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GREAT BARRIER REEF
MARINE PARK AUTHORITY

R E E F R E S E A R C H

VOLUME 9 No. 3
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Oil spills...
our greatest fear
pages 14 to 20

**Managing ballast
water**
page 3

**Includes
REEF MANAGEMENT
NEWS**

Editorial

Welcome to our Christmas 1999 issue. It's been eight years since *Reef Research* 'hit the shelves' and a lot has certainly happened during that time. As the newsletter has evolved, so too in many ways has the Authority. During those eight years we've seen a restructure or two and a refocus towards critical issues. It begs the question, what will the next eight years hold?

There's quite a mixed bag of articles this time around. The newsletter's former editor, Steve Hillman, makes an appearance in *Slick Talk*. Steve briefly discusses the recommendations that were made at a recent ballast water workshop. The workshop was organised by the Association of Australian Ports and Marine Authorities and the Ports Corporation of Queensland and aimed to bring together a range of people to discuss what actions need to be taken to ensure that there are adequate and effective responses to the ballast water problem.

To continue on with the shipping-related theme, and also to compliment the oil spill feature of *Reef Management News*, guest writer Michael White provides a brief overview of an oil spill scenario. We also have a short introductory article from the Queensland Society of Accredited Maritime Professionals Inc.

As promised in the last issue, James Innes and Jayne Ormsby report on the results of the second Whitehaven Beach study. This study was carried out by Jayne Ormsby and Scott Schafer and aimed to ascertain the values local residents and visitors have for the Whitehaven Beach, Whitsunday Islands area.

Reducing sediment and nutrient loss from pastoral lands in northern Australia is the focus of *What's Out There?* A grazing trial has been

established on a property near Charters Towers, northern Queensland. The trial will look at many factors including nutrient and sediment loss and the economics of different grazing strategies. It is hoped that the results of the trial will encourage graziers to adopt sustainable management practices.

The restoration of mangrove forests is the focus of Paige Rothenberger's article. Even though this article concentrates on a reforestation project that is being carried out in the US Virgin Islands, the methods employed by the project team, and the lessons learnt, will no doubt be of interest to some of you.

And finally, I join up with Paul Hough, a biologist with ReefHQ, to delve into the fascinating world of the seahorse.



REEF MANAGEMENT NEWS

Our last edition for this year, in fact this century.

GBRMPA has been in the Marine Park management business only during the last quarter of this century, almost 25 years, and yet we have developed and implemented management systems, which are now being followed in many parts of the world. The next century will bring with it huge challenges for managing and protecting this vital World Heritage Area—challenges in which we all have a part to play.

Significant developments in planning and management have seen the implementation of Amendments to the Plans of Management for Cairns and the Whitsundays. One of the most important tasks for the Plans is to maintain recreational opportunities, setting aside areas for high-use tourism and areas where visitors can

WHAT'S IN THIS ISSUE

REEF RESEARCH:

- 2 Editorial
- 3 Slick Talk #27
- 5 Oil spills are always a worry
- 6 The Society of Accredited Maritime Professionals (Qld) and marine safety
- 7 A brief report on the assessment of the impacts from aircraft and other factors on visitor use and amenity at Whitehaven Beach
- 9 Environmental Impact Management at GBRMPA
- 25 What's out there?
- 28 Utilisation of encasement technology in restoration of mangrove forest on St. Croix, U.S. Virgin Islands
- 30 Seahorses – a forgotten species

REEF MANAGEMENT NEWS:

- 2 Editorial
- 10 Radar protection for birdlife
- 11 New chair faces critical issues
- 12 Local knowledge recruited
- 13 Reef advisory heads meet
- 14 FEATURE: Oil spills... our greatest fear
- 21 Spy-in-the-sky coral protection
- 21 Plans of Management amended
- 24 Traditional hunting

enjoy a low-key experience with small numbers of boats and people.

Also in this edition, we look at protecting bird life on Michaelmas Cay using the control tower at Cairns Airport, what you can expect if you damage corals while anchoring on the reef, dugong hunting, more community involvement as a result of developing Local Marine Advisory Committees, the ever present threat of oil spills on the Reef, and some thoughts from the new Chair of the Authority, Virginia Chadwick.

Finally, from all of us here at the Great Barrier Reef Marine Park Authority, a very happy Xmas and a productive New Year. ■

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

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THE BALLAST WATER PROBLEM — WHERE TO FROM HERE?

Steve Hillman

Environmental Coordinator, Ports Corporation of
Queensland, GPO Box 409, Brisbane Qld 4001

As reported in Slick Talk No. 26 by Steve Raaymakers in the last issue of *Reef Research*, in May 1999 the Association of Australian Ports and Marine Authorities and the Ports Corporation of Queensland (PCQ) jointly organised a workshop on the current state of play regarding ballast water. Since then the proceedings of the workshop have been published as one of the EcoPorts Monograph series (Hillman 1999) by PCQ.

The Ports Corporation has for a number of years been actively addressing the issue of ballast water management and has now surveyed five ports for invasive organisms. At this point in time no pest species have been found, although, given the limited state of knowledge regarding the distribution of tropical species, there is still no room for complacency. Even though the risk assessment that was commissioned by PCQ and most other Queensland Port Authorities (Hilliard and Raaymakers 1997) found that risks of invasions are low due to the differences in environmental parameters at 'source' and 'sink' ports, there is still a significant potential risk. This is evidenced by the outbreak of black striped mussels in Darwin marinas earlier this year (Pyne 1999).

The key recommendation of the workshop was that technical treatment solutions to the problem could and should be further developed through to the implementation stage as a matter of urgency. As an initial step to further this, the Ports Corporation commissioned Darren Oemcke of Gutteridge, Haskins and Davey to scope arrangements for an Australian consortium that could develop on-board treatment options for ballast water. Darren was engaged to do this because of his significant contribution to the field of international ballast water research over the past few years. This scoping document has been sent to potentially interested organisations such as government, ports and port users for their consideration and potential support.

There are a number of valid and different approaches to the disinfection of ballast water and one of these is a combination of initial filtration or cyclone/centrifuge followed by exposure to ultra-violet light. Darren's research has shown that this is a particularly promising way of dealing with the issue if a ship-based system is to be developed. While there is some developmental work taking place overseas, the consortium's approach will differ in that it will use 'off-the-shelf' components and not be tied to the commercialisation and development of a particular product. It is proposed to build on the overseas results and 'value add' to them in a practical, non-duplicative manner. When sufficient funding and/or in-kind support is found, the consortium will be established and a shore-based pilot plant built. Design data will be developed to examine solids loading rates and removal efficiencies of filters and cyclones, UV penetration of treated waters and the effect of UV dose on target organisms. While not, at this stage, a ship-borne system, this has an advantage in that testing is not restricted to when a ship is in port or the ports that the particular vessel visits. It will also be flexible and able to be varied relatively simply to determine appropriate designs under a wide range of conditions. For example, it could be moved to Tasmania to test effectiveness against the northern Pacific seastar, *Asterias amurensis* or dinoflagellate algal blooms, or taken to ports that have high sediment loads. Despite being shore-based, the design of the facility will be such that it will be transferable to ship-board operations.

The Commonwealth Government's Australian Quarantine Inspection Service is currently developing a Decision Support System (DSS) to categorise ships based on the risk they could impose due to ballast water. It is not yet clear what management actions will be taken for ships that pose a high risk, but it seems timely and necessary to explore practical and cost-efficient treatment options for ballast water that may not be able to be discharged in Australian ports.

The Ports Corporation will continue to act as facilitator for the consortium development and will continue its involvement in the reduction of the risk of ballast water transfers of exotic species. Organisations that can provide assistance for the project are urged to contact the author.

It is anticipated that the total project, including equipment purchase, will cost about \$900 000 over three years. Already a number of equipment suppliers have indicated that they would support the project if it proceeds which will reduce overall costs. While \$900 000 may seem a large amount of money, it should be considered against the cost of demurrage for a ship of Panamax's size which can be as high as US\$10 000 per day.

Recommendations of the Workshop

Participants at the workshop 'The Ballast Water Problem — Where to from here?' agreed that the long-term objective of ballast water management in Australia is to identify, adopt and implement the ultimate solution to the introduced marine species issue. All activities undertaken by Australia in this area will be directed at achieving this objective in an integrated, coordinated and collaborative manner. It is recognised by all



participants that there is little likelihood that there will be one solution to a complex issue. It is more likely that there will be a number of different methodologies which will be applied to different aspects of the issue.

A summary of the main recommendations of the workshop appears below.

- **Funding Requirements**

The Federal Government, through the Oceans Policy and the National Heritage Trust, as well as all State/Territory Governments, should be requested to contribute to the funding of port baseline studies and to the subsequent management of ballast water issues.

- **Port Baseline Studies**

All baseline studies need to be completed in the next one to two years and a review of resource availability should be undertaken at the earliest opportunity.

The Commonwealth Scientific and Industrial Research Organisation's Centre for Research on Introduced Marine Pests (CRIMP) undertook to review the sampling protocols for all ports following their experience over the last three years. The protocol should set the minimum standard for survey methodologies which can be used by all ports and marinas.

The Port Baseline study methodology should be approved by the Australian Ballast Water Management Advisory Committee so that the nationally coordinated approach is formally ratified.

- **National Management System**

A national management system should be adopted.

- **Cooperation and Coordination of Research Activities**

The need for closer, formal cooperation and coordination between Australian and New Zealand institutions undertaking research into ballast water, hull fouling and general incursion research was strongly supported by participants at the workshop.

The establishment of a Cooperative Research Centre into Marine Bioinvasions was recommended.

- **Ballast Water Control Options**

Open ocean ballast water exchange was identified as a viable tool and ought to be encouraged as an option. Development of other control options should have a

high priority as some vessels may not be able to undertake ballast water exchange, and a cost/benefit analysis should be considered.

Ship builders and ship owners building new ships should be encouraged to immediately include the best ballast options in ship design and work together with classification societies.

- **Decision Support System**

A guide to the DSS ought to be prepared for broader circulation and include a more comprehensive description of the approach that is being taken to evaluate risk.

Risk assessment will develop over time with the further accumulation of information but there will be a higher cost involved in developing the DSS to more sophisticated levels.

- **Port Contingency Plans**

Port contingency plans should be developed for situations where contaminated ballast water does enter a port.

- **Port Environment Plans**

Port environment plans must be in place, or developed, for all ports.

- **Hull fouling**

Regulations covering ships and recreation vessels should be reviewed so that they are harmonised and that differences between vessels under international law and vessels under domestic law be recognised.

There should be a nationally coordinated approach to hull scrubbing and propeller cleaning of international ships and all international and domestic marine craft not covered by international law.

- **Communications**

As far as possible, all regulations and procedures should be written in plain English and include glossaries where appropriate.

The responsibility for communications and support for incursion management procedures should be a coordinated effort including both the regulatory and industry sectors (i.e. governments, ports, the fishing industry, etc.).

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OIL SPILLS ARE ALWAYS A WORRY

Michael White

Centre for Maritime Law, T.C. Beirne School of Law, The University of Queensland Qld 4072

Oil spills in the Great Barrier Reef are always a worry. The spill in Sydney Harbour (300 tonnes) on 3 August 1999 resulted in the media showing an understandable interest in the possibility of a major oil spill in the Great Barrier Reef region. There have been 38 marine casualties in the Reef and Torres Strait since 1985¹ and, fortunately, they have not resulted in oil spills. There are about 3000 ship entries into the Reef each year².

The last major spill in the region was from the *Torrey Canyon* in 1970, and this actually occurred in the Torres Strait. In that case a large tanker had its bottom opened up by a rocky projection on the seabed, the presence of which was not previously known. As ships regularly traverse channels with the bottom of the hull only one or two metres off the seabed there is always a risk of a ship's hull being opened up. If there are double bottoms, or a pumping device for pumping oil from the damaged tank, then no oil need necessarily escape. However, if there is a major shipping casualty then the likelihood of an oil spill is high.

Of course there are major international conventions which establish a worldwide structure on ships carrying oil to increase the safety. Some 99.999 per cent of oil carried by sea worldwide arrives safely. The International Maritime Organization (IMO), with its headquarters in London, has been instrumental in having over 30 international conventions passed and implemented to give effect to its aims of 'Safer Ships and Cleaner Seas'. Australia has been a disciplined subscriber to the international conventions, has participated in most of the discussions and has ratified all of the conventions that are relevant and appropriate. Foremost amongst the conventions dealing with oil is MARPOL 73/78, which is actually two conventions that must be read together. This explains its unusual name. The more recent convention which came into effect in 1994, the 1982 United Nations Convention on the Law of the Sea (UNCLOS), has major provisions about protecting and preserving the marine environment, but it is not as specific and detailed as many of the IMO conventions. Details of the international conventions and the Australian laws are published and readily available³.

Not only have the various Australian Governments been assiduous in ratifying these conventions, they have also taken trouble to ensure that the relevant ones have been given the force of law in Australia by passing domestic legislation. There are a plethora of Commonwealth Acts which give effect to the conventions, and there are strict administrative policies and guidelines to give effect to those conventions that only require administrative action.

From a legal administrative point of view, Australia being a federation of States has created a most confused situation in the territorial sea, in which much of the Great Barrier Reef lies (the rest of it is in the contiguous zone, the Exclusive Economic Zone or internal waters). Under the 1979 Offshore Constitutional Settlement the States and the Commonwealth agreed to joint jurisdiction from the baselines out to three nautical miles. From the three-mile

limit further out to sea there is still State jurisdiction if there is a nexus between the vessel, the people and the activity in question and the State legislation. Also, the Commonwealth was only granted certain, limited, powers under the Constitution. If one places the Great Barrier Reef in this matrix of State and Federal jurisdiction and then one adds an oil spill from a ship with the oil drifting in wind and tide from one area to another, one has a most complex legal and administrative situation. It is time a major effort was made to rationalise this complex situation.

This is not to ignore that the National Plan, of which Reefplan for the Great Barrier Reef is part, is not well structured and organised. Under the National Plan skilled personnel and oil spill equipment can be gathered at short notice from all parts of Australia, and overseas if necessary. But this planning for cleaning up an oil spill can only be effective where there are small spills and they occur in protected waters. The world statistics are that for large spills that occur in open waters something less than 10 per cent of the oil is recovered. This is a statistic which the scientists well know but the media and the general public do not. On the positive side, if the spill occurs in open water then it does very little damage in the long run. The problem is in the interim period if the spill occurs near delicate parts of the coast, near holiday beaches, marinas, major ports and so on. It may be that if a major spill occurs in the Reef then a difficult decision may need to be made as to which part of the Reef is to be protected, by floating booms and the like, and which part is to be left to take its chances. Some research indicates that coral will recover faster from oil pollution than, for instance, mangroves.

Many oil spill authorities now consider that the initial steps to cope with spilled oil in the sea is to use dispersants. These chemicals change the characteristics of the oil so that it spreads down and through the water column, instead of staying concentrated on the surface. The dispersant also makes the oil less 'sticky' so that it does not attach to objects with which it comes into contact. By dispersing the oil in this fashion the toxicity is lessened and less damage is done by its presence in the water than otherwise would be the case.

This article has concentrated on oil spills that actually occur. Of course the best policy is to take steps to ensure that they do not occur at all. Such steps are being taken with compulsory pilotage, compulsory reporting of position, more emphasis on safe ship navigation and the like. Suffice to say that the Great Barrier Reef is subject to daily risk from a marine casualty and a marine casualty often means a major oil spill. Navigating a ship is a highly developed skill, but even the best navigators make mistakes from time to time. The risk has to be borne as the Australian public wants the benefits of oil. One can only do the best to try and prevent a marine casualty and then, if one occurs, do the best to contain the damage. It has to be faced, however, that it is likely that a major marine casualty will occur in the Reef one day. If it does, it is fairly certain that the public and the media will ensure that it becomes a major issue.

(Dr Michael White QC was a former mariner in the Australian Navy and then a barrister for many years. He has written widely on marine matters and he is the Executive Director of the Centre for Maritime Law, University of Queensland.
[Web site: www.uq.edu.au/law/cml/])



¹ Data from Captain Kit Filor, Marine Incident Investigation Unit, Department of Transport.

² Data from Fiona Thorburn, Australian Maritime Safety Authority.

³ See White, M. 1994, *Marine Pollution Laws of the Australasian Region*, Federation Press, Sydney.

THE SOCIETY OF ACCREDITED MARITIME PROFESSIONALS (QLD) AND MARINE SAFETY

Ship safety is one of the vital components of the marine industry and managing our Great Barrier Reef Marine Park. Before 1996, the issue of marine safety was mainly the responsibility of officers of the Queensland Department of Transport (QDoT). In those years a ship's design was first assessed by QDoT naval architects, its construction was inspected by QDoT surveyors and the ship's ongoing operations were monitored by QDoT surveyors and officers from the Queensland Boating and Fisheries Patrol. These naval architects, surveyors and officers were not held personally accountable to the public for the standard of their work.

The introduction of the *Queensland Transport Operations (Marine Safety) Act 1994*, *Transport Operations (Marine Safety) Regulation 1995* and associated standards, *Transport Operations (Marine Pollution) Act 1995* and *Transport Operations (Marine Pollution) Regulation 1995* dramatically changed the marine safety strategy for Queensland shipping. The legislation introduced in 1996 created a more flexible approach to achieving marine safety while placing a great deal more responsibility on ship owners and others in meeting their general safety obligations. There are now penalties in the hundreds of thousands of dollars and imprisonment terms of many years for those who do not meet their designated responsibilities.

