REEF RESEARCH

GREAT BARRIER REEF MARINE PARK AUTHORITY

VOLUME 7 No. 3–4
SEPTEMBER–DECEMBER 1997

NEWSLETTER OF THE RESEARCH AND MONITORING SECTION

Editorial

1997 may have been the 'International Year of the Reef' but it was also quite a busy time for staff in the Research and Monitoring Section. Ethics of manipulative research, outbreaking crown-of-thorns starfish populations in the Cairns Section of the Marine Park, research into the effects of cyclone Justin on the Great Barrier Reef and the launch of 'COTSWATCH - International' are just a few of the things which have kept us busy during the year. Not to mention the release of long-awaited publications such as the *State of the Great Barrier Reef World Heritage Area Workshop* proceedings, *The Outstanding Universal Value of the Great Barrier Reef World Heritage Area* and *The Great Barrier Reef: Science, Use and Management* conference proceedings.

Reef Research has expanded to include a regular new section called **Reef Management News**. Science plays a major role in GBRMPA's management decisions and so it's important to understand how research and reef management work together in developing strategies for sustainable use of the Marine Park. There are many challenges facing reef planners and managers, including the down stream effects of land based activities on the Reef biology, the effects of fishing programs, minimising human impacts and the development of zoning plans to meet future user needs. **Reef Management News welcomes your comments on topics published each quarter.**

Things have certainly progressed on the ethics issue. The Research Ethics Committee, which was established by the Authority early in 1997 (see *Ethics of Manipulative Research, Reef Research* Vol. 7, No. 1), has met on a number of occasions and terms of reference have been finalised by the Committee. An Australian Academy of Science Fenner Conference on the Environment, 'Ethics of research and management practices in World Heritage and ▶

REEF RESEARCH is published quarterly by the Research and Monitoring Section of the Great Barrier Reef Marine Park Authority (GBRMPA).

Views expressed in *REEF RESEARCH* are not necessarily those of GBRMPA.

Readers are invited to submit material for publication. Inclusion is the decision of the Editor. All contributions or inquiries should be addressed to:

The Editor REEF RESEARCH
Great Barrier Reef Marine Park Authority
PO Box 1379, TOWNSVILLE QLD 4810
Phone: (07) 4750 0700
Fax: (07) 4772 6093
E-mail: kimd@gbrmpa.gov.au

Editor ..... Kim Davis
Design & Art ..... WWd – Andreas Wagner
Printed by ..... Image Print Townsville
Printed ..... January 1998

ISSN 1037–0692

Formatted in DTP program QuarkXPress 3.31 on Apple Macintosh. Printed on recycled paper.

WHAT'S IN THIS ISSUE

RESEARCH AND MONITORING STAFF

Jon Brodie	*Director*
David Haynes	*Coordinator – Water Quality*
Andy Steven	*Project Manager – Water Quality*
Michelle Devlin	*Project Officer – Water Quality*
Udo Engelhardt	*Acting Coordinator – Crown-of-thorns Starfish*
Michael Hartcher	*Acting Project Manager – Crown-of-thorns Starfish*
John Robertson	*Coordinator – Effects of Fishing*
Martin Russell	*Project Officer – Effects of Fishing*
Rozel Brown	*Administrative Assistant*
Jamie Oliver	*Coordinator – Monitoring*
Ray Berkelmans	*Project Manager – Monitoring*
David Wachenfeld	*Project Officer – Monitoring*
Dominique Benzaken	*Project Manager – Socioeconomic*
Joan Crawford	*Acting Project Officer – Socioeconomic*
Maree Gilbert	*GIS Officer – Socioeconomic*
Francis Pantus	*Information Coordinator (consultant)*
Ken Melchert	*GIS Officer*
Kim Davis	*Assistant Project Officer – Administration and Editor, Reef Research*

Editorial

continued from front page

other environmentally sensitive areas: Policy and practice' was held on the 26–28 November in Canberra, Australia. The outcomes of the conference are reported in **Reef Management News**.

1998 – the International Year of the Ocean – sees the Authority with a new executive structure. John Tanzer, who was previously the Executive Chairman of the Queensland Fisheries Management Authority, joined the Authority as an Executive Director in November 1997. John joins Richard Kenchington, who was also appointed as an Executive Director in 1997.

This issue of *Reef Research* includes three articles from guest writers. Gayle Jennings has written two articles for *What's Out There?* on the use of Shoalwater Bay by recreationalists and cruising yachtpersons. Brad Fisher, of the Royal Melbourne Institute of Technology, writes about Environmental Sensitivity Indexes. David Haynes, Water Quality Coordinator of the Research and Monitoring Section summarises data on debris found in the Far Northern Section of the Great Barrier Reef Marine Park.

COTS COMMs reports on the goings on at the 8th Pacific Science Association Inter-Congress in Suva, Fiji and the latest with the 'COTSWATCH - International' scheme. Steve Raaymakers discusses the steps that have been taken to boost the prevention of pollution for the Great Barrier Reef, and in the update by the CRC Reef Research Centre, we hear how recommendations have been made for the CRC Program to be drastically cut, a move that could have tremendous implications for many of us.

Happy New Year.

Regards

Kim Davis
Editor

CRC Reef Research Centre UPDATE

CRC National Program Update

Brien Holden[1], Kylie Knox[1] and Chris Crossland
[1] Cooperative Research Centre for Eye Research and Technology

'Australia loses $million development again' may well be the headline of the future, if the recently released recommendations of the Mortimer Review with regard to Cooperative Research Centres are accepted.

Cooperative Research Centres (CRCs) are now fighting the recommendation that funding for the CRC Program be cut from $149 million to $29 million per year, and the CRC Program is undergoing an interdepartmental review. Dr Mark Sceats, Deputy Chairman of the CRC Association, says that the CRC Program has created much-needed profitable links between research and industry.

'A major and justified criticism levelled at Australian scientific research is that ideas and inventions developed here are lost to overseas interests, with little or no benefit returning to Australia. A second major criticism is that Australian researchers are isolated from the needs and demands of industry.

'The CRC Program is a unique system specifically designed to directly attack these problems, and it has done so with tremendous success. The 66 CRCs currently established are successfully bringing research and industry together in creative and cost-effective collaborations to develop new products and opportunities of immense value. They are making money for Australia.

'To suggest, as the Mortimer Review does, that the Program should now be cut down is a really shortsighted shot at the goose that is laying the golden egg', says Dr Sceats.

Professor Brian Holden, Director of the CRC for Eye Research and Technology, says that one of the most important aspects of the Program has been to provide CRCs with the equity to enable them to retain ownership of intellectual property. This

ensures that the rewards for these developments are returned to Australia, rather than researchers being required to sell off their research to the highest bidder, as has so often been the case. Without the equity provided by Commonwealth funding, this control, and possible profits, will be lost.

'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. Yet it is under attack in its own country', says Professor Holden.

Dr Sceats believes that the Mortimer recommendation is based on misconceptions.

'The Review categorised the CRC Program as a "business assistance" program. But the Program is designed to foster collaboration between research and industry. The suggestion that most CRCs conferred a "private gain" demonstrates a misunderstanding of the aims and operations of CRCs. All CRCs must act in the Australian interest, and deliver benefits to Australia through job creation, wealth generation, education programs which provide industry-familiar graduates for Australian industry and the development of spin-off companies which contribute to a growing economy.

Says Professor Holden, 'Attacking this program attacks science just where Australia needs it most. Cutting the CRC budget may well save money in the short term, but in the long term the government is killing the development which will bring in export dollars and lucrative industrial agreements. If Mortimer's recommendations are accepted, Australia will lose a unique system that is contributing significantly to the creation of new products, jobs and wealth.'

Chris Crossland, Director of the Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef comments:

'This Centre, like Australia's other 65 CRCs, involves industry and management agencies directly in the research programs. 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.

'Employers and government have expressed the need for graduates who are experienced in industry. The unique educational environment created in CRCs is producing highly trained and experienced graduates, with the majority obtaining employment in industry and research institutions associated with applied research. Cooperative Research Centres have exposed researchers, including postgraduate students, to interaction at all levels with industry, from product development through to the development of new public policy.

'Following the Centre's third-year review, 32 individual achievements were listed, demonstrating an array of direct benefits to the Reef's fishing, tourism and shipping industries, and to various government management agencies. A list is available from the Centre's Secretariat, telephone +61 7 4781 4976.

'This list, though not a complete record, has been sent to all Australian Members of Parliament and most Queensland MPs to make them aware of the Centre's progress. It has helped many Reef operators better understand how a part of their environmental management charge is being used. It has even helped our own (CRC) staff appreciate scientific achievements in a range of disciplines outside their area of expertise.'

CRC Reef Research Centre

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

ADDRESS

Post Office
James Cook University
Townsville Queensland 4811
Telephone: (07) 4781 4976
Facsimile: (07) 4781 4099
E-mail: crcreef@jcu.edu.au
Web site: http://www.gbrmpa.gov.au/~crcreef

with Steve Raaymakers

Major Boost for Pollution Prevention in the Great Barrier Reef

Shipping through the Great Barrier Reef will always present the risk of a major oil spill. The possibility of a 10 000 tonne spill is not out of the question. There is only one thing certain about a 10 000 tonne spill, you can not clean it up. Obviously, it is far more effective to *prevent* such spills from occurring than to put priority into arrangements for *responding* to spills. Because major spills are caused by shipping accidents resulting in damage to oil tanks, such as a collision or grounding, the best spill prevention measures relate to safety of navigation.

Safety of navigation for ships transiting the Great Barrier Reef has received a major boost with the recent opening of the Ship Reporting Centre (REEFCENTRE) at the Port of Hay Point, south of Mackay, and the commissioning on 1 January 1997 of a new mandatory ship reporting system (REEFREP), for the Great Barrier Reef region and Torres Strait.

Under REEFREP, all ships greater than 50 metres in length and all tankers transiting the inner route of the Great Barrier Reef and Torres Strait are now required to report their position and course to REEFCENTRE, via VHF radio, upon arrival at designated reporting points. These reporting points have been established about every 100 miles along the coast. REEFREP is supported by three radar stations located at focal points in the Torres Strait, Green Island and Penrith Island which enable REEFCENTRE to confirm ships' reports.

The new system allows authorities to track all shipping movements in the region from a central control point. This is a major advancement as it allows navigational information to be provided to ships, including courses being taken by other ships, concentrations of fishing vessels and adverse weather conditions. This is a major boost to ship safety and incident prevention.

REEFREP can also be used to assist the response to incidents and in enforcement of marine pollution regulations. For example, in July 1997 the Indian vessel *Dakshineshwar* was refloated from a sand-bank in Torres Strait under direction from REEFCENTRE, and REEFREP was used to keep other ships in the area informed. REEFREP has also been used to identify and track another ship, the *Karin B*, which was illegally transiting the inner route without a pilot. A successful prosecution was effected.

REEFREP will also increase the chances of identifying and prosecuting ships which undertake illegal 'operational' discharges in the region, a problem that has been extremely difficult to police in the past. Overtime, REEFREP will provide a comprehensive and complete database on shipping movements through Torres Strait and the Great Barrier Reef, which has never been available before. This will be extremely useful to authorities in developing further strategies to improve shipping safety in the region.

Implementation of REEFREP, the world's first mandatory ship reporting system for an international seaway, is one of a number of initiatives stimulated by a risk assessment of shipping in the Great Barrier Reef conducted by the Queensland and Commonwealth Governments in 1993. It has only been possible with the approval of the International Maritime Organization (IMO). Under the International Law of the Sea, coastal States such as Australia are obliged to provide 'right of innocent passage' for all ships. Coastal States cannot unilaterally impose restrictions on shipping that may impinge on

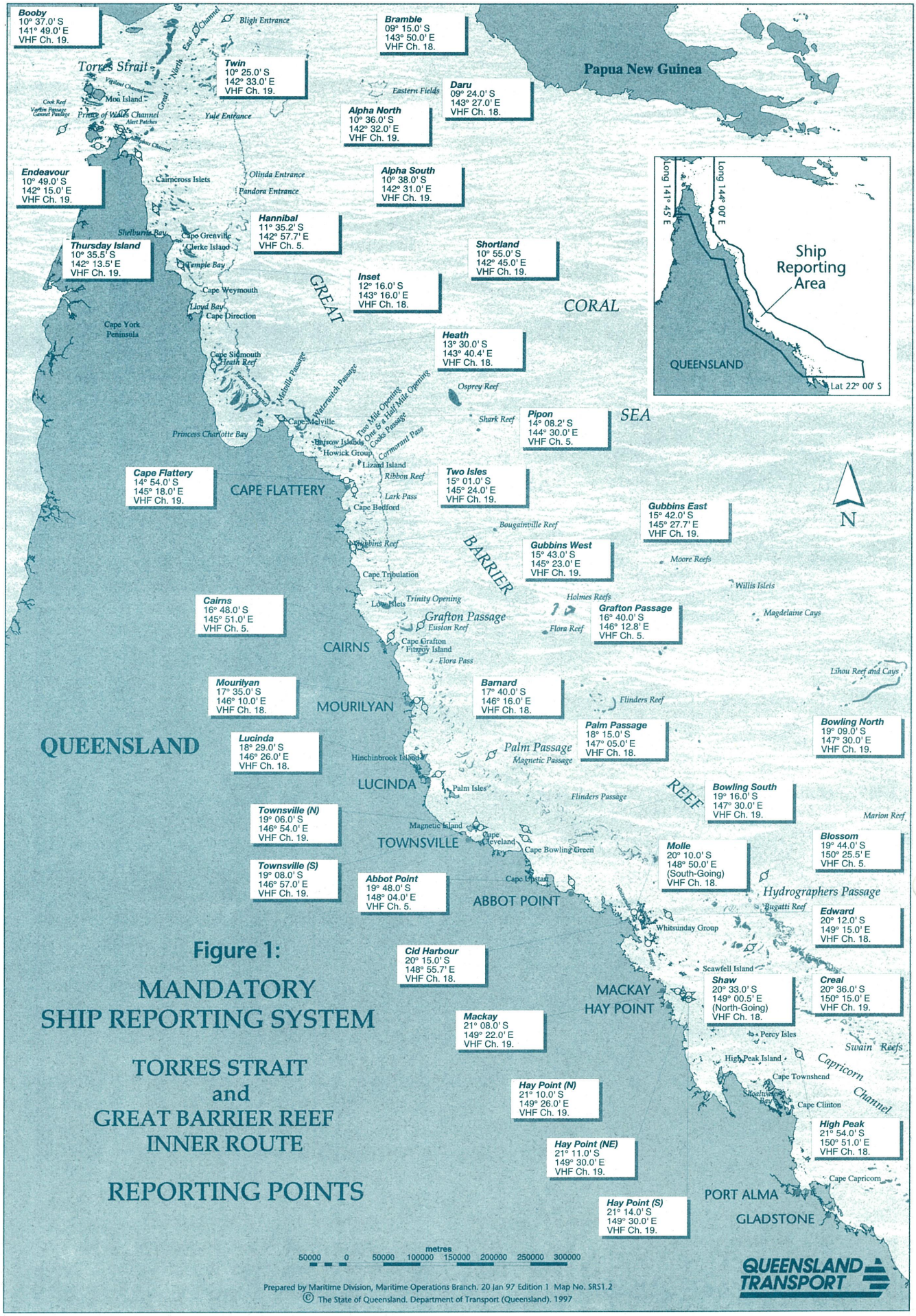


Figure 1:

MANDATORY SHIP REPORTING SYSTEM

TORRES STRAIT and GREAT BARRIER REEF INNER ROUTE

REPORTING POINTS

this right. Declaration of the Great Barrier Reef as a Particularly Sensitive Sea Area by the IMO in 1991 has given Australia a mandate to take more stringent action, such as REEFREP, to control international shipping through Reef waters.

