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NEWSLETTER  
OF THE  
RESEARCH  
AND  
MONITORING  
SECTION

# REEF RESEARCH



Great Barrier Reef  
Marine Park  
Authority

VOLUME 4 - No. 3 SEPTEMBER 1994

## EDITORIAL

There is certainly a mixed bag of offerings in this issue of *Reef Research*. COTS COMMS describes the 'big picture' for 1992-93 as well as examining a number of the outcomes of the past five years of research. The Lassig/Engelhardt team assure me that this is the tip of the outcomes iceberg so readers can look forward to further interesting reading in the coming months. They also write about the policy of controlling starfish populations which has been an area of controversy for many years. Basically, unless it can be shown that outbreaks are human-induced, then starfish have rights too.

Readers may not be aware that a review of the zoning arrangements for the Far Northern Section of the Marine Park is presently underway and expected to be completed by the end of 1996. An article by Joan Phillips describes the process. There will be a number of phases of public consultation before a draft plan is prepared but it is probably appropriate for interested parties (including vicarious users) to start to think about how this unique part of the world should be managed during the term of the new zoning plan, which may be for six or seven years after declaration. As is the case for the rest of the Marine Park, the Section will be zoned for multiple use and the plan will, with a few exceptions, allow all uses to occur but at different levels in different zones. The plan will, therefore, be most concerned with levels of permitted uses. Given the remoteness of the area, there may be a tendency to think that this alone would protect it from over-development (whatever that level may be). I don't think that this is a wise assumption given the rapid increase in usage in the rest of the Park and I urge people to think about the balance that will need to be made between the industries using the Far Northern Section and Australia's commitment to ecologically sustainable use, habitat protection and the maintenance of biodiversity. This Authority manages the Park on behalf of all Australians, indeed for the world, and the management arrangements that are put in place can only reflect the inputs that have been made by you. Have your say when the opportunity arises.

On a different note, Beryl Dennis has retired from the dreaded working life (well she won't be getting paid for her work) and has left the Authority. Beryl was one of GBRMPA's longest serving employees and will be missed by many. I would like to thank her personally for all the assistance she has given me over the years and wish her every happiness in her retirement.

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Over the last three years we have introduced you to the staff of the Research and Monitoring Section of the Great Barrier Reef Marine Park Authority. Now, as we have come to the end of the list of staff, we will be introducing to the members of the CRC Reef Research Centre. We will, of course, continue to keep you up to date with new members of staff in Research and Monitoring.

The CRC Reef Research Centre is a joint venture involving several organisations. These organisations will be profiled in *Reef Research* over the next few issues.

### Association of Marine Park Tourism Operators (AMPTO)

The Association of Marine Park Tourism Operators was formed in November 1988 to represent the views of those operators providing tourism services in the Great Barrier Reef Marine Park on all matters concerning their operations. It is recognised by Governments, both State and Federal, and their agencies, as the spokesman for the industry.

Membership of the Association includes all areas of tourism activity on the Reef, for example day tours, extended cruising, diving, charters, bareboat charters, aviation, game fishing and the resort islands.

The Association is a core Member of this Cooperative Research Centre and provides four members of its Board; namely Mike Burgess (Chairman, AMPTO), David Hutchen (Deputy Chairman, AMPTO), Tom Stratton (P&O Resorts) and Keith Nielson (Executive Director, AMPTO). Contact numbers for the Association are: Telephone (06) 299 5631  
Fax (06) 299 5632.



An unincorporated joint venture between:  
 Association of Marine Park Tourism Operators  
 Australian Institute of Marine Science  
 Great Barrier Reef Marine Park Authority  
 James Cook University  
 Department of Primary Industries  
 established under the  
 Cooperative Research Centres Program

## Update

Chris Crossland

### Priority Setting for the Centre

A team of Reef managers, scientists and tourism operators met last June to identify Areas of Research Opportunity (ARO) for the Centre's program.

Priority setting is probably the central issue in research management - working out which issues should be supported and which should be wound back. Using CSIRO guidelines, the CRC team are developing a methodology for reaching group consensus on the Centre's research priorities.

Fourteen areas were listed, each with a 'champion' to coordinate descriptive data and evaluation information about each issue. Key statistics, including dollar values, numbers of people involved and geographic information will be gathered as well as potential benefits to industry and managers concerned with the Great Barrier Reef region.

The fourteen ARO's and 'champion' coordinators are:

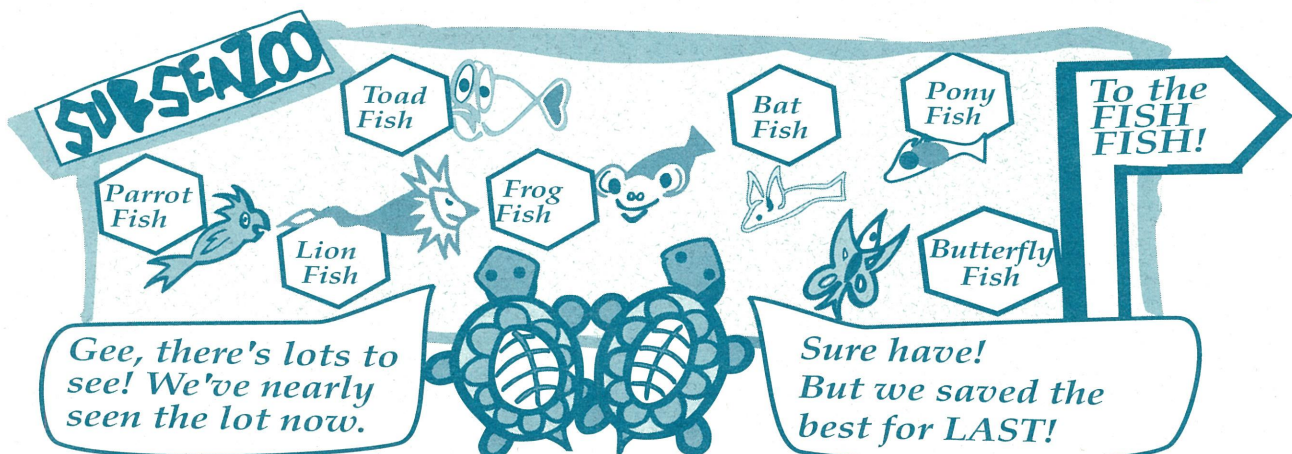
### Identified Areas of Research Opportunity (ARO)

1. Availability and status of resources - what is at stake? - knowledge base of environment and users  
 'Champion' Terry Done  
 Organisation AIMS<sup>1</sup>
2. Benefits of uses (including non-use)  
 'Champion' Helene Marsh  
 Organisation JCU<sup>2</sup>
3. Expectations of users  
 'Champion' Helene Marsh  
 Organisation JCU
4. Fishing  
 'Champion' Simon Woodley  
 Organisation GBRMPA<sup>3</sup>

### Coralations

### Tanked

### Pongase



5. Agriculture  
'Champion' Simon Woodley  
Organisation GBRMPA
6. Tourism  
'Champion' Zena Dineson  
Organisation GBRMPA
7. Other land-based activities  
'Champion' Simon Woodley  
Organisation GBRMPA
8. Natural phenomena  
'Champion' Terry Done  
Organisation AIMS
9. Capacity to measure change (monitoring)  
'Champion' Helene Marsh  
Organisation JCU
10. Engineering  
'Champion' Archie Johnston  
Organisation JCU
11. Efficiency, Equity, Adaptability, Impacts of Management  
'Champion' Zena Dineson  
Organisation GBRMPA
12. Carrying Capacity  
'Champion' Keith Nielson  
Organisation AMPTO<sup>4</sup>
13. Costs (including lost opportunities)  
'Champion' Mike Burgess  
Organisation AMPTO
14. Maintenance of opportunities (reasonable range)  
'Champion' Jon Day  
Organisation QDEH<sup>5</sup>

- |   |        |   |
|---|--------|---|
| 1 | AIMS   | Australian Institute of Marine Science            |
| 2 | JCU    | James Cook University of North Queensland         |
| 3 | GBRMPA | Great Barrier Reef Marine Park Authority          |
| 4 | AMPTO  | Association of Marine Park Tourism Operators      |
| 5 | QDEH   | Queensland Department of Environment and Heritage |

## Extension and Training Plan

A twelve-month plan to develop interactive communication and training programs between the Centre's partners and client groups has been finalised. Don Alcock, who has temporarily left GBRMPA to manage the CRC Reef Research Centre Extension and Training Program, has developed the plan with input from various groups. Don believes the term extension means a 'coordinated advisory service providing information exchange between Reef management, research, user and industry groups'. It is also 'a system of direct contact between management and user groups which aims to encourage responsible behaviour of Reef user groups and a change in user practices'.

