NEWSLETTER OF THE RESEARCH AND MONITORING SECTION

REEF RESEARCH

Great Barrier Reef Marine Park Authority

VOLUME 3 – No. 3 SEPTEMBER 1993

EDITORIAL

Well, now we are two years old and it has been another successful year here at Reef Research. More information is flowing in from different sources and the newsletter has increased in size from 12 pages a year ago to 24 pages in recent issues. Hopefully, there has been no drop in quality as a result of more quantity. Circulation has also increased from about 1200 to 1500 copies over the past 12 months and input from external writers has given every issue more than enough material. Apologies to some contributors who have not seen their material printed quite as quickly as I (and probably they) would have liked.

This issue bids farewell to some longstanding Research and Monitoring staff. From the Torres Strait Baseline Study group, David Lawrence has gone to the Northern Territory to work on joint management with Aboriginal groups, and William Gladstone has changed hemisphere and will be working on planning and management of marine aspects of an island group in the Red Sea. While realising that they will be missed, both with regard to their input to achieving Authority aims and their contributions to Reef Research, I and the rest of the Authority wish them every success in their new endeavours.

In this newsletter an issue raised in 'Cots Comms' is of particular importance at the moment. The report that there is a reluctance on the part of some Marine Park operators to report crown-of-thorns starfish numbers because of excessive media coverage is of great concern. The Authority has a commitment to monitoring and researching the status of the starfish and spends considerable amounts of money (in conjunction with the Australian Institute of Marine Science) in the carrying out of broad-scale surveys. These surveys cannot examine the reef at the detail that operators and users are able to and it is highly desirable that all COTS that are observed are reported. While regular users are able to observe their own 'patch' and report its condition on much smaller spatial and temporal scales than our surveys, the overall spatial-scale, when large numbers of operators are taken into account, is very significant. The object of the monitoring is to create a large picture of starfish occurrence over time so it is equally important that 'nil' sightings are also reported. The short term inconvenience of a less than accurate press is, in my view, not to be compared with the benefits of the best monitoring program that we can cooperatively achieve.

Ed.

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

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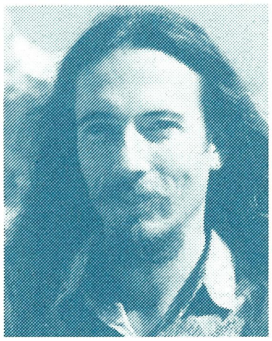
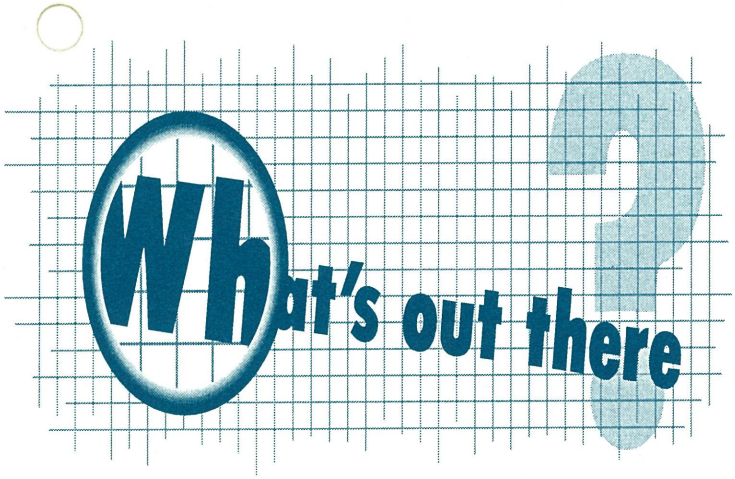


Rob McGill

Rob has been with Research and Monitoring in GBRMPA since January 1992. During this time he has worked within the Water Quality Program, assisting with the management of research projects and long-term water quality monitoring. He has also assisted in the development and installation of infrastructure associated with the ENCORE Project on One Tree Island. Prior to joining the Authority, Rob was involved with quality assurance in the food and beverage industry, and with environmental pesticide residue analysis. His academic background includes a BA from the University of New England, and a BSc from James Cook University. He is now studying towards a Post-Graduate Diploma in Science, with emphasis on environmental management, environmental law and geographic information systems.

Christine Dalliston

Christine has been at the Authority since August 1985. She has been an assistant project officer in the Research and Monitoring Section except for a year as the staff clerk in the Administration Section. Her work includes keeping track of the expenditure and resulting reports of the 750 or so research projects organised by the Authority since its inception in 1976 and especially the student grants funded through the Augmentative Research Grant Scheme. Christine is involved with copy editing and proof reading many of the publications produced by the Authority that range from single sheet information bulletins to workshop proceedings. The Section has many work experience students each year and Christine's teaching background has led to a keen involvement with this program. Her interest and previous work experience with field botany has been put to use many times when queries have arisen regarding mangrove ecosystems.



THE HERON ISLAND MONITORING PROGRAM:

A SYNOPSIS

R. Berkelmans

Introduction

Between September and November 1987 the existing harbour at Heron Island was re-dredged and enlarged. Public concern was expressed about the quantity of fine material which emanated from the dredging operation and from the settlement pond (spoil dump) where the dredge spoil was pumped. A multidisciplinary environmental monitoring program was subsequently initiated to investigate the status of the biological communities and aspects of the sediment regime and dredge spoil in the area. The primary aim of the monitoring program was to commence a long-term data collection program which would serve as a benchmark against which future changes could be assessed. Nevertheless, despite the absence of baseline data, impacts which may have been dredging related were inferred where appropriate.

The monitoring program covered the investigation of sediment deposition on the reef flat, the distribution and dynamics of reef flat sediment, the nature and quantity of the spoil material deposited on the beach and conditions affecting its erosion, the coral communities of the reef flat, the biological communities of the beachrock on the southern side of the cay and the population dynamics of one species of shell, the volute *Cymbiolacca pulchra*.

The monitoring program is currently under review in the lead up to further harbour works proposed by P&O. The Authority is currently assessing an application to reconstruct the bund wall on either side of the harbour to restore, as far as practical, the natural hydrodynamics of the Heron Island reef flat and lagoon and halt further unnatural erosion of the cay.

A brief summary of the main results of each component of the monitoring program follows.

Sediment Trap Study -

Dr Ian Lawn and Ms Miriam Prekker

Sediment transport near Heron Island was studied by measuring sediment deposition on the reef flat at 3 transects (stations A1 - C3) perpendicular to the shoreline on the western side of the harbour, 1 transect (stations D1 - D3) on the eastern side of the harbour and at a single station (E1) on the northern side of the cay (see figure 1). Sediment traps were deployed on the western side of the harbour in October 1987 (immediately after dredging) and on the eastern side and north of the cay in June-December 1988. Sediment traps were emptied every two months and analysed. Sampling continued until December 1990.

The results indicated that the highest rates of sedimentation occurred along the transect adjacent to the harbour (A1 - A3). The winter period from April to October clearly exhibited heavier sedimentation than the summer period. In addition, the authors suggested that under stormy conditions, the prevailing currents carry sediment out of the harbour and along the Wistari Channel and then up onto the reef flat. Deposition takes place when topographical and/or tidal conditions cause the water movement to slow down (e.g. when eddies form) and lose its sediment load. The results therefore indicate that the harbour is influencing sediment movement patterns.

Coralations **Bi Partisan Planning** **Pongase**

In a Preservation Zone somewhere in the Marine Park	Some months earlier	Back in the water
		

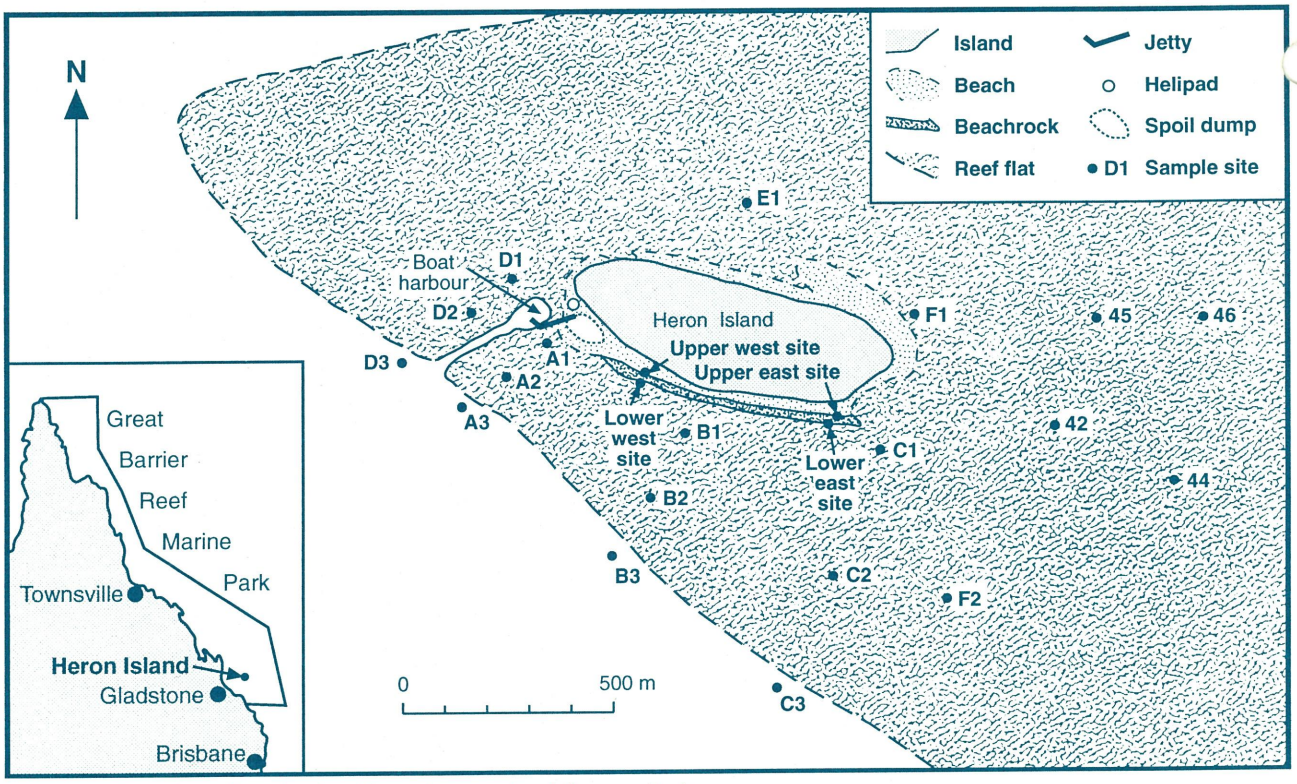


Figure 1. Location of study sites for various parts of the monitoring program

The Effects of Sediments on the Beachrock Communities -

Dr Ian Lawn and Ms Miriam Prekker

The effects of sediment on the beachrock on the southern side of the cay were investigated during the post-dredging period from March 1988 to March 1991. No data of sediment coverage and faunal and floral abundance were available immediately prior to dredging and hence quantitative before/after comparisons could not be made. Impacts of the 1972 dredging event on the beachrock community however were noted by Cannon (1979).

