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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. 2
JUNE - SEPTEMBER 1999



Reef Research June - September 1999

includes
**REEF MANAGEMENT
NEWS**

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Editorial

In this issue I'd like to extend a warm welcome to the Authority's new Chair, the Hon. Virginia Chadwick. Mrs Chadwick joined the Authority as Chair on 19 July 1999. Mrs Chadwick replaces Dr Ian McPhail who left the Authority to take up the position of Executive Director with the Queensland Parks and Wildlife Service. A profile of Mrs Chadwick will appear in the next issue of Reef Management News.

To overcome the problem of each issue looking exactly like the previous one images will appear on the front cover which reflect the content or major story of that particular issue. Another new feature – a glossary – appears in this issue. As readers of *Reef Research* have different backgrounds and areas of expertise the addition of a glossary listing the more technical terms was thought to be a useful tool. Any feedback you have on the addition of this glossary would be greatly appreciated, i.e. do you find it a useful tool, should more basic terms be included??

A wide range of topics is covered in this edition. *What's Out There?* presents an update on coral bleaching on the Great Barrier Reef. Following on with this theme, Andrew Baird reports on an unusually large aggregation of coral-eating snails which he observed on a reef near Pelorus Island following the 1998 mass bleaching event.

A summary of the Augmentative Research Grants awarded by the Authority for 1999 is included. This is followed by the twenty-sixth edition of *Slick Talk*. Steve Raaymakers discusses the action the World Bank and the United Nations is taking to combat marine pests which are carried via ships' ballast water.

Two articles which report on social studies commissioned by the Authority also appear. The first article describes a study which monitored the impact aircraft sound and other human activities had upon visitor use and amenity at Whitehaven Bay in the Whitsunday Islands. The second summarises the preliminary findings of a study which looked at the social and motivational aspects of recreational fishing in the Great Barrier Reef Region.

COTS COMMS has not appeared for quite a few issues and obviously isn't a regular feature any more. Udo Engelhardt may provide 'guest' articles in the future so stay tuned! We are also farewelling the CRC Update from the newsletter. As *Reef Research* and the CRC Reef Research Centre's newsletter, *CRC Reef Research News*, will be mailed out jointly it was felt that news from the Centre did not need to be included in *Reef Research*.

This edition of *Reef Management News* features a story about the significant contribution that social science research makes to the decision-making processes of management agencies such as the Authority. People's social and cultural affiliations and economic ties to the Great Barrier Reef are many and varied. How do we even begin to measure the total social, cultural and economic value placed on the Reef, not only by Queenslanders and Australians, but by people from across the globe? We spoke to the Authority's Socio-cultural and Economic Project Manager about some of the research commissioned by the Authority to delve into these important issues.

Staff from the Authority travelled to the site of the 17 May ship grounding north of Cooktown to check on the physical impact the ship may have had on Heath Reef. Photos and video footage revealed the extent of the

REEF RESEARCH is published quarterly by the Great Barrier Reef Marine Park Authority (GBRMPA).

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

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Editor Kim Lally
Design & Art..... Magneto Designs
Printed by Prestige Litho
Printed Sept 1999

ISSN 1037-0692

Printed on recycled paper.

damage, which is 'not too severe' according to the Authority's Research and Monitoring Project Manager Ken Anthony. Reef Management News also looks at the role of the Authority in oil spill response and contingency plans developed for the Great Barrier Reef, and at some of the initiatives in place to improve navigational safety in Great Barrier Reef waters.

The future of a marine project to protect turtles in the Great Barrier Reef Marine Park is looking secure, with a new Marine Turtle Conservation Policy announced. Public contributions to this policy are welcomed and the process is explained in an article in this issue. Dugong conservation is also in focus, after concern over the continued decline in numbers on the Great Barrier Reef prompted a review by the Great Barrier Reef Ministerial Council of all dugong conservation strategies currently in place in the Marine Park.

The Whitsundays bareboat industry has been praised for its adoption of new industry standards and an accreditation and training scheme designed to improve knowledge of marine safety and environmental best practices. Whitsunday Bareboat Operator's Association president Terry Kemp says this training and accreditation will do "much for the solidarity and professionalism of the industry".



Thanks for reading!

CENTRES FOR MARITIME LAW AND MARINE STUDIES, UNIVERSITY OF QUEENSLAND

The Centre for Maritime Law (CML) has been established within the T.C. Beirne School of Law, University of Queensland, led by Dr Michael White QC, Executive Director and Dr Sarah Derrington. The Centre has integrated links with the Centre for Marine Studies in the University of Queensland and other Australian centres.

The CML services include:

- promoting teaching and research in all aspects of maritime law and the law of the sea;
- providing the legal profession, academia, law students and the marine and shipping industries with detailed information and specialist expertise relating to developments in, and application of, maritime law;
- monitoring international developments in maritime law and providing advice and expertise to governments on policy and legislation related to maritime law, and the law of the sea;
- encouraging and promoting publications in all aspects of maritime law and the law of the sea;
- cooperating with other major centres in the University of Queensland and other major Australian and international centres, and to develop interdisciplinary policies, research and teaching; and
- holding seminars and conferences to enable access by lawyers and the maritime community to emerging and developing areas of marine and related law.

The CML holds regular seminars, having held them on *Marine Oil Spill Claims* in Brisbane and *Ship Arrest & Oil Spill Claims* in Cairns, both sponsored by Queensland Department of Transport, Maritime Division. Seminars in Singapore (July) and in South Africa (September) are currently in hand.

The CML offers post-graduate specialist subjects in maritime law and international law of the sea for Australian and overseas students in the **Masters of Law** degree. For graduates whose primary degrees do not include Law, the CML offers a **Masters of Applied Law**, which contains four familiarising the student with Law and then eight subjects in maritime law for the degree. Distance education is accommodated through some research subjects (on a topic chosen by the student and approved by the course supervisors) and some subjects being offered in a two-week intensive mode. Further, students can undertake some of the Law subjects at Australian universities other than the University of Queensland, and also by approved universities overseas. Those students who so chose can proceed overseas to finish the degree and obtain overseas experience.

The University of Queensland has also formed the Centre for Marine Studies, which will offer a **Master of Marine Studies** from early 2000. This is an interdisciplinary degree which will combine studies in the marine area from marine science, transport economics and marine laws. This degree would particularly suit graduates who wished to specialise in the marine environment in the Masters degree.

There is also demand for those who already have their post-graduate degree and wish to engage in a PhD. The PhD can be undertaken for distant students quite easily as all supervision can be handled electronically as well as through personal contact. Dr White's own PhD was in the marine environment, 'Marine Pollution Laws of the Australasian Region', and Dr Derrington's was on comparative insurance. Suitable supervisors can be arranged for theses in any maritime law subject from overseas if they cannot be found in Australia.

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CORAL BLEACHING AND CLIMATE CHANGE ON THE GREAT BARRIER REEF – AN UPDATE

*Kim Lally and Ray Berkelmans
Great Barrier Reef Marine Park Authority*

In early 1998 a mass coral bleaching event took place on the Great Barrier Reef (refer Berkelmans 1998; Hyne 1998). Even though the phenomenon of coral bleaching is not new – coral bleaching on the Great Barrier Reef was noted as early as the late 1920s – mass bleaching events have been recorded since the late 1970s. Broad-scale aerial surveys conducted in March and April 1998 of 654 reefs on the Great Barrier Reef indicated that 87 per cent of inshore reefs showed at least some bleaching compared to 28 per cent of offshore reefs (Berkelmans and Oliver 1999).

Post-bleaching surveys were carried out in late 1998 to ascertain the recovery of these reefs from the bleaching event. Preliminary results from these surveys showed that generally corals recovered quite well. The region with the highest bleaching-related coral mortality was in the central Great Barrier Reef between Townsville and Cairns. Mortality levels were highly variable ranging from less than five per cent to 80 per cent of living coral cover. Of the 23 inshore reefs surveyed in the central Great Barrier Reef 17 exhibited coral mortality of less than 50 per cent, while six reefs suffered high to severe coral mortality (figure 1). Reefs in the Palm Island Group near Townsville were the worst affected.

Offshore reefs have generally recovered very well with only one out of eight reefs (Otter Reef) surveyed suffering greater than 50 per cent bleaching-related coral mortality. Coral mortality varied widely with species, habitat, reef zone and region. In the Keppel Island group near Rockhampton, coral mortality was less than two per cent despite up to 80 per cent of coral cover bleaching in early 1998.

This bleaching event was not confined to the Great Barrier Reef. Reports received from many other countries made it clear that the Great Barrier Reef bleaching event was part of a major global bleaching episode. By comparison with many other tropical coral reef systems, the Great Barrier Reef was only mildly affected.

Effects of 1998 Coral Bleaching in the Central Great Barrier Reef

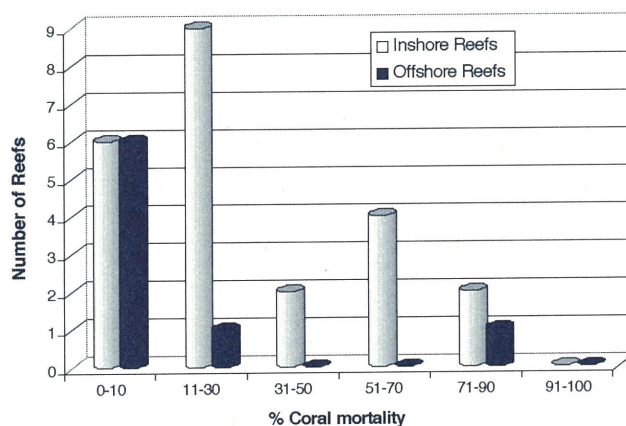
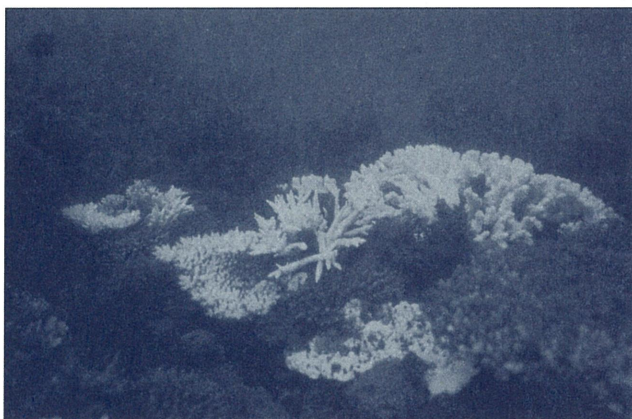


Figure 1. Number of reefs in each of six coral mortality categories following the 1998 coral bleaching event, based on surveys conducted in the central Great Barrier Reef during the bleaching event (March–April 1998) and seven months after the bleaching event (October–November 1998).

Reefs in the Indian Ocean appear to have been the worst affected with reports of 60–90 per cent coral mortality over large areas of reef in the Seychelles, Maldives and the east African coast (Wilkinson et al. 1999).

The 1998 coral bleaching event coincided with an unusual year, meteorologically speaking. The National Oceanographic and Atmospheric Administration (NOAA) reports that 1998 was the warmest year on record globally and that the warmest three years on record all occurred in the 1990s (Wilkinson et al. 1999). It also appears that 1998 was the most extreme year for sea temperatures on the Great Barrier Reef based on a 95-year record (Lough, in press).

The 1998 bleaching event also coincided with the end of a long El Niño event. In the western Pacific and Atlantic



Aerial surveys conducted during the 1998 bleaching event showed that, of the reefs surveyed, 87% of inshore reefs and 28% of offshore reefs were bleached.

Oceans, there has been a strong link between the ENSO cycle and coral bleaching. This is mainly due to warming of surface waters on both sides of the American continent. However, on the Great Barrier Reef, the connection between coral bleaching and El Niño cycles is not as strong. Three of the last six coral bleaching events at Magnetic Island near Townsville, for example, took place when the Southern Oscillation Index was either positive or close to zero. This may reflect the fact that during El Niño years, there is generally a pool of cool oceanic water off eastern Australia. Although this should mean cooler temperatures on the Great Barrier Reef, these years can also coincide with low cloud cover and unusually dry periods in Australia. During these times, high irradiance and warm dry winds can increase local surface water temperatures and cause bleaching. The meteorological signals on the Great Barrier Reef can therefore be rather mixed.

A recent report from the Australian Institute of Marine Science (Lough, in press) presents an analysis of long-term sea temperature data for the Great Barrier Reef. The results contained in the report are the first documented findings of climate change on the Great Barrier Reef.

The major findings of the report are that sea surface temperatures on the Great Barrier Reef have warmed significantly since 1903 when continuous records were first compiled from the Global Ocean Surface Temperature Atlas Plus (GOSTAplus) 'ships of opportunity' data. These data were supplemented and calibrated with the Integrated Global Ocean Services System (IGOSS) blended satellite data (recorded since 1981) and continuous *in situ* measurements from automatic weather stations (recorded since the late 1980s) and data loggers. Data from loggers was obtained through the Great Barrier Reef Marine Park Authority's long-term temperature monitoring program which began in the early 1990s.