REEFREP has been established under a joint effort by the Australian Maritime Safety Authority (AMSA) and the Queensland Department of Transport (QDoT).

REEFCENTRE is operated and staffed by QDoT, and is located within the Port Control Centre at the Port of Hay Point, under lease from the Ports Corporation of Queensland. It represents a major commitment by the State and Commonwealth Governments to further protect the Great Barrier Reef from shipping impacts.

The location of REEFCENTRE, REEFREP reporting points, VHF stations and radar stations are shown on figure 1. For further information contact John Macdonald at AMSA on +61 7 3835 3683 or Sean O'Mahony at QDoT on +61 7 3224 2832.

Major Spill Conference for the Great Barrier Reef

In August 1998, the 7th International Oil Spill Conference (SPILCON '98) will be held in Cairns, bringing an international focus on oil pollution issues to the Great Barrier Reef for the first time.

SPILCON is held in Australia every two years and is considered one of the premier professional conferences on marine oil pollution, providing papers, presentations, posters and trade exhibits on the full range of disciplines relating to this serious environmental issue, from legislation to technological advances to scientific developments.

In addition to conventional conference papers, a field demonstration of spill response techniques and equipment will be held, along with field trips to the Great Barrier Reef.

SPILCON is being organised by AMSA and the Australian Institute of Petroleum (AIP) and has endorsements from the following organisations:

- International Petroleum Industry Environmental Conservation Association (IPIECA)
- International Maritime Organization (IMO)
- Australian Petroleum Production and Exploration Association (APPEA)
- Maritime Safety Authority of New Zealand

For further information, contact the meeting planners on telephone +61 3 9819 3700 or fax +61 3 9819 5978.

Attention Modellers!

In Slick Talk #16 (*Reef Research* Vol. 6, No. 1) I reported on progress being made by the Australian Institute of Marine Science with oil spill trajectory modelling and coastal resource mapping, through development and marketing of OILMAP. At the end of that article I stated that despite an ongoing review of literature, I have as yet been unable to identify a single case world-wide where operational use of a computer model in a particular real-spill situation has demonstrably resulted in decreased environmental impact from the spill. This remains the case today, a year and a half later.

I would like to reiterate my invitation to readers to send any published papers which unequivocally show that use of a model in a particular incident has actually protected the environment to a larger degree than if the model had not been used. While impressive graphics associated with the front-end of computer models can be tempting, I would suggest that until such proving has occurred, authorities should be cautious about investing significant resources in oil spill trajectory models.

(Steve Raaymakers is currently the Environment Manager with the Queensland Ports Corporation. Opinions expressed through his authorship of 'Slick Talk' are not necessarily those of the Ports Corporation nor the Great Barrier Reef Marine Park Authority.)

The Development of a Spatio-temporal Environmental Sensitivity Index using GIS

B. Fisher, C. Bellman and G. Ellis
Department of Land Information, Royal Melbourne Institute of Technology,
Melbourne, Australia

Abstract

A coastal environment's sensitivity to oil may be quantitatively ranked through the application of the classification scheme known as the Environmental Sensitivity Index (ESI). An ESI for oil spills is primarily based upon the understanding of the relationships between the physical coastal processes and the geomorphology. Hence ESI rankings do not directly incorporate the spatio-temporal nature associated with many coastal environments. Geographic Information Systems (GIS) offer a potential platform to incorporate such spatio-temporal characteristics, improving the accuracy, reliability and usefulness of the ESI. This paper considers current Environmental Sensitivity Indexes, their apparent shortcomings and the incorporation of spatio-temporal information in the development of a modified ESI.

Introduction

The ESI mapping concept was developed in the 1970s to provide oil spill response coordinators with a means of evaluating a shoreline's sensitivity to oil spill damage (Gundlach and Hayes 1978).

The basis of the sensitivity index is the relationship between the physical and biological characteristics of a coastal environment (Owens and Robilliard 1981; Hayes et al. 1992). The relationship between the physical and biological characteristics of a coastal environment is governed by four main factors:

1. relative exposure to wave and tidal energy,
2. shoreline slope,
3. substrate type (grain size, mobility, penetration, and trafficability), and
4. biological productivity.

Using quantifiable measures of these four factors (such as slope – degree of steepness; substrate type – sandy or rocky) an environmental vulnerability index can be developed that classifies coastal environments on a scale of 1 to 10 in terms of a shoreline's potential vulnerability to oil spill damage. An illustration of the relationships between the quantified measures and the shoreline rankings is:

Exposed rocky headlands and wave-cut platforms (*rankings 1 and 2*) are least likely to be harmed from an oil spill and oil should disperse within a few weeks. Minor clean-up action may be necessary.

The Digital ESI Atlas

The application of GIS technology has resulted in the ESI atlas no longer being a static product of limited usage. An ESI atlas is now an automated information system that is capable of recording and maintaining data, readily producing up-to-date maps and most importantly allowing spatial queries to be performed. The ESI atlas is not only restricted to oil spill response and planning, but may also be applied to coastal management in a broader context.

Digital ESI atlases contain three general types of information:

1. shoreline classification (ESI rankings),
2. biological resources, and
3. human use resources.

The inclusion of spatio-temporal data

The problem with the ESI classification scheme is that it typically considers a physically similar coastline to be biologically similar. In reality this is not always the case (Owens and Robilliard 1981).

Due to the diverse and complex nature of biological features, it is proposed that through the inclusion of spatio-temporal aspects of biological features, the ESI classification scheme may be improved to yield a more accurate description of the resources at risk to oil spills at a given time. Traditional techniques of ESI ranking have not directly incorporated spatio-temporal aspects often associated with environmental data, limiting the range of input variables which can be included and the analysis techniques that may be employed. The National Oceanic and Atmospheric Administration (NOAA) Guidelines (Research Planning Inc. 1996) recommend the inclusion of temporal attributes in the ESI atlas but this information is not used to determine the ESI rankings. Spatio-temporal variability should be included within the classification scheme to provide a more accurate indication of the

resources at risk at any given moment (Owens and Robilliard 1981). This may be illustrated by an example:

> Traditionally a bird habitat would be indicated on an ESI atlas by a symbol and this might influence the ESI ranking of the coastal zone. There is no direct correlation between the ESI ranking and bird occupancy. In the case of a migratory species, it is possible that for much of the year, a site ranked as highly sensitive could be quite low in sensitivity due to the absence of the bird population. A modified ESI ranking would take into account both the spatial and temporal aspects and produce a more complex and accurate sensitivity ranking for the bird habitat.

The inclusion of spatio-temporal data would also enable the investigation of spatio-temporal relationships between independent biological species. While an area may have quite low sensitivity for much of the year, the combined presence of two species during a particular period may significantly increase the sensitivity of a habitat.

Case study

Western Port is a large, semi-enclosed body of water formed from a sunken river bed and contains French Island and Phillip Island. Two hundred and seventy square kilometres of the bay (about 40% of the total area) are intertidal mudflats. The bay environs are home to approximately 65% of the known bird species in Victoria and over 1350 species of marine invertebrates (Gittens and McColl 1974). The large intertidal area results in massive exchanges of water between different parts of the bay during tidal changes. However, this tidal flow does not extend to the ocean outside the bay and water in the northern end of the bay can take up to 12 weeks to circulate through the bay and mix with ocean waters outside (Harris et al. 1979).

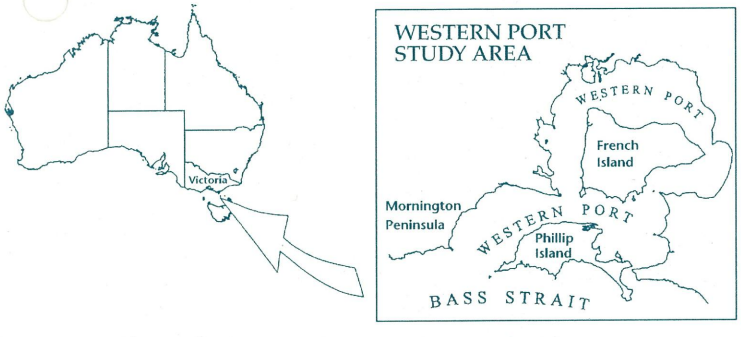


Figure 1. Location of Western Port Study Area

As part of an ongoing program, the Australian Maritime Safety Authority and the Victorian (National Plan) Marine Pollution Committee have funded the development of a Coastal Resource Atlas for Western Port. This atlas was created under contract by the Marine and Freshwater Resources Institute and has been made available to this project for research purposes.

The ready availability of data, the rich diversity of the biological resources of Western Port and the large number of migratory species that inhabit the bay (Australian Nature Conservation Agency 1997) make it an ideal area for a case study to investigate the inclusion of temporal factors in a GIS to establish ESI values for coastal zones.

Conclusion

The study is developing a standard ESI model for Western Port, based on the guidelines published by NOAA (Research Planning Inc. 1996). A refined ESI will then be produced that incorporates the spatio-temporal component of species and activities in the area. The refined ESI values for specific times will be compared with the values obtained from the standard ESI model to determine the variations in sensitivity that occur over time.

Acknowledgments

The support of the Marine and Freshwater Resources Institute, the Australian Maritime Safety Authority and the Victorian Marine Pollution Committee in making the coastal resource atlas for Western Port available is gratefully acknowledged.

Thanks are also extended to Mr David Ball of the Marine and Freshwater Research Institute for the advice he provided and for his help in obtaining the coastal resource atlas.

References

Australian Nature Conservation Agency 1997, *Site 19 - Western Port*, URL http://www.environment.gov.au/land/wetlands/RAMSAR/site19.html (accessed 9 March).

Gittens, W.J. and McColl, J.C. 1974, The collection and preparation of data on existing land-use in the Westernport Bay Catchment, Brief no. L3, Western Port Environmental Study, May 1974.

Gundlach, E.R. and Hayes, M.O. 1978, Vulnerability of coastal environments to oil spill impacts, *Marine Technology Society Journal* 12(4): 18–27.

Harris, J.E., Hinwood, J.B., Marsden, M.A.H. and Sernberg, R.W. 1979, Water movements, sediment transport and deposition, Western Port, Victoria, *Marine Geology* 30: 131–161.

Hayes, M., Hoff, R., Michel, J., Scholz, D. and Shigenaka, G. 1992, *An Introduction to Coastal Habitats and Biological Resources for Oil Spill Response*, Hazardous Materials Response and Assessment Division, NOAA, USA.

Owens, E.H. and Robilliard, G.A. 1981, Shoreline sensitivity and oil spills – a re-evaluation for the 1980s, *Marine Pollution Bulletin* 12(3): 75–78.

Research Planning Inc. 1996, *Environmental Sensitivity Index Guidelines*, NOAA Technical Memorandum NOS ORCA 92, Seattle, Hazardous Materials Response and Assessment Division, NOAA, USA.

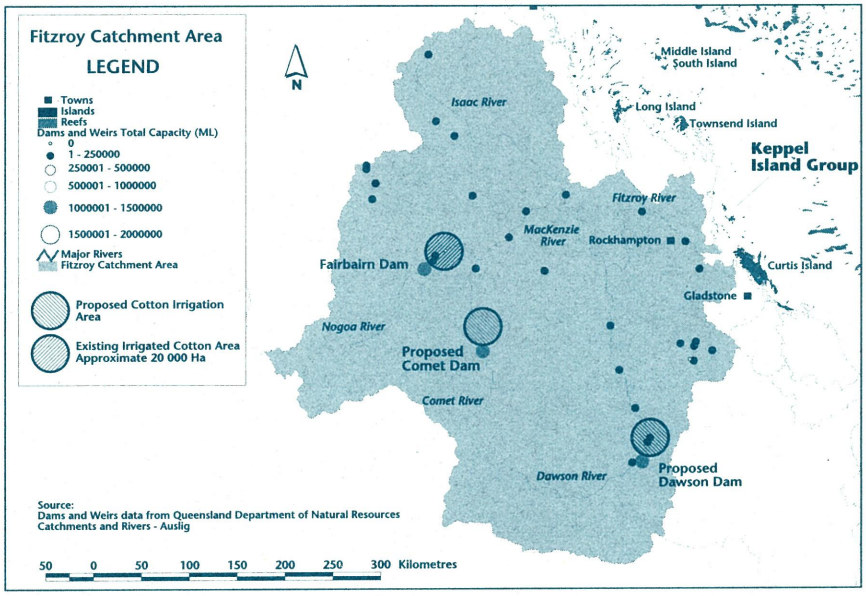
New!

