Great Barrier Reef Marine Park Authority

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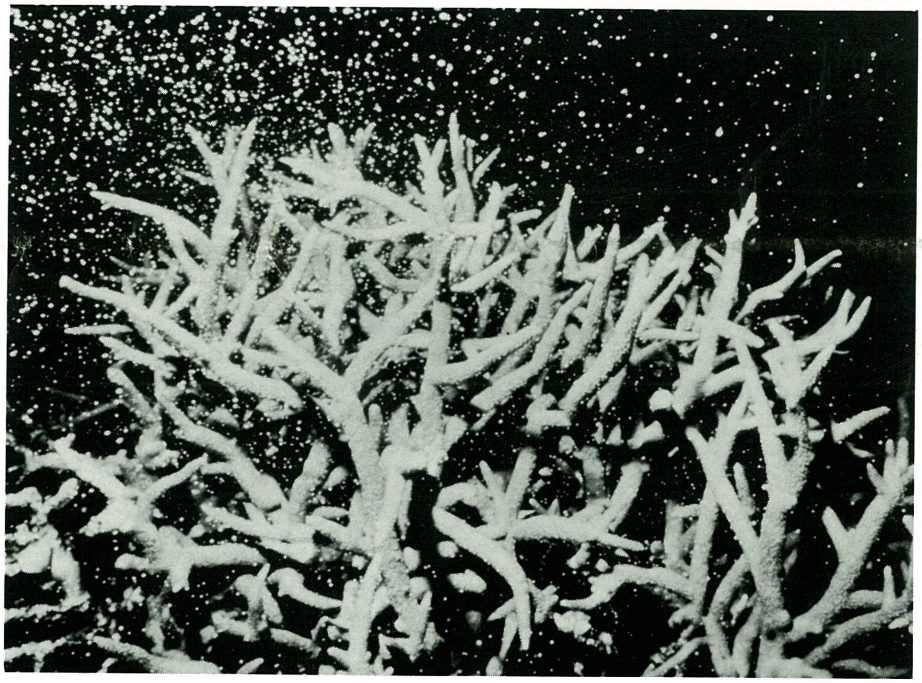
Reeflections

Reeflections

CORAL SPAWNING IN THE WONDERLAND AQUARIUM

AQUARIUM



On the evening of 10 December the Great Barrier Reef Aquarium resembled a snow storm as many of its corals spawned at the same time as those on the Reef itself. Great Barrier Reef Marine Park Authority staff and Aquarium volunteers assembled at the Aquarium to observe and record a world first for a public aquarium: the mass spawning of hard corals that occurs 3-6 nights after the full moon in summer on the Great Barrier Reef.

The Aquarium holds the world's largest living coral reef ecosystem on land. Since the Aquarium opened in June 1987, development of the coral reef tank has continued with new corals and fish being added on a monthly basis. This reef on land has been designed to precisely replicate the Reef, by using natural lighting and wave motion. Eventually a tidal range will be introduced to the tank.

In the weeks leading up to coral spawning season, Assistant Curator, Dr Vicki Harriott, observed the corals closely and was optimistic that most of the corals in the tank would spawn.

The fact that corals in the tank spawned on cue confirms that the conditions in the tank are close to ideal. In addition, it shows that many of the corals have overcome the stress of transplantation from the Reef during the time of development of their reproductive products.

From about 8.30 pm, the corals packaged their eggs and sperm into small bundles, then these were slowly extruded through the mouths of the polyps. The egg bundles float to the surface where they break up, and if they are lucky, the eggs are fertilised. The spawning event also aroused the interest of many of the Aquarium's fish who were observed feeding on the eggs.

The small larvae produced after fertilisation float and swim in the water for 4 to 7 days before seeking a place to settle. A special set of removable settlement plates have been added to the tank to record the number of types of corals that have completed their reproductive cycle and established a new colony in the tank.

Aquarium biologist Dr Jan Morrissey said that the 17 observers were kept busy recording the details as each coral colony spawned. 'It was a spectacular sight and we are delighted with the extent of the spawning.' If similar breeding success occurs for other species, within a few years the reef tank will be able to seed itself and will even more closely resemble a little piece of the Great Barrier Reef.

Dr Harriott hopes that it may be possible in the future to make this special event in the life of the corals available for the general public. However there are a few difficulties. The timing of spawning is generally predictable only within 3 or 4 days, and it is possible that the extra lighting around the reef tank will make the timing even more variable, so on some nights few or no corals might spawn. If the problems can be resolved, the Aquarium could present a unique opportunity for many people to observe this fascinating process.

TRACKING CORAL SLICKS

RESEARCH

Aerial photograph of a coral spawn slick in the lagoon at Bowden Reef.

Bette Willis
James Cook University

Each year, over a period of several nights in the latter part of spring the Great Barrier Reef sports a magnificent reproductive event. During this time at least one third of the corals on the Reef spawn in synchrony. Three to six nights after a full moon the corals release their gametes, en masse, into the ocean water above the reefs. The following day slicks of eggs and developing embryos (elongate pink or white streaks) can be seen on the water's surface.

The fate of these eggs and sperm, in the few days between spawning and settlement of the coral planulae may determine the degree of dependence between reefs. Tracking the movement of the slicks was one objective of researchers involved in the coral spawning experiments undertaken during November 1986.

CORSPEX 1986

CORSPEX (CORal SPawning EXperiments) was a collaborative, multidisciplinary project in which biologists and physical oceanographers combined their skills to determine the fate of coral larvae after spawning. Bette Willis (JCU) and Eric Wolanski of the Australian Institute of Marine Science led a multidisciplinary and international team of scientists: Jamie Oliver (JCU), Derek Burrage (AIMS), Tom Shay of the University of Western Australia, Howard Choat (JCU), Bill Hamner and Peggy Hamner of the University of California, Thomas Lee (University of Miami) and several students from JCU. Funding was provided by GBRMPA, AIMS and the Marine Sciences and Technologies Grant Scheme. The biological studies of CORSPEX addressed the general question: Do coral larvae spawned during the annual mass spawning of corals on the Great Barrier Reef disperse away from their source reef during the obligate planktonic stage of their life cycle, or are they retained within the parent reef system? Sampling was directed towards determining the significance of coral spawn slicks for the transport of larvae between reefs.