Four stations were set up on the beachrock (see figure 1); 1 each on the west and east side of the upper tidal reaches of the beachrock and the same on the lower beachrock. Sediment depth and faunal/floral cover were measured at 3-monthly intervals.

Most of the sediment is thought to have leached from the spoil dump (see Gourlay and Jell, 1992). The lower beachrock showed highest silt coverage which, for the western end, ranged from 25mm in March 1988 (5 months after dredging) and slowly decreased over time to 12mm in March 1989, 5mm in October 1989 and then levelling off to less than 3mm in December 1990 (see figure 2).

Silt depth in pockets during the earlier period ranged from 90-120mm. The eastern lower beachrock displayed a similar trend ranging from 10mm to less than 3mm over the same period. The upper beachrock had less silt (<5mm) for the whole period due to less exposure to sedimentation. Some silt remained present at all stations over the whole study period and has combined with blue-green algae to form a resistant layer which dried and cracked with exposure.

Algal cover at the lower west site was completely absent at the time of study and eventually became established and increased in cover as silt depth decreased (see figure 2). Algal cover stayed high at the other 3 sites and is attributed to some blue-green algae which was left to grow on top of the silt.

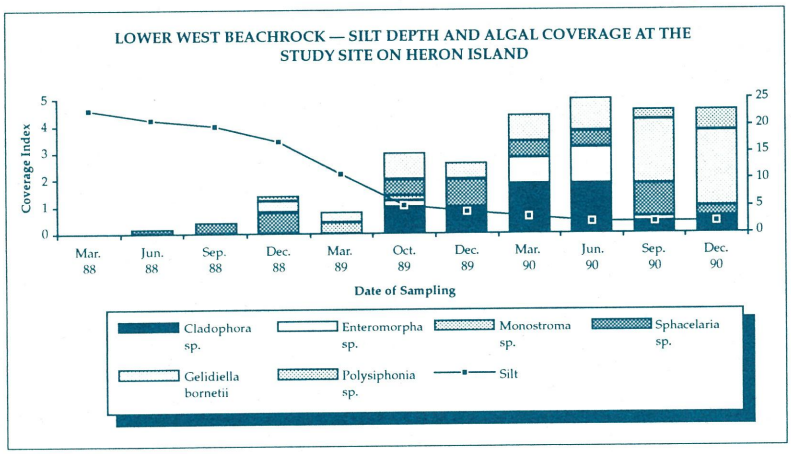


Figure 2. Change in silt depth and algal communities 1988-1990

Overall, the algal communities showed a significant alteration compared to earlier studies (e.g. Cribb, 1966) and algal zones previously noted had failed to re-establish themselves by the end of the study. Quantitative data on the algal communities from these early studies are not available.

The faunal communities showed similar trends with the disappearance of at least 2 mollusc species on the western side, followed by a partial re-establishment during the study period. The fauna in the lower west site failed to re-establish itself during the study period and the

area became algal dominant. On the eastern side, faunal communities remained relatively evenly abundant over time. Recovery is thought to be hampered by the lack of suitable hard substrate. Limited quantitative data from early studies are available on faunal abundance. These show that the 2 molluscan species had variable, but generally large abundances in the areas where they are now absent. Aggregations at low tide numbered from a few hundred to several thousand. The total number of species at the end of the study compares favourably with previous species lists, but species richness was generally lower in areas with thick silt deposits.

Heron Island Spoil Dump -

Drs Michael Gourlay and John Jell

The nature and distribution of the sediments on the reef flat after dredging and in the spoil dump were investigated in this study. In addition the quantity of material in the spoil dump and the sea, and weather conditions responsible for eroding and reshaping the spoil dump, were investigated over a 3-year period (May 1988 - June 1991).

Reef flat sediments

Good data sets were available for comparing the nature and distribution of reef flat sediments prior to dredging (e.g. Maxwell, Day and Fleming, 1961; Maxwell, Jell and McKellar, 1963, 1964). Sediment samples were collected at 50m intervals along 9 transects radiating out from the cay to the edge of the reef flat. Generally, the dredging operation contributed large quantities of fine material which was initially deposited south of the spoil dump and particularly along the outer edge of the reef. The dredged material did not appear to affect the area east of the research station at the south of the cay and east of the resort at the north of the cay.

In the 2 years following the dredging, much of the fine material was redistributed and removed from the reef flat by natural action. The distribution pattern of fine material is now slowly returning to former levels, although the spoil dump and the channel continue to affect the local sediment patterns.

Cyclone Fran (March 1992) was generally responsible for removing a large amount of silt from the reef flat and from the harbour channel itself (see figure 3). In this way the cyclone seems to have had a positive effect on the reef flat corals by reducing the amount of silt which would have otherwise contributed to sedimentation and stress on them. The silt eroded from the spoil dump during the cyclone also appears to have been carried off the reef flat and hence is unlikely to have caused significant adverse effects on the corals.

Spoil dump

The initial volume of the spoil dump in December 1987 was estimated as 14 860m^3. About 10% of this material is silt. Erosion of the spoil dump was initially rapid with 6% reduction in total volume within 5 months of dredging and then tapering off to

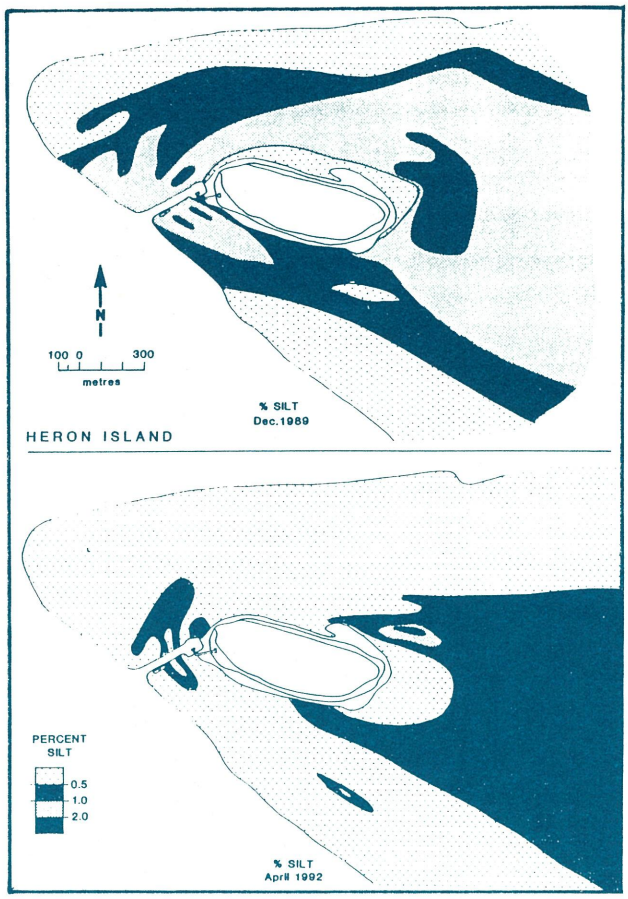


Figure 3. Change in sediment distribution between 1989 and 1992

a total of 11% over the following 3 years. During Cyclone Fran, another 4% of the spoil dump was lost and the shoreline was also substantially re-aligned. Silt is concentrated in lenses in the spoil dump which are generally more prevalent in the northern side, which is also the side most prone to erosion. The cyclone was also responsible for a substantial re-alignment of the beach profile including that of the spoil dump. The erosion scarp south of the jetty receded by 3.2m.

Wind erosion of the spoil dump as a result of Cyclone Fran was also responsible for removing much of the finer fractions leaving the top of the spoil dump very rubbly.

The environmental conditions causing silt plumes to be produced from the spoil dump are episodic and the incidence of plumes has decreased in frequency over time. At present, the formation of silt plumes does not occur at wind speeds of less than 15-20kn and at tide levels of less than 2.5m. However, the direction of the wind and the periodic exposure of new silt lenses in the spoil dump increase the variation in conditions under which silt plumes form.

Coral Communities - *Mr Dave Fisk*

Surveys of the coral communities were conducted in February 1989 and again in April 1990. No quantitative estimates of coral cover were available from the reef flat near the harbour prior to dredging and therefore no inferences could be made about the effect of the dredging on the reef flat corals. In this study, the percentage of coral cover was measured at 5 sites on the inner reef flat and 4 sites on the outer reef flat. The numbers of individual coral colonies were also monitored at the 5 inner reef sites, but not at the outer reef flat sites.

The first survey was designed to establish a baseline against which future changes in coral cover could be assessed. This survey established that coral cover on the inner reef flat, although patchy, is generally very low (average total cover 2.1%). On the outer reef flat stations however, coral cover was moderate (average total cover 20.4%). The dominant coral group was *Acropora* sp. (18.6% total cover). The highest coral cover on the outer reef flat occurred at site B2 (29.5% total cover), the lowest at site F2 (15.3% total cover). At all inner reef flat sites, the vast majority of corals were very small (< 20cm^2). There were very few corals larger than 100cm^2. It is unknown if these juvenile corals had settled after the dredging.

The second survey 14 months later established that there had been a significant decline in numbers of corals from 933 to 620 colonies/28m^2 of transects. This decline was most severe at the eastern and northern side of the cay (sites C1, E1,F1) . The decline was slightly less severe at the sites closest to the harbour (sites A1 and B1)(see figure 4).