REEF MANAGEMENT NEWS

Editor: **Craig Sambell** *Writer:* **Jacqui Hyne**
Email: **C.Sambell@gbrmpa.gov.au** *Email:* **J.Hyne@gbrmpa.gov.au**

Downstream effects of cotton expansion causes concern

The expansion of cotton production in Queensland has been rapid over the past 10 years and it appears the industry has planted its foot on the accelerator in the hope to increase its current crop worth of $300 million.



In order to increase production an increase in resources, such as water, is also required and currently there are 24 proposals for new dams in Queensland and two of these proposed dams, primarily for cotton, are of interest to the Great Barrier Reef Marine Park Authority.

Of serious concern is the proposed introduction of the Dawson and Comet dams (in addition to the existing Fairbairn Dam) for the Fitzroy Catchment.

The catchment looks to be under consideration for a proposed threefold increase in cotton crops from the current 24 000 hectares to around 60 000 hectares.

The proposed increase in the expansion of cotton growth in Queensland needs to be researched and scrutinised carefully say managers of the Great Barrier Reef because its effects on water quality and associated organisms can be deleterious.

Mr Jon Brodie head of Research and Monitoring with the Authority believes cotton can be an environmentally unfriendly crop because of its reliance on large quantities of fertilisers and pesticides to increase the chance of high productivity.

High quality management, he said, is essential to prevent environmental damage from this crop.

'The fertilisers increase phosphorus and nitrogen levels which create mass algal blooms that kill off many plants and animals,' Mr Brodie said.

'The pesticides contain endosulfan (a chlorinated hydrocarbon related to DDT), which was the cause of the mass fish kills on the Sunshine Coast around three years ago, and

atrazine which can inhibit plant growth.'

Indeed, a recent study by the Queensland Department of Natural Resources, of cotton growing in the Fitzroy, indicates large amounts of endosulfan, atrazine, phosphorus, nitrogen and sediments far exceeding the accepted water quality levels set out by the Australian and New Zealand Environment and Conservation Council (ANZECC).

In the *Downstream Effects of Land Use in the Fitzroy Catchment* report it states that total nitrogen (TN) and total phosphorus (TP) values in run-off from cotton are extremely high.

'For sustainable use of the riverine resource, a much better understanding of factors involved in the dynamics of algal growth (and how to manage them) is urgently needed,' the report states.

It further states that it is a matter of concern that the levels of atrazine, endosulfan and heavy metals clearly exceed the 1996 draft Australian Drinking Water Guidelines and Water Quality Guidelines for the protection of aquatic ecosystems.

Another concern is that because the proposed dams are on tributaries of the Fitzroy River the dams will change the water flow in the river system.

This change in flow will have an affect on salinity and mangrove systems which are nursery grounds for many organisms and could affect the catchment's tropical and temperate Australian freshwater fish species.

'Excessive changes to the river system will be very detrimental for fish breeding and migration and could negatively affect many other estuarine plants and animals,' Mr Brodie said.

However, this river system is not the only system that needs considerable attention paid to the environmental effects of cotton crops.
Because the Fitzroy River discharges south-east of Rockhampton and flows toward the Keppel Island group, the reef systems that surround the islands are also under threat.

'Baseline information studies need to be undertaken in these reef systems before the dam proposals can be seriously considered by the Queensland Government,'
Mr Brodie said.

'The Authority is not opposed to agricultural development in the Fitzroy Catchment in principle but believes it is essential that such development is managed for minimal environmental damage to the Reef.

'The Authority compiled written comments for the Department of Natural Resources and the Queensland Government because we are concerned about the proper management of this issue.' ■

Welcome! John Tanzer

The Great Barrier Reef Marine Park Authority is pleased to announce the appointment of John Tanzer to the position of Executive Director.

John, who has a Bachelor of Economics (Honours), left his position as Executive Chair of the Queensland Fisheries Management Authority to join the Marine Park Authority.

His extensive experience in organisational and institutional management, environmental management issues and Federal and State government advisory roles will be an asset to the Authority.

The Authority needs to make clear its focus and key priorities, said John, to lift its profile and ensure that a constructive relationship is established with the community, industry groups, interest groups and government.

'The position is an exciting challenge because the Authority has a pivotal role in many special and important areas. One of the greatest challenges is the marriage of ecological and economic interests in the Marine Park and World Heritage Area,' he said.

'The Authority is a unique organisation with a large and important management function, locally and in world terms, for the protection of the marine environment.

'I look forward to the challenge that this position affords me and the opportunity to stay in north Queensland because of my ties to its unique natural and cultural aspects.' ■

Devices deemed beneficial to environment and industry

Queensland trawl fisheries are about to improve their environmental approach and public image through the use of Bycatch Reduction Devices (BRDs) and Turtle Excluder Devices (TEDs).

The BRDs are devices that exclude bycatch through various designs and use either the size of an animal or the behaviour of an animal to exclude them from the trawl net. TEDs are a specially designed BRD that exclude larger animals such as turtles.

Development of the devices in Australia was an initiative of the Queensland Department of Primary Industries in conjunction with the Australian Maritime College and Northern Territory Fisheries.

In recent years there has been considerable pressure on government agencies for the need to develop management policies for ecologically sustainable fisheries.

The Great Barrier Reef Marine Park Authority developed a draft fisheries policy in 1995 with a view to having TEDs installed in trawlers operating in the Great Barrier Reef Marine Park (which is also a World Heritage Area) by the year 2000.

Commercial Fisheries Consultant for the Authority Brett Shorthouse believes fisheries managers are changing from direct target species and associated habitat management to management of the whole ecosystem.

This approach is in line with their legal obligation to ensure ecologically sustainable development in all fisheries, while taking into consideration industry and other interest group concerns.

'Despite considerable misinformation, conservation groups and other interest groups have had legitimate concerns about bycatch and have pressured governments to tighten up fisheries management to ensure a sustainable fishery and ecosystem,' Mr Shorthouse said.

'The trawl fishery, through the adoption of the devices, will reduce bycatch in trawls which will help reduce environmental impacts and improve their public image.'

There was initial reluctance from the trawl operators because they also had legitimate concerns about how effective the devices would be and the cost involved. Trials of the devices have been conducted on many trawlers with variable results.

'The initial cost to set up a boat with the devices is between $1000 and $2000, depending on how much labour the fisherman is involved in. However, there may also be prawn losses and loss of income from the marketable by-products, such as sharks,' Mr Shorthouse said.

'Further, because of the varied geographic ocean bottom populations, the effectiveness of the devices appears to be area specific and it is therefore important for operators to continue developing BRDs to suit the area worked and the style of fishing.'

Green turtle caught in trawl catch

Workshops have already been undertaken to discuss bycatch issues and display the devices to allow trawl operators to consider various designs that may suit their needs. Further workshops run by the Queensland Department of Primary Industries (QDPI) are planned for 1998.

Gear technologists from the QDPI and Australian Maritime College are available for trials of BRDs and TEDs and will assist with the adaptation of the devices to suit particular fishing conditions.

The workshops already held have discussed the benefits to the fishing

industry which include less sorting time, less damage to prawns and the availability of previously unworkable fishing grounds, such as areas high in small fish. A video summarising BRDs is also available free of charge from the QDPI Southern Fisheries Centre.

The Management Advisory Committee for the State's trawl fisheries (TRAWLMAC), made up of representatives from industry and government agencies, has worked with scientists and trawl operators to determine the areas of most concern.

The outcomes from this process are that TEDs be implemented in six areas between Moreton Bay and Princess Charlotte Bay and be compulsory from 31 December 1998.

These areas include environmentally sensitive areas for recognised turtle nesting, feeding and aggregation areas.

A recommendation was made to commence an accreditation process immediately and continue a monitoring program on turtles and the devices' effectiveness.

It was also suggested that the use of BRDs be compulsory by early 1998 for all trawlers fishing for banana prawns during daylight hours, excluding Moreton Bay.

When changes in management have been implemented by the Queensland Fisheries Management Authority, Department of Environment rangers and Queensland Boating & Fisheries Patrol officers will patrol the trawl areas to ensure the devices are being used. Fines for non-compliance will be incurred along with licence penalties if operators are convicted. ■

A question of ethics

Good environment and natural resource management relies on good science. But how do managers ensure that the conduct of research is accountable and consistent with management objectives?

These issues recently attracted public attention and led to the consideration, by managers and scientists, of the relationship between environmental ethics, science and management.

Over the past two decades ethical guidelines have been developed to address the issues of research on animals. However, despite a growing interest in environmental ethics, the broader issues raised by research on ecological communities and natural environments have not been addressed.

Government representatives, conservation groups, scientists and ethicists participated in the Fenner Conference, held in Canberra in late November 1997 to discuss the ethics of manipulative research and management practices in World Heritage Areas and other environmentally sensitive areas.

The conference provided an avenue for the review of the draft *Principles and Guidelines for the Ethical Conduct of Research in Protected and Environmentally Sensitive Areas*, prepared by the Australian Science, Technology and Engineering Council (ASTEC).

The draft guidelines address the roles and responsibilities of researchers and agencies, criteria for referring research for ethical consideration, issues and questions to be addressed in designing and assessing research proposals, terms of reference for an ethics committee and principles for research on indigenous lands.

Overriding principles for researchers and supervisors to consider in planning activities in environmentally sensitive areas as stated by the draft are movement, minimisation and modification.

Can the research be moved away from highly protected or environmentally sensitive areas?

Can the research procedures be minimised to reduce impact on the area while ensuring that the research has the required statistical power?

Can the research experimental activities be modified or can alternative techniques such as computer modelling be used?

The conference considered case studies to assess the relevance of the ASTEC draft guidelines in a number of controversial issues ranging from bioprospecting, research in Antarctica, and fire management in Kakadu National Park to the translocation of native fauna and fishing.

This was the first step of an ongoing process to develop national guidelines to aid managers and researchers in the decision-making process.

As demonstrated at the conference, managers and researchers have operated in the absence of formal ethical guidelines when preparing and assessing research permit applications. Without a broadly accepted and transparent process

they have been limited in their capacity to respond constructively to public scrutiny.

Richard Kenchington, Executive Director of the Great Barrier Reef Marine Park Authority (GBRMPA), said there was a need to address ethical issues via a formal committee process to deal effectively with any concerns brought about by research practices.

'In 1996 a number of research projects raised complex ethical issues so the Authority established an independently chaired Research Ethics Advisory Committee to advise whether research proposed in referred permit applications constitutes reasonable use of the Marine Park,' Mr Kenchington said.

'To do this the Committee considers ethical aspects, the objectives and methods of manipulative research, and a review process to ensure all relevant issues have been addressed.

'The work of the Authority's Research Ethics Advisory Committee provided a major input to the development of the ASTEC draft guidelines and principles and the Fenner Conference.

'In turn, the outcomes from the Fenner Conference will help with the review of the Authority's guidelines to insure an effective and equitable process in the assessment of research proposals.'

Ms Dominique Benzaken, coordinator of the conference and manager of the Great Barrier Reef Marine Park Authority's Research Ethics Advisory Committee, said the conference encouraged public discussion of research issues and highlighted the complexity of ethics and research.

'There are difficult questions to answer. In particular, how should the benefits and impacts of research be considered in the context of protected area management?' Ms Benzaken said.

Coordinator of Effects of Fishing at GBRMPA John Robertson acknowledges the difficulties and complexities of dealing with research and ethics due to his involvement with the Effects of Line Fishing experiment.

The Effects of Line Fishing experiment, the world's largest manipulative fisheries experiment, conducted by the CRC Reef Research Centre and approved by Parliament and the Authority came under heavy criticism when it was proposed.

In order to conduct the experiment an amendment to the Great Barrier Reef Marine Park Act was required because eight National Parks (green reefs) were rezoned as 'Fisheries Experimental areas'.

Much heated debate surrounded the approval of the experiment and green groups were particularly concerned about the approval of the experiment because it involved opening up green reefs for one year.

Mr Robertson said the Authority was extremely sensitive to the ethical issues of opening up green reefs to fishing and the experiment went through an extensive review and consultation process to ensure all understood the design and need for the experiment.

'Green groups, the Authority and ministers had reasonable concerns. We, along with the CRC, made every effort to put in place an effective consultation process. But what are the trade-offs? We can't protect the Reef without information,' he said.

Conservation groups were also concerned that the information obtained from the experiment would not be useful or relevant for future management.

'The Effects of Trawling experiment which also operated in green zones was heavily criticised but we are now receiving invaluable information on the impacts of trawling. This will be incorporated into Queensland Fisheries and our management plans to protect the Great Barrier Reef,' Mr Robertson said.

In light of community concern and the need to protect the environment, there is clearly an important need to ensure that design of research experiments, to be conducted within protected areas, takes place under formal ethical guidelines.

Ms Benzaken believes that, while research is an integral part of management, the application of an ethical review with appropriate consultative mechanisms will give strength and support to the use of experimental science.

'A more transparent process that clarifies the basis for consideration of the approval and conduct of research activities should not be perceived as a threat but as an opportunity for researchers to ensure that their work is recognised and supported in the broader social context,' she said.

The Fenner Conference and the ASTEC draft national ethical principles and guidelines provide a good starting point for better management of research activities in environmentally sensitive areas. The revised guidelines compiled from the Fenner workshops will be placed on the ASTEC website for further comment. ■

New proposed plans to ensure better protection

December 1997 saw the release of two plans by the Great Barrier Reef Marine Park Authority (GBRMPA) to ensure the careful long-term protection and management of the Marine Park in the Whitsundays and Far Northern areas.

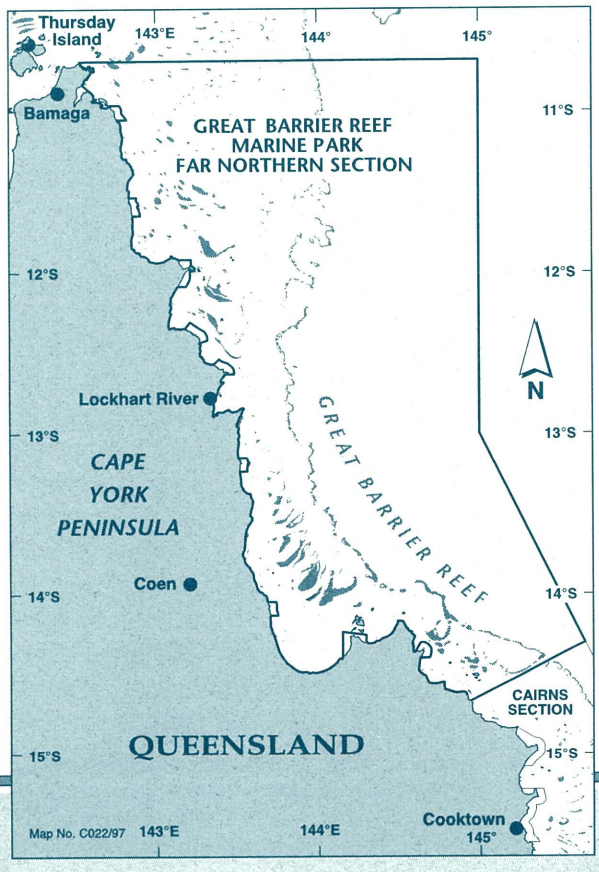
The release of the draft plans provides a further opportunity for interest groups to comment on and address concerns to managers to ensure a satisfactory consultative process and mutually acceptable outcomes.

