change is pertinent to national and international policy in relation to greenhouse gas emissions.



Studies of scuba diver behaviour have helped tourism operators improve their pre-dive briefings.

Photo by
Seiji Nakaya

operators, such as revised pre-dive briefings and instructor training programs. Studies into the impacts of snorkellers and divers have received considerable overseas interest. Results have contributed to coral reef diver codes of conduct and on-site management of marine parks in the Red Sea, Florida Keys, Yemen, Malaysia and the Mediterranean. The Professional Association of Dive Instructors (PADI) is incorporating aspects of the CRC volunteer reef monitoring study into the revised Research Diver Speciality Course. A training manual for volunteer monitoring of coral reefs has been produced to assist dive masters, tourism operators and volunteer groups implement 'state of the reef' monitoring studies that are consistent with scientific programs. Research evaluations of potential tourism impact concerns, such as SCUBA diving and fish aggregation at pontoons, have demonstrated existing management and industry practices are ensuring no significant impact by Reef visitors.

7.2 KEY ACHIEVEMENTS: TOURISM AND FISHING

DIVER CODES OF PRACTICE

VISITOR SURVEYS IMPROVE TOURISM SERVICES

Tourism researchers have assisted the Queensland Tourism & Travel Corporation, marine park management staff and regional tour operators better understand the motivation and segmentation of

Reef tourists, assisting the marketing of their products and the provision of quality services to domestic and international Reef visitors. With support from regional associations including Tropical North Queensland, Townsville Enterprise and the Whitsunday Tourism Bureau, more than 6,000 visitors have been surveyed and coded into a database for use by stakeholder and interest groups. Information on demographic trends, activity preferences and satisfaction levels is now available to industry on the database at James Cook University.

DATABASE FOR INDUSTRY AND GOVERNMENT

Industry can now access information on Japanese, Korean, Chinese, German and British visitor numbers and characteristics in the Cairns, Townsville and Whitsunday regions. Database workshops for resource managers and business operators have helped in utilisation and access of results, including the development of a website for research summaries. The QTTC continues to support the project and provide unit data from the Queensland Visitor Survey. Purdue University in the United States provides international survey data. The 'one-stop' visitor database describes all types of visitors to the Reef region and surrounding coastal centres, and assists tour operators and associations develop better marketing strategies and products. The CRC research team provides a direct advisory service, free to any organisation wanting help on visitor issues.



DUGONG STUDIES HELP MANAGEMENT PLANS

Dugong satellite tracking and aerial surveys in the Hinchinbrook region have helped Queensland and Commonwealth government agencies develop a boat traffic management plan for the area. CRC surveys on dugong populations and boating patterns, provided to GBRMPA and the Department of Environment, have been used for dugong protection measures in the Hinchinbrook Regional Coastal Management Plan and Zone 'A' Dugong Protection Area.

Surveys of dugong populations have been used for new conservation and management measures along the Hinchinbrook Channel.

Photo by Duane Yates

Information on dugong habitat use has been utilised by the Department of Defence in their environmental management of the Shoalwater Bay Training Area. A probabilistic evaluation of the risks of dugongs drowning in fishing nets has been used by GBRMPA in the development of performance indicators to determine the effectiveness of eight Dugong Protection Areas that came into effect in 1997.

REEF EDUCATION PROGRAMS EVALUATED

An Australian survey to collect information about visitor and community attitudes about the GBR World Heritage Area has found increasing numbers of people are concerned for the Reef's future. Results are being used to help shape GBRMPA's public education programs and are also being considered by the tourism industry in its marketing efforts. Evaluation of new and existing reef interpretive activities has helped improve the design of foreign language products. For example, a planned series of display symbols to reinforce appropriate codes of behaviour by foreign tourists were evaluated. Product testing found poor understanding of messages by overseas groups so the project was dropped, thus saving GBRMPA and tourism industry operators thousands of dollars worth of effort.

VISITOR SATISFACTION MEASURED

Studies to determine what influences visitor enjoyment of a Reef experience – mainly helpful, trained staff together with natural features such as coral cover and fish - have assisted large day trip operators improve the quality of their interpretive services for guests. As vessel staff rated so highly, effort is now being made to provide more staff training in marine biology and environmental education programs by industry. Some companies, such as Quicksilver Connections and Great Adventures, have expanded their interpretation services as a result of this study.

GUIDELINES FOR SNORKELLERS

Recommendations developed by CRC researchers for snorkellers at Ningaloo Marine Park interacting with whale sharks have been adopted by the West Australian Department of Conservation and Land Management. All snorkellers must now keep at least three metres away from whale sharks - a distance still considered suitable for diver enjoyment. Recommendations are also forming the basis for similar diver codes of practice in other states.

CORAL TRANSPLANTATION METHODS ADOPTED

Rapid rehabilitation techniques to economically transplant corals and repair damaged reefs have been developed to help government agencies and tour operators accelerate the natural coral regrowth process in the event of future disturbances. The Government of Fiji is utilising the research results to help repair popular fringing island reefs. Transplantation techniques developed by the Centre are being used to set up a commercial coral mariculture project in Cairns for the international aquaria market.



Recommendations have been made to help design and locate underwater snorkel trails on shallow reefs. Self-guided reef walking trail brochures and interpretive signs have been evaluated.

Photo by
Mark Simmons

GUIDELINES FOR UNDERWATER TRAILS

Research into visitor use of snorkel trails recommended management guidelines for the design and location of new trails, and was to be the basis for revised interpretive signage and self-guided brochures of the Magnetic Island reef walking trail. Unfortunately, due to the effects of coral bleaching, the trail is now expected to close. However, the study's results were used by reef operators and other state management agencies for underwater trail designs.

FISH SPAWNING AREAS PROTECTED

Unique studies into commercial fisheries and a review of recreational line fishing have been pivotal to the QFMA in developing Reef fish management plans. Seasonal spawning closure areas for coral trout are being considered by the QFMA and other public groups to help sustain populations of this important reef fish throughout the Great Barrier Reef. The implications of spawning closures have been used by QFMA's ReefMAC to develop a draft management plan for that fishery.

ADVICE TO LIVE FISH TRADE

CRC fisheries scientists have advised commercial line fishers on improved methods for holding and transporting live coral trout for export. Careful handling of targeted reef fish in the live fish trade will reduce mortality and improve the product quality. Advice on improved specifications for holding tanks has also been utilised. CRC researchers have also provided detailed information about the effects of the live fish trade on how, where and when fishing occurs, and how that might affect the management of line fishing on the Great Barrier Reef.

In a project sponsored by the FRDC, QDPI and CRC Reef, information on the spatial distribution of turtles caught in trawl nets, collected with assistance from commercial operators, has been used to identify priority areas for management intervention.

LINE FISHING DATA HELPS RESOURCE MANAGEMENT

QFMA are considering using coral trout age structure information as an indicator of the effects of fishing. CRC Effects of Line Fishing Experiment findings could trigger management decisions as a result of data collected from 24 reefs with different histories of fishing. Results from the experiment have helped QFMA's ReefMAC to distinguish how much recent drops in coral trout catches were likely to be due to the effects of Cyclone Justin in 1997, as opposed to increased fishing. Key Effects of Line Fishing researchers assisted QFMA's ReefMAC in devising performance measures and trigger points for the management of the reef line fishery.