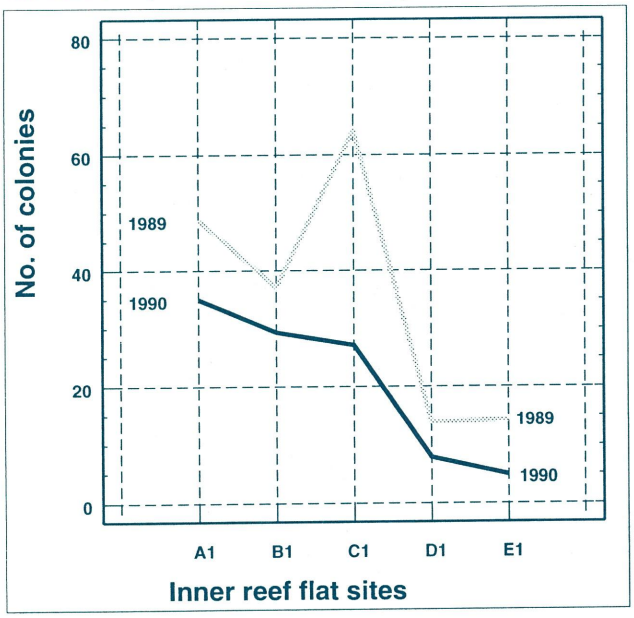


Figure 4. Change in number of coral colonies between 1989 and 1990

There was also a significant reduction in clams on the inner reef flat over this time. Of the 14 clams (9 *Tridacna maxima* and 5 *T. crocea*) found in the 1989 belt transects, only 1 *T. maxima* was alive in 1990. There had been no significant changes in another dominant filter feeder (the sponge *Jaspis* sp.). It difficult to interpret the results as being due to increased sediment levels over this period, without further information about the relative susceptibility of the clams and sponges to sediment increases, adequate control groups, sediment levels and other relevant parameters.

Whilst the percent coral cover decreased at the inner reef flat sites, the outer reef flat sites increased slightly in cover from 20.4% to 26.3%. However, this increase was not statistically significant (see figure 5). Interestingly, the greatest increase appears to have occurred at sites closest to the bund harbour (A2 and B2).

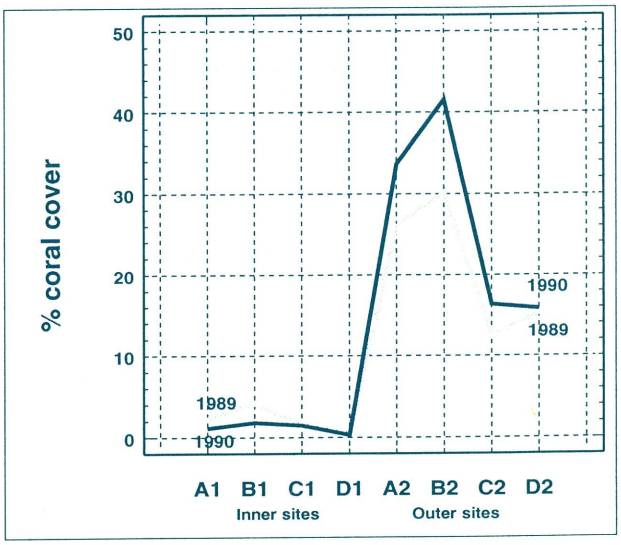


Figure 5. Change in coral cover between 1989 and 1990

The dominant group of corals in this area are staghorn *Acropora* growing in shallow water which limits their vertical growth. One possible explanation for the apparent increase in coral cover is that the new bund wall which was established after the 1987 dredging event, slowed the outflow of water and effectively raised the water level in the lagoon near A2 and B2, thereby allowing the corals to grow up and spread further out.

Volute Study -

Drs Carla Catterall, Ian Poiner and John Kerr

The volute, *Cymbiolacca pulcra*, is a moderately common shell on the Heron Island reef flat. Its abundance and distribution had been monitored annually since 1984 by the above researchers. It proved to be a good indicator of change in sediment conditions because of its unusual reproductive strategy (it does not have planktonic larvae). In addition, these molluscs are predators of small bivalves and gastropods and their populations appear to be sensitive to generalised perturbations which affect their prey species. A report was commissioned to compare population sizes and size distribution of the volutes before (1984 - 1986), during (1987) and after the dredging event (1988 - 1989).

Eight study sites located to the north, south-east and far east of the cay were used in this study. Each study site contained 12 transects which were 5m long and 1m wide. Both surface and buried shells were counted.

Four of the eight sites had naturally low densities of volutes due to lower cover of sand and higher cover of hard substrate and macro algae. The other 4 sites (42, 44, 45 and 46) (see figure 1)naturally had high numbers of volutes and for the purposes of this study, analyses were restricted to these sites.

The results showed that average abundances, while variable prior to dredging, decreased during dredging and fell to zero in 1988 (see figure 6). In 1989, total population numbers had largely recovered, but were made up mainly of small juveniles. Large adults were still rare or absent in 1989.

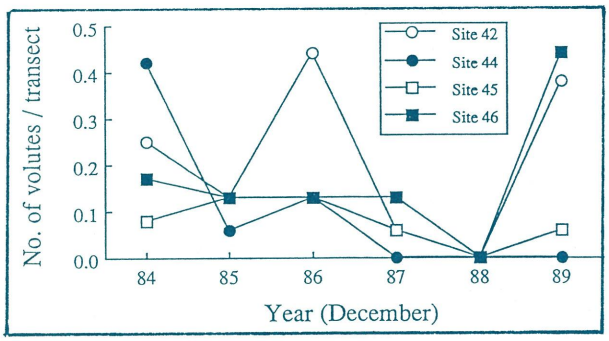


Figure 6. Change in volute density from 1984 to 1989

Other environmental changes were also measured including changes in macro algae, sand and rubble. There were significant changes in all these categories. *Caulerpa* sp., the dominant large alga for example, declined dramatically in 1987 during the dredging event, but had recovered by 1988.

The decline in volute populations and the algal biomass, and the pattern of recovery is highly coincidental with the dredging operation. The authors suggest that unfavourable environmental conditions caused failure of recruitment in the summer of 1987 and that larger adults either emigrated or died during this time resulting in local extinction. Recovery was probably by immigration of a few adults which managed to successfully reproduce in the summer of 1988/1989, resulting in relatively high numbers of juveniles in late 1989.

Conclusion

Even though the monitoring studies were not specifically designed to infer dredging impacts (there were no baseline data for most of the studies), most of the studies showed that the size and pattern of the distribution of the biological communities and their post-dredging changes are consistent with a substantial disturbance at the time of the dredging event.

The nature and distribution of sediment on the reef flat has undergone substantial changes. As at April 1992, most of the fine silt has been removed from the reef flat. Whilst cyclones can cause massive erosion of the coral cay, they appear to act as a cleansing agent by removing accumulated silt which could otherwise affect the health of the biological communities.

Erosion of the spoil dump appears to have slowed down and more severe weather conditions are now required for silt plumes to be generated from the spoil dump.

The biological communities of the beachrock have been increasing in abundance and diversity in all but 1 site in the 4 years that they were monitored after dredging. The lower west site was still covered in silt in December 1990 which appears to be preventing plants and animals from settling.

The abundance of corals on the inner reef flat declined dramatically between 1989 and 1990 however, coral cover on the outer reef flat increased slightly over the same period.

The volute population, *Cymbiolacca pulchra*, crashed after the dredging event, but appeared to be recovering by 1989.

The information from these monitoring studies contribute to a long-term data set which will help us understand natural variability and form a baseline against which future changes can be compared.

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THE RAINE ISLAND CORPORATION

Kira Jackson

The Raine Island Corporation administers a trust fund which was set up to promote the protection of the natural and cultural values of Raine Island, Moulter (formerly Pandora) Cay, Maclennan Cay and the surrounding seas. The islands are located 250 kilometres south-east of Cape York on the outer Great Barrier Reef.

The Corporation is a non-profit, self-funded organisation formed in June 1981 by an Act of the Queensland Parliament. The Corporation administers funds generated from an original bequest of around $1 million. It funds research in the areas of wildlife, geology and relics, encourages publication of findings and undertakes restoration of historic artifacts and buildings. This year the Corporation established the Brian R. King Research Award for seabird research in memory of Mr Brian King, who spent many years studying seabirds on Raine Island and other areas on the Great Barrier Reef. Mrs Helen King donated the initial funds to the award.

Raine Island is an outstanding nature reference site on a world scale, particularly for turtle and bird nesting. The turtle breeding populations on Raine Island and Moulter and Maclennan Cays dominate the Coral and Arafura Seas and most funding supports turtle research. The islands are also important seabird nesting areas. Red-tailed tropicbirds and herald petrels nest on Raine Island and red-footed and brown boobies, least frigatebirds and several species of tern also congregate to breed. Rufous night-herons feed their young on turtle hatchlings from January to May.

Raine Island has an interesting history. In 1844 a beacon was built from rock mined on the island to guide ships through the Raine Island Entrance. 1994 will mark its 150th anniversary and it stands as the oldest European-built stone building in tropical Australia (see Reef Research 2(4) for more detail).

Raine Island is a protected area for nature. The Corporation administers access approvals to Raine Island from the Queensland Department of Environment and Heritage and the Queensland Department of Family Services and Aboriginal and Islander Affairs. The Raine Island Corporation is trustee of, and oversees permits to visit, Moulter and Maclennan Cays. They are reserves for scientific purposes. Permission to visit any of these islands is generally restricted to researchers conducting studies with minimal disturbance to wildlife. The Great Barrier Reef Marine Park Authority and the Queensland Department of Environment and Heritage are responsible for the waters surrounding the islands.

In recent years the Corporation reviewed the current knowledge of the islands and considered future directions. A workshop was held in Townsville in November 1991. Copies of the proceedings from the workshop, 'Raine Island and Environs, Great Barrier Reef: Quest to Preserve a Fragile Outpost of Nature', covering topics on the history, physical environment, flora and fauna and the human impact of the Raine Island area, are available from the Corporation.

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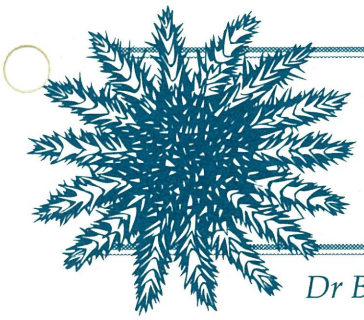

COTS COMMS

Dr Brian Lassig

DAMNED IF YOU DO ...