Setting Up

Bowden Reef, an oval-shaped reef east of Townsville in the Central Section of the Great Barrier Reef Marine Park, was selected as the major study site. For the dispersal studies, Bowden Reef was targeted as the source reef and Stanley Reef, 26 km to the south-east, was targeted as the sink reef. On the first two days of the expedition, dry runs of all procedures were held to familiarise participants with plankton sampling equipment. Physical oceanographic teams set out current meters and released surface and subsurface drogues to gather background information on the prevailing circulation patterns around Bowden Reef. Their results provided invaluable information for predicting the movements of the coral larvae. Dive sites were established at Bowden and Stanley Reefs and underwater trails were set up to monitor spawning during night dives. Approximately 100 coral colonies were tagged and samples taken to check for spawning readiness.

The Mass Spawning

The majority of corals spawned on the 19th and 20th of November at Bowden Reef. On these nights, eggs accumulated at the sea surface in scattered patches extending for several kilometres. In less than two hours, this material was swept together into slicks located both over and around Bowden Reef. At least two physical phenomena contributed to the process of slick formation. A boundary mixing effect, and the deflection of warm lagoon water flowing over the reef slope by tidal currents running along the reef slope, caused coral eggs to be accumulated into fronts oriented parallel to the reef face. The accumulation of eggs and developing larvae in these fronts were visible as slicks the next morning.

Tracking the Slicks

Aerial surveys were used to locate and map the positions of coral spawn slicks on the mornings following spawning. VHF radios were used by the plane team to direct researchers in speedboats to the larger slicks, and these were then sampled and tracked. Slicks generally dispersed and were no longer visible as surface features 20 hours after the spawning. However radar drogues were placed in slicks before they disappeared so that water parcels containing larvae could be tracked further. Larvae were found adjacent to these drogues 36 hours after spawning. In contrast, sampling at predetermined stations in interreefal waters yielded few larvae, suggesting that although slicks were not visible, the larvae were still distributed in patches.

A major finding of the study is that large numbers of coral larvae are transported away from their source reefs, and these larvae can in a few days reach down current reefs where they presumably settle. However, the story is not simply one of coral reefs connected by free-drifting clouds of coral larvae kept together by various physical phenomena. Planulae were also found in the lagoon of Bowden Reef at the end of the study period (five days after the initial spawning) despite intense predation of these larvae by reef fish and invertebrates. Although the origin of these larvae is not known conclusively, it is possible that self-seeding of reefs may occur concurrently with between-reef dispersal of coral larvae, at least for reefs which have a lagoon.

Implications for Management

CORSPEX 1986 showed that coral larvae do disperse between reefs. We have demonstrated quite clearly that there is bulk export of larvae away from the source reef in strong wind conditions, and in slicks when winds are light. However, the question which must be addressed before we can categorically state that reefs are interconnected, is whether larvae are still competent to settle following their transport away from the source reef?

Wind Effects

The strength of the connection between reefs will vary from year to year, dependent primarily on wind events. Wind has the greatest potential to introduce variability into the system. When wind events are strong, it is likely that there is extreme dilution of larval concentrations.

Such factors could contribute significantly to the variability in recruitment patterns which have been recorded for corals, and must be considered if one is evaluating the possibility that damaged reefs may be repopulated solely through larval recruitment.

Currents

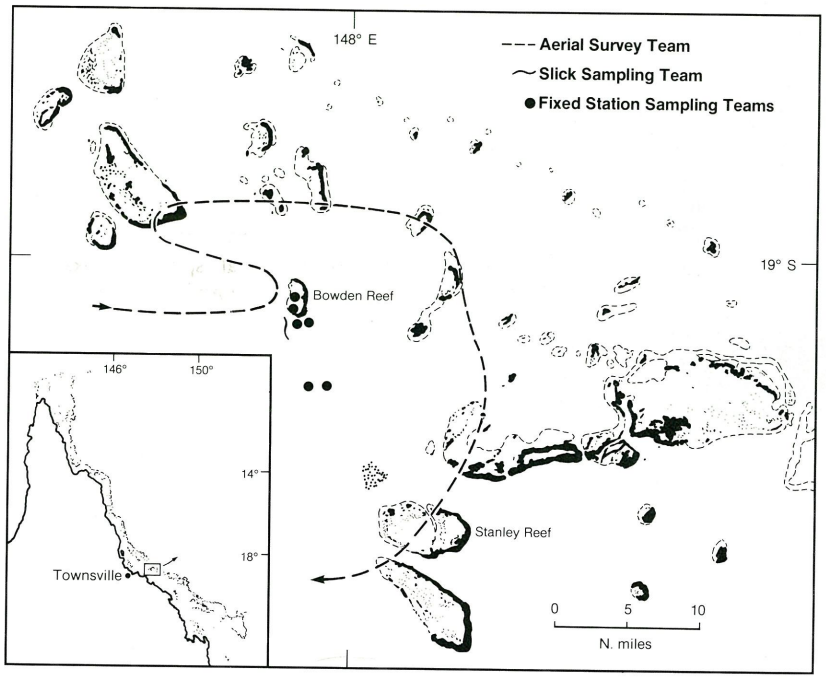
In light wind conditions we saw that Bowden Reef had a 'cone of influence' which extended down-current from the Reef. Tracking of surface drifters suggested that larvae from Bowden could have been transported to Stanley Reef or more easterly to Darley Reef. It is obvious that the geographic location of reefs with respect to the prevailing currents and to up-current reefs will influence the degree of connection between reefs.

Self-Seeding

Self-seeding may occur concurrently with between-reef dispersal of coral larvae for reefs such as Bowden which have lagoons capable of trapping larvae. However, further research is required to clarify the origins of larvae which are found within the lagoon following spawning. The relative contributions of imported and self-seeded larvae to recruitment on a given reef is an important issue. We are not in a position to be able to answer this question, other than to say that it too may vary with ambient wind and current patterns at the time of the mass spawning.