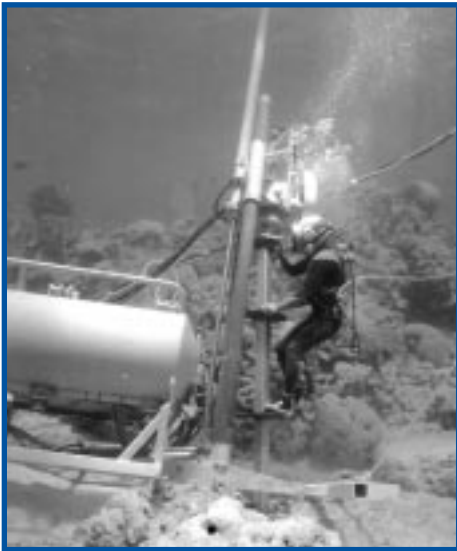
INTEGRATED REEF DATABASE USED IN CAIRNS PLAN

A new decision support system has been developed to integrate biological, physical and social data on the Reef, helping GBRMPA planners improve future management and zoning plans, with particular application in the Cairns and Townsville regions. The Centre designed a model for systematically cross-checking bio-physical and social information contained in existing monitoring databases, commercial permits, tourism records, fishing studies and public surveys. The model was applied in the final stages of the Cairns Area Plan of Management to identify key marine park hot spots, new anchoring zones and practices, and is now the basis for a reef-wide tourism strategy. It provided critical information about the use of the area, local perceptions of reef resources and impacts. The model has been also been applied for the development of a management plan for the Hinchinbrook Channel.

SEABIRD STUDIES SHAPE VISITOR POLICIES

Studies of how visitors affect nesting seabird populations on tropical islands has found topography to be a major influence with certain species. Information on breeding colonies of bridled terns has been used in revised management plans for island national parks by the Queensland Department of Environment. Terns, which nest on both continental islands and coral cays along the entire length of the GBR, can accommodate moderate levels of visitor disturbance, but chicks and eggs are less protected on small, flat coral cays. Michaelmas Cay is the most significant seabird nesting site in the

Cairns area. Tighter controls have been put in place on all modes of transport and recreational activities due to disturbance of nesting seabirds that has led to breeding failure. The results are also providing the basis of visitor management policy to islands in the Swain Reefs region.



7.3 KEY ACHIEVEMENTS: SHIPPING AND COASTAL ENGINEERING

SCREW ANCHOR DESIGN RESEARCH APPLIED AGAIN

Earlier CRC engineering program research into seabed capacities of new screw anchor systems have continued to assist one marine company, Pacific Marine, install another 46 'eco-friendly' anchor systems at popular mooring spots within the Marine Park. GBRMPA and Department of Environment staff identified new mooring sites for the permanent anchors, averaging about \$5,000 each to install, to reduce anchor damage to corals by commercial and recreational vessels.

CRC engineering studies into the holding power of underwater screw anchors continues to be used by a marine engineering company to install permanent mooring buoys at popular sites.

Photo courtesy Pacific Marine Group

SHIPPING STUDY HELPS SET NEW REEF CODE

An earlier Shipping Risk Analysis for the Great Barrier Reef and Torres Strait Shipping Study provided the basis for the Federal Department of Transport's policy decision to move current concentrations of bulk shipping away from the inner route of the Great Barrier Reef. The findings, mainly an analysis of shipping traffic and environmental data obtained from government agencies, provided a preliminary assessment for the Government in a complex and uncertain area of scientific forecasting.

The report concluded that there are likely to be benefits in reducing the overall risk by improving the opportunity for safer navigation, especially in the outer route. A number of recommendations continue to be adopted, including that the Australian Marine Safety Agency, in consultation with the Queensland Government and the GBRMPA, adopt a Reef Code covering navigational, operational and environmental procedures to be observed by major shipping, fishing and tourism operators.

INDUSTRY CONSULTATION FOR PONTOON GUIDELINES

Draft 'Engineering Guidelines for Infrastructure Development in Reef and Coastal Environments' are being prepared for the Reef tourism industry, private engineering consulting companies GBRMPA and the Department of Environment to streamline future tourist pontoon development proposals.



Jason McConochie and Tom Hardy (right) have developed wave measuring devices to determine, and ultimately predict, cyclonic wave and water levels inside coral reef lagoons.

Photo courtesy JCU

WAVE MODEL DEVELOPED

A numerical model of wave generation and transformation during tropical cyclones has been developed, tested and validated. The model is being used to provide information for the *Atlas of Waves in the Great Barrier Reef*. 147 historical cyclones have been simulated since accurate meteorological records began in 1969. A large group of more than 3,000 synthetic cyclones are being simulated to provide statistics on extreme wave characteristics. The atlas will be used by tourism operators to plan new developments and by marine and coastal engineers to redevelop existing sites. It will provide accurate and inexpensive inputs to the engineering design phase and help reef managers to assess permit applications.

TREATED WATER TRACKED AT ISLAND RESORTS

Groundwater studies have tested whether treated effluent irrigation systems on island resorts affects local fringing reef environments. Many resorts use treated sewage effluent systems for golf courses, lawns and gardens. Results are being used to develop better island land use management studies and maintain high standards of water quality. With logistic support from Club Med and Australian Resorts, CRC researchers have developed numerical models for predicting the sub-surface fate of nitrogen at four different island resorts. Results show that islands will need to be considered individually to determine the most effective waste disposal procedures. Key results have been utilised by GBRMPA and Department of Environment staff to refine existing wastewater management policies. Industry guidelines and local government planning codes for effluent irrigation may also be developed.

BALLAST WATER TREATMENT RESULTS

Concern about potential impacts of introduced marine species via ships' ballast water led to an inter-agency study to test the efficiency of different treatment systems. Ultraviolet irradiation, filtration, ozonation and heat were tested to disinfect ballast water. The major outcome is that ozone is not a suitable treatment and that UV combined with filtration has considerable potential, which should be pilot tested by port and shipping companies. Results have been published by the Australian Quarantine Inspection Service at the International Maritime Organisation's Marine Environment Protection Committee.

7.4 KEY ACHIEVEMENTS: INDUSTRY EXTENSION AND TRAINING

CAIRNS MARINE TOURISM ACTION PLAN

Reef Tourism 2005, a research and development program involving Cairns marine tourism industry groups working with government management agencies and research institutions, is implementing a regional strategy developed with assistance from the Centre. The Centre has provided more than \$400,000 of in-kind support to RT 2005 since 1994 to support a range of economic, training, environmental and social initiatives. Action plans are now in progress with more than 20 industry associations and government agencies. The strategy is strengthening tourism consultation networks to resolve planning issues, develop new products and services to enhance sustainable tourism, and improve staff training and employment conditions for approximately 1900 full-time industry workers.

TRAINING ANALYSIS FOR TOUR OPERATORS

A training needs analysis was conducted for the marine tourism industry in the Cairns section through the Reef Tourism 2005 project group and used to establish a marine tourism training committee and project officer. An implementation strategy is currently improving career pathways for local industry staff, developing accreditation standards, helping young people with traineeships and employment, and conducting staff training programs to address environmental and cultural issues.

TRAINING FOR COMMERCIAL FISHERS

An *Endangered and Threatened Species Awareness Course* for commercial fishers, developed with assistance from the Centre, was conducted throughout Queensland in 1997. The course trained 126 participants about threatened marine species in Queensland and why it is important to conserve species, including relevant international conventions and state legislation. The Queensland Fishing Industry Training Council course has now been integrated into the Trainee Commercial Fishers Course and is a compulsory industry requirement for anyone wishing to fish commercially. Another round of regional courses will be delivered in 1998.

TRAINING FOR TOUR GUIDES

Queensland tour operators are improving their professional environmental interpretation services for visitors. Highlighted as a need by several CRC visitor surveys, the *Heritage and Interpretive Tourism*

Certificate Course helps graduates take up new jobs in national parks, outback centres, marine parks and world heritage areas. The HIT course, expanded by the Centre through a Commonwealth grant, is now offered through 10 regional TAFE colleges and several secondary schools. The ecotourism training course was developed by north Queensland's tourism industry working with natural resource management agencies and educational institutions. More than 100 people have graduated in the ASF level 3 course in the last four years with 80 students gaining immediate employment upon completion. The Centre helped revise and publish new student learning guidelines, conduct planning workshops and information networks, and produced a 'how to get started' kit for industry. More than 40 large tourist operators in Queensland actively

support the course with industry placement programs. It is now expanding to other popular tourist regions throughout Australia.