Lough (in press) reports that there is a clear long-term warming trend in average annual and maximum summer temperatures at all latitudes along the north-east Australian coast. The magnitude of the warming trend is highest in southern Queensland waters and lowest in the far northern Great Barrier Reef. The

warming appears to have occurred mainly since the 1950s and temperatures are rising up to 0.1°C per decade. The cumulative average increase in sea temperature this century ranges from around 0.3°C near the Torres Strait to just under 1°C near Brisbane. From the perspective of the Great Barrier Reef, the greatest threat from changing sea surface temperatures is an increase in the magnitude of anomalous, or extreme, temperatures and a decrease in the return time of such events. Maximum monthly mean sea temperature anomalies have also increased significantly this century at rates and in a pattern similar to the above (Lough, in press). Moreover, the return time of extreme events has shortened from an average of one in 10 years during the period 1904–1933 to around one in four years between 1964 and 1994. In the last two decades, maximum sea temperatures have exceeded the bleaching thresholds of sensitive corals at least six times at Magnetic Island.

To what extent climate change is caused by greenhouse gas emissions, or is simply an existing natural trend, is still being debated by climatologists. Certainly, coral bleaching is connected to climate extremes. Evidence is also building of a consistent and statistically significant upward trend in sea temperatures at many places in the world.

Although management agencies such as the Great Barrier Reef Marine Park Authority cannot do anything about climate change itself, the importance of documenting potential links between climate change and bleaching is recognised. Factors such as sediment runoff, nutrients, pollutants, dredging etc. may also contribute to, or exacerbate, coral bleaching and mortality.

An international research collaboration between the Great Barrier Reef Marine Park Authority, the Australian Institute of Marine Science and the US National Oceanographic and Atmospheric Administration has begun to study the climate change issue and other stress factors which may contribute to coral bleaching and mortality. For further information on this collaboration please contact Dr Jamie Oliver at the Great Barrier Reef Marine Park Authority (telephone +61 7 4750 0700) or Dr Terry Done at the Australian Institute of Marine Science (telephone +61 7 4753 4211).

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A LARGE AGGREGATION OF *DRUPELLA RUGOSA* FOLLOWING THE MASS BLEACHING OF CORALS ON THE GREAT BARRIER REEF

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Muricid gastropods of the genus *Drupella* are common throughout the tropical Indo-Pacific. These snails prey almost exclusively on living coral tissue but are rarely present in sufficient numbers to cause significant coral mortality. However, when the abundance of snails is high, extensive loss of coral tissue and colony mortality have been recorded (Turner 1994). In most of these incidents the damage has been restricted to a small area of reef, except on Ningaloo Reef in Western Australia where, between 1987 and 1989, live coral cover decreased by up to 75% over a 280 kilometre stretch of reef (Ayling and Ayling 1987; Stoddart 1989).

On the Great Barrier Reef the damage caused by *Drupella* has generally been considered slight (Turner 1994). Typically, less than one snail per square metre is found on the Great Barrier Reef and it is rare to find more than 10 individuals in a single group (e.g. Oxley 1988; Fellegara 1996; Sutton 1996). Only one study has suggested there might be enough snails present to cause significant coral mortality. In a survey of 50 reefs in the Cairns Section of the Great Barrier Reef in 1991, Ayling and Ayling (1992) reported that the mean number of corals affected per reef ranged from 0.4 to 26%. At one site on Lizard Island, 48.3% of corals were affected. However, the researchers provided no estimate of coral mortality and no details of the number of snails present.

On the night of 7 December 1998, on the fringing reef surrounding Pelorus Island (18°46'S, 146°15'E) in the Townsville region of the Great Barrier Reef, 850 ± 150 *Drupella rugosa* were observed feeding on a single *Acropora youngi* colony (figure 1). In a second survey, on 9 February 1999 (64 days later), the group was again located but 12 meters to the west of the original colony in a second *A. youngi* thicket. The snails had consumed all but the outer 5–8 centimetres of tissue of the original colony (figure 2) and most of the thicket in between: an area of approximately eight square metres.



Figure 1. Numerous *Drupella rugosa* teeming over a colony of *Acropora youngi* at night on the fringing reef at Pelorus Island. There were approximately 850 snails on the colony.

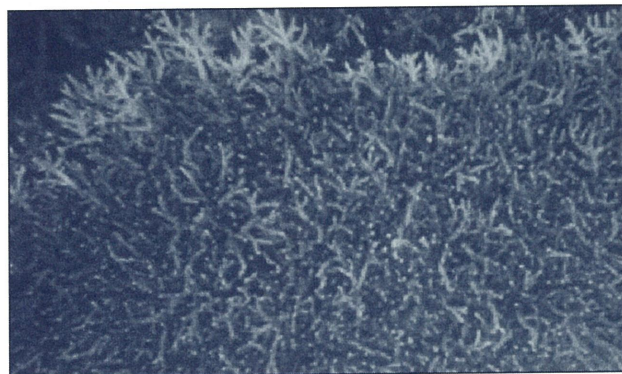


Figure 2. The same colony as in figure 1 two months later. All but the outer 5–8 centimetres of the colony, which is approximately 1.5 metres long, had been consumed by the snails.

The second census was conducted during the day, at which time the snails were clustered deep within the branches of the colony, making it impossible to estimate the current size of the aggregation without damaging the coral (figure 3). During a further one-hour daytime census at this site groups of between one to eight snails were observed on another 12 colonies. In addition, feeding scars typical of *Drupella* spp. were apparent on another 18 corals. The species affected, all from the Family Acroporidae, were *Acropora formosa*, *A. intermedia*, *A. valida*, *A. youngi*, *A. gemmifera* and *Montipora tuberculosa*. On the *Acropora* colonies damage was restricted to the base of branches and in each case less than 5% of the colony had been consumed. The size of snails within the large group ranged from 13.9 millimetres to 28.0 millimetres (figure 4).



Figure 3. During the day snails are clustered deep within the branches of the colony. The feeding scar could easily be mistaken for bleaching.

No *Drupella* were observed during over 120 hours of research diving at this site prior to December 1998 which suggests the presence of numerous snails at this site to be fairly recent. This site was one of the worst affected during the 1998 mass coral bleaching event (Berkelmans and Oliver 1999; Marshall and Baird in review), with up to 70% mortality recorded in some *Acropora* species (Baird and Marshall 1998). Thus the appearance of the

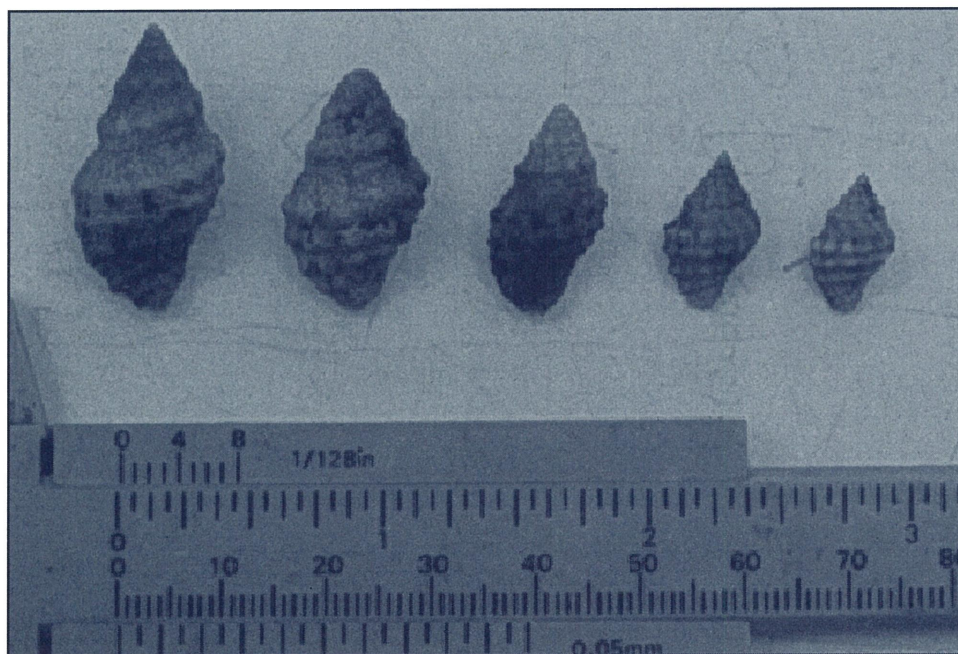


Figure 4. Snails within the large group ranged in size from 13.9 millimetres to 28 millimetres.

aggregations approximately eight months after the mass mortality supports Antonius and Riegl's (1997) suggestion of a link between *Drupella* aggregations and coral mortality. A similar relationship was noted by Ayling and Ayling (1992) who found the proportion of corals affected by *Drupella* to be higher on reefs affected by cyclone Ivor. This relationship has been demonstrated experimentally by Forde (1992) who showed that *Drupella* aggregate on dying corals which also appears to stimulate the snails to feed.

Should we be concerned? While the proportion of corals currently affected is low – between 5–10% of susceptible species and less than 1% of colonies overall – and the area of tissue consumed small, this aggregation of snails is much larger than any previously reported on the Great Barrier Reef. It is comparable to the numbers of snails recorded during some of the worst damage attributed to *Drupella* in the Pacific (Turner 1994). While the mortality of corals affected by the bleaching had levelled off by August 1998 (Baird and Marshall in review), predation by *Drupella* has the potential to be a significant source of secondary mortality, particularly among the acroporids which *Drupella* appears to prefer. A similar phenomenon was described by Knowlton et al. (1981) who found that predation by corallivorous snails in the months following hurricane Allen killed many more corals than were killed by the storm.

It remains to be established whether other reefs in the Palm Islands, and elsewhere on the Great Barrier Reef, are being similarly affected. If the aggregation is restricted to Pelorus Island, why are the snails aggregating at this particular site? Furthermore, researchers monitoring the recovery of the reef following bleaching should be aware of these snails, because the feeding scars can easily be mistaken for bleached tissue, particularly in daylight when the snails are less obvious (figure 3). Indeed, Loch (1987) has suggested that some of the damage previously attributed to the crown-of-thorns starfish may in fact have been caused by *Drupella* spp. Finally, *Drupella* are rarely this abundant and this large and accessible aggregation of snails presents a significant opportunity for research into

the population biology and feeding ecology of this important and poorly understood corallivore.

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REEF MANAGEMENT NEWS

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WATER QUALITY AND COASTAL DEVELOPMENT CRITICAL ISSUE GROUP



GBRMPA, QPWS INVESTIGATE SHIP GROUNDING

Staff from the Great Barrier Reef Marine Park Authority and the Queensland Parks and Wildlife Service travelled to the site of the 17 May ship grounding at Heath Reef north of Cooktown to record any reef damage that may have resulted from the incident.

The 22 000 tonne cargo carrier *New Reach* went aground 350 kilometres north of Cooktown but lifted off the reef at high tide six hours later, with no major pollution incident resulting.

"The damage is not too severe", says the Authority's Research and Monitoring Project Manager, Ken Anthony, after having dived on the site over the weekend (5 – 6 June). "The ship was buffered by a lot of sand and mud before driving a wedge into the western end of the reef."

Underwater video footage shows an approximately 125-metre long scar where the ship ground into the near-shore patch reef. Coral disturbed by the ship has been banked up on either side of the wedge, although the majority of this rubble is likely to be washed away during the next storm.

"We would hope to see some re-growth within the next two years," Mr Anthony says. "Corals need a solid substrate on which to grow, so substantial re-growth would not be expected to occur until the banked-up rubble is cleared away by wave action."

The damage was relatively minimal according to Mr Anthony. "Had the reef been a bowl-like reef that holds water even at low tide a hole in the side caused by a ship grounding could have had a more significant impact," he said.

"It could have caused the water to drain out of the bowl, leaving the plant and animal communities living there high and dry during low tide. In this case, though, one end of the reef has been damaged somewhat while the rest of the reef is still healthy. We will let nature take care of the repairs."

Acting chair of the Authority John Tanzer praised the quick action of the QPWS, Australian Maritime Safety Authority (AMSA), the Qld Department of Transport (QDoT) and the Authority's staff in assessing the grounding and preparing to respond had the situation deteriorated.

As soon as the first report arrived that the vessel was in difficulty, REEFPLAN – a marine oil spill contingency plan developed especially for the Great Barrier Reef by the Authority, AMSA and QDoT – was implemented. The Authority's primary responsibility under REEFPLAN in the case of an oil spill threat is to provide environmental and scientific advice to AMSA and QDoT.

"We undertook an initial oil spill response as a precautionary measure but, thankfully, there was no pollution from

this incident," says Mr Tanzer.

Correspondence to the Authority from the Commonwealth Department of Transport and Regional Services indicated that, under the provisions of the Navigation (Marine Casualty) Regulations, it would be conducting an investigation into the circumstances and causes of the grounding.

The Authority's Shipping and Maritime Project Manager, Jamie Storrie, was alerted to the oil spill threat in the early hours of the morning on 17 May. "If a major incident did occur, the Authority would prioritise the habitats in most need of protection from pollution," says Mr Storrie. "In most cases, mangrove communities would be awarded the highest priority, followed by seagrass beds and coral reefs."

An appropriate oil spill response technique would then be put into action. "Different spills require different clean-up operations dependent upon the type and quantity of pollutant, and how quickly a response strategy could be implemented," Mr Storrie says.