Part of this transfer of responsibility involved the appointment from the private sector of accredited ship designers, marine surveyors and ship builders. These accredited entities took over the duties of assessing a ship's design, inspecting during ship construction and periodic ship inspecting during the ship's life. The chief executive of QDoT has the responsibility of ensuring that accredited entities have a thorough knowledge of the relevant Acts, Regulations and standards that apply to their categories of accreditation. Appointment as an accredited entity is only granted once the chief executive of QDoT is satisfied that the entity has the required knowledge.

The process of ship design acceptance is now the responsibility of accredited ship designers (with provision also for QDoT naval architects to perform this function). Ship inspections during construction are now the responsibility of accredited ship builders or accredited marine surveyors (where the ship builder is not accredited). Ship owners may also engage, as required, an accredited marine surveyor to inspect the condition of their ship for seaworthiness. All accredited entities are required to take personal responsibility for their work.

To monitor and audit the actions of accredited entities, ship owners and operators, the chief executive of QDoT has appointed shipping inspectors. Some of these inspectors are QDoT officer specialising in certain fields, others are police in uniform and many are Boating and

Fisheries Patrol officers. The chief executive of QDoT has the responsibility of ensuring that shipping inspectors have a thorough knowledge of the relevant Acts, Regulations and standards that apply to those in the marine industry.

In mid-1998, a group of accredited ship designers, builders and marine surveyors saw the need for a representative body. This developed (with encouragement from QDoT) into the Society of Accredited Maritime Professionals (Qld) Inc. (SAMP(Q)) which was established in September 1998. SAMP(Q) now represents over one half of all active accredited ship designers, builders and marine surveyors. The main role of the society has been to:

- keep members informed of legislative updates so that they may provide the best and most accurate advice to their clients;
- provide expert advice to QDoT on marine safety matters and legislative issues; and
- provide a means of redress, through the society's Professional Conduct committee, for the public in any dispute they may have with a member.

As can be expected, there have been many 'teething problems' associated with the introduction of such radically new legislation in the marine industry. Members of SAMP(Q) have been at the forefront in working with QDoT to fine tune the system for the benefit of the marine industry and achieve a better marine safety environment. The two most vital issues that are currently affecting marine safety are:

- a lack of adequate monitoring of ships and their operations; and
- QDoT officers giving incorrect advice to accredited entities and ship owners that could lead to the entities and owners breaching the Acts and Regulations.

The society is working with QDoT to try to resolve these two issues. The first issue involves more funding or the better allocation of existing funding. The second issue involves better education of, and control over, departmental officers.

Not all accredited entities are members of the society, however those who are members have been generally proven to provide the best service to their clients.

Further details on SAMP(Q) and its members may be obtained from the Secretary by phoning +61 7 4053 6402 or faxing +61 7 4053 7180. Further details are also available at www.sampq.asn.au



A BRIEF REPORT ON THE ASSESSMENT OF THE IMPACTS FROM AIRCRAFT AND OTHER FACTORS ON VISITOR USE AND AMENITY AT WHITEHAVEN BEACH, WHITSUNDAY ISLAND.

James Innes¹ and Jayne Ormsby²

¹ Great Barrier Reef Marine Park Authority

² Consultant – Social Scientist, c/- GBRMPA

This paper briefly presents the results of a research project commissioned by the Great Barrier Reef Marine Park Authority (GBRMPA) to report upon the impact aircraft and watercraft activity have upon the use and amenity values visitors attribute to Whitehaven Beach. The final report from this study will be available in January 2000. This report complements an article that appeared in the previous edition of *Reef Research* (Vol. 9, No. 2) by Hamilton and Innes that reported on a sound-monitoring project undertaken at Whitehaven Beach in October 1998 (see also Hamilton 1999).

Whitehaven Beach is a dazzling six kilometre stretch of silica sand located on the south-eastern side of Whitsunday Island

the largest island in the Whitsundays group (figure 1). The beach is a popular destination for visitors to the Whitsundays and locals alike, with approximately 14 000 visitors travelling there each year¹. The need to protect the unique natural and cultural values of the area combined with the pressure of high use presents a challenge for management.

To address this challenge the GBRMPA, with the Queensland Parks and Wildlife Service (QPWS), has developed a specific site plan for the Whitehaven Bay and Beach area. In keeping with the Marine Park's philosophy of multiple use, the object of the site plan is to protect the natural and cultural values of the area whilst providing a range of users opportunity to access and enjoy the area.

The object of the research project was to provide specific information to the Authority's Planning Section to report on the level of impact aircraft and watercraft activity had upon the values visitors ascribed to Whitehaven Beach. The Authority commissioned consultant social psychologists Jayne Ormsby and Scott Shafer to undertake this project.

People mainly travel to Whitehaven Beach using services provided by local Whitsundays tour operators². The tour services provided include a large cat ferry that

can transport up to 250 people, small- to medium-sized watercraft that carry 15 to 30 people, and seaplanes and helicopters. Marine Parks managers recognise that the variety of air and watercraft that provide people with the opportunity to access Whitehaven Beach can also affect peoples' use and amenity of the area as well as its natural values. The challenge for the Authority and

QPWS is to achieve a balance of use at Whitehaven Beach that is acceptable to all users and other stakeholders.

The Authority recognises the importance of incorporating objective and accurate social science information into its planning and management decisions (Williams 1996; Wachenfeld et al. 1998). The current

Whitehaven Beach research follows on from social research undertaken at Whitehaven Beach by Gooch (1991) and a field experiment conducted at Green Island in 1986 to measure the impact of seaplanes on peoples' enjoyment (Brown 1986). The Whitehaven research is also built upon applied research that has been undertaken by the Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef (CRC Reef Research Centre) (Shafer et al. 1998). Similar work reporting on the impact of aircraft sound on wilderness experiences has also been conducted for the United States Parks Service (Tabachinick et al. 1992) and other environmental resource management applications in the United States (Shafer and Hammitt 1995; Tarrant et al. 1995).

Data for the Whitehaven research was obtained in three ways: 1) visitor survey; 2) on-site observations; and 3) a

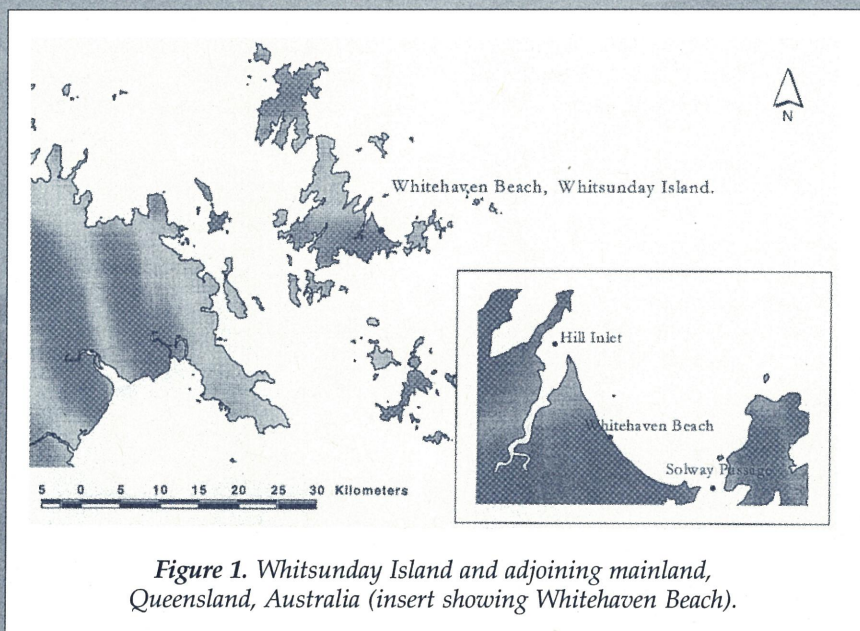


Figure 1. Whitsunday Island and adjoining mainland, Queensland, Australia (insert showing Whitehaven Beach).

¹ This figure is sourced from Great Barrier Reef Marine Park Authority Environmental Management Charge returns and is based upon the number of visitors who access the site through the services of Whitsunday tour operators, sail yourself yacht charters (bareboat), seaplanes and helicopters. Visitors aboard private vessels also access the beach but the exact numbers of this type of visitor are not known.

² Logistical support for the Whitehaven project was provided by Fantasea Cruises, Hamilton Island Aviation, Operators of Baby J and Ocean Rafting, On the Edge and QPWS Marine Parks.

local interest group survey. Self-administered questionnaires were completed by 583 day trip visitors on-board tourist boats during March and April 1999³.

There was a 97% response rate to the questionnaire. Of the sample, 56% were female and 44% were male, with 40% aged between 20–29 years of age. Fifty per cent were Australian visitors (4% local residents) and 50% were international travellers, mostly from Great Britain (41%), Europe (21%) and North America (21%). Twenty-two per cent had previously visited the Whitsundays and 10% had visited Whitehaven Beach before.

The presence of other people and their activities did not generally affect visitors' social amenity whilst at Whitehaven Beach. Twelve per cent reported that they felt there were too many people on the beach, whilst 85% indicated that the number of other people did not concern them. There was no significant influence in the activities of aircraft or vessels upon visitor use and amenity at Whitehaven Beach. Ninety per cent of the people interviewed indicated that the noise, distance and number of these craft did not affect their enjoyment of Whitehaven Beach.

The majority of people interviewed (88%) indicated that they would like Whitehaven Beach to remain in its present state – natural and undeveloped. Eighty-nine per cent rated their Whitehaven Beach visit as highly satisfying with 69% indicating they would definitely like to return in the future.

Both visitors to the Whitsundays interviewed and members of local interest groups were of the opinion that Whitehaven Beach was most valuable for its natural and ecological processes, conservation, recreation and educational opportunities. The values associated with economic opportunities and spiritual meaning were of least importance to respondents. The most popular words that people used to describe Whitehaven Beach were 'beautiful', 'relaxing and calming', 'quiet' and 'tranquil'. The 'clean beach', 'pure white sand', 'clear water' and 'unspoilt natural environment' were also Whitehaven Beach reflected in many peoples' responses.

The three experiences the majority of respondents were seeking related to participating in water-based activities such as swimming and snorkelling, enjoying the beach and water, and relaxing and sunbathing.

The natural and scenic qualities of Whitehaven Beach were attributes that visitors enjoyed the most. The area was not valued highly as a physically or socially active place.

The Whitehaven Beach study has highlighted that a number of experiential preferences and conditions can be developed as social indicators to monitor changes in social amenity for particular locations in the Marine Park. The results of the Whitehaven study are also consistent with the more general findings of Gooch's 1991 research. The findings also demonstrate that current management strategies being applied to

Whitehaven Beach and Bay area by both the Authority and QPWS are providing opportunity for balanced multiple use of the area in line with the site plan and the settings-based structure of the Whitsundays Plan of Management.

Ormsby and Shafer's Whitehaven study provides one source of information to inform GBRMPA and QPWS planning decisions. The long-term benefit of such social science information is realised when it compounds in value when developed into a time series data set. The social science tools developed for the Whitehaven study provide GBRMPA with the capacity to regularly acquire information on usage and amenity values for specific locations with the Marine Park.

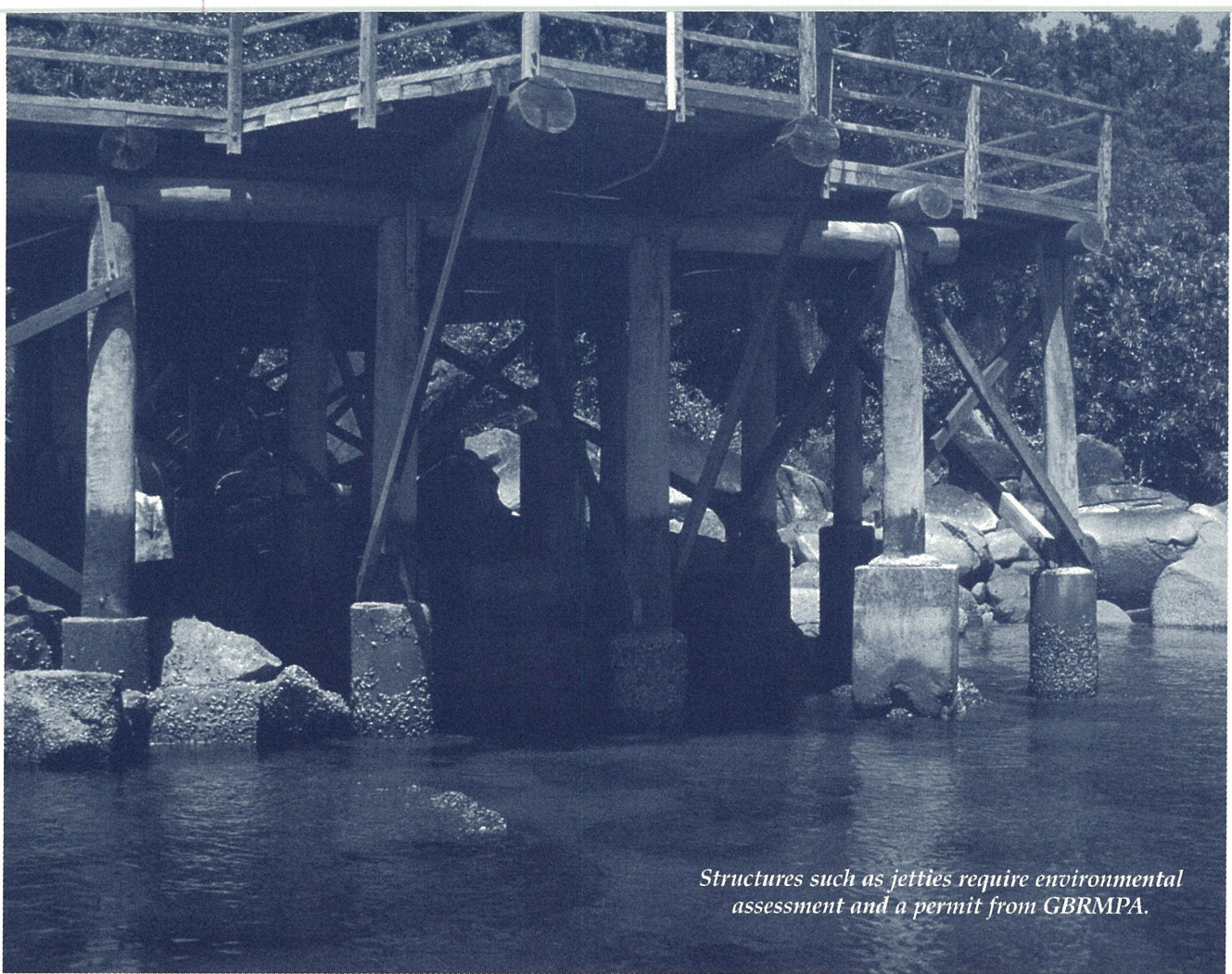
During 2000 the Authority, with the CRC Reef Research Centre, will examine the development of social science monitoring programs based upon the Whitehaven research and other relevant social research. Like the long-term monitoring of the biophysical aspects of the Great Barrier Reef World Heritage Area, the development of social science monitoring programs to regularly report on a social indicators will add to the Authority's capacity to fairly balance competing uses of the Marine Park whilst protecting the area's unique natural and cultural values.

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³ Volunteers from the QPWS Whitsundays Volunteers provided research assistance to the consultants by administering interviews to visitors on-board commercial tour vessels.



Structures such as jetties require environmental assessment and a permit from GBRMPA.

ENVIRONMENTAL IMPACT MANAGEMENT AT GBRMPA

The Great Barrier Reef Marine Park is managed to ensure conservation of its natural and cultural values, and to provide for a range of opportunities for use. Management tools include zoning and management plans, permitting, impact assessment, monitoring and policy.

The Environmental Impact Management Unit manages **environmental impact assessment (EIA)** and **permitting**. EIA is defined as 'the systematic identification and evaluation of the potential impacts (effects) of proposed projects, plans, programs or legislative actions relative to the physical-chemical,

biological, cultural and socio-economic components of the total environment'. The thrust of EIA is that balanced decisions regarding the environment occur in the public interest. The Great Barrier Reef Marine Park Authority (GBRMPA) assesses approximately 30 major projects per year. Current projects include marinas and associated developments at Hinchinbrook and Keswick Islands, Molongle Creek and Nelly Bay; dredging and disposal adjacent to the ports at Cairns and Townsville; sewage discharge in the Whitsunday Islands; and submarine communication cables and pontoons.

Permits may be defined as 'a written order giving permission' and generally include conditions, bonds (money placed in trust to ensure that works are carried out according to conditions) and insurance. The permit system helps GBRMPA and the Queensland Parks and Wildlife Service (QPWS) to reduce impacts on high-usage and sensitive areas, separate potentially conflicting activities, and collect data for better management. The Authority issues approximately 500–800 permits per year with the majority being for tourism and scientific research. Permits are complex, often require native title notification and may require four to six months for an application to be processed. Permits usually require a Permit Application Assessment Fee and are usually issued for a maximum of six years. The Authority and QPWS are renewing their permit systems to make them faster and less complex. Recent changes to management plans are a part of this process. Our goal is to 'process 80% of permits within eight weeks'.