SEAGRASS TRAINING FOR RESOURCE MANAGERS

Monitoring and mapping skills developed by the DPI Seagrass Ecology Group in Cairns are being used to train natural resource managers in Queensland and overseas. The CRC team are internationally recognised for their work in seagrass surveys and have developed techniques for visual assessment of seagrass habitats that help determine resource status and management options.

The team developed training courses for Queensland Department of Environment coastal management staff in the Cairns and Hervey Bay regions. They visited Thailand to train fisheries and forestry rangers on how to map and monitor seagrass beds. Their work, now accepted as the Australian Standard for monitoring changes in seagrass habitat, has enabled the Queensland prawn trawling industry to avoid trawling in sensitive marine areas and to protect juvenile prawn nursery areas.



Townsville
TAFE graduates,
during a launch
of the national
*Heritage and
Interpretive
Tourism*
training video.
clockwise from
bottom left:
Nicole Lincoln,
Anne Keegan,
Michael Wilson,
Mat McKenzie
and Jody Nelson.

Photo by
Don Alcock

8. STAFFING AND ADMINISTRATION

In 1997/98, approximately 250 people were involved in Centre activities including 53 CRC-funded positions and 84 postgraduate students and associates.

The inaugural Director, Professor Chris Crossland, resigned effective from 24 June 1998 to take up a position as Executive Officer, Land Ocean Interaction in the Coastal Zone (LOICZ) based in Holland. Dr Terry Done was appointed Acting Director until 30 June 1998. Mr Simon Woodley will take up the position as Director for one year as from 1 July 1998. Recruitment of a Director will commence in July 1998. There were no other major staff changes during the year.

STAFF TRAINING

Professor Chris Crossland (Order of Merit) and Ms Anne Tucker completed the Company Directors Course conducted by the Australian Institute of Company Directors. Dr Bruce Mapstone completed CSIRO-B/HERT Achievement Through Teams: Leadership in R&D residential course. Mrs Lisa Arnell attended a residential program, Towards Middle Management, conducted by the Association for Tertiary Education Management.

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

There were no changes to the Specified Personnel during 1997/98.

Specified Personnel

Name and Title	Contributing Organisation	Centre Role	% Time Commitment
Prof Chris Crossland	CRC	Director	100
Dr Terry Done	AIMS	Assistant Director Leader, Program 1 Leader, Project 1.5	75
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	GBRMPA	Leader, Project 1.6	40
Prof Helene Marsh	JCU	Leader, Program 2 Leader, Project 2.1, 2.5	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 Leader, Project 2.3	25
Dr Stan Massel	AIMS	Leader, Project 3.3	25

Professional Staff Contributions in 1997/8

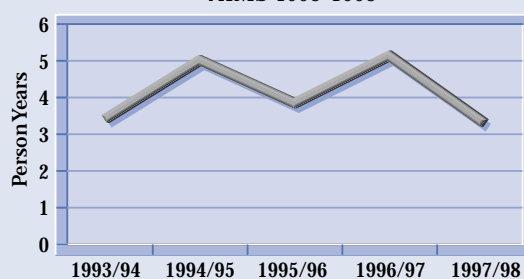
AUSTRALIAN INSTITUTE OF MARINE SCIENCE

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	84	70			70			14
Dr M Furnas	R	49	49			49			
Dr G Brunskill	R	34	34			34			
Dr H Sweatman	R	26	26			26			
Dr S Massel	R	17			17	17			
Mr C Steinberg	R	16	16			16			
Ms I Zagorskis	R	15	15			15			
Dr D Burrage	R	14	14			14			
Mr B King	R	14	14			14			
Dr D Williams	R	12		12		12			
Dr K Burns	R	11	11			11			
Dr J Lough	R	11	11			11			
Dr D Barnes	R	10	10			10			
Mr S Spagnol	R	10	10			10			
Dr P Doherty	R	3	3			3			
Mr S Clarke	C	2						2	
Dr R Reichelt	A	5							5
Total		333	283	12	17	312	0	2	19

* Comm - Commercialisation

* Admin - Administration

PROFESSIONAL STAFF CONTRIBUTIONS
AIMS 1993-1998



STAFFING AND ADMINISTRATION CONT'D

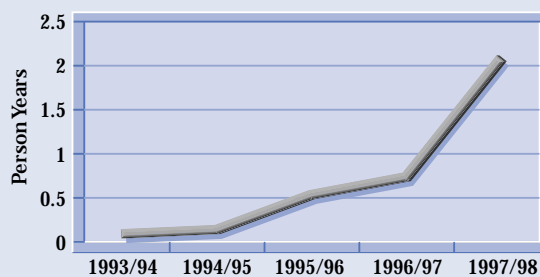
ASSOCIATION OF MARINE PARK TOURISM OPERATORS AND OTHER CONTRIBUTING AGENCIES

Name	Role	Total % of time	% Spent on Research				% Spent on Education	% Spent on Comm*	% Spent on Admin*
			Program			Total			
			1	2	3				
AMPTO									
Mr M Burgess	A	5							5
Mr T Briggs	A	5							5
Mr D Windsor	A	5							5
Sir S Schubert	A	5							5
CSIRO									
Dr B McDonald	R	10		10		10			
Dr A Punt	R	10		10		10			
Dr A D Smith	R	10		10		10			
QCFO									
Mr E Loveday	A	5							5
BTR									
Dr B Jones	R	5		5		5			
FRDC									
Mr A Davidson	R	100		100		100			
Dr D Lou	R	50		50		50			
Total		210	0	185	0	185	0	0	25

* *Comm* - Commercialisation

* *Admin* - Administration

PROFESSIONAL STAFF CONTRIBUTIONS
AMPTO 1993-1998



STAFFING AND ADMINISTRATION CONT'D

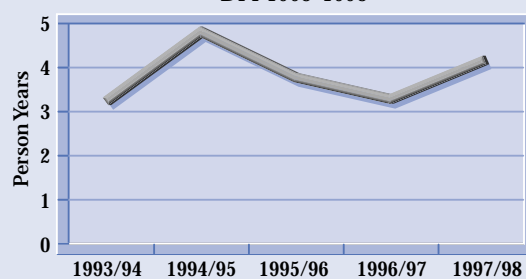
DEPARTMENT OF PRIMARY INDUSTRIES

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	97	97			97			
Dr R Coles	R	28	28			28			
Ms J Mellors	R	25	25			25			
Ms M Samoily	R	45		45		45			
Mr P Daniel	R	50	50			50			
Ms C Roder	R	48	48			48			
Mr A Roelofs	R	28	28			28			
Mr H Malcolm (DoE)	R	5	5			5			
Ms A Cahill	C	4						4	
Dr B Pollock	A	5							5
Total		335	281	45	0	326	0	4	5