In the last issue of COTS COMMS I discussed the possibility of future crown-of-thorns starfish outbreaks on the GBR (COTS in the News). Unfortunately some of the media took the opportunity to beat up the story and a few newspaper headlines (incorrectly) suggested that another outbreak was now underway. Although the content of most of the articles was reasonably accurate, many readers absorb headlines but not the detailed text. This naturally concerned some of the tourist operators in the area, particularly those who provided the information in the first place. It also concerned me. But what worries me most is the possibility of Reef users not reporting starfish numbers for fear of potentially damaging headlines. Remember the movie Jaws? To set the record straight ...

I wrote the 'COTS in the News' article in April but the newsletter was printed and distributed in June. Between the time of writing the article and publication of Reef Research I received records of COTS sightings on three reefs off Cairns from a tourist operator, an Authority staff member and a recreational diver. Although the numbers of COTS seen were small (5-12) these were the first records of COTS in that area for some years. The fact that people bothered to send in the completed sighting forms also pointed to an emerging trend. Further conversations indicate that a few COTS are being seen on a larger number of reefs in the Cairns area for the first time in years.

Subsequent surveys of Michaelmas Cay off Cairns by QDEH and the AIMS Monitoring Team indicated that there is indeed a build up of starfish numbers in the area, although the density is far from being classified as an outbreak and damage is very localised. The Team recorded most of the 13 starfish seen on two bommies in 10m+ water depth. The range of sizes seen (15-40cm) suggests a gradual build up to the present population level rather than a single cohort derived from one successful settlement period.

Given the arguments for future COTS outbreaks that I presented in the last issue of COTS COMMS - the 17-year interval between the previous two outbreaks on the GBR, coral cover getting to the point of being able to support high densities of COTS and possible connections with El Nino events - the reporting of increased numbers of COTS gains added significance.

While there's nowhere near the numbers of starfish to constitute an outbreak in the immediate future, we're concerned that this apparent increase may lead to outbreaks later this decade. If the starfish being observed aggregate in the summer spawning season and if conditions are favourable for high survival of larvae and recruitment, outbreaks of adults may be observed in 1995/96 when the progeny of the currently observed starfish generation reach the observable size of 20-30cm. Rough calculations by Dr Russ Babcock indicated that outbreaks may be initiated from the successful spawning of just a few hundred starfish if conditions were right. The 'ifs' are important. They may not eventuate and we may not witness another outbreak on the GBR in our lifetimes, but on the scant information available it would be irresponsible to ignore the signs.

So what do we do? First and foremost, continued monitoring of starfish numbers and coral damage is critical. This doesn't mean just the formalised surveys by AIMS, but perhaps more critically, reports of sightings of starfish by all Reef users. Reports of no starfish are equally important. While the AIMS surveys help with the big picture they are not designed to provide the necessary level of fine detail on all GBR reefs. Regular and casual Reef users are in a prime position to see and report on fine scale changes (including gradual increases of COTS numbers) on a huge number of reefs.

Let me know if you need crown-of-thorns

starfish sighting (REEFWATCH) forms to help record your observations. The questionnaire folds into a postage paid, self-addressed envelope.

If you have been using the REEFWATCH forms, I'm always interested in feedback on how easy they are to use and any particular difficulties you've experienced when filling them out. We plan to re-vamp the form in the near future based on comments we've received to date.

CURRENT COTS

While this section is generally reserved for conveying the results of the latest AIMS survey results I need to eat some of my words from the last edition of COTS COMMS. I noted that COTS outbreaks seemed to be 'joining the dinosaurs, full-strength beer, high quality bleached paper and the GST.' Thanks to reports from Mr Dale Westwood of 'Banjoora', Kevin Sangster and Jim Cruise (QDEH) in Airlie Beach I must qualify that statement. According to Dale, Kevin and Jim, Bait Reef in the Whitsunday area continues to support reasonable numbers of starfish (around 20 per dive at some sites). The starfish seem to be mostly small adults and are being seen in 10-20m water depth as they come up from deeper water. Similar numbers of COTS have been appearing periodically at the same sites on Bait Reef for the past 3 years but control action by local operators and QDEH seems to be stemming the tide.

The appearance of the starfish coming up from deeper water is consistent with the 'deep water recruitment hypothesis'. This hypothesis suggests the reason we don't see many small juvenile starfish on the GBR is that larval starfish settle in deep water (beyond our normal diving depths) where their preferred food of coralline algae is most abundant. As they grow the starfish move up the reef in search of coral prey.

The AIMS Monitoring Team manta towed 13 reefs in the Cooktown/Lizard Island Sector and 5 reefs in the Cairns Sector in April and May. They surveyed a further 6 reefs in the Cairns Sector and 2 reefs in the Innisfail Sector in June. Eight COTS were recorded on the surveyed reefs in the Cooktown/Lizard Island Sector, 6 of them on MacGillivray Reef. A total of 5 COTS were observed on 4 of the surveyed reefs in the Cairns Sector. No COTS had previously been recorded on three of these reefs (Mackay, Undine (A) and St Crispin). Live coral cover for 8 of the 11 surveyed reefs in the Cairns Sector were in the 2 or 3 category (11-50%). Two COTS were observed at Flora Reef in the Innisfail Sector where none had been observed during previous manta tow surveys.

MAP OF GBR SHOWING AIMS SURVEY SECTORS, INDICATING BAIT REEF

1993/94 PROGRAM

In May our advisory committee on COTS issues, the Crown-of-thorns Starfish Research Committee (COTSREC), met to discuss and recommend the research program for 1993/94. Recommendations of the Committee were endorsed by the Marine Park Authority in June.

New and continued research projects and their nominal funding (depending on the outcome of the Federal budget in August) are tabled over.

PROJECT	FUNDING
Broadscale surveys (AIMS, through the Coral Reef CRC)	$286 553
Trophodynamic implications of outbreaks (Klumpp & Hart - AIMS)	$20 200
Larval and juvenile COTS nutrition (Okaji - AIMS)	$32 841
Larval and juvenile COTS rearing (AIMS)	$61 833
Backup rearing facilities (GBRMPA Aquarium)	$45 000
Secondary backup juvenile rearing facilities (JCU)	$5 000
Local control techniques improvements (GBRMPA)	$10 000
Identification of COTS larvae using monoclonal antibodies (Roper - JCU)	$17 000
Effects of COTS outbreaks on bioerosion (Choat & Musso - JCU)	$6 850
Monitoring of COTS recruitment on Suva Reef, Fiji (Zann - GBRMPA)	$1 000
Fish predation on COTS (Sweatman - JCU)	$11 969
Survey of Giant Tritons (Poulsen)	$2 500
Hydrodynamic model field testing (Black - VIMS)	$20 000
Hydrodynamic model testing using *Linckia* and COTS genetics (Benzie - AIMS)	$30 000
Hydrodynamic model standards (Wilkinson)	$15 000
Green Island Eastern shoals survey (Pearson - QDPI)	$2 000
Water quality monitoring in the Cairns Region (Ayukai - AIMS)	$4 548

These projects add to another nine projects funded in previous years that are still not complete - making a total of 26 projects underway in the 1993/94 financial year. COTS research lives!

Other recommendations of the COTSREC for the 1993/94 financial year included:

increased efforts in the education and information activities to be carried out by the Authority, including further development of the Reef user survey scheme for the early detection of outbreaks;

a workshop to focus on the application of population dynamics modelling to help resolve issues in relation to the ecological interactions between COTS, corals, fishes and management;

the preparation and publication of a manual for local scale COTS controls; and

the preparation of a joint AIMS - GBRMPA synthesis of the research funded through the COTSREC Program between 1989 and 1993.

LATEST FINAL REPORTS

Broadscale surveys of crown-of-thorns starfish along the Great Barrier Reef

by PJ Moran, G De'ath, VJ Baker, DK Bass, CA Christie, IR Miller and AA Thompson

AIMS has just released this latest 10 year synthesis of their COTS surveys. Copies of the report are available from the AIMS Production Editor, Information Services Section. The Executive Summary of the report is reproduced here:

Between October 1982 and June 1992 a total of 412 reefs were surveyed throughout the Great Barrier Reef region using the manta tow technique. In all, this has involved 1,127 individual surveys. A total of 109 reefs were surveyed during 1991/92, 34 of these for the first time. The main results of the broadscale surveys conducted over the last 10 years can be summarised as follows:

1. About 28% (116) of all reefs surveyed have

been affected by outbreaks of starfish since 1980. An estimate for the percentage of reefs, within the whole GBR, which have been affected by outbreaks during the last 12 years is 17±4%. This figure is similar to that derived during the previous year.

2. The estimated percentage of reefs with active outbreaks rose from 9.7% in 1985/86 to 15.6% in 1988/89. By the end of 1991/92 the figure had declined to 8.5%. It differs from that observed (i.e. 9%) due to the stratified nature of the sampling scheme.

3. Despite a slight increase (ca. 3.3%) in the estimated proportion of surveyed reefs with outbreaks over the last year the data show continued evidence of a slow decline in the activity of the starfish within the GBR. Over the last 3 years the estimated proportion of reefs with outbreaking populations of starfish has been between 5% and 9%.

4. Changes in the estimated percentage of reefs (surveyed) affected by outbreaks over the last 7 years show no consistent trend with between 27% and 42% of reefs either having active outbreaks or recovering from recent outbreaks.

5. A total of 10 reefs were recorded to have outbreaks during the 1991/92 fiscal period. Almost half of these (4 reefs) were found on reefs in the Swain sector.

6. There is some evidence to suggest that the GBR system is beginning to recover from outbreaks of the starfish. Estimated live coral cover has increased slightly (ca. 4%) over the last year to about 27%. On the other hand, estimated dead coral cover has continued to decline and is now at about 3%.

The role of predation in factors influencing the survival of small juvenile *Acanthaster planci* cultured in the laboratory

by John K. Keesing

This tome presents the methods, results and discussion of research undertaken between November 1989 and September 1992 (when John left to join the South Australian Research and Development Institute). It covers aspects of the early life history of *Acanthaster planci* including larval rearing, laboratory and field studies on mortality rates of juvenile *A. planci* and the factors affecting mortality, habitat studies and settlement patterns of *A. planci* and other echinoderms in the field.

Techniques developed to rear large numbers of larvae and juvenile COTS for ecological experiments that are described include spawning induction, fertilisation, larval rearing, feeding, settlement and growout. Photographs of the different larval stages are provided to aid identification.