Please do not hesitate to contact the following GBRMPA staff for information on EIA and permits on +61 7 4750 0700 or visit our website on <http://www.gbrmpa.gov.au>

Dr Adam Smith	EIA and permit management
Leigh Grey	EIA—Far Northern Section
Andrew Costen	EIA—Cairns Section
Johanna Johnston	EIA—Central Section
Carol Honchin	EIA—Mackay/Capricorn Section
Kylie Glasgow	Permits—routine inquiries

REEF MANAGEMENT NEWS

Writer: John Camplin

Editor: Craig Sambell

E-mail: J.Camplin@gbrmpa.gov.au

E-mail: C.Sambell@gbrmpa.gov.au

Design and layout: John Camplin

BIRD life on Michaelmas Cay is now being further protected by the introduction of a unique monitoring system to ensure aircraft do not fly below a 3000ft ceiling established by the Queensland Parks and Wildlife Service (QPWS).

Under an agreement between the QPWS and Air Services Australia (ASA), the control tower at Cairns Airport has begun monitoring the

Is it a bird? Is it a plane? No, it's Michaelmas Cay radar man

Michaelmas Cay area with a new computer system which will provide early warning of possible incursions.

From December 2 this year, flight plans filed before aircraft left their departure point have been automatically appearing on the Air Traffic

Control screen if the flight was due to approach Michaelmas Cay.

Further "defence" of the air space will swing into action two minutes ahead of the incursion if an aircraft approaches the area flying below 3000ft. Aircraft will also be banned from flying within one nautical mile of the centre of the cay.

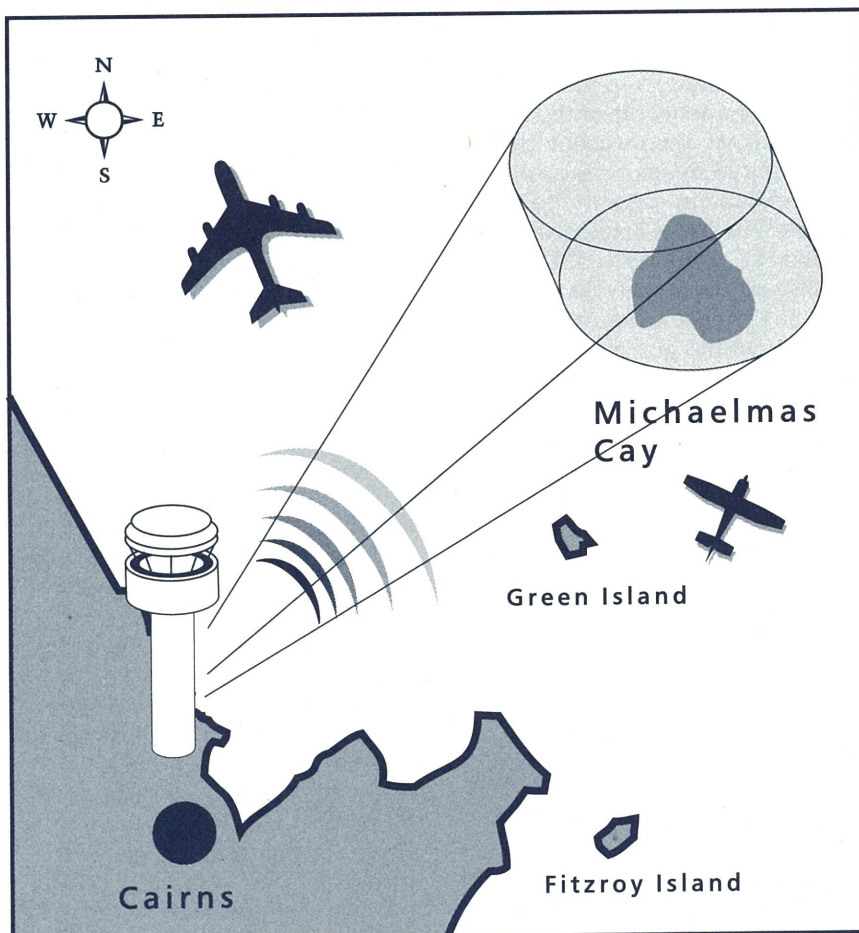
Consultation with the ASA has been continuing since 1997 in a bid to achieve a higher enforceable level of the airspace. Michaelmas Cay is unique in that it falls within the radar field of the Cairns air traffic control tower monitored airspace.

The joint QPWS-Great Barrier Reef Marine Park Authority negotiations with the ASA were the first time airspace restrictions had been sought on environmental grounds, so process and assessment criteria were required to be developed by the ASA.

The ASA is now monitoring aircraft movements in the Michaelmas Cay region on a 24-hour basis by computer modelling a cylinder of airspace around and above the cay. The ASA will undertake prosecutions under its legislation, effectively on behalf of the QPWS and GBRMPA.

Protection of bird life on the sand cay 40km north-east of Cairns has become a critical issue because of a decline in some species of up to 40 per cent since monthly monitoring began in 1984.

Statistics indicate that, after removing the effects of cyclones, numbers of the Common Noddy have



On guard: Cairns air traffic control tower monitors Michaelmas Cay

dwindled by 40 per cent and the Sooty Tern population has decreased by 26 per cent on Michaelmas Cay, which is the most important seabird nesting site in the Cairns Section.

The GBRMPA had proposed that tourist programmes using aircraft would not be permitted to operate at less than 1500ft above Michaelmas Cay but supports the 3000ft agreement settled by the QPWS and the ASA.

The 1500ft limit is consistent with guidelines for managing visitation to seabird breeding islands. The Cairns Area Plan of Management also prohibits vessels or aircraft under power from exceeding a six-knot speed limit in the Michaelmas Cay locality.

An amendment to the GBRMPA's Plan of Management for the Cairns Area also makes it easier for aircraft to access all but the most sensitive locations. Apart from those sensitive locations, it is considered that scenic flights operating above 500ft have minimal impact on conservation values and other users.

The current restriction in the Cairns Area of the Marine Park allows 50 days access a year for aircraft operations with a booking. Scenic flights operating above 500ft can access the Cairns Area all year without a booking.

Tony Stokes, manager of the Conservation, Biodiversity and World Heritage critical issues group at the GBRMPA, pointed out that the Queensland government had published a plan of management for Michaelmas Cay in the mid-1980s.

"It introduced certain restrictions and prohibitions on aircraft use around the cay, including a ban on seaplanes, as the result of a study of the effects of planes on the birds," Mr Stokes said.

"The report suggested that seaplane operations to Michaelmas Cay had a significantly greater likelihood of resulting in seabird disturbance — that is birds taking off from their nests — than vessel operations.

"Seaplane departures were about 17 times more likely to result in sea bird disturbance than seaplane arrivals."

Project officer Gordon LaPraik, of the QPWS, emphasised that the downward trend in numbers of seabirds, while not scientifically linked to any one cause, was raising serious concern about the long-term future of the colony.

"The restriction of airspace above and adjacent to Michaelmas Cay is a prudent management action," he said.

"The basis of this restriction is that the QPWS is obliged to adopt the precautionary principle in its

management decisions where environmental resources appear to be threatened and where scientific knowledge is limited.

"Given the potential impact of even an occasional low-level overflight upon nesting seabirds, the regulation of airspace will complement existing on-ground measures and reduce the potential for any aircraft disturbance."

Monthly monitoring of birds by the QPWS started in 1984. Aircraft disturbance trials were first conducted in 1986 and seaplanes were prohibited from accessing Michaelmas Cay in 1987.

Controls on tourist access began in the late 1980s and on-ground measures now include:

- A management plan for the National Park;
- A restricted access area under the Nature Conservation Act which prohibits human access to the colony;
- A restricted area under the Queensland Marine Parks Act which prohibits human access to the beach apart from a defined area on the northern side; and
- A code of conduct for tourism operators which limits the number of people on the cay at any one time. ■

New Chair swaps politics for more critical issues

A BETTER balance between commercial fishing and preservation of the biodiversity of the Great Barrier Reef are at the top of a long list of issues being addressed by the new chair of the Great Barrier Reef Marine Park Authority, Virginia Chadwick.

Mrs Chadwick, who was appointed in July after a long and distinguished political career, has quickly found her feet after admitting she had a "steep learning curve" ahead of her in getting to grips with the major issues facing the Authority's management of the GBR Marine Park.

She considers physical damage by fishing trawlers to the floor of the Marine Park a serious concern because it threatens the biodiversity of bottom-living communities which are, incidentally, beginning to be mapped by the Authority's Representative Areas Programme.

"There is an increasing recognition that if you fish beyond the point of

Cont page 12



Steep learning curve: Virginia Chadwick at her new 'home'

sustainability it's not going to be the Authority's regulations and guidelines that put your business at risk. We won't need those regulations, because the fish won't be there and there won't be a viable industry," she said.

The Great Barrier Reef Ministerial Council's recent decision to tighten up regulations in Dugong Protection Areas highlighted one of the most emotional current issues in the Marine Park and Mrs Chadwick said the large

'I would like to think we will see high explosive bombing cease'

number of reported deaths along the coast this year had sparked real concern at the Authority as well as among conservationists.

"We have to do more monitoring before we can really judge whether the DPAs are working well or need further fine tuning, because we don't have a model anywhere else in the world with which we can compare our actions," she said.

"People should be interested and proud of the fact that what we are doing here is unique. It is always hard being the first with anything because you've got nothing to measure your performance against.

"I am sure the concern about the large number of reported deaths is proper and legitimate but I also have a suspicion that, because of the high profile in the public mind that the issue has had in recent times, the incidents have helped remind people about the message to report deaths and strandings.

"There is probably an element of increased awareness that has given rise to some of the increase in reports but that is obviously too simple an answer to explain it all."

Mrs Chadwick believes that, through the GBRMPA's management of the Reef, it can contribute not only in Australia but internationally to furthering knowledge of coral bleaching — whether it is a cyclical phenomenon or whether it is of greater immediate concern.

"In the short term I was happy that we were able to get the amendments to the Cairns and Whitsundays plans of management in place. Greater pain, more anomalies and greater

difficulties would have emerged the longer the implementation had been delayed," she said.

Mrs Chadwick considers as "odd" the use of high explosives for target practice in a World Heritage Area of which the whole country is proud and will make the Authority's views known yet again when more exercises are planned.

"The Authority has made its position clear and it's not a startling position. Clearly we prefer it not to happen and I would like to think we will see high explosive bombing cease during my period as chair," she said.

Other challenges will be the impact of legitimate human activities which impact on the Marine Park, including farming, grazing, aquaculture and tourism.

Mrs Chadwick acknowledges that her appointment surprised many people who drew attention to the fact that she did not have any experience as a scientist, marine biologist or in a related field, but she emphasises that the job has something in common with positions she has held over the last 20 years.

During a parliamentary career from 1978 until she resigned from the New South Wales upper house last March, she held the portfolios of Minister for Education and Minister for Tourism — areas she considers gave her the experience in management which are important in her current position.

"It does have some commonality with most of the work I have done over the last 20 years in terms of managing large, complex organisations," she said.

"The other field where there is a great commonality is that it (the GBRMP) is an area about which people feel passionate — not just the people in particular industries, interest groups or research areas.

"Because the Reef itself is such an icon it is an area in which the broad community is engaged. As a result we have to balance not only our obligations in terms of legislation like World Heritage and Marine Park management but also the interests of all the stakeholders and the general public. It's very much a balancing act.

"I am very conscious of ensuring that a variety of interests and views are taken into account as we try not only to reach decisions on a number of difficult issues but to make sure the decisions we reach are fair to all concerned, underpinned by our obligations to protect and conserve the Reef."

On a personal note, Mrs Chadwick has resumed her twin passions of ceramics and performing arts at her new home in the Townsville suburb of Heatley where she lives with her husband Bruce, a retired computer bureau operator, and their dog which she describes as a 'bitzer'.

"One of the reasons we bought the house was that it had a big shed in the back yard where I can do my pottery," she said. ■

Local knowledge recruited to preserve Reef...

COMMUNITIES along the Queensland coast are becoming more involved in aiding management of the Great Barrier Reef Marine Park as a result of the establishment of Local Marine Advisory Committees.

The Great Barrier Reef Marine Park Authority launched the LMACs in May, inviting interested volunteers to join an enhanced system of involvement with local communities by building on the success of the former

Regional Marine Resources Advisory Committees

John Tanzer, executive director of the GBRMPA, identified a need for the Authority to make it easier and more desirable for people to become involved but acknowledged that, because of the enormous number of issues associated with the Reef, it was difficult to spread networks throughout the communities.

"Some very good work has been done in this regard in the past but I

think we can improve on how we go about supporting the involvement of these groups," he said.

"If we can do that, and adopt a more open approach, then I think we will see a greater desire on the part of people to become involved."

Each LMAC includes a senior manager from each of the GBRMPA's critical issues groups — Water Quality, Fisheries, Tourism, and Conservation, Biodiversity and World Heritage — who will take responsibility for

ensuring the Authority's involvement is maintained or increased.

A full-time position has been created for a GBRMPA officer to work exclusively with the LMACs and there will be improved liaison with the Queensland Parks and Wildlife Service to ensure there is a co-ordinated approach to the groups' involvement.

Mr Tanzer said GBRMPA's goal was to make the LMACs evolve into a stronger medium for feedback from the local communities.

"Hopefully they will become involved in some concrete projects, like creating a volunteer programme with the park rangers so they can receive some training in surveillance, recording and education," he said.

"Local communities have a good appreciation, understanding and

knowledge of the Marine Park and what happens in it — and they have legitimate goals and aspirations for what they believe should happen.

"It is also important that they understand what the Marine Park Authority is about and what our work is doing, because communication and understanding go a fair way to achieving co-operation."

Mr Tanzer said that if the GBRMPA allowed itself to lose contact with communities along the coast there would probably be a level of resentment.

"We have to take hard decisions sometimes which impact on sections of the communities, and those people need to be consulted about what we do as part of our day-to-day operations," he said.

"From the GBRMPA's point of view, we get local knowledge on a range of things, such as the appearance and numbers of dugongs and where illegal activities may be occurring.

"The LMACs give us the opportunity to hear directly the views of the communities in a concerted, organised way which would otherwise be difficult to achieve.

"As interested observers, the communities benefit from knowing what goes on in their areas. The LMACs give them the opportunity to get better information and a chance to be involved with the GBRMPA and its work programmes."

LMACs have been established in nine communities — Cooktown, Port Douglas, Cairns, Mission Beach, Hinchinbrook, Townsville, the Whitsundays, Mackay and Gladstone. ■

...and RACs provide feedback on wider issues



Photo courtesy: Townsville Bulletin

Virginia Chadwick with RACs heads (left-right) Greg Pearce, Peter Frawley, Simon Woodley and Noel Dawson

Newly appointed chairs of the recently established Great Barrier Reef Advisory Committees (RACs) met for the first time in Townsville in early November.

The committees, representing four critical Issues Groups within the Great Barrier Reef Marine Park Authority, have been established to provide the Authority with more effective and direct communication with Reef stakeholder groups.

The chairs of each of the critical issues groups are: **Mr Noel Dawson:** Water Quality and Coastal Development; **Mr Peter Frawley:** Tourism and Recreation; **Mr Greg Pearce:** Fisheries; and **Mr Simon Woodley:** Conservation, Biodiversity and World Heritage.

RACs are competency-based committees comprising a cross-section of Reef stakeholder interests with expertise

and experience across a range of relevant areas.

Welcoming the four RAC chairs, Authority CEO Virginia Chadwick said that the establishment of the critical issues groups and the input from the Advisory Committees would mean greater efficiency and a more immediate and positive response in dealing with Reef management issues.

"These high profile chairs will not only ensure that discussions remain focused, but that the work of the Authority is transparent and open," she said.

Each RAC will work closely with the relevant critical issues group to ensure that policy and strategic direction are developed in consultation with appropriate stakeholders. They will also address such matters as priorities for policy development and for research and monitoring. ■

Oil spill exercise proves there'll be no slip-ups

AN OIL spill exercise in the Whitsundays has confirmed that not only are contingency response plans adequate but also highlighted several procedures which will be enhanced as a result of the operation.

Four government agencies — the Queensland Department of Transport, Great Barrier Reef Marine Park Authority, the Queensland Parks and Wildlife Service and the Australian Maritime Safety Authority — took part in Exercise Cumberland in the Whitsundays.

In the mock exercise an imaginary barge being towed by the tug *High Spirit* collided with the 6000-tonne cargo ship *MV Seletan* close to South Molle Island in the Whitsunday Passage. Two crew members from the tug were injured and taken to Shute Harbour for medical attention.

The tug sank shortly after the collision, losing its cargo of 25 drums of assorted oils. The *MV Seletan* spilled 200 tonnes of bunker fuel as well as 50 tonnes of coal tar naptha into the ocean.

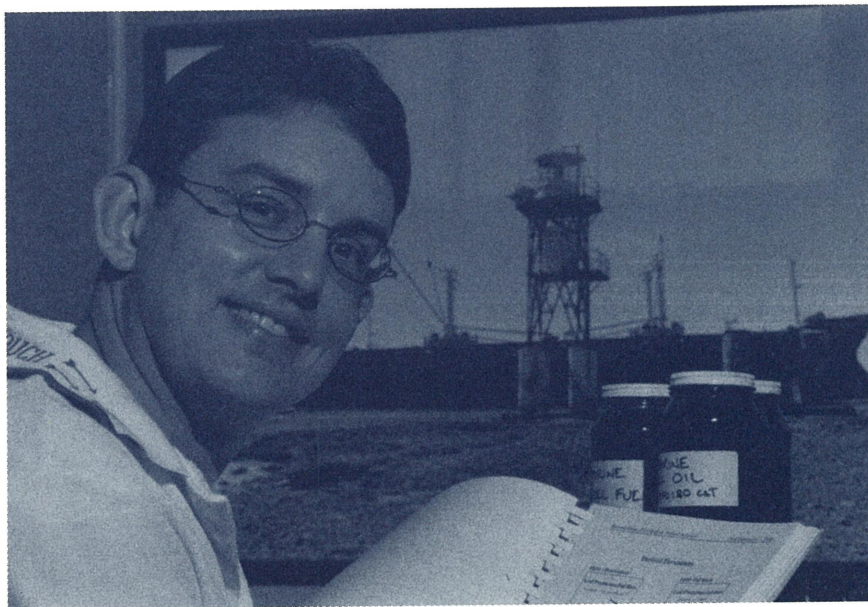
The GBRMPA's project officer of shipping and marine pollution response, Jamie Storrie, said preliminary reaction to the incident centred on ensuring the safety of the *MV Seletan*, securing cargo and fuel, and organising fixed-wing aircraft to spray the area with dispersants.