The final draft of the Whitsundays Plan of Management, a collaborative effort between the Authority, the Queensland Department of Environment (DoE) and the Whitsunday Coastal Advisory Committee (WCAC), was released on 3 December with the aim of protecting and conserving the region's natural assets while satisfying the needs of all interest groups.

Increasing use of the area has managers and interest groups concerned about the impact on the area's unique natural and cultural values.

The Whitsunday Islands are world renowned for the tourist resorts located amongst magnificent densely forested islands and fringing coral reefs.

However, few visitors are aware that the Whitsundays area is a critical calving ground for humpback whales, many of the islands are regionally important bird rookeries, and other sites, such as Hill Inlet, contain natural values and cultural sites of significance.



The area is extremely important for scientific reasons also because one of the corals (*Goniastrea* sp.) found in Double Bay has been found no where else in the world and the reef fringing Deloraine Island is an important location for a rare sponge (*Rhabderemia sorokinae*).

Director of Planning at the Authority Peter McGinnity said the Whitsundays area has reached the point where the increasing number of vessels and the intensity of use is starting to have impacts on the environment.

'Evidence of these impacts is seen in anchor damage to coral reefs and damage to dune vegetation in some of the popular destinations,' Mr McGinnity said.

'The new plan will allow us to counteract and control these impacts.'

In addition to protecting the natural and cultural values of the Whitsundays, the plan will have many benefits for users of the area.

The plan recognises the limits on sustainable use of the area and regulates the number of vessels, boat size and numbers of users allowed into the area at any one time.

These limits are set in the plan which means visitors will continue to have the opportunity to experience a healthy and beautiful part of the Great Barrier Reef.

Provisions that have been included in the plan also mean the Authority and the DoE can introduce a new, simplified licensing system for tourism operators.

The new licensing system gives recognition to tourist operators who have established regular use of the Whitsundays and provides them with greater flexibility to vary their style or size of operation.

Under the new system operators will no longer have to apply to change their permits when they want to upgrade their vessel, increase the

number of passengers they carry or venture into a new area.

'As long as they conform with the management plan there will be no need for this arduous procedure,' Mr McGinnity said.

'By having a recognisable group of operators who regularly use the area we will be able to work with them much more closely to identify the best practices for managing the area.

'Also our management staff will not have to spend so much time administering a complex permit system. This will allow more attention to be directed into other management strategies such as the installation of public moorings, education and monitoring programs.'

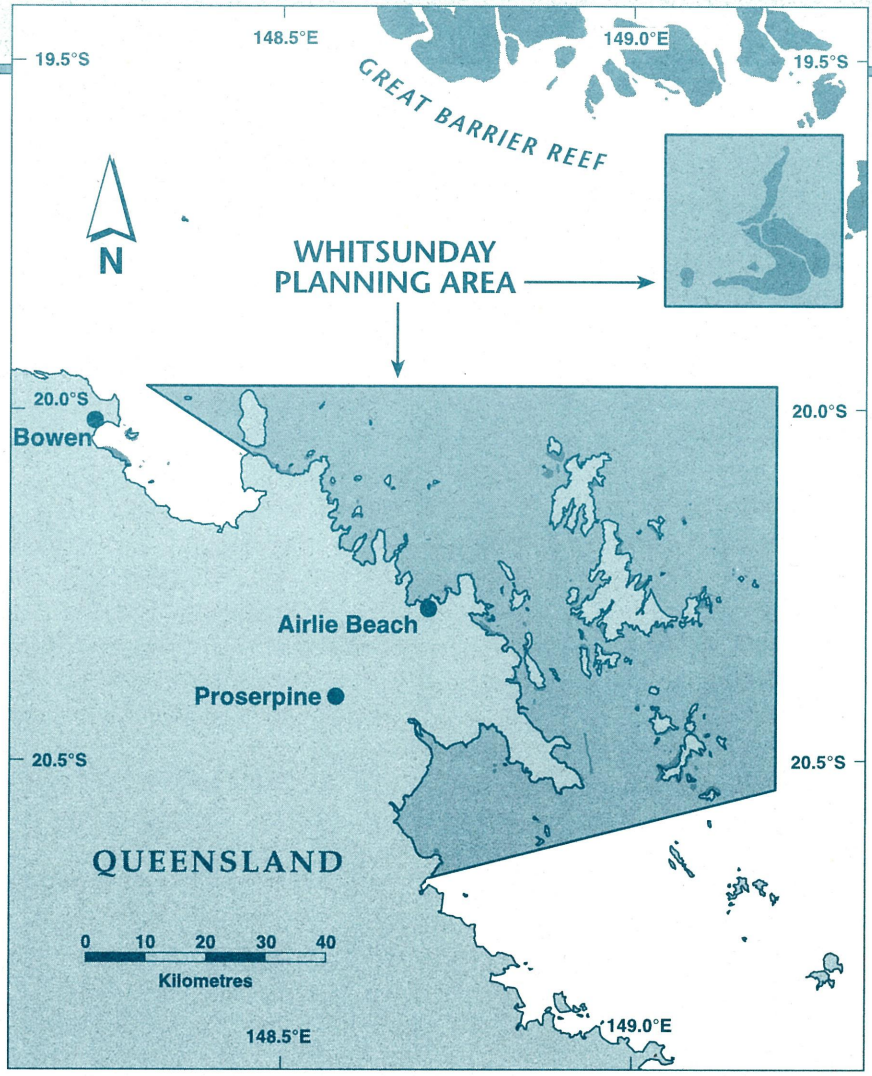
Another outcome of the planning process has been the development of a better awareness of cultural sites and issues by managers and the community.

The local Aboriginal community is represented on the Whitsunday Coastal Advisory Committee and has also achieved better coordination with Marine Parks by the appointment of Aboriginal rangers who work with the DoE.

'The involvement of Aboriginal people in management of the area has increased dramatically,' Mr McGinnity said.

'Programs have been developed to look at cultural sites, and the local community has been able to get resources to compile their own information and pass it on. This increased involvement has come largely from the planning process.

'There is a need for good management in all areas and I think the plan has achieved that. There are a few issues which still need to be resolved but I'm confident that this will be achieved through the public review process.'



Nonetheless, there has been an expression of concern from recreational fishing groups in regard to specific sites of significance, such as Hill Inlet.

Chris Thomas, GBRMPA Planning Officer for Whitsunday, said the Authority supported the legitimate right of recreational fishers to access the area.

'In fact, one of the major objectives of the plan is to ensure that recreational users are catered for, and for example, not inadvertently displaced by increasing commercial use of the area,' Mr Thomas said.

However, there are a small number of sites such as Deloraine Island and Hill Inlet where additional management measures are required to ensure protection of unique and fragile natural and cultural values.

The Authority is aware that the proposed restrictions are of concern to recreational fishers, who have previously had unlimited access to these sites.

'We need to work closely with user groups over the next couple of months to finalise the types of access for appropriate management of these last few sites to ensure they are sustained for the future,' Mr Thomas said.

Consultation will continue until 16 February 1998 and interested parties are encouraged to obtain a copy of the plan from the GBRMPA or the DoE and submit any comments in writing by that date.

Further comments and written submissions are also encouraged for

the draft Far Northern Section Zoning Plan which was released on 5 December 1997.

The draft plan was released in conjunction with DoE's draft zoning plan for the proposed Cape York Marine Park. Both proposals emphasise management of the Far Northern Section for its exceptionally high natural, cultural and wilderness values.

Senior Planning Officer for Far Northern Joan Phillips said it is clear from submissions made in the first stage of public consultation that the Far Northern Section is perceived as a very significant ecological area which has been protected by its remoteness and undeveloped adjacent coastline.

'A Wilderness Area zone overlay has been put in place to limit intensive, large-scale tourism and associated infrastructure in most of the Section, while encouraging a range of opportunities for low level nature-based tourism, in response to the public submissions,' Ms Phillips said.

The overlay will maintain low level impacts in order to conserve the pristine and remote nature of the region but it will exclude certain inshore areas which are potential nodes of activity or are already developed.

Special habitats will be protected to maintain conservation of threatened species, commercially and recreationally important species, biological diversity and scientific interest. Foremost is the protection of seagrass meadows, algal beds and coral reefs.

'Seagrassbeds provide habitat for many species. For example they are important primary producers, therefore crucial in supporting the food web. Dugong and turtles rely on them for shelter and food and they are important nursery grounds for commercial prawn species and other marine fauna,' she said.

'Coral reefs and algal beds in the northern Great Barrier Reef are considered to be the richest and most pristine in the whole of the Great Barrier Reef system.'

One way to protect this diversity is to zone an area as National Park. The Far Northern Section already includes a large cross-shelf transect near Shelburne Bay. This transect, and the other existing National Park zoning, has been maintained in the new plan.

Although the Far Northern Section is reasonably well represented in the amount of area included in National Park zoning, scientific input and public submissions have highlighted some inadequacies in the current protection of some inshore areas.

The draft plan addresses this concern by proposing the re-zoning of four inshore areas identified which have particularly significant conservation values such as seagrass beds, fish and prawn nurseries, dugong habitats, shallow water ecosystems, and indigenous sites of significance.

It is proposed that these inshore areas, Lloyd Bay, Temple Bay, Bathurst Bay and the area inshore from Cliff Islands, be protected by National Park zoning.

'Some individual inshore fisheries will be affected by these changes and negotiation processes are in place to discuss the implementation of these proposed changes and the need to minimise hardship,' the Senior Planning Officer said.

'Other commercial fishing will operate under the already existing arrangements, with some additional access for pelagic fishing at a few reef sites by the inclusion of a 500 metre buffer zone from the reef edge.

'These changes accommodate the requests of fishers who have asked for access to troll for pelagic fish around those particular reefs.'

The Far Northern Section also contains the only inshore Preservation Zone in the Marine Park, between Wakooka Creek and Jeannie River near the southern boundary of the Section.

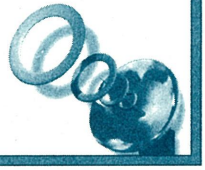
This area is an important dugong habitat and minor changes have been proposed to further protect the seagrass beds and to take into consideration cultural needs of the traditionally associated indigenous community.

'We recognise the connections and custodial rights of indigenous groups on the Cape and through the negotiation process we have become aware of many sites of cultural value,' Ms Phillips said.

'This draft plan identifies the intrinsic relationship indigenous people have with the marine environment and reflects indigenous interests in management proposals.'

The proposed changes to the Far Northern plan will be subject to ongoing consultations with user and interest groups and are open for public comment until 27 February 1998.

Copies of the draft plans can be obtained by calling the Great Barrier Reef Marine Park Authority on 1800 802 251 or (07) 4750 0700 or through the World Wide Web at http://www.gbrmpa.gov.au/information/publications/fns or http://www.gbrmpa.gov.au/information/publications/wts ■



Recreational use of Shoalwater Bay and adjacent waters

Gayle R. Jennings
Lecturer, Tourism and Leisure Studies, Faculty of Arts, Central Queensland University, Rockhampton, Queensland, Australia

Abstract

A study of the recreational marine usage of Shoalwater Bay and adjacent waters was commissioned by the Great Barrier Reef Marine Park Authority and conducted from June 1995 to July 1996. Data was collected using mail surveys of registered boat owners, recreational clubs and commercial operators, and self-completion surveys which were available at various bait and tackle shops, general stores and service stations.

Results from the study indicated that recreationalists from Yeppoon and Rockhampton were the primary users of Shoalwater Bay and adjacent waters. The main recreational activity was recreational fishing and recreational users of the area were often accompanied by friends and family. The key areas of use were Port Clinton, Island Head Creek, Corio Bay, Five Rocks area and the northern section of Shoalwater Bay including Stanage Bay.

The main reasons expressed by recreational users for using the area related to the quality of the fish stocks, the amenity of the area, the proximity of the study area to users' homes as well as the provision of safe anchorages. The recreational users expressed negative attitudes towards commercially based extractive activities. The recreational users considered such activities as being inappropriate in the study area.

Background to the study on recreational use of Shoalwater Bay and adjacent waters

Very few studies have focused on the recreational usage patterns of the marine areas of Shoalwater Bay. In fact Gutteridge Haskins and Davey (1996) suggest none exist. Several studies of land usage patterns have been conducted as part of the *Commonwealth Commission of Inquiry: Shoalwater Bay, Capricornia Coast, Queensland*. AGB McNair conducted a study of central Queensland residents and residents residing elsewhere in Queensland regarding their attitudes towards various land-use issues related to the Shoalwater Bay Military Training Area; while Wood, Thompson, McIntyre and Killion (1994) developed a theoretical recreational and tourism opportunity spectrum for the Shoalwater Bay Military Training Area.

In order to obtain information on recreational marine usage of Shoalwater Bay and adjacent waters, a study was commissioned by the Great Barrier Reef Marine Park Authority (GBRMPA). This article will present and discuss the major findings relating to recreational use of Shoalwater Bay and adjacent waters as determined by mail surveys of club members, commercial operators and registered boat owners located in Gladstone, Rockhampton, Yeppoon, Marlborough, St Lawrence, Sarina and Mackay. A self-selection survey was also used to gather information from users of the area who were not affiliated with clubs nor were registered boat owners.