Pollutants are sometimes able to be removed from the ocean using containment booms and oil skimming equipment; recovery operations are most effective when the oil is concentrated and thick on the water. Chemical dispersants are a valuable response tool when the oil is spread over large areas or in remote locations, as they can be applied by aircraft.

The relatively high volume of shipping traffic in Great Barrier Reef waters and the navigational difficulty involved with negotiating a path through coral reefs, especially north of Cairns, increases the likelihood that a major pollution incident may occur. However, the Authority has worked through a risk-assessment process which demonstrates that the level of risk is still low.

Each year, approximately 3000 ships over 50 metres in length use the Grafton Passage near Cairns, the Palm Passage near Townsville and Hydrographers Passage offshore from Mackay in order to get to the inner shipping route that runs between the coastline and the Reef from just north of Gladstone to the Torres Strait. There have been five groundings on the Great Barrier Reef since 1995. Fortunately, none have had a significant environmental impact.

"Considerable risk comes not only from oil tankers but from vessels carrying dry bulk cargo because they also have a certain amount of fuel and oil on board for normal operation," says Mr Storrie.

"Because major spills are usually caused by shipping accidents resulting in damage to oil tanks, such as a collision or grounding, the best spill prevention measures relate to safety of navigation."

In a world first, Australia sought and obtained formal International Maritime Organisation adoption of a mandatory ship reporting system (REEFREP) for the inner shipping route of the Great Barrier



Photographs taken after the New Reach grounding on 17 May, show banked-up coral rubble on either side of the wedge driven into the reef by the ship.

Reef, which took effect on 1 January 1997. Six years earlier, in 1991, mandatory pilotage was adopted for all vessels over 70 metres and all loaded oil, chemical and liquefied gas carriers. Experienced pilots provide information to the master of the ship to assist in navigating through the passages.

"The Australian initiatives taken to improve marine safety and environmental protection of the Great Barrier Reef are an indication of how much value is placed on the area," Mr Storrie says.

Under REEFREP, all ships more than 50 metres in length transiting the inner passage are required to report via radio their position and course at designated report locations situated at approximately 160-kilometre intervals

along the coast, as well as when entering all ports.

REEFREP is based at Port Hay Point, south of Mackay, and is supported by three radar stations in the Torres Strait and at Green and Penrith Islands. AMSA is currently extending the radar coverage to include a fourth station at Palm Island (off Townsville).

"The vessels also benefit from mandatory reportage in that they receive regular updates on the concentration of fishing vessels and other ships, weather reports and navigation-related information," says Mr Storrie. "REEFREP has also been a valuable source of information on shipping trends and has been instrumental in identifying and tracking ships illegally transiting the inner passage. ■

FEATURE

Representative Areas in the Great Barrier Reef Marine Park

(The following is a compilation of recent press releases on the Representative Areas Programme.)

Federal Environment Minister, Senator Robert Hill, recently launched a key initiative to provide better protection for a range of diverse marine habitats in the Great Barrier Reef Marine Park.

Senator Hill said the Great Barrier Reef Marine Park Authority's Representative Areas Program would implement the Coalition's pre-election undertaking to conduct a review of existing arrangements to ensure appropriate levels of protection for all habitat types in the World Heritage Area.

"At the moment only about five per cent of the Marine Park is classified as highly protected," Senator Hill said. "This includes many of the more visually spectacular coral reefs and fish habitats. Unfortunately a number of less charismatic, yet vitally important, habitats and communities are under-protected."

The Great Barrier Reef Marine Park encompasses one of the most diverse tropical marine systems in the world. Apart from the famous coral reefs it also includes algal and sponge gardens, seagrass meadows, mangroves, sandy and muddy bottom communities and deep ocean troughs – and all these habitats are connected to each other.

Senator Hill said the Representative Areas Program would involve Great Barrier Reef Marine Park Authority managers working with scientists to select a series of representative habitat types and identify possible threats to their viability. The Authority's Representative Areas Program will contribute to a nationwide review of marine and terrestrial areas aimed at protecting Australia's biodiversity.

"While land-based regions of high biodiversity, like rainforests, have been extensively mapped, there is little

knowledge of marine habitats including the Great Barrier Reef World Heritage Area.

"Providing highly protected representative areas will ensure a safety margin against threats arising from human activities," Senator Hill said. "They will serve as environmental insurance policies, providing a sound ecological base from which to maintain the biodiversity that is important for the region's ecological and economic wellbeing."

Public participation is being encouraged, with a wide range of stakeholders including commercial and recreational fishers, conservationists, Indigenous groups, the tourism industry and scientists being urged to have input into the process.

"This initiative follows on from our recent commitment in the Federal Budget to provide an additional \$3.4 million over the next three years for improved surveillance and enforcement, and is further evidence of the Government's commitment to protecting the values of the Great Barrier Reef," Senator Hill said.

Marine scientists have applauded steps taken by the Authority to provide better protection for a range of diverse marine habitats in the Marine Park. More than 100 scientists from around Australia are contributing to the Representative Areas study, which will provide the Authority with a good idea of where different plants and animals live and the location of their corresponding habitats.

Dr Terry Done, senior principal research scientist at the Australian Institute of Marine Science, said the Authority was

to be commended for its efforts to review how well the existing network of highly protected areas protected the biodiversity of the Great Barrier Reef World Heritage Area.

"Researchers can contribute much more to developing the most effective network than we could when the protected areas were first created a couple of decades ago," Dr Done said.

The acting chair of the Authority, Richard Kenchington, said the scientists' advice was assisting the Authority to understand more about such biodiversity.

"These experts have been extremely supportive of the Authority's efforts to go out into the scientific and wider community to ensure that the best available information and data are used in the review of highly protected areas," Mr Kenchington said.

"Managers undertaking similar programs to determine representative areas in other States are also excited about the Authority's proactive approach and several are seeking to conduct similar data collection exercises.

"Feedback from the scientific community is that the outcomes of the Representative Areas Program will be of critical importance, which is why experts have been keen to contribute their knowledge and understanding of the Great Barrier Reef region."

For further information on the Representative Areas Program please contact the Representative Areas Planning Team on +61 7 4750 0700 or visit the web site at [p://www.gbrmpa.gov.au/rep_areas/](http://www.gbrmpa.gov.au/rep_areas/) ■



WHITSUNDAY BAREBOAT INDUSTRY SAILS INTO SELF-REGULATION

TOURISM AND RECREATION CRITICAL ISSUES GROUP

The Whitsundays bareboat industry is leading the way in the adoption of a more self-regulatory approach to marine tourism on the Great Barrier Reef, with the recent introduction of a mandatory accreditation and training scheme to be undertaken by all bareboat staff operating in the area by 1 July 1999.

The training scheme has been designed to equip operators with the information needed to fully brief bareboat hirers on marine safety and emergency procedures, radio operation, best environmental practices, Marine Park regulations and features of the local marine area.

Endorsed by the Great Barrier Reef Marine Park Authority, the Queensland Parks and Wildlife Service (QPWS) and the Queensland Department of Transport (QDoT), the accreditation program is expected to help minimise the impact of the large volume of bareboat users on the marine environment and ensure that visitors have an enjoyable, yet safe, boating experience.

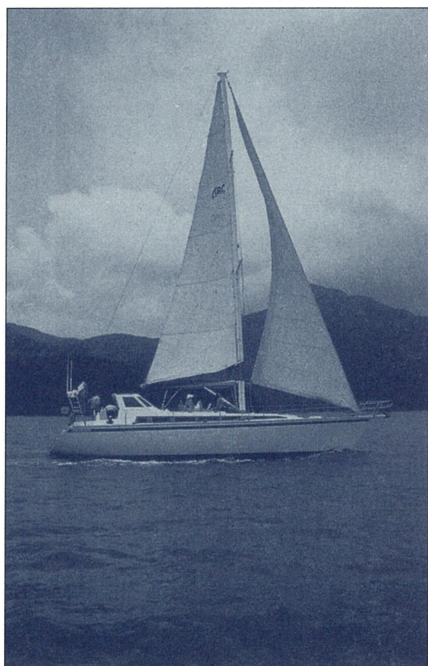
Bareboat operators have certain responsibilities in line with QDoT marine safety requirements and the Authority's Marine

Park permit system. The new accreditation scheme incorporates some these legal requirements.

The Whitsunday bareboat industry is one of the largest boat-hire industries in Australia, and provides visitors with an opportunity to cruise some of the finest sailing grounds in the world. Before hiring a bareboat, clients must show a resume of boating experience, view a QDoT marine safety video and attend a briefing by bareboat staff on the day of departure. Training and accreditation of bareboat staff is aimed at standardising and improving the quality of the information transferred during the briefing.

With over 80 people having already completed the training course at Cannonvale TAFE since it was launched in May, Whitsunday Bareboat Operators' Association president Terry Kemp says organisers are very pleased with the interest the course has generated.

"It is not only bareboat managers and staff who have enrolled in the course," says Mr Kemp. "People who are not directly involved in the bareboat industry but are boat owners interested in learning more about marine safety and Marine



The Whitsunday bareboat industry is one of the largest boat-hire industries in Australia.

Park regulations have also completed the course."

According to Mr Kemp the training and accreditation of bareboat operators will do much for the solidarity and professionalism of the industry. "By setting a benchmark against which all operators can measure the quality of information given to clients by their staff, operators will be able to maintain a high standard of service," he says.

There has been some concern in the

past from Reef managers that inexperienced or ill informed bareboat clients might have been contributing to reef damage through careless anchoring, as well as to litter problems around popular moorings. Suspected illegal fishing in Marine Park 'green zones' was also of concern. "The course highlights the significant role of bareboat staff in transferring important information regarding both safety and the environment," says Mr Kemp. "Better informed clients mean fewer marine accidents and less environmental damage."

For safety reasons, accredited bareboat industry staff will be required to have a restricted radio operator's certificate and the Australian Yachting Federation (TL4 Inshore certificate or equivalent) qualification.

The training course is run over four 2-3 hour evening sessions, with an additional short practical assessment session on board a vessel at the Abel Point Marina. The course also includes on-the-job assessment of staff during client briefings. Teaching staff have been recruited primarily from the marine tourism industry, as well as from the QPWS and the Authority.

According to the Authority's Project Manager for Industry Training/Accreditation, Bryony Barnett, industry support for the training and accreditation scheme has been very strong. "Even the most experienced bareboat staff have said that they learned something from the course, and the vast majority said that it not only met their expectations, but far exceeded them," says Ms Barnett.

"This course has also provided more cohesion for the bareboat industry by providing a rare opportunity to meet and discuss ideas in a non-competitive environment."

Accreditation of Whitsundays bareboat operations is expected to coincide with the gazettal of the Authority's Whitsundays Plan of Management. New Marine Park regulations will require all bareboat operations in the Whitsundays to have accreditation according to the new industry standards.

The Authority has also proposed that all permitted bareboat vessels display a unique 'identifier' to enable ready identification of permitted bareboat vessels and charter companies.

Day-to-day managers of the Marine Park, the QPWS, may already be witnessing the positive results of the accreditation scheme. According to QPWS Airlie Beach ranger Tim Schneider a number of recent patrols, which targeted bareboats, revealed 100 per cent compliance with Marine Park zoning and regulations.

"During a patrol, we approach a number of vessels to determine whether or not they are doing the right thing, as well as to see whether they have a handle on Marine Park zoning, mooring requirements, environmental best practices for anchoring and restrictions on fishing," says Mr Schneider.

"Of the 15 bareboats we approached on a standard patrol over the weekend (5-6 June), all seemed to have a good knowledge of reef protection concepts."

Self-regulation by the tourism industry and the adoption of industry standards is strongly supported by the Authority. In fact, the success of the bareboat training and accreditation program may provide the framework for future development of similar accreditation for other facets of the marine tourism industry. ■

FEATURE

GBRMPA active in Fisheries Issues

The newly formed Fisheries Issues Group (FIG) at the Great Barrier Reef Marine Park Authority (GBRMPA) is working actively to ensure fishing activities in the Marine Park and World Heritage Area are undertaken in an ecologically sustainable manner. Members of the group work closely with agencies such as Queensland Fisheries Management Authority (QFMA), Queensland Department of Primary Industries (DPI) and the Australian Fisheries Management Authority (AFMA) and with industry and stakeholder groups such as the Queensland Commercial Fishermen's Organisation and SUNFISH

(recreational fishing interests). Now that the Fisheries Issues Group is fully operational the group thought it would be timely to introduce its members to readers.

The Fisheries Issues Group comprises five staff and is supported by a part-time administrative assistant,

Paul Davies. All staff in the group are actively involved in Management Advisory Committees (MACs) for various fisheries. They are also members of Zonal Advisory Committees (ZACs) that advise the QFMA on regional fisheries issues and also are responsible to various Local Marine Advisory Committees (LMACs) for fisheries issues.

The Fisheries Issues Group actively contributes to and has members on the Queensland Fishing Industry Research Advisory Committee and the Queensland Aquaculture Development Advisory Committee.

The Fisheries Issues Group Director, Dr Phil Cadwallader, has provided articles in the two latest issues of *Reef Research*, and has over 25 years experience in fisheries science and management. Phil coordinates the activities of the group and is GBRMPA's representative on Trawl MAC. The ecological sustainability of trawling in the Great Barrier Reef Marine Park (GBRMP) is of major concern to GBRMPA and Phil is involved closely in negotiations with the QFMA as it develops a new Management Plan for the trawl fishery.