"Dispersants would provide the quickest and most effective response to any spill within the Whitsundays," Mr Storrie said. "We would follow that up by using booms to surround the vessel and then turn our attention to protecting the areas of sensitive wetlands in the neighbouring region."

Mr Storrie emphasised that the scenario demonstrated the difficulties of undertaking any form of oil spill response in non-port areas within the Great Barrier Reef Marine Park.

He said that, while the Whitsundays could not be considered a remote location on the Queensland coast, the physical deployment of personnel and equipment to such an area would take some hours.

"The exercise estimated that it would have taken us 5-6 hours to



Defending the Reef: Jamie Storrie with the tools of his trade and a reminder of the ever-present danger, the Peacock pictured on Piper Reef

transfer the first boom equipment to the incident from Mackay, and equipment from other centres would have taken 8-10 hours," he said.

Dispersants remain the primary means of controlling the impacts of an oil spill immediately following an incident. In Exercise Cumberland the dispersant aircraft were already in Mackay as part of a training programme and were therefore on the scene earlier than would normally be the case.

Dispersant spray fixed-wing aircraft in Queensland are based at Emerald and are contracted to be in transit to the scene of an incident within four hours of call-out. Helicopters based in Mackay would spray the oil until the fix-wing aircraft arrived but their rate of application would be substantially less.

The mock exercise, which replicated a significant incident in the Whitsundays, revealed that there would be substantial pollution of the islands adjacent to the Whitsunday Passage, including sandy and rocky shorelines and some areas of highly-protected wetlands.

"There would be low recovery rates of significant numbers — probably hundreds — of oiled seabirds as well as impacts on a number of beaches at tourist resorts," Mr Storrie said.

"This would obviously result in the tourist industry losing significant revenue and there would also be flow-on effects to resorts which escaped pollution, because of the public image of an oil spill in the region.

"It would take many months to clean the oil from the shoreline because of the large number of bays and headlands and the high level of cleanliness required of those areas due to tourism pressures."

Mr Storrie reported to the GBRMPA: "The main lesson to be learned...is that the Authority can expect significant shoreline impacts. The Authority should not be under any illusion as to capability to prevent impacts given that physical response times will be measured in terms of 6-10 hours and chemical dispersant response times 2-4 hours."

He said the main point of Cumberland and similar exercises was to identify shortcomings in responses to pollution incidents in general. A major flaw was a problem with information management and exchange in the early stages of the event.

"We could have made greater use of aerial surveillance, as well," he said. "There wasn't enough surveillance to derive information as we needed it, although I think that was a function of the exercise

which would not be replicated in a real event.

"The positive thing was that the shortcomings were all minor elements of the overall exercise."

Mr Storrie said that, while a response of 6-7 hours from Mackay to the Whitsundays may appear to be a long time in a fairly centralised area, it was acceptable considering the various responses which follow an oil spill.

"It may take up to an hour before call-out," he said. "If the vessel has an incident and starts leaking immediately it's probably going to take upwards of 15-20 minutes for

anyone on board to realise it is leaking oil.

"Then 10 minutes later the first call-out message goes out. By the time the message works its way down the chain, to the stage when we actually get people into the store room, you are talking 30 minutes to an hour, just to get people to the storeroom and loading equipment.

"You've got to get a truck there and load it, which probably takes another hour. It's a good hour or 90 minutes travelling time from Mackay to the Whitsundays. Then you've got to unload, get the equipment on to a barge and take it

out to the scene."

Mr Storrie said the actual responses to the incident — the action on the water — were fairly good, although they were only desk-topped. There was no actual deployment of equipment except for the fixed-wing dispersant aircraft.

"Assuming that the oil was dispersable we would have got rid of about 50 per cent of it in a real incident," he said. "But dispersant ceases to be an option pretty quickly because heavy fuel oil generally becomes undispersable after a while. It becomes thicker and tarrier and the chemicals no longer work." ■

HUMAN error induced by fatigue will probably be the cause if there is ever a major oil spill in the waters of the Great Barrier Reef.

The Great Barrier Reef Marine Park Authority has logged human error as the reason for five of the seven most recent groundings, and an inquiry is currently under way to establish why the 22,000-tonne bulk carrier New Reach hit Heath Reef last May.

The GBRMPA's marine pollution response officer, Jamie Storrie, has highlighted the human factor in a report on the New Reach grounding to the Federal Environment Minister, Senator Robert Hill.

Mr Storrie reported that there had been a number of similar incidents within and adjacent to the Marine Park. Since 1995 there have been three groundings within the Marine Park and three within Torres Strait. They were:

- **March 1995:** The *Carola* grounded on South Ledge Reef in the Far Northern Section. No pollution resulted but there was extensive damage to the Reef and the bow of the ship was holed. The vessel was refloated after six hours. The cause was human error. A pilot was on board the vessel but not present on the bridge at the time of grounding.
- **June 1995:** The *Svendborg Guardian* grounded on Kurrimine Beach,

Wake-up call as human error, fatigue lead to groundings

south of Cairns. The vessel was undamaged and refloated 12 hours later. No pollution resulted.

The cause was human error. The grounding occurred outside the compulsory pilotage area and there was no pilot on board at the time. The bridge was unmanned at the time of grounding and had been unmanned for five hours prior to impact. The second mate had left the bridge and fallen asleep in his cabin.

- **July 1996:** The *Peacock* hit Piper Reef in the Far Northern Section and remained aground for eight days. The vessel was refloated with no pollution resulting. Substantial damage to the reef occurred. The cause was human error. A pilot was on board the vessel and present on the bridge at the time of grounding but he had fallen asleep on the bridge.
- **June 1997:** The *Thebes* ran aground on Larpent Bank in the Torres Strait. It was refloated and no pollution resulted. The cause was navigation error. A pilot was present on the vessel.
- **July 1997:** The *Dakshineshwar* ran aground near Wednesday Island in the Torres Strait. It was refloated with no resulting pollution. The cause was engine failure. A pilot

was on board and in charge of navigation at the time of grounding.

- **November 1997:** The *Nol Amber* ran aground on Larpent Bank but was refloated with no pollution. The cause was navigation error. A pilot was on board and in charge of navigation at the time of grounding.

Apart from the grounding of the *Dakshineshwar* all incidents resulted from human error. Bridge and ship-board management practices in particular were contributing factors with all the Marine Park groundings.

The three groundings within the Marine Park need to be placed within the context of more than 12,000 shipping movements through Great Barrier Reef waters in the period since 1995.

In October 1991 mandatory pilotage was adopted for all vessels longer than 70m and all loaded oil, chemical and liquefied gas carriers. These classes of vessels must carry a licensed pilot from Cape York to Cairns Roads or when using Hydrographers Passage.

Mr Storrie reported that the introduction of compulsory pilotage reflected the navigational difficulty of the two areas selected and government's concern for the protection and conservation of the Great Barrier Reef.

"There are three pilotage companies operating within the Marine

Cont page 16

'The pilot is not liable for any advice affecting navigation'

Shipping meets at northern boundary

SHIPPING is a significant user of the waters of the Great Barrier Reef World Heritage Area and several major routes intersect at Torres Strait at the northern boundary of the Marine Park.

Ships transiting the inner shipping route between the Queensland coast and outer reefs carry a wide range of cargoes, including bauxite and alumina, manganese, iron ore, coal, sugar, general container freight and oil.

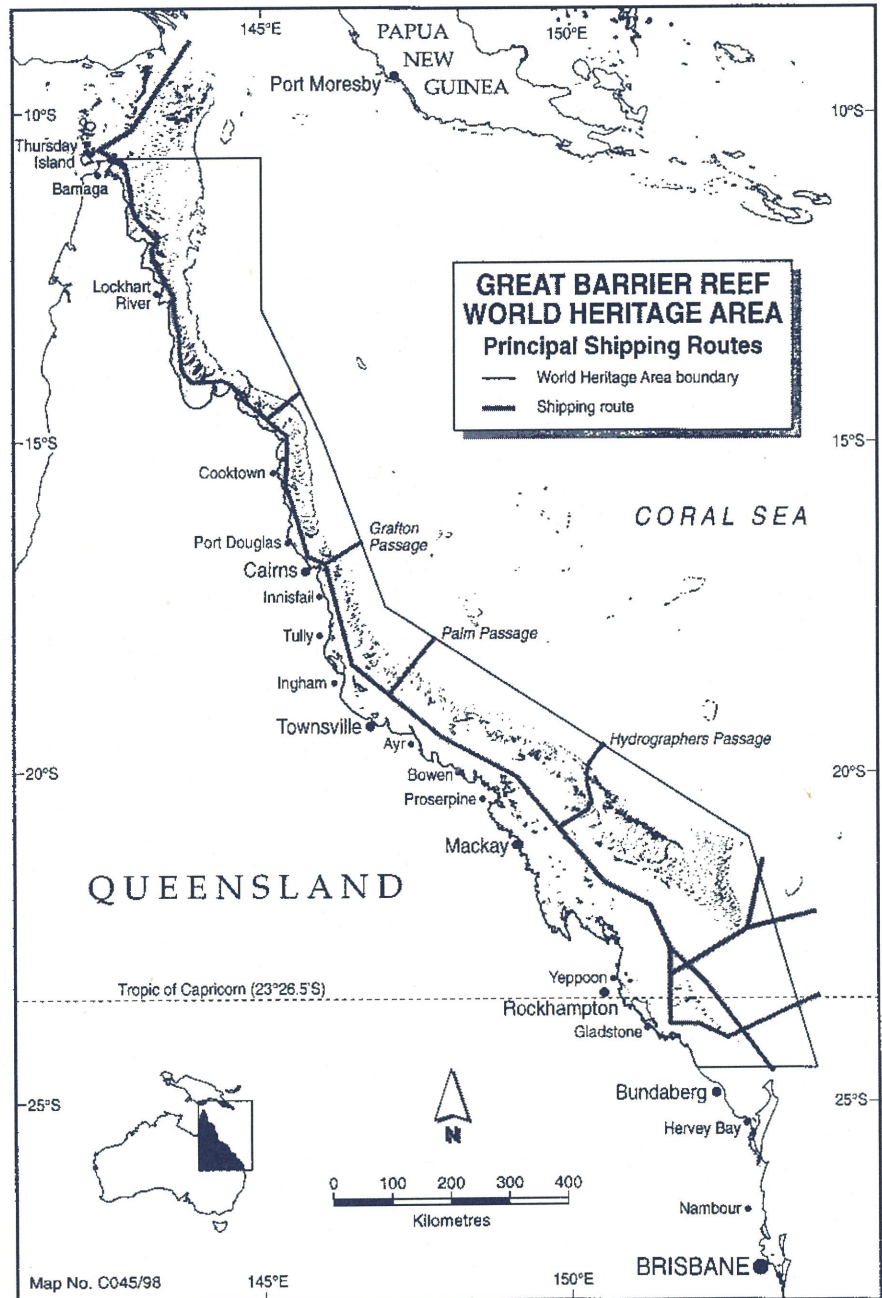
The ships transiting the inner route fall into several categories:

- International through traffic not visiting Australian ports (a proportionately small group);
- Foreign-flagged trading vessels visiting Australian ports;
- Australian-flagged overseas trading vessels;
- Australian coastal traders;
- Australian fishing vessels; and
- International and Australian non-commercial traffic, such as yachts, motor cruisers, and tourist and naval vessels.

Accurate knowledge of the types, cargoes and movements of ships using the Great Barrier Reef routes has been difficult to obtain in the past. However, the Ship Reporting System (REEFREP) has provided managers with the first complete picture of the numbers and type of vessels using the inner route and, more importantly, entering and departing the Reef through Hydrographers, Palm and Grafton Passages.

There are about 3000 shipping movements (vessels in excess of 50 metres in length) within the Great Barrier Reef every year. Two thirds of these use the inner shipping route with the rest entering or departing through Hydrographers, Palm and Grafton Passages.

Bulk carriers comprise the largest proportion of the shipping, which is consistent with the large amount of trade through the bulk ore ports of Hay Point, Abbot Point and Gladstone. Only five per cent are oil tankers with most on northerly transits, which indicates that most of the oil cargo carried through the Reef is refined product. ■



Wake-up call over human error

From page 15

Park. Two companies provide services for the entire reef, whilst a third provides a specialist service for Hydrographers Passage," he said.

"The function of a pilot on board a ship is to provide information and advice to the master of the ship and to assist the master and the ship's navigating officer to make passage through the pilotage area or areas for which the pilot is engaged.

"The pilot is not liable for any advice affecting the navigation of

the vessel which results in damage or loss, provided that advice is given in good faith and was not reckless in intent. The master is at all times responsible for the conduct of the vessel.

"Australia has been instrumental in attempting to consolidate Bridge Management Systems on board ships — that is, developing a management system whereby the pilot and ship's crew work together as a team to ensure the safe navigation of the ship." ■

DESPITE the best preventative measures, marine oil spill incidents can and will continue to occur. The aim of the response initiatives is to minimise impacts on the environment.

There are a number of response mechanisms in place to ensure prompt and effective action within the Great Barrier Reef using dedicated and competent resources, though it must be recognised that there are significant limitations with responding to maritime incidents within much of the Marine Park.

Inner v Outer routes: mariners weigh up surveys, hazards

THE Great Barrier Reef and Torres Strait Shipping Study was completed in 1995 with one of the terms of reference being an assessment of the relative risk of an accident occurring on either the inner or outer shipping routes.

The findings were inconclusive although the initial analysis suggested the outer route had a lower risk of an accident until the presence of a pilot was included, in which case the inner route had a slightly lower risk.

The inner route tends to be favored by mariners because:

- There is mandatory pilotage within the inner route north of Cairns and through Hydrographers Passage and, while the occasional pilot error will occur, it is preferable to non-pilotage;
- The inner route has been well surveyed and navigation hazards and water depths are well charted;
- There is a comprehensive network of navigational aids throughout the inner route, including Differential Global Positioning System;
- The inner route is closer to safe havens for disabled and damaged vessels to shelter and be repaired;
- The inner route provides greater capability to control and monitor the movement of shipping; and
- The inner route has calmer weather and sea conditions than the outer route.

National, Reef plans ensure prompt, effective responses

The **National Plan** provides the framework for oil spill response in Australia. It came into operation in 1973 and represents a co-operative integrated effort between governments (Commonwealth and State) and the oil and shipping industries. The purpose of the National Plan is to prepare, equip and train designated and competent people for oil spill response.

In the Great Barrier Reef Marine Park, National Plan activities are co-ordinated and managed by the Maritime Division of Queensland Transport and the Queensland State Committee. The State Committee comprises members from relevant government agencies such as the Environment Protection Agency, the Great Barrier Reef Marine Park Authority and the oil industry.

The National Plan ensures that Australia always has a response capability designed to meet the likely risk posed by oil tanker and other traffic in Australian waters.

Contingency plans are in place to respond to any incident and, in addition, equipment and personnel are provided to respond effectively to any likely risk.

Should an incident be too great for local resources to deal with, plans are in place to support a response from other Australian locations and from overseas stockpiles. The Australian capability is based on the combined resources of Government and industry for sufficient containment, recovery and dispersal capacity.

When the National Plan was instigated in 1973 Australia had a response capability of 1000 tonnes of oil. This was increased to 10,000 tonnes in the 1993 review of the National Plan and most recently the National Plan Advisory Committee meeting in April 1997 endorsed an indicative capability of 20,000 tonnes.

The initial response utilises personnel and equipment at a local level but if and when the incident escalates, additional resources will be deployed from other agencies and industry.

The Queensland Government, through the Department of Transport, is responsible for initiating oil spill response within the Great Barrier Reef using **Reefplan** and the GBRMPA

Cont page 18

Arguments against the use of the outer route include:

- The route is surveyed to a width of 10km, which means traffic is restricted to that corridor;
- Water in the outer route is so deep that vessels cannot anchor if they experience difficulties and would be at the mercy of the prevailing weather conditions which could result in a vessel being set upon the outer edge of the Great Barrier Reef; and
- The ability to mount an effective response to a spill on the outer edge of the Great Barrier Reef is extremely limited if not non-existent.

There is a perception in the community that because vessels use the outer route there will be not be an impact on the Great Barrier Reef in the event of an incident leading to an oil spill. This is incorrect.

The nature of the impacts is likely to be different to what might occur due to an accident on the inner route. An incident on the outer route would lead to impacts on the outer edge of the Great Barrier Reef and inward into the lagoon, whilst an inner route incident is likely to cause impacts to coastal fringing reefs and coastal and estuarine environments.

It needs to be noted that in the north of the Great Barrier Reef the seaward edge of the Reef is still close to the coast and an outer route accident in that area could lead to impacts on both the outer reefal and coastal environments. ■

National, Reef plans aim to minimise worst impacts

From page 17

provides an environmental and scientific advisory role.