* *Comm* - Commercialisation

* *Admin* - Administration

PROFESSIONAL STAFF CONTRIBUTIONS
DPI 1993-1998



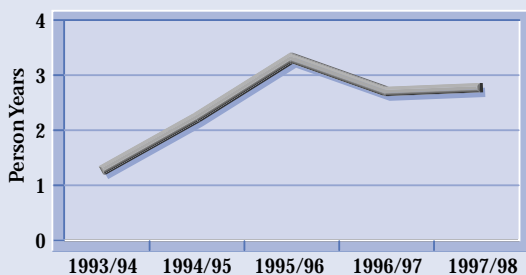
STAFFING AND ADMINISTRATION CONT'D

GREAT BARRIER REEF MARINE PARK AUTHORITY

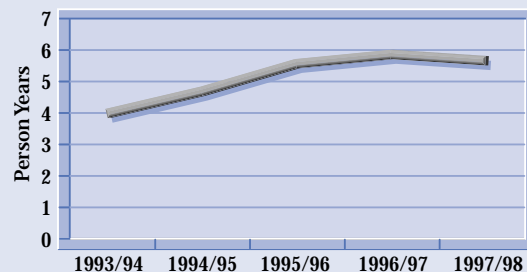
Name	Role	Total % of time	% Spent on Research Program				% Spent on Education	% Spent on Comm*	% Spent on Admin*
			1	2	3	Total			
Mr U Engelhardt	R	55	55			55			
Dr B Mapstone	R	50		50		50			
Mr M Hartcher	R	42	42			42			
Mr R Berkelmans	R	30	30			30			
Dr J Oliver	R	20	15	5		20			
Mr J Robertson	R	20		20		20			
Mr J Brodie	R	10	10			10			
Ms B Breen	R	8		8		8			
Mr J Innes	R	5		5		5			
Mr A Williams	R	5		5		5			
Dr D Wachenfeld	R	3	3			3			
Dr Z Dinesen	R	2		2		2			
Ms D Turner	R	2		2		2			
Mr C Cook	R	1			1	1			
Mr R McGill	R	1		1		1			
Mr M Turner	C	5						5	
Dr R Kenchington	A	10							10
Dr I McPhail	A	10							10
Total		279	155	98	1	254	0	5	20

* Comm - Commercialisation
* Admin - Administration

PROFESSIONAL STAFF CONTRIBUTIONS
GBRMPA 1993-1998



PROFESSIONAL STAFF CONTRIBUTIONS
JCU 1993-1998



STAFFING AND ADMINISTRATION CONT'D

JAMES COOK UNIVERSITY OF NORTH QUEENSLAND

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	50		50		50			
Dr T Hardy	R	40			35	35	5		
Prof H Marsh	R	35		20		20	10		5
Dr L Bode	R	30	30			30			
Prof P Pearce	R	30		25		25	5		
Dr K Woolfe	R	25	20			20	5		
Mr L Mason	R	25			25	25			
Dr P Larcombe	R	25	25			25			
Ms E Fulton	R	25		25		25			
Dr L Murphy	R	25		25		25			
Dr G Russ	R	25		25		25			
Dr E Gyuris	R	15		15		15			
Prof R Volker (UQ)	R	15			15	15			
Dr G Ross	R	10		10		10			
Dr U Kaly	R	10		10		10			
Dr M Fenton	R	6		6		6			
A/Prof C Alexander	R	5	5			5			
Dr P Ridd	R	5	5			5			
A/Prof D Johnson	R	2	2			2			
Prof J H Choat	E	32		5		5	27		
Prof J Patterson	E	7					7		
Dr A Birtles	E	5					5		
Dr D Bowden	E	5					5		
Dr J Holtum	E	5					5		
Dr R Carter	E	5					5		
Dr C Cuff	E	5					5		
A/Prof D Coomans	E	5					5		
Dr T Hughes	E	5					5		
Prof D Griffiths	E	5					5		
Dr B Molony	E	5					5		
Mr S Smithers	E	5					5		
Dr B Willis	E	5					5		
A/Prof O Stanley	E	5					5		
Prof H van Leeuwen	E	5					5		
Dr A Miles	C	50						25	25
Ms K Graydon	C	5						5	
Prof P Arlett	A	7							7
Total		569	87	216	75	378	124	30	37

* Comm - Commercialisation

* Admin - Administration

STAFFING AND ADMINISTRATION CONT'D

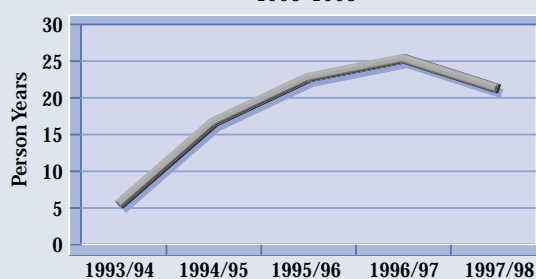
CRC FUNDED STAFF

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 D Lou	JCU	R	50		50		50			
Mr M Gallagher	JCU	R	100			100	100			
Dr G Moscardo	JCU	R	85		85		85			
Mr R Kapitzke	JCU	R	80			80	80			
Mr L Mason	JCU	R	75	50		25	75			
Dr G Inglis	JCU	R	50		45		45	5		
Dr B Mapstone	JCU	R	50		50		50			
Mr M Matheson	JCU	R	50			50	50			
Dr T Preen	JCU	R	50		50		50			
Ms B Woods	JCU	R	25		25		25			
Mr M James	JCU	R	20	20			20			
Ms S Giffney	JCU	C	100						100	
Ms G Brodie	JCU	E	50					50		
Ms A Crump	JCU	A	100							100
Ms A Tucker	JCU	A	100							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			
Dr B Schaffelke	AIMS	R	75	75			75			
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			
Mrs L Arnell	AIMS	A	100							100
Mr D Alcock	GBRMPA	C	100						100	
Prof C Crossland	GBRMPA	A	100						30	70
Mr L McKenzie	DPI	R	100	100			100			
Total			2135	720	505	255	1480	55	230	370

* Comm - Commercialisation

* Admin - Administration

CRC FUNDED PROFESSIONAL STAFF
1993-1998



STAFFING AND ADMINISTRATION CONT'D

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	17.26	8.06	5.56	0.93	14.55	1.24	0.41	1.06
Total Funded by CRC	21.35	7.20	5.05	2.55	14.80	0.55	2.30	3.70
Grand Total	38.61	15.26	10.61	3.48	29.35	1.79	2.71	4.76
Proportion of total professional staff resources in each activity	100	40	27	9	76	5	7	12

* *Comm* - Commercialisation

* *Admin* - Administration

SUPPORT STAFF

(1) Contributed	
Organisation	No. staff (person years)
AIMS	0.75
AMPTO & Others	5.50
DPI	1.48
GBRMPA	0.00
JCU	0.81
Total	8.54

(2) CRC Funded (by employing organisation)	
Organisation	No. staff (person years)
AIMS	3.16
DPI	0.35
GBRMPA	1.6
JCU	6.7
Total	11.81

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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, education and training courses, and activities that contribute to improved public policy and industry development.

The Centre has achieved a high public profile through presentations to various public fora, support of community groups and its contribution to public debate in the media on wise use of the Great Barrier Reef World Heritage Area.

A range of communication, extension and information products and services are used to present research outcomes to stakeholders and industry groups. All staff are actively involved in the Centre's overall communication efforts. As a result, the Centre is well known and respected for its high quality, reliable and relevant research and training programs. The Centre has a Communication and Extension Strategy for its research programs. For further information see Chapter 12 (Performance Indicators).

10.1 PUBLIC DISPLAYS

The Centre organised several marine research displays of posters, tropical aquaria, information lists and student competitions during Science Week in May. A joint GBRMPA, AIMS and CRC display was set up for the Australian Science Festival in Canberra and at the Great Aussie Science Show in Melbourne. Approximately 50,000 young people visited the displays with many entering a tourism industry-sponsored competition to win a free holiday to the Reef.

A similar Science Week display was set up for the Townsville Science Expo which also included a student prize to the Reef. A range of media interviews with CRC marine scientists were broadcast during the week. CRC fisheries research displays were set up during the Townsville Fishing Expo in March and at the Cairns Boat Show in April. Information brochures on water quality and ballast water treatment research were distributed nationally to secondary schools during Seaweed '98.