Mick Bishop is responsible for the group's input into management of the reef line fishery and is actively involved in Reef MAC to ensure the reef line fishery is managed appropriately. Mick is also responsible for coordination of research related to fishing and the application of such research to management, and advises on enforcement and surveillance in relation to fishing activities. Mick has management experience in a range of fisheries managed by the Australian Fisheries Management Authority, including managing the Torres Strait fisheries office at Thursday Island.

Darren Cameron is the Fisheries Policy and Stakeholder Liaison Officer for the group and has a background as a fisheries biologist and manager with Queensland fisheries agencies. Darren is responsible for liaison with all fishing sectors that utilise the Marine Park and World Heritage Area and is responsible for the group's input into the management of the commercial and recreational inshore net and line fisheries. Darren will be involved in explaining the Representative Areas Program to the fishing sectors over the next few months.

Jan Forbes is the Fisheries Policy Officer with responsibility for input into the management of harvest fisheries through her membership on Harvest MAC. Harvest fisheries include those fisheries/harvest activities for aquarium fish, coral, trochus, sea cucumber, tropical rock lobster, baitworms and specimen shells. Jan is also the contact officer for all aquaculture, developmental fisheries and permit policy with respect to fisheries related issues. Jan has a background in environmental impact assessment of mariculture proposals and other activities, having joined the FIG from GBRMPA's former Impact Assessment Unit.

Martin Russell is a Project Management Officer in the group. Martin is trained as a fisheries scientist and manages contracted research projects, and analyses and presents fishing effort and catch data for management and planning purposes. He also provides advice and coordinates GBRMPA's involvement in Queensland's Vessel Monitoring System and provides technical advice on fishing gear used in and adjacent to the Marine Park and World Heritage Area. Martin represents GBRMPA on AFMA's Eastern Tuna MAC responsible for tuna and billfish fisheries on Australia's east coast, and recently has become a member of QFMA's Crab MAC that has responsibility for developing management plans for Queensland's crab fisheries.

With the formation of the Fisheries Issues Group, the GBRMPA is taking a more proactive and assertive role in ensuring that the management plans being developed by Queensland address not only issues related to target species, but also to non-target species and the ecosystems on which the group's goal is to have ecologically sustainable fisheries that do not compromise the values of the GBRMP and World Heritage Area.

Members of the group may be contacted directly by phoning +61 7 4750 0727. ■

FEATURE

Social Science on the GBR

While social science is not the first thing to come to mind when considering management of the Great Barrier Reef, sociologists, anthropologists, psychologists and economists provide essential information about Reef-related cultural, economic and social issues to Reef managers.

The Great Barrier Reef Marine Park Authority has a long tradition of drawing upon top local, national and international social scientists to couple cultural, economic and social information with ecological data under the Authority's multiple-use management philosophy.

Socio-cultural and Economic Project Manager, James Innes, says that while the bottom line for the Authority is conservation of the natural values of the Great Barrier Reef, human use and non-ecological values must be factored into the decision-making processes of management. "People develop important long-standing cultural affiliations, social associations and economic ties to natural resources such as the Great Barrier Reef," says Mr Innes.

"There are a number of studies under way which will give us a clearer picture of how people use the Reef, the

values they attribute to certain locations and activities, and their motivations for visiting and returning to the Reef.

"The Great Barrier Reef's status as a World Heritage Area means that we have to take into account the values that people from Melbourne, New York or Tokyo place on the Reef. We have to think about current users, potential users, future generations of users, interest groups and industry."

The results from cultural and socio-economic studies on the wide variety of values attributed to the Great Barrier Reef are passed on to decision-makers to facilitate equitable and comprehensive decision-making. The Authority works within a legal and legislative framework that requires social, economic and cultural values be given due consideration in Marine Park and World Heritage Area management regimes.

One project under way is a collaborative study with JCU into the cultural heritage values contributed to marine environments. The Cultural Heritage Values study will examine how the Authority can best have regard for a range of cultural values of different groups of people contributing to the Great Barrier Reef region, with a report to be submitted to the Authority at the end of 1999. Results



The Great Barrier Reef is significant to many people for a variety of reasons.

from the study will contribute to a growing body of international research into the application of such concepts as 'cultural landscapes'. Cultural landscape research looks at people's cultural associations with certain places which help them to form identity.

When zoning and developing Plans of Management for the Great Barrier Reef, the Authority calls upon the community to submit public comments regarding the proposed management of particular areas. In light of the multitude of people who value the Reef—socially, culturally and economically a process of negotiation and compromise usually precedes decision-making.

The Authority commissioned Dr Scott Schaffer and environmental psychologist Jayne Ormsby to assess people's use and amenity of popular Whitehaven Beach in the Whitsundays (see page 26).

Planners at the Authority were interested to know whether noise from sea planes and helicopters landing in the area had affected the value that people ascribed to Whitehaven Beach.

"Why do people visit Whitehaven Beach? Would their perceptions of the area's value as an enjoyable destination change if noise increased? What level of noise is acceptable to visitors? These are the sorts of questions that we are trying to answer," says Mr Innes.

"However, it is not simply a matter of going out there and asking visitors haphazard questions. Researchers have conducted interviews with visitors to the area based on well-established methods of inquiry that have stood up to rigorous testing by the social science community."

In addition to these interviews, the researchers also used tape recorders to measure sound levels during plane and helicopter activity.

The information gathered by Dr Schaffer and Ms Ormsby will be used by management to refine the tourism settings

outlined in the Whitsundays Plan of Management. Settings separate and define areas with particular features that might be disturbed if conflicting activities are carried out at the same location. Some settings cater for visitors who require limited human interaction, while others provide for activities such as boating and recreational fishing.

It is anticipated that the study will provide a framework for continued social science research on the use and amenity of both the Whitehaven Beach area and throughout the rest of the Marine Park.

"Ideally, we would like to have comprehensive data sets for the values placed on various locations in the Marine Park so we can see changes over time and work out which management planning works best in which areas," says Mr Innes.

The Great Barrier Reef is an important source of income for many people, such as commercial fishers and tourism operators. The Authority recognises these economic ties to the Reef and a study to assess both the market and non-market value of the Reef to determine its overall economic value will begin in June.

"The distinction between the market and non-market value of natural resources is an important one," says Mr Innes. "The Authority needs to have a good understanding of the value of the Great Barrier Reef as a revenue-generating commodity in the market place. But we also need to know how valuable are less tangible elements of the Reef. For example, can the value of a fish be calculated simply according to how much you could sell it for? Its value may also be measured in terms of how important conservation of that species is to the millions of people who visit the Reef each year to see wildlife and the income generated from these visits by tourist operators."

The economic study is expected to be completed by 2000 and is intended to form the framework for a continuing economic assessment of the Reef tailored to meet the information needs of the Authority. ■

ON THE BOIL

REVIEW OF DUGONG CONSERVATION STRATEGIES

On 30 July 1999, the Great Barrier Reef Ministerial Council endorsed the recommendations of a review of all dugong conservation strategies currently in place in the Great Barrier Reef and Hervey Bay regions (see box). The review was commissioned by the May meeting of the Great Barrier Reef Ministerial Council, which is concerned about the continuing decline of dugong numbers south of Cooktown.

The Ministerial Council, made up of the Commonwealth and State Environment and Tourism Ministers, is committed to not only halting the decline in dugong numbers, but to restoring populations in the southern Great Barrier Reef.

"The Great Barrier Reef Ministerial Council has said it will keep conservation measures for dugong in the southern Great Barrier Reef under review," says the new chair of the Authority, Virginia Chadwick.

The Commonwealth Government is providing \$1.14 million per year over the next three years to enhance surveillance and enforcement in the Marine Park, including the 16 Dugong Protection Areas (DPAs) along the Queensland coastline.

John Tanzer, Executive Director of the GBRMPA, said up to 27 confirmed and unconfirmed deaths had been reported in Great Barrier Reef waters from January to June this year. Five confirmed dugong carcasses were reported in the Cleveland Bay Dugong Protection Area between 27 March and the end of June.

A dugong carcass was found on 27 March drowned in a shark net set to protect swimmers at Magnetic Island and another, found floating in Cleveland Bay on 27 April, died from causes that have not been established. A necropsy found the cause of death was sudden but undetermined. The carcass had markings around the neck and head of uncertain origin.

A possible dugong carcass was also reported in Cleveland Bay on 3 May. Only the middle section of the animal was reported by the observer however, making it difficult for authorities to confirm that it was in fact a dugong and not a dolphin. Nevertheless, a dolphin carcass would also be of concern.

Another carcass from Cleveland Bay on 15 May died as a result of an underwater explosion from an unknown source. The fourth confirmed dugong carcass was found in Florence Bay on 10 May, and the fifth in Nelly Bay on 13 August.

A number of reports are being investigated that many dugong have died in traditional fishing nets since April at Mission Bay, near Cairns.

Three other carcasses have been reported from the Midge Point region, north of Mackay. A young male dugong found on 15 February appeared to have drowned, while two other carcasses displayed wounds attributable to human cause. Investigations into these and other carcasses are continuing.

The Ministerial Council endorsed recommendations made by a task force of senior Commonwealth and Queensland government officials in relation to dugong recovery and conservation in the Great Barrier Reef and Hervey Bay-Great Sandy Strait regions. These recommendations included:

- Further restrictions on the use of commercial fishing nets in Dugong Protection Areas (DPAs) including the size and types of nets used and the way they are fixed;
- A new strategy to form co-operative agreements with Indigenous communities to implement hunting moratoriums of dugong;
- Implementing a 40-knot boat speed limit in Hinchinbrook Channel;
- Negotiations with the Department of Defence to phase out the use of high explosive ordnance within the Great Barrier Reef World Heritage Area;
- Especially in regard to DPAs at risk from on-land water quality influences, pursuance of legislative protection of riparian zones and wetlands and progression of codes of practice from voluntary to mandatory; and
- Upgrading procedures for responding to reports of stranded dugong including refining processes to established cause of death and fast release of information to the public.

According to Mr Tanzer, very few dugong are caught in trawl nets and the possibility that a trawler was responsible for the 27 April death in Cleveland Bay was most unlikely. The Authority has also said that RAAF bombing in Halifax Bay was unlikely to have caused the death of the carcass discovered on 15 May.

"A veterinary necropsy determined that the dugong in question was between one and two days old when discovered and had died from the effects of an underwater explosion. However, it was found more than 20 km south of the Halifax Bay Defence Practice Area. As the winds then were generally from the south-east, the Authority commissioned an independent report into the possible floating pattern of the carcass," says Mr Tanzer. "That report indicated that it is highly unlikely the carcass could have floated from the Halifax Bay Defence Practice Area."

During the government review the Ministerial Council also welcomed the Queensland Commercial Fisherman's Organisation's voluntary two-month moratorium on commercial netting inside the Cleveland Bay DPA. The closure was implemented under the *Fisheries Act 1994*.

An urgent meeting was convened by the Queensland Parks and Wildlife Service (QPWS) on 20 May in Townsville to consider the recent numbers of dugong carcasses found in Cleveland Bay. The meeting was attended by representatives

from the QPWS, GBRMPA, Townsville Water Police, Queensland Boating and Fisheries Patrol, North Queensland Conservation Council, Queensland Commercial Fishing Organisation, dugong scientist Professor Helene Marsh, seagrass scientist Rob Coles and a RAAF representative.

Participants concluded that there were no obvious patterns associated with the dugong deaths in Cleveland Bay. However, the need to raise public awareness about the importance of reporting suspected dugong carcasses immediately was stressed. A very low proportion of dugong deaths is actually recorded due to the low incidence of carcass sighting, reporting and recovery. This makes it difficult to distinguish between the human and natural factors contributing to dugong mortality. The need to improve protocols for necropsy procedures was also highlighted during the meeting.

Recent initiatives to increase public awareness of the urgent need to reduce dugong mortality rates include the introduction of a Marine Animal Hotline for public reports of any injured or dead dugongs, turtles or dolphins (1300 360 898).

In August 1999, the Queensland Department of Transport commenced including *Go slow for marine animals* and marine hotline promotion stickers in its mail-out of boat registrations during the next year.

"The Ministerial Council review has been another step on the long road to ensuring both a halt and a reversal in the decline of dugong numbers in the southern Great Barrier Reef," says Tony Stokes, manager of the species conservation unit at the GBRMPA.

The Authority has also commissioned a number of studies to improve knowledge of the dugong's staple source of food, seagrass. The fine-scale seagrass distribution studies will give the Authority baseline data on seagrass in all zone 'A' and a number of zone 'B' DPAs.

"This study will be important in determining the comparative value of dugong habitat," says Mr Stokes. "It will give us a good benchmark against which to detect any future habitat changes." ■

FEATURE

Conserving Marine Turtles

Of the world's seven species of marine turtles, six – the green, hawksbill, loggerhead, flatback, olive ridley and leatherback turtles – are found in the waters of the Great Barrier Reef, making it one of the few remaining havens for marine turtles in the world.