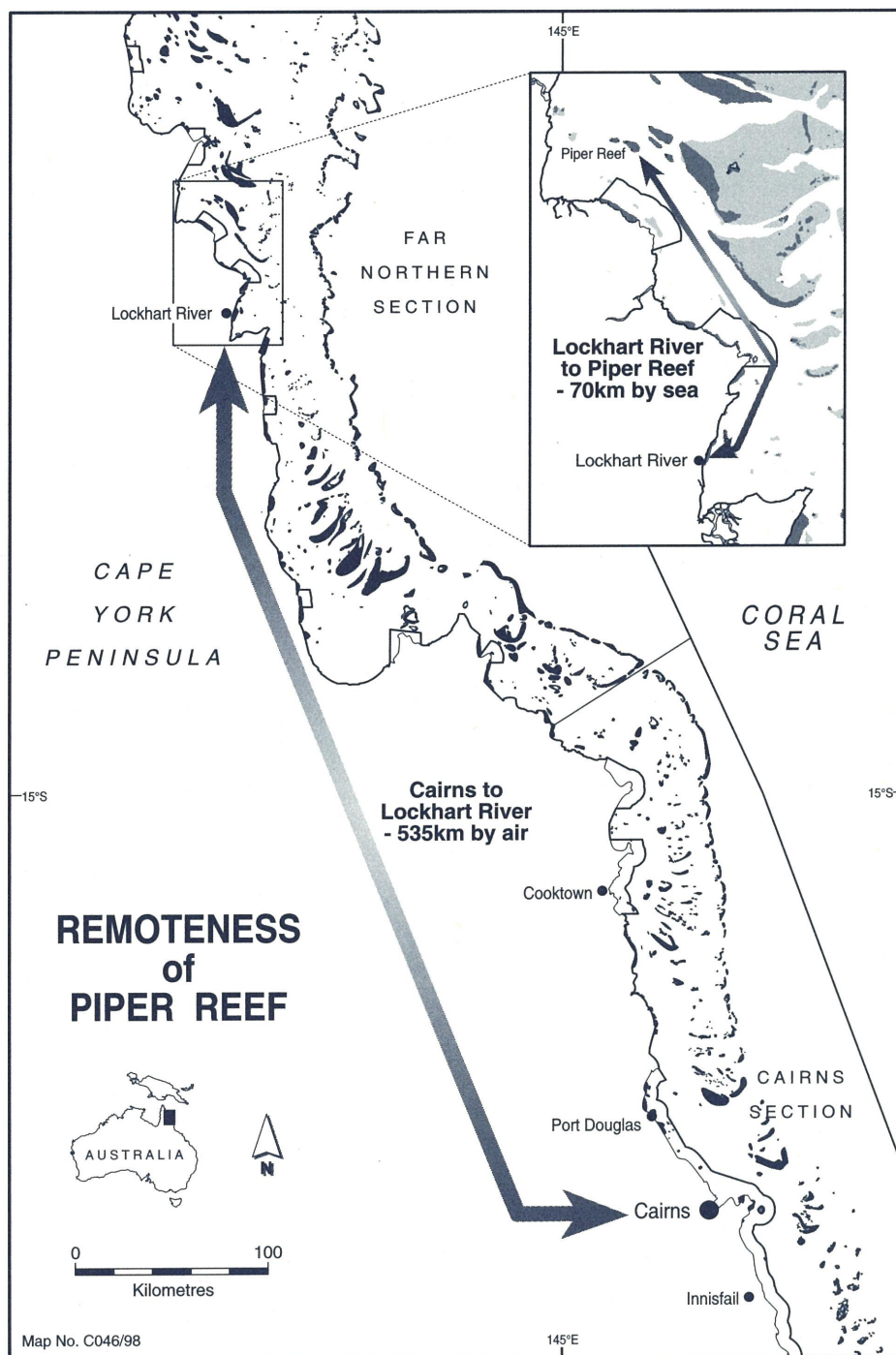
Significant resources have been placed along the Queensland coast to respond to oil spills. Each port has been provided with resources to respond to minor incidents of pollution of up to 10 tonnes of oil.

Larger stockpiles are stored in Townsville and Brisbane to respond to incidents of 10-1000 tonnes of oil. For the very large spills of 1000 tonnes and more resources are available from interstate, in particular the AMSA equipment on loan to the States and Northern Territory held in major centres, the Australian Marine Oil Spill Centre in Geelong and internationally.

There are several factors limiting oil spill response within the GBRWHA:

- The small population centres adjacent to the Reef mean there is only a limited pool of trained response personnel. In the event of a significant incident response personnel will travel from areas remote from the centres adjacent to the Reef. It should be noted that the response to the *Iron Baron*, which spilled about 300 tonnes of heavy fuel oil in northern Tasmania, sourced response personnel from all over Australia.

- The remoteness of large areas of the Reef, particularly north of Cairns, makes a physical response very difficult. Certainly there will be significant delays in moving equipment given the limited transport infrastructure in the north of Queensland. The response to the *MV Peacock*, which grounded north of Lockhart River in July 1996, demonstrated the logistical problems associated with remote areas responses. The map above demonstrates the logistical problems associated with responding to the *Peacock*.



- Oil spill dispersants provide the most credible response option in the northern and offshore areas of the Reef but their use is significantly limited by the sensitivity of reefal and inter-tidal communities. More importantly, the oil most likely to be spilled (heavy fuel oil) is not readily dispersed.

Given these factors and also the technological limitations of oil spill

response in general, it should be recognised that a significant oil spill is likely to result in impacts to inter-tidal and coastal habitats.

The extent of any damage is not easily predicted because it is highly dependent upon local conditions, environments and the specific type of oil. However, significant impacts can be expected on a regional scale in the short to medium term. ■

SHIPS posing the greatest risk to life and the marine environment have been required to implement the International Safety Management (ISM) Code since July 1.

Shipping companies which operate passenger ships, oil tankers, chemical tankers, gas carriers, bulk carriers and high speed cargo craft of 500 gross tonnage and above are co-operating with governments and regulators to ensure appropriate measures are being enforced.

There is a strong view amongst the industry that of all the prevention measures, the most important is to ensure that crews are competent. ISM is a positive step in eliminating sub-standard crews and unsatisfactory management practices.

It is common knowledge amongst marine incident investigators that the human element is a major contributing factor to incidents and the resulting pollution. Regulators are striving to develop standards, systems and practices which mitigate the inherent human element-induced incidents.

While the regulators accept that a major oil spill cannot be fully cleaned up and that most major spills will result from collisions and groundings, a sound prevention regime is improving navigational safety through technology.

Queensland Transport and the Australian Marine Safety Authority have focussed on joint venture initiatives when phasing in technical improvements to navigational safety and ship reporting and surveillance systems such as the SRS.

Existing and emerging technology such as Differential Global Positioning System (DGPS), Electronic Chart and Display Information Systems (ECDIS), surveillance radar and satellite communications further improve safety.

These systems will augment the existing navigation aid infrastructure supporting the Great Barrier Reef. DGPS in particular, is a means for improving the safety of and redundancy within navigation.

DGPS and ECDIS provide another strong link in the chain to protect

Safety code targets ships posing greatest threat to life

the Great Barrier Reef. DGPS can provide positional accuracy to plus or minus 10m or better.

The AMSA DGPS network covering the Great Barrier Reef currently consists of base stations at Horn Island, Cape Flattery, Mackay, Gladstone and Brisbane with further extensions planned for Weipa, which will cover the inner route off Lockhardt River, and Ingham by the end of this year. This completed configuration will ensure 100 per cent, 24-hour coverage within the waters of the Great Barrier Reef and also entrances to the Coral Sea.

The enhanced accuracy of DGPS can only be fully utilised when combined with ECDIS, a navigational Geographic Information System which continuously displays a vessel's position in relation to navigational aids and dangers.

Basically ECDIS allows the display of digital chart information over which is superimposed the continuous real time position of the ship. Manual plotting or fixing is not required and an instantaneous

appreciation of position with respect to dangers is apparent to the mariner.

A significant feature of ECDIS is the provision of warnings and alarms that are specifically intended to counter human error, which is the most significant factor in groundings.

ECDIS requires a special digital data base in vector format. The Royal Australian Navy's hydrographic office is currently compiling such a database, termed ENC 1 (Electronic Nautical Chart 1), for the Great Barrier Reef inner route from Weipa to Gladstone. ENC 1 will be commercially available in January 2000.

There is currently no national or international legislative requirement for a vessel or reef pilot to carry ECDIS. However, with all performance, technical and test standards for the system developed and adopted internationally and national digital chart databases being compiled throughout the world, ECDIS technology is now being applied operationally. ■



Passenger shipping companies are co-operating to ensure enforcement



Ships must report when entering or leaving ports in the area

Navigation safety at heart of world-first reporting system

THE Ship Reporting System was implemented jointly by the Australian Marine Safety Authority and Queensland Transport as a Commonwealth and State initiative to increase maritime safety and enhance marine environmental protection and response within the Great Barrier Reef.

To achieve the twin aims within the Great Barrier Reef, Australia sought and obtained formal International Maritime Organisation adoption of the mandatory ship reporting system (REEFREP) which took effect from January, 1997.

A world-first initiative, the SRS covers the Torres Strait and the inner route of the Great Barrier Reef. It is operated by Queensland Transport from the Ship Reporting Centre (REEFCENTRE) at the port of Hay Point, near Mackay.

The objectives of the SRS are:

- To enhance navigational safety and thereby minimise the risk of a maritime accident and consequential marine pollution and major damage to the marine environment; and
- To provide a monitoring capability ashore which interacts with shipping, providing improved information on the presence, movements and patterns of shipping in the area.

SRS provides for an extremely intelligent surface picture of shipping operations over the entire SRS area. The surface picture is produced at REEFCENTRE using a sophisticated Traffic Information Module (TIM).

Ship reporting has been formally adopted by the IMO under the SOLAS Convention. Reporting is mandatory for all ships of 50m or longer, all oil and chemical tankers regardless of

length and ships engaged in towing or pushing operations.

Ships must report to REEFCENTRE at designated reporting points in the SRS area and when entering or leaving ports in the area. In return, ships receive reports from REEFCENTRE advising of other ship movements, concentration of fishing vessels, weather reports, navigation safety and other information. This is a major boost to ship safety.

Structured as an information service, the SRS does not have the capability in either equipment or operator qualification to provide navigational assistance or direction to individual ships.

Accurate knowledge of a ship's position in real time is only available within the coverage of the SRS radar sites at Hammond and Warraver Islands in Torres Strait and Green and Penrith Islands within the Inner Route.

Strong support for the SRS has been achieved by industry as well as voluntary participation by non-mandatory classes of vessels. REEFCENTRE has already been able to identify and track ships which were illegally transiting the inner route without a pilot on board.

SRS is proving invaluable in identifying and assessing trends in shipping and shipping patterns within the Great Barrier Reef. The information will be an excellent tool in reviewing current risk management practices for the Great Barrier Reef.

AMSA is extending radar coverage to include Palm Passage, off Townsville, in view of the size and density of shipping now using the passage, as identified through data collected by the SRS. ■

Prevention still the key issue

THE ability of government to implement unilateral actions to direct shipping outside the Great Barrier Reef is tempered by traditional rights of passage. Current preventative measures, such as compulsory pilotage and mandatory reporting, have been sought by multi-lateral agreement through the International Maritime Organization.

Jamie Storrie, the marine pollution response officer at the Great Barrier Reef Marine Park Authority, said there had been a low incidence of grounding within the Reef when compared to the total number of shipping movements.

However, he added that although there had been relatively few accidents,

Conclusions

continued improvement of preventative regimes was required to ensure the rate was reduced.

"There is no conclusive evidence to suggest that the use of the outer route will provide any greater safety for shipping activities or reduce the risk of impacts on the Great Barrier Reef," Mr Storrie said.

"Arguments for the outer route may well be an 'out of sight, out of mind' attitude to the problem. However it may still be desirable to encourage ships which do not stop at Queensland ports to use the outer route.

"Response arrangements are in place for the Great Barrier Reef and are tested regularly but there needs to be an acceptance that responding to marine oil spills within Reef waters is extremely difficult, particularly within the northern areas."

Mr Storrie concluded that a significant oil spill within the Great Barrier Reef would undoubtedly result in impacts to marine and coastal environments at a local to regional scale. ■

At last... plans finalised as tourism concerns allayed

AMENDMENTS to the Plans of Management for the Cairns Area and Whitsundays have been implemented by the Great Barrier Reef Marine Park Authority after being delayed because of concerns by tourism operators about some of the restrictions they asked the government to re-examine.

The Plans of Management for the two regions were introduced in June 1998 and approved by the federal government last October, setting in place a legally binding policy to protect the biodiversity and beauty of the most popular areas of the GBR.

The GBRMPA emphasised its policy was to ensure that recreational opportunities for everyone were preserved and, with more than 90 per cent of tourism activities taking place near Cairns and in the Whitsundays, they were the two areas under the most intense pressure.

Andrew Skeat, director of programme development, pointed out that the rapid growth in use of the areas prompted the GBRMPA to prepare plans which would protect their natural, cultural and scenic values.

"Without the plans, the real concern was that the ecosystem would be damaged and we would end up with the lowest common denominator throughout the entire Marine Park," he said.

BOAT operators who damage corals by anchoring in the Cairns and Whitsundays areas of the Great Barrier Reef Marine Park face prosecution and fines of up to \$1100 for an individual and \$5500 for a company.

The new regulations were detailed in amendments to the Plans of Management for the Cairns Area and Whitsundays enacted by the Commonwealth government in a move designed to protect corals, especially in the two high-use regions of the Marine Park. The rules will be enforced by the day-to-day management section of the Queensland Parks and Wildlife Service assisted by Coastwatch aerial surveillance.

The Great Barrier Reef Marine Park Authority has issued guidelines for recreational and commercial operators, emphasising that it is now an offence punishable by law to intentionally,

"One of the most important tasks for the plans is to maintain recreational opportunities — it would be all too easy for mass tourism development to make every beach and bay the destination for a crowd.

"Some areas are set aside for high-use tourism but there will always be some parts of the Marine Park where visitors can expect a low-key experience, with small numbers of craft and people.

"The plans set out a vision to particularly protect coral from damage as well as safeguarding wildlife such as whales, birds, dugong and turtles while maintaining a full range of recreational opportunities."

Activities like motorised water sports can only be undertaken in Setting 1 areas — existing high-use regions — near tourist resorts so that the tranquility of large tracts of the Marine Park is maintained, and scenic flights cannot be conducted below 1000 feet.

It is the Plans of Management which make it an offence to intentionally, recklessly or negligently cause damage to corals. No-anchoring areas have been established so that precious fringing coral reefs are protected and, in high use areas, public moorings have been installed.

The Whitsundays is a significant calving ground for humpback whales, so the GBRMPA established a protection area which limits the level

of commercial whale-watching; boats and aircraft are banned from approaching within 300 metres.

However, a deep-water area east of Whitsunday Island has now been gazetted outside the protection area, giving dedicated whale-watching operators easier access.

The Cairns and Whitsundays regions are also important areas for both sea birds and shore birds, and a stopover spot for several migratory species. Some of them are disturbed by human activity, particularly in the nesting season, and access to a small number of sites has been restricted during that time.

The high-profile cruise ship market is targeted in the changes, with the plan easing restrictions and allowing up to three cruise ships in the area at any one time. Restrictions on destinations to protect the environment will remain.

"We have different ways of managing distinct areas of the Reef," Mr Skeat said. "On the broadest scale we have zoning plans which set down which activities are appropriate for the area in question throughout the 340,000 sq km of the Marine Park.

"However, there are some areas which are subject to intense activity, and we have to plan on a closer scale — the Cairns and the Whitsundays regions, for example. They make up only five per cent of the Marine Park but more than 90 per cent of tourist activity occurs in those areas." ■

Coastwatch spy-in-the-sky to aid coral protection strategy

recklessly or negligently damage coral.

The GBRMPA pointed out that some of the most spectacular coral reefs in the world were to be found in the Cairns Area and the Whitsundays and, to preserve them, operators should:

- Anchor in sand wherever possible;
- Use a reef pick instead of an anchor if possible; and
- Anchor in a designated reef anchorage.

Special consideration will be given if it is necessary to anchor among coral in order to shelter from northerly winds, provided due care is taken not to damage the coral. The rules do not restrict anchoring whenever necessary for the safety of life or vessels.

To encourage the use of places where coral damage is least likely, a number

of locations in the Cairns Area have been designated as reef anchorages where new private moorings or pontoons will not be permitted.

The chair of the GBRMPA, Virginia Chadwick, said no anchoring would be allowed around moorings or pontoon sites to protect the areas from anchor damage and to encourage tourism operators to exercise responsibility for managing use of the moorings.

The GBRMPA has designated the new moorings for commercial tourist boats at about 50 sites identified in the Cairns Area PoM.

Mrs Chadwick said priority for allocation of the moorings would be given to operators who could demonstrate historic use of a particular

Cont page 22

Moorings to cut anchor damage

From page 21

site or were prepared to stop using sensitive locations, especially on coral reefs.

"Some dive operators will want to stop at a certain point in the morning and then move on to a different location in the afternoon, so they need a broader range of moorings," she said.