10.2 CENTRE PUBLICATIONS

Exploring Reef Science Fact Sheets. Seven new brochures featuring CRC research stories were produced and distributed to reef managers, scientists, teachers and industry groups. Approximately 80% of readers say they read most to all of the topics, find all topics interesting and useful, and keep copies for future reference.

CRC Reef Research News. The Centre's bi-monthly newsletter reaches approximately 3000 stakeholders. It includes research updates, staff news, conference reports and features stories. Survey results indicated 86% of people read most articles and rate it as very useful.

CRC Corporate Video: Researching the Reef.

A 15 minute documentary video was produced for Centre staff to help explain their work to various Australian and international audiences. Approximately 400 copies have been distributed, many now being used by tourism operators to screen to their guests, and as a staff training resource.





CRC Technical Reports. At the conclusion of most research tasks, a final report is produced and distributed to key stakeholders and public libraries. Research results, implications for industry and public policy and recommendations are included. Six reports were published and used as the basis of meetings, workshops, publicity and public presentations.

CRC Postgraduate Student Handbook. The Centre produced a policy and guide book for all postgraduate students to assist with their involvement in various Centre functions such as scholarships, thesis writing and industry placements.

Effects of Line Fishing Newsletter. The Effects of Line Fishing Project produced a quarterly newsletter to update commercial and recreational fishers, community groups and reef managers on issues relating to this major research effort. Approximately 1800 copies were circulated for each edition. All other publications, scientific reports and research papers are listed in Chapter 9.

Reef Watch Television Broadcasts. Following the successful broadcast of *Reef Brief*, a series of commercial radio announcements on the Great Barrier Reef played throughout 1995-6, CRC Reef Research Centre, GBRMPA and Channel 10 collaborated to produce a similar weekly series for television. The series, called *Reef Watch*, covered contemporary marine science,



ecology and management issues. Topics included research into screw anchor systems, cyclones, coral trout spawning, effects of nutrients and visitor trends to the reef.

Each topic was broadcast (with additional local sponsorship from Quicksilver Connections and FantaSea Cruises) on the Channel 10 television network throughout north Queensland, from stations in Cairns, Townsville and Mackay. New topics appeared in prime time after the evening news and were usually repeated for several days. The free series was valued at approximately \$86,000 for the year. Prime time broadcast periods and additional slots on the network were equivalent to \$2,600 per week worth of advertising. The series reached

an estimated weekly audience of 60,000 people – based on prime time ratings of the station's marketshare for evening news.

9.3 MEDIA ACHIEVEMENTS

The Centre's media monitoring service shows similar levels of CRC media publicity this year. Accurate and positive publicity between 1 July 1997 to 30 June 1998 is grouped below with previous year shown in brackets:

	Local	State/National	International
Print	74 (170)	75 (92)	8 (11)
Radio	55 (94)	14 (36)	1 (1)
Television	7 (36)	135 (15)*	2 (0)

* includes 120 *Reef Brief* announcements

The Centre received less controversial media attention this year. Due to the efforts of the Director, Leaders of Programs 2 and 4, the Project Leader of the Effects of Line Fishing Project and other members of the Centre, manipulative research in protected and environmentally sensitive areas was the subject of the Fenner Conference in November, from which national principles and guidelines for the ethical conduct of such research were published by ASTEC in May. Much of the Centre's media planning and publicity is undertaken in association with GBRMPA, QDPI, AIMS and JCU.

Staff of the Centre led much of the public debate about Reef issues through the media this year, on topics such as coral spawning, coral bleaching, and the creation of snorkel trails to limit any inadvertent damage which divers may cause. Many journalists now regard the Centre as a reliable source of knowledge about marine research in general, and make it their first point of call.

In addition, media staff continued an active campaign of releasing news of research outcomes, research in progress, and ensuring the support and engagement of a well-informed general public in all matters pertaining to the GBR. This has included, for instance, 25 separate interviews with ABC Radio 4QN during the year, which were frequently syndicated to all regional ABC stations adjacent to the Reef, and often to other, national ABC strands.

As an example of effective media coverage, publicity for the ballast water treatment task was independently assessed as having a commercial value equivalent to \$55,000. Using press clippings and audience share on radio and television, this estimate of comparative advertising costs was calculated by Media Plus (Qld). It represents the wide public exposure and cost savings the Centre is able to make communicating many research projects and issues to the public.



Environment Sector CRC Booklet. The Centre coordinated the production and launch of a national booklet highlighting significant Australian environmental research by 13 CRCs. The booklet, *Exploring CRC Research*, was launched by the Hon. John Moore, Minister for Industry, Science & Technology at the National CRC Association Conference in Adelaide in April. 26,000 copies of the booklet were distributed nationally and internationally to politicians, environmental managers, industry groups, conservation organisations, the media and educational institutions.

World Wide Web (www.gbrmpa.gov.au/~crrcreef). The Centre updated its website, CRC Reef Research Online, to include summaries of its technical reports, scientific papers, research tasks, special feature stories and news updates. The site is linked to many other related websites and was recognised as an excellent reference in the Australian Broadcasting Commission and the International Reef Resource Page websites. CRC Reef Research Online had more than 90,000 'hits' during the year and is becoming known as a respected reference tool by students, scientists and natural resource managers around the world.

Student Communication Training. As communication skills in report writing, public presentations and the media are becoming more important for tertiary students, the Centre organised several short courses to help train postgraduates in these areas. Two CRC students were sponsored to participate in a media skills course and 3 for a science writing course during the year. The Centre also sponsored a Marine Science Journalism competition for all students at James Cook University and Central Queensland University to encourage professional reporting of a contemporary Reef issue. Two \$1,000 prizes were awarded from more than 20 entries.

National CRC Program Publicity. The Centre jointly organised a national CRC communication planning workshop held at Robinson, NSW in September. More than 30 representatives from different CRCs attended to coordinate national exhibition, media, publicity, and training opportunities for the CRC Program. Assistance was also provided to the CRC Association to develop a national strategy promoting CRC achievements, and in the employment of a part-time communication consultant. As a result, communication staff in each CRC sector are collaborating more on various public contact projects.

The Centre's website design, communication strategy and science feature brochures were used as models by 10 other CRCs for their information transfer programs.



Visits. The Centre hosted visitors from government, industry and other research organisations during the year. Visitors included: Dr Peter Bridgewater, Chief Science Adviser, Environment Australia; Dr William Erb, IOC, Paris; Dr Yaeko Masuchi, Research Center for Advanced Science and Technology, University of Tokyo; Dr Anugerah Nontji, Deputy Chairman for Natural Sciences, Indonesian Institute of Sciences; Mr Chris Irons, Centre for Resource and Environmental Studies, Australian National University; Prof Marc Herselman, School of Marine Affairs, University of Washington and Mr Duncan Kerr, Shadow Environment Minister, Australian Labour Party.

Conference Participation. Conferences and major public meetings are vital, disseminating research results and raising awareness about the Centre's programs, activities and aims. During the year, staff and students participated in a total of 60 national and 29 international conferences and major meetings.

'Unsung Hero Award' to Director. An award was made to Professor Chris Crossland for his contributions in communicating marine science issues to the Australian public. The 'Unsung Hero of Australian Science' Award was presented to Professor Crossland by the Australian Association of Science Communicators in February. The award was made for his outstanding contribution in making Great Barrier Reef science relevant to everyday Australians, and for encouraging other scientists to speak out.

Professor Crossland took a leading part in organising the 1997 Fenner Environment Conference, a special meeting of the Academy of Science, where 200 participants examined ethical issues associated with experiments in high value conservation areas. Throughout his directorship he strongly encouraged all Centre staff to be more active in communicating their work to stakeholder and client groups.