The report also contains:

- preliminary results of a survey of the meiofauna inhabiting the extensive areas of coral rubble around reefs (including likely juvenile COTS predators);
- results of a number of laboratory experiments including determination of the suitability of techniques for field study of mortality rates of juvenile COTS, measurement of growth rates and predator identification experiments;
- measured rates of mortality of small juvenile COTS in the field together with a description of the factors that cause variability in mortality rates; and
- descriptions of settlement collectors that were designed to measure settlement intensity of COTS and other echinoderms together with results of a field trial of the collectors.

The base report is 133 pages long but it also contains a number of publications and manuscripts amassing a total weight of about 1.3kg. Please contact me if you *need* a copy of the report, but don't expect it to be faxed!

3RD EDITION (effective to September 1994)

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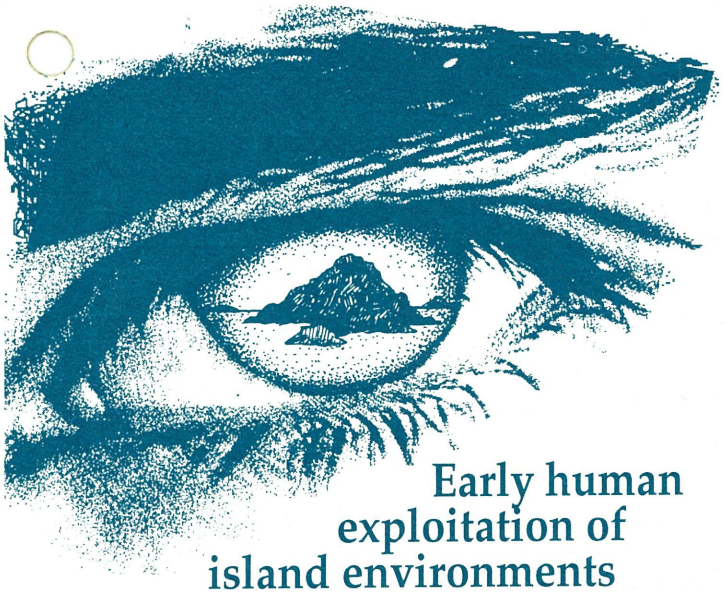

Early human exploitation of island environments within the Great Barrier Reef Marine Park

Bryce Barker

Archaeological evidence from the coast of Queensland has tended to show that Aboriginal exploitation of coastal and island environments only occurred in the late Holocene period with an overwhelming majority of sites dating from the last 3000 years (Beaton 1985, Rowland 1983, Hall 1982). Results from the Whitsunday Islands however provide evidence of much earlier use of marine environments. Nara Inlet, a rockshelter site on Hook Island (NI1), and a rockshelter site on Border Island (BI1) have radiocarbon dates of initial occupation at 8577 (±80) BP and 6400 (±60) BP respectively. These two sites provide the earliest evidence of human coastal occupation in Queensland (see figure 1).

The dominant paradigm within Australia prehistory has been that marine resources were only established some thousand years after the stabilisation of sea levels at approximately 6000 BP and it was only at around 3000 BP that marine environments became viable for human exploitation. It has been argued elsewhere, however, (Barker 1989, 1991) that Aboriginal people have always used marine environments. As sea levels rose following the last post glacial period they simply followed the coastline utilising the quickly established marine ecosystems (there is a large body of literature on the resilience and adaptability of marine ecosystems, especially the establishment of macrophytic communities; see in particular Woodroffe, C. 1988). The evidence for this is found in Nara Inlet 1, where, despite a period of extreme environmental change between the time of initial occupation of the area at 8577 BP and 6000 BP when present sea levels were attained and when some of the mainland coast became the islands we know today, there is little change in the range of marine resources exploited (see figure 2). Environmentally sensitive biota such as mud crab (*Scylla serrata*) are present throughout the time of human occupation of this site attesting to the continuous presence of macrophytic communities in the region despite radical environmental change including changes in sea levels, water temperature and salinity.

The archaeological evidence shows that the Ngaro people of the Whitsunday Islands were maritime fisher-gatherers with terrestrial resources, with the notable exception of plant foods, accounting for very little of the subsistence base. Although a range of mainly gastropod shellfish were exploited the overwhelming emphasis is on fish (species present are tuskfish (*Choerodon* sp.), sweetlip (*Lethrinus* sp.), red emperor (*Lutjanus* sp.), and bream (*Acanthopagrus* sp.). There is evidence that the Ngaro became even more specialised marine hunter gatherers after 3000 BP when large marine mammals such as small toothed whales (Cetacea), dugong (*Dugong dugon*) and reptiles such as green turtle (*Chelonia mydas*) were exploited with the help of relatively sophisticated three piece bark canoes that were capable of long voyages between islands.

Human exploitation and management of the Whitsunday region has been constant since initial human occupation of the region. Historical accounts of large scale burning of the islands and adjacent mainland as well as archaeological evidence of firing regimes (Barker and David in prep.) show that humans have a long interactive history with the environment in the region. Intensive burning of the region could have promoted erosion and soil loss thus influencing sedimentation regimes effecting reef systems and promoting the establishment of macrophytic communities. The relatively small population (estimated to have been approximately 200 people) meant that resource levels were maintained and detrimental impacts to the environment were kept to a minimum. There is no evidence of over exploitation of resources which would have resulted in a change in size

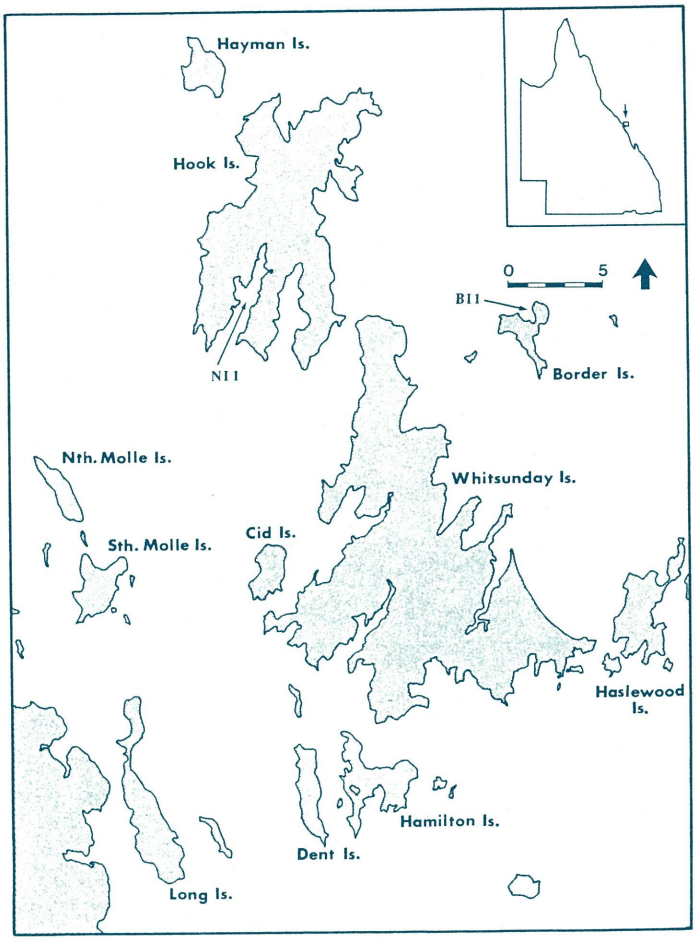

Figure 1

of shellfish, crustacean, or fish biota through time. There is evidence, however, that prehistoric shellfish and crustacean species were in the main larger that those observed in the region today.

Research is continuing into the long-term effects of humans on marine environments in the region and it is hoped that this may provide useful information for contemporary human use of a fragile ecosystem.

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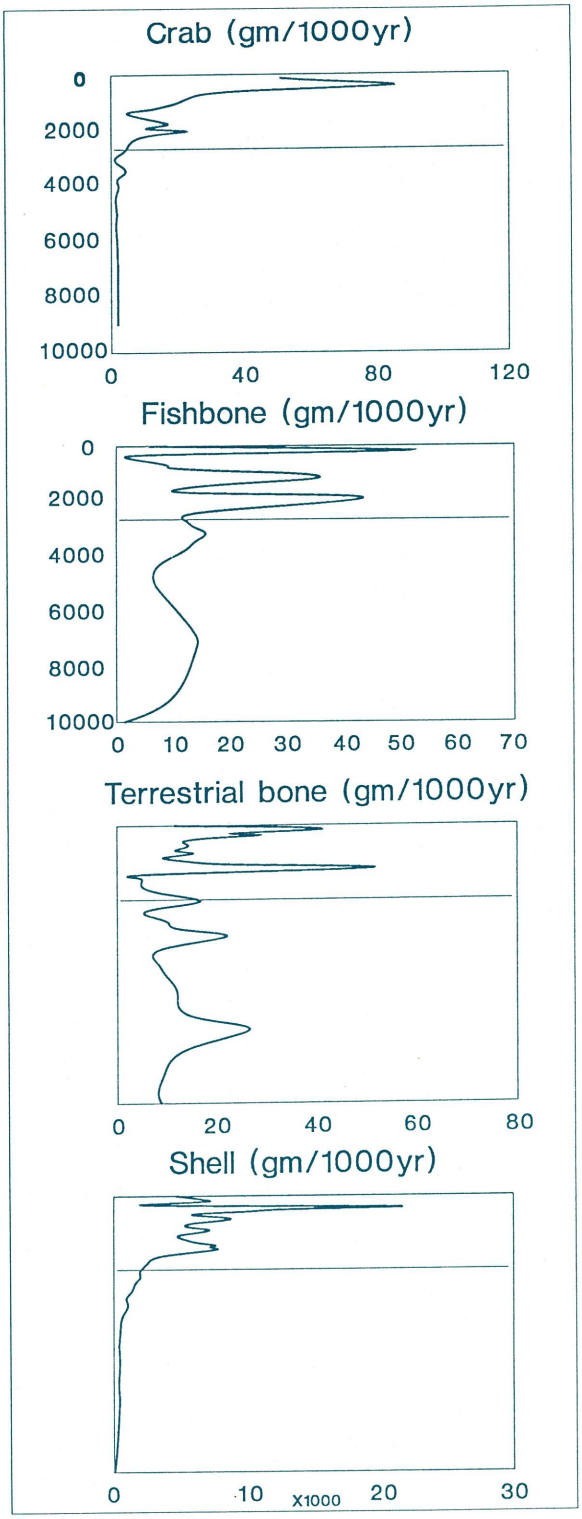

Figure 2

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Bryce is a PhD student at the Department of Anthropology and Sociology University of Queensland

The Australian National Plan to Combat Pollution of the Sea by Oil (the National Plan) has recently been the subject of a major review, and a summary of the results of this review is presented in this appearance of 'Slick Talk'. In addition we have contributions from Paul Nelson of the Australian Maritime Safety Authority (AMSA) and Lindsey West of GBRMPA. Their respective reports on the new AMSA 'OILSPILL' database and GBRMPA's review of dispersant toxicity testing exemplify the ongoing progress that is being made across the board in improving oil spill response arrangements in Australia.