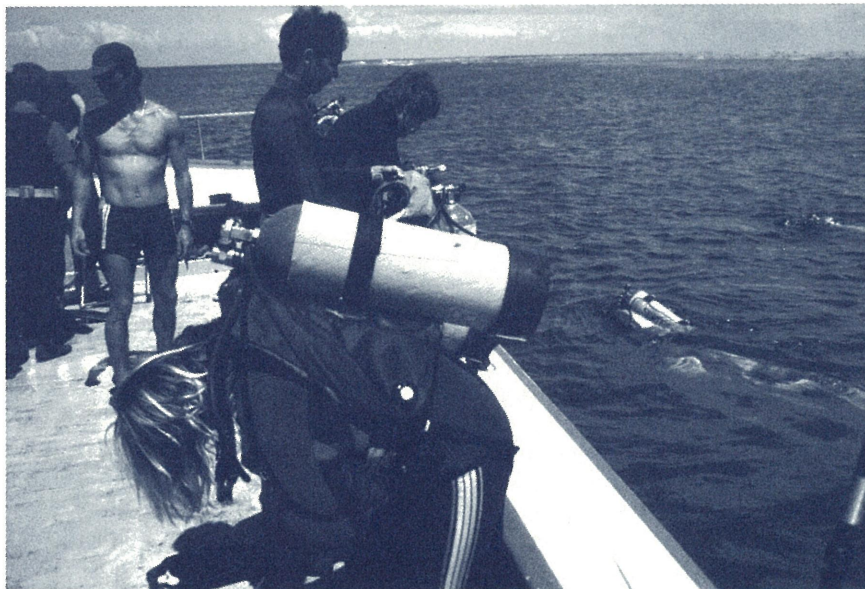
"The tourism industry will benefit and so will the Reef, because the trade-off for operators securing moorings on a daily basis is that they will look after the site, keep the area in pristine condition and preserve World Heritage values."

The new moorings were welcomed by one of the Far North's biggest tourism operators, Sunlover Cruises of Cairns. Director of operations John Millward said the GBRMPA move was a positive step towards minimising anchor damage.

"It means we can maximise people's experiences of the Reef by moving into more pristine locations where, with the use of anchors, we have previously been reluctant to go," he said.

"It is a win for the environment and a win for the tourism industry in presenting the Reef to clients and the world community in general."

Tourism in the Whitsundays received a boost when the GBRMPA ratified



Long-range tourism gives divers more freedom

operators to relocate to Bowen from elsewhere."

Mrs Chadwick said potential operators may consider targeting offshore reefs and the coastal area for eco-tourism experiences as well as planning trips to the Whitsunday Islands.

Long-distance tourism operators received a boost with a new permit issued by the GBRMPA which will increase their access to the Whitsundays and Cairns regions.

Amendments to the Plans of Management will allow Long Range Rovers to double their annual days of

only — that is by a single client — and operators will not accept bookings from individual passengers or agents.

"The new permit was finalised with the assistance of the Association of Marine Park Tourism Operators. It is a positive move towards boosting tourism right across the Marine Park and also emphasises fairness in how the business is shared among all tourism operators."

The regional economy will be boosted by extra tourist dollars after a decision by the GBRMPA to allow three cruise liners a day to visit the Whitsundays.

New sites will expand the number of anchorages in the region from two to nine, and the move has also streamlined the booking system to make it easier for cruise ship operators to gain permits to sail into Great Barrier Reef waters.

Operators had expressed concerns that they were finding it difficult to plan visits to the Whitsundays because only one ship a day was allowed to anchor in the region. The new anchorages are at South Hayman Island, Port Molle, south-east Hamilton Island, Pioneer/Funnel Bay and three sites at Turtle Bay.

The GBRMPA is currently assessing a further 20–30 prospective anchorages in the Central, Cairns and Far Northern Sections of the Marine Park from Hinchinbrook Island to the tip of Cape York.

Mrs Chadwick said a new 'seamless' booking system was being developed in conjunction with the QPWS which would ensure certainty of bookings at the anchorages and would automatically include application to relevant Queensland government regulators as well as the Authority.

'Positive move towards boosting tourism across Marine Park'

plans to issue 10 new permits to operators based in Bowen.

The permits, which were included in amendments to the Plan of Management, will be issued to operators who agree to be based in Bowen. They will begin and complete tours and trips in Bowen.

Mrs Chadwick said one of the reasons Bowen had not developed a marine tourism industry and associated infrastructure base in the past had been because Airlie Beach, 60kms to the south, had established itself as the major access point for the Whitsundays.

"The permits now on offer will provide a welcome stimulus to the tourism industry based in Bowen," she said.

"It is not necessary for potential operators to come from Bowen — there are opportunities for new and existing

operation within the areas from 50 to 100 and carry up to 30 passengers.

Long Range Rover operators are usually hired for fishing, snorkelling and diving trips. They do not sail to a fixed schedule or operate on a regular basis to particular reefs or locations.

Mrs Chadwick said the new permits would give more tourists the opportunity to recapture the essence of traditional Reef experiences with the "freestyle" type of travel which was common before the introduction of the more structured day-trip industry.

"Long Range Rover operations will not be subject to eligibility requirements, notification or bookings to enter the area, but will be required to operate in accordance with a number of specific conditions," she said.

"These conditions include being surveyed for overnight operations. They will also be whole-vessel charters

"The delay in issuing permits has been overcome by a streamlined process, so that the standard permit for cruise ships will be processed in 4-6 weeks from the time of application," she said.

"Implementation of the new cruise ship policy has required minor amendments to the Cairns Area and Whitsundays Plans of Management, specifically to incorporate the additional anchorage sites and provide for the use of ships' tenders."

Mrs Chadwick emphasised that the easing of restrictions would provide cruise shipping companies with the opportunity to demonstrate their commitment to codes of best environmental practice in promoting World Heritage values.

"The companies can enhance their marketable commodity — the Great Barrier Reef — by continuing their 'clean, green' image while operating in one of the world's best known and most pristine marine environments," she said.

Mike Bartlett, chair of Cruising Down Under, welcomed the easing of restrictions and pointed out that the economy could receive a much needed boost as a result of more cruise liners stopping in the region.

"We estimate that one ship carrying 800 passengers is worth about \$77,000 to the local economy; a ship carrying 1200 passengers is worth about \$116,000, and those are conservative estimates," he said.

"Even if the new anchorages only draw an extra 10 ships a year, that would be worth about \$750,000 which is a significant economic impact.

Whale-watching in the Whitsundays will be made easier following a decision

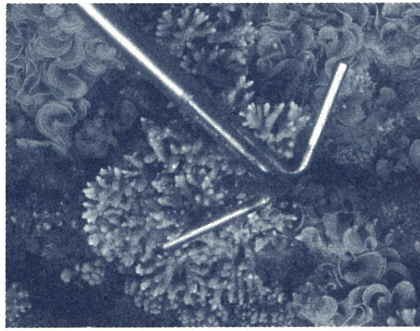
'Main danger is that whales can be driven towards reefs'

to allow tourist boats into a previously excluded area.

And whale watchers will no longer have to "run away" when approached by the animals, as long as they shut down their engines and do not approach them.

Under amendments to the Whitsundays Plan of Management, a ban on commercial whale watching in a deep-water area east of Whitsunday Island, south of Border Island and west of Edward Island has been lifted to allow dedicated operations greater flexibility.

The rest of the whale protection area encompasses the islands and coastal waters between Gloucester Island and



Reef picks cause less damage

Thomas Island, including the Whitsunday Passage and Repulse Bay. It remains off limits to commercial whale watching and boats must not breach a one nautical mile exclusion zone to the east of any island.

Mrs Chadwick said there was no conservation reason to retain the exclusion zone east of Whitsunday Island, where humpback whales and their young were frequently sighted during the calving season. But she emphasised that boats were still not allowed to approach closer than 100m in open water and 300m in the whale protection area.

"The main danger is that whales and their calves can be frightened in high traffic areas and driven towards reefs and islands, where they can be injured. That is why dedicated whale-watching can only be conducted in open waters," she said.

"Whale-watching is one of those rare activities where people can get very close to nature in the wild and we are determined to make sure we do not drive these beautiful animals away or put them in danger."

At Vlasoff Reef, north-east of Cairns, plans for a helipad have been dropped because of its high recreational usage

and following concerns that rare species of birds may be stressed when helicopters are landing and taking off.

The GBRMPA received submissions from environment, tourism and recreational groups before agreeing on the helipad prohibition at the popular swimming and snorkelling site.

Vlasoff Cay is home to about 160 little terns, which are listed under the Commonwealth's Endangered Species Protection Act and considered vulnerable in the Queensland Conservation Act.

New rules have been applied to significant bird sites within both the Cairns Area and Whitsundays, including a six-knot speed limit and

aircraft ban at some sensitive locations during the breeding season. In particular, Michaelmas Cay, the most important seabird nesting site in the Cairns Area, has come under increased monitoring.

Mrs Chadwick said protection of bird life on the sand cay had become a critical issue because of a decline in some species by up to 40 per cent since monthly monitoring began in 1984.

"However, in all but the most sensitive locations it will be easier for aircraft to access the Cairns Area because they are now allowed to operate daily above 500ft," she said.

"The new restrictions typify our commitment to sustainable use while ensuring protection for the diverse flora and fauna which make the Great Barrier Reef the world's most ecologically diverse region."

New laws designed to protect the World Heritage values of the Reef mean that commercial operators will be restricted at sensitive sites where tourism has been capped.

The GBRMPA and tourism and recreational users have identified a range of opportunities for areas designated for intensive visitation through to low and sensitive locations.

In some areas vessel and group sizes have been limited to protect remote areas for low-intensity, nature-based users. GBRMPA will provide well managed areas at other locations for the development of tourism opportunities.

The amended plans allow some established tourism operators to be exempt from the regulations and continue their operations because of historical precedent. Application forms for non-conformity were released in April and are now being processed.

A number of locations in the Whitsundays which were previously in the moderate-use category have now been redefined to only allow visitation by groups of up to 15 people at a time, although boat size limits have been raised from 20m to 35m to accommodate a range of recreational users.

Mrs Chadwick said the amended Plans of Management were settled as the result of public submissions and consultation with a diverse range of users.

"In some places, like Low Isles off Port Douglas, there will be limited access for tourism by a booking system," she said.

"However commercial operations have been capped at other, sensitive, locations to protect the ecological and cultural values of those sites. Recreational boats are not subject to the cap; they are able to turn up at their favourite spot and not find the place swamped by tourists." ■

Traditional hunting not to blame for dugong decline

THE Great Barrier Reef Marine Park Authority has distanced itself from claims that indigenous hunting is a significant factor in the decline in dugong numbers over the past 13 years in southern waters of the GBR.

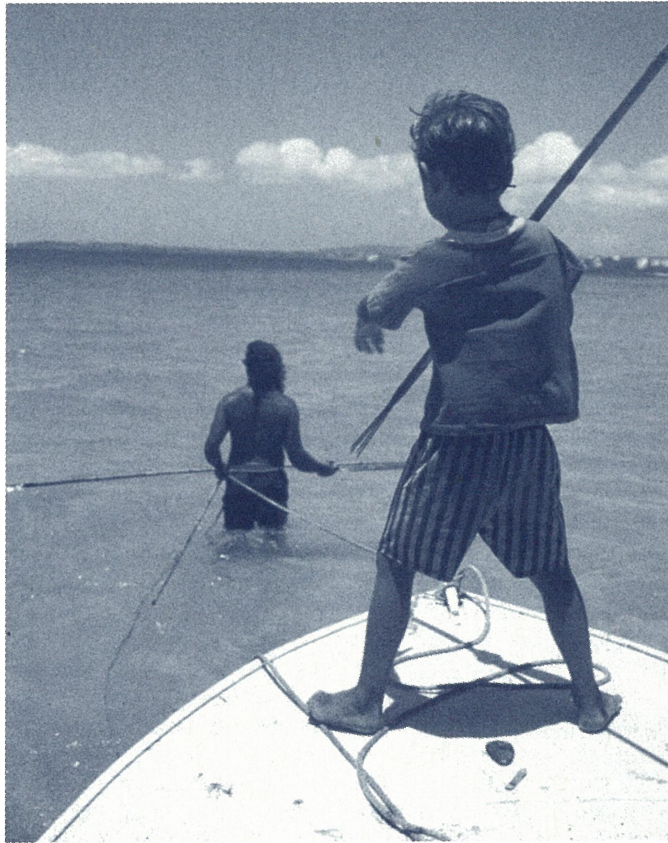
The dugong population south of Cooktown has fallen by about 50 per cent — and in some areas by up to 80 per cent — since surveys started in 1986–87 but the Authority has reaffirmed its view that the major reasons have little or nothing to do with Aboriginal and Torres Strait Islander hunters.

Indigenous people raised their concerns with the GBRMPA after the Queensland government tabled a dugong recovery plan which asserted, in part, that traditional hunting posed a serious threat to the already depleted population where their numbers had already been reduced by habitat loss.

While they do not deny that hunting a depleted species has some impact, they emphasise that the level of hunting undertaken in the past did not cause the decline.

The Aboriginal and Torres Strait Islander peoples told the GBRMPA that other factors including netting, the loss of sea grass, pollution, coastal development and boating were the main causes. As a result the level of indigenous hunting, which has not increased and has probably decreased over time, is now unsustainable in some areas, particularly in the southern GBR area.

Greg Smith, manager of the Indigenous Cultural Liaison unit at the GBRMPA, said many indigenous communities south of Cooktown had voluntarily ceased hunting until dugong numbers have recovered to a sustainable level and had asked that action be taken to mitigate the wide range of threats to dugongs and their habitat.



Indigenous hunters have pursued dugong for thousands of years

“Most indigenous people have acted responsibly in relation to dealing with the decline in dugong numbers,” Mr Smith said.

“The GBRMPA does not attribute the decline to indigenous hunting but would welcome the opportunity to work with indigenous people to ensure that hunting does not present a threat under the currently depleted circumstances.”

Dugongs have been hunted by Aboriginal and Torres Strait Islander peoples for thousands of years and they hold cultural, spiritual, social and economic significance in indigenous culture. They are an important part of celebrations such as weddings and funerals and many communities feature them in stories and accounts of their histories.

Indigenous people have a very good knowledge of dugongs, their habitats and environments and many communities have said the mammals are not now found in areas where they once lived in great numbers.

Mr Smith pointed out that there had been no evidence of declining numbers in the southern GBR before

an increase in modern human activities brought pressure to bear on dugong populations.

“There is no significant decline in dugong numbers north of about Cooktown and we believe that is because the region is relatively free of problems like habitat loss, pollution, boat strikes and protective shark netting,” he said.

“The GBRMPA has established one formal Memorandum of Understanding with the Darumbal people in Shoalwater Bay that they will not continue traditional hunting, but several other groups have also agreed to stop voluntarily until numbers are re-established.

“Many indigenous groups had already started talking among themselves about putting a halt to hunting before we approached them, because they had noticed a drop in numbers.”

The GBRMPA is working with the Hopevale and Mossman Gorge communities in co-operative management arrangements designed to enhance dugong protection. The Mossman Gorge group is now also active in the co-management of turtle hunting and is involved in turtle, dugong and seagrass surveys.

The Giringun Elders and Reference Group is working on day-to-day management projects aimed at the general preservation of the Hinchinbrook area, funded by a range of sources including ATSC and the Department of Employment and Workplace Relations.

Mr Smith emphasised that, far from being a major cause of declining numbers, indigenous communities were becoming increasingly involved in the management of dugongs in the Marine Park. ■



REDUCING SEDIMENT AND NUTRIENT LOSS FROM THE PASTORAL LANDS OF NORTHERN AUSTRALIA: SUSTAINABLE GRAZING STRATEGIES FOR THE SEASONABLY VARIABLE TROPICAL SAVANNAS

Peter O'Reagain¹, Michelle Devlin² and David Haynes²

¹ Queensland Beef Industry Institute, PO Box 976, Charters Towers Qld 4820

² Great Barrier Reef Marine Park Authority

Changes in the Catchment—Concerns for the Great Barrier Reef

Declining water quality is seen as one of the major threats to the Great Barrier Reef lagoon with elevated inputs of sediments and nutrients having the potential to profoundly effect the ecology of a number of marine communities (ENCORE, in press; Schaffelke and Klumpp 1998; Dennison and Kirkman 1996; Van Woesik et al. 1999).

Estimates of total river discharges of sediment and nutrients (nitrogen and phosphorus) into the lagoon have been derived from models relating erosion to regional land-use patterns in catchments adjacent to the Reef (Moss et al. 1993; Neil and Yu 1996). Current estimates are of an annual input of 22 million tons of sediment, 90 000 tons of nitrogen and 12 000 tons of phosphorus. This is estimated to be approximately four times the load before European settlement of the catchments. Overall, 66% of the estimated nutrient and sediment flux is estimated to come from grazing lands (Moss et al. 1992).

The Fitzroy and Burdekin Rivers are the biggest source of nutrients and sediments discharged into the Great Barrier Reef lagoon. The amount of sediments and nutrients emanating from these catchments is not static, but strongly dependent upon land use, condition and management. Grazing has the potential to have a major impact on water quality through its effects on plant cover and soil condition (figure 1). In general soil loss and run-off increase sharply when cover declines on grazing lands, e.g. McIvor et al. (1995). The importance to the Great Barrier Reef lagoon of these large 'dry'

catchments where cattle grazing is the dominant land-use is therefore self-evident.

Burdekin catchment

More than 98% of the 129 000 km² Burdekin catchment is under some form of extensive cattle grazing. It may therefore be assumed that this form of land use contributes a major portion of the nutrient and sediment inputs (Moss et al. 1993) into local rivers and ultimately to the Great Barrier Reef (figure 2).