The Queensland Department of Primary Industries have developed a very useful definition of extension as 'the use of communication processes to identify and assist change in the decisions of its target population without coercion'.

The results of extension will include:

- inputs into policy, legislative, technological and industry development,
- assisting people to identify and solve problems,
- education and training, and
- information and technology transfer.

A summary of the CRC Extension and Training Program for the next year includes:

### Communication

- Develop industry technical/extension advisory groups to assist in program delivery
- Undertake or facilitate social market research for Centre programs
- Develop a communication network
- Promote the Centre, its programs and staff
- Facilitate internal communication
- Facilitate and promote liaison with industry and media

### Training

- Identify training needs of CRC staff and provide skills workshops for effective

communication with client groups

- Develop non-technical short courses to improve understanding of Reef research, ecology and management issues for client groups
- Present courses using Centre resources or by contract with agencies such as TAFE

### Community Education

- Facilitate preparation and distribution of quality written and audio-visual materials
- Assemble technical output from the Centre into information packages for target groups

- Arrange preparation of technical posters and visual displays
- Promote Centre staff presentations at seminars, workshops and industry meetings

It is a very strong view of the CRC Reef Research Centre's Extension Advisory Group that extension is seen in its broadest context, that is, as 'facilitators of change' in the Great Barrier Reef region.

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# THE SIRENS PROJECT

## Study of Inshore Reefs under Enhanced Nutrients and Sediments

*Terry Done*  
*Steering Committee Convenor*

A major issue for the conservation and ecologically sustainable development of the Great Barrier Reef is whether land run-off has already reduced water quality enough to contribute to degradation of coral reefs, or whether present trends may in future lead to such degradation. A wide range of research and management agencies are currently addressing elements of this issue: CSIRO, QDPI, QDEH, AIMS, GBRMPA and universities in Queensland and NSW.

The SIRENS Project, an initiative of the CRC Reef Research Centre, will initiate its own research, and seek to maximise the effectiveness of those elements of the research concerning coral reef responses to water quality variations. Planned for commencement in 1996-97, SIRENS is proposed to be a 3 - 5 year 'inshore' successor to the ENCORE experiment currently in process at One Tree Island (an offshore reef). It seeks to determine key processes and thresholds which

may elicit a management or regulatory response to ensure continued viability of coral reefs, their amenity and their resources.

SIRENS will involve a range of research activities based in the vicinity of the Orpheus Island Research Station of James Cook University. Activities will include, but not be restricted to, experimental manipulation of water quality on sections of a fringing coral reef. Other activities envisaged include: hydrodynamic measurement and modelling of delivery and dispersion of sediments and nutrients; measurement and modelling of biological responses; aquarium studies of tolerance thresholds; studies of overgrazing and undergrazing; mapping and measurement of natural spatial and temporal variation in benthic community structure and; function within the vicinity of the main study area(s).

Now is an opportunity to influence the size and direction of SIRENS. Researchers and institutions are invited to notify expressions of interest in this new coral reef research initiative to any of the following steering committee members.

### STEERING COMMITTEE:

J Brodie (GBRMPA); T Done (CRC/AIMS);  
D Kinsey (Nimbin, NSW); D Klumpp (AIMS);  
A Larkum (Sydney University); B Willis (James Cook University of North Queensland);  
D Hopley (James Cook University of North Queensland)



# Reviewing the Zoning of Far Northern Section

Joan Phillips\*

**The area of the Great Barrier Reef from north of Lizard Island to Torres Strait is a remote and beautiful region, still little visited by tourists, with significant biological, cultural and economic values. This is the Far Northern Section of the Great Barrier Reef Marine Park, adjacent to the sparsely populated east coast of Cape York Peninsula.**

The Far Northern Section was established in 1983 and the existing zoning plan became operational in 1986. In accordance with GBRMPA policy that zoning plans will be reviewed as soon as practicable after they have been in operation for five years or so, the Authority is now reviewing the zoning plan and management of the Section. Public input will be sought between now and the end of 1994 about the issues which should be addressed in the review. The review will be conducted jointly with Queensland Department of Environment and Heritage which is currently planning for the proposed State Cape York Marine Park and existing island national parks in the region. The proposed State marine park takes in intertidal areas and estuaries. The joint reviews are expected to be completed in late 1996.

A major feature of both reviews, and a change from current practices, will be the increased

involvement of indigenous peoples in decision making and management.

The review will also pick up other critical issues facing the Authority, notably the management of tourism and recreation to ensure the maintenance of a range of settings and opportunities, integrated planning of the Great Barrier Reef with adjacent land and sea, and an assessment of the adequacy of the existing zoning and management arrangements to meet the conservation objectives of protecting representative areas and critical habitats. In addition to these focuses and underlying all planning for the Marine Park is the need to ensure that current uses are ecologically sustainable and that biodiversity is maintained.

The following article briefly discusses two elements of the review program. Other aspects of the review will be covered in future issues of *Reef Research*.

### *Aboriginal and Torres Strait Islander interests*

The requirements of coastal indigenous peoples will play a major part in the development of plans for the future management of marine and island national parks. The Great Barrier Reef

Marine Park Authority recognises that indigenous interests are of a strong and enduring nature and should be incorporated directly into management. Recognition of Aboriginal and Torres Strait Islander interests is also a major objective of the 25 Year Strategic Plan for the Great Barrier Reef World Heritage Area. The connection of Aboriginal peoples to the sea remains strong in the Cape York area where Aboriginal individuals and groups continue to identify themselves as the traditional custodians of sea country (coastal lands, islands, reefs and waters) and continue to care for special places and sacred sites, maintain story places, and practise their traditional skills.

The Great Barrier Reef Marine Park Authority has begun to negotiate with indigenous custodians on Cape York about how joint decision making and on ground management might be put in place for the Far Northern Section of the Marine Park. This represents a major change from the way in which GBRMPA has sought Aboriginal involvement in the Marine Park in the past.

A significant step was made in April this year when a workshop was held at Pajinka Wilderness Lodge, on the northern extremity of Cape York Peninsula, to seek the views of the traditional custodians of eastern Cape York on principles and protocols for their involvement in the review. The workshop was attended by about fifty people, including elders and people from all communities and clan groups with interests in the Far Northern Section. The workshop was organised and facilitated for GBRMPA by the Cape York Land Council, and was introduced by GBRMPA Chairman, Graeme Kelleher, and the Executive Director of Cape York Land Council, Noel Pearson.

The response of Aboriginal people to the workshop initiative has been enthusiastic, and has established a positive basis for future negotiations. The role of the GBRMPA Aboriginal liaison officer in establishing communication and trust with communities, and the openness with which all parties entered the discussions were keys to the success of the workshop.

Recognition of and respect for Aboriginal interests are the basis of future negotiations between GBRMPA and traditional custodians of sea country in the Marine Park. However, we cannot ignore the complex political context of these discussions, and that they are taking place amidst national moves towards reconciliation and self-determination. Unlike previous zoning exercises for the Marine Park, processes and timelines are uncertain, and dramatically different management outcomes are possible.

A program of involvement for Torres Strait Islander people in the review is also being developed and will begin later this year.

### *Managing recreation and tourism use*

Most people would be surprised to learn that there are few areas of the Great Barrier Reef forecast to be beyond the reach of a daytrip on a fast tourist vessel by the year 2000. Sceptics are reminded that in the early 1980s, Cairns was a small coastal town. The expansion of Reef-based tourism offshore from Cairns began in the mid 1980s with the introduction of fast large catamarans.

The Far Northern Section of the Marine Park is currently not easily accessible to tourists, making it especially valuable for people who want to visit remote, uncrowded locations.

The only other remaining area of the Marine Park with comparable remoteness is the Swain Reefs complex at the southern extremity of the Great Barrier Reef.

For the current review of management of the Far Northern Section it is necessary to define the existing recreation and tourism settings and use levels. A particular issue is

whether to actively manage the area to maintain its remote and undeveloped character.

Two projects are currently being conducted with the Research and Monitoring Section's Socio-economic Program to provide information which will assist in planning for recreation and tourism use in the Far Northern Section:

- A grant has been made to GBRMPA by the Federal Department of Tourism under its Ecotourism Program to compile an inventory of marine ecotourism settings and opportunities for the Far Northern Section, and to examine

mechanisms for integrated regional planning. This study will be carried out in close cooperation with other tourism projects being conducted on Cape York Peninsula.