Aims of the study

The study sought to determine the number of users, key areas of use and types of recreational use undertaken in Shoalwater Bay and adjacent waters as well as current users' opinions regarding activities appropriate for the area. The scope of the study as commissioned by GBRMPA excluded the study of recreational usage of the area by indigenous users as well as the direct targeting of commercial fishers. A study of recreationally based transient users, that is, cruising yachtspersons has also been completed (refer to next article).

The Shoalwater Bay area as defined for the purposes of the study are those waters located between the latitudes of 22°08' S and 23°00' S and longitudes of 150°02' E and 151°02' E. See figure 1 below.

Most of the marine area in figure 1 is jointly managed by GBRMPA and the Queensland Department of Environment (QDoE). However, some waters are not designated as part of the Great Barrier Reef Marine Park. (Interested readers are referred to GBRMPA, *Shoalwater Bay BRA Q120 Map* for details). Further, Shoalwater Bay marine and terrestrial areas are also utilised by the Commonwealth Department of Defence. Defence usage occasions periodic closures of the area to public use and this impacts on the overall recreational usage patterns of the study area.

Recreational marine usage patterns found in other studies

As mentioned above, literature relating to recreational usage patterns of the marine areas of Shoalwater Bay and adjacent waters is limited. However, literature on general marine-based recreation provided useful information for the study. Most of the literature was associated with recreational fishing which was reported as a popular leisure time activity in national parks and wilderness areas (Borschmann 1987: 42). Though the desire to catch a fish was noted as the primary goal of recreational fishers, non-catch related motivations associated with the experience were considered important (Dovers 1994: 103). These non-catch related motivations included a desire to escape from the everyday environment, a need to experience freedom and a need for rest and relaxation within a natural 'wilderness' environment with the social aspect of being with friends and family while recreational fishing also being a component of the experience (PA Management Consultants 1984: 38).

Literature which was accessed for the study on Shoalwater Bay and adjacent waters also noted that participation in recreational fishing and boating has increased in western countries during the twentieth century (Dovers 1994: 103; Kenchington 1993: 8). Within Australia, at the time the draft report was submitted to GBRMPA, the most recent published figures on recreational fishers were supplied by the National Recreational Fisheries Working Group (Dovers 1994: 104), who proposed that for 1990 there were 4.5 million people who participated in recreational fishing, which approximated to between 25 and 30 per cent of the population. Seventy per cent (70%) of those recreational fishers were men (National Recreational Fisheries Working Group in Dovers 1994: 104).

The conflict of interests associated with the use of marine-based environments for recreational and commercial activities was mentioned by a number of other writers (Gartside 1986: 17;

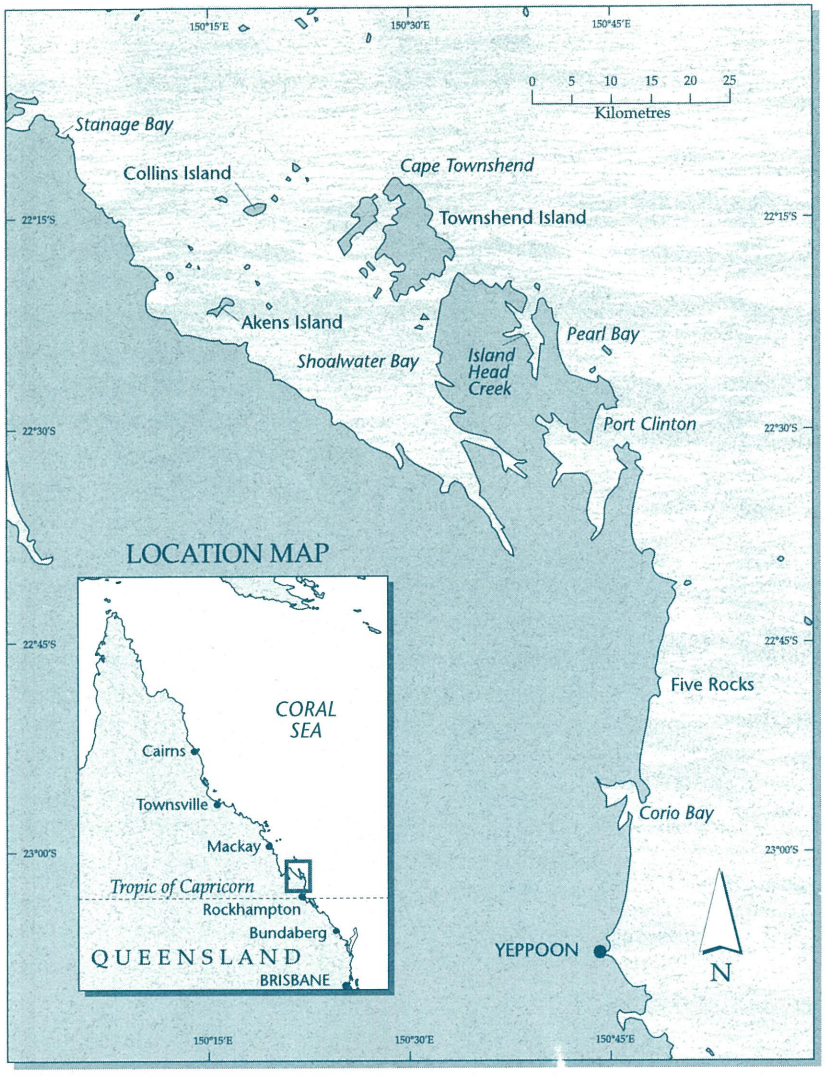


Figure 1. Study area of Shoalwater Bay and adjacent waters. Source: Great Barrier Reef Marine Park Authority, *BRA Q120*

Kenchington 1993: 8; Dovers 1994: 106). Especially, the continuous debate between recreational and commercial fishers regarding who is responsible for diminishing fishing stocks with each blaming the other (Gartside 1986: 17; Dovers 1994: 106).

Literature also noted the desire by recreationalists to experience a 'wilderness' setting while participating in outdoor activities which was coupled with a desire to 'preserve [the] *environmental quality*' (Jackson 1986) of recreational settings.

Methods used in the study of recreational marine usage of Shoalwater Bay and adjacent waters

The study used quantitative research methods which included the secondary analysis of existing data sets held by GBRMPA and QDoE. These databases provided information relating to user numbers and user locations. Mail surveys of registered recreational boat owners and recreational club members, the use of self-selection surveys by the general public, and mail surveys of commercial operators were also used. These surveys used stratified sampling, purposive sampling, convenience sampling and attempted saturation sampling respectively. The use of expert opinion through the use of a modified Delphi technique was also applied.

Findings of the study of recreational marine usage of Shoalwater Bay and adjacent waters

Based on survey data, it was estimated that between 329 and 3587 local recreationalists used the Shoalwater Bay and adjacent waters from June 1995 to July 1996. The total number of days Shoalwater Bay and the adjacent waters was visited between June 1995 and June 1996 was approximately 3106 days for mail survey respondents, approximately 244 days for club survey respondents and approximately 352 days for self-selection respondents. The cumulative number of usage days approximated to 3702 days. Commercial tourism operators who responded accessed the area for a total of 44 days.

The study found local recreational users mostly came from Yeppoon and Rockhampton, were men mostly aged 45–49 years of age, were employed as skilled workers or service industry employees or professionals and had lived in the study area between 1 to 10 years and accessed the study area directly via their own vessels or by vehicular transport. Those who accessed the area by vessels usually departed from Rosslyn Bay, near Yeppoon. The key areas of use were Port Clinton, Island Head Creek, Corio Bay, Five Rocks area and the northern section of Shoalwater Bay including Stanage Bay. Smaller vessels utilised the Shoalwater Bay area and open-water vessels accessed the outer coastal areas. Sail-powered vessels utilised the outer coastal areas in preference to Shoalwater Bay itself.

Shoalwater Bay and the adjacent waters were used by local recreationalists because of the quality of the fish stocks, the amenity of the area, the proximity of the study area to the users' residences as well as the provision of safe anchorages in various sections of the area. The primary activities conducted within the study area were recreational fishing, boating, sightseeing, camping and tourist activities with recreational fishing being the dominant recreational activity.

The local recreationalists visited the area on weekends, week days and holiday periods with holiday periods being preferred by sail-powered vessels due to the time needed to access the area. The minimum usage of the area by recreationalists was once or twice a year with the most popular selected usage being 3–4 visits per year. Some users expressed a monthly usage pattern. Most users had visited the area in the last three months of the study period and were generally accompanied by friends and family. The local recreationalists also considered non-recreational fishing extractive activities as inappropriate for Shoalwater Bay and the adjacent waters and were concerned with the need for protection of the recreational setting.

Discussion of the findings of recreational marine usage of Shoalwater Bay and adjacent waters

As mentioned previously, the main recreational activity pursued in Shoalwater Bay and adjacent waters was recreational fishing. The primary reasons for the use of Shoalwater Bay and adjacent waters for recreational fishing were the quality of the fish stocks, the amenity of the area (amenity was reported as including scenic qualities, wilderness values, lack of crowding, peace and tranquillity), the area's proximity to the user's place of residence and the provision of safe anchorages. The first two reasons supported those reported by Dovers (1994: 103) who stated that the primary motive of recreational fishers was to catch a fish followed by non-catch related motivations. The non-catch related motivations reported by recreational users of Shoalwater Bay and adjacent waters reflected those found in other studies: to relax in the outdoors, to enjoy the environment, to get away from everyday life and work (PA Management Consultants 1984: 38; Gartside 1986: 15; Johnson and Orbach 1986: 326).

The two main categories of passengers who accompanied users on their recreational trips in Shoalwater Bay and adjacent waters were friends and family. Accompaniment by friends and family reflected one of the non-catch related motivations of recreational

fishing which was to enjoy the company of others. It also mirrored the trend that men preferred the company of friends over family (PA Management Consultants 1984: 38-39). Further, since men were the main recreational users of the area, this supported the trend identified by the National Recreational Fisheries Working Group (Dovers 1994: 104). The Working Group noted that nationally seventy per cent (70%) of recreational fishers were men.

Recreational users considered that most commercial operations were inappropriate for the study area. Specifically, recreational users commented upon the need to keep out the commercial fishers. Recreational users also provided suggestions for activity controls in Shoalwater Bay and adjacent waters. Other extractive activities such as spearfishing and indigenous activities received either negative attitudes or mixed attitudes relating to the appropriateness of those activities within the study area. The negative attitude to other extractive activities apart from recreational fishing highlighted that having to share an area had the ability to detract from users' satisfaction (Jaakson 1989: 96). It also reiterated the conflict of interests between commercial and recreational activities including the continuous debate over whom is responsible for diminishing fish stocks (Gartside 1986: 17; Kenchington 1993: 8; Dovers 1994: 106).

Conclusion

Recreational users of Shoalwater Bay and the adjacent waters were primarily fishers, who used the area because of the quality of the fish stocks and the desire to experience a 'wilderness' setting while participating in outdoor activities in the company of friends and family. These users expressed the need for the *'preservation of* [the] *environmental quality'* (Jackson 1986) of Shoalwater Bay and adjacent waters. From their perspective, the preservation and/or maintenance of the quality of the fish stocks and the setting was best achieved through the exclusion of commercial operations. Since management of the Great Barrier Reef Marine Park is predicated to multi-use, managers now need to provide for the recreational experiences desired by local recreational users. However, as this study only focused on local recreational users, managers must also gather data on the usage patterns and the perspectives of commercial users, indigenous users, and other non-local recreational users so that all user groups and their usage patterns, attitudes and opinions are canvassed and accounted for within the overall planning for Shoalwater Bay and adjacent waters.

Endnote

A final report has been submitted to GBRMPA. If anyone is interested in further information about this study, please contact Mr Ray Berkelmans at the Authority on +61 7 4750 0700.

Acknowledgments

The study, *Recreational usage patterns of Shoalwater Bay and adjacent waters*, was funded by the Great Barrier Reef Marine Park Authority and supported by Central Queensland University. Personnel from the Queensland Department of Environment, the Queensland Department of Transport and the Commonwealth Department of Defence provided data and/or feedback during the course of the study.

Executive members of various clubs, associations, fisheries advisory committees, regional marine resources advisory committees as well as managers of marine recreation businesses and marine recreation-related businesses and long-term recreational users of the area are thanked for their cooperation and the sharing of knowledge regarding recreational use of the study area.

Thanks are also extended to the recreational users of Shoalwater Bay who chose to participate in the study.

References

AGB McNair 1994, Survey of attitudes toward land use issues for Shoalwater Bay Military Training Area, Research Report 13 in Commonwealth Commission of Inquiry into Shoalwater Bay – Research Reports, Report No. 5 Volume C, Australian Government Publishing Service, Canberra, pp. 301–327.

Borschmann, R. 1987, Recreational fishing in national parks and wilderness areas, Conference paper presented at the Twenty Second Assembly of the Australian Fresh Water Fishermen's Assembly, Khancoban.

Commonwealth Commission of Inquiry into Shoalwater Bay 1994, Commonwealth Commission of Inquiry into Shoalwater Bay – Research Reports, Report No. 5 Volumes A and C, Australian Government Publishing Service, Canberra.

Dovers, S. 1994, Recreational fishing in Australia: review and policy issues, *Australian Geographical Studies* 32(1): 102–114.

Gartside, D.F. 1986, Recreational fishing, Paper presented to National Coastal Management Conference, Coffs Harbour, Australia, Safish, 11(2): 15–17.

Great Barrier Reef Marine Park Authority, Shoalwater Bay BRA Q120 Map, Great Barrier Reef Marine Park Authority, Townsville.

Gutteridge Haskins and Davey 1996, Department of Defence: Shoalwater Bay Training Area Draft Strategic Plan, Gutteridge Haskins and Davey, Cairns.

Jaakson, R. 1989, Recreation Boating and spatial patterns: theory and management, *Leisure Sciences* 11: 85–98.

Jackson, E.L. 1986, Outdoor recreation participation and attitudes to the environment, *Leisure Studies* 5: 1–23.

Johnson. J.C. and Orbach, M.K. 1986, The role of cultural context in the development of low-capital ocean leisure activities, *Leisure Studies* 8(3): 319–339.

Kenchington, R. 1993, Tourism in coastal and marine environments – a recreational perspective, *Ocean and Coastal Management* 19: 1–16.