RECOMMENDATIONS OF NATIONAL PLAN REVIEW ENDORSED BY MINISTERS

After the 'Oceanic Grandeur' oil spill of 1400 to 4000 tonnes in Torres Strait in 1970 the Australian Government decided to develop and implement a 'National Plan to Combat Pollution of the Sea by Oil' (the National Plan) to ensure a coordinated, effective response could be mounted to protect the environment from ship-sourced oil spills. The National Plan came into operation in 1973 and in the 20 years of its existence has proven effective in providing a framework for the response to spills around the country.

However since 1973 there have been changes in shipping patterns and intensity and an expansion of offshore oil activity, and advances in the understanding of the behaviour and effects of oil spills and in spill response methodologies. These factors, combined with a number of major oil spills in recent years such as the 'Exxon Valdez' in Alaska and the 'Kirki' off Western Australia, prompted Ministers of the Australian Transport Advisory Council (ATAC) to initiate a review of the National Plan in 1992.

The review was completed in March 1993 and its recommendations endorsed for implementation by ATAC in June 1993. In summary the results of the review are as follows:

- Prevention is and will remain the first line of defence against oil spills. However there will always be a need for a response capability and the National Plan focuses strictly on oil spill response.
- It must be recognised that in the event of a major oil spill, damage to the environment and economic loss are likely regardless of the extent of preparedness and equipment. However, proper planning and a high level of preparedness can certainly increase the chances of minimising damage.
- There will be greater integration between government and industry under the National Plan, with standing agreements being entered into between government and the oil industry regarding integration, including use of equipment from the industry owned and operated Australian Marine Oil Spill Centre in Geelong.
- The National Plan will be expanded to respond to marine oil spills from *all* sources, not just shipping.
- For the immediate future the National Plan will continue to focus on response to spills of oil only, with a review to be undertaken of the requirements for response to chemical spills.

- AMSA will retain responsibility for managing the National Plan, with State authorities being the 'lead agency' for responding to oil spills within and near State waters, supported by AMSA.
- The Queensland Department of Transport will take over from AMSA as the lead agency for responding to oil spills in the Great Barrier Reef region, with support from AMSA.
- A coordinated, integrated national training program will be developed by the Commonwealth, States and industry.
- Acquisition of an extra $5.6 million worth of capital equipment is to commence immediately, with a significant proportion of this to be stationed in high risk/particularly sensitive areas including the Great Barrier Reef region.
- Arrangements will be made to ensure availability of suitable aircraft around Australia for dispersant spraying.
- The National Plan will continue to be wholly funded by a levy on shipping.
- Specific legislation will be developed to support recovery of clean-up costs from the polluter.
- A National Scientific Support Coordinators Advisory Group will be formed to allow representation of scientific and environmental issues to the National Plan.

Implementation of these measures is now underway. While representing a major step forward in improving our ability to protect the environment from marine oil spills, there are still are number of significant areas for improvement that have not been adequately addressed by the review. These include development of a National oil spill research and development program to investigate and develop new, alternative and more effective response methodologies and the development of an effective regime for the recovery of costs of oiled wildlife operations, post-spill damage assessment and compensation for ecological damage.

NEW 'OILSPILL' DATABASE

Assessment of the risk of oil spills was a significant issue during the review of the National Plan, particularly when assessing equipment requirements for different areas. The major difficulty encountered in assessing risk was the lack of a centralised, coordinated, National database on oil spills reported in Australia. This has meant that reliance has had to be placed on overseas data in risk assessment methodology.

To address this problem and to provide data to support management of oil spills generally, the Marine Environment Protection unit of AMSA has developed a central, National database known as 'OILSPILL'. The program has been written using SUPERBASE and operates in the Windows environment.

Data on oil spills are being entered from the following sources:

- reports received through the AMSA Maritime Rescue Coordination Centre (MRCC) in Canberra, which includes reports from aircraft (Coastwatch, RAAF and civil) and vessels at sea,
- records of National Plan expenditure in responding to reported spills,
- monthly incident reports submitted by relevant State authorities,
- other sources such as the Department of Primary Industries and Energy (in relation to offshore oil activities) and industry.

The database includes details such as date, time and location of spill, identity of the reporter, source of the spill, type and quantity of oil, cost of clean-up (if any), details on any legal action and general comments. The initial aim is to complete entry of data from 1987, with nearly 1200 records having already been entered for the period 1989 to 1992. The database is of course only as good as the data which has been entered. AMSA is looking to improve

reporting procedures which in certain areas have been somewhat irregular to date.

And the early results? There were 183 reported oil spills in Australian waters in 1989, 166 in 1990, 198 in 1991 and 202 in 1992. Fishing vessels are responsible for around twice as many oil spills as tankers (168 to 78), and 49% of reported spills are from unidentified sources.

The establishment of the OILSPILL database by AMSA is a significant step forward in the management of oil spills on a national basis, providing quantitative data that will allow management action to be formulated in an informed environment. For example particular 'problem' areas and sources of spills can be identified and targeted for education, surveillance, enforcement or improved prevention and response measures.

For further information on the OILSPILL database and access to data contact:

Paul Nelson
Marine Environment Protection
Australian Maritime Safety Authority
Ph (062) 795 007
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OIL SPILL DISPERSANTS - DEVELOPMENT OF TOXICITY TESTING PROCEDURES FOR THE GREAT BARRIER REEF

There has been much debate about the use of chemical dispersants on oil spills in the marine environment, largely as a result of their diverse nature and, more specifically, their varying degrees of toxicity to marine organisms. Dispersant toxicity tests have been developed and expanded greatly over the past 15 years, particularly amongst first-world nations that have the capacity to fund such testing. Because most first-world nations are located in the temperate zone, the majority of dispersant toxicity standards are immediately applicable to temperate marine waters. This has important implications for the management of tropical ecosystems, where coral reefs, mangroves and seagrasses are vulnerable to oil pollution due to their coastal location. Despite this problem being identified, there is still limited information available to assess the toxicity of dispersants to tropical ecosystems and critical tropical organisms, should their use be necessary in the event of an oil spill.

At present, the Australian dispersant toxicity testing guidelines administered by AMSA do not provide an adequate means of assessing the toxicity of dispersants currently stockpiled for use in the Great Barrier Reef (GBR) region. The guidelines do not require the oil/dispersant mixture to be tested, representative organisms from the GBR region, e.g. coral, mangrove and seagrass species, are not included as test species and there is no requirement for replication, thereby limiting the statistical rigour of the results. In addition, the procedure gives no indication of sub-lethal toxicity effects or the effect on the ecosystem as a whole.

In order to address these issues, a full literature review of dispersant toxicity research and testing procedures in tropical areas is now under-way at GBRMPA. This review will contribute to the understanding of the effects of oil dispersants on tropical marine organisms and the development of a comprehensive dispersant toxicity testing procedure for the GBR. The results of this review and a draft of proposed new testing procedures for tropical environments will be sent to State and Commonwealth government agencies, industry and the scientific community for assessment and comment.

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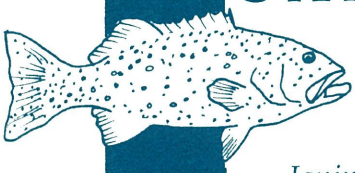
CORAL TROUT DO THEY STRIKE IN THE SAME PLACE TWICE ?



Janine Kuhl

One of the two main components of the Effects of Fishing Programme at GBRMPA is the 'GBR Experiment'. This project involves experimental control of line fishing and trawling within special 'Fisheries Experimental Areas' incorporated into the rezoning of the Cairns Section of the Marine Park. Work towards this experiment is being conducted by researchers from Queensland Department of Primary Industries, Australian Institute of Marine Science, James Cook University and private consultants.

The rates and spatial extent of movement of large fish have not been investigated on the Great Barrier Reef on an experimental scale appropriate to the fisheries they support or the zoning plan by which they are managed. One of the research projects currently underway is a large scale fish tagging study which aims to determine the extent of movement of large reef fish (such as serranids, lutjanids and lethrinids) within and among reefs. The sampling design for the 'GBR Experiment' incorporates the assumption that there is no significant movement of fishes among reefs within the experimental clusters.

The research is being conducted by Campbell Davies from James Cook University and is funded by the Great Barrier Reef Marine Park Authority. Three tagging exercises have already been completed and a total of 5260 fish have been tagged.

An initial tagging trip was carried out from 1-12 April, 1992, and was performed on the southern cluster of Effects of Fishing experimental reefs, south of Innisfail. These included: Potter, 17-060 and 17-061, Farquharson, Taylor and Beaver Reefs (see figure 1). Commercial trout fishermen provided the necessary expertise to catch the fish, and trained personnel from JCU performed the tagging. A total of 2153 fish of 48 species were caught with a total effort of 560 hours of fishing. Coral trout (*Plectropomus leopardus*) was the most abundant species in the catch with 1156 individuals caught, representing 53.7% of the total catch. Of these, 1136 were tagged and successfully released.

The first tag recovery trip took place from 23-28 September, 1992. At this time of the year coral trout are known to aggregate to spawn, and this was coincident with a pronounced increase in catch per unit effort of this species during the recovery trip. A total of 1749 fish (including 1045 coral trout) were tagged and released on this trip.

A second tag recovery trip was carried out between 16-22 April, 1993, approximately 12 months after the initial tagging exercise. The sampling protocol and tagging procedure was similar to that of the previous two trips and the objectives of this trip were to tag and release more fish and to recapture fish tagged during the previous two tagging exercises. A total of 1358 fish were caught which included 803 coral trout.