In recognition of the Reef's intrinsic value to marine turtles, the Great Barrier Reef Marine Park Authority is developing a *Marine Turtle Conservation Policy* for the Marine Park. Although marine turtles have always been protected within the Marine Park, the new policy will review and expand upon the *Turtle and Dugong Conservation Strategy* of 1994 to look specifically at issues related to the protection of marine turtles and their habitats.

Some of the turtles that come to nest in Australia actually live in the waters around Papua New Guinea, New Caledonia, Indonesia and the Solomon Islands. In fact, the migratory habits of turtles pose significant problems for marine turtle conservation. Although the Authority can protect turtle populations while they are visiting waters of the Marine Park, some species come under threat in other parts of the world where conservation policies are less stringent.

The hawksbill turtle is listed as *critically endangered* worldwide on the IUCN Red List of Threatened Animals, and green, olive ridley, loggerhead and leatherback turtles are listed as *endangered*. The flatback turtle (listed as *vulnerable*) nests only on Australian beaches, while other species of marine turtles make long migratory voyages to the Great Barrier Reef to feed and nest.

"Turtles do not recognise national boundaries when migrating to and from their feeding and nesting sites", says Kirstin Dobbs, the Project Officer for the development of the new conservation policy. "This policy will help us to maintain the Great Barrier Reef as a safe haven for the world's turtle species."

Under Australia's *Endangered Species Protection Act 1992*, the green, hawksbill, olive ridley and leatherback turtles are listed as *vulnerable*, and the loggerhead turtle is listed as *endangered*. The flatback turtle is not listed.

The policy development process will include a review and assessment of a range of threats to and impacts on marine turtles in the Marine Park, including habitat destruction, boat strike, fishing activities, strandings and oil spills. The policy will specify the manner in which the Authority will manage the conservation of marine turtles in the Marine Park and is intended to support related conservation initiatives, such as the , which is currently being prepared by Environment Australia –Biodiversity Group. The format of the policy will be similar to the *Whale and Dolphin Conservation Policy for the Great Barrier Reef Marine Park*, produced in 1998. A draft policy is expected to be completed by the end of 1999.

The Authority welcomes comments on issues and activities that threaten, disturb or impact on the Marine Park's turtles, their habitats and nesting behaviour. A full list of relevant issues is available from Kirstin Dobbs at the Authority. All written comments will be carefully considered in preparing the draft policy. Unless marked "CONFIDENTIAL", comments may be made available for public inspection.

Written comments are requested by 15 October 1999 and should be sent via facsimile, e-mail or post to:

Attention: Kirstin Dobbs
Great Barrier Reef Marine Park Authority
PO Box 1379
TOWNSVILLE QLD 4810
Phone: +61 7 4750 0700
Fax: +61 7 4772 6093
E-mail: registry@gbrrmpa.gov.au ■



AUGMENTATIVE RESEARCH GRANTS SCHEME 1999

The Great Barrier Reef Marine Park Authority awarded twelve grants this year to students undertaking research relevant to the management of the Great Barrier Reef Marine Park. All students are working towards a Doctorate or Masters degree. Rozel Brown reports.

KEY: **Researcher** / Supervisor, *Project title*
(\$ awarded) Description of project

JAMES COOK UNIVERSITY

Samantha Adams / Dr B. Molony & Prof. J.H. Choat,
*Effects of fishing on the sexual structure dynamics of
protogynous serranids* (\$1350)

Plectropomus maculatus is considered a minor component of the commercial fishery however it is an important species to the recreational sector. Preliminary results from this study have shown that *P. laevis* and *P. leopardus* differ markedly in reproductive biology and that *P. laevis* populations, on average, mature at a substantially larger size and over a broader size range than *P. leopardus*. For this project Samantha proposes to:

1. Compare and describe variations in the reproductive biology of three species of coral trout, *P. laevis*, *P. maculatus* and *P. leopardus* and the subsequent differences in their response to fishing pressure. The reproductive biology of *P. laevis* and *P. maculatus* will be described and compared with existing information for *P. leopardus*.
2. Experimentally investigate the effects of fishing on the sexual structure of *P. leopardus* populations within the Great Barrier Reef Region. This component is directly linked with the Effects of Line Fishing Experiment that is being carried out by the Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef (CRC Reef Research Centre) and will relate variations in effort to changes in the sexual structure of *P. leopardus* populations.
3. Predict the effects of fishing on coral trout species with varying reproductive strategies.

Samantha states that results from the Effects of Line Fishing experiment will provide the means to predict how the sexual structure of coral trout populations respond to fishing pressure and how this response may differ between species. Data obtained from Samantha's research will address whether managing the three species of coral trout as a single stock is appropriate. Such information will assist the Great Barrier Reef Marine Park Authority with management of specific issues relating to coral trout.

James Aumend / Dr M. Sheaves & Dr B. Molony, *The use of Inductively Coupled Plasma-Mass Spectrometer*

(ICP-MS) trace-element analysis of otoliths as a means of identifying the coastal nursery grounds of tropical offshore fish stocks (\$1000)

James states that techniques and approaches used in various studies in the field of otolith microchemical analysis have varied considerably. As a result he has spent a great deal of time researching the appropriate procedural and analytical techniques for this type of study. James intends to focus his research on usage patterns of coastal nursery grounds and recruitment to adult stocks by *Lutjanus sabae*, *L. malabaricus* and *L. erythropterus*. He believes that he should be able to discriminate amongst fish captured from different drainage catchments within North Queensland based on the trace-element chemistry of their otoliths. Techniques such as ICP-MS trace-element analysis will be used to investigate patterns of how trace elements are incorporated into otoliths.

If successful this research will provide a means of obtaining information on recruitment, stock structure and patterns of habitat utilisation during migrations to adult habitats. It will also reveal whether certain areas are more important sources of recruits than others (and thus of greater conservation value) and whether reefal adult stocks are sustained entirely by recruitment from coastal juvenile habitats. James is confident that the data produced from this study will help to determine ecological boundaries for reserves. It will also assist with identifying the potential impacts of coastal activities and development on recreationally and commercially valuable fish stocks in the Great Barrier Reef Marine Park.

Andrew Baird / Dr B. Willis & Dr T. Hughes, *The length of the larval phase in corals: new insights into patterns of reef connectivity* (\$1000)

From preliminary results Andrew reports that patterns in the geographic distribution of the scleractinia suggest that the species found in remote locations are not a random subset of the species pool. He explains that, in the Acroporidae, this pattern can be attributed to differences in the capacity of species to delay metamorphosis. Andrew also states that species differences in settlement rates suggest that successful colonisation of remote locations also depends on rapid settlement. Regular long-distance dispersal between populations within the Indo-Pacific will result in levels of gene flow sufficient to prevent

divergence and may explain why the Order Scleractinia contains so few species when compared to other marine invertebrate taxa.

The central hypothesis of Andrew's research is that the geographical ranges of coral species are determined by the length of the larval phase. Andrew aims to identify the physiological mechanism behind species differences in larval duration by using material already collected along with samples he plans to collect in 1999. His objectives for this project are to: a) determine the likelihood of localised recruitment by quantifying the number of larvae from single cohorts settling over time, b) test whether species geographical distributions are influenced by the capacity of coral larvae to delay metamorphosis, and c) examine ontogenetic changes in the biochemical composition and morphology of coral larvae.

Andrew was previously awarded grants in 1997 and 1998 for this project (see *Reef Research*, Vol. 7, No. 2 and Vol. 8, No. 2). Data produced from this research will assist management authorities with effective conservation and management of reef ecosystems by determining relevant boundaries for marine reserves and identifying reefs which are vulnerable to human impact due to their distance from regular larval replenishment.

Jo-Anne Cavanagh / Dr R. Coventry, Dr K. Burns & Dr G. Brunskill, *Biological impact of organic agricultural chemicals* (\$1350)

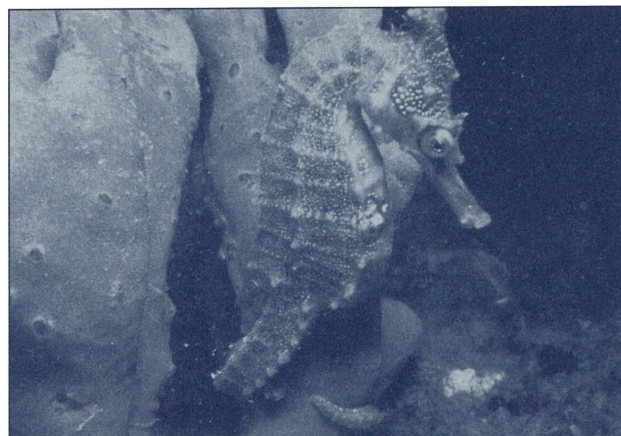
Sediment and nutrient discharges from rivers to the Great Barrier Reef lagoon have increased markedly (about fourfold) since European settlement on the catchments. However, evidence of widespread adverse effects on the Great Barrier Reef ecosystems from this increase is not yet available (Brodie 1995). While comprehensive monitoring of river discharge of sediments and nutrients has occurred, few monitoring surveys for chlorinated hydrocarbons, pesticide residues, trace metals and petroleum hydrocarbons have been carried out. In her application for funding Jo-Anne reports that there is limited information available on the distribution of organic contaminants in regions of the Great Barrier Reef lagoon, and even less information available regarding the degree of biological exposure to organic contaminants.

Targeting creeks and mangrove channels draining canelands in North Queensland, Jo-Anne aims to assess the biological impact of organochlorine insecticides on the near-shore estuarine environment using biomarkers (mixed function oxidases, MFOs) from *Acanthopagrus berda* (pikey bream). Jo-Anne is confident that results from this research will furnish a direct link between land-based activities and potential disturbances in the Great Barrier Reef lagoon. Such information will prove invaluable in managing and reducing the impacts from land-derived sources of contaminants in the Great Barrier Reef Marine Park.

Reference: Brodie, J. 1995, The water quality status of the Great Barrier Reef World Heritage Area, in *State of the Great Barrier Reef World Heritage Area Workshop, Proceedings of a technical workshop held in Townsville, Queensland, Australia, 27-29 November 1995*, eds D. Wachenfeld, J. Oliver and K. Davis, Great Barrier Reef Marine Park Authority, Townsville, pp. 69-96.

Marshall Chang / Dr P. Southgate, *Tropical seahorse project* (\$500)

Seahorses have become a vulnerable species due to their growing demand in the far east where they are commonly used in traditional Chinese medicines. Widely traded among marine fish collectors, they are recognised by Western cultures as economically important fishes that must be ecologically sustained. It is Marshall's intent to research the specific nutritional requirements and general husbandry of seahorses found on the Great Barrier Reef.



Seahorses are widely traded among marine fish collectors.

As seahorses require constant feeding and consume a considerable amount of live food – consisting of small crustaceans and fish fry – they are rather difficult to maintain. However, from his own studies Marshall reports promising survival rates of *Hippocampus kuda* (75-80% of newborn seahorses survive to two months). If seahorses are nutritionally maintained and kept in an appropriate environment, they will reproduce regularly.

Data produced from this project will provide the Authority with valuable information on the captive breeding of seahorses. This information is important if we are to sustain and conserve one of the most fascinating fish species found in the Great Barrier Reef Marine Park. Marshall would like to see captive-bred seahorses replacing wild caught animals on the market.

Halmar Halide / Dr P.V. Ridd & Prof. M. Heron, *Hindcasting coral bleaching events using a neural network technique* (\$600)

In early 1998 the Great Barrier Reef experienced a mass coral bleaching event. Though bleaching is a known phenomenon on the Great Barrier Reef this event has further increased the focus on understanding the causes of bleaching. Some speculate a link between bleaching episodes and El Niño Southern Oscillation (ENSO) or global warming. However, coral bleaching events that have occurred at Magnetic Island have not been coincident with the ENSO phenomenon (Hoegh-Guldberg et al. 1997).

Halmar will focus his coral bleaching study around Magnetic Island where he aims to: a) develop a neural network scheme for long-term prediction of oceanic

and meteorological data, b) hindcast the 1980, 1982 and 1987 bleaching events at Magnetic Island using a trained neural network, and c) develop better predictive capabilities of coral bleaching events at Magnetic Island. Using the Comprehensive Ocean and Atmospheric Data Sets which consist of sea surface temperatures, air temperature, cloud cover, and wind data along with rainfall and simulated tidal height, Halmar will investigate the hydro-meteorological variables, other than the ENSO signal, that contributed to the coral bleaching events at Magnetic Island.

Results from this project will assist with further scientific studies into coral bleaching with the possibility of predicting future coral bleaching events around Magnetic Island.

Reference: Hoegh-Guldberg, O., Berkelmans, R. and Oliver J. 1997, Coral bleaching implications for the Great Barrier Reef Marine Park, in *The Great Barrier Reef, Science, Use and Management: a National Conference Proceedings*, Townsville, Great Barrier Reef Marine Park Authority, Vol. 1, pp. 210-224.

Michael Pido / Dr P. Valentine & Dr M. Fenton, *Evaluation of resource management in small-scale tropical marine fisheries: A comparison of marine reserves/parks in the Philippines and Australia* (\$1000)

Michael was awarded grants in 1997 and 1998 for this project and has been successful in obtaining another grant in 1999 to continue his research. The objective of Michael's study is to evaluate the performance and outcomes of resource management in small-scale tropical marine fisheries.