- In order to establish whether there is community support for maintaining undeveloped recreation settings on the Great Barrier Reef, GBRMPA has commissioned opinion research on community attitudes to 'wilderness'. The study will obtain qualitative information on how Queensland residents define different Reef experiences (including 'wilderness') and what value they place on the maintenance of wilderness areas on the Reef. The project will also provide an evaluation of methodological and sampling options for a national survey, and input to the design of a national survey instrument.

*(\* Joan Phillips is the planning officer that leads the team responsible for the review. She works in the Planning and Management Section of the Authority.)*



Pajinka Workshop Jimmy Wallace, Greg Smith, Wendy Craik.

Photograph © GBRMPA



# What's out there

## Opportunistic monitoring or masochism?

Hamish Malcolm

### Background:

*In May 1993 a reactive monitoring program (using photographed tagged corals) was winding to a close. The monitoring team were breathing non-compressed sighs of relief and vowing never to look at these particular corals again. However, such is the human beast that where there are tagged corals, there is the temptation to keep checking on them.*

This particular reactive monitoring program was designed to assess the immediate effects that development dredging (in Townsville shipping channel in early 1993) may have been having on corals at Magnetic Island and Middle Reef, relative to control sites. An article describing this program can be found in *Reef Research* 3(2). The scope of this particular monitoring program did not include monitoring longer-term effects following the completion of dredging (other programs were in place to do this).

It is more than a year since the dredging program was completed and I have kept an eye on the tagged colonies in Geoffrey Bay on an opportunistic (i.e. no cost) basis about once every four months. These results cannot be regarded as longer-term monitoring of the 1993 dredging event as I have kept an eye on only one 'impact' site and no control sites, and the original reactive monitoring method was not designed for long-term, non-

intensive sampling. However some readers may be interested in how the tagged corals at Geoffrey Bay are going.

There were 80 colonies in total tagged in Geoffrey Bay. Twenty colonies were tagged from each of four different species. The four species were *Pocillopora damicornis*, *Merulina ampliata*, *Acropora latistella* and *Montipora aequituberculata*. These corals are (or were) joined by a rope transect line to assist in finding them, especially in low visibility conditions. The transect line in Geoffrey Bay is about 400 m long.

I went back and looked at this transect in September 1993, and was able to relocate all the colonies. However, since then I have been unable to find a number of them, due to a variety of reasons. One problem that has occurred since September has been that of boat anchors ripping up sections of the transect line. Other problems include tag loss and the inability to identify many of the *Montipora aequituberculata* colonies. These colonies change shape quickly (flanges grow out and internal holes fill in) and I am still using the original photographs (remember I mentioned no cost).

### Observations:

In September 1993, all the corals in all four species appeared externally healthy with low levels of bleaching and no obvious increase in mortality.

In December two lengths of the transect had been ripped up. I was able to locate all the *Pocillopora* and *Merulina* colonies, but only 6 *Montipora* and 15 *Acropora* colonies. All the colonies I located generally appeared healthy, except one *Pocillopora* that was bleached white. This colony had died by January 1994, when I next looked at the transect.

The January observations followed a Christmas period of consistently high air temperatures with water temperatures at Geoffrey Bay recorded above 32°C. Bleaching had occurred in a number of *Pocillopora* and *Acropora* colonies. We had a look at some of the *Pocillopora* colonies again in late March

(although miserable visibility did not enable us to find many) and I did an assessment of the transect in mid-July 1994. By July 1994 a number of the *Pocillopora* colonies had died.

There is a definite correlation between tagged *Pocillopora* colonies in Geoffrey Bay that were bleached in January 1994 and those that were dead by July.

Of the 17 *Pocillopora* colonies relocated in January 1994:

- 7 were not bleached and 6 of these were alive and healthy in July. The other was almost completely dead in July except for a few small tips,
  - 7 were strongly bleached all over (but not white). Of these 7 colonies, 4 went on to die completely, and 1 suffered 90% mortality. The other 2 colonies suffered about 10% mortality,
    - 1 colony was 100% bleached white and this was dead by July, and
    - 2 colonies had about 10% of the colony bleached in January which corresponded to a similar amount of mortality observed in July.



About half the *Acropora* colonies were also bleached all over (but not white) in January. Unfortunately by July a lot of the tags had been lost. Some of the colonies found alive in July had been bleached in January.

I was also able to locate 7 *Montipora* colonies and 17 *Merulina* colonies in July 1994 and these were still in good condition.

#### Summary:

This reactive monitoring method (developed by Drs Mary Stafford-Smith and Ursula Kaly) was excellent for the short-term intensive sampling program for which it was designed. However it would require refining for longer-term monitoring use, although some interesting information has been cheaply gleaned at Geoffrey Bay.

*Pocillopora damicornis* colonies in Geoffrey Bay were affected by the bleaching event that occurred in this general area

(early 1994). Most of the tagged *Pocillopora* colonies that were **not bleached** in January 1994 were **alive** in July and most of the *Pocillopora* colonies that were **bleached** all over in January were **dead** by July.



The encrusting colonies (*Merulina* and *Montipora*) appear to still be going well at Geoffrey Bay, although this is not definite for *Montipora* because of the small number of colonies relocated.

#### Personal Opinion:

There has been negligible mortality of *Merulina ampliata* corals (and probably *Montipora aequituberculata*) at Geoffrey Bay due to any medium-term effects of the 1993 dredging program. However, any effect on the other two species cannot be interpreted, using results specific to Geoffrey Bay. If dredging had not been undertaken in 1993, would similar mortality levels of *Pocillopora* (and *A. latistella*?) have occurred after the 1994 bleaching event? This question cannot be answered because control and other 'impact' sites were not assessed during the 1994 bleaching event.

Had the dredging program been undertaken a year later it would have coincided with the bleaching event that occurred in early 1994. Combined effects from

high temperatures and dredging may or may not have resulted in higher levels of mortality in Magnetic Islands corals, however it is probably fortunate that they did not coincide. As bleaching events have occurred 5 times in the last 14 years at Magnetic Island,

the timing of any future major dredging program should be considered.



10

# SLICK TALK

with Steve Raaymakers

**In 'Slick Talk #10' I report on a current oil pollution initiative being undertaken by the Ports Corporation of Queensland, and Jamie Storrie of GBRMPA presents an analysis of 'Exercise Capricorn', the major real-time oil spill response exercise held off Gladstone, central Queensland in May 1994.**

## **Corporation Tackles Spills in Ports**

The Ports Corporation of Queensland (PCQ), a State Government owned corporation and statutory port authority, was formed in July 1993, taking responsibility for management of those ports in Queensland that are not managed by individual, local port authorities.

Five major PCQ ports, Hay Point, Abbot Point, Lucinda, Mourilyan and Cape Flattery, are located within the Great Barrier Reef Region (figure 1). Approximately \$3.6 billion worth of bulk exports are handled through PCQ ports each year, with Hay Point and Abbot Point

together exporting approximately 50 million tonnes of coal in 1992-93, Lucinda and Mourilyan exporting a combined total of around 1 million tonnes of sugar and molasses each year, and Cape Flattery handling about 1.7 million tonnes of silica sand each year. In addition, the port of Weipa, in the Gulf of Carpentaria, exports about 10 million tonnes of bauxite and kaolin each year. Karumba,

another PCQ port within 'the Gulf', exports live cattle and handles general cargo, and is currently the subject of detailed economic, engineering and environmental studies relating to the possible export of mineral concentrates from the Mt Isa/Carpentaria Minerals Province.

PCQ ports turn around over 1000 ships per year, handling over 50% of Queensland's shipping trade. These include bulk carriers of up to 200 000+ gross registered tonnes, which may carry up to 8 000 tonnes of fuel oil.

While tankers and bulk transport of oil and oil products are not major issues for PCQ, the quantities of oil carried and frequency of ship visits by large bulk carriers, which access and egress PCQ ports through Great Barrier Reef waters, are the subject of environmental concern.

While PCQ's primary 'mission' is to provide industry with efficient and cost-effective port services, generate planned profits and return a dividend to Government, proaction to ensure minimisation of environmental impacts, including those from oil spills, is seen as a core component of sound business practice.

Under the Australian National Plan to Combat Pollution of the Sea by Oil (the National Plan), port authorities, including PCQ, have 'Lead Agency' responsibilities for initiating and managing the response to oil spills that occur within their designated port limits.