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- Sweatman, H.P.A. (1998) *The 2nd AIMS Status Report on the Great Barrier Reef*. Great Barrier Reef Marine Park Authority, 15 April 1998.

CONFERENCE ATTENDANCE

International

- Done, T. (1997) *Reefs at Risk Workshop*. ICLARM, Manila, Philippines, 24-25 September 1997.
- Done, T. (1997) *Coral Reef Resilience Workshop*, Beijer Institute, Swedish Academy of Science, 8-10 October 1997.

National

- Crossland, C.J. (1997) *Ethics of research and management practices in World Heritage and other environmentally sensitive areas: policy and practice*. Australian Academy of Science Fenner Conference on the Environment, Canberra, 26-28 November 1997. (Session Chair)
- Crossland, C.J. (1998) *University Science: Crisis or Crossroads?* Federation of Australian Scientific and Technological Societies National Forum, Canberra, 25 February 1998. (Rapporteur)
- Fernandes, L. (1997) *Dugong Cooperative Management Working Group Meeting*, Magnetic Island, 9-10 December 1997.
- Furnas, M. (1997) *Sugar Research and Development Corporation workshop on off-farm water flows* (informal workshop to prioritize SRDC environmental research priorities), 22 December 1997.
- Furnas, M. (1998) *Verification of Ballast Water Replacement Workshop*. AQIS, Melbourne, 3 March 1998.
- Lee Long, W.J. (1997) *Oil Spill Response*. Cairns Training Workshop, Administration Support Staff: Cairns, September 1997.
- Mapstone, B.D. (1997) *Ethics of research and management practices in World Heritage and other environmentally sensitive areas: policy and practice*. Australian Academy of Science Fenner Conference on the Environment, Canberra, 26-28 November 1997.
- McKenzie, L.J. (1997) *National Seagrass Workshop*. Environment Australia, Canberra, 7-8 September 1997.

11. GRANTS & AWARDS

GRANTS

Researcher & Organisation	Title of Grant	Source	Period of Grant	\$
Prof Helene Marsh (JCU)	Pew Fellowship in Marine Conservation	Pew Foundation	3 years	US\$150,000
Ms Jo-Anne Cavanagh (AIMS)	SETAC/Taylor & Francis Advanced Training Fellowship	Society for Environmental Toxicology & Chemistry	4 months	US\$9950
Ms Jo-Anne Cavanagh (AIMS)	International Student Prize	Australian Marine Science Association	international conference	4,000
A/Prof Garry Russ (JCU)	Marine Fisheries Reserves	Australian Research Council	2 years	195,000
Drs Piers Larcombe & Ken Woolfe & Mr Scott Smithers (JCU)	Evolution of a Turbid Water Reef	Australian Research Council	1 year	20,000
Mr Paul Marshall & Mr Andrew Baird (JCU)	GBRMPA Bleaching Research Grant	Great Barrier Reef Marine Park Authority	1 year	1,860
Dr Graeme Inglis (JCU)	Merit Research Grant	James Cook University	1 year	8,000
Drs Michelle Waycott & Graeme Inglis (JCU)	The development of techniques for assessing population genetic structure in tropical seagrasses	Australian Research Council	2 years	18,000
Mr Darren Oemcke (JCU)	Merit Research Grant	James Cook University	1 year	4,000
Mr Ken Anthony	Supplementary PhD Award	CSIRO Marine Division of Fisheries	1 year	10,000
Dr G De'ath (JCU)	Postgraduate Merit Award	James Cook University	1 year	1,280
Mr Jake Kritzer (JCU)	Augmentative Grant	Great Barrier Reef Marine Park Authority	1 year	1,400
Dr Ken Woolfe & Mr Andrew Heap (JCU)	Age of Whitsunday Sediments	AINSE	1 year	3,350
Dr Bruce Mapstone (CRC/JCU) (Principal Investigator) plus ELF Task Leaders	The effects of line fishing on the GBR and evaluation of potential management strategies	FRDC	1 year	231,059
Dr Bruce Mapstone (CRC/JCU) (Principal Investigator) plus Dr Campbell Davies, Dr Glenn De'ath & Mr John McKinlay	The effects of live fish capture and targeting of spawning aggregations on logbook catch rate data in the GBR commercial demersal line fishery	FRDC	1 year	73,429
Dr Norm Duke (AIMS)	Fate and effects of oil and dispersants on mangroves in Australia: protection, clean-up and rehabilitation	ERDC/APPEA	1 year	38,000
Prof Helene Marsh (JCU)	Distribution and movements of dugongs in the Hinchinbrook region and their relationship to boat traffic	DEST	1 year	88,000
Ms Elizabeth Fulton (JCU)	1998 Shell Postgraduate Scholarship	Shell Australia	3 years	60,000

AWARDS

Title of Award	Researcher or Organisation	Description
Unsung Hero of Australian Science Award	Prof Chris Crossland	Outstanding contribution in making GBR science relevant to everyday Australians and encouraging scientists to speak more with public
AMSA Jubilee Award	Prof Howard Choat	Lifelong excellence in marine research and education; significant contributions to knowledge and taxonomy of marine organisms
DPI Client Services Team Award 1997	Seagrass Ecology Group, Northern Fisheries Centre	Excellence in seagrass research, delivery of expert advice and contributions to advances in fisheries and fish habitat management

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				
A. COOPERATIVE ARRANGEMENTS		1993/4	1994/95	1995/96	1996/97	1997/98
■ Industry partners involved in program logistics	Operators	6	21	35	35	33
■ Development of collaboration with other research groups (see Section 4.2)	Universities	5	6	7	14	16
	TAFE Colleges			4	5	12
	CSIRO Divisions	3	4	5	4	5
	Gov't/industry	3	15	31	60	74
	Marine Research Agencies	2	3	4	12	8
■ 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 Section 4.2)					
■ Development of involvement by fishing industry	Yes; a high level of liaison and involvement in the Effects of Fishing project. (see Sections 4.2 and 7.2)					
■ National and international recognition of the success of CRC approach	Liaison/advice over CRC approach to representatives from Malaysia, Indonesia, USA, UK, Thailand, Korea. Centre model proposed as a core structure in Indonesia and United Kingdom. (see Section 4.3)					
B. RESEARCH AND RESEARCHERS		1993/4	1994/95	1995/96	1996/97	1997/98
■ Refereed papers accepted (see Chapter 9)		29	31	50	92	111
■ Invitations to present keynote/plenary papers in the name of the CRC		9	10	11	15	10
■ Research papers presented (see Chapter 9)		49	59	115	115	100
■ Presented/published papers on the practical application of CRC findings (see Chapters 9 and 10)		56	59	78	153	120
■ Recognition by the communications media (see Section 9.3)	TV	23	33	34	51	24
	radio	11	20	50	131	75
	print	10	91	175	273	163
	Frequent requests for comments on Great Barrier Reef issues					
■ Industry product design produced (see Sections 7.1, 7.2, 7.3, 7.4)	Diver Awareness course, Heritage and Interpretive Tourism Training Course, Endangered Species Awareness Course, COTS Control Program, Integrated Coastal Zone Planning & Management Training Course, Seagrass Watch Community Monitoring Program					
■ Management tools produced (see Sections 7.1, 7.2, 7.3, 7.4)	Oil spill risk assessment model, reefal site selection model, QFMA fisheries assessments, information underpinning Shoalwater, Hinchinbrook, Cairns Management Plans, Tourism Segmentation and Database for Central and Cairns Sectors, RT2005 Strategic Action Plan, Information Support System for Reef Planning.					