A total of 68 recaptures have been obtained during the two recovery exercises. Tag returns from recreational and commercial fishers have amounted to 182, so the final number of fish re-captured to date is 250 (the majority of these returns have been from coral trout, see table 1). The tag returns have been very valuable to the research and suggest that the majority of coral trout do not move from their 'home' bommie, although some movement may be occurring around spawning time and usually only within the reef boundaries. A further two tagging exercises have been planned for the near future, and the ongoing research should substantiate whether these preliminary findings are true.

This research is essential for the successful management of the Great Barrier Reef as it will provide the basis of ongoing research about the sustainable rates of fishing, and the usefulness of current management practices (e.g. zoning strategies) of the Marine Park Authority.

	Beaver Reef	Taylor Reef	Farquharson Reef	060/061	Potter Reef	Total
April '92	416	186	248	102	184	1 136
September '92	193	167	261	143	281	1 045
April '93	451	178	36	0	138	803
Total tagged	1 060	531	545	245	603	2 984
No. returns/recovery exercise #1	10	1	13	4	11	39
No. returns/recovery exercise #2	10	7	1	0	9	27
No. returns/fishermen	0	39	43	36	58	176
Total No. returns	20	47	57	40	78	242

Table 1. Number of coral trout *(P. leopardus)* tagged on each reef during the initial tagging exercise (April '92) and the two recovery exercises, and the number of returns

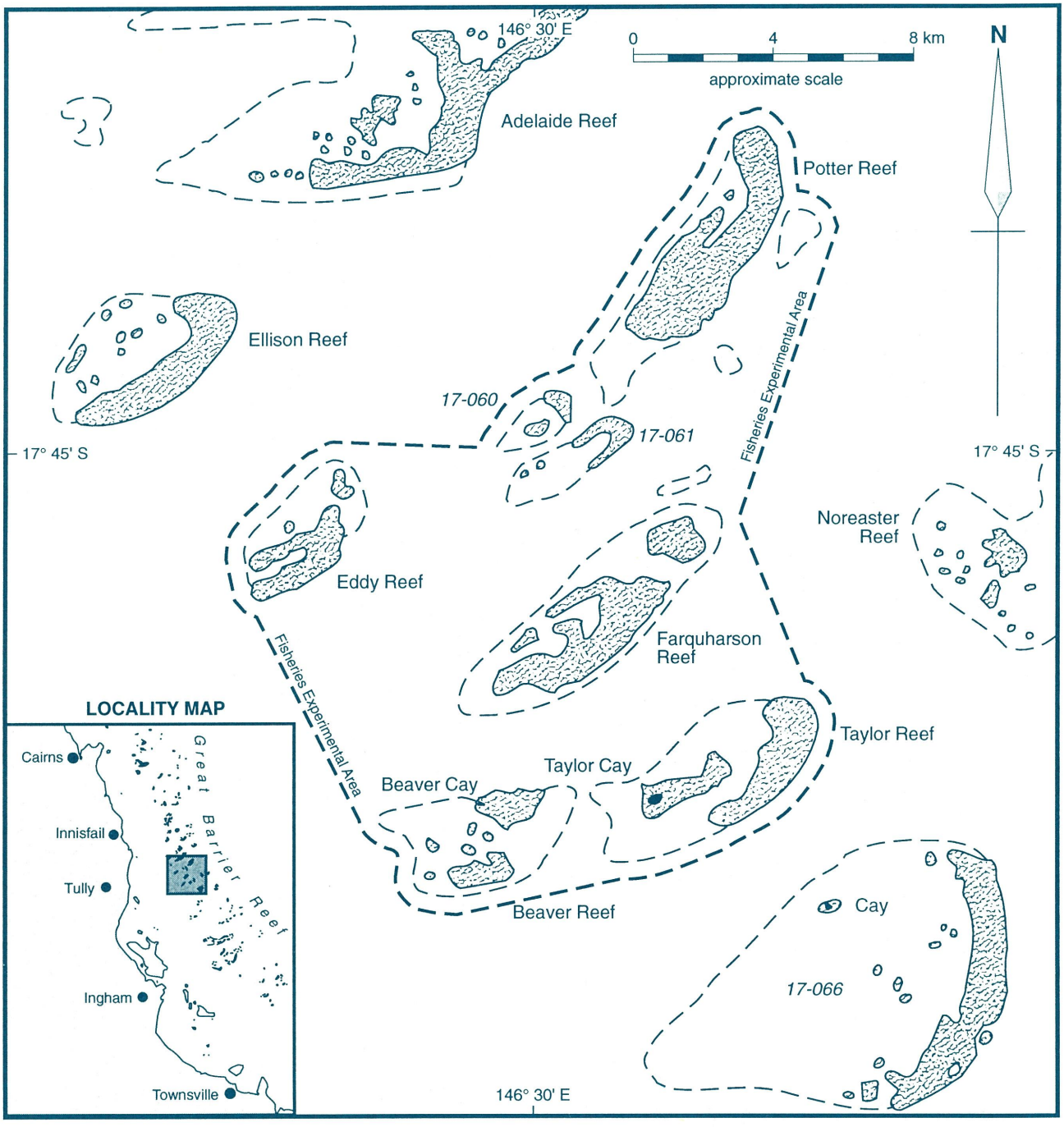


Figure 1. Fisheries Experimental Area

Where was Woodley?

Research and Monitoring Director Simon Woodley recently returned to GBRMPA after spending the past eight months at James Cook University of North Queensland. Simon was seconded to the Environmental Studies Unit for three and a half months to set up and run a Masters level Summer School on Coastal Zone Management in the Tropics. He also participated in teaching two introductory courses on marine park management for the Queensland Department of Environment and Heritage. The rest of the time was study leave spent on the final stages of a Masters degree in Tropical Ecology. Oh, and there was a trip to Malaysia on behalf of INTROMARC to set up the arrangements for an AIDAB sponsored training workshop on tropical marine ecosystem management (TROMES) to be conducted in September of this year. All in all an interesting and stimulating time away from the tyranny of the telephone and day-to-day pressures at GBRMPA.

Ed.

SUMMER SCHOOL

COASTAL ZONE MANAGEMENT IN THE TROPICS

Simon Woodley

This course emphasised marine aspects of coastal zone management in the tropics and attracted a wide variety of participants and post-graduate students from Australia, the Philippines, Indonesia and Thailand and natural resource managers and planners from both government and industry

The following objectives were set for the course:

1. to examine coastal management issues in tropical Australia and other tropical areas;
2. to promote an understanding of the concepts, causes and complexity of tropical coastal zone management issues and strategies for management;
3. to promote an understanding of methods for group problem solving, decision making and conflict resolution in an environmental context.

The core area for study was the Great Barrier Reef Region and adjacent coastal area but other areas were used for contrast and comparison. The sites used for case study exercises were Gulf of Carpentaria, Torres Strait, Cairns Area, Great Sandy Region and Lingayen Gulf in the Philippines. These provided students with many complex and difficult coastal zone management issues. The contrast of Australian issues with those from the Philippines and Thailand was particularly valuable.

Students gained an appreciation of the multi-faceted nature of coastal zone issues from examining subjects such as the zoning and management of the Great Barrier Reef Marine Park, public participation processes, Magnetic Quay marina decision making processes, the 'user-pays' concept, Aboriginal and Torres Strait Islander values and uses of protected areas and water quality issues. Concepts such as ecologically sustainable development and biodiversity were introduced.

The course also addressed the following questions drawing extensively on material from the Resource Assessment Commission Inquiry into the Coastal Zone:

1. What is the 'coastal zone'? What is its scope? How does the definition differ depending on the purpose? What are the jurisdictional arrangements which determine the extent of the coastal zone?

2. What are the resources of the coastal zone and what are their environmental, cultural, social, industry and economic values? What changes are likely to take place in the quality and quantity of these resources in future and how are the values associated with the resources likely to be affected by such changes?

3. What are the existing uses and likely future uses of the resources of the coastal zone and what are the effects and potential effects of the uses on the quantity and quality of the resources? To what extent do these uses compete with each other and what are the effects of such competition?

4. What are the current mechanisms used to manage the coastal zone and what are the objectives of management ? What are the specific arrangements for management of the Great Barrier Reef Marine Park and Queensland Marine Parks? What are the effects of existing management mechanisms on the availability and use of coastal zone resources? What institutional and administrative arrangements are in place and what regulatory and economic instruments are used? Do they result in an efficient and equitable distribution of resources?

5. What are the current roles and responsibilities of the various levels of Government in the management of coastal zone resources? How might these roles and responsibilities change under the proposed Queensland Coastal Management Strategy and the Inter Governmental Agreement on the Environment? What contribution do non-government organisations make to the management of the resources of the coastal zone of Queensland?

6. What does integrated management of the coastal zone mean? What would be required to implement such management for the coastal zone?

Because the scope of the course was ambitious, some major issues could not be covered adequately, being worthy of courses in their own right e.g. jurisdictional arrangements for management of the coastal zone, integrated planning and management systems, environmental decision making processes, understanding and measuring use and resource values, and questions of efficiency and equity in the distribution of resources.

Cooperative learning techniques, particularly small group problem solving, were used to maximise the transfer of information to students from reading, lectures and the experiences and backgrounds of other students. Students of differing backgrounds and experiences were deliberately mixed in the groups (rather than streaming students of similar backgrounds) to encourage cross-fertilisation of ideas and experiences. There were five groups of four students and all were given opportunities to contribute to the group outcome and were not able to hide in the group. Assessment was by a combination of course participation, essay and take-home exam.

This was a very popular course and I will be running a similar course in January 1994 at James Cook University. Enquires can be directed to me at GBRMPA.

Does turbidity affect coral ?

R. van Woesik

Rationale

This study stems back from a statement made in 1982 in a book by Professor Hopley (Hopley 1982) that suggested that fringing reefs were poorly developed south of 21°S. Investigations in 1987 showed that extensive fringing reefs do occur at 23°S around the Keppel Islands. Clearly, latitudinal effects per se do not directly suppress reef development. Then why are fringing reefs poorly developed near 21°S?

Objectives

We set out to examine the reefs around this naturally stressed region (i.e. 21°S), record their composition and compare them with a non-stressed region (20°S). More specifically we sought to:

- Examine the biological composition of coral assemblages near 21°S.
- Assess the relationships between coral composition and environmental gradients.