Unfortunately, many areas of the upper Burdekin catchment show some form of landscape degradation (De Corte et al. 1991). Most of this degradation appears to be initiated in dry years when overstocking in combination with low rainfall results in the over-utilisation and eventual death of perennial grasses species. This results in their replacement by annual grasses, reduced ground cover and increased soil erosion and nutrient loss (figure 3). Possible solutions to the problem of rainfall variability are that graziers stock conservatively, spell parts of their property on a regular basis and/or adopt some variable stocking strategy that matches animal numbers to available feed.

Unfortunately however, these strategies have not been widely adopted by the beef industry. As with many other resource management problems the reasons for this non-adoption are complex and include a host of cultural, social, economic and legislative issues. However, possibly the biggest single reason is the absence of quantitative data to show that sustainable strategies are economic and therefore equal to, or superior to, existing management strategies.

Figure 1a (top). Drought, coupled with overstocking, can lead to severely reduced cover over significant areas of the interior grazing lands.

1b (middle). Sustainable grazing systems result in healthy, productive landscapes. Widespread adoption of such systems is essential for the long-term viability of the beef industry.

Wambiana Grazing Trial

To address the above issues, the Department of Primary Industries established a grazing trial in 1997 to produce objective data on the impact of different grazing systems on sustainable production and to demonstrate the economic benefits of sustainable management.

This large scale (1000 ha), long term (> 10 years) trial is being conducted on the property 'Wambiana', 70 kilometres south of Charters Towers (figure 4). The research involves investigation of a range of grazing strategies and their effects on animal production, pasture condition, biodiversity and nutrient and sediment loss. The data will also allow the economics of the different grazing strategies to be calculated (table 1). Management strategies being investigated are those already used by local graziers, together with new ones that utilise the latest climate forecasting techniques or strategic pasture spelling.

Liaison between Department of Primary Industries / Great Barrier Reef Marine Park Authority

Concerns about sediment and nutrient run-off and potential downstream impacts have prompted the Great Barrier Reef Marine Park Authority to be one of the major funding bodies of the grazing trial. The investigation of particular relevance to the Authority, is how different stocking strategies effect soil and nutrient loss. Although this question has received attention previously (e.g. McIvor et al. 1995) there is little data on how grazing affects nutrient run-off, while extrapolation of results to larger areas has been problematic due to the small plots used in these studies. Earlier work also failed to link soil loss to cattle production and hence the economics of the trade-offs between these two variables were not addressed.

A series of five bounded run-off catchments have been installed on the Wambiana site to quantify soil and nutrient loss under the different grazing strategies (figure 5).

Each experimental catchment consists of a 1 ha bounded area with wing walls to funnel run-off water through a San-Dimas flume, each of which is fitted with an electronic device to record the height of the run-off water. Calculations based on flow height and duration

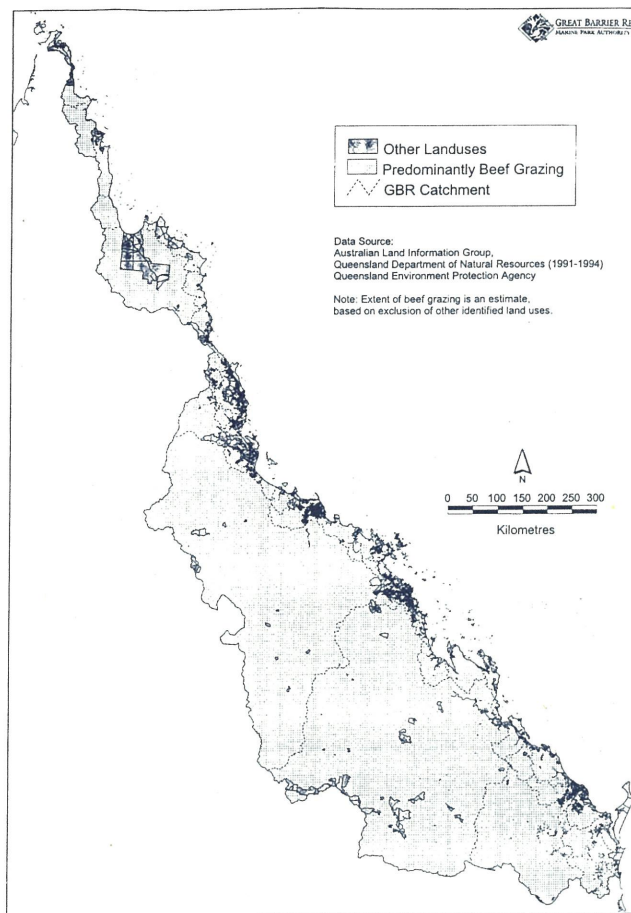


Figure 2. Extent of beef grazing on the Great Barrier Reef catchments

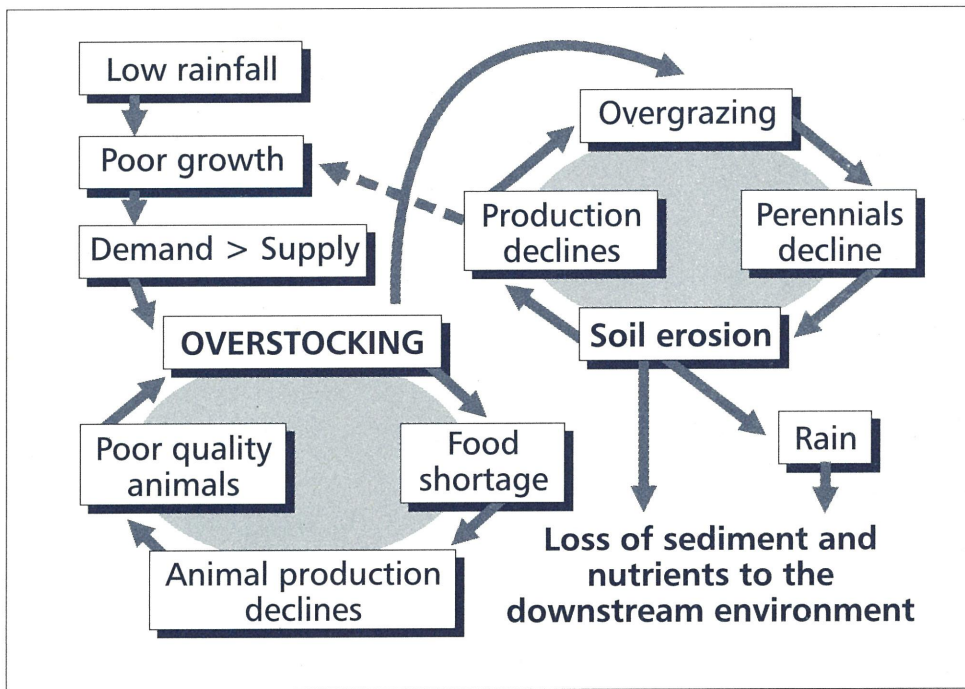


Figure 3. Processes leading to land degradation in the semi-arid grazing lands

recorded. This is due to the excellent ground cover that has resulted from the above average rainfall and the fact that most of the rain that fell was of unusually low intensity and therefore failed to run off.

Detailed measurements of aerial, basal and ground cover, as well as species composition and standing biomass in each catchment, are also made on a regular basis to allow the quantification of the relationship between run-off and these variables.

will provide accurate estimates of the total amount of run-off. To collect data on erosion rates flumes are also fitted with a sediment box to trap heavier soil particles before they move through the flume.

Automatic pumping samplers are used to sample the run-off water for dissolved nutrients and sediments. These samplers are programmed to sample at specific intervals over the flow event to obtain an accurate estimate of nutrient concentration in the run-off water. Rainfall amount and intensity is also measured at each site using a pluviometer. Although the equipment was installed in December 1998 in the middle of the wet season, as yet, no measurable run-off has been

Table 1. Description of sampling design

Location:	'Wambiana' 70 km south of Charters Towers
Rainfall:	650 mm (C.V. 38%)
Layout:	Five treatments, two replications per treatment
Treatments:	<ul style="list-style-type: none"> • Heavy stocking (5ha/adult steer) • Light stocking (10ha/adult steer) • Rotational spelling—spell one third of the pasture annually (7.5ha/adult steer) • Variable: adjust animal numbers in May according to available feed • SOI—Variable: animal numbers adjusted annually in October based on the Southern Oscillation Index and the availability of feed
Paddocks:	93–127 ha
Soils:	Infertile earths, sodosols, cracking clays
Cattle:	Yearling steers (11–27 per paddock)
Measurements:	<ul style="list-style-type: none"> • Animal production/diet quality • Spatial selection • Pasture condition and production • Species diversity • Soil/nutrient loss • Plant population demographics

Conclusions and Outcomes

Run-off data will ultimately be integrated with economic information, pasture production and biodiversity data to allow an objective assessment of the cost-benefits associated with different grazing strategies. Hopefully this data will provide an impetus for graziers to adopt sustainable management practices. The development and adoption of these strategies by the grazing industry will be facilitated by a Grazer Advisory Committee, which has played a key role in the development and management of the project. The committee was formed before the trial started and has been very important in ensuring that the project remains as relevant as possible to the grazing industry. Extension programs detailing the benefits of sustainable management will also be used to encourage uptake of sustainable grazing strategies by the industry. Appreciation of catchment water quality issues and their potential impact on marine systems will also assist in this process.

In the longer term, the adoption of sustainable grazing strategies will not only ensure a sustainable and viable beef industry but will also have flow on effects to the wider community. These include reduced drought subsidies, reduced rural debt, better woody weed control, improved biodiversity and better water quality. The last will have direct benefits for two major Queensland industries, i.e. tourism and fisheries which currently generate \$850 million for the State's economy (Driml 1999).

This cooperative research is one of the first to demonstrate a recognition of catchment-to-coast connectivity. Improved grazing strategies will benefit the local grazer as well as reduce sediment and nutrient run-off to the Great Barrier Reef. This is vital for the continued preservation of the unique and beautiful features of the Great Barrier Reef.

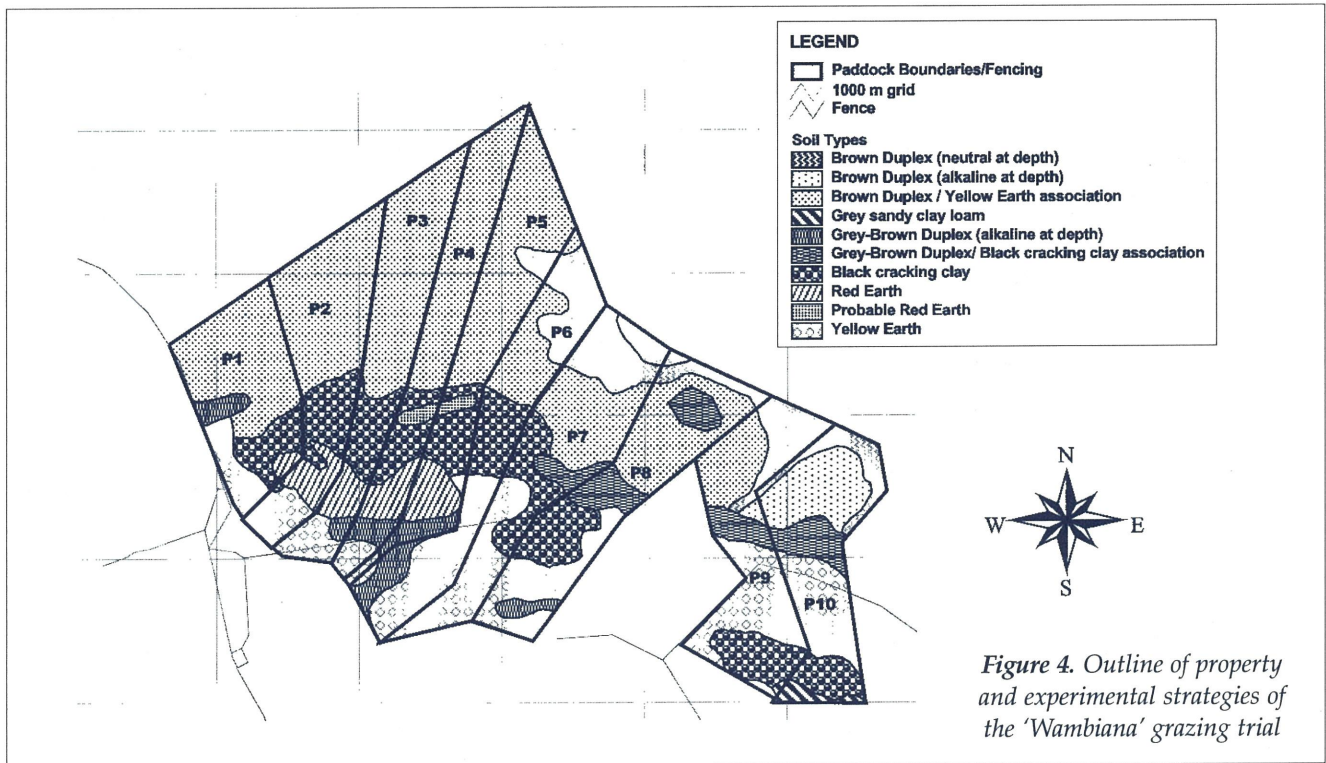


Figure 4. Outline of property and experimental strategies of the 'Wambiana' grazing trial

Acknowledgments

We gratefully acknowledge the cooperation of the Lyons family, 'Wambiana', and the financial assistance provided by the Drought Regional Initiative, the National Heritage Trust, the Great Barrier Reef Marine Park Authority and the CRC for the Sustainable Development of Tropical Savannas.



Figure 5. One of the bounded catchments at the 'Wambiana' site. The wing walls funnel run-off water through the San-Dimas flume to allow sampling and measurement of the flood profile.

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UTILISATION OF ENCASEMENT TECHNOLOGY IN RESTORATION OF MANGROVE FOREST ON ST. CROIX, U.S. VIRGIN ISLANDS

Paige Rothenberger

University of the Virgin Islands, VI Marine Advisory Service,
RR #2, Box 10000, Kingshill, St. Croix VI 00850

Mangrove forests are important for many reasons. Not only do they provide essential habitat for many species of animals such as birds, crabs, insects and larval fish, but their existence benefits people as well. Mangroves help to protect shorelines against erosion by buffering the land against storms. The trees trap sediment and debris in their root systems, thereby keeping our bays and reefs clean and healthy. Mangroves are also able to absorb contaminants through their roots, and so are important mitigators of Nonpoint Source (NPS) Pollution.

Background

The old growth mangrove forest within Sugar Bay, a sub-watershed of Salt River Bay, was nearly 100% destroyed when the island of St. Croix sustained a direct hit by Hurricane Hugo in 1989. When these mangroves were destroyed, valuable habitat, storm buffers and mitigators of NPS Pollution were lost. The St. Croix office of the VI Marine Advisory Service (VIMAS), a part of the University of Puerto Rico Sea Grant College Program and the University of the Virgin Islands' Marine and Environmental Investigations Unit, is working in partnership with the St. Croix Environmental Association (SEA) to restore the mangrove forest within Sugar Bay.

Salt River Bay is a Category 1 (threatened) watershed consisting of 3510 acres, making it the second largest watershed on St. Croix. Salt River Bay is recognised as highly significant by both territorial and federal governments. Established as Salt River Bay National Historical Park and Ecological Preserve in 1992, the area is also a territorial marine reserve and wildlife sanctuary.

This summer, VIMAS and SEA began a three-year project to restore one of the most important watersheds on St. Croix. During the course of the project, 18 000 red mangroves (*Rhizophora mangle*) and 3000 black mangroves (*Avicennia germinans*) will be planted in Sugar Bay. This project is utilising a planting method called the Riley Encased Methodology[©] (REM) to replant the red mangrove propagules. This technology was developed for planting red mangroves along high-energy shorelines to assist in shoreline protection, estuary restoration and to bolster the health of the marine environment. In addition, this methodology allows for a natural protective structure rather than concrete breakwaters and revetments, which usually only offer temporary solutions to shoreline erosion.

Young mangrove trees are especially vulnerable to several environmental factors. Substantial wave action, tides, upland run-off and damage from debris all threaten the success of any restoration project. Since Sugar Bay is a relatively sheltered bay, VIMAS and SEA conducted a pilot project to determine the effectiveness of the REM in 1997.

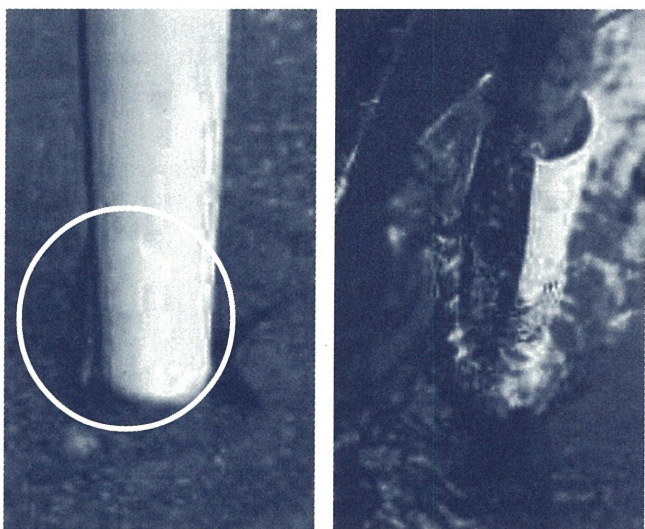
Pilot Project

In the pilot project, a one-piece PVC encasement was used for half (500) of the planted propagules. In the monitored test plots, a survival rate of 31.7% was observed. This overall low survival rate is attributed to the inadequacy of the one-piece system to account for the considerable estuarine influences experienced within Sugar Bay. During the pilot project, the seasonal high tide and run-off from rain events totalled between eight and 10 inches. However, even the limited protection provided by the one-piece encasement proved to be invaluable. Of the propagules that did survive, 74.3% were encased.