PERFORMANCE INDICATORS CONT'D

C. EDUCATION AND TRAINING (see Chapter 6)

	1993/4	1994/95	1995/96	1996/97	1997/98
■ Graduate students aligned with CRC	12	46	61	77	84
■ Higher degrees awarded	N/A	2	3	2	6
■ Short courses conducted	5	6	7	11	20
■ Industry briefing workshops conducted	17	20	36	>70	>70
■ Industry employment of CRC-aligned graduates	N/A	N/A	2	4	6

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 INTROMARC & AMSAT
■ Application by industry of CRC products	Implementing Diver Awareness course, Volunteer Monitoring Handbook by PADI and tourism operators; Regional tour operators employ HIT course graduates; Contracts and consultancies, and key research findings, notably RT2005; Live fish holding tanks redesign; Improved permanent screw anchors; New PADI Research Diver course
■ Implementation by partners of environmental management products	Yes; tools include COTS control and diver protocols. Use of educational and informational products by tourism and fishery industries. Seven staff members input to ASTEC's <i>National Principles and Guidelines for the Ethical Conduct of Research in Protected and Environmentally Sensitive Areas</i> . Integrated database used for Cairns Area Plan of Management. Aerial surveillance system for dugongs.
■ 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.

E. MANAGEMENT AND BUDGET (see Chapter 8)

	1993/4	1994/95	1995/96	1996/97	1997/98
■ Increase in % commitment by Centre staff	N/A	15.68	6.62	3.34	-4.00
■ Satisfactory increase in collaboration with researchers outside the CRC	non-CRC researchers - national - International	19 14 5	32 23 9	48 40 8	112 84 28
■ Board endorsement of Centre management and operation	Approved strategic plans and activity, operational base and research direction.				
■ Great Barrier Reef Consultative Committee endorsement of Centre management and operation	Operational Plan endorsed and a dynamic of advice to Centre of further issues and concerns. The GBR CC did not formally meet during the year.				
■ 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	Agreement 1997/98	Actual	Agreement	Agreement 1998/89 (\$1992/93)	Estimate 1998/99	Agreement 1999/00 (\$1992/93)	Estimate 1999/00	Total* 7 Yrs	Agreement 7 Yrs	Variance 7 Yrs
AIMS															
Salaries	357	410	402	524	350	370	2,043	1,841	371	375	372	375	2,793	2,584	209
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	823	1,218	1,385	1,684	1,149	753	6,259	3,612	753	1,100	753	1,100	8,459	5,118	3,341
Total	1,180	1,628	1,787	2,208	1,499	1,123	8,302	5,453	1,124	1,475	1,125	1,475	11,252	7,702	3,550
TOURISM INDUSTRY (Represented by AMPTO & Others)															
Salaries	7	24	24	43	326	9	424	45	9	45	9	45	514	63	451
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	31	91	153	172	213	51	660	245	44	55	44	55	770	333	437
Total	38	115	177	215	539	60	1,084	290	53	100	53	100	1,284	396	888
GBRMPA															
Salaries	93	138	167	166	200	129	764	645	129	130	129	130	1,024	903	121
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	88	126	157	162	188	121	721	605	121	125	121	125	971	847	124
Total	181	264	324	328	389	250	1,486	1,250	250	255	250	255	1,996	1,750	246
JCU															
Salaries	289	374	458	475	476	454	2,072	2,270	454	476	454	476	3,024	3,178	(154)
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	633	710	932	887	828	717	3,990	3,643	717	800	717	80	5,590	5,077	513
Total	922	1,084	1,390	1,362	1,305	1,171	6,063	5,913	1,171	1,276	1,171	1,276	8,615	8,255	360
QDPI															
Salaries	100	157	685	119	227	151	1,288	755	151	160	151	160	1,608	1,057	551
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	136	228	237	158	306	223	1,065	1,115	223	250	223	250	1,565	1,561	4
Total	236	385	922	277	534	374	2,354	1,870	374	410	374	410	3,174	2,618	556
TOTAL IN-KIND CONTRIBUTIONS															
Salaries	846	1,103	1,736	1,327	1,580	1,113	6,592	5,556	1,114	1,186	1,115	1,186	8,964	7,785	1,179
Capital	0	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	1,865	12,696	9,220	1,858	2,330	1,858	2,330	17,356	12,936	4,420
Grand Total In-Kind	2,557	3,476	4,600	4,390	4,265	2,978	19,288	14,776	2,972	3,516	2,973	3,516	26,320	20,721	5,599

* Total = Cumulative Actual + Outyear 'Estimate'

BUDGET CONT'D

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

							Cumulative Total To Date						Grand Total		
Actual 1993/94	Actual 1994/95	Actual 1995/96	Actual 1996/97	Actual 1997/98	Agreement 1997/98	Actual	Agreement	Agreement 1998/89 (\$1992/93)	Estimate 1998/99	Agreement 1999/00 (\$1992/93)	Estimate 1999/00	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	0
Tourism Industry (Rep by AMPTO)	500	750	810	875	945	945	3,880	3,880	1,020	1,020	1,102	1,102	6,002	6,002	0
GBRMPA	665	671	672	669	665	665	3,342	3,325	665	665	665	665	4,672	4,655	17
JCU	100	0	40	0	0	0	140	100	0	0	0	0	140	100	40
QDPI	100	0	0	0	0	0	100	100	0	0	0	0	100	100	0
Total Cash from Participants	1,365	1,421	1,522	1,544	1,610	1,610	7,462	7,405	1,685	1,685	1,767	1,767	10,914	10,857	57
OTHER															
Interest	13	21	53	21	17	0	125	0	0	20	0	20	165	0	165
Industry	0	0	129	168	75	0	372	0	0	9	0	0	381	0	381
Research Grants	82	25	0	160	94	0	361	0	0	48	0	6	415	0	415
FUNDING FROM THE CRC GRANT															
1,134	1,520	2,656	2,151	2,200	2,000	9,661	8,955	2,000	2,184	2,000	2,095	13,940	12,955	985	
TOTAL CRC CASH CONTRIBUTION															
2,594	2,987	4,360	4,044	3,996	3,610	17,981	16,360	3,685	3,946	3,767	3,888	25,814	23,812	2,002	
Cash carried over from previous year															
1,016	1,092	934	627	627		3,669		728		139		4,536			
Less Unspent Balance															
1,016	1,092	934	627	728		4,397		139		0		4,536			
TOTAL CASH EXPENDITURE															
1,578	2,911	4,518	4,351	3,895	3,610	17,253	16,360	3,685	4,535	3,767	4,027	25,814	23,812	2,002	
ALLOCATION OF CASH EXPENDITURE BETWEEN HEADS OF EXPENDITURE															
Salaries	894	1,222	1,914	1,952	1,765	1,907	7,748	8,119	1,921	2,041	1,994	1,812	11,600	12,034	(434)
Capital	50	93	80	59	0	0	282	225	0	0	0	0	282	225	57
Other	634	1,596	2,524	2,340	2,130	1,703	9,223	8,016	1,764	2,494	1,773	2,215	13,932	11,553	2,379
Total	1,578	2,911	4,518	4,351	3,895	3,610	17,253	16,360	3,685	4,535	3,767	4,027	25,814	23,812	2,002

* Total = Cumulative Actual + Outyear 'Estimate'