PA Management Consultants 1984, National Survey of Participation in Recreational Fishing, Report No. 1 for the Australian Recreational Fishing Confederation, PA Management Consultants, Melbourne.

Wood, J., Thompson, D., McIntyre, N. and Killion, L. 1994, Recreation and tourism opportunities of the Shoalwater Bay Military Training Area and environs, Research Report 7A in Commonwealth Commission of Inquiry into Shoalwater Bay – Research Reports, Report No. 5 Volume A, Australian Government Publishing Service, Canberra, pp. 282–331.

Cruising yachtspersons and their usage patterns of Shoalwater Bay and adjacent waters

Gayle R. Jennings
Lecturer, Tourism and Leisure Studies, Faculty of Arts, Central Queensland University, Rockhampton, Queensland, Australia

Abstract

Shoalwater Bay and adjacent waters are used by cruising yachtspersons (cruisers) from Queensland, other Australian states and also by overseas cruisers. The key locations used by cruisers as stop-overs and as cruising destinations in their own rights are Island Head Creek, Port Clinton, Corio Bay and Pearl Bay. The area is valued by cruisers primarily because of its 'wilderness' values and its provision of safe anchorages. The main activity engaged in by cruisers when using the area are boating, sightseeing and recreational fishing. Cruisers were concerned that management plans should allow continued access to the area and maintenance of its environmental setting.

Introduction

In 1995, the Great Barrier Reef Marine Park Authority (GBRMPA) commissioned a study to investigate marine-based recreational usage of the Shoalwater Bay area. The study entitled *Recreational usage patterns of Shoalwater Bay and adjacent waters* (Jennings 1997a) focused primarily on local usage patterns. Information on transient users travelling at leisure was only gathered by chance through surveys left at marinas, kiosks, fuelling stations, general stores or boating and fishing supply outlets. Since local and transient users are

the primary public recreational users of the area, a second study was commissioned to gather information on the latter user group so that Marine Park Authority and Queensland Department of Environment (QDoE) planners and managers might be further informed of the diversity in usage patterns within the study area.

The aim of this second study was to determine the recreational marine usage of the Shoalwater Bay area by cruising yachtspersons.

As in the study, *Recreational usage patterns of Shoalwater Bay and adjacent waters*, the scope of the brief excluded the study of recreational usage of the area by indigenous users as well as the direct targeting of commercial fishers. Further, to allow comparison between the study *Recreational usage patterns of Shoalwater Bay and adjacent waters* and this second study on cruising usage, the Shoalwater Bay area was again defined as those waters located between the latitudes of 22°08' S and 23°00' S and longitudes of 150°02' E and 151°02' E. See figure 1 on page 15.

Most of the marine area included in the scope of both studies is jointly managed by GBRMPA and QDoE. However, some waters are not designated as part of the Great Barrier Reef Marine Park, specifically the waters located adjacent to the coastline for approximately 2.5 nautical miles offshore starting just south of Yeppoon and running north to Delcomyn Bay north of Port Clinton. Furthermore, Shoalwater Bay marine and terrestrial areas are also utilised by the Commonwealth Department of Defence for military training exercises. These Defence training operations restrict or deny non-military access to parts or all of the Shoalwater Bay Defence Area during training exercises and this impacts on overall usage patterns.

Background

Prior to the *Recreational usage patterns of Shoalwater Bay and adjacent waters* study (Jennings 1997a), very few studies have investigated recreational usage patterns of the marine areas of the Shoalwater area. The target population for this second study was cruising yachtspersons (cruisers). Cruisers are transient users, who travel at leisure on water, that is, who engage in cruising. Cruisers themselves, may be defined as 'people who have adopted a cruising lifestyle, who live aboard [their own vessels], have independent means, are self sufficient and have been away from their port of departure for an extended period of time' (Jennings 1996).

Within the cruising community, various types of cruisers may be identified. One way of differentiating cruisers (people who go cruising) is based on the main source of energy used to drive the boat: either sail or engine powered. However, within both the sail and engine categories there are also various subcategories. These subcategories may be determined based upon boat design (for example, material of construction, number of hulls, and for sail-powered vessels: the number of masts, and mast(s) location(s) and sail configurations). Three other ways of differentiating cruisers are by the number of people aboard the vessel (solo or single handed, double handed (two people) or crewed (more than one person aboard)); the duration of the cruise (short term – for example, three months, to long term – for example, eighteen months or more); or by the geographical location of the cruise (coastal, offshore, also known as blue water, or around the world cruising, that is, a circumnavigation).

Motivations

Cruisers are motivated by a desire to travel, to experience nature, adventure, challenges, new cultures (if travelling offshore), and to pursue a lifestyle which provides freedom and a sense of personal control (Macbeth 1985; Jennings 1997b). Some cruisers are also motivated to adopt a cruising lifestyle as a result of an interest in sailing and/or previous life experiences with boats and/or sailing (Jennings 1997b).

Participation rates and patterns

During the twentieth century, in western countries, the number of recreational boaters (and fishers) has increased (Dovers 1994: 103; Kenchington 1993: 8). This can be attributed to a number of social changes particularly the establishment of a minimum basic wage and the length of the working day; increases in holiday period entitlements (and the associated payment of such holidays), increases in income levels, and increases in leisure time including forced leisure through early retirements (Parker and Paddick 1990: 5–17).

Moreover, current research suggests that increases in the number of cruising yachtspersons is related to:

- improvements in yacht design especially sailing efficiency and live aboard comfort;
- the increased affordability of navigation equipment due to innovation costs being carried by earlier adopters of technological advances;
- developments in telecommunication equipment, particularly, wider ranging satellite coverage which provides greater contact with home bases and linkages to search and rescue facilities;
- greater freedom to travel resulting from early retirement packages and improved income bases of the middle class; as well as
- a change in values regarding work and leisure relationships and the notion of active retirements and early retirements (Jennings 1997c).

Overall, technological advances and increases in the standard of living as well as income levels in western countries have respectively increased the leisure time and/or discretionary income available for pursuing cruising and/or boating as a recreational activity and/or lifestyle.

Socio-demographics of cruisers

In a study of long term ocean cruisers reported in 1985, 59 cruisers were interviewed at locations within the Pacific Ocean (Macbeth 1985). The average age of cruisers was 43 years and the range in ages was 25–69 years. The majority of cruisers interviewed had tertiary education (64.4%) or some tertiary education (20%), while all had received some high school education and had previously been employed in professional/managerial occupations (51.8%) while 10.6% had been business owners/managers. In a later study of long-term cruising yachtspersons[1] conducted between 1992 and 1994, cruising folk were also found to have had either secondary or tertiary education, careers in either managerial, professional positions or in the service industry (Jennings 1996). Primarily, the cruisers who were interviewed were drawn from middle class or upper middle class backgrounds (Jennings 1996). Most boats cost between $50 000 to $100 000 (Jennings 1997b) and cruising budgets ranged between $7000 and $73 000 per annum [these figures have not been indexed to take into account inflationary trends] (Jennings 1997b).

Methodology

The study used quantitative research methods which included the secondary analysis of existing data sets, mail surveys of cruising yachtspersons in marinas and mail surveys of cruising yachtspersons affiliated with yachting/sailing and cruising clubs. On-site surveys were attempted however received a nil response rate. Content analysis of cruising literature including cruising guides and magazines was also undertaken.

Findings

The GBRMPA and QDoE databases indicated that cruising vessel usage predominated in the outer coastal areas with Island Head Creek and Corio Bay being the most visited locations. Cruising guides and magazine articles also promoted the outer locations in preference to the Shoalwater Bay itself, although Patrick (1986, 1995) suggested that Shoalwater Bay was worth visiting. The study area was appreciated for its safety, particularly its various all-weather anchorages as well as its variety of anchorages and for its 'wilderness values'. The outer coastal area, Corio Bay, Port Clinton and Island Head Creek was mostly described as being used for stop-overs on passages north and south, however, cruisers were also noted as seeing and using Corio Bay, Port Clinton and Island Head Creek and their environs as cruising destinations in their own rights. Areas particularly recommended in cruising literature were Island Head Creek, Port Clinton, Cape Townshend, Corio Bay. Shoalwater Bay received varying recommendations.

Specifically, the study area was described as:

> This section is a cruising yachtsman's paradise... The anchorages on the coast north of the Keppels deserve more than an overnight stop. They are accessible, offering good shelter and scenery. Places such as Port Clinton, Pearl Bay and Island Head Creek are mentioned with enthusiasm by cruising people, deservedly so. Together with those mentioned in other sections in this book, nowhere else on the East Australian coast will be found such secure, attractive stopovers. The visitor is advised not to rush them as their like will not be discovered again. (Patrick 1995: 164)

Data analysed from cruisers' responses to marina and club surveys reiterated the fact that Shoalwater Bay and the adjacent waters were used by cruisers because of the amenity of the area and the provision of safe anchorages in various sections of the study area. The key areas of use noted by cruisers themselves were Island Head Creek, Port Clinton, Corio Bay and Pearl Bay. The primary activities conducted within the study area were boating, sightseeing and recreational fishing with boating, not surprisingly, being the dominant recreational activity.

Due to the very low response rates to the surveys, socio-demographic details cannot be considered representative of the cruising community, though they do reflect patterns evidenced in other studies of long term cruising yachtspersons (Macbeth 1985; Jennings 1997c). The majority of respondents to the surveys were men, the age range for cruisers was between 30–79 years, with the mode for occupation being the professional categories. Cruisers who responded to the survey were drawn from Queensland and New South Wales with lengths of residency between 1 to 10 years. No overseas cruisers participated in the study though international vessels pass through the study area and use it (Jennings, research in progress).

Visitation by cruisers to the study area occurred mostly during holiday periods due to the time needed to access the area. Cruisers living closer to the study area indicated a more frequent visitation pattern. The mode for usage of the area by cruisers was once or twice a year. Most cruisers

[1] These cruisers had been away or were intending to be away from their home port for more than 18 months.

who responded to the surveys had last visited the area in the period August–December 1996. These cruisers were generally accompanied by family and friends. Cruisers considered commercially based extractive activities as inappropriate for Shoalwater Bay and the adjacent waters with spearfishing and indigenous activities receiving mixed comments regarding their suitability in the various sections of the study area. Cruisers expressed concern regarding the need to protect the amenity of the study area, particularly its wilderness qualities as well as the maintenance of access to the area for cruisers in-transit and cruisers wanting to access and use the area as a cruising destination in its own right.

Some of the management issues noted in the draft report on cruising usage of Shoalwater Bay and adjacent waters were:

- The need for access to be maintained, particularly to Island Head Creek, Port Clinton and Corio Bay and their environs. These areas contain safe anchorages which are utilised by cruisers when passing through the study area during their passages north and south.

- The need to recognise 'established' usage areas by cruisers and to incorporate these into any recreational and tourism opportunity spectrums (Stankey and Wood 1982) being prepared for the study area. The 'established' usage areas being Island Head Creek, Port Clinton and Corio Bay and their respective environs.

- As in the *Recreational usage patterns of Shoalwater Bay and adjacent waters* study (Jennings 1997a) the 'wilderness' qualities of the study area need to be maintained through the development of appropriate recreational opportunity spectra for Shoalwater Bay and the adjacent waters. [Cruisers noted the amenity of the area, especially its 'wilderness' qualities was one of the primary motivations for using the area.]

- Planners and managers need to acknowledge and include management practices which account for in-transit use of the area by both sail and motor driven vessels for both short-term recreation and for the provision of safe anchorages.

- The two studies, *Recreational usage patterns of Shoalwater Bay and adjacent waters* and *Cruising usage of Shoalwater Bay and adjacent waters*, only surveyed recreational users, commercial operators of tourist activities, and cruising yachtspersons. They did not study commercial fishers or the indigenous users' activities. To address this bias, any consideration of overall management of the area by GBRMPA and QDoE agencies must incorporate information and data gathered from these two user groups.

Acknowledgments

Thanks are extended to the cruisers who participated in this study, to the marina managers and staff and the executive of the various clubs which were approached regarding the conduct of this study. Thanks are also extended to the staff at GBRMPA, QDoE and Central Queensland University for their assistance in the various stages of this study.

Note

Those readers interested in further information regarding the study of cruising yachtspersons and their usage of Shoalwater Bay and adjacent waters should contact Mr Ray Berkelmans at GBRMPA on +61 7 4750 0700.

References

Dovers, S. 1994, Recreational fishing in Australia: review and policy issues, *Australian Geographical Studies* 32(1): 102–114.

Great Barrier Reef Marine Park Authority, Shoalwater Bay BRA Q120 Map, Great Barrier Reef Marine Park Authority, Townsville.

Jennings, G.R. 1996, Cruising and associated 'touristic' experiences, Paper presented at the Pacific Rim Tourism 2000: Issues, Interrelations, Inhibitors Conference, Rotorua, New Zealand, 3–5 November 1996.

Jennings, G.R. 1997a, Recreational usage patterns of Shoalwater Bay and adjacent waters, A report prepared for the Great Barrier Reef Marine Park Authority. Rural Social and Economic Research Centre, Central Queensland University, Rockhampton.

Jennings, G.R. 1997b, Independent travellers' motivations for travelling: a study of cruising yachtspersons and a subsequent critique of theory and practice, A working paper presented to the International Tourism Research Conference: Tourism research building a better industry, Sydney, Australia, 6–9 July 1997.

Jennings, G.R. 1997c, An overview of cruising and the contribution of cruising yachties to Pacific Rim Economies. A working paper, Paper to be presented at the 1997 Annual ISTTE Conference, Pacific Rim: tomorrow today, San Diego, California, United States of America, 23–26 October 1997.

Jennings, G.R. (research in progress), PhD study of the subculture of cruising yachtspersons.

Kenchington, R. 1993, Tourism in coastal and marine environments - a recreational perspective, *Ocean and Coastal Management* 19: 1–16.

Macbeth, J. 1985, Ocean cruising: a study of affirmative deviance, Unpublished PhD thesis, Murdoch University, Murdoch.

Parker, S. and Paddick, R. 1990, *Leisure in Australia*, Longman Cheshire, Melbourne, pp. 5–17.

Patrick, N. 1986, *Cruising the Curtis Coast*, Riverstone Holdings, Gladstone, Australia, pp. 170–183.