In order to ensure that it is able to meet its 'Lead Agency' responsibilities properly, PCQ is proceeding with the development of port-specific oil spill contingency plans. Up until now the response to spills within PCQ ports has been managed by a generic state-wide plan which implements the National Plan within Queensland.

PCQ considers that this generic plan is of too broad a geographic scale to ensure optimum response to oil spills within its ports, and perceives a need for more geographically relevant plans.

The PCQ port-specific plans will adopt state-of-

the-art contingency planning practices, including:

- international methodology risk assessments to determine worst-case and maximum credible oil spill response scenarios,
- development of coastal resource maps for each port, including pre-identification of protection priorities and response options for each resource type,
- predesignation and preapproval of dispersant use/non-use zones and situations.

Because PCQ operates as a 'landlord' port authority, with an extremely limited physical presence in its ports, the port-specific oil spill contingency plans will have a strong multi-agency focus, with port users and operators playing a major role.

Development of these plans is being undertaken by consultants on contract to PCQ. They will be finalised and operational by December 1994, strengthening yet another link in the chain protecting the Great Barrier Reef Region from oil pollution.

While PCQ is confident that implementation of its port-specific contingency plans will improve the ability to minimise environmental and economic impacts from oil spills, it has no illusions about current serious and inescapable limitations on oil spill response. These limitations are imposed by the nature of oil on water, logistic realities and the current state of technology and management systems.

PCQ is fully aware of findings such as those of the Canadian Public Review Panel on Tanker Safety and Marine Spills Response Capability (1990):

'... large scale marine oil spills are not manageable, not in any stretch of the imagination are they manageable',

and the United States General Accounting Office Report to Congress of 1989:

'... with current technology, the best that can typically be expected after a major spill is to recover 10 to 15 per cent of the oil'.

As such PCQ fully supports the 'common sense' concept of 'prevention is better than cure'. Safety of navigation, maintenance of vessel integrity and insurance of sound operational practices are the keys to oil spill prevention, aside from actually abandoning the use of oil. As a port authority responsible for the commercial management and development of port facilities and services, PCQ has limited capability to influence actual shipping practices. Responsibility for these matters rests primarily with the shipping industry itself, the Australian Maritime Safety Authority (AMSA) and the Queensland Department of Transport (QDoT).

However, in addition to preparing its port specific response plans, PCQ is actively exploring ways to assist industry, AMSA and QDoT with improving oil spill prevention. One possibility is structuring port fees to provide incentives for ships and operators which have certain spill prevention measures in place.



Figure 1. Ports administered by the Ports Corporation of Queensland

**4**TH EDITION (effective to September 1995)

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<b>Hulls, hazards and hard questions: Shipping in the Great Barrier Reef: Reducing the risk of spilling oil and other hazardous substances.</b> P Ottesen (ed). Townsville, GBRMPA, 1994. (Workshop Series No. 19) 195pp. ISBN 0 642 17427 X	29.40
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PCQ is liaising closely with other Queensland port authorities, such as those at Cairns, Townsville, Mackay, Gladstone and Brisbane, and other government agencies such as GBRMPA, to ensure that its approach to oil issues is consistent and coordinated with these bodies.

*(Steve Raaymakers is currently Manager, Environment and Communication with the PCQ. The views expressed through his continued authorship of 'Slick Talk' are not necessarily those of that Corporation or GBRMPA).*

### Exercise 'Capricorn'

At 0655 hours on Tuesday 24 May 1994, Exercise 'Capricorn', a simulated oil spill response operation, commenced near Gladstone, off the Queensland coast (figure 2). The largest exercise of its type held in Australia to date, 'Capricorn' required Queensland, Commonwealth and industry response bodies to effectively deal with a major oil spill. The exercise was designed to provide training for government and industry agencies and to test current contingency plans, in particular REEFPLAN and the Queensland Coastal Contingency Action Plan.

Details of the exercise were restricted to a limited number of individuals, and participants were required to respond as they would in a real incident. The exercise was held over a two-day period, in real time, and involved the movement and deployment of equipment and personnel. Exercise 'Capricorn' differed from previous exercises in that response personnel were required to travel to the scene from their bases in Australia and travel time was not compressed.

### The Incident!

At 0655 hours on 24 May 1994, a Kamarian fishing vessel, the *Ocean Venture*, collided with the Australian motor tanker, the *Ampol Sarel*, 11 nautical miles north-east of Bustard Head. The initial impact resulted in the fracturing of the *Ampol Sarel's* hull and the release of 250 tonnes of bunker oil.

The *Ocean Venture* suffered mechanical failure and eventually grounded near Pancake Creek. Approximately 1000 tonnes of heavy fuel and

hydraulic oils were released from the *Ocean Venture* as a result of the collision and the grounding.

The *Ampol Sarel* managed to stop the leakage of bunker oil and sought refuge from the weather in Gladstone Harbour. En route the vessel developed structural failure and lost 2500 tonnes of Lalang crude oil, which was being carried as cargo.

By midday, response crews were faced with three separate spills of oil and were required to respond appropriately.

### The Response!

Under REEFPLAN and the Queensland Coastal Contingency Action Plan, the On Scene Coordinator (OSC) is pre-designated as the Regional Harbour Master of the Queensland Department of Transport (QDoT), in this case from Gladstone. The OSC immediately established an operations centre at the Gladstone Clinton Coal Facility Administration Building and assembled key support staff, these being the Offshore Operations Coordinator, the Foreshore Operations Coordinator and the Scientific Support Coordinator (SSC). The SSC was provided initially by the Queensland Department of Environment and Heritage and then by the pre-designated SSC from the Great Barrier Reef Marine Park Authority who assumed responsibility upon arrival from Townsville.

Due to the obvious size of the incident the Queensland State Oil Pollution Committee was assembled in Brisbane. The function of the State Committee is to provide advice and support to the Operations Team. Exercise 'Capricorn' was the first time the State Committee role has been exercised to this degree.

Initial response operations focussed on securing the safety of the *Ampol Sarel* and its cargo to ensure that no further leaks could occur and that the vessel itself was anchored and boomed in sheltered waters. The *Ampol Sarel* was secured by midday on the first day and was at anchorage early the same evening.