Michael aims to: a) identify and develop a set of performance and outcome indicators for evaluation of resource management regimes in small scale tropical marine fisheries, b) use performance and outcome indicators in a comparative evaluation of selected small-scale marine fisheries sites under marine reserves/parks in the Philippines and Australia, and c) evaluate the core findings in terms of relevance to broader fisheries management issues. The three management areas for Michael's research are Hinchinbrook Island, Magnetic Island and Bowling Green Bay.

Michael reports that in 1998 he distributed a social survey questionnaire to 91 commercial fishers from the Lucinda, Townsville and lower Burdekin areas of North Queensland and that results are currently being analysed. This survey will generate information on people-resource interaction as they relate to inshore fisheries management within the Townsville/Whitsunday regions of the Great Barrier Reef Marine Park. The practical significance of this study is to provide a structured set of quantitative indicators to measure the success (or otherwise) of fisheries management.

Morgan Pratchett / Assoc. Prof. T.P. Hughes & Dr G.P. Jones, *Feeding preferences of crown-of-thorns starfish* (\$620)

A considerable amount of coral is destroyed during major outbreaks of crown-of-thorns starfish (COTS) and, despite considerable scientific research, there still remains uncertainty as to what causes these outbreaks. Morgan states that coral mortality is not evenly apportioned between coral species and, therefore, COTS also affect patterns of community composition, species diversity and coral zonation (Kenchington and Kelleher 1992). He also states that there are some colonies of preferred coral species (e.g. *Acropora hyacinthus*) which persist despite predation by COTS. Although previous data has already been obtained regarding the feeding preferences of COTS in the field, Morgan intends to conduct manipulative experiments under controlled conditions to test specific hypotheses which he formulated during field observations. Morgan will examine the role of physical parameters, such as colony size, coral morphology and the presence of commensal infauna, on the feeding preferences of the the starfish.

Understanding the basis of feeding preferences of COTS may lead to an increased ability in predicting the extent of crown-of-thorns outbreaks and their impact on coral reef ecosystems.

Reference: Kenchington, R. and Kelleher, G. 1992, Crown-of-thorns management conundrums, *Coral Reefs*, 11: 53-56.

Sarah Omundsen / Dr B. Molony & Dr M. Sheaves, *Variability of nursery ground value within and among tropical estuaries and reefs, using growth and condition analysis of *Lutjanus russelli** (\$700)

Tropical estuaries are considered to be important nursery grounds for a wide variety of species. One such species, *Lutjanus russelli* (Moses perch), is an important recreational fish common in the Great Barrier Reef Marine Park. Sarah reports that previous studies on the abundance of *L. russelli* in nurseries has been qualitative in nature, describing only the abundance and diversity of juveniles found in these areas. She goes on to say that the benefits a juvenile may obtain from tropical estuarine nurseries as opposed to other nursery systems such as reefs, plus the variability of these benefits both within and between tropical estuaries are important issues that have not been addressed. It is these issues that Sarah will investigate in her research by attempting to quantify the value of tropical estuaries as nurseries. She will achieve this by analysing habitat differences in the condition of juvenile *L. russelli*. Experimental studies will be carried out to examine the influence of factors such as predation pressure on condition, so as to determine what causes the variability in the value of these nursery areas.

Results from this research will provide valuable information for the management of these habitats. Sarah believes that, for informed management decisions to be made, a greater understanding of the role tropical estuaries play in the ecosystem and Marine Park is necessary.

David Williamson / Dr G. Russ, *An assessment of the effectiveness of management zoning in protecting fish stocks in the Palm Islands and Whitsunday Islands, Central Section of the Great Barrier Reef* (\$1280)

Management issues relating to fishing are a major focus for the Great Barrier Reef Marine Park Authority. In order to preserve fish stocks, among other things, in the Great Barrier Reef Marine Park, 'no fishing' or 'green' reefs were introduced by the Authority. Other reefs were zoned 'blue', that is they were left open to line fishing activities.

For this study, David will attempt to determine the success of management in protecting fish stocks on fringing coral reefs of the Palm Islands and the Whitsunday Islands in the Central Section of the Great Barrier Reef. That is, he aims to determine the effectiveness of the Authority's zoning plans. The specific aims of this research project are to: a) determine if there are higher densities and average sizes of targeted reef fish species in 'green' compared to 'blue' zones in the Palm Islands, b) determine if there are higher densities of non-targeted reef fish species in these zones, and c) determine if there are higher catch rates in fish traps of targeted reef fish species in the 'green' zones than in 'blue' zones of the Palm Island area.

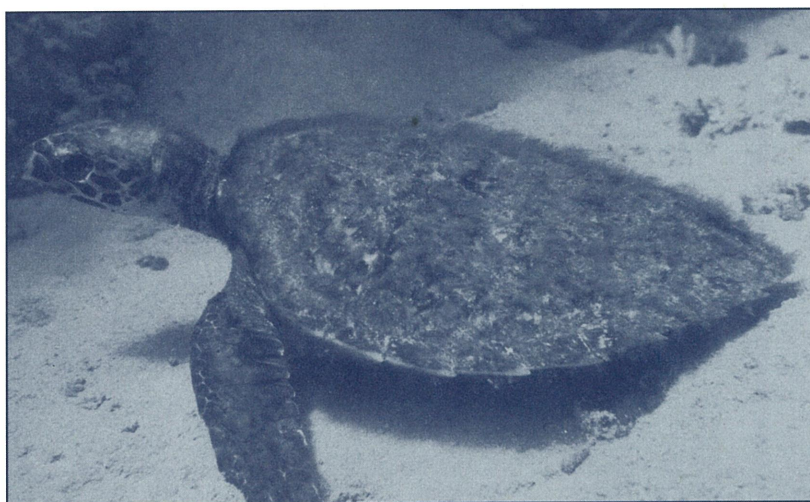
David states that results obtained from this study will provide the sort of baseline information which is required to form proactive strategies for optimal management of the Great Barrier Reef Marine Park and similar marine park areas around the world.

Nicholas Wynn / Dr P. Appleford & Dr J. Miller, *Nutritional requirements of the hawksbill turtle* (*Eretmochelys imbricata*) (\$1000)

The hawksbill turtle is widely known and sought after for its tortoiseshell. Threatened by international commercial trade, it is now classified as endangered under the Convention on International Trade in Endangered Species of Fauna and Flora (CITES).

Preferring the surrounds of tropical shoals and reefs, the hawksbill turtle's diet consists mainly of fish, crabs, sponges and jellyfish. A major nesting rookery exists for this turtle within the Great Barrier Reef Marine Park at Milman Island. Using hatchlings collected from Milman Island, Nicholas aims to quantify the following factors of the hawksbill turtle's biology: nutritional requirements, growth, digestibility, gut transit times and appetite.

These turtles will be held in the Sea-Turtle Centre of Reef HQ (previously known as the Great Barrier Reef Aquarium) which is a new purpose-built facility intended for the display, rehabilitation and scientific



The hawksbill turtle is listed as critically endangered on the 1996 IUCN Red List of Threatened Animals.

research of sea turtles. Juveniles from a number of different clutches will be reared, enabling data to be obtained which relate each clutch to growth rates.

Nicholas believes that this study will lead to an acceptable diet and feeding regime being developed for temporarily captive hawksbill juveniles. All species collected will be returned to their natal region on completion of experiments. This research will enhance public awareness and provide scientific knowledge and invaluable data for the future survival and conservation of the hawksbill turtle.

CENTRAL QUEENSLAND UNIVERSITY

Kevin Strychar / Dr T. Tentori and Dr P. Sammarco, *Zooxanthellae* (*Symbodinium microdriaticum*) *symbiosis in soft coral* (\$600)

Corals as reef builders can, in part, contribute their success to tiny single-celled algae called zooxanthellae which live within their tissues. By complementing the nutritional needs of one another, zooxanthellae enhances the coral's ability to build skeletons. Kevin reports that knowledge about zooxanthellae in soft corals is poorly documented and little information is available that adequately describes the effect variant zooxanthellae may have during bleaching episodes.

For this project Kevin will compare the effects of zooxanthellae diversity in soft corals during the winter (June) and summer (December) seasons. He will collect colonies from at least four species of soft coral from a fringing reef in order to a) characterise zooxanthellae within soft corals using molecular techniques, and b) determine host-zooxanthellae ultrastructure distribution and abundance in soft corals associated with bleaching. Kevin believes that his research will contribute to our basic understanding of zooxanthellae diversity, distribution and abundance in associated hosts on the Great Barrier Reef. The results from this project may help explain why some soft corals are more resilient to environmental pressures than others.



Glossary

aggregation: may refer to 'schooling' which involves behavioural grouping of animals; but 'aggregation' is also used to reflect concentration (of fish) for unknown or direct causes such as the concentration of food organisms

cohort: those individuals of a stock born in the same spawning season

colony: a group of organisms of the same species living in close association with each other

demographic: referring to numerical characteristics of a population (e.g. population size, age structure)

dispersal: the spreading of individuals away from each other

El Niño Southern Oscillation: 'El Niño' refers to the occasional appearance of large masses of warm water (towards year ends), off the coasts of Ecuador and northern Peru, where the water normally is cold. These appearances are linked, through the 'Southern Oscillation' to oceanographic and atmospheric changes around the world, leading to major climatic anomalies.

gastropods: snails and snail-like animals

husbandry: farming or looking after animals and crops

maritime: connected with the sea in relation to navigation, shipping etc.

metamorphosis: a change in form an animal undergoes as it develops from a larvae to an adult

morphology: the form and structure of an organism

ontogenetic: occurring during the course of an organism's development

otolith: a small ball of bony material found in a fish's inner ear. A fish's three pairs of otoliths seem to help it keep its balance in the water. Growth bands in otoliths also contain important clues about a fish's age.

protogynous: fish which mature first as males and later become females

rookery: a breeding place or colony of other birds or animals

species: groups of animals or plants having common characteristics and able to breed together to produce fertile (capable of reproducing) offspring, so that they 'maintain' their 'separateness' from other groups

stock: group of individuals of a species (usually genetically distinct and/or physically separated) which can be regarded as an entity for management or assessment purposes

symbiosis: a close relationship between two differing types of organisms where both derive benefits

zooxanthallae: symbiotic algae of coral and other organisms or one-celled plants that live inside the bodies of coral polyps and giant clams. Zooxanthallae use sunlight to produce food for themselves and their hosts.



with Steve Raaymakers

World Bank/United Nations Tackle Marine Pests

The Global Environment Facility (GEF), a cooperative effort by the World Bank, the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP), has joined the fight against invasive marine pests transported in ships' ballast water.

The new project, entitled *Removal of Barriers to the Effective Implementation of Ballast Water Controls and Management Measures in Developing Countries*, was approved by the Global Environment Facility Council in May 1999 and provided with a total budget of US\$11.5 million over three years.

The issue of the transfer of harmful exotic organisms through ballast water discharges is a global one requiring a concerted, coordinated, global response. The long-term objective of this project is to assist developing countries in reducing the transfer of harmful organisms from ships' ballast water. The project will increase the extent to which ships calling on developing country ports adhere to the, at present, voluntary ballast water management guidelines of the International Maritime Organization (IMO). Further, it will assist developing countries to implement the expected international regulatory framework currently being developed by IMO. This framework is most likely to constitute a ballast water annex to the MARPOL Convention or a separate, new Convention.

Developed countries such as Australia, Canada and the United States of America will be well placed to implement the new IMO regime, having pioneered its development and implemented voluntary ballast water management systems for several years now. Most developing countries – where even basic awareness of the issue is lacking – will require assistance to implement the IMO regulatory framework.

Country-based Pilot Demonstration Projects at specified ports will be supported within six developing nations (representative of each global development region). The countries include Brazil/port of Sepetiba, China/port of Dalian, India/port of Mumbai (Bombay), Iran/Kharg Island, South Africa/port of Saldanha and Ukraine/port of Odessa.

Regional involvement will be effected through Regional Task Forces. Barriers to be overcome include those of an educational, informational, technical, institutional, financial, political, cultural and legal nature. There are six major project objectives, addressing:

- the need for effective project management and coordination;
- stakeholder and public awareness and educational activities;
- barrier-removal efforts in targeted countries;
- monitoring activities;
- regional involvement; and
- self-financing and the recruitment of additional donors to ensure long-term sustainability.

The project will be executed by IMO, with a Program Coordination Unit being established at IMO headquarters in London.

Australian Ports Lead the Way

Whilst the Global Environment Facility and IMO pursue the solution to the ballast water problem globally, Australian ports have been active in addressing this serious concern at the local level for some years now. This was highlighted by the recent Association of Australian Ports and Marine Authorities (AAPMA) Annual Environment Workshop held in Brisbane on 4 and 5 May 1999.

Each year the AAPMA environment workshop focuses on a particular theme or environmental issue of direct interest and relevance to ports. The aim of the 1999 workshop was to bring together a wide range of people involved in ballast water management to discuss current issues. The workshop also aimed to facilitate a better understanding of where we are now in terms of research and the development of practical management systems, both in Australia and internationally.