Patrick, N. 1995, *Cruising the Curtis Coast*, Second Revised edition, Riverstone Holdings, Gladstone.

Stankey, G. H. and Wood, J. 1982, The Recreation Opportunity Spectrum: an Introduction, Australian Parks and Recreation, February.

Marine Park Debris in the Far Northern Section of the Great Barrier Reef Marine Park

David Haynes

Dumping of rubbish and other debris into the marine environment has become an increasingly serious problem (Ross et al. 1991). Discarded debris can have a range of environmental consequences. It can entangle wildlife and cause limb amputation and/or death through drowning or strangulation. Debris can also be ingested and cause internal blockages and result in starvation or other complications, particularly in animals such as turtles (Laist 1987; Beck and Barros 1991; Hutchinson and Simmonds 1991; Slip and Burton 1991; Lucas 1992). Dumped glass containers and medical wastes may be hazardous to humans coming in contact with them (Dixon and Dixon 1981). There are also economic impacts of debris and rubbish accumulation on beaches. These include the loss of aesthetic values of recreational areas which are reliant on tourism-generated income (Corbin and Singh 1993; Garrity and Levings 1993; Faris and Hart 1994) and the fishing industry may also be impacted through the loss of fish catches to abandoned or lost fishing gear (Dixon and Dixon 1981; Jones 1995).

There is little data available concerning the extent of rubbish accumulation on Australian beaches, including the northern Queensland coast (Wace 1995; The Australian Marine Debris Status Review 1996). This report summarises data on the quantity and nature of debris contamination of islands and cays in the Far Northern Section of the Great Barrier Reef Marine Park north of Lockhart River. Twelve vegetated sand cays and three continental islands were surveyed for stranded debris during June 1996 (Haynes 1997) (figure 1). All visible anthropogenic debris (i.e. that greater than 1–2 cm (Dixon

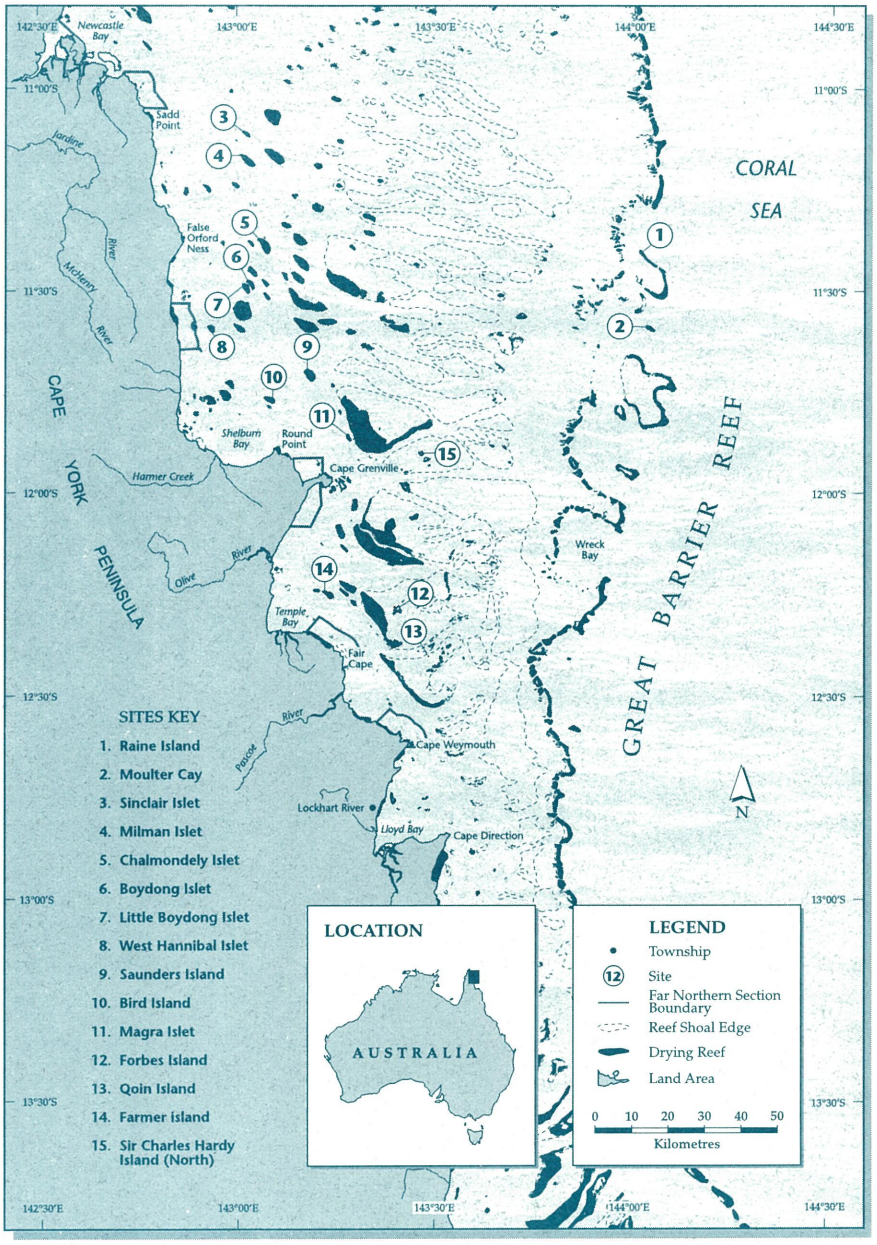


Figure 1. Debris survey locations, Far Northern Section, Great Barrier Reef Marine Park

and Dixon 1983; Ribic et al. 1992)) stranded between the low water mark and the vegetation line along the perimeter of the twelve sand cays was recorded. Visible debris (that greater than 1–2 cm) stranded over the same beach height was also recorded on exposed beaches on the three continental islands. Results were recorded as numbers of items of debris by composition (Dixon and Dixon 1983; Ribic et al. 1992). The perimeter of each cay or length of island beach over which debris was recorded was calculated from a computer-based Geographic Information System.

A range of rubber, plastic and glass artefacts were commonly found on far northern sand cays and islands (table 1). The majority of glassware observed consisted of alcoholic drink-bottles and neon and incandescent light globes. Rubber footwear (thongs) comprised the majority of rubber debris and small fishing net floats and fragmented packing cases were the source of most polystyrene debris. The most commonly encountered metal and aluminium debris was aluminium drink cans and aerosol spray-cans. Fishing netting, rope fragments and plastic bags were also found at many sites, but they were present in low densities (tables 1 and 2).

The most common debris on near-shore sand cays were artefacts made from plastics, rubber and glass. Plastic items were the most numerous item recorded on the two outer sand cays, and rubber, plastic and expanded polystyrene artefacts were common on exposed continental island beaches (table 2). The relative importance of plastics, polystyrene and glass in marine debris is typical of littered beaches (Pruter 1987; Corbin and Singh 1993; Garrity and Levings 1993; Wace 1995). Debris on sand cays was concentrated on the windward side of the cays (the south-eastern side) and was usually present only in very low concentrations on the lee side of most cays. Densities of stranded glass and rubber were similar on near-shore and outer sand cays, whereas outer cays had relatively higher densities of metal, plastic, rope and netting and polystyrene debris (table 2). Densities of plastic, rubber and polystyrene debris were much higher per length of beach on continental islands than on sand cays as surveyed island beaches were surrounded by rocky cliffs which tended to concentrate stranded debris and prevent wind driven re-mobilisation.

Table 1. Number of debris items recorded by type

Debris type	No.	Debris type	No.
Plastic		**Glass**	
Plastic container	66	Fluorescent tube	33
Plastic bottle	334	Incandescent bulb	36
Plastic fragment	368	Deck light	3
Plastic toy	3	Car headlight	1
Plastic comb	2	Glass bottles	263
Plastic 12" bouy	96	Glass jars	22
Plastic 20 L container	9	Glass fragment	8
Cigarette lighter	25		
Plastic strapping	14	**Rubber**	
Plastic toothbrush	4	Thong (footwear)	487
Pen	7	Rubber matting	12
Vegetable peeler	1	Shoe	56
Plastic jerry can	10	Tennis ball	6
Plastic clothes peg	3	Truck tyre	1
Plastic clothes basket	3	Inflatable boat	1
Plastic crate	3		
Plastic flower pot	2	**Metal**	
Plastic paint container 20 L	1	Fuel drum	5
Plastic ladle	1	Paint tin	1
Plastic bag	3	Can	6
Plastic hand fishing reel	1	Fishing lure	1
Shot gun cartridge	2	Boat exhaust	1
Thermos	1	LPG Gas tank	1
Plastic cup	3	Drift net light	1
Plastic rope spool	5	Refrigerator	3
Baby dummy	1	Electric stove	1
Plastic bucket	5	Fire extinguisher	1
Wine esky	1		
Plastic plate	2	**Aluminium**	
Plastic straw	1	Al drink can	16
Plastic funnel	1	Al spray can (deodorant)	8
Plastic soap holder	1	Al spray paint can	1
Plastic deck chair	1	Al fly-spray can	2
		Al 'laundry spray' can	1
Rope and Netting		Al decking sheet	1
Rope fragment	39		
Fishing netting	12	**Polystyrene**	
Mooring rope	6	Fragment	195
		Packing case	9
Other		Net float	38
Scrubbing brush	1	Life jacket	1
Milk carton	5	Egg carton	1
Surfboard skeg	2	Drink holder	1
Paint roller	1		

Table 2. Number of debris items recorded for each survey location

Survey location	Beach length (m)	Debris category							
		Glass	Rubber	Metal	Plastic	Rope and netting	Polystyrene	Other	Total
Offshore cays									
Raine Island	2000	30	31	1	23	0	2	0	87
Moulter Cay	800	20	16	2	23	1	3	0	65
Near-shore cays									
Sinclair Islet	1480	46	38	4	54	8	19	0	169
Cholmondeley Islet	1480	6	18	2	18	1	0	0	45
Boydong Island	2740	65	69	8	261	4	19	0	426
Little Boydong Islet	880	18	18	1	25	1	3	1	67
West Hannibal Island	1060	11	23	3	96	10	5	2	150
Saunders Islet	1540	36	40	9	114	4	9	2	214
Bird Islands	3220	18	14	4	13	1	5	1	56
Magra Islet	1740	33	33	5	185	8	7	1	272
Farmer Island	1200	46	31	3	32	4	8	0	124
Milman Islet	2760	14	38	6	40	7	14	0	119
Continental islands									
Sir Charles Hardy Islands (North)	270	6	77	2	61	4	36	1	187
Forbes Islands	210	8	86	0	24	2	51	1	172
Quoin Island	30	1	31	0	11	2	64	0	109

References

The Australian Marine Debris Status Review 1996, Final report to the ANZECC Working Party on Marine Debris, Maunsell Pty Ltd.

Beck, C.A. and Barros, N.B. 1991, The impact of debris on the Florida Manatee. *Mar. Poll. Bull.* 22: 508–510.

Corbin, C.J. and Singh, J.G. 1993, Marine debris contamination of beaches in St. Lucia and Dominica, *Mar. Poll. Bull.* 26: 325–328.

Dixon, T.R and Dixon, T.J. 1981, Marine litter surveillance. *Mar. Poll. Bull.* 12: 289–95.

Dixon, T.J. and Dixon, T.R. 1983, Marine litter distribution and composition in the North Sea, *Mar. Poll. Res.* 14: 145–148.

Faris, J. and Hart, K. 1994, Sea of Debris: A Summary of the Third International Conference on Marine Debris, North Carolina Sea Grants College Program.

Garrity, S.D. and Levings, S.C. 1993, Marine debris along the Caribbean coast of Panama. *Mar. Poll. Bull.* 26: 317–324.

Haynes, D. 1997, Marine debris on continental islands and sand cays in the Far Northern Section of the Great Barrier Reef Marine Park, Australia, *Mar. Poll. Bull.* 34: 276–279.

Hutchinson, J. and Simmonds, M. 1991, A Review of the Effects of Pollution on Marine Turtles, London: Greenpeace.

Jones, M.M. 1995, Fishing debris in the Australian marine environment, *Mar. Poll. Bull.* 30: 25–33.

Laist, D.W. 1987, Overview of the biological effects of lost and discarded plastic debris in the marine environment. *Mar. Poll. Bull.* 18: 319–326.

Lucas, Z. 1992, Monitoring persistent litter in the marine environment on Sable Island, Nova Scotia. *Mar. Poll. Bull.* 24: 192–199.

Pruter, A.T. 1987, Sources, quantities and distribution of persistent plastics in the marine environment, *Mar. Poll. Bull.* 18: 305–310.

Ribic, C.A., Dixon, T.R. and Vining, I. 1992, Marine Debris Survey Manual, NOAA Technical Report NMFS 108, US Department of Commerce, Washington, DC, USA.

Ross, J.B., Parker, R. and Strickland, M. 1991, A survey of shoreline litter in Halifax Harbour 1989, *Mar. Poll. Bull.* 22: 245–248.

Slip, D.J. and Burton, H.R. 1991, Accumulation of fishing debris, plastic litter and other artefacts on Heard and Macquarie Islands in the Southern Ocean, *Environ. Cons.* 18: 249–254.

Wace, N. 1995, Ocean litter stranded on Australian coasts, pp. 73–87, in *The State of the Marine Environment Report for Australia Technical Annex 2: Pollution*, L.P. Zann and D.C. Sutton (eds), Great Barrier Reef Marine Park Authority, Townsville, Australia.

Udo Engelhardt

By the time you read these lines, the new crown-of-thorns starfish (COTS) survey season will already be under way. Planning and preparing for the fourth year of the CRC Reef Research Centre / Great Barrier Reef Marine Park Authority fine-scale surveys is taking up quite a bit of my time, hence this somewhat brief edition of COTS COMMS. This year's surveys will literally 'break some new ground', that is, the fine-scale surveys will for the first time extend into the Central Section of the Great Barrier Reef Marine Park. Given the fact that last season we identified substantial populations of juvenile COTS on some reefs near the southern boundary of the Cairns Section, I anticipate that similar trends may now be occurring to the south of this area. The likely spread of new outbreaks to the south of the current survey area would not really come as a surprise, rather it would be indicative of a repeat of the events of the 1960s and 1980s when a similar progression of outbreaks from north to south was recorded. The new survey season will go from October 1997 right through to March/April 1998. So stay tuned for the latest on the COTS front!