It was obvious that the most immediate threat

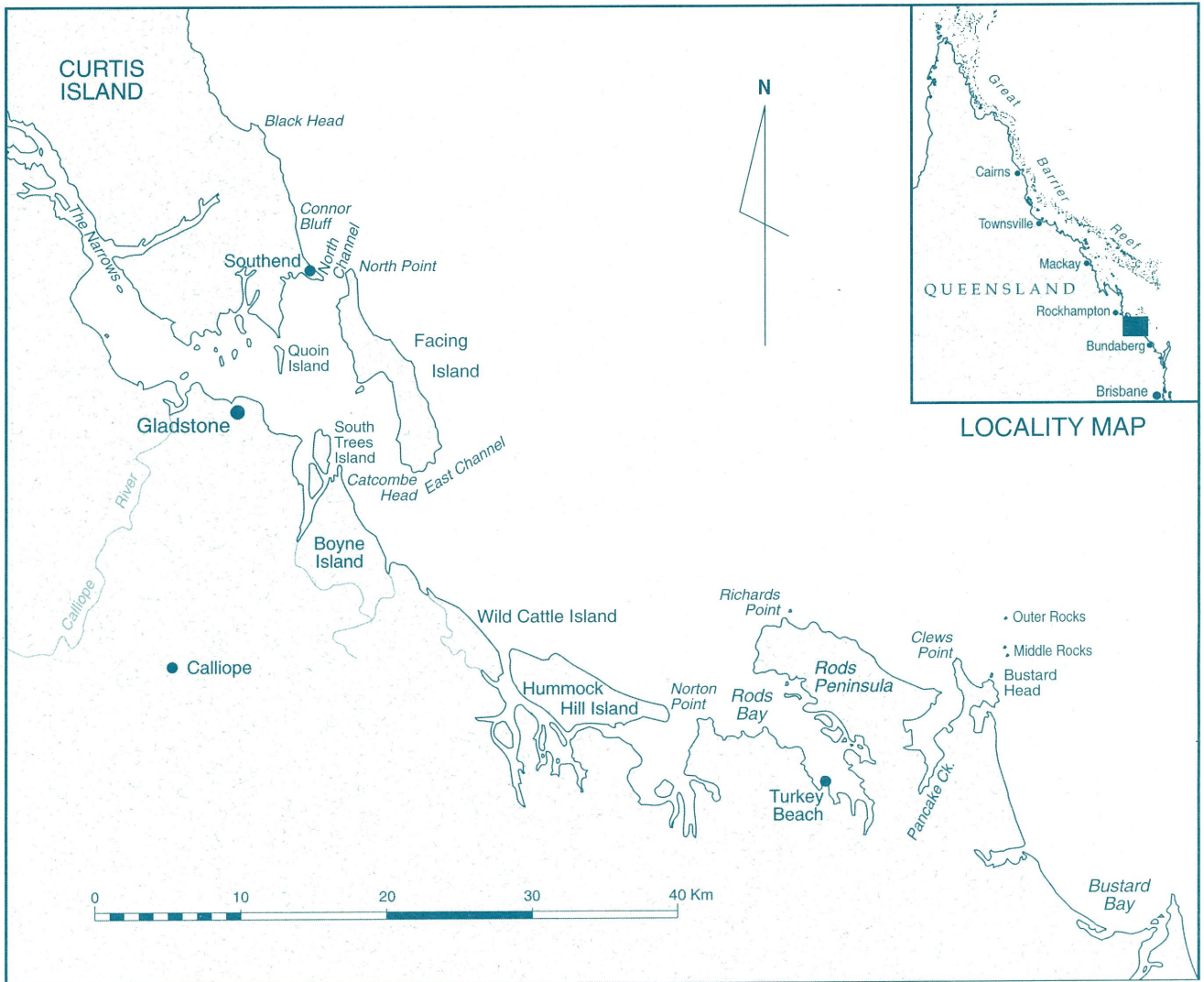


Figure 2. Location of exercise 'Capricorn'

to the coastline was the 1000 tonne spill from the *Ocean Venture*, which threatened the Pancake Creek area. Pancake Creek is a highly sensitive area containing mangroves, seagrass beds and large numbers of sea and wading birds. Access was primarily by fire and forestry tracks or by sea during high tides. A four-wheel drive vehicle and trailer, carrying booms, was dispatched to Pancake Creek to meet a Queensland Department of Environment and Heritage (QDEH) vessel already present in the area with the aim of containing oil as it entered the area. The boom was deployed throughout the afternoon of the first day as the oil impacted this stretch of coastline.

Significant numbers of birds were impacted in the Pancake Creek area as the oil entered the shallow water areas. QDEH Marine Parks rangers immediately set up oiled wildlife

treatment stations in the field and in Gladstone to cope with the expected influx of animals. Months of work with community groups by local QDEH staff also paid off, as volunteer organisations were organised to aid in the cleaning of impacted wildlife.

Early in the response it was apparent that oil spill response equipment held in Gladstone was insufficient to combat an incident of this scale. The OSC requested that the State Committee organise for additional resources to be brought in from other sources in Queensland and from the Australian Marine Oil Spill Centre in Geelong. These resources arrived with trained personnel late on the first day from Brisbane, Townsville and Geelong. The equipment was readied overnight for deployment on the second day.

The two slicks which emanated from the *Ampol*

*Sarel* were monitored throughout the first day. Being out to sea, and the lack of ocean boom in the Gladstone area, meant that booming and reclamation of the oil was not possible.

Chemical dispersion of these spills was also considered. However, Lalang crude, with a pour point of 33 degrees Celsius, is not amenable to dispersion, and the types of dispersant present in any quantities were not considered appropriate for use in the conditions prevailing. The bunker oil was amenable to dispersion and further quantities of dispersant were flown in from other centres and crop-dusting aircraft and helicopters with spray buckets were readied for use on the second day.

Operations were scaled down during early evening. A final surveillance flight took place at last light to get a final position of the spill before dark and planning for the next day commenced. Nightfall gave the Operations Team the first opportunity to get a full overview of the situation, as much of the first day was spent responding to incidents as they took place.

Overnight six trawlers were deployed to pass through the Lalang crude slick to attempt to speed up the degradation of the oil. This had limited effectiveness.

On the second day the Lalang crude spill was located south-east of Facing Island and computer modelling suggested that impacts would occur on Facing and Curtis Islands during the early afternoon. Surveillance also located the bunker spill near Rodds Harbour with impacts possible during the early morning.

The lengths of coastline expected to be impacted were beyond the resources available and the manpower required to deploy the equipment needed. Prioritisation of environmental resources became necessary so that available resources could be effectively utilised. The prioritisation of resources was made by the SSC and support staff and discussion took place with the OSC regarding contingencies for protecting these areas.

Of highest importance were the environments of Gladstone Harbour and Rodds Bay. Both areas contain significant mangrove and seagrass communities and dugong and turtle feeding grounds. Unfortunately these areas were also the most difficult to protect. Of secondary importance were the turtle nesting beaches on the south-east end of Curtis Island (turtle nesting was not expected to take place for several months), and the lowest priority was assigned to the beaches of Facing Island.

It was not practicable for the bunker oil threatening Rodds Bay to be cleaned up mechanically or boomed. A decision was therefore made to attempt to disperse the oil before impacts occurred to the mangroves within the Bay. Dispersant spraying is often a contentious issue, particularly in areas of high environmental sensitivity such as Rodds Bay, where dispersed oil could mix into the seagrasses of the area, however, oil spill response often requires impacts to be accepted on certain resources to prevent damage to others. In this case the mangroves were considered to be of greater importance than the seagrasses.

The dispersants had limited effectiveness on the oil, but impacts to the area were averted when the tides changed and the oil was dragged northward with the tide change.

Gladstone Harbour is subject to strong tidal currents. Due to this it was impossible for booms to be deployed to prevent oil entering the Harbour. The booms were, therefore, set up in a deflective pattern so that oil could be directed onto beaches for physical removal.

Foreshore clean-up crews and equipment were deployed to Curtis and Facing Islands to prepare for the beaching of oil on these sites. A major consideration in these operations was the avoidance of sites of cultural importance to the local Aboriginal community. A liaison officer from the local QDEH office was assigned to aid the clean-up crews in avoiding these sites.

Exercise 'Capricorn' finished at 1400 hours on 25 May 1994, with the main slicks still off the coast but expected to impact within the next few hours.

## The Aftermath!

This overview of Exercise 'Capricorn' provides only a glimpse of all the activities that took place over the two days. Organisations involved in the exercise were forced to field crank calls, public protests and media demands. Activities took place throughout the country including GBRMPA offices in Townsville, QDEH Central Coast Regional and District offices and AMPOL offices in Sydney.

Following the exercise two debriefs have been held to review the outcomes of the exercise.

Issues raised covered all aspects of the response, including commentary on response actions, the logistics of moving and deploying equipment, communications between different levels of the response and use of support staff. All of these issues are currently being reviewed and recommendations are being formulated. It is expected that several months will be required to act upon all the outcomes of Exercise 'Capricorn'.

*(Jamie Storrie is currently acting Project Officer for oil spills and other shipping matters within the Planning and Management Section of GBRMPA).*



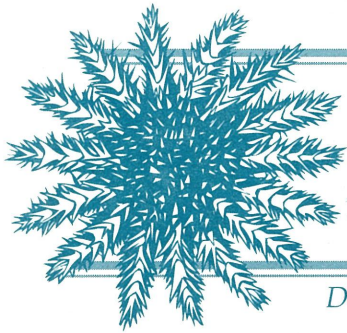
## IBM, AIMS, Computers and the Environment

Steve Hillman

*On the twentieth of July of this year, at the Great Barrier Reef Aquarium, the Prime Minister of Australia, Mr Keating, announced that the Australian Institute of Marine Sciences had been awarded a grant of 1.4 million Australian dollars. The grant, one of four IBM Environmental Research Program Awards, will provide AIMS with state-of-the-art, high level computing power in the form of a number IBM RISC System/6000 workstations, as well as salary support.*

*The grant was the result of a proposal developed by Dr Eric Wolanski. Dr Wolanski's proposal is to take a multi-disciplinary approach to work on coral reef and mangrove systems and to develop existing mathematical models to assist in the management of these critical ecosystems. Not only is it proposed to use the extensive computing power to run high spatial and temporal resolution, three dimensional models which will improve the understanding of processes in complex environments, the work will provide graphics that will be easily understood by non-scientists charged with using science in a practical way. Instead of users having to interpret large arrays of numbers, graphs and so on, the model outputs are intended to actually represent what is happening in the chosen part of the real world. This will be done by using sequential images that will appear to the user as a moving picture of events representing phenomena such as currents, tides, salinity and other variables around reefs and mangroves. The models will also examine the fate of fish, coral, and crown-of-thorns starfish eggs and larvae under the influence of the complex oceanography around reefs.*

*The end result will be much better communication between scientists and managers and this will address what has been a major stumbling block in the incorporation of good science into good management. The project also has the aim of transferring the technology into the South-East Asian region and will involve active participation from researchers and students from the region.*



# COTS COMMS

*Dr Brian Lassig and Udo Engelhardt*

Since it began 10 years ago, the Authority's crown-of-thorns starfish program has been called a *Research* Program. Although most Program funds are allocated to research and monitoring projects, some funds and a substantial amount of our time are devoted to extension and education work. This is in line with one of the three major objectives of the Program - keeping the public informed of research results and the status of COTS on the Great Barrier Reef. Achieving this goal involves liaising with Reef-Users (including tourist operations and dive clubs), day-to-day managers (Queensland Department of Environment and Heritage officers), the media and high schools.

plan is close to being finalised. Not surprisingly, the plan itself reinforces the enduring need for close liaison between all of the parties involved. Outcomes from the finalised plan will be reported in future issues of *Reef Research*.

