REEF RESEARCH

GREAT BARRIER REEF MARINE PARK AUTHORITY

VOLUME 8 No. 3–4
SEPTEMBER–DECEMBER 1998

WHAT'S IN THIS ISSUE

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Editorial

REEF MANAGEMENT NEWS:

In line with the Authority's sharper focus on critical issues facing the Great Barrier Reef Marine Park, Reef Management News will be reporting on the four 'Critical Issue Groups', providing a forum for the clarification and discussion of the workings of the Groups, their individual concerns and the issues at the forefront of their agendas.

Included this month is an overview of the aims and objectives of each of these 'Critical Issue Groups': Water Quality and Coastal Development; Tourism and Recreation; Fisheries; and Conservation, Biodiversity and World Heritage. In future, topical items relating to these Groups will be featured in 'ON THE BOIL'.

Reef Management News looks not only at what these groups are about, but just as importantly, who they are about. When you first delve into these 'critical issues' it is easy to be overwhelmed by the enormity of the Great Barrier Reef Marine Park; its wealth of ecological, social, cultural and economic values that are so very important, not only to Australia, but to the rest of the world. Once you speak to the people responsible for managing such a precious, complex and dynamic resource you realise, however, that the task is in the hands of a team of dedicated, caring and entirely competent people.

Reef Management News has profiled just two of these people this month – Director of the 'Fisheries Group', Dr Phil Cadwallader, and Director of the 'Conservation, Biodiversity and World Heritage Group', Jon Day. The next issue will look at the Directors of the other critical issue groups, Annie Ilett of the 'Tourism and Recreation Group' and Jon Brodie who is head of the 'Water Quality and Coastal Management Group'.

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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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Editorial

REEF RESEARCH:

We begin this issue with re-prints of two of the CRC Reef Research Centre's Exploring Reef Science brochures. The first article introduces a program which aims to involve community groups and volunteers in the collection of information on seagrass meadows. The second article discloses that river-borne sediments settle inshore on the Great Barrier Reef and, do not as many think, settle on mid- and outer-shelf reefs.

Wearing my other hat of Project Officer – Monitoring, I report in *What's Out There?* on some of the monitoring projects that the Research and Monitoring Coordination Unit is involved in. In *Slick Talk*, Steve Raaymakers summaries the report *The International Response to the Ballast Water Issue – Implications for Australian Bulk Exports.* He also discusses a manual (*Ship Groundings in the Pacific Islands Region – Issues and Guidelines*) which was recently released by the South Pacific Regional Environment Programme to assist Pacific island countries to deal with environmental issues associated with ship groundings.

Michelle Devlin, Jeremy Taylor and Jon Brodie summarise the results of a mapping and sampling exercise that was undertaken in January 1998 to study the flood plumes associated with cyclone Sid and cyclone Katrina. Also included is a media release from the CRC Reef Research Centre which announces the release of a report aimed at assisting marine tourism operators and volunteer groups develop coral reef monitoring programs.

You'll notice a subscription form included with your newsletter. While subscription to *Reef Research* is free we ask that if you wish to continue receiving the newsletter you take a few minutes to fill out the form and send it back to us by **1 February 1999**. We can then be sure that only those people who are truly interested in receiving the newsletter do so.

Finally, I must offer our apologies to Offshore Scientific Pty Ltd. The article *Assessing seagrass resources of the Great Barrier Reef Marine Park* which appeared in our March 1998 issue failed to acknowledge the involvement of Offshore Scientific Pty Ltd in the project to evaluate the use of acoustic techniques to map seagrass resources. Offshore Scientific Pty Ltd supplied the expertise, equipment and half of the personnel for the project mentioned in the article. If you are interested in learning more about mapping seagrasses using acoustic techniques please contact Offshore Scientific on +61 2 9980 7842.

Merry Christmas and best wishes for 1999.
Kim Lally
PS I recently got married – hence the new name!

SEAGRASS WATCHERS GET SCIENTIFIC ABOUT COASTAL MONITORING

Don Alcock[1] and Len McKenzie[2]
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Local community groups are joining forces with marine scientists to monitor changes in the growth, distribution and composition of what is probably Queensland's most important marine plant – seagrass.

Researchers for the Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef (CRC Reef Research Centre), who are based at the Queensland Department of Primary Industries' Northern Fisheries Centre in Cairns, are harnessing local knowledge to assist in mapping and monitoring seagrass habitats. These habitats are vital for fish, prawns, turtles and dugongs. In a collaborative effort with government agencies and regional communities, they have recently been helped with a federal government Natural Heritage

Community groups and volunteers can become involved in monitoring seagrass meadows through *Seagrass-Watch*

CRC Reef Research Centre/DPI Seagrass Ecology Group (from left) Rob Coles, Warren Lee Long, Chantal Roder, Len McKenzie, Wendy Baker, Michael Rasheed, Anthony Roelofs and Paul Daniel

Trust grant of $350 668 through the Coast and Cleans Seas program. The funding will support community-based *Seagrass-Watch* projects in the Whitsunday and Hervey Bay regions with support from regional staff at the Queensland Department of Environment and Heritage and the Queensland Department of Primary Industries.

Seagrass-Watch is a new program that is being developed with assistance by the CRC Reef Research Centre, community groups and volunteers. The aim of *Seagrass-Watch* is for community groups and volunteers to collect quality information on changes in seagrass meadow characteristics, such as the extent of coverage, position and depth of habitat, species composition, estimates of biomass, presence of dugong feeding trails and possible human impacts.

'*Seagrass-Watch* programs will establish a reliable early warning system on the status of our seagrass resources, and a broad measure of changes in these resources,' says senior research scientist Len McKenzie of the Seagrass Ecology Group at the Northern Fisheries Centre. 'Often, it is the residents of an area who have lived in the same place for many years that can provide the most precise information about changes to the marine environment,' he said.

In 1998, the Seagrass Ecology Group conducted the first in a series of training sessions to interested community members to develop *Seagrass-Watch*. Guidelines and scientific protocols for long-term monitoring of Hervey Bay's seagrass resources were developed with local Queensland Department of Environment and Heritage staff and volunteers from the Seagrass and Dugong Monitoring Program. Participants were trained to identify local seagrass species, undertake rapid visual assessment methods, preserve seagrass samples for a herbarium, and collect data for interpretation in a Geographic Information System.

'After training, volunteers and community groups are able to collect data from their region that will now give resource managers an indication of the extent of seagrass resources,' said Len McKenzie. 'They can also identify any areas of loss which may need particular attention.'

Coordinator of the Seagrass and Dugong Monitoring Program, Mr Jerry Comans, says grassroots action began in 1997 following a public meeting of concerned residents. 'We wanted to know why it was taking so long for the seagrasses to recover from the 1992 floods that killed off nearly 1000 square kilometres of meadows,' he said. 'With the subsequent 40 per cent drop in commercial net catches from the area, and concern over the dugongs food source, we wanted to do something about it.'

Mr Comans, who is a retired charter boat operator with more than 30 years experience in the region, helped form the group to better understand and conserve marine resources. 'Without seagrass Hervey Bay would be a desert,' he said. 'The Department of Primary Industries team have been great – really adding quality science to help us manage and protect seagrass meadows. We have now mapped most of the inter-tidal areas between Burrum Heads and Point Vernon. Each week we've been out taking site transects and photographs to send up to Cairns Department of Primary Industries with our data sheets.'

Mr Comans says there is local support for the new Dugong Protection Area in Hervey Bay with increasing reports of dugong herds feeding offshore. 'Commercial and recreational fishers have been seeing more dugong from their boats recently, and we are expecting them to move closer inshore as many of the meadows have now recovered,' he said.

Community groups and secondary schools in the Whitsunday and the Hervey Bay regions will begin formal training on seagrass mapping and monitoring in 1999. Aboriginal and Islander communities, and volunteer groups in other areas along the Queensland coast are also asking for assistance in monitoring techniques. A newly appointed *Seagrass-Watch* coordinator is helping to develop the program state-wide and a training manual and video is being produced.

Overseas interest in the CRC Reef Research Centre and Department of Primary Industries seagrass monitoring methods has grown. The Seagrass Ecology Group recently conducted similar training sessions to seagrass and fisheries scientists, and marine park staff in Thailand. Their mapping techniques and project management skills are now recognised as an Australian standard with international export potential.

The success of the monitoring program depends on considerable input and feedback from community volunteers. *Seagrass-Watch* aims to be user-friendly with simple field sampling methods, uncomplicated data recording and handling, and prompt follow-up from the coordinator to ensure information is fully used in coastal zone management for continuous good health of fisheries and dugong populations.

For further information on seagrass monitoring and management, or how to become involved in *Seagrass-Watch*, contact Warren Lee Long, Len McKenzie or Chantal Roder at the Department of Primary Industries Northern Fisheries Centre, Cairns on +61 7 4035 0100.

This article previously appeared as an Exploring Reef Science (August 1998) brochure and is reprinted with the permission of the CRC Reef Research Centre.

RIVER SEDIMENT STAYS CLOSE TO COAST

Colleen Davis

People have become increasingly concerned in recent years that sediment washed down by rivers into the sea might be harming corals on the Great Barrier Reef. However, such fears may be unfounded, according to James Cook University sedimentology lecturer Dr Ken Woolfe.

Not only does the sediment remain close inshore – contrary to popular belief that it settles on and destroys offshore coral reefs – but some species of corals are remarkably resilient to turbid waters, he says. There is no doubt that the sediment load in rivers has increased in recent decades, but it is mainly being deposited in sheltered coastal bays and inlets.

Dr Woolfe, a researcher for the Cooperative Reef Research Centre for Ecologically Sustainable Development of the Great Barrier Reef (CRC Reef Research Centre), together with a team of James Cook University marine geologists, collected sediment samples – using surface grabs and cores – from hundreds of sites in the Great Barrier Reef lagoon. The scientists found almost no evidence of sediment from rivers accumulating on mid-shelf and outer reefs. Furthermore, by measuring tides, waves and turbidity at inshore sites where river sediment accumulates, they found that any sand or mud is quickly removed from corals by physical processes such as wave action.

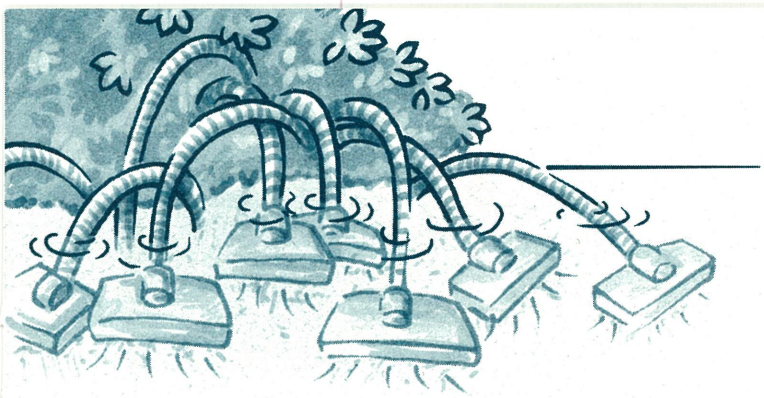
After organic and carbonate matter from coral reef sediment samples in the mid- and outer-lagoon had been removed the scientists found that more than 90 per cent of the remainder was ancient volcanic air-carried ash, most probably from Indonesia and Papua New Guinea. 'The amount of mainland sediment carried to these reefs by river plumes is small compared to the background flux of volcanic dust,' Dr Woolfe said.

Samples taken from deeper mid-shelf areas, 20–40 metres from the surface, also showed little evidence of accumulated sediment. 'In most places the sediment is less than half a metre thick and most of it is carbonate debris,' Dr Woolfe explained. 'This indicates that processes along the Queensland coast ensure river-borne sediment stays close to the shoreline instead of being carried out to sea.'

As the south-east trade winds – that prevail for nine months of the year – generate waves travelling in a north-westerly direction, wave and wind-driven currents run parallel to the coast. 'The net result is that riverine sediment entering the Great Barrier Reef lagoon is by and large moved to the north, and keeps close to the mainland. Most sediment is found within a few kilometres of the coast.'

Dr Woolfe and his team found that this wedge of riverine sediment extends to about 20 metres in water-depth off Townsville, but only to 10 metres deep further north. Sediments can be kicked up in the water column above this wedge during windy periods, sometimes to more than 10 times the concentration than a river plume following a flood. The entire water column can be turbid as opposed to plumes that are mostly on the surface. However, prevailing wind and sea conditions keep pushing suspended sediment inshore.

Sediment carried north in this boundary layer gradually settles in large north-facing bays, such as Cleveland Bay near Townsville, Trinity Bay near Cairns, and Princess Charlotte Bay in far north Queensland. Wave energy in these sheltered bays is much less than along exposed reaches of the coast. Some sediment is deposited on the ocean floor and the rest is carried into mangrove-lined estuaries by tides.



'Mangrove swamps act like giant vacuum cleaners, sucking up the sediment,' Dr Woolfe said. 'Because wind-driven coastal currents are already carrying as much sediment as the wave regime will permit, a rapid increase in sediment from river systems will not result in an increase in turbidity. The limiting factor in transporting sediment is wave and wind action.'

An interesting management implication of this research is that the bulk of sediment entering the Great Barrier Reef lagoon may come from well south of the Great Barrier Reef itself, and that rivers adjacent to the Great Barrier Reef region contribute a relatively small amount of sediment. 'Bays at the southern end of the Great Barrier Reef are already full of sediment which may have come from New South Wales rivers. Northern bays still have considerable capacity, and there is not much spilling out from them,' Dr Woolfe said.

He estimates it will take thousands of years for northern bays to reach sediment capacity. 'The amount of sediment reaching the Great Barrier Reef lagoon is about 30 million tonnes per year, compared with the 100 million tonnes discharged into the Gulf of Papua from the Fly River in Papua New Guinea.'

The team has found that corals that do live in the turbid coastal current are remarkably tolerant to high turbidity. 'We worked on reefs with turbidities regularly 10 times greater than what most biologists previously believed corals could tolerate,' Dr Woolfe said. These observations are supported by another project that is being funded by the CRC Reef Research Centre to measure the tolerance levels of certain species of filter-feeding corals found on inshore reefs. PhD marine biology student, Ken Anthony, has found that organic sediment suspended in water can actually contribute to energy needs of these corals or growth and respiration. Inshore populations of some species even appear to adapt their nutritional requirements to higher levels of sediment in surrounding waters.

'It is quite likely that nearly all reefs on the Great Barrier Reef started out life in turbid conditions,' Dr Woolfe said. 'So long as there is enough light, and the sediment is not accumulating, the corals don't seem to mind.'

Although he is convinced that sediment itself poses no danger to the Great Barrier Reef, Dr Woolfe sounds a few cautions. 'Just because river plumes are not posing a direct sediment threat to the coral reefs doesn't mean they are not posing a contaminant threat. Contaminants adhere to the smallest particles and remain suspended in plumes. 'And a few reefs along the coast are under threat from sediment – eventually they will be physically overwhelmed as the coast moves out. Over the past 6000 years, the coast has advanced up to 10 kilometres.'

Although there is little doubt that sediment loads in rivers in Queensland have increased since human settlement, it remains close inshore and does not generally accumulate on corals, contrary to popular belief. 'Although this increased sediment load has greatly modified the rivers themselves, it has had little identifiable effect on the coral reefs,' Dr Woolfe said.

(Colleen Davis is a freelance science writer.)

This article previously appeared as an Exploring Reef Science (August 1998) brochure and is reprinted with the permission of the CRC Reef Research Centre.

Barrier Reef research news on Web

Access to research on Australia's Great Barrier Reef World Heritage Area has just been made easier with a new information service available on the Internet.

Regular news about the current state of research into corals, dugongs, seagrass, coastal sediment, fishing and climate history is now available as a free service for anyone with Internet access and an e-mail address.

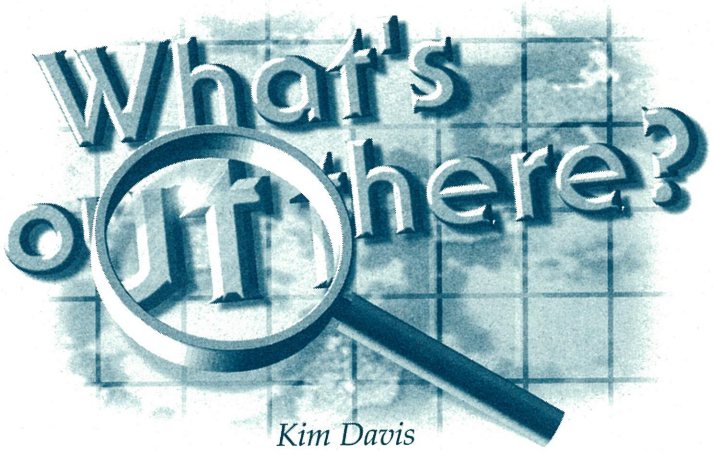
The CRC Reef Research Centre recently launched the service on its popular website, increasing access to contemporary coral reef research, education and training programs throughout Australia and the world.

Mr Simon Woodley, Director of the Centre said CRC Reef Research Centre Online adds a new dimension to the growing number of marine environment and science websites published on the Internet.

'It is faster way Reef researchers can communicate their news and scientific progress – such as coral bleaching updates – to students, colleagues, reef user groups and the media,' said Mr Woodley.

Subscription to the free news service can be found at:

http://www.gbrmpa.gov.au/~crcreef



Kim Davis

In this issue of What's Out There? *we take a look at some of the monitoring projects that the Research and Monitoring Coordination Unit is currently involved with.*

Hardy Reef – Monitoring of the impact of the relocation of the Fantasea Cruises pontoon

Status: Project completed
Consultants: Sea Research

The Great Barrier Reef Marine Park Authority is responsible for ensuring that pontoon operations in the Great Barrier Reef Marine Park do not cause significant environmental impacts on the Marine Park and its users. All pontoon operations within the Marine Park require a permit and the permittee must fund and maintain an environmental monitoring program for the pontoon. This program is undertaken by a consultant who is nominated by the permittee but who enters into a contract with the Authority.

In December 1995, the Authority granted Fantasea Cruises permission to relocate their pontoon, Reefworld I, about a kilometre south of its original position at Hardy Reef. Hardy Reef is situated in the Whitsunday Group. A monitoring program was initiated to establish the effect of the relocation and the ongoing operations of the pontoon on the reef community; specifically on the percentage cover of encrusting organisms and the extent of damage caused to coral colonies.

Results of this project indicate that in the reef-flat habitat, tourist snorkelling activities apparently had no measurable effect on the coral community. Even though coral cover decreased slightly during this study at both the impact and control sites, the consultants attribute this decrease to some unknown perturbation which occurred during 1995 and to cyclone Justin which occurred during March 1997.

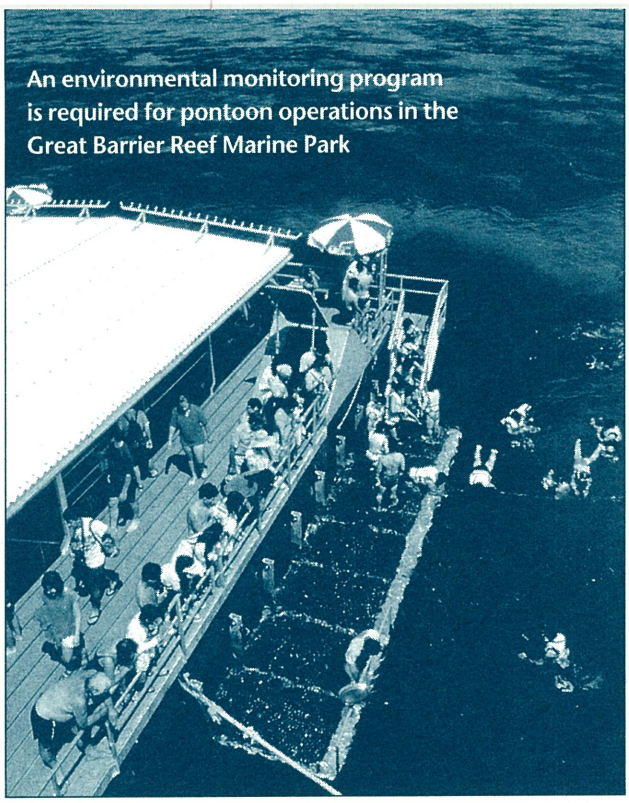
The effect of inexperienced resorts divers on the coral community was also investigated. An increase in coral damage levels was recorded along the dive trail immediately after the pontoon was relocated. However, after 15 months of the pontoon operating, coral cover and damage levels were recorded at similar levels along the dive trail and in the control sites. This suggests that use of the dive trail was having a minimal impact on the reef communities.

Biological monitoring at the Quicksilver Connections visitor pontoon, Agincourt Reef No. 3, 1994–96

Status: Project completed
Consultants: Marine Environmental Monitoring

In July 1994 the Authority contracted Marine Environmental Monitoring to monitor fish and coral assemblages at the Quicksilver Connections visitor pontoon at Agincourt Reef No. 3. Agincourt Reef No. 3 is a 2-kilometre long outer-shelf reef located approximately 40 kilometres east of Cape Tribulation. Marine Environmental Monitoring was asked to meet a number of monitoring requirements for this project including:

- documenting the loss of coral cover on the four main bommies beneath the pontoon;
- determining if resort divers were damaging prominent corals, through physical contact, and quantifying the amount of damage;
- documenting changes in the aggregation of large mobile predatory fishes; and



An environmental monitoring program is required for pontoon operations in the Great Barrier Reef Marine Park

- quantifying changes in small benthic fish resulting from the pontoon operation.

Results show that there were reductions in coral cover on the bommies that were surveyed both under and beside the pontoon which may be attributed to shading effects. However, it should be noted that bommies made up less than 10 per cent of the area directly below the pontoon and the coral mortality in these areas was anticipated during the environmental impact assessment which was carried out by marine park management staff. Marine Environmental Monitoring also found small increases in the average number of new breaks, and a decrease in mean height, for individual staghorn colonies in two of the high diver-use areas and in one of the medium diver-use areas. Increases in the number and variety of fish under the pontoon were observed during the initial site surveys and mooring installation but this levelled out during the first year of tourist operation.

A visual survey of demersal biota in the Cairns Section of the Great Barrier Reef Marine Park

Status: Project due to be completed in 1998
Consultants: B. Mapstone, H. Choat & A. Ayling

In 1991, the Authority implemented a new zoning plan for the Cairns Section of the Great Barrier Reef Marine Park. A research project was developed to examine the effects of the previous zoning strategies for this section as well as to prepare a baseline for future examination of the effects of the new zoning plan. The aim of the project was to survey selected organisms on reefs in the Cairns Section prior to commencement of the new zoning plan.

Fifty reefs were surveyed, including reefs that had a history of closure to fishing, reefs that had always been open to most uses, and reefs that were to have their zoning status changed under the new zoning plan. Counts of the following organisms were taken: coral trout, chaetodontids, acanthurids, lethrinid and lutjanid species, crown-of-thorns starfish, blue starfish, clams, pomacentrids and total live soft and hard corals.

The consultants have found that there were no definite patterns in the abundances of organisms related to either zoning or notional tourist use. For many of the taxa surveyed, there was no effect of either past zoning or tourist use. For other taxa, the zoning-related patterns frequently depended on either where across the continental shelf the consultants were, on the habitat considered, or on the notional history of consistent tourist use. Patterns in abundances which related to the frequency of tourist use also varied with habitat, zoning status or shelf position.

Generally, the consultants concluded that the potential to infer effects of management strategies from simple one-off 'before and after' estimates of abundance or community structure is poor. They stated that greater attention needs to be paid to the assessment and monitoring of management strategies.

Magnetic Quays monitoring program benthic transects: a re-survey

Status: Completed
Consultants: Sea Research

A benthic monitoring program was initiated in December 1988 to determine the effects of dredging and other construction activities from the Magnetic Quays Development on the fringing reefs of Nelly Bay, Magnetic Island (off Townsville, Queensland). A number of permanent transects were set up and surveyed as part of this reef monitoring program. However, these were not surveyed again, excluding some sites that were surveyed in 1993, and the Authority became concerned that the transects would not be able to be relocated in the future if they were not maintained.

In 1997 Sea Research was contracted to re-survey and re-mark all of the transects that were located on the reef slope using both line intersect techniques and video techniques.

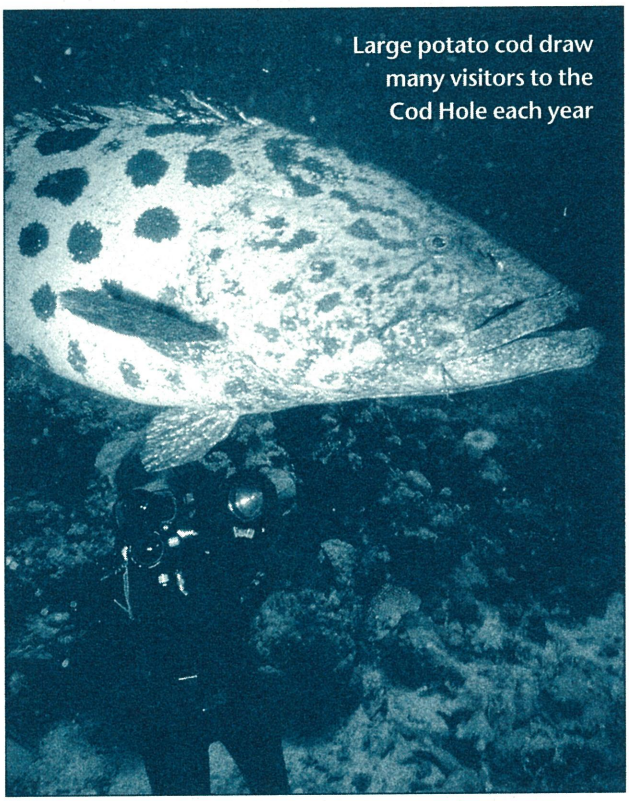
A comparison of the line intersect technique and the video technique showed that generally, the video technique overestimated the cover of *Sargassum* algae and turf algae. Similarly, the video technique underestimated the cover of sponges, hard corals, faviid and fungiid corals. The underestimates were generally thought to be due to the corals being covered by *Sargassum* fronds.

The researchers also found that coral cover had increased markedly in all sites in the 4.5 years since the last survey of the area. This was primarily due to increases in the cover of the fast growing *Acropora* and *Montipora* species, along with *Turbinaria* species in Nelly Bay.

The Cod Hole: long-term monitoring of human usage, fish populations and injuries to fish and the environment

Status: Report due to be completed in 1998
Consultants: L. Vail & A. Hoggett

The Cod Hole is an internationally renowned dive site in the Cairns Section of the Great Barrier Reef Marine Park. The main attraction of this area is the numerous large potato cod which allow divers to approach them. Through an industry volunteer monitoring program conducted by the staff of *Volare*, data on visitor/diver numbers and the number of potato cod at the Cod Hole have been collected since April 1992. The aim of this monitoring program is to monitor the number of potato cod and also to record diver visitation rates, injuries to cod and other large animals. In May 1997, the Authority contracted Lizard Island Research Station to collate, analyse and write up the data for the period April 1992 – April 1997.


Large potato cod draw many visitors to the Cod Hole each year

In October 1995, the Cod Hole was granted further protection when, in addition to its National Park zone status, it was designated a Special Management Area. Following this designation anchoring was prohibited in the area and boats visiting the area had to use one of the four moorings installed there.

Human usage of the Cod Hole peaked in 1993–94 and since that time usage has dropped only slightly. Despite increased protection of the area the contractors report that the number of potato cod at the Cod Hole has declined significantly. The average number of potato cod seen per dive has almost halved since 1992. On average, 11.9 cod were seen per dive in 1992–93. In the last three years of the survey 6.5 and 7.3 cod were counted, on average, per dive. The cause of this decline is unknown. Virtually nothing is known about the demography of the population at the Cod Hole, the home range of individuals and very little is known about the life history of the potato cod. The consultants do, however, report that recruitment of small potato cod into the Cod Hole population appears to have occurred during the last three years of their survey.

The consultants also report that injuries were noted to potato cod and other large fish at the Cod Hole and a conflict between fish during feeds by divers was most probably responsible.

The decline in numbers of potato cod at the Cod Hole is somewhat of a concern for local industry groups and reef managers. However, the level of experience being offered to divers is probably still highly satisfactory to many and staff from the Lizard Island Research Station report that monitoring of numbers of potato cod will continue.

If you would like further information regarding any of the above projects please contact Ray Berkelmans or Kim Lally at the Authority on +61 7 4750 0700.

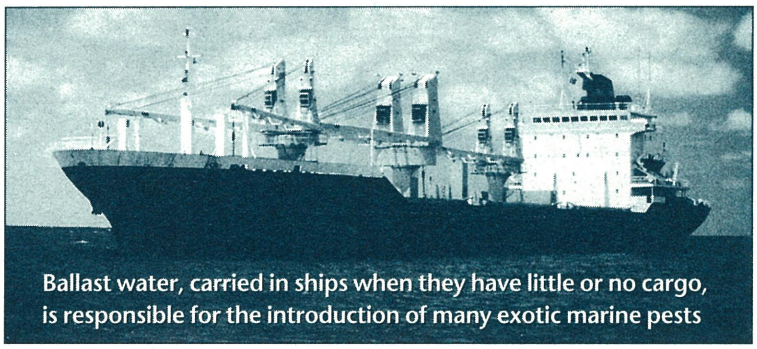
with Steve Raaymakers

International ballast report released

In 1997, I was fortunate enough to receive a Travelling Scholarship from the Australian Minerals and Energy Environment Foundation, with supplementary support from my employer at the time, the Ports Corporation of Queensland, to undertake an international review of ballast water management. An important task of the study tour was to assess implications of international developments for Australian bulk ports. The report on my study has now been released as a joint publication by the Australian Minerals and Energy Environment Foundation and the Ports Corporation, and is entitled *The International Response to the Ballast Water Issue – Implications for Australian Bulk Exports.*

In undertaking my research, I investigated regulatory and management responses to the threat of marine species introductions via shipping at four levels: global, regional, national and local. The global study focused primarily on the ballast water regulatory regime currently being developed by the International Maritime Organization (IMO). The regional case study focused on two areas, the Baltic Sea and the American-Pacific north west. The national case study considered the comprehensive regime being developed by the United States Federal Government and the local case study looked at the Port of Valdez in Alaska. As a result of this study, the following recommendations were made to the Australian minerals and energy export industries (the industry):

- Industry should lead, rather than be led, by government, especially in relation to environmental and regulatory matters. The industry should therefore *become far more involved* in addressing this issue than it currently is in Australia. Such increased involvement would include adoption and implementation of the recommendations below.
- The industry should ensure continued *broad representation* on all levels that deal with the ballast water issue, including the Australian Ballast Water Management Advisory Council (ABWMAC) and the Marine Environment Protection Committee of the IMO.
- The industry should strongly support the Australian Government in its push to secure a standardised, international regulatory regime for ballast water through IMO/MARPOL 73/78, and ensure that all ships serving the industry begin to comply with MARPOL 73/78 provisions as soon as possible, not waiting for them to come into force.
- The industry should extend its consideration of biological introductions to sources in addition to ships' ballast water, including hull fouling and fouling on offshore structures that may be moved between areas (e.g. oil exploration and production infrastructure).
- If the 'optional mandatory' formula for ratification of the ballast water Annex of MARPOL 73/78 is not accepted by IMO, the industry should work to *accelerate* the introduction of Australian legislation ahead of the IMO timeframe.



Ballast water, carried in ships when they have little or no cargo, is responsible for the introduction of many exotic marine pests

- Given the limitations associated with re-ballasting/ballast exchange at sea, the industry should develop and fund a concerted, comprehensive strategic *research and development* effort that is focused purely on developing the ultimate, practical *engineering solution* to this problem. An industry-led solution will significantly reduce the need and push for regulatory approaches, and would be the most likely to succeed. Given the size of the global shipping fleet, development of the ultimate solution to the ballast water problem could prove *commercially lucrative* for the developer.
- Such a research and development program should be *complimentary to and coordinated with* research carried out by other parties, including government, academia and overseas parties.
- The industry should ensure that *all contracts* between member companies and shipping companies include *legal requirements* for *all ships to comply* with the Australian Ballast Water Management Strategy*.

* Please note that the Australian Ballast Water Management Strategy is currently being reviewed (Ed.).

- The industry should ensure that at least a first-port semi-quantitative ballast water *risk assessment* is conducted for each bulk mineral and energy export port in the country (e.g. as per Hilliard and Raaymakers 1997).
- The industry should develop a program to ensure that all bulk mineral and energy export ports in the country are *systematically surveyed* for the presence/absence of introduced marine species, according to port survey protocols developed by the Commonwealth Scientific and Industrial Research Organisation's Centre for Research on Introduced Marine Pests (CRIMP).
- The industry should develop a program to ensure that all bulk mineral and energy export ports in the country have a *port-specific ballast water management plan*, which complies with the general requirements of the Australian Ballast Water Management Strategy.
- The industry should thoroughly investigate the *risks and possible impacts* of foreign marine species introductions during the *environmental impact assessment* of all *proposed new* export facilities, and *should not proceed* with such developments should the risks and potential impacts be deemed too great.
- The industry should thoroughly investigate the potential incorporation of ballast water *treatment facilities* during the design of all *proposed new* export facilities.
- The industry should spearhead the *development of a regional approach* to marine biological introductions with Australia's immediate northern neighbours.
- The industry should consider conducting an assessment of ballast water management initiatives in relevant South American countries, for comparison with Australian bulk export ports, given various similarities between the two areas.
- The industry should investigate potential options for obtaining *protection* against possible *legal action and compensation claims* should an introduction be shown to have occurred via a particular bulk export port, and should *minimise the risk* of such an occurrence by adopting the recommendations above.

For further information on the report contact either the Australian Minerals and Energy Environment Foundation (ameef@amira.com.au) or the Ports Corporation of Queensland (portsqld@ozemail.com.au).

New ship grounding manual released

The South Pacific Regional Environment Programme (SPREP) has recently released a manual to assist Pacific island countries in dealing with the environmental impacts of ship groundings. Entitled *Ship Groundings in the Pacific Islands Region – Issues and Guidelines*, the 107-page document outlines the various environmental issues associated with ship groundings, including physical damage to marine habitats and pollution from oil and hazardous cargoes, and provides comprehensive guidelines for responding to such incidents.

It also contains a list of major ship groundings that have occurred in the region in recent years, and contact details for resource personnel with expertise in this area. Ship groundings are a significant environmental concern for the Pacific islands, which are heavily reliant on their coastal and marine environments for both subsistence and commercial fishing. The relatively small size of many Pacific islands combined with the importance of their coastal and marine environments, means that they are particularly vulnerable to even small pollution incidents.

Coastlines and reefs in the region are literally littered with shipwrecks, many of which are foreign-owned fishing vessels, and many of which are simply abandoned by their owners with no clean-up or salvage responsibility. The list of incidents contained in the manual indicates that there have been over 160 groundings of ships larger than 100 'gross registered tonnes' in the region since 1976. These data are derived from Lloyds Maritime Information Service Casualty Register. There are many more incidents that have occurred that are not on this database.

Most Pacific island countries have limited capacity to respond to such incidents, with the high costs of salvage and clean-up being a major limiting factor when owners are often difficult to identify for cost recovery.

The manual was written by environmental and maritime consultants on contract to SPREP. It represents a useful tool that can be used to improve responses to ship groundings. The manual includes guidelines on environmental issues, crew safety, vessel salvage, legal, insurance and compensation issues. For further information contact me at SPREP through the channels listed overleaf.

Spill response training resurrected for Pacific islands

The development of regional and national capabilities to effectively respond to marine spills constitutes an important part of efforts to protect the coastal and marine environments in the Pacific islands region.

During the 1980s and until 1992, SPREP, in conjunction with the IMO and the Australian Maritime Safety Authority (AMSA), and AMSA's predecessor, the Australian Department of Transport and Communications, held biannual workshops in both Fiji and Australia to train personnel from Pacific island countries in marine spill response. No such workshops have been held since 1992. Apart from in-house oil industry activity, training in this important area has been largely absent in the region over the last six years.

In 1998, SPREP, with support from the Commonwealth Secretariat and Canada, commenced development of PACPOL, the Pacific Ocean Pollution Prevention Programme. PACPOL is a comprehensive initiative to address all forms of shipping-related pollution throughout the Pacific islands region. An important project under PACPOL is the resurrection of regional training in marine spill response. PACPOL Project MS 3: *Annual Workshops on Marine Spill Response*, provides for the holding of a five-day training workshop within the region every year for five years from 1998.

Seed funding for the workshops has been provided by the IMO under its Integrated Technical Cooperation Programme (ITCP), representing ITCP Project H03 RAS/97/309. Support has also been committed, although not yet secured (July 1998), by Australia through AMSA.

The first of the new workshop series is to be held in Suva, Fiji from 30 November to 4 December 1998. It is intended that the venue for the workshops will be rotated throughout the region in each subsequent year.

The aim of the workshop is:

To improve the protection of coastal and marine environments in the Pacific islands region, by training personnel from Pacific island countries, in the response to spills of oil and other hazardous substances into the marine environment.

Previous spill response workshops in the region have tended to focus exclusively on oil pollution. There is increasing recognition internationally that it is more effective and efficient to integrate oil spill response arrangements with those for all hazardous substances.

The workshop will therefore cover the response to spills of all forms of hazardous substances. However, it will retain a focus on oil spills, as oil is the main hazardous substance carried by shipping in the region.

The workshop will cover spills into the marine environment from all sources, including both shipping and shore-based facilities.

The workshop will aim to train personnel from the following countries:

Cook Islands
Republic of Fiji
Republic of Kiribati
Republic of Marshall Islands
Federated States of Micronesia
Republic of Nauru
Niue
Republic of Palau
Papua New Guinea
Samoa
Solomon Islands
Kingdom of Tonga
Tuvalu
Republic of Vanuatu

as well as the following territories:

American Samoa (United States – Territory)
Commonwealth of the Northern Marianas (United States – Commonwealth)
French Polynesia (France – Territory)
Guam (United States – Territory)
New Caledonia (France – Territory)
Pitcairn Islands (United Kingdom – Protectorate)
Tokelau Islands (New Zealand – Territory)
Wallis & Futuna (France – Territory)

The workshop is designed to target middle-management personnel from government environmental and maritime agencies and the oil industry, who would play key roles in the response to marine spills within their respective countries. It is designed to provide a general but reasonably detailed overview of all aspects of the response to marine spills, and provide the participants with the knowledge and skills necessary to develop effective marine spill response arrangements within their countries.

Due to limits on resources and limits on the capacity of small island countries to absorb multiple training activities, it is not proposed to provide detailed training in specialist areas (e.g. first level responder, environmental and scientific support coordinator etc.) under the PACPOL/IMO Integrated Technical Cooperation Programme. It is considered to be more cost-effective to instead take advantage of the numerous specialist spill training activities that are already offered in countries adjacent to the region (e.g. Australia, New Zealand, United States of America), by sending Pacific islands delegates to these specialist courses on an opportunistic and needs basis, rather than to duplicate these courses within the region.

The annual marine spill response workshops under the PACPOL/IMO Integrated Technical Cooperation Programme are designed to provide an important supplement to these supra-regional courses by ensuring a regionally relevant content within a regional location.

This combination of an annual regional workshop with attendance at specialist courses in countries adjacent to the region should provide the optimum level of marine spill training for the region, within the limits of available resources.

In addition to the seed funding from IMO, support-in-kind for the workshop, mainly in the form of providing expert presenters and trainers, is being sought from Australia, New Zealand, the United States and the oil industry.

Reference

Hilliard, R.W. and Raaymakers, S. 1997, *Ballast Water Risk Assessment – 12 Queensland Ports: Stage 5 Report – Executive Summary & Synthesis of Stages 1–4*, EcoPorts Monograph Series No. 14, Ports Corporation of Queensland, Brisbane.

(Steve Raaymakers is currently engaged as Marine Pollution Adviser with SPREP. His authorship of 'Slick Talk' does not necessarily represent the views of SPREP nor the Great Barrier Reef Marine Park Authority. His contact details are: PO Box 240, Apia, SAMOA, Telephone (685) 21929, Facsimile (685) 20231, E-mail stever@sprep.org.ws)

REEF MANAGEMENT NEWS

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Directors:

At the Forefront of GBR Critical Issues

Director: Fisheries
Dr Phil Cadwallader

Phil comes from the Queensland Fisheries Management Authority where he was Program Manager, Natural Resource Management. Phil has worked in fisheries management since 1974 in various parts of Australia and Papua New Guinea, before which he was a lecturer at the Zoology Department at the University of Auckland.

Director: Conservation, Biodiversity and World Heritage
Jon Day

Jon has had 25 years of professional experience with resource management across Australia with agencies/Authorities in Victoria, the Northern Territory and Queensland. Jon has previously been with the Great Barrier Reef Marine Park Authority from 1986-1990 as a Park Management/ Planning Officer, before his appointment as the Regional Manager (Coastal Management) for the Department of Environment and Heritage, Northern Region. He returns from an assignment in Canada to take up this position.

ON THE BOIL

FISHERIES CRITICAL ISSUE GROUP

FISHING AND THE MARINE ECOSYSTEM

The Great Barrier Reef Marine Park Authority recognises that effective fisheries management is crucial for the preservation of the ecological integrity of the Great Barrier Reef.

The 'Fisheries Critical Issue Group' will report on the status of fisheries in the Marine Park and work towards ensuring that the world's best environmental practices are applied to fisheries resources in the Marine Park.

The Group will continue to work closely with state government agencies such as the Queensland Fisheries Management Authority (QFMA), the Department of Primary Industries and the Department of Environment and Heritage to maintain an ecologically sustainable fishing industry.

While the QFMA is responsible for fisheries management in Queensland, the Great Barrier Reef Marine Park Authority (the Authority) is committed to ensuring that such management is consistent with World Heritage and Marine Park obligations.

In line with World Heritage objectives, the group aims to preserve both the natural and cultural heritage values of the Marine Park while ensuring there is an acceptable balance of access for the various users of the Great Barrier Reef World Heritage Area.

Within this framework, protection of rare, threatened and endangered fish species and communities, as well as their habitats, will be of crucial concern.

Authority representatives will also continue to play an active role in the various QFMA Fisheries Management Advisory Committees currently developing management plans for fisheries resources.

Director of the Group, Dr Phil Cadwallader, believes that the fishing industry, fisheries management agencies and the Authority can work together to ensure that fisheries resources are used in an ecologically sustainable way.

'Fishing is regarded as an important and reasonable use of the Marine Park', says Phil.

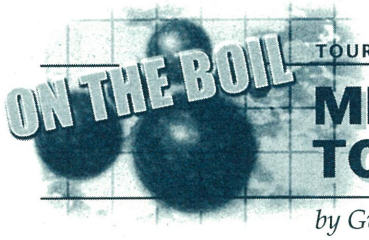
The fishing industry contributes substantially to both the Queensland and Australian economies and provides employment for many people. 'It must be acknowledged, however, that fishing can have significant ecological impacts', Phil says.

'Because the area is so important – not only to Australians, but to the rest of the world – its fish stocks and the ecosystems on which they depend must be monitored and managed in a way that ensures they are passed on to future generations in the best possible condition.'

According to Phil, new technologies such as vessel monitoring systems and by-catch reduction devices must be utilised to their full potential.

'It is also essential that we have an effective information base to assess the ecological and socioeconomic impacts of fishing', he says.

The Group stresses the importance of integrating fisheries and ecosystem management so that the health of both the fish stocks and the Great Barrier Reef can be sustained. ■



TOURISM AND RECREATION CRITICAL ISSUE GROUP

MINIMISING TOURISM IMPACTS

by Gwenneth Toa

Tourism is the main commercial use of the Great Barrier Reef Marine Park, contributing over one billion dollars to the Australian economy in 1997 and bringing 1.5 million visitors to the area.

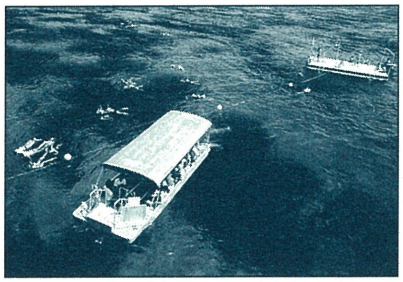
The volume and profile of tourism use of the Great Barrier Reef World Heritage Area has increased significantly over the past 20 years, presenting new challenges for reef managers and stakeholders.

Of most concern are the areas around Cairns and the Whitsunday Island group, which draw 95 per cent of tourists but account for only 5 per cent of the total reef area visited.

To continue to minimise the impact of tourism on the Great Barrier Reef, the Great Barrier Reef Marine Park Authority has formed an expertise-based 'Tourism and Recreation Critical Issue Group'.

As Marine Tourism has expanded and diversified, the Authority has adopted a more strategic and integrated management approach which accounts for both individual and cumulative impacts of the tourism use.

The Group aims to develop a Reef-wide plan for managing tourism use throughout the Marine Park. This Plan will identify natural, social and cultural heritage values that can be affected by tourism and recreational activities, as well as identifying methods to protect those values.



1.5 million people visited the Great Barrier Reef last year

Director of the Group, Ms Annie Ilett , says 'it is important that the policies developed allow for the conservation of both natural and cultural values and provide an appropriate balance of opportunities for a variety of tourism-orientated, recreational and other uses'.

According to Annie, 'the strategies will be implemented through changes in legislation and policy, as well as education and training and codes of best practice in partnership with the tourism industry'.

REEF BRIEF

VISITORS' VALUES REVIEWED

by Pheobe Kinley

Planning for a project to assess and report on how visitors experience and use the Whitsundays and the values they ascribe to particular locations such as Whitehaven Beach began in early September.

The project will be undertaken by the Great Barrier Reef Marine Park Authority in conjunction with the Queensland Department of Environment and Heritage as a component of the Authority's review of certain aspects of the Whitsundays Plan of Management.

Project Manager, James Innes, says a consultant for the Authority will interview visitors at popular locations to determine the most valued aspects of these locations and to gain an insight into the motivations behind visitor usage.

The project will also monitor and assess aircraft and vessel (especially those over five metres) activity around locations such as Whitehaven Beach and the Hill Inlet to determine the impact these activities may have on visitor use and amenity of the area.

Project results will assist the Authority with any necessary amendments to the Whitsundays Plan of Management so users of the region can be assured their experiences of the Whitsundays will remain as enjoyable in the future and that the region's conservation values will continue to be protected. ■

REEF BRIEF

EXPERT RECOMMENDS NATURAL COMBAT FOR OIL SPILLS

by Phoebe Kinley

In a seminar at the Great Barrier Reef Marine Park Authority during August, international expert on oil spill response, Dr Tim Lunel, emphasized the role of natural processes, such as those carried out by oil degrading bacteria and during oil dispersion, in oil spill clean-up.

According to Dr Lunel, of the National Environment Technology Centre in England, natural processes have proven to be the most effective means for combating the effects of an oil spill.

Dr Lunel led a scientific advisory team during the 'Sea Empress' oil spill response in 1996, which is considered to be one of the best examples of managing the impacts of a large oil spill.

Techniques employed during the 'Sea Empress' oil spill response worked with natural processes which proved to be effective in minimising the impact on the environment, said Dr Lunel.

The techniques were also more successful than the aggressive and intrusive response techniques employed in the past, which often proved to do more harm than good.

Jamie Storrie, the Authority's Maritime Pollution Response Coordinator, says the environmental significance and vastness of the Great Barrier Reef pose many difficulties for oil spill responders.

According to Mr Storrie, Australia has been very fortunate in that there has not been a major oil spill on the Great Barrier Reef.

However, Mr Storrie highlighted the need for oil spill responders to learn from overseas experiences such as the 'Sea Empress', and stressed the importance of monitoring and documenting the long-term effects of oil spills.

'It is crucial that we keep up to date with the best practices in oil spill response to ensure that we are in a position to minimise the effects of a major oil spill', he says. 'Each spill poses new challenges from which we can learn.' ■

In particular, the group has given priority to building strong working relations with tourist operators such as the Association of Marine Park Tourism Operators as well as government agencies like the Queensland Department of Environment and Heritage.

The Group will continue to enact the Authority's goals and aims through strategic policy and planning, direct management and self-regulation by the industry. ■

FEATURE

Additional moorings to help protect sensitive Whitsunday sites

by Karina Scott

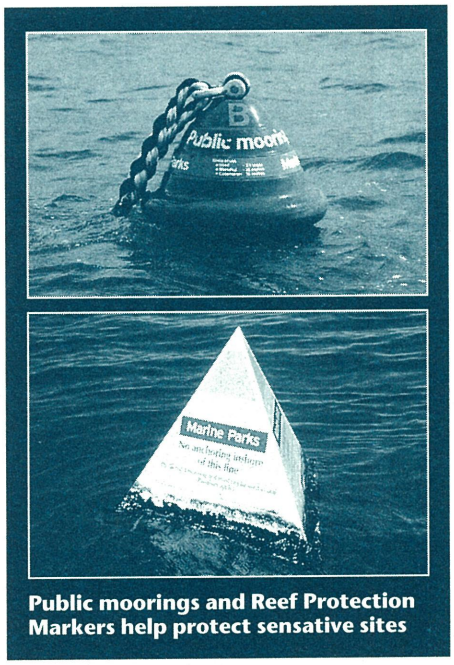
Imagine sailing in a place where you have to navigate around beautiful islands and colourful fringing reefs. A place where you can snorkel in crystal clear tropical waters and walk on beaches of brilliant white sand.

Every year these breathtaking images attract over half a million people to the Whitsundays, an area that makes up only one per cent of the Great Barrier Reef World Heritage Area but draws 50 per cent of all tourists boating in the Marine Park.

Such a high volume of traffic is a potential concern for the delicate and fragile fringing reefs that are one of the most popular attractions to the Whitsundays. One of the major problems associated with large numbers of boats visiting the Great Barrier Reef is anchor damage to the corals. Careless anchoring can cause chains and anchors to drag along the seabed, damaging the structure of the reef which can take years to repair.

To protect these fragile environments the Reef Protection Program was set up in 1993 by the Great Barrier Reef Marine Park Authority (the Authority) and the Queensland Department of Environment and Heritage (QDEH), with the initial placement of 17 public moorings and eight 'no anchoring' areas in the Whitsundays.

In recent months, thanks to generous support through grant monies from the Department of Industry, Science and Tourism (through the National Tourism Development Program) and the Department of Environment, Sports and Territories (through Coastcare), park managers have been able to place 43 additional public moorings and four more 'no anchoring' areas in the Whitsundays.



Public moorings and Reef Protection Markers help protect sensative sites

Public moorings help to reduce coral damage while maintaining continued access for reef appreciation activities. Each public mooring is marked by a blue, bell-shaped buoy with one of four colour-coded bands. The colour-coded bands let the public know what size boats can be moored there. To allow a number of boats access to each mooring, a limit of two hours per boat applies during the day (7 am – 5 pm), with unlimited use overnight (5 pm – 7 am).

Public moorings have been placed at various sensitive sites in the Whitsundays including Butterfly Bay, Luncheon Bay, False Nara Inlet (Hook Island), Blue Pearl Bay (Hayman Island), Sunlovers Bay (Daydream Island) and Black Island Reef.

'No anchoring' areas are marked by a line of white, pyramid shaped buoys (reef protection markers) displaying the blue 'Marine Parks' label. Where reef protection markers cannot be placed, the no-anchoring areas have been defined using coordinates and/or landmarks. Although anchoring is not permitted inside the line of reef protection markers, the 'no anchoring' area can be used to approach or leave a mooring or beach. Reef protection markers have been placed at a number of sensitive sites within the Whitsundays such as Maureens Cove, Pinnacle Bay, Stonehaven Bay and Langford Island Reef. No-anchoring areas at such sites as Manta Ray Bay, Saba Bay and Bait Reef are defined using coordinates and/or landmarks.

The Authority and the QDEH work together to manage and patrol the Whitsundays and to implement such projects as the Reef Protection Program. Public moorings and 'no anchoring' areas assist in allowing everyone to experience the natural wonder of the Whitsundays and the Great Barrier Reef World Heritage Area, while ensuring that the delicate and fragile fringing reefs will be just as beautiful when people next visit the area.

ON THE BOIL

WATER QUALITY AND COASTAL DEVELOPMENT CRITICAL ISSUE GROUP

FROM THE LAND TO THE SEA

The 'Water Quality and Coastal Development Critical Issue Group' is concerned with the quality of the water emptying into the ocean through the river systems adjacent to the Great Barrier Reef Marine Park, as well as activities within the Marine Park that may adversely affect water quality.

The extensive clearing of the land along the Queensland coast for cropping and grazing has led to water quality problems including widespread soil erosion and an influx of fertilisers and pesticides into the marine ecosystem.

This increase in both the suspended sediment load from eroded soil and the volume of noxious chemicals entering the marine system is believed to have had detrimental effects upon habitats in the Marine Park.

A growing Queensland population also provides potential problems for the Great Barrier Reef, not just due to extensive coastal development, but as a result of an increase in sewage, storm water run-off and litter being dispersed into the delicate marine environment.

According to Group Director, Jon Brodie, it is crucial that the Group monitor and regulate the quality of waste water and sewage discharged from heavily populated Islands and vessels within the Marine Park itself.

However, says Jon, population expansion is not the greatest adversity facing inshore habitats.

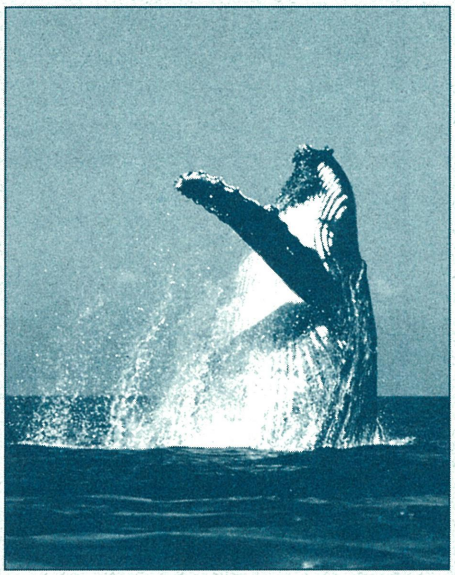
'Sewage and storm water run-off do contribute to water quality problems, but in the grand scheme of things they provide a much smaller load in comparison to agriculture'. Fertilisers and pesticides from agriculture trickle down through the catchments scattered along the coast, increasing the phosphorus and nitrogen levels in the ocean and prompting the unnatural growth of plants.

Another of the most pertinent water quality concerns to the Great Barrier Reef is the ever-present threat of a major oil spill. Management strategies to combat environmental catastrophes such as oil spills and the plumes of storm water run-off caused by cyclones, also form an integral part of the Group's research, planning and development role.

REEF BRIEF

CETACEAN CARE IN MARINE PARK

The Great Barrier Reef Marine Park Authority is developing a whale and dolphin conservation policy for the Great Barrier Reef Marine Park. The policy will provide a framework for managing a wide array of human activities that affect, or are likely to affect, any of the whale and dolphin species that occur throughout the Marine Park.



A new management policy will help to protect whales and dolphins in the Marine Park

The policy will complement Queensland's Nature Conservation (Whales and Dolphins) Conservation Plan 1997 and Management Program for the Conservation of Whales and Dolphins in Queensland 1997–2001.

The policy will also take into account the proposed National Guidelines for Cetacean Observation being prepared by 'Environment Australia'.

Consultations are being held with a variety of interested parties, including scientists, marine tour operators, fishers, and various State and Commonwealth departments.

The policy is being prepared by a consultant for the Authority, and is expected to be completed by early 1999.

For more information contact:

Tony Stokes at GBRMPA on +61 7 4750 0700 or e-mail t.stokes@gbrmpa.gov.au ■

REEF BRIEF

TOWNSVILLE HOSTS INTERNATIONAL CORAL REEF CONFERENCE

Situated on the doorstep of the world's biggest coral reef ecosystem, Townsville provided the perfect venue for the International Tropical Marine Ecosystems Management Symposium (ITMEMS), which was held in Australia for the first time from 23-26 of November.

Nearly 300 coral reef experts from across the globe descended upon Townsville to discuss the sustainable management and conservation of coral reefs and to develop further capacity to manage these reefs and associated ecosystems.

The conference was the latest step in a worldwide campaign by the International Coral Reef Initiative (ICRI) to both prevent and reverse the degradation of coral reefs, many of which already face dire threats to their sustainability.

ICRI symposiums are designed to meet the particular needs of management. Debate was stimulated by a series of inclusive, interactive discussion sessions on coral reef management case studies from around the world. ITMEMS also reviewed progress resulting from previous conferences and set an agenda for future conservation and sustainable management of coral reef ecosystems.

The outcomes of these sessions will form the basis of an action statement that will guide coral reef and related ecosystem managers around the world for the next four years.

ICRI Coordinator Richard Kenchington said that the future action would include a focus on factors contributing to coral reef decline, such as resource extraction, over harvesting, diving and boat activities.

According to Mr Kenchington, the threats to coral reefs and associated ecosystems place at risk the sustainable development of many communities, global biodiversity and the health of the oceans.

As one of the premier events during 1998, the United Nations International Year of the Ocean, the Townsville symposium is expected to have made a major contribution to understanding how coral reef ecosystems around the world are coping with climatic changes and human impacts. ■

The Group acknowledges that it is imperative that the Authority works alongside industry as well as other government agencies to conserve the Great Barrier Reef by improving the quality of the water entering the marine ecosystem.

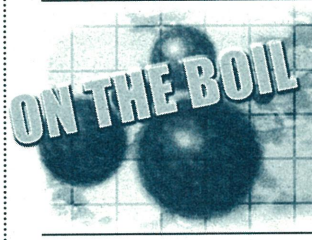
According to Jon, this objective can only be reached through a collaborative effort involving industry, government and the public to ensure that good environmental management practices are established and implemented.

For example, the sugar cane industry has already adopted a voluntary code of practice, part of which is designed to minimise the volume of pollutants entering the marine environment.

'We hope that other industries along the coast will take this example on board and implement their own codes of practice in conjunction with government', Jon says.

The Group is committed to continued catchment care and to addressing water quality issues that impact upon the Marine Park. ■

CONSERVATION, BIODIVERSITY AND WORLD HERITAGE CRITICAL ISSUE GROUP



INTERNATIONAL ACCEPTANCE IN CONSERVATION PLANNING

With a title like the 'Conservation, Biodiversity and World Heritage Critical Issue Group', one might be confused and think that this particular group deals with fairly esoteric matters like nature, the world and the Universe!

According to Director, Jon Day, 'the Group's name sounds a bit all-encompassing and theoretically could involve everything that the Great Barrier Reef Marine Park Authority does, but the Group will be focusing on what might be considered the 'green' issues ... primarily such things as the identification and protection of representative areas and threatened species in the Marine Park'.

The Group has a number of clear mandates, given that the Authority's primary obligation is to ensure the conservation of the Great Barrier Reef. As the Great Barrier Reef is the largest of the World Heritage protected areas, the Group will play an integral role in ensuring that management practices in the Marine Park are consistent with World Heritage values.

In addition to the Authority's obligations under the World Heritage Convention, the Group will need to consider a number of other relevant international agreements including the Convention on Biological Diversity, the Convention on International Trade in Endangered Species (CITES), the Ramsar Convention (Convention on Wetlands of International Importance) and the Convention on the Law of the Sea (UNCLOS).

'We are currently undertaking a program to identify the broadscale habitats occurring in the Great Barrier Reef World Heritage Area with an aim to ensuring representative areas of each habitat are protected in a way that minimises human impacts and is free from structures and extractive uses', says Jon.

The development of this representative network of protected areas is of crucial concern and has won international acceptance in conservation planning.

According to Jon, 'such a network of highly protected areas will be fundamental to the effective long-term management of the Marine Park and will ensure that marine biodiversity and World Heritage values are conserved'.

'The Authority is committed to protecting representative habitats and the ecological processes upon which species depend', he said. The formation of an expertise-based 'Reef Advisory Committee' will enable stakeholders to contribute to the identification of the information and research needs of the Authority in terms of conservation, biodiversity and World Heritage and policy development in these areas.

'The preparation of a policy for management of cetaceans (whales and dolphins) in the Marine Park in conjunction with all stakeholders is one of a number of strategies being undertaken to achieve the Group's objectives', says Jon.

The Group has also proposed strategies to ensure the cultural heritage of Aboriginal and Torres Strait Islander peoples within the Marine Park, as well as non-indigenous cultural heritage values, are maintained and enhanced.

'Both cultural landscape values and aesthetic values are important considerations in the planning and management of the Marine Park,' Jon says.

Proposed strategies will thus include the identification of culturally significant sites and values in liaison with indigenous communities and the development of conservation and protection programs for these sites.

The Group also aims to establish more effective mechanisms for achieving coordination between local, Queensland and Commonwealth agencies as well as increasing public awareness of Great Barrier Reef World Heritage values. ■

REEF BRIEF

DUGONGS ON THE WEB

The Great Barrier Reef Marine Park Authority is happy to announce that the dugong story is now on the web. Just a click of a mouse is all it takes to access the dugong web pages. The pages are overflowing with interesting information about the dugong, its habitat, threats to the animal and what we are doing to try and protect these fascinating creatures.

The dugong is a mystical creature that has long been part of Aboriginal dreaming and the mermaid tales of European mythology. Dugongs, or sea cows as they are sometimes called, can grow to three metres long and weigh up to 400 kilograms! They get their name 'sea cow' because they are mammals and feed on the seagrass beds that form meadows in warm, coastal waters.

But dugongs around the world are in trouble. Although Australia is the last stronghold for the dugong, numbers in the southern Great Barrier Reef and Hervey Bay areas are on the decline.

To halt this decline, the Great Barrier Reef Marine Park Authority has worked with other interest groups to put in place a wide range of actions including the establishment of a series of 'Dugong Protection Areas' along the Barrier Reef coastline. Maps of the recently introduced 'Dugong Protection Areas' are just one of the features of the new web site. Also included are other measures the Authority is taking to preserve dugong populations.

'The web site gives people a great opportunity to learn about, and understand the marine environment and the animals that live there', says Jon Day, Director of the 'Conservation, Biodiversity and World Heritage Critical Issue Group at the Authority'. 'We hope that this understanding will encourage people to appreciate and protect the environment and all its inhabitants.'

The dugong web site provides an exciting learning experience for all ages. The Authority encourages questions and comments, so 'log-on', take a peek at the intriguing world of the dugong and let us know what you think! ■

Dugongs on the web can be found at:
http://www.gbrmpa.gov.au/information/dugong

REEF BRIEF

GBR CONSULTATIVE COMMITTEE MEETING

The Great Barrier Reef Consultative Committee met briefly with Senator the Hon Robert Hill, Commonwealth Minister for the Environment, in Townsville on 13 and 14 August.

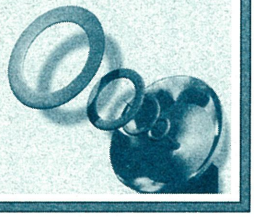
Under the *Great Barrier Reef Marine Park Act 1975*, the Consultative Committee operates as an independent advisory body for both the Great Barrier Reef Marine Park Authority and the Commonwealth Minister for the Environment.

The Committee represents a wide cross-section of interests including tourism, fishing, science, conservation, local government and Aboriginal communities.

The August meeting centred around two workshops, the first of which examined the 25-year Strategic Plan for the Great Barrier Reef World Heritage Area from the perspective of each of the newly formed critical issue groups.

The second workshop focused on the development of a work-plan for the Committee over the next three years and addressed the role of the Committee in the context of recent changes to the Authority's overall advisory structures.

Also considered were recommendations made in the report on 'The Outstanding Universal Value of the Great Barrier Reef World Heritage Area and its Application' and recent progress of programs concerning Community Rangers and moorings within the Marine Park. ■



FLOOD PLUMES, EXTENT, CONCENTRATION AND COMPOSITION: JANUARY 1998

Michelle Devlin[1], Jeremy Taylor[2] and Jon Brodie[1]
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Introduction

One of the most important processes directly impacting the Great Barrier Reef lagoon is the input of terrestrially derived nutrients and sediments into nearshore regions. This mainly occurs via river run-off, especially during periods of large-scale flooding.

The Great Barrier Reef Marine Park Authority, in conjunction with other agencies, runs a multi-institutional research effort to collect quantitative and qualitative information on the composition and spatial dynamics of flood plumes. The sampling design was initially envisaged to sample flood events and at this stage, five Great Barrier Reef cyclone-initiated events and their associated flood-waters have been studied and mapped (through aerial photography) since 1994. It is worth noting that not all flood events are cyclone related as is evidenced by the recent high rainfall and discharge events in September 1998.

The effects of terrestrial run-off on inshore coral reefs are, however, still only poorly understood and this research program aims to quantify some of these effects. This program aims to sample flood events as rapidly as possible after the onset of high river discharge to:

- define concentrations coming from individual rivers,
- categorise the plume composition,
- understand biogeochemical transformations occurring as materials are transported into the Great Barrier Reef lagoon,

and to relate this data to changes in the inshore coral reefs.

Eventually it may be possible to link land use and catchment characteristics with the composition of the plume, and to estimate the short- and long-term effects of flood waters impinging on reef biota.

This paper presents the mapped distribution of the flood plumes associated with cyclone Sid (December 1997 and January 1998) and cyclone Katrina (January 1998) as well as preliminary results from the composition and evolution of nutrient concentrations and particulate matter in the freshwater flood plumes from two Queensland rivers. A summary of the weather conditions and river flow over the duration of the flood event is presented for the Russell–Mulgrave and Burdekin catchments.

Methodology

Over the monsoonal season, weather reports were monitored closely and all low pressure systems monitored. Heavy rain caused by Sid and Katrina in early January of 1998 was the catalyst for the flood monitoring contingency plan to be set into motion. As soon as logistically possible after the onset of flooding, aerial mapping of the flood plume in terms of spatial and temporal movement and sampling for water quality parameters commenced.

Cyclone Sid and cyclone Katrina

Cyclone Sid developed to the north of Arnhem Land on 26 December 1997 and moved south-east through the Gulf over the next three days. The cyclone subsequently weakened and formed a rain-bearing depression over land on 29 December, and slowly moved south for the next week. As a rain depression it caused widespread wind and rain damage in the areas between and including the Barron and Burdekin catchments. There was widespread flooding in these rivers with heavy rains falling on the upper Burdekin catchment, resulting in significant floods south of Ingham and north of Ayr.

Cyclone Katrina developed in the Coral Sea on 3 January 1998 approximately 700 kilometres due east of Cairns. The cyclone intensified over the next week and this produced heavy rains along the north Queensland coast. The cyclone weakened and intensified as it travelled erratically around the Coral Sea over the next 14 days.

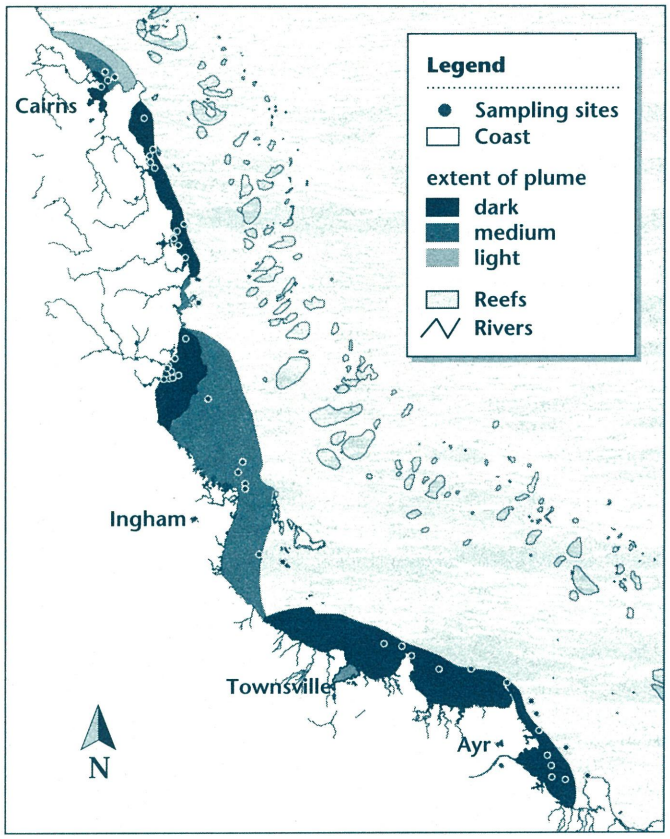


Figure 1. Extent of Sid plume recorded over 13 and 14 January 1998

Its movement in the Coral Sea partly contributed to the rain falling over the Queensland coast, though most flooding rivers were receiving heavy rains from ex-cyclone Sid.

Plume mapping and sampling

Flood plumes discharged from catchments between Ayr and Cairns following cyclone Sid and cyclone Katrina were mapped along and outwards from the Queensland coast on 13 and 14 January (figure 1). Mapping of the areal extent of the plumes was achieved by tracking the obvious brown turbid water masses contrasting with clear reef waters. The locations of the plume fronts were fixed with Geographic Positioning Systems (GPS) and loaded into a Geographic Information System (GIS) where the plume coverage was calculated.

The main focus of sampling the inshore plume was to take water samples of the initial intrusion of the freshwater plume and to identify concentration gradients of water quality parameters. Salinity and temperature depth profiles were also recorded.

Water samples were collected 0.5 metres below the seawater surface in clean containers at each sampling site. Water samples were collected from multiple sites from plumes originating from the Burdekin, Herbert, Tully, Johnstone, Russell–Mulgrave and Barron rivers. Water samples were collected for an initial three days at the onset of flooding, with further collections off Townsville and the Burdekin over the next two weeks.

Water samples were analysed for salinity, temperature, suspended solids, chlorophyll *a* and phaeophytin, dissolved inorganic nutrients (ammonia, nitrate, nitrite and phosphate), dissolved organic nitrogen and phosphorus, particulate nitrogen and phosphorus. Laboratory analysis procedures are outlined in detail in Devlin and Lourey (1996).

Results

Results presented here summarise data collected in flood plumes adjacent to the Russell–Mulgrave River and the Burdekin River. This provides a good contrast between a wet tropic river, which floods annually, and a dry river, with a greater catchment area and more infrequent flood events from a drier catchment (table 1).

a. Weather characteristics

Areal extent of the flood plume is governed by many factors. Flood plumes will generally advect northwards due to Corolis force and barotropic hydrodynamics and the slope of the coastline (Wolanski and van Senden 1983). However, each individual event has a range of conditions that affects the cross-shelf dispersion of the plume, including magnitude and duration of the rainfall event and wind (table 2) (Devlin 1997; Steven et al. 1996; Brodie and Furnas 1996). Catchment characteristics can

Table 1. Comparison of land use areas and other statistics for wet tropics and Burdekin rivers (* Source: Tarte et al. 1996)

Catchment	Land use areas (km²)							Mean annual flow (1000 ML)	Mean annual run-off (ML/km²)
	Pristine*	Grazing			Cropping*	Urban	Total*		
		DPI estimate	Un-allocated	Total grazing					
Burdekin–Haughton	2344	118060	11672	129732	1384	50	133510	10850	0.08
Ross–Black	530	850	1400	2250	10	100	2890	1100	0.38
Herbert	1584	7970	114	8084	447	15	10130	5000	0.41
Tully–Murray	1861	530	273	803	151	10	2825	2300	1.88
Johnstone	916	570	465	1035	359	20	2330	4700	2.02
Russell–Mulgrave	982	160	550	710	313	15	2020	4200	2.08
Barron	869	1200	110	1090	116	100	2175	1150	0.53

also have a defining role in extent and composition of the plume.

Table 2. Characteristic wind speed and direction in the Great Barrier Reef lagoon during plume movement with associated cyclones

Year	Associated cyclone	Wind speed (knots)	Wind direction
1994	Sadie	10	NW–NE
1995	Violet	20–25	SE
1996	Ethel	20	SE
1997	Justin	30–75	E
1997	Sid	30–45	E–SE
1998	Katrina	40–90	E–SE

The Burdekin River (130 000 km^2) is one of the largest catchments (other than the Fitzroy) draining into the Great Barrier Reef (Hausler 1990). Annual discharge from this river varies considerably from year to year, with major flood events separated by long, drier periods with little river flow (figure 2a). Major flooding in the Burdekin catchment can result in high discharge rates persisting over several weeks. In 1998, low salinity, turbid water was being measured for up to three weeks after initial flooding at large distances away from the river mouth (Devlin, personal observations). In contrast, annual discharges from a wet tropic river, such as the Russell–Mulgrave, are much smaller and short-lived.

Figure 2b demonstrates how the Russell–Mulgrave River displays episodic flooding with one or more major flows occurring almost every year. Figure 3 presents the flow rates for the Burdekin (figure 3a) and Russell–Mulgrave rivers (figure 3b) over December and January.

The dominant factor in the development of a flood plume is rainfall as this induces river run-off, which subsequently discharges its suspended load to the marine environment. Heavy rains fell on the Russell–Mulgrave and Burdekin catchments from 7 to 15 January, following persistent rainfall in late December (figure 4). In the Burdekin catchment, heavy rains fell in the upper catchment and resulted in peak flow rates from 10 to 12 January. Figure 3a shows just how quickly the Burdekin River can reach peak flow and the amount of water that can be discharged. Rainfall in the Russell–Mulgrave catchment was not as heavy as in the Burdekin area but flow did increase rapidly (figure 3b).

Predominant east and south-east winds worked to constrain the plume in a northerly onshore direction. The extent of the Burdekin plume was large and was furthered by the high amount of rain that fell over Townsville (figure 4b) which resulted in large flooding of all surrounding rivers. Flooding from Townsville rivers added significantly to the extent and movement of

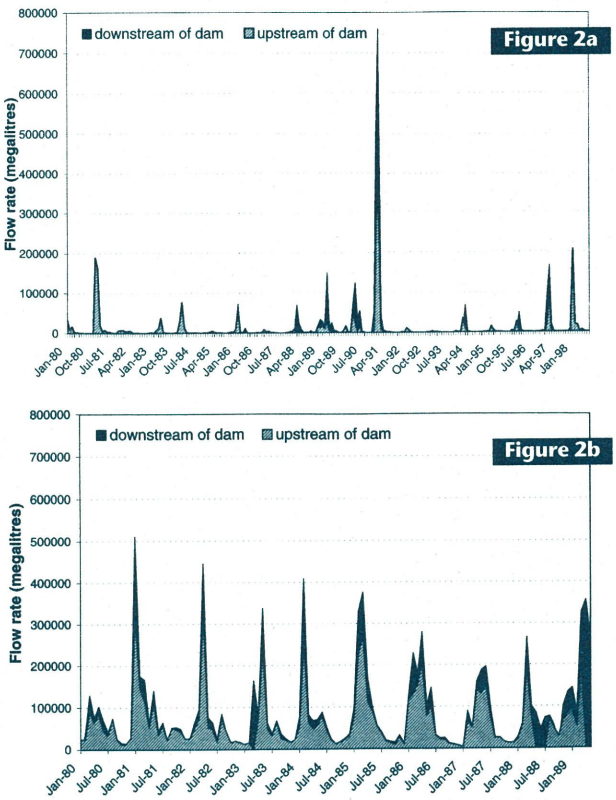


Figure 2. Monthly averages of flow rates between 1980 and 1998 for upstream and downstream sites on the Burdekin **(a)** and Russell–Mulgrave **(b)** rivers

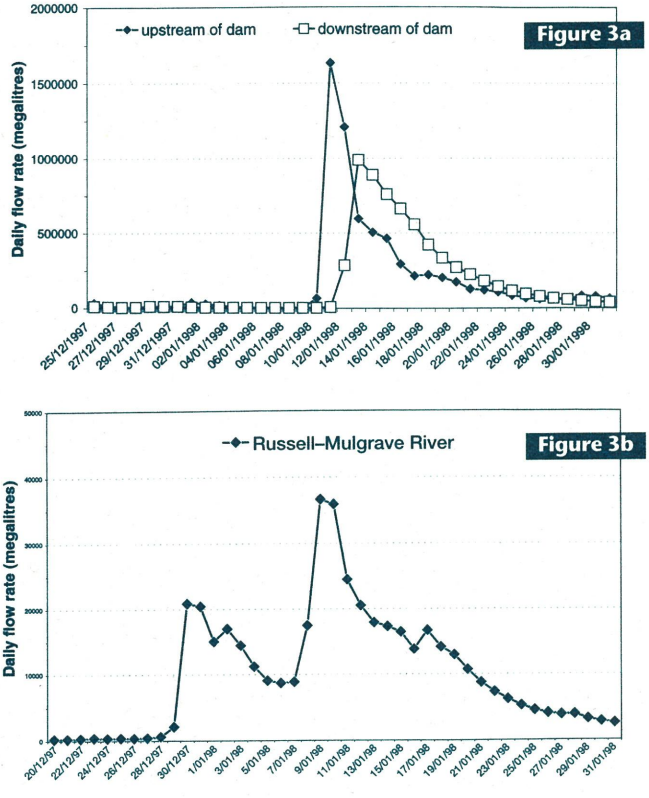
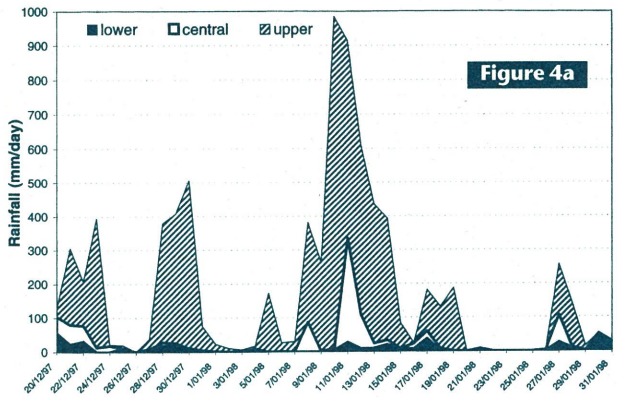


Figure 3. Daily flow rates for Burdekin **(a)** and Russell–Mulgrave **(b)** rivers from 25/12/1997 to 30/01/1998 on upstream and downstream sites



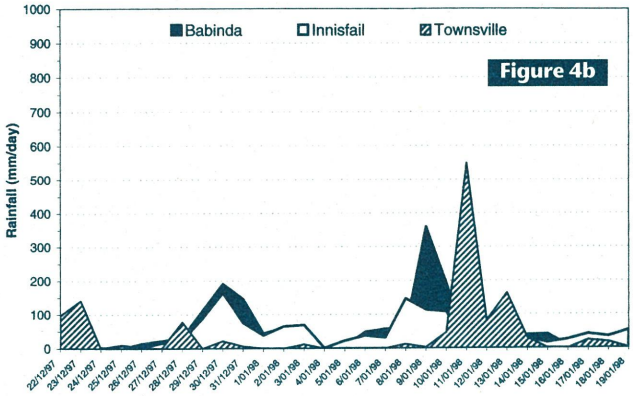


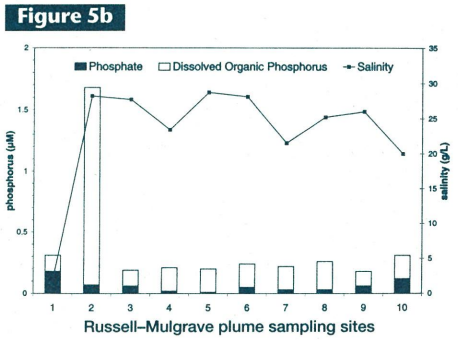
Figure 4. Variations in rainfall over the wet tropics and Burdekin catchment areas from late December to early January. Daily rainfall over the Burdekin **(a)**, Russell–Mulgrave (Babinda), Innisfail and Townsville **(b)** catchments from 22/12/97 to 30/01/98

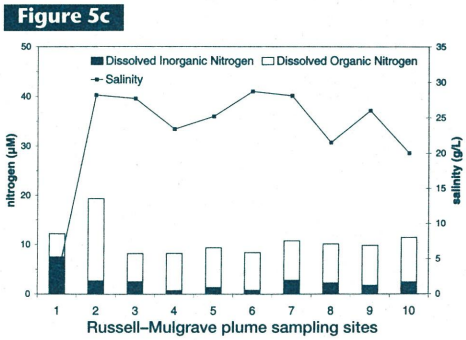
the northward constrained Burdekin plume.

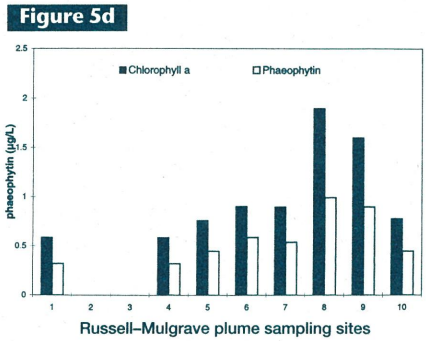
b. Characteristics and extent of plume

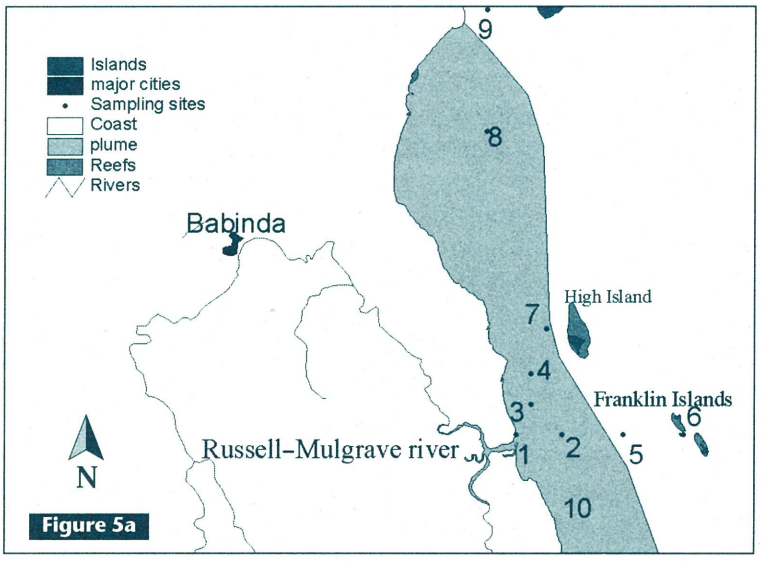
The plume emanating from the Russell–Mulgrave had a reduced extent and composition (figure 1) but did merge with other wet tropics plumes in a northerly direction in a very constrained nearshore band. It is worth noting that the aerial fly over and water sampling of the northern flood plume was done on 13 and 14 January, three days after peak flows, and may not be representative of the total extent of the plume and maximum concentrations. Previous work has shown (Taylor and Devlin 1997; Brodie and Furnas 1996; Devlin 1997) that the timing of sampling is critical to obtaining reliable estimates of material exported in the flood plumes.

Due to this time lag, concentrations measured in the Russell–Mulgrave plume were considered to be more representative of a several day old plume mass. Salinities ranged from 2 to 28.7, with a general trend of increasing salinity away from the river mouth. The low salinity was measured close to the river mouth, with all other sites ranging from 20 to 27.8, indicating that water mixing processes have been occurring.









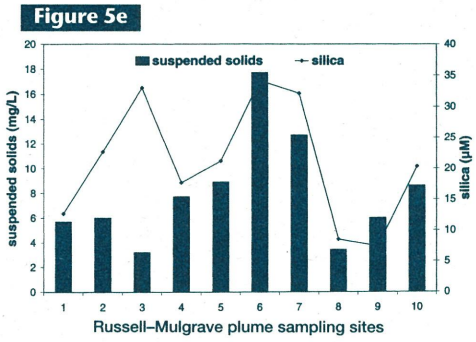


Figure 5. a. Extent of Sid plume from the Russell–Mulgrave catchment with sampling sites (lowest number = closest to river mouth) **b.** Concentrations of dissolved inorganic and organic phosphorus measured at sampling sites in gradients out from river mouth **c.** Concentrations of dissolved inorganic and organic nitrogen measured at sampling sites **d.** Concentrations of phytoplankton measured at sampling sites **e.** Concentrations of suspended solids and silica measured at sampling sites

Table 3.

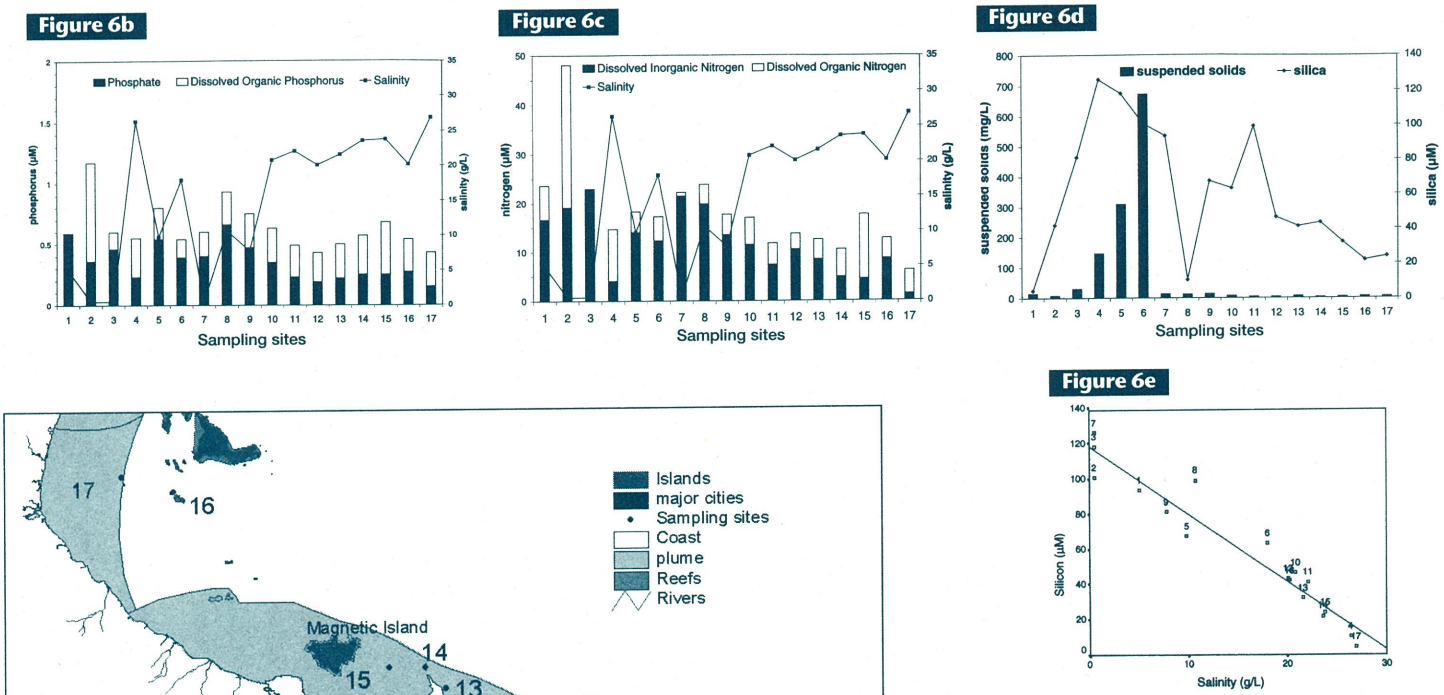
Range of values measured inside Russell–Mulgrave and Burdekin plumes in 1998 compared to long-term mean concentrations (*Furnas et al. 1996)

Parameter	Cyclone Sid and Katrina plume sampling		Long-term mean values*	
	Russell–Mulgrave	Burdekin	Cairns	Innisfail
Salinity	2–28.7	0.5–26.4	34.7	34.8
Suspended solids (mg L^{-1})	3.2–17.7	2.9–672	0.6	0.7
Silica (µM)	17.7–33.0	10.5–126.1	3.1	2.5
Ammonia (µM)	0.48–2.7	3.29–12.79	0.05	0.07
Nitrate + Nitrate (µM)	0.05–4.80	0.53–12.46	0.08	0.08
Dissolved organic nitrogen	4.71–16.67	0.75–28.93	5.5	5.5
Phosphate	0.01–0.18	0.19–0.66	0.09	0.12
Dissolved organic phosphorus (µM)	0.13–1.61	0.01–0.81	0.08	0.32
Chlorophyll *a* (µg L^{-1})	0.59–1.96		0.4	0.34
Phaeophytin (µg L^{-1})	0.29–0.96			

Dissolved nutrients are generally slightly higher than ambient concentrations, with sites 1 and 2 having significantly higher concentrations of inorganic nitrogen and phosphorus. In particular, Site 2, which is north of the river mouth, has the highest concentrations of inorganic nutrients. This is most likely to be related to the northward movement of the plume and desorption of the inorganic nutrients from the particulate phase as the river water mixes with seawater (Cosser 1989).

Salinities in the Burdekin plume range from 0.5 to 26.4, generally increasing northwards away from the mouth, though there were low salinities measured at sites 7 and 8, which are just north and outwards of a small flooding tributary (figure 6).

Elevated levels of dissolved inorganic phosphorus were recorded at nearly all sites, with levels greater than 0.5 µM adjacent and north of the Burdekin River (figure 6). Dissolved phosphorus at the mouth is present only as dissolved inorganic phosphorus with non-detectable concentrations of dissolved organic phosphorus. Currently the calculation of particulate nutrients for this study is unavailable. However, other studies have shown



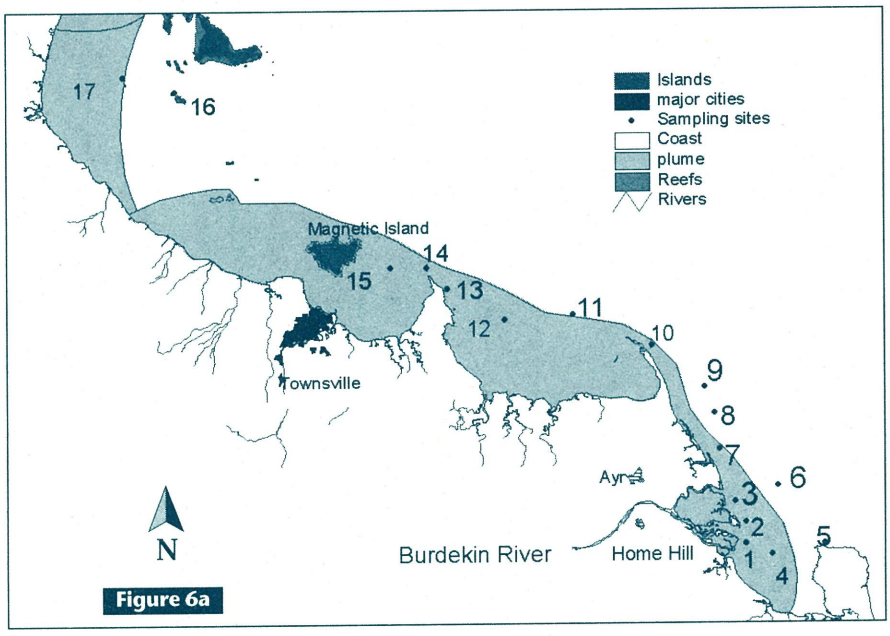


Figure 6. a. Extent of Sid plume from the Burdekin catchment with sampling sites (lowest number = closest to river mouth) **b.** Concentrations of dissolved inorganic and organic phosphorus measured at sampling sites in gradients out from river mouth **c.** Concentrations of dissolved inorganic and organic nitrogen measured at sampling sites **d.** Concentrations of suspended solids and silica at sampling sites **e.** Pattern of distribution of silica and salinity in relation to distance from river mouth

that particulate phosphorus concentration is the largest concentration of all phosphorus in the river (Brodie and Mitchell 1992; Furnas et al. 1996). High phosphate (PO_4) in the plume is a result of both high PO_4 in the river plus desorbed PO_4 from the particulate stage. Desorption of PO_4 from particulate phosphorus is a commonly observed process in river plumes (Brodie and Mitchell 1992). This desorption process may allow phosphorus to remain in the water column as the plume moves offshore rather than settling near the coast via sedimentation processes.

Levels of dissolved inorganic nitrogen were very high in Burdekin plume samples. The number of sites with elevated nutrients suggests clear evidence that the high nutrient composition of the Burdekin plume does carry over lengthy spatial and temporal scales. Suspended sediment levels were high with significantly elevated concentrations adjacent and north of the flooding river. Reefs and seagrass beds in the Great Barrier Reef lagoon will have experienced dissolved inorganic nitrogen concentrations greater or equal to 5 µM for periods of up to two weeks. At these levels, significant detrimental effects on the biota would be expected.

The relationship between salinity and dissolved silica (figure 6e) displays typical characteristics exhibited by conservative mixing behavior. The slope of the relationship indicates that the waters are being physically mixed with little deviation from the theoretical dilution time. Given the wide expanse over which samples are collected, the extent of normal estuarine mixing appears to have moved offshore and north to Magnetic Island.

Conclusion

This is a very brief summary of the data that has been taken over the previous wet season. Further analysis of the samples for particulate concentrations will show a more complete picture of nutrient transport into the reef lagoon from the flooding rivers. Movement of the visibly discernible plume over the following fortnight and changes in water quality concentrations will also be presented in a later publication. This is still a major area of research and many questions are still to be answered. The subtle, indirect effects of elevated nutrients on the biota in the lagoonal system is not clear and the long-term effects of chronic stress upon the communities are largely, if not entirely, unknown.

Acknowledgements

Thanks to everyone who helped collect samples even in the most unpleasant weather, David Haynes for advice and support, the Department of Natural Resources for access to the flow data and the Great Barrier Reef Marine Park Authority for support of this project.

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MEDIA RELEASE

Guide for volunteer divers to monitor coral reefs

A research report to help marine tourism operators and volunteer groups develop coral reef monitoring programs has been launched by the Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef (CRC Reef Research Centre) in Townsville.

A report, recently released by the CRC Reef Research Centre, will assist tourism operators and volunteers groups develop dive volunteer-based monitoring programs

The project that led to the report was initiated in response to growing interest by recreational divers to become more involved in monitoring the condition of coral reef sites they visit. A set of scientific protocols has been developed to help groups plan reef survey programs, collect useful data, train local participants and ensure quality control.

CRC Reef Research Centre researchers Drs Barbara Musso and Graeme Inglis of James Cook University conducted a feasibility study into developing reliable coral reef surveys with support from the former Commonwealth Department of Tourism, several reef tourism operators and community groups in 1997. They have designed quantitative methods for volunteer divers to use to monitor the amount and type of coral and other marine organisms. These methods use a modified line transect intercept technique which involves observing and recording organisms beneath several transect lines at various sites on a regular basis.

The researchers say that with only limited training, volunteers can provide quantitative estimates of the total percentage cover of corals that are comparable in accuracy to estimates obtained by marine scientists.

'Coordinated programs of sampling by volunteers using these techniques have the potential to complement existing scientific monitoring programs in the Great Barrier Reef Marine Park by providing information on natural patterns of change from a greater range of sites, and at more frequent time intervals, than is currently possible', Drs Musso and Inglis state.

However, the researchers point out that several conditions must be met by each group to ensure quality control and useful results can be obtained. They suggest their pilot program cannot be used reliably by divers with less than 30 hours SCUBA experience.

They also say it is unsuitable for visitors on dive trips of less than three days duration as the time required for training and underwater surveys does not fit the tight schedules of many dive operators. Furthermore, they found some divers are unwilling to get involved in volunteer research on short trips. Sustained monitoring programs require a long-term commitment of resources and enthusiasm from all involved. These factors are crucial to any program's success.

Mr Dave Windsor, Executive Director of the Association of Marine Park Tourism Operators, says that the report will encourage extended dive tour companies to adopt sites for monitoring. 'It will also augment existing projects, such as the "Eye on the Reef" monitoring program in Port Douglas, used by day-tour operators', he said.

A short training program developed for the study is outlined in the report. The report includes a handbook, photographic guide and instruction manual for tour operators. The researchers emphasise the importance of rigorous training to ensure accurate and useful survey data are collected. Guidelines for the sampling design of volunteer-based monitoring have been prepared which aim to reduce the effect of bias identified during the feasibility study.

The CRC Reef Research Centre report, *Developing Reliable Coral Reef Monitoring Programs for Marine Tourism Operators and Community Volunteers*, provides a framework for developing future dive volunteer-based monitoring programs. But the report does not give ready-made answers for every dive operator or community group. Volunteer programs work only if they meet the needs and aspirations of individuals and associated groups involved. Arrangements must be made to manage the program, to design survey methods and train participants. Some centralised coordination is necessary to ensure that information obtained from different groups is comparable. Enthusiasm must be maintained. Survey data must be used and feedback given to volunteers. Regular reporting on the findings, media publicity and recognition must be arranged to instil a sense of ownership with participants.

Drs Inglis and Musso say that although resources and advice may be given to groups to set up and run a monitoring program, the principle responsibility lies with those carrying out the surveys – the volunteers.

For further information please contact Dr Graeme Inglis on +61 7 4781 4705 or Don Alcock on +61 7 4781 4976.

Please report stranded, injured and dead marine wildlife in the Great Barrier Reef region by phoning the stranding hotline on 1300 360 898*. This will greatly assist marine park authorities with enforcement of regulations and the collection of scientific information.

* Cost of a local call