BUDGET CONT'D

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

							Cumulative Total To Date						Grand Total		
Actual 1993/94	Actual 1994/95	Actual 1995/96	Actual 1996/97	Actual 1997/98	Agreement 1997/98	Actual	Agreement	Agreement 1998/89 (\$1992/93)	Estimate 1998/99	Agreement 1999/00 (\$1992/93)	Estimate 1999/00	Total* 7 Yrs	Agreement 7 Yrs	Variance 7 Yrs	
GRAND TOTAL															
In-Kind Expenditure	2,558	3,476	4,600	4,390	4,265	2,978	19,288	14,776	2,972	3,516	2,973	3,516	26,320	20,721	5,599
Cash Expenditure	1,578	2,911	4,518	4,351	3,895	3,610	17,253	16,360	3,685	4,535	3,767	4,027	25,815	23,812	2,003
Total Resources Applied to Activities of Centre	4,136	6,387	9,118	8,741	8,159	6,588	36,540	31,136	6,657	8,051	6,740	7,543	52,134	44,533	7,601
ALLOCATION OF TOTAL RESOURCES															
Total Salaries (Cash & In-Kind)	1,741	2,325	3,650	3,279	3,345	3,020	14,340	13,675	3,035	3,227	3,109	2,998	20,565	19,819	746
Total Capital (Cash & In-Kind)	50	93	80	59	0	0	282	225	0	0	0	0	282	225	57
Total Other (Cash & In-Kind)	2,345	3,969	5,388	5,403	4,815	3,568	21,919	17,236	3,622	4,824	3,631	4,545	31,288	24,489	6,799

* Total = Cumulative Actual + Outyear 'Estimate'

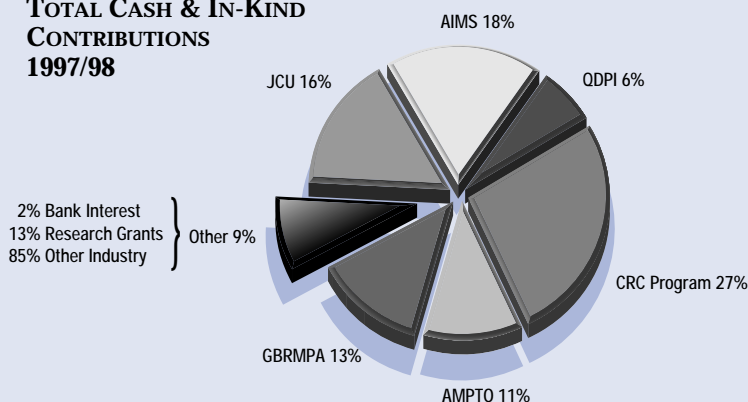
**TABLE 4 : ALLOCATION OF RESOURCES
BETWEEN CATEGORIES OF ACTIVITIES**

PROGRAM	Resource Usage			
	\$ CASH ⁽¹⁾ (<i>'000s</i>)	\$ IN-KIND (<i>'000s</i>)	STAFF CONTRIBUTED ⁽²⁾	STAFF FUNDED BY CRC ⁽²⁾
RESEARCH	2,803	3,906	14.05	15.30
EDUCATION	331	200	1.24	0.55
EXTENSION/TRAINING	395	27	0.41	2.30
ADMINISTRATION	366	132	1.06	3.70
Total	3,895	4,265	16.76	21.85

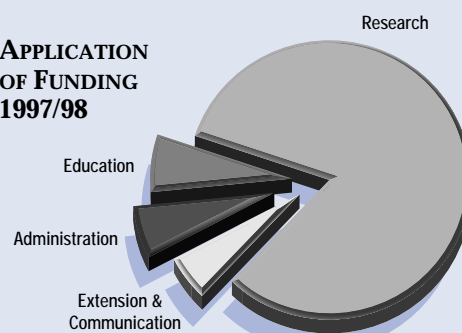
(1) Cash from all sources, including CRC Program

(2) Person years, Professional staff

TOTAL CASH & IN-KIND CONTRIBUTIONS 1997/98



APPLICATION OF FUNDING 1997/98



NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENT

Basis of accounting

The Financial Statement (Tables 1-4) was prepared on the accrual basis of accounting.

Capital Purchases

In 1997/98, there were no capital equipment purchases.

Receipts - Partners

\$945,000 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 1997 to 30 June 1998. James Cook University adopts a four-weekly financial reporting cycle and has reported from the 14 June 1997 to the 12 June 1998, being the end of the four-weekly cycle immediately prior to 30 June 1998.

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 1998/99 and 1999/00 are not Board-approved estimates and are based on current income and expenditure determinations. A revised 1998/99 Budget will be submitted to the Commonwealth following allocations made at a Board meeting to be held in August 1998. Major in-kind resource allocations will also occur in association with the disbursement of these funds to the Parties.

Unexpended Balance

The amount of \$728,062 on hand consists of (i) \$287,006 Unexpended Research Advances to Parties and (ii) Funds at Bank \$441,055 which includes advance payments to the Centre and planned cash reserves for projects in 1998/99. 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.

AIMS In-Kind Salaries Contribution

Salaries of AIMS employees have been calculated under the 'Australian Institute of Marine Science Certified Agreement 1998-2000'. The Agreement outlines salary increases to be backdated to the fifth of February 1998 for all employees which has been included in the in-kind contribution. This has resulted in an increase of \$6,000. The Agreement was unsigned at the date of the audit and is to be voted on and finalised by 31 August 1998.

**AUDITORS REPORT TO
THE COOPERATIVE RESEARCH CENTRES SECRETARIAT,
DEPARTMENT OF INDUSTRY, SCIENCE AND TOURISM
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 1997

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 1998 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 1998 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).

2. 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)).
3. 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	\$4,815,000	\$3,568,000	\$1,247,000	34.95%

4. Capital Items acquired from the Grant and Researcher's Contributions are vested as provided in the Joint Venture Agreement (Clause 5(3)).
5. 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)).
6. 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

MP

Ken Pickard

Dated:

17 July, 1998

ABBREVIATIONS

List of Organisational Abbreviations

ACRS	- Australian Coral Reef Society
AIMS	- Australian Institute of Marine Science
AINSE	- Australian Institute of Nuclear Science & Engineering
AMCS	- Australian Marine Conservation Society
AMPTO	- Association of Marine Park Tourism Operators
AMSA	- Australian Marine Science Association
AMSAT	- Australian Marine Science & Technology Ltd
APPEA	- Australian Petroleum Production & Exploration Association
ASTEC	- Australian Science, Technology and Engineering Council
BHP	- The Broken Hill Proprietary Company Limited
BTR	- Bureau of Tourism Research
DOE	- Department of Environment
ERDC	- Energy Research & Development Corporation
FRDC	- Fisheries Research Development Corporation
GBRMPA	- Great Barrier Reef Marine Park Authority
IGBP	- International Geosphere-Biosphere Programme
JCU	- James Cook University
LOICZ	- Land-Ocean Interactions in the Coastal Zone
OUCH	- Order of Underwater Coral Heroes
PADI	- Professional Association of Dive Instructors
PCQ	- Ports Corporation of Queensland
QCFO	- Queensland Commercial Fishermen's Organisation
QFMA	- Queensland Fisheries Management Authority
QDPI	- Queensland Department of Primary Industries
ReefMAC	- Reef Line Fishing Management Advisory Committee
RMIT	- Royal Melbourne Institute of Technology
SARDI	- South Australian R & D Institute
USGS	- United States Geological Survey

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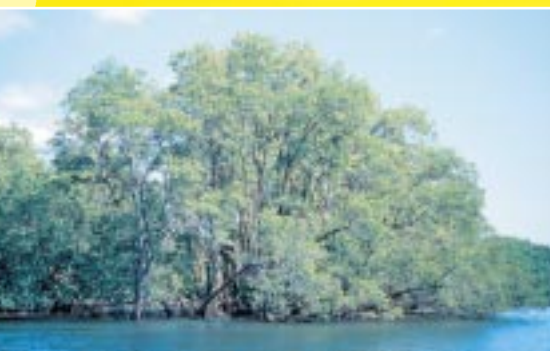
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MANGROVES