Extension and education activities will continue this year (see details of the 1994-95 Program below) with a view to further consolidating the good working relationships that have been developed over the past 12 months.

## CURRENT COTS

### *AIMS Surveys*

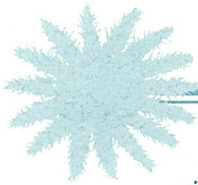
One of the major spin-offs from taking our Program out of these airconditioned offices is in building a cooperative approach to the COTS issue rather than alienating the managers from the public, or vice versa. The enthusiastic response by Reef-Users to our COTSWATCH Survey Scheme demonstrates that a high level of cooperation is being achieved as a result of our extension activities.

Since the June issue of *Reef Research* the AIMS monitoring team has conducted and reported on surveys in the Swains and Capricorn / Bunker Sectors at the southern end of the Great Barrier Reef. Two of the 10 reefs surveyed in the Swains had outbreaks (Snake Reef and Gannet Cay) although the numbers of COTS recorded were substantially lower than in 1992-93 when they were last surveyed. One reef (Lavers Cay) which was classified as outbreaking when last surveyed in 1991-92 was reclassified as recovering. While there was a significant decline in coral cover on these reefs, the largest drop in hard coral cover occurred at East Cay (coral cover down from 50% to 20%) which does not have a history of COTS outbreaks. The remainder of the reefs showed no changes in coral cover since they were last surveyed.

Two successful COTS workshops in Cairns over the last six months also highlight the value of extension work in developing a cooperative approach to a shared problem. The workshops involved staff from several sections of the Authority, representatives from a variety of tourist operations, QDEH and the Australian Institute of Marine Science. We met to develop a plan that would outline individual as well as organisational roles and responsibilities in relation to the COTS issue. We covered a wide range of topics such as communication between the major players, controls, media issues, surveys, training and research. A number of the major issues (such as the speed of obtaining permits to control COTS) have already been addressed and the

### *Reef-User Reports (COTSWATCH)*

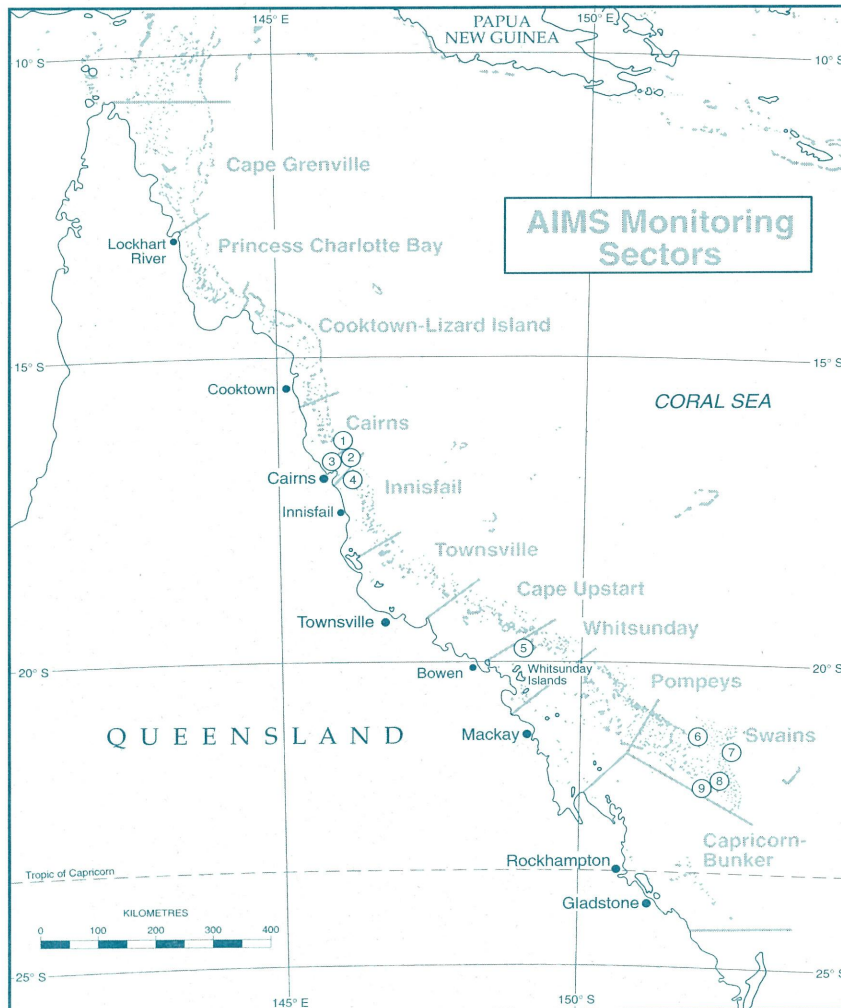
Again we would like to acknowledge the continued strong support of the COTSWATCH scheme by Reef-Users up and down the coast. The COTS reports continue to include a good proportion of 'zeros' as well as actual sightings of starfish.



This is particularly encouraging, given that we consider these 'negative' records as being equally important. In the last issue of COTS COMMS, we presented a summary of the scheme's main results since its relaunch in November 1993. This issue focuses on the latest reports only, covering the period from May to July 1994.



activity. Local tourist operators on these reefs are continuing to control starfish numbers in the vicinity of some important high-use sites. The total number of starfish removed from two sites on Moore Reef now stands at more than 250. Approximately 50 COTS have also been removed from Norman Reef. To date, these control measures have been very successful in maintaining the coral cover at these sites.



- |                  |               |              |
|------------------|---------------|--------------|
| ① Norman Reef    | ④ Moore Reef  | ⑦ East Cay   |
| ② Michaelmas Cay | ⑤ Bait Reef   | ⑧ Gannet Cay |
| ③ Green Island   | ⑥ Lavers Reef | ⑨ Snake Reef |

Isolated medium density populations have also been recorded in other areas of the Marine Park. Bait Reef, off the Whitsunday Islands, continues to support significant numbers of starfish. Similar numbers of COTS have also been reported from a number of reefs in the Lockhart River area in the Far North.



As always, many thanks to all you COTSWATCHERS out there. Just a reminder - there is certainly no shortage of survey forms (*we've just received another 2500 forms waiting to be filled in by keen observers*), so let us know if you need any more.

As always, we would like to acknowledge the most recent (May - July 1994) contributors to our survey scheme:

*Summary statistics:* 111 site reports were received with information about 25 individual reefs. A total of 599 COTS were observed.

Overall, it appears that the COTS picture has remained largely unchanged, with the majority of starfish still being recorded on reefs in the Cairns Section of the Marine Park. Moore, Norman and Michaelmas Reef, all located off Cairns, are still a focus of current COTS

**J Purcell** / Great Adventures, **J Anderson** / Cairns, **C Dunk** / Coral Princess Cruises, **F Gunst** / Edmonton, **G Connett** / Port Douglas, **J Cruise** / QDEH Airlie Beach, **C Hopkins** / Deep Sea Divers Den, **P Whitley** / Viper Diving Services, **T Stovell** / Mike Ball Dive Expeditions, **B Kahn** / Reef Biosearch, **R Miller** / Haba Dive, **Bruce X** / Mike Ball Dive Expeditions, **P Wright** / Port Douglas, **H Sweatman** / JCU, **J White** / JCU, **M Short** /

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### THE BIG PICTURE FOR 1992-93

AIMS recently published its latest synopsis of the Institute's COTS surveys. The report *Broadscale surveys of crown-of-thorns starfish and corals on the Great Barrier Reef: 1992 to 1993* by SJ Bainbridge, DK Bass and IR Miller is the first of a series describing the results of the Long-Term Monitoring Program. The results have shown:

- COTS were recorded on 27 of the 85 reefs surveyed. They were recorded in all of the 11 monitoring sectors except the Capricorn/Bunker and Pompey Complex,
- The total number of COTS recorded was 273. This is consistent with a continuing decline in the total number observed over the past 4 years,
- Of the total number of starfish, 77% were recorded in the Swains Sector,
- Three active outbreaks were recorded, two in the Swain Sector and one in the Princess Charlotte Bay Sector, and
- Thirty-seven per cent of surveyed reefs were recovering from previous Cots outbreaks.