From this data, the project partners decided to encase all of the propagules for the current project. In addition, to compensate for the mean high tide as well as the seasonal high tide and estuarine influences (run-off), the two-part REM was chosen. The methodology used in the current project incorporates a two-part PVC system to encase the red mangrove propagule during the first few years of development. The encasement provides protection against extended periods of submersion (due to tidal action and estuarine influences), damage from the wrack line (floating debris) and crab predation on the young trees.

Methodology

The two-part encasement system utilises a bottom piece of PVC of variable height. The bottom piece is longitudinally split to allow for drainage, maintenance of water level equilibrium and root migration. An artificial bottom is created by filling the pipe with sediment to the level of the mean high tide. This piece



On the left, a root begins to protrude through the longitudinal split (circled). At right, the split will continue to widen as the young tree develops. ©Robert W. Riley, Jr.

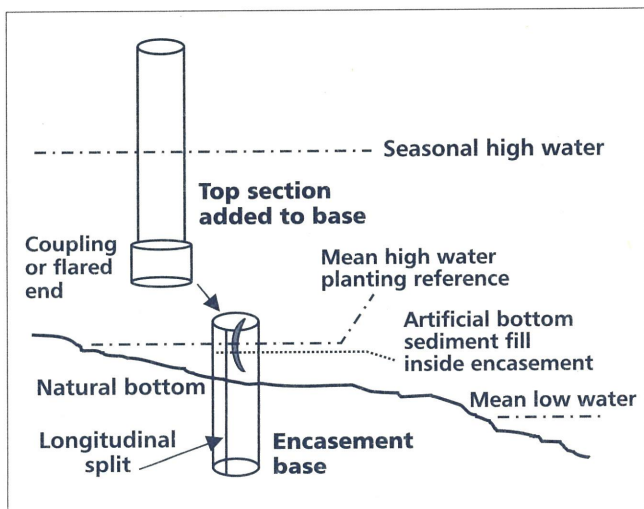
will split successively lower as the tree grows and widens. As the split becomes wider, the artificial bottom material will drop lower, encouraging the roots to migrate down to the natural substrate and anchor the developing tree. This bottom piece is designed to reach just above the mean high tide mark and is attached to the top with a PVC coupling.

The top piece is of uniform length, and compensates for the seasonal high tide and run-off. Once the young tree has established prop roots (about two years), the top piece of PVC can be removed allowing it and the coupling to be reused. The bottom piece of PVC cannot be removed without uprooting or damaging the young tree. Over time the bottom piece becomes encrusted with organisms, reducing its appearance and improving aesthetics at the site.

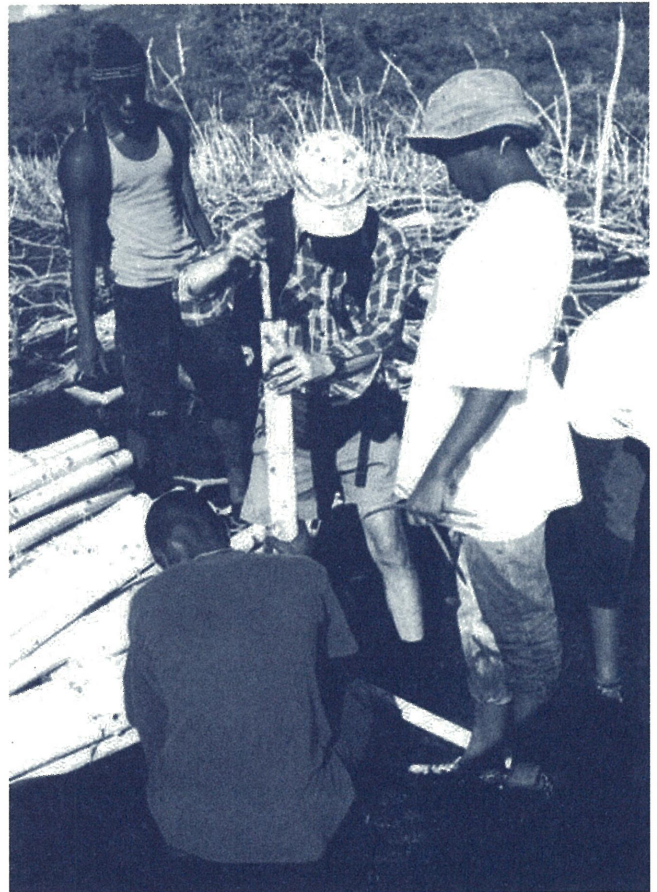
This project is also testing the performance of a one-piece encasement made of cardboard. The project partners are hoping to determine whether the cardboard would be an effective substitute for the PVC in areas with similar conditions to those within Sugar Bay (high estuarine influences, limited high-energy wave action). The main benefit from using a cardboard encasement would be that, over time, it would naturally break down eliminating any effect from PVC left within the bay (aesthetic or environmental). The drawbacks that have been experienced so far are that the one-piece encasement is bulky, heavy, and since it is one-piece, it is difficult to see down into the encasement.

Conclusion

The project to reforest Sugar Bay is important for many reasons. The restoration of the mangrove forest will provide a significant and unique habitat for thousands of organisms, provide protection from storm events, help to reduce NPS pollution and will educate many people about the importance of mangroves in our island ecosystem. Project planting volunteers have included individuals from many different organisations as well as students from several local high schools. This project has already benefited these students by teaching them about the life cycle of the mangrove and its important



This diagram shows the two-part Riley Encased Methodology©, used in the current project. Reprinted with permission from Robert W. Riley, Jr. of the Mangrove Replenishment Initiative.



Planting volunteer, and UVI Science Professor, Dr. Stuart Ketcham demonstrates how to set the cardboard encasement to students from the St. Croix Educational Complex Science Club. Photo courtesy of Emy Thomas, SEA.

role in our ecosystem. This project will continue to provide hands-on learning for students from nearly every elementary and middle school on St. Croix, who will learn about mangroves through field trips and presentations.

An additional component of the project will be the enhancement of the mangrove exhibit at the St. Croix Aquarium. The existing exhibit will be enlarged and a collection of photos depicting the reforestation procedure will be displayed. As a result of the pilot project in 1997 an educational module about mangroves was created for inclusion in SEA's 'My Environment' program.

This project is being funded by the V.I. Government's Department of Planning and Natural Resources through section 319(h) of the federal Clean Water Act, and the Royal Caribbean Ocean Fund.

For more information on this project please contact Paige Rothenberger of VIMAS at (340) 779-3141, or by e-mail prothen@uni.edu. For more information on the Riley Encased Methodology©, please see the Mangrove Replenishment Initiative web site (www.mangrove.org).

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SEAHORSES — A FORGOTTEN SPECIES



Kim Lally¹ and Paul Hough²

¹ Great Barrier Reef Marine Park Authority ² ReefHQ, PO Box 1379, Townsville Qld 4810

Seahorses have fascinated people for many centuries. Mysterious looking creatures, they have a horse-like head, an upright body and a tail which resembles that of a monkey. Seahorses are fish which belong to the Family Syngnathidae. The scientific name *Hippocampus* is given to all species of seahorse. The word *Hippocampus* was used by ancient Greek poets to describe a half-horse, half-fish mythical creature on which sea gods rode (Lourie et al. 1999).

It is believed that seahorses evolved 40 million years ago (Fritzche 1980). Today they are found in many parts of the world, but mostly frequent coastal seagrass, mangrove, coral reef or estuarine areas of tropical and temperate waters (Lourie et al. 1999). Most species occur in the IndoPacific region (Vincent 1996). Generally seahorses are found in depths between one and 15 metres. They range in size from the newly discovered Australian seahorse *Hippocampus minotaur* (10–20 millimetres) to the 300-millimetre Pacific seahorse *H. ingens* (Vincent 1996).

Adult seahorses are poor swimmers and use their tails to anchor onto objects. It is perhaps due to their often immobile state that they have become masters of camouflage and can change colour dramatically to suit their habitat. No doubt this ability to camouflage helps them to avoid predators.

Syngnathids are unique in that the male gives birth to the young. Female seahorses transfer eggs to the male's pouch where the eggs are fertilised. Depending on the species and water temperature, the pregnancy lasts for 10 days to six weeks (Lourie et al. 1999). Young seahorses are born as independent, miniature adults and receive no care from their parents. Most seahorse species produce 100–200 young per pregnancy (Vincent 1996). Young seahorses are eaten by many animals including fish, crustaceans and anemones. The diet of young seahorses varies as they grow (Lourie et al. 1999) while adults feed on crustaceans, larval fishes and plankton.

***Hippocampus kuda*—or is it?**

Approximately 120 species of seahorse have been recorded. Thirty-two of these are believed to be true species (Lourie et al. 1999). The Australian (*H. abdominalis*, *H. angustus*, *H. bargibanti*, *H. breviceps*, *H. histrix*, *H. kuda*, *H. minotaur*, *H. planifrons*, *H. spinosissimus*, *H. whitei*, *H. zebra*), North American (*Hippocampus erectus*, *H. ingens*, *H. reidi*, *H. zosterae*) and European (*H. hippocampus*, *H. ramulosus*) seahorses are moderately well defined but the IndoPacific species are difficult to classify. Vincent (1996) reports that *H. kuda* has become a default name for at least 10 distinct species. Because seahorses are so flexible in their appearance, identification is often very difficult, hence the 120 recorded names*.

A population at risk

Because seahorses live in areas along the coast, the potential for impact from human activities is great. Very few studies have been carried out on wild seahorse populations and, as a result, scientists have no idea how many seahorses live in the wild and do not fully

understand the basic biology of the creature. This lack of information makes it extremely difficult to predict how seahorse populations will be affected by exploitation. However, fishers and traders agree that, over a five-year period, exploited populations in Southeast Asia have declined by 15–50% (Vincent 1996).

Humans are noted as being one of the seahorses' greatest predators. Vincent (1996) states that in 1995 at least 20 million dried seahorses were traded worldwide and several hundred thousand more were exported for home and public aquaria. Seahorses are not only used as ornamental aquarium fish and curiosities but are also used in traditional Chinese medicine as a remedy for a range of ailments including asthma, broken bones, kidney disorders and impotence. They are also highly regarded as an aphrodisiac.

Approximately 45 countries are involved in trading seahorses (Lourie et al. 1999) with China, Hong Kong and Taiwan being the largest importers of seahorses. In 1992 China consumed approximately 20 tonnes of dried seahorse (or six million animals), while in 1994 Taiwan imported approximately three million animals (Seahorse culture 1998). The largest exporters of seahorses are India—with an annual sale of at least 1.3 million seahorses or 3000 kilograms—the Philippines, Thailand and Vietnam (Vincent 1996).

The Australian Quarantine and Inspection Service estimated that more than 150 000 specimens were exported from Australia between July 1995 and January 1997 (Media Release—Senator the Hon Robert Hill, 5 September 1997). Some evidence exists that live seahorses are being imported from Indonesia (Lightowler 1998). About one half of the world's syngnathid species live in Australian waters—including 11 species of seahorse—so it is not surprising to learn that scientists are predicting that Australian syngnathids will come under greater pressure as demand for them increases and wild populations decrease (Vincent 1996).

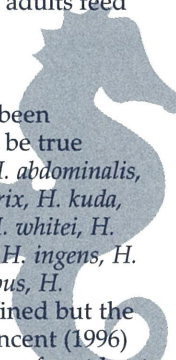
Individually seahorse fisheries are small, but collectively they are very large and have the potential to detrimentally affect wild populations. These fisheries have become an important source of income for many subsistence fishers in developing countries who use their hands or small nets to catch seahorses (Lourie et al. 1999).

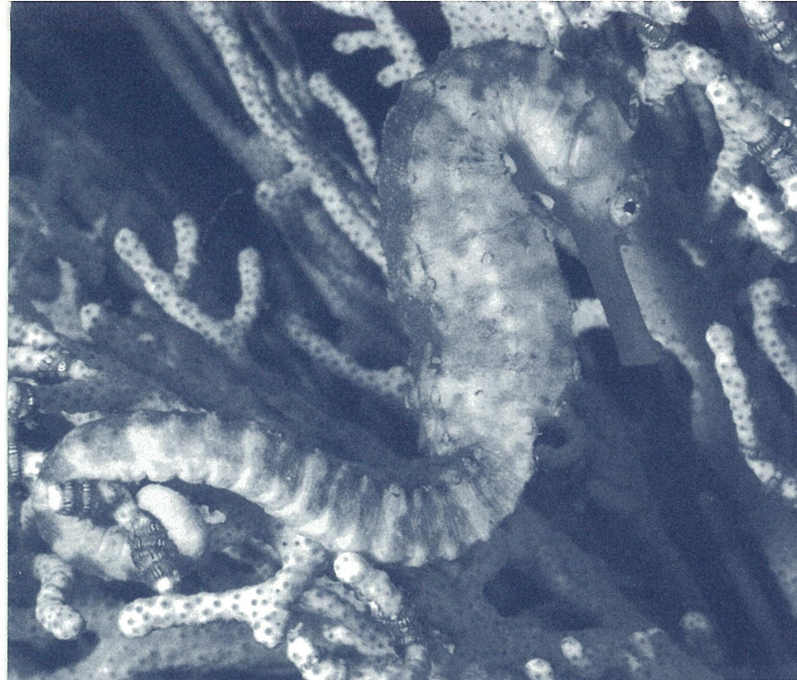
Most of the seahorse trade is legal and unregulated, but more and more countries are starting to monitor or control trade (Lourie et al. 1999). Most seahorse species are listed as *vulnerable* on the 1996 IUCN (World Conservation Union) Red List of Threatened Animals but unfortunately this list has no direct legal implications for trade (Lourie et al. 1999). As of 1 January 1998, any exports of syngnathid species from Australia require a permit from Environment Australia. These permits are only granted for captive-bred animals or those that have been taken from the wild under an approved management regime (Media Release—Senator the Hon Robert Hill, 5 September 1997).

Is captive breeding the answer?

As a result of a growing demand for seahorses, and the uncertainty of the effect exploitation is having on wild

* Lourie et al. (1999) provides an excellent guide to seahorse identification.





Seahorses are traded worldwide.

populations, seahorse farming is being seriously considered and conducted. Not only would farming reduce the pressures faced by wild populations but it would also provide an alternative livelihood for seahorse fishers.

However there are numerous technical difficulties associated with farming seahorses. Because seahorses thrive on live animals only, farms have to culture a large amount of algae to feed the zooplankton on which the seahorses feed. This can be quite a demanding task as seahorses have been known to consume large amounts of food. Seahorses are also susceptible to a range of bacterial, fungal and parasitic diseases (Wood 1992). A preference for wild-caught seahorses for traditional medicine also exists.

Lourie et al. (1999) warns that large-scale culturing of seahorses should not proceed until evidence is gathered to show:

- that the cultured seahorses will be acceptable for trade;
- that the captive-bred seahorses will not escape to cause disease and genetic problems in wild populations;
- what effect farming seahorses will have on the subsistence fishers;
- that farming is not dependent on continually removing seahorses from the wild; and
- that high percentages of young can be bred to market size and maturity.

Many countries have attempted to culture seahorses but none of these attempts have proven to be economically successful (Lourie et al. 1999). ReefHQ, the Reef Education Centre of the Great Barrier Reef Marine Park Authority (Townsville, Australia), has reported success in rearing seahorses to three generations.

Masaharu Mizukami, an intern at ReefHQ, conducted a successful study over a seven-month period (June 1998 – January 1999). Masaharu studied three species (*H. kuda*, *H. histrix* and *H. angustus*). His best results were achieved with *H. kuda* where, in the second and third batches, 86.2% and 73.9% of juveniles survived. *Hippocampus angustus* was susceptible to a gill parasite infection but, after successful treatment, a 37% increase in the survival rate was observed.

A further study, looking at the nutritional requirements and general husbandry of seahorses, is being carried out

by another ReefHQ Masters MSc candidate, Marshall Chang. Whilst it is early days yet, Marshall also reports success with rearing *H. kuda*. He has observed that 75–80% of newborns survive to two months.

While researchers are a long way from being able to successfully breed large numbers of seahorses, studies such as these will lead to a greater understanding of seahorse biology and will hopefully assist conservation efforts worldwide.

Conserving the species

In 1996 a program called *Project Seahorse* was established in response to the increasing evidence of the worldwide, destructive fishery for seahorses. *Project Seahorse* is an integrated program of conservation and management initiatives that works to ensure long-term persistence of wild seahorses, their relatives and their habitats, while still respecting human needs and aspirations (Lourie et al. 1999). *Project Seahorse* is led by Dr Amanda Vincent (McGill University, Montreal, Canada) and Dr Heather Hall (Zoological Society of London, United Kingdom). Teams are based in Canada, the United Kingdom, the Philippines, Vietnam and Hong Kong with affiliations at ReefHQ.

Project Seahorse undertakes many activities including:

- studying the biology of seahorses in the wild and in the laboratory;
- monitoring seahorse fisheries and trades worldwide;
- coordinating seahorse aquarium husbandry worldwide;
- running community-based conservation in Philippines fishing villages, including the establishment of no-take marine sanctuaries, education programs, and the development of alternative livelihoods for seahorse fishers; and
- hosting national and international workshops on the conservation and management of seahorses, especially those used in traditional medicine (Lourie et al. 1999).

For further information about *Project Seahorse* and how you can help, please visit their web site at <http://www.seahorse.mcgill.com>

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