The unwanted dispersal of marine organism 'cocktails' via ship's ballast water and hulls is a growing problem involving the international shipping fleet and port authorities around the world. The problem has become increasingly apparent in the past 20 years as ships get bigger and their voyages faster. Of the 170 foreign marine species now thought to have been introduced to Australian waters, several have become 'pest' species such as the European green crab, the northern Pacific seastar, the Asian 'wakame' kelp and toxic microalgae. The Asian Date mussel, now present in some Australian and New Zealand harbours, and the European Zebra mussel, which has invaded many United States waterways and is causing major economic impacts, pose comparable threats. New Zealand is in a similar position to Australia, with over 150 of its marine species now thought to be non-native. Of these it seems that about 60% were introduced by hull fouling, 3% by ballast water and 21% by either mechanism.

Recent evidence implies that San Francisco Bay has been receiving non-native marine and estuarine species at a rate of one every 24 weeks since 1970, but which in recent times has increased to one every 55 days. It is also estimated that, without improved

management measures, large ports such as Los Angeles, Long Beach, Sydney and Auckland will contain very similar assemblages of exotic harbour species within a few decades.

The main aim of the two-day workshop was to discuss what needs to be done over the next five years to ensure that there are adequate and effective responses to the problem in the areas of management, risk assessment and analysis, practical treatment options and scientific support.

Eight sessions were organised to achieve this. Each session was hosted by a researcher or manager who has been involved in critical aspects of the ballast water issue and each session contained a discussion period preceded by papers from invited speakers. Speakers included representatives from:

- Australian Quarantine and Inspection Service
- BHP Transport;
- Bishop Museum (Hawaii);
- Cawthron Institute (NZ);
- CSIRO- Centre for Research on Introduced Marine Pests (CRIMP);
- Gutteridge, Hasking & Davey (consultants);
- James Cook University;
- Keppel-Cairncross Dry Dock;
- LeProvost Dames & Moore (consultants);
- New Zealand Ministry of Fisheries;
- Port of Brisbane Corporation;
- Ports Corporation of Queensland;
- South Pacific Regional Environment Programme (SPREP); and
- University of Tasmania.

The topics and content of the workshop program formed a logical order to facilitate development of conclusions and broad agreements on what should be done over the next five years. Topics included:

- Where are we now? Recent international and Australian developments;
- Port sampling programs;
- Risk analysis and assessment;
- Reducing the risk: non-engineered solutions;
- Reducing the risk: engineered solutions;
- Reducing the risk: other solutions; and
- Where to from here?

The workshop was organised and sponsored jointly by AAPMA, the Ports Corporation of Queensland and Dames & Moore Pty Ltd. All papers and the outcomes of the workshop are being published in the Ports Corporation of Queensland's EcoPorts monograph series, an ISBN-registered environmental publication series which has been in regular production since 1996.

PACPOL Projects Proceed

Slick Talk No. 23 (*Reef Research*, Vol. 8, No. 1) reported on my move from the Ports Corporation of Queensland to the South Pacific Regional Environment Programme (SPREP), and the proposed development of a new program to address marine pollution in the Pacific islands region. I am pleased to report that after 12 months, the new program, called PACPOL (Pacific Ocean Pollution Prevention Programme), has been developed, approved and endorsed by member countries and donors, funds have been secured and implementation of projects has commenced.

The aim of PACPOL is:

'To maintain, protect and enhance the quality of coastal and marine environments in the Pacific islands region by minimising ship-sourced marine pollution.'

PACPOL seeks to achieve this aim through, amongst other things, assisting Pacific island countries to become members of the IMO and implement the various IMO conventions which deal with marine pollution.

The following organisations are involved in PACPOL.

- SPREP: Overall responsibility for development, delivery and management of the program, through Marine Pollution Adviser (MPA).
- IMO: Coordination with its global programs aimed at safer shipping and cleaner oceans and seed-funding for project implementation (see below)
- Commonwealth Secretariat (ComSec): Funding SPREP Marine Pollution Adviser's salary.
- Forum Secretariat (ForSec): General policy coordination and cooperation with its Petroleum Programme.
- Forum Fisheries Agency (FFA): Cooperation with its surveillance programme and collaboration on education/awareness raising targeting foreign fishing fleet.
- Secretariat of the Pacific Community (SPC): Cooperation with its Regional Maritime Programme.
- South Pacific Applied Geoscience Commission (SOPAC): Potential collaborator/consultant for some projects.
- University of the South Pacific (USP): Potential collaborator/consultant for some projects.
- Regional oil and shipping industries: General cooperation and assistance to the program.

The following countries are involved:

- Canada under Canada – South Pacific Ocean Development Programme Phase II (C-SPOD): *Bulk funding for program development and project implementation (see below).*
- Fourteen independent Pacific island countries: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu: *Targeted recipients of PACPOL assistance.*
- Eight Pacific island territories: American Samoa, French Polynesia, Guam, New Caledonia, Northern Mariana Islands, Pitcairn, Tokelau, Wallis and Futuna: *Linkages between PACPOL and marine pollution activities in these territories.*
- Four SPREP Metropolitan members: Australia, France, New Zealand, United States of America: *Supporters of PACPOL.*

The duration of the program is as follows:

- Phase I: program development – 12 months (completed during 1998).
- Phase II: project implementation – Five years (1999–2004).

Projects to be implemented include:

- An initial three-year engagement of a national from a Pacific island country as Marine Pollution Project Officer to assist the Marine Pollution Adviser with project implementation, to build regional capacity in the marine pollution area

and to enhance the sustainability of the program.

This is a training position with the aim of assuming the overall program management function;

- Completion of a marine pollution risk assessment for the region;
- Development of a regional marine spill contingency plan (PACPLAN);
- Assistance to countries to develop national marine spill contingency plans (NATPLANS), including a standard NATPLAN template;
- Holding of annual PACPOL regional workshops, including:
 - Training in marine spill response (based on IMO model course)
 - Regional marine spill response exercise (desk-top scenario)
 - Regional PACPOL coordination meeting;
- Establishment of a regional marine pollution surveillance system;
- Marine pollution education and awareness raising campaigns;
- Development of marine pollution legislation for Pacific island countries (consistent with IMO conventions);
- Review of ships' waste reception facilities in Pacific island ports;
- Environmental Management Guidelines for Pacific island ports; and
- Effective representation of the Region at IMO.

Many PACPOL projects remain unfunded. These are:

- Marine Pollution Education Video;
- Marine Pollution Education Kit for Schools;
- Introduced Marine Species Risk Assessment;
- Surveys for Introduced Marine Species in Pacific island ports;
- Regional Marine Spill Response Equipment Strategy & Rolling Programme;
- Coastal Resource Mapping;
- Marine Spill Trajectory Modelling;
- Review of Impacts of Marine Oil Spills on Pacific Island Environments;
- Environmental Audits of Regional Oil Terminals; and
- Country-specific projects (as identified in the PACPOL workplan).

Funding needs to be secured for remaining PACPOL projects. The four SPREP metropolitan members (Australia, France, New Zealand and the United States of America) are seen as potential supporters of these projects, especially as all resourcing provided or committed to date has been from Canada (US\$660K) and IMO (US\$220K).

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(Steve Raaymakers is currently engaged as Marine Pollution Advisor with SPREP. His authorship of 'Slick Talk' does not necessarily represent the views of SPREP nor the Great Barrier Reef Marine Park Authority.)



A PRELIMINARY REPORT ON THE SOCIAL AND MOTIVATIONAL ASPECTS OF RECREATIONAL FISHING IN THE GREAT BARRIER REEF REGION

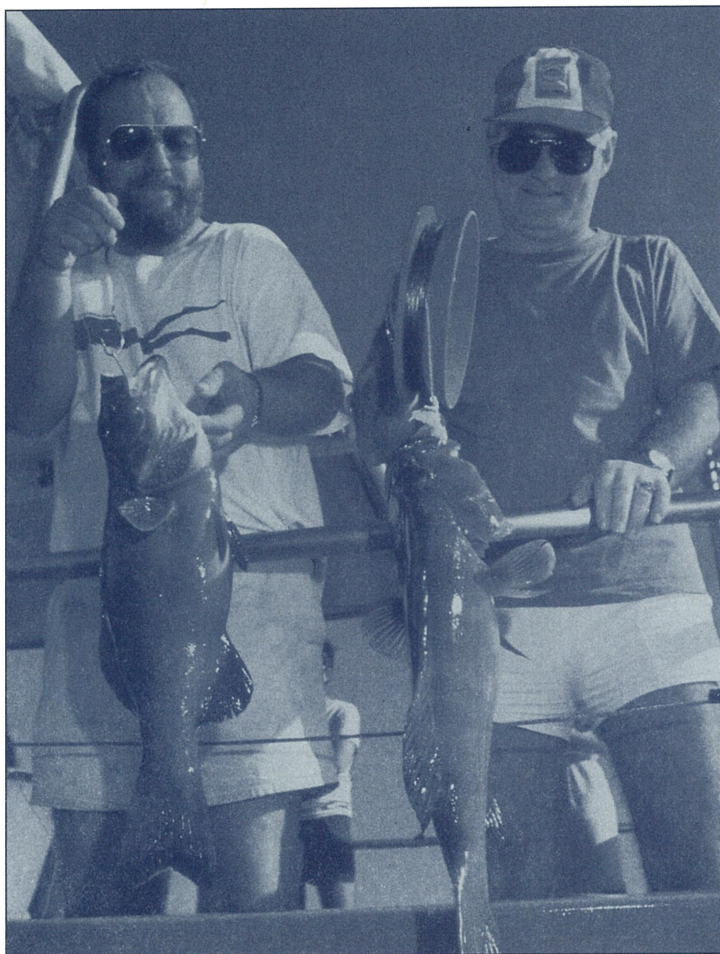
Jayne Ormsby¹ and James Innes²

¹Consultant – Social Scientist, c/- GBRMPA

²Great Barrier Reef Marine Park Authority

Recreational fishing is a frequent yet still to be fully understood activity in terms of motivation, effort and effect on the environment of the Great Barrier Reef. The Great Barrier Reef Marine Park Authority has, as part of the Queensland Fisheries Management Authority Recreational Fishing Log Book Program, undertaken a preliminary investigation into the socio-motivational aspects of recreational fishing.

Recreational fishing is a popular leisure time activity for many Queenslanders. Fisheries managers are continuously faced with the challenge of conserving fish stocks and the environment that sustains them, and ensuring equitable resource allocations between sector groups.



A study, recently commissioned by the QFMA and GBRMPA, aims to determine the social and motivational aspects of recreational fishing.

The Queensland Fisheries Management Authority and the Great Barrier Reef Marine Park Authority recognise recreational anglers as being an important sector of Queensland's fishing population. As part of the development of an integrated Recreational Fishing Information System (RFISH) the Queensland Fisheries Management Authority instigated a research program designed to deliver the information that is required to manage Queensland's diverse recreational fisheries. Components of the RFISH program are designed to estimate participation rates and demographic characteristics of Queensland anglers, recreational catch and effort, and the socioeconomic characteristics of recreational fishery. Information gathered as part of the RFISH socioeconomic survey

will provide an insight into the needs and preferences of recreational anglers whilst building a database from which effective management decisions can be made.

During 1997–98, a total of 2061 surveys were completed by recreational anglers from Queensland. This sample comprised 1180 fishers from south-east Queensland, 593 from the Great Barrier Reef region and 288 western Queensland anglers. Information collected included respondent's motivations for participating in recreational fishing, an assessment of their fishing experience, details of their last fishing trip, trip satisfaction and demographic characteristics.

The results of the study are due to be published by the Great Barrier Reef Marine Park Authority/Queensland Fisheries Management Authority later this year. The report will provide a description of the motivational and demographic profile of recreational anglers from Queensland, and more specifically the Great Barrier Reef region.

It will also explore anglers' motivations for pursuing recreational fishing activities, and present details of anglers' last fishing trip experiences within the Great Barrier Reef region.

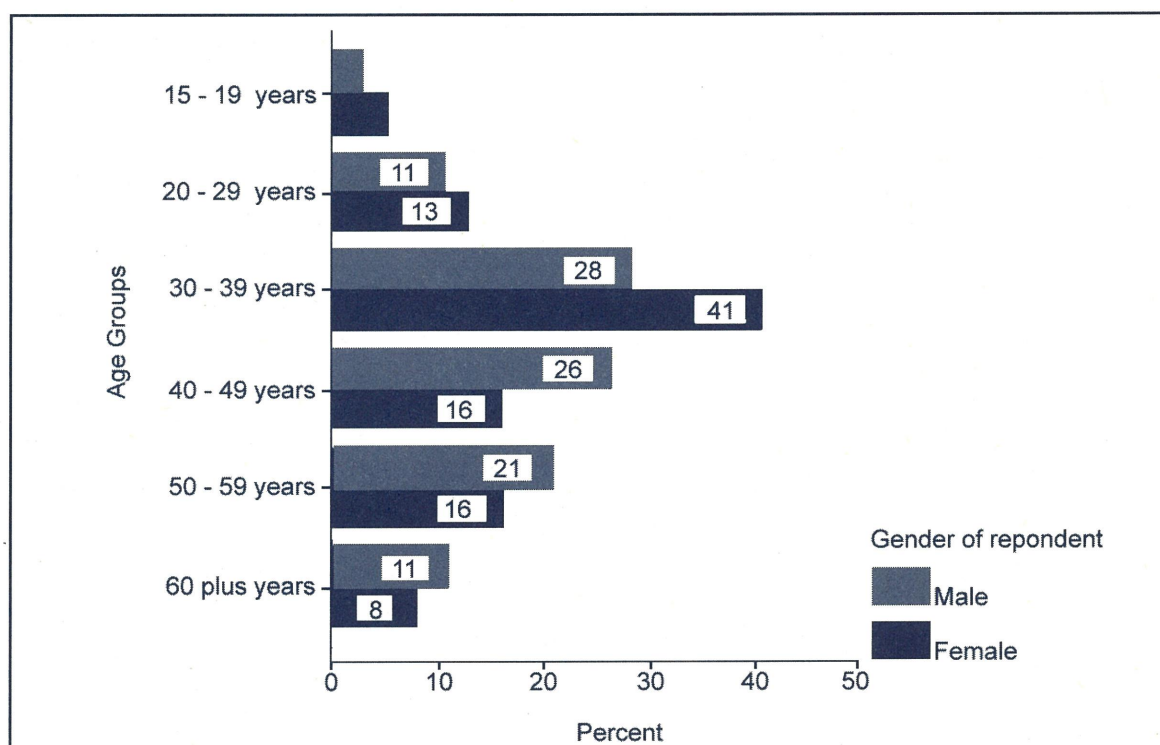


Figure 1. Age/gender distribution of surveyed recreational anglers

In summary the results from the investigation include the following key findings:

Profile of recreational fishers from Queensland and the Great Barrier Reef region

Eighty-five per cent of recreational anglers from Queensland possessed at least 10 years of fishing experience. Eighty per cent reported spending less than a quarter of their leisure time participating in fishing activities, and the majority of anglers regarded their fishing abilities as average. Overall, very similar levels of fishing skill and experience were reported by anglers from the south-east, western and Great Barrier Reef regions of Queensland.

The majority of recreational anglers from the Great Barrier Reef region were male, aged between 30 and 49 years (figure 1) and had lived in their prospective areas for more than 10 years. Most of these recreational anglers had completed schooling to a secondary level and were wage earners with incomes greater than \$41 000 per annum.

Almost 50 per cent of anglers from the Great Barrier Reef region possessed at least 30 years of fishing experience and rated their skill at fishing as average. Seventy-eight per cent spent less than a quarter of their leisure time fishing. Anglers who reported the most years of fishing experience were male, over 50 years of age, had retired or were pensioners, and completed schooling at a primary level. These males spent more of their recreational time fishing and scored their fishing abilities at a higher level. Those

who indicated more years of fishing experience and allocated the greatest amount of their leisure time to participating in fishing activities also rated their fishing expertise at a high level. Results demonstrated no differences in the levels of fishing experience, participation or abilities between anglers from the four sections of the Great Barrier Reef region.

Motivations for participating in recreational fishing

For Queensland anglers the strongest motivations for pursuing fishing activities were 'for rest and relaxation', 'to be outdoors' and 'to enjoy nature'. Although 'catching fish to eat' was very important to 77 per cent of respondents, almost 70 per cent felt that 'a fishing trip could be successful even if no fish are caught' and 'were happy even if a fish wasn't caught on every trip, as long as they had the opportunity to catch a fish'. Anglers reflected the high importance of these motivations across each of the Queensland regions.

Non-catch motivations for fishing relating to 'Psychological / Physiological' and 'Natural Environment' experiences, were rated of more importance than 'Fishery Resource' motives by anglers from the Great Barrier Reef region. Anglers with various levels of fishing participation and experience sought different types of motivations and experiences. Less experienced anglers were mostly interested in the non-catch related benefits gained from participating in recreational fishing activities. Individuals who allocated a greater

percentage of their leisure time to fishing and those with higher levels of fishing expertise were more motivated to catch fish, and fish for the skills and challenge involved, thus reflecting a greater resource dependency.

Last trip experiences

Sixty-six per cent of recreational anglers from Queensland fished in salt water during their last fishing trip. Sixty-two per cent of anglers indicated that they were targeting a specific species on their last trip with whiting, bream and flathead being the most popular species targeted.

Seventy per cent of anglers surveyed from the Great Barrier Reef region also fished in salt water on their last trip. Species mostly targeted were mackerel, crabs and barramundi. Most salt water boating trips were a single day outing, undertaken with friends and family with approximately six persons per boat. Most time was spent line fishing, crabbing and collecting bait.

Catching fish was not the main benefit received from a fishing trip. Indicators of fishing trip satisfaction most frequently mentioned included weather conditions, personal / social benefits, natural environment experiences and catch-related outcomes. Very few activities undertaken by other people or boats had a negative or detracting influence on anglers and their experiences of the Great Barrier Reef region.

Unlike previous studies of recreational fishing in the Great Barrier Reef region (e.g. Blamey and Hundloe 1993; QFMA 1999a,b; Roy Morgan Research 1997) this report examines the social and motivational aspects of recreational fishing as distinct from economic and catch effort studies. This is comparable with studies undertaken in the United States of America (e.g. Toth and Brown 1997; Fedler 1984; Fedler and Ditton 1994; Driver and Cooksey 1980) and a recent study of motivations for recreational boating in the Shoalwater Bay area (Jennings 1996).

The findings of this study indicate that, for the anglers sampled, recreational fishing is pursued for a range of motivations other than catching fish. The opportunity to experience nature and be outdoors for rest and relaxation were quite dominant motivations for fishing amongst the anglers involved in this study.

This study should be considered as a first step in developing a more holistic range of information for managers to draw upon in the management of the Marine Park.

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MONITORING AIRCRAFT USAGE OF THE MARINE PARK: A CASE STUDY FROM WHITEHAVEN BEACH, WHITSUNDAY ISLAND

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Aircraft overflights and associated noise in national parks is an environmental management issue which has attracted the attention of researchers in the United States of America and Australia for at least the last 10 years (e.g. Beal 1994; United States National Parks Service 1994).

The Great Barrier Reef Marine Park Authority recognises that sound from aircraft operations in the Marine Park is a management issue (Adami and Jennings 1995).

Accordingly the Authority has developed guidelines for the management of aircraft operations in particular areas of the Great Barrier Reef Marine Park, such as Whitehaven Beach in the Whitsunday Islands. What is critical for assessing whether these policies are effective, however, is the provision of accurate information on the impacts of aircraft activity upon the natural and cultural values ascribed to locations such as Whitehaven Beach (figure 1).

To provide such information the Authority's Research and Monitoring Coordination Unit, in September 1998, commissioned a study of Whitehaven Beach/Bay to assess the impact of aircraft sound and other human activities upon visitor use, amenity and values held for the site. The Authority will use this information to develop policy for the management of aircraft operations and other uses of Whitehaven Beach to maintain the integrity of the settings applied to the area as per

the Whitsundays Plan of Management (Great Barrier Reef Marine Park Authority 1998).

The research project comprises two studies. One

research program was a pilot trial study undertaken by Mary Hamilton, a post-graduate student from James Cook University, that recorded aircraft sound and activity levels at Whitehaven Bay.

Jayne Ormsby and Scott Shafer are conducting the other research program. This study involves the administration of a

survey to local residents of the Whitsundays and visitors to Whitehaven. The survey asks about the values those groups hold for the site and their perception of the impact of aircraft and other activities on their use and amenity of the area.

The aircraft sound monitoring project has concluded and a published report will be available from the Authority by October 1999. The local resident and visitor values and perceptions study is in the data analysis stage. It is also planned that a report on that study be published in October 1999.

This paper will briefly report on the outcome of the aircraft sound monitoring project and a future issue of *Reef Research* will report on the results of the Ormsby/Shaffer study.

For management purposes Whitehaven Beach is divided into a range of recreation opportunity spectrum (ROS) settings designed to provide for a

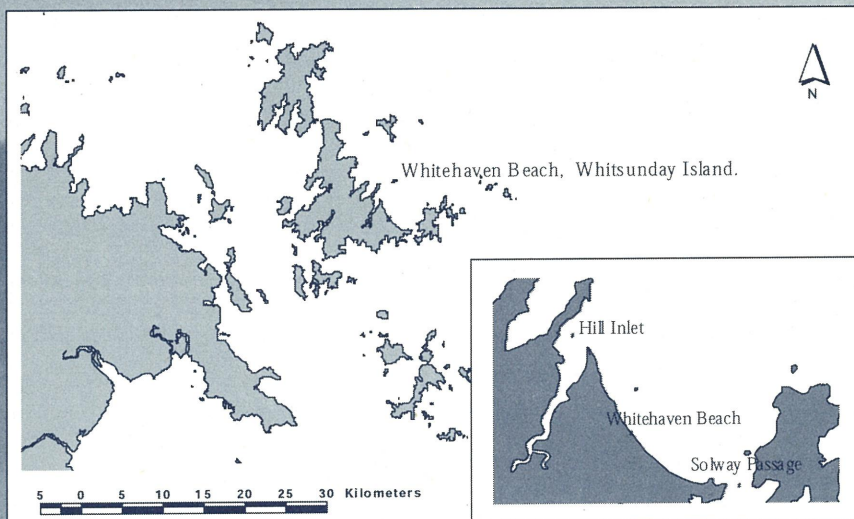


Figure 1. Whitsunday Island and adjoining mainland, North Queensland, Australia (insert showing Whitehaven Beach)

variety of user tastes and environmental needs. The ROS is a park management tool that aims to provide Park visitors with a range of different experiences. The basic premise of the ROS is that quality recreational experiences can best be assured by providing a diversity of recreation opportunities. A recreation opportunity is defined as 'a chance for a person to participate in a specific recreational activity in a specific setting in order to realise a predictable recreational experience' (Stankey and Wood 1982:5).

The ROS, as applied to Whitehaven, seeks to provide for a range of experiences that correspond with the intent of the settings as defined in the Whitsundays Plan of Management. The settings along Whitehaven Beach are high use (setting 2) at the southern most end of the beach, moderate use (setting 3), natural (setting 4) and protected at the northern most end of the Beach at Hill Inlet (setting 5) (refer figure 2). In the high use setting it would be expected that visitors would experience the highest intensity of a variety of human impacts. The degree of impact decreases in a gradient from the south end to the north end of the beach in a line with the definitions of the setting. The protected setting has the least intensity of human induced impacts. For management to achieve this it should seek to ensure that the attributes (such as degree of crowding and natural quite) required to ensure the provision of each setting are appropriate. Various human-induced variables act upon these settings subsequently influencing their attributes. Aircraft overflight frequencies and their associated sound levels are two such variables. Mary Hamilton's research sought to investigate these two variables relative to the four settings along Whitehaven Beach, Whitsunday Island.

The study also sought to compare the results between the settings.

The data for the research was collected during two four-day field trips in October 1998, a relatively low use season for aircraft tour operators. Each site was situated approximately in the middle of the setting it represented (refer figure 2). Data was collected on the frequency of aircraft overflights and attributes of their associated sound levels as well as background sound levels.

As a comparison with aircraft impacts, data was also recorded on watercraft and human activity sound levels. Sound level data was primarily collected with Techcessories analogue sound level meters.

In terms of the frequency of overflights and their sound level duration above background sound levels, sites (settings) 3 and 4 were found to experience the greatest impact from aircraft. This was followed by sites (settings) 5 and 2.

Thus the high use setting, which would be expected to experience the highest impact, actually experienced the lowest impact. In terms of the absolute and average maximum aircraft induced sound levels experienced, no significant difference was found between the settings although raw results suggested that sites 3 and 4 experienced the greatest impact from these variables followed by sites 2 and 5.

Most aircraft events (88%) registered above background sound levels and most (71%) affected three or all study sites. Overall, the busiest time of day was from 1130 to 1330. The most common type of aircraft observed were seaplanes, followed by helicopters,



Figure 2. The recreation opportunity spectrum settings along Whitehaven Beach, Whitsunday Islands

other light aircraft and high-altitude jets. Seaplane take-offs and helicopter landings and take-offs had the greatest sound impact. Setting 2 was found to have the greatest impact from watercraft and people. Settings 3, 4 and 5 received similar levels of impact from both these variables.

Although a significant difference was found between the frequencies of aircraft and the duration of aircraft induced sound levels between settings, the trend exhibited did not follow that expected by the definition of the ROS settings. No significant difference in aircraft induced sound impact was found between settings. Therefore no gradient of impact was exhibited for this variable. Consequently this study concludes that aircraft sound and activity are influencing the attributes of the ROS settings along Whitehaven Beach beyond the levels and gradient of impact expected for the types of settings. Thus, in relation to aircraft, the ROS spectrum along Whitehaven Beach does not appear to be functioning as it should. It is speculated that a more detailed study may confirm this.

The results of this trial aircraft study will be compared with the results of the values, use and amenity study being conducted by Ormsby and Shafer. The results from both studies will provide the Great Barrier Reef Marine Park Authority with information to allow a more detailed evaluation of aircraft and other activities at Whitehaven Bay. The methods developed and trialled by Mary Hamilton at Whitehaven could also have application for other locations in the Marine Park.

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