Copies of the report, which gives detailed survey results (COTS, live and dead coral cover) for each reef, are available from Science Communications, Australian Institute of Marine Science, PMB No 3, Townsville MC QLD 4810.

### 1994-95 PROGRAM

In May our advisory committee on COTS issues, the Crown-of-thorns Starfish Research Committee (COTSREC), met to discuss and recommend the 1994-95 program. Recommendations of the Committee were endorsed by the Authority in June, with some adaptation necessary to cope with financial adjustments that were not known at the time of the COTSREC meeting. Major projects for the year are listed below.

**Project:** Feeding ecology of early developmental stages of *Acanthaster planci*.  
**Researcher:** Mr K. Okaji (AIMS)  
**Funding:** \$28 920

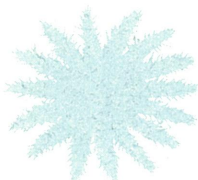
**Project:** Improvement of the rearing technique for the larvae and juveniles of COTS.  
**Researchers:** Dr T. Ayukai,  
Ms C. Cartwright (AIMS)  
**Funding:** \$87 320

**Project:** Backup COTS rearing facility  
**Researcher:** Mr P. Hough (GBR Aquarium)  
**Funding:** \$64 000

**Project:** Fine-scale surveys of COTS populations in the Cairns Section of the Great Barrier Reef Marine Park.  
**Researcher:** Mr U. Engelhardt (GBRMPA)  
**Funding:** \$75 000

**Project:** Development of effective, environmentally friendly techniques for the local control of COTS.  
**Researcher:** Mr U. Engelhardt (GBRMPA)  
**Funding:** \$12 750

**Project:** Starfish larvae: identification and capture  
**Researcher:** Ms K. Roper (JCU)  
**Funding:** \$18 500



**Project:** Socioeconomic consequences of COTS outbreaks  
**Consultant to be selected**  
**Funding:** \$25 000

**Project:** Significance of river run-off to the nutrient and plankton dynamics in the Cairns–Cooktown region: crown-of-thorns starfish perspective.  
**Researcher:** Dr T. Ayukai (AIMS)  
**Funding:** \$30 000

**Project:** Establishment of hydrodynamic model standards  
**Researcher:** Dr F.W. Wilkinson  
**Funding:** \$15 000

**Project:** Monitoring of recruitment of *Acanthaster planci* and community changes on Suva Reef and adjacent reefs, Se Vitu Levu, Fiji Group  
**Researcher:** Dr L. Zann (GBRMPA)  
**Funding:** \$1 000

**Project:** Review of techniques for assessment of COTS history from massive corals  
**Consultant to be selected**  
**Funding:** \$5 000

**Project:** Education and Extension  
**Researcher:** GBRMPA  
**Funding:** \$11 000

These projects add to another eight funded in previous years that are still not complete - making a total of 20 projects underway in the 1994–95 financial year.

## PROGRAM OVERVIEW

It's five years since the Authority's current COTS Program started. To commemorate the milestone we've been working on a review of the considerable progress in research and hopefully will have a publishable report ready in the near future. The review will give details of individual projects, together with an overview of the major program areas and a summary of likely future directions. The review is aimed at a technical audience, but because a lot of the information is probably of

interest to a much wider audience we are serialising the program overview in a more readily digestible form. This issue looks at the achievements in the areas of *Coral and Starfish Dynamics* and the *Ecological Effects of COTS Outbreaks*.

Recent projects in these areas have focused on four major issues:

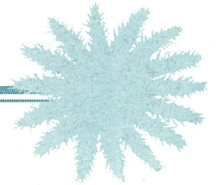
- the broadscale (*reefwide*) distribution of COTS populations on the Great Barrier Reef,
- the effects of COTS outbreaks on coral communities and the characteristics of reef recovery,
- the impacts of COTS outbreaks on local fish communities, and
- the development and refinement of survey techniques for monitoring COTS and their effects on the reef.

## Broadscale (Reefwide) Patterns of Outbreaks

Since 1985, the annual broadscale surveys conducted by AIMS have provided critical information to address the widespread uncertainty over the actual extent of damage to the Great Barrier Reef from COTS outbreaks. These surveys have shown that  $17\% \pm 4\%$  of the total number of reefs on the Great Barrier Reef (approximately 2900) were affected by outbreaks during the most recent outbreak episode from 1979 to 1991.

Impacts of the feeding starfish on coral communities on individual reefs were highly variable. Approximately 57% of reefs affected by outbreaks had moderate (30%) to high (>50%) coral mortality over at least a





third of their perimeter. About 10% of affected reefs had high coral mortality over most of their perimeters. A comparison of records of affected reefs from the two recent outbreak episodes showed that 35 reefs had experienced outbreaks on both occasions. Interestingly, on these reefs the average time between outbreaks was 14–15 years, which is consistent with earlier research that showed that coral cover on reefs may return within 12–15 years. However, it should be noted that this figure refers to the quantity of corals (i.e. per cent hard coral cover) only, and not to the quality or diversity of corals. Depending on the intensity and duration of the outbreak, reefs may or may not suffer loss of coral diversity, in which case the true rate of recovery may be significantly prolonged.

When comparing the available information on the two outbreak events recorded to date, it appears that the overall patterns and characteristics of the two episodes were very similar. Both apparently originated north of Green Island somewhere near latitude 16°S, spread predominantly to the south over the next 12–14 years before waning to the north of the Pompey Group at about latitude 21°S. Hydrodynamic processes such as the flow of major current systems can largely explain the spread of the outbreaks away from their origin as well as the eventual waning of outbreaks in the southern parts of the Great Barrier Reef.

While the patterns of outbreaks during the two observed episodes on the Great Barrier Reef appear to be very similar, there is little information on the relative severity of the two episodes because of differences in the purpose and design of the programs and the survey techniques used.

In addition to describing the status of COTS populations in various parts of the Great Barrier Reef Marine Park, the AIMS broadscale surveys have provided valuable information for the scientific modelling of the spread of

the outbreaks through the planktonic larvae of the starfish. The observed distributions of COTS have already been used to assess the validity of some of the predictive models.

### *Impact on Corals and Recovery*

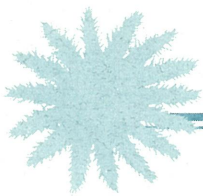
Several projects have been investigating the impacts of COTS outbreaks on both individual reefs as well as entire regions of the Great Barrier Reef.

#### *Individual reefs*

Monitoring of the coral communities on Green Island Reef since 1986 has provided a unique dataset, detailing the recovery process following the outbreak in 1979–80. For the first 10 years, coral recovery followed the typical pattern with the fast growing branching staghorn corals and the plate-like *Acropora* spp. dominating the community. Later, competition among hard corals became an important factor in structuring the community, particularly as coral cover approached pre-outbreak levels. During these early recovery phases few COTS moved into the area and the density of adult starfish remained low throughout.

However, dramatic changes occurred on parts of Green Island Reef over the next three years (1990–92) with >30% reductions in coral cover at some sites. Unfortunately these changes occurred during a period when the sites were not closely monitored, hence the exact causes of the decline in coral cover could not be identified. However cyclones, localised predation by COTS and in particular coral-feeding snails (*Drupella* spp.) as well as disease were listed as likely factors. This study has highlighted the fact that the recovery process following a COTS outbreak is highly complex and somewhat unpredictable with a variety of biological and environmental factors having an effect at different times. Computer modelling has also provided





valuable insights into the general variability of coral recovery. Models indicate that recovery may depend on a range of variables including the spatial extent of damage, the intensity of damage on individual reefs, the connectivity between reefs (*is there a regular supply of coral larvae from nearby reefs?*), the degree of self-seeding (*what proportion of the larvae can be retained by the reef?*), as well as the life history characteristics of the affected coral species (*what types of larvae are produced and how often?*). These computer models have produced recovery scenarios ranging from very little recovery, where the reef remains in a degraded state of low coral cover indefinitely, to almost complete recovery within a few decades. The models demonstrate clearly the need to know more about biological processes and water movement between Great Barrier Reef reefs.

#### *Regional Patterns of Recovery*

At a larger, regional scale, analysis of the observed patterns of coral recovery have matched the outbreak movements as identified by the broadscale surveys. For example, recovery of hard coral populations on impacted reefs in the Central Section of the Great Barrier Reef typically lags behind recovery of reefs to the north in terms of both coral cover and colony size. The southward spread of COTS outbreaks is eventually followed by a matching 'wave' of coral recovery.

#### *A Special Case: Massive Corals*

Massive, dome-shaped corals are significant structural components of coral reef systems. They also play a potentially significant role in understanding the impacts of COTS outbreaks. While massive corals are not the preferred prey of COTS, they may suffer high mortality during major outbreaks, when the starfish are competing for a diminishing supply of food. Typically, massive coral species have very slow growth rates (about 1 cm/yr), indicating that very large colonies of these corals would take decades or even centuries to be replaced. Because of these characteristics, some researchers have claimed that reefs could not

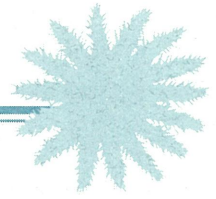
sustain outbreaks at the observed frequency (i.e. every 17–20 years) without rapid degradation in, and possibly loss of, massive coral communities. Furthermore, they argue that the current distribution of massive corals in the Central Section of the Great Barrier Reef provides indirect evidence of increased outbreak frequency (*or indeed novelty of outbreaks*) in recent times.

However, evidence for the inability of massive coral communities to cope with 15–20 year outbreak return periods was based on surveys of reefs affected by *severe* outbreaks. A major study that compared reefs affected by outbreaks to varying degrees and non-impacted reefs confirmed the significant mortality of massive corals on reefs affected by severe outbreaks (>200 COTS/ha). However, where outbreaks were less intense (<100 COTS/ha), there was relatively little effect on the communities of massive corals.

Continuation of current monitoring of coral communities is essential if we are to fully understand the impacts of outbreaks on massive corals. Such information may help to clarify the historical pattern of outbreaks on the GBR.

#### *Impacts on Fish Communities*

Although the effects of COTS outbreaks on coral communities are relatively well documented, there is surprisingly little information on the repercussions of such dramatic changes to other reef organisms. Intuitively, the influence of substantial coral mortality should flow through the affected reef system, resulting in marked changes in community structures and trophodynamic (feeding and energetic) relationships. Research to date has focused on numerical responses in fish communities and has produced conflicting results. The actual size of the area studied appears to explain some of the inconsistency between research results. Changes in fish communities tend to be significant on small scales such as bommies or small patch reefs but



not at reef scales. An exception are the butterfly fishes (chaetodonts) many of which rely on living coral for food.

Research conducted through the COTSREC program has found no evidence of a post-outbreak response from particular herbivorous fish at reef scales. Although there was a significantly greater amount of turf algae on reefs affected by outbreaks than on non-impacted reefs, there were no detectable differences between the populations of a surgeonfish (*Acanthurus nigrofuscus*) on impacted and non-impacted reefs in the central Great Barrier Reef region. Attributes measured included diets, feeding rates, densities, biomass, growth rates and body condition. These results indicate that food supply is probably not a major limiting factor for populations of at least this coral reef herbivorous fish.

### *Survey Techniques*

Monitoring a large-scale phenomenon, such as COTS outbreaks on the Great Barrier Reef, has required the development and refinement of cost-effective survey techniques. The use of a wide range of survey techniques during the 1962-1975 outbreak episode meant that spatial and temporal comparisons of the information collected were extremely difficult. Standardisation of the manta tow technique has overcome many of these problems, but concern over methodological inconsistencies, as well as the precision and accuracy of the technique needed to be addressed to resolve long-standing contention.

Field assessment of manta towing and recording of a range of factors that potentially influenced accuracy and precision have resulted in improvements to the way in which the technique is now applied. In general, manta towing is regarded as a useful tool for assessing the broadscale distribution and abundance of qualitative differences between population levels of COTS, and for

estimating broad changes in live and dead coral cover.

### **CONTROLS POLICY**

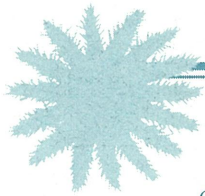
In 1984 the Authority decided that our policy regarding the control of COTS in the Marine Park would be that controls for the purpose of protecting corals at specific sites of importance to tourism or approved scientific research should be an activity allowable by permit. This policy of only limited intervention has been criticised by a few scientists who believe that COTS outbreaks are the result of human activity and the need for a permit has been questioned by some tourist operators, mostly because of the delays in processing permit applications. A quick response to initiating controls has been shown to be a key factor in the success of local COTS controls around the world.

The policy has been reviewed internally and by independent reviewers of the COTS Program from time to time. All reviews have supported the policy of limited intervention given our knowledge of COTS outbreak causality. Recently our advisory committee, COTSREC, thought it necessary for the policy to be expanded to include a more explicit statement about the use of broadscale control measures. The full policy now reads:

*Broadscale control of crown-of-thorns starfish is not to be attempted in the Great Barrier Reef Marine Park unless human activity is proven to cause or exacerbate outbreaks, or unless any future outbreaks are much more extensive and intensive than the two that have been observed.*

*Local control of crown-of-thorns starfish (by any method involving treatment of individual starfish) must be consistent with zoning plan provisions and should be consistent with management plan provisions.\**

*Recognising the potentially high risks associated with biological and chemical control measures in complex coral reef*



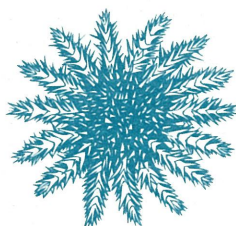
*environments, research into biological and chemical control of crown-of-thorns starfish should not be supported other than in identifying potential agents whose application is consistent with the two policies above.*

*In the event of a causal relationship between human activity and crown-of-thorns starfish outbreaks being established, the Authority should use all its powers and influence to regulate that activity to minimise the effects of that activity on crown-of-thorns starfish populations, and should also seek to minimise the effects of outbreaks.*

\* *Note: A permit will be required for local control measures in General Use A and B Zones where it is desired to collect more than 5 starfish per person in any 28-day period. A permit may be granted for local control measures in higher protection areas (Marine National Park A and B, Conservation Park, Buffer and National Park Zones) where the provisions allow for the taking of animals that pose a threat to ecosystems or the use and amenity of an area.*

The revised policy reinforces the Authority's view that broadscale controls are not an option in the absence of evidence that outbreaks result from human activity and that research in this area should be limited. If such evidence is forthcoming, the Authority will do its utmost to minimise the effects of outbreaks. Given our current knowledge of control techniques, the most effective response would be to regulate the human activity shown to be responsible rather than initiate broadscale controls. Broadscale controls have not worked anywhere in the world where they have been tried.

The policy also reinforces the fact that COTS are a natural inhabitant of coral reefs and they should not be given any special consideration. Permits for collection (which includes killing) are required for COTS just as they are for any other species. However, recognising the need to respond quickly to control increasing COTS numbers in particular areas, we have developed ways to speed up the permit assessment process. The most recent application was processed a few days after it was received.



## *Great Barrier Reef Documentary TV Special*

# *50 Million Years Under the Sea*

**ABC TV**

**Wednesday 28 September 1994,  
8.30 p.m.**

Tune in for this one-hour special insight into the science and survival of the world's coral reefs. Filmed at locations including the Red Sea, Florida Keys, the Philippines and the Great Barrier Reef, this documentary covers threats and solutions to the future survival of coral reefs.

Produced by the ABC Science and Documentary Unit with support from the Great Barrier Reef Marine Park Authority, *50 Million Years Under the Sea* investigates how research is helping better understand these unique ecosystems.

Producer Dr Richard Smith from Quantum's science series takes us on a fascinating journey to explore the structure and evolution of some of the world's best known coral reef systems, including how they are managed and conserved for ecologically sustainable development.

This documentary is a 'must see' for all Reef researchers, commercial tourist operators, marine park managers, fishermen and anyone who loves Australia's Great Barrier Reef.

Let your friends and colleagues know about this documentary so they can also mark it in their diaries.

**For further information contact  
Don Alcock**

Documentary Project Manager

CRC: Reef Research Centre  
Extension and Training Program