Study area and environment

The study area was situated nearshore along the southern Great Barrier Reef. It was divided into four sections progressing south; the Whitsunday (A), Cumberland (B), Northumberland (C) and the Keppel Islands (D) (see figure 1). Ten metre tidal fluctuations in Broad Sound are greater than anywhere else on the Great Barrier Reef. These large fluctuations induce consistently high turbidity that becomes progressively greater towards Broad Sound. A natural turbidity gradient allowed an examination of coral communities that were tolerant to high turbidity and, perhaps of more pertinence, which coral species were most susceptible to high turbidity.

Methods

The study was undertaken between 1987 and 1992. Fringing reefs around 34 continental islands were surveyed. A total of one hundred and twenty-five study sites were examined within the four sections. Each site measured 20m by 10m. Coral composition, abundance and morphology were recorded. Each coral colony was allocated to one of five size classes based on the coral's maximum diameter.

To find out whether coral distribution patterns were reflected along environmental gradients the following information was recorded for each site and utilised in comparative analyses: distance to mainland (km); distance to nearest river (km); mean annual tidal range (m); surrounding shelf depth (m); site depth (m); region of study; shelter by a headland; and macroalgal abundance.

Results

The four main sections varied considerably in species composition:

- Whitsunday and Cumberland Islands supported mainly poritids, faviids, pocilloporids and acroporids.
- Northumberland Islands supported mainly Montipora and Turbinaria species.
- Keppel Islands supported mainly Acropora species.

Depth, exposure by a headland, distances from mainland and tidal fluctuations have a strong influence on species composition. Near 21°S the biotic zone narrowed because of reduced light transmissions (see figure 2) and reef crest assemblages that normally support large monospecific stands were entirely absent. Major framework builders, massive and branching corals, dominated reefs north of 21°S but significantly declined at 21°S. Hard coral colonies were considerably smaller near 21°S. Soft coral abundance was not significantly influenced by tidal fluctuations. Encrusting and plate-like corals were more adapted to the Northumberland conditions, however their encrusting growth does not contribute overly to reef development. These influences appear to have restricted coral growth and reef initiation to such a degree that only limited reef accretion has occurred in this region throughout the last 10,000 years.

Conclusions

Isolation of larval pools was suggested as a major determinant structuring coral distribution patterns across the continental shelf in the 1980s. However, it is postulated that distribution patterns on these fringing reefs may not be a prime consequence of inefficient dispersal but largely dependant on the physical environment.

Most fringing reef growth has occurred over the last 6,000 years. Areas with little development can be assumed to be unfavourable for coral growth. An arc of (turbidity) influence extended from Broad Sound. Coral communities along this gradient are useful as indicator communities as they show varying resilience to natural turbidity (Van Woesik 1992).

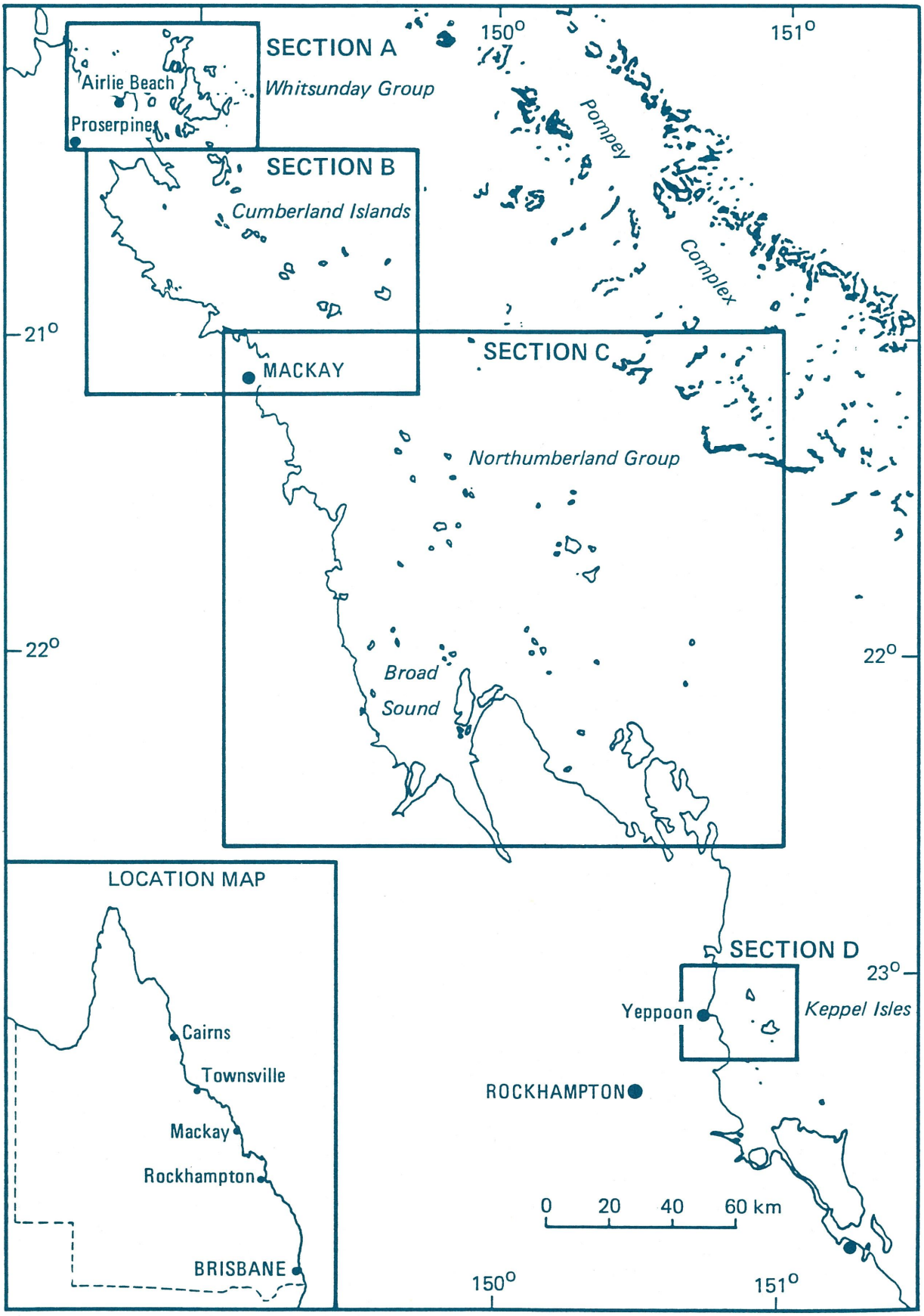


Figure 1. Study location

Future directions

This study outlines ecological evidence for suppressed reef development near 21°S. However it remains unknown why communities differ along the turbidity gradient. Are larvae available? Do larvae settle? Do they settle and die? Are corals outcompeted by algae? These questions are being addressed by the author in a three-year study (supported by GBRMPA) using Repulse Bay as a gradient source. This study will use regression analyses to examine the influence of

turbidity and nutrient loading on rates of calcification, productivity and recruitment. The independent (or predictor) variable will be the turbidity source, that is the distance from Repulse Bay. In this manner we can obtain predictive models (Peters 1991) that identify how nutrients and sediments influence coral growth, recruitment and post-settlement mortality. These types of models are useful to management as they predict fundamental changes before they occur and allow managers to set tolerance and response levels.

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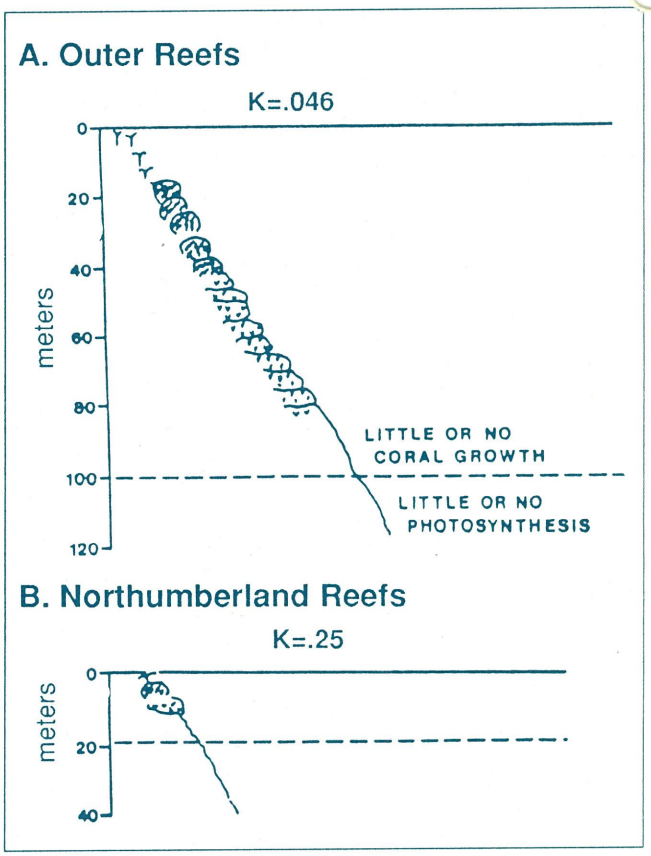

Figure 2. Light penetration on the outer reefs (A) and Northumberland Islands (B). Where K is the light extinction coefficient. High light extinction in the Northumberland Islands is caused by consistently high turbidity induced by large tidal fluctuations (8-10m)

SYMPOSIA REPORTS

MEETING ANNOUNCEMENT AND CALL FOR POSTER PAPERS

THE FUTURE OF TROPICAL SAVANNAS: MANAGING RESOURCES AND RESOLVING CONFLICTS

17-22 JULY 1994

TOWNSVILLE QUEENSLAND AUSTRALIA

This symposium is about people living in topical savannas and how science can help resolve conflicts that arise from their activities. Resolving those conflicts will depend on how successfully different perceptions of land use and management can be accommodated. Scientific information, societal needs and values, and economic costs and benefits must all be integrated into policy if sustainable land use is to be a reality.

The meeting will consist of invited speakers on a range of topics that includes pastoralism, tourism, mining, aboriginal use, cropping, parks and conservation and conflict resolution. In addition, the Organising Committee invites the submission of abstracts for contributed poster papers that address the theme of the meeting. Abstracts will be evaluated and authors notified to develop a poster paper for the meeting. Authors of selected posters will be invited to submit a two-page paper for publication in the proceedings of the meeting. Criteria for selection will include relevance to the theme of the meeting and originality. Please submit abstracts of 300 words or less by 1 December 1993 to:

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PO Aitkenvale, Queensland 4814 AUSTRALIA