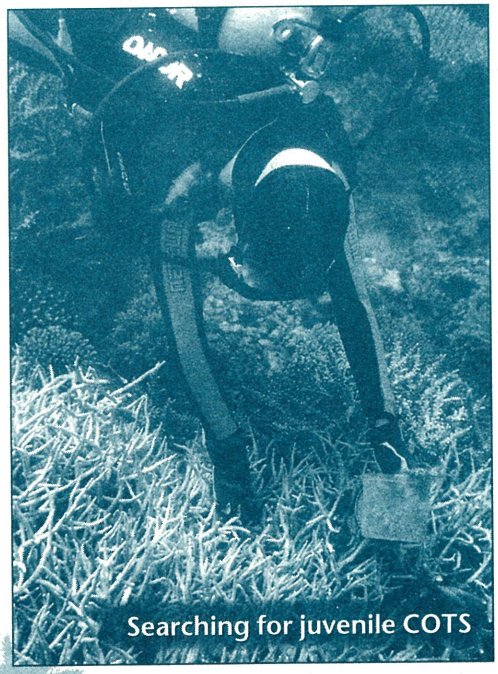
COTS at the 8th Pacific Science Association Inter-Congress, Suva, Fiji

In July this year, with financial support from both the CRC Reef Research Centre and the Great Barrier Reef Marine Park Authority, I attended the 8th Pacific Science Association (PSA) Inter-Congress in Suva, Fiji.

The particular focus of the congress was on the future development and resource use of Pacific island nations in the 21st century. As part of the proceedings, I was able to present a paper entitled 'The early detection of outbreaks of the crown-of-thorns starfish *(Acanthaster planci)* – implications for local-scale control measures' (see abstract below).

The paper stimulated considerable interest and discussion amongst participants from a large number of Pacific nations currently experiencing starfish outbreaks of a similar nature to the ones affecting the central parts of the Great Barrier Reef. Having had the opportunity to present the paper at two separate sessions – a special coral reef symposium as well as a marine biodiversity session, I feel confident that my presentation would have reached the greater majority of marine scientists and managers present at the congress. Since that time, I've had a number of requests for further information on the new COTS monitoring (fine-scale survey) and control (sodium bisulphate injection) techniques.

In discussions with the coordinator of 'Reef Check 97', a special international initiative as part of the International Year of the Reef (IYOR), it was agreed to incorporate various aspects of COTS monitoring into the program's formal activities throughout the Indo-Pacific region. Furthermore, several individuals as well as overseas tourism operations have indicated their willingness to participate in an expanded Reef-user survey program termed 'COTSWATCH - International'. Following the recent publication of a short promotional article in a regional dive magazine, I anticipate growing interest in this expanded Reef-user monitoring scheme.



Searching for juvenile COTS

Only one other paper dealt with aspects of COTS research. Quinn and Kojis reported on a survey of the Northern Mariana Islands where COTS outbreaks have occurred in the past. When applying our criteria for what constitutes an unsustainably high (outbreaking) population of COTS, then at least one of the reefs surveyed in that part of the world appears to be supporting a current active spot outbreak. See their abstract for further details.

Overall, the opportunities for networking and information dissemination as well as information gathering facilitated through the congress were found to be invaluable in gaining an improved appreciation of the truly large-scale nature of the COTS phenomenon.

ABSTRACTS

The early detection of outbreaks of the crown-of-thorns starfish *(Acanthaster planci)* – implications for local-scale control measures

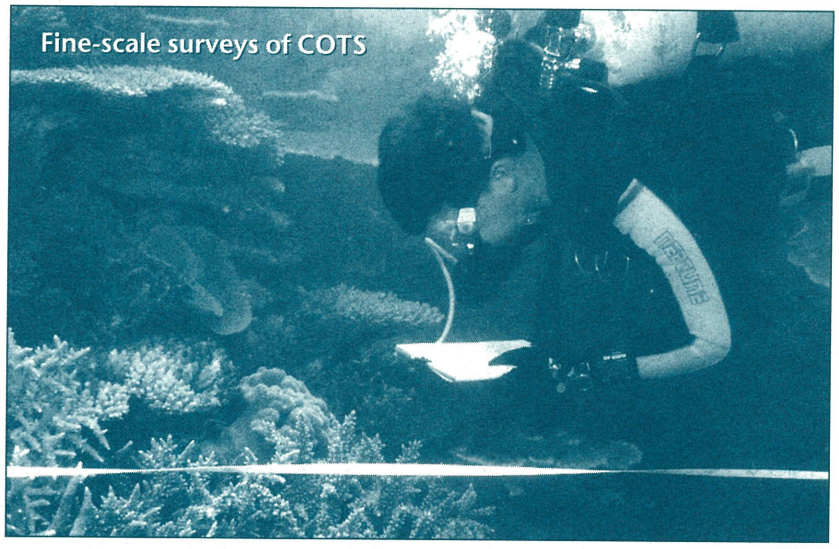
U. Engelhardt
Great Barrier Reef Marine Park Authority, PO Box 1379, Townsville Qld 4810, Australia

Using a new transect-based survey methodology, current outbreaks of crown-of-thorns starfish *(Acanthaster planci)* in parts of the Great Barrier Reef have been detected much earlier than has previously been possible using other survey methods. Intensive, fine-scale surveys have been successfully applied to detecting the early stages of developing *A. planci* populations including the usually cryptic juvenile starfish (1+ year old).

On the Great Barrier Reef, fine-scale monitoring of *A. planci* has detected early signs of developing outbreaks some 12 to 24 months before the outbreaks became obvious to untrained divers. Reef users in the Great Barrier Reef Marine Park are already benefiting from the improved early warning capacity of the fine-scale surveys. Reef-based tourism operations on *A. planci* affected reefs have been able to initiate local-scale control measures before starfish outbreaks had developed their full potential, thereby reducing the loss of live hard coral cover. Injecting starfish with an environmentally-acceptable compound – sodium bisulphate – has been shown to be the most efficient method for protecting small reef sites of particular importance.

Current outbreaks of *A. planci* are not confined to the Great Barrier Reef. Recent reports suggest that outbreaking populations are now appearing on many reef systems in the Indo-Pacific region. The geographically widespread nature and apparent synchrony of these events suggests that a truly large-scale phenomenon may provide the initial trigger. Applying the fine-scale survey methodology outlined here may greatly assist in the early detection of similar trends on other Indo-Pacific reefs with a known history of *A. planci* outbreaks.

Key words:
crown-of-thorns starfish, *Acanthaster planci*, outbreak detection, survey methodology, local-scale controls



The coral reefs of the Northern Mariana Islands 27 years after a crown-of-thorns outbreak

N.J. Quinn[1] and B.L. Kojis[2]
[1] School of Pure and Applied Sciences, The University of the South Pacific, Suva, Fiji
[2] U.S. Virgin Islands Department of Natural Resources

Scleractinian coral cover on reefs around Rota, Saipan and Tinian was substantially reduced by the crown-of-thorns starfish *(Acanthaster planci)* in the 1960s. Following the outbreak, coral cover on the outer reef slope to the western side of Saipan was estimated to be between 5 and 60%, with 50 to 98% of that dead. Twenty-seven years after the outbreak coral cover on many reefs remains below pre-outbreak levels. Many of the reefs had become dominated by *Porites rus*, a non-preferred prey species. *Acanthaster planci* and *Culcita noveaguinea* were present in low densities along most of the reefs surveyed on Rota, Saipan and Tinian. Larval recruitment rates were very low suggesting that much of the recruitment occurs asexually. The low larval recruitment rates for the Northern Mariana Islands in comparison with those observed along the Great Barrier Reef suggest that coastal zone managers in the Commonwealth of the Northern Mariana Islands need to look with increased caution at activities which are likely to affect the reefs. Although the reefs around Saipan have recovered from war and an *A. planci* invasion, it does not appear that larval recruitment has contributed much to the recovery. The species diversity is not likely to be either maintained or increased swiftly by larval recruitment brought in by water currents. We postulate that the Northern Mariana Islands coral reefs of Rota, Saipan and Tinian provided some of the recruits for the recovery of Guam reefs.

Key words:
Western Pacific Ocean, *Acanthaster planci*, *Culcita noveaguinea*, coral community, larval recruitment

COTSWATCH

Thanks to the efforts of our dedicated volunteer COTSWATCHERS, the COTS program continues to receive valuable information on the whereabouts of the starfish across the reefs of the Great Barrier Reef.

For 1997, the 'vital statistics' up to and including 29 September 1997 read as follows – 431 completed reports have been received, providing details on 761 individual sites from 108 different reefs.

As usual, my sincere thanks to all contributors for continuing to support this valuable scheme. 1997 COTSWATCHERS to date are:

A Ballard / Townsville; **A Crabtree** / Port Douglas; **A Lloyd** / Ingham; **A Payne** / Captain Cook Cruises, Cairns; **AB Petith, AB Davis, AB Warren** / RAN, HMAS Cairns; **A Knight** / Quicksilver Connections; **B Astill** / HMAS Cairns; **B Knuckey** / DoE Gladstone; **B Jewel** / Cairns; **C Coxon** / Cairns; **C Davies** / Cairns; **CJ Piper** / Lane Cove; **C MacKenzie** / Sydney; **C McCokell** / HMAS Cairns; **C Purdon** / DoE Townsville; **C Smith** / Townsville; **CPO D Hamilton-Thompson** / HMAS Tobruk; **Cairns Dive Centre**/ Cairns; **C Bartello, N Roper, A Kelly, D Schappendonk, S Wilson, S Payne, P Paxton, I Davis, D Hicks, D Kusnezow, D Anderson, M Woodhouse, T Lace, W Pearce, J Purcell, J Lackinosh** / Great Diving Adventures, Cairns; **D Brooks** / Townsville; **D Clements** / Townsville; **D Conwell** / North Epping; **D Pennell** / Andergrove; **D Wachenfeld** / Undersea Explorer; **D Wiseman** / Sunlover Cruises; **Dive Team** / HMAS Brisbane; **The Diving Officer** / HMS Gloucester UK; **Dungeness Marine Park Base** / Lucinda; **E Hardman** / Birmingham UK; **F Helligman** / Lady Elliot Island; **F Gunst** / HMAS Cairns; **F Soper** / Brinsmead; **F Muir** / DoE Cairns; **Friendship Cruises** / Mission Beach; **GA Conwell** / North Epping; **G Burns** / Roseville; **G Blazinic** / Port Douglas; **Greg Smith** / Townsville; **H Bailey** / Captain Cook Cruises, Cairns; **H Malcolm** / DoE Townsville; **R Buck** / DoE Mackay; **IR Fleetwood** / Gladstone; **I Stapleton** / Nimrod Cruises, Cairns; **I Bachtiar** / FKIP Universitas Mataram, Indonesia; **J Curtin** / DoE Cairns; **J Jones** / HMAS Cairns; **J Lothian** / Reef Biosearch, Port Douglas; **J Money** / HMAS Cairns; **J Oliver** / Townsville; **Jill Thorsborne** / Cardwell; **Jim McKenzie-Smith** / Endeavour Diving Services, Cooktown; **K Wallis** / Magnetic Island; **Kai Hoppe** / Kiel Germany; **L Whiteley** / Seascape Charters, Townsville; **Lady Elliott Island Resort; L Bright**

/ Townsville; **M Abela** / Pure Pleasure Cruises, Townsville; **M Cunningham** / Innisfail; **M Puotinen** / Townsville; **M Earney** / Mackay Adventure Divers, Mackay; **M Watterson** / Innisfail; **M Greet** / Port Douglas Dive Centre; **M Allen** / FV Seafari, Cairns; **M Mathews** / Undersea Explorer; **N Munro** / Sixteen South Charters, Port Douglas; **N Heath** / Aspley; **Ocean Spirit Cruises** / Cairns; **P Bikaunieks** / Kewarra Beach; **P Erasmus** / Kangaroo Explorer, Cairns; **P Heatherwick** / Port Douglas; **P Daniel** / DPI Qld; **Port Douglas Dive Centre** / Port Douglas; **R Avery** / Menai; **R Loudon** / HMAS Cairns; **RD Sluka** / Oceanographic Society of Maldives, Republic of Maldives; **R Lewis** / Big Cat Dive, Cairns; **R Berkelmans** / Townsville; **R Taube** / Kelvin Grove; **S Balson** / DoE Cardwell; **S Johnson** / Townsville; **S Martin** / DoE Cairns; **S Moon** / Ocean Spirit Cruises, Cairns; **S Wilson** / Cairns; **S & G Ellaby** / Sunlover Cruises; **S Wood** / Friendship Cruises, Mission Beach; **S Zannino** / Gladstone; **T Adami** / Townsville; **Great Diving Adventures** / Cairns; **T Sheaves** / HMAS Protector; **V Eiter** / Townsville.

COTSWATCH - INTERNATIONAL

Following the publication of a small promotional article in the June/July issue of 'Asian Diver', expansion of the COTS program on to the international arena is well under way. A slow trickle of reports from overseas locations is now coming in, with many of the new contributors to 'COTSWATCH - International' indicating their willingness to provide regular reports and updates on their respective reef areas.

Similar to the October 1993 launch of 'COTSWATCH' in Australia, I anticipate a somewhat slow start followed by a more rapid expansion of the scheme as our network of new observers increases.

Recent reports from overseas have confirmed the existence of current COTS outbreaks on quite a few reef systems in both the Indian as well as the Pacific Ocean. For example, verified records have come in from the Seychelles, Mauritius, Indonesia, Malaysia, the Philippines, the Solomon Islands, Fiji and the Cook Islands. Many of these outbreak reports were accompanied by requests for further information on how to design and implement a local strategy for the control of the outbreaks. As such, 'COTSWATCH - International' is already facilitating the regular exchange of information between geographically isolated parties affected in similar ways by the COTS phenomenon.

Some of the figures provided by overseas observers are quite impressive to say the least. For example, local control measures in parts of Indonesia have resulted in the removal of more than 13 000 COTS over a four-month period from just a few small fringing reef areas.

To make COTSWATCH reporting a little bit easier for those who are already connected to the wonderful world of the Web, survey reports can now be submitted electronically using our new Web site located at

http://www.gbrmpa.gov.au/cots