From a management point of view, the important result from larval dispersal studies concerns the question of whether or not reefs are interconnected. The overriding concern must be whether reefs can be managed on an individual basis, or whether they should be managed in larger units.

The answer to the question whether or not reefs are independent or interconnected can be used in several ways in the preparation of zoning plans. In the long term, it makes little sense to protect an isolated reef, if the up-current reef which is providing the majority of its recruits is heavily exploited. On the other hand, in the short term, it may be reasonable to exploit a down-current reef if up-current reefs are not exploited. But in either case it is necessary that a group of reefs be managed as a unit if the objective is to maintain a renewable resource of larvae.



SUMMARY OF PRELIMINARY RESULTS

Larval Transport in Slicks

- During periods of light winds, large numbers of coral larvae were transported away from source reefs in coral spawn slicks.
- Slicks only formed under calm conditions, and once formed rapidly dispersed when winds rose above 10-15 knots.
- Up to 2 days after spawning, larvae could be found in the vicinity of drogues which had originally been placed in slicks. In one case the larvae had drifted 26 km to the south-east.
- Coral spawn slicks were consistently associated with oceanographic features such as fronts, eddies and wakes behind reefs.

Oceanographic Patterns

- Before spawning: A closed circulation around Bowden Reef prevailed, which was dominated by tidal currents.
- During spawning: An increase in the south-easterly mean current, coincident with neap tides.
- After spawning: A south-easterly longshore mean current dominated the subsequent drift of coral spawn.
- Wind events may be significant, depending on wind strength and direction.
- Leeward eddies were unstable.

Patterns of Larval Distribution and Abundance

- When winds rose above 15 knots, larval concentrations within the lagoon and close to the reef were extremely low.
- Concentrations of larvae persisted within Bowden lagoon and close to the southern reef front for at least 5 consecutive days under light to moderate winds.
- Larvae were concentrated in the surface layer on the first day following spawning, but were relatively evenly mixed throughout the water column by the fourth day.

NEW EVIDENCE ON THE CROWN OF THORNS STARFISH

RESEARCH

A selection of skeletal elements from the crown of thorns, photographed using a scanning electron microscope. The size ranges from about 2 mm to 25 mm. Individual elements have been aged using experimental accelerator mass spectrometry.

The latest findings on the crown of thorns starfish were discussed at a special session of ANZAAS 'Science and Life in the Tropics'. Research reports covered evidence of past outbreaks, effects of the starfish on long-lived corals, distribution of outbreaks, possible predators and biological control, as well as the effects on Reef tourism. The lessons were clear. The crown of thorns starfish issue raises fundamental questions about coral reefs, one of the most complicated of all ecosystems and requires a broad-based, long-term program of research to find solutions for Marine Park management.

Evidence of past outbreaks

Geologists have found new evidence that large numbers of the coral-eating starfish were present on some reefs of the Great Barrier Reef long before European people came to Australia.

Associate Professor Robert Henderson and Peter Walbran of James Cook University told the meeting they had found large numbers of fragments of the starfish from below the sediment surface of Green Island and John Brewer Reefs. A new experimental dating technique used for the first time in Australia and New Zealand confirmed that the spines were several thousand years old.

Mr Graeme Kelleher, Chairman of the Great Barrier Reef Marine Park Authority which funded the study, stressed that the findings were very significant as it is the first firm evidence to suggest that outbreaks may have occurred in the past. He added a note of caution that it was still not clear whether or not the abundance of skeletal fragments represent outbreaks equivalent to the current ones.

'Future work in this project will address this question', Mr Kelleher said. 'Nevertheless, the initial findings do indicate that we should be viewing the crown of thorns starfish as a species naturally tending to occur in outbreaks and we should now be trying to determine if people have had any influence on the current situation.'

The research has been exhaustive because of the intense debate on whether the outbreaks are natural events, or the result of recent human activities. Firstly the geologists examined the surface sands of reefs known to have suffered outbreaks of the starfish in recent years to determine if the remains of their skeletons were left in the sands.

Teams of assistants were employed to scan sand samples grain-by-grain, and the starfish skeletal fragments were found to be abundant in many of the samples from Green Island and John Brewer Reefs.

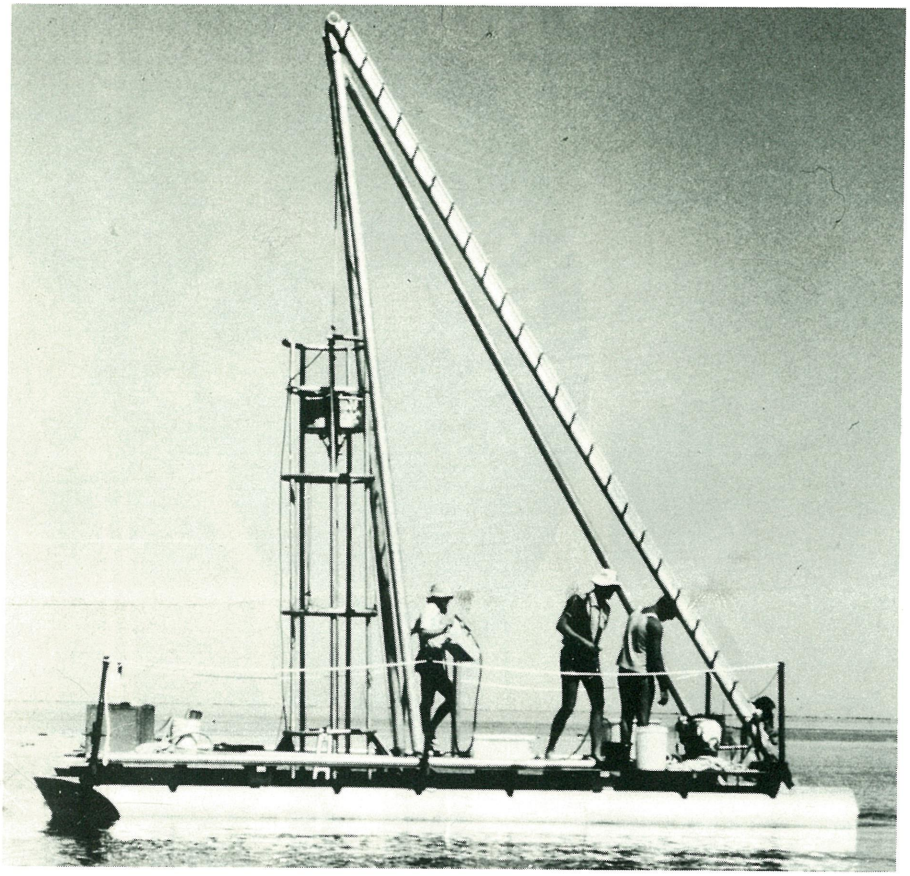
They then sampled at Heron Island, a reef which had not experienced a recent outbreak, and found only two minute fragments in all their samples. From this they concluded that a normal starfish population left very few fragments in evidence.

Confident that outbreaks left a permanent record in reef sands, Henderson and Walbran then began searching 'back in time' beneath the surface. Cores from the Green Island and John Brewer Reefs produced similar numbers of fragments to the surface samples down to several metres beneath the surface of the sand.

'It might be argued that these fragments actually came from the recent outbreaks of starfish as it is thought that coral sands are frequently turned over by sand burrowers and cyclones. However the age of the fragments was confirmed to be between 1500 and 7700 years old using the new dating technique,' Associate Professor Henderson explained.

The work has been time-consuming and expensive because of the high cost of research vessels, the intensive labour in searching for the fragments, and the dating — at about $1000 per sample. The committee of review for the Great Barrier Reef Marine Park Authority's research program on the starfish has resolved to continue funding this research.

This work will extend to other reefs to see if the conclusions on the first three are general or specific.



Vibrocoring platform at Green Island. The corer is lowered from the A-frame to the sea floor of the reef. Motors in the head spin in opposite directions causing it to vibrate and thereby push an aluminium pipe into the sandy bottom. The corer is winched out and the sediment-filled core removed.

Corals provide a clue to modern outbreaks

Some of the long-living massive corals on the Great Barrier Reef may carry scars of crown of thorns outbreaks before the 1960s. Dr Terry Done of the Australian Institute of Marine Science has observed interruptions in the growth of the giant corals which indicate that many had been partially killed at intervals before the recent outbreaks, though the cause of death could not be identified.

Although the damage to the massive corals is less that that suffered by the faster-growing branching corals (the staghorns), Dr Done has found the massive corals take much longer to recover. Their populations may take about 40 years to recover on the least affected reefs and a century or more on the seriously affected ones.

Surveys establish damage and suggest trends in outbreaks

The Australian Institute of Marine Science has now undertaken surveys of 228 reefs — approximately one tenth of the entire Great Barrier Reef. The area is vast, bigger than Tasmania and Victoria combined, and the task has been immense. The logistics of the survey are equally impressive ... 2300 man-days at sea, 12000 nautical miles steamed, 3000 km of underwater dive tows, and 150000 data records. The $1m survey employed 45 young marine science graduates and was funded by the Commonwealth Community Employment Program.

The surveys found that outbreaks have been largely confined to the central third of the Reef between Cooktown and just south of Townsville. About 35% of reefs in this area have been seriously affected by the starfish and a further 30% slightly to moderately affected. Only about 6% of those reefs examined in the northern and southern thirds have been affected to varying degrees by the starfish.

The surveys by AIMS are continuing in the program of crown of thorns research. The information acquired in the surveys is being used in mathematical models to examine the complex predator-prey association between the starfish and the coral.

Few cases of predation reported

In a controversial paper on the predators of the starfish, Associate Professor Robert Endean of the University of Queensland described the outbreaks as an 'ecocatastrophe' with disastrous effects on the tourist industry.

Dr Endean believes that the removal of the natural predators of the starfish has caused the population outbreaks. His research, funded by GBRMPA over the past year, confirmed the triton shell as a predator of the adult starfish.

Although several types of reef fish were recorded attacking the starfish, in no cases did they kill them.

Little apparent effect on Reef tourism

A study of the economic impact of the starfish on Reef tourism by Dr Tor Hundloe of Griffith University found there had been no apparent adverse effects, even on twice-hit Green Island off Cairns.

'Reef tourism has doubled in the past decade, despite the starfish. Economic factors such as the value of the Australian dollar, international and domestic airfares, and Paul Hogan have been the most important factors. Any adverse effects of the starfish have been masked by the natural growth.'

Research into biological controls

Biological controls on land such as the prickly pear moth, rabbit myxomatosis virus and the salvinia beetle have been used with success in Australia but some, like the cane toad, have run riot. Research on the diseases of the starfish was being funded by GBRMPA, in the eventuality of a biological control ever being required.

One possibility for biological control of the crown of thorns starfish is a disease which has killed many juvenile starfish in Fiji. Dr Glazebrook of James Cook University has described the disease and isolated the micro-organism thought to be responsible. Meanwhile microbiologists at the university are studying bacteria associated with the starfish and its larvae.

It was stressed that before any biological control could be considered there must be irrefutable evidence that the outbreaks are definitely caused by human activity and that the agent only attacks the crown of thorns starfish and that other reef inhabitants will not be endangered.

REEF ENCOUNTERS

An exhibition of fibre art inspired by the Great Barrier Reef
28 July — 22 August 1987
Organised by Fibres and Fabrics Creative Textile Association Inc.
Funded by the Great Barrier Reef Marine Park Authority
Further support from the Perc Tucker Regional Gallery, Townsville

The drifting planktonic jellyfish with trailing tentacles, characteristic of tropical reef waters, inspired invited NSW artist, Tarpie Watts, in the creation of her delicate mobile ***Sea Sculpture****. Crafted from natural grasses and sea grasses, this piece is an example of fine coiling and wrapping, techniques used in traditional basketry.*

Reef Vision in Black and White *is the title of this detailed wall sculpture by invited NSW artist, Robyn Gordon, which incorporates silk, polyester, glass, ceramic, shells and coral. Taking inspiration from the natural designs of the tiny nerite shells, the artist has built up a sculpture which captures the complexity of a reef community.*

A feature of the quilt ***Patch Reef Percept****, machine-pierced and hand-quilted by Townsville artist, Bryony Barnett, is the stylised reef shapes and foreground detail achieved by printing with cut coral blocks. Bryony discusses the techniques with Graeme Kelleher at the opening function.*

The diversity of interpretations of a common theme included both representational and abstract pieces. The bold quilt ***Silent Shadows*** *was entirely hand-sewn by invited quilter from Proserpine, Denise Vanderlugt, photographed with her work. The artist has used a variety of fabrics to capture the patterns created by light on the dorsal surface of the manta ray as it glides silently over the reef. The diverse patterns of the corals are represented by printed fabrics, and further movement is created by heavy quilting.*

BOULT REEF REVISITED

PARK MANAGEMENT

Konrad Beinssen
Management Officer
Queensland National Parks and Wildlife Service

The Great Barrier Reef conjures up many images; one of the strongest of these images is the magnificent fishing opportunities which it provides. Each year, tens of thousands of people spend hundreds of thousands of enjoyable hours fishing on the Reef.

Like any other renewable natural resource, the reef fishery must be carefully managed to avoid depletion and the associated long-term productivity losses which come with 'overfishing'. Only through careful, scientifically-based management will this fishery be available in perpetuity for successive generations to profit from and enjoy.

Managing Fisheries

When an unfished population of fish is subjected to fishing pressure, the population structure changes. Fish become less abundant and their average size is reduced. If the fishing pressure becomes extreme, **overfishing** of two types can occur.

Recruitment overfishing may occur when the catch rate exceeds the rate at which the population can naturally replenish itself. This form of overfishing may result in a catastrophic population decline and subsequent long-term loss of productivity. Recruitment overfishing is not common and is unlikely to occur widely on the Great Barrier Reef in the short term.

Growth overfishing may occur when the population is so intensively fished that fish (on average) do not have time to grow before they are caught. A great deal of potential growth may be wasted in this way resulting in productivity losses which translate into large economic losses. This form of overfishing is very likely to occur on the Great Barrier Reef.

If the objective of management is to maximise the catch (or economic value) of a fishery, then it is also possible to **underfish** a resource. In this case fish are being 'wasted' because they are dying before being harvested. It is likely that many parts of the Great Barrier Reef are being **underfished**.

Scientific management aims to match the fishing pressure to the natural ability of the resource to produce fish. Of course, economic and social factors are also important in setting management objectives and determining optimum annual harvest levels.

The re-opening of Boult Reef provided an ideal opportunity to measure the impact of fishing on stocks ie, the rate at which fish can be removed from a fished population.

Management decisions can be made on a knowledge of fishing mortality. In the case of coral trout for example, it can be argued that an annual fishing mortality of about one quarter to one third of the stock would be sustainable. If values higher than this are estimated, management action to reduce the catch should be taken.

Many techniques to reduce the catch are available, for example, they may include bag limits for amateurs, limits on the number of commercial licences, closed seasons, restrictions on areas which can be fished and types of gear which can be used. Each technique has economic and social implications and the 'best' method may be subject to debate. The bottom line however is simple; fishing must not unduly deplete the resource if its potential productivity is to be maintained.

Fisheries management is not an exact science. Order of magnitude figures only are required to make initial management decisions which can be progressively fine tuned as more detailed information becomes available.

Apart from the aim of measuring **catchability**, other important information also came from the experiment. In particular, information about the species composition of the catch, size composition of important species and fish movements around the Reef was collected. Information about the movements of fish is particularly needed, since it has relevance to zoning decisions.

The Boult Reef Experiment

The experiment was designed to measure the rate at which fish stocks on a typical coral reef can be **fished out**.

Picture it this way. If there is a very large number of fish and/or the fishing intensity is low and/or fish are 'hard' to catch, then fishing may be having little impact on the stocks. If there are few fish and/or fishing intensity is high and/or the fish are 'easy' to catch, fishing may be depleting the resource.

The degree to which fish are 'hard' or 'easy' to catch is a function of their behaviour relative to the fishing gear in use; fisheries scientists measure this parameter as a mathematical constant called the **catchability**. It is this parameter which the experiment at Boult Reef set out to measure.

Once the **catchability** is known, optimum fishing level for larger areas can be calculated. If the total area (in hectares) covered by the stock is measured and the total fishing time in hours is known (in this case calculated from aerial surveillance observations) then the fraction of the total available stock taken each year by fishermen can be estimated. This fraction is called the fishing mortality.

Tagging Fish

The experiment simply involved tagging fish at the Reef in the weeks leading up to its re-opening and then recording the catch, fishing hours and tags caught by the fishing public for two weeks following re-opening. A relationship could then be calculated between fishing effort (measured in hours) and fishing mortality (the fraction of fish caught).

For several weeks prior to the re-opening, tagged fish were released into five fishing area blocks around Boult Reef. Care was taken to mix the tagged fish through the fish population present on the reef. Professional fishermen were employed to catch the fish to be tagged.

A total of almost 1700 fish of 33 species were tagged, of which 567 were coral trout. Plastic loop tags, inserted through the muscles at the front of the dorsal fin, were used. It was soon discovered that this type of tag is vulnerable, since it can be snagged and broken if the fish swims through coral. Trout were marked with a second tag, placed at the tail end. In this position, the tags are far more secure.

Prior to opening, an extensive publicity campaign using radio, newspaper and direct mailing of information to charter boat operators, fishing clubs, commercial fishermen and others, was arranged on the adjacent mainland. A reward of five dollars for each tag returned, was announced. To further encourage cooperation and accuracy, two substantial prizes were donated by Charles Alvey and Son and P & O Resorts.

For fourteen days after the Reef re-opened to fishing, Marine Parks staff handed a log book to each person fishing there. Daily catch, fishing time and tags taken were recorded in the book. The project team was based on nearby Hoskyn Island during this time and travelled to Boult Reef daily by dinghy.

Findings

Coral Trout

The **catchability** of coral trout was measured. In the two weeks following the re-opening of Boult Reef to fishing, about 1200 fishing hours were spent and about 2000 coral trout were caught. This is an estimated 25% of the fish at the reef prior to opening and shows that reefs can very rapidly be depleted by fishing.

Using the above data, with estimates of the fishing hours spent in Capricornia from surveillance data and a knowledge of the total fishing habitat available, it can be shown that the current level of fishing in Capricornia is likely to be having a significant impact on coral trout stocks. Early management action to contain the catch should therefore be considered.

While the reef fishery is based on many different species, management decisions based on a few of the major species would be sufficient to protect the fishery for a while against depletion.

Fish Mobility

In general, fish moved very little from their tagging location. Boult Reef was divided into five blocks, each with a linear distance measuring up to two kilometres along the reef crest. Of all coral trout returned, 90% were re-captured within their release block, 7% had crossed one boundary and 3% had crossed two boundaries. Results for other species such as sweetlip and hussar were similar.

The above results cover only a relatively short time span. Longer-term studies may still show significant movement of fish seasonally and such studies are needed. However, it can be tentatively concluded that the species studied do not disperse quickly and show strong site attachment.

Stock Replenishment

Management methods which encourage an even distribution of fishing effort over the available fishing grounds should be implemented. While fishermen themselves tend to fish where the catch is best, action to limit the catch on the more accessible reefs may be needed. Commercial and amateur fishermen need to be closely consulted to determine the least socially and economically disruptive way of achieving a more even distribution of fishing effort.

Do Closures Work?

There is little doubt that the three and a half year closure of Boult Reef resulted in a significant replenishment of stocks of commercially important species. Catch rate and average size of fish were much greater than the nearby reefs which had not been closed.

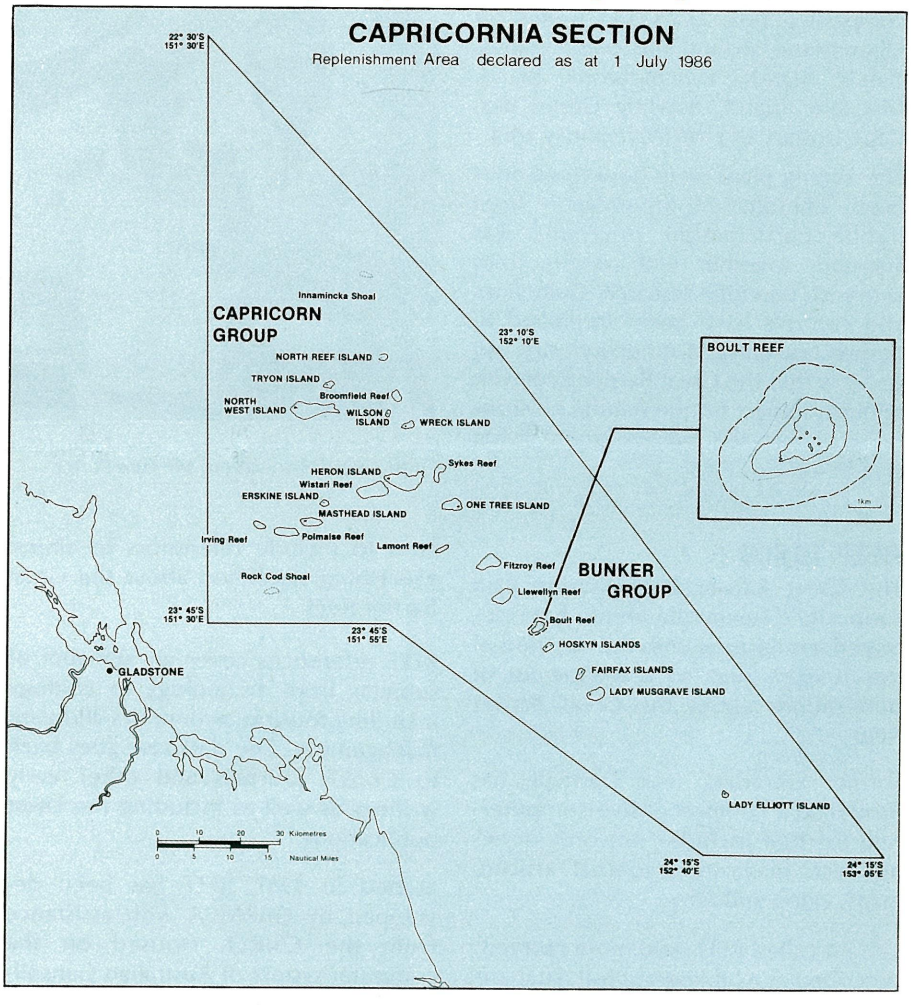
One of the aims of Marine Park management is 'to involve the community meaningfully in the establishment and management of the Marine Park'. The public was significantly responsible for the success of this experiment through its cooperation during the 'fishing phase'. Marine Parks staff learnt a great deal through contact with experienced fishermen. The contribution of all participants to the success of this experiment is gratefully acknowledged.

Background

Boult Reef lies about sixty nautical miles due east of Gladstone, near the extreme southern end of the Great Barrier Reef. It is 'tear drop' shaped, measuring about three and a half kilometres long and two kilometres wide.

Under the current Zoning Plan for Capricornia, Boult Reef is declared a 'replenishment area' and may be closed from time to time to fishing and collecting to allow resources to replenish.

The Reef was closed to fishing on 1 July 1983, the first such area to be closed on the Great Barrier Reef. Its closure was therefore largely experimental and its re-opening on 1 December 1986 provided an ideal opportunity to obtain information on the effectiveness of replenishment areas and more generally on the mechanisms governing coral reef fisheries.



NEWS AND NOTICES

CENTRAL SECTION ZONING IN FORCE

On 1 October 1987, zoning plans came into effect to coordinate the management of intertidal and marine areas in the central part of the Great Barrier Reef Region.

In a joint statement, the Federal Minister for the Environment, Senator Graham Richardson, and Queensland's Minister for Tourism, National Parks and Sport, Mr Geoff Muntz, welcomed the operation of the zoning plans as a further positive step in a cooperative program of effective management of the Region.

Under Commonwealth legislation, the Great Barrier Reef Marine Park's Central Section covers 77 000 square kilometres, about one-fifth of the Reef Region's area. This extends about 500 km from Dunk Island off Tully to south of the Whitsunday Islands off Proserpine.

Under Queensland legislation, the Townsville-Whitsunday Marine Park comprises eight management areas encompassing tidal lands and waters off Queensland around the outer islands, Family Islands, Hinchinbrook Island, Magnetic Island, Bowling Green Bay, Cape Upstart and the Whitsunday area.

The zoning plans were developed after much consultation. Information from public participation programs was assessed, together with results from extensive scientific research. Guidelines and controls have been developed to ensure tourism and other industry can occur within the Great Barrier Reef with minimal impact on the natural environment of this, the world's largest living system.

COASTGUARD AND AIR SEA RESCUE GIVE ZONING INFORMATION

The Australian Volunteer Coast Guard and the Northern Zone Air Sea Rescue Association of Queensland have agreed to cooperate with the Great Barrier Reef Marine Park Authority to provide zoning information to the general boating public about using the Central Section of the Marine Park. The Central Section zoning regulations came into effect on 1 October 1987.

Many boating people who did not know enough about the zoning requirements but wanted to find out about such things as 'can we visit this or that area', would now be able to readily obtain this information by a radio call to the nearest Coastguard or Air Sea Rescue Squadron at either Burdekin, Bowen, Whitsunday, Mackay, Townsville, Innisfail, Tully or Ingham.

Air Sea Rescue Northern Zone Chairman, Mr Mat Patane, and Squadron Commodore for the Volunteer Coastguard Association, Mr Tom Porter, said their Associations were pleased to add this service to the support their organisations already gave to the boating public. 'Safety and better boating are what we are all about and this additional information about the Marine Park will, I'm sure, be of great benefit to everyone who uses the Park,' said Mr Patane.

The aim in developing the Great Barrier Reef Marine Park is to provide for the protection, wise use, understanding and enjoyment of the Great Barrier Reef. GBRMPA has, through public participation, developed the Zoning Plan for the Central Section that balances human needs with the need to conserve the Reef. Radio frequencies maintained by the Air Sea Rescue Association in the Central Section include 2182, 2524 and 27.88 MHz, and Ch. 16 VHF.

Craig Sambell explains the Cairns Zoning Plan to the Squadron Commodore of the Volunteer Coast Guard Association, Mr Tom Porter.

REEF 10 000

The Great Barrier Reef Marine Park Authority's Townsville library has celebrated a milestone with the addition of the 10 000th item to a unique list of publications about the Great Barrier Reef.

Former Librarian, Jean Dartnall, has produced a comprehensive computerised list that includes not only books but also magazines, journal articles, maps, video and films.

The list called REEF, and more correctly described as a bibliographical database, aims to include references to almost everything published about the Great Barrier Reef.

REEF references cover an alphabet of subjects from archeology to zoology including tourism, economics and park management. The database goes back to Cook's journals and other early writings as well as including the latest publications.

Started in 1981, REEF has been developed by GBRMPA with assistance from the CSIRO. Housed on the computer system of Australian Consolidated Industries, the information is available through the public access network, AUSINET.

Bulletins of new additions to REEF are sent regularly to scientists and reef enthusiasts around Australia and overseas, thus REEF is one of the many ways in which GBRMPA is keeping the world abreast of developments in the Barrier Reef Region.

Jean Dartnall has left the GBRMPA after 8 years as Librarian. Her efforts and success in developing the GBRMPA library are thoroughly appreciated by its many users.

THE CROWN OF THORNS STORY

Dr Leon Zann and Elaine Eager (GBRMPA), Professor Howard Choat (James Cook University) and Dr John Cross (Editor of Australian Science Mag) discuss the crown of thorns publication at the ANZAAS Congress in Townsville in August 1987.

The large starfish, known to scientists as *Acanthaster planci*, eats the living part of corals leaving the skeleton behind. It is usually an uncommon animal on coral reefs and the damage is negligible, but sometimes, and for reasons unknown, populations explode and damage to the reefs may become very great.

GBRMPA is very concerned about finding the explanations for this phenomenon so that appropriate action can be taken to ideally reduce the incidence of outbreaks, or at least their effects, in the future. GBRMPA is also concerned to dispel popular misconceptions about the phenomenon and to keep the community informed of the current situation.

The damage to coral reefs caused by outbreaks of the crown of thorns starfish is one of the most serious scientific and management issues on the Great Barrier Reef.

THE BOOKLET

A 44-page feature published for GBRMPA by the Darling Downs Institute Press in its 'Australian Science Mag', outlines the history, research and possible reasons for crown of thorns outbreaks. Each chapter investigates the most up-to-date information on the starfish phenomenon, including its biology, recent outbreaks, and possible control methods.

Price: $3.00 plus postage.

THE VIDEO

The documentary tells the story of the crown of thorns on the Great Barrier Reef. It portrays the damage this coral predator can do to the Reef, the biology and ecology of the starfish, its management and control options, and the coordinated research program being undertaken to learn more about this echinoderm.

Price: $35.00 plus postage.

MESA CONFERENCE TOWNSVILLE 1988

The 4th National Conference of the Marine Education Society of Australasia will be held in Townsville on September 23, 24, 25, 1988.

The Marine Education Society of Australasia (MESA) is an organisation formed to represent the broad spectrum of interests in marine education in Australasia.

Membership is open to all interested individuals and organisations including teachers, college and university educators, aquarium and museum curators, representatives from research facilities, government and private organisations and environmental groups.

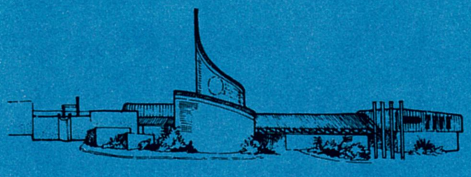
MESA aims to provide a focus for marine education in Australasia and a network for the exchange of ideas and information.

The objects of the Society are:

- To promote and publicise marine education in all its aspects.
- To facilitate and coordinate initiatives in marine education throughout Australasia.
- To conduct meetings, conferences etc.
- To publish and distribute information about marine education.
- To represent the interests of marine educators to government bodies and statutory organisations.

For further information on joining MESA or attending the National Conference, contact the Editor.

AT THE AQUARIUM SHOP



The Aquarium Shop at Townsville's Reef Wonderland Complex is fast becoming a great source of reading material on all aspects of the Great Barrier Reef, with all the Great Barrier Reef Marine Park Authority publications and a comprehensive collection from other publishers too.

A new arrival is Jacques Cousteau's **The Ocean World** — this is a must for avid readers of marine life and fans of this underwater pioneer. The photography as you would expect is breathtaking. It is priced at $60.00, but we have been informed the next shipment will not be at this price, so don't miss out!

Please write for our new complimentary catalogue which lists all our reef books.

All retail inquiries should be addressed to

The Manager
Aquarium Shop
Great Barrier Reef Wonderland
Flinders Street East
TOWNSVILLE QLD 4810
Phone (077) 81 8875

Wholesale inquiries should be addressed to

Education/Information Section
Great Barrier Reef Marine Park Authority
PO Box 1379
TOWNSVILLE QLD 4810

REVIEWS

SHELLS OF QUEENSLAND AND THE GREAT BARRIER REEF

Marine Gastropods
J G Short and D G Potter
Published by Golden Press Pty Ltd
133 pages, 60 colour plates.

This addition to an extensive library on the Indo-Pacific Mollusca is intended primarily as an updated guide to the more commonly encountered shelled gastropods on the Great Barrier Reef. Over 600 species from 63 families are illustrated in 60 clear colour plates. The text is consise and includes the main characters for each family with notes on the biology of each group. Species information includes recent synonyms and distribution ranges.

The subject of Great Barrier Reef shells has already been covered in a number of well-presented texts, dealing more generally with Australian and Indo-Pacific molluscs. As an addition to an existing library, this book therefore must offer something new. It succeeds on several counts and falls short on others.

The updating of existing information on identification, synonomy and distribution of the Great Barrier Reef gastropods is significant, as is the inclusion in the text of the main characters of each family. The addition of some biological information is well worthwhile, and serves to remind the reader that the shells were once part of a living organism.

As an identification guide, however, the book appears to offer little more than existing references, aside from the clarity of the plates and updated information. The authors, both associates of the Queensland Museum, in minimising the text, have forgone information on useful identifying features for individual species, except in a few cases. The reader, therefore, must rely solely on the photograph to provide the key. In some cases the figures may be inadequate.

Shells of the Family Cypraeidae would be more readily identifiable by the amateur collector had additional photographs of the ventral (under) surface been included. Likewise the figures in the family Volutidae, largely an endemic group with distinctive local forms, could have been expanded to include examples of variants.

On a point of detail, this popular family would be better represented on the cover of a book of shells of the Great Barrier Reef by *Cymbiolacca pulchra* than the *Cymbiola magnifica* featured, which is not found north of Fitzroy Island.

The overall layout of the text and figures is spacious and could have benefited either by compaction into a 'Pocket' book and useful field guide, or by inclusion of additional information on individual species, enabling it to compete more favourably with existing references.

PLANTS OF MAGNETIC ISLAND

By Betsy R Jackes
Department of Botany
James Cook University 1987
Plastic cover, 141 pp, black and white photocopy illustrations

At last we have a guide to plants on one of the most significant continental islands in the Reef. Where 'Plant Life of the Great Barrier Reef and Adjacent Shores' by A B and J W Cribb, is an excellent guide to the flotsam and near-beach flora of the reef islands, this well-illustrated field guide allows those interested in our native vegetation to continue their exploration into the woodlands and grasslands of a continental island.

The illustrations are well done. The life-size illustrations allow non-botanists and botanists alike to easily identify the more common plants of the mangroves, dune and woodlands without having to access difficult glossaries. Small sketches have been included where necessary to illustrate botanical terms such as crenate, domatia etc. while other terms have been illustrated by the use of a small vertical arrow indicating the particular structure described in the text.

The book is indexed to both common names and scientific names and describes 375 plants growing in the more accessible parts of the island.

CORALS OF AUSTRALIA AND THE INDO-PACIFIC

J E N Veron, Angus and Robertson, 1986
ISBN 0-207-15116-4, 644p.

This is an overwhelming book. It is overwhelming in its wealth of illustrations: each species is covered at more than one scale, in colour as well as monochrome and the quality of the photography is as impressive as its quantity. It is overwhelming in its level of scholarship. Very often in marine biology the choice of identification books is between poorly presented, difficult to use, accuracy or coffee table presentation of dubious facts. In this case we have a superb publication, from the acknowledged experts in the field. Finally it is overwhelming in its size. The book not only deals with about 1000 coral species but also includes chapters on coral biology, coral communities and the biogeography and geological history of corals.

As an identification book for Australian corals, this work has no equal competition and it provides the supporting material to ensure that identification is not just an empty labelling exercise.

Minor points of criticism are that the index is not particularly good and the publisher's binding is unlikely to survive much use on so large a volume. Nevertheless, everyone with an interest in corals or coral reefs will want to own this book.

NOTES

Reeflections is published by the Great Barrier Reef Marine Park Authority on a quarterly basis with the intention that it should cover a range of topics and serve as a forum for discussion. Your contributions are important to ensure that representative points of view are presented and items of interest are brought to the attention of our readers.

We ask that contributions be kept to a maximum length of 1,500 words and accompanied by the author's name, designation and address. Photographs (preferably black and white prints) drawings and diagrams will be gratefully received.

The Editor will assume that material submitted for publication has appropriate organisational approvals where necessary. The Editor reserves the right to reject or modify contributions. If modification is considered necessary, it will be referred to the author for approval.

Contributions should